



# Proceedings of the Mediterranean Seagrass Workshop 2012

Essaouira, Morocco





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## ***Welcome note***

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It is a pleasure to welcome all of you to the third Mediterranean Seagrass Workshop (MSW12)!

Thanks to the dedication of a large group of scientists and institutions, and particularly those that hosted the three editions of the MSW, this workshop continues to bring together seagrass experts, scientists, government agencies and NGOs, to discuss current knowledge of the state of Mediterranean seagrasses, and to present aspects of their latest research.

This event, hosted for the first time in North Africa, will see a larger participation of scientists and student from Tunisia, Algeria and Morocco, as well as many other Mediterranean countries. It is important to bring this even across the region to ensure the wider network of seagrass scientists can have the opportunity to participate.

In the current research and policy scenario, seagrasses are becoming key habitats for assessing the quality of Mediterranean marine waters. The EU - Marine Strategic Framework Directive, the IUCN Red Listing process, the UNEP Ecosystem Approach and the implementation of the Natura 2000 Network all include seagrasses to different extend and recognise their value of ecological indicators. At the MSW12 several sessions will address these issues. At the same time, new and innovative science continues to be published on seagrasses, their habitat function and ecosystem services.

It is our hope that the MSW12 creates once again the opportunity for new collaborations, the development of new science and projects and for consolidating existing partnerships.

As for past editions, we are embedded again in a great cultural setting. Seeped in history, Essaouira is one of Morocco's most atmospheric and inviting coastal towns, providing a unique venue for this event, for social interactions and cultural tours.

On behalf of the organising committee, we would like to acknowledge the University of Cadi Ayyad (the Ecole Supérieure de Technologie Essaouira and the Faculté Polydisciplinaire Safi) for hosting us and to the local and scientific committees for their support and dedication.

We are looking forward to yet another successful workshop and to seeing all of you in Essaouira!

Giuseppe Di Carlo and Khalid Elkalay  
MSW12 Co-Chairs

## **Committees**

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The event is organised by the Ecole supérieure de technologie Essaouira and the polydisciplinary faculty Safi Université Cadi Ayyad (Morocco) and supported by the Mediterranean Seagrass Association – Seagrass 2000.

### **Chairs**

Dr Khalid Elkalay, Polydisciplinary faculty Safi, Université Cadi Ayyad, Morocco  
Dr Giuseppe Di Carlo, Mediterranean Seagrass Association – Seagrass 2000

### **Organising Committee**

Dr Eugenia Apostolaki, Hellenic Center for Marine Research, Heraklion-Crete, Greece  
Dr Salvatrice Vizzini, Department of Earth and Marine Sciences, University of Palermo, Italy  
Dr Joao Silva, CCMar – Universidade do Algarve, Portugal  
Dr Yolanda Fernandez Torquemada, Depto. de Ciencias del Mar y Biología Aplicada Universidad de Alicante.

### **Local Organising Committee**

Dr Karima Khalil, Université Cadi Ayyad, Ecole supérieure de technologie Essaouira  
Prof. Blaïd Bougadir Université Cadi Ayyad, Ecole supérieure de technologie Essaouira  
Dr Younes Chihab Université Cadi Ayyad, Ecole supérieure de technologie Essaouira  
Dr Kaloun Soulaïman Université Cadi Ayyad, Ecole supérieure de technologie Essaouira  
Dr Jadir Mohamed Université Cadi Ayyad, Ecole supérieure de technologie Essaouira  
Prof. ElHassan Boumaggard, Université Cadi Ayyad, Faculté polydisciplinaire de Safi,  
Dr Abdallah Dahbi, Université Cadi Ayyad, Faculté polydisciplinaire de Safi,  
Dr Abdallah Badou Université Cadi Ayyad, Faculté polydisciplinaire de Safi,  
Dr Khalid Elkalay Université Cadi Ayyad, Faculté polydisciplinaire de Safi, Morocco

### **Scientific Committee**

Prof. Gerard Pergent, Faculté des Sciences, Université de Corse, Corsica, France.  
Dr Maria Cristina Buia, Laboratorio di Ecologia del Benthos, Stazione Zoologica Anton Dohrn, Italy.  
Dr Joseph Borg, Department of Biology, Faculty of Science, University of Malta  
Dr Chedly Rais, Okianos, Tunisia  
Prof. Mohammed Loudiki, Faculté des Sciences Semlalia, Université Cadi Ayyad, Morocco  
Prof. Sven Beer, Department of Plant Sciences, Tel Aviv University, Israel  
Dr Robert Turk, Institute of the Republic of Slovenia for Nature Conservation, Slovenia  
Dr Teresa Alcoverro, Centre d'Estudis Avançats de Blanes, Spain  
Mr Vedran Nikolic, Institute of Oceanography and Fisheries, Split, Croatia  
Ms Vesna Macic, Institute for Marine Biology, Kotor, Montenegro  
Dr Gilles Lepoint, University of Liege, Belgium

# ***The World Seagrass Association***

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The World Seagrass Association (WSA) is a global network of scientists and coastal managers committed to research, protection and management of the world's seagrasses.



WORLD SEAGRASS ASSOCIATION

## **WSA VISION:**

We envision healthy seagrass ecosystems, under appropriate conservation and management measures, that continue to provide key ecological functions in the world's oceans and critical services for human well-being.

## **WSA MISSION:**

The WSA is an international, non-profit organisation dedicated to raise the profile of seagrass ecosystems worldwide. We foster cooperation and promote networking among scientists, conservationists, managers and educators from coastal nations worldwide. By informing and communicating on locally relevant and globally impacting seagrass issues, WSA promotes a culture where thriving seagrass ecosystems are secured for the future.

The WSA is proud to be associated with the Mediterranean Seagrass Association (Seagrass 2000) and pleased to be able to assist the present meeting with some logistical support. We wish delegates of MSW12 in Essaouira an enjoyable and productive workshop.

Please consider becoming a member of the World Seagrass Association. For more info, visit our website at: [wsa.seagrassonline.org](http://wsa.seagrassonline.org)

## ***Seagrass 2000 – A Mediterranean Seagrass Association***

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The association Seagrass 2000 is a non-profit organization, committed to promote seagrass research, management and conservation in the Mediterranean Sea and to create a communication network across Mediterranean countries.



The Association has set a series of priority activities:

- (i) promote the protection and conservation of Mediterranean seagrass species;
- (ii) increase awareness of seagrass issues by establishing public and scientific initiatives, including support for the organization of future MSW and other local meetings;
- (iii) set up and maintain a web page for literature, data and information exchange; and
- (iv) to enhance conservation, monitoring and educational issues linked to Mediterranean seagrass ecosystems.

The Association functions as a regional but independent body of the WSA and the two together share efforts and initiatives as well as organise joint meetings (ISBW and MSW) to reach a larger audience inside and outside the field.

To join Seagrass 2000 or learn more, visit us at [mediterranean.seagrassonline.org](http://mediterranean.seagrassonline.org)

# **MEDITERRANEAN SEAGRASS WORKSHOP 2012 PROGRAM**

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## **Workshop overview**

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### **DAY 1: MONDAY MAY 28**

Arrival to Essaouira, settle in and registration

18:00 MSW Welcome Reception

### **DAY 2: TUESDAY MAY 29**

9:00 Workshop opening

9:36 Morning session

10:30 Coffee break

11:00 Morning session (cont.)

13:00 Lunch break

15:00 Workshop I

### **DAY 3: WEDNESDAY MAY 30**

9:00 Morning Field Trip

15:00 Poster Session II

### **DAY 4: THURSDAY MAY 31**

9:00 Keynote Lecture

10:30 Coffee Break

11:00 Morning session (cont.)

13:00 Lunch break

15:00 Poster Session II

20:00 MSW Dinner Reception

### **DAY 5: FRIDAY JUNE 1**

9:00 Keynote Lecture

9:45 Morning session

10:30 Coffee break

11:00 Morning session (cont.)

11:15 Workshop II

12:30 Wrap up and Good-bye

13:00 Lunch break

15:00 Special session

## Workshop program in more detail

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### DAY 1: MONDAY MAY 28

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Arrival to Essaouira, settle in and Registration

18:00 MSW Welcome Reception

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### DAY 2: TUESDAY MAY 29

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9:00 Workshop Opening

9:36 12-minute oral presentations will be delivered in the following order

CHAIR: Salvatrice Vizzini:

Gérard Pergent, Céline Lafabrie, Roger Kantin, Christine Pergent-Martini - Temporal evolution of metal concentrations in *Posidonia oceanica*.

David Celdrán, Arnaldo Marín - Photosynthetic activity of the non-dormant *Posidonia oceanica* seed.

Ana Alexandre, João Silva, Pimchanok Buapet, Mats Björk, Rui Santos - Long-term effects of CO<sub>2</sub> enrichment on photosynthesis, growth and nitrogen metabolism of the seagrass *Zostera noltii*.

Luciana Migliore, Alessia Piccenna, Alice Rotini, Samantha Garrard, Maria Cristina Buia - Can ocean acidification affect chemical defenses in *Posidonia oceanica*?

10:30 COFFEE BREAK

11:00 12-minute oral presentations will be delivered in the following order:

J. Richir, N. Luy, G. Lepoint, R. Biondo, S. Gobert - Trace element kinetics in contaminated *Posidonia oceanica* meadow.

Ylva S. Olsen, M. Potouroglou, C.M. Duarte - Impact of temperature on the vulnerability of *Posidonia oceanica* and *Cymodocea nodosa* to *Labyrinthula* sp.

Candela Marco-Méndez, Luis Miguel Ferrero-Vicentea, Patricia Pradob, Kenneth L. Heck - Just Cebriánc, Jose Luis Sánchez-Lizaso Evidence of preference of *Cymodocea nodosa* over *Posidonia oceanica* by the herbivores *Paracentrotus lividus* and *Sarpa salpa* in a mixed habitat.

Christine Pergent-Martini, Céline Labbe, Roger Kantin, Gérard Pergent - Comparison between *Posidonia oceanica* and *Mytilus galloprovincialis* as Polycyclic Aromatic Hydrocarbon biomonitors.

Costantin Frangoulis, Skliris N., Khalil K., Elkalay K., Lepoint G. - Zooplankton detritus contribution to *Posidonia oceanica* production in an oligotrophic Mediterranean area.

Jordi Boada, Oriol Mascaró, Simone Farina, Teresa Alcoverro, Javier Romero - Habitat complexity influence predation rates on sea urchin (*Paracentrotus lividus*) in NW Mediterranean seagrass and rocky systems.

Karim Mezali, Larbi Neghli - Contribution to the study of the reproduction of three aspidochirotid holothurians (Echinodermata: Holothuroidea) inhabiting the *Posidonia oceanica* meadow of two contiguous areas: La Marsa and Ain Taggourait (Algeria).

Dina Lila Soualili-Mezali, Aicha Oulhiz - Inventory of the associated fauna of the rocky algal covers of Mostaganem area (Algeria).

Sylvie Gobert, Pierre Lejeune, Aurélie Chery, Pierre Boissery, Stéphane Sartoretto, Bruno Andral, Gilles Lepoint, Jonathan Richir - Assessment of the ecological status of *Posidonia oceanica* meadow with a "Non Destructive Shoot Method": NDSM.

Salvatrice Vizzini, Antonio Mazzola - *Posidonia oceanica* loss in a Mediterranean semi-enclosed coastal system: response of polychaete assemblage

13:00 LUNCH BREAK

15:00 WORKSHOP I: *Posidonia oceanica*: a good bioindicator?

Coordinator: Sylvie Gobert

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## DAY 3: WEDNESDAY MAY 30

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Morning Field Trip

15:00 POSTER SESSION I (see list below)

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## DAY 4: THURSDAY MAY 31

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9:00 KEYNOTE LECTURE

Gérard Pergent – Mediterranean Seagrass Meadows: Resilience and Contribution to Climate Change Mitigation.

9:45 12-minute oral presentations will be delivered in the following order :

CHAIR: Maria Cristina Buia

Monya M. Costa, João Silva, Irene Olivé, Isabel Barrote, Rui Santos - *Posidonia oceanica* photosynthesis along a depth gradient.

Mauro Lenzi, Francesca Birardi - Can the marine ecosystem of a *Posidonia oceanica* back-reef react and defend itself from the spread of *Caulerpa racemosa* var. *cylindracea*?

Irene Olivé, Emilio García-Robledo, Sokratis Papaspyrou, Alfonso Corzo, Ignacio Hernández - Effects of *Ulva* sp. blooms and its associated decomposition in *Cymodocea nodosa* meadows.

10:30 COFFEE BREAK

11:00 12-minute oral presentations will be delivered in the following order:

Ivan Guala, Zrinka Jakl, Milena Šijan, Mosor Prvan, Ante Žuljević, Giuseppe Di Carlo - Monitoring of conservation status of *Posidonia oceanica* in two Croatian marine protected areas.

Panos Panayotidis, Vasillis Gerakaris - *Posidonia oceanica* meadows in the Inner Ionian Archipelago and adjacent gulfs.

Nor-Eddine Rezzoum, Mohammed Najih - Study of the seagrass distribution at the lagoon of Marchica (Nador, Alboran sea).

Ian Dapson, Jennifer J. Verduin, Mike van Keulen - Assessing Ecosystem Recovery in Transplanted *Posidonia australis* at Southern Flats, Cockburn Sound.

Chokri Mansour, Zohra El Asmi Djellouli - Distribution of the different threatened habitats, the seagrass beds of *Posidonia oceanica* and the barrier reefs around the future marine protected area in Kuriat Islands-Tunisia.

Andrea Cossu, Lorenzo Chessa - Focus on *Posidonia oceanica* in Sardinia (Italy): current situation and perspectives.

Karim Mezali, Noredine Belbachir - The state of health of *Posidonia oceanica* meadows in two localities of the Mostaganem coastal area (Stidia and Hadjadj - Algeria).

