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- **MONDAY 04-nov**
  - **08:30 - 10:40** Coffee & Pastries
  - 08:30: Lheureux, Dreujo, Pierrejean, Vanoverbeke, Breine
  - 09:00: Lheureux, Dreujo
  - 09:20: Pierrejean, Vanoverbeke
  - 09:40: Breine
  - 10:00: Lheureux, Dreujo
  - 10:20: Pierrejean
  - 10:40: Breine

- **TUESDAY 05-nov**
  - **08:30 - 10:40** Coffee & Pastries
  - 08:30: Duarte, Medeiros, Lavergne, Vigouroux, Schlacher
  - 09:00: Duarte, Medeiros
  - 09:20: Lavergne, Vigouroux
  - 09:40: Schlacher
  - 10:00: Duarte, Medeiros
  - 10:20: Lavergne
  - 10:40: Vigouroux

- **WEDNESDAY 06-nov**
  - **08:30 - 10:40** Coffee & Pastries
  - 08:30: Duarte, Medeiros, Lavergne, Vigouroux, Schlacher
  - 09:00: Duarte, Medeiros
  - 09:20: Lavergne, Vigouroux
  - 09:40: Schlacher
  - 10:00: Duarte, Medeiros
  - 10:20: Lavergne
  - 10:40: Vigouroux

- **THURSDAY 07-nov**
  - **08:30 - 10:40** Coffee & Pastries
  - 08:30: Duarte, Medeiros, Lavergne, Vigouroux, Schlacher
  - 09:00: Duarte, Medeiros
  - 09:20: Lavergne, Vigouroux
  - 09:40: Schlacher
  - 10:00: Duarte, Medeiros
  - 10:20: Lavergne
  - 10:40: Vigouroux

- **FRIDAY 08-nov**
  - **08:30 - 10:40** Coffee & Pastries
  - 08:30: Duarte, Medeiros, Lavergne, Vigouroux, Schlacher
  - 09:00: Duarte, Medeiros
  - 09:20: Lavergne, Vigouroux
  - 09:40: Schlacher
  - 10:00: Duarte, Medeiros
  - 10:20: Lavergne
  - 10:40: Vigouroux
Session 1 - Global changes in coastal systems: trends and predictions

Worldwide monitoring programmes have been collecting data that should be analysed in order to put in evidence long-term trends and to explore spatial and temporal comparisons. This topic will also cover recent work on predictive tools and global change scenarios in coastal systems. Climate-induced changes, as well as other human-induced changes are welcomed in this session. Contributions covering different types of coastal systems, a wide range of geographical areas and a large diversity of methods are expected.

Keynote: Hervé Le Treut

Hervé Le Treut is Professor at the Pierre and Marie Curie University, Director of the Pierre-Simon Laplace Institute (IPSL) and a member of the French Academy of Sciences. His work focuses on numerical modelling of the climate system and the understanding of radiative climate disturbances, in particular the role of the additional greenhouse effect related to human activities. He is also interested in the impacts of climate change and the analysis of associated environmental risks. He is editor of chapter 1 of volume 2 of the 5th report of the IPCC.
Keynote by Hervé Le Treut
S1.1. NW Iberian Peninsula, coastal and estuarine temperature projections.

Marisela Des*, M. deCastro¹, M.C. Sousa², M. Gómez-Gesteira¹

¹ Environmental Physics Laboratory (EPhysLab), CIM-UVIGO, Universidade de Vigo, Ourense, Spain
² CESAM, Physics Department, University of Aveiro, Aveiro, Portugal

Global change impacts on marine and estuarine areas affect their productivity. The NW Iberian Peninsula is a high primary production area whose economy is high fishing dependent. Numerical models have been proved to be a useful tool to study the potential impact of climate change. However, the spatial resolution of projections provided by CMPI5 models is insufficient for a detailed study in the NW Iberian Peninsula. In this sense, the numerical model Delft3D has been implemented with a domain which covers from 10.00 ºW to 8.33 ºW and 41.18 ºN to 43.50 ºN. The horizontal resolution increase gradually from 2200 m x 800 m on the West boundary to 220 m x 140 m in the Rias Baixas and 50 m x 77 m in the Minho River estuary. The vertical resolution is 16 sigma layers with top layers refined. The outputs of numerical models available on CORDEX and CMPI5 projects were analysed to determine which one reproduces observations better. These outputs were used to force Delft3D under historical and future RCP8.5 scenarios. Heat and salinity transport of predicted scenarios show an increase in water temperature and a stronger stratification. Temperature is one of the most important factors affecting organisms, making them vulnerable to climate warming. Temperature maps provided by Delft3D are a very useful tool for ecological researches; for example, in studies about changes in the spatial distribution of species.

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S1.2. Evolution of physical settings in the Gironde estuary in a perspective of global change

Aldo Sottolichio*1, Joselyn Arriagada1,2, Hervé Derrienic1, Isabel Jalon-Rojas1,3, Vincent Hanquiez1, Katixa Lajaunie-Salla1,4, Barend Van Maanen1,5

1 University of Bordeaux, EPOC, Pessac, France
2 Universidad de Chile, Faculty of Geography, Santiago, Chile
3 UNSW Canberra, Canberra, Australia
4 Aix Marseille University, MOI, Marseille, France
5 University of Exeter, Life and Environmental Sciences, Exeter, UK

Recent studies have emphasized on the drastic physical evolution of many European urbanized estuaries, which have became more turbid during the XXth century because of artificial deepening and narrowing. However for some other systems, detailed analysis of morphodynamics evolution remain limited. For these latter, it is still difficult to elucidate any effect due to climate change, extreme events or human activities. Among them, the Gironde estuary is a macrotidal funnel-shape system, the largest estuary of Western Europe, and characterized by high natural levels of turbidity. An investigation on tidal patterns in the Garonne tidal river (i.e. the upper extension of the Gironde estuary) showed that gravel extraction during the sixties has deeply modified the mean depth of the channel. In the meantime, there is evidence of a long-term shift of the turbidity maximum in this area, mainly due to a reduction of river flow in the last 40 years. However, for the main estuarine portion, which represents 80% of the total surface, morphology evolution and associated physical processes remained under-investigated. In this study the morphological evolution of the Gironde estuary has been documented, based on bathymetric and tidal data collected from the archives of the port of Bordeaux. Six bathymetric maps covering a period of 50 years, from the 1953 to year 2014 were compared, highlighting areas of accretion and erosion. Results show that the zone of maximum volume of deposited sediment has migrated continuously towards the upstream portion of the estuary, which is coherent with the intensification of the low river flow periods and the upstream shift of the turbidity maximum zone to the riverine sections. The application of a numerical model allows to discuss possible further evolution of physical settings and dissolved oxygen under projected climate changes, in particular sea level rise and global warming.

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S1.3. When is the position in the tidal frame an indicator of marsh resilience?

Anna Hilting*, Jenny Davis, Carolyn Currin

National Centers for Coastal Ocean Science, National Ocean Service, United States National Oceanic and Atmospheric Administration (NOAA)

Measuring the ability of coastal marshes to keep up with relative sea level rise is the focus of many long-term marsh monitoring programs. The position of a marsh in the tidal frame is a major predictor of marsh resilience to sea level rise because it affects inundation time and depth, which can affect species distribution, sediment delivery, and biogeochemical feedbacks. Although inundation at individual marshes is better represented by local water level conditions over the study period, resources and site conditions can limit the ability to collect local water level data.

Commonly, marsh position in the tidal frame is determined using the published 19-year National Tidal Datum Epoch (NTDE) datums which represent average water levels from 1983-2001 when global sea level was ~ 8 cm lower than present. The advantage of using NDTE datums to determine marsh position in the tidal frame is 1) they can be estimated using National Oceanographic and Atmospheric’s (NOAA) vertical datum transformation tool, VDatum, for sites where local water level data is unavailable and 2) datums from multiple sites can be compared at the same temporal scale. However, the relationship of position in tidal frame to inundation may vary along an estuarine gradient as non-tidal influences become more important.

We utilized the NOAA tide gauge records at Beaufort, NC, VDatum, marsh elevation and water level data along an estuarine gradient from more than a decade of marsh monitoring in microtidal (0.2 to 1.0 m tidal range) North Carolina, USA estuaries, to evaluate factors affecting marsh resilience to sea level rise. The study period (2004-2018) includes a 5-year period of accelerated relative sea level rise (14 mm y⁻¹). Our assessment provides support for marsh monitoring program decision making.

