



Mares
Conference

Mares Conference

Marine Ecosystems Health and Conservation

February 1st - 5th 2016

Olhão Portugal

Abstract Book

Mares Conference

Marine Ecosystems Health and Conservation

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Olhão, Portugal

An initiative from

The MARES Joint Doctoral Programme on Marine Ecosystem Health & Conservation
and the EuroMarine Network

Organised by:

Mares Conference Coordination Office
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Cover image: Katherine Brownlie © 2014

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CONFERENCE ORGANISERS

The Mares Conference on Marine Ecosystems Health and Conservation 2016 is an initiative of the MARES Joint Doctoral Programme and the EuroMarine Network.

MARES JOINT DOCTORAL PROGRAMME

This joint international thematic doctoral programme was initiated in 2010 within the framework of Erasmus Mundus. Since then over 40 scientists have been actively conducting research focused on the impacts of human activities on marine ecosystems. Organised by the MARES Consortium, a network composed of 24 partners from 14 different countries, the programme has evolved from a doctoral research programme into an active international research network.



EUROMARINE NETWORK

EuroMarine is a new European marine science network formally launched in June 2014. It represents the merger of the communities of three former European Networks of Excellence: EUR-OCEANS, Marine Genomics Europe, and MarBEF. It was designed by the EuroMarine FP7 preparatory project (2011-2013) to represent a bottom-up organisation and the voice of the European marine scientific community at large.



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Katherine Brownlie - Ghent University
Dr. Pierre-Francois Baisnée - University
Pierre and Marie Curie
Prof. Dr. Marina Cunha - University of Aveiro
Prof. Dr. Adelino Canario - University of Algarve
Prof. Dr. Karim Erzini - University of Algarve

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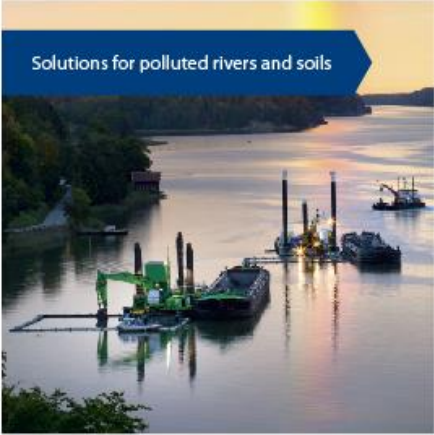
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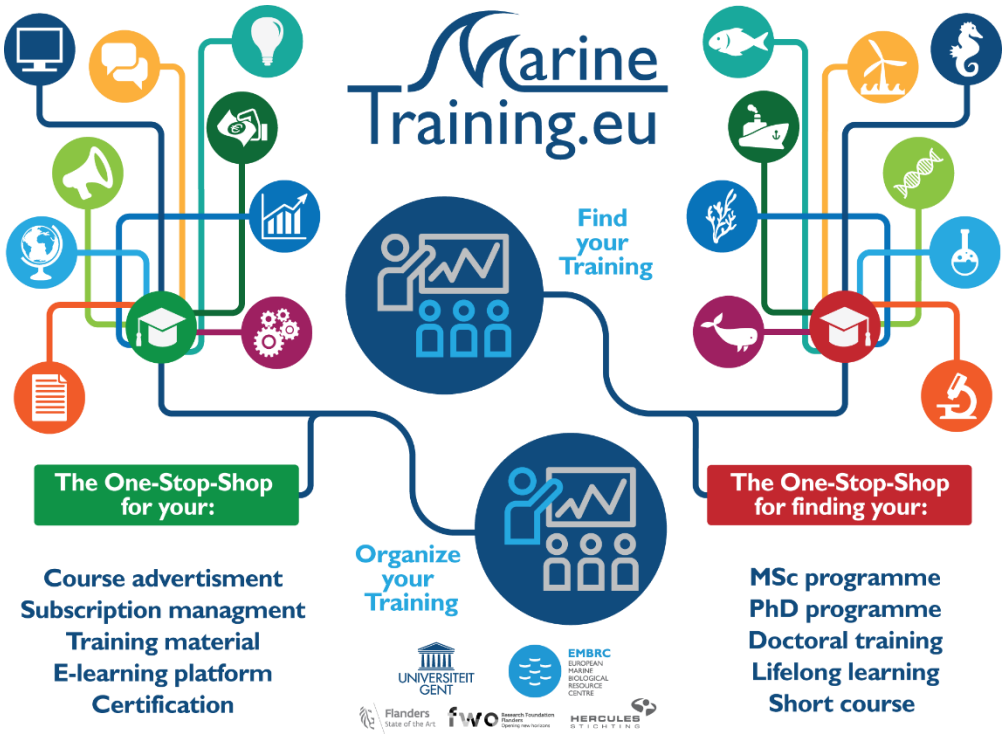
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SUPPORTERS



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CONFERENCE THEMES

FUTURE OCEANS: TEMPERATURE CHANGES - HYPOXIA - ACIDIFICATION

Temperature increase, ocean acidification and expanding hypoxic zones in the ocean have the most prominent impacts on marine ecosystems health on the global scale. All three phenomena are at least partly related to the anthropogenic release of carbon dioxide and climate change. Changes in ocean temperature can lead to shifts in the distribution ranges of many marine species. Dramatic biogeographical shifts have already been documented for zooplankton communities in the Northeast Atlantic, where warm-water species have moved 1000 km further north over the past 40 years, whereas cold-water inhabitants have contracted their range. Recent results show that the reaction of marine ecosystems towards climate change, including ocean warming, acidification and expanding hypoxic zones, is often not linear but may occur in abrupt reorganisations of marine communities. It is now generally accepted that such regime shifts can transfer a marine ecosystem from one steady state to another as soon as certain thresholds of important key species are transgressed.

UNDERSTANDING BIODIVERSITY EFFECTS ON THE FUNCTIONING OF MARINE ECOSYSTEMS

During the last decades, it has become increasingly clear that the biodiversity of an ecosystem and its functional features are intricately linked. While before the emphasis mainly lay on trying to understand how environmental constraints maintain and regulate diversity, during the last years the focus has shifted to the reverse question, namely how does the biodiversity of an ecosystem affect its functioning? This paradigm shift was brought about by the alarming decline in global biodiversity caused by human activities. If altered diversity seriously impacts the basic functions of ecosystems, will this have serious consequences for the goods and services provided by ecosystems to humans? The objective of this theme is to further our understanding of how interactions between species, both within and between trophic levels, affect the key functions of marine benthic ecosystems, namely biomass production and nutrient regeneration, and how these biodiversity effects on ecosystem functioning can be influenced by anthropogenic activities (pollution, fisheries).

BIOLOGICAL INVASIONS

Species, subspecies or lower taxa introduced outside their natural past or present range (or of their natural dispersal potential) are named non indigenous species (NIS). Due to the globalisation of human activities, intentional or unintentional introductions of marine species have become a priority issue for marine conservation. During the last century a consistent subset of NIS demonstrate their capability of spreading over a level that alters the invaded ecosystems. Invasive alien species (IAS) can have adverse effects on biological diversity, ecosystem functioning, socio-economic values and/or human health in invaded regions. Understanding biological invasions requires multidisciplinary expertise including taxonomy, molecular biology, biogeography, population ecology, ecological modeling and economics. There is a global need to train scientists in assessing key descriptors of biological invasions (i.e. abundance and distribution, vectors of introduction, impact on native

communities and habitat, impact on ecosystem functioning and energy flow) and find management solutions to NIS introduction and IAS spread.

NATURAL RESOURCES: OVEREXPLOITATION, FISHERIES AND AQUACULTURE

Since the late 19th Century, the world fisheries catch has increased steadily, however, analysis of global trends of the most important marine stocks in the world shows that the majority are overexploited or depleted. New and constantly improving technology (synthetic fibres, electronics, remote sensing), along with overcapitalisation and subsidies are the driving forces behind the overexploitation of marine fisheries resources. The effects of overexploitation can be seen in the decreasing mean size, “fishing down the food chain” phenomenon as fisheries turn to species lower down the food chain as those higher up are depleted, loss of genetic variability, changes in community structure, loss of biodiversity and regime shifts. Aquaculture is already an important industry and is seen by some as a replacement for fisheries. However, commercial aquaculture also relies heavily on fisheries (by) catch for oils and fish meal, which puts further pressure on fish stocks. A range of different approaches are needed to better understand the interactions of fisheries (and aquaculture) with the marine environment and provide a scientific basis for the management of marine resources.

OCEAN NOISE POLLUTION

Anthropogenic sources of noise in the marine environment have increased in line with expansion in shipping, oil and gas exploration, infrastructure development, offshore renewable energy generation, naval sonar and research activities. These sound sources vary in intensity and frequency and can result in chronic and acute impacts on marine organisms. Marine fauna that use sound for social interactions may have inter- and intra-specific communication masked or impeded. In addition, organisms that use sound for foraging may suffer direct impacts through masking or indirect impacts through alteration in prey distribution or habitat loss.

HABITAT LOSS, URBAN DEVELOPMENT, COASTAL INFRASTRUCTURES AND MARINE SPATIAL PLANNING

The coastal zones are changing under pressure from a growing human population and the conversion of shoreline habitat to urban development. Marine landscapes have been globally altered by the introduction of a variety of human-made infrastructures such as breakwaters, artificial reefs, offshore platforms, wind farms and tidal gauges. While the conservation challenges associated with the expansion of human infrastructures are well understood in terrestrial systems, urban ecology has not been of as much focus in marine science and management. However, some of the most obvious and economically important negative effects on natural ecosystems are already being seen in the coastal zone. With the expansion of maritime activities and the increasing need of complying with international agreements on the protection of biodiversity there is also a growing interest in marine spatial planning as a tool to manage the use of marine systems.

CONFERENCE PROGRAMME

MONDAY 1ST FEBRUARY

TRAINING WORKSHOPS

09:00 Presentation skills: speaking enthusiastically in front of a group
Frederik Imbo
Media skills for researchers - *Alun Lewis*
aRe you Ready foR R? - *Fernando Cánovas*

12:30 Lunch

13:30 Presentation skills and poster design - *Toon Verlinden*
Media skills for researchers - *Alun Lewis*
Non Statistics with R - *Fernando Cánovas*

TUESDAY 2ND FEBRUARY

TRAINING WORKSHOPS

09:00 Advantages of Open Science to research career - *Ivo Grigorov*
aRe you Ready foR R? - *Fernando Cánovas*
Scientific illustration - *Jorge Palma*

12:30 Lunch

13:30 Dos and don'ts in manuscript submission and review: an editor's perspective
John Roff
Non Statistics with R - *Fernando Cánovas*
Dredging and the environment - *Marc Huygens*

OPENING SESSION

17:30 Introduction
Tim Deprez
17:40 Marine biodiversity and ecosystem functioning are the pillars of good
environmental status
Ferdinando Boero
18:20 What do we need to tackle marine global changes?
Sam Dupont
19:00 Welcome reception

WEDNESDAY 3RD FEBRUARY

FUTURE OCEANS

CHAIR: LAURA AIROLDI

- 09:00 Future oceans: warming, acidification and deoxygenation
Jean-Pierre Gattuso
- 09:45 Monitoring stress in warming oceans - a non-lethal approach for the tropical reef fish *Amphiprion ocellaris*
Carolina Madeira
- 10:00 Could the intertidal *Ellisolandia elongata* reef be affected by climate changes expected in the near future in the Mediterranean Sea?
Matteo Nannini
- 10:15 Effects of ocean acidification on biochemical biomarkers and swimming ability of the sand-smelt larvae
Cátia Silva
- 10:30 Coffee break**
- 11:00 Impact of ocean acidification and warming on the functioning of a North Eastern Atlantic maerl bed community
Erwann Legrand
- 11:15 Recent demographic changes at a rear edge of giant kelp (*Macrocystis pyrifera*) did not reduce the overall levels of genetic diversity of extant populations
Jorge Assis
- 11:30 Complex global change: multifactorial pressure, multivariate response and the role of fluctuations in a benthic community
Martin Wahl
- 11:45 Marine canopies in a changing environment: projecting the distribution of species of *Cystoseira* under alternative climatic scenarios
Roberto Buonomo
- 12:00 Another side of the climate change coin: effects of fluctuating vs stable temperature regimes on the population dynamics and species interactions of marine nematodes
Anna-Maria Vafeiadou
- 12:30 Lunch**

NATURAL RESOURCES

CHAIR: JEAN-MARC GUARINI

- 14:00 Overfishing – Not one problem and not one solution
Jake Rice
- 14:45 Species composition and mortality rates of sea turtles interacting with the Portuguese pelagic longline fishery targeting swordfish in the Atlantic
Rui Coelho
- 15:00 Contrasting timing of life stages across latitudes: a case of a marine forests forming species
Tânia Pereira
- 15:15 Relationship between the *Octopus vulgaris* life cycle and its exploitation patterns by the trap fishery in the southern coast of Portugal
Carlos Sonderblohm
- 15:30 Coffee break**
- 16:00 CIA; assessment of Atlantic Herring spawning beds as an example of effective transboundary co-operation
Phil Latto
- 16:15 Technical and economic viability of traps in the Portuguese fishery of deep-water rose shrimp (*Parapenaeus longirostris*)
Moritz Eichert
- 16:30 Recovery of seaweed at barren ground using steelmaking steel slag and sediment on bottom of dam reservoir in Japan
Yuji Sakai
- 16:45 The impact of Amazon and Orinoco river plumes on the eutrophication of Caribbean coral reefs
Pierre-Alain Mannoni
- 17:00 Demography of the bigeye thresher shark *Alopias superciliosus* in the Atlantic Ocean: Application of Leslie matrices with incorporated uncertainties
Joana Fernandez-Carvalho

AWARENESS PRESENTATIONS

- 17:45 European Marine Biological Resource Centre (EMBRC) - *Jan Vanaverbeke*
18:00 DEME group - *Marc Huygens*

SCIENTIFIC EXHIBITION

- 18:30 Scientific Exhibitions: Future Oceans & Natural Resources

THURSDAY 4TH FEBRUARY

BIODIVERSITY EFFECTS

CHAIR: JAN VANAVERBEKE

- 09:00 Are biodiversity - ecosystem function relationships an important ecological paradigm or a distraction from understanding environmental and ecological interactions?
Stephen Widdicombe
- 09:45 Multiple, alternative stable states in marine metacommunities: risk of unintended consequences in MPA management scenarios
Jean-Marc Guarini
- 10:00 Seahorse population fluctuations in the Ria Formosa Lagoon, South Portugal
Miguel Correia
- 10:15 Assessing functional diversity of marine nematodes in the 21st century: moving away from the black box approach
Tom Moens
- 10:30 Coffee break**
- 11:00 What's a picture really worth? On the use of drone aerial imagery to monitor intertidal rocky shores
Inês Gomes
- 11:15 Assessment of faunal communities and ecosystem Interactions within a sub – tropical lagoon using baited remote underwater video
Henriette Grimmel
- 11:30 Trophic diversity of seagrass detritus copepods: a consequence of species-specific specialization or a random diet?
Thibaud Mascart
- 11:45 Development of a novel molecular tool for the rapid assessment of the biodiversity changes of benthic nematodes assemblages
Ana Patrícia Avó
- 12:00 Biodiversity-ecosystem functioning relationships under environmental change: the need for empirical evidence
Nessa O'Connor
- 12:15 Homing behaviour in two concurring species of limpets: *P. vulgata* and *P. depressa*
Claudia Bommarito
- 12:30 Lunch**

- 14:00 Non indigenous marine species: science and management for their control in Europe - *Anna Occhipinti-Ambrogi*
- 14:45 Effects of ocean acidification on the microbiome of an invasive brown seaweed and the gutmicrobiome of a native isopod consumer
Alexandra Serebryakova
- 15:00 A robust DNA-based marker for detection of invasive anadromous Salmonids from estuary water eDNA
Laura Clusa
- 15:15 Winners and losers in expanding marine urban habitats: can we do it better?
Laura Airoidi
- 15:30 Coffee break**
- 16:00 Non-native species in northern Europe: investigating the potential for future spread using high resolution climate projections
Bryony Townhill
- 16:15 Molecular barcoding of red algae in the Cantabrian Sea reveals the presence of exotic Asian seaweeds (*Pachymeniopsis gargiuli*, *Grateloupia imbricata* Holmes and *Grateloupia turuturu* Yamada) - *Yaisel Juan Borrell Pichs*
- 16:30 Assessing the marine fouling community in a man-made marina at Manila Bay
Melody Anne Ocampo
- 16:45 Changes in the food web structure in the Eastern Mediterranean Sea under cumulative impacts
Xavier Corrales Ribas
- 17:00 Fast and cheap environmental DNA method to detect the invasive black-pygmy mussel *Xenostrobus securis* in water samples
Laura Miralles
- 17:15 Lessons from Pacific islands: marine protected spaces help to control the spreading of exotic species
Alba Ardura

SCIENTIFIC EXHIBITION

- 17:30 Scientific Exhibitions: Biodiversity Effects, Biological Invasions and Habitat Loss

CONFERENCE DINNER

- 19:30 Conference dinner

FRIDAY 5TH FEBRUARY

HABITAT LOSS AND OCEAN NOISE

CHAIR: HELENA ADÃO

- 09:00 The future of ocean noise management - advances, gaps, priorities
René Dekeling
- 09:45 Effects of short term exposure with mine tailings on deep-sea benthic ecosystem function and services
Lisa Mevenkamp
- 10:00 Understanding the impact of coastal renewable energy technology on the marine environment
Christina Comfort
- 10:15 Deep-sea megafaunal response to physical disturbance along the SW Portuguese continental slope
Sofia Pinto Ramalho
- 10:30 Coffee break**
- 11:00 Marine spatial planning to address habitat loss, coastal infrastructure development, urbanization, and the loss of coastal and ocean values
Tundi Agardy
- 11:45 Artificial holdfast units: accessing their usefulness for the recovery and conservation of seahorse populations in the Ria Formosa lagoon, South Portugal
Miguel Correia
- 12:00 Barrier island restoration following Hurricane Katrina affects habitat quality for oysters in a northern Gulf of Mexico estuary
Kyeong Park
- 12:15 Assessment of marine biodiversity enhancement measures for tidal lagoon developments
Rachel Crabtree
- 12:30 Assessing ecosystem services in coastal lagoons
Miguel Inácio
- 12:45 Quantifying resistance to erosion in salt marshes of the Northern Adriatic Sea
Veronica Lo
- 13:00 Lunch & closing words**
- 14:30 Optional excursion

SCIENTIFIC EXHIBITION - WEDNESDAY 3RD FEBRUARY

FUTURE OCEANS	PRESENTING AUTHOR
FO.01 The effects of phthalates on <i>Nereis diversicolor</i>	<i>Ashwaq Alnemari</i>
FO.02 Stress response to El Nino conditions in giant kelp	<i>Luis Barreto</i>
FO.03 What is the acidification level in the Mediterranean Sea?	<i>Abed El Rahman Hassoun</i>
FO.04 Average pH variations in the Mediterranean Sea surface waters	<i>Elissar Gemayel</i>
FO.05 What's for dinner? Harpacticoid eating habits in hypoxic environment	<i>Marina Giunio</i>
FO.06 Larvae of coral eating crown of thorns starfish <i>Acanthaster planci</i> in a warmer-high CO ₂ ocean	<i>Pamela Kamyra</i>
FO.07 Photoprotective response and recovery of phytoplankton communities in the Southern Ocean against high light exposure	<i>Tomoyo Katayama</i>
FO.08 Trace elements in future oceanic conditions in Seagrass ecosystem: Ecological implications and toxic effects	<i>Amrit Kumar Mishra</i>
FO.09 A framework for assess vulnerability of coastal fisheries to climate change in Portuguese coast	<i>Francisco Leitão</i>
FO.10 Thermal stress biomarkers in the widespread tropical and subtropical sergeant-major fish: temperature as a major environmental stressor in a warming ocean	<i>Carolina Madeira</i>
FO.11 Physiological resilience of southern edge populations of <i>Fucus vesiculosus</i> to consecutive desiccation and heat shock	<i>Neusa Martins</i>
FO.12 Altered epiphyte community and sea urchin diet in <i>Posidonia oceanica</i> meadows in the vicinity of a volcanic CO ₂ vent	<i>Patricia Nogueira</i>
FO.13 Population dynamics of temperate kelp near their low-latitude limit	<i>Tânia Pereira</i>
FO.14 Long-term changes in the occurrence of intertidal seaweeds in NW Iberia	<i>Cristina Piñeiro-Corbeira</i>
FO.15 A novel system to manipulate and control CO ₂ levels in mesocosms for ocean acidification experiments	<i>Laura Sordo</i>

FO.16 How to deal with food deprivation under three temperature regimes: a lipid perspective of the intertidal copepod species *Platychelipus littoralis* (Harpacticoida) *Eva Werbrouck*

FO.17 Living in multi-stressed sediments: behavioral consequences for the functioning and diversity in coastal habitats *Ee Zin Ong*

NATURAL RESOURCES

NR.01 What are we losing? - an Economic perspective of fisheries discards in Portugal *Vânia Baptista*

NR.02 A well-kept treasure at depth: precious red coral rediscovered in Atlantic deep reefs (SW Portugal) after 300 years *Joana Boavida*

NR.03 Assigning *Hippocampus guttulatus* recruits to the populations of origin using microsatellites: results from a field study in the Ria Formosa (South Portugal) *Miguel Correia*

NR.04 Science, technology and society initiative to minimise unwanted catches in European fisheries – the MINOUW project *Karim Erzini*

NR.05 Monitoring approaches for supporting offshore aquaculture management and EU Directives at Sagres, Portugal *Bruno Fragoso*

NR.06 Impact of farming non-indigenous scallop (*Argopecten irradians*) on benthic environment in Bohai Sea *Qian Huang*

NR.07 Trawling and creeling for *Nephrops* fisheries. Comparison of environmental impacts and bycatch assessment *Lino Marques*

NR.08 Mapping of the chemosensory system in *Holothuria arguinensis* *Nathalie Marquet*

NR.09 Methodology: optimizing protein extraction and separation in *Fucus* macroalgae to study desiccation-tolerance *Catarina Mota*

NR.10 Barrier trap selectivity improvement for the management of coastal lagoons: case study from an Eastern Mediterranean lagoon *Dimitrios Moutopoulos*

NR.11 Marine commercial fish feeding: dietary characterization and food availability of three fish species from a southern European temperate estuary (Mondego estuary, Portugal) *João M. Neto*

NR.12	Impact of coastal mussel farms on the macrobenthic soft bottom community	<i>João M. Neto</i>
NR.13	Metabolic enzyme activities as indicators for physiological conditions in early developmental stages of <i>Amphiprion ocellaris</i>	<i>Nina Paul</i>
NR.14	Approaches to characterize the fishing effort of the artisanal fisheries in the Algarve (Southern Portugal)	<i>Pauline Raimbault</i>
NR.15	Developing a network of underwater routes at the Algarve	<i>Mafalda Rangel</i>
NR.16	Mapping the socio-economic and cultural importance of inshore fisheries	<i>Marleen Roelofs</i>
NR.17	Three decades of sandy commercial bivalves surveys on the South coast of Portugal: a spatio-temporal analysis	<i>Marta Rufino</i>
NR.18	Spatial protection and size composition of soft bottom fish communities: the case of the Luiz Saldanha Marine Park (Portugal)	<i>Inês Sousa</i>

SCIENTIFIC EXHIBITION - THURSDAY 4TH FEBRUARY

BIODIVERSITY EFFECTS

PRESENTING AUTHOR

BE.01	Hybridization signals in <i>Fucus</i> diversification	<i>Susana Almeida</i>
BE.02	Diversity of pelagic fish larvae in a latitudinal gradient across the Atlantic Ocean estimated through DNA Barcodes and visual identification.	<i>Alba Ardura</i>
BE.03	Photo-identification and bioacoustics analysis to investigate the growth of sperm whale (<i>Physeter macrocephalus</i>) and its movements in the Mediterranean Sea	<i>Alice Briola</i>
BE.04	Food and feeding habits of the Lessepsian migrant pufferfish <i>Lagocephalus sceleratus</i> from two different habitats, the Gulf of Suez and the Mediterranean Sea	<i>Azza El Ganainy</i>
BE.05	Composition and dynamics of armored dinoflagellates assemblages in the upwelling region (Cape Saint Vincent, Sagres, South-West Portugal)	<i>Bruno Fragoso</i>
BE.06	Shell discoloration in intertidal mussels due to endolithic parasitism: a cool phenotypic shift?	<i>Miguel Gandra</i>
BE.07	Fatty acids as indicator of the effect of an herbicide in two marine bivalve species: <i>Cerastoderma edule</i> and <i>Scrobicularia plana</i>	<i>Ana Marta Gonçalves</i>
BE.08	Mixture and individual effects of a herbicide and a metal on marine and estuarine planktonic species	<i>Ana Marta Gonçalves</i>
BE.09	Nutrient stoichiometry as a tool for determining nutrient condition in coastal systems	<i>John Icely</i>
BE.10	Do shorter bills alter the foraging strategy of red knots <i>Calidris canutus canutus</i> ?	<i>Michelle Jewell</i>
BE.11	Tracking white sharks in a dynamic system at the southern tip of Africa	<i>Oliver Jewell</i>
BE.12	Investigation of the abundance, distribution and composition of microplastics at coastal upwelling sites in the Atlantic Ocean	<i>La Daana Kanhai</i>
BE.13	Linking environmental, climatic and human-induced impacts on a Mediterranean semi-enclosed embayment (Amvrakikos Gulf, Greece): a food-web modelling approach	<i>Dimitrios Moutopoulos</i>

- | | | |
|-------|--|-------------------------------|
| BE.14 | Iceland, between boreal and arctic waters: benthic tunicates (Chordata: Ascidiacea) | <i>Alfonso A. Ramos-Esplá</i> |
| BE.15 | The BIOMETORE Project - Biodiversity in seamounts: the Madeira-Tore and Great Meteor | <i>A. Miguel Santos</i> |
| BE.16 | Relationships between taxonomic and functional diversity: insights into assembly processes | <i>Doriane Stagnol</i> |

BIOLOGICAL INVASIONS

- | | | |
|-------|---|----------------------------------|
| BI.01 | Developing molecular tools for early detections of invasive species: the case of the zebra mussel <i>Dreissena polymorpha</i> in the Baltic Sea | <i>Alba Ardura</i> |
| BI.02 | Biological invasions in the Mediterranean sea: ports versus Marine Protected Areas | <i>Alba Ardura</i> |
| BI.03 | Species detections in environmental DNA using metabarcoding: a useful tool in estuaries monitoring | <i>Yaisel Juan Borrell Pichs</i> |
| BI.04 | Reporting of Non Indigenous Species including harmful microalgae in the port of Trieste (North Adriatic Sea) | <i>Marina Cabrini</i> |
| BI.05 | Further spreading of the non-indigenous bryozoan <i>Celleporaria brunnea</i> in the Mediterranean Sea: port to port morphological variations | <i>Jasmine Ferrario</i> |
| BI.06 | Antipode marine fauna invasions in ports: a pilot survey in North Iberia | <i>Laura Miralles</i> |
| BI.07 | Resting egg production of the invasive copepod <i>Acartia japonica</i> in Sagami Bay, Japan | <i>Yoshiki Takayama</i> |
| BI.08 | Recreational boating as a vector of spread of non-indigenous species around the Mediterranean Sea | <i>Aylin Ulman</i> |

HABITAT LOSS AND OCEAN NOISE

HL.01	Design optimization of a small coastal MPA considering different conservation targets and costs	<i>David Abecasis</i>
HL.02	Larval development and early life history of a temperate reef fish – implications for the design and implementation of MPAs	<i>Joao Afonso</i>
HL.03	Mapping of ecosystem services in Mida Creek Kenya, an initial step to integrated natural resource management	<i>Margaret Awuor Owuor</i>
HL.04	Habitat suitability modelling of a vulnerable gorgonian in the Mediterranean and Eastern Atlantic	<i>Joana Boavida</i>
HL.05	Aeolianite as a proxy to evaluate former coastline position in northwest Ceara state – Northeast Brazil	<i>Alexandre Carvalho</i>
HL.06	Habitat loss: climate change vs tidal lagoon construction	<i>Rachel Crabtree</i>
HL.07	Density and distribution patterns of the endangered species <i>Pinna nobilis</i> within the harbour bay of Favignana (Egadi Islands MPA)	<i>Riccardo D'Agostaro</i>
HL.08	A novel interdisciplinary approach to building system based environmental impact assessments for marine and aquatic environments	<i>Jody Edmunds</i>
HL.09	Temporal behavior of the population genetic structure of <i>Nucella lapillus</i> in the intertidal coast of Galicia (NW Spain)	<i>Belén Carro Espada</i>
HL.10	Mapping biodiversity and human activities for Marine Spatial Planning in the Algarve (Portugal)	<i>Jorge M.S. Gonçalves</i>
HL.11	Occurrence patterns of individual Bottlenose dolphins (<i>Tursiops truncatus</i>) in coastal waters of SW Portugal	<i>Sara M. Magalhães</i>
HL.12	Malacological survey at the Las Piñas-Parañaque Critical Habitat and Ecotourism Area (LPPCHEA): A listing of molluscan species in a critical habitat	<i>Melody Anne Ocampo</i>
HL.13	Challenges of open ocean seagrass restoration	<i>Diogo Paulo</i>
HL.14	Mapping marine extraction pressure within UK waters	<i>Frankie Peckett</i>
HL.15	Macrodebris and microplastics from beaches in Slovenia	<i>Rita Melo Franco Santos</i>

OVERVIEW OF ABSTRACTS



OPENING SESSION

Opening Session

Marine Biodiversity and Ecosystem Functioning are the pillars of Good Environmental Status

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The definition of Good Environmental Status in the Marine Strategy Framework Directive considers eleven descriptors based on the structure and functioning of marine ecosystems. The first descriptor is Marine Biodiversity, most of the other descriptors cover various impacts of human activities on the functioning of ecosystems. This calls for the centrality of bio-ecology in the way we evaluate the conditions of the ocean. Current observation systems focus mostly on physics, chemistry and biogeochemistry, with the use of sophisticated devices, from satellites to oceanic buoys, gliders and other state of the art instruments that, however, cannot measure neither biodiversity nor its bearing on ecosystem functioning. The revolution of GES, thus, calls for the upgrade of current observation systems, so as to include biotic variables that, so far, have been disregarded. This will spark technological innovation and, also, the building of human capacities that have been neglected in the last decades. Our knowledge of biodiversity, in terms of the species composition of marine biota, and on their roles in making ecosystems function is to be improved, with the construction of experts that are presently lacking in the scientific community. This does not mean that reductionistic approaches must be abandoned, but requires also a timely evolution towards holistic visions that account for the emerging properties of complex systems covering, for instance, the consideration of cumulative impacts that are presently almost unexplored. This evolution of marine sciences gives a new centrality to marine stations and long-term series, and to disciplines such as taxonomy that, however, will have to profit from modern technologies based, for instance, on molecular approaches to the exploration and understanding of marine biodiversity and ecosystem functioning.