Monica Montefalcone, Matteo Vacchi, Chiara F. Schiaffino, Giulia Gatti, Carla Morri, Carlo Nike Bianchi, Giancarlo Albertelli and Marco Ferrari - An innovative hydrodynamic model to define the natural position of the upper limit of *Posidonia oceanica* (L.) Delile meadows.

13:00 LUNCH BREAK

15:00 POSTER SESSION II (see list below)

20:00 MSW Dinner Reception

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## DAY 5: FRIDAY JUNE 1

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### 9:00 KEYNOTE LECTURE

João Silva, Rui Santos - European seagrass network: Seagrass productivity, from genes to ecosystem management

### 9:45 12-minute oral presentations will be delivered in the following order:

CHAIR: TBA

Tiziano Bacci, Sante Francesco Rende, Domenico Rocca, Luigi Maria Valiante, Enrico Casola, Stefania Giglio, Simone Scalise, Piero Cappa, Michele Scardi - Macrostructure of *Posidonia oceanica* (L.) Delile beds: spatial analysis at small scale.

Melita Mokus, S.T. Schultz - First record of vertical rhizome growth in *Zostera marina*.

Marina Bonacorsi, Nils Bréand, Philippe Clabaut, Gérard Pergent, Christine Pergent-Martini - Evolution over time of seagrass meadows along Cap Corse coastline.

### 10:30 COFFEE BREAK

### 11:00 12-minute oral presentations will be delivered in the following order:

Carmen Mifsud, Duncan Borg, Christopher Cousin, Darrin T. Stevens - *Posidonia oceanica* (Linnaeus) Delile meadows designated as Special Areas of Conservation in the Maltese Territorial Sea.

### 11:15 WORKSHOP II – IUCN Red List assessment of seagrasses

Coordinators: Maria del Mar Otero and Catherine Numa

### 12:30 Wrap up and Good-bye

### 13:00 LUNCH BREAK

### 15:00 Special Session: Marine Research in North Africa – status and challenges

Coordinator: Khalid Elkalay (this session will be in French).

## Venue

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### **Essaouira**

Seeped in history, Essaouira is one of Morocco's most atmospheric and inviting coastal towns. It's been a trading base for well over 1,000 years, dealing in everything from slaves and rare purple dye to tea and sardines, and its medina, fortified by the Portuguese in the 15th century, is still a thriving commercial centre, full of tiny shops selling beads, carpets and handmade shoes. But it's most famous for the friendly, laidback vibe which, since the 1950s, has inspired artists, musicians and filmmakers. Several beautiful, historic towns are within easy reach. South of Essaouira, Taroudannt is a delightful, elegant walled town, with lively souks and good hotels, while Tafraoute makes a good base from which to explore the Anti-Atlas Mountains; it's particularly lovely in spring when the almond trees are in blossom.

### **Cadi Ayyad University**

Founded in 1978, UCA has efficiently dedicated the last thirty years to meet the joint challenges of massive increase in student numbers and transformations on social need for education and research. The scope of its disciplinary competencies has expanded over the years; at the same time, its role in preparing students for new professions got asserted. UCA has currently 13 institutions located in 2 regions of the kingdom: Marrakech Tensift Elhaouz and Abda Doukkala. It covers 4 university cities: Marrakech, Kalaa of Sraghna, Essaouira and Safi.

The workshop sessions will take place in the University. A bus service will be provided from and to the hotel.

### **The Mogador Hotel**

Situated in Essaouira, Ryad Mogador Essaouira is close to Essaouira Beach, Bordj el Berod, and Skala du Port. Also nearby are Place Moulay el Hassan and Mohammed Ben Abdallah Museum. You can visit the hotel website at [www.ryadmogador.com](http://www.ryadmogador.com)

# ***Information for Oral and Poster Presenters***

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## **Abstracts**

Abstracts for the MSW 2012 will be included in an abstracts volume, which will be distributed to registered participants at the meeting.

## **Oral Presentations**

Oral presentations will be scheduled in 12-minute time slots. Presentations should not exceed 8 minutes, to allow at least 4 minutes for discussion and response to questions from the audience. The time limit will be strictly enforced to keep the Workshop to schedule.

A PowerPoint projector, computer, and a screen will be set up in the conference hall. To minimise any compatibility problems, please assure that your presentation design does not exceed XGA (1024 x 768).

## **Additional Equipment Needs**

An overhead projector, slide projector, audio system, provision of extra power outlets, extra tables, stands, etc. can be handled.

Please contact our Secretariat office at [medseagrassworkshop@gmail.com](mailto:medseagrassworkshop@gmail.com) if you require any special equipment.

## **Poster Presentations**

Posters will be up all week for viewing with designated days and times for poster presentations.

Poster space should be no more than 900mm in width and 1200mm in height. Size requirements must be strictly adhered to so they fit within the space assigned to them. If your poster exceeds these specifications, it may be subject to removal by the organizing committee. Pushpins will be provided to place your poster on the poster boards.

Posters will be presented depending upon the poster session to which your presentation has been assigned. You will be expected to be available to present your poster during the designated session. Authors of posters are asked to adhere to designated set-up and tear-down instructions and times.

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### DAY 2: TUESDAY MAY 29

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CHAIR: Salvatrice Vizzini

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#### **Temporal evolution of metal concentrations in *Posidonia oceanica***

G rard Pergent<sup>1\*</sup>, C line Lafabrie<sup>1</sup>, Roger Kantin<sup>2</sup>, Christine Pergent-Martini<sup>1</sup>

<sup>1</sup>University of Corsica, Faculty of Sciences, Equipe Ecosyst mes Littoraux, BP 52, 20250 Corte, France

<sup>2</sup>IFREMER/LEP/AR, Quai du Commandant Silhouette, 33120 Arcachon

Ten trace metals (Ag, As, Cd, Co, Cr, Cu, Hg, Ni, Pb, and Zn) have been measured in foliar tissues of *Posidonia oceanica* in four sites (Calvi, Canari, Marseilles and Toulon) which have different levels of human impact. The metal concentration, in a given tissue, was followed over time by successive samplings. The results show that most of the metals' concentrations increase over time (according to the age of the tissues). They also show that the temporal evolution is more pronounced in the site of Toulon, which is the most contaminated site. A biological dilution of metal accumulation by *Posidonia oceanica* is hypothesized and quantified. This study shows the importance of the leaf tissue age and the effect of biological dilution by plant in metal contamination researches, in order to compare data from literature and to set up biomonitoring networks based on this bio-integrator.

Keywords: Metal contamination, temporal evolution, *Posidonia oceanica*, tissue age, biological dilution, Mediterranean Sea

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#### **Photosynthetic activity of the non-dormant *Posidonia oceanica* seed**

David Celdr n, Arnaldo Mar n

Dept Ecolog a e Hidrolog a, Universidad de Murcia, 30100, Murcia, Spain.

The photosynthetic adaptive features of non-dormant seeds in *Posidonia oceanica* were studied in order to evaluate the effects of light on germination success. Transmission electron micrographs showed the presence of chloroplasts in the epidermal cells, close to the nucleus at the periphery of the cytoplasm. The well developed thylakoid membranes and the presence of starch granules indicated that the chloroplasts were photosynthetically active. The relationship between photosynthesis versus irradiance in *P. oceanica* seeds incubated at 15 and 21  C was analysed. The net photosynthesis in the non-dormant seed of *P. oceanica* was positive and compensated its respiration demand (90  mol quanta m<sup>-2</sup> s<sup>-1</sup>) at both temperatures. Net photosynthesis was negative at the other irradiance values. To test the effects of light on germination success, seeds were placed both in dark and light conditions. Germination success was significantly higher in light rather than in dark condition. The characteristics observed in the photosynthesis in *P. oceanica* seed could be a mechanism to guarantee seedling survival in temperate waters, demonstrating though the specialized nature of this species.

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#### **Long-term effects of CO<sub>2</sub> enrichment on photosynthesis, growth and nitrogen metabolism of the seagrass *Zostera noltii***

Ana Alexandre<sup>1</sup>, Jo o Silva<sup>1</sup>, Pimchanok Buapet<sup>2</sup>, Mats Bj rk<sup>2</sup>, Rui Santos<sup>1</sup>

<sup>1</sup>Marine Plant Ecology Research Group, CCMAR – Centre of Marine Sciences, Universidade do Algarve, Gambelas, 8005-139 Faro, Portugal

<sup>2</sup>Botany Department, Stockholm University, 10691 Stockholm, Sweden

Seagrass ecosystems are expected to benefit from the global increase of CO<sub>2</sub> in the ocean because the photosynthetic rate of these plants may be Ci-limited at the current CO<sub>2</sub> level. Here we investigate the long-term effects of CO<sub>2</sub> enrichment on both carbon and nitrogen metabolism of the seagrass *Zostera noltii* in a mesocosm experiment where plants were exposed to two experimental CO<sub>2</sub> concentrations (present levels of 360 ppm and future levels of 700 ppm) for five months. Both the maximum photosynthetic rate

(Pm) and photosynthetic efficiency ( $\Phi$ ) were higher (1.3- and 4.1-fold, respectively) in plants exposed to CO<sub>2</sub>-enriched conditions, whereas the electron transport rate (ETR) was significantly higher (1.4-fold) only at the highest light intensity. Surprisingly, no significant effects of CO<sub>2</sub> enrichment on leaf growth rates were observed, which was probably due to nitrogen limitation as revealed by the low nitrogen content of leaves. This suggests that the global effects of CO<sub>2</sub> on seagrass growth may be spatially heterogeneous and depend on the specific nitrogen availability of each system. The leaf ammonium uptake rate and the glutamine synthetase activity were not significantly affected by increased CO<sub>2</sub> concentrations. On the other hand, the leaf nitrate uptake rate of plants exposed to CO<sub>2</sub>-enriched conditions was 4-fold lower than the uptake of plants exposed to current CO<sub>2</sub> levels. In contrast, the activity of nitrate reductase was 3-fold higher in plant leaves grown at high CO<sub>2</sub> concentrations. The decrease of the nitrate uptake rates observed at high CO<sub>2</sub> (low pH, higher H<sup>+</sup> concentration) suggests that in the seagrass *Z. noltii* nitrate is not co-transported with H<sup>+</sup> as in terrestrial plants. The CO<sub>2</sub>-driven stimulation of the nitrate reductase activity of *Z. noltii* plants exposed to enriched-CO<sub>2</sub> concentrations and low nitrogen availability was probably related with high internal carbohydrate levels, which contribute with energy and carbon skeletons for nitrate reduction.

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### **Can ocean acidification affect chemical defenses in *Posidonia oceanica*?**

Luciana Migliore<sup>1</sup>, Alessia Piccenna<sup>1</sup>, Alice Rotini<sup>1</sup>, Samantha Garrard<sup>2</sup>, Maria Cristina Buia<sup>2</sup>

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Seagrasses employ a wide variety of traits to reduce plant quality as food for herbivores, such as nutrient content, structural and chemical defenses. In particular, the presence of tannin cells, specialized in the production of phenolic compounds, is well documented in *Posidonia oceanica*. According to the optimal defense theory, in this marine plant the phenolic content is higher in younger leaves, located in the centre of the shoots, which have a greater potential to contribute to future plant fitness. These metabolic compounds contribute to reduce the direct herbivore-seagrass interaction, restricted to few grazers, mainly fishes and sea urchins. An abnormal high grazing activity by *Sarpa salpa* has been recorded in a *P. oceanica* meadow (Castello Aragonese, Ischia, Naples) where natural CO<sub>2</sub> emissions reduce the water pH. In order to understand the changes in plant-animal interactions in a high CO<sub>2</sub> world, the total phenol content in *P. oceanica* intermediate leaves, the assessment of bite marks (to quantify grazing pressure) and the abundance of *Paracentrotus lividus* and *Sarpa salpa* were done at acidified and controlled conditions. Although a high variability in the phenol content was found among leaves under the same conditions, as already recorded in literature, plants exposed to acidified waters showed a significant reduction of 1/3 in the phenol content in comparison to controlled plants. The percentage of grazing scars from *Paracentrotus lividus* and *Sarpa salpa* varied between pH conditions but a significant increase in % grazing scars was recorded in acidified sites for both species.

These results are a preliminary step to understand how changes in interactions between flora, fauna and their environment may drive alterations in *P. oceanica* ecosystem function with respect to projected future acidification.

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### **Trace element kinetics in contaminated *Posidonia oceanica* meadow**

J. Richir, N. Luy, G. Lepoint, R. Biondo, S. Gobert

MARE Centre, Laboratoire d'Océanologie, Université de Liège, Sart-Tilman, B6c, 4000 Liège, Belgium

The seagrass *Posidonia oceanica* (L.) Delile is widely used since the mid-70th to biomonitor trace elements (TEs). However, there is a lack of knowledge regarding to pollutant kinetics in that species. *Posidonia oceanica* were in situ contaminated by a mix of 15 TEs (Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Mo, Ag, Cd, Pb and Bi) at experimental levels equivalent to 10 (moderate) and 100 (acute) times seawater average concentrations. TEs concentrations were measured by ICP-MS in *P. oceanica* leaves and rhizomes sampled at regular time intervals, in epiphytes, in water and in sediment.

*Posidonia oceanica* immediately accumulated pollutants from the beginning of experiments; once contaminations ended, TE concentrations came back to their original levels within two weeks, or at least showed a clear decrease. Leaves exhibited different uptake kinetics for many elements (e.g. Cr, Cu, Ag, Bi

etc.): the younger growing leaves forming new tissues incorporated chemicals more rapidly than the older senescent. Rhizomes did not show any clear trend, except for Cu, Zn and Bi. Results demonstrate that *P. oceanica* is a very sensitive sentinel to immediately delineate punctual pollutions similar to what might be measured in contaminated Mediterranean waters. The good response of *P. oceanica* leaves to pollutant short-term expositions suggests their routine use in regularly scheduled monitoring programs. Nevertheless, to by-pass *P. oceanica* leaves deciduous character and their capability to detoxify rapidly, long term accumulation recordings would also necessitate belowground tissues analyses.