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S1.4. Prototype Oceanographic Monitoring System development for the Kalloni Bay, Lesvos, Greece

Stamatis Petalas*, Alexandros-Agisilaos Dimitrakopoulos, Ioannis Mamoutos, Aggeliki Sampatakaki, Vasilis Zervakis

Department of Marine Sciences, University of the Aegean, Greece

The Bay of Kalloni is one of the most productive coastal regions of the otherwise extremely oligotrophic Aegean Sea. Its ecological wealth (which in Classical times provided Aristotle with material and inspiration for his founding work on biology) is currently under intense anthropogenic and climatic pressures. The Department of Marine Sciences of the University of the Aegean is currently implementing a medium-term plan to make Kalloni Bay a model region for coastal studies and management, and a focal point for coastal research and education in the Eastern Mediterranean. A first step towards developing a permanent oceanographic monitoring of the Bay is the study of its thermohaline functioning, circulation and exchanges with the open sea through a sill-less Strait, typical of Aegean Sea islands. To that aim (and for the first time in the Mediterranean), a submarine telephone cable laid across the Strait is exploited in order to obtain a low-cost, high-frequency time-series of the net exchange with the Aegean. This is based on the measurement of voltage difference induced between the two across-strait coasts by the motion of conducting material (sea water) moving through the earth’s magnetic field. Two different methods of estimation of the net exchanges through the Strait and the preliminary results of their application, and comparison to the cable measurements are presented and discussed. Furthermore, issues related to seasonal variability of thermohaline functioning of the Bay and its impact on the exchange estimates are examined. Finally, we describe and discuss the present and near-future implementation of the Department’s policy of making Kalloni Bay a state-of-the-art coastal oceanographic observatory connecting science and education and leading to an example of good practices for coastal management of Mediterranean semi-enclosed basins.

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S1.5. Evolution of water quality in a large eutrophic European estuary under changing pressures: past, present and future of the Scheldt Estuary

Tom Maris*1, Natacha Brion2, Patrick Meire1

1 Universiteit Antwerpen, Ecosystem management group (ECOBE). Universiteitsplein 1, 2610 Wilrijk, Belgium.
2 Vrije Universiteit Brussel, Analytical and Environmental Geochemistry (AMGC). Pleinlaan 2, 1050 Brussels, Belgium

The freshwater Scheldt Estuary (Belgium), located in one of the most densely populated areas of Europe (over 500 inh./km²), is a highly eutrophic system currently recovering from hyper-eutrophication thanks to improved waste water treatment efforts. As a result, the ecosystem shifted from a respiration dominated system towards a more autotrophic system, causing a spectacular and rapid improvement of the water quality, especially documented by increased oxygen levels. However, focusing at the biogenic parameters in the water column, the freshwater Scheldt does not meet good water quality standards yet, and for the past 10 years, no important further improvement is recorded. On the contrary, there are indications of a declining quality again. This time, water quality from the catchment is no longer the major problem. Important hydrodynamic and geomorphologic changes within the estuary itself seem to influence water quality. Altered residence times and a changing light climate can indeed strongly reduce pelagic primary production.

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S1.6.   Endangered eels: a symbol of the effects of global change

Hilaire Drouineau*¹, Maria Mateo¹, Martin Castonguay², Caroline Durif³, Eric Rochard¹, Guy Verreault⁴, Kazuki Youkouchi⁵, Patrick Lambert¹

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² Ministère des Pêches et des Océans, Institut Maurice-Lamontagne, C.P. 1000, 850, route de la Mer, Mont-Joli, QC G5H 3Z4, Canada
³ Institute of Marine Research, Storebø 5392, Norway
⁴ Ministère des Forêts, de la Faune et des Parcs – Direction Régionale du Bas Saint-Laurent, 186 rue Fraser, Rivière-du-Loup, QC G5R 1C8, Canada
⁵ National Research Institute of Fisheries Science, Fisheries Research Agency, 2-12-4 Fukuura, Kanazawa, Yokohama, Kanagawa 236-8648, Japan

Temperate eels are three catadromous fish species undergoing dramatic declines since the 1970s/1980s despite amazing adaptation capacity. Because of their specific life cycles, shared between distant oceanic spawning grounds and continental growth stage, eels were affected by all the five components of the global change. (i) Climate change affects larval survival and drift. (ii) Anguillicola crassus is an alien nematode that impairs spawning success. (iii) Fragmentation and habitat loss has dramatically reduced available habitats and induced spawners mortality. (iv) Because of their high trophic level and high lipid storage, eels are especially sensitive to contaminants which reduce spawning success. (v) Eels are targeted by commercial and recreational fisheries, and amazingly high exploitation rates are observed on glass-eels. Moreover, most of these anthropogenic pressures affect specific types of habitats and individuals. In this context, the rapid increase of pressures during the “Great Acceleration” have surpassed and altered the adaptation capacity of eels. This illustrate how the rate of changes due to global change, when all its components have synergistic effects, can lead to the collapse of species, even species that have proved to have amazingly high adaptation capacity and were sometimes considered as nuisance species till the 80s.

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S1.7. A tale of *Spartina* Bioinvasions in Mediterranean Marshes: Past, Present and Future

**Bernardo Duarte***¹, Patrick Reis-Santos¹², Ricardo Cruz de Carvalho¹³, Eduardo Feijão¹, Enrique Mateos-Naranjo⁴, Susana Redondo Gómez⁴, Anabela Silva⁵, Ana Rita Matos⁵, Rui Rosa⁶, Isabel Caçador¹, Vanessa Fonseca¹

¹ MARE – Marine and Environmental Sciences Centre, Faculty of Sciences of the University of Lisbon, Campo Grande 1749-016 Lisbon, Portugal
² Southern Seas Ecology Laboratories, School of Biological Sciences, The University of Adelaide, SA 5005, Australia
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⁴ Departamento de Biologia Vegetal y Ecología, Facultad de Biología, Universidad de Sevilla, 1095, 41080 Sevilla, Spain
⁵ Biosystems and Integrative Sciences Institute (BioISI), Plant Functional Genomics Group, Departamento de Biologia Vegetal, Faculdade de Ciências da Universidade de Lisboa, Campo Grande, 1749-016, Lisboa, Portugal
⁶ Marine and Environmental Sciences Centre (MARE), Laboratório Marítimo da Guia, Faculdade de Ciências da Universidade de Lisboa, Avenida Nossa Senhora do Cabo 939, 2750-374, Cascais, Portugal

The invasion of natural communities by non-indigenous species (NIS) represents one of the most serious threats to biodiversity. While these invasive processes are rather well studied in river corridors and riparian communities, the invasiveness of non-indigenous aquatic plants in wetlands has received far less attention. The *Spartina* genus (cordgrasses) is one of the most ecologically successful halophytes (species that can survive and complete their life cycle under saline conditions) present in a wide range of latitudes across the globe. Typically, Mediterranean systems are inhabited by the endemic small cordgrass *Spartina maritima*, native from the Atlantic African and European Atlantic coasts. Alongside *S. maritima*, and with very similar geographical distribution ranges, two invasive species from the *Spartina* genus have been detected in Mediterranean systems: *Spartina patens* (present in the Iberian Atlantic coast) and *Spartina versicolor* (present in the south coasts of the Mediterranean). This bio-invasion is conditioned not only by the invasive species’ ecophysiological fitness but also by their ability to adapt and compete with native species. Additionally, this introduction has impacts in various processes including carbon storage, ecosystem feedback to climate change, natural remediation capacity and energy flows through the trophic web. Cross-tolerance mechanisms derived from a tailored adaptation to stresses present in their specific habitat will have significant effects in how plant mechanisms will respond to upcoming abiotic stresses, thus determining plant growth and development. This is a key factor to allow us to better predict the future of bio-invasions and the counteractive measures needed to be implemented.

In this work, the phylogeny of these invasive species’ populations and of its mother populations will be addressed as well as its physiological fitness, biogeochemical impacts and feedback to climate change to better understand the past, present and future of invaded salt marshes.

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https://cheers2019.sciencesconf.org/
S1.8. Resilience and temporal trajectories of micro-phytoplankton communities in the Bay of Seine

Angéline Lefran*1,2, Pascal Claquin2,3, Francis Gohin4, Tania Hernández Fariñas1

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2 Normandie Universités, Université de Caen Normandie, F-14032, Caen, France
3 Unité Biologie des Organismes et Ecosystèmes Aquatiques (BOREA, UMR 7208), Sorbonne Universités, Muséum National d'Histoire Naturelle, CNRS, Université Pierre et Marie Curie, Université de Caen Normandie, IRD 207, Université des Antilles, Esplanade de la paix, F-14032, Caen, France
4 IFREMER, Département Dynamiques de l’Environnement Côtière, DYNECO/PELAGOS, Ifremer Brest, BP 70, 29280 Plouzané Brittany, France

The Bay of Seine is a major area for fish and shellfish production in France. As first link of the trophic network, the phytoplankton community structure and spatio-temporal variations need to be explored in order to improve our understanding of the biological compartment dynamics within the Bay. Studies show that nutrient inputs, temperature and salinity with the stratification that they entail are major drivers to structure the phytoplankton community. This work aim to study the effects of environmental changes on micro-phytoplankton spatio-temporal variability, in order to give a complete description of the Bay of Seine status in term of phytoplankton community dynamics. What temporal trajectories characterize the community and the environmental conditions throughout the Bay of Seine? Is the community resilient? How the estuarine environment affects the phytoplankton community? National (REPHY) and local (RHLN) monitoring programs gather the abundance of 284 taxons since 1987 along with abiotic parameters such as temperature, salinity, turbidity, oxygen and nutrients. A complete and regular database for over a decade is available in order to understand the resilience and phenology of the phytoplankton community at different coastal stations within and around the Bay of Seine. First observations indicate an influence of two major winds (SW–NE) on the hydrodynamic which induce a heterogeneous pattern between the Eastern and Western Bay areas (such as contrasted spring bloom species distribution). Overall, decreasing chlorophyll a and oxygen concentrations has been noticed throughout the Bay of Seine especially at rivers mouths which could be linked to changing nutrients inputs by fluvial transport. Bray Curtis dissimilarities have however indicated resiliency in the community and stable seasonal periodicity. Multivariate analysis of beta diversity (Partial Triadic Analysis) have also shown that the community has evolved through a common trajectory along the years.

