



VI EUROLAG & VII LAGUNET Conference

ABSTRACT BOOK



16-19 December 2013, LECCE, ITALY



Aim of the conference

The VI EUROLAG & VII Lagunet Conference is aimed at stimulating a fully trans-disciplinary discussion among scientists, managers, policy makers and other stakeholders promoting innovative researches and opening new research fields as well as fostering participative approaches to lagoon resource management. The Conference is open to contributions towards the science-based management and spatial planning of lagoon ecosystems increasing the effectiveness (or, 'decreasing uncertainty') of governance actions and policy implementation. Theoretical, modeling, experimental and descriptive studies are welcome as well as researches in the field of history and archeology, ethno- biology, geomorphology and hydrodynamics, metagenomics and molecular ecology, microbiology and nutrient cycling, biology and ecology, conservation biology and integrated coastal zone management, spatial planning and lagoon engineering, ecosystem services and sustainability, policy implementation and governance at local, ecosystem, catchment and regional scales.

Conference topics

TOPIC 1

MATTER FLOWS AND CYCLING - the topic will address the input and output flows of matter and how this matter is being processed and converted within the lagoons. Particular emphasis will be on the following issues: a. the connectivity of lagoons with their surrounding environments, b. the nutrient and pollutants loadings from the watersheds, atmosphere and the sea to the lagoons, and the internal processes that contribute to nutrient abatement or enrichment and to transformations of contaminants, c. sediment transport and how it will impact the geomorphology and hydrology of the lagoons d. the decomposition processes and benthic-pelagic coupling, d. the assessments of benefits of nutrient cycling as ecosystem service and their conservation; e. implementation policy (e.g., Nitrate Directive and WFD); f. the eutrophication processes and the hypoxia/anoxia phenomena - the topic will host a The Josema ZALDIVAR ROUND TABLE on 'Lagoon eutrophication processes' and will Award the best student presentation;

TOPIC 2

CARRYING CAPACITY AND BIOLOGICAL RESOURCES - the topic will address a. lagoon energetics, b. trophic transfer and food web architecture, c. population dynamics and exploitation, d. biological resource dynamics; e. fishery and aquaculture: use and use conflicts; f. migratory birds and lagoon citizen science;

TOPIC 3

BIODIVERSITY PATTERNS, ORGANIZATION AND CLIMATE CHANGES - the topic will address a. mapping biodiversity in Euro-Mediterranean lagoons: genetic, taxonomic and habitat diversity, trait and functional diversity; functional aspects, from individual behavior



to collective trophic behavior are included; b. modeling biodiversity as niche modeling, SARs modeling and modeling underlying coexistence mechanisms; c. biodiversity threats, including alien and invasive species; d. climate change scenarios of biodiversity and species richness;

TOPIC 4

RESILIENCE TO DISTURBANCES AND PERTURBATIONS - the topic will address a. characteristic response of coastal lagoon ecosystems to internal and external pressures, b. disentangle analysis of natural and anthropogenic driven changes and responses;

TOPIC 5

CONSERVATION AND MANAGEMENT OF COASTAL LAGOONS - the topic will address a. conservation strategies for lagoon ecosystems, b. use sustainability and specific mitigation strategies; c. ecological foundation of niche modeling of competing lagoon uses - The session include a Round Table on CONDITIONS FOR PROPOSING COASTAL LAGOONS AS MPA.

Invited Speakers

TOPIC 1

Prof. Masumi Yamamuro

Masumi Yamamuro is a Professor at the Department of Natural Environmental Studies, Graduate School of Frontier Sciences, University of Tokyo. She has studied coastal lagoons for more than 30 years. Her works on coastal lagoons encompasses various disciplines some of which include geology, ecology, chemistry and atmospheric science. She is the current chair of the task force of the Ministry of the Environment which develops the best monitoring methods for coastal lagoons in Japan. She is a review editor of the journal 'Aquatic Biology', and serves as an expert of aquatic ecology at the International Ecology Institute. She was also SSC of TGBP-THDP LOICZ in TCSU.

TOPIC 2

Prof. Mike Elliott

Director of the Institute of Estuarine & Coastal Studies (TECS) and Professor of Estuarine and Coastal Sciences at the University of Hull, UK. Professor Elliott is a marine biologist with a wide experience of marine environmental issues but especially in human impacts, marine management and policy of estuaries and marine areas. Mike's teaching, research, advisory and consultancy work has included studies of sediments, water quality, zooplankton, intertidal and subtidal benthic communities and fish communities, as well as policy, governance and management of



estuaries and coasts. Mike has published widely, co-authoring/co-editing 12 books and over 190 peer-reviewed publications and he has acted as an advisor on many environmental matters for academia, industry, government and statutory bodies worldwide. Mike is a past-President of the international Estuarine & Coastal Sciences Association (ECSA) and is also one of the 4 Editors-in-Chief of Estuarine, Coastal & Shelf Science; he has Adjunct Professor positions in Australia, Italy and South Africa.

TOPIC 3

Prof. Omar Defeo

Omar Defeo is a professor in the Marine Science Unit at the Universidad de la Republica in Uruguay. Defeo has worked on assessment and management of artisanal (traditional small-scale) fisheries and conservation of biological diversity (biodiversity) for over 30 years. He also works on sandy beach ecosystems and how they are threatened by climate change. His long-term research evaluates the effects of human activities on near-shore invertebrate populations and communities in coastal systems of Uruguay. For the past 15 years, Defeo has also been involved in artisanal shellfisheries, ecology and conservation of coastal marine invertebrate biodiversity research in Latin America, primarily in Mexico and Chile. He specializes in the development of experimental and co-management practices to improve the ecological knowledge and management of harvested shellfish species. Defeo is currently involved in a research study that addresses the implementation of marine protected areas (MPAs) as tools for fisheries management and conservation of biodiversity in the Uruguayan coast. He is also addressing the effects of climate variability in coastal systems. Defeo has co-authored two FAO Technical Papers and has published more than 200 papers, 115 of them in primary journals. He has supervised more than 80 graduate and postgraduate students from Uruguay, Chile, Brazil, Ecuador, Colombia, Mexico and Italy. He has received the Pew Fellowship in Marine Conservation (2010), the SCOPUS award (2010) and the Uruguayan Science and Technology Morosoli Award (2009).

TOPIC 5

Dr. John M. Baxter

John Baxter is a Principal Adviser - Marine (including National oil Spill Response Coordinator) for Scottish Natural Heritage, the Scottish Government's independent advisers on nature conservation. John is a marine biologist with extensive experience and particular expertise in the interpretation and communication of science and applying the results to provide practical advice and implementation of conservation measures. He has been involved in the implementation of a number of key European Directives such as the Habitats Directive and the Marine Strategy Framework Directive as well as national legislation such as the Marine (Scotland) Act which has involved the development of a network of Marine Protected Areas around Scotland. John has wide ranging experience and expertise from marine mammals and intertidal and subtidal benthic communities to the implications of climate change and ocean acidification. John is Chief Editor



- Marine of the international journal Aquatic Conservation - Marine and Freshwater Ecosystems and has also published widely including co-editing Scotland's Marine Atlas. He sits on the UK Special Committee on Seals and is Chair of the UK Marine Climate Change Impacts Partnership expert panel as well as Vice Chair of the Ocean Acidification international Reference User Group. He is an honorary reader at the University of St Andrews.

Round Tables

TOPIC 1

A decade of studies on coastal lagoon eutrophication (2001-2010 and beyond): a tribute to José Manuel Zaldivar Comenges

Speakers

Pierluigi Viaroli, University of Parma - Italy
Alice Newton, University of Algarve - Portugal
Arturas Rakinkovas, University of Klaipėda - Lithuania
Angel Perez-Ruzafa, University of Murcia, Spain
Sophia Reizopoulou, Hellenic Centre for Marine Research - Greece
Rutger de Wit, University of Montpellier 2 - France
GianMarco Giordani, University of Parma - Italy
Nicholas Murray, European Commission, Joint Research Centre - Italy

TOPIC 5

Red listing lagoon ecosystems and conservation

Speakers

Alberto Basset, University of Salento - Italy
Gian Carlo Carrada, University of Salento - Italy
Christos Arvanitidis, Hellenic Center for Marine Research - Greece

Scientific Committee

- Sophia Reizopoulou, Hellenic Centre for Marine Research - Greece
- Rutger De Wit, University of Montpellier 2 - France
- Saimir Beqiraj, University of Tirana - Albany
- Alberto Basset, University of Salento - Italy



- John Baxter, Scottish Natural Heritage - Scotland
- Pier Paolo Campostrini, CORILA - Italy
- Gian Carlo Carrada, University of Naples - Italy
- Alberto Castelli, University of Pisa - Italy
- Raffaele D'Adamo, CNR-ISMAR Lesina - Italy
- Omar Defeo, University of the Republic - Uruguay
- Meltem Dural, Mustafa Kemal University - Turkey
- Mike Elliott, University of Hull - United Kingdom
- Piero Franzoi, University of Venice "Cà Foscari" - Italy
- Simona Frascchetti, University of Salento - Italy
- Adriana Giangrande, University of Salento - Italy
- Paolo Magni, CNR-IAMC Oristano - Italy
- Giorgio Mancinelli, University of Salento - Italy
- Conception Marcos, University of Murcia - Spain
- Piotr Margonski, National Marine Fisheries Research Institute - Poland
- Joao Carlos Marques, University of Coimbra - Portugal
- Antonio Mazzola, University of Palermo - Italy
- Nicholas Murray,
- Alice Newton, University of Algarve - Portugal
- Angel Perez-Ruzafa, University of Murcia, Spain
- Maurizio Pinna, University of Salento - Italy
- Victor Quintino, University of Aveiro - Portugal
- Arturas Rakinkovas, University of Klapeida, Lithuania
- Maria Snussi, University Mohammed V-Agdal - Morocco
- Gerald Schernewski, Leibniz Institute for Baltic Sea Research - Germany
- Carlo Storelli, University of Salento - Italy
- Patrizia Torricelli, University of Venice "Cà Foscari" - Italy
- Pierluigi Viaroli, University of Parma - Italy
- Sebastiano Vilella, University of Salento - Italy
- Masumi Yamamuro, University of Tokyo - Japan

Organising Committee

- Alberto Basset, University of Salento - Italy
- Ilaria Rosati, University of Salento - Italy



ORAL COMMUNICATIONS PROGRAMME

Monday, 16th December 2013

10:00 - 14:00 **Registration and welcome to Participants**

Lecture Room Bernini

14:00 - 14:30 **Welcome addresses**

Session Topic 3. BIODIVERSITY PATTERNS, ORGANIZATION AND CLIMATE CHANGES

14:30 - 15:20 **Keynote speaker: Omar Defeo**

Global patterns in sandy beach macrofauna: species richness, abundance, biomass and body size.

Chairman: *Sofia Reizopoulou*

15:20 - 15:40 **S3.1** - Benthic taxonomic and functional diversity patterns across habitats in Messolonghi lagoon, Greece.

D. Cabana, K. Sigala, A. Nicolaidou, A. Basset, S. Reizopoulou

15:40 - 16:00 **S3.2** - Tool for assessing status of marine and coastal biodiversity - case study on brackish Gulf of Riga, NE Baltic Sea.

G. Martin, K. Torn, K. Martin

16:00 - 16:30 **Coffee break**

16:30 - 16:50 **S3.3** - Spatial scaling of phytoplankton biodiversity in lagoon ecosystems.

L. Roselli, E. Stanca, G. Durante, J.S.D. Souza, J.L. Attayde, R. Panosso, P. Galli, D. Seveso, M. Dural, T. Alp, V.Gjoni, S. Ghinis, M. Cellamare, A. Basset

16:50 - 17:10 **S3.4** - Spatial distribution of 3 resting cysts of Harmful Algal Bloom (HAB) species in Bizerta Harbor.

M. Bellakhal, M. F. Bellakhal, S. Turki, L. Aleya

17:10 - 17:30 **S3.5** - Water quality and macrophytic assemblages' in different types of transitional water ecosystems in W. Greece (Mediterranean Sea).

C. Christia, E. Papastergiadou

17:30 - 17:50 **S3.6** - Testing the saprobity hypothesis in a Mediterranean lagoon using benthic communities.

A. Foti, G.A. Fenzi, F. Di Pippo, M.F. Gravina, P. Magni

17:50 - 18:10 **S3.7** - Comparison of structural and functional stability of polychaete assemblages in coastal lagoons.

S. Faulwetter, V. Markantonatou, C. Pavlouti, N. Papageorgiou, A. Vasileiadou, G. Chatzigeorgiou, K. Keklikoglou, L. Fanini, P. Koulouri, E. Chatzinikolaou, A. Basset, M. Pinna, I. Rosati, S. Reizopoulou, A. Nicolaidou, C. Arvanitidis



Tuesday, 17th December 2013

Lecture Room Bernini

Session Topic 5. CONSERVATION AND MANAGEMENT OF COASTAL LAGOONS

- 09:00 - 9:45 **Keynote speaker: John Baxter**
Managing conflict - it is good to talk but better to act.
- 09:45 - 10:00 Synchronization Break
Chairman: *Alice Newton*
- 10:00 - 10:20 **S5.1** - Assessment and conservation of goods and services provided by biodiversity in coastal lagoons.
A. M. Velasco, C. Marcos, A. Perez-Ruzafa
- 10:20 - 10:40 **S5.2** - DPSIR revisited for Eutrophication in coastal lagoons
A. Newton, J. Icely
- 10:40 - 11:00 **S5.3** - The effects of the integrated Monitoring Program in managing the lowest environmental impact during large civil works at the Venice lagoon inlets.
P. Campostrini, C. Dabalà
- 11:00 - 11:30 **Coffee break**
- 11:30 - 11:50 **S5.4** - Efficiency and consequences of the existing protection context of the Hellenic lagoons.
C. Koutsikopoulos, E. Dimitriou, D.K. Moutopoulos, G. Katselis
- 11:50 - 12:10 **S5.5** - Assessing the Status of Coastal Lagoons in the Northern Baltic Sea by GIS.
J. Ekebom, M. Sahla, R. Kalliola
- 12:10 - 12:30 **S5.6** - The Ghar El Melh lagoons complex: impact of recent coastal managements and risks with a sea level rise.
A. Oueslati
- 12:30 - 12:50 **S5.7** - Acquatina Lagoon: a model ecosystem to study community patterns.
A. Basset, S. Maci, A. Mazzola, I. Rosati, L. Roselli, C. Tramati, S. Vizzini, M. Pinna
- 12:50 - 13:10 **S5.8** - Conservation and management issues in the Vistula Lagoon (southern Baltic Sea).
P. Margonski, B. Chubarenko
- 13:10 - 14:30 **Lunch break/Poster session**
- 14:30 - 14:50 **S5.9** - Unexpected impact of connectivity management of a Mediterranean coastal lagoon.
Gavini A., M. Garrido, P. Cecchi, B. Bec, N. Malet, J. Bracconi, V. Orsoni, V. Pasqualini
- 14:50 - 15:10 **S5.10** - Shellfish culture in Bizerta Lagoon: current state and prospects.



- M. Bellakhal, M.F. Bellakhal, J. Ksouri, H. Missaoui*
15:10 - 15:30 **S5.11** - A multilevel approach for the evaluation of the nursery potential of the Venice lagoon for the gilthead seabream *Sparus aurata*.
M. Zucchetta, V. Georgalas, M. Pellizzato, E. Ciccotti, P. Franzoï
15:30 - 15:50 **S5.12** - The pink shrimp fishery in the estuarine system of Laguna, South Brazil: history and unexpected effects of management policies.
P.S. Sunye, T. J. Pereira, S. A. Netto
16:00 - 16:30 **Coffee break**
16:30 - 18:00 **Round Table - Topic 5. Conservation and Management of Coastal Lagoons**
Red listing lagoon ecosystems and conservation.
18:00 - 19:00 **EUROMEDLAG Assembly**
20:30 **Social Dinner**

Lecture Room Donatello

Session Topic 3. BIODIVERSITY PATTERNS, ORGANIZATION AND CLIMATE CHANGES

Chairman: *Sofia Reizopoulou*

- 10:00 - 10:20 **S3.8** - Brackish-water polychaetes as good descriptors of environmental changes in space and time.
A. Giangrande, M.F. Gravina
10:20 - 10:40 **S3.9** - Variation of phytoplankton densities in a coastal lagoon from south Mediterranean Sea.
M. Bellakhal, M. F. Bellakhal, J. Ksouri, H. Missaoui
10:40 - 11:00 **S3.10** - Macrobenthic community in Klissova lagoon, Greece.
K. Sigala, D. Cabana, A. Nicolaidou, S. Reizopoulou
11:00 - 11:30 **Coffee break**
11:30 - 11:50 **S3.11** - The low basin of the Arno River (Tuscany, Italy) as hot spot of alien species introductions: new data on *Limnoperna securis* (Bivalvia, Mytilidae) and *Rhithropanopeus harrisii* (Crustacea, Panopeidae)
J. Langeneck, M. Barbieri, C. Lardicci, F. Maltagliati, C. Piccirilli, A. Castelli
11:50 - 12:10 **S3.12** - Population dynamics of two scyphomedusae species, *Aurelia* sp. and *Phyllorhiza punctata* in Bizerte lagoon and their trophic impact on the zooplankton community
S.K.M. Gueroun, B. Loussaief, O.Daly Yahia-Kefi, D. Bonnet, S. Piraino, O. Pringault, M.N. Daly Yahia
12:10 - 12:30 **S3.13** - Taxonomy, distribution and adaptive strategies of the sponge fauna from lagoon systems of the Italian coast.
C. Longo, C. Nonnis Marzano, F. Cardone, M. Mercurio, C. Pierri, G. Corriero



- 12:30 - 12:50 **S3.14** - Role of environmental variables and heavy metal contamination in affecting diatom diversity in Adriatic transitional ecosystems.
C. Facca, M. Masiol, B. Pavoni, A. Sfriso
- 12:50 - 13:10 **S3.15** - Correlation of genetic diversity patterns from polychaete populations to environmental data from lagoonal ecosystems.
K. Vasileiadou, C. Pavloudi, F. Camisa, I. Tsikopoulou, G. Kotoulas, C. Arvanitidis
- 13:10 - 14:30 **Lunch break/Poster session**
- 14:30 - 14:50 **S3.16** - Nematodes diversity and coastal lagoons connectivity.
S. A. Netto, G. Fonseca
- 14:50 - 15:10 **S3.17** - Internal measures to manage eutrophication in lagoons: Mussel farming in the Oder (Szczecin) Lagoon in the southern Baltic.
G. Schernewski, N. Stybel, T. Neumann
- 15:10 - 15:30 **S3.18** - Dinoflagellate cyst assemblages in surface sediments from three shallow Mediterranean lagoons (Sardinia, North Western Mediterranean Sea).
C.T. Satta, S. Anglès, E. Garcés, N. Sechi, S. Pulina, B.M. Padedda, D. Stacca, A. Lugliè
- 15:30 - 15:50 **S3.19** - Multiplicity of alternative steady states of ecosystems and social-environmental management: Case of the Crimean hypersaline lagoons.
N.V. Shadrin
- 16:00 - 16:30 **Coffee break**

Wednesday, 18th December 2013

Lecture Room Bernini

Session Topic 1. MATTER FLOWS AND CYCLING

- 09:00 - 9:45 **Keynote speaker: Masumi Yamamuro**
Towards the sustainable bivalve fisheries in coastal lagoons.
- 09:45 - 10:00 Synchronization Break
Chairman: *Arturas Razinkovas-Baziukas*
- 10:00 - 10:20 **S1.1** - Integrated eutrophication modelling and management of a river basin – lagoon sea system: The Oder/Odra river and lagoon in the southern Baltic.
G. Schernewski
- 10:20 - 10:40 **S1.2** - Eutrofication in Baltic transitional waters: role of seasonality and internal loadings.
A. Razinkovas-Baziukas, M. Bartoli, T. Ruginis, J. Petkuvienė, R. Pilkaitytė, I.



Lubienė, M. Žilius, R. de Wit

- 10:40 - 11:00 **S1.3** - Mixing volume: a hydrodynamics indicator for ecological studies.
A. Fiandrino, V. Ouisse, F. Dumas, S. Le Noc, N. Malet, F. Lagarde, N. Garcia, P. Raimbault, A. Giraud, M. Barral, R. de Wit
- 11:00 - 11:30 **Coffee break**
- 11:30 - 11:50 **S1.4** - The decision support system O’GAMELAG for the management of eutrophied coastal lagoons.
S. Le Noc, R. de Wit, A. Fiandrino, V. Ouisse, N. Malet, M. Hebert, M. Barral, L. Moragues
- 11:50 - 12:10 **S1.5** - Benthic compartment in eutrophied Mediterranean lagoons: nutrient sink or sources?
V. Ouisse, A. Fiandrino, R. de Wit, D. Munaron, S. Le Noc, M. Fortune, J. Oheix, C. Jouanneaud, M. Baleux, M. Durozier, N. Garcia, V. Lagadec, P. Raimbault, R. Buscail, D. Aubert, A. Giraud, M. Barral, N. Malet
- 12:10 - 12:30 **S1.6** - Recent insights on cyanobacterial blooms in a freshwater estuary.
M. Zilius, M. Bartoli, J. Petkuvienė, G. Giordani, M. Bresciani, R. de Wit, A. Razinkovas-Baziukas
- 12:30 - 12:50 **S1.7** - RITMARE and the Italian lagoons: first modelling results for Taranto Seas
F. De Pascalis, G. Umgiesser, M. Ghezzi, C. Ferrarin, D. Bellafiore, M. Bajo, L. Zaggia
- 12:50 - 13:10 **S1.8** - Sediment metabolism and nutrient fluxes of different habitats in Messolonghi lagoon (Greece).
E. Arévalo, J.S.P. Ibánhez, A. Nicolaidou, S. Papaspyrou
- 13:10 - 14:30 **Lunch break/Poster session**
- 14:30 - 14:50 **S1.9** - Eutrophication in the Berre Lagoon: matter cycling and remaining questions.
E. Gouze, J. Vidal-Hurtado, L. Martin, M.J. Salençon, P. Gosse
- 14:50 - 15:10 **S1.10** - Tidal exchange of sediments and nutrients within saltmarsh ecosystem: a case study in a small reconstructed saltmarsh in the Venice Lagoon.
A. Bonometto, A. Feola, F. Rampazzo, C. Antonini, S. Noventa, C. Gion, D. Berto, R. Boscolo
- 15:10 - 15:30 **S1.11** - Is bioturbation by macrofauna adequately included in coastal lagoons biogeochemistry?
M. Bartoli, G. Castaldelli, D. Nizzoli, E.A. Fano, G. Giordani, P. Viaroli
- 15:30 - 15:50 **S1.12** - Stable isotope analysis reveals preferential feeding grounds of opportunistic marine-estuarine fish in a coastal lagoon.
S. Como, P. Magni, G. Van Der Velde, F.S. Blok, M.F.M. Van De Steeg
- 16:00 - 16:30 **Coffee break**



16:30 - 18:00 **Round Table - Topic 1 Matter Flows and Cycling**

A decade of studies on coastal lagoon eutrophication (2001-2010 and beyond): a tribute to José Manuel Zaldivar Comenges.

18:00 - 19:00 **General Assembly LaguNet**

Lecture Room Donatello

Session Topic 4. RESILIENCE TO DISTURBANCES AND PERTURBATIONS

Chairman: *Rutger de Wit*

- 10:00 - 10:20 **S4.1** - 12 years of eutrophication monitoring on French lagoons (Languedoc-Roussillon, France): relevance of an assessment tool to highlight restoration paths.
V. Derolez, A. Fiandrino, A. Baehr, D. Munaron, V. Ouisse, N. Malet, M. Kloareg, M. Cadoret, C. Bissery, M. Hebert, M. Barral, L. Moragues
- 10:20 - 10:40 **S4.2** - Occurrence of *Trichodesmium erythraeum* Blooms in Northeastern Brazilian.
R. Panosso, I.A.S. Costa, M.M.N. Santos, E. Stanca, J.S.D. Souza
- 10:40 - 11:00 **S4.3** - Hydrodynamics and eutrophication modeling of the Berre Lagoon (France): a tool to identify rehabilitation strategies.
E. Gouze, L. Martin, N. Durand, M. Gant, E. Razafindrakoto, C.T. Pham
- 11:00 - 11:30 **Coffee break**
- 11:30 - 11:50 **S4.4** - Effects of marine acidification on net primary production of seagrass *Zostera marina* in the shallow coastal brackish water ecosystem.
L. Pajusalu, G. Martin, A. Pollumae
- 11:50 - 12:10 **S4.5** - Response of zooplankton to a prolonged HAB event in Papas Lagoon (W Greece).
G. Papantoniou, D. Danielidis, Y. Cladas, M. Sokratous, Z. Vaitsi, V. Ketsilis-Rinis, N. Frangopoulou
- 12:10 - 12:30 **S4.6** - Passive samplers as a useful tool to better characterize the water chemical contamination of French Mediterranean coastal lagoons.
D. Munaron, M. Hubert, N. Tapie, H. Budzinski, J. Guyomarch, B. Andral, J.L. Gonzalez
- 12:30 - 12:50 **S4.7** - Impact of sediment resuspension on the phytoplankton structure and productivity in the human-impacted lagoon of Bizerte (TunisiaMediterranean Sea).
C. Lafabrie, A. Sakka Hlaili, C. Leboulanger, I. Tarhouni, H. Ben Othman, N. Mzoughi, L. Chouba, O. Pringault
- 12:50 - 13:10 **S4.8** - Long term observations on *Chattonella subsalsa* (Raphidophyceae) blooms and related environmental conditions in a Mediterranean lagoon (Santa Giusta Lagoon, Sardinia, Italy).
C.T. Satta, D. Stacca, A. Lugliè, A. Loria, N. Sechi, S. Pulina, B. M. Padedda



- 13:10 - 14:30 **Lunch break/Poster session**
- 14:30 - 14:50 **S4.9** - Long term dynamics of ichthyoplankton-jellyfish relationships in a coastal lagoon: who control the system?
A. Perez-Ruzafa, J. I. Quispe, C. Marcos
- 14:50 - 15:10 **S4.10** - First steps of the Mediterranean lagoon restoration process: shifts in phytoplankton communities.
A. Leruste, N. Malet, D. Munaron, R. de Wit, Y. Collos, B. Bec
- Session Topic 5. CONSERVATION AND MANAGEMENT OF COASTAL LAGOONS**
Chairman: *Alice Newton*
- 15:10 - 15:30 **S5.13** - The Réseau de Suivi Lagunaire (RSL) a tool for eutrophication survey and management in the Languedoc-Roussillon lagoons.
M. Hebert, M. Barral, L. Moragues, V. Derolez
- 15:30 - 15:50 **S5.14** - Trace elements and PAHs in surface sediments and biota from a contamination hotspot (Augusta Bay, Italy): potential export to the adjoining coastal marine areas.
R. Di Leonardo, S. Vizzini, A. Vaccaro, C. Tramati, A. Mazzola
- 16:00 - 16:30 **Coffee break**

Thursday, 19th December 2013

Lecture Room Bernini

Session Topic 2. CARRYING CAPACITY AND BIOLOGICAL RESOURCES

- 09:00 - 9:45 **Keynote speaker: Michael Elliott**
Unbounded boundaries and moving baselines - how can we create functional definitions of lagoons and estuaries?
- 09:45 - 10:00 Synchronization Break
Chairman: *Angel Perez Ruzafa*
- 10:00 - 10:20 **S2.1** - The assessment of the eel population in the Comacchio Lagoon: evidence of stock collapse and management hypothesis for the recovery.
G. Castaldelli, V. Aschonitis, M. Lanzoni, M. Merighi, R. Rossi, E.A. Fano
- 10:20 - 10:40 **S2.2** - Crustacea in the Crimean hypersaline lagoons: diversity, long-term changes, natural and economical values.
E.V. Anufriieva, N.V. Shadrin
- 10:40 - 11:00 **S2.3** - Integrated approach to ecotoxicity tests on unicellular algal species: a case study of *Phaeodactylum tricorutum*.
M. Renzi, L. Roselli, A. Giovani, S. E. Focardi, A. Basset
- 11:00 - 11:30 **Coffee break**
- 11:30 - 11:50 **S2.4** - Qualitative study of phytoplankton populations in a shellfish farm in Bizerta lagoon, northern Tunisia.