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### **Impact of temperature on the vulnerability of *Posidonia oceanica* and *Cymodocea nodosa* to *Labyrinthula* sp.**

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Vulnerability of seagrasses to pathogens may be greater under certain environmental conditions and infections may become detrimental to seagrasses under stress. We examined the hypothesis that increased temperature makes seagrasses more vulnerable to infection by *Labyrinthula* sp. This protist was isolated from *Posidonia oceanica* and *Cymodocea nodosa* collected around Mallorca, and maintained in culture on seawater agar medium. *P. oceanica* and *C. nodosa* shoots were incubated for 2 weeks at temperatures between 24 and 32 °C with uninfected and *Labyrinthula*-infected vectors. Infected shoots had significantly more pathogenic lesions than shoots from control treatments and lesion size decreased with increasing temperature. To examine the photosynthetic response of the plant to infection and temperature, we measured fluorescence yield using a PAM fluorometer. Quantum yield was not significantly affected by *Labyrinthula* infection or temperature in *P. oceanica*. In *C. nodosa* yields peaked at 30°C, and were significantly reduced in *Labyrinthula*-infected shoots. These results suggest these seagrasses are most vulnerable to *Labyrinthula* infection at lower temperatures and that the photosynthetic response to infection is species specific.

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### **Evidence of preference of *Cymodocea nodosa* over *Posidonia oceanica* by the herbivores *Paracentrotus lividus* and *Sarpa salpa* in a mixed habitat.**

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The trophic role of the sea urchin *Paracentrotus lividus* and the fish *Sarpa salpa* as well as the importance of seagrass leaf epiphytes as mediators of trophic interactions were evaluated by food preference and leaf tethering experiments during the summer period 2011 in a mixed habitat containing *Cymodocea nodosa*, *Posidonia oceanica* and rock (Cabo de las Huertas, Spain). We carried out 4 field experiments with the following paired combinations: 1) Epiphytized leaves of *C. nodosa* vs *P. oceanica* (CE vs PE); 2) Nonepiphytized leaves of *C. nodosa* vs *P. oceanica* (CNE vs PNE); 3) Epiphytized leaves of *C. nodosa* vs nonepiphytized leaves of *C. nodosa* (CE vs CNE) and 4) Epiphytized leaves of *P. oceanica* vs nonepiphytized leaves of *P. oceanica* (PE vs PNE). Results indicated that both herbivores consistently preferred epiphytized vs. nonepiphytized leaves of either seagrass. Furthermore the herbivores exhibited a clear preference for *Cymodocea nodosa*, even when epiphytes were removed. Results also showed that consumption of *C. nodosa* was approximately twice that of *P. oceanica*. *C. nodosa* leaves harbored higher epiphytic biomass, which may have accounted for the higher consumption of this seagrass species in comparison with *P. oceanica*

Key words: Food preferences, *Paracentrotus lividus*, *Sarpa salpa*, *Cymodocea nodosa*, *Posidonia oceanica*, epiphyte biomass.

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## **Comparison between *Posidonia oceanica* and *Mytilus galloprovincialis* as Polycyclic Aromatic Hydrocarbon biomonitor**

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Due to their mutagenic and/or carcinogenic properties, US EPA Polycyclic Aromatic Hydrocarbons (PAHs) are listed as priority dangerous substances. The aim of this study was to evaluate the capability of seagrasses in PAHs contamination. For this purpose, concentrations in *Posidonia oceanica* were analyzed in three sites along a North West radial in front of Livorno harbour (NW Mediterranean Sea), and compared to those in *Mytilus galloprovincialis* considered as a validate biomonitor. Among the sixteen PAHs analyzed, twelve concentrations above detection limit were present in *Posidonia oceanica* leaves. Of these, eight (medium and high molecular weight) with the highest values, are referred to plants growing close to the harbour. For *Mytilus galloprovincialis*, nine present concentrations above detection limit. Our results confirm the harbor like potential contamination source.

According to this preliminary work, it appears that (i) *Posidonia oceanica* is able to accumulate PAHs in its tissues, (ii) most of PAHs analyzed exhibit a higher concentration in the vicinity of contamination source and (iii) similar trend are observed in *Posidonia oceanica* and *Mytilus galloprovincialis*.

Keywords: PAH contamination, accumulation, *Posidonia oceanica*, *Mytilus galloprovincialis*, Mediterranean Sea

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## **Zooplankton detritus contribution to *Posidonia oceanica* production in an oligotrophic Mediterranean area**

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The aim of the present work is to explore the pelagic-benthic coupling in an oligotrophic Mediterranean area by examining the potential role of zooplankton detritus in supporting the *Posidonia oceanica* production, as has been recently suggested by a field study (Frangoulis et al. 2011, ECSS, 92, 456-423). Two models are used for this purpose. A 1D NPZD model of the water column plankton ecosystem (Skliris et al. 2001, JMS, 27, 337-362), modified in order to express separately zooplankton detritus in terms of carcasses and faecal pellets, coupled off line with a growth model of *Posidonia oceanica* (ElKalay et al. 2003, EM, 167, 1-18). The coupled model is applied in the Bay of Calvi (Corsica, W. Mediterranean) to simulate the winter spring period (to cover the whole plankton bloom). Model calibration and validation is based on observational biochemical/hydrodynamic/meteorological data collected in the area during the considered period. Model results are analyzed in order to assess when and at which degree zooplankton products are an important contributor of nitrogen for *Posidonia oceanica*.

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## **Habitat complexity influence predation rates on sea urchin (*Paracentrotus lividus*) in NW Mediterranean seagrass and rocky systems.**

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Predation on sea urchin *Paracentrotus lividus* which is a key species in seagrass communities and rocky habitats can be modulated by habitat structural attributes. Here we study the importance of the

habitat structure in determining predation on the sea urchin *Paracentrotus lividus* in two different coastal habitats (seagrass *Posidonia oceanica* and macroalgal covered rocks). 8 shallow sites (<10m depth) were determined along the continental NW Mediterranean coast with presence of both selected habitats. Predation pressure was measured using tethering methods. A total of 160 urchins were placed in each habitat. Attributes of habitat complexity and *P. lividus* densities were measured in each site. Type of predators (benthic species or fishes) was determined by dead urchin carcass marks. The same method was used in two sampling periods corresponding with the warm and the cold season, reflecting a lower predatory activity in winter. On average results evidence differences in predation between the two habitats, being greater in the rocks than in seagrasses. This fact reflects that the more complex the habitat is, the lower predation rates are found. Defining the way in which habitat complexity alters predation rates it's important to understand how habitats affect to relationships between organisms.

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### **Contribution to the study of the reproduction of three aspidochirotid holothurians (Echinodermata: Holothuroidea) inhabiting the *Posidonia oceanica* meadow of two contiguous areas: La Marsa and Ain Taggourait (Algeria)**

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Aspidochirotid holothurians have a considerable ecological role in the chain of decomposition of the *Posidonia oceanica* ecosystem of the Mediterranean sea by their capacity of recycling of the organic matter. A total of 128 individuals of *Holothuria (Holothuria) tubulosa*, *Holothuria (Lessonothuria) polii* and *Holothuria (Platyperona) sanctori* were sampled at 5m depth, from March to September 2011, in two stations: La Marsa (polluted area) and Ain Taggourait (unpolluted area). The evolution of the diameter of the female gonadic tubules of *H. (H.) tubulosa* shows a maturation beginning in March and reaches a maximum in May. The diameter of the gonadic tubules of the males shows a decrease in April and then a progressive increase until July. For *H. (L.) polii*, the male gonadic tubules showed decreases of their average diameter during May and then an increase until July. The evolution of maturation was continuous throughout the study period for the female. The gonads maturation of the males of *H. (P.) sanctori* undergoes the same diagram as for the others species with a decrease of the diameter of the gonadic tubules in April and a progressive recovery. The females maintained the diameter of their tubules constant until June, follow-up thereafter by a fast maturation in July.

Keywords: Sea cucumbers, *Posidonia oceanica*, reproduction, Algerian basin.

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### **Inventory of the associated fauna of the rocky algal covers of Mostaganem area (Algeria)**

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In this last decade, benthic macro invertebrates are classified like good indicators of the state of their medium. For this purpose, in this study, we propose to make a first application of these indicators near the Mostaganem coastal areas. Thus, three stations were selected, characterized by a rocky substrate: Stidia, Kharouba and Hadjadj. Two types of analyses were used: (I) statistical descriptors allowing describing in a quantitative way the settlements and (II) the indices of diversity illustrating the complexity of the settlements. Thus, a total of 29 species of benthic macro fauna or 3993 individuals were determined, represented respectively by 28 species or 1538 individuals in the Stidia station; by 16 species or 1434 individuals at Kharouba station and by 21 species or 1021 individuals at the Hadjadj station. As a whole, both Stidia and Hadjadj seems like a stations perfectly diversified and balanced, contrary to the station of kharouba, which shows a state in light imbalance of the medium.

Key words: biodiversity; macro fauna; algal covers; Mostaganem.

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## **Assessment of the ecological status of *Posidonia oceanica* meadow with a “Non Destructive Shoot Method”: NDSM**

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*Posidonia oceanica* (L.) Delile is a protected species, included in the Red list of marine threatened species of the Mediterranean. Because of its sensitivity to disturbance, *P. oceanica* is used as a bioindicator to define the health status of coastal waters. Monitoring methods generally require to sample plants, followed by measurements on picked shoots. This implies the total destruction of several tens of shoots. This study presents a method, “The Non Destructive Shoot Methodology”: NDSM, that permits the measurement of (1) the most used seagrass metrics, (2) the determination of C, N, P contents and (3) the measurement of the trace metal levels in *P. oceanica* leaves. Our technic has been firstly tested by comparison with the results obtained with classic method of biometry. Secondly, differences between levels of C, N, P and trace metals obtained with classic picking and our methodology were tested. Thirdly, the physiological consequences on the shoots were investigated (% of survival, growth, essential element contents (C, N, P, Fe, Cu...)). The NDSM gives similar results to classic investigations to assess the ecological status of *P. oceanica* meadow (i.e. PREI, BiPO...) and avoid the uprooting of the “K-strategist” protected species. This methodology is usable in cases of monitoring and impact studies.

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## ***Posidonia oceanica* loss in a Mediterranean semi-enclosed coastal system: response of polychaete assemblage**

Salvatrice Vizzini, Antonio Mazzola

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Seagrass beds play a facilitative role for benthic assemblages as they increase the complexity of the space, provide food and shelter from predators and stabilize the sediment. Despite their overall importance, seagrasses are declining on a global scale, mainly due to anthropogenic causes. Seagrass loss has been linked to dramatic changes in habitat structure and associated benthic assemblages. In this study, the effect of the regression of the seagrass *Posidonia oceanica* on abundance and biomass of polychaetes was investigated in a semi-enclosed coastal system, the Stagnone di Marsala (western Sicily, Italy), where *P. oceanica* lives at the upper limit of its salinity and temperature tolerance and it is interested by marked regression conditions. Sampling was carried out in two sites in the central area of the basin characterised by different habitats: *P. oceanica* and dead matte. Polychaetes were identified at the family level and attributed to trophic groups according to the literature. Abundance, size and biomass were analysed. Sediment features in terms of grain-size, organic matter content and biochemical composition were also investigated. The results highlighted a greater effect of *P. oceanica* loss on biomass than on abundance, suggesting that seagrass loss may have relevant effects on size-related features of macrozoobenthos communities and direct implication on trophic processes and functioning.

## **WORKSHOP I: *Posidonia oceanica*: a good bioindicator ?**

Coordinator: Sylvie Gobert, MARE Centre, Laboratoire d'Océanologie, Université de Liège, B6c, 4000 Liège, Belgium. Sylvie.gobert@ulg.ac.be

For more than 40 years, *P. oceanica* has been used as bio-indicator in the Mediterranean sea. Several studies, approaches and methodologies (e.g. WFD, trace metals, nutrients, stable isotopes, lepidochronology), provide evidences that *P. oceanica* can be considered as an useful, relatively inexpensive and easy indicator to assess the quality of the marine environment.

Since the MSW 2006 in Malta and the Round Table dedicated to "the potential application of the seagrass *P. oceanica* as a bio-indicator for EU Water Framework Directive (WFD)", much work has been done to apply this indicator to understand the status of Mediterranean waters. The focus of this workshop is to resume the known potential uses of *P. oceanica* as bio-indicator and to define their limits. After a brief presentation, the different approaches, techniques, methodologies will be discussed, compared and criticized with, and by, all participants.

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## **DAY 3: WEDNESDAY MAY 30**

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### ***POSTER SESSION I***

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#### **Overview and recent improvements of the global and regional Mercator Ocean operational systems**

Abdelali El Moussaoui and Mercator Ocean teams

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In the framework of the European project GMES/MyOcean, Mercator Ocean has designed a hierarchy of ocean analysis and forecasting systems based on numerical models of the ocean/sea-ice, data assimilation methods and biogeochemical coupling. Since December 2010, Mercator Ocean runs new versions of the global system at  $\frac{1}{4}^\circ$  and the Atlantic and Mediterranean system at  $\frac{1}{12}^\circ$  between  $20^\circ\text{S}$  and  $80^\circ\text{N}$ . Both new systems deliver weekly and daily services and are operated in real time. The Atlantic and Mediterranean one is nested in the global  $\frac{1}{4}^\circ$  at the south and north open boundaries.