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S1.9. Benthic habitat tool to evaluate management and/or climate scenarios in the Sea Scheldt estuary

Alexander Van Braeckel*¹; Jeroen Speybroeck¹; Joost Vanoverbeke¹, Frank Van de Meutter¹, Gunther Van Ryckegem¹, Joris Van Lede², Yves Plancke², Erika Van den Bergh¹

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With the expected increase of hydrological pressure caused by sea level rise, the Scheldt estuary is expected to face morphological river modifications that can reduce or amplify expected ecological responses to climate change. Therefore a predictive tool for benthic habitat assessment is developed, allowing inclusion of hydrodynamics as a potentially important driver of benthic community composition and density.

In order to develop such a tool, a sampling campaign and ecological modelling approach were set up to characterise the habitat of the benthic species and communities in subtidal habitats of the freshwater and brackish part of the Scheldt. Along with the benthic communities, data on flow velocities, soil morphology type, water depth, sediment characteristics and organic matter content were collected.

Multiple regression analyses revealed distinct subtidal benthic communities in shallower areas with low flood velocity and deeper areas with higher flood velocities.

A new habitat typology is derived by threshold analysis of the most relevant variables in relation to macrobenthic density. The robustness of the typology is tested on independent macrobenthic long-term monitoring data (the Belgian-Dutch framework of MONEOS). Compared to the previously used ecological typology, water velocity is included to monitor and predict the evolution of subtidal habitats and species in the Sea Scheldt estuary (Belgian part of the Scheldt estuary). This has resulted in an improved, ecologically validated instrument for impact assessment of climate change in 2050 and management measures and infrastructure works, such as sediment dumping or river cut-offs. As such, abiotic data can allow defining mitigation measures to minimise the ecological impact of these measures.

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S1.10. The influence of local drivers on the long-term variability of the nutrients in the French marine coastal ocean: the case study of the Arcachon Lagoon

Arnaud Lheureux*1, Nicolas Savoye1, Yolanda Del Amo1, Dominique Soudant2, Eric Goberville3, Isabelle Auby4, Florence D’Amico4, Florian Ganthy4, Laure Gouriou4, Claire Meteigner4, Hélène Oger-Jeanneret5, Loïc Rigouin4, Myriam Rumebe4, Marie-Pierre Tournaire4, Florence Trut4, Gilles Trut4, Valérie David1

1 Université de Bordeaux-CNRS, UMR 5805, Environnement Paléoenvironnement Océaniques et Côtières (EPOC), 2 Rue du Professeur Jolyet, 33120 Arcachon, France
2 Ifremer Nantes, Valorisation de l’Information pour la Gestion Intégrée Et la Surveillance (VIGIES), 44311 Cedex 03, Rue de l’Île d’Yeu, 44980 Nantes, France
3 Sorbonne Université, MNHN, UNICAEN, UA, CNRS, IRD, UMR 7208, BOREA, 61 rue Buffon, 75005 Paris, France
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Coastal marine ecosystems, which play a crucial role in the biogeochemical and ecological functioning of the earth system, are highly sensitive to the combined effects of climate variability and human activities. Because nutrients are among the main limiting factors of phytoplankton growth, even subtle changes in their dynamics may therefore induce pronounced modifications at the ecosystem scale. However, it remains challenging to assess the spatial and temporal scales at which climate influence operates on coastal ecosystems, especially in a climate change context. By focusing on the Arcachon Bay, a small semi-enclosed lagoon, we investigated (1) the long-term changes in nitrate, phosphate and silicate concentrations, (2) spatial changes in the hydrological features of the lagoon and (3) the relationship between the nutrients evolution and the climatic and anthropogenic drivers.

Long-term time series (ARCHYD monitoring program) that encompass 6 sampling stations (located within the subtidal 40 km² of the lagoon), was used to describe exhaustively this ecosystem, from the most outer sites close to the Bay aperture, and therefore mainly influenced by oceanic conditions, to the most inner sites close to the streams flowing into the bay, directly under the influence of continental inputs. In addition, the geomorphological characteristics of this shallow system (average depth of 4.6m and a maximum of 20m in the main channels), together with a meso- to macro-tidal regime induce vertical inputs of nutrients.

Dynamic Linear Models (DLMs) enabled to identify evolution patterns in the nutrients concentrations. By applying multivariate analyses combined with a correlative approach, we quantified how local (i.e. meteorology and riverine nutrients concentrations and flows) forcings contributed to the spatio-temporal modifications in nutrients over the last 20 years in the Arcachon Bay. Moreover, the physical (temperature, salinity, suspended matter) and biological (phytoplankton biomass) ecosystem variables were considered to complete the overview.

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S1.11. Linking coastal benthic communities and cumulative impacts from human activities: evaluation of the exposition and prediction of an environmental status at the bay scale

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With the development of coastal human activities comes the growing need to develop methods to describe and predict their cumulative impacts on marine benthic communities locally, which rank among the most vulnerable communities in marine ecosystems. Local assessments facilitate dialogue between multiple users of the ecosystem (industries, individuals) and allow a better understanding of ecosystem components variability (e.g. benthic species, habitats) in a given region. Our objective was to evaluate the local effects (~0.01 km$^2$ resolution) of the cumulative exposure of anthropogenic drivers on benthic species composition and diversity. Our study was conducted in the Sept-Îles region in Québec, where numerous human activities vary in local intensity (e.g. international shipping, fisheries or domestic and industrial wastes). Macro-infaunal diversity and abiotic parameters of the sediments were characterized in situ, and cumulative exposure scores were computed for each activity as a function of distance from the source, intensity and physical constraints (e.g. bathymetry). Community composition and diversity were then modelled as a function of abiotic parameters and cumulative exposure scores using Hierarchical Bayesian modelling (HMSC). We will use outcomes of these models to predict community compositions under different scenarios of human activity exposure in the bay, and to support the development of indicators of environmental status considering multiple anthropogenic drivers.

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S1.12. Predicting the benthic communities in the Hudson Bay Complex

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Most benthic organisms living at the surface of sediment are either sessile or have low mobility; they are therefore directly affected by changes in environment. Physical properties (i.e. bathymetry, ice cover, salinity, temperature), resources and substrate are mainly responsible for the benthic communities’ structure and thus modulates these ecosystems. The Hudson Bay Complex in the Canadian Arctic varies in salinity because of the impact of climate change and freshwater discharge from several rivers. According to the RCP 8.5 emission scenario, freshwater discharge along the coastlines will show notable increase in the southeastern portion of the Bay. Salinity gradients influence species richness and could thus impact ecological communities, e.g. by influencing specific distribution and richness. Our study is part of the BaySys project that aims to understand the relative contributions of climate change and regulation on the Hudson Bay system. Our objective in this study is to predict the spatial structure of benthic communities in the Hudson Bay Complex. To determine how the environment structure communities, we used Hierarchical Modelling Species Communities (HMSC); a new modelling approach. Using this model, we will model community composition and predict community structure under different river regulations and RCP 8.5 emission scenarios. Our study will lead to a better understanding and will support the economic and management decision within the Hudson Bay Complex.

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S1.13. Habitat suitability for Twaite shad in the Sea Scheldt

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Migratory fish such as Twaite shad (*Alosa fallax*) are important indicators of ecosystem functioning in estuarine habitats. They depend on a good quality of the entire stretch from the open sea to the freshwater areas, where they migrate to spawn and where the larvae develop. In the second half of the previous century the Sea Scheldt (Belgian part of the Scheldt estuary) was heavily polluted, hypertrophic and anoxic. As a result, fish were absent from almost its entire stretch. The last decades, thanks to a strong improvement of the water quality, fish have returned and both spawning activity and the presence of larvae of Twaite shad are observed in the freshwater reaches of the estuary.