Opening Session

What do we need to tackle marine global changes?

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All aspects of our life (e.g. cultural, historical, biological, and economic) are deeply rooted in the ocean, no matter where we live. Unfortunately, as we enter the Anthropocene at full speed, the ocean is threatened by disastrous human impacts and every citizen has a moral duty to slow down the pace of destruction of the atmospheric, terrestrial, fresh water and marine environments. In this respect, scientific research and science communication have a key role to play in fostering our appreciation of the importance of the ocean, our understanding of our own responsibility in its alteration and our awareness of the relevance of its protection. However, increase marine environmental awareness constitutes a real challenge as many features of the ocean and global environmental changes are difficult to experience because they are too small, too big or too abstract. Using ocean acidification as a case study, I will discuss the importance of an ocean and climate literate citizenry as well as opportunities and challenges to communicate marine global change science; specifically, what information and research are needed today for a successful mitigation and adaptation to marine global changes.



SCIENTIFIC SESSION: FUTURE OCEANS

Future oceans: warming, acidification and deoxygenation

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The ocean moderates anthropogenic climate change at the cost of profound alterations of its physics, chemistry, ecology, and services flows. We evaluated and compared the risks of impacts on marine and coastal ecosystems -and the goods and services they provide - for growing cumulative carbon emissions under two contrasting emissions scenarios. The current emissions trajectory would rapidly and significantly alter many ecosystems and the associated services on which humans heavily depend. A reduced emissions scenario - consistent with the Copenhagen Accord's goal of a global temperature increase of less than 2°C - is much more favorable to the ocean but still significantly alters important marine ecosystems and associated goods and services. The policy options to address ocean impacts narrow as the ocean warms and acidifies. Consequently, any new climate regime that fails to minimize ocean impacts would be incomplete and inadequate.

Gattuso J., Magnan A., Billé R., Cheung W. W. L., Howes E. L., Joos F., Allemand D., Bopp L., Cooley S., Eakin C. M., Hoegh-Guldberg O., Kelly R. P., Pörtner H., Rogers A. D., Baxter J. M., Laffoley D., Osborn D., Rankovic A., Rochette J., Sumaila U. R., Treyer S. & Turley C., 2015. Contrasting futures for ocean and society from different anthropogenic CO₂ emissions scenarios. *Science* 349:aac4722. <http://dx.doi.org/10.1126/science.aac4722>

Monitoring stress in warming oceans – a non-lethal approach for the tropical reef fish *Amphiprion ocellaris*

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Climate warming presents new challenges for environmental biomonitoring. There is a need for the development of biomarkers that respond not only to chemical pollution but also to thermal stress events. Current research on biomarkers of cellular stress uses lethal methods, which should be avoided, particularly in sensitive and/or disturbed systems, like coral reefs. In this study, the effects of thermal stress were tested in ocellaris clownfish, *Amphiprion ocellaris*, in a non-lethal approach, using caudal fin tissue. Fish were exposed to a long-term experiment following two temperature treatments: control (26°C) and current average El Niño temperatures (30°C). Samples were taken at 0, 7, 14, 21 and 28 days for evaluation of stress biomarkers (catalase, glutathione-S-transferase, superoxide dismutase, lipid peroxidation, heat shock protein 70kDa (HSP70) and total ubiquitin). HSP70 showed a rapid increase at 30°C, followed by a temporary depletion, a typical response pattern previously reported for other tissues of several species, indicating it is appropriate for thermal stress biomonitoring. Other biomarkers were generally unresponsive to higher temperature. They should be useful for contamination monitoring, given that they have already been widely used for that purpose and this work showed temperature will not be a confounding variable in their assessment. It is concluded that *A. ocellaris*, as a site attached fish (to its anemone host) can be a good sentinel species to be monitored in field-conditions along time by using a simple sampling method – fin-clipping, and measuring biomarker levels under stressful conditions.

Keywords: tropical fish, temperature, oxidative stress, biomarkers, environmental monitoring

Could the intertidal *Ellisolandia elongata* reef be affected by climate changes expected in the near future in the Mediterranean Sea?

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The concentration of Green House Gasses and specifically the concentration of CO₂ in the atmosphere is continuously increasing since the industrial revolution and it is the most relevant anthropic cause driving climate changes. Two of the strongest symptoms of those changes are the Global Warming and the Ocean Acidification which are progressively altering marine ecosystems and the populations of living organisms they support. The Mediterranean Sea is widely considered a 'laboratory basin' by suffering dramatic changes in its oceanographic and biogeochemical conditions derived from natural and anthropogenic forces. Calcifying seaweeds are the most important 'bioconstructors', from mesolittoral to circalittoral fringe, providing habitats and ecological niches for other species (i.e. biodiversity promoters) but also are good 'recorders' of the environmental condition they experience (i.e. bioindicators). In this study we focused on the reef-forming *Ellisolandia elongata* from the Gulf of La Spezia (N-W Mediterranean Sea) by comparing the physical properties, growth rate and abundance of associated fauna in natural and experimental conditions (temperature and pH expected for 2050-2100). Four sampling sites were chosen in the intertidal zone. Reef samples were brought in the laboratory and put in experimental conditions for a month. Four aquaria simulated the actual conditions of temperature and pH, other 4 aquaria simulated temperature (+3°C) and pH (7.7) expected for the year near future. *E. elongata* grown in the natural and experimental conditions withstand mechanical stress in slightly different ways. The study of the effect of temperature and pH variations on growth rate and associated fauna of *E. elongata* reef is still in progress.

Keywords: Ecosystem, Global warming, Ocean acidification, Coralline algae, Mediterranean Sea

Effects of ocean acidification on biochemical biomarkers and swimming ability of the sand-smelt larvae

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The ocean acidification is a critical global problem and scientific investigation of its effects is still in its infancy. Most research has been conducted on calcifying organisms and little attention has been given to the potential impact on other ecosystem processes and components, like the early life-stages of non-calcifying organisms such as fish. In this context, the main goal of this study was to investigate the effects of exposure to elevated pCO₂ on behavior, development, oxidative stress and metabolism of the early stages of sand-smelt, *Atherina presbyter*. Wild larvae in flexion and post-flexion stages were caught at Arrábida Marine Park, Portugal and kept in controlled conditions with different pCO₂ levels (Control: ~600µatm; Medium: ~1000µatm; High: ~1800µatm) between 7-15 days, before being tested to assess critical swimming speed (Ucrit). Additionally, morphometric measurements and biochemical biomarkers were determined. The measured biomarkers were related with oxidative stress (SOD, CAT, LPO, DNA damage and ROS) and energy metabolism (total carbohydrate levels, ETS, LDH and IDH). Results suggest that swimming behavior of sand-smelt is unaffected by exposure to high pCO₂ levels; however the biochemical results suggest higher energetic costs may be associated with morphometric changes and also with the exposure to a stressful environment. This study contributes with information on this species sensitivity to future ocean acidification conditions, showing that despite the absence of swimming behavior effects, the metabolic responses demonstrate an evidence of oxidative stress at elevated pCO₂, whose future consequences are still unknown.

Keywords: Acidification; fish; Ucrit; Oxidative stress; Sand-smelt

Impact of ocean acidification and warming on the functioning of a North Eastern Atlantic maerl bed community

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Coralline red calcareous algae are especially vulnerable to OA due to the high solubility of their magnesium calcite skeleton. In communities dominated by coralline algae like maerl beds, OA and warming can lead to significant changes in species interactions and community structure and functioning with drastic effects on ecosystems. This work aims to assess the impact of OA and warming on the response of a maerl bed community, by considering interactions between calcareous and non-calcareous algae and interactions between herbivores and macroalgae. Experimental assemblages of the coralline algae *Lithothamnion corallioides* (living and dead maerl), and associated epiphytic fleshy macroalgae and dominant grazers (gastropods *Jujubinus exasperatus* and *Gibbula magus* and echinoderm *Psammechinus miliaris*) were maintained in mesocosms in winter and summer conditions under controlled pH (ambient and -0.32 pH units [RCP8.5, IPCC 2014]) and temperature (ambient and + 3.7°C [RCP8.5]) conditions. Measurements of metabolic rates (primary production, respiration, and/or calcification) were performed at both species and community scales. In winter, the respiration rates of the grazers were mainly influenced by temperature and/or pH, while their calcification rates remained unaffected. Primary production and respiration rates in living maerl were affected by temperature but not pH. In contrast, its calcification rates were negatively affected by pH decrease but increased with temperature. OA also induced significant dissolution rates in dead maerl. At the community scale, there was no effect of OA and warming on community primary production and respiration. Warming enhanced community calcification rates, whereas OA led to a significant drop in calcification with high dissolution rates observed in the dark. The differences observed here between community and species responses highlight the importance of species interactions in the community functioning and its response to global changes.

Keywords: Ocean acidification, warming, community, maerl, metabolism

Recent demographic changes at a rear edge of giant kelp (*Macrocystis pyrifera*) did not reduce the overall levels of genetic diversity of extant populations

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The negative outcomes of recent climate change may be particularly evident in extant populations at distributional edges. There, limiting environmental conditions can reduce population sizes and cause erosion of genetic diversity that may prevail over past evolutionary processes, reducing evolvability. This study aimed to test whether populations of giant kelp (*Macrocystis pyrifera*) from two regions close to a distributional edge (Baja California; Pacific Ocean) experienced range contraction and recent genetic erosion due to ongoing climate change. Canopy abundance was analysed from 1992 to 2014 using satellite-based methods. Levels of genetic diversity and differentiation were inferred by genotyping ~400 individuals for seven microsatellite loci. Signatures of bottlenecks were further evaluated by testing for reductions in M-ratios, departures from equilibrium in heterozygosity and by contrasting different scenarios of population history using Approximate Bayesian Computations (ABC). Our findings show large variance in abundance, primarily linked to positive anomalies in sea surface temperatures. These produced more detrimental effects closer to the edge, where range reduction bordered extinction for different periods. Genetic analyses supported the two regions as separate groups, both with private diversity and low differentiation. The southern edge displayed lower diversity, yet all tests failed to provide evidence for bottlenecks. Furthermore, the ABC indicated that changes in population sizes could only have occurred >1000 generations ago, when both regions likely diverged. Thus, we propose that other processes like founder effects and/or random drift are predominant in shaping the genetic diversity at this rear edge, and that despite strong demographic changes, giant kelp might sustain large population sizes by persisting, possibly in deeper reefs, unaffected by the warming trends, or in persistent microscopic development stages.

Keywords: climate change, rear edge, range shift, genetic diversity, kelp, *Macrocystis pyrifera*

Complex global change: multifactorial pressure, multivariate response and the role of fluctuations in a benthic community

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Simultaneous and sequential impacts of the global change factors warming, acidification, nutrient enrichment and hypoxia were investigated in all seasons with regard to multivariate responses of a benthic community of the Western Baltic Sea. The factors were generally applied as "delta.treatments", i.e. as offsets from the ambient conditions. The latter, and consequently the applied treatments, were naturally fluctuating at different temporal scales (seasonal, circadian, sporadic). We assessed the responses of the community components macroalgae, epibionts and grazers, at the individual level and regarding the shifts of interactions among species. The emerging pattern showed that effects differed strongly among seasons, acidification plays a minor role at most, warming and hypoxia are the strongest drivers of change, nutrient enrichment may modulate some stress effects, interaction shifts show a substantial potential for the enhancement or the buffering of environmental stress, and genetic diversity favors adaptation. The latter, however, only holds true when sensitivities towards single stressors correlate positively. Anti-correlation of sensitivities will accelerate the decline of a population. Most effects were strongest in summer. Indirect effects were often stronger than any direct impacts. In our effort to understand the ecological impact of complex global change we should strive for experiments of appropriate complexity including multiple global, regional and local factors, multiple responses, multiple scales, natural fluctuations, all seasons, all ontogenetic stages, shifts of biotic interactions, plasticity and adaptation.

Keywords: global change, fluctuations, benthos, fluctuations

Marine canopies in a changing environment: projecting the distribution of species of *Cystoseira* under alternative climatic scenarios.

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Canopy forming algae are key ecosystem engineers helping to sustain ecosystem services and function in rocky shore habitats. However, these valuable species are globally threatened by cumulative anthropogenic impacts. Increase in mean SST and extreme events such as heat waves linked to global climate change are considered important drivers of future loss of these species. Evidence of accelerating climate change enhances the need of predicting the consequences for species distribution and range shifts in order to plan effective mitigation strategies. We selected three species of canopy-forming algae belonging to the genus *Cystoseira* (Phaeophyta) that are representative of European Mediterranean and Atlantic ranges for this genus, *C. tamariscifolia*, *C. amentacea* and *C. compressa*. We compiled georeferenced information from about 100 peer-reviewed publications and 2 online databases reporting their distribution in the Mediterranean and close North Atlantic Ocean. We modelled the environmental niche and found suitable habitats for the three macroalgae throughout their entire range of distribution. We examined the environmental response of each species as well as the most relevant variables defining their co-occurrence. Then we simulated the shift in predicted range of distribution and risk of extinction using the most contrasting IPCC scenarios of greenhouse gas concentration and the corresponding change in local climatic conditions. This knowledge enhances the prediction of spatially variable climate change impacts for these ecologically valuable ecosystems and the development of site-specific conservation priorities.

Keywords: niche modelling, distribution shift, extinction risk, macroalgae

Another side of the climate change coin: effects of fluctuating vs stable temperature regimes on the population dynamics and species interactions of marine nematodes

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The effects of average temperature increase on population dynamics and species interactions have been the subject of many studies. Nevertheless proper predictions of how species respond to climate changes depend on accurate records of their plasticity under realistic thermal regimes and not on a mere consideration of adaptation to changes in mean values. The present work focuses on the effects of temperature fluctuations on the fitness of marine nematodes. We examine whether daily temperature fluctuations affect a) fitness and population dynamics and b) interspecific interactions of two congeneric species: *Diplolaimelloides meyli* and *D. oschei*. The two species co-occur in nature and have shown strong competition under constant temperature conditions. Microcosm experiments were performed using mono-species and two-species combinations incubated under constant and daily fluctuating temperature. Measurements in time included total nematode abundance, species-specific numbers of eggs, juveniles and adult nematodes, sex ratio and fecundity. Several other life-cycle parameters related to development and generation time were recorded. Only small effects of temperature regime on the population fitness were revealed for the monospecific populations. Higher numbers of adults for both F1 and F2 generations were recorded as well as shorter minimum development time for *D. meyli* under fluctuating temperature compared to the control. Furthermore, our results showed that interspecific competition negatively affects the involved species' fitness under both stable and fluctuating temperature conditions, with fluctuating temperature showing a more pronounced effect. The outcome of the interaction is though dependent on thermal regimes. We conclude that apart from changes in mean values, temperature fluctuations are important for assessing the effects on species interactions.

Keywords: climate change, fitness, interspecific competition, free-living nematodes



SCIENTIFIC SESSION: NATURAL RESOURCES

Overfishing – Not one problem and not one solution

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This talk will first review what overfishing is, from the perspectives of fish populations, fish communities, and human communities. Overfishing has meaning at each of these scales, but the nature and consequences of overfishing get increasingly complex as the scale expands. Moreover, although the core of what constitutes overfishing may remain the same at each scale, the boundaries between what is overfishing to all perspectives, and what are just different choices made by harvesters, managers, and ultimately society become increasingly blurred. Unfortunately the boundaries also become increasingly important for policy decision-making. No one wants to see the outcome that is “overfishing” perpetuated, and all interests would like to see the practices that produce that outcome avoided or altered. However, many factors contribute to unsustainable fishing, and choice of effective measures to deter overfishing depends which factors dominate in a particular case. This talk will explain how a more than decade-old framework can help to decompose the large and heterogeneous category of practices called “overfishing” into factors related to the fish population, fish community, and human community components of sustainability. It will then review evidence the types of policies and measures that can be used to address the causes at each scale. Unfortunately the integration of that framework will show how policies designed to address one factor of unsustainability may necessarily amplify the threats from other factors, and measures effective at one scale may be undone by practices continuing at a different scale. Overfishing cannot be effectively addressed without taking on challenges of globalization of economies and equity in distribution of benefits from using our resources. These are far more complex issues than just finding ways to “fish less”.

Species composition and mortality rates of sea turtles interacting with the Portuguese pelagic longline fishery targeting swordfish in the Atlantic

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Sea turtles occasionally interact and are captured as bycatch in pelagic longline fisheries. In oceanic waters of the eastern and tropical north Atlantic, the main species interactions are with leatherbacks (*Dermochelys coriacea*), loggerheads (*Caretta caretta*), olive ridley (*Lepidochelys olivacea*) and Kemp's ridley (*Lepidochelys kempii*). However, a relatively large proportion of the interactions are only reported as not-identified sea turtles, making species-specific assessments difficult to conduct. In this work we used statistical models to estimate species composition and fate of sea turtles captured in a pelagic longline fishery, specifically the Portuguese pelagic longline fishery targeting swordfish in the equatorial and tropical north Atlantic. Multinomial models were used to predict the species composition and binomial models to predict the fate of the captured specimens, with both models including spatial and seasonal effects. Both models showed good goodness-of-fit. In the multinomial models the estimated coefficient of determination (R^2) was 0.562 and the 10-fold cross-validation procedure resulted in a classification error rate of 46.8%. In the binomial models the estimated R^2 was 0.293, the Area Under the Curve (AUC) was estimated to be 0.805 with a sensitivity of 74.5% and a specificity of 75.5%, and the 10-fold cross validation procedure resulted in a prediction error rate of 21.1%. The models produced can be used to reconstruct the species composition and estimate the fate of sea turtles that interact with this pelagic longline fishery in the equatorial and tropical north Atlantic, providing a better understanding of the impacts of this fishery in sea turtle populations.

Keywords: Catch reconstruction, mortality rates, pelagic longline fisheries, sea turtles, species composition.

Contrasting timing of life stages across latitudes – a case of a marine forests forming species

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At low latitudes, *Saccorhiza polyschides* forests are highly seasonal, with macroscopic sporophytes present only between spring and autumn. At high latitudes, however, these are able to overwinter and survive for longer than a year. This seasonality at lower latitudes is commonly attributed to temperature. To test if this might be the factor leading to such differences across latitudinal ranges, field demographic surveys were combined with controlled culture experiments in two populations with contrasting timing of life stages: a central population in Brittany, France and a southern one in Northern Portugal. Our results did not support the initial hypothesis that such differences were caused by temperature. In the field, we found recruitment to be limited to spring in the south while further north sporophytes recruited year-round. Culture experiments showed that zoospores were able to develop under temperatures between 5 and 20°C, with optimum at 10-15°C, placing Portuguese winter temperatures within the optimum range, and thus indicating that seasonal recruitment is not caused by winter temperatures. Furthermore, zoospores took a maximum of 62 days, at 5°C, to develop into visible sporophytes, and only 20 days at 10°C, excluding the possibility that the absence of recruits through winter was a consequence of synchronized release of zoospores in autumn. While temperature doesn't offer an explanation for the differences between populations at different latitudes, the presence of macroscopic sporophytes in southern populations coincides with the typical upwelling season, which is accompanied by increased nutrient levels. This seasonality of nutrient availability in the south, in contrast with more constant levels in north-central range, led to the alternative hypothesis that nutrient availability, and not temperature, might explain the differences in life stage timing across latitudes. This hypothesis was, however, not initially considered and requires testing.

Keywords: *Saccorhiza polyschides*, seasonality, upwelling

Relationship between the *Octopus vulgaris* life cycle and its exploitation patterns by the trap fishery in the southern coast of Portugal

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Fishers of the *Octopus vulgaris* trap fishery from the south coast of Portugal have proposed a seasonal closure of the fishery in order to protect its reproduction and recruitment. In order to implement this management strategy, information based on the scientific knowledge for defining the length and timing of such closure has been requested. For this purpose official landing data from the last 25 years (1990 – 2014) of the commercial trap fishery of *O. vulgaris* along the southern coast of continental Portugal have been analysed to delve into the life cycle of this cephalopod. A seasonal pattern of landings has been observed: average landings during the seasons of autumn and winter have been higher than those during the rest of the year indicating the existence of two main fishing recruitment periods. Lower landings during summer may be related to mating and spawning. The landing data is coherent with the reproductive biology described for the area, confirming an annual cycle with two main spawning periods, in spring and late summer. Non-Metric Multi-Dimensional Scaling (NMDS) applied to 12 monthly time series of landings per port exhibited a clustering pattern among them. Leeward ports had larger landings during autumn, especially in November, according to a common pattern described for the Mediterranean Sea and Gulf of Cadiz waters while windward ports had larger landings during spring, suggesting that this area to be more like the western Iberia Atlantic coast. Understanding the life cycle of *O. vulgaris* and its exploitation patterns by means of analysing landing data may contribute to support the management of its fishery in the Algarve.

Keywords: *Octopus vulgaris*, fishery, reproductive cycle, recruitment, fishery management, Algarve

CIA; assessment of Atlantic Herring spawning beds as an example of effective transboundary co-operation.

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In the UK, Cumulative Impact Assessment (CIA) has become a staple component of the licensing and regulatory assessment process. CIA considers the prospective impacts originating from new developments alongside impacts arising from existing activities. This assessment provides a representation of the disturbance experienced within UK waters, yet international transboundary effects are often overlooked or data is not freely available. An assessment of Atlantic Herring *Clupea harengus* spawning beds was conducted. Seabed sediment maps, fisheries information and larval survey data were used to identify likely spawning sites. Interactions with seabed user activities and cumulative effects were then assessed for UK waters only. This methodology and the subsequent assessment have informed revised ICES management advice on activities interacting with spawning beds. The benefit of assessing single species interactions with developments is recognised, and the need for expanding the assessment to transcend territorial boundaries accepted. To extend this assessment to cover the geographic range of a mobile species such as Atlantic Herring requires more data than considered previously. A proposed wider mapping project seeks to include data from fisheries, renewable energy companies, dredging companies, and statistics and mapping experts. This co-ordination between sea users and policy makers will allow a more robust assessment of the interaction of Atlantic Herring with marine activities. Extending beyond this initial single species assessment it is suggested that there is a requirement for the quantifiable assessment of other individual transboundary receptors such as habitats, and mobile species such as birds and mammals. This can only be achieved through effective co-operation and free data exchange between developers and policy makers. Without clear co-ordination and the inclusion of all parameters in a CIA the true extent of impacts on the receptor cannot be determined.

Keywords: Cumulative Impact Assessment, Atlantic Herring, Habitat Modelling, Transboundary Effects, Intersectoral Collaboration

Technical and Economic viability of Traps in the Portuguese Fishery of deep-water rose shrimp (*Parapenaeus longirostris*)

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The Marine Strategic Framework Directive and the Reformed Common Fisheries Policy are following the ambitious objective to stop the loss of biodiversity and to make fisheries more sustainable. The exploitation of deepwater rose shrimp (*Parapenaeus longirostris*) and other nektobenthic crustacean is exclusively reserved to the demersal trawling with enormous bycatch proportions exceeding economical, ecological and ethical limits. The other side of the damages is the social inequity by distributing the revenues of high value crustaceans only over a small proportion of fisherman. The promising results with semi-floating traps in the Canary Islands have shown that alternative fishing practices exist. The following work was done to provide information about the feasibility using of semi-floating traps on the edge of the continental shelf and upper slope in a commonly trawling dominated territory. The catch of the deepwater rose shrimp showed to be a challenging task due to the specific feeding habits of the species. More frequently the golden shrimp (*Pelsonika martia*) was caught, a species already commercially exploited with traps in the Canary Islands. The quantities for both species are not allowing the consideration of an economic viable fishery but the use of alternative attractants may change this in the future. The golden shrimp showed a significant preference for minced oily fish in relation to other fish baits and moderately successful catches with fluorescent fishing lights. The use of light as attractant in traps for crustaceans is reported for the first time during this study and should be further investigated because it can be a possible solution make trap fisheries for deepwater rose shrimp bait independent and economically viable.