Many improvements concern the ocean/sea-ice model, the assimilation scheme and the biogeochemical model. The ocean and sea-ice models are based on the NEMO code. The data assimilation algorithm is a reduced order Kalman filter using 3D multivariate modal decomposition of the forecast error covariance. The biogeochemical coupled model is based on the PISCES-NEMO code. The systems assimilate conjointly altimeter data, SST and in situ observations (temperature and salinity profiles, including ARGO data) in order to provide the initial conditions required for numerical ocean prediction.

After a description of the updated systems, we will present recent validation results. It demonstrates the high level of performance and the stability of the new systems for all variables, and their superiority to the previous ones in most aspects.

In addition, since February 2011, a global  $\frac{1}{12}^\circ$  ocean forecasting system delivers weekly services in a real time mode. This system offers a new perspective on the global ocean mesoscale predicting.

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#### **The *Posidonia* meadows and algae bottoms are they promote diversity of settlement of Amphipods?**

Amel Ayari and Karima Nasri-Ammar

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Diversity of amphipodofauna was studied in spring and autumn 2008 in two geomorphologically different beaches: Bizerte, in the North of Tunisia ( $37^\circ19'17.1''\text{N}$ ;  $09^\circ51'57.3''\text{E}$ ) and the Gulf of Gabes in the South

of Tunisia (33°52'34.0"N; 10°07'38.8"E). The first one, in contrary to second beach, is characterized by the presence of a meadow of *Posidonia oceanica* with algae bottoms (*Ulva Sp.*; *Padina sp.*; *Cymodocea nodosa*) that runs parallel to the coast. During study period, 6854 specimens were identified from Bizerte beach and 602 individuals from Gabes beach. Specimens collected were identified, sexed and counted. On Gabes beach, only one species was found that it is the supra-littoral amphipod *Talitrus saltator*, while on Bizerte beach five different species, belonging to the Talitridae family, were identified: *Talitrus saltator* was collected in sand and *Talorchestia deshayesii*, *Orchestia gammarellus*, *Orchestia montagui* and *Orchestia mediterranea* were found under a meadow of *Posidonia oceanica* associated with algae bottoms. This last result suggested confirmed that the marine vegetation deposited on the supra-littoral zone may be used as a nursery, food resource and habitat for many species of the family of Talitridae.

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## **A possible effect of salinity fluctuation on growth and survival of the Mediterranean seagrass *Cymodocea nodosa* exposed to a brine discharge**

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The increase of seawater desalination plants may affect seagrasses as a result of its hypersaline effluents that are discharged into the sea. There are some studies on the salinity tolerance of seagrasses under controlled laboratory conditions, but few have been done in situ. The aim of this study is to estimate the tolerance of the Mediterranean seagrass *Cymodocea nodosa* to a brine discharge. To this end, *C. nodosa* shoots were placed during one month at four localities, two close to a brine discharge and other two not affected by the discharge, and the experiment was repeated five times. The results obtained showed a decrease in growth and an increased mortality at the localities adjacent to the brine discharge. It was also found an increase in the percentage of horizontal shoots respect vertical shoots at the impacted localities, where the average salinity was approximately 1 psu higher than the control ones. It is probably that not only the average salinity but also the fast fluctuations in salinity and slightly higher temperatures associated with the brine may have caused physiological stress that reduced growth and survival at the impact localities.

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## **Dispersal potential of *Zostera* species**

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Dispersal potential of seagrass propagules was investigated for the two *Zostera* species present in the Ria Formosa lagoon, *Z. noltii* the dominant species in the intertidal and the subtidal, low abundant *Z. marina*. The sedimentation rate and dispersal potential of seeds and vegetative fragments were experimentally quantified under still water and different water currents. The critical re-suspension speed of the seeds was determined. Seeds from *Z. marina* showed higher sedimentation speed in still water. When released under different current levels, *Z. noltii* seeds dispersed over longer distances. Critical current velocity for re-suspension of the seeds from the bottom was very similar. The dispersal of isolated seeds thus occurred across scales of meters for both species. Seed dispersal via floating shoots carrying spathes might account for larger seed dispersal distances. To address this hypothesis, vegetative fragments were placed in still water and their survival and growth were monitored. Higher dispersal potential was observed for *Z. noltii* fragments, with 25% of the floating fragments remaining alive over 8 weeks; 74% of those were growing. Less than 10% of *Z. marina* fragments were viable after the same time period and none of them grew. These results indicate higher dispersal potential for *Z. noltii* compared to *Z. marina*.

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## **Multidisciplinary Methods For Assessing Ecological Structure Of *Posidonia Oceanica* Meadows Along The Central Tyrrhenian Sea.**

Carla Micheli, Alessandro Belmonte, Giulia Grosso, Luigi De Cecco, Sandro Martini, Flavio Borfecchia.

Different underwater techniques were applied for mapping *Posidonia oceanica* meadows along the coasts in the central Tyrrhenian Sea (Mediterranean).

With the aim to assess the *P. oceanica* health status and its management at local and large scale we start a multidisciplinary study for mapping populations and its distribution in relation to substrate morphology and abiotic and biotic factors to which this ecosystem respond to stress over time.

At first our approach is based on laboratory and field evidence by SCUBA diving exploration. Moreover innovative Remote sensing techniques, Side Scan Sonar as well as Remote Operate Vehicle (ROV) were integrated for mapping the underwater landscape.

Maps of marine cartography were obtained for monitoring the ecosystems for coastal management purposes.

In this research we assembled the tools needed to monitor *P. oceanica* status and to provide update and detailed indication of biophysical parameters related to water quality as part of an adaptive approach to coast management

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### **Long term evolution of upper and lower limits of two *P. oceanica* meadows in the Central Mediterranean Sea.**

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Current methodologies of investigation (SSS, ROV, SCUBA, GPS) allow to obtain highly detailed maps of the distribution and status of *Posidonia oceanica* meadows. Comparing such data with reliable historical maps we can have a tool to highlight changes in the distribution, like regressive phenomena, over time.

Particularly, the GIS analysis of the upper and lower margins allows to describe the regression patterns of the meadows and to estimate the extent and speed of lost coverage and margins modification of both the lower and deeper portions.

In the present work we analyze the temporal evolution of lower and deeper margins of two *Posidonia* meadows along the coast of Latium, in the Central Mediterranean Sea.

The meadow of “Montalto di Castro” showed the upper limit at 11 m depth in 1960 and at 10 m in 2010, the lower limit moved from 25 m in 1960, at 22-23 m in 1990 and at 19 m depth in 2010. The upper limit of the “Caprolace” meadow passed from 10 m in 1960 to an average of 15 m in 1990 and 18 m depth in 2010, the lower limit from 26-27 m in 1960 to 25 m depth in 1990 and 2010. The different regression pattern observed in the limits of the two meadows is the result of different causes of impact.

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### **A feasible and cost-effective approach for monitoring the conservation status of *Posidonia oceanica* in marine protected areas**

Ivan Guala, Giuseppe Di Carlo

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The monitoring of *Posidonia oceanica* meadows in marine protected areas is crucial for the assessment of their conservation status, the identification of pressures and threats, and to inform appropriate management measures for this ecosystem.

Nowadays, because of the high number of marine reserves and different systems of protection of the coastal-marine environment (e.g. Marine Protected Areas, Natural Parks, Sites of Community Interest, the latter established ad hoc for the protection of the habitat 1120 “*Posidonia* beds” according to the Directive 92/43/EEC), funding resources allocated for monitoring of meadows in marine protected areas are often modest and inadequate to ensure their conservation and sustainable management.

Here, we propose a monitoring protocol for *Posidonia oceanica* meadows based on informative and replicable actions which are, at the same time, achievable in a short time period and can be adopted with limited funding resources. In particular, we suggest common detection techniques of structural variables that

can detect the effects of mechanical impacts without involving the removal of biological material. The objective of this paper is to open a discussion within the seagrass community on the minimal requirements needed for assessing the conservation status of *P. oceanica* meadows in Mediterranean marine protected areas.

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### **Experimental study of *Cymodocea nodosa* tolerance to copper toxicity.**

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Trace metals associated to urban and industrial development may reach coastal areas and cause nuisances to the marine environment. The associated ecological risks are difficult to assess, due to their complex behavior in marine waters and, although a big effort to expand our ecotoxicological knowledge, the response of some key species to trace metals remains unknown. We assess here the effects of increased copper concentrations on an habitat-forming species, the seagrass *C. nodosa*, through a microcosms experiment. To this end, we examined *C. nodosa* performances (photosynthetic efficiency, Fv/Fm; leaf elongation: incidence of leaf necrosis and Cu content in tissues) under three Cu concentrations in water (1 ppm, 2.5 ppm and 5 ppm) and compared them to those obtained in control microcosms. The results show that *C. nodosa* tolerates Cu concentrations up to 1 ppm, as plants under that concentration behaved equally that those used as controls. In contrast, at 2.5 ppm, leaf growth and photosynthetic efficiency decreased, while leaf necrosis incidence increased. These changes were even sharper at 5 ppm. We conclude that Cu toxicity is between 1 and 2.5 ppm, although, due to the short duration of the experiment (21 days), we cannot ascertain if this toxicity is lethal or sublethal.

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### **A first attempt at seagrass repartitioning in the Moroccan coasts**

Laila Natij<sup>1</sup>, karima khalil<sup>2</sup>, Mohamed Loudiki<sup>3</sup>, Mounia Elhaj<sup>4</sup>, Khalid Elkalay<sup>1, 2,\*</sup>

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Seagrasses play a prominent ecological role and support the productivity on which many communities of marine animals feed and reproduce. In this work that addresses a first look at seagrasses in the Moroccan coast, we will compile and analyze the available bibliographic data pertaining to seagrass. We will summarize the requirements for seagrass data acquisition and introduce an overview of the physical-chemical conditions of seagrass. We then will determine the physical-chemical conditions of the Moroccan coasts, and compare the physical-chemical conditions of those regions and the optimum conditions required for seagrass. Our data show that the six lagoonal selected environments are propitious for the development of seagrasses. There are four seagrass species known throughout the Moroccan coasts: *Zostera noltii*, *Zostera marina*, *Cymodocea nodosa* and *Posidonia oceanica*.

Keywords: Seagrass determination; Moroccan Mediterranean Sea; Moroccan Atlantic Ocean.

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### **Cartography of macrophytobenthic communities in the north lagoon of Tunis**

Manel Soltani <sup>(1)</sup>, Naceur Ben Maïz <sup>(2)</sup> et Aslem Sami Djellouli <sup>(1)</sup>

<sup>(1)</sup> Faculté des Sciences Mathématique, Physiques et Naturelles de Tunis. Campus universitaire. 2092, Tunis.

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In order to monitor the evolution of the ecological status of the north lagoon of Tunis after purification and its water quality improvement, a map of distribution of dominant phytobenthic macrophyte communities in the lagoon was established using the satellite remote sensing images analysis confirmed by field observations

along 19 equidistant transects covering the surface of the lagoon. Samples of vegetation were collected from about 75 stations during the field campaigns. A total of 23 species was listed, including 11 Rhodophyceae, 4 Phaeophyceae, 5 Chlorophyceae and three species of seagrasses. The lagoon is dominated by three species of seagrasses: *Ruppia cirrhosa* (Pentagana), *Cymodocea nodosa* (Ucria) Ascherson and *Nanozostera noltii* (Hornemann) and two species of Chlorophyceae: *Chaetomorpha linum* (Muller) Kützing and *Caulerpa prolifera* (Forsskål) Lamouroux. Compared to its previous situation, the analysis of distribution of dominant phytobenthic macrophyte communities has revealed a great improvement of ecological status of this lagoon.

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### **Characterization of a *Cymodocea nodosa* (Ucria) Aschers meadow in the region of Sidi Rais (Tunisia)**

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The sea bottom of the locality of Sidi Raïs (north-eastern coast of Tunisia) is occupied by an extended *Posidonia oceanica* (L.) Delile meadow with an important reef barrier. Between this barrier and the shore line we can note the presence of a shallow lagoon that offers good conditions for *Cymodocea nodosa* development. Special conditions of this ecosystem prompted us to conduct a study which allows us to characterize this herbarium. The aim of this work is to present the results of structural parameters: biomass and recovery of the seagrass *Cymodocea nodosa* and its phenological parameters. In accordance with the literature these results show a variation of the studied parameters clearly linked to seasonality with a maximum of total biomass recorded during the warm season and a minimum during the cold one. But we also note that the leaves biomass winter decrease is compensated by some development of the rhizomes and roots. We also present here a list of species associated to the meadow.

Key-words: *Cymodocea nodosa*, Magnoliophyta, Sidi Rais.

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### **Preliminary study of the monthly evolution of the leaf area index of *Posidonia oceanica* (L.) Delile in two areas of the coastal fringe of Mostaganem (Hadjadj, Stidia - Algeria)**

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A monthly survey of the Leaf area index of *Posidonia oceanica* of two areas (Hadjadj, Stidia) in Mostaganem coastal fringe, was carried out from February to July 2011 with an average depth of -3m; that for having an outline and comparison on the vitality of the *Posidonia* meadows of these two areas. In Hadjadj station, the leaf area index (in m<sup>2</sup> of leafs per m<sup>2</sup> of surface of the bottom) shows a monthly variation with a minimum recorded in February ( $6.15 \pm 2.64$  m<sup>2</sup>/m<sup>2</sup>) and a maximum in June ( $9.09 \pm 3.35$  m<sup>2</sup>/m<sup>2</sup>). At Stidia area, the leaf area index also presents monthly variations with a minimum recorded in February ( $1.36 \pm 0.78$  m<sup>2</sup>/m<sup>2</sup>) and a maximum in May ( $3.40 \pm 1.28$  m<sup>2</sup>/m<sup>2</sup>). The state of health of the *Posidonia oceanica* meadow at Hadjadj area is better than that of the Stidia area, since the values of the leaf area index obtained in Hadjadj are definitely higher than those obtained in Stidia ( $P < 0,01$ ). However, the leaf area index of *Posidonia oceanica* obtained in both studied areas present values which are abnormal, thus translating a sign of disturbance.