In order to better assess habitat quality, a suitability index was developed for Twaite shad. This suitability index is calculated both for the spawning of adults and for larval development. The index takes key variables (e.g. oxygen, suspended matter, ...) related to habitat quality as input and uses fuzzy logic to score the habitat quality. Viability ranges for each input variable are derived from the literature.

Based on monitoring data of water quality, the index indicates that the most important factor determining the return of Twaite Shad in the Sea Scheldt is the increase in oxygen. Besides oxygen, also turbidity can strongly affect suitability for larval development.

Within the framework of the Integral Plan of the Upper Sea Scheldt modeling results are available that allow to make predictions of the evolution of habitat suitability for Twaite Shad towards 2050 in response to habitat and climate change. These predictions indicate that suitability will not deteriorate substantially towards 2050. Nevertheless, predictions of slightly decreasing oxygen levels could increase exposure to oxygen dips typical of annual variation and increasing salt intrusion might decrease the occurrence of freshwater habitat.

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S1.14. Smelt in the Sea Scheldt: from complete absence to overwhelming dominance

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The Scheldt estuary (Belgium/The Netherlands) experienced a very high organic load for decades causing hypoxia over a significant section of its freshwater and brackish reach. Until 2006 untreated sewage water from Brussels reached the oligohaline zone through the Zenne and Rupel tributaries. As a result an hypoxic stretch persisted near the confluence with the Rupel, in the oligohaline zone, acting as a migration barrier for fish despite substantial water purification efforts along the estuary. In 2007 this last hypoxic zone finally vanished and re-establishment of a pelagic foodweb, causing major shifts in the estuarine carbon flows, is observed.

Migratory fish are important indicators of ecosystem health since they need suitable habitats along the complete estuarine gradient to complete their life cycle. Smelt (Osmerus eperlanus) one of the diadromic species is by far the most abundant fish species in the Sea Scheldt, making up almost 90% of the total fish population numbers and biomass. In 2009 Smelt recruitment was observed for the first time. Very soon the species recolonized the estuary as a spawning, nursery and feeding ground. A steady population increase was observed until 2013 in the meso- and oligohaline zone and until 2015 in the freshwater zone. More recently the number of adults entering for reproduction decreased but recruitment is still very successful. Smelt population dynamics in the Sea Scheldt from the first re-occurrence till now is discussed. Observed patterns are related to the evolution of other fish species and trophic links, abiotic conditions, habitat creation projects and infrastructure works in an attempt to understand some of the underlying mechanisms. Prospects on how climate change might additionally affect these developments are discussed.

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S1.15. Magnitude ranges of heavy metals in seagrass throughout the world – evidence for heavy metal pollution in the bays of South-Eastern Australia

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Worldwide, seagrass is becoming established as a reliable bio-indicator of heavy metals, with numerous studies now being documented. Seagrass has been shown to have a high capacity to bio-accumulate heavy metals and appears to have a high resilience to toxicity, although the actual phytotoxic levels of heavy metals in seagrass remain largely unknown. However, the bioaccumulation of such elements is reasonably considered to be a potential risk to ecosystem services. It is becoming increasingly evident that seagrass could play a vital role as an early warning system or as a monitoring tool for chemical pollution, especially heavy metals. In this regard, over the last four years, we have been engaged in utilizing the seagrass species Zostera muelleri as a bio-indicator of heavy metals in three bays along the south-eastern coast of Victoria, Australia. In order to relate our findings to similar studies around the world, we have comprehensively reviewed the magnitude ranges of various elements as reported in fifty-eight separate studies. These studies represent one hundred and fifty-four sets of data covering thirty-one elements. In doing this, we have endeavoured to establish what constitutes “expected values” as opposed to “elevated levels” that are, perhaps, representative of pollution or pollution events. Thus, from our own data, we report evidence for a major pollution event (or events) in relation to certain heavy metals affecting all three bays that are under study; namely Port Phillip Bay, Western Port Bay and Corner Inlet. Notably, the latter two bays, which are considered the more pristine, were the worst affected. We suggest this event(s) occurred in the year prior to the Australian winter period of 2018. Our results are discussed in the context of the aforementioned worldwide magnitude ranges that have been gleaned from the international literature.

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Seagrass species are some of the most productive and diverse coastal marine ecosystems on the planet. These ecosystems provide nursery grounds and food for fish and invertebrates, coastline protection from erosion, carbon sequestration, and nutrient fixation. For marine macrophytes, temperature is generally the most important range limiting factor, and ocean warming is considered the most severe threat among global climate change factors. According to the most recent IPCC reports the duration and frequency of extreme heat wave events are likely to increase in the Mediterranean area. At the region of the planet the dwarf eelgrass, *Zostera noltii*, is among the most abundant and ecologically relevant seagrass species. Photosynthesis is one of the most essential physiological processes that will be affected by increasing ocean temperatures. From a physical point of view, increasing water temperatures reduce oxygen solubility and CO_2_ availability, with consequent impairing of photosynthetic metabolism, shifting these ecosystems from carbon sinks to carbon sources and reducing the amount of oxygen produced, thus affecting all the heterotrophic food chain. Additionally, ocean warming can lower chlorophyll contents and, thus, lead to seagrass browning. Among other energy storage molecules, fatty acids play an important role not only for the physiology of the plant itself, but also in terms of macrophyte-based trophic chains, which are either directly based on seagrasses as food-source or on detritus exportation. Global warming is expected to reduce the global production of PUFAs by marine macrophytes. These biochemical and physiological cascades are predicted to affect also terrestrial animals because of the flux of aquatic biomass, containing n-3 LC-PUFA, which normally passes from aquatic to terrestrial ecosystems. Considering these factors, the present work intents to evaluate the effect of a heat wave on the multiple dimensions of the dwarf seagrass physiology and how it will impact the surrounding communities.

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S1.17. Hyperbenthos in the upper reaches of the Scheldt estuary (Belgium): re-establishment of an indispensable trophic link

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The Scheldt estuary is a classic example of a highly stressed ecosystem that has degraded by anthropogenic pressures. Especially the valuable freshwater tidal zone suffered from hypereutrophication and permanent hypoxia. Thanks to substantial water purification efforts, water quality improved considerably and zooplankton, hyperbenthos and fish recolonized the upper reaches of the estuary. With their intermediate position in the estuarine food web, hyperbenthic organisms act both as consumers and prey and play a key role in channeling carbon and energy fluxes from the lower to the higher levels of the food web. They also provide estuarine nursery and food supply for fish and waterbirds. Here we present results of an intensive (monthly) and long-term (2013-2018) monitoring campaign of epi-and hyperbenthos in the mesohaline to freshwater tidal zones of the Scheldt estuary. Hyperbenthos was present on all the sampled locations and was taxonomically dominated by juvenile fish, amphipods, mysids and decapod shrimps. Species composition was, like in other European estuaries, spatially governed by the salinity gradient and changed also seasonally, with the lowest species richness and densities observed in winter. Densities were generally influenced negatively by a high river discharge and positively by the particulate organic content of the water. Characteristic estuarine residents, such as *Neomysis integer*, *Palaemon longirostris* and *Pomatoschistus microps* (common goby), seem to flourish again in the oligo- and freshwater zones of the Scheldt. This part of the estuary also recovered its spawning and nursery function for several diadromic and marine fish species such as *Osmerus eperlanus* (European smelt) and *Platichthys flesus* (European flounder).

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The Gironde estuary, the largest estuary in Western Europe, has been exposed for decades to a diversity of environmental impacts related to human activities (fishing, dredging, industry, chronic pollution, etc.). Significant changes in community structure have been identified in recent years as a result of global change at different trophic levels: on zooplankton, crustaceans or fish. In addition, recent research highlights potential changes in predator-prey relationships and, more broadly, significant changes in the functioning and overall properties of the food web. Particularly, in recent years, there has been a collapse in the abundance of some of the main prey of marine predators, while the latter have shown record abundances in the environment. Several processes can explain these observations, including: (1) a change in environmental conditions and/or (2) variability in interspecific relationships (predation, competition). To carry out this study, the time series of the fish monitoring of the Gironde estuary were analysed. Ecological time series can be considered as the result of complex dynamic systems, which reflect the evolution of dynamic behaviour over time. Thus, recent methods - flexible, non-linear and non-parametric - based on dynamics encoded in time series (empirical dynamic modelling - EDM) have been used to investigate these causal links between the different factors associated with these processes (environmental factors such as temperature or salinity, prey abundances, predator abundances...). We show that these techniques allow us to better understand the relative importance of stochastic forces impacting prey abundances.