Keywords: demersal trawl, traps, nektobenthic shrimp, gear substitution

Recovery of Seaweed at Barren Ground Using Steelmaking Steel Slag and Sediment on Bottom of Dam Reservoir in Japan

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Barren ground develops when coastal areas are depleted of seaweed and has expanded to coastal areas in many countries. The increase of barren ground area leads to a significant reduction in fisheries production and biodiversity. Several reasons for barren grounds have been proposed, for instance, elevated seawater temperatures, grazing by herbivorous animals, and a shortage of dissolved iron (Fe). Phytoplankton growth and nitrogen fixation in the ocean are strongly influenced by Fe availability and Fe is an essential micronutrient for algal growth. Macroalgae need high concentrations of iron as well as nitrogen, phosphorus, and silicate. Therefore, the barren ground caused by the lack of dissolved Fe (II) in coastal water. The physicochemical speciation of dissolved Fe (II) is very important in the ocean. In addition, Humic substances (HS), and especially humic acids (HA) and fulvic acids (FA), are considered to exert a major control on metal mobility and bioavailability in the environment. Our group indicated that the iron-humate (Fe-HS) concentration in seawater of seaweed growth area was higher than that in barren ground area in Japan. And we demonstrated that Fe-HS was effective in recovering the vegetation on the areas of barren ground in the sea of Japan. The field experiments were performed at coast in Okushiri-cho, Hokkaido, Japan. Experimental test by using Fe-HS elution unit made with steelmaking slag and compost including much humic substances has been performed since 2006, and dam iron-humate (D-Fe-HS) elution unit made with sediment on bottom of dam reservoir has been performed since 2009. The Fe-HS, phosphoric acid, and silicic acid concentration in seawater at all experimental sites have been analyzed since 2006 and 2009, respectively. We investigated the relationship with the growth of seaweed. The growth areas of seaweed species growing at distance of 0, 5, 10, 20, and 30 m offshore were measured once a year. Consequently, the area of seaweed growth in all experimental sites using elution units (Fe-HS and D-Fe-HS) increased and was larger than that in control site. Moreover, from relationships between concentration of Fe-HS, P, and Si and the growth area of seaweed at all experimental sites, the concentration of Fe-HS was considered to be effective for the growth of seaweed.

Keywords: Barren grounds, Dam reservoir, Iron-humate, Sediment, Steelmaking slag

The impact of Amazon and Orinoco river plumes on the eutrophication of Caribbean coral reefs

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In the Caribbean, eutrophication has long been identified as a major factor of coral reefs degradation and loss of biodiversity. This nutrient enrichment is usually attributed to local anthropogenic sources, but considering that eutrophication is triggered above a threshold of nitrogen and phosphorus concentration and identified by chlorophyll concentration, the background concentration of these variables is a key element to determine the sensitivity of coral reef ecosystems to nutrient inputs. For this reason, long term biogeochemical time series have proven to be crucial for investigating these ecosystems changes supporting that satellites monitoring the oceans are a valuable tool. The Aqua satellite with its MODIS spectrometer is collecting data regularly since 2002 providing concentration on a 1 to 2 day basis. Although nitrogen and phosphorus are not directly measured, the variables available give indications on nutrients levels and include chlorophyll, particulate organic carbon, particulate inorganic carbon and absorption due to gelbstoff and detrital material. The analysis of these times series sampled upstream from the 3 islands of Martinique, Guadeloupe and St-Martin and the observation of dynamic scenes focused on the Caribbean Arch and the North Brazil Current confirm that ocean background concentrations at these locations are directly influenced by the Amazon and Orinoco river plumes. Background concentrations vary seasonally, occasionally reaching levels over eutrophication thresholds proving that local nutrient inputs are not the only factors responsible for these events. The rivers plumes, observed as precise spatio-temporal structures, fluctuate according to the seasonal cycles of the North Brazil Current, forcing the plumes along the South American coast in winter and allowing the plume to travel with the North Brazil Current rings as far as the north end of the Lesser Antilles in the warm season.

Keywords: Coral reef eutrophication, Caribbean, North Brazil Current, Amazon, Orinoco, river plume

Demography of the bigeye thresher shark *Alopias superciliosus* in the Atlantic Ocean: Application of Leslie matrices with incorporated uncertainties

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The bigeye thresher shark, *Alopias superciliosus* is an oceanic pelagic shark, occasionally caught as bycatch in pelagic longline fisheries targeting tunas and swordfish. It is particularly vulnerable to fishing pressure, with overexploitation occurring even at low levels of fishing, due to their slow growth rates, low fecundity (two to four pups) and migratory nature crossing both national and international waters. A stochastic population dynamics model was developed for this species using age-structured Leslie matrices. Uncertainties were incorporated in the fecundities and survivorship parameters using Monte Carlo simulation. The estimated population growth rate was very low ($\lambda = 1.008$, 95% CI = [0.9968, 1.0189]), with this being one of the lowest value known for shark populations, highlighting the very low growth potential of this species. Elasticities for the matrices were estimated and it was observed that the matrix elements with higher elasticities were the survivorship parameters for the juvenile stages. This pattern is typical of the larger sized and slower growing shark species. If conservation efforts are to be applied to specific components of this species they should be focused mainly on the survivorship of the juveniles. The estimated λ for bigeye thresher are extremely low and any added source of mortality to this population will likely result in declines, since even under stable condition the population only grows at a rate of ~1% per year. This study presents new and important information about the population dynamics of the bigeye thresher in the Atlantic, highlighting its high vulnerability to fishing pressure which can be used to assist fishery managers to adopt more informed and efficient conservation measures for this species in the Atlantic.



SCIENTIFIC SESSION: BIODIVERSITY EFFECTS

Scientific Session: Biodiversity Effects Keynote Presentation

Are biodiversity- ecosystem function relationships an important ecological paradigm or a distraction from understanding environmental and ecological interactions?

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When observing the natural world it is clear that the presence and activity of organisms exert strong influence over the key biological and biogeochemical processes around them and, ultimately, the functioning of marine ecosystems. What has been less clear is how the actual type and variety of organisms has affected process rates and the provision of ecosystem function. It is perhaps easy to assume that highly diverse habitats automatically equate to areas of high function, but is this really the case, and if so, which aspects of diversity are most important? To this end, are traditional descriptors of diversity appropriate for considering biodiversity-ecosystem relationships? In particular, the importance of diversity at other levels of biological organisation may be more appropriate than traditionally measured species-level diversity. To this end, is the search to identify generic biodiversity – ecosystem function relationship distracting us from the study of key ecological and environmental interactions? This presentation will explore some of these ideas and will reflect on whether biodiversity itself plays a role in a variety of ecosystem functions, from more process orientated functions (e.g. productivity), to those functions needed for ecosystem maintenance (e.g. resistance or resilience).

Multiple, Alternative Stable States in Marine Metacommunities: risk of unintended consequences in MPA management scenarios

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Marine area protection has had some spectacular failures, despite a century of effort to establish conservation measures in marine environments. We hypothesize that these failures may be explained by the existence of alternative stable equilibrium states in ecosystems. In other words, if multiple alternate basins of attraction exist, then the implementation of protection together with other disturbances may trigger a shift from the present regime to an unintended one. This can be induced by a shift to a different basin of attraction (leading to a negative effect), or based on the fact that the dynamic regime is trapped in a basin of attraction and cannot return to a desirable past condition (leading to a null effect). The common idea in mathematical ecology is that the canonical equation to formalize alternative stable states (ASS) is the Hill-equation. This is nonetheless a mathematical statement, which does not find any equivalent in term of ecological process. Besides, it rests on the assumption that the conditions for ASS to exist are local but cannot come from the dynamics of other remote connected systems. We demonstrated, from simple competition models in a metacommunity framework, that multiple stable states (which exist when inter-specific competitions are strong) allows the dynamics to alternate between ASS without to include a hill-type function. In the case of post-recruitment dispersal, this possibility only exists if local populations are rescued by the supplementation from a small flux of immigrants. The analysis of the relative importance between regional dispersal and local demographic processes provides an explicit and quantitative criterion to distinguish between the rescue effect and the mass effect. Finally, the possibility to shift between Alternate Stable States in the community (which implies several sites simultaneously) exist sustainably only, in the competition perspective, if at least, in one of the interconnected sites, the competition between the two targeted populations is weak, hence ensuring the conditions for their coexistence. This suggests that the pressure and intensity of the competition should be represented explicitly, through the quantification of the dynamics of available resources in the ecosystem. This paradigm is part of the new context of MPA development based on ecological principles and management of networked MPAs. The application of this so-called ecosystem-based approach should prevent negative consequences of management plan, and should optimize effort for MPA managers.

Keywords: Alternative Stable States, Inter and Intra-Specific Competition, Metacommunities, Mathematical Models

Seahorse population fluctuations in the Ria Formosa Lagoon, South Portugal

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Identifying sources of marine population variability is a central goal in marine ecology and conservation, which requires long-term, repeated monitoring to assess whether there is cause for concern, particularly for species with vulnerable life history traits. Between 2001 and 2009 there were substantial declines in populations of two seahorse species (*Hippocampus guttulatus* and *H. hippocampus*) throughout the Ria Formosa lagoon (94% and 73%, respectively). During 2010-2013, the lagoon was re-surveyed using 16 of the sites previously monitored. This new data set was then compared with the information obtained from those same locations in two earlier studies (2001-2002 and 2008-2009). *H. guttulatus* populations increased significantly between 2008-2009 surveys and in the most recent 2010-2013 surveys but there were no significant differences between 2001-2002 and 2010-2013 surveys, suggesting that these populations are fluctuating rather than consistently decreasing. In contrast, there were no significant differences in *H. hippocampus* densities among the 16 sites surveyed throughout the three sampling periods, although the ability to detect any change was hampered by the overall low densities of this species in all time periods. Fluctuations in *H. guttulatus* densities were positively correlated with the percentage of holdfast coverage but with none of the other environmental variables tested. These results highlight the importance of holdfast availability in maintaining stable seahorse populations. While population fluctuations are certainly more promising than a consistent downward decline, such extreme fluctuations observed for seahorses in the Ria Formosa lagoon could still leave these two species vulnerable to any additional stressors, particularly during low density periods.

Keywords: *Hippocampus guttulatus*; *Hippocampus hippocampus*; long-term survey; habitat changes; population fluctuation

Assessing functional diversity of marine nematodes in the 21st century: moving away from the black box approach

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Nematodes are by far the most numerous and, at least at local scales, usually also the most species-rich metazoans in marine soft sediments. They affect ecosystem functions like nutrient cycling, organic matter decomposition and even sediment stability through a variety of trophic and non-trophic interactions with sediment microbiota. However, little is known on whether and how such functional roles depend on species composition and diversity. Assessments of nematode functional diversity still heavily rely on a black-box approach which assigns nematodes – usually at family level – to a limited number of feeding types, life-history groups, size groups or other guilds. Such guilds are of limited use for our understanding of nematode functional diversity because (a) categorically distributed descriptors of function are inherently inferior to continuous descriptors (e.g., a real size measure outperforms an assignment to size groups), (b) phylogenetic relatedness does not necessarily match functional relatedness (hence family-level approaches may be biased), and (c) functional diversity is often assessed from traits which bear little relationship with the ecosystem function at stake. We use stable isotope signatures to demonstrate differences in resource use and even in trophic level between confamiliar species. A metagenetic study of the microbiomes of individual nematodes even demonstrates differences in diet between cryptic species. These findings largely invalidate the traditional assignment of nematodes to family-level feeding guilds. We also discuss some of the latest methodological developments to unravel nematode resource utilization at the species and individual level. We then present an assessment of nematode functional diversity in relation to microbially driven ecosystem processes such as organic matter decomposition and nitrogen cycling based on relevant continuous descriptors approximating, among other factors, grazing rate and microbioturbation potential.

Keywords: functional diversity, nematodes, functional guilds, continuous descriptors of function

What's a picture really worth? On the use of drone aerial imagery to monitor intertidal rocky shores

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Describing the distribution and abundance of organisms on the rocky intertidal zone is crucial to generate ecological models of broad scope and validity. Our aim was to combine aerial images with ground-based quadrat sampling to quantify mussel (*Mytilus galloprovincialis*) bed coverage and adult biomass for later use in biophysical models. A remotely piloted aircraft (V-form octocopter-drone) was used to conduct intertidal surveys, during low tides (<0.4m) over 9 study sites along the Portuguese central west coast. At each site, we collected low altitude (30m) high resolution aerial photographs (130 to 200 airborne photographs, 80% overlap, error estimates <1 pixel), encompassing an average intertidal area of 20000m². Images were mosaicked, georeferenced and a 3D photogrammetric model was reconstructed with a ground resolution of 1cm/pixel. We conducted an analysis of the spectral signature of mussels' coverage and used it to perform a maximum likelihood supervised classification, with overall high classification accuracy (80-97%). Finally, adult mussel biomass parameters were used in a biophysical model of larval dispersal to improve the fine-scale variability of mussel larval supply in the area. Our results support several emerging studies which combine low altitude multispectral imagery with high resolution surface models and ground based observations as a viable and powerful tool for surveying intertidal ecosystems. Potential cost-competitive applications in marine resource mapping, monitoring and conservation are discussed.

Keywords: aerial imagery, rocky intertidal, spatial scale, Mussel bed

Scientific Session: Biodiversity Effects

Assessment of Faunal Communities and Ecosystem Interactions within a Sub – Tropical Lagoon using Baited Remote Underwater Video

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Animal behaviour, in particular predator-prey interactions, can influence ecosystem functioning through a variety of direct and/or indirect mechanisms. Despite coastal systems, such as seagrass and mangroves, having been identified as critical habitat for a variety of species and life-stages they are increasingly threatened by anthropogenic activities with little known about the impact of their removal. Baited remote underwater video (BRUV) was used to survey fauna in both seagrass and mangrove communities within a sub-tropical, shallow-water system at Bimini, Bahamas. In particular, the spatial interconnectivity between these habitat types and the nature of predator-prey interactions for lemon sharks (*Negaprion brevirostris*) and known teleost prey species was examined. Additionally, a variety of abiotic factors were assessed to determine their influence on species distribution and abundance. A total of 140 BRUV deployments, over 13 months between April 2013 and May 2014, recorded 62 species of mainly teleosts, invertebrates and elasmobranchs from 27 families. MaxN was used as a measure of relative abundance and multivariate analyses assessed differences in community composition across a range of factors (e.g. mangrove proximity and tidal phase) and environmental variables (e.g. temperature, dissolved oxygen and salinity). Results showed distinct differences in distribution and abundances and demonstrated contrasting habitat use between faunal groups, emphasize the importance of mangrove fringed sub-habitat. Although typically employed in deep-water environments, BRUVs proved to be an effective, non-invasive tool in shallow water. Therefore BRUVs could serve as a scalable instrument to assess faunal community structure and elucidate predator-prey interactions in these systems. Furthermore, if employed in a Before-After-Control-Impact survey design, results could document the impacts of coastal development, specifically mangrove degradation.

Keywords: BRUVs, predator-prey interaction, MaxN, mangrove habitat, Bimini

Trophic diversity of seagrass detritus copepods: a consequence of species-specific specialization or a random diet?

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One of the major ecological research questions is understanding how biodiversity influences ecosystem functioning. Unravelling interspecific feeding preferences of organisms with overlapping trophic niches will give part of the answer. Subsequently, the present study displays the trophic diversity of a benthic copepod community in a North-Western Corsican *Posidonia oceanica* seagrass ecosystem. These seagrass meadows are often interrupted by bare sand patches serving as deposition area for loose detritus. The accumulated macrophytodebris, mainly derived from senescent macrophytes, harbour a diverse community of Harpacticoida (Crustacea, Copepoda). The most abundant copepods (i.e. three harpacticoids and one calanoid, belonging to different eco-morphological types) and their potential food sources (i.e. macrophytodebris, epiphytic biofilm and suspended organic matter) were analysed for stable isotope ratios ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$) and total lipids content. The results revealed a harpacticoid copepod feeding preference towards the epiphytic biofilm, while calanoid copepods preferred suspended organic matter. Additionally, a species-specific composition variation revealed finer partitioning of food resources (e.g. different micro-organisms present in the biofilm like bacteria, diatoms, fungi) over time. In conclusion, results showed species-specific food preferences, resulting in trophic niche and resource partitioning. Every eco-morphological type seems to cope in different ways with temporal fluctuations of food sources to comply with their nutritional needs. This illustrates the high resilience of the copepod community present in macrophytodebris accumulations. Moreover, our results underlined the importance of multiple biomarker species-specific analysis in trophic ecology studies, especially in complex and dynamic environments offering numerous food items to consumers.

Keywords: Copepods, Seagrasses, Stable Isotopes, Fatty Acids, Trophic niches, Benthic ecology

Development of a novel molecular tool for the rapid assessment of the biodiversity changes of benthic nematodes assemblages

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The molecular profiling system was developed using directed terminal-restriction fragment length polymorphism (dT-RFLP) to characterize soil nematode assemblages by relative abundance of feeding guilds and validation by comparison to traditional morphological method. The good performance of these molecular tools applied to soil nematodes assemblages create an opportunity to develop a novel approach for rapid assessment of the biodiversity changes of benthic nematodes assemblages of marine and estuarine sediments. The main aim of this research is to combine morphological and molecular analysis of estuarine nematodes assemblages, to establish a tool for fast assessment of the biodiversity changes within habitat recovery of *Zostera noltii* seagrass beds; and validate the dT-RFLP as a high-throughput tool to assess the system recovery. It was also proposed to develop a database of sequences related to individuals identified at species level to develop a new taxonomic reference system. A molecular phylogenetic analysis of the estuarine nematodes has being performed. After morphological identification, barcoding of 18S rDNA are being determined for each nematode species and the results have shown a good degree of concordance between traditional morphology-based identification and DNA sequences. The digest strategy developed for soil nematodes is not suitable for marine nematodes. Then five samples were cloned and sequenced and the sequence data was used to design a new dT-RFLP strategy to adapt this tool to marine assemblages. Several solutions were presented by DRAT and tested empirically to select the solution that cuts most efficiently, separating the different clusters. The results of quantitative PCR showed differences in nematode density between two sampling stations according the abundance of the nematode density obtained by the traditional methods. These results suggest that qPCR could be a robust tool for enumeration of nematode abundance, saving time.

Keywords: dt-RFLP, new molecular tool, marine nematodes, assessment biodiversity changes

Biodiversity-ecosystem functioning relationships under environmental change: the need for empirical evidence

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Predicting the consequences of species loss remains an elusive goal of critical importance for the maintenance of ecosystem functioning and services. To understand the consequences of biodiversity loss, it is necessary to test how biodiversity–ecosystem functioning relationships vary with predicted environmental change. Currently, marine ecosystems are impacted heavily by multiple anthropogenic stressors including nutrient enrichment, ocean warming and the spread of invasive species. However, little is known about how these disturbances interact to affect ecosystem functioning. This presentation will synthesise the recent findings of several mesocosm and field-based experiments, which have manipulated species diversity and other environmental factors simultaneously, to determine the effects of loss of species under changing environmental conditions. For example, we have shown that hydrodynamic disturbance exacerbates the effects of changing consumer diversity on algal communities and functioning, and disrupts the influence of other environmental stressors on key consumer–resource interactions. We also found that the effects of loss of grazer species depends strongly on both the identity of the species lost and of those remaining in the community. Moreover, the effects of loss of species depended on nutrient availability, making it extremely difficult to predict the effects of species loss generally without detailed knowledge of a system. These findings highlight the need to include key physical drivers, such as nutrient availability and ocean warming, explicitly into biodiversity–ecosystem functioning models to move towards a predictive framework that incorporates the effects of both environmental heterogeneity and anthropogenic stressors.

Keywords: species loss, ecosystem functioning, global change, multiple stressors, coasts

Homing behaviour in two concurring species of limpets: *P. vulgata* and *P. depressa*

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Amongst the species of the intertidal rocky shore communities limpets are important keystone grazers and one aspect of their behavioural ecology is represented by homing. All the members of the genus *Patella* are generally thought to have a home scar to which they return after excursions. There is a general agreement that homing is an adaptation to avoid desiccation and to also reduce predation risk providing a site of protection. This study analyses homing behaviour in two concurring species, *Patella vulgata* and *Patella depressa*, both common in North-East Atlantic. It tested the explanatory model that in the protrandrous species *P. vulgata* young males have a riskier behaviour than females measured by changing home more often. This would lead to energy maximizing. In contrast large females are expected to show greater homing fidelity to minimize risk and spend more energy for the gonads development. In the non-protrandrous *P. depressa* males are expected to be more adventurous than females but less than in a protrandrous species. Experiments were done during spring-summer 2014 on the south coast of England (Plymouth, UK) and during the spring-summer 2015 on the central Portuguese coast (shores of Cabo Raso, Avencas, Caxias, Portinho da Costa). In each shore, three areas in eulittoral zone were chosen, with irregular vertical surfaces. In each one of these replicates limpets of various size were marked and the movements, growth and mortality recorded. The results confirmed the hypothesis that in *P. vulgata* small males move more than large females, in *P. depressa* this difference is less marked.

Keywords: ecology, homing, limpet, *Patella vulgata*, *Patella depressa*



SCIENTIFIC SESSION: BIOLOGICAL INVASIONS

Non indigenous marine species: science and management for their control in Europe

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Non-indigenous species are an important agent of ecosystem change: the EU project VECTOR has completed a review of introductions and outbreaks occurring in Europe, in the framework of the main issues regarding the impact of human activities on the natural marine environment. The need for standardizing the criteria used for compiling inventories and data bases and for cross-comparison of different regional situations across Europe has been dealt with and strict scientific rules have been advocated. The Mediterranean Sea is particularly affected, mainly because of the continuous introduction of Erythrean species through the Suez Canal. Besides the Levantine basin (the obvious but not only receptor of Erythrean species), other hotspots of bio-invasion have been described. In the Northern Adriatic Sea, the Lagoon of Venice has been the theatre of dramatic community and ecosystem changes. Examples are provided by the change in algal populations of introduced red and brown algae, that are now dominating on native aquatic plants and the green alga *Ulva rigida*, or by imported bivalves such as *Ruditapes philippinarum*, that have affected also sediment dynamics and benthic pelagic coupling. The biological traits of the most widespread species (i.e. 69 species found in more than 10 European countries) have been analyzed in order to find out some common characters, deemed useful to better understand potential threats to marine biodiversity. The objective of the scientific work is to provide a sound basis to management options such as prevention, remediation and adaptation to biological change caused by alien species in the European and international context.

Scientific Session: Biological Invasions

Effects of ocean acidification on the microbiome of an invasive brown seaweed and the gutmicrobiome of a native isopod consumer

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Ocean acidification significantly affects marine organisms. This is particularly true for seaweeds, which can benefit from raising CO₂ through increased photosynthesis and carbon acquisition and subsequent higher growth rates. Changes in plant leaf chemistry in response to increased CO₂ is expected to result in reduced nutritional quality of tissue for grazers. However, none of these organisms live in isolation, but in close association with diverse microbiota. As such changes in environmental conditions, associated with ocean acidification, may influence the abundance and composition of microbial communities and the services required by / provided for their host. In this study we investigated the effects of ocean acidification on the microbiome of the invasive brown seaweed *Sargassum muticum* and the gutmicrobiome of a native isopod consumer. We anticipate that as a result of ocean acidification, seaweed-associated microbial community will change, leading to further changes in the gutmicrobiome of grazers and adaptation of their digestive systems. The microbiome diversity and composition will be determined using the next generation sequencing of variable regions of the 16S rDNA, and bioinformatics analysis. This will allow better understanding of the role of microbiota in adaptation of invasive seaweeds, including the functional relationships, as well as direct and cascading effect of ocean acidification on the gutmicrobiome of mesoherbivores.

Keywords: invasive seaweeds, ocean acidification, seaweed and grazer microbiomes

Scientific Session: Biological Invasions

A robust DNA-based marker for detection of invasive anadromous Salmonids from estuary water eDNA

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Many environmental changes alter today biological communities, for that reason the advent of genomic tools is becoming necessary to control invasive species. In the case of anadromous salmonids, they are widely spread over the world and have been introduced for aquaculture and sport fishing in many temperate regions. In their marine phase they use estuaries as gates for invading new river basins. Five species are in the list of the Global Invasive Species Database. Here we have developed a method to detect the presence of salmonids directly from water samples, focusing on estuaries of the Iberian Peninsula as a case study. We have designed Salmonidae-specific primers. From these primers, with a simple PCR-RFLP procedure the species present in the Peninsula can be unequivocally identified, like the native Atlantic salmon (*Salmo salar*) and Brown trout (*Salmo trutta*), and the invasive Rainbow trout (*Oncorhynchus mykiss*). The method was validated experimentally as well as from water samples with known Salmonid populations. This powerful and economical tool can be applied in routine monitoring of the presence of invasive anadromous salmonids on estuary waters.

Keywords: Invasive, Salmonids, detection

Winners and losers in expanding marine urban habitats: can we do it better?

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Marine landscapes have been globally altered by the introduction of a variety of human-made artificial structures. Some of the most obvious and economically important negative effects on native ecosystems are already being seen in the coastal zone, and understanding the value and benefits of conserving biodiversity in these urban systems is becoming a pressing question. Amongst the less cognized impacts of urban infrastructures are the effects on connectivity in marine populations. In most instances structures are built in areas which would otherwise be sedimentary, thereby causing on one side the fragmentation and loss of native sedimentary habitats and on the other creating stepping stones or corridors for hard-bottom species. I will demonstrate that, as currently designed and managed, many artificial habitats tend to disproportionately favour non-indigenous over native hard bottom species, affecting their spread at regional scales. I will discuss the potential consequences of these changes, and options to promoting some level of habitat enhancement and environmental quality in marine urban environments

Keywords: Marine infrastructures

Non-native species in northern Europe: investigating the potential for future spread using high resolution climate projections

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Climate change can affect every stage of introduction, colonisation, establishment and invasion of non-native species. In southern Europe there are numerous species that are considered commonplace, and many of these organisms are now spreading northwards as seawater temperatures increase. The similarity of climatic conditions between source and recipient areas is assumed to influence the probability of successful establishment, however in a changing climate this is difficult to quantify. We have adapted and applied a risk assessment methodology in order to scope out new species with proven invasive qualities that have not yet arrived in northern Europe, but which could arrive and then become problematic in the future. Those species determined to have the highest risk have been taken forward, as well as some species that may be economically beneficial, for species distribution modelling to determine their future potential habitat distributions under climate change scenarios. In the past, species distribution models have usually relied on low resolution global data. In this study, in order to increase the local resolution of the distribution models, recently available high resolution UK shelf seas climate change model outputs were nested within a lower resolution global climate model. The subsequent distribution modelling showed that habitat suitability will increase further north within Europe for some of the non-native species. Some of these species are potentially valuable and so may present an opportunity for the fishing industry or aquaculture. Other species are known to be nuisance species and so this early warning of their potential future distributions could be valuable in informing monitoring programmes, particularly for vulnerable infrastructure or protected or threatened ecosystems, and for prioritising control actions.