Key words: *Posidonia oceanica*, Leaf area index, perturbation, Mostaganem.

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### **Monitoring of seagrasses through underwater photographic images and video: underwater pipelines case study**

Seagrass meadows are considered to be the most important marine ecosystems for biodiversity, ecological, sedimentary and economic reasons. Their progressive degradation may be due to anthropogenic or natural disturbances, although losses of the seagrass meadows are mainly related to coastal development, pollution, trawling, fish farming, moorings, dredging, dumping and the competition with introduced species. As a consequence it is necessary to establish monitoring programs that follow a unified and complete protocol of actions to preserve these important marine resources. In this work we explore a procedure for monitoring the *Posidonia oceanica* and *Cymodocea nodosa* meadows by using image analysis through underwater photcamera, or alternatively, georeferenced towed underwater video-camera or remotely operated vehicles (ROV), in order to control the effects of submarine pipelines. The considered variables were: area, continuity, proximity, coverage percentage (using the software estimate), and species composition. The combination of these five variables were used to calculate the habitat structure index, H'. This method has several advantages over other techniques: 1) provides a permanent archive of visual images; 2) allows more objective estimates of changes over time; 3) give details of the meadows which is not possible with acoustics techniques; 4) allows to easily work over wide areas.

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### **Trace metals in *Cymodocea nodosa* (Ucria) Ascherson and *Zostera noltii* Hornem. from transitional waters in the Adriatic Sea**

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The concentrations of seven trace metal elements (Pb, Cd, Cu, Zn, Ni, Mn and Fe) were measured in root, rhizome and leaf tissues of two seagrass species, *Cymodocea nodosa* (Ucria) Ascherson and *Zostera noltii* Hornem. These elements represent the most frequent toxic metals found in coastal environments. The sampling was made at 10 stations in transitional waters of the Adriatic Sea in the areas of Novigrad Sea, Prokljan lake, Jadro river mouth, Cetina river mouth and Neretva delta, spreading across the pollution gradient, from pristine to heavily disturbed areas, including urban and industrial regions and commercial harbours. Dried tissue samples were analyzed by inductively coupled plasma mass (ICP-MS; for elements: Pb, Cd, Cu, Zn and Ni) and optical (ICP-OES; for elements: Mn and Fe) spectrometry, after acid digestion. In general terms, *Z. noltii* seems to accumulate more metals than *C. nodosa*. Patterns of accumulation across plant organs are coherent for all elements, except for Zn, Ni and Cu. Spatial variability related to the pollution gradient confirm the high potential of both species for use in biomonitoring programs.

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### **Associated polychaete communities of a *Posidonia oceanica* meadow in Cap Zebib (off North East Tunisia)**

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Polychaete communities associated with the seagrass *Posidonia oceanica* were investigated in Cap Zebib (North-Eastern Tunisia). Samples were collected monthly from May 2007 to May 2008, in two stations located at 3 and 12 m depths using a corer of 25 cm diameter. A total of 1359 individuals belonging to 46 species were identified. The families of Eunicidae, Syllidae and Sabellidae were represented by more than 62% of the total of individuals. The species richness (S) and Shannon-Wiener diversity index (H') showed significant variation in relation with depth and sampling period. The structure of the polychaete communities varied considerably from one season to another but depth did not show any influence. The

results of similarity percentage (SIMPER) showed that each season was characterized by the dominance of some species. Taking into consideration a possible relationship between the faunal composition and abiotic parameters, a positive correlation was observed between number of polychaete species and dissolved oxygen and a negative correlation between number of species and temperature. In contrast, it was no correlations between faunal indices and plant feature.

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### **Five years of *Posidonia oceanica* monitoring in the Valencian Coast (E Spain) for the implementation of the European Water Framework Directive**

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The Water Framework Directive (WFD) 2000/60/EC prescribes that the ecological status of waters inside the European Union should be assessed based on biological quality elements, including the endemic Mediterranean seagrass *Posidonia oceanica*. In order to implement the WFD along the Valencian Coast (E Spain) it has been carried out a five years (2005 – 2009) monitoring program focused in different *P. oceanica* descriptors. We found that localities subjected to anthropogenic disturbances have lower covering of *Posidonia* and higher percentages of dead-matte, with lower shoot density and smaller shoot size if compared with localities with less anthropogenic influence, where *Posidonia* meadows showed a better conservation status. In addition, it has been observed that during these 5 years of monitoring *Posidonia oceanica* meadows in localities submitted to a higher anthropogenic influence have increased its regression while the rest of the meadows remained quite stable.

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## DAY 4: THURSDAY MAY 31

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### ***Posidonia oceanica* photosynthesis along a depth gradient**

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Seagrass photosynthetic rates depend largely on light availability, along with other environmental factors and the physiological condition of the plants. Along a vertical gradient, seagrasses are permanently exposed to distinct light environments, to which the photosynthetic apparatus must adapt. In this study, the response of *Posidonia oceanica* photosynthesis to light was investigated in plants collected at three different depths (3, 20 and 30m) in the Bay of Revellata, Corsica, France, in the the marine research station Stareso (42°34'4"N, 8°43'2"E) in October, 2011. Photosynthesis-irradiance curves (P-I) were measured in an oxygen electrode system (DW3/CB1, Hansatech). Photosynthetic rates were determined over an increasing range of irradiance values, from darkness to 850  $\mu\text{mol quanta m}^{-2} \text{ s}^{-1}$ . The Jassby and Platt hyperbolic model (1957) equation was fitted to the obtained data, to calculate the relevant photosynthetic parameters. For each depth, maximum photosynthetic rate ( $P_{\text{max}}$ ), initial slope ( $\alpha$ ), light saturation point ( $I_k$ ), light compensation point ( $I_c$ ) and dark respiration ( $R_d$ ) were determined. Photosynthetic parameters showed significant variations with depth, particularly between the shallowest plants (3m) and the two other depths. As expected, *P. oceanica* from 3m depth revealed a "sun-adapted" photosynthetic behavior in contrast with plants from deeper waters.

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### **Can the marine ecosystem of a *Posidonia oceanica* back-reef react and defend itself from the spread of *Caulerpa racemosa* var. *cylindracea*?**

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A back-reef of *Posidonia oceanica* (S. Liberata, Orbetello, Italy) subject to degradation lost its typical mixed meadow of *Cymodocea nodosa*, *Nanozostera noltii* and *Caulerpa prolifera*, and was colonised by the invasive chlorophycea *Caulerpa racemosa* var. *cylindracea* (Sonder) Verlaque, Huisman, Boudouresque (Bryopsidales, Chlorophyta) between 2003 and 2004. When the flora was studied in 2005-2006, *C. r. cylindracea* constituted 25-38% of the algal biomass. In 2011, it had fallen to 2-3% and other species predominated: dead mats were covered in a turf of photophiles, dominated by balls *Cladophora albida*., while residual dead patches of the mixed meadow had been colonised by *Penicillus capitatus*. Moreover, residual clumps of *P. oceanica* in the back-reef showed plagiotropic growth, expanding into sandy areas. The lists of flora of the two periods are compared and the possible causes of these transformations discussed in relation to the characteristics of the area and human impacts. The results suggest that autochthonous populations can recover and oppose the spread of *C. r. cylindracea*; they also sustain the view that invasion occurs in degraded or altered ecosystems and may be reversible.

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### **Effects of *Ulva* sp. blooms and its associated decomposition in *Cymodocea nodosa* meadows**

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Eutrophication is increasing the frequency and magnitude of green macroalgal blooms in coastal shallow environments, such as seagrass meadows. In order to determine the effects of green macroalgal accumulations on seagrasses, undisturbed *Cymodocea nodosa* meadows (0.24 m<sup>2</sup>) were collected from Cadiz Bay (Spain) and transferred to six mesocosms. *Ulva* sp. (210 g DW m<sup>-2</sup>) was added to 3 of them

and the evolution of the mesocosms was followed for 6 weeks. Vertical distribution of oxygen and free sulfide concentrations were recorded in the water column and the sediment using needle microsensors. Biometrics of *C. nodosa* were measured during the experiment. In macroalgal mesocosms, hypoxic and anoxic conditions developed along the experiment inside the macroalgal mat and at the sediment surface. The concentration of free sulfide increased significantly in the sediment being detected even inside the macroalgal canopy in the water column. These conditions affected *C. nodosa* biometrics, decreasing leaf length and shoot weight. However, from the fourth week, a decrease in macroalgae coverage, due to decomposition, occurred. As a consequence, the presence of sulphide and the hypoxia in the water column disappeared. As a result, biometrics of *C. nodosa* treatments were similar at the end of the experiment. These results highlight the potential of *C. nodosa* to face moderate macroalgal blooms.

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### **Monitoring of conservation status of *Posidonia oceanica* in two Croatian marine protected areas**

Ivan Guala, Zrinka Jakl, Milena Šijan, Mosor Prvan, Ante Žuljević, Giuseppe Di Carlo

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Standardized monitoring protocols for Croatian marine protected areas (MPA) were developed to assess the conservation status of *Posidonia oceanica*, as well as to identify changes in seagrass meadows over time. Main detrimental effects come from sewage outfalls and boat anchoring, as the MPAs are well known to boaters destinations, both at national and international level. As anchoring mainly impacts the structure of the meadows, shoot density and percentage cover of *P. oceanica* were assessed. A hierarchical sampling was designed for each MPA; field survey was carried out in the summer 2011 and will be carried out yearly. Here we present the results of the first year of monitoring for two MPAs, Nature Park Telašćića, Nature Park Lastovo Islands. While these islands remain largely untouched, the increasing human presence is beginning to threaten their marine habitats, and *P. oceanica* already shows sign of regression at several sites. At Lastovo and Telašćića MPA, the management authority is now implementing a series of actions to reduce human pressures and promote a more sustainable approach to tourism. Thus, this monitoring is the first ever conducted in Croatia and it will be critical to provide a first baseline to ensure that habitat changes are monitored and managed appropriately.

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### ***Posidonia oceanica* meadows in the Inner Ionian Archipelago and adjacent gulfs**

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In the framework of the European FP7 project MESMA (Monitoring and Evaluation of Spatially Managed Areas) the distribution pattern of *Posidonia oceanica* meadows was studied to be used as criterion for the evaluation of management priorities in the Inner Ionian Archipelago, Patraikos and Korinthiakos gulfs. Thirteen coastal Natura 2000 sites are included in the study. Six of them have a marine area which has been studied previously. The surface of *Posidonia* meadows in these sites was estimated at about 24.909 ha. Two more sites have only terrestrial part, but recent investigations showed that important *Posidonia* meadows occur at their marine front. It is the same for other four sites which are designated only as coastal lagoons, which also have important *Posidonia* meadows at their marine front. *Posidonia* meadows are considered by the Habitat Directive a "priority habitat type", hence the 60% of their surface has to be included in the Natura sites. The present paper proposes a better design of the Natura sites in study area, in order to meet the requirements of the Habitat Directive.

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### **Study of the seagrass distribution at the lagoon of Marchica (Nador, Alboran sea).**

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Marchica lagoon with an area of 115 km<sup>2</sup> and a maximum depth of 8 m is the second lagoon at the southern Mediterranean basin; it is classified as a Ramsar site since 2005 and has an undeniable biological and ecological value. In 2010, a study of fauna, flora and sediment was conducted at the ecosystem as part of the study's baseline. The results of sampling by scuba diving focused on a network of 250 points at the lagoon and showed a large distribution of seagrass beds. These are mainly the following species: *Cymodocea nodosa*, *Zostera marina*, *Ruppia maritima*. However *Posidonia oceanica* is absent. These phanerogams are found at depths ranging from 0.5 m to 6 m and having fresh biomass that can reach 9 kg / m<sup>2</sup>, the ratio of dry to fresh weight ranged from 19.86 to 21.03%. Distribution maps of these seagrass beds are being analyzed. These reference maps will allow us to follow the evolution of these ecologically important species of interest in the coming years. A study of problems related to the preservation of seagrass (impacts, anchoring, trawling) is required.

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## **Assessing Ecosystem Recovery in Transplanted *Posidonia australis* at Southern Flats, Cockburn Sound**

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Following on from the large scale loss of seagrass in Cockburn Sound, Western Australia and extensive transplanting of *Posidonia australis* has taken place in this area. Assessment of the recovery of the seagrass benthic infauna ecosystems was undertaken in Samples from the outer, middle and centre edge zones of four different density transplant plots (1 m, 0.5 m, 0.25 m and 0.125 m spacing) located within a larger transplantation meadow were compared against two natural meadows and a bare sand site. Four years after transplantation the 0.25 and 0.125 m Plots had shoot densities comparable to those of the natural seagrass sites with a two-way ANOVA revealing significant effects of site and edge zone on the seagrass shoot density. Total infauna abundance and infauna assemblages within the 0.25 and 0.125 m Plots had reached equivalent level to the natural meadows but not at the 1 and 0.5 m Plots. A two-way ANOVA showed a significant difference in the total infauna abundance between the different sites but no significant edge effect was detected. Eusiridae, Solecurtidae, Diogenidae, Columbelloidea, Fissurellidae, Oweniidae and Ischnochitonidae were found to occur in the two natural meadows and in the 0.25 and 0.125 m Plots and may be climax or K-species indicating the recovery of the transplanted seagrass to natural levels. The transplanted seagrass was also found to support small numbers of pipefish, seahorses and a sea lion. From this study it can be seen that the shoot densities and infauna abundances and assemblages of the 0.25 and 0.125 m Plots have reached levels comparable the nearby natural meadows and that those of the 1 and 0.5 m Plots are likely to reach comparable level another in one to two years.