M. Bellakhal, M.F. Bellakhal, J. Ksouri, H. Missaoui

Session Topic 5. CONSERVATION AND MANAGEMENT OF COASTAL LAGOONS

- 11:50 - 12:10 **S5.15** - Integrated study of water uses in the Thau basin in the context of climate changes.
I. La Jeunesse, D. Aubin, C. Cirelli, G. Pellon, H. Sellami
- 12:10 - 12:30 **S5.16** - The white stork (*Ciconia ciconia*) in the wetlands of tarf (North East Algeria), and climate change.
Mammeria Aicha Beya
- 12:30 - 12:50 **S5.17** - Lagoon and Habitat (EUNIS) fragility to alien species in Mediterranean lagoons
A. Basset et al.
- 13:00 - 14:00 **Conference Outcomes and Conference Closure**
A. Mazzola, P. Campostrini

Lecture Room Donatello

Session Topic 5. CONSERVATION AND MANAGEMENT OF COASTAL LAGOONS

Chairman: *Alice Newton*

- 10:00 - 10:20 **S5.18** - An intercalibration exercise for benthic macrophyte indices across the Mediterranean Sea coastal lagoons.
S. Orfanidis, A. Sfriso, T. Laugier, V. Derolez, A. Ramfos, K. Nakou, S. Birk, N. Zampoukas, W. Bonne
- 10:20 - 10:40 **S5.19** - Characterization of cholinesterase in *Aphanius fasciatus* (Teleostei, Cyprinodontidae) from Orbetello Lagoon (Tuscany, Italy).
C. Pretti, S. Brandi, M. Oliva, E. Mennillo, A. Castelli, F. Maltagliati
- 10:40 - 11:00 **S5.20** - The Lagoons of Corfu: multiple impacts, conservation strategies and economic exploitations.
S. Ghinis, A. Basset, M. Pinna, V. Gjoni
- 11:00 - 11:30 **Coffee break**
- 11:30 - 11:50 **S5.21** - Ecological restoration of coastal lagoons; prediction of ecological trajectories and economic valuation.
J. Balavoine, H. Diop, H. Rey-Vallette, R. Lifran, R. de Wit
- 11:50 - 12:10 **S5.22** - Restoration of coastal sandy dunes: Acquatina (Lecce, Italy).
F. Ippolito, P. Medagli, S. Arzeni, A. Albano
- 12:10 - 12:30 **S5.23** - Propagule predation by crabs and the restoration of Neotropical mangroves.
A. Ferreira, G. Ganade, J.L. Attayde

POSTER COMMUNICATIONS PROGRAMME



Topic 1. MATTER FLOWS AND CYCLING

P1.1 Estimate of algal biomass in two Mediterranean lagoons: shifting between planktonic and macroalgal production.

A. Specchiulli, F. Borghini, D. Cassin, R. D'Adamo, A. Fabbrocini, E. Fanello, P. Penna, T. Scirocco, S. Bastianoni

P1.2 Trophic status and possible evolution of the Maghrebian Lagoons: a tipping point for economic development.

M. Snoussi, G. Giordani, D. Alimi, F. Halim, N. Trigui El Menif, H. Kara, G. Mahél

P1.3 Litter decomposition and associated benthic macrofauna: the case study of a coastal lagoon (Acquatina, ITALY) in natural and perturbed conditions.

F. Sangiorgio, L. Rossi, M. Manganelli, A. Basset

Topic 2. CARRYING CAPACITY AND BIOLOGICAL RESOURCES

P2.1 Distribution and abundance of freshwater fish in two Tunisian dams: Ghezala and Lahjar.

S. Mili, R. Ennouri, H. Laouar, H. Missaoui

P2.2 Is there a role for Mediterranean lagoons in the European eel (*Anguilla anguilla* L., 1758) stock recovery process?

F. Capoccioni, M. Schiavina, J. Terràdez, C. Leone, G. De Leo, E. Ciccotti

P2.3 Consequences of a gelatinous dominated ecosystem: Preliminary observations from a Mediterranean lagoon.

S. Scorrano, J. Njire, D. Lucic, F. Boero, S. Piraino

P2.4 Effect of coastal lagoon environmental instability on the dual nature of sea urchin gonads.

C. Fernandez, M. Johnson, V. Leoni, L. Ferrat, V. Pasqualini

P2.5 Integrated aquaculture in a Mediterranean coastal lagoon: the Acquatina (Frigole, Lecce-Italy) case study

C. Storelli, V. Zonno, G. Bressani S. Vilella

Topic 3. BIODIVERSITY PATTERNS, ORGANIZATION AND CLIMATE CHANGES

P3.1 Étude otolithométrique comparée de deux populations lagunaires (Ghar El Melh et Bizerte) de *Sparus aurata* de Tunisie.

B. Marsaoui, M. Fatnassi, M. Trojette, A. Chalah, R. Massoued, J.P. Quignard, M. Trabelsi

P3.2 Discrimination de trois populations tunisiennes de *Engraulis encrasicolus* (Clupeiforme, Engraulidae) par analyse de la forme des otolithes.

H. Messaoud, N. Ayed, M. Fatnassi, A. Chalh, M. N. Daly Yahia, J.P. Quignard, M. Trabelsi

P3.3 Utilisation de la morphologie des otolithes pour la discrimination de deux espèces de poissons (Perciformes, Gobiidae) de Tunisie. *Gobius niger* et *Gobius paganellus* (Linnaeus, 1758).

N.E.H. Mahouachi, A. Chalh, M. Fatnassi, D. Menif, H. Messaoud, H. Ben Alaya, J.P. Quignard,



M. Trabelsi

P3.4 Étude comparée du profil en acides gras de trois populations lagunaires tunisiennes de *Atherina lagunae*.

S. Chakroun, N. Bouriga, M. Fatnassi, M.N. Daly, E. Faure, J.P. Quignard, M. Trabelsi

P3.5 Does water quality change in different lagoon types? Study cases from coastal lagoons of Western Greece.

C. Christia, G. Giordani, E. Papastergiadou, P. Viaroli

P3.6 The effect of habitat on the condition factor of three estuarine resident fish: a quantile regression approach.

F. Cavraro, M. Zucchetta, P. Franzoi

P3.7 The TWS Mar Piccolo of Taranto (Ionian Sea, southern Italy): an important hot spot for the introduction of alien seaweeds in the Mediterranean Sea.

E. Cecere, G. Portacci, A. Petrocelli

P3.8 Preliminary study on the macrozoobenthic community in the Santa Gilla lagoon (Southern Sardinia, Italy).

S. Cabiddu, F. Palmas, G. Atzori

P3.9 Is movement behaviour a taxon-free trait? Inter- and intra-specific, body size-related variation in movement patterns of benthic macroinvertebrates under resource-free conditions.

E. Longo, T. Verschut, L. Carrozzo, G. Mancinelli

P3.10 Utilisation de la morphologie des otolithes pour la discrimination de deux populations de *Mugil cephalus* dans le Barrage de Nebeur et la lagune de Ghar el Meleh.

M. Khedher, M. Fatnassi, M. Trojette, A. Chalah, M. Rebaya, R. Messaoud, B. Marsaoui, J.P. Quignard, M. Trabelsi

P3.11 Étude otolithométrique comparée de deux populations de *Liza ramada* de deux sites (barrage Mellegue et lagune de Bizerte) de Tunisie.

M. Rebaya, M. Fatnassi, M. Trojette, A. Chalah, M. Khedher, B. Marsaoui, R. Messaoud, J.P. Quignard, M. Trabelsi

P3.12 Importance de la morphologie des otolithes dans la discrimination de deux populations lagunaires tunisiennes (Ghar el Melh et Bizerte) de *Liza aurata* de Tunisie.

R. Messaoud, M. Fatnassi, M. Trojette, A. Chalah, B. Marsaoui, M. Khedher, M. Rebaya, J.P. Quignard, M. Trabelsi

P3.13 Genetic diversity in phytoplankton communities in eutrophicated and oligotrophic coastal lagoons of Languedoc (South of France)

D. Grzebyk, S. Audic, C. de Vargas, E. Hately, B. Lasserre, D. Munaron, N. Malet, B. Bec

P3.14 The Boring fraternity: A research network on marine woodborers

D. Tagliapietra, M.J. Ahrens, C. Appelqvist, C. Björda, L. Borges, S. M. Cragg, D. L. Distel, D. J. Gregory, K. Hoppe, K.M.L. Hutalle-Schmelzer, E. Keppel, P. Paalvast, S. Palanti, P. Palma, R. Shipway, M. Sigovini, H. Sivrikaya, R. Weigelt



P3.15 Distribution and production of chironomids (Diptera: Chironomidae) in a shallow, hypereutrophic boreal lagoon (Baltic Sea, Lithuania).

T. Ruginis

P3.16 Reconstruction of food webs in three coastal lakes: a mixing model approach.

R. Santoro, G. Careddu, F. Bentivoglio, L. Orlandi, P. Carlino, E. Calizza, M.L. Costantini, L. Rossi

P3.17 Temporal scales of the body size structure and body condition variation in the brackish isopod *Lekanesphaera hookeri*: is there a role of temperature patterns?

A. De Pascali, M.A. Giannone, A. Basset, M. Pinna

P3.18 Influence of interspecific horizontal interactions and biodiversity on ecosystem functions: an experiment in laboratory mesocosms.

L. Mazzotta, M. Pinna, V. Gjoni, G. Marini, A. Basset

P3.19 Influence of reproductive traits in the organization of macroinvertebrate communities: a study case in Mediterranean and Black Sea transitional waters.

L. Potenza, M. Pinna, A. Basset

P3.20 Openness and parsimony as key properties of ecological quality indices. The M-AMBI case.

M. Sigovini, E. Keppel, D. Tagliapietra

Topic 4. RESILIENCE TO DISTURBANCES AND PERTURBATIONS

P4.1 Effects of multicontamination on the structure of phytoplankton communities in North-Tunisia (Mediterranean Sea).

O. Daly Yahia-Kefi, C. Lafabrie, N. Salhi, C. Leboulanger, M. N. Daly Yahia, O. Pringault

P4.2 Sensibility of natural phytoplankton from coastal Mediterranean lagoons towards polycyclic aromatic hydrocarbons.

H.B. Othman, C. Lafabrie, E. Lanouguère, P. Got, H.H. Mabrouk, A.S. Hlaili, C. Leboulanger

P4.3 Assessment and spatial distribution of mineral elements in surface sediments of Tunis bay (Tunisia).

R. Nouri, S. Mili, L. Chouba

P4.4 Assessment of hydroclimatic changes in the Curonian Lagoon of the Baltic Sea.

I. Dailidiene

P4.5 Ice regime changes in the south and east lagoons of the Baltic Sea.

I. Dailidiene, H. Baudler, E. Grebliauskaitė

P4.6 Clumps of *Zebra* mussel is a “biogeochemical reactor or litterlout” on sandy sediments?

M. Zilius, M. Bartoli, T. Ruginis, J. Petkuvienė, I. Lubienė, A. Razinkovas-Baziukas

Topic 5. CONSERVATION AND MANAGEMENT OF COASTAL LAGOONS

P5.1 Which is the influence of management on lagoon communities ? A case study in the Central



Tyrrhenian, to assess response of fish assemblages to changing strategies.

E. Ciccotti, C. Leone, M. Zucchetto, C. Manzo, L. Tancioni, P. Franzoi

P5.2 Towards the definition of environmental indicators for the quality assessment of Mediterranean coastal lagoons: a case study of three small-size lagoons from the Central Tyrrhenian coast.

C. Leone, M. Zucchetto, P. Franzoi, E. Ciccotti

P5.3 Ecological quality assessment in the Cabras lagoon (Sardinia, Italy): which benthic index performs best?

A. Foti, G.A. Fenzi, S. Como, M.F. Gravina, P. Magni

P5.4 Taxonomic and ecological data on the macrozoobenthos of Orikumi Lagoon, Albania.

I. Nasto, S. Beqiraj

P5.5 Condition monitoring: design and methodologies. A case-study of NW European lagoons.

A. Franco, K. Mazik, A. Leighton, M. Bailey, H. Latham, J. Fincham, M. Elliott

P5.6 First phytochemical evidence of chemotypes for the seagrass *Zostera noltii*.

M. Grignon-Dubois, B. Rezzonico

P5.7 Chemical warfare in coastal ecosystems: the *Zostera-Alexandrium* case.

M. Grignon-Dubois, B. Rezzonico, M. Laabir, P. Cecchi, E. Masseret

P5.8 Exposition and contamination in the Venice lagoon. From experimental evidence in *Zosterisessor ophiocephalus* towards a numerical evaluation.

M. Ghezzi, F. Acri, F. DePascalis, S. Manente, G. Umgiesser, R. D'Adamo, M. Botter



ABSTRACTS ORAL COMMUNICATIONS



Session Topic 1. MATTER FLOWS AND CYCLING

Invited speaker

Towards the sustainable bivalve fisheries in coastal lagoons

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Some suspension-feeding bivalves, such as *Tapes* are chief fishery targets in coastal lagoons. Bivalves control phytoplankton abundance and fisheries of bivalves contribute to the prevention of further eutrophication through the removal of nutrients from lagoons. Aside from anthropogenic disturbances, natural environmental changes may alter the sustainability of bivalve fisheries. Revival of submerged macrophytes may serve as habitats for zooplankton and juvenile fish, while catching bivalves without damaging the vegetation is impossible. In Shinji lagoon, Japan, reduction of herbicides has induced the increase of blue-green algae and submerged macrophytes, both of which are serious threats to bivalve fisheries. The submerged macrophytes which covered the Shinji lagoon before the use of herbicides in 1950's were charophytes, while the emergent macrophytes after 2008 are all angiosperms, which extend their leaves until the water surface. Dense coverage of surface water due to leaves may induce hypoxia at the bottom, via reduction of water circulation. It is assumed that the more eutrophic conditions at present, favors such type of submerged plants. In order to diminish freshwater floating-leaved *Trapa* and blue-green algae, as well as to increase the brackish commercial bivalves, salinity was artificially increased at Koyama lagoon. Because salinity increased more than expected, aside from *Trapa* and blue-green algae, some protected freshwater species also disappeared; this shows the difficulty in maintaining salinity levels at the ideal condition. Changes in temperature during spawning season of bivalves also alter the recruitment of juveniles which in turn decreases the fishery resources. Even under global warming, the increase of cool freshwater inflow due to increased rainfall may induce cooling of lagoons. Temperature change in river water may also be induced by construction of dams. It is vital that we examine complex effects of environmental factors towards sustainable bivalve fisheries in coastal lagoons.



S1.1 Integrated eutrophication modelling and management of a river basin - lagoon sea system: The Oder/Odra river and lagoon in the southern Baltic

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The Odra river basin (area: 120000 km², average discharge: 550 m³/s, annual N-load 60000 t) and the Oder (Szczecin) Lagoon (687 km²) are an eutrophication hot-spot in the Baltic region. To be able to carry out large scale, spatially integrative analyses, we linked the river basin nutrient flux model MONERTS to the coastal 3D-hydrodynamic and ecosystem model ERGOM. Objectives were a) to analyse the eutrophication history in the river basin and the resulting functional changes in the coastal waters between early 1960's and today and b) to analyse the effects of an optimal nitrogen and phosphorus management scenario in the Oder/Odra river basin on coastal water quality.

The models show that an optimal river basin management with reduced nutrient loads (e.g. N-load reduction of 35%) would have positive effects on lagoon water quality and algae biomass. The availability of nutrients, N/P ratios and processes like denitrification and nitrogen-fixation would show spatial and temporal changes. It would have positive consequences for ecosystems functions, like the nutrient retention capacity, as well. However, this optimal scenario is by far not sufficient to ensure a good coastal water quality according to the European Water Framework Directive. A "good" water quality in the river will not be sufficient to ensure a "good" water quality in the coastal waters. Further, nitrogen load reductions bear the risk of increased potentially toxic, blue-green algae blooms.

The presentation will a) summarize recent results, b) give an overview how the models were used to provide a comprehensive and consistent set of water quality thresholds for the Water Framework Directive and c) will show the implications for an optimised river basin - lagoon quality management.

S1.2 Eutrofication in Baltic transitional waters: role of seasonality and internal loadings

A. Razinkovas-Baziukas^{1,*}, M. Bartoli^{2,1}, T. Ruginis¹, J. Petkuvienė¹, R. Pilkaitytė¹, T. Lubienė¹, M. Zilius¹, R. de Wit³

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Despite the absence of estuaries sensu stricto in the Baltic as a non-tidal sea, most of the Baltic



transitional waters share processes that are typical for classical estuaries. A number of large rivers discharging in the Baltic Sea produce estuarine gradients reflecting transition of physical, chemical and biological processes from the river to the coastal plume. As there are three of the largest coastal lagoons in the Baltic, the retention, loss and transformation of nutrients is maximized in these semi-enclosed coastal formations. Traditionally, the water quality problems such as dinoflagellate or diatom "blooms", opportunistic macrophyte proliferation are known to be connected to the nutrient loads from the river catchments. That is true when the so-called "new" production is considered. However, in most of the Baltic lagoons and semi-enclosed regions of restricted exchange (RRE) maximum chlorophyll A concentrations are observed not during the spring diatom "bloom", but rather in the second part of the summer, when external nutrient inputs to the system are much lower. Our seasonal assessments of bento-pelagic exchange in the Curonian lagoon indicate that internal nitrogen and phosphorus loads during the summer period are several times higher than riverine contributions. Moreover, internal phosphorus loads are found to be mostly climatically driven and related to the cyanobacteria bloom development. Such findings bring an evidence of two partially independent mechanisms of spring and summer "bloom" regulation - straightforward "new production" based in the spring and internal load based in the summer. That also implies different management strategies for eutrophication in open coastal regions and RREs as the latter could be considered as a sink in the spring and predominantly source of nutrients in the summer.

S1.3 Mixing volume: a hydrodynamics indicator for ecological studies

A. Fiandrino^{1,*}, V. Ouisse^{1,2}, F. Dumas³, S. Le Noc², N. Malet⁴, F. Lagarde¹, N. Garcia⁵, P. Raimbault⁵, A. Giraud⁶, M. Barral⁷, R. de Wit²

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Since the 1960s, Mediterranean lagoons have been particularly affected by large nitrogen and phosphorus inputs from watersheds leading to eutrophication of these semi-enclosed ecosystems. Since the 2000s, most public policies are pursued to reduce the external nutrient loadings (N and P). Despite of this reduction, the restoration of eutrophied lagoon is still incomplete and depends on (1) the capacity of the ecosystem to export matter towards the sea and (2) the exchanges of past-accumulated nutrients from the benthic compartment to the water. We focus here on the



efficiency of physical cleaning processes that is commonly approached with residence time. To our point of view this hydrodynamics indicator is not sufficient for addressing ecological questions that need a spatio-temporal indicator to distinguish between areas where the lagoon water is well-mixed with the inflowing sea water, and confined areas. We propose a hydrodynamics indicator the mixing volume that can be estimated using hydrodynamics modelling and based on the renewal time concept defined for well-mixed tank.

An example of calculation of the mixing volume is proposed for the Bages-Sigean lagoon (Western Mediterranean French coast) using the numerical hydrodynamic MARS-3D model. Preliminary results show how this indicator varies during the year responding to the seasonally changing environmental conditions. It appears that the mixing volume, depending on wind and tide induced water body circulation and freshwater runoff, exhibits a low seasonal variability except during flood event.

This indicator is then used to improve simulation of seawater exchange processes in an unspatialized biogeochemical budget model. The ability of this model to reproduce water and nutrients exchanges between the Bages-Sigean lagoon and the Mediterranean sea is estimated with a confrontation of simulation results to in situ measurements of outflowing nutrients loads sampled during flood event.

S1.4 The decision support system O'GAMELAG for the management of eutrophied coastal lagoons

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The monitoring programme the Réseau de Suivi Lagunaire (RSL) monitors the eutrophication status of the coastal lagoons in the Languedoc-Roussillon region (S. France). In order to support the lagoon managers in new innovative ways, the RSL has called for development of a decision support system for defining the maximal allowable N and P loadings to lagoons for achieving and maintaining good ecological status. Therefore, we developed O'GAMELAG as a demonstrator based on a simulation program that communicates with databases. To improve accessibility for the lagoon managers it also comprises a user-friendly man-engine interface, menu-selected output



options including graphic representations and a methodological guide that can be consulted on-line during execution. The simulation model is based on the methodology provided by the LOICZ (Land-Ocean Interactions in the Coastal Zone) model, which calculates the fluxes of water, salt and nitrogen and phosphorus across different interfaces. It is based on the coupling of a simple hydrological and a biogeochemical model. The hydrological model focuses on water inputs from the catchment, exchanges between the lagoon and the sea, and between the lagoon and the atmosphere. The biogeochemical model calculates the distribution and dynamics of N and P in different compartments (water column, phytoplankton, macroalgae, seagrass meadows, cultured bivalves and sediments). The development of O'GAMELAG has initiated a participative approach with the lagoon managers for compiling the essential data bases for the external forcing (time series of water and nutrient flows from the catchments into the lagoon) for different lagoons and to analyse the water and N and P budgets during wet and dry years. The final aim of O'GAMELAG is to provide a tool to test the impact of different management scenarios, which can be combined with scenarios of climate change, on the water quality in the lagoon.

S1.5 Benthic compartment in eutrophied Mediterranean lagoons: nutrient sink or sources?

V. Ouisse^{1,2*}, A. Fiandrino¹, R. de Wit², D. Munaron¹, S. Le Noc², M. Fortune¹, J. Oheix¹, C. Jouanneaud¹, M. Baleux¹, M. Durozier¹, N. Garcia³, V. Lagadec³, P. Raimbault³, R. Buscail⁴, D. Aubert⁴, A. Giraud⁵, M. Barral⁶, N. Malet⁷

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Since the 1960s, Mediterranean lagoons have been particularly affected by large nitrogen and phosphorus inputs from watersheds leading to significant changes in ecosystem structure, functioning and services. In the context of Water Framework Directive (WFD), most public policies and management of Mediterranean lagoons are pursued with the aim of restoring their ecological qualities and have been focused on reducing the external nutrient loadings (N and P). Despite of the reduction of nutrients inputs, the restoration is still incomplete and it depends also on (1) the capacity of the system to export the matter from the lagoons to the sea and on (2) the exchanges of past-accumulated nutrients from the benthic compartment (internal source) to the water. The present study aims to quantify the sedimentary stocks and benthic fluxes of N and P in order to assess the internal N and P loadings to the pelagos and to estimate the time needed for



restoration of an acceptable eutrophication status of these Mediterranean lagoons. In addition to nutrient sediment stock estimation (data from the monitoring programme RSL), nitrogen and phosphorus benthic fluxes were measured using undisturbed cores along the eutrophied gradient in spring, summer, autumn and winter. Our first results concern the spring period that show a clear efflux of nitrogen for the most eutrophied sediments. In addition, we also showed that the benthic nutrient fluxes are also linked to the O_2 -DTC community metabolism (uptake of DIN and DTP by autotrophic marine Magnoliophyta, net release in net heterotrophic systems). Finally, we predict that the time needed for restoration of lagoons depends on the stocks of N and P in the sediments, which are an internal source, and the presence of benthic macrophytes, in particular seagrasses, which can directly use nutrients from sediment.

S1.6 Recent insights on cyanobacterial blooms in a freshwater estuary

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We review the main results of research activities carried out in the last 5 years and focusing on potential triggers, regulating factors and consequences of cyanobacterial blooms in the Curonian Lagoon, the largest in Europe. Blue-green algae are a serious threat in this lagoon: blooms are a recurrent phenomenon in the summer period and may cover a major fraction of the whole basin surface with chlorophyll *a* concentrations over 500 $\mu\text{g l}^{-1}$. Reinterpretation of satellite images allowed to produce a number of maps showing the spatial distribution and entity of the blooms; they have large inter and intra-annual variability probably due to season-specific meteorological features and a defined cascade of related events. A detailed seasonal oxygen budget revealed that during blooms the probability of water column and sediment hypoxia/anoxia ($>62.5 \mu\text{mol l}^{-1}$) is elevated, in particular in more confined areas and under calm weather conditions when reaeration is limited and water stratification is stable over time. At those levels of hypoxia or anoxia phosphorus is released to water column at $30 \mu\text{mol m}^{-2}\text{h}^{-1}$ while also promoting nitrogen loss via denitrification: under such circumstances cyanobacteria are favored by strongly unbalanced nutrient stoichiometry. Calm weather, water stratification and early blooms induce a positive feedback loop "vicious circle" involving sediment biogeochemistry and the benthic cycle of P and N.



S1.7 RITMARE and the Italian lagoons: first modelling results for Taranto Seas

F. De Pascalis*, G. Umgiesser, M. Ghezzi, C. Ferrarin, D. Bellafiore, M. Bajo, L. Zaggia

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The Italian research project RITMARE, coordinated by the National Research Council, brings together, in an integrated effort, the Italian scientific community involved in research on marine and maritime issues.

One of the project objectives is to improve the knowledge on the lagoon systems through the study of the hydrodynamic regime, transport processes and morphological evolution of Italian lagoons, using advanced numerical modeling, supported by dedicated measures.

In order to reach this aim the application of an high resolution numerical model is planned in different study areas, identified in the North Adriatic Sea lagoons, the Taranto Seas and the Gulf of Oristano with its lagoons.