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Estuaries and their biota are highly dynamic and productive systems that have been historically exploited by humans. There is urgent need to understand how climatic events may drive changes in estuarine biota to avoid degradation of estuarine ecosystem services. We evaluated temporal changes in abundance, diversity and trophic structure of shallow-water fish assemblages in the estuarine area of Patos Lagoon (10,360 Km²), the largest choked coastal lagoon in the world and one of the sites of the Brazilian Long-Term Ecological Research (B-LTER) program. Analyses were performed on two long-term datasets: (i) fish diversity and abundance data obtained from five beach seine surveys performed monthly at five sampling stations in shallow waters (<2 m) of the estuary between 1996 and 2019, and (ii) carbon and nitrogen stable isotope ratios of food web components (fishes, macroinvertebrates, primary producers, particulate organic matter) obtained from seasonal surveys conducted in a shallow embayment of the estuary between 2010 and 2018. Rainfall and freshwater discharge, which are higher during strong El Niño events, were important predictors of temporal changes in fish assemblage structure. The abundance of estuarine-dependent and estuarine-resident fishes usually decreased during periods of high rainfall and freshwater discharge associated with El Niño events. In contrast, freshwater fishes were more common in the estuary during these periods, and this increased assemblage diversity both in terms of species richness and evenness. Periods of high rainfall also affect trophic diversity when many herbivorous, insectivorous and piscivorous freshwater fishes enter the estuary. Further monitoring is needed to evaluate the resilience of Brazilian estuarine systems to extreme climatic events, which are expected to increase in frequency and intensity under current global warming projections.

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S1.20. Biodiversity components in lagoon ecosystems: patterns, drivers, mechanisms and impacts

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Lagoons are model ecosystems to study biodiversity; under relatively controlled and experimentally feasible conditions. Main open questions deal with the deterministic and stochastic components of biodiversity organisation in lagoon ecosystems, the underlying mechanisms and scales and the responses to changing environmental conditions, including climate. The answers would have very relevant implications on our capability to preserve ecosystem services under the currently changing scenarios. Here, we are addressing these topics and questions using data from the LifeWatch Italy data portal, mapping Mediterranean lagoons.

A few patterns, common to different guilds from benthic macrophytes to fishes, are observed. Low α and very high γ biodiversity occur in lagoons, most species are rare and few widespread; taxonomic similarity among lagoons is low, despite the converging selection of abiotic drivers, and consistent SAR are observed. Deterministic and stochastic factors seem likely to force biodiversity development at different spatial scales, defining also the characteristic scales of biodiversity conservation and management. Scale dependent drivers and mechanisms have to be ascertained in order to address realistic solutions and effective planning of the management of lagoon biodiversity and related services. Fragility patterns of selected benthic invertebrate functional groups to most affordable climate change scenarios can also be observed, giving insight in the adaptation and mitigation strategies applicable within the Mediterranean basin.

The analysis emphasise what we know, suggest how might we go on in order to deepen our understanding but also which are the critical gaps in knowledge that we need to fill in or at least to address.

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S1.21. Cellular and oxidative stress response of the European glass eel (Anguilla anguilla) to ocean warming and acidification

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The European eel (Anguilla anguilla) has a complex and puzzling life cycle making it focus of attention by scientists and stakeholders for centuries. Its dramatic decline over recent decades is raising serious concerns. Several studies have been suggesting that climate change is contributing for eels decline. We investigated the single and combined effects of ocean warming (OW; Δ + 4°C; 18°C) and acidification (OA; Δ − 0.4 pH units) on the survival and oxidative stress response of the European glass eel. We measured several stress-related biochemical endpoints in different tissues: i) oxidative damage [lipid peroxidation (by quantification of malondialdehyde, MDA) and DNA damage]; ii) protein repair and removal mechanisms [heat shock proteins (HSPs) and ubiquitin (Ub)]; as well as iii) antioxidant responses [superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) and glutathione-S-transferase (GST)] and total antioxidant capacity (TAC). At the end of exposure OW increased mortality while OA resulted in higher proportion of surviving individuals. Isolated OW and OA decreased MDA levels whilst combined exposure to both stressors increased lipid peroxidation. Associated with higher mortality, OW produced greater DNA damage, reinforcing the detrimental effects caused by a 4°C rise in water temperature. OA decreased HSP levels in viscera and muscle, nonetheless when combined with OW levels were counteracted. Decreased HSP resulting from OW and OA exposure (alone) triggered protein ubiquitination, a process known to target irreversibly damage proteins to be eliminated. The production of H + ions due to OA caused intracellular acidosis that affected pH-dependent proteins. Nevertheless, when acting together (OW+OA) HSPs levels increased and Ub declined, suggesting that OA could dampen the effect of the co-occurring stressor. Moreover, the total antioxidant capacity boosted under OW+OA. Further research about the effects of climate change on eel ecophysiology is needed to implement efficient conservation plans for this critically endangered species.

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Session 2 - Functional ecology tools to assess global change impacts

A wide diversity of functional species traits have been used in order to characterize biological communities. This session will include contributions that assessed these traits and explored its relationships with global change, highlighting the relevance of different anthropogenic impacts on the functioning of coastal communities. It would be particularly interesting that the contributions presented have analysed different biological groups in order to enhance a more integrative perspective of coastal systems, and point out some commonalities and singularities.

Keynote: Ana Queirós

Dr Ana Queiros is a senior benthic and climate change ecologist at Plymouth Marine Laboratory. Ana has a track record assessing the impacts of global stressors, including climate, acidification, plastics and ALAN, on marine species and ecosystems, through the uptake of experimental data towards development of macro-scaled species distribution and ecosystem models. She has more recently focused on the role of the ocean in stabilizing global climate through Blue Carbon, and in climate proofing marine spatial planning. She is currently leading research initiatives through programs in Europe, SE Asia and Western Indian Ocean, and has collaborations from Antarctica to central Africa. Ana is a visiting lecturer at the University of Southampton and the University of Exeter.
Climate driven changes in communities and processes in the coastal ocean – bridging scales through modelling approaches

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Global climate-driven changes in ocean systems are most difficult to tackle in the coastal and shelf ocean, where human activities are most intense. Addressing these challenges requires ecological approaches that overcome the difficulty of translating evidence acquired at an accessible scale, to characterise and represent ecological change in a format usable at the scale at which marine policy operates. In this talk, I explore how experimental and observational ecologists can work alongside macro-scale modellers to overcome this issue of scale, how modelling applications allow us to interrogate coastal and shelf systems at scales at which we can help inform and tailor the management of the temperate ocean: the importance of jointly focusing on individual and the ecosystem; season and century.
S2.1. Linking traits across ecological scales determines functional resilience to disturbance

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The Anthropocene has seen a global explosion of ecological disturbances and maintaining critical ecosystem functions in the face of escalating rates of species loss and change has become a priority. Characterising the attributes that make ecosystems resilient to this change is critical. Functional diversity is commonly used as a surrogate measure of function, where groups of species with similar functional traits are considered functionally redundant and theoretically buffer against some level of species loss; but this framework ignores the resistance and recovery capacity of communities that occurs across multiple spatial and temporal scales. We develop a more complete theory of functional resilience to disturbance that links processes operating across multiple scales of ecological organisation (from individual species to landscape scales). Specifically, we explore how different combinations of scale-dependent resilience attributes are linked to functional resilience against disturbances that vary in intensity, spatial extent, and frequency. To demonstrate these concepts, we characterise a seafloor community of macroinvertebrates by resilience attributes (including individual species traits, population connectivity, and functional group species richness). Using a conceptual Bayesian Network, we illustrate how functional diversity of the community responds to different disturbance regimes. We suggest that with increasing disturbance extent (spatial or temporal), functional resilience switches from being dominated by attributes at the landscape scale (recovery attributes) to being dominated by attributes at the individual species scale (resistance attributes). Characterising communities by multi-scale resilience attributes provides a new approach to practically assessing vulnerability of marine ecosystems in the face of cumulative disturbances.

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S2.2. Can we understand and predict patterns of community composition from limited site data?

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Understanding the combined role of environmental variability and system structure in the functioning of biological communities remains a major challenge, as most empirical studies address these two elements in isolation. Here, we build on recent work that used general community assembly mechanisms for the functional grouping and qualitative modelling of benthic macroinvertebrates in the Rance estuary (Brittany, France). We present a novel approach that allows the direct comparison of model predictions with spatial observations of community composition. Easy-to-build qualitative mathematical models predict the system’s response to input through each of its variables. A response to input through a specific variable that agrees with the observed pattern of community composition indicates this variable as a likely gateway for environmental variability into the system. Commonly available data of community composition are thus linked to external drivers, considering not only the direct effect of environmental variability on community members, but also its propagation through complex interaction networks. The application of the approach to benthic macroinvertebrates in the Rance estuary produced results that agree with the documented occurrence of a severe winter and its impact on estuarine benthos. The combined investigation of system structure and environmental variability offers the potential to dramatically increase the mechanistic understanding derived from the statistical analysis of limited site data. This can in turn lead to robust predictions about the responses of biological communities to future environmental change.