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## **Distribution of the different threatened habitats, the seagrass beds of *Posidonia oceanica* and the barrier reefs around the future marine protected area in Kuriat Islands, Tunisia.**

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This work keeps with a general pattern of natural heritage preservation policy of Kuriat islands which constitute a marine turtle nesting place and pursues a vision for creating a protected marine area. We completed the work done in 2008 by INSTM, RAC / SPA and the University of Alicante . The work is based on an ecosystem approach and studying the various components and the main natural biocenoses of the archipelago. We have tried to show the vulnerability of the area and the potential of Kuriat Islands in terms of creation of marine protected area. A particular interest was given to seagrass beds and mainly *Posidonia oceanica* and habitats of ecological interest such as lawns of *Cymodocea nodosa* in order to propose zoning scenarios depending on the geographical repartition of different habitats. We studied the *Posidonia* meadow distribution depending on the depth of the zone. The observation was made in 4 radials around the large Kuriat from the coast to the depths of 20m (1 radial sector Northeast, 2 radials North-

west sectors and a radial sector south-west). We defined the barrier reef of *Posidonia oceanica* around Kuriat archipelago that by its role as protector of turtle nesting sites induces the establishment of a marine protected area. The barrier reefs extends from the position 35°80'04,44"N;11°04'50,55"E to the position 35°85'95,33"N;11°04'59,66"E, around the large Kuriat and not only protects the islands from coastal erosion but also ensures the conservation of the morphology of the coast. Finally we evaluated the impact of towed fishing gear on *Posidonia oceanica* (length of *Posidonia* leaves not exceeding 18 cm).

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### **Focus on *Posidonia oceanica* in Sardinia (Italy): current situation and perspectives**

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The island of Sardinia with its 1,850 km of coastline is a place of great interest for the study of *Posidonia oceanica* meadows. This study is based not only on the authors' research but also on other works concerning the definition of marine areas at different level of protection as national Parks and Marine Protected Areas. The data-set used included the classic descriptors: physical, physiographic, structural and functional of the meadows. Among these studies there are two projects of the Ministry of the Environment. Other sources of information came from research on marine biocoenoses, made before the institution of M.P. A. and from various investigations on Sites of Community Interests (SIC). Some special cases to which we referred are represented by sites where ecological studies on flora and fauna have been carried out in wide *Posidonia oceanica* meadows of a considerable physiographic heterogeneity. With this paper we also propose to define important aspects of general nature concerning *Posidonia* beds of the Island as their width and the different typologies: rocks, sand, matte, dead matte. The extension of these beds is more than 170,000 ha, 1/7 of which belongs to dead matte. A particular focus on the areas which are most severely affected by anthropic impact is made. Besides, the results of the research made in areas of particular environmental value are underlined.

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### **The State of health of *Posidonia oceanica* meadows in two localities of the Mostaganem coastal area (Stidia and Hadjadj - Algeria)**

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The studies relating to the *Posidonia oceanica* meadows near the western coast of Algeria (Mostaganem) are practically non-existent.

In order to characterize the state of health of a *Posidonia oceanica* meadow of the coastal fringe of Mostaganem, measurements of the shoot density and a follow-up of the phenological parameters were carried out near two localities (Hadjadj and Stidia) at mean depth of 3 m, from February to July 2011. In Stidia area, The meadow develops on a rocky substratum with an average percentage of covering; contrary in Hadjadj area, the meadow is installed on soft bottom substrate with a small percentage of covering. An average densities of 359.47 shoots/m<sup>2</sup> and 266.10 shoots/m<sup>2</sup> were obtained respectively in Hadjadj and Stidia areas. That means that the meadows of the two localities have abnormal densities. The phenological parameters in the two localities present an increase at the end of spring – beginning of summer (May and June) and a reduction in the end of winter - beginning of spring (February and Mars). Thus, the *Posidonia oceanica* meadow of Hadjadj area has a better vitality compared to the one of Stidia; though both meadows of the studied areas shows a light sign of disturbance dues to their weak shoot densities.

Key words: *Posidonia oceanica*, phenology, density, Mostaganem, vitality.

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### **An innovative hydrodynamic model to define the natural position of the upper limit of *Posidonia oceanica* (L.) Delile meadows**

Monica Montefalcone, Matteo Vacchi, Chiara F. Schiaffino, Giulia Gatti, Carla Morri, Carlo Nike Bianchi, Giancarlo Albertelli and Marco Ferrari

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The recognition of reference conditions is mandatory to assess status and evolution over time of seagrass meadows. Reference conditions can be defined from: i) historical cartographies, when available and reliable, which is not always the case; ii) data collected in pristine areas, actually very scarce worldwide; iii) modelling. This contribution takes into account the adequacy of a hydrodynamic model. Surveys were conducted at a regional-wide spatial scale in the Ligurian Sea (NW Mediterranean) on the shallow portions of eleven *Posidonia oceanica* meadows subjected to low human pressures. Results evidenced that local morphodynamic features strongly affect the natural position of the meadow upper limits, which was always located between the breaking limit (i.e. the depth where the wave breaks) and the closure depth (i.e. the depth where wave action on the seafloor becomes negligible). From the significant correlation found between a morphodynamic index (i.e. Surf Scaling) and the distance of the meadow upper limit from the coastline, an innovative hydrodynamic model was developed, which allows to predict the natural position of the meadow upper limit. This model was then applied on a number of Ligurian meadows located in either marine protected areas or urbanized areas, in order to investigate the evolution of the shallow portions of these meadows over time and to discriminate human-induced effects on meadow health. Research done within the project GIONHA (Interreg IV Marittimo programme) funded by the Liguria Region.

## POSTER SESSION II

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### Detritus stocks influenced by seascape attributes

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The importance of detritus in carbon and nutrient fluxes in the coastal zone has been recognized for a long time. However, to which extent detritus dynamics can be affected by seascape attributes, such as habitat connectivity or fragmentation status remains poorly known. Yet those features have potential deep implications on carbon and nutrient exchanges between and within habitats, with associated effects on key ecosystem functions, such as trophic structure or nutrient cycling.

As a first attempt to gain knowledge on these aspects, we evaluated how habitat connectivity - between rocky algal reefs and the seagrass *Posidonia oceanica* - and other seascape attributes - patch size, patch configuration, edge effect - influence detritus stocks, to better understand habitat fragmentation process. To this end, we sampled macrodetritus (by means of a suction device) and microdetritus (organic matter fraction of surface sediments) on two NW Mediterranean locations (Cabdells and Fenals, central Catalan Coast) displaying different seascape configurations (continuous and patchy meadows, with various degrees of rocky-seagrass connectivity). The main source of variability concerning seagrass detritus was patch size and edge effect. Unexpectedly, algal detritus accumulation was unaffected by connectivity between habitats. We tentatively conclude that the smaller the patch, the higher the new to total production ratio would be. This contention is relevant for the understanding of fragmentation processes in threatened seagrass meadows.

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### Seagrass community metabolism in a Mediterranean volcanic vent

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We studied community metabolism of a seagrass community extending near a volcanic vent. The vent is situated in a shallow bay in Vulcano (Aeolian Islands, Italy) and is in ambient seawater temperature, ejecting mainly CO<sub>2</sub>. The gas acidifies the surrounding water, and pH reaches values of 5.5 close to the main emission point. We selected two stations at different distance from the main vent: the first (hereafter

called 'low pH') was situated close to the vent (approx. 250 m away) where pH was 7.6 and the seabed was colonized by the seagrass *Cymodocea nodosa*; the second (hereafter called 'control') served as a reference station (approx. 500 m away from the vent) where pH was 8.1 and the seabed was colonized by the seagrasses *C. nodosa* and *Zostera marina*. We measured shoot density and biomass in both stations, along with diurnal fluctuation of pH. Concurrently, we assessed metabolism of seagrass communities by incubating them in situ, using benthic chambers, and following oxygen evolution over time. The diurnal excursion of pH was around 1 pH unit and 0.6 units for the low pH and control stations respectively. Shoot density and biomass were lower in the low pH station. Seagrass community showed intense metabolism in the low pH station, with higher net community production, respiration and gross primary production than the control community.

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## **Seasonal and depth-related distributions of epiphytic Bryozoa in a Mediterranean seagrass meadow**

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Although biofouling on *Posidonia oceanica* (L.) Delile is thought to be driven by the variability of environmental parameters and phenology of the plant, effect of these parameters on sessile animal colonization is still poorly understood. This study aims to document the seasonality and the bathymetric variability of epiphytic Bryozoa diversity and abundance on this seagrass. *Posidonia* shoots were collected in the Revellata bay (Corsica, Mediterranean) in five seasons from 7 to 30 m depth. Colony densities may reach more than 87000 colonies m<sup>-2</sup> at 10 m depth in spring. This probably implies an important contribution of Bryozoa larvae to spring plankton where *P. oceanica* meadows are present. The Bryozoa specific distribution and abundance appeared to be determined by the seasonality of both the environmental parameters and the plant phenology. However, depth and associated environmental gradients played a structuring role. Based on our data and on the literature, we propose a classification of epiphytic Bryozoa in four categories from hyper-epiphytic specialist to accidental epiphytes and underline the necessity to protect seagrass systems on their full depth range to maximize biodiversity conservation.

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## **Preliminary data on phenology and density of *Posidonia oceanica* meadow in two western localities of Mostaganem area (Algeria)**

Karim Mezali and Noredine Belbachir

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The studies relating to the *Posidonia oceanica* (L.) Delile meadows near the western coast of Algeria (Mostaganem) are practically non-existent.

In order to characterize the state of health of a *Posidonia oceanica* meadow of the coastal fringe of Mostaganem, measurements of the shoot density and a follow-up of the phenological parameters were carried out near two localities (Hadjadj and Stidia) at mean depth of 3 m, from February to July 2011. In Stidia area, the meadow develops on a rocky substratum with a medium percentage of covering; contrary in Hadjadj area, the meadow is installed on soft bottom substratum with a small percentage of covering. An average densities of 359.47 shoots/m<sup>2</sup> and 266.10 shoots/m<sup>2</sup> were obtained respectively in Hadjadj and Stidia areas. That means that the meadows of the two localities have abnormal densities. The phenological parameters in the two localities had an increase at the end of spring - beginning of summer (May and June) and a decreases in the end of winter - beginning of spring (February and Mars). The *Posidonia oceanica* meadow of Hadjadj area has a better vitality compared to the one of Stidia and both meadows of the studied areas shows a light sign of disturbance dues to their weak shoot densities.

Key words: *Posidonia oceanica*, phenology, density, Mostaganem.

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## **The sea *Aspidochirotida* holothurians (Holothuroidea: Echinodermata) of the *Posidonia oceanica* meadow of Stidia area (Mostaganem, Algeria): Ecological role, microhabitat and feeding behavior**

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The *Aspidochirotida* holothurians or "sea cucumbers" are major component of the benthic compartment of the *Posidonia oceanica* ecosystem. Active actors of the sedimentary rehandling (by their mode of feeding "deposit feeding"), sea cucumbers play a major role in the recycling of the organic matter.

The sampling was carried out in July 2011 by scuba diving, in three stations (500 m<sup>2</sup> each) of the site of Stidia. The selectivity of the sea cucumbers (choice of the sediment grain size) was studied through the calculation of the index of selectivity.

This study reveals that there exists a certain micro-distribution of the sea cucumbers within the various biotopes of the *Posidonia* meadow: *Holothuria (H.) tubulosa* and *H. (R.) poli* prefer the inter-mattes (medium not well protected and influenced by the hydrodynamism which disperses food); *H. (P.) forskali* and *H. (P.) sanctori* often meet between the *Posidonia* rhizomes on the level of "tombants de matte" (protected medium which is characterized by a great availability of biodegradable materials). The rate of the organic matter found in the sediment of the guts and feces is high compared to that found in the sediment of the biotopes. Our results enable us to classify the studied holothurians species according to their selectivities: *H. (P.) sanctori* is the most selective species followed by *H. (P.) forskali* then by *H. (L.) poli*, whereas *H. (H.) tubulosa* constitutes the least selective species. It is supposed that the results obtained in this study are coherent with the feeding behavior of the marine "deposit-feeders", proposed by Thagon et al., (1978). This model share of the principle that these animals have tendency to select the smallest covered particles by important rate of organic matter, in order to maximize their profits in energy.

Key words: *Aspidochirotida* holothurians, *Posidonia oceanica* meadow, organic matter, selectivity, optimal foraging, Mostaganem.

## **Détermination de la qualité physicochimique et bactériologique de la nappe du couloir Fès-Taza (Maroc)**

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The present study consist of evaluating the impact of untreated wastewater discharges, on the physico-chemical and bacteriological groundwater quality of the Fez-Taza corridor. The results obtained in this study highlight the existence of a too high concentration of nitrate that reaches a peak value five times greater than the standard set by Moroccan standards. Moreover, in some springs such as P6 and S9, the concentration of chlorides (respectively 1100.50 and 1011.75 mg / l) exceeds the standards recommended by WHO. However, groundwater of the Fez-Taza corridor shows very low concentrations of sulphates (23.55 mg / l). From a bacteriological point of view, the groundwater of Fez-Taza corridor is heavily polluted and fecal contamination is highlighted through the presence of high levels of total coliforms, fecal coliforms and fecal streptococci. In this study, it follows that eventually, the use of this groundwater could be a serious health hazard for the inhabitants of Fez-Taza corridor area.

Keywords: groundwater, physical chemistry, bacteriology, Fez-Taza corridor, Morocco.

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## **Spatial variation in the structural parameters of *Cymodocea nodosa* seagrass meadows in the Gulf of Gabès (South Mediterranean)**

Rym Zakhama-Sraieb, Yassine Ramzi Sghaier, Samia Mouelhi and Faouzia Charfi

Meadows of the seagrass *Cymodocea nodosa* are among the dominant vegetated communities in shallow soft substrates throughout the Gulf of Gabès (South of Tunisia) where they form extensive subtidal meadows. Seagrass meadows are considered as a habitat in decline throughout the Gulf of Gabès areas, and hence *Cymodocea nodosa* is legislated as an endangered species. However, there are no studies on this seagrass in this area. Hence, the general aim of our study was to describe the spatial variability of structural descriptors of *C. nodosa* seagrass meadows through a multiscaled perspective to provide baseline information datasets for management and conservation proposals throughout coastal areas of the Gulf of Gabès.