In the Gulf of Taranto the modelling activity is focused on the hydrodynamic characterization of the Taranto Seas and on the study of transport time scales (residence time, transit time and confinement). The study aims to describe the general water circulation of this system and to assess the processes related with the submarine freshwater sources (citri) and their effects on the temperature and salinity fields. For this application the SHYFEM finite element model is used in its 3D formulation, with hybrid vertical discretization (sigma and z-layers). The first modelling results for the Taranto Seas are presented, in terms of water circulation, temperature and salinity patterns and 3D distributions of the transport time scales.

S1.8 Sediment metabolism and nutrient fluxes of different habitats in Messolonghi lagoon (Greece)

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Sediment metabolism and inorganic nutrient (NH_4^+ , NO_x , SiO_4^{4-} and PO_4^{3-}) fluxes were studied in four different benthic habitats - macroalgae (*Valonia* sp.), seagrass (*Cymodocea nodosa*), bare sediment and bare sediment station located in the outlet of a water treatment plant (BIOL) - at Messolonghi coastal lagoon (Greece). At each site, undisturbed sediment cores were incubated



under dark and light conditions in the laboratory and under close to in-situ conditions. Sediment-water oxygen flux varied among the different habitats. In light, the BIOL station acted as net heterotrophic ($-1470 \mu\text{mol O}_2 \cdot \text{m}^{-2} \cdot \text{h}^{-1}$), whereas the seagrass site showed the highest oxygen production rate ($626 \mu\text{mol O}_2 \cdot \text{m}^{-2} \cdot \text{h}^{-1}$); in darkness, the station colonized by seagrass showed the highest consumption rate ($-1686 \mu\text{mol O}_2 \cdot \text{m}^{-2} \cdot \text{h}^{-1}$), whereas the minimum consumption rate corresponded to the bare sediment station ($-526 \mu\text{mol O}_2 \cdot \text{m}^{-2} \cdot \text{h}^{-1}$). We also found significant differences in the nutrient fluxes between different habitats. Mean flux rates at the four contrasting sites ranged from $-941 \mu\text{mol N} \cdot \text{m}^{-2} \cdot \text{h}^{-1}$ to $2389 \mu\text{mol N} \cdot \text{m}^{-2} \cdot \text{h}^{-1}$ (for NH_4^+), $-1170 \mu\text{mol N} \cdot \text{m}^{-2} \cdot \text{h}^{-1}$ to $223 \mu\text{mol N} \cdot \text{m}^{-2} \cdot \text{h}^{-1}$ (for $\text{NO}_2^- + \text{NO}_3^-$), $-273 \mu\text{mol P} \cdot \text{m}^{-2} \cdot \text{h}^{-1}$ to $31 \mu\text{mol P} \cdot \text{m}^{-2} \cdot \text{h}^{-1}$ (for PO_4^{3-}) and $-841 \mu\text{mol Si} \cdot \text{m}^{-2} \cdot \text{h}^{-1}$ to $2575 \mu\text{mol Si} \cdot \text{m}^{-2} \cdot \text{h}^{-1}$ (for SiO_4^{4-}). Important differences regarding the net consumption/production role of the target compounds were found among the sampled sites. The BIOL station acted as a net source of nutrients, whereas the seagrass assemblage acted as a net sink. The high fluxes observed in seagrass habitat demonstrate the important role of seagrasses in the overall productivity and in nutrient and oxygen sediment-water fluxes and hence, water composition and quality of the lagoonal ecosystem.

S1.9 Eutrophication in the Berre Lagoon: matter cycling and remaining questions

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The Berre lagoon is one of the biggest Mediterranean lagoons (155 km^2). The lagoon receives freshwater and nutrients from two anthropised rivers (600000 inhabitants). Moreover, a hydroelectric powerplant has become the main tributary of the lagoon since 1966. As a consequence, salinity dropped and ranged between 2 and 30 psu and eutrophication nuisances appeared. For 20 years, freshwater, suspended matter and nutrients discharges have been greatly reduced by means of regulating the flows from the powerplant and improving the sewage treatment throughout the watershed. In response to these physico-chemical forcings, eutrophication showed no linear trend. For example, chlorophyll ranged between 20 and $100 \mu\text{g/l}$ in the 90s and dropped sharply in the early 2000s. Today, values range between 5 and $25 \mu\text{g/l}$ in the summer. This net decrease was mainly attributed to the disappearance of the dinoflagellate *Prorocentrum minimum*. Primary production (PP), nitrogen assimilation and mineralization were measured in the water column using the dual-isotopic $^{15}\text{N}/^{13}\text{C}$ technique in 2005-2006. Annual PP ranges between 500 and $750 \text{ gC} \cdot \text{m}^{-2} \cdot \text{yr}^{-1}$. Regeneration processes in the water column are very active: 95% of the annual pelagic PP is based on local pelagic mineralization. At the seasonal scale, the benthic fluxes can play an



important role during summer: high benthic fluxes of PO_4 during summer anoxia can remove P limitation and maintain/increase the phytoplankton bloom. Using benthic chambers, we showed that benthic flux of PO_4 is multiplied by 5 in anoxic conditions. A recent study also shows that high denitrification takes place in the sediment and DNRA process is not present in the lagoon. Despite advances in the understanding of malter cycling, many questions remain. The intensity and duration of phytoplankton blooms and anoxia are still difficult to predict due to the complex interactions between biotic and abiotic processes with sometimes paradoxical effects. The study of benthic stocks of nutrients and the conditions for their mobilization is essential to assess the role of sediment in the resilience of the ecosystem. Studies must go on both in field works and through numerical modeling.

S1.10 Tidal exchange of sediments and nutrients within saltmarsh ecosystem: a case study in a small reconstructed saltmarsh in the Venice Lagoon

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Historical land reclamation for agricultural and industrial purposes and the high rate of loss of salt marshes surface led to decrease the self-purification capacity of inner part of Venice lagoon, characterized by low seawater renewal. Different plans and projects developed in these years for the Venice lagoon and its drainage basin, identify the restoration of saltmarshes and estuarine wetlands as measure to enhance morphological and ecological sustainability of the lagoon and water bodies quality improvement (Water Framework Directives objectives and National Law requirements). In order to support the design of these ecological restoration projects, the proposed experimental study investigates the capacity of intertidal ecosystems to filter suspended sediments, nutrients and organic matter.

The experimental site is located in a small (almost 2 ha) reconstructed salt marsh in the southern part of the Venice Lagoon. The system includes two salt ponds, characterized by different vegetation distribution and hydroperiod, connected to the lagoon by two consecutive small creeks. The elevation at the boundaries of this system prevents lateral flow of water during high tide, ensuring well controlled hydraulic conditions. Three series of water sampling was carried out in different seasons during ebb and flood cycle in 4 stations within the system, in order to determine the role of salt marshes dominated system in the quality water dynamics.

First results highlight the role of boundary conditions in terms of suspended matter and tidal amplitude on sediment and particulate nutrients transport processes within the system. In condition



of high TSS input, settling processes seem to prevail on erosion dynamics, mainly related to high tidal currents within creeks. Dissolved nutrients showed a less clear behavior and will be better investigated in 2013.

S1.11 Is bioturbation by macrofauna adequately included in coastal lagoons biogeochemistry?

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Benthic macrofauna, whether in natural abundances or in high densities as is the case of invasive or farmed organisms, affects a number of microbial and geochemical processes through bioturbation. Macroinvertebrates-mediated processes may be quantitatively relevant and uncouple expected seasonal relationships between microbial activities and water temperature. This is particularly true in eutrophic coastal lagoons where densities of macrofauna can vary dramatically, even in the short term, even in relatively small patches, due to algal blooms or dystrophic events.

The detailed knowledge of fauna distribution and activity should drive sampling strategies in terms of explored sediment surface, sediment depth and number of replicates. However, macrofauna appears insufficiently integrated in monitoring and experimental activities, leading to large amounts of unexplained variance, insufficient understanding of regulating factors and budget errors during up scaling procedures.

Our understanding of the effects of bioturbation on sedimentary and pelagic processes can also be substantially improved. Most bioturbation experiments are in fact short-term, on reconstructed sediments and performed with a single species. As such, they probably provide a partial picture of in situ dynamics, with either amplification or attenuation of some processes due to oversimplified experimental design. There is need of long-term experiments, performed with intact sediments and with interacting macrofauna species. A review of relevant work published in the literature and new, original data are presented and discussed with respect to these topics.



S1.12 Stable isotope analysis reveals preferential feeding grounds of opportunistic marine-estuarine fish in a coastal lagoon

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We identified feeding grounds (FG) and trophic level (TL) of four opportunistic marine-estuarine fish species, *Atherina boyeri*, *Anguilla anguilla*, *Liza ramado* and *Mugil cephalus*, in a selected area of Cabras lagoon (Sardinia, Italy). The $\delta^{13}\text{C}$ values of macroinvertebrate deposit feeders (DF) along a nearshore-offshore gradient (Como et al. ECSS 2012) were used as reference values to identify the FG of the investigated fish, whereas the TL was calculated from the $\delta^{15}\text{N}$ values of fish and DF. The sampling was conducted in March, May and August 2006.

A. boyeri had the highest TL (3.3 ± 0.0 to 4.1 ± 0.0), followed by *A. anguilla* (3.0 ± 0.1 to 3.8 ± 0.0). *L. ramada* and *M. cephalus* were found at a lower TL (2.7 ± 0.1 to 3.5 ± 0.2 and 2.6 ± 0.0 to 2.7 ± 0.1 , respectively). The $\delta^{13}\text{C}$ values of fish ranged from -23.9 ± 0.7 ‰ in *M. cephalus* in May to -21.0 ± 0.1 ‰ in *A. boyeri* in August. These values were more enriched than $\delta^{13}\text{C}$ values of offshore-DF, with differences < 2.00 , whereas they were more depleted than $\delta^{13}\text{C}$ values of nearshore-DF (-20.9 ± 0.2 to -17.1 ± 0.8 ‰).

TL values show that *L. ramado* and *M. cephalus* exploit more resources at the base of the food web (detritus) than *A. boyeri* and *A. anguilla*. Independently of the trophic position occupied by fish, there was feeding segregation within the study area. According to the C-isotopic fractionation between fish and resources of $+0-20$, fish exploit resources offshore whereas avoid littoral areas, possibly because vulnerable to risk of predation by seabirds. The linkage between offshore environmental features and the accessibility to food resources will be discussed within the context of management and conservation of fish production and fisheries in this lagoon.



Session Topic 2. CARRYING CAPACITY AND BIOLOGICAL RESOURCES

Invited speaker

Unbounded boundaries and moving baselines - how can we create functional definitions of lagoons and estuaries?

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There have been many recent developments in the definitions of transitional waters (including estuaries, rias, lagoons, fjords, etc.), which have focused on the physiographical, chemical and ecological features. Similarly, recent papers have attempted to define paradigms which synthesise our knowledge of the structure and functioning of transitional waters and their management. Finally there have been several important governance instruments which rely on definitions and boundaries of estuaries, lagoons and other transitional waters. Despite all of these, there have been difficulties in defining the geographical boundaries of the transitional waters and the definitions of structural and functional change due to external and internal influences. Because of this, it has proved valuable to discuss transitional waters in terms of 'unbounded boundaries' and 'moving baselines' - these are concepts developed and given examples in the present paper. Many of the physical and ecological features are dependent on events many kilometres away from the water body, for example salinity regimes dependent on catchments, nutrient balances dependent on climatic forcing, wading bird populations dependent on polar and tropical conditions and diadromous fish populations dependent on the catchment and oceanic areas such as breeding in the Sargasso Sea - hence the term 'unbounded boundaries'. Because of climate change, the baselines against which change is measured such as temperature regimes, relative sea level, population dynamics and species abundance, are changing (hence 'moving baselines') thus making it more difficult to detect anthropogenic change against background variability. The paper discusses these concepts and compares estuaries and lagoons against that background.



S2.1 The assessment of the eel population in the Comacchio Lagoon: evidence of stock collapse and management hypothesis for the recovery

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Aim of the study is to assess the present conditions of the eel stock in the Comacchio lagoon (north-eastern Adriatic, Italy), discuss the causes of decline by comparing it with previous surveys and define a strategy of recovery. With this purpose, a monitoring programme of glass, yellow and silver eel, together with the most important water parameters, was performed from 2011 and is still ongoing. Silver eels were all caught at the beginning of migration (November- December) using two fixed trap structures, locally called "lavorieri", positioned on the two canals which connect the basin to the sea, while yellow eels were caught using 20 modified fyke nets, locally called "cogolli", homogeneously positioned on the whole lagoon surface, in September- October, before migration. Modeling techniques were used to assess the stock of yellow eels, recruitment, survival and metamorphosis rates. Results indicated a yellow eel density of 7.86 individuals per hectare (ind. ha^{-1}) and a total abundance, of yellow plus silver eel, of 8.58 ind. ha^{-1} . The recruitment in the same year was estimated in 4.41 ind. ha^{-1} . The comparison of the results with the ones of Rossi (1979) and Carrieri et al. (1992) evidenced the collapse of the stock with a drastic change in all population parameters, as the growth rate, age distribution, sex ratio and sex differentiation age. Results are discussed with respect to the application of the Regional and National Plans and of the Council Regulation (EC), No 1100/2007, and with reference to environmental and institutional suitability for this purpose of the Comacchio lagoon.

S2.2 Crustacea in the Crimean hypersaline lagoons: diversity, long-term changes, natural and economical values

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In the Crimea - the biggest peninsula in the Black Sea - there are a lot of hypersaline lagoons of different sizes, salinity ranges, hydrological regimes, biotic compositions. These habitats are very harsh and changeable but high productive environment. Several lagoons were the subject of our research in 2000-2013. Different crustacean species play a leading role among animals in lagoons. A composition of crustacean taxocen is very variable in space and time. About 30 species of Crustacea were found in them totally. There were the sharp changes of the composition of the



planktonic crustaceans in lagoons due to primarily two factors - the sharp fluctuations in salinity and exchange between lagoons and the sea. The general trend realizations in different lagoons are diverse and complicated ones. Impact of climate change on Crustacea taxocen is not only direct, but through an extensive network of intermediate effects which are discussed. Lagoons in the Crimea play a crucial role in supporting a large number of water birds during seasonal migrations, breeding and wintering periods. Crustacean species are their main food. For conservation of European bird diversity we need to conserve the crustacean diversity and productivity in our lagoons. It is particularly important because the Crimea has a cross-road position in the Afro- Eurasian waterbird flyway system. This issue with its potentially far-going ecological and conservation consequences becomes increasingly important under the conditions of global climate change. Sustainable and ecosystem based aquaculture is independent of the biomass produced by natural ecosystems. A creation of industry of live food organisms to go to sustainable aquaculture is needed. There are Amphipoda, Isopoda, Mysida, Anostraca, Cladocera, Copepoda species in the Crimean lagoons which can be effectively used as cultivated food organisms. They are discussed.

S2.3 Integrated approach to ecotoxicity tests on unicellular algal species: a casa study of *Phaeodactylum tricorutum*

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In this study, *P. tricorutum* was exposed to various toxic substances (zinc, copper and dodecylbenzenesulfonic acid sodium salt) in accordance with the AlgalToxkit® protocol based on the UNT EN TSO 10253 method in order to compare traditional results based on the inhibition of the growth rates with here proposed morphological and physiological endpoints based on chemical and confocal microscopy analysis which allow to distinguish the typology of cell physiological stress (alteration of chloroplast, frustule formation process, or morphological traits). The results obtained showed that fluorescence reduction and effects on the photosynthetic complex are powerful tools for the evaluation of early and sub-lethal effects of exposure to toxins. Particularly, their use allows to: i) reduce quantification errors due to colour interferences during spectrophotometric readings that could affect traditional growth inhibition tests; ii) evaluate early and sub-lethal effects; iii) highlight effects at the single-cell level and not only at the population level; iv) assess the effect of toxicants in cell size with the help of an image analysis system; v) integrate, on a biological, ecological and ecotoxicological point of view,



information referred to population dynamics obtained by the analysis of the growth inhibition rates. Further researches are needed to test the applicability of this technique to complex matrices as well as natural samples with mixtures of toxicants at sub-lethal doses and in combination with nutrient availability; to quantify the toxicological effects on physiological and morphological endpoints using confocal microscopy; to identify ultrastructural impairments or damage sites (cell wall, protoplasm, chloroplasts, thylakoids, nucleus, etc.) by combining confocal microscopy and specific fluorophores.

S2.4 Qualitative study of phytoplankton populations in a shellfish farm in Bizerta lagoon, northern Tunisia

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Microalgae are essential food for filter-feeding bivalves and therefore are important for shellfish farming. In last decade shellfish aquaculture continued to develop with growing rhythm in Tunisia. Thus several shellfish parks were recently installed in open sea, while others exist since the 1970s within Bizerta lagoon. This lagoon is an important coastal biotope and could be considered as the most favorable environment in Tunisia for natural reproduction of the mussel *Mytilus galloprovincialis*. Investigations about phytoplankton populations in a shellfish farm from this ecosystem, revealed the existence of 40 taxa of diatoms and 40 taxa of dinoflagellates. 7 taxa from each group could be considered as taxa with constant presence. *Navicula* spp. and *Scrippsiella trochoidea* presented the highest index of presence respectively for the class of diatoms and dinoflagellates.



Session Topic 3. BIODIVERSITY PATTERNS, ORGANIZATION AND CLIMATE CHANGES

Invited speaker

Global patterns in sandy beach macrofauna: species richness, abundance, biomass and body size

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Global patterns in species richness in sandy beach ecosystems have been poorly understood until comparatively recently, because of the difficulty of compiling high-resolution databases at continental scales. We analyze information from more than 200 sandy beaches around the world, which harbor hundreds of macrofauna species, and explore latitudinal trends in species richness, abundance and biomass. Species richness increases from temperate to tropical sites. Abundance follows contrasting trends depending on the slope of the beach: in gentle slope beaches, it is higher at temperate sites, whereas in steep-slope beaches it is higher at the tropics. Biomass follows identical negative trends for both climatic regions at the whole range of beach slopes, suggesting decreasing rates in carrying capacity of the environment towards reflective beaches. Various morphodynamic variables determine global trends in beach macrofauna. Species richness, abundance and biomass are higher at dissipative than at reflective beaches, whereas body size follows the reverse pattern. A Generalized Linear Model showed that large tidal range (which determines the vertical dimension of the intertidal habitat), small size of sand particles and flat beach slope (a product of the interaction among wave energy, tidal range and grain size) are correlated with high species richness, suggesting that these parameters represent the most parsimonious variables for modelling patterns in sandy beach macrofauna. Large-scale patterns indicate a scaling of abundance to body size, suggesting that dissipative beaches harbor communities with highest abundance and species with the smallest body sizes. Additional information for tropical and northern hemisphere sandy beaches (underrepresented in our compilation) is required to decipher more conclusive trends, particularly in abundance, biomass and body size. Further research should integrate meaningful oceanographic variables, such as temperature and primary production, in deciphering latitudinal trends. Further, deconstruction of these communities reveals that both brooders and spawners, as well as the three main feeding groups, all show similar response to beach type, whereas there is a dichotomy between intertidal and supralittoral forms.



S3.1 Benthic taxonomic and functional diversity patterns across habitats in Messolonghi lagoon, Greece

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The lagoon system of Messolonghi is situated on the northern side of the Patraikos Gulf, between the Acheloos and Evinos rivers. It is the biggest lagoon complex in Greece covering about 15000 ha and it consists of 6 lagoons with different geomorphological and hydrological features. Messolonghi Lagoon complex is part of a Marine Protected Area (MPA), as National Park of Messolonghi, Ramsar Site, Important Bird Area (TBA), and part of the Natura 2000 network. The present study is focused on the Messolonghi Central lagoon which is an open lagoon communicating with the sea through a long frontal area. The lagoon presented a wide range of salinity and temperature as a result of the lagoon shallowness (mean depth 1 m), whereas climatic factors such as rainfall and wind rapidly affect the temporal variations of abiotic parameters of the water masses.

In order to investigate biodiversity patterns in Messolonghi lagoon macrobenthic communities were studied across a gradient of communication with the sea and across unvegetated and vegetated bottoms dominated by *Cymodocea nodosa* and *Valonia aegagropila*. The sampling periods include 2 seasons (i.e. winter and spring). Taxonomic diversity was studied throughout commonly employed diversity indices and functional diversity was accomplished by Biological Trait Analysis where feeding type, mobility, habitat modification and body size among other main traits were included. This study reports the highest biodiversity of macroinvertebrate fauna for a lagoonal environment in Greece, whereas vegetated areas supported a higher number of species and revealed also a higher functional diversity. Seawater influence and habitat type had the primary control in determining species richness and community structure in Messolonghi lagoon.

S3.2 Tool for assessing status of marine and coastal biodiversity - case study on brackish Gulf of Riga, NE Baltic Sea

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Tool for assessment of the status of marine and coastal biodiversity was developed in the framework of LIFE + MARMONT (Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea) project. Assessment of the status of marine and coastal biodiversity is required by several European and international legal instruments e.g. EU Marine Strategy Framework Directive (MSFD), EU Habitat Directive, HELCOM Baltic Sea Action Plan (BSAP) etc. At the same time, no methodologically sound and straightforward assessment scheme exists so far for the Baltic Sea area. Our approach was to develop the assessment scheme and practical tool following several general principles: 1) assessment scheme is based on set of biodiversity indicators covering different features and components of marine and coastal biodiversity; 2) assessment is done in one common software package enabling assessment results on indicator, biodiversity component and whole waterbody level; 3) assessment result is fully comparable and follows requirements of EU MSFD and HELCOM BSAP and could be used in national reporting process; 4) assessment result shows both actual status of biodiversity and level of pressures altering different components of marine and coastal biodiversity in the assessment area. Tool was tested in the Gulf of Riga project area and compared with traditional assessment methodology used so far in national and international (HELCOM) assessment procedures. Totally over 50 different indicators were used covering different aspects of marine and coastal biodiversity (marine habitats and landscapes, phyto- and zoobenthos, phyto- and zooplankton, fish communities, birds and mammals). Main methodological aspects and conditions of applicability of the Tool are presented and discussed. Possible directions for further development of similar tools are presented.

S3.3 Spatial scaling of phytoplankton biodiversity in lagoon ecosystems

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How biodiversity scales with space is a central goal in ecology. Patterns in the spatial distribution of organisms provide important clues about the underlying mechanisms that structure ecological communities and are central to setting conservation priorities. Although phytoplankton have crucial roles in biogeochemical cycling and ecosystem functioning, little is known about their biodiversity scaling relationships. Here, we discuss a pattern of phytoplankton diversity at global and local scales in lagoonal ecosystems. Phytoplankton samples were collected following a hierarchical sampling design in the Mediterranean, North Atlantic, South Atlantic, Indo-Pacific and Western Pacific areas. We found that phytoplankton shows i) a geographic pattern in biodiversity; ii) a decline in taxonomic similarity with increasing geographic distance; iii) a variation of community structure in function of habitat heterogeneity; iv) a negative taxa-area relationship. The presence of these patterns could be interpreted at different spatial scales as evolution or adaptive strategy of phytoplankton to survive in a given environmental condition.

S3.4 Spatial distribution of 3 resting cysts of Harmful Algal Bloom (HAB) species in Bizerta Harbor

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Studies of resting cysts in surface sediment were conducted in different quays of the Bizerta Harbor. The results indicated the presence of four cyst morphotypes of potentially toxic dinoflagellates among which three may induce Harmful Algal Blooms (HAB) namely *Alexandrium catenella*, *A. pseudogonaulax* and *L. machaerophorum*. The highest average cyst density (60.08 cysts g⁻¹ DS) was recorded for *A. catenella* with an important spatial distribution in Menzel Bourguiba quay area. *A. pseudogonyaulax* concentration was about 13.61 cysts g⁻¹ DS and *L. machaerophorum* reached a maximum abundance of 54.54 cysts g⁻¹ DS in the same area. The restricted hydrological nature of the harbor may particularly influence cyst distribution. Our results indicate the usefulness of cyst analysis in the assessment of the potential risk of HAB.



S3.5 Water quality and macrophytic assemblages' in different types of transitional water ecosystems in W. Greece (Mediterranean Sea)

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Coastal lagoons are a particular type of estuarine systems where seasonal fluctuations of salinity and temperature may present stressing conditions for many aquatic species, while the abiotic gradients may also influence the structure of biological communities. Submerged vegetation had a strong influence on the physical and chemical features of aquatic ecosystems. The presence and the recovery of submerged vegetation is one of the targets of the Water Framework Directive (WFD 2000) in order to achieve good ecological status of the European water bodies. In the present study, coastal lagoons of Western Greece, distinguished into three different types, were investigated seasonally, regarding the composition and abundance of macrophyte species and water quality parameters. A total of 38 submerged macrophytic species have been inventoried during the sampling campaign. The dominant species were the angiosperms *Zostera noltii*, *Ruppia cirrhosa*, *Cymodocea nodosa* and the Charophyte *Lamprothamnium papulosum*. The analysis revealed significant differences among lagoon types. Chocked lagoons were more impacted by anthropogenic activities showing higher nutrient concentrations. However, the degree of confinement and salinity played relative high role on species distribution. The chocked and more isolated lagoons with lower salinity had low species number dominated by the angiosperm *Zostera noltii* and the charophyte *Lamprothamnium papulosum*. However, into this type the average abundance of *Z. noltii* diminished and replaced by *R. cirrhosa* that proved to be a more adaptive and less sensitive species not only to high salinity variance but also to nitrogen concentrations. On the other hand, into restricted lagoons they were recorded submerged species typical of marine ecosystems, in which the angiosperms *Cymodocea nodosa* and *Ruppia cirrhosa* were forming dense mats in accordance with several epiphytes or opportunistic species.

S3.6 Testing the saprobity hypothesis in a Mediterranean lagoon using benthic communities

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For over a millennium, brackish-water bodies located between terrestrial, freshwater and marine habitat, known as transitional waters (TWs), focused human interests for providing several key ecosystem services: sheltered harbours for vessel traffic and commerce, fisheries and aquaculture resources, salt production, touristic and recreational areas, habitat and food for migratory and resident fauna. Their sharp heterogeneity at spatial and temporal scales is highlighted both within and among biotopes and lengthily discussed. On the other hand, the implication of homogeneity vs. heterogeneity patterns affect the management and governance of such ecosystems and moreover their conservation is a fundamental objective of the present EC Directives.

Various conceptual models have been proposed, comprehensive of the environmental heterogeneity and the biotic diversity patterns in such ecosystems. In this paper we analyzed taxonomic and habitat diversity within the Cabras lagoon, the largest brackish system in Sardinia and one of the most important wetlands along the Mediterranean coast. We focused on the macrobenthic community and associated physical and chemical variables (e.g. water residence time, salinity, dissolved oxygen, Chl-*a*, organic matter) at four sites representative of the different environmental features of the biotope. The roles of factors determining ecosystem heterogeneity were considered in the light of the concept of saprobity, determined by organic matter metabolism, recently suggested as a suitable selection factor for species diversity and a state descriptor for the natural conditions of coastal lagoons. A conceptual scheme summarizing community structure and habitat diversity along the gradients of the two main selective agents is proposed for the Cabras lagoon with an indication of the dominant species identified and assigned to different saprobic levels.