Keywords: non-native, invasive, climate, change, impact

Scientific Session: Biological Invasions

Molecular barcoding of red algae in the Cantabrian Sea reveals the presence of exotic Asian seaweeds (*Pachymeniopsis gargiuli*, *Grateloupia imbricata* Holmes and *Grateloupia turuturu* Yamada)

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Introduction of exotic species may cause serious consequences for marine ecosystems. On the shores of the Cantabrian Sea (North of Spain) there is no routine examinations of seaweeds combining molecular and morphological methods for early detection of exotic species and thereby to assess in early stages their establishment and expansion processes as a result of anthropogenic activities (e.g.: shipping, aquaculture, etc). In this work we conducted molecular barcoding (COI and Rbcl genes) of red algae collected in Asturias, Bay of Biscay (Gijón and Candás harbours). The results reveal the presence of the exotic Asian seaweeds (*Pachymeniopsis gargiuli*, *Grateloupia imbricata* Holmes and *Grateloupia turuturu* Yamada). This study constitutes the first report where the presence of these Asian algae in this area of the Bay of Biscay is confirmed. The work demonstrates the success in combining morphological and genetic methods in the early detection of exotic algae and proposes that the "molecular barcoding" must be made primarily using the Rbcl gene. The COI Databases are still incomplete and imprecise to obtain successful results in red algae species-level identifications.

Assessing the Marine Fouling Community in a Man-made Marina at Manila Bay

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Manila Bay holds the largest port in the Philippines, and hence facilitates transport of organisms from one region to another. This study aims to assess the fouling community inhabiting a man-made marina in Manila Bay. It provides baseline information on what constitutes the current fouling community thriving in the waters of Manila Bay. The study represents a one-off assessment of fauna at five areas in close proximity at the South Harbor of Manila Bay using artificial collectors. Fouler collectors were deployed in 5 sampling points for 60 days, between November and December 2013 (wet season). Fouler collector design was adapted from the North Pacific Marine Sciences Organization (PICES). Collected fouling organisms were identified using taxonomic keys. Species diversity (H) through Shannon Wiener Index and the Species Evenness (H/H_{\max}) were determined. A total of 9725 fouling organisms were obtained in all the sampling points. Of this total, the fouling organisms obtained belong to 13 families. The total abundance of the fouling communities did not show significant differences ($F=0.198$; $P=0.939$) at the different sampling points. A relatively consistent diversity index was also observed ($H = 1.02$ to 1.42 ; $H/H_{\max} = 0.44$ to 0.55). The most common fouling organism was *Balanus amphitrite*. Other abundant organisms include anthozoans, bryozoans, and polychaetes which were similar to other studies around the globe. The presence of polychaete species *Capitella capitata* and *Polydora* sp. in the study area may indicate that the environment is under stress due to pollution. Two species that were observed in the man-made marina are known to be invasive species; *Mytilopsis sallei* and *Brachidontes* sp., although their abundance does not show them to be invasive. It is important to monitor these species particularly *Mytilopsis sallei* as the species has been detected in high densities in Singapore, Hong Kong, Thailand, India, Taiwan, Malaysia and Australia. Its presence has caused ecological and economic damages to these locations. This study generates a list of fouling organisms that will be useful in the future evaluation of Manila Bay. Continuous monitoring of these organisms particularly the invasive species is necessary as these organisms may bring about consequent risks and damages to Manila Bay's aquatic ecosystems.

Keywords: Fouling, Manila Bay, Diversity

Changes in the food web structure in the Eastern Mediterranean Sea under cumulative impacts

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The ecosystems of the Israeli Mediterranean coast have undergone significant ecological changes in recent decades caused primarily by the introduction of invasive species through the Suez Canal, intense fishing activities and the effects of climate change. An important challenge for conservation is the understanding of how multiple human stressors, environmental factors and marine resources interact and influence each other. To analyse main historical ecosystem dynamics, a temporal dynamic ecosystem model representing the continental shelf of the Israeli Mediterranean coast was developed. We calibrated and fit an Ecopath with Ecosim model to available time series of biomass and catch data from early 1990's to 2010. The baseline ecosystem model was composed of 42 functional groups, ranging from primary producers to top predator species. The model included eight invasive groups encompassing several crustacean and fish species with a diversity of trophic levels that have settled in the ecosystem over a continuous period of time. The ecosystem model was used to explore the historical dynamics of the ecosystem considering the effects of invasive species, fishing activities and climate change (through changes in temperature and salinity) as the main drivers of the ecosystem and to evaluate their historical cumulative effects. The historical model predictions satisfactorily matched the observed data, especially the invasive groups. The model showed an increasing proportion of invasive species in biomass and catch over time, with important effects on the food-web. Results also highlighted the important role that fishing activities and climate change are playing in the ecosystem. The ecosystem model represents a baseline from where to develop exploratory analysis about future management scenarios

Keywords: Food web model, Ecopath with Ecosim, Eastern Mediterranean Sea, invasive species, cumulative impacts

Scientific Session: Biological Invasions

Fast and cheap environmental DNA method to detect the invasive black-pygmy mussel *Xenostrobus securis* in water samples

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The black-pygmy mussel *Xenostrobus securis* is an invasive species that produces serious ecological and economical loss worldwide. It can occupy different niches and can adhere to different substrates. This invasive mussel can spread fast due to a wide physiological tolerance, together with a short generation time and high plasticity. Furthermore, *Xenostrobus securis* can carry the parasite *Marteilia refringens* that causes high mortality in local and commercial species. For all these reasons, its early-detection is essential for management purposes. In this work, a species-specific marker in the cytochrome c oxidase I (COI) gene were developed and tested in water samples from laboratory experiments (in-vitro conditions) as well as in nature experiments (Port of Avilés, North Spain). PCR protocol spent less than 2 hours and products are visualized in agarose gel, meaning a fast and cheap detection method. Positive amplification from water samples correlated with the physical presence of *Xenostrobus securis* confirming the value of the marker for environmental monitoring with good detection sensitivity.

Scientific Session: Biological Invasions

Lessons from Pacific islands: marine protected spaces help to control the spreading of exotic species

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One of the more dangerous threats to biodiversity today is the uncontrolled expansion of non-indigenous species. These can become biological invasions, especially in degraded or human-modified environments. Protection of marine spaces, principally reducing their uses and the human activities carried out inside, is sought to protect biodiversity. The benefits of marine protected areas (MPA) has been proved at varied levels, but their effect on NIS control has been insufficiently addressed by now. In this study we have used two Pacific islands of very different size, type of human uses and climate as a model, and treated them equally for analysis of impacts and protection scaling. Mollusks were chosen as taxonomic group model because they contain a great proportion of the recognized marine invasive species. We have employed genetic Barcoding for ascertaining the species to avoid taxonomic incertitude. We have found strong and significant protective effect of MPA against NIS, likely due to a combination of less habitat degradation and a higher occupation of niches by native species.



SCIENTIFIC SESSION: HABITAT LOSS & OCEAN NOISE

Scientific Session: Habitat Loss & Ocean Noise Keynote Presentation

The future of ocean noise management- advances, gaps, priorities

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Ocean underwater noise was recognized as important anthropogenic pressure around the turn of the century. Concern was initially driven by strandings of cetaceans after use of military sonar; the uncertainty about the mechanism causing these incidents and whether there was potential for large-scale impact added to this concern. Military organisations, worried about implications for their ability to use essential sonar systems, reacted by initiating research on the effects of sound on the marine environment- legislators soon followed, and the European Marine Strategy Directive that came into force in 2008 now requires EU member states to ensure that deleterious effects of man-made noise on the ecosystem are prevented- both from loud impulsive noise sources and by the increase of low frequency ambient noise levels. The requirement to think at ecosystem scale has prompted regulators to broaden the scale of underwater noise impact assessments- in the EU required by the Marine Strategy, but also the approach taken in the US Ocean Noise Strategy. In future broader scale assessments, regulators aim to determine whether the scale of sound generating activities and anthropogenic sound levels requires further action at a larger scale/or in a wider region. Where we still struggle to understand and quantify the impact of ambient noise, the knowledge about effects of loud impulsive noise sources has increased significantly over the last years. Research initially focused on physiological effects in marine organisms, but behavioural disturbance leading to habitat loss, which may happen at low levels of exposure and thus at large scale, may be more significant for ecosystems. Combining scientific expertise is needed to quantify the scale of habitat loss and understand the effect of this (often temporary) habitat loss on the ecosystem, to identify the zones where action is needed to protect ocean values.

Effects of short term exposure with mine tailings on deep-sea benthic ecosystem function and services

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Mining activities in the deep-sea will have different impacts on marine benthic life on different scales including mechanical habitat destruction, release of toxic amounts of heavy metals or burial with sediment or mine tailings. We evaluated the short term effect of burial with mine tailings on ecosystem functions of deep-sea (207 metres) benthos originating from a Norwegian fjord. Sediment cores were sampled and incubated in the laboratory under constant water flow and a temperature of 8°C. Mine tailings were added to the cores resulting in different thicknesses of added substrate (0 cm (control), 0.1 cm, 0.5 cm and 3 cm). Sediment cores were kept at constant temperature and water flow for a duration of eleven days. Oxygen profiles were measured at the beginning and at the end of the experiment. Sediment oxygen consumption, silicate content and dissolved inorganic carbon content was measured at the end of the incubation. Sediment cores were sliced and macrofauna as well as meiofauna was sampled. In order to assess viability of the animals, a life check was done for macrofauna and meiofauna was stained with a trypan blue stain. Results regarding vertical meiofauna community structure, nematode mortality and diversity will be explained and related to the abiotic variables and respiration measurements.

Keywords: MIDAS, nematodes, sediment deposition

Understanding the impact of coastal renewable energy technology on the marine environment

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Renewable energy from the ocean has the potential to provide sustainable and locally sourced energy for island communities. Honolulu, HI is one of the most isolated urban centers in the world, and currently relies on imported fossil fuel for >80% of its energy use. Seawater air conditioning (SWAC) is a renewable energy technology that could reduce fossil fuel use in Honolulu's urban core by 40%. The proposed SWAC system would be the first district-scale system in a tropical environment, and while SWAC has many benefits, it also will have unique environmental impacts. To access the cold temperatures needed for air conditioning, the Honolulu SWAC system will draw seawater from 500m depth. Through the industrial process, this water will be warmed and then released at 100-140m depth. Many of the predicted impacts of this system are related to the relatively high nutrient concentrations in the plume and the locations of the intake and effluent. Over the past two years, we have documented the natural oceanographic variability at the proposed SWAC site using long-term moorings and shipboard profiling. These data will enable us to track changes and perturbations to the ecosystem once the system is operational. Our data show that the projected release depth is at the base of the photic layer, slightly shallower than the pycnocline. The negatively buoyant plume will encounter the pycnocline, which may lead to flow along isopycnals. Rapid horizontal spreading could enhance the spatial scale of impacts. If the isopycnal depth of the plume is above the compensation depth for phytoplankton growth, it may cause increases in primary production. Additionally, the depths of the intake and effluent correspond with areas that are inhabited by the Hawaiian mesopelagic boundary community, a key component of the slope food web. Overall, we advocate releasing the plume below the pycnocline and we recommend that the spatial scale of monitoring be expanded once SWAC becomes operational.

Keywords: Marine ecosystem health, sustainable energy, anthropogenic threats

Deep-sea megafaunal response to physical disturbance along the SW Portuguese continental slope

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Continental slopes support highly diverse ecosystems strongly influenced by habitat heterogeneity and increasing anthropogenic disturbance, of which bottom trawling fisheries are considered of major importance. Recent studies showed that megafauna assemblages are particularly sensitive to trawling disturbance in hard substrate habitats (e.g. seamounts) but impacts on soft sediments are mostly unknown. Video surveys obtained by Remotely Operated Vehicle (ROV) were used to investigate megafaunal structural and functional diversity in areas subjected to different degrees of disturbance (no, low and high trawl intensity) covering different soft sediment habitats (muddy-sand and sandy bottoms) along the SW Portuguese continental slope. In total, 17 km of video transects were analysed within a bathymetric range of 200m and 700m water depths. All disturbed areas displayed frequent and recent trawl marks (up to 3 marks per 100m), with general flattened seafloor topography and low bioturbation. Additional scattered litter presence was observed. Megafauna abundances were highly variable among habitats, revealing more than 80 morphospecies, belonging to 17 classes. Overall, communities from muddy-sand habitats presented higher species richness in undisturbed locations, where sessile groups such as sponges (Porifera) and soft corals (e.g. Pennatulacea) were predominantly found. In contrast, locations subjected to high disturbance showed lower diversity and high abundances of the dominant polychaete *Hyalinoecia tubicula*. The use of several biological traits (e.g. mobility, living habit, feeding type) will be discussed in relation to the community composition and structural diversity among the different habitats and disturbance pressures to better understand on the vulnerability of the continental slope benthic habitats.

Keywords: Epifauna communities, diversity, biological traits; sensitive species; EUNIS habitat, bottom trawling

Scientific Session: Habitat Loss & Ocean Noise Keynote Presentation

Marine Spatial Planning to address habitat loss, coastal infrastructure development, urbanization, and the loss of coastal and ocean values

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Marine spatial planning (MSP) and the subsequent zoning and regulations on use that flow from it are emerging in various forms around the world. However, many countries are missing opportunities to use MSP to its full potential to promote sustainable use of ocean space and resources, while at the same time meeting social and conservation objectives. In the rush to promote 'blue growth', the focus in some places is on accommodating as many uses within the ocean space as possible, and in such scenarios MSP is used primarily to reduce conflict between big, industrial users. Effective MSP can do much more: it can synch to coastal planning to create truly effective ecosystem-based management, in which degradation of important ecosystems is prevented by focusing management on drivers of degradation (even if those drivers do not trace back to ocean use but rather have their base in land and freshwater use). Thus the spatially-oriented regulations that emerge from MSP can address the loss and degradation of habitats that occurs through urbanization and coastal infrastructure development, to ensure that nature's benefits from coastal and ocean ecosystems continue to flow. This sort of holistic planning also creates opportunities for transboundary collaboration to effectively manage shared resources, at a variety of scales. MSP and related ocean zoning can ensure that ecologically important areas are fully represented in a mosaic of use and protection. Finally, the planning process can ensure that the needs of local communities, and the safeguarding of values that extend beyond those captured by large maritime industries, are considered in decisions on how to allocate space and resources in an equitable way, while promoting economic growth.

Artificial Holdfast Units: Accessing Their Usefulness for the Recovery and Conservation of Seahorse Populations in the Ria Formosa lagoon, South Portugal

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A significant decline in the seahorse populations in the Ria Formosa (south Portugal) was recently reported and holdfast availability suggested as a particularly important variable that influences the abundance of the long-snouted seahorse *Hippocampus guttulatus* and the short-snouted seahorse *H. hippocampus*. In order to test the usefulness of artificial holdfast units (AHU) for the recovery of seahorse habitats, four different artificial holdfasts (S1-S4) were initially tested in laboratory for seahorse preference under different conditions and different holdfast densities. Seahorses, both juveniles and adults, preferred the holdfast S4, consisting of a “Codium-like” polyethylene nautical rope, even when submitted to different water flows. Preferred holdfast density was 156 holdfast.m⁻², and most of seahorses were observed grasping at the base of these structures (0-10 cm in height). Later on, based on the information collected in the first experiment, several of these structures were built and deployed in the lagoon at four locations with distinct environmental characteristics and surveyed for seahorse abundance during a 6 months period. All AHUs were colonized by seahorses within a month after deployment, reaching a maximum density of 13.1 seahorse m⁻² at one of the sites. Results suggest that these AHUs have the potential to aggregate seahorses in damaged habitats and promote their recovery, improving local habitats and overall biodiversity. The results also provide useful guidance for the use of artificial structures to improve degraded seahorse habitats in other similar situations, as part of management plans (including the creation of marine protected areas (MPAs)) for seahorse population recovery and conservation.

Keywords: seahorse, artificial holdfast, habitat enrichment, marine protected areas

Barrier island restoration following Hurricane Katrina affects habitat quality for oysters in a northern Gulf of Mexico estuary

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Changes in geomorphology of estuaries are common following major perturbations such as hurricanes and may have profound impacts on coastal ecosystems. Hurricane Katrina in 2005 created a new pass, called Katrina Cut, halving a barrier island, Dauphin Island, in Mobile Bay, USA. Significant decline in oyster population at Cedar Point Reef, the primary oyster harvest grounds, had persisted since then until the Cut was artificially closed in 2010. A bio-physical model for oyster larval transport was used to evaluate two potential mechanisms responsible for oyster population declines: salinity changes in the context of oyster habitat suitability and larval transport changes in the context of larval retention. The model results revealed that the presence of Katrina Cut increased salinity at Cedar Point Reef. During high freshwater discharge, in particular, water exchange through the Cut increased the bottom salinity from < 5 psu to well over 15 (sometimes > 20) psu during the tropic tides. Elevated salinities are associated with greater predation on oysters and higher disease incidence. The presence of the Katrina Cut also reduced larval retention in the spawning area regardless of tidal or river discharge conditions. It was likely due to more dynamic transport conditions owing to the enhanced tidal energy coming in through the Cut, which then resulted in increased westward transport of larvae from the spawning area. Decreases in larval retention at Cedar Point Reef were particularly large for near median river discharge conditions (450-537 cm), which are most frequently occurring conditions in Mobile Bay. Closing the Katrina Cut hence likely improved conditions for oysters within the Bay system and these improved conditions have contributed to increased oyster landings. We believe our results highlight how large scale changes in the marine landscape can alter habitat quality for a key biological component of the ecosystem.

Keywords: Oyster population, Hurricane Katrina, Recovery, Salinity, Larval retention

Assessment of Marine Biodiversity Enhancement Measures for Tidal Lagoon Developments

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Tidal lagoons use the capture and release of tidal waters to generate a sustainable source of long-term renewable energy. Within the UK consent has been given for an initial project at Swansea Bay, Wales, with further projects likely in the future. Operation of tidal lagoons involves the construction of seawalls with in-built tidal flow power generation turbines. As part of a tidal lagoon development, habitat loss can be expected, through direct and indirect effects. Provision of replacement habitats may be necessary to mitigate these effects. A method of reviewing and assessing the mitigation and enhancement measures proposed for the construction and operation of tidal lagoons in the UK was developed. The assessment reviewed a number of proposed mitigation methods. For each habitat a review of the available literature was conducted, and the feasibility of biodiversity enhancement measures was evaluated. The review and assessment examined similar measures within UK or temperate waters where applicable. Analogous examples from tropical waters were considered when relevant temperate information was not available. The implications for the use of enhancement or creation of particular habitats were also considered. The level and relevance of available information was assessed through the use of a confidence matrix, allowing a semi-quantitative comparison of the suitability of the enhancement and mitigation. The evaluation showed a varying degree of confidence in the different proposed measures. Habitat re-creation within the marine environment is severely constrained by local conditions. It is therefore a matter of developing a clear policy approach to habitat loss and replacement. Such a policy would need to make a judgment of the habitats that are 'least' and 'most' important. It is suggested that this method of confidence assessment can be used to inform future coastal and marine plans and projects.

Keywords: Marine habitat enhancement, mitigation, confidence assessment, habitat loss, renewables.

Assessing ecosystem services in coastal lagoons

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Ecosystem services can be broadly defined as benefits that humans take up (or use) from the environment. These can be divided into: provisioning, maintenance and regulation, and cultural services following the Common International Classification of Ecosystem Services (CICES). They can virtually be found in every part of the marine environment, but the awareness of their use is more notable in coastal and transitional waters, specifically coastal lagoons being the last notable suppliers in more direct contact with humans. These ecosystems (coastal lagoons) were chosen as study sites of this research, precisely the Oder Lagoon in Germany and the Curonian Lagoon in Lithuania. The objective is to assess and map ecosystem services for the lagoon using a new methodological approach through an easy to apply tool based on supply and real use (based on Burckhard and colleagues approach) called Ecosystem Service Assessment Tool (ESAT), with the focus on these types of ecosystem. The assessment will provide information that can be used as a comparison study between the lagoons highlighting differences and similarities, and this can then be analysed from a management point of view to see which practices were performed in the past and how it contributed to changes in ecosystem services. Other objective of this study is the reproducibility of this approach to other lagoons and also for the coastal waters of the Baltic Sea. This study will be developed in cooperation with BONUS BaltCoast Project, which aims to develop a systematic management approach that encompasses multiple impacts in a spatially heterogeneous context, by using Systems Approach Framework and to implement a long lasting Baltic coastal management competence network and integration with EU policies.

Keywords: Ecosystem services, coastal lagoons, CICES, BaltCoast, Baltic Sea

Quantifying resistance to erosion in salt marshes of the Northern Adriatic Sea

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Salt marsh ecosystems provide multiple ecosystem services, including protecting coastlines via sediment stabilization. Despite their value, the global extent of salt marshes is decreasing due to human pressures, such as land reclamation, climate change and eutrophication, one of the primary drivers of change in salt marsh systems. We quantified resistance to erosion in salt marshes of the Northern Adriatic Sea by subjecting salt marsh sample cores to waves in a flume experiment, and determined factors affecting resistance to erosion. Results showed that *Spartina* vegetation had a significant effect on erosion rates, and in the absence of vegetation, erosion rates were primarily driven by grain size and surface water nitrate and nitrite concentrations. In a second experiment, we investigated the impacts of increased eutrophication on resistance to erosion through nitrogen enrichment in Grado Lagoon. Results show that in vegetated plots, organic matter and below-ground biomass were the best linear predictors of erosion rates, and in non-vegetated plots, no predictor variable tested was significant in explaining variation in erosion rates. Our study demonstrates the critical role of vegetation and sediment characteristics in resistance to erosion, raising important considerations for management of salt marshes for coastal protection.

Keywords: coastal protection, erosion, salt marsh, eutrophication



SCIENTIFIC EXHIBITION: FUTURE OCEANS AND NATURAL RESOURCES

The Effects of Phthalates on *Nereis diversicolor*

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Animals are exposed, in the natural environment, to a range of human activity related dissolved chemicals that are potentially impacting on their fitness. The animals responses to such stress determines its fitness, physiology and in case of chemical signals also its behaviour. If physical or chemical changes in the ecosystem make the detection of such a chemical impossible, then it can be reasonably assumed that vital behaviours of the animal will be significantly altered. Plastics are lighter, more durable, stronger and cheaper than other materials used for the same purposes, making them most suitable for producing a very broad range of goods and products. However, these same properties also make them serious environmental hazards i.e. they are easily carried and dispersed by water over long distances, and stopped by barriers and settle in the form of sediments that can persist for centuries. Phthalate esters are widely used as additives to offer flexibility to polyvinyl chloride (PVC) resins. DEHP and DMP are the most frequently used plasticizer in PVC formulas in consumer products. In general phthalate esters harmful environmental and human health effects are well documented and a range of studies documented harmful effects on both land and aquatic organisms. *Neanthes (Nereis, Hediste) diversicolor* is a bio-indicator species to monitor levels of pollution in a particular environment i.e. to by quantify levels of contaminant presents in the worms. Measuring these in *H. diversicolor* makes it possible to estimate and monitor levels of contamination in marine environments. The worms are easy to keep in laboratory conditions and can be collected in large numbers in the field and used as model species since the 1950s. The main aim of this study is to investigate and determine the fate of phthalates in a *Nereis* culture system and to assess the impact of phthalates upon fitness such as feeding behaviours. For this worms are exposed to different concentration of DEHP and DMP (0.05, 2, and 10 ug/mL) over short term (days) and long term (3months / lifespan). The aim of short term of exposure was to determine the fate of phthalates in a *Nereis* culture system to examine if phthalate degradation takes place. GC-MS is used to measure the phthalates. Liquid: liquid extraction was used to extract phthalates from water, worm tissue whereas accelerated solvent extraction was used to extract phthalates from sediment. The aim of long term of exposure was to investigate and assess the impact of phthalates on animals' functional traits (feeding response).

Keywords: Phthalate, *Nereis diversicolor*, functional traits, fate of phthalates

Stress response to El nino conditions in giant kelp

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The study of marine foundation species is a crucial step in order to understand how climate alterations will affect the entire ecosystem. Here we test the effect of increase water temperature and reduction of nutrients on a foundation species *Macrocystis pyrifera* combining a photosynthesis indicator (Fluorometer) and gene expression within four populations from the Northeast Pacific and two depths (surface and bottom). Five blades from each population and depth were placed at three temperatures (15, 20 and 24°C) and with and without nutrient (three replicates per treatment) for 72h. Our results show that top blades and south populations are less able to cope to stress conditions.

Keywords: *Macrocystis pyrifera*, climate change, photosynthesis, ecophysiology

What is the acidification level in the Mediterranean Sea?

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Using the biogeochemical data of the May 2013 MedSeA cruise, we were able to estimate the anthropogenic CO₂ (C_{ANT}) concentrations and the acidification levels ($\Delta\text{pH}=\text{pH}_{2013}-\text{pH}_{\text{pre-industrial}}$) in the Mediterranean Sea. Applying the TrOCA approach, our results show that the most invaded waters ($>60 \mu\text{mol kg}^{-1}$) are those of the intermediate and deep layers in the Alboran, Liguro- and Algero-Provencal Sub-basins in the Western basin, and in the Adriatic Sub-basin in the Eastern basin. This study shows that the hydrography in the Mediterranean Sea impacts both C_{ANT} concentrations and acidification levels in the intermediate and deep layers. It also indicates that the entire Mediterranean Sea is still highly saturated in calcium carbonate minerals. The acidification ranges between -0.055 and -0.156 pH unit, which reflects the fact that all Mediterranean Sea waters are already strongly influenced by the ocean acidification phenomena.

Keywords: Carbonate System, Acidification, Anthropogenic Carbon, Mediterranean Sea

Average pH variations in the Mediterranean Sea surface waters

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This study presents an estimate of the pH variations over a 7 years average (2005-2012) in the Mediterranean Sea surface waters. Using the CO₂ calc software, the pH was calculated at the seawater scale by choosing as input parameters the total alkalinity (A_T), total dissolved inorganic carbon (C_T), temperature, salinity, pressure and the relevant dissociation constants. The average fields of A_T and C_T were previously presented by Gemayel et al. (2015). The mapped fields at 1/4*1/4 degree resolution, show that the pH at in situ temperature (pH_T) ranged from a minimum of 8.007 in the Levantine sub-basin, to a maximum of 8.098 in the Ligurian sub-basin. Moreover there was a general decreasing North-South gradient in surface pH_T variations. In fact, all the water masses that are located south of the Balearic sub-basin and the Aegean Sea (at around 36°N latitude), have a pH_T lower than 8.06. With decreasing latitude, the pH_T reaches its minimum around the coasts of Libya and Egypt. Low pH_T values coincided with high A_T and C_T concentrations and vice-versa. This shows the effect of high carbon penetration on lowering the pH_T in surface waters. Hence this study provides an estimate of current pH_T variations in the Mediterranean Sea and could be useful in forecasts analyses and models validation.