Sampling was carried out by snorkeling in July 2009 and 2010 in ten stations distributed along the Gulf of Gabès coast. Stations were located in the subtidal zone, between 50 – 150m from shore where *Cymodocea nodosa* grew in dense monospecific beds.

Shoot density and coverage varied widely as a function of site and time. Shoot density is ranged from  $204 \pm 36$  shoot  $m^{-2}$  to  $1861 \pm 155$  shoot  $m^{-2}$  and coverage varied from a minimum of 3.80 % to a maximum of 100%. The structural parameters of beds respond differentially to different ecological and physical parameters.

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### **Invertebrate communities in seagrass beds: the influence of plant features on diversity and distribution of Amphipod populations**

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The seagrass characteristics (shoot density, leaf morphology, leaf biomass, epiphyte biomass ...) can influence the associated faunal assemblage composition. Here, we compared the amphipod assemblages associated with different *Posidonia oceanica* along the Tunisian coast. Nine beds were sampled: two in the north, four in the centre and three in the south. Samples of amphipods and *P. oceanica* were collected during July 2007 by scuba diving.

A total of 44 amphipod species were recorded. The number of species in each bed ranges from 12 to 26 species. The abundance and diversity of amphipods is higher in meadows with high epiphyte loading. Multivariate analyses of data indicated that epiphyte biomass and geographical position were major determinants of the distribution and composition of amphipod assemblages along Tunisian coasts.

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### **Occurrence of the seagrass *Halophila stipulacea* (Hydrocharitaceae) in the Southern Mediterranean Sea**

Yassine Ramzi Sghaier<sup>1,2</sup>, Rym Zakhama-Sraieb<sup>1</sup>, Ibrahim Benamer<sup>3</sup>, Faouzia Charfi-Cheikhrouha<sup>1</sup>

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*Halophila stipulacea* is a dioecious seagrass that probably colonized the Mediterranean basin following the opening of the Suez Canal (1869). We investigated its occurrence in the southern Mediterranean. This was done by conducting targeted surveys in two countries (Tunisia and Libya) and compiling existing information from former research. Four new meadows of *H. stipulacea* were found in the study area, these were: Al-wahesh lagoon and Tobrouk Bay in Libya, and Kerkennah Island - Allama and Cap Monastir in Tunisia. The new record in Cap Monastir (Tunisia) documents a displacement of about 150 km north of the previously limit of *H. stipulacea* in the southern Mediterranean, which probably represents the westernmost extension of *H. stipulacea*'s distribution 3000 km west along the coast from the site of first colonization at the mouth of the Suez Canal in Port Said. In the Cap Monastir meadow, the shoots density ( $\pm$ SD) was  $9900 \pm 3509$   $m^{-2}$  and the LAI (leaf area index) value was  $3.15 \pm 0.5$   $m^2$   $m^{-2}$ . In Libya, a small meadow of *H. stipulacea* was documented for the first time in Tobrouk Bay, with an estimated shoot density of  $476 \pm 83$   $m^{-2}$ .

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## **Spatio-temporal dynamics and biomass of *Cymodocea nodosa* in Bekalta (Tunisia, Southern Mediterranean Sea)**

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Leaf growth, biomass and production of *Cymodocea nodosa* (Ucria) Ascherson were measured from October 2006 to September 2007 in the eastern limit of Monastir Bay (Tunisia). Three stations were established on an intertidal transect running 300 m. Shoot density showed a clear seasonal pattern, increasing during spring and summer and decreasing during fall and winter. Annual mean shoot density was ranged between  $633 \pm 75$  shoots  $m^{-2}$  to  $704 \pm 146$  shoots  $m^{-2}$ . The annual average total biomass varied respectively between  $565 \pm 52$  g DW  $m^{-2}$  and  $646 \pm 48$  g DW  $m^{-2}$ . The total biomass varied significantly among stations and sampling time but did not show any seasonal variation. Leaf plastochrone intervals varied seasonally with an annual average of about 28 to 30 days. Leaf productivity was highest in August ( $2.61$  g DW  $m^{-2} d^{-1}$ ) and lowest in February ( $0.35$  g DW  $m^{-2} d^{-1}$ ). The annual below ground primary production varied from  $263$  g DW  $m^{-2} year^{-1}$  to  $311$  g DW  $m^{-2} year^{-1}$ . As for the annual leaf production, it was approximately equal for the three stations (from  $264$  g DW  $m^{-2} year^{-1}$  to  $289$  g DW  $m^{-2} year^{-1}$ ). Variability in water, air temperature and insolation explained the annual variability of ten measured biological characteristics. Changes in below ground and total biomass were independent from seasonal variability of environmental parameters monitored.

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## **Up take of total mercury in foliar tissues of *Posidonia oceanica* (L.) Delile in Bou Ismail Bay (Algeria)**

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The concentration of total mercury was measured in the seagrass *Posidonia oceanica*, between June 1996 and February 1997. These measurements were performed on adult and intermediate leaves and sheaths, using Atomic absorption spectrophotometry (SAA). Sampling was carried out at two stations at 10 m depth: Kouali (reference station) and Bou Ismail (anthropic station). Concentrations of total mercury recorded in the three types of tissues showed seasonal variations, with higher mean value observed in spring-summer than in winter. These results seemed to be positively correlated with the plant's phenology. The concentration of total mercury did not show difference between adult and intermediate leaves of each station; this result is often observed in sites characterised by low degree of anthropisation. In an other hand, values of total mercury (annual mean) detected in leaf tissues of *Posidonia oceanica* were systematically higher at Bou Ismail, thus confirming the use of this plant as biological indicator of mercury uptake.

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## **Effects of disturbances caused by coastal discharges on phenolic compounds in the seagrass *Posidonia oceanica***

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*Posidonia oceanica* meadows are sensitive to the disturbances that are often associated with the highly human-impacted coast. This study aimed at examining the number of tannin cells (specialized cells believed to produce phenolic compounds) and the concentration of total water-soluble phenolic compounds within the leaves, in response to coastal discharges (Tamentfoust, Algiers bay). An additional meadow (Kouali, Bou Ismail bay) was sampled as a control. The sampling was carried out in these two sites in July 2001 at 5 m depth. The concentration of phenolic compounds in the adult and intermediate leaves and sheaths showed no response to nutriment enrichment. Moreover, the concentration of phenolic compounds was significantly higher in the intermediate leaves than in the adult leaves and sheaths. Conversely, the number of tannin cells (specialized cells supposed to produce the phenolic compounds) increased highly in intermediate leaves at Tamentfoust ( $62.0 \pm 23.8$  tannin cells  $cm^{-2}$ ) against ( $30.1 \pm 16.1$  tannin cells  $cm^{-2}$ ) at Kouali. Thus, the increase in the number of tannin cells appeared to be effective indicators for the assessment of water quality.

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## DAY 5: FRIDAY JUNE 1

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### **European seagrass network: “Seagrass productivity, from genes to ecosystem management”**

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The European concerted research action “Seagrass productivity, from genes to ecosystem management” (COST Action ES0906) started in 2010 and will remain in force for a period of 4 years. This European-wide network involves 15 European countries and institutions from Australia and USA, and over 70 experts in physiological ecology, ecological genomics and conservation/resource management. Its main aim is to provide the scientific basis for preserving the goods and services arising from the productivity of European seagrass ecosystems under anthropogenic pressure and to develop comprehensive best practices for integrated seagrass habitat management. The network is organized into four working groups WG1) Ecophysiology: drivers of seagrass plant productivity, vulnerability and resilience to anthropogenic driven change, WG2) Genetics: understand genetic seagrass responses to environmental stressors, WG3) Scientists-Managers Interface and WG4) Innovative approaches to seagrass monitoring and management in Europe. The WGs will coordinate research and management actions to address the following questions: 1) How is the productivity of seagrass meadows along European coastlines affected by anthropogenic disturbances that alter the light, temperature and pH environment and, consequently, how does this affect their capacity to adapt while still providing ecological services and function? and 2) how can we implement a scientifically-based management system across Europe that will provide both baseline and predictive information to help to prevent seagrass decline?

This Action is unique for Europe, consolidating existing knowledge and coordinating research efforts, but will also be assembled in a way so as to link directly with local managers and other seagrass monitoring and research programs. It will constitute Europe’s significant contribution to global efforts towards understanding and preserving the important habitats based on seagrasses.

### **Macrostructure of *Posidonia oceanica* (L.) Delile beds: spatial analysis at small scale**

Tiziano Bacci<sup>1</sup>, Sante Francesco Rende<sup>1</sup>, Domenico Rocca<sup>2</sup>, Luigi Maria Valiante<sup>3</sup>, Enrico Casola<sup>3</sup>, Stefania Giglio<sup>2</sup>, Simone Scalise<sup>2</sup>, Piero Cappa<sup>2</sup> and Michele Scardi<sup>4</sup>

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Although shoot patchiness has long been studied in *P. oceanica* beds, small scale spatial structure of *P. oceanica* beds is poorly known, as very few studies focused on this problem. In order to detect spatial patterns within *P. oceanica* beds that appear as uniformly dense, we analyzed density data from two sites in Southern Italy where sampling was carried out within a square lattice at small spatial scale (i.e. in the 10-1-102 m<sup>2</sup> range) and shoot counts (more than 1000 counts, more than 40 m<sup>2</sup> overall) were obtained from sample squares of different size (60, 40, 20 cm). In addition, in order to better investigate spatial patterns, actual spatial distribution of shoots was recorded by cutting all the leaves and by digitizing shoot location from images of 6 square frames (1 m<sup>2</sup>), i.e. at very small spatial scale (i.e. in the 10-2-100 m<sup>2</sup> range). Data have then been processed using the most appropriate spatial analysis methods. Although our results cannot be generalized, they certainly suggest how density measurements are affected by small scale variability in apparently homogenous stands. In addition, our work shows how sampling aimed at obtaining density estimates can be optimized in order to achieve pre-defined accuracy goals.

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### **First record of vertical rhizome growth in *Zostera marina***

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Increased sediment loads in marine environments are caused by many different anthropogenic activities and more frequent storms due to climate change. Increases in sedimentation leads to increases in turbidity, which reduces penetration of light in the water. Deposited sediment buries the lower parts of the plant including photosynthetic tissues. A plant can respond to burial with vertical or horizontal rhizome elongation. Vertical rhizome growth is interpreted as a mechanism selected to counteract the effects of burial. Vertical rhizome growth has been described in many seagrass species, but no published records exist of vertical rhizome growth in *Zostera marina*. As a part of the research on effect of sediment relocation processes on the seagrass community in the Novigrad Sea, central Croatian Adriatic, seagrass samples were taken in summer, 2011. Novigrad sea is known to be an area with high sediment movement with 3 seagrass species occurring in that area: *Zostera noltii*, *Zostera marina* and *Cymodocea nodosa*. Three replicates of seagrass samples were collected by SCUBA divers at each of 8 different locations on 3 and 4,5 meter depth. Seagrass analysis included measurement of biomass and morphological characteristics. Vertical rhizomes in *Zostera marina* were recorded for the first time according to existing literature. Length and width of vertical internodes were measured. At the end of vertical rhizomes there were shoots present growing from the last node. Vertical growth of *Zostera marina* might be triggered by sediment accumulation which is present in Novigrad sea. Substantial annual sediment movement, due to natural processes, could have stimulated this developmental response in *Z. marina* growth. Vertical growth enables *Z. marina* to withstand negative effects of burial more than it would be possible with only a horizontal rhizome growth, and may contribute to the adaptability of *Z. marina* to increased storm activity and sediment movement as a result of global climate change.

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### **Evolution over time of seagrass meadows along Cap Corse coastline**

Marina Bonacorsi<sup>(1)</sup>, Nils Bréand<sup>(1)</sup>, Philippe Clabaut<sup>(2)</sup>, Gérard Pergent<sup>(1)</sup>, Christine Pergent-Martini<sup>(1)</sup>

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The evolution of seagrass meadows was studied over a period of fifteen years, on 100 km of coastline running along the Cap Corse (France).

The techniques used are similar for both studies (processing of aerial photographs and side scan sonar) but the results are more accurate in 2011 (thanks to the optimization of image processing, the amount of field data, the coverage of the side scan sonar).

The surfaces covered by *Posidonia oceanica* meadows show no significant difference, with a coverage of about 10,175 ha in 1995 and 9,977 ha in 2011, and mainly reflect the optimization of mapping techniques. However, *Cymodocea nodosa* meadows, that could not be detected in 1995, are clearly visible in several areas - both superficial (aerial photographs) and deep (side scan sonar). In addition to the general location of these biotic communities, the new mapping makes it possible to follow their progress in areas which are particularly interesting because of the impact of human activities or because of conservation : (i) *Posidonia oceanica* meadow which undergoes intensive trawling, (ii) recolonization by seagrasses of old traces of explosives, (iii) development of a *Posidonia oceanica* platform reef and barrier reef.