S3.7 Comparison of structural and functional stability of polychaete assemblages in coastal lagoons

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The loss of species is known to have a negative effect on ecosystem functioning, but detailed mechanisms of this relationship are still far from being fully understood. Several hypotheses have been proposed in the past to explain the functional response of ecosystems to species loss, but many studies still rely on using community structure as a surrogate for ecosystem functioning. This study investigates how the spatio-temporal distribution patterns of polychaetes and their associated functional patterns in six Mediterranean coastal lagoons change under simulated scenarios of species loss. The results show that each lagoon responds differently to potential species loss: in stressed lagoons with few dominating species the change of patterns is extremely variable and unpredictable, whereas lagoons characterised by complementarity seem to be more robust towards changes. The patterns between community structure and functioning in each lagoon show strong similarities in the lagoons dominated by few species, but the patterns diverge in complementary communities. The findings highlight the importance of considering the idiosyncratic effects of species loss on ecosystem function as well as the risk of using structural patterns as surrogates for functional patterns when taking decisions at a managerial level.

S3.8 Brackish-water polychaetes as good descriptors of environmental changes in space and time

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Benthic communities are the "biological memory" that means composition and changes in time and space of benthic assemblages are the resultant of complex interaction among multiple factors difficult to individuate and to measure. Among benthic organisms, polychaetes are one of the highly utilized groups in environmental monitoring. Species-sediment relationships and life-cycle



of the species give long trend information on global condition of the system, allowing causal interpretation of the observed biological structures.

Brackish-water biotopes represent a good opportunity to study factors influencing the distribution of species, because of the existence of sharp environmental gradients, moreover, brackish-water environments might be ideal models for assessing directional changes in the assemblages' structure. In fact, modifications requiring decades in more stable marine communities can happen in only a few years in transitional water environments.

In the present work we summarize results from studies carried out on polychaete assemblage from different biotopes along both Tyrrhenian (4 central coastal lakes) and Adriatic coast, (Acquatina lake), where species composition was used to identify patterns of distribution inside the same biotope and among different biotope, as well as changes in time in the same biotope. Polychaetes have proved good descriptors of different situations, including long trend changes due to the improvement of trophic conditions, and short trend changes of recovery after disturbance.

S3.9 Variation of phytoplankton densities in a coastal lagoon from south Mediterranean Sea

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Bizerta lagoon is located in northern Tunisia. Its surface is 150 km² and its depth reaches 12 m in the medium area. This lagoon is connected from one side to a fresh water lake (Ichkeul Lake) and from another side to the Mediterranean Sea through a 7 km length channel. Many activities are related to this lagoon: Industrial, shellfish farming, fishing and marine traffics. Study of the spatiotemporal fluctuations of phytoplankton density in four stations, located in in this lagoon, revealed the existence of two important autumnal peaks. The first reached 1 649 030 cel.l⁻¹ and occurred at the beginning of September, whereas the second was about 1 846 914 cel.l⁻¹ and occurred at the end of October. The average of phytoplankton densities oscillated between 8 940 and 560 732 cel.l⁻¹. Phytoplankton Taxa in this lagoon mainly belong to microplankton category represented principally by diatom and dinoflagellate species.

S3.10 Macrobenthic community in Klissova lagoon, Greece

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Benthic community was studied in Klissova lagoon, part of the biggest lagoon complex in Western Greece in two seasons (early winter and spring). The lagoon was covered by *Cymodocea nodosa* meadows, although their density and biomass differed among stations. In the inner part biomass was higher, while in the outer part the presence of algae (*Chondria capilaris*, *Cladophora* sp., *Chondrophycus patentirameus* etc.) was more evident. Salinity and temperature did not present large spatial variation within the lagoon, whereas oxygen concentrations were enhanced by the presence of *C. nodosa* meadows. Community structure and functional trait analysis were studied. Benthic assemblages in *Cymodocea* meadows were characterised by high species richness and abundance. Preliminary results showed that species richness increased towards marine communication. The dominant taxa were *Microdeutopus gryllotalpa*, *Ericthonius difformis*, *Pettiboneia urciensis* and *Oligochaeta* sp. in the outer stations, while *Chironomidae* sp., *Microdeutopus gryllotalpa*, *Ericthonius difformis*, *Abra segmentum* and *Spirorbis corrugatus* dominated the inner part of the lagoon. Functional analysis showed a more diverse community than that in previous studies in Mediterranean lagoons, due to the higher habitat complexity and good water circulation.

S3.11 The low basin of the Arno River (Tuscany, Italy) as hot spot of alien species introductions: new data on *Limnoperna securis* (Bivalvia, Mytilidae) and *Rhithropanopeus harrisii* (Crustacea, Panopeidae)

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The low basin of the Arno River is characterized by several canals that are interconnected and in proximity of the Livorno harbour. This area can be considered a hot spot of alien species introductions. In fact, a number of brackish-water species (the bivalves *Arcuatula senhousia*, *Limnoperna securis*, the crustaceans *Procambarus clarkii*, *Rhithropanopeus harrisii*) and marine species (the bivalves *Fulvia fragilis*, *Theora lubrica*, the crustacean *Portunus segnis*) have been observed.

Here we focus on two brackish-water species, the pigmy mussel *Limnoperna securis* and the Harris' mud crab *Rhithropanopeus harrisii*. The current distribution of *L. securis* in the canals between the Arno River and the harbour of Livorno is updated, and a number of individuals collected in six sites were characterized with a molecular and morphological approach.

R. harrisii, previously known in the Italian Seas only for the Northern Adriatic Sea, is reported



for the first time in coastal environments of the Ligurian basin. Its distribution in the Arno River canalization has been investigated, and in summer 2013 both ovigerous females and recruits were found. The species, considered as highly invasive, appears to be established in the study area, and, due to its tolerance to low salinity values (~ 4 PSU), may also represent a danger for a high number of environments.

S3.12 Population dynamics of two scyphomedusae species, *Aurelia* sp. and *Phyllorhiza punctata* in Bizerte lagoon and their trophic impact on the zooplankton community

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Among the five scyphomedusae species recorded in Bizerte lagoon (*Aurelia* sp., *Pelagia noctiluca*, *Rhizostoma pulmo*, *Cothylorhiza tuberculata* and *Phyllorhiza punctata*), the population dynamics of *Aurelia* sp. and *Phyllorhiza punctata* have been investigated from February to December 2012. *Aurelia* sp. blooms from March to mid-May, followed by the lessepsian migrant, *P. punctata*, (new record for Tunisian coastal waters), which extends from August to November. In their peak periods, both species reach a maximum abundance of 4.87 ind.m^{-3} and 0.04 ind.m^{-3} respectively. Temperature and salinity turns to be the most important hydrologic parameters that control jellyfish dynamics. While *Aurelia* sp. jellyfish population is associated to cold water (average surface temperature: $16.1 \pm 1.6^\circ\text{C}$) and low salinity (25.8 ± 1.7), *P. punctata* has a strong affinity to warmer water ($25.2 \pm 2.1^\circ\text{C}$) and higher salinity (37.5 ± 0.1). These two species are carnivorous and their predatory impact may have different effects on the zooplankton community of Bizerte lagoon, which reaches an average abundance of $4392 \pm 1257 \text{ ind.m}^{-3}$ in spring months and $1082 \pm 309 \text{ ind.m}^{-3}$ in the summer season, when *P. punctata* is encountered

A preliminary study on scyphomedusae predatory impact was performed on *Aurelia* sp. and will be performed on *P. punctata* during 2013 summer. Gut content analysis reveal great prey diversity, dominant prey being mostly represented by veliger larvae, copepods and tintinnids. An estimate of *Aurelia* sp. predatory impact based on scyphomedusae and mesozooplankton abundances showed that only 1 % of the mollusk larvae standing stock was eaten per day, and that the predatory



pressure did not exceed 0.06% of copepods standing stock eaten per day.

Overall, although *Aurelia* sp. was more abundant than *P. punctata*, its trophic impact on the zooplankton community seems to be quite limited.

S3.13 Taxonomy, distribution and adaptive strategies of the sponge fauna from lagoon systems of the Italian coast

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Mediterranean lagoons host a rich and diversified benthic fauna associated with hard substrates that has long been neglected by researchers of benthic bionomy. The present work focused on the taxonomic composition, spatial and temporal distribution of the sponge fauna from some Italian lagoon systems: Marsala (TP), Marinello, Ganzirri and Faro (ME), Fusaro (NA), Lesina and Varano (FG), Alimini (LE), Taranto and Venice.

All the basins considered hosted sponges, though wide differences in species richness and abundance occurred: lagoons with larger seawater inlets (Marsala, Taranto, Venice) harboured a very rich and diversified sponge fauna, while more confined basins (Marinello, Lesina, Varano) generally hosted a few sponge species, often with high abundance values.

Overall, 97 sponge species were recorded, 86.6% represented by demosponges. Only 3 species (*Hymeniacidon perlevis*, *Halichondria (Halichondria) bowerbanki* and *H. (H.) panicea*) occurred in more than 50% of the lagoons, while 18 were present in 30% of them. However, the majority of species (51) could be considered occasional, being present only in one of the basins studied. However, the comparison between present data and literature records shows that sponge assemblages from the studied basins are quite persistent.

Salinity appeared to be the main ecological factor responsible for the distribution of sponges within the basins. No sponges were found in waters with salinity values lower than 170. Seasonally, anoxia cases could result in local die-offs in the deeper layers of some lagoon systems. Differently from what occurs in open shallow waters, in lagoon environments several sponge species used to live in association with macroalgae, often utilized as substrate or as a filter against the intense light. Further defenses against excessive lighting were the development of a simbiocortex or living partially buried in the sediment. The ability to colonize soft bottoms is common to several demosponges displaying different morphological adaptations.



S3.14 Role of environmental variables and heavy metal contamination in affecting diatom diversity in Adriatic transitional ecosystems

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In shallow ecosystems, in absence of macrophytes, benthic diatoms may play a key role for the food chain and in stabilizing surface sediments. To describe community diversity, dynamics and the interactions with planktonic diatoms, water and surface sediment samples (1 cm top-layer) were collected in almost 240 sites and cell abundance and taxonomic composition by means of conventional light microscopy were determined. Most of the observations were done in the Venice lagoon but surveys were also carried out in Grado-Marano, Goro and Lesina lagoons. Physico-chemical parameters and nutrient concentrations in water and sediments were measured in all sites; moreover, data on heavy metal concentrations were available for 25 sites.

This study focuses particular attention to planktonic and benthic diatom diversity and to the factors affecting it. 128 and 133 taxonomic entities were identified in the water column and in surface sediments, respectively. The highest number of species was represented by pennate diatoms, whereas centric diatoms were often the most abundant. The number of taxa (2+23 in water; 4+25 in sediments) and the species richness (0.11+1.95 in water; 0.23+1.72 in sediments) varied significantly site by site. Seasonal trends were quite different if planktonic and benthic diatoms were compared: the former had significant seasonal fluctuations, whereas the latter tended to be more stable without a clear seasonal pattern. Planktonic contribute to the diversity of benthic community resulted negligible, but the contrary seemed more significant probably due to sediment resuspension, and a large taxonomic distinctness was observed in the water.

Both planktonic and benthic diatom spatial diversity was positively correlated with light availability and negatively with nutrient concentrations. Benthic diatom taxonomic composition depended also on sediment grain size and heavy metal concentrations. In particular, Cadmium, Cobalt, Chromium, Nickel and Zinc were found to have a significant negative effect on diversity.

S3.15 Correlation of genetic diversity patterns from polychaete populations to environmental data from lagoonal ecosystems

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Coastal lagoons are dynamic ecosystems characterized by vigorously changing temporal and spatial conditions. They are an intriguing field for the study of genetic adaptations and community behavior as they are characterized by stressful environmental conditions due to both natural and anthropogenic influence. In these ecosystems, a small number of species is able to tolerate these conditions. Polychaetes were one of the most abundant taxa in the lagoonal complex of Amvrakikos Gulf (W Greece). Genetic diversity inferred from COT gene of polychaete populations was found to be relatively high. The current study attempts to correlate genetic diversity patterns to the patterns of environmental data from each lagoonal system.

S3.16 Nematodes diversity and coastal lagoons connectivity

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Free-living nematodes are the most abundant metazoans on Earth with a huge taxonomic diversity. They occur literally everywhere, from poles to tropics. The mouth dynamics of coastal lagoons play a key role in their overall functioning. Intermittent breaching of coastal lagoons mouth may lead to remarkable changes in their physico-chemical environment over short time periods, which in turn triggers major biological responses. On contrary, permanently open or closed are relatively more stable over the time, though unpredictable and fast changes in the water column may also occur. The presence of a connection between the lagoon and the sea is also important because it determines the degree of connectivity among their populations with other adjacent areas. Therefore we can hypothesize that permanently open coastal lagoons have a higher degree of connectivity, ensuring gene flow of cosmopolitan species, while closed or temporary opened lagoons will have a higher degree of endemism. So, higher degree of connectivity has been predicted to result in homogenization of local communities and dominance of the regionally superior competitor in all local communities. In this study we analyzed the relationship between coastal lagoons and ocean connectivity and genera diversity of nematodes. Twenty coastal lagoons (permanently open, closed or temporarily closed) were sampled (360 samples) along 400 km of the southern Brazil coastline. One hundred and twelve genera of nematodes were record - 90 in the open, 60 in the temporarily closed and 21 in closed lagoons. Densities varied significantly, with higher values in open and temporarily closed (mean of 680 inds.10cm⁻²) than closed lagoon (only 34 inds.10cm⁻²). Multivariate dispersion index showed higher values for nematode samples



from permanently open lagoons and lower for permanently closed. Our results suggested that due to higher environmental heterogeneity within open lagoons higher connectivity may not result homogenization of nematodes assemblages.

S3.17 Internal measures to manage eutrophication in lagoons: Mussel farming in the Oder (Szczecin) Lagoon in the southern Baltic

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The Oder Lagoon in the southern Baltic is a heavily eutrophicated and degraded coastal ecosystem. Our model simulations suggest that external nutrient load reductions in the river basin alone seem insufficient to reach a good water quality in the lagoon. A comprehensive eutrophication management approach should also include internal nutrient retention and removal measures in the lagoon. Several measures will be briefly presented. Most promising is mussel farming using the Zebra mussel (*Dreissena polymorpha*), because they are efficient in removing nutrients and improving water transparency in the lagoon. The present state of farming and a cost-effectiveness analysis will be presented. For this purpose, the 3D ecosystem model ERGOM is extended by a mussel module and an economic model. The economic model describes costs and benefits of mussel cultivation depending on the farm size. We included additional potential sources of income such as water quality tax. The model simulations show that mussel farming in the lagoon is a suitable supportive and, at a load reduction target of 50% and more, a cost-efficient measure to remove nutrients and to implement the Water Framework Directive and the Baltic Sea Action Plan. However, in the Oder Lagoon, mussel farming could potentially remove only about 1000 t N (70 t P) per year or about 2% of the present N and P load but has the additional benefit of improving water transparency. Possibilities and limits will be critically evaluated.

S3.18 Dinoflagellate cyst assemblages in surface sediments from three shallow Mediterranean lagoons (Sardinia, North Western Mediterranean Sea)

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The present study identified and quantified dinoflagellate cysts in surface sediments from three Mediterranean lagoons. Sediment samples were recovered from 11 stations in May 2009 at Cabras Lagoon, eight stations in May 2010 at Corru S'Ittiri Lagoon, and five stations in May 2011 at Santa Giusta Lagoon. Fifty-three dinoflagellate cyst morphotypes were identified. Sixteen species represent first reports for the lagoons, and two are new records for the Mediterranean Sea. Moreover, a new *Scrippsiella* species was discovered in Cabras. Seven harmful algal species were identified, primarily belonging to the potentially toxic genus *Alexandrium*. Total cyst abundance, number of morphotypes, and assemblages varied among lagoons, and a degree of heterogeneity was also detected within lagoon. In addition, each lagoon showed a distinct morphotype composition. Cabras and Santa Giusta cyst assemblages were characterised by morphotypes belonging to the autotrophic genus *Scrippsiella*, whereas Corru S'Ittiri assemblages showed dominance of heterotrophic morphotypes, including *Protoperidinium cf. tricingulatum*. Differentiation among lagoons was also evident according to environmental conditions. Salinity proved to be a fundamental variable in determining total cyst abundance, morphotype number and composition. This study was among the first to examine dinoflagellate cyst composition in coastal lagoons, especially from the Mediterranean region, and contributed data that increased our knowledge of cyst-producing dinoflagellates in these environments.

S3.19 Multiplicity of alternative steady states of ecosystems and social-environmental management: case of the Crimean hypersaline lagoons

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Lagoons are common, occurring along nearly 15 percent of the world's shorelines. They are among the most valuable for humanity components of coastal zones. Increasing of changes of lagoon ecosystems is a global threat to human life, livelihoods and natural life-supporting systems. It generates a lot of biological & ecological risks. One of main reasons of such situation is an inadequate management of our activities, which effectively multiplies these risks. Reasonableness of our environmental management is determined primarily by how our concepts are adequately to the physical world around us in its variability. There are two conceptual views on ecosystem. Main paradigm in modern ecology - The Concept of sustainable quasi-stationary ecosystem: Mature ecosystems are stable and in dynamic equilibrium. They fluctuate around alone point of equilibrium. All changes are within the framework of one norm of reaction. But really every ecosystem as well as every complicated integrated system has several alternative stable states - The Concept of multiplicity of alternative stable states of ecosystem. There are a lot of hypersaline closed



lagoons in the Crimea (Black Sea). Our long-term study shows that every lagoon ecosystem can be in several alternative sustainable states. In different alternative states the different ecological-physiological groups of the primary producers play leading role as well as different animal compositions. Salinity is a main but not alone a driving factor. In different year in same lagoon under same salinity we can find different alternative steady states. There is an effect of hysteresis in ecosystem changes. Objectives of management in such case should be: foresight when system to reach a tipping point, estimate of transition probabilities in one of the new alternative stable states, to identify the spectrum of possible alternative states, developing a set of possible socio - economic adaptation strategies in the new environment to flexible use.



Session Topic 4. RESILIENCE TO DISTURBANCES AND PERTURBATIONS

S4.1 12 years of eutrophication monitoring on French lagoons (Languedoc-Roussillon, France): relevance of an assessment tool to highlight restoration paths

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The Lagoon Monitoring Network (LMN) is operated since 2000 in order to assess the eutrophication level of 25 lagoons in the Languedoc-Roussillon (Gulf of Lion, France). It provides informations to guide management decisions on the watershed to improve lagoon quality. The eutrophication diagnosis is based on the monitoring of the water column, phytoplankton, macrophytes and sediments. After 12 years of monitoring, an analysis of the data collected was performed to evaluate the relevance of the parameters monitored and the quality assessment grid. It led to validate the diagnostic tool (summer monitoring, sampling strategy), with some changes on the parameters and quality grid thresholds. Moreover, a statistical analysis of data collected in the water column (nutrients, phytoplankton) validated the use of multivariate statistical methods (PCA, MFA) to highlight temporal trajectories of lagoon regarding eutrophication level. The example of Palavasian lagoons water quality improvement following the disconnection of Montpellier waste water treatment plant in 2005 is illustrated by the statistical analysis. However, results of the monitorings on macrophytes and sediments show that ecosystem restoration will take time for these lagoons. Further analyses are conducted to disentangle the effect of weather conditions (temperature, rainfall) and of works implemented on the watershed.



S4.2 Occurrence of *Trichodesmium erythraeum* Blooms in Northeastern Brazilian Coastal Waters

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This study reports two events of high density blooms caused by the cyanobacterium *Trichodesmium erythraeum* in areas of oligotrophic waters (Chlorophyll-*a* < 2 µg.L⁻¹) at the northeastern Brazilian coast at latitude ~05° to 06°. We also aimed to provide a detailed description of the morphotype of *T. erythraeum* found during the blooms events in order to contribute to the knowledge of the diversity of *Trichodesmium* phenotypes in the South Atlantic. The thickest recorded bloom of *T. erythraeum* reached around 137x10³ filaments mL⁻¹ (16 x 10⁶ cells mL⁻¹) on September 2002, covering an area of 20 Km along the shoreline at Tibau do Sul beach (06°12'S and 35°06'W). Unusual shrimp mortality at the shrimp farms were reported simultaneously to the bloom occurrence. On December 2006 another bloom was recorded along Maracajau beach shoreline (5°24'S; 35°17' W) where density was found to be 13.4 x 10³ trichomes mL⁻¹ (15 x 10⁵ cells mL⁻¹). Local fisherman reported this phenomenon eventually to occur at Maracajau waters where it is locally known as 'tobacco', referring to the surface water aggregation viewed as dark red-brown-colored patches. We also performed a survey on year 2012 which revealed that *Trichodesmium* filaments are rare or absent in surface water sampled at non-bloom period at latitude ~05° to 06° along the Brazilian coast. Although *Trichodesmium* populations have been reported to occur at high abundances only between the equator and ~15°N the present report highlight the need to monitor South American Atlantic coast in order to better understand *Trichodesmium* population dynamics. At regional level *Trichodesmium* blooms may have negative impacts on the shrimp and tourism industries in northeastern Brazil. At a global level *Trichodesmium* biomass in the western South Atlantic should be carefully evaluated in order to better estimate the role of this cyanobacterium on global carbon and nitrogen budgets.

S4.3 Hydrodynamics and eutrophication modeling of the Berre Lagoon (France): a tool to identify rehabilitation strategies

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The Berre lagoon is one of the biggest Mediterranean lagoons. It receives freshwater from two anthropised rivers and a hydroelectric power plant. As a consequence, it became unstable, showing considerable salinity drop and variations (2 to 30 p.s.u.) and eutrophication. An in situ continuous monitoring of the lagoon has been set up: CTD, chlorophyll and oxygen probes have been installed at 10 stations. Thanks to these measurements, a 3D hydrodynamic model (TELEMAC) has been developed and validated to better qualify and quantify the relationships between the salinity of the lagoon, the fresh water inputs, the water exchanges with the sea and the wind mixing. Then, a biogeochemical model (DelWAQ) was chained with the hydrodynamic model to understand the ecosystem functioning and to assess the hydroelectric powerplant involvement implication in the eutrophication of the lagoon. The model was calibrated for two years (2005 and 2006) and validated with a 13 years simulation (1998-2010). It is able to reproduce seasonal and interannual variations of the biogeochemical processes and variables observed in situ. Chlorophyll concentrations decreased from 1998 to 2010: according to the model, phytoplanktonic Chlorophyll/C ratios decreased as a consequence of the better light penetration in the water column and of increasing phosphorus limitation. Primary production remains very active, fed by nutrients from autochthonous organic matter mineralization. Ulvae biomass is at least 100 times less than the phytoplanktonic biomass (on a daily scale): this means that macroalgae are not a significant nutrients reservoir. Only a program of regular extractions of ulvae over a long period would be effective on the internal nutrients stock. Sensitivity tests show that the phytoplankton biomass decreased significantly when allochthonous P is reduced, or when allochthonous N is at least halved. Only a reduction of both N and P would decrease phytoplankton biomass and also maintain the diversity of the community. Works are still in progress in order to improve the representation of current speed in the lagoon, the water time residence and the benthic compartment.

S4.4 Effects of marine acidification on net primary production of seagrass *Zostera marina* in the shallow coastal brackish water ecosystem

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Seagrasses are distributed across the globe and their communities play several key roles in the coastal ecosystems while their response to marine acidification and climate change is not well understood yet. In the brackish Baltic Sea seagrass *Zostera marina* is one of the most abundant macrophytes on exposed sandy bottoms and is regarded as a key species of this habitat. The main aim of current study was to clarify how acidification, induced by elevated atmospheric carbon dioxide,



possibly affects the physiology and performance of macrophytes. This was done by measuring photosynthetic net production of seagrass *Zostera marina* in mesocosms with manipulated levels of $p\text{CO}_2$. The second objective examined the short-term variability of $p\text{CO}_2$, pH, alkalinity, and oxygen saturation in shallow-water benthic habitats and evaluated the importance of high pH/low CO_2 for seagrass photosynthesis. The field experiments were conducted in the shallow, semi-enclosed, brackish water Koiguste Bay (northern part of Gulf of Riga, the Baltic Sea) during the field season of 2013. Separate mesocosms were operated with different CO_2 concentrations. As a response variable - photosynthetic activity was measured by the oxygen method. Preliminary results showed that increased CO_2 levels in seawater favoured photosynthetic activity of the seagrass *Zostera marina*. In shallow coastal brackish-water conditions the daily pH and CO_2 is characterized by natural variability of large amplitude. Daily pH and CO_2 changes in shallow water with high macrophyte densities may be of a larger magnitude than those predicted due to ocean acidification over the next 100 years.

S4.5 Response of zooplankton to a prolonged HAB event in Papas Lagoon (W Greece)

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This study describes the response of zooplankton community in Papas lagoon (W Greece), during a prolonged bloom of toxic dinoflagellates (e.g. *Akashiwo Sanguinea*, *Karenina mikimotoi*, *Alexandrium minutum*, *Prorocentrum minimum*). Abundances of holoplankton, meroplankton, microzooplankton, and phytoplankton were determined as well as temperature, salinity, dissolved oxygen and chl_a concentrations before, during and after the toxic bloom (from May to November 2012). Total mesozooplankton, collected with a 90 μm net, was more abundant at the western part of the lagoon and peaked 2 months prior (May: 89 750 ind. m^{-3}) and 4 months after (November: 99 800 ind. m^{-3}) the harmful algae bloom (HAB). The bloom was initiated at the eastern part of the lagoon at the end of June and spread out westwards, covering the whole lagoon area by mid July. It resulted in anoxic conditions and extensive fish mortalities with financial implications for the fishing cooperative in the region. During the bloom abundances of all zooplankton groups drastically declined (78 ind. m^{-3}). The first to demonstrate signs of recovery were ciliates in late July followed by rotifers in August and mesozooplankton in September at the western part of the lagoon when oxygen reached favourable levels (8 ppm). Multivariate analysis (nMDS) clearly distinguished three assemblages: a) a bloom assemblage, b) a before and after bloom assemblage and



c) a fully recovered assemblage. Spatial patterns and temporal trends in zooplankton distribution suggest that wind direction, chl_a, salinity and temperature regimes are important driving factors in the composition and abundance of zooplankton in Papas lagoon.