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Understanding the factors that determine the distribution of phytoplankton has been an increased interest in aquatic ecology. Morpho-functional traits are individual features influencing distributions along environmental gradients as interspecific interactions and resource partitioning within local communities. Specific traits, as shape and size, are master traits influencing the phytoplankton community structure, acting on the most important functions, from growth (light and nutrient assimilation) to loss (sinking and grazing) processes. The goal of this work is to characterize phytoplankton according Phytoplankton Geometric Shape classification, according to shape and size (biovolume) traits and to evaluate their distribution patterns related to environmental drivers.

We analysed phytoplankton communities of 9 South-Eastern Mediterranean lagoons: Margherita di Savoia salt pans, Torre Guaceto salt marsh, Le Cesine salt marsh and Alimini in Italy, Patok and Karavasta lagoons and Narta salt pans in Albania, Lehaova and Sinoe in Romania.

Statistical analyses of morphological traits were performed by two-way ANOVA. Canonical correspondence analysis (CCA) was used to select the most useful environ-mental driver explaining the variability of phytoplankton characteristics and the relationships among them.

53 taxa, occurred for more than 95% of numerical abundance, classified in 12 geometric shape, 8 simple and 4 complex. Number of cells and number of taxa showed statistical differences between 12 phytoplankton shapes. Phytoplankton mean individual size varies inter- and intra-shapes at spatial scale.

Different shape and size characterize phytoplankton of these transitional systems. Environmental factors are the drivers acting as selector for particular shape and/or size. The best fit seems to be a mechanism supporting a specific function.
An assessment of Allis shad larvae and juvenile tolerance to oxythermic stress

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Allis shad (Alosa alosa) populations showed important decline among last decades, and it is assumed that the species' distribution area has restricted. In some watersheds, the status of the species is preocupating, however this remains poorly explained. In the Gironde-Garonne-Dordogne system (SW France), its decline leads to the adoption of a fishery moratorium in 2008. Despite this measure, local populations don't show signs of a recovering. One hypothesis consists in the unefficiency of the recruitment process: indeed, young-of-the-year Allis shad are exposed to many pressures during their downstream migration, such as hypoxia (low water oxygen concentration). In the Gironde estuary, hypoxic events are frequent in summertime, and can consist in episodes of several days with water O2 saturations under 30%. In addition, hypoxic events are thought to be even more severe and frequent in the future, according to most of climate change scenarios. Such low O2 availability could threaten young Allis shad, and as a consequence, this could condition their migration success.

To our knowledge, if authors have suggested that 3-months old Allis shad show lower resistance to hypoxia at higher temperature, the abilities of younger developmental stages (larval and migrating stages) have never been studied. Here we meant to describe tolerance range of 10, 30, 60 and 90-days old Allis shad to oxythermic stress, by conducting behavioural analysis at individual scale in decreasing water oxygen saturation conditions (from 100 to 30%), at temperatures 18, 22, or 26°C. By this study, we aimed to bring useful information on the importance of oxythermic conditions for Allis shad in both larvae reintroduction purposes and juvenile migration success.

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S2.5. Back to the future: riverine spawning habitat suitability for a migratory fish species between 1950 and 2099 under RCP scenarios

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Diadromous fish, which migrate between ocean and river to fulfill their life cycle, are facing multiple anthropogenic pressures resulting in a global decline of these species. Despite this well-documented decline, the potential disruptive force of global warming has not been fully considered. Environmental cues driving fish reproduction are changing with climate change leading to unknown consequences in terms of reproductive success. A deeper assessment of the causal links between fish reproduction and climate change might be of crucial importance especially for species of low conservation status such as allis shad (Alosa alosa). As such, a boosted regression tree model (BRT) was applied to predict allis shad reproduction as a function of key climate-related and environmental factors. The calibration was based on data collected in the observed spawning grounds from 2003 to 2016. Then, the calibrated BRT model was used to calculate the historical suitability of environmental conditions in the spawning grounds from 1950 to 2018 using simulated time series of environmental factors. Finally, the BRT model was applied to simulate the evolution of environmental suitability from 1950 to 2099 according to ‘projected’ times series of environmental variables under RCPs 2.6 and 8.5. Results suggested that no major changes in environmental suitability at the spawning grounds had occurred and are expected in a near future. This study pointed towards the importance of studying climate change impacts on additional life-history phases such as early stages.

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S2.6. Energetic constraints to colonisation of transitional water ecosystems by amphipods

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Individual energetics is a basic phenotypic component, which depends from both intrinsic and extrinsic factors. The former consists in differential influences of sex, stage of maturity and phenotypic traits, including individual body size and other size-dependent traits; the latter includes many abiotic drivers, which could characterize the different ecosystem types.

In aquatic ecosystem, both temperature and salinity are considered as the main community drivers. The response to temperature is well defined and predictable while the response to salinity changes are less known, information is limited to a small number of species and data seem to show even strong heterogeneity among species. It could be due to still limited knowledge on metabolic costs of osmoregulation of aquatic macroinvertebrates to salinity variations.

The aim of this work was to understand the role of metabolic constraints in niche filtering processes of amphipod species in transitional water ecosystems. The amphipod species were selected according to their ecosystem type, including marine, brackish and freshwater species. The animals were collected in transitional water ecosystems (i.e. lagoons and river mouth) located in South Italy.

Here, we describe the standard metabolic rates (SMR) of different amphipod species related to changes in salinity (0-35) using open-flow respirometric system at fixed temperature (18° C). The SMR at individual level ranged between 0.18 and 7.13 J d⁻¹. The marine and brackish origin species showed higher metabolic rate when salinity decreased, in contrast the freshwater species exhibited an opposite trend.

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S2.7. An allometric approach at potential scenarios of future coastal ecosystems

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According to both ecological theory and empirical evidences, global warming will lead to an increase in metabolic costs of individuals proportional to individual body size. Thus, it is important to investigate how temperature dependent variations of individuals energetic may affect the individual behavior and population dynamics. There is a very direct linkage between feeding behavior and metabolism because the quantity of energy acquired through foraging must meet the organism’s energetic requirements for survival, growth and reproduction. The aim of the present study is to evaluate the individual traits mediating the response individual metabolism and resulting space use behavior to global warming. For this purpose, the covariance of Standard Metabolic Rate (SMR) and space use behavior has been analyzed across a water temperature gradient mimicking the expected temperature rise in the next decades (RCP2.6 IPCC scenario). In particular, we tested the hypothesis that increase in temperature should lead to anticipated patch departure. The SMR assessment was carried out using flow through microrespirometric techniques on male specimens of gammarids as model organisms. The space-use behavior of those animals has been monitored using a novel recording technology, that allowed us to collect a great number of individual observations (N=96). The results of the study showed the existence of a significant relationship between individual SMR and foraging behavior: the time spent foraging on a resource patch decrease with the increase of SMR. This relationship is consistent across the tested gradient of individual size and temperature that influence the individual SMR. Even a limited increase in temperature (1.2 °C) had a significant influence. Upon examination of the residuals, it appears that the small animals move more at higher temperature, while the large animals kept constant their movement.

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S2.8. Drugs, diatoms and artificial intelligence: new ways to evaluate toxicity

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Based on the biophysical mechanisms of the photosynthetic metabolism, where the energy from photons is conveyed to electrons, ultimately producing chemical energy, this work provides a different approach to ecotoxicological assessments. These biophysical processes can be assessed by remote sensing, using different bio-optical tools such as diverse types of fluorometry and spectroradiometry. These techniques provide complementary information, regarding the stress level of the target organism, without disturbing any occurring test and are entirely non-invasive. Considering this, bio-optical tools arise as possible and efficient instruments for ecotoxicology of marine primary producers, alternative to the traditional, expensive and time-consuming biochemical biomarker assays. Over the last decades, the impact of human activities in marine systems have increased exponentially, due to uncontrolled development. Beyond the classical contaminants, we are currently observing an increase in the appearance of what are normally known as Emerging Pollutants (EPs), such Pharmaceuticals and Personal Care Products (PPCPs).
All these EPs are being continuously released from wastewater treatment plants purification mechanisms to the marine environment. Therefore, the development of new ecotoxicological methodologies for the evaluation of the impacts of these new EPs in marine organisms is of paramount importance. Within this context, diatoms arise as excellent test organisms for ecotoxicity assays. The information gathered from the exposure to different EPs at different concentrations, using a variety of bio-optical tools allied to state-of-the-art metabolomics, will provide comprehensive information on the physiological stress imposed by the exposure to contaminants. All this data is given as input to highly efficient artificial intelligence and machine learning methods that discover the combinations of bio-optical variables that more efficiently detect dose-related stress for each organism and contaminant. This information will then be integrated into ecotoxicological indexes, for better communication to stakeholders and management entities. Summing up, this multi-disciplinary approach will fill the knowledge gaps existent on the ecotoxicology of EPs, while providing high-throughput screening tools possible to be applied in: i) impact assessment studies and ii) tests of new substances possible to be released in the environment.