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### ***Posidonia oceanica* (Linnaeus) Delile meadows designated as Special Areas of Conservation in the Maltese Territorial Sea**

Carmen Mifsud<sup>1</sup>, Duncan Borg<sup>1</sup>, Christopher Cousin<sup>1</sup>, Darrin T. Stevens

<sup>1</sup>Environment Protection Directorate, Malta Environment and Planning Authority (MEPA), St Francis Ravelin, Floriana, FRN1230

The Maltese islands are known to have an extensive distribution of *Posidonia oceanica* meadows, particularly on the east side of the islets, due to its gentle slope and the bathymetric limit of this seagrass. Approximately 1.4 % of the Maltese territorial waters is occupied by this seagrass, representing a total coverage of 56.38 km<sup>2</sup> (Mapping Unit MEPA - This figure includes other surveys apart from the 2002). Along the 271 km of the Maltese coastline, four sites for the *Posidonia* meadows habitat type (one of them covering about 90 km, a third of the whole Maltese coastline) have recently been declared as Special Areas of Conservation (SAC) of International Importance. These sites have been designated through Government Notice 851 of 2010 - issued through the powers of the Flora, Fauna and Natural Habitats Protection

Regulations, 2006 (Legal Notice 311 of 2006 as amended). The selection was also based on the criteria used to define Sites of Community Importance (SCI), as defined in the Habitats Directive, 92/43 EEC. Under the above-mentioned regulation more than 88% of the total Posidonia beds in Malta are protected as SAC of International Importance.

## **Workshop II - IUCN Mediterranean Red List assessment of seagrasses**

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The IUCN Red List Categories and Criteria are the most widely accepted system for classifying the extinction risk at the species level. At present, five of the 59 species of seagrasses assessed at global level are at a high threat of extinction. The assessment of native species at Mediterranean level has however not been conducted yet. In addition, given the importance of seagrass species for other communities and the continuous human pressures in Mediterranean coastal zones, it is imperative to determine the conservation status and trends of these species at regional level. Information available for the assessment of all seagrass species in the Mediterranean will be presented to begin the discussion among experts on the initial assignation under the categories and criteria of the IUCN Red List of Threatened Species. Data on taxonomy, distribution, population trends, ecology, life history, past and existing threats, and conservation actions for each species will be introduced, quantified and reviewed for accuracy. The workshop results together with the information compiled will be an important first step to establishing an agreed regional baseline to monitor population fluctuations at a Mediterranean scale.

## **Special Session: Marine Research in North Africa – status and challenges**

Coordinator: Dr Khalid Elkalay, Polydisciplinary faculty Safi, Université Cadi Ayyad, Morocco; [elkalay\\_khalid@yahoo.fr](mailto:elkalay_khalid@yahoo.fr)

Marine research faces many problems in Morocco and in North Africa in general (Algeria and Tunisia). There is a fairly small community working on marine research (especially on seagrass) compared to other research fields. So the focus of this session is to stimulate the North African researcher to work on seagrass and related topics. In this workshop there will be some general environmental and marine research presentations ending with a discussion concerning how we can prioritise and start working on seagrass. Moroccan researchers can gather ideas from all the participants especially from Algeria and Tunisia.

### **Presentations:**

Marie Bonnin, Samira Idlallene. Vers un droit de l'environnement marin au Maroc

Majid Mansour. Le littoral marocain et la problématique urbaine

M. Cheggour, A. Maarouf, M. Ait Fdil, A. Mouabad - Outils biologiques de biosurveillance du milieu marin: Bionomie intertidale du littoral « anthropisé » de la ville de Safi (côte atlantique marocaine)

Taoufiq Fechtali - Effects of Environmental Factors (Free Radicals) on Inflammation in Brain and its Remediation by Moroccan Endemic Medicinal Plants Products (MEMPP)

### **Posters:**

I Rhouddani, A. Maarouf, M. El Makhfouk - Mise au point d'une chaîne trophique marine caractéristique du littoral de la ville de Safi

Belkoda Wafae, Elkalay Khalid, Loudiki Mohamed, Khalil Karima - First Scenario For The Dynamics And Diversity In Phytoplankton Of The Dyke Sidi Abderrahmane

Damsiri Zainab, Natij Laila, Khalil Karima, Loudiki Mohamed, Rabouille Christophe, Elkalay Khalid - Les données préliminaires de la répartition spatio-temporelle des nutriments au niveau de la lagune Oualidia (côte Atlantique marocaine)

Siham Salah, Ahmed Errhif, Amina Berraho, Aïssa BenAzzouz, Ahmed Makaoui et Omar Ettahiri - Comparaison de deux filaments d'upwelling sur la côte atlantique marocaine : Cap Ghir (31°N) et Cap Juby (28°N).

## Vers un droit de l'environnement marin au Maroc

Marie Bonnin et Samira Idlallene

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Le Maroc commence à développer une politique environnementale qui se remarque dans différentes domaines et notamment dans l'environnement marin. Dans la cadre de programmes de recherches bilatéraux franco-marocain, une analyse de la sectorialisation du droit sur le littoral et les côtes marocaines est en cours. Cette démarche permettra de démontrer les avancées juridiques liées à la protection de l'environnement marin que ce soit en termes de pollution, de protection de la biodiversité, ou de gestion des activités anthropiques. Ce programme qui vient de commencer en janvier 2012 permettra de faire un état des lieux identifiant les forces et faiblesses du droit marocain de l'environnement marin à vocation scientifique et pédagogique.

## Le littoral marocain et la problématique urbaine

Majid Mansour

Ecole Nationale d'architecture à Rabat

Le Maroc possède deux façades maritimes longues d'environ 3.500 Km et une zone maritime qui dépasse un million de km<sup>2</sup>. Contrairement à la partie continentale, les milieux côtiers se caractérisent par une forte densification et sont très convoités pour leurs intérêts économiques et touristiques.

En ce qui concerne l'étude juridique et institutionnelle de l'aménagement et de la protection du littoral, on peut constater qu'actuellement, les zones côtières sont régies par une simple circulaire du Premier Ministre datant de 1964, relative au développement touristique du littoral. Un droit propre au littoral va émerger ce qui va constituer un véritable point de départ d'une réflexion sur l'aménagement des côtes.

## Outils biologiques de biosurveillance du milieu marin: Bionomie intertidale du littoral « anthropisé » de la ville de Safi (côte atlantique marocaine)

M. Cheggour<sup>1</sup>, A. Maarouf<sup>2</sup>, M. Ait Fdil<sup>2</sup> et A. Mouabad<sup>2</sup>

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Les côtes eaux marines du Maroc sont caractérisées par une grande richesse biologique.

Selon l'étude nationale sur la Biodiversité, la faune marine, comptant plus de 7,000 espèces connues, est encore incomplètement répertoriée. Cette faune riche et variée subit néanmoins de nombreuses contraintes majoritairement de nature anthropique, qui pèsent sur les peuplements et de là sur l'équilibre écologique marin. Les plus importantes contraintes sont la surexploitation, l'urbanisation galopante, la pollution chimique et la destruction des habitats.

Dans la zone intertidale ou estran, ces « agressions anthropiques » affectent fortement le littoral en raison de sa proximité et son exposition aux apports continentaux. A ces agressions s'ajoutent des contraintes naturelles liées aux conditions drastiques du milieu, en particulier l'alternance de l'immersion et de l'émersion, suite au va-et-vient des marées.

Dans ce travail nous nous proposons de contribuer à la connaissance de la biodiversité marine du littoral marocain dans la région de la ville de Safi qui reçoit de nombreux effluents polluants à la fois urbains et industriels émanant d'activités anthropiques dans la région. Nous nous proposons en fait l'évaluation de l'impact de ces activités sur le milieu littoral en utilisant des outils biologiques. Ainsi nous comparons la distribution du macrobenthos intertidal selon un gradient spatial répartie le long du littoral de Safi de part et d'autre des rejets polluants. De ce fait, nous pouvons caractériser l'évolution spatiale de la pollution. Les résultats montrent comment la diversité biologique et la densité spécifique chutent aux abords des rejets, puis comment les communautés benthiques recolonisent le milieu. De nombreuses études complémentaires sont réalisées sur le milieu marin. Celles ci permettront d'avoir un aperçu plus complet de l'impact des rejets sur la biologie de l'estran.

## Mise au point d'une chaîne trophique marine caractéristique du littoral de la ville de Safi

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Pour illustrer l'impact des rejets domestiques et industriels de la région de Safi, nous avons retenu l'étude des métaux lourds (zinc, cadmium, plomb, cuivre, arsenic, mercure) en raison de leur forte toxicité et leur abondance dans divers rejets industriels et domestiques du littoral atlantique marocain. Pour ce faire, on se propose d'étudier le transfert de ces métaux chez des organismes marins d'une chaîne alimentaire caractéristique du littoral de la région.

Le choix d'une chaîne alimentaire marine caractéristique du littoral de la région de Safi a été basé essentiellement sur la sélection des organismes qui répondent bien aux critères requis pour un bio-indicateur de pollution métallique afin de mettre en évidence le transfert éventuel entre les différents niveaux trophiques de cette chaîne.

Plusieurs paramètres ont été pris en considération notamment, la disponibilité des espèces dans toutes les stations d'étude, leurs niveaux trophiques, leur capacité d'accumulation des métaux lourds et leur représentativité des stations étudiées.

A ce propos, nous avons exploré cinq stations sur le littoral de safi allant du Cap Cantin (Beddouza) jusqu'au Souiria Lekdima, soit une distance de 60 Kilomètres. La chaîne alimentaire retenue comporte deux niveaux trophiques à savoir :

- Producteurs primaires représentés par les macro-algues (*Dichotoma*, *Codium*, *Corallina*, *Ulva lactuca* ...)
- Consommateurs primaires représentés par deux mollusques, il s'agit des patelles (*Patella\_intermedia*) et des moules (*Mytilus galloprovincialis*).

Mots-clés : Bioaccumulation, Transfert, Métaux lourds, Littoral, Chaîne alimentaire, Safi, Maroc

## First Scenario For The Dynamics And Diversity In Phytoplankton Of The Dyke Sidi Abderrahmane

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The Variation of environmental parameters and phytoplankton population were studied in Lake Sidi Abderrahman Safi Morocco, according to the seasons, (MAI 2011 to Mars 2012).

The physicochemical parameters monitored at the surface of the water for three sampling stations are silica, sulfate, orthophosphate, nitrite and ammonium. On the station S1, a profile is done according to the same previous settings

Phytoplankton samples and water parameters data were collected from three different stations located. Most of phytoplankton genera belong to diatom, dinoflagellates; Chlorophyll a of phytoplankton varied significantly during the course of months, with the lightest levels recorded in august (1, 06 µg/l).

## Les données préliminaires de la répartition spatio-temporelle des nutriments au niveau de la lagune Oualidia (côte Atlantique marocaine)

Damsiri Zainab, Natij Laila, Khalil Karima, Loudiki Mohamed, Rabouille Christophe, Elkalay Khalid

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L'étude de la variation des nutriments de la lagune Oualidia a été réalisé entre Janvier 2010 et Juin 2011. La variation temporelle montre que les plus fortes teneurs en phosphates ont été enregistrées en Mai - juin qui sont de l'ordre de 796µg /L. Par contre durant la période entre Février-Avril les teneurs se situent entre 11,6 et 367µg/l.

Concernant les nitrites les fortes valeurs sont enregistrées lors de la période Février-Mars (1287µl/L) par contre les teneurs diminuent en Avril 26µl/L.

Les plus fortes teneurs se situent généralement au milieu et en amont de la lagune, les plus faibles sont notés à l'aval, surtout lors de la pleine mer, ou la dilution des eaux lagunaires se fait par la remontée massive des eaux marines de bonne qualité et la poussée des masses d'eaux polluées vers l'amont.

Mot clés : Lagune Oualidia, Nutriments.

## **Comparaison de deux filaments d'upwelling sur la côte Atlantique Marocaine : Cap Ghir (31°N) et Cap Juby (28°N)**

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Dans le but de comprendre la dynamique globale des filaments d'upwelling marocains, une étude de deux structures à méso-échelle (Cap Ghir (31°N) et Cap Juby (28°N)) a été entreprise. Pour répondre à cette problématique, quatre campagnes océanographiques ont été réalisées en 2009. Le prélèvement des échantillons d'eau et du matériel biologique a été effectué à bord du navire océanographique « Al Amir Moulay Abdallah ». Au niveau de Cap Ghir, 11 stations ont été échantillonnées sur deux radiales perpendiculaires: l'une méridionale (31°N) avec 7 stations côte-large et l'autre longitudinale (10°09'W) avec 5 stations d'orientation nord-sud. Le filament de Cap Juby a été prospecté au niveau de 5 stations sur une radiale côte-large. La collecte du zooplancton a été réalisée à l'aide d'un filet Bongo, les paramètres hydrologiques ont été également mesurés.

Au niveau du filament de Cap Ghir, la répartition des paramètres du milieu accuse des fortes extensions qui mettent en évidence le trajet du filament. Les images satellites ont confirmé ces extensions. La distribution des différentes espèces de copépodes et les analyses multivariées ont permis également de visualiser le trajet du filament en différentes périodes. Le déplacement est dévié vers le sud en février et en avril, et vers le nord en juin et en octobre. La distribution des espèces néritiques recensées au large, témoigne en conséquence de cette dynamique. Le schéma de distribution de ces paramètres biologiques suppose qu'ils suivent les deux tourbillons qui gênèrent ce filament. Ces structures sont responsables de la dispersion planctonique, vers le nord et le sud de Cap Ghir en fonction de la saison.

Pour ce qui est du filament de Cap Juby, les résultats ont montré des tâches côtières d'eaux froides et de fortes concentrations en chlorophylle 'a', témoignant d'une activité d'upwelling. Le suivi des espèces néritiques, dominantes à la côte et recensées au large, témoigne de la dynamique du filament. Une hétérogénéité spatiale et temporelle liée à la complexité de la dynamique de ce filament a été mise en évidence par les analyses statistiques. Il s'agit d'une dispersion planctonique tout autour du filament, avec une faible dérive.

Ces deux filaments contribuent donc à des degrés variables et de façon très significative au transport vers le large. Ainsi, l'upwelling au niveau du cap Ghir est plus accentué par rapport au filament de Cap Juby.

Mots clés : Upwelling Nord Africain, Cap Ghir, Cap Juby, Copépodes, dynamique.

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