S4.6 Passive samplers as a useful tool to better characterize the water chemical contamination of French Mediterranean coastal lagoons

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There is a growing awareness that chemical contamination may cause perturbation of ecosystem functioning in coastal lagoons, but actual data of contaminant levels are scarce. A preliminary large-scale study of the French Mediterranean coastal waters using passive samplers in 2008 showed higher contamination levels of pesticides and pharmaceuticals in the few lagoons sampled (Thau and Berre lagoons in particular) in comparison with coastal marine waters.

The PEPS-LAG project, supported by the French Water Agency in 2010, was focused specifically on the contamination in French Mediterranean coastal lagoons. The aim of this project was to realize a first comprehensive assessment of the dissolved chemical contamination of these lagoons, and to confirm the usefulness of passive samplers for sampling contaminants present at trace levels.

Twenty-three transitional lagoons water-bodies were investigated along the French Mediterranean coast, using three kinds of passive samplers (DGT, POCTS and SBSE) in order to have a holistic representation of the water contamination. So, 141 contaminants from various chemical families (trace metals, pesticides, pharmaceuticals, alkylphenols, PAHs, PCBs..) were searched and their concentrations compared to their Environmental Quality Standard (EQS) when existing.

With passive sampling techniques used, concentrations of many contaminants have been detected and measured in their "dissolved" forms, even at trace levels, which are generally difficult to quantify with classical methods, especially in marine and coastal waters.

Among usual contaminants detected, many did not exceed their EQS (when existing). Nevertheless, most water bodies have been considered in a bad chemical quality according to WFD (WFD, 2000/60/CE), because of some insecticides and trace metals, highlighting the great anthropogenic pressure affecting transitional water bodies like lagoons. Passive samplers could clearly help to better characterize the real exposure of marine organisms to complex mixtures of contaminants present at low concentrations.



S4.7 Impact of sediment resuspension on the phytoplankton structure and productivity in the human-impacted lagoon of Bizerte (Tunisia, Mediterranean Sea)

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We investigated the combined effects on a natural lagoon phytoplankton community of the chemical contaminants and nutrients released into the water column from the sediment during sediment resuspension. Our study was carried out using an in situ microcosm experiment in the anthropized lagoon of Bizerte (north Tunisia, Mediterranean Sea). Phytoplankton was exposed to sediment elutriates (untreated: E; and sterilized: SE) prepared from a sediment resuspension simulation process, and its structural and functional responses were evaluated for 4 days and compared with controls. The elutriate additions induced an enrichment of the water with contaminants (mix of metals and PAHs) and nutrients (NO^- , NH^+ , PO_3^- , $\text{Si}(\text{OH})$). The resulting 2444 contaminant enrichment was similar in both elutriate treatments, but the nutrient enrichment was slightly higher in the SE treatment than in the E treatment. Both elutriates strongly stimulated phytoplankton growth. At the end of the experiment the Chl *a* concentrations were twice and three times higher in the E and SE microcosms than in controls. Both elutriates also induced slight shifts in the phytoplankton composition. Diatom species appeared particularly sensitive, their contribution to total phytoplankton decreasing after elutriate exposure. Both elutriates stimulated the net primary production after 24 h and 48 h of exposure for SE and E. These findings suggest that in anthropized lagoon ecosystems sediment resuspension events may have significant effects on the dynamics of phytoplankton communities, and hence on carbon transfer towards the upper trophic levels.

S4.8 Long term observations on *Chattonella subsalsa* (Raphidophyceae) blooms and related environmental conditions in a Mediterranean lagoon (Santa Giusta Lagoon, Sardinia, Italy)

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Chattonella Biecheler (Raphidophyceae) exhibits a worldwide distribution, and includes



deleterious species causing fish kills in natural environments and aquaculture systems, with very important ecological damage and economic losses in different areas of the planet. Since the mid- 1990s, Santa Giusta Lagoon (Sardinia Island, Italy, Western Mediterranean Sea), one of the Italian Long Term Ecological Research network stations has suffered *Chattonella* blooms, associated with fish kills. During the blooms, difficulties in the taxonomic determination of *Chattonella* species with traditional light microscopy methods had not permitted definitive classification of *Chattonella* at the species level due to the species pleomorphology, and loss of morphological characteristics in fixed samples. Recently, the application of molecular methods on fixed samples taken during the blooms allowed us the identification of *C. subsalsa* Biecheler. This species exhibits relatively recent history as a harmful species. Data on *C. subsalsa* is scarce, in particular many knowledge on its ecology, life cycle and fish-killing mechanisms have yet to be obtained. Pluriannual ecological data (1990-2012) from Santa Giusta Lagoon were analysed to evaluate environmental conditions favouring the blooms. Moreover, the presence of resting cysts in the sediments was investigated. *C. subsalsa* blooms (density > 1.5 x 10⁶ cells l⁻¹) were observed in 1994, 1998, 1999 and 2010. These events always coincided with massive fish deaths. *C. subsalsa* cell densities showed a significant positive correlations with temperature and salinity. Correlations with nutrients were less clear, probably for the high availability of nutrients in the lagoon. However the increase in ammonia seems to be an important factor in influencing *C. subsalsa* dynamic. The presence of resting cysts in the sediments was confirmed by their germination, implying an inner source of inoculum for future blooms. The study contributes to the knowledge on *C. subsalsa*, providing valuable ecological data from the field.

S4.9 Long term dynamics of ichthyoplankton-jellyfish relationships in a coastal lagoon: who control the system?

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Coastal lagoons are complex ecosystems that in recent years are changing our concept of how naturally stressed and transitional aquatic ecosystems function in response to human impacts and climate change. Faced with the traditional assumption of being environmentally and bottom-up controlled systems, they seem to have complex trophic and population dynamic mechanisms that contribute to an efficient homeostatic regulation of the food web to prevent eutrophication consequences. In the Mar Menor lagoon, a long term study, from 1997 to 2012, of the relationships between ichthyoplankton-jellyfish and chlorophyll shows that these mechanisms are far to be simple and predictable.



S4.10 First steps of the Mediterranean lagoon restoration process: shifts in phytoplankton communities

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Located along the French Mediterranean coast, eight lagoons close to Montpellier have received effluents from the sewage treatment plant of this urban agglomeration (350 000 inhabitants) during several decades until the end of 2005. Since 2001, these 8 lagoons are monitored each summer (June, July and August) based on physical, chemical and biological (phytoplankton) parameters of the water column. They display a wide trophic gradient, from mesotrophy to hypertrophy. At the onset of monitoring, summer phytoplankton biomass peaked at 20 to 413 $\mu\text{g/l}$ Chlorophyll a (Chl a), depending on lagoons. In December 2005, the implementation of a 10 km oulfall system diverted secondarily treated waters from the sewage treatment plant of the Montpellier district, leading to a major decrease of the nutrient inputs (over 60%). This major change has coincided with an additional decrease of nutrient inputs from the watersheds during 4 consecutive dry years. Eutrophication-related water variables (total nitrogen (In), total phosphorus (TP) and Chl a) were used to assess whether these events have resulted in an improvement in lagoon quality. Seven years after the implementation of the oulfall, summer concentrations have significantly decreased: by factors of 1.1 to 4.1 for In and TP, and by factors of 3.0 to 47.5 for Chl a, depending on lagoons. Although no significant emerging trend was observed in water nutrient concentrations, the structure of phytoplankton communities has shifted in terms of abundances, pigment composition and taxonomic diversity. The decrease of Chl a was concomitant with significant decreases of picoeukaryotes abundances and diatom pigment markers, and with an increase in dinoflagellate pigment markers. Moreover, strong differences are observed in the phytoplankton community structure between the 8 lagoons, suggesting that the initial trophic status of coastal lagoons could partly drive the shifts of phytoplankton communities during the restoration process.



Session Topic 5. CONSERVATION AND MANAGEMENT OF COASTAL LAGOONS

Invited speaker

Managing conflict - it is good to talk but better to act John M. Baxter

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The Dornoch Firth is an estuary on the north-east coast of Scotland that empties into the Moray Firth, a large marine inlet. The whole area is very rich in wildlife and is recognised through various national and international designations. The Moray Firth is a Special Area of Conservation (designated under the EU habitats Directive) for its bottlenose dolphin population and sandbanks slightly covered by seawater at all times. The Dornoch Firth and Morrich More SAC is designated for its harbour seal population, and its estuarine and coastal dune features. There are also a number of rivers that empty into the area designated for their Atlantic salmon interests as well as their otter populations, and a number of Special Protection Areas designated under the Birds Directive for the piscivorous birds.

In the late 1990s there were concerns about the decline in harbour seal numbers both in the Dornoch Firth SAC and the wider Moray Firth, largely as a result of shooting by fishery managers to control the predation of salmon by the seals. The initial solution was to impose a Conservation Order making it illegal to shoot seals except under licence but illegal shooting continued and the numbers of seals continued to decline. The challenge was to find a balance between predator control for fishery management and providing adequate protection to ensure that favourable condition was achieved.

Lack of trust between the different parties (fishery managers, conservationists, government advisers, scientists, and government officials), lack of mutual understanding of the different parties aims, a lack of any common objectives were all barriers to finding a solution.

The solution was eventually found as a result of a 'champion' taking on the challenge of getting all the different parties together to talk, build trust, identify common goals and take the necessary action. The result was the development of the Moray Firth Seal Management Plan that has seen the level of shooting of seals being greatly reduced, more considered targeting of 'problem' seals and a reduction in seal predation of salmon. As a result of this experience there have been changes to national seal conservation legislation and more recently the desire to develop an even more comprehensive Moray Firth Predator Management Plan to consider how to deal with other salmon predators such as piscivorous birds.



S5.1 Assessment and conservation of goods and services provided by biodiversity in coastal lagoons

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The European Commission proposed in 2011 a common strategy on biodiversity which seeks to avoid its deterioration and claim it as one of the main basis for sustainable economic development. Beyond this, the Commission-sponsored project on The Economics of Ecosystems and Biodiversity (TEEB) recommends that the economic value of biodiversity and ecosystems be factored into public and private decision making and reflected in accounting and reporting systems.

Coastal lagoons (that occupy 13% of the world coastline) are among the marine habitats showing the highest biological productivity. Their physiographic and ecological features supply many goods and services for humans, and at present they are considered a key factor in many regional development plans since they provide key tourist and recreational services and maintain important fisheries.

The Mar Menor is a hypersaline lagoon located in the SE of Spain. It has an area of 135 km² with a mean and maximum depth of 3.6 m and 7.0 m, being one of the most important coastal lagoons of the Mediterranean. It supports, as many others lagoons all over the world, a wide range of uses that have led, despite the efforts for its conservation, to great changes in recent decades with a detrimental impact on its assemblage structure and dynamics. Some of these changes are the result of coastal works to develop tourism facilities (land reclamation, the opening, deepening or extension of channels, urban development and associated wastes, marinas, artificial beaches, etc.), while others are related with agricultural practices in the watershed.

In this work we present a first assessment of the lagoon ecosystem value made from more than 300 surveys to different stakeholder sectors. This socioeconomic study has been performed in February-July 2013, based on a contingent valuation that deals with lagoon environment services and human activities, their quality and economic value.

S5.2 DPSIR revisited for Eutrophication in coastal lagoons

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Lagoons are valuable social ecological systems (SES) in the coastal zone. Several frameworks are



used in the analysis of SES such as the System Approach Framework (SAF), the Ostrom framework and the DPSIR framework. The DPSIR framework has a long track history and has been applied by organizations such as OECD, UNEP and EEA. However, problems with terminology continue to hamper understanding and use of the framework. A new interpretation of DPSIR is proposed that clarifies some of the issues. In particular, this approach clarifies the nature of the arrows linking the DPSIR boxes. The revised version is tested for the analysis of eutrophication in lagoons.

S5.3 The effects of the integrated Monitoring Program in managing the lowest environmental impact during large civil works at the Venice lagoon inlets

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The actions for the defence against flooding of all the settlements of the lagoon are the core of Venice lagoon safeguarding. This requires the execution of wide engineering works (MoSE) in environmentally precious and fragile coastal areas: the Venice lagoon has been classified as SPA (Directive 79/409/EEC) since 2007, and it includes some Sites of Community Importance areas (according to Directive 92/43/EEC), very close to the work sites. The "Ministero delle Infrastrutture e dei Trasporti Magistrato alle Acque di Venezia" (Venice Water Authority) entrusted CORILA to perform a wide and integrated monitoring program about the environmental and socio-economic effects of the MOSE work yards.

The Monitoring Plan, started together with the construction works in 2004, defined the list of parameters of concern. Appropriate thresholds have been stated on the basis of historical measurements and a dedicated modeling activity, where the legislation did not offer precise indications. The ecological disturbance was carefully studied considering also the possible cumulative effects of a 10 years long work activity. The going on Monitoring Plan consists in both real time monitoring and investigation surveys.

"To monitor" is not only "to measure"; on the contrary, this Monitoring Program includes possible suggestions in order to limit the pressures of the works, the careful examination of the mitigation action performed at the yards and the possible suggestions for compensation, when necessary. So, over the years, an effective feedback procedure between the monitoring researchers and the operators in the MoSE's yards has been implemented, in accordance with Public Administrations. The MoSE project is probably the largest civil work occurred in a lagoon and the Monitoring Programme is probably one of the largest ever occurred in such an environment. The achieved experience can identify some general rules to be applied elsewhere.



S5.4 Efficiency and consequences of the existing protection context of the Hellenic lagoons

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Despite the international, national and regional protection context an integrated study of 76 Hellenic lagoons, based on the fisheries exploitation, revealed that the overall environmental quality was higher in lagoons with well organised fisheries. In addition to the strong economic, social and cultural contribution of the fishing cooperatives they seem resisting to the numerous pressures downgrading the lagoon ecosystems. Since 2006 the technical measures for the Mediterranean fisheries impose new limitations to the lagoon fisheries. In addition, the measures for the restoration of the European eel, the leasing cost and the decreasing fish prices reduce the viability of the lagoon fisheries. At least half of the jobs disappeared with obvious social and environmental consequences.

The Hellenic lagoons receive pressures from activities carried out far from them. Two striking examples illustrate the fact: The first concerns the rapid changes in the geomorphology of the lagoons due to the modification of the main river characteristics (dams, trajectories). The consequences consist of continuous empirical backfilling actions to maintain the integrity of the offshore limits altering their nature and modifying the lagoon hydraulics with consequences on water quality, habitats and species behavior. The second one observed in the Messolonghi lagoons (40% of the Hellenic lagoon surface) concerns large scale non intentional sea bream enhancement. The last decade the sea bream abundance increased rapidly due to accidental escapement and in cage reproduction in the numerous farms of the region. Likewise, the consequences on the biodiversity of remote actions incidence, such as sea farm cages acting like efficient FADs or the individual species targeted protection (i.e. cormorants), remain unknown.

The above elements reveal that the present protecting and management context is geographically limited or inadequate, sector specific, heavy and of poor efficiency and as it is frequently reported, the fisheries sector is disproportionately affected.

S5.5 Assessing the Status of Coastal Lagoons in the Northern Baltic Sea by GIS

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Coastal lagoons, priority habitat 1150 in the Annex I of the European Union's Habitats Directive, are under severe pressure. In the Baltic Sea the status of lagoons is classified as unfavourable in five of the eight riparian EU Member States. In this study we describe how GTS analysis is applied for the assessment of the status of lagoons in Finland. Approximately 15000 coastal lagoons with a size range of less than a hectare to more than 10 km² were identified from nautical chart data and aerial photographs and further digitized into polygons based on the nautical chart shoreline data. The potential pressure on lagoons was quantified by overlay analysis using commonly available national GTS data relating to human activities relevant for lagoons. Calculations of the lagoons' drainage area made it possible to use these as proxies when assessing the potential pressure of diffuse nutrient load on a subset of the lagoons. These general methods allowed us to compare the status of coastal lagoons within the Natura 2000 and HELCOM Baltic Sea Protected Area networks with the lagoons outside these networks and estimate possible benefits from MPA networks. A digital elevation model allowed us to depict the geomorphologic development of a subset of the lagoons, from historic times up until present times. The present geomorphologic development of lagoons that benefit of the 3mm to 8mm land-uplift that occur in Finland as a result of the last glacial period. Climate change may cause changes in the seawater level that alter this development.

S5.6 The Ghar El Melh lagoons complex: impact of recent coastal managements and risks with a sea level rise

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The Ghar El Melh lagoons are located in on the Gulf of Tunis and constitute the remains of the ancient Utique Bay, which represented an open Coastal bay in the Mediterranean Sea in the 2nd century AD. They are nowadays isolated from the sea by a sandy barrier beach which is confronted to important problems especially marine erosion since the creation in 1974 of the new fishing harbour. But the originality of the area consists in the exploitation of the lagoon shorelines by the so-called "Ramli" technique. This corresponds to land reclamation using polderisation where crops are irrigated close to the roots following tidal induced variations of the height of a freshwater groundwater lens that develops in the artificial soil on top of saline intrusion. This resulted in a unique territory of high patrimonial value, whose creation is several centuries old. The barrier beach has been strongly modified following the building of a fishing harbour in 1974. This harbour changed the sediment dynamics, which in certain areas resulted in beach erosion while in other places it resulted in beach accretion. These changes have caused



different impacts on the hydrological dynamics in the lagoon and thus have also influenced the freshwater lens, which constitutes the key element for the durability of the Ramli system. The situation may become more complicated in view of sea level rise and it is particularly important that the local farmers, i.e. the fellahs, are correctly informed and trained to cope with the changing situation.

The situation is particularly difficult as the threats to the area, and especially for the Ramli Culture, are already increasing for socio-economic reasons. This has been revealed by socio-economic polls, i.e. particularly by the questions related to tendencies, environmental perception by the local population, attachment of local populations to their territories and questions related to existing and expected future problems. Problems that are already encountered by the landowners include low yields, cost of labour, lack of materials requested for maintaining and renovating soil qualities. In addition, threats are related to the socio-demographic characteristics of these populations, which in at least a part of the territory express a new perception of spatial use privileging touristic developments at the expense of farming and fishing activities. Contributions to a solution can be found in part among the land users in particular among the older people, who are both landowners and natives of the region. The polls have shown that these landowners have been able to adapt the exploitation techniques to the changing environmental conditions, and that younger people also may possess this savoir-faire. However, the population that has strong links of attachment and a traditional perception of this environment are becoming rarer.

This work tries to make some recommendations on how to prevent further degradation of this territory and how to conserve its originality and attractiveness.

S5.7 Acquatina Lagoon: a model ecosystem to study community patterns

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Acquatina is a small lagoon ecosystem (0.45 km²) located on the Adriatic coast only 5 km north of Lecce (Italy). The lagoon has a freshwater input in the northern part and a connection with the sea at the south edge, being characterised by a latitudinal gradient of salinity and an internal patchiness of habitats. Here, we have used the lagoons as a model to study the influence of these sources of variation on the spatial distribution of macrobenthos and fish fauna, using both taxonomic and on taxonomic descriptors.

Results showed a non random distribution of both species and functional traits of macroinvertebrate and fish fauna within the lagoon, despite the relatively small surface area. Salinity had an higher



influence than bottom habitat patchiness on both macroinvertebrates and fishes; moreover, spatial co-variance of the two guilds was observed both at the taxonomic and at the size level. As regards fishes, these patterns were common to the dominant species (*Atherina Boyeri*) and to the rest of the fish guild.

Results emphasise that common non random distribution patterns are observed even in small lagoons and for different guilds, including vagile fauna, as fish are. It suggests the occurrence of high intra-specific and inter-specific divergence in lagoon ecosystem allowing resource use optimisation through niche specialisation, available energy partitioning and individual energy budget adaptation.

S5.8 Conservation and management issues in the Vistula Lagoon (southern Baltic Sea)

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Vistula Lagoon is one of the three largest lagoons located along the southern coastline of the Baltic Sea. It is a trans-boundary inner coastal waters shared by Poland (367 km²) and Russia (Kaliningrad Oblast, 471 km²). The state border divides the lagoon into two parts, and the only connection with the Baltic Sea is the Baltiysk Strait located in the Russian part. Lagoon is separated from the Baltic Sea by a stable sandy barrier. The Polish part of the Vistula Lagoon has been designated the NATURA 2000 area (both habitat as well as bird one).

Lagoon was historically formed as an estuary of the Vistula River. In 1916 after regulation, when the Vistula runoff was mostly directed to the Baltic Sea, hydrological and sedimentation regimes of the lagoon changed dramatically and the lagoon evolved from freshwater plain estuary toward estuarine lagoon with significant influence from the Baltic. Administrative division of the lagoon as well as its drainage basin creates many trans-boundary problems regarding managements of renewable resources and conservation issues. Moreover, Russian-Polish border is a border between EU and non-EU states with different priorities as well as administrative and legal systems which is not easy to reconcile. This presentation is based on our experience gained during several international projects as Mantra-East (EU FP5), ARTWET (South Baltic Cross-border Cooperation Programme 2007- 2013), as well as the ongoing LAGOONS (EU FP7). We will review the up-to-date knowledge on the current state and background of the Vistula Lagoon eutrophication, fisheries pressure and potential consequences of planned hydro-technical constructions on lagoon environment. Those three groups were identified at the meetings with stakeholders as having the most significant impact on trans-boundary conservation issues in the Vistula Lagoon.



S5.9 Unexpected impact of connectivity management of a Mediterranean coastal lagoon

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Biodiversity and productivity of coastal ecosystems are primarily controlled by continental and marine fluxes. Anthropogenic disturbers carried by continental inputs are described as the main drivers of eutrophication processes in promoting accumulation of sediments and nutrients. Situation is exacerbated when connection to the sea is intermittent. In such cases, restoration operations often target the enhancement of this connectivity, in order to dilute continental fluxes and / or to facilitate their exportation.

This situation is experimented by the Biguglia lagoon (Corsica, France), a shallow Mediterranean coastal ecosystem where eutrophication is increasing for several years. Exchanges with the sea are carried by a long (1.5 km) and narrow (<100 m) channel, regularly clogged by sand accumulations, then inducing important salinity gradients within the lagoon and increasing its confinement. The mechanical reopening of the channel might constitute an operational strategy to alleviate these deleterious consequences, and this strategy has been tested in March 2012.

Our presentation aims at documenting the impacts of this operation, with a focus on phytoplankton communities within the channel. Samples have been weekly studied (Microscopy, HPLC, Phyto-PAM, Flow cytometry) in three stations during five weeks just after a reopening of the channel, whereas abiotic parameters were daily monitored.

Marine influence was associated to the importation of diatoms and cyanobacteria that did not successfully develop further within the lagoon. Conversely, dinoflagellates assemblages were proliferating within the lagoon, with a stimulating influence of marine inputs. This corresponded to an unexpected impact, particularly because of the recent apparition of *Prorocentrum minimum* in the Biguglia lagoon. Significant blooms of this harmful species have been observed during our survey, suggesting that remediation measures may sometimes lead to pernicious consequences. These very preliminary observations sustain the necessity of in-deep studies, to better understand the ecological processes involved, and then, to better support managers and authorities in their decisions.



S5.10 Shellfish culture in Bizerta Lagoon: current state and prospects

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Shellfish culture activity in Bizerta Lagoon, located in southern Mediterranean Sea, is mainly based on the farming of mussels (*Mytilus galloprovincialis*) and oysters (*Crassostrea gigas*). It was created in the 1960s with reduced state experience which continued for 40 years. Privatization in the 2000s allowed more rapid development of this activity including the adoption of new techniques namely floating long lines that allow a larger choice for farm sites. Nevertheless, the absence of natural oyster spats, the presence of biotoxins from toxic algae, organic and chemical pollution and the obstruction of the export market are serious problems hampering the development of this activity. Several actions such as artificial production of oyster spats in hatcheries, limitation of the contamination by stopping pollutant effluents, opening the market to export and a good strategic vision aiming the organization of different activities, are solutions to be adopted for a better management of this coastal lagoon.

S5.11 A multilevel approach for the evaluation of the nursery potential of the Venice lagoon for the gilthead seabream *Sparus aurata*

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Near-shore and transitional habitats have been largely recognized as important nursery areas for many species of fish and invertebrates, and the identification, conservation and restoration of nekton essential habitats, such as nursery areas, has been pointed out as a key element for the sustainable management of resources in transitional water bodies. In order to evaluate the potential nursery role of the Venice lagoon for *Sparus aurata*, a multi level approach was adopted: 1) Integrating data from surveys carried out in different years (2004-2005, 2008-2012), the size structure of gilthead seabream juvenile populations was analyzed, in order to describe the dynamics of juveniles shallows utilization. 2) A stage specific distribution model was developed



using catch data by beach seine, in order to describe fish fry distribution as a function of the main chemical and physical parameters (water temperature, salinity, turbidity, dissolved oxygen content and bottom grain size). The model was calibrated considering two size classes: below and above 20 mm (Standard Length). Application of this model to a series of continuous surfaces of the environmental variables allowed to describe over time the evolution of the potential habitat distribution maps for gilthead seabream juveniles. It was thus possible to identify differences in habitat utilization between the two size classes. 3) Time series (1997-2009) of *S. aurata* fry catches by local fishermen were analyzed to describe the dynamic of fish recruitment from the sea and to estimate the contribution of marine climatic condition on the post-larval supply to the estuarine environment. The integration of these different approaches allows to describe space and time dynamics of colonization within the lagoon basin, taking into account the dependence from fish recruitment in marine waters and its migration towards transitional areas.

S5.12 The pink shrimp fishery in the estuarine system of Laguna, South Brazil: history and unexpected effects of management policies

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The fishery of pink shrimp *Farfantepenaeus paulensis* could be described as subsistence fishing with the use of cast nets before the 1960s in the Laguna Estuarine System. The introduction of a fixed trap between 1970 and 1980 increased the exploitation scale that reached a peak in the late 1980s with 5,000 active fishermen, and declined to about 2,500 at the end of the 1990s due to stock reduction. The culture of an exotic shrimp was introduced in the region in 2001 and collapsed some years later due to the white spot syndrome virus (WSSV). The federal government closed the pink shrimp fishery during four months a year since 2005. In 2010, there were 6,223 fishermen entitled to fish compensation programs, indicating a failure in the registration system. The estimated catch in the 2004/5 harvest was only 45 tons. The impact on other resources due to the low selectivity of this fixed trap was high: for every kilo of pink shrimp, one kilo of crabs and nearly 700 g juvenile fishes. The recent improvement in the quality of life of the fishermen in Laguna appears to be associated with the increase in their supplementary income due to other activities in the closed season, the increase in the pink shrimp price due to the shrimp culture collapse after 2005, the replacement of the shrimp by the blue crab catches and the insurance



income itself. This example showed that the welfare of fishermen and resource protection can be achieved by management measures, but not necessarily as expected. So it is important that management measures are periodically evaluated and eventually replaced by actions that support the inclusion of ex-fishermen in other tracks of the labor market.