What's for dinner? Harpacticoid eating habits in hypoxic environment

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Coastal hypoxia is one of the fastest growing environmental challenges and areas with significant anthropogenic impact are especially sensitive to decreasing dissolved oxygen concentration (DO), in particular in benthic communities where oxygen is recognised as a major structuring factor. In order to investigate the impact of hypoxia on second-most abundant taxon of estuarine meiofauna, harpacticoid copepods were sampled at Westerschelde intertidal mudflats and exposed to low DO in laboratory studies. Functional response of the most abundant species, *Platychelipus littoralis*, to hypoxia was examined in two experimental setups. First experiment has the scope of revealing potential differences in food uptake by means of tracing stable isotope (SI) signature from diatom source. Prelabelled ¹³C diatoms were fed to the copepods in hypoxic condition and control samples in air saturated conditions (3 replicates per treatment containing 250 to 380 individuals each). Preliminary results show that survival rate is above 90% in all the samples, with no significant difference between samples exposed to low DO and air-saturated environment. Further SI analyses will provide information on food uptake. In the second experiment animals were divided in 4 groups (3 replicates per group), containing ca 100 harpacticoids per replicate, according to the food source. Three groups received 3 different monodiatom diets, each with a specific and mutually different FA composition, and fourth food source was a combination of the three diatom species. Each group exposed to hypoxia had a control in air saturated conditions. Fatty acid analysis should reveal whether harpacticoids prefer certain food if stressed with low DO. Results of these laboratory studies will shed light on feeding ecology of harpacticoid copepods in hypoxic conditions.

Keywords: hypoxia, harpacticoid copepods, stable isotopes, fatty acids

Larvae of coral eating crown of thorns starfish, *Acanthaster planci* in a warmer-high CO₂ ocean.

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Outbreaks of coral eating crown-of-thorns starfish (COTS), *Acanthaster planci*, contribute to major declines of coral reef ecosystems throughout the Indo-Pacific. Oceans are predicted to warm and decrease in pH due to increased anthropogenic CO₂ production, making coral reefs susceptible to bleaching, disease and reduced calcification. While corals are expected to continue to decline under predicted ocean warming and acidification it is not known how its major predator will fare in a changing ocean. Because larval success is a key driver of population outbreaks, this study investigated the sensitivities of larval *A. planci* to increased temperature (2–4 °C above ambient) and acidification (0.3–0.5 pH units below ambient) in flow-through cross-factorial experiments (3 temperature X 3 pH/pCO₂ levels). There was no effect of increased temperature or acidification on fertilization or very early development. Larvae reared in the optimal temperature (28 °C) were the largest across all pH treatments. Development to advanced larva was negatively affected by the high temperature treatment (30 °C) and by both experimental pH levels (pH 7.6, 7.8). Increased temperature and reduced pH had an additive negative effect on reducing larval size. The 30 °C treatment exceeded larval tolerance regardless of pH. Thus, planktonic life stages of *A. planci* may be negatively impacted by near-future global change. As oceans continue to warm, *A. planci* populations may move to higher latitudes following optimal temperature gradients. It is important to investigate later life stages, particularly the early benthic juvenile to assess prospects for *A. planci* populations in a changing ocean.

Keywords: coral reefs, Crown of thorns starfish, larvae, ocean acidification, ocean warming

Photoprotective response and recovery of phytoplankton communities in the Southern Ocean against high light exposure

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Future shoaling of surface mixed layer depth due to an increase in sea surface temperature will expose phytoplankton to increased mean light intensities. One of the photoprotection mechanisms to reduce a damage of photosystem II (PSII) by high light exposure is the heat dissipation of excess energy by xanthophyll pigments. The photoprotective acclimation could determine the ecological success of a species or group in high light conditions. This study investigated the photoprotective response to natural sunlight and recovery in phytoplankton communities during the austral summer in the Australian sector of Southern Ocean. Water sampling were carried out at three stations north (45°S) and south (61°S and 65°S) of the Polar Front (PF) along 110°E in 2014. The phytoplankton communities, collected from subsurface chlorophyll maximum layer, were exposed to sunlight for 2 hours, and were incubated further in the continuous darkness, and 14% and 57% irradiance of sunlight for 3 days. Phytoplankton communities north and south of the PF were dominated by coccolithophores and diatoms, respectively. During the phytoplankton communities were exposed to sunlight, maximum quantum efficiency (Fv/Fm) of PSII decreased around 50% in the all experiments at three stations. The largest increase in diatoxanthin (DT) was observed in the experiment north of the PF under the strongest irradiance during the light exposure experiments. It is suggested that they could reduce the PSII damage by the enhancement of DT synthesis with increasing in the irradiance. When the light-exposed cells were stored in the three light conditions within 3 days, Fv/Fm recovered to more than initial values in the experiment north of the PF, but did not reached to initial values south of the PF. It is suggested that the fast recovery of phytoplankton communities north of the PF may have advantage of acclimating to fast-changing light conditions when the surface mixed layer will be shallower in the Southern Ocean.

Keywords: Maximum quantum efficiency, Photodamage, Polar Front, Xanthophyll pigments

Trace elements in future oceanic conditions in Seagrass ecosystem: Ecological implications and toxic effects.

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Ocean acidification (OA) and reduced pH, affects the speciation and availability of metals and the metal bio-geochemistry via alteration of metal uptake rates of the biota in marine ecosystem. Seagrass ecosystem production is predicted to increase in the future oceanic conditions, but in lower pH, trace elements concentration will increase, leading to metal toxicity and it can act as a stressor for the seagrass ecosystem. So in our work we try to quantify the concentration of trace elements and their toxicity levels in three natural (CO₂) vents of Greece in seagrass *Posidonia oceanica* and *Cymodocea nodosa*. Trace elements (TE) Cd, As, Co, Hg, Cu, Pb, Fe, Ni, Mn and Zn, of sediments and seagrass (leaves, rhizomes and roots) of *Posidonia oceanica* and *Cymodocea nodosa* were analysed from the natural (CO₂) vents of Greece by ICP-OES and ICP-MS technique. Trace Element Pollution Index (TEPI), Trace element spatial index (TESVI) provided detailed concentration and availability of trace elements in sediments. Critical toxicity level (CTL) and Bio concentration factors (BCF) provided TE concentration for seagrass, to detect the toxicity level and the difference between sediment and seagrass concentration respectively for each element. TE concentrations increased from the control towards the (CO₂) vents. In the high (CO₂) conditions the concentration of Fe (37625.21 mg/kg), Co (13.19 mg/kg), Pb (3.96 mg/kg) were higher in sediments, whereas Cu (248.35mg/kg), Zn (82.84mg/kg), Ni (43.00 mg/kg), As (525.30 mg/kg), Hg (0.46 mg/kg) were higher in roots, Mn (2006.59) mg/kg in rhizomes and Cd (1.74 mg/kg) in leaves. In the control sites TE was lower in concentration than the vents. Cu (248.35mg/kg), Pb (3.96 mg/kg) and Ni (43.00 mg/kg) concentration was higher than CTL to both *P. oceanica* and *C. nodosa*. Trace elements concentration increased and varied for each (CO₂) vents between sediments and seagrass significantly along the gradient with toxic effects of few TE in future ocean conditions.

Keywords: *P. oceanica*, *C. nodosa*, CTL, TEPI, TESVI, ICP-OES, ICP-MS

A framework for assess vulnerability of coastal fisheries to climate change in Portuguese coast

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Concerns about the effects of climatic changes on marine ecosystems are widespread. For instance, climatic oscillations can change water temperature, nutrient dynamics, winds and circulation patterns. These changes can affect survival, growth, reproduction and distribution of species, but the impacts can be also displayed at the population, community and ecosystem level. Global and regional assessments have been initiated to determine the vulnerability fishing stocks to impacts of climate change and fisheries. As expected, the global climate will suffer big changes in next years, and the fishing resources will become increasingly overfished, and will varies along the world, so it is necessary that studies will be made at a local context. The Portuguese coast has experienced substantial changes in climatic events, namely increasing sea surface temperatures, changing wind patterns, intensification of upwelling and frequency of negative and positive phases of the North Atlantic Oscillation Index. Climate change projections indicate that these modifications could have significant impacts on fishing resources in this biogeographical area. To understand the level of fisheries impact to climatic change we will develop a vulnerability framework (based on exposure, sensitivity and adaptive capacity) in a fisheries context providing an index for species/fisheries to climatic change. These will require information on coastal landings data and scientific information about biology and ecology of species and the climate projections that will be compiled from a range of sources including IPCC scenarios of future climate change for Portuguese coast commercial main species. This simple semi-quantitative approach is adopted to pro-mote the use of vulnerability framework for fisheries status assessment as well as development of actions and strategies in areas that are data-limited but necessitate for preparation to climate change.

Keywords: Climate change, Vulnerability framework, Coastal fisheries, Fisheries assessment, Portuguese coast

Thermal stress biomarkers in the widespread tropical and subtropical sergeant-major fish: temperature as a major environmental stressor in a warming ocean

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Tropical and subtropical reef associated organisms have been recognized as being among the most vulnerable organisms towards environmental change, namely due to climate warming and consequent habitat loss. The study of their physiological responses under environmental stress seems to be a key issue for assessing ecosystem health in these areas but this knowledge is still missing for most species. This study investigates the effect of increased temperature (29°C - control, 32°C - thermal stress) over one experimental month (samplings at 0, 7, 14, 21 and 28 days) in the response of heat shock protein 70kDa (Hsp70) and ubiquitin (Ub) in different body tissues - gills, muscle and skin (including scales) - of a common shallow water fish *Abudefduf saxatilis*. Results show significantly increased levels of both proteins in gills under increased temperature exposure, suggesting the cellular stress response was activated, but there was nevertheless an accumulation of irreversible damaged proteins, which explains why ubiquitin showed an increase at 32°C. Muscle showed an increase in Hsp70 levels at 32°C but no significant differences were found for ubiquitin, suggesting in this tissue Hsp70 production was enough to cope with stress. No significant differences between temperature treatments were found for skin tissue. This may present an interesting opportunity for ecotoxicology studies, as it suggests skin and scales might be a good target tissue for chemical pollution analyses, given that temperature will not be a confounding factor. Significant differences were found for biomarker levels along time and among different tissues. Muscle and especially skin showed the lowest levels of the biomarkers tested when compared to the gills. It was concluded that this fish species can be used as an indicator for thermal stress, and it is proposed it should be included in standard biomonitoring programs in tropical and subtropical areas, given its vast geographical range.

Keywords: sergeant-major fish, thermal stress biomarkers, climate warming, environmental assessment, ecosystem health

Physiological resilience of southern edge populations of *Fucus vesiculosus* to consecutive desiccation and heat shock

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Intertidal communities are particularly sensitive to climatic stress, since they are exposed to a wide range of adverse environmental fluctuations, especially towards their southern distribution limits. In previous work our group examined how microhabitat thermal conditions relate to physiological limits in a recently extinct southern edge population of the intertidal alga *Fucus vesiculosus*. The authors suggested that desiccation may function as a protective strategy by maintaining algal tissues in a metabolically inactive state during peak stress periods [1]. Although several studies focused on intertidal algal responses to environmental stress, little is known about their responses to the repeated adverse conditions to which they are exposed in the field. In this study we evaluated the physiological resilience of southern edge populations of *F. vesiculosus* to 3 consecutive cycles of heat shock or desiccation. Apices of this species were acclimated for approximately 1 week immersed at 15°C under a 12 h day photoperiod (50-100 $\mu\text{mol m}^{-2} \text{s}^{-1}$). The assays were carried out by exposing acclimated apices to heat shock or desiccation at 25 and 35°C for 5 h. Controls were manipulated as stress treatments at 15°C. Physiological responses were determined by measuring maximum photosynthetic efficiency (Fv/Fm) after the stress treatment and following a 2 and 19 h recovery period under acclimation conditions. Overall, *F. vesiculosus* can withstand higher levels of thermal stress when aerially exposed than when immersed. Consecutive exposure to thermal stress led to cumulative loss of resilience, as algae failed to fully recover from the damage caused by previous exposures. [1] Mota CF et al. (2014) Functional Ecology doi: 10.1111/1365-2435.12373

Keywords: intertidal stress, desiccation, heat shock, range edge populations, *Fucus vesiculosus*

Altered epiphyte community and sea urchin diet in *Posidonia oceanica* meadows in the vicinity of a volcanic CO₂ vent

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Uptake of anthropogenic CO₂ from the atmosphere by the oceans is causing a progressive decrease in seawater pH, in a process commonly known as ocean acidification (OA). Changes in pH and carbonate chemistry predicted by the end of the century are expected to highly impact the growth and survival of most calcifying organisms. Sea urchins are key species in marine ecosystems and their feeding behaviour in seagrass meadows has been reported as closely linked to the presence and abundance of seagrass epiphytes. Shifts in the seagrass epiphyte community towards the dominance of more tolerant taxa (e.g. non-calcifying species) are expected under future OA, which may have relevant consequences in sea urchin diet. However, to our knowledge, this indirect effect of OA has not been investigated so far. To this aim, we compared the composition and abundance of the epiphyte community of the seagrass *Posidonia oceanica*, as well as the diet of the commercially important sea urchin *Paracentrotus lividus*, in a control site (usual pH) and in two sites close to volcanic CO₂ vents (predicted pH by 2100) at the Ischia Island (NW Mediterranean Sea). We found significant differences between control and low-pH sites in the composition and abundance of epiphytes, with such differences related to a reduction in calcifying taxa in only one of the low-pH sites. Contrasting shifts in the epiphyte community at both low-pH sites translated to a lower abundance of seagrass and epiphytes and increased green algae in sea urchin diet. Overall, our study suggests that complex responses in CO₂ vent systems may indirectly propagate through the food web, while it also indicates that factors other than direct OA effects may influence local differences within the whole CO₂ vent system.

Keywords: ocean acidification, pH, sea urchins, epiphytes, *Posidonia oceanica*

Population dynamics of temperate kelp near their low-latitude limit

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Due to the lack of long term monitoring efforts, little information is available on temperate kelp populations at their shallower and lower latitude distribution limits, in Northern Portugal. To overcome this, populations of *Laminaria ochroleuca* were monitored for two years, and *Laminaria hyperborea* and *Saccorhiza polyschides* for one year. Projection matrix models were used to assess the state and most important demographic processes for the maintenance and growth of these populations. Furthermore, during the second year of census, the Northern Portuguese coast was impacted by a strong late winter storm that caused extensive destruction in these communities, allowing an assessment of their ability to recover. Population dynamics and initial state differed strongly among species. Due to the seasonality of macroscopic sporophytes of *S. polyschides* in Portugal, its persistence depended totally on the survival of microscopic forms through winter. Our results show that yearly climate variation may affect their recruitment timing, making it impossible for them to reach maturity, thus impairing local spore production. In contrast, year-round production of *L. ochroleuca* spores offers an advantage as it is less likely to be impaired by extreme events. Nevertheless, although populations of the two species were resilient to major disturbances, *L. ochroleuca* took longer than two years to recover, while *S. polyschides* was able to recover in the next year. This indicates that if recurrence and duration of such highly energetic storms increases with climate change, these populations are expected to be affected, becoming gradually younger and providing lower canopy. In contrast, abiotic factors and insufficient dispersal from the subtidal already impaired repopulation of *L. hyperborea*.

Keywords: *Laminaria ochroleuca*, *Laminaria hyperborea*, *Saccorhiza polyschides*, population dynamics, periodic dis

Long-term changes in the occurrence of intertidal seaweeds in NW Iberia

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Recent surveys of the European Atlantic coastline have revealed changes in the composition of seaweed assemblages that may be linked to global change over the last years. Nonetheless, the intricate coastal profile of Atlantic Europe and the large upwelling system off western Iberia suggest that the susceptibility to global change may be different from one region to another. In particular, NW Iberia has been an important omission because no study has systematically evaluated long-term changes in a large number of species. Here, we assessed the changes in the occurrence of 33 perennial seaweeds in NW Iberia by surveying 36 intertidal sites in 1998-99 and in 2014. We found a significant decline in the average number of species per site, particularly in semi-exposed and semi-sheltered sites, that involved red and brown algae alike. Although most of the species were less frequent in 2014, the largest drops involved kelps, fucales, and some carrageenan-producing red algae. Parallel analyses of environmental data revealed significant upward trends in sea surface temperature, near-surface air temperature (summer only) and, strong waves (frequency). In agreement with a weakening of the Iberian upwelling, nitrate and phosphate concentrations showed statistically significant, but very mild, downward trends. Our results agree with similar studies of subtidal assemblages in other regions of the European Atlantic, suggesting that the drivers of these changes may be likewise ubiquitous. Further surveys will be required to tell global from local impacts, and long-term trends from transitory fluctuations. Nonetheless, the regular monitoring of intertidal perennial seaweeds seems as a cost-effective tool for this job.

Keywords: NW Iberia; Global change; Intertidal; Perennial seaweeds

A novel system to manipulate and control CO₂ levels in mesocosms for ocean acidification experiments

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Contradictory results in Ocean Acidification (OA) experimental studies may derive from existing technical problems in the manipulation and control of desired CO₂ levels. Most experimental OA systems rely on pH as an indirect way to control CO₂. However, accurate pH measurements are difficult to obtain and shifts in temperature and/or salinity alter the relationship between pH and pCO₂, leading to uncertainty in real pCO₂ levels, even if pH is apparently stable. Trying to overcome this problem, we developed a system, in which the target pCO₂ is controlled via direct pCO₂ analysis of seawater. Water in a header tank is permanently re-circulated through an air-water equilibrators, in which a low-volume closed air circuit is equilibrated with the system water. The air is then routed to an infrared gas analyzer (IRGA) that conveys the pCO₂ value to a PID (Proportional-Integral-Derivative) controller, which in turn commands a solenoid valve that opens and closes the CO₂ flush to the header tank. The PID controller is pre-programmed and set to maintain a certain pCO₂ and its embedded algorithm allows for a fine-tuning of the CO₂ flush. The pre-mixed water of the header tank is then distributed to the experimental units in a low-flow open circuit. This direct type of control eliminates the problems associated with pH electrodes and accommodates potential temperature and salinity shifts, as the target variable is directly measured instead of calculated. A prototype unit using this control system is now running for two years in CCMAR field lab in southern Portugal, with good long-term stability. Because there is no direct bubbling into the experimental units, this system is also suitable for experiments with phytoplankton and most other marine organisms.

Keywords: Ocean Acidification (OA), OA experimental design, gas bubbling, CO₂

How to deal with food deprivation under three temperature regimes: a lipid perspective of the intertidal copepod species *Platychelipus littoralis* (Harpacticoida)

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Intertidal herbivores are confronted with variable environmental conditions including fluxes in food supply and weather conditions (e.g. temperature). One strategy to cope with these periods of resource limitation is the efficient storage and utilization of lipid reserves. Lipids are major energy storage products in copepods (Crustacea), which constitute an important link between primary producers and higher trophic levels. However, information on the time span of lipid depletion, and in particular of their building blocks i.e. fatty acids (FA) is lacking. Temperature potentially regulates the rate of lipid breakdown and may determine which FA are catabolized during starvation. Consequently, temperature may affect the organism's capacity to bridge periods of resource limitation and also which FA are retained in the copepod and passed on to higher trophic levels. This study monitored the dynamics and the FA composition of the reserve and membrane lipids of an intertidal benthic copepod (*Platychelipus littoralis*, order Harpacticoida) that was starved during 3, 6 and 14 days under three temperature regimes (4, 15 and 24°C). Along with these biochemical parameters, the physiological condition of the copepods was studied by quantifying alterations in body weight and survival. Copepod body weight stayed relatively stable over time and mortality only occurred after 14 days of starvation under 24°C. In contrast, the reserve lipids (115±10 µg FA/ mg DW) declined already substantially after 3 days with the strongest changes observed at 15°C (9±5 µg FA/ mg DW), followed by 4°C (23±1 µg FA/ mg DW) and 24°C (76±7 µg FA/ mg DW). While the decline in reserve lipids was moderate in copepods starved under 24°C, their FA composition changed profoundly, owing to the relative increase of 16:0 and 18:0 at the expense of 16:1ω7 and 20:5ω3. These biochemical changes allow the copepod to adjust its energy household and will be further discussed.

Keywords: temperature, copepod, lipids, fatty acid, starvation

Living in multi-stressed sediments: behavioral consequences for the functioning and diversity in coastal habitats

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Estuaries play an important role in providing essential ecosystem system services and functions. Unfortunately, these habitats are increasingly threatened by multiple interactive stressors including ocean acidification, warming and hypoxia. The effects of these stressors may be additive, synergistic or antagonistic, thus, it is crucial to investigate how they affect the behavior of shallow water marine organisms e.g. feeding, predation avoidance, competition among others. The behavioral changes are likely to influence individual health and finally affecting ecosystem services and functioning of the community. Benthos behavior can be measured by non-destructive pressure sensors that insert in sediment to obtain porewater pressure signals created by hydraulic activities of marine benthos, for example burrowing, pumping, siphon movement, feeding and sediment excavation. Furthermore, visual observation on the behavioral of marine benthos under stress can be documented using time lapse cameras. By synchronising and analysing both porewater pressure signals and visual images, the activities of marine benthos under control and stress conditions can be quantified and compared. This experiment will generate valuable information on how these multiple stressors interactively affect the behavior of marine benthos that will mediate the diversity and functioning of shallow sediment ecosystems.

Keywords: Ocean acidification and warming, hypoxia, shallow marine benthos, porewater pressure measurement

What are we losing?- An Economic perspective of fisheries discards in Portugal

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The quantification and composition of the discarded catches and the understanding of the fate and impact of these unreported action is key issue in fisheries. In Portugal it was estimated that 35.5% of the total catch was unreported between 1938 and 2009, most of reports due to. Despite the interest of estimate total catches in weight caught by national fleets few is known about the economy of the fisheries sector. Therefore, new opportunities in fisheries economic sector might arise from unwanted fish that should be obligatory landed. Herein, Portuguese landings economic value were analyzed and discards that account 96% of illegal, undeclared and unreported catches, and represent one third of the total catches, for the period between 1938 and 2009 were used to estimate the potential economic value driven from discards under discard ban policy. The economic value of the fish was measured across time considering national inflation in 2011 and considering different scenarios based on auction sale prices. The decadal price of fish (€/kg) rise from 1940s until 1970s dropping thereafter. Under a discard ban scenario the economic value generated by discards could contribute between 10 ± 4 to $53\pm 16\%$ of the total landings economical value and between 9 ± 3 to $34\pm 6\%$ of the total catches (landings + discards) economical value. Fishing landings auction sales contributed 0.63% in average to gross domestic production (GDP), 1938-2009. The fishing sector with high percentage contribution to economical fleet income under discard ban policy is multispecies (54%), trawl (26%) and seine (20%). Under discard ban scenario the sale of discards could increase fish landings contribution up to 2 to 6% of GDP. Thus, the importance of fisheries to a country's economy, if only based on reported commercial statistics, may be considerably undervalued in cases where discards fisheries are significant, yet unreported. Discard ban can bring some opportunities in national context for revitalize at some extend fisheries economy.

Keywords: Fisheries economic sector, Discards, Portuguese Landings, Discards ban

A well-kept treasure at depth: Precious red coral rediscovered in Atlantic deep reefs (SW Portugal) after 300 years

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The highly valuable red coral *Corallium rubrum* is listed in several Mediterranean Conventions for species protection and management since the 1980s. Yet, the lack of data about its Atlantic distribution has hindered its protection there. This culminated in the recent discovery of poaching activities harvesting tens of kg of coral per day from a deep rocky reef off SW Portugal. Red coral was irregularly exploited in Portugal between the 1200s and 1700s but since then it has remained forgotten. Here we provide the first description of an Atlantic red coral assemblage, recently rediscovered at 60-100 m depth. The population is composed of very large colonies, estimated to be over one century old. Their growth rate ($0.23 \text{ mm year}^{-1}$) is very slow comparable to Mediterranean specimens. The complex coral branch architecture promotes a rich assemblage of associated fauna, including species with boreal and Mediterranean affinities. Mitochondrial polymorphism shows that red coral populations from the Atlantic are genetically differentiated from the Mediterranean ones. Our underwater surveys, using advanced mixed-gas diving, retrieved lost fishing gear in all coral sites, likely to cause direct impacts on these assemblages. Our findings of distribution and genetic distinctness, together with its rich associated deep-dwelling fauna, now enable further research on population genetics, phylogeography and ecology of *C. rubrum* in the Atlantic. The present contribution shows the uniqueness and vulnerability of a relatively pristine red coral from SW Portugal and represents a baseline against which to monitor future disturbances. We argue that its protection from any mechanically destructive activities is urgent as a precautionary approach. Overall, our contribution should assist further research and conservation of this delicate coral, particularly in Portugal.

Keywords: Red coral; *Corallium rubrum*; Atlantic; Genetic connectivity; Poaching

Assigning *Hippocampus guttulatus* Recruits to the Populations of Origin Using Microsatellites: Results from a Field Study in the Ria Formosa (South Portugal)

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The deployment of Artificial Holdfast Units (AHU) has been demonstrated as an effective tool for creating holdfast and sheltering conditions for *Hippocampus guttulatus* in the Ria Formosa (South Portugal). Preliminary results obtained with a pilot-scale AHU showed a high settlement rate, with recorded densities of up to 13.1 individuals.m⁻². With the present study, we aim to understand whether the AHU's contributed to attract new *H. guttulatus* recruits or concentrate those previously existing in these areas. Prior to the deployment of the AHU's in a total of four focal sites, a sample of the skin filaments was collected from each *H. guttulatus* (n= 70) sighted in those locations. The same sampling protocol was later carried out on the recruits (n=14) sighted in one pilot-scale AHU since its deployment. Upon DNA extraction the variation of 13 highly polymorphic microsatellite loci isolated for *H. guttulatus* (or obtained by cross-amplification in *H. hippocampus*) has been analyzed. PCR reactions with labeled primers were performed using standard procedures and amplified products were run on an ABI PRISM 3130 XL Genetic Analyser©. Based on the genetic data, ONCOR software package was used to estimate the population of origin of recruits. Preliminary results indicate that more than 90% of the recruits at the AHU were assigned to the sites located up to 500 meter apart. No assignment has been demonstrated for the other sampled locations, situated further away from the AHU.

Keywords: *Hippocampus guttulatus*, *Hippocampus hippocampus*, PCR, recruitment

Science, technology and society initiative to minimise unwanted catches in European fisheries – the MINOUW project

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The MINOUW project (<http://minouw.icm.csic.es/>) is a Research and Innovation Action (RIA) of the Europe's Horizon 2020 Framework Programme, addressing the topic "Towards a gradual elimination of discards in European fisheries". Built around a Consortium of 15 beneficiaries and 4 linked parties, the Consortium includes fisheries technologists, fisheries scientists, universities, non-governmental organization and local fisheries managers. The project overall objective is to minimise unwanted catches by incentivising the adoption of fishing technologies and practices that reduce pre-harvest mortality and post-harvest discards, while avoiding damage to sensitive marine species and habitats. The project aims at contributing to the gradual elimination of discards on a case by case basis, using the best available scientific advice, taking into account the economic impacts on the industry, and promoting innovations and changes in the fish harvesting tools and technologies. The project will follow a holistic approach to minimizing the problem of unwanted catches by developing activities in seven workpackages. Practical solutions will be developed in 18 case studies, representing the three main European fish harvesting fleets: bottom trawl, pelagic purse seine, and small scale fleets. Both valuation of the real dimension of by catch and discards, as well as technological solutions are envisaged. In dialogue with end users involved in fish harvesting and representatives of policy makers and civil society, technologists and scientists will explore solutions to the discard problem, covering the domains of technologies, bio-economic models and policies. The solutions will be investigated and demonstrated in case studies, in cooperation with end users. The project encompasses a diverse range of activities to achieve the objectives: research, experimental, consultation, participatory, mathematical modelling, knowledge transfer, outreach and capacity building.