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S2.9. Knowing about the environmental and biological patterns in low salinity environments: how big is the challenge?

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Identifying habitat types according to structural environmental factors and biological communities in low salinity environments may be appropriate to better explain observed scales of variability, related processes and to assess biotic condition. Available studies indicate a co-occurrence of freshwater and marine-origin organisms, providing the opportunity to understand patterns and processes of a stressful ecosystem, dominated by species that live on their tolerance limit which knowledge is mainly limited due to the taxonomic challenges. DNA barcoding has the potential to overcome these challenges in biological community assessments. However, fulfilling that potential requires successful amplification of a large and unbiased portion of the community. In this study, we attempted to identify mitochondrial gene cytochrome c oxidase I (COI) barcodes from 1024 benthic invertebrate specimens belonging to 54 taxa from low salinity environments of the Mira estuary and Torgal riverside (SW Portugal). Up to 17 primer pairs and several reaction conditions were attempted among specimens from all taxa, with amplification success defined as a single band of approximately 658 bp visualized on a pre-cast agarose gel, starting near the 5' end of the COI gene and suitable for sequencing. Amplification success was achieved for 99.6% of the 54 taxa, though no single primer was successful for more than 88.9% of the taxa. However, only 68.5% of the specimens within these taxa successfully amplified. Inhibition factors resulting from a non-purified DNA extracted and inexistence of species-specific primers for COI were pointed as the main reasons for an unsuccessful amplification. These results suggest that DNA barcoding can be an effective tool for application in low salinity environments where taxa such as chironomids and oligochaetes are challenging for morphological identification. Nevertheless, its implementation is not simple, as methods are still being standardized and multiple species-specific primers are required at present to achieve amplification success.

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S2.10. Coastal fish community of 31 major river basins around Japan

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In ecology, assessing the level biodiversity, such as taxon richness or differences in community composition at different spatial and temporal scale is of prime interest. Environmental DNA (eDNA) is a recent method that can accurately measure biodiversity, although like other sampling methods it can be biased and does not catch the full biodiversity extend, it is however highly effective in terms of time and cost at larger scales and non-invasive compared to other more conventional approaches. Fish eDNA of seawater collected slightly outside the mouth of 31 rivers around Japan between June and August 2018 was amplified and sequenced in order to estimate and understand fish biodiversity traits and fish community structure. A total of 187 fish species belonging to 133 genera and 63 families were identified. Presence/absence data at each site were used to compare diversity measures and community compositions from site to regional levels and provide insights into how these measures relate to socio-environmental parameters. Additionally, fish community clusters were compared to existing biogeographical hypothesis.

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Quality assessment of water bodies, belonging to the monitoring control network, requires the use of biological and physicochemical indicators. There is a strong need for the establishment of new biotic indices specific to particular environments (estuaries). Sampling of the estuarine ichthyofauna of the Guianese territory were realized one time per year from 2015 to acquire a dataset allowing the implementation of a suitable fish index specifically adapted to these estuaries water bodies. To date, we realized samplings on 7 different estuaries: Kourou, Mahury, Maroni, Cayenne, la Mana, Iracoubo, and Oyapock, using two different fishing gears: trawl and fyke. Our results demonstrated high populations variations trough the estuaries. Along an estuarie, we observed 3 different types of fish populations: marine species, springwater species, and fish species wich can evolve in all estuarian areas. Thus, depending the sampling position in the estuarie, and the tide, we fobserved the displacement of these different populatons. Our results demonstrated also that each sampling zone is mostly represented by one or two families, themselves represented by one or two fish species. Finally, we also identified new occurence of species in some estuaries (28 new species in Mana estuaries for example) wich were never described in this estuarie before. Estuaries are essential area for many species of fish by its ecological role as refuge, breeding site, permanent habitat, spawning grounds and flyways. Establishment of new biotic indices specific to particular environments is therefore essential to assess and to prevent anthropogenic impacts of this tropical environments still poorly known.

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S2.12. Key ecological function is enhanced at a land-ocean ecotone via convergence of species assemblages

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Ecotones can form hotspots of biodiversity by containing species from multiple ecosystems. Because biodiversity is often linked to ecological function, we posit that rates of key ecological functions are highest at ecotones, and decline away from them. Here we test this hypothesis by measuring spatial decays in the function of carrion scavenging on a gradient ranging from ocean beaches upland into abutting coastal dunes. A large field experiment in Eastern Australia, at the ecotone formed by ocean beaches, employed multiple carrion placements and motion-triggered cameras to identify the animals consuming carcasses and the removal rates of necromass. Significantly more carrion was consumed by vertebrate scavengers at the beach interface (50-80% of total necromass removed), and declined significantly with distance (max. 350 m) into the abutting coastal dunes (20-25%). This marked cline was due to the consumption of carrion by both dune-dwelling and beach-dwelling animals at the beach-dune interface, and a decline in scavenging activity by both groups farther upland. These spatial effects were consistent between sites, but the lower carrion removal away from the beach ecotone became less pronounced as the carcasses putrefied, suggesting that microbial actions can modify carrion suitability for vertebrate scavengers and hence change spatial patterns in ecological function. Our findings provide quantitative support for the widespread notion that ecotones are hotspots of ecological functions, and highlight the importance of managing functionally important species at ecotones.

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Session 3 - Integrative approaches to assess ecosystem functioning

This topic will cover innovative and integrative approaches and methods to assess the functioning of coastal systems. Properties and processes, such as productivity, consumption, nutrient cycling, food webs, among others, have been poorly studied and hardly related with climate and other drivers of global changes. Contributions exploring these topics are expected to be presented in this session.

Keynote: Jeffrey Dambacher

Jeffrey Dambacher is Associate Professor at the University of Tasmania and is recognized as for the theoretical development, practical application and teaching of qualitative mathematical modelling. He is noted for his ability to provide solutions for complex ecological and socio-economic problems that require a synthetic interdisciplinary approach. His work with the Australian CSIRO has resulted in novel solutions to the monitoring and management of Australian ecosystems, as well has a better understanding of human impacts in marine ecosystems.
Joining the edges of our science: integrative approaches to the research and management of marine ecosystems

Jeffrey M. Dambacher

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The vast size and complexity of the world’s oceans continue to present us with a formidable scientific challenge. Ocean environments and ecosystems are shaped by processes that operate at spatial and temporal scales spanning many orders of magnitude. Study of these processes has progressed through the distinct disciplines of physical, chemical, geological and biological oceanography, with the general trend of cutting-edge science being delivered by ever more focused fields of inquiry. And while the reach and scope of the problems addressed in recent decades has been significantly extended through a technological renaissance in ocean sampling and observation platforms, one can argue that the greater portion of these advances has been made for those problems that are most amenable to a narrowly focused approach, with lesser gains being realized for those arising from multiple interacting processes that span multiple scales. Advances in these kinds of problems instead require critical questions and hypotheses that emerge not at the narrow edge of any one discipline or research program, but rather along the broad intersection of many; here our collective endeavour becomes “joining-edge” science. A primary task for an interdisciplinary (or transdisciplinary) research program, then, is to develop a conceptual synthesis or model that makes clear which components and processes are relevant to the problem at hand, and just as importantly, which are not. Here we will explore how an integrative modelling approach is being used at CSIRO to advance research and monitoring programs, assessment of cumulative impacts, and assist in the management of large-scale marine ecosystems.
S3.1. Assessing impacts of human activities and global changes on ecosystem functioning and ecosystem services – methodology for the Belgian coastal ecosystem

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A sustainable management of the coastal ecosystem requires a thorough understanding of its functioning, processes and complex interactions among abiotic, biotic and socio-economic components, including pressures related to climate change. With increasing human activities in coastal ecosystems, tools are needed that allow to assess how these human activities and global pressures affect the functioning of the ecosystem and how this ultimately changes supply and demand for ecosystem services. While for terrestrial ecosystems a multitude of methodologies and instruments exists that allow to evaluate changes in ecosystem services, for coastal environments these are scarce or even inexistent. This can be explained by a lack of integration of available knowledge that is needed to develop cause-effect chains between changes in ecosystem structures, processes and ecosystem services.

We here present a methodology and instrument that was developed to assess impacts of human activities and climate change in the Belgian coastal zone on ecosystem processes and ecosystem services. The methodology is based on an extensive scientific review of the Belgian coastal ecosystem and socio-economic functioning, complemented with input from scientific experts and local stakeholders. It focusses on the key role of ecosystem processes as underlying mechanisms for ecosystem services and biodiversity. For each process, the parameters are identified that may lead to changes in the (rate of the) process. These so-called drivers of change form the basis from which an assessment is performed. Based on an evaluation of how a project or activity in the coastal zone affects the drivers of changes, the instruments identifies how this affects the ecosystem processes and how this results in impacts on habitats and ecosystem services.