S5.13 The Réseau de Suivi Lagunaire (RSL) a tool for eutrophication survey and management in the Languedoc-Roussillon lagoons

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Because of the increasing anthropogenic pressure on the Languedoc-Roussillon region, the lagoons that react as nutrient accumulators stock the deposits carried by runoff and waste water from treatment plants from the catchment basin. The nutrients are stocked in their different biological compartments (phytoplankton, macro-algae, seagrass meadows and animals) and sediments. In 2000, while facing the ecological and economic impacts of lagoon eutrophication, the Languedoc-Roussillon Region and the Water Agency (Agence de l'Eau RMC), with the technical support of Ifremer and the Cépralmar, implemented a monitoring program the Réseau de Suivi Lagunaire (RSL). This program comprises three aspects: (i) observing and monitoring, (ii) providing information and (iii) providing help for managing.

The eutrophication status of the lagoons is based on the annual observation of physical, chemical and biological variables. Information is provided by the diffusion of scientific reports and popularized notes and also by interventions to expose the results to the local actors. Help for management is provided by the transmission of knowledge and savoir-faire through seminars and technical trainings and the publishing of technical guidelines but above all by participating at local management level in decision-making concerning management and environmental issues in order to improve water quality with respect to eutrophication. To this end an innovating decision support system has been introduced : le défi eutrophisation and O' GAMELag.

During the last twelve year, the RSL has succeeded in attracting a lot of local interest in the quality of the lagoon environments. So far, many actions have been undertaken in the catchments of the lagoons in particular for upgrading the WWTP. In addition, the water exchanges have been improved among the compartmentalized lagoons. Nevertheless, additional efforts are



still required to reduce the diffuse sources of agriculture and rainwater runoff in the urbanized areas, considering the maximum allowable N and P loading and the lagoon management objectives (including aquaculture, nature reserve and recreation).

S5.14 Trace elements and PAHs in surface sediments and biota from a contamination hot spot (Augusta Bay, Italy): potential export to the adjoining coastal marine areas

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An assessment of trace element and polycyclic aromatic hydrocarbon (PAHs) contamination based on surface sediments and marine biota (phytobenthos, zoobenthos and fish) collected in summer 2012 was carried out in the Priolo area, within one of the most polluted areas of the Mediterranean Sea, the industrial Augusta Bay (SE Sicily, Ionian Sea, Italy). Sediment inorganic and organic loadings were generally not remarkable, although occasional elevated concentrations of Hg, As, Ni and PAHs, exceeding sediment quality guidelines, were detected close to the artificial harbour and on the northern coast of the Priolo Bay as a possible result of drainage of industrialized and urbanized areas. Here, sediments may be a potentially important source of pollutants and could represent a threat to local biota. Generally, concentrations of trace elements and PAHs in biota were low in comparison to those recorded in the same species collected in other high contaminated sites, although elevated concentrations of Hg and Pb, measured in several fish and macroalgae, suggested a possible impact on local flora and fauna, posing threats to public health. Finally, the most important consequences of coastal contamination for humans are likely to be through the biomagnification of trace elements in food-chains. Future research efforts should be directed at further identifying sources, fates and impacts of contaminants in the Augusta ecosystem and the role played by this area as an important pollutant point-source for the Mediterranean Sea. Maintenance of long-term monitoring programs should also be regarded as a priority because of collection of these data will enable assessment of change in concentrations of these contaminants over time. However, improved land management practices are essential if environmental quality in the Augusta area should to be restored.



S5.15 Integrated study of water uses in the Thau basin in the context of climate changes

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The latest reports of the intergovernmental panel on climate change explained that the Mediterranean regions are especially vulnerable to the impacts of climate change. These latest are expected to have strong impacts on the management of water resources and on regional economies. The aim of this paper is to discuss impacts of climate changes on the Thau basin in relation to the evolution of water balance and water uses.

A questionnaire on water uses filled in by stakeholders has permitted to assess the current level of integration of water uses. A complementary analysis of social network conducted with Pajek software allowed to draw the main interactions between water managers and water users. It stood out that if stakeholders are aware of the importance of the Thau lagoon water quality to sustain economic activities, all activities are not represented by all stakeholders. Also, water resources seem to be already impacted by the increase of water demand.

Climate changes projections are presented following the implementation of 4 downscaled climatic models. Impacts on water balance are modelled with SWAT (Soil Water Assessment Tool) for 2041-2070 compared to the 1971-2000 reference period. The decrease of precipitations and water balance will impact discharges and thus decrease the freshwater inputs to the coastal lagoon. Following this study, expected impacts of climate changes on the Thau system are not only due to water scarcity but also to the answer to water scarcity. In fact, the main threats are related to the enhancement of water deficit during the summer period while the demand is high due to urban and agricultural activities. In this context, it seems the access to a new water resource distorts the representations of water resource availability while it possibly enhances pressures on water quality.



S5.16 The white stork (*Ciconia ciconia*) in the wetlands of Tarf (North East Algeria), and climate change

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Our study focuses on the distribution of the white stork "*Ciconia ciconia* L. 1758" in the wetlands of El Tarf (North eastern of Algeria): recognized by its remarkable number of breeding pairs, monitoring of nesting, using a GPS, has been performed in an attempt to explain the functioning of populations and population strategies for an overall design of its distribution, which has not so far been investigated in this region.

Between 2012, and 2013, the number of breeding pairs has increased considerably, from 174 in 1996 to 475 in 2007 and 968 in 2013. It should be noted that in the distribution of breeding pairs between 1996 and 2011, there is a significant development since the density of nests increased from 25.22 in 1996 to 84.16 couples/100 km² in 2013.

More endemic bread appears in the region, this fluctuation is related to climatic change and changing season. Changes related to local climatic conditions might induce binding conditions for the development of this species.

S5.17 Lagoon and Habitat (EUNIS) fragility to alien species in Mediterranean lagoons

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Lagoons are ecotone ecosystems, naturally exposed to immigration from their freshwater and marine input environments; strictly lagoonal species are rare, if ever occurring, and lagoon community are likely to be organised through lottery competition processes. These evidences suggest the study of lagoons as models address ecosystem fragility to alien species.

Here, we present an analysis of lagoon guild fragility to alien species carried out using the e-Science facilities of LifeWatch, the European Research Infrastructure on biodiversity and



ecosystem research. The analysis has been performed on two EUNTS habitat (X02 and X03) using data existing on 18 Italian lagoons.

The analysis has been carried out taking into account that rarity, redundancy and singularity are key properties of different guilds in lagoon ecosystems at every geographical area, affecting β and γ diversity. At every area an high regional biodiversity is determined by a large number of rare species and a high dissimilarity among lagoons. Life cycle traits and the behaviour of larval stages, at the species level, as well as lagoon openness and vigour, at the ecosystem level, seem to have a major role to explain the difference in patterns of biodiversity between study areas at a biogeographical scale. The same species and ecosystem level properties, together with spatial patchiness, seem also to be key factors downscaling biodiversity analysis at the landscape level.

S5.18 An intercalibration exercise for benthic macrophyte indices across the Mediterranean Sea coastal lagoons

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Within the transitional waters macrophyte Mediterranean Geographical Intercalibration Group (MEDGIG) of the Water Framework Directive intercalibration, three countries (France, Greece, and Italy) compared their methodologies (Exclame, EET-c, R-MaQT, respectively) for coastal lagoons. All methods classified soft bottom benthic macrophytes (angiosperms, seaweeds) in several sensitivity groups following the concept that "anthropogenic pressure" (stress) drives the ecosystem from a pristine state, where seagrasses are dominant, to a degraded state, where opportunistic species and phytoplankton are dominant. While Greece and Italy assessed the species abundance as coverage (%) in the laboratory, France assessed the species abundance as cover



(%) in the field. A database consisting of 105 taxa abundance and pressure data from 55 shallow (depth=1-3m) and vegetated (cover >10%) sites (14 in France, 20 in Greece, 20 in Italy) belonging to meso-, poly- and euhaline (salinity >50) coastal lagoons, either confined or not confined, has been created. The 3 methods used a similar scale at biological (species), spatial (site) and temporal (one sampling per year during spring-summer) level, enabling a direct comparison of the 3 indices at biological community level. A common pressure index based on expert judgment was calculated. Multivariate analyses (MDS, Cluster) indicated no biogeographical differences across the Mediterranean Sea. STMPER analyses confirmed that reference "benchmark" sites communities (pressure index :S 6) were characterized by the dominance of angiosperm species (Cymodocea nodosa=49.9%, Ruppia cirrhosa=35.67%, Zostera noltii=10%), while "borderline" communities between good and moderate ecological status were dominated by macroalgae-cyanobacteria in coexistence with angiosperms. Due to ecosystems high natural variability and to relative low number of benchmark sites provided, it was decided to use continuous benchmarking to determine the differences between the countries. Greece appeared more precautionous and adjusted its quality class boundaries by lowering both High/Good and Good/Moderate boundaries to 0.7 and 0.4, respectively (France, and Italy: H/G=0.8, G/M=0.6).

S5.19 Characterization of cholinesterase in *Aphanius fasciatus* (Teleostei, Cyprinodontidae) from Orbetello Lagoon (Tuscany, Italy)

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Cholinesterases (ChEs) in the cyprinodont fish *Aphanius fasciatus* (Valenciennes 1821) were characterized. ChEs are a family of enzymes which include acetylcholinesterase (AChE) that plays an important role in neurotransmission of both vertebrates and invertebrates; its inhibition results in a disruption of the transmission of nervous impulse.

Agricultural insecticides such as organophosphorous compounds and carbamate have an inhibitory effect on ChE enzyme activity. The use of ChE activity as biomarker requires a careful characterization of the enzymes present in a given species, tissues and in order to minimize possible erroneous interpretation of the results that could be affected also by environmental conditions.

Fifty female individuals of *A. fasciatus* were collected in the Orbetello Lagoon (Tuscany, Italy) and acclimated to aquarium conditions. Fish were randomly distributed in three distinct aquaria (20 fish/aquarium) and gradually adapted to three salinities conditions (15, 35, 55 PSU) for a 28-day period. ChE activities (Ellman's method) were performed on different tissues/organs-10000xg



surnatants (3/4 individuals pools). Characterization of ChEs was carried out using different specific substrates and model inhibitors.

The effect of the adaptation at different salinities on ChEs was evaluated. An in vitro experiment was performed in order to evaluate the inhibitory activity on ChEs of an insecticide carbamate (Methomyl).

Results showed that muscle was the tissue with the highest acetylthiocholine iodide (ATChT) hydrolysis rate. The analysis of kinetic constants K_m and V_{max} indicated ATChT as the substrate with highest affinity. The outcome of experiments with model inhibitors suggested that acetylcholinesterase is the prevalent form of ChEs. Methomyl inhibited ChEs at a μM range. The adaptation at different salinities had no significant effects on ChEs normal range activity levels. Results of the present work showed that *A. fasciatus* can be considered as a promising candidate sentinel model to be included in monitoring programs of transitional environments.

S5.20 The Lagoons of Corfu: multiple impacts, conservation strategies and economic exploitations

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In the Island of Corfu there are seven lagoons which have different biological and chemical characteristics and also different impacts and human interventions. In this research, a preliminary description of the lagoons is reported using available data from the literature. The lagoons of Corfu have been poorly studied from the point of view of ecological functions and biodiversity. Specifically the lagoons are: 1. Lagoon Korission, it is the largest lagoon of Corfu. Located in the southwest of the island has an area of 600 hectares approximately. Works like a fish farm and is protected area Natura 2000. The main intervention of the lagoon is the increasing of the human activities in the area of the lagoon; 2. Lagoon Chalkiopoulos, the second largest lagoon of Corfu, it has a total size of 180 hectares. There was a fish farm fifteen years ago. It is estimated that the last seventy years the lagoon has lost about 1/3 of its extent. This lagoon has received the most and the major intervention is the reduction in the area in order to create the Airport of Corfu; 3. Lagoon Antinioti, it is located northeast of Corfu and it has a total size of 100 hectares with the marshland Kounoufadi which is part of the lagoon. Works like a fish farm and is included in the protected areas Natura 2000. The main interference of the area has been done on the part of the marshland Kounoufadi where twenty years ago have been put polders by the municipality of Corfu in order to build a Municipal Stadium; 4. Lagoon Alykes Lefkimmis, it is a small lagoon of



about 30 hectares in the southeast of Corfu. Along with former Alykes Lefkimmi is included in the protected areas Natura 2000. There is not significant human intervention in the lagoon in addition with the former Saline of Lefkimmi (which forms a single ecosystem) for which the area has decreased due to residential use. Three small lagoons in the area of Erimitis which is in the northeast part of Corfu, there are 3 small lagoon ecosystems (Akoli, Vromolimni and Avlaki) located on the northeast coast of Corfu. Each of these has a size of 2-4 hectares. The most remarkable is that the lagoon Akoli in the past served as a fish farm and had an artificial orifice communicating with the sea. Such abandonment of this orifice it is noticed a decrease in the depth of the lagoon.

S5.21 Ecological restoration of coastal lagoons; prediction of ecological trajectories and economic valuation

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The seven lagoons of the Palavas complex (S. France) were exposed to nutrient over-enrichment during at least four decades mainly from the effluents of the WWTP of Montpellier. In order to improve the water quality of the lagoons this WWTP was renovated and upgraded and, since the end of 2005, its effluents are discharged 12 km offshore into the Mediterranean through a blast pipe (total investment 150 M€). We studied the possibilities of this lagoon to recover more oligotrophic conditions and the spontaneous recolonisation of the associated seagrass communities. While, the phytoplankton communities respond quickly to the reduction of the nutrient loading, the sediments have accumulated large amounts of N and P, which delays the recovery of a good ecological status. In our combined ecological-economic study we used a focus group of experts (i) to predict ecosystem trajectories for the current management (passive restoration) and (ii) to design additional measures applied in a two-step approach for accelerating the process (active restoration). Only for the least impacted lagoon Ingril, the passive restoration will yield good result within a reasonable time frame. For the most impacted lagoon Méjean, we studied the willingness to pay, by local populations and tourists, for the extra costs related with the active restoration. We used a multiple contingent valuation (MCV) considering 6 different management options. Three levels of recovery of seagrass meadows were combined with different options for access (status quo, increasing access, increasing access with measures to reduce disturbance). We also considered that increasing seagrass meadows represent a trade-off for the emblematic flamingos, while other bird species (ducks, swans, herons), emblematic seahorses



and other fishes increase concomitantly with the seagrasses. Our results will contribute to the Cost-Benefit. Analyses and identify the population preferences for the restoration project.

S5.22 Restoration of coastal sandy dunes: Acquatina (Lecce, Italy)

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The coastal dunes of the Salento have undergone a significant anthropic process of destruction and fragmentation. In many cases this has led to the loss of the typical species of this habitat, in particular the dune juniper thickets. In response to this situation, several projects of restoration were carried on in the last decades.

In the coastal lagoon of Acquatina, near Lecce, the Botanic Garden of the University of Salento has experimented since 1999 different techniques of dune restoration, both with the plantation of dune-building species of plants and with the construction of new dune sand profiles. This study shows the results of monitoring of the process of natural colonization of plant species in the restored dune over a period of 15 years. The results show that the vegetation dynamics in the restored dune followed a process of primary succession, with a progressive increase in species number, coverage and heterogeneity. The study demonstrates that applied botany can greatly support bioengineering in the dune restoration.

The study has been also an opportunity to update, for the lagoon and the surrounding area, the map of vegetation and of the habitats according to the Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora.

S5.23 Propagule predation by crabs and the restoration of Neotropical mangroves

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Mangrove deforestation for housing development and shrimp farming has left many deforested areas in need for restoration. In Neotropical mangroves, propagule predation by the crabs *Ucides cordatus* and *Goniopsis cruentata* can inhibit tree recruitment and mangrove restoration. Therefore,



restoration programs have focused on planting propagules of tree species that are more resistant against crab predation, and have been questioned about its functionality and resilience considering that most planted stands maintain low tree richness in respect to naturally recovered areas. Here we compared an artificially restored area and a self-recovered area to test the null hypothesis that the two areas do not differ significantly in plant richness and biomass as well in crab richness and density. In the restored area we have planted *Rhizophora mangle*, while in the self-recovered area mangrove was left recovering without human intervention. In each area, 10 quadrates were randomly sampled for analyses of tree richness, diameter, height, tree biomass, and crab density 5 years from the start of the restoration experiment. Results shows that plant height and biomass as well as crab density were significantly higher in the artificially restored than in the self-recovered area. No significant differences were found in crab richness and composition between the two areas, but tree richness was higher in the self-recovered area. These results suggest that planting *R. mangle* propagules can significantly improve mangrove recovery if the restoration goal is to increase tree biomass and crab density. If the restoration goal, however, is to improve tree and crab richness mangrove recovery can be satisfactorily achieved without restoration intervention.



ABSTRACTS POSTER COMMUNICATIONS



Topic 1. MATTER FLOWS AND CYCLING

P1.1 Estimate of algal biomass in two Mediterranean lagoons: shifting between planktonic and macroalgal production

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The results presented in this work are part of a pilot project aimed at the evaluation of the potential biodiesel production from algal biomass. Specifically, macroalgal and phytoplanktonic biomass of two Italian lagoon, Orbetello (north Tyrrhenian Sea) and Lesina (south Adriatic Sea), regarded as highly productive and eutrophic, were monitored in spring and summer 2011 and 2012. The study has been divided in two main sections. Firstly, a general qualitative outline of the submerged vegetation distribution by visual census techniques was conducted. Secondly, macroalgae and water samples for chlorophyll a determination were collected in order to study the primary production (in Kg.m⁻² and µg.L⁻¹ for macroalgae and phytoplankton, respectively). Accordingly the lagoons have been divided into transects oriented according to the direction NS and WE. We obtained a total of 18 transects oriented in NW-SE direction in the Orbetello (8 in the western basin and 10 in the eastern basin) and 13 in the Lesina (10 of them in the "Sacca Orientale"). At the same time, physico-chemical parameters were measured by multiparametric probe. The results show a basic difference between the two systems, with a productivity shift towards phytoplankton biomass in Lesina and macroalgae in Orbetello. In Lesina, mean concentrations of chlorophyll a were $2.97 \pm 3.63 \mu\text{g.L}^{-1}$ (spring, with maximum of $15.27 \mu\text{g.L}^{-1}$) and $2.36 \pm 2.60 \mu\text{g.L}^{-1}$ (summer, with peak of $12 \mu\text{g.L}^{-1}$), while macroalgal biomass ranged from 1.9 to 2.6 kg.m⁻² for both observation periods. Conversely, in Orbetello lagoon mean phytoplanktonic chlorophyll a did not exceed the level of $0.51 \pm 0.31 \mu\text{g.L}^{-1}$ in spring and $0.81 \pm 0.70 \mu\text{g.L}^{-1}$ in summer (with maximum of $3.21 \mu\text{g.L}^{-1}$), while biomass of submerged vegetation was always an order of magnitude greater. In particular, macroalgal biomass was higher in the western basin than in the Eastern one with mean values that increased from spring (28.2 Kg.m⁻²) to summer (66.1 kg.m⁻²). This study indicates that the high macroalgal production in Orbetello lagoon could be evaluated for biodiesel production, while in Lesina the macroalgae distribution is more casual e quantitatively less abundant.



P1.2 Trophic status and possible evolution of the Maghrebian Lagoons: A tipping point for economic development

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Coastal lagoon ecosystems of North Africa represent a valuable asset for the Southern Mediterranean region. Indeed, the services they provide, such as hydrological processes and buffering capacities, nutrient cycling, and healthy fisheries are increasingly recognized as vital to society and of significant economic and social value. However, the demand for space and natural resources around and from these coastal bodies has increased tremendously over the years due to increasing population, expanding agriculture, rapid urbanization and economic development and thus, many of them are experiencing acute environmental problems, which have led to a decrease in their resilience and adaptability to variability and change. In view of the above and in the context of future socio-economic requirements, a first assessment of the trophic status of these coastal lagoon ecosystems is a highly challenging policy issue in the region and critical for planning long-term strategies, developing recovery measures and preventing further pressures on these ecosystems.

In the framework of the START/MaghLag Project, a preliminary estimation of the biogeochemical budgets of four North-African lagoons lying to Morocco, Algeria and Tunisia, showed that Nador and El Mellah lagoons are net denitrifiers and then can provide an extremely valuable ecosystem service, while in Bizerte, Ghar el Melh and El Biban, N fixation is the dominant process. Being aware that these budgets are preliminary and need additional data, they nevertheless provide perspectives for managers with regards to the mechanism by which the ecosystem could cope with new-nutrient loading. The calculation of the water residence time within the lagoons showed that El Biban and Bizerte have high water residence time and thus are more sensitive to pollution than small sites with fast water renewal such as El Mellah and Ghar El Melh. Expected warming in the Mediterranean Region and changes in freshwater, sediment and nutrients flows will be additional pressures on these lagoons and will potentially jeopardize food security and livelihoods for coastal communities that depend on these ecosystems.



P1.3 Litter decomposition and associated benthic macrofauna: the case study of a coastal lagoon (Acquatina, ITALY) in natural and perturbed conditions

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Plant detritus decomposition is a key process in aquatic ecosystems, contributing to the energy flow, nutrient dynamics and sediment accretion.

Here, we analyse the patterns of leaf litter breakdown and associated benthic macrofauna in Acquatina, a coastal lagoon in the southern Italy (45 ha). The study was carried out on leaves of *Cymodocea nodosa* (Ucria) Asch., *Phragmites australis* (Cav.) Strin. ex Steud., *Spartina juncea* (Michx.) Willd. in presence and absence of an anthropogenic perturbation. Sampling was performed in two sites during the spring period on protected and not-protected leaf bags in order to analyse the contribution of the benthic macrofauna to the detritus decomposition.

Leaf decay rate ranged from 0.005 for *C. nodosa* to 0.002 for *S. juncea* in absence of the detritivorous component (i.e., protected bags), while it was comprised between 0.046 for *C. nodosa* and 0.003 for *S. juncea* in presence of the detritivores (i.e., not-protected bags).

In absence of detritivores, the exponential simple model was verified ($p < 0.05$) for all species in natural condition, while it was significant for *S. juncea* at both sites and for *C. nodosa* at one site in presence of the perturbation. Moreover, an effect of the perturbation was highlighted also by an increased average leaf half life from 152 to 221 days in natural and perturbed conditions, respectively. This results was evident mainly for *S. juncea* with respect to the other species.

In presence of benthic component, the exponential model was significant ($p < 0.01$) for all species in both conditions and the half life did not change between natural and perturbed conditions.

Overall, 30 taxa were found on the leaf bags with a dominance of four taxa (*C. insidiosum*, *I. baltica*, *M. palmata*, Anisopoda). *S. juncea* with respect to the other species showed the lowest Shannon index in perturbed with respect to natural conditions.

The results highlighted a different contribution of the benthic component to the litter decomposition depending of the leaf species. Moreover, a role of the perturbation on the key ecosystem process was evidenced with a different sensitivity of the macrophyte species.



Topic 2. CARRYING CAPACITY AND BIOLOGICAL RESOURCES

P2.1 Distribution and abundance of freshwater fish in two Tunisian dams: Ghezala and Lahjar

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In order to develop a sampling strategy for assessing fish resources in Tunisian dams, tow surveys were carried out. Samplings were conducted between February and May 2013, a period when fish catchability is high. Two reservoirs with differing surface areas and bathymetries were selected (Ghezala and Lahjar). So as to test the hypothesis that fish distribution is related to water depth, and to verify results given by the acoustic method for stock assessment, we apply the standardized method for sampling fish in lakes, using multi-mesh gillnets (Benthic and pelagic gillnets). This method provides a dam estimate for species occurrence, quantitative relative fish abundance and biomass. From the dam to the tributary of the entire water column, it was concluded that fish biomass distribution was governed by depth and was most abundant in areas with shallow waters. Sampling in our reservoirs must be done during night and both vertical and horizontal beaming must be used to obtain the best possible picture of the fish stocks.

P2.2 Is there a role for Mediterranean lagoons in the European eel (*Anguilla anguilla* L., 1758) stock recovery process?

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The European eel (*Anguilla anguilla* L., 1758) is facing a dramatic decline in most of its distributional range and the species is now considered critically endangered according to the TUCN Red list. In 2007 the European Commission issued a Regulation (EU 1100/2007) for eel recovery and the sustainable use of eel stocks. Accordingly, management measures need to be implemented so as to guarantee, for each water basin, the downstream migration of at least 40% of silver eel biomass with respect to the historical baseline.

The first step of any eel management plan is thus to estimate spawner escapement under current and pristine conditions. While in central and northern Europe the estimation of eel baselines has received a considerable investigation effort, very little is known about the eel productivity of Mediterranean coastal lagoons under historical and present conditions. This is unfortunate as coastal lagoons usually exhibit a very high biological productivity and can sustain eel densities substantially higher than rivers and lakes.

Aim of this work is to perform the first stock assessment of the European eel in Mediterranean coastal lagoons. Yield, climatic, geographical and other environmental and fishery data for over fifty Mediterranean lagoons were collected through an extensive review of both peer-reviewed and grey literature spanning a period between 1950 and 2012. Here we present the statistical analyses of these data and the preliminary results of a modeling exercise to estimate spawning escapement under current and pristine conditions.

P2.3 Consequences of a gelatinous dominated ecosystem: Preliminary observations from a Mediterranean lagoon

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In recent years, many coastal environments by the Mediterranean Sea (Varano, Etang de thau, Empuriabrava, Bizerte lagoon) were invaded by carnivorous gelatinous organisms like jellyfish and ctenophores. Jellyfish, which are voracious consumers, may cause significant alterations in zooplankton abundance and dynamics. A confined environment like Varano Lagoon represents a suitable habitat for invasion and establishment of the scyphomedusa *Aurelia* sp., which has successfully resided there since 2000 and represents our case study. The role of this gelatinous top predator was investigated by analyzing spatial and temporal dynamics of the meso- and microzooplankton community and jellyfish abundance. We also studied the composition and



abundance of prey in the jellyfish stomach contents. Comparison between 2 years of sampling showed that high jellyfish abundance in the second year (3 ind/m³) exerted a top - down control on zooplankton community. The peaks of phytoplankton, mesozooplankton and gelatinous predator biomass distributions occurred sequentially as a result of prey-predator interaction, visible also spatially in the four areas analyzed. The selectivity index C calculated from medusa diet and prey availability showed null selection toward most prey, suggesting that *Aurelia* sp. medusae feed on zooplankton prey mostly non-selectively.

Ongoing activities on jellyfish trophic ecology (e.g. stable isotopes) will clarify their predatory impact on zooplankton community and the consequences for the fish harvested in the lagoon (sea bass, sea bream, sand smelt, gray mullet), which now must compete with jellyfish as top predators from April to December. Zooplankton depletion due to the gelatinous explosion should be considered as a cause of for possible decreasing fish yields in the lagoon ecosystem.