Keywords: Fisheries by-catch; fisheries discards; fisheries technology; European fisheries

Monitoring approaches for supporting offshore aquaculture management and EU Directives at Sagres, Portugal

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The increasing development of aquaculture activity in the coast of Sagres, area included in the Parque Natural do Sudoeste Alentejano e Costa Vicentina (PNSACV) SW Portugal, has to comply with regional and national regulations. The development also has to comply with EU directives including: Quality of Shellfish Waters Directive 2006/113/EC (QSWD); Water Framework Directive 2000/60/EC (WFD); Marine Strategy Framework Directive 2008/56/EC (MSFD); Maritime Spatial Planning 2014/89/EU, (MSP). During 2014/2015, a monitoring routine was established to assess the potential impact of aquaculture in the region, as required by the Agência Portuguesa do Ambiente (APA). This involved a weekly sampling routine of water parameters at surface and bottom, including temperature (SST), salinity (Sal), Secchi depth, chlorophyll (Chl), suspended particulate matter (SPM), pH, oxygen (O₂) and nutrients. Additional water samples were collected for phytoplankton counts to provide information on the species contributing to Harmful Algal Blooms (HABs). Associated with the routine sampling, innovative approaches to understanding the impact of aquaculture have been undertaken including: use of remote sensing products to provide spatial and temporal data for SST, Sal, Chl, and SPM validated with *in situ* radiometric data (Satlantic and WISP-3); genomics for HABs and flow cytometry for nanoplankton; a survey of impact on the benthos; determination of nutrient condition in the region through nutrient stoichiometry; automisation of data collection with an oceanographic bouy. Preliminary data from both routine and innovative studies will be presented in relation to aquaculture management and to the requirements of the WFD and the MSFD.

Keywords: Monitoring, Offshore, Aquaculture, EU Directives

Impact of farming non-indigenous scallop (*Argopecten irradians*) on benthic environment in Bohai Sea

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Aquaculture has expanded largely in recent decades, which has caused negative impacts on coastal marine ecosystem especially from the respect of organic and nutrient pollution. Among the aquaculture products, more than 25% is derived from farming non-indigenous species (NIS). Culturing NIS include ecological risks since the most dramatic ecosystem changes have been found in areas after rapid growth of NIS. NIS has been widely cultured in China. Bay scallop *Argopecten irradians* is one of the most popular NIS culturing in the open sea, which has high loading onto the sediment bottom. We have investigated the impact of organic loads due to bio-deposition of a large bay scallop farm in the coastal area of Bohai Sea, north China. Sedimentation, sediment chemistry and meiofaunal assemblages were investigated in the year of 2015 in two phases when scallop were juvenile and adult. Impacted sites were compared with the control sites. Sediment deposition and redox values were different between the impacted and reference. However, benthic meiofauna did not show clear signs of organic enrichment inside the farm for the juvenile phase. So far, it is concluded that NIS scallop farming is having little impact on benthic environment during the juvenile phase. Further study is conducting in terms of the impact on benthic trophic relationships.

Keywords: Scallop-farm impact; NIS; bio-deposition; meiofauna; Bohai Sea

Trawling and creeling for *Nephrops* fisheries. Comparison of environmental impacts and bycatch assessment.

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The Norway Lobster (*Nephrops norvegicus*) is a deepwater burrowing decapod crustacean with a widespread distribution ranging from Iceland, the Faroe Island and northwestern Norway to the south Atlantic coast of Morocco, with a patchy distribution in the Mediterranean Sea. On the Portuguese shelf and slope areas, adults are found at depths ranging from 150 to 800 meters and more. Along the years this species acquired some importance in the fisheries sector due to its market value, being nowadays one of the main target species of crustaceans in Europe. Fishing for this species has shown severe environmental impacts. Trawl fisheries in particular, are known to directly impact the bottoms and are associated with considerable amounts of bycatch and discards. Recently the European Community has turned the attention to creel fishery for *Nephrops*, encouraging the change from trawl to creels in order to reduce the amount of by-catch and discards. In this study we investigated the consequences of that gear change through the effects on *Nephrops* population, as well as on by-catch species affected by both gears. Possible consequences with respect to the EU landings obligation are discussed.

Keywords: *Nephrops norvegicus*, bycatch, trawl, creel, management

Mapping of the chemosensory system in *Holothuria arguinensis*

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There is a growing interest in sea cucumbers in Europe, while at the same time they are already being over-exploited in many parts of the world. Thus attempts are starting to cultivate them at an industrial scale. However, little is known about their biology and life strategy, hindering decisions on population management. In particular, the role of chemical cues has been largely ignored. Previous studies indicated that the mucus and perivisceral coelomic fluid as sources of chemical cues. Information about the nature of these compounds, the sensory mechanisms involved and the effects elicited are scarce. An important step in studying chemical communication is to have a clear map of the organization of the sensory system in the target organism. The present study was performed to characterize the major tissue(s) in contact with the environment in order to generate a map of the sensory system in sea cucumbers. The animals were dissected and divided into four regions: anterior, posterior, dorsal and ventral. As a first step, classical histology was used to characterise each of these regions. They had a common organisation and possessed an outer cuticle, over the epidermis, a nerve plexus and a wide zone of connective tissue in which water vascular canals were observed. Three ambulacral appendages were present in the body of the sea cucumbers: (1) tentacles surrounding the mouth, (2) tube feet distributed along the body and (3) papillae organized in rows on the dorsal region. The results obtained and the previous studies suggest that tentacles are sensory organs and could potentially have a role in perception of chemical signals. They consist of a stem divided into secondary and tertiary branches ending in a papilla formed by several highly innervated buds. The next step of this work will use next generation sequencing to identify potential chemosensory receptors in tentacles and bioassays that demonstrate responses to chemical signals.

Keywords: tissue, *Holothuria arguinensis*, histology, sensory organs

Methodology: optimizing protein extraction and separation in *Fucus* macroalgae to study desiccation-tolerance

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Shifting between marine and terrestrial habitats, *Fucus vesiculosus* is a brown intertidal alga that can desiccate rapidly when exposed to air, yet forms dense canopies along European intertidal areas. Desiccation, like temperature and high light, often limits the distribution of intertidal organisms. To identify mechanisms responsible for desiccation tolerance, we searched for proteins differentially expressed during the recovery period following intense desiccation at low tide, when repair and protection mechanisms should be activated. First we selected an optimized method for protein extraction from *Fucus vesiculosus*, an organism rich in polysaccharides and phenolics, which are known to interfere with protein extraction from other macroalgae and terrestrial plants. Of the four methods tested, two that included phenol extraction and were developed specifically for brown algae, were effective with *Fucus* adult tips, producing well resolved protein spots in 2-DE. A simpler, commercial protocol for plant tissues, with successive methanol and acetone precipitations, resulted in a viscous yellow extract with few discernible proteins. Another method, developed for macroalgae using RNA extraction columns from a kit, also failed to eliminate contaminants causing viscosity or aggregating proteins. To detect differential expression during recovery from desiccation, purified proteins were separated in 2-DE gels, CBB-stained and the resulting spot patterns analysed. Despite good spot separation and resolution, no significant changes in expression were detected between control and recovery treatments. Our results therefore suggest that constitutive expression is the predominant mode of desiccation protection in intertidal fucoid alga.

Keywords: protein extraction methods, brown algae, 2-DE, differential protein expression, desiccation

Barrier trap selectivity improvement for the management of coastal lagoons: Case study from an Eastern Mediterranean lagoon

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Lagoons have been emphasized for their importance as nurseries grounds for different marine species, which in turn supports significant abundances of undersized individuals that can be harvested by fishing, thus causing more intensive discarding problems. This becomes particularly critical because the current European Regulation 1967/2006 has been incorporated in its issues the lagoons, as they are properly considered as part of the coastal zone of the Mediterranean. Especially on chapter 5 reports for the minimum marketing sizes of marine organisms. In this respect an initiative aiming to improve fisheries management in the Messolonghi-Etoliko lagoon complex (Western Greece) is presented. The main goal is to evaluate whether the installation of modified fish barrier traps has resulted in reducing the catches of undersized individuals and thus the resulting discards. So, small - scale modifications in the technical characteristics of the fish barrier traps were planned by the prefectural fisheries department of the area accompanied by the active participation of the professional fishermen cooperation's under scientific monitoring. The new type of barrier traps lead both to a reduction of small sized individuals and to an increase of the larger ones in the catch. Especially, it allows a significant escapement of undersized fish leading to a reduction of discards in the area. Differences in species size selectivity between the traditional and the new type of barrier traps were found for all studied species. Regarding the most abundant species of the study, *Sparus aurata*, the total commercial value was found higher for the catch derived from new traps in comparison to the old type. This leads to economic benefit by almost 20% and on the boost of commercialization of the product. The results will be also discussed in the context to improve the sustainability of lagoon multi-species and multi-gear fisheries.

Keywords: lagoon, fisheries, seabream, traps, discards, Mediterranean Sea

Marine commercial fish feeding: dietary characterization and food availability of three fish species from a southern European temperate estuary (Mondego estuary, Portugal)

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The diet composition of three important marine commercial fish species *Platichthys flesus*, *Solea solea* and *Dicentrarchus labrax* was studied. Sampling was conducted seasonally (spring; summer / autumn), from 2012 to 2014, at six stations located along the saline gradient of the Mondego estuary, Portugal. The work aimed to: 1) characterize the diet of three marine fish species based on the identification of their gut contents; 2) identify possible inter-annual and seasonal food preferences; and 3) determine if the annual interposes to seasonal variations. In 2014 the number of preys in gut contents was much higher than in 2012 and 2013. The stations in the mouth (M) and at downstream areas of south (St 9) and north (St 18) arms are the ones with the higher number of preys in guts. *Corophium multisetosum* (10.16 ± 0.29) and *Streblospio shrubsolii* (9.16 ± 0.37) followed by *Cyathura carinata* (0.42 ± 0.01) and *Crangon crangon* (0.40 ± 0.01) are the preys most consumed by *D. labrax*; *C. multisetosum* (5.32 ± 0.12); *Abra alba* (3.87 ± 0.13) followed by *S. shrubsolii* (1.74 ± 0.06) are the most consumed by *P. flesus*; *Cerastoderma edule* (2.52 ± 0.08) followed by *C. carinata* (0.32 ± 0.01) and *Carcinus maenas* (0.90 ± 0.03) are the most consumed by *S. solea*. At St M *P. flesus* and *S. solea* present a common prey (*C. edule*) whereas at St 12 *D. labrax* and *S. solea* show as common prey *C. carinata*, while at downstream stations *D. labrax* and *P. flesus* show as common prey *C. multisetosum*. At the south arm overall fish species show as common prey *C. maenas*. In general, consumption of *C. multisetosum* by *D. labrax* and *P. flesus* does not reveal correlation with prey availability. Still, the consumption of *C. crangon* by *D. labrax*, reveals a correlation with prey availability, showing a feeding preference.

Keywords: Commercial marine fish species, Preys, Gut contents, Feeding, Mondego estuary

Impact of coastal mussel farms on the macrobenthic soft bottom community

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The work aimed to ensure scientific support to aquaculture concessions located within a sensitive coastal area near Sagres (PNSACV - Parque Natural do Sudoeste Alentejano e Costa Vicentina; SW Portugal), by assessing the modifications observed in the macrobenthic community and the sediments they live in. Samples were collected inside and outside the mussel concession, with a 0.025 m² area grab and sieved through 1 mm mesh size for biological assessment, which will enable future identification of temporal modifications resulting from aquaculture activity and help this activity comply with National and European regulations (e.g., QSWD - Quality of Shellfish Waters Directive 2006/113/EC; WFD - Water Framework Directive 2000/60/EC; MSFD - Marine Strategy Framework Directive 2008/56/EC; MSP - Maritime Spatial Planning 2014/89/EU). Benthic macrofauna is an important Biological Quality Element (BQE) for WFD as they aggregate information about environmental changes and their potential impacts. Density and biomass data were obtained for square meter and analysed using the PRIMER 6 + PERMANOVA © software package (Plymouth Marine Laboratory, UK): (a) to test differences between sites (PERMANOVA, Bray Curtis as similarity method, 9999 permutations, unrestricted permutation method, $\alpha = 0.05$); (b) to identify species contributing most to differences between sampling sites (SIMPER, 90% cut off value); (c) to analyse the spatial ordination of samples (PCO). Ecological indicators (Margalef index - d , Pielou evenness index - J' , Shannon-Wiener diversity index - H' , Simpson - $1-\lambda$, AZTI marine biotic index - AMBI) were calculated to assess the condition of the benthos. The Benthic Assessment Tool (BAT), was used to calculate the Ecological Quality Status (EQS) of the samples (official methodology for the WFD in Portugal). The Reference site presented a better distribution of individuals between species than the farm site, but ecological quality was never below GOOD EQS.

Keywords: Aquaculture, mussel longline, macroinvertebrates, quality assessment, Water Framework Directive

Metabolic Enzyme Activities as Indicators for Physiological Conditions in Early Developmental Stages of *Amphiprion ocellaris*

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Growing popularity of tropical marine aquaria creates a great demand for tropical reef organisms, resulting in increasing pressure on natural coral reefs. As most ornamental species are still caught in the wild with mainly destructive fishing methods, ornamental fishing causes population decline and habitat loss. Detailed knowledge about the basic metabolism in early life stages of tropical fish could optimize maintenance and captive breeding of ornamental fish. Enzymatic analyses of specific key enzymes for anaerobic and aerobic metabolic pathways reveal the organisms' physiological conditions. In this study, activities of the metabolic key enzymes, citrate synthase (CS), pyruvate kinase (PK) and lactate dehydrogenase (LDH) of eggs, larvae and juveniles of false clownfish (*Amphiprion ocellaris*) were investigated to establish a set of baseline data for this economically important ornamental fish species. Within all developmental stages, the oxidative enzyme CS showed the lowest activities, whereas glycolytic enzymes, PK and LDH, were at least five times higher. With ongoing ontogenetic development, enzyme activities followed a bell-shaped curve, with highest activities for PK and LDH in 7-8 days old larvae (PK: $91.48 \pm 16.55 \text{ U g}^{-1} \text{ WM}_g$; LDH: $76.87 \pm 12.09 \text{ U g}^{-1} \text{ WM}_g$), and highest CS activities in 1-2 days old larvae ($7.47 \pm 0.78 \text{ U g}^{-1} \text{ WM}_g$). However, one of the key results of our study is that parental influences play an important role for metabolic enzyme activities in early developmental stages of *A. ocellaris*. Differences in enzyme activities due to parental origin may be higher than those given by developmental stages. Further investigations on differences in enzyme activities in offspring of one breeding pair, but different clutches are needed. This will show whether metabolic key enzymes are suitable as general indicators for overall physical conditions of early life stages.

Keywords: ornamental fish, citrate synthase (CS), pyruvate kinase (PK), lactate dehydrogenase (LDH), parental effects

Approaches to characterize the fishing effort of the artisanal fisheries in the Algarve (Southern Portugal)

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Characterizing small scale fisheries effort is challenging worldwide. Their functioning is not fully understood due to the lack of information on fishing season, catch effort, and gear types used. This work aims to present different approaches to characterize the Algarve artisanal fishery fleet. The Algarve artisanal fishing fleet is mainly composed of small vessels that target a large variety of coastal species using multiple fishing gears (trammel nets, gill-nets, traps, long-line). The data compiled from various literature will provide baseline information on the catch as well as the evolution of the fleet over the past fifteen years. Methods, such as face-to-face interviews, on board-observations and Automatic Identification System (AIS) data will be used to characterize the spatial distribution of the fishing effort. For example, boat speed obtained through AIS can be used to determine the vessel activity. The fishing effort data collected will then be compiled into a GIS database. This information can be used later on for marine planning such as MPA implementation. It will ensure long term livelihood for the fishing community and a sustainable exploitation of the resource.

Keywords: AIS; GIS; small scale fishery

Developing a network of underwater routes at the Algarve

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The use of coastal natural areas for diving activities is growing, leading to increasing concern regarding environmental protection of underwater visited areas. In the Algarve (southern Portugal), under the “EcoSub” project, a network of underwater self-guided routes was designed and implemented as a way to protect the underwater environment by increasing environmental awareness of users. Overall, six snorkelling routes were implemented at popular beaches: “Praia da Marinha” in Silves, “Praia D. Ana”, in Lagos, “Praia dos Arrifes” in Albufeira. Also, four scuba diving routes were designed for some of the most popular scuba diving sites: “B24” off Faro, “Poço” off Armação de Pêra, and “Ponta dos Caminhos” and “Grutas do Martinhal” off Sagres. For each route, after biodiversity mapping using visual census techniques, an underwater path was designed and interpretative sites with specific environmental information were defined. Routes and educational tools were planned according to expected socio-demographic characteristics of visiting divers. Different educational and interpretative tools were used, such as: environmental briefing, in situ interpretative slates, leaflets and guided tours. The routes were implemented in association with several scuba diving companies, beach concessionaires and education/science centres. The project started in 2008 and, since then, routes have been implemented during the summer season and whenever logistic and atmospheric conditions allow it. Overall, the underwater self-guided routes seem to have pleased the visitors, resulting in a satisfactory way of engaging snorkelers and scuba divers in the activity. Moreover, the interpretative and educational tools used seem to promote effectively environmental awareness, leading to the protection of the visited environments.

Keywords: Underwater routes, snorkelling, scuba diving, awareness, environmental education, environmental interpretation.

Mapping the socio-economic and cultural importance of inshore fisheries

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Inshore fisheries (IF) are more than a food source and livelihood for inshore fishermen; they play a role in cultural and social aspects and heritage in coastal communities. The GIFS project (Geography of Inshore Fishing and Sustainability) aimed to understand and capture the socio-economic value of IF, together with its rich cultural identity and heritage. Biologists, ecologists, social scientists, community developers and fishing communities worked together in order to better understand the relation of IF and the community. A range of research methods going from in-depth case studies, interviews, community surveys to photography and fisheries statistics analysis were used to explore the diversity and similarity of IF along the English Channel and Southern North Sea. Research focused on different themes and involved multiple case studies. As part of the case studies, regeneration was undertaken in the historic fishing village of Arnemuiden (NL). Heritage research was used as a source of inspiration to improve the image and brand of Arnemuiden. In Hastings (UK), the GIFS education project developed a fisheries related and fisher-led model of Alternative Education Provision. The 'Fishing places & Community research' resulted in a community-based appraisal of IF and an extended photo collection. The role of IF in coastal zone development schemes was analysed and an assessment was conducted of the diversity of governance mechanisms in place: the results are summarized in policy briefs to better inform fisheries policy. An intensive analysis of the economic impact of IF led to several economic approaches for the valuation for IF. The project outcomes and methodologies can be applied in other community research context: they are summarized in the 21st century catch Toolkit: a guide for practical approaches for sustainable IF communities. Project results are available from the GIFS portal -embedded in the Coastal and Marine Wiki- and accessible through an interactive map.

Project Title: Geography of Inshore Fishing and Sustainability GIFS

Funding: INTERREG IVa 2 Seas project Participants: Université de Bretagne Occidentale (UBO) and AGROCAMPUS-OUEST (FR); University of Greenwich (UoG) and University of Brighton (UoB) (UK); Municipality of Middelburg (NL); Flanders Marine Institute (B)

Project duration: January 2012 and September 2014

Website: www.gifsproject.eu

Three decades of sandy commercial bivalves surveys on the South coast of Portugal: a spatio-temporal analysis

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Most marine species are known to be aggregated in spatial patches. Those patches vary through time, both in biomass and location, as a response to a set of drivers. Thus, to understand the ecological, environmental and anthropological drivers of species biomass, long term spatial analysis on species dynamics are essential. In particular, target species of small-scale fisheries are further influenced by governance and market drivers, with a significant impact on its dynamics, which in turn have considerable economic and social impacts. In the coast of the Algarve (southern Portugal) an important small-scale fishery targeting three commercial bivalve species takes place on sandy bottoms. In the current work almost three decades (1986-2014) of striped venus clam (*Chamalea gallina*) biomass was analysed using spatio-temporal geostatistical methods. The studied area comprises 119 km² of coast, distributed between -8.1o to -7.4oW longitude and 36.95 - 37.17oN latitude, and from 3 to 15 m depth. Species biomass was modelled in function of space and time using a spatio-temporal variogram. The model was then used to produce interpolations over the studied area and period using spatio-temporal kriging. The striped venus clam (*C. gallina*) showed a simple sum metric covariance spatio-temporal model, explaining 53% of covariance. The model showed that bivalve species is aggregated in 2.9 km spatial patches, whose location and dimension varied throughout the sampling period. Spatio-temporal kriging predictions maps were used to extract the main summarizing statistical features, such as the mean, maximum and variance, for all time-series stacked, thus determining the persistent favourable areas for this species and corresponding spatial patterns of variation through time. The main spatio-temporal patterns of variation were further explored using Empirical Orthogonal Function analysis (EOF), is a particular principal component analysis, which decomposes the spatio-temporal variability in the time series into principal spatial orthogonal components. This analysis permits to identify the main types of spatial distribution and temporal evolution of a given variable. The stock estimates produced and the corresponding spatial distribution will be used within the European project SAFI (<http://www.safiservices.eu/>; REA Grant Agreement 607155), that aims to develop indicators between species and aspects of their environment to support fisheries operations and help in management decisions, assuring a sustainable exploration of the living marine resources by using satellite-derived information.

Spatial protection and size composition of soft bottom fish communities: the case of the Luiz Saldanha Marine Park (Portugal)

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Marine protected areas have been increasingly recognized as conservation and fisheries management tools, with the size composition of fish assemblages being one of the strongest indicators of protection measures. Size-based metrics are increasingly being used as indicators of anthropogenic impacts and marine reserves performance. We analyzed size-based metrics of one soft bottom fish assemblage within a multiple zoning MPA in the north-eastern Atlantic, the Luiz Saldanha Marine Park (Portugal). Data were collected by trammel net in three protection level areas, during the implementation period and for three years after full implementation of the marine park. The fish assemblage was found to be dominated by the families Soleidae, Triglidae and Rajidae. Two indexes were tested to evaluate the effect of protection on the size composition of this fish assemblage, over time and between the three protection levels. One used the maximum size described per species and the other looks at the percentage of ‘mega-spawners’ in the catch, i.e. fish of a size larger than optimum length plus 10%. Both indexes proved to be adequate to identify differences in size composition in this case-study. Results indicate different trends both in space and time according to different species, with some species showing positive trends that are likely related to protection.

Keywords: Marine Protected Areas, Size-based metrics, Soft bottom fishes, Spatial protection



**SCIENTIFIC EXHIBITION: BIODIVERSITY EFFECTS, BIOLOGICAL INVASIONS &
HABITAT LOSS**

Hybridization signals in *Fucus* diversification

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Analysing the role of hybridization in speciation processes is of key importance for understanding extant patterns of biodiversity. Patterns of hybridization may reflect different pathways of the evolutionary history of species that can be related to biogeographic processes. Additionally, it may have ecological consequences for ecosystems assemblages. Hybridization between closely related species is known to occur in many taxa, but the extent to which it blurs species boundaries or results in the evolution of new lineages, remains unclear. Coastal ecosystems in the eastern North Atlantic harbour great biological diversity, where groups of related cold-temperate species co-occur, and is thus an excellent system for studying relationships between biodiversity and ecosystem functioning. The marine genus *Fucus* includes some key foundational species that are vital ecosystem engineers throughout its wide distribution on North Atlantic rocky intertidal shores. A recently described species, *Fucus guiryi* reveals signals of introgressive hybridization in the northern part of its range involving the sister group *F. vesiculosus*/*F. spiralis* where these occur in sympatry. In contrast, it occurs in allopatry in its southern distribution range. The extent of nuclear introgression and its contribution to adaptive divergence remains unknown, requiring new genome-wide approaches to detection and analysis. Understanding the contribution of genomic hybridization on diversification processes presents a great challenge, which will provide a knowledge base to test the ecological implications of cryptic diversity across biogeographic scales and to better understand processes involving interspecific gene flow. Using high-throughput techniques and phylogenomic methods, we aim to determine the degree to which hybrid diversification exists in nature by testing the extent of hybridization across populations throughout the allopatric and sympatric distributional ranges of both parental and putative hybrid lineages.

Keywords: hybridization, *Fucus*, North Atlantic, RNA-seq, cryptic diversity

Diversity of pelagic fish larvae in a latitudinal gradient across the Atlantic Ocean estimated through DNA Barcodes and visual identification

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Mid-trophic pelagic fish are essential components of marine ecosystems because they represent the link between plankton and higher predators. Moreover they are the basis of the most important fisheries resources, for example in African waters. In this study we have sampled pelagic fish larvae in the Eastern Atlantic Ocean across a latitudinal gradient between 37°N and 18°S. We have employed Bongo nets for plankton sampling and conducted DNA analysis (Barcoding) for accurate species identification. From a total of 403 larvae we have identified 56 fish species. Some of them are cosmopolitan and others are latitude-specific, as expected. The latitudinal pattern of diversity did not exhibit a temperate-tropical cline; instead it was correlated with environmental conditions with a maximum in subtropical zones. These results are important in the context of ecosystem functioning and may serve for designing ecosystem-based management of fisheries resources.

Keywords: Fish larvae, Barcoding, visual identification, Eastern Atlantic Ocean

Photo-identification and bioacoustics analysis to investigate the growth of sperm whale (*Physeter macrocephalus*) and its movements in the Mediterranean Sea

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This work combines photo-identification and bioacoustics to study the body growth and the movements sperm whales in the Mediterranean Sea. The Mediterranean sperm whale is a sub-population considered endangered according to ACCOBAMS and IUCN. Hence it is necessary to study sperm whales, their ecology, their population structure, distribution and movements to implement appropriate conservation strategies. Four individuals size estimated, photo-identified and recorded in the Ligurian Sea (Italy) by CIBRA in 1994-1997 have been searched in photo-id catalogues available from other areas of the Mediterranean Sea. Two of the individuals have been recaptured photographically in the Western Ligurian Sea by Tethys and one of them also in the Gulf of Lion (France) by EcoOcéan, in different years (31 resightings in years 1994-2014). CIBRA and Tethys also performed acoustic recording of the photo-identified whales by means of a towed array of hydrophones. It was possible to retrieve the original recordings and to accurately measure the Inter Pulse Interval of the recorded sperm whales' clicks by using cepstral techniques. The IPI measure allows to estimate the size of the recorded whales. The IPI analysis of the two whales photographically recaptured reveals that have grown up respectively by 68 cm in 16 years (4.25 cm/year), and 79 cm in 20 years (3.95 cm/year) and give the size estimation of the other two no photographically recaptured. The growth rate fits to the curve of asymptotic limit of the maximum size reached by the species. The adults measured are smaller than the Atlantic's, and thanks to comparison with stranded animals it is possible to estimate the age. This work demonstrates the importance of the multidisciplinary approach and of the data sharing between different research institutes. It is also demonstrated that the combination of photo-identification and bioacoustics allows to obtain important information about the ecology of sperm whales.

Keywords: Sperm whale, Photo-ID, marine bioacoustics, IPI, body-growth

Food and Feeding habits of the Lessepsian migrant pufferfish *Lagocephalus sceleratus* from two different habitats, the Gulf of Suez and the Mediterranean Sea.

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The Pufferfish *Lagocephalus sceleratus* is one of the most important lessepsian migrant species from the Red Sea to the Mediterranean Sea. The current study is aiming to investigate the food and feeding habits of the Pufferfish *Lagocephalus sceleratus* in two different habitats. Seasonal samples were collected from the Gulf of Suez and the Egyptian Mediterranean Sea during winter 2013 autumn 2014. The average total lengths, weights and alimentary tracts in the Gulf of Suez were larger than that in the Mediterranean. The diversity of food items found in stomachs of pufferfish *Lagocephalus sceleratus* collected from Gulf of Suez were greater than that found in stomachs of the same species collected from the Mediterranean Sea. Eighteen food items from different families recorded in the stomachs of *L. sceleratus* collected from the Gulf of Suez, while eleven items recorded in samples collected from the Mediterranean. The analysis of diet composition showed that the pufferfish *Lagocephalus sceleratus* is mainly omnivore, feeding on a wide variety of items in both study sites. Fishes food item recorded the highest rank in both study sites. It constituted by 7 varied species from different families constituting 41.54% of all food consumed in Red Sea while represented by 5 species from different families represented by 47.63% of all food items in the Mediterranean Sea, followed by crustaceans, Molluscs, Gastropods, Echinoderms, algae and nemertean. The percentage of intensity of feeding in *L. sceleratus* clearly indicates a high rate of feeding activity. Fishes with stomachs half, three-quarter full and full of food constituted more than 50% of all analyzed individuals in the studied habitats, the maximum feeding intensity was observed in spring season and the minimum feeding intensity was observed during summer, which coincides with the spawning period. The seasonal changes in diet composition of *L. sceleratus* collected from both investigated areas showed that fish remains and crustacean parts were found in fish stomachs during all study period, while the other food components fluctuated in the different seasons. This study suggests a diet shift with increased body size to a molluscivore feeding which means that with increased body size, *L. sceleratus* was shown to shift its diet to molluscivore feeding. The study recommends further investigations on the lessepsian migrant species to monitor their ecological and biological impacts on the Mediterranean ecosystem.

Composition and dynamics of armored dinoflagellates assemblages in the upwelling region (Cape Saint Vincent, Sagres, South-West Portugal).

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The armored dinoflagellate community from the Iberian upwelling region at Sagres, in the Cape Saint Vincent region of Portugal was studied at an offshore concession for bivalve aquaculture. Plankton samples were collected with a 55 micron net on a weekly to monthly basis between 1994 to 2001. The dinoflagellate community demonstrated successive changes following wind-induced upwelling-stratification and seasonal changes. Several types of communities, including genera of *Ceratium*, *Protoperdinium*, *Dinophysis*, *Prorocentrum*, were identified on the basis of ecologically grouped species, comparable to life-form types associated with mixing-nutrient habitats. It is suggested that analysis of oceanographical and meteorological data, including those obtained by satellite remote sensing, can be useful for detecting the conditions for development of dinoflagellate communities containing harmful species in the region, with potential use for aquaculture management.

Keywords: Dinoflagellates, upwelling, harmful algae

Shell discoloration in intertidal mussels due to endolithic parasitism: a cool phenotypic shift?

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It has long been recognized that parasites play an important role in shaping community structures and determining species' distribution. However, the complex processes by which they impact and regulate host populations are still not completely understood. In intertidal mussels, phototrophic endolithic parasitism has been proven to produce both lethal and sub-lethal effects. Microorganisms such as cyanobacteria actively bore into mussel shells weakening their strength; the demand for shell repair depletes energy resources decreasing byssal attachment strength, which can reduce organisms' capacity to withstand wave action in highly hydrodynamic ecosystems. However, endolith-induced shell erosion is also associated with a change in organisms' phenotype (marked whitening of the shell). Results show that this discoloration can influence the amount of heat absorbed during emersion periods, positively enabling infested individuals to maintain lower body temperatures than non-infested, darker individuals. Using non-invasive infrared technology, we examined mussel cardiac frequencies to assess the physiological response of both infested and non-infested individuals directly exposed to heat stress.

Keywords: Endoliths, *Mytilus galloprovincialis*, Bioerosion, Heartbeat, Heat stress

Fatty acids as indicator of the effect of an herbicide in two marine bivalve species: *Cerastoderma edule* and *Scrobicularia plana*

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In Europe, mainly in the Mediterranean region, an intensive usage of fertilizers and pesticides was recorded at the past 30 years reporting, in some cases to an exceed of contamination up to EU limits. The intensive usage of pollutants in fields near ecological coastal wetlands, led to the implementation of the Pesticide-Monitoring programs to recover aquatic systems, such as in the Mondego estuary (Figueira da Foz, Portugal). According to the information from agricultural cooperatives of the Mondego valley, Primextra® Gold TZ is the most used herbicide in corn crops fields. Biomarkers, such fatty acids (FA), proved to be a new and potential powerful tool to detect, document and evaluate exposure to and the effects of contamination hazards. FA play an important role on neural levels of biochemical and physiological response of the organisms, be considered a good bioindicator of ecosystem health and bioindicator of stress. Bivalves are currently used in ecotoxicological bioassays due to their ecological importance, their wide geographic distribution, ease of handling in the laboratory and in the field, and their ability to filter and ingest large volumes of water and sediment particles. Thus, the main goal of this work are to determine toxic and biochemical (namely fatty acids profiles) responses of two size classes (Small=S and Big=B) of two marine bivalve species - *Cerastoderma edule* and *Scrobicularia plana*, to the herbicide Primextra® Gold. Furthermore, this work also aims to compare the fatty acid (FA) contents and thus, the nutritive value of both species and size classes, collected in the field with those under laboratory conditions. Results show *S. plana* is more sensitive to the herbicide than *C. edule*. In general, on the field, *S. plana* (B) is more nutritive than *C. edule* (B), whereas the smallest organisms present an opposite tendency, with *C. edule* presenting higher abundance of FA.

Keywords: Herbicide, Marine bivalves, Fatty acids, Food quality

Mixture and Individual Effects of a Herbicide and a Metal on Marine and Estuarine Planktonic Species

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Marine and estuarine water pollution usually results from discharges of combined chemicals near the areas with high anthropogenic activity. Understanding mixture effects is of great importance as it may enhance the biodiversity losses. Moreover, there still exist an important knowledge gap on the toxicity resulting from multi-stress scenarios, and therefore potential synergistic effects that may arise are ignored. Thus, this study address single and equitoxic mixture effects of two formulated compounds - the herbicide Primextra® Gold TZ and the metal copper - by assessing toxicological endpoints in species from two trophic levels: algae growth - marine diatom *Thalassiosira weissflogii* - and immobilization - estuarine calanoid copepod *Acartia tonsa*. Single effects revealed the herbicide Primextra® Gold TZ is considerably more toxic to diatoms: EC₁₀=0.001 (0.0008 – 0.0013), EC₂₀=0.002 (0.0015 – 0.0022), EC₅₀=0.005 (0.0041 – 0.0051) mg/L, than to copepods: EC₁₀=0.684 (0.003 – 1.314), EC₂₀=1.003 (0.036 – 1.860), EC₅₀=2.087 (0.944 – 12.578) mg/L, whereas the metal copper is in general more toxic to *A. tonsa*: EC₁₀=0.057 (0.021 – 0.093), EC₂₀=0.100 (0.051 – 0.150), EC₅₀=0.296 (0.200 – 0.522) mg/L, than to *T. weissflogii*: EC₁₀=0.174 (0.074 – 0.273), EC₂₀=0.200 (0.107 – 0.294), EC₅₀=0.256 (0.120 – 0.392) mg/L. Considering the equitoxic mixture, planktonic species revealed different sensitiveness. Individual compounds are slight more toxic to *T. weissflogii* than the mixture of both chemicals. An opposite trend was observed to *A. tonsa* where the mixture was more toxic than the single exposure. Overall, the great sensitivity differences observed within species did not allow the conclusion that one trophic level is more tolerant than the other. On a whole, further studies are needed toward a comprehensive understanding of organic and inorganic compounds mode of action, their effects at lower biological-level endpoints, and under different mixture designs.

Keywords: Mixture and single bioassays, diatom, copepod, herbicide, metal

Nutrient stoichiometry as a tool for determining nutrient condition in coastal systems

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Nutrients and light are critical requirements for primary production that sustain life in coastal ecosystems. The EU Water Framework Directive (WFD), implemented in 2000 recommends assessment of nutrient conditions under the physico-chemical biological supporting elements to ensure the achievement of 'good ecological status' by 2015. However, not much work has been carried out to develop tools for assessing nutrient conditions. This study examined the use of nutrient stoichiometry as a tool for assessing nutrient conditions in coastal waters in four sites with different nutrient inputs along the Algarve coast, Portugal namely natural inputs (Praia De Faro), municipal sewage effluents (Ramalhete), agricultural inputs (Ponte) and upwelling inputs (Sagres). This study was carried out for a period of one year between July, 2014 and June 2015. Nutrient concentrations were used to develop nutrient ratios (N:P and N:Si) which were then employed in computing Ecological Quality Ratios (EQR) based on the reference condition (RefCon) and actual deviation (AcDev) of AcStat with percentiles metrics used to establish class boundaries. The final status was defined by averaging N:P and N:Si EQRs. Results showed N: P and N: Si values below normal for Praia De Faro, Ramalhete and Ponte while very high ratios were found for Sagres resulting to Good/Moderate and Moderate/Poor ecological status for all the water bodies under study. This tool is essential for assessment and identification of areas with nutrient condition problems and for establishment of effective management actions to ensure maintenance of healthy coastal ecosystems. The study however recommended the analysis of nutrient stoichiometry together with biological quality elements like phytoplankton, macro-algae and benthic fauna.

Keywords: Nutrient inputs, Nutrient concentrations, Nutrient ratios, WFD, Ecological status, EQR.

Do shorter bills alter the foraging strategy of red knots
Calidris canutus canutus?

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Red knots, *Calidris canutus canutus*, may be harbingers of Arctic climate change to the mudflats of Mauritania. Decades of morphological data indicate that red knots are shrinking in size, a universal response to climate change effects. Shrinkage of bill lengths, specifically, may cause red knots to shift foraging strategies once they reach Banc d'Arguin, Mauritania. The following scientific exhibition describes the behavioural experimental set up we will construct in Banc d'Arguin to establish whether shrinking bill lengths impact red knots' foraging ability. We also discuss how this shift in foraging behaviour may trigger a trophic cascade.

Keywords: climate change, trophic cascades, predator prey interactions, morphological shrinkage

Tracking white sharks in a dynamic system at the southern tip of Africa

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Sharks and rays are among the most important of marine megafauna as they are ecologically vital predators. However, most species are threatened and over exploited. Identifying core-habitats and movement patterns within aggregation areas is critical for conservation and management efforts. White sharks are threatened globally and considered at risk of extinction. South Africa hosts the largest known concentration of the species with several documented coastal aggregations. This digital object details the various types of biotelemetry used to collect movement data from sharks as well as deployment methods and data analysis, with specific emphasis on active acoustic transmitters and manual tracking of individual sharks in Gansbaai, Western Cape (as in Jewell et al., 2014).

Reference: Jewell OJD, Wcisel MA, Towner AV, Chivell W, van der Merwe L, Bester MN. 2014 Core habitat use of an apex predator in a complex marine landscape. *Marine Ecology Progress Series* 506: 231–242.

Additional Information: There are no competing interests

Author Contributions:

Oliver Jewell: PI of shark tracking project, conceived initial idea, tagged and tracked sharks, co-wrote screenplay, narrated final product

David Edwards: Directed, filmed and edited footage, wrote screenplay, produced final product

Investigation of the abundance, distribution and composition of microplastics at coastal upwelling sites in the Atlantic Ocean

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Microplastics are an issue of international concern due to the fact that these substances may potentially threaten biota by (i) causing physical harm, (ii) transporting persistent, bioaccumulating and toxic (PBT) substances and, (iii) leaching plastic additives. Within the world's oceans, areas which experience coastal upwelling are biota rich due to their high levels of primary productivity. The assessment of microplastic presence in areas which experience coastal upwelling is vital as it will indicate whether microplastics are an issue of concern in areas which support key biological resources. The null hypothesis of the present study is that microplastic abundance will be lower in areas where there is upwelling. As such, the present study aims to investigate whether microplastic abundance in upwelled areas in the Atlantic Ocean is significantly different from non-upwelled areas. Based on an opportunistic voyage aboard the RV Polarstern, microplastics will be sampled in sub-surface waters along a diverse latitudinal gradient in the Atlantic Ocean i.e. from Bremerhaven (Germany) to Cape Town (South Africa). Based on the proposed route, it will be possible to determine microplastic levels at two areas of coastal upwelling in the Atlantic Ocean (i) Canary Upwelling Ecosystem (CUE) and (ii) Benguela Upwelling Ecosystem (BUE). The results will then be analysed to determine whether there was a statistically significant difference between 'upwelled areas' and 'non-upwelled areas'.

Keywords: Microplastics; Atlantic Ocean; Coastal upwelling

Linking environmental, climatic and human-induced impacts on a Mediterranean semi-enclosed embayment (Amvrakikos Gulf, Greece): a food-web modelling approach

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Understanding the functioning and the response of food webs to multiple stressors is essential for defining their good ecological status (GES), particularly in the context of the Marine Strategy Framework Directive (MSFD). Ecosystem modelling tools have been increasingly used worldwide because they can assess the dynamics and interactions between different levels of biological organization (either species or functional groups), the main drivers and stressors and provide indicators useful for conservation and management issues. In this respect, we developed a food web model to assess and quantify the health status of a semi-enclosed embayment, Amvrakikos Gulf, the only in the Mediterranean Sea that is characterized by a fjord-like oceanographic regime. The first aim of the study was to investigate dynamics of marine resources over the last three decades considering the effects of rivers runoff, climatic induced changes, development of fish and shellfish farming and modernization of fisheries as the major drivers impacting the system. Moreover, the second aim was to assess biodiversity, structural and functional ecosystem changes through time using indicators derived from temporal simulations. Here, we will present results obtained from simulations tuned for the period during 1980-2013 showing a selected set of model derived indicators from diversity to network analysis and fisheries related indicators. Overall the approach is for supporting the planning and implementation of the MSFD, which requires the assessment of all European marine ecosystems and pressures associated, as well as the establishment of environmental targets (e.g., indicators) to achieve "Good Environmental Status" by 2020.

Keywords: food web model, fisheries-climatic interaction, human activities, Amvrakikos gulf, Mediterranean Sea

Iceland, between boreal and arctic waters: Benthic Tunicates (Chordata: Ascidiacea)

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Sea squirts represent the class of Tunicata whose adult life is benthic and sessile. This characteristic, together with a free larval stage (lecitotrophic), relatively short empowers as an excellent taxon in biogeographical studies. The BIOICE cruises (Benthic Invertebrates of Iceland) were carried around the economic exclusive waters of Iceland during 1991-2004 on the continental shelf and slope (20-2000m depth). They have contributed to enlarge the knowledge about ascidian species, horizontal and vertical distribution and the zoogeographical relationships with the neighboring areas (North Atlantic and Arctic). To date, 61 spp. have been identified for Icelandic waters, of which 5 are added after BIOICE campaigns. The geographical and bathymetrical distribution of ascidian species suggest that Iceland can be divided in three sectors: i) South, continental shelf and upper slope (0-600m depth), related with the Atlantic Boreal region; ii) North, continental shelf and upper slope (0-500m depth), related with the Arctic region; iii) Deep, middle and lower slope (> 600m depth).

Keywords: Benthic tunicata, Ascidiacea, Iceland, Biogeography

The BIOMETORE Project-Biodiversity in seamounts: the Madeira-Tore and Great Meteor

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The BIOMETER project brings together Portuguese and Norwegian researchers from a total of 18 institutions and diverse scientific domains related to oceanography, ecology, integrative taxonomy, geology, fisheries and spatial mapping. The project main goals are to improve knowledge of relevant descriptors related to biodiversity within the Marine Strategy Framework Directive (MSFD) in the Atlantic seamounts of the Madeira-Tore and Great Meteor geological complexes and to increase our knowledge on deep-sea ecosystems. The project outputs will provide important information for the understanding and sustainable management of the target seamount ecosystems, thus contributing to fulfill knowledge gaps on their biodiversity, from bacteria to mammals, and food webs, as well as to promote future sustainable fisheries and sea-floor integrity. During the summer of 2015 and 2016, a total of eight multidisciplinary surveys are planned focusing in the North-East Atlantic seamounts of the Madeira-Tore (Gorringe bank seamounts, Josephine, and Seine) and of the Great Meteor (Pico Sul, Tyro, Irving and Atlantis). We will present the BIOMETORE project and first developments, namely the four 2015 summer surveys already performed and the planning for the next four surveys to be carried out in summer 2016.

Keywords: biodiversity, deep-sea ecosystems, MSFD, seamounts, North Atlantic Ocean

Relationships between taxonomic and functional diversity: insights into assembly processes

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Among the potential indicators of biodiversity, those based on the functional traits of species are interesting because they measure the aspects of diversity that potentially affect community assembly and function. However, trait-based approaches are still rarely considered and little is known about the degree to which taxonomic diversity (TD) and functional diversity (FD) are correlated. Yet, this relationship is thought to depend on the extent of ecological redundancy within the assemblage, i.e. the number of taxonomically distinct species that exhibit similar ecological functions. In this study, we characterized taxonomic and functional diversity within and between two marine habitats (rocky shore vs mudflats) under human-induced disturbances. Models were also used to test whether the relationship between TD and FD differed according to the indices used to characterize them. We found little effect of human disturbance on the shape of the TD-FD relationship, whereas communities of the mudflat appeared to be less redundant than those of rocky shore. This could be explained by the assembly rules of ecosystems: biotic filtering (competition and resource partitioning) reduces redundancy by selecting for functionally dissimilar species, whereas abiotic filtering increases redundancy by selecting for similar species sharing adaptations to a particular environment. The rocky shore environment is characterized by heterogeneity that allows the formation of distinct ecological niches that can be colonized by similar species: the abiotic filtering does not limit the redundancy permitted by habitat. Conversely, in the more homogeneous environment of mudflat, the biotic filter mitigates redundancy. Trait-mediated abiotic filtering appears to play an important role in community assembly in complex habitats, whereas the relative importance of competitive exclusion appears to be greater in homogeneous habitats.

Keywords: community assembly, biological traits, functional redundancy, ecosystem functioning

Developing molecular tools for early detections of invasive species: the case of the zebra mussel *Dreissena polymorpha* in the Baltic Sea.

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The zebra mussel *Dreissena polymorpha* is one of the worst invasive species in the world. It is a benthic bivalve with dispersive planktonic larvae native to the drainage basins of the Black, Caspian and Aral Seas in Eastern Europe and Western Asia. Originating from the harsh environments of the Caspian Sea, the mussel has evolved to be robust against diverse conditions. In the 30 years since zebra mussels first appeared in North America, they have become one of the most widespread and abundant freshwater animals, and have fundamentally transformed freshwater food webs and biogeochemistry. A problem for early detection of *Dreissena* by conventional methodology is that, in general, larvae of benthic species are not identified in traditional zooplankton surveys due to their cryptic morphology and lack of sufficient specific taxonomical expertise. This implies potential biosecurity risks, since many invasive sessile organisms have a dispersive planktonic stage, like *Dreissena*, that might be overlooked in morphologically analyzed samples. It means that these and other non-indigenous species can spread unnoticeably in the region until their presence and impacts become apparent and irreversible. Since the traditional sampling tools seem to be insufficient to detect NIS in aquatic environments when organisms are not apparent, alternative approaches are being investigated in the last decade. Several studies demonstrate the efficacy of environmental DNA (eDNA) coupled with Next-Generation Sequencing of informative regions such as 16S rRNA and Cytochrome oxidase I gene (COI) as a tool for eukaryote species detection in aquatic environments. Species-specific molecular markers can be PCR-amplified from eDNA, allowing to detecting the presences of organisms of interest such as pests from early invasion fronts. The objective of the present study was to develop and test species-specific molecular markers for early detection of the dangerous zebra mussel *D. polymorpha* from environmental samples. We have designed new species-specific primers, evaluated their sensitivity in vitro and from field DNA samples, and compared gel and capillary electrophoresis for visualization of the PCR products. NGS Metabarcoding (PCR amplification and massive sequencing of a DNA Barcode) was used as an independent method for quantifying *Dreissena* DNA molecules in natural environmental samples. Such environmental samples were taken from two different environments within the Baltic Sea with different densities of *Dreissena*: the River Odra Estuary (Szczecin Lagoon) in Poland, highly invaded by this species, and the Klaipeda coast (Lithuania) where *Dreissena* is also present but the density is much lower in comparison with the Odra lagoon.

Biological Invasions in the Mediterranean Sea: ports versus Marine Protected Areas

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The Mediterranean Sea is the largest semi-enclosed European sea which main characteristics are quite different from other European sea. These characteristics determine in a unique way the fate of physicochemical and biological cycles affecting all aspects of ecological process. The fauna and flora present in this sea, is one of the richest in the world particularly in the coastal zone, highly diverse and with a high rate of endemism. But, on the other hand, a lot of human activities are important sources of degradation to the Mediterranean marine ecosystem. One of the more dangerous threats to global biodiversity is the introduction of exotic species like an ongoing process. This phenomenon is apparent across the Mediterranean, which is caused by the Suez Canal, shipping and/or aquaculture. Besides, lagoonal ecosystems in the south of Francia, with around 100 exotic species inventoried, are considered hot-spot areas for exotic species. The main objective of this work is analyzing the benefits of marine protected areas (MPA) with Saint-Nazaire lagoon like a model (Natura 2000 network) on NIS control, versus one more modified ecosystem, Canet port; both in Languedoc-Roussillon (South Mediterranean). We have employed genetic Barcoding for ascertaining the species to avoid taxonomic uncertainty. We have found strong and significant difference between MPA and port effect of MPA against NIS, with only one invasive species in the lagoon some invasive species. These differences are likely due to a combination of less habitat degradation and a higher occupation of niches by native species.

Species detections in environmental DNA using metabarcoding: a useful tool in estuaries monitoring.

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Estuaries are amongst the most productive habitats in Earth, producing more organic material than forests, meadows or agricultural lands. In addition, estuaries exhibit high, and precious, biodiversity levels. In this study an environmental DNA analysis of the two most important estuaries in Asturias (Cantabrian Coast, north Iberia) in terms of food production (Ría del Eo and Ría de Villaviciosa) was carried out. The objective was to monitor aquatic biodiversity and also to detect alien species that can be associated with anthropogenic activities (e.g.: aquaculture). To achieve these objectives, a metabarcoding methodology based in NGS (next generation sequencing) and the mitochondrial COI gene as a DNA Barcode was used. Results showed that this methodology was useful to detect the presence of three different non-native genera (*Crepidula*, *Lymnaea*, *Macrobrachium*) that are probably parasitating species cultured in these estuaries. It is true that Metabarcoding has still unsolved problems such as the lack of 100% universal primers and paucity of referenced sequences for some taxonomic groups in the databases. However, it represents already a powerful tool to manage the resources of these important ecosystems and to guarantee their long-term sustainability.

Reporting of Non Indigenous Species including harmful microalgae in the port of Trieste (North Adriatic Sea)

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The introduction of Non Indigenous Species and harmful microalgae through ships' ballast water is recognized by United Nations as one of the four most serious threats to human health, environment and resources. In the world, 3-5 billion tons of ballast waters are annually discharged from the ships with the consequence that 7.000 species among microorganisms, plants and animals can be transferred from a sea to another. For this reason, ports are considered as potential areas of NIS introduction by discharged ballast waters. In the frame of the Ballast Water Management System for Adriatic Sea Protection project, the Port Baseline Survey and the monitoring of the ballast waters in the ships incoming in the port of Trieste were carried out. The PBS in the port of Trieste was performed from 2014 to 2015 to seasonally analyse the phyto, zooplankton and macrofauna communities. Sampling was carried out in 6 stations located in the port of Trieste and in the reference site (C1) located inside the Marine Reserve of Miramare. One NIS was recorded among phytoplankton communities, the diatom *Pseudo-nitzschia multistriata*. Many harmful species were also identified among dinoflagellates (*Alexandrium pseudogonyaulax*, *Dinophysis caudata*, *D. fortii*, *D. sacculus*, *D. tripos*, *Lingulodinium polyedrum*, *Phalacroma mitra*, *P. rotundatum*, *Prorocentrum cordatum*, *Protoceratium reticulatum*) and diatoms (*Pseudo-nitzschia multistriata*, *P. cf. galaxiae* and *Pseudo-nitzschia* spp.). In some sediment samples, cysts of the potentially toxic dinoflagellate *Alexandrium margalefi*, never been reported in Northern Adriatic Sea, were identified. About zooplankton, the copepod *Pseudodiaptomus marinus*, a NIS found in the Gulf of Trieste in the 2010 for the first time, was recorded. Finally, we reported the first recordings of the macrozoobenthic NIS, the polychaete *Notomastus aberans* and the bivalve *Arcuatula senhousia*.

Keywords: NIS, North Adriatic, Diatoms, Copepods, Macrofauna

Further spreading of the non-indigenous bryozoan *Celleporaria brunnea* in the Mediterranean Sea: port to port morphological variations

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The Pacific cheilostome bryozoan *Celleporaria brunnea* (Hincks, 1884), a non-indigenous species already known for the Mediterranean Sea, was recorded in 2013-2014 from nine Italian port localities (Genoa, Santa Margherita Ligure, La Spezia, Leghorn, Viareggio, Olbia, Porto Rotondo, Porto Torres and Castelsardo) in the North-western Mediterranean Sea; in 2014 it was also found for the first time in the Adriatic Sea, in the marina “Kornati”, Biograd na Moru (Croatia). In Italy, specimens of *C. brunnea* were found in 44 out of 105 samples (48% from harbour sites and 52% from marinas). These data confirm and update the distribution of *C. brunnea* in the Mediterranean Sea, and provide evidence that recreational boating is a vector responsible for the successful spread of this species. Previous literature data have shown the existence of differences in orifice and interzooidal avicularia length and width among different localities of the invaded range of *C. brunnea*. Therefore, measurements of orifice and avicularia were assessed for respectively 30 zooids and 8 to 30 interzooidal avicularia for both Italian and Croatian localities, and compared with literature data, in order to verify the existence of differences in the populations of *C. brunnea* that could reflect the geographic pattern of its invasion range. Our data show high variability of orifice measures among and within localities: zooids with broader than long orifice coexisted with others displaying longer than broad orifice, or similar values for both length and width. The morphological variation of *C. brunnea* in these localities, and above all the large variability of samples within single localities or even within colonies poses questions on the reliability of such morphometric characters for inter and intraspecific evaluations.

Keywords: introduced species, fouling organism, bryozoan, harbours, recreational boating, zooid morphometrics

Antipode marine fauna invasions in ports: a pilot survey in North Iberia

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Ports are gateways for many marine organisms transported by ships worldwide. In any port, the origin of non-indigenous organisms would expectedly reflect the major marine routes operating in the region. The longest travel that a marine organism can accidentally undertake corresponds to Antipode transfers by ships. However, for unintentionally transported organisms, the survival and consequently the number of viable propagules transported from the source ecosystem and released into a new ecosystem should negatively correlate with the distance from the donor area. In this study carried out in North Iberian ports (Cantabrian Sea, Bay of Biscay) we have observed a high proportion of Antipode invertebrate species, and some of them (*Xenostrobus securis* and *Ficopomatus enigmaticus*) exhibited clear signs of invasiveness. Based on the phylogenetic screening, introductions from multiple source populations (including the native one in Oceania) are suspected. Similar environmental conditions in temperate antipode regions, as well as selection for wider tolerance ranges during the long and ordeal travel, may explain these results. More insight on the propagule survival on the transport vector and possible mechanisms of adaptation is desirable for a better pathway management.