P2.4 Effect of coastal lagoon environmental instability on the dual nature of sea urchin gonads

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The reproductive cycle of *Paracentrotus lividus* was studied in Corsica, France (Mediterranean Sea) during an annual cycle in two different environments: a coastal lagoon (unstable) and the open ocean (stable). Gonad index, histological analysis and maturity index were measured monthly. A high gonad index was observed in the unstable lagoon environment where food availability was high which highlights the role of the gonad not only in reproduction but also as a nutrient reserve. The histological and maturity index analyses detected a complete spring spawning period in the two environments. For the lagoon environment, these analyses revealed a chronological anomaly in the reproductive cycle with a reverse chronological order in the development stages which lead to a putative used of gonad as reserved tissues. This anomaly and used of tissues gonads is most probably related to environmental (large fluctuations in salinity) stress instability. This phenomenon demonstrates the plasticity of sea urchin populations, particularly in coastal lagoons.



P2.5 Integrated aquaculture in a Mediterranean coastal lagoon: the Acquatina (Frigole, Lecce-Italy) case study

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Aquaculture and fishery related activities play an important role in ensuring a sustainable exploitation of coastal marine zones since they basically depend on the availability and renewal of biological resources. In order to achieve the integrated management of the coastal lagoon of Acquatina, located in the South-East of Italy, in Apulia Region, the University of Salento, owner of a great part of the area, has implemented a series of infrastructures and promoted several interdisciplinary research and innovation projects in the area.

In the present paper, data on aquaculture activity and environmental monitoring of the coastal area, and its relation with other economic activities, such as agriculture, boating, fruition for eco-tourism, sport and leisure, are presented. Results give clear evidence on the possible full integration of the several activities and represent a first step towards the definition of an applicable model for the sustainable exploitation of the coastal confined area.

Topic 3. BIODIVERSITY PATTERNS, ORGANIZATION AND CLIMATE CHANGES

P3.1 Étude otolithométrique comparée de deux populations lagunaires (Ghar El Melh et Bizerte) de *Sparus aurata* de Tunisie

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Les otolithes sont de petites concrétions calcaires de l'oreille interne des poissons téléostéens ; ils représentent les organes de l'ouïe et de l'équilibre. De nombreux travaux ont permis de meltre



en évidence l'importance des otolithes dans l'identification des poissons et ont montré l'intérêt de ces pièces anatomiques dans la constitution de l'identité de l'espèce.

Le présent travail a été réalisé sur les sagittae (gauche-droit) de l'espèce *Sparus aurata* échantillonnée de deux lagunes (Ghar El Melh et Bizerte) situées dans partie occidentale de la Tunisie. Cette étude est basée sur la forme de l'otolithe et sa variation intra spécifique au sein de deux populations lagunaires composées d'individus dont les tailles varient de 19 à 24 cm. Une fois prélevés et photographiés, les otolithes ont été soumis à des traitements d'images par les deux logiciels (Photoshop / Shape) et des analyses statistiques multidimensionnelles afin de détecter la présence de différences ou de similitudes entre les deux populations lagunaires.

Les résultats obtenus permettent de tirer les conclusions suivantes:

- Les deux populations lagunaires se séparent selon l'axe F1 (absorption=51,11%); la population de Bizerte occupe la partie positive de cet axe, tandis que celle de Ghar El Melh se place dans la partie négative.

- Pour chacune de ces populations, les otolithes droits et gauches sont séparés par l'axe F2 (absorption=31,15%); les otolithes droits se placent du côté positif de l'axe 2 tandis que les otolithes gauches occupent la partie négative de ce même axe.

Cependant, les tests statistiques ne montrent aucune différence significative, d'une part, entre les deux les populations lagunaires, et d'autre part, entre les otolithes droits et gauches de chaque population ($P > 0.05$).

P3.2 Discrimination de trois populations tunisiennes de *Engraulis encrasicolus* (Clupeiforme, Engraulidae) par analyse de la forme des otolithes

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L'anchois européen, *Engraulis encrasicolus*, est un petit poisson pélagique de la Famille des Engraulidae. Sa répartition géographique s'étend de la mer du Nord à l'Afrique du Sud en colonisant la Méditerranée, les mers Noire et d'Azov. Il a été signalé, également, dans une partie de l'océan Indien.

Les travaux portant sur la structure des populations d'anchois peuplant les eaux méditerranéennes ont permis de mettre en évidence l'hétérogénéité des stocks de cette espèce et ont suggéré la présence de plus qu'une forme. Des variations ont été enregistrées au niveau de la croissance, de la



morphologie et des séquences des ADN nucléaire et mitochondriale. Etant donné que les variations morphologique et morphométrique sont influencées par les conditions environnementales, elles ne peuvent être utilisées pour la comparaison de populations et/ou de groupes de populations en provenance de milieux présentant des paramètres physico-chimiques différents. En Méditerranée, les études réalisées ont permis de conclure à la présence de variabilités morphométrique et génétique entre les populations de *Engraulis encrasicolus* peuplant les eaux côtières et celles du large et ont déduit la présence de deux formes distinctes.

La présente étude porte sur l'analyse de la variation de la forme des otolithes (sagitta) de trois lots d'anchois capturés dans les eaux tunisiennes (lagune de Bizerte, le littoral de Korba et au large de l'île Zembra).

Pour chaque individu, les otolithes ont été prélevés, nettoyés, photographiés et soumis à l'analyse elliptique de Fourier. L'analyse factorielle discriminante (A.F.D.) des descripteurs de Fourier a permis de mettre en évidence une nette discrimination entre les trois lots étudiés.

P3.3 Utilisation de la morphologie des otolithes pour la discrimination de deux espèces de poissons (Perciformes, Gobiidae) de Tunisie. *Gobius niger* et *Gobius paganellus* (Linnaeus, 1758).

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Tous les poissons osseux possèdent des otolithes qui sont des petits corpuscules de carbonates de calcium localisés au niveau des oreilles internes. Le développement des techniques numériques utilisant l'analyse de forme a offert à la biologie de pêches des nouvelles possibilités de recherche pour identifier et discriminer les stocks à travers des caractères morphométriques des otolithes de poissons. Le changement de la forme de l'otolithe peut résulter de variations génétiques et/ou environnementales.

Le présent travail porte sur l'analyse morphologique comparée des otolithes de deux espèces de gobies : *Gobius niger* et *Gobius paganellus* capturées dans la Lagune de Bizerte (lagune située à l'extrême Nord de la Tunisie entre les latitudes 37°8' et 37°14' et les longitudes 9°46' et 9°56'). Pour chaque individu, les otolithes ont été prélevés, nettoyés, photographiés et soumis à l'analyse elliptique de Fourier 'Shape', suivi d'un traitement statistique multidimensionnel (A.F.D.).



Les résultats obtenus ont permis de mettre en évidence la présence de divergences morphologiques, d'une part, entre les otolithes de *Gobius niger* et *Gobius paganellus* et, d'autre part, entre les otolithes droits et gauches au sein de chacune de ces espèces.

P3.4 Étude comparée du profil en acides gras de trois populations lagunaires tunisiennes de *Atherina lagunae*

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Atherina lagunae est un poisson téléostéen qui présente une grande plasticité éco-biologique et morpho-anatomique. C'est une espèce eurytherme et euryhaline fréquentant les estuaires et les lagunes. Les travaux portant sur la biométrie de *Atherina lagunae* ont mis en évidence une importante hétérogénéité entre les athérines provenant de différentes lagunes.

Le présent travail se propose de comparer le profil lipidique d'Athérines en provenance de trois lagunes méditerranéennes du nord-est de la Tunisie : Bizerte, Ghar El Melh et l'Ichkeul.

L'extraction des lipides totaux de *Atherina lagunae* est faite selon la méthode de Folch et al. (1957) modifiée par Bligh et Dyer (1959). Pour l'obtention des esters méthyliques d'acide gras, la technique utilisée est celle de Metcalfe et al. (1966). Ces esters méthyliques sont analysés par chromatographie en phase gazeuse (C.P.G.).

Les résultats obtenus montrent que les Athérines lagunaires présentent des lipides riches en acides gras polyinsaturés AGPT de la famille oméga 3 tels que l'acide eicosapentaénoïque « EPA C20 :5 » et l'acide docosahexaénoïque « DHA C22 :6 » avec une tendance à l'accumulation des A.G.P.T. n-3 chez les Athérines de la lagune de Bizerte par rapport à celles du lac Ichkeul et de la lagune de Ghar EL Melh. C'est cette richesse en AGPT n-3 qui confère aux poissons leur qualité nutritionnelle ou leur valeur diététique.



P3.5 Does water quality change in different lagoon types? Study cases from coastal lagoons of Western Greece

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Coastal lagoons are heterogeneous, variable and unstable systems which cover a wide range of physiographical and hydrological characteristics. The interactions determining their structures and dynamics have to be taken into account in order to identify the main criteria for the typological analysis. The European Water Framework Directive (WFD 2000/60/EE) requires a typological classification of water bodies by defining common typological descriptors. A set of ten coastal lagoons of Western Greece were selected as case study for the application of WFD in the Mediterranean ecoregion. The physiographical and hydrological characteristics of several lagoons in northern Greece and across the Mediterranean region were analyzed and compared with those located in Western Greece. The salinity range, the depth, the surface area and the confinement with the sea were factors enable to differentiate the typological classification of the lagoons. Other parameters such as tidal range or geographical distribution had scarce relevance. The results of data analysis suggest four different types and indicate that physiographical and hydrological characteristics of coastal lagoons, which drive the typological classification, can affect their physicochemical properties. The lagoon types defined in Western Greece showed significant differences in physical and water quality parameters such as depth, transparency, salinity, temperature, pH, DO, nitrogen compounds and Chl-*a*. Highly confined lagoons showed higher nutrient and Chl-*a* concentrations and lower salinity values comparing with coastal lagoons that have higher water exchanges with the sea. Our approach can be applied to other coastal transitional water types in order to provide a general framework for rational strategies for management and policy.

P3.6 The effect of habitat on the condition factor of three estuarine resident fish: a quantile regression approach

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Transitional water systems play a key role in the functioning of marine ecosystems. They are a



critical ecological component for the functioning of the coastal area and an important economic element of the coastal landscape, in terms of production of exploitable resources. Among the ecological guilds represented in coastal lagoons, estuarine resident fish species are the most suitable to be used as an indicator of environmental conditions. Within the Venice lagoon, three target species were chosen: the sand smelt *Atherina boyeri*, the lagoon Goby *Knipowitschia panizzae* and the black-striped pipefish *Syngnathus abaster*. Aim of the study was to test for habitat influence on fish condition factor, accounting for spatial and temporal variability. Samplings campaigns were conducted during Spring, Summer and Autumn 2012 in 19 sites within the Venice lagoon, covering four types of habitats: seagrass meadows, vegetated and unvegetated mudflats and salt marshes. All specimens sampled were measured (LS) and weighted (WT). For the three species, condition factor WR was then calculated for each specimen, according to the relative weight method, using the length-weight quantile regression calculated on all the sampled specimens. Quantile regression analyses were performed on WR, considering two different factors: season and habitat. In all the species were found a significant effect of both seasons and habitats on condition factor. Results suggest a different use of lagoon habitats by the three species. Therefore the use of WR could be a valid tools in assessing small-scale differences within the nektonic community of coastal lagoons, allowing a comprehensive estimates of population status for estuarine resident species.

P3.7 The TWS Mar Piccolo of Taranto (Ionian Sea, southern Italy): an important hot spot for the introduction of alien seaweeds in the Mediterranean Sea

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Transitional Water Systems (TWS) are particularly exposed to the introduction of alien species due to aquaculture activities, particularly mussel cultivation, and their importation. In the Mediterranean, the main hot spots for the introduction of alien seaweeds are the Thau Lagoon (France), the Venice Lagoon and the Mar Piccolo of Taranto.

In the Mar Piccolo, the temporary presence of alien seaweeds was observed already in the twenties'. From the end of the eighties' the phenomenon became more evident and reached a great importance in the first decade of 2000's. Just in the last two years, four alien seaweeds were observed for the first time in the basin: *Ascophyllum nodosum* (Linnaeus) Le Jolis, *Colpomenia peregrina* Sauvageau, *Grateloupia minima* P.L. Crouan et H.M. Crouan, and *Polysiphonia morrowii* Harvey. *A. nodosum* and *G. minima* are first reports also for the Mediterranean Sea.

These species add to *Undaria pinnatifida* (Harvey) Suringar (disappeared), *Caulerpa racemosa* (Forsskal) J. Agardh var. *cylindracea* Verlaque et al., *Grateloupia turuturu* Yamada, *Hypnea*



cornuta (Kiitzing) J. Agardh and the following *Agardhiella subulata* (C. Agardh) Kraft et M.J. Wynne, *Solieria filiformis* (Kiitzing) Gabrielson, *Codium fragile* (Suringar) Hariot subsp. fragile, recently again observed after some years of absence. All these species were found in zones where locally reared and imported molluscs are packed or sold.

The presence of seafood retailers and the illicit submersion of imported mussels before sale lead us to suppose their importation to be the main vector for the introduction of alien seaweeds in the Mar Piccolo, as already demonstrated in other TWS.

Therefore, this basin was included in LIFEWATCH, an European research infrastructure, within which a show case on alien species was formulated to evaluate the vulnerability of marine and terrestrial environments to alien invasiveness.

P3.8 Preliminary study on the macrozoobenthic community in the Santa Gilla lagoon (Southern Sardinia, Italy)

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The Santa Gilla lagoon is one of the most important wetlands in Sardinia. This lagoon is located close to the urban area of Cagliari and intensely influenced by anthropogenic related activities. In spite of the environmental importance of this area, only few data are available on its benthic macrofauna, therefore the aim of this work is to provide information on the macrozoobenthic community and to investigate possible relation between the community structure and the main environmental parameters.

The samples were collected seasonally with a Van Veen grab in 3 stations (3 replicates) along a salinity gradient and the water parameters were measured. Different measures of species diversity were calculated and Cluster and MDS analysis were performed using the Bray-Curtis similarity index. The differences observed were tested using ANOSIM, and the SIMPER procedure was used in order to identify the species responsible for discriminating between groups. Finally, the BIOENV analysis was performed to investigate relation between environmental parameters and the assemblages observed (Primer v6).

A total of 13031 specimens were collected belonging to 92 taxonomic groups. The number of specimens was the lowest in the station nearest to the sea, while the number of taxa, as Shannon diversity and Margalef richness, decreased gradually from this station to the one nearest to the freshwater sources. Multidimensional analyses revealed two main groups: the first group was formed by all the samples taken from the station nearest to the freshwater sources, and the second group by those sampled in the other two stations. The ANOSIM test confirmed the dissimilarity



between groups, showing significant statistical differences. The overall dissimilarity between these groups was the result of differences in the abundance of a lot of species, that contributed equally. Finally BIOENV analysis showed a low correlation between the observed groups and the water parameters.

P3.9 Is movement behaviour a taxon-free trait? Inter- and intra-specific, body size related variation in movement patterns of benthic macroinvertebrates under resource-free conditions

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Over recent years, it has become of increasing importance to thoroughly understand the underlying mechanisms generating biodiversity patterns. Noticeably, the movement behaviour of individuals has long been acknowledged as a key determinant of species distribution; however, the importance of intraspecific variation in the ecology of mobile organisms is to date a still inadequately investigated factor.

In the present study, the movement behaviour of three crustacean species (the isopods *Proasellus coxalis* and *Lekanesphaera hookeri* and the amphipod *Gammarus aequicauda*) and two gastropod species (*Ecrobia ventrosa* and *Bithynia leachii*) collected in two Mediterranean coastal habitats (i.e., the Acquatina and Le Cesine lagoon - SE Italy) was analysed under resource-free laboratory conditions. The mean step length, total path length and average speed were determined for individuals encompassing a 10-fold range in body length. The scale-independent fractal dimension D was used to quantify the tortuosity of the movement paths.

In general, significant differences were observed in movement metrics between crustaceans and gastropods; yet, species-specific effects were obscured within each taxonomic group due to strong intra-specific variation. Path tortuosity and movement speed resulted the most and the least affected metric, respectively. However, irrespectively of species identity, a significant relationship was observed between path tortuosity and body size.

The results of the study suggest that body size may represent a better predictor of movement behaviour than taxonomic identity. The metabolic and ecological implications of these findings are discussed.



P3.10 Utilisation de la morphologie des otolithes pour la discrimination de deux populations de *Mugil cephalus* dans le Barrage de Nebeur et la lagune de Ghar el Meleh

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Les otolithes « pierres d'oreille » sont de petites concrétions présentes dans la tête de tous les poissons autres que les requins, les raies et les lamproies. Ils donnent aux poissons un sens de l'équilibre, et participent aussi à la fonction d'audition.

Le présent travail porte sur l'analyse morphologique comparée des otolithes de *Mugil cephalus* entre deux milieux différents : Barrage Nebeur et Lagune de Ghar El Melh. Pour chaque individu les otolithes sont prélevés, nettoyés, et photographiés et soumis à l'analyse elliptique de Fourier 'Shape', suivi d'un traitement statistique multidimensionnel (A.F.D.). Les deux stations sont séparées par l'axe F1 (absorption= 84,68%) ; la population du barrage occupe la partie négative de cet axe tandis que la population lagunaire est placée du côté positif de même axe. Donc les résultats obtenus ont permis de mettre en évidence des différences inter populationnelles entre les individus échantillonnés les deux sites Barrage Nebeur et Lagune de Ghar El Melh. Pour la station du Barrage de Nebeur, il existe une asymétrie entre les otolithes gauches et droites des femelles ($p\text{-value} < 0,05$) ; alors ceux des mâles sont symétriques ($p\text{-value} = 1$). Quant à la lagune Ghar El Meleh, les résultats statistiques révèlent des différences peu significatives entre les otolithes droits et gauches des deux sexes ; ce qui traduit une symétrie.

P3.11 Étude otolithométrique comparée de deux populations de *Liza ramada* de deux sites (barrage Mellegue et lagune de Bizerte) de Tunisie

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Les otolithes sont des petits corpuscules de carbonates de calcium localisés au niveau des oreilles internes de tous poissons osseux. De nombreux travaux ont permis de mettre en évidence l'importance des otolithes dans l'identification des poissons.

Le présent travail porte sur l'analyse morphologique des sagittae (gauches et droites) de l'espèce *Liza ramada* capturées dans la Lagune de Bizerte et le barrage Mellegue. Les individus sont traités au laboratoire.

Les résultats obtenus ont permis de mettre en évidence: - absence de ressemblance entre les otolithes gauches-gauches et droites-droites des femelles des deux populations (p-value <0.05), quant aux males du barrage et de la lagune, se différent, seulement, par leurs otolithes droites.

- présence d'une asymétrie entre les otolithes gauches-droites des femelles dans les deux sites : barrage et lagune, aussi bien chez les males du barrage avec une valeur de p-value inférieure au seuil de significativité alpha (0.05).

Par contre une symétrie a été signalée, seulement, chez que les otolithes gauches-droites des males de la lagune avec une valeur de p-value supérieur au seuil de significativité alpha (0,05); ressemblance des otolithes gauches-gauches et droites-droites des males et femelles du barrage (p-value>0.05). Au niveau de la lagune du Bizerte, une différence aperçue, uniquement, au niveau des otolithes droites-droites des deux sexes. Selon les résultats obtenus on peut conclure la présence de deux populations bien définie avec absence d'un dimorphisme sexuel au niveau des deux sites.

P3.12 Importance de la morphologie des otolithes dans la discrimination de deux populations lagunaires tunisiennes (Ghar el Melh et Bizerte) de *Liza aurata* de Tunisie

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Le présent travail consiste à comparer la morphologie des otolithes de deux populations lagunaires tunisiennes (Ghar el Melh et Bizerte) de l'espèce *Liza aurata*. Cette comparaison s'est basée sur l'Analyse Elliptique de Fourier suivie par une Analyse Factorielle Discriminante (A.F.D.).



Les résultats obtenus montrent que les deux populations lagunaires sont séparées par l'axe F1 (absorption = 38,93%). Pour chacune de ces deux populations, les otolithes droits et gauches des deux sexes (males et femelles) sont séparés par l'axe F2 (absorption = 19,31%).

Les analyses statistiques montrent des différences significatives entre ces deux populations avec des p -value < 0.05. Au niveau de la lagune de Bizerte, les différences entre les otolithes droits et gauches des deux sexes sont non significatives (p -value > 0.05) ce qui révèle que les otolithes d'une même paire sont symétriques. Au contraire, les différences enregistrées entre les otolithes droits et gauches des males, d'une part, et des femelles, d'autre part, prélevés dans la lagune de Ghar el Melh sont très significatives (p -value < 0.05) ce qui prouve l'existence d'une asymétrie.

P3.13 Genetic diversity in phytoplankton communities in eutrophicated and oligotrophic coastal lagoons of Languedoc (South of France)

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On the Languedoc coast along the Mediterranean Sea, a set of eight lagoons has been for several decades under the influence of waste water discharges from the depuration plant of the nearby city of Montpellier. Since the discharges stopped at the end of the year 2005, these lagoons entered in a process of ecological restoration. In five of these lagoons representing a large eutrophication gradient, between hyper-eutrophic and mesotrophic, and in a sixth oligotrophic lagoon serving as a reference status, we investigated the genetic diversity of eukaryotic phytoplankton communities by a barcoding method targeting the D1-D2 region of the 28S rRNA. In these lagoons, pico- and nano-phytoplankton represent important parts of the whole phytoplankton communities, but these organisms can hardly be identified under the microscope. The plankton communities were collected once a month, between May and early October 2012, by separating three size fractions: 0.8-5 μ m, 5-20 μ m and 20-100 μ m. The genetic study was carried out from RNA extracts and the sequencing was performed using the Roche 454 GS-FLX Titanium technology. Pigment composition associated with dominant phytoplankton classes (e.g., Dinophyceae, Bacillariophyceae, Cryptophyceae, Chlorophyta) were also analyzed on all fractions for describing the phytoplankton size structure and for testing the possibility of selection biases generated by the molecular approach. The



comparison of diversity patterns highlighted a higher phytoplankton diversity in the smallest size fractions, which distinguished from the medium and large size fractions. The analysis also distinguished the oligotrophic lagoon from the eutrophicated lagoons. This study will serve as a reference point for following the evolution of genetic diversity patterns along with the ecological restoration of most eutrophicated lagoons in future.

P3.14 The Boring fraternity: A research network on marine woodborers

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With this poster we present to the scientific community the establishment of a research network on marine woodborers.

The marine woodborers are a functional group of organisms that, due to their peculiar ecology, interact with any woody substrate present in the sea. Marine woodborers belong to different taxonomic groups, including crustaceans, especially *Limnoria* and *Chelura*, and bivalve mollusks, foremost among them, shipworms (*Bivalvia*, *Teredinidae*) have been logged in European waters since antiquity.

The choice of wood as habitat and food source combined with the adoption of very specific life history strategies, led to strong changes in their morphology and physiology, and the evolution of complex bacterial symbiosis. These evolutionary modifications have put marine woodborers in direct conflict with another main user of timber in the marine environment, the humans.

Despite the ecological, economical and cultural importance, research on marine woodborers is carried out by few specialists scattered across Europe. The setting up of a highly interdisciplinary approach is needed, including taxonomy, genetics, physiology, microbiology, synbiology, autoecology and synecology up to historical analysis, with wide applicative outcomes. With these premises and aims a group of woodborer researchers, belonging to different scientific disciplines from archaeology to genetics, convened in Venice in April 2013 for the first European workshop on marine woodborers, organized by CNR-ISMAR, Venice headquarters and sponsored by the European Science foundation. During the workshop a research network aiming to coordinate scientists with an European perspective and a global view was established. Specific aims of such a network are to facilitate the exploration of new research areas and future collaborations.



P3.15 Distribution and production of chironomids (Diptera: Chironomidae) in a shallow, hypereutrophic boreal lagoon (Baltic Sea, Lithuania)

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Chironomids are dominated invertebrate group in freshwater ecosystems. In general, this insect's group well tolerates oxygen deficiency and this feature makes them one of the most abundant insects group in stagnant eutrophic or hypereutrophic waterbodies. Mostly studies on chironomids life cycles and production come from freshwaters ecosystems and only few come from coastal lagoons. Lagoons are very heterogeneous systems. In one hand lagoons are very productive ecosystems and provide abundant food material for benthic invertebrates. On the other hand these ecosystems suffer from periodic hypoxic event and accidental sea water intrusion in these systems. These environmental factors negatively affected population's dynamics of chironomids. Our aim of this study is to calculate secondary production of chironomids in different lagoon site contrasting with different salinity and oxygen gradient.

P3.16 Reconstruction of food webs in three coastal lakes: a mixing model approach

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Coastal lagoons constitute extremely complex and productive environments. These ecosystems represent a preferred route of migrating birds and optimal location as nursery area for a many fish species. Present research performed a detailed analysis of the food web topology in three small coastal lakes: Caprolace, Fogliano and Sabaudia. Macrobenthos and fishes were sampled in four sites in each lake. Stable isotope analysis ($\delta^{13}C$ e $\delta^{15}N$) was carried out in all the sampled specimens. The communities of three lakes showed different values of both stable isotopes and consequently differences of food web structures emerged. The linkage density for each species was determined by multisource partitioning model S.T.A.R (implemented by R-software). The analysis were based on two criteria: output confidence at 50% and 75% in the use of resources. This two criteria offered different resolution in the reconstruction of the natural network and help us to understand the correct arrangement of the node in the different network. It was observed: large variability of food web robustness in Caprolace and good level of robustness in Sabaudia but the communities of the three lakes showed risk of species extinction.



P3.17 Temporal scales of the body size structure and body condition variation in the brackish isopod *Lekanesphaera hookeri*: is there a role of temperature patterns?

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In this research, we analyzed the variation of body-size structure and condition of *Lekanesphaera hookeri* (Leach, 1814) (Crustacea, Sphaeromatidae) in relation to the variation of temperature over time, using both small and large temporal scales.

L. hookeri is a common isopod in detritivore benthic guilds of transitional waters and it is widely distributed from the North-European coasts to the coasts of the Mediterranean Sea and Black Sea. Despite its relatively low individual biomass and secondary production rate, *L. hookeri* has a key functional role in the lagoon food webs because it is a first consumer of the lagoon detritus, both autochthonous and allochthonous origin. For these reasons, *L. hookeri* seems to be a model species for analyzing spatial and temporal patterns of population dynamic, size structure and body condition in relation to climatic factors, such as temperature.

The climate has been changing over time and temperature variation is one of the main factors. Climatic data, collected in our study site from 1990 to 2010, show two climate trends: the period 1990-2000 shows rising temperatures and, during the period 2000-2010, temperatures were relatively constant.

Here, a population of *L. hookeri* was sampled at the end of these sub-periods, that is at the end of 2001 and at the end of 2010. At each sampling, body-size metrics (total length, dry weight, ash content, AFDW) were recorded for 96 randomly selected individuals. Abiotic data of the site were recorded at each sampling time. Body-size metrics were calculated and compared on small temporal scales (among months) and large temporal scales (among years). Body condition was calculated through statistical analysis, using residuals of length-weight relationship according to the formula: $W = aL^b$.

The main results of this research show: 1. individual biomass decreases significantly with increasing atmospheric temperature, 2. length-weight relationships vary significantly between the two sampling periods.

P3.18 Influence of interspecific horizontal interactions and biodiversity on ecosystem functions: an experiment in laboratory mesocosms

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Studying the relationship between structures and functions in natural ecosystems is one of the most relevant ecological topics. In the last decades has been paid attention to how the mechanisms of community organization and mechanisms of coexistence between species can influence the ecosystem functions. In the formulation of the theory of niche, the competitive relations and coexistence were measured in terms of overlap in the use of limiting resources. Fundamental theories emphasize the role of biodiversity and body-size in the organization of communities and in the mechanisms of the resource partitioning among individuals and species (e.g., niche theory, lottery competitive, body-size theory, metabolic theory). In this research we analyzed: i. the role of benthic macroinvertebrate biodiversity on the functional process of plant detritus decomposition comparing experimental conditions without benthic macroinvertebrates, mono-specific and bi-specific conditions; ii. the role of benthic macroinvertebrate inter-specific competition on the functional process of plant detritus decomposition comparing bi-specific conditions characterized by different body-size ratio between species. Four benthic macroinvertebrate species *Lymnaea truncatula* (Muller), *Physa acuta* (Draparnaud), *Gammarus aequicauda* (Martynov), *Proasellus coxalis* (Dollfus) collected in a slightly brackish habitat were used in mono-specific and in six bi-specific experimental conditions to obtain a gradient of increasing biodiversity and competitive pressures due to body-size overlapping. Control condition was built without benthic macroinvertebrates. The resource availability (*Phragmites australis* leaves) was constant in each condition. The results of this laboratory mesocosm experiment were treated to address the following issues: i. is the rate of *P. australis* decomposition affected by species richness? ii. is the ecosystem function of decomposition affected by interspecific competitive pressures between species due to body-size overlapping? Our results showed: i. considering species richness, the decomposition rate of *P. australis* increased with increasing of biodiversity; ii. considering mono-specific conditions, the decomposition rate of *P. australis* decreased with increasing of species body-size; iii. considering the bi-specific conditions, the decomposition rate *P. australis* increased with increasing the body-size ratio between species.

P3.19 Influence of reproductive traits in the organization of macroinvertebrate communities: a study case in Mediterranean and Black Sea transitional waters

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This research analyzes the influence of reproductive trait on biodiversity organization mechanisms. In particular, the research aims to evaluate the influence of a reproductive functional trait, presence/absence of a planktonic larval stage, in determining the benthic macroinvertebrates ability to colonize the lagoon ecosystems and to highlight species distribution patterns which, together with some specific drivers (i.e., dimension, openness, connectivity, temperature, salinity), determine the taxonomic and functional diversity of the ecological communities. These goals have been reached through a meta-analysis of bibliographical and empirical data about the lists of species for Mediterranean and Black Sea transitional waters and the identification of a reproductive trait of the species (direct development or indirect development with planktonic larval stage). Mollusks and Crustaceans have been mainly considered; more precisely, the class of Bivalvia, Gastropoda and Malacostraca have been analyzed. For Malacostraca, only Amphipoda, Isopoda and Decapoda have been considered. In mollusks, the bivalve species have the planktonic larval stage and show a wider distribution range than gastropods which mainly have a direct development. A partially similar situation has been also observed in crustaceans malacostraca, in which the decapods with planktonic larval stage have a wider distributional range than isopods with direct development; however, even if the amphipods have a direct development, their distributional range was widest. The results underline that the different reproductive strategy does not appear to affect the ability to colonize the lagoon ecosystems. The Bivalvia and Amphipoda, which show the wider distributional average range, reveal distribution patterns correlated with the lagoon ecosystems surface and connectivity apparently determined by purely stochastic effects: i.e., the wider is the distributional range the greater is the probability to colonize ecosystems with small dimensions and low connectivity too. Similarly, the Gastropoda and Isopoda, having different reproductive strategy, are characterized by restricted distributional range and show distribution patterns related to ecosystems' thermal and saline characteristics, highlighting niche specificity.

P3.20 Openness and parsimony as key properties of ecological quality indices. The M-AMBI case

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Reproducibility is a main tenet of the scientific method. In this work, we reproduced and analysed the algorithm of a widely known ecological quality index for transitional and marine waters, M-AMBI using the open source R software.

M-AMBI is based on marine macrozoobenthos and integrates the biotic index AMBI Shannon diversity and species richness by means of factor analysis. The index is enforced in several European countries in the context of Water Framework Directive (2000/60/EC). A user-friendly



freeware has been provided by the authors to calculate the index, however, the software code is not open source and the user is precluded from fully understanding and controlling the algorithm. By reproducing the algorithm, and applying it to three data sets, we were able to deal with the method's assumptions and constraints. Main results include: 1) factor analysis itself is not functional to M-AMBI; 2) M-AMBI can be approximated by the simple mean of the normalised metrics, in this way removing the original dependence to the number of samples in the data set; 3) a bivariate version integrating the species sensitivity index with a single diversity measure is highly correlated with M-AMBI, at the same time avoiding redundancies. According to *lex parsimoniae* (aka Ockham's Razor) the model with the least number of assumptions should be preferred. Desired properties of indices, including simplicity, robustness, openness and ecological meaningfulness, are discussed.

Topic 4. RESILIENCE TO DISTURBANCES AND PERTURBATIONS

P4.1 Effects of multicontamination on the structure of phytoplankton communities in North-Tunisia (Mediterranean Sea)

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In human-impacted areas, sediment may act as a sink for contaminants. However, this storage is not permanent; sediment-bound contaminants may be released into the water column during sediment resuspension events and affect the pelagic community. The goal of this study was to evaluate the impact of contaminated sediment resuspension on the growth and the structure of phytoplankton communities which differ by the level of the human pressures to which they are exposed. For this purpose, we conducted a 5-day in situ microcosm experiment in Bizerte, north-Tunisia (Mediterranean Sea). A "pristine" phytoplankton community and an "impacted" phytoplankton community were exposed to contaminated sediment elutriates prepared from sediment resuspension simulation process. The evolution of their abundance and structural composition was evaluated through taxa identification and counting by microscopic examination.



In this study, we discussed about the difference of sensitivity of phytoplankton communities in relation to their exposure, and their tolerance and adaptability capacities towards multiple contamination in coastal ecosystems.

P4.2 Sensibility of natural phytoplankton from coastal Mediterranean lagoons towards polycyclic aromatic hydrocarbons

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The toxicity of PAH mixture was evaluated towards two natural phytoplankton communities: one from the French lagoon of Thau (Southern France) and another one from the Tunisian lagoon of Bizerte (Northern Tunisia). Phytoplankton communities were exposed to increasing concentrations of PAHs mixture, from 1.5 to 441 $\mu\text{g L}^{-1}$, through in situ microcosm experiments. The effects of PAH mixtures-prepared considering the sediment contamination levels of each lagoon-were assessed at the population level, through chlorophyll *a* (Chl *a*) concentration measurements, and, at the structural level, through taxonomic identification and counting by microscopy and flow cytometry. Regarding the Thau community, 1.8 $\mu\text{g L}^{-1}$ of PAH mixture resulted in a transient decrease of Chl *a* biomass after 24 h of exposure, whereas a higher PAH level (25 $\mu\text{g L}^{-1}$) caused permanent collapse. By contrast, the decrease of the cell density of the Bizerte community was dose-dependent. The EC50 value, calculated after 24 h of exposure, was 0.75 and 1.21 $\mu\text{g L}^{-1}$ for the Thau and the Bizerte phytoplankton community, respectively, suggesting that the Thau community was more sensitive than the Bizerte one. After 24 h of exposure, flagellates (<5 μm) strongly decreased in both experiments, for PAH concentrations equal to 25 and 15 $\mu\text{g L}^{-1}$ for Thau and Bizerte phytoplankton, respectively. Large cells (diatoms and dinoflagellates) were negatively affected by PAHs mixture in both communities, but still remained abundant at the highest contamination levels with 1.1 10⁶ and 0.6 10⁶ Cells L⁻¹ for Thau and Bizerte, respectively. On the other hand, picophytoplankton and picocyanobacteria exhibited contrasted responses to PAH contamination. This can be explained by the fact that smaller cells have a higher surface to volume ratio, which increases their potential uptake rates towards solutes and in turn increase their susceptibility to environmental contaminants.



P4.3 Assessment and spatial distribution of mineral elements in surface sediments of Tunis bay (Tunisia)

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Tunis Gulf (Northern Tunisia, Mediterranean Sea) is the most important bay in Tunisia, according to the importance of its fisheries resources. Due to the increase of urbanisation and development of industrial zones, this Gulf received treated and untreated domestic discharges and industrial effluents which are heavily polluted by serious contaminants throughout streams.

In this work, spatial distribution of metal concentrations in the surface sediment samples collected from 49 marine stations covering the coast of Tunis Gulf was studied. Metals (Cd, Pb, Hg, Cu, Zn, Fe and Mn) and Major elements (Mg, Ca, Na and K) concentrations were measured on the grain fine fraction <63 µm by Atomic Absorption Spectrophotometry.

Multivariate statistic approaches (Principal Component Analysis) were adopted for data treatment, allowing the identification of two main factors controlling the metal variability in the sediments. The results showed that the measured metals have varied spatial distribution patterns, indicating that they had complex origins and controlling factors like anthropogenic activities. Sediment metal abundances were in the order: Fe > Mg > Zn > Mn > Pb > Cu > Cd > Hg. Metals tend to concentrate in proximity of the point sources which suggested that the main sources of mineral pollutants are sewage from the coastal town, industrial dumps and pollution discharged by rivers (Mejerda, Meliane..) and lagoons (Ghar El Melh and Tunis).

P4.4 Assessment of hydroclimatic changes in the Curonian Lagoon of the Baltic Sea

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Climate and hydrological regime lagoon was and still is the most important physic-geographic factor to determine the biological and environment formation processes. The water salinity variations in the Baltic Sea near the Lithuanian coast and in the Curonian Lagoon, a shallow and enclosed sub-basin of the Baltic Sea, were analyzed along with the time series of some related hydroclimatic and anthropogenic factors. The water exchange between the Curonian Lagoon and the south-eastern part of the Baltic Sea occurs through the Klaipeda strait. There were the



reconstruction and dredging works carried out extensively in the Klaipeda strait during the last decade of the 20th century and 21th century in order to meet the growing needs of the only Lithuanian port located there. The global climate warming, rising global sea level as well as the anthropogenic activities may have influence on this transitional water system and, therefore, influence the salinity in the Curonian Lagoon. The study results show that increasing water level, air and water temperature, and decreasing ice cover duration are related to the changes in atmospheric circulation, and more specifically, to the changes in wind regime climate. The latter is also associated with the increasing trends in local storminess and in higher intensity of westerly winds, and correlates with the winter NAO index that indicates the change of the atmospheric circulation in the North Atlantic region, including the Baltic Sea and the Curonian Lagoon areas.

P4.5 Ice regime changes in the south and east lagoons of the Baltic Sea

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Enclosed lagoons are the small continental seas models with a sensitive ecosystem to internal and external pressures. Water temperature appears to be the key factor determining the seasonal and long-term variability of the primary production and abundance of phytoplankton and therefore the level of biological production and trophic status. This study was to investigate the features of the inter-annual ice cover variations and trends in the south and eastern Baltic Sea lagoons. One of the main aims of this study is to compare tendencies of temporal changes of yearly ice cover season in the lagoons of the South and East Baltic -in the Darss-Zingst Bodden Chain (DZBC) and in the Curonian Lagoon (CL) respectively. Also we have analysed time series of some related hydro- climatic factors.

The study results show that increasing air and water temperature, and decreasing ice cover duration are related to the changes in macro scale atmospheric circulation, and more specifically, to the changes in wind regime climate. The ice season in the lagoons of south and eastern part of the Baltic Sea is shortening. In such conditions the absence of stable ice cover and domination of pack ice and ice drift will cause severe problems for navigation and coastal stability. Lagoons climatic changes in ice cover is a good indicator of describing the effects of climate change in the water catchment ecosystem.



P4.6 Clumps of Zebra mussel is a "biogeochemical reactor or litterlout" on sandy sediments?

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In shallow estuarine environment sandy sediments primary acts a sink for nutrients. However, it seems likely that there invasive zebra mussel could modify this habitat and consequently shift the function of sediments. In the Curonian lagoon we found that clumps of zebra mussel, primarily attached to hard substrate, can be carried out from place to the place during storm events. We tried to check if recently settled zebra mussels can fuel biogeochemical processes within sandy sediment. By placing clumps of dreissena in intact sediment cores were have analyzed metabolism by measuring O₂ and TCO, fluxes of nutrient NH₄⁺, NO₃⁻ and PO₄⁻. We have also studied *Zebra* mussel role in denitrification process.

Result from this short-term study demonstrates that recent settled 'mobile' clumps of dreissena mussel evidently changed energy flow. In presence of zebra mussel benthic metabolism increased by 80 %, however, this was primarily due the respiration of mussels themselves. Consequently, denitrification rates decreased 3 times as a result of decline in nitrification. Presumably this is a result of restricted and reduced availability of O₂ to nitrifiers when mussels physically cover surface sediment. Furthermore settled zebra mussel excreted NH₄⁺ and PO₃⁻ shifting this habitat from sink to source of nutrients. However, only a minor part of these nutrients was incorporated into sediment metabolism processes, while the most became available for pelagic primary producers. Although in presence of *zebra* mussel molar N:P ratio increased from 6.5 to 10, this still favored cyanobacteria blooms. Summarizing results we can conclude that dreissena settled on shallow sandy sediment becomes a hot spot of nutrient release.



Topic 5. CONSERVATION AND MANAGEMENT OF COASTAL LAGOONS

P5.1 Which is the influence of management on lagoon communities ? A case study in the Central Tyrrhenian, to assess response of fish assemblages to changing strategies

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The structure and function of coastal lagoon ecosystems, as can be seen today, are the results of interactions among natural dynamics and management by man for centuries. These highly ecological resilient ecosystems sustain biodiversity, also supported by the high productivity. The latter in turn sustains fish productivity and thus important fisheries, a typical pattern of exploitation in most Mediterranean lagoons.

Notwithstanding, local traditions and specific management models, aquaculture and capture fisheries, but also environmental protection of coastal lagoons in the Mediterranean, have usually received marginal attention because of the prevailing interest of alternative uses, such as land reclamation, agriculture, urbanization, industry and tourism. These have generated pressures that seriously have impacted these vulnerable ecosystems, sometimes affecting their preservation.

The historical lifetime of a coastal lagoon is in fact closely linked to the nature of management interventions that are made in it, because lagoons systems are ephemeral systems that tend to disappear over time. This stresses the importance to assess the role of different management strategies in coastal lagoons, as a tool to plan adequate strategies for conservation.

Against this background, the case study of the Pontinian coastal lakes (Italy, Central Tyrrhenian) has offered a unique opportunity to evaluate the relative role of lagoon management strategies and anthropogenic pressures on fish assemblages and fisheries. The lagoon system consists of four small-size coastal lakes, included since 1975 within the boundaries of the Circeo National Park. In the lakes, directly managed by the National Park authorities, a small-scale sustainable fishery was present up to 2007, while the fourth lake is privately owned and its management has included, besides lagoon fisheries, also an aquaculture facility and a marina.

In this work, preliminary results of the assessment of the fish assemblages are presented, by comparing their structures in different moments and under different management strategies.



P5.2 Towards the definition of environmental indicators for the quality assessment of Mediterranean coastal lagoons: a case study of three small-size lagoons from the Central Tyrrhenian coast

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Mediterranean lagoons have been facing a high rate of change over recent decades, that results from the impact of the wide range of human activities affecting them. These include hydrological modifications, water pollution and habitat loss, that have brought about detrimental impacts on the dynamics of these peculiar ecosystems and on the structure of the biological assemblages.

Fish-based multi-metric indices are becoming important tools for the assessment of the ecological status of transitional waters, and in particular of coastal lagoons, also because in Europe the WFD recommends fish assemblages as a biological quality element to be used to assess and manage transitional waters.

In this work, a comparative assessment of the ecological status of three small-sized coastal lagoons in the Tyrrhenian area was carried out with the aim to define and test a methodological framework for a quantification of pressures for this coastal lagoon typology.

The fish-based multimetric index approach was applied to evaluate the quality of three coastal lakes (Fogliano, Caprolace and Sabaudia) in the Circeo National Park (Italy, Central Tyrrhenian). A detailed investigation of the anthropogenic pressures present on each lagoon water body and terrestrial boundaries was carried out, also taking into account management strategies of the lagoons, and their magnitude was quantified. Reference was made to the scheme proposed by Aubry and Elliot (2006), taking into account three pressure categories: coastline morphological change, resource use change and environmental quality.

The fish assemblage was studied by seasonal samplings carried out in 2006, 2007 and 2012 in Fogliano and Caprolace, and in 2012 in Sabaudia, in four stations in each lagoon, by fine-mesh beach seine.

Preliminary results based on quantile regressions allow to identify the most relevant pressure indicators for the fish assemblage of the three coastal lakes, through the identification of pressure-response relationships of the fish community.



P5.3 Ecological quality assessment in the Cabras lagoon (Sardinia, Italy): which benthic index performs best?

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The conservation of natural habitats and of wild fauna and flora is a fundamental objective of European Community actions in the field of water policy. Benthic macroinvertebrates are one of the biological elements used for assessing the ecological quality (EcoQ) status of water bodies within the WFD 2000/60/EC. Many benthic indices have been developed and at present a large debate is taking place about the selection of appropriate indices and their performance towards the management of coastal transitional ecosystems (CTEs).

In this paper, we assessed the performance of four widely used biotic indices, M-AMBI, BENTIX, BITS and BOPA, in the Cabras lagoon, the largest CTE of Sardinia which is renowned both for its fishery activities (e.g. *Liza ramado*, *Mugil cephalus*) as well as its naturalistic value (e.g. it is part of the Ramsar Convention on Wetlands and the Natura 2000 network following the EU habitat directive). The dataset for the computation of the indices were extracted from monitoring activities carried out seasonally during 2001-2003 and 2010-2011 in four sites along a salinity and saprobity gradient. The benthic community was also investigated by means of traditional approaches, including the analysis of species composition and abundance, the spatial and temporal distribution, as well as the relation with the hydrological and sediment features at the sites. The indices provided contrasting results and different levels of the ecological quality (EcoQ) status of the lagoon, being BITs and M-AMBI more appropriate in selecting the areas along the different environmental gradients, in contrast with BOPA and BENTIX. The possible causes of the different results obtained are suggested also in the light of the results provided by the structural analysis of the community.

P5.4 Taxonomic and ecological data on the macrozoobenthos of Orikumi lagoon, Albania

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The aim of the study was to assess and analyze the species composition, quantitative characteristics, seasonal variations and stability of macrozoobenthic community of Orikumi Lagoon (Albania, Adriatic Sea). Sampling was carried out during 2011 at four different sites in two seasons, spring and autumn. A total of 64 taxa of benthic macroinvertebrates have been recorded, of which: 39 (61%) Mollusca, 17 (26%) Arthropoda, 5 (8%) Anelida and 3 (5%) other taxa. Four benthic species have been reported for the first time in Albania (*Paranemonia cinerea*, *Chrysallida incerta*, *Paludinella sicana*, *Hemigrapsus sanguineus*). Among the recorded species, three of them are considered as alien species to the Mediterranean Sea (*Ruditapes philipinarum*, *Ficopomatus enigmaticus*, *Hemigrapsus sanguineus*). One of the reasons for the high diversity of benthic macroinvertebrates in Orikumi Lagoon may be related to the microhabitats diversity within the lagoon, where different sediment typologies and salinity gradients are present. The macrovegetation of the lagoon plays an important role in the characteristics of macrozoobenthic populations, providing a suitable sheltering and feeding habitat, especially for mollusks. Taking into account the species distribution within the lagoon, quantitative characteristics and their seasonal variations, the degree of stability of the macrozoobenthic community in the lagoon can be considered as a relatively medium. Compared to the other lagoons of the Albanian coast, the environmental impact in Orikumi lagoon seems to be more limited, mainly because of the more limited human access, as the western part of the lagoon is situated within a military base.

P5.5 Condition monitoring: design and methodologies. A case-study of NW European lagoons

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Coastal lagoons are ecosystems of nature conservation importance in Europe and they are often relevant features of designated areas of interest for species/habitat protection at both international (e.g., SAC, SPA) and national level (e.g., SSST, UKBAP areas in the UK). Lagoons are characterised by the presence of saline-brackish water, relatively shallow and sheltered conditions. They can have a wide variability in physiographic characteristics (including geographical distribution, morphology and hydrology) not only at an international scale (e.g., differences between Mediterranean and North Atlantic regions) but also at a national one. This may result in significant differences in the species and communities these systems support. While coastal lagoons are a common transitional water body type in the Mediterranean region, they are relatively uncommon in the UK. Here they are generally of small size, with a range of physiographic sub-types often supporting species which are restricted in their distribution to the



lagoon habitats. Consequently a high proportion of UK lagoons have been included within SAC designations. As a result, monitoring plans are in place to assess the condition of lagoon features against a set of targets based on attributes such as extent, salinity regime and species composition. Sampling designs and methods have been devised to combine the collection of high quality data, using statistically rigorous and repeatable monitoring programmes, with the need of minimising disturbance in a vulnerable environment. The present study presents the methods and possible issues/lessons learnt in this type of monitoring by using two UK lagoon systems, South Walney lagoons and North Norfolk lagoons, as case studies. Results are also compared with monitoring programmes in Southern European lagoons and related to differences in monitoring aims and lagoon characteristics (e.g., size, rarity of habitats/species).

P5.6 First phytochemical evidence of chemotypes for the seagrass *Zostera noltii*

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Zostera noltii Hornem. (common name dwarf eelgrass) is an important species of seagrass occurring along European and North African coasts. Until recently, *Zostera* taxonomy was only based on morphology. The development of DNA-based molecular markers has led to an abundant literature on seagrass genetics over the last decade. The existence of geographically distinct populations of *Z. noltii* throughout its biogeographic range has been reported. As yet, the factors underlying this geographical genetic variability are poorly understood. Their possible consequences for the secondary chemistry of *Z. noltii* have not been considered despite the role of these substances as chemical defences. Flavonoid sulfates have been identified as possibly of taxonomical and ecological significance for seagrasses and other plants of saline habitats, and may play a role in their allelochemical relations.

In this context, our aim was to fully characterize the flavonoid profile of *Z. noltii*, and examine how these compounds vary among seagrass meadows located throughout the Atlantic and Mediterranean. Samples were collected at thirteen localities, and extracts were prepared by maceration in water. The phenolic content was fully characterized, and the concentration of the individual phenolic was determined by quantitative HPLC-DAD.

Analysis of the results showed that the 3 populations from the French Atlantic coast and the 7 populations from the Mediterranean Sea share the same flavonoid fingerprints. In contrast, the three populations grown in the sub-basin of the North Atlantic nearest to the Strait of Gibraltar are chemically distinct from all the others. These results fit well with the existence of geographically distinct populations of *Z. noltii* reported in the Literature.

This work reveals unknown features about the chemical plasticity and patterns of flavonoid



composition in *Z. noltii*. Understanding the underlined causes of the geographic variation of *Z. noltii* sulfated flavonoid content and its possible link with ecological factors appear crucial to elucidating the functioning of *Z. noltii* communities, and for monitoring and management of *Zostera* beds.

P5.7 Chemical warfare in coastal ecosystems: the *Zostera-Alexandrium* case

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Plants are provided with a large arsenal of defensive secondary metabolites. The most important group of toxic chemicals produced by plants is the huge family of phenolics, including the subgroups of flavonoids and tannins. Phenolic compounds are well known as allelopathic agents in terrestrial plants, and similar ecological functions have been proposed for seagrasses. There is now strong evidence that chemical interactions play an important role in marine ecosystems regulating algal biodiversity, structure and seasonal variation. However, the effects of marine plant secondary metabolites on co-occurring microorganisms remain largely undocumented

Z. marina and *Z. noltii* are important seagrasses occurring along European and North African coasts. *Alexandrium catenella* is a widespread PSP toxin-producing dinoflagellate species. Since 1998, recurrent *A. catenella* blooms have been observed in the Thau lagoon (French Mediterranean coast), but never in Arcachon lagoon (French Atlantic coast), which led us to hypothesize that *Zostera* beds regression could facilitate the settlement of *Alexandrium* blooms. In support of this, we have demonstrated that methanolic and aqueous extracts of *Zostera* leaves from Arcachon or the Thau lagoon significantly inhibits the growth of *A. catenella*. The highest concentrations of phenolics were found to correspond to the lowest EC50 values, suggesting that these secondary metabolites might be responsible for the observed algicidal activity. Our findings support a possible natural negative effect of allelochemicals produced by *Zostera* against *A. catenella*, and threw a new light on the role that *Zostera* chemistry could play in regulating HAB dynamics.

In continuation of this work, we proceeded to the purification of the crude extracts in order to identify the causative bioactive substances in the cocktail of phenolics produced by *Z. marina* and *Z. noltii*: zosteric acid, rosmarinic acid and flavonoids. The effect of fresh tissue of *Zostera* on the growth of *A. catenella* was also studied.



P5.8 Exposition and contamination in the Venice lagoon. From experimental evidence in *Zosterisessor ophiocephalus* towards a numerical evaluation

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During 2010, a wide monitoring of the concentration of metals in the sediment and in different tissues of *Zosterisessor ophiocephalus* has been carried out in the lagoon of Venice.

Z. ophiocephalus is a native fish with a territorial behavior during the breeding season, and it has often been used as a bioindicator. Experimental evidence indicates that the fishes from stations characterized by low contaminated sediments are more exposed.

To explain this result, the numerical finite element model SHYFEM has been applied to reproduce the lagoon's circulation in the year 2010 under realistic conditions. A Lagrangian module, that was developed in order to calculate the connectivity between stations, has been added to the model. The behaviour of a generic contaminant in the water column has been assumed and has been represented as a Lagrangian particle, characterized by a time of suspension and bioavailability of 15 days.

The particles are emitted continuously and exchanged through the entire network of stations. This network consists of 38 points, identified on the basis of the presence / proximity to pollution sources such as inhabited islands, industrial areas, docks and shipyards. Each station acts simultaneously as source and receiver of pollutant particles. The simulations cover the period of six months prior to each sampling.

In this way we estimated cumulative exposure of each station to all the others. At the same time, it has been possible to specify the contribution of individual stations to the total exposure of each station.

The results obtained highlight the reason of high metal concentrations found both in the tissues and in the diet of the fish in stations considered as "not contaminated".

The methodology developed and partially validated in this study, as well as being exportable to other sites, offers a wide applicability in management studies.



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