Resting egg production of the invasive copepod *Acartia japonica* in Sagami Bay, Japan

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The calanoid copepod *Acartia japonica* Mori, 1940, is one of seven endemic species in the coastal waters of Japan. The occurrence of this species had been limited to the coastal areas of the Sea of Japan and the Ryukyu archipelago. However, *A. japonica* was recently observed at Manazuru Port in the temperate coastal waters of Sagami Bay, Japan which faces the Pacific Ocean. In order to clarify the invasive qualities, population dynamics and reproductive behaviour of *A. japonica* at Manazuru Port, the present study investigates the monthly occurrence and abundance of this species from May 2011 to October 2015. The *in situ* egg production was also examined in 2014 and 2015 to understand its reproduction strategies. *A. japonica* was not observed in samples collected from 2011 to 2012, but appeared as the dominant species from summer to early autumn from 2013 to 2015. The maximum abundance reached 211 inds. m⁻³ in October, 2014. The egg production rate ranged from 0.23 ± 0.73 to 5.50 ± 4.27 eggs female⁻¹ day⁻¹, and spawned eggs included resting eggs which do not hatch until the passing of the refractory phase. Subitaneous eggs, which hatch within a few days, comprised 80-100% and 0-55% of total egg production near the beginning and end of the occurrence period, respectively. The ratio of resting to total egg production increased with decreasing temperature where some of the resting eggs did not hatch for more than a year. *A. japonica* may be utilizing the strategy of producing resting eggs to avoid low temperatures in the invaded area.

Keywords: Resting eggs, Invasive copepod, *Acartia japonica*, Sagami Bay, Reproductive strategy,

Recreational boating as a vector of spread of non-indigenous species around the Mediterranean Sea

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The object of this project is understanding the effect recreational boating has on the secondary spread of non-indigenous species in the Mediterranean Sea. The first targets of this work have been the identification of highly connected marinas in three Mediterranean regions and the determination of NIS richness and abundance within marinas and on the hull of non-resident vessels. In 2015 several marinas have been sampled in France, Italy, Turkey and Greece, chosen amongst the most connected marinas in the investigated region. This digital object presentation will show a map of the marinas surveyed in 2015, accompanied by photos/video clips of abundant NIS encountered from certain marinas, a map of marinas to be surveyed, accompanied by some text of the preliminary findings. The preliminary findings thus far are that there seem to be some commonalities between heavily fouled ports such as: proximity to freshwater source, proximity to shellfish farming, water temperature, age and structure of marina and level of marine traffic. These findings will hopefully be able to direct invasive species managers towards which factors are important to consider for future implications, once they are published and verified. Keywords: alien, non-indigenous species, NIS, Mediterranean, recreational boating.

Keywords: alien, non-indigenous species, NIS, Mediterranean, recreational boating

Design optimization of a small coastal MPA considering different conservation targets and costs

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Currently, there is still much discussion on how to establish marine protected areas (MPAs) regarding their location, size and shape. These three factors were analyzed for a small coastal MPA, the Luiz Saldanha Marine Park (LSMP), for which a very limited amount of local ecological information was available at the start of its implementation in 1998. Marxan was used to provide a number of solutions considering different protection levels for the various conservation features and different costs. These solutions were compared with the existing no-take area of the LSMP. Information on 11 habitat types and distribution models for 3 of the most important species for the local artisanal fisheries were considered. The human activities with highest economic and ecological impact in the study area (commercial and recreational fishing and scuba diving) were used as costs. The results show that the existing no-take area is actually located in the best area. Yet, the no-take area offers limited protection to vagile fish and covers a very small proportion of some of the available habitats. The comparative framework used in this study can be applied anywhere, providing relevant information to local stakeholders and managers in order to proceed with adaptive management.

Keywords: Marxan, marine spatial planning, marine reserves

Larval development and early life history of a temperate reef fish – implications for the design and implementation of MPAs

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An understanding of population connectivity and the scale of larval dispersal is important for the design and implementation of marine protected areas (MPAs) or networks of marine protected areas. In demersal reef fish early life history characteristics and behaviour during the pelagic larval phase interact with oceanographic processes and habitat characteristics to determine the extent of larval dispersal and connectivity. In this study we examined early life history traits and larval development of the black-faced blenny, *Tripterygion delaisi*, from the Arrábida Marine Park, Portugal. We described distinctive morphometric and meristic characteristics which are central to identifying this species from related taxa. Growth coefficients generated from bivariate morphological relationships indicated that most of the body proportions of *T. delaisi* exhibited allometric growth during larval development. When inflexion points of growth were detected, growth was biphasic. Considering allometric growth patterns and ontogenetic descriptions together, the 1st developmental phase includes the preflexion and flexion stage larvae, while the 2nd phase characterizes the postflexion larvae prior to the transition from larvae to juvenile. Several early life history parameters (instantaneous growth rates, size-at-hatching and size-at-settlement) derived from otolith microstructure analyses were similar to that obtained for other demersal reef fish. Pelagic larval duration, ranged between 29 and 34 with a mean of 31.75 ± 1.54 days. These estimates are higher than obtained from previous studies conducted in the Mediterranean on *T. delaisi*. The characteristics of this pelagic larval stage may have consequences for larval dispersal and connectivity and hence for the design and implementation of marine protected areas.

Keywords: larval dispersal, population connectivity, Marine Protected Areas, Portugal,

Mapping of ecosystem services in Mida Creek Kenya, an initial step to integrated natural resource management

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Mida creek on Watamu Marine Reserve is an important socio-ecological system (SES) along the Kenyan Coast. Ecosystems of the creek like mangroves provide the community living around it with different Ecosystem Services: provisioning services (food, honey, and fuel), supporting services (Nursery and breeding grounds, nutrient cycling), regulating services (storm protection) and cultural services (recreation, education and research). However, this complex SES faces environmental, economic and social challenges which call for renewed integrated natural resources management. The ecosystem based approach to management provides a framework aimed at sustainable management. However, to achieve this, ecosystem services mapping has been proposed as one of the first steps towards its application. This study aimed at finding; the important ecosystem services in Mida Creek, the characteristic land use classes that exist in Mida creek and how the ecosystems services flow are spatially distributed. A total of 50 expert interviews were carried out with different stakeholders and community members involved in different community based groups with different projects aimed at conserving the creek. The matrix model was applied in which land use/land cover classes map was created using GIS software. Preliminary results show that fish (provisioning service) is the most important. In addition there is significant flow of ecosystem services from the mangroves. Findings from this spatially explicit approach will allow better interaction between stakeholders and decision makers who believe in what they see.

Keywords: Ecosystem services, mapping Ecosystem Services, Landscape, GIS.

Habitat suitability modelling of a vulnerable gorgonian in the Mediterranean and Eastern Atlantic

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Much is still unknown about the factors controlling the distribution of circalittoral octocorals (30-200 m depth). The scarcity of data about these relatively deep assemblages has often left them out of marine spatial planning, including marine protected areas. Here we used Ecological Niche Modeling relating relevant environmental variables and the most (to date) comprehensive presence data set to assess the potential suitable habitat of an important structuring species, *Paramuricea clavata*, along its global distribution (the Mediterranean and adjacent Atlantic). The model accurately identifies all known locations of *P. clavata* and includes previously unknown and unreported occurrence sites along the coasts of Portugal and Africa, including offshore seamounts. *P. clavata* was found to occupy a niche well defined by temperature (12.3 to 26.5 °C) and strong dependence on non-horizontal slope, a proxy for sediment-free rock. The species does not occur under extreme nutrient levels. The predicted distribution strengthens historical and recent occurrence information for the northern Mediterranean coastline, and reveals suitable areas at depths down to 200 m which may act as refugia during extreme temperature events. New habitat areas predicted along the Algerian coast, Alboran Sea and on the Atlantic coasts between Morocco and southwest Iberia are worth investigating. Surveys joining expert knowledge and target areas from our predictive modeling may lead to discoveries of new or under-represented *P. clavata* sites and identify areas of conservation concern. Our study also highlights the need for increased access to higher resolution environmental datasets and species distributional records to resolve local-scale phenomena.

Keywords: *Paramuricea clavata*; Atlantic Ocean; circalittoral rocky reefs; Habitat suitability mapping; Ecological niche modeling

Aeolianite as a proxy to evaluate former coastline position in northwest Ceara state – Northeast Brazil

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Stretches of the northwest coast of Ceará (NE - Brazil) were analyzed to identify whether the current coastline is a possible sediment source for the aeolianites that are currently present. Various factors were considered: modern day wind dynamics, coastline geometry, internal structures of the aeolian deposits, and dune migration pattern and evolution through the analysis of geological maps, GPR, and patterns of wind transport. For the latter we assume the generation and evolution of the dunes is controlled by the relationship between the wind direction transport and orientation of coastline segments and that the morphology of the aeolianites and their spatial distribution can be correlated to the current dunes fields. It was observed that the aeolianites have similar internal structures compared to the modern compound dune type, thus eliminating its correlation with isolated barchans, parabolic and frontal dunes. The outer edge limits of the compound dunes are 1000 to 5000 m away from the coastline that is its sediment source. This, in addition to the fact that the aeolianites are currently distributed very close to the coastline (and in some cases are being eroded by the waves) makes it impossible to assume that the present coastline was the sediment source of this aeolianites. The analysis of the distances between aeolianites outer edge and a line of sandy reefs, which is assumed as the hypothetical ancient coast line position, ranges from just over 700 to more than 4000 m from the outer boundary of aeolianites, demonstrating certain compatibility. Combined, these provide convincing evidence that the sediments that yielded the aeolianites likely came from an ancient coastline positioned offshore from the current coastline.

Keywords: Coastline position, aeolianite, dunes, internal structures, GPR sections, wind dynamics.

Habitat loss: climate change vs tidal lagoon construction

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The 2009 Renewable Energy Directive sets a target for the UK to achieve 15% of its energy consumption from renewable sources by 2020. The creation of tidal lagoons at locations around the UK coast will help to meet these renewable energy targets. However, there will be a level of localised habitat loss associated with the construction of these projects. Additionally anthropogenic induced climate change will affect UK marine and coastal habitats in the future which will also result in the loss of habitats. According to the Intergovernmental Panel on Climate Change (IPCC) coastal systems will increasingly experience adverse impacts such as submergence, coastal flooding and coastal erosion due to relative sea level rise. This will result in the loss of sensitive habitats such as seagrass beds, as well as sand and mudflats. Mitigation measures associated with the development of tidal lagoons have been developed. These mitigation and offsetting methods, such as managed realignment of saltmarsh habitat, will reduce the impacts of habitat loss at a local scale following the construction of the Tidal Lagoon. The construction of tidal lagoon structures and other marine renewable energy projects is considered important at a national scale in order for the UK to reach its renewable energy targets and reduce the impacts of climate change i.e. habitat loss. Although the construction of tidal lagoons and other renewable energy projects will inevitably result in the loss of habitat it is important to consider the long term positive impacts when performing Environmental Impact Assessments (EIA). Through construction of renewable energy projects, the longer term benefits and larger spatial scale of habitat no longer at risk of impact by climate change could be considered to offset the overall loss of habitat caused during construction of these projects.

Keywords: Habitat loss, mitigation, climate change, renewables.

Density and distribution patterns of the endangered species *Pinna nobilis* within the harbour bay of Favignana (Egadi Islands MPA)

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The fan shell *P. nobilis* (Linnaeus, 1758) is the largest marine bivalve in the Mediterranean Sea which acts as ecosystem engineer, offering an adequate substratum to several associated benthic species. *P. nobilis* is threatened by the reduction and loss of its natural habitat and by increased anthropogenic inputs into coastal waters. The knowledge on the population of this species are scarce, especially as concerns Sicily and its coasts. This study focused on the density of population, spatial distribution, level of burial and orientation of the population of *P. nobilis* in the harbour area of Favignana island (western coast of Sicily, Italy). The fan shell surveys were carried out by SCUBA diving using a 50m-transect line perpendicular to the coastline. For each *P. nobilis* censused, maximum (W) width, minimum width (w) and unburied length (UL) were measured; shell orientation (Or) was determined using an underwater compass and considering the magnitude of the angle formed by the vector and the magnetic north. The specimen status (dead or alive), the depth (by using the electronic depth meter of a diving computer) were recorded. In addition, the geographical coordinates were marked for each individual along the transect by means of a Global Positioning System (GPS). Total shell height (HT) was estimated using a formula considered suitable for the populations of this studied area. The density of *P. nobilis* was ± 11 ind. 100m², the total height (HT) and the maximum width (W) of the shells was 33cm and 13,6cm respectively. In the aim of the "MPA of Egadi Islands" to confirm the need of a new management to protect the biodiversity of the harbour area, more conservation measures are necessary in order to improve the preservation of this endangered species.

Keywords: Fan shell, habitat loss, MPA, density, mapping

A novel interdisciplinary approach to building system based environmental impact assessments for marine and aquatic environments

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Environmental Impact Assessments (EIAs) are designed to both evaluate environmental consequences and suggest means to mitigate possible impacts that may occur from development projects (infrastructure creation, urban expansion, offshore development, mining, etc.). The formal EIA process is critical to ensuring decision makers consider the environment prior to proceeding with a project. EIAs are used in almost every country in the world today; yet despite the important role they have in decision-making, there is little or no standardization in the practice. The process is essentially a qualitative exercise which does not take fully into account the complexity of ecosystems nor the true aggregate impacts. We suggest a new approach to EIA is necessary today to incorporate advances in ecosystem based modelling, hydrodynamic modelling and survey technologies made over the last two decades. To achieve this, we are examining three different aspects:

1. Developing a screening or scoping framework for system based environmental impact assessment (J.Edmunds);
2. Using a system based hydrodynamic modeling approach to predict environmental responses in coastal systems (J.Wilson); and
3. Using remote sensing and ground truthing to optimize nearshore environmental survey methodologies (S.Hinz)

The goal is to be able to understand impact in terms of the interactions and functions attributable to ecosystem processes. This would replace the current focus on a receptor based approach which does not integrate the full picture of physical and biological processes nor does it allow effective evaluation of alternatives. The expected outcome of our work is a new methodology for full lifecycle assessment of environmental impacts which can be applied at any scale and at any phase of the EIA process.

Keywords: environmental impact assessment, ecosystem based modelling, hydrodynamic modelling, marine survey technology

Temporal behavior of the population genetic structure of *Nucella lapillus* in the intertidal coast of Galicia (NW Spain)

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The dogwhelk *Nucella lapillus* is a common predator in the rocky intertidal of the European Atlantic. Its females are sterilized by TBT, a powerful biocide released by antifouling paints that was a serious issue in coastal areas around the world due to the heavy maritime traffic. Although banned today, TBT exposure led to the collapse of some populations in the recent past. The rocky shore is a habitat particularly subjected to natural and anthropogenic pressures where population survival can greatly rely on the ability to recruit new individuals from adjacent sources. In this regard, *N. lapillus* is a direct developer with low dispersal ability. In a previous study, we found that the pattern and amount of individual exchange among populations varies with wave exposure. In sheltered coasts, *N. lapillus* fitted an isolation-by-distance (IBD) pattern, while its populations were chaotically connected and more strongly differentiated in open coasts. Nonetheless, our study involved a single sampling survey and we could not discriminate whether the unordered genetic pattern was a consequence of restricted dispersal in open coasts or, conversely, whether the stronger water movement actually promotes unordered exchanges among populations that result in the chaotic genetic pattern. Here, we show a new study where both subadults and juveniles were sampled and genotyped two years after the first survey. Both surveys revealed a similar chaotic pattern. However, there was a significant genetic differentiation between generations sampled at the same place in different years (first survey subadults vs. second survey subadults), but not between generations collected within the same year (subadults vs. juveniles). Our results seem consistent with a model where dispersal is restricted in open coasts but only a small, variable fraction of the population produces successful recruits each year.

Keywords: *Nucella lapillus*, rocky intertidal, wave exposure, dispersal ability, temporal genetic structure

Mapping biodiversity and human activities for Marine Spatial Planning in the Algarve (Portugal)

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Given the rise of human activities in the world's coastal areas over the last decades, Marine Spatial Planning has become an essential coastal management tool. The Algarve region in southern Portugal has been no exception to this rising development. In this region, fisheries, navigation and nautical tourism have been the main activities at sea. However, in recent years, several offshore aquacultures, including sea ranching of tuna fish (locality called “armações de atum”), have also played a major role in this field. In order to contribute to a MSP process for the Algarve coast, a search for available information related to main biophysical features, such as spatial distribution of marine biodiversity and major anthropogenic activities was carried out. The spatial distribution of OSPAR’s habitats and marine habitats listed in the EU Habitat Directive was gathered to the extent possible, trying to identify not only any type of Marine Protected Area (MPA) already in place, but also potential priority habitats and threatened species not yet under protection. The fishing grounds were mapped using data obtained through questionnaires to the small scale fisheries (SSF) and from Automatic Identification System (AIS) and/or Vessel Monitoring System (VMS) analysis of the industrial fleets (vessel length >15m). Additionally, offshore aquaculture, nautical tourism, artificial reefs and sand and energy extraction were mapped based on actual or programmed infrastructures/areas, while navigation spatial data were derived from AIS. Following the identification of key issues, specific objectives were developed in accordance with the particular needs of the region and following an Ecosystem Based Approach. Different planning options were explored, in particular by using scenarios and spatial modelling.

Keywords: Marine Spatial Planning, biodiversity conservation, sustainable exploitation, fisheries and aquaculture, coastal management

Occurrence patterns of individual Bottlenose dolphins (*Tursiops truncatus*) in coastal waters of SW Portugal

Magalhães, S.M.

Mar Ilimitado, Tourism & Research

The presence of common bottlenose dolphins (*Tursiops truncatus*) is documented in Portugal mainland, but studies of the species focus mainly on a well known resident population in Sado estuary and only very recently also on animals occurring in the adjacent coastal area. This species is one of the best known and widespread of the small cetaceans, occurring throughout the world's tropical and temperate seas and oceans. Coastal bottlenose dolphins tend to form resident, transient or temporary migrant populations across their distribution range. This study aims to analyse for the first time the occurrence patterns of individual dolphins of this species in the coastal area of SW Portugal mainland. Data available (geographic location, group size, composition and images of individual animals) was collected by one qualified observer onboard of platforms of opportunity (dolphin watching) between 2007 and 2015 in the coastal area between Sagres and Lagos, and covered all seasons of the year. The identification of individual animals using photographs of natural markings (photo-identification) was the key method used. A total of 288 individual dolphins were identified so far, of which 38.9% were sighted in more than one occasion. Few of the animals re-sighted more than once occurred in different years and seasons, showing some degree of residency and site fidelity. Results also indicate that we are in the presence of an open population, as new individuals are constantly being identified. This information has implications for conservation, as Bottlenose dolphins are listed in Annex II of the European Union's Habitats Directive and EU governments are required to consider the areas where this species occurs for the establishment of Special Areas of Conservation (SACs). This study also contributes to the knowledge of the ecology of bottlenose dolphin populations occurring in coastal waters of Portugal mainland.

Malacological survey at the Las Piñas-Parañaque Critical Habitat and Ecotourism Area (LPPCHEA): A listing of molluscan species in a critical habitat

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Las Piñas-Parañaque Critical Habitat and Ecotourism Area (LPPCHEA) in Manila Bay, Philippines is the only critical habitat located within Metropolitan Manila. It hosts about 5,000 heads of migratory and native species that feed on its mudflats and breed in its mangrove forests. It is part of the East-Asia Australasian Flyway (EAA Flyway). It has been included in the Ramsar List of Wetlands of International Importance. A malacological survey was done along its intertidal zone to provide a listing of molluscs present in the area. The sampling protocol utilized was adapted from the Natural Geography In-Shore Areas (NaGISA) method for rapid and regular monitoring of beach and shoreline sites. Samples were collected from three sites in LPPCHEA within three successive weekends (November 2012). Thirty four molluscan families were identified, 15 of which belonged to Class Bivalvia and 19 to Class Gastropoda. Twenty eight species were bivalves and 35 were gastropods. Based on literature, 22 molluscan families appear to be possible sources of the birds' nourishment. The study area is ecologically important as it houses a diverse species of birds that feed on its molluscs. Threats, however, are present in the area, such as pollution from nearby cities, reclamation projects and mangrove cutting. The study provides baseline data that could support conservation efforts in the area.

Keywords: Manila Bay, LPPCHEA, intertidal zone, wetland, molluscs

Challenges of open ocean seagrass restoration

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Open ocean restoration of seagrasses poses special challenges, both logistical and environmental, as periodic high wave energy limits operations and can quickly erode or bury seagrasses that have not reached abundance in equilibrium with the disturbance regime. A large-scale seagrass restoration operation was undertaken in a Marine Park in Portugal (LIFE Biomares project), an open ocean setting that lost all 30 ha of seagrass cover over the last 2 decades, presumably from human impacts. Between 2007 and 2013, *Zostera marina*, *Z. noltii* and *Cymodocea nodosa* were transplanted, creating 61 restoration sites. We tested survival and persistence of the three seagrass species, transplanted from two donor populations, in different seasons (Spring to Autumn) with two different initial planting areas. All transplants survived and increased, either in density or area, for at least some time. The average transplant persistence was 9 months, with one site persisting >50 months, during which the initial transplant area increased by more than four times, from 11 to 50 m². The data indicate that transplant persistence at this location may benefit from the rapid creation, in spring, of large patches of *Z. marina*. We propose that meadow restoration success is significantly improved by surpassing area cover tipping points of vulnerability beyond which seagrass coverage is sufficient to resist the most common perturbation levels.

Keywords: Open ocean restoration; *Zostera marina*; *Z. noltii*; *Cymodocea nodosa*; seagrass transplants.

Mapping Marine Extraction Pressure within UK waters

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Joint Natural Conservation Committee (JNCC)

There are a growing number of human activities occurring within the marine environment which can result in pressures and, in some instances, adverse impacts on marine habitats and species. Therefore it is important to understand how human activities interact with biodiversity so that any impacts can be managed. To do this, there is a requirement to know where, spatially, human activities occur across UK waters and if the habitats and species exposed to these activities are sensitive to associated pressures. When combined, exposure and sensitivity provide an indication of a habitat's 'vulnerability' to impacts. To support this vulnerability assessment approach, JNCC are developing methods for creating geospatial pressure datasets. These datasets are created using a GIS to delineate their spatial extent and all activities that are known to exert the pressure are considered. In the UK one of the priority pressures on benthic habitats is considered to be 'extraction', which is described as the 'physical damage caused by selective extraction (e.g. by exploration and exploitation of living and non-living resources on seabed and subsoil)'. The method for creating a geospatial pressure dataset for extraction will be explored as an example of the work being undertaken by JNCC. Activities known to exert the pressure of extraction were evaluated. Aggregate and navigational (both for shipping lanes & for port development) dredging were identified as having the greatest spatial extent. To create the dataset the spatial extents of the two activities were mapped in a GIS and combined to produce yearly pressure footprints. Issues identified during the development of the dataset include: the navigational dredging dataset overestimated the extent of dredged areas, and currently, the pressure dataset does not include information on intensity of the activities. The potential uses of the pressure datasets are wide-reaching and these will be discussed further in the conclusions of the talk.

Keywords: Pressure, Extraction, Management, Vulnerability, GIS

Macrodebris and microplastics from beaches in Slovenia

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The amount of marine debris in the environment is increasing worldwide, which results in an array of negative effects to biota. This study provides the first account of macrodebris on the beach and microplastics in the sediment (shoreline and infralittoral) in relation to tourism activities in Slovenia. The study assessed the quality and quantity of macrodebris and the quality, size and quantity of microplastics at six beaches, contrasting those under the influences of tourism and those that were not. Beach cleanliness was estimated using the Clean Coast Index. Tourism did not seem to have an effect on macrodebris or microplastic quantity at beaches. Over 64% of macrodebris was plastic, and microplastics were ubiquitous, which calls for classification of plastics as hazardous materials. Standard measures for marine debris assessment are needed, especially in the form of an all-encompassing debris index. Recommendations for future assessments are provided for the Adriatic region

Keywords: Marine debris, plastic, pollution, tourism, Adriatic

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Monday, February 1		Thursday, February 4	
Pre conference workshops		Biodiversity Effects	
9:00	Presentation Skills	9:00	Stephen Widdicombe
9:00	Media Skills	9:45	Jean-Marc Guarini
9:00	Are You Ready for R	10:00	Miguel Correia
12:30	Lunch	10:15	Tom Moens
13:30	Presentation Skills & Design	10:30	Coffee break
13:30	Media Skills	11:00	Inês Gomes
13:30	Non Statistics in R	11:15	Henriette Grimmel
Tuesday, February 2		11:30	Thibaud Mascart
Pre conference workshops		11:45	Ana Patrícia Avó
9:00	Advantages of Open Science to research career	12:00	Nessa O'Connor
9:00	Are You Ready for R	12:15	Claudia Bommarito
9:00	Scientific illustration	12:30	Lunch
12:30	Lunch	Biological Invasions	
13:30	Manuscript Submission and Review	14:00	Anna Occhipinti-Ambrogi
13:30	Non Statistics in R	14:45	Alexandra Serebryakova
13:30	Dredging and the environment	15:00	Laura Clusa
Opening Session		15:15	Laura Airoidi
17:30	Introduction	15:30	Coffee break
17:40	Ferdinando Boero	16:00	Bryony Townhill
18:20	Sam Dupont	16:15	Yaisel Juan Borrell Pichs
19:00	Welcome reception	16:30	Melody Anne Ocampo
Wednesday, February 3		16:45	Xavier Corrales Ribas
Future Oceans		17:00	Laura Miralles
9:00	Jean-Pierre Gattuso	17:15	Alba Ardura
9:45	Carolina Madeira	17:30 Scientific Exhibitions: Biodiversity Effects, Biological Invasions and Habitat Loss	
10:00	Matteo Nannini	19:30	Conference dinner
10:15	Cátia Silva	Friday, February 5	
10:30	Coffee break	Habitat Loss and Ocean Noise	
11:00	Erwann Legrand	9:00	René Dekeling
11:15	Jorge Assis	9:45	Lisa Mevenkamp
11:30	Martin Wahl	10:00	Christina Comfort
11:45	Roberto Buonomo	10:15	Sofia Pinto Ramalho
12:00	Anna-Maria Vafeiadou	10:30	Coffee break
12:30	Lunch	11:00	Tundi Agardy
Natural Resources		11:45	Miguel Correia
14:00	Jake Rice	12:00	Kyeong Park
14:45	Rui Coelho	12:15	Rachel Crabtree
15:00	Tânia Pereira	12:30	Miguel Inácio
15:15	Carlos Sonderblohm	12:45	Veronica Lo
15:30	Coffee break	13:00	Lunch & closing words
16:00	Phil Latto	14:30 Optional excursion	
16:15	Moritz Eichert		
16:30	Yuji Sakai		
16:45	Pierre-Alain Mannoni		
17:00	Joana Fernandez-Carvalho		
Awareness Presentations			
17:45	EMBRC		
18:00	DEME		
18:30	Scientific Exhibitions: Future Oceans & Natural Resources		



**Mares
Conference**