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S3.2. From a benthic-terrestrial link towards a benthic-pelagic link: a changing food web in a changing estuary

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Estuaries worldwide suffer from anthropogenic pressure causing them to change or lose their natural morphology and biodiversity. The Scheldt estuary (Belgium/The Netherlands) experienced a very high organic load for decades causing hypoxia over a significant section of its freshwater and brackish reach. The impoverished benthic life was dominated by some tolerant Oligochaeta taxa. During the ‘90s of the last century and the beginning of the new millennium, Oligochaeta biomass topped reaching densities up to 300g/m² which attracted an impressive number of overwintering ducks. Accumulated efforts of water purification finally stopped hypoxia in the Scheldt by 2007, causing the food web to shift. Current research aims to understand the altered food web and carbon flows, concentrating on the pivotal Oligochaeta. Combining a large-scale exclosure experiment on the freshwater mudflats and a diet study using 3 stable isotopes, we investigated which re-established aquatic predators feed on the Oligochaeta, and how strong their impact is on Oligochaeta biomass. The exclosure effect revealed that over summer positive size-selective predation decreased standing biomass of Oligochaeta at least by 1/3th. Combining these results with monitoring of predator species narrowed the predator candidate list to three small predators: *Crangon crangon*, *Palaemon longirostris* and *Pomatoschistus microps*. Stable isotope analysis excluded the first species but supported a predatory link of *Pomatoschistus* and especially *Palaemon* on the Oligochaeta. However, the low Oligochaeta biomass currently being observed is most likely due to food limitation, as evidenced by increased worm densities with increased sedimentation of organic material, and the lack of a link between predator densities and Oligochaeta densities along the intertidal gradient. We conclude that the major energy pathway from benthos to birds has decreased and has been re-oriented towards aquatic predators. Future prospects on how this system may further change under climate change are discussed.

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S3.3. Carbon concentration, source and flux variations over two close temperate estuarine-coastal continuums

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Located along the Poitevin marsh, the Aiguillon bay and the Breton Sound (France), the studied coastal system shelters important blue mussel farming sites and is also pressured by human activities on the watershed where hydraulic lock managements regulate freshwater inputs. Concentrations and sources of organic and inorganic carbon were measured twice a month during two years along two close temperate estuarine-coastal continuums. Terrestrial carbon exports were computed as well from both upstream available discharge stations and direct water velocity measurements at our watershed sampling sites. During years of 2017 and 2018, dissolved inorganic carbon (DIC) concentrations ranged from 2 to 19 mmol.l⁻¹ and 2 to 3 mmol.l⁻¹ while total organic carbon (TOC) concentrations ranged from 3 to 180 mg(C).l⁻¹ and 1 to 16 mg(C).l⁻¹ at estuarine and coastal sites respectively. Throughout the studied period, bicarbonates represented the majority of DIC (HCO₃⁻ ; about 80%). To the contrary particulate organic carbon (POC) only predominated (~70%) at one estuary site during summer probably due to the maximum turbidity zone advection upstream to our sampling point under lower discharge values. Significant differences in DIC concentrations at estuarine locations were observed according to different watershed characteristics (soil occupation and geology). Strong variations in DIC and TOC concentrations were observed between the two sampled years and between seasons according to contrasted hydrological cycles. During the year of 2017, about 13 and 5 Gt of DIC and TOC respectively were exported from estuaries to the coastal zone. Due to higher discharge values recorded in 2018, terrestrial inputs and their influences on coastal carbon dynamics are expected to be quite different. This kind of study illustrating environmental drivers and climate importance on carbon dynamics over terrestrial-aquatic continuum needs to be pursued to better understand ecological functioning of coastal zone under global change.

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S3.4. Is trophic capacity spatially variable in the bay of Seine?

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Estuarine and coastal ecosystems are composed of spatially restricted habitats fulfilling a nursery function for many demersal fish species. These nursery-dependant species concentrate at the juvenile stage in these habitats, resulting in density-dependent regulation affecting growth and survival. However, the underlying mechanisms are still poorly understood and the limitation of the food supply on the juvenile fish remains a pending issue.

The Seine estuarine and coastal ecosystem (Eastern English Channel) is a nursery composed of a mosaic of habitats offering diverse food resources. Over the last decades, important anthropogenic activities significantly reduced the surface, especially of mudflats, likely reducing the gross production of this ecosystem. In here, we aim at assessing the trophic contribution of the different habitats to different nursery-dependant fish juveniles at two important periods of their juvenile stage: the post-settlement period (early spring) and the end of the growth season (late summer). Using a recently developed bioenergetics-based approach, we investigate the food limitation hypothesis applying the trophic contributions estimated in each habitat.

The bioenergetics-based approach estimates in each habitat the exploitation efficiency (EE), i.e. the part of the production consumed by the juveniles, assuming that the consumption occurs locally, i.e. is restricted to the habitat in which the fish was captured. We challenged that assumption by weighting the fish consumption with the estimated habitat contribution, thereby assuming that a fish captured in one habitat can feed in other habitats independently from where it was captured. The comparison of the EE assessed in different habitats identifies trophically-limited habitats and highlights the functional role of the intertidal mudflats in the assessment of the trophic capacity of the bay of Seine. These results likely support the integrated coastal zone management of this highly man-shaped ecosystem.

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S3.5. Isotopic inferences need dynamic modelling: the one of the turnover rate should not be excluded

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Stable isotopes are used in trophic ecology as a powerful tool to estimate trophic metrics and the contributions of resources to consumers’ diets. This tool is particularly relevant for marine coastal and estuarine ecosystems that gather a significant amount (>30%) of the literature on stable isotope studies in trophic ecology. In addition, these ecosystems host complex food webs and high spatio-temporal variations in prey-predator relationships, without the possibility to observe them directly. These estimations demand inferential methods (e.g. mixing models), which assume for instance (1) isotopic equilibrium between a consumer and its resources (i.e. the isotopic value of the consumer reflects immediately its resources, the turnover rate named Lambda, is infinite); (2) that the trophic enrichment factor (TEF, also called consumer-resource discrimination) is known and constant; (3) Lambda and TEF are independent. These assumptions are weak and unsupported by experimental results and process-based modelling.

Our aim is to assess the consequences of violating these assumptions when inferring diet composition from stable isotope analysis. A new model of isotopic incorporation dynamics was used as a reference to generate in-silico experiments in which a mixture of resources – for a given animal under environmental constraints – varies at different frequencies over the animal’s life span. In this model, Lambda and TEF are dynamically interconnected and are both function of bioenergetics and therefore scale with body mass. When assumptions (1), (2) and (3) are made, the error in diet estimates is systematically large. When (1) is relaxed – by assuming a dynamically varying Lambda – the predictions of a consumer's diet are considerably improved. Our results demonstrate the importance of including Lambda in mixing models to improve the quality of diet estimates. Lambda appears to have much higher impact than TEF. Including the emerging properties that result from incorporation dynamics will improve inferences on trophic estimation derived from stable isotope measurements. Finally, two examples of estuarine species, the Pacific oyster and the sand goby, will be used to picture the results. Indeed, we suggest that incorporating the effect of turnover will improve the estimation done by any isotope metrics.

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S3.6. Providing trophic, bioaccumulation and isotopic-like functional indices to investigate estuarine food webs functioning from a single Bayesian mixing model

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In the context of Global Changes, estuarine and coastal ecosystems are increasingly exploited and polluted. In particular, chemical contaminations impact their ecological status and associated ecosystem functions. Among those substances, Persistent Organic Pollutants (POPs) cause potential adverse effects on wildlife due to their bioaccumulation, trophic magnification and toxicity potential. A comprehensive understanding of the trophodynamics of POPs in these ecosystems is thus needed to better manage the ecological functions associated with these areas. However, in most empirical approaches, the food web structure, trophic flows, bioaccumulation levels, Trophic Magnification Factors (TMFs) and contaminants flows are approximated independently while each of the steps requires specific assumptions and creates specific uncertainties. In the present work we propose an innovative approach that combines both biomagnification and food web analysis using a single model. By combining (1) a Bayesian mixing model using both isotopes and POPS as chemical tracers with (2) biomass estimates and (3) classical mass-balance assumptions, this original model (ESCROpath) provides empirical estimations of various indices to investigate estuarine food webs: trophic pathways and flows, bioaccumulation, food web indices derived from Ecological Network Analysis (ENA) but also ENA-like indices designed for contamination status assessment, and isotopic-like functional food web indices. Using the Gironde and Seine estuarine food webs as case studies, outputs from ESCROpath are compared with classical outputs from MixSIAR and Ecopath. The new set of indices is then estimated in order to provide some insights about the ecological status of these two French estuaries.

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Estuarine nursery grounds are essential transitory key habitats for various fish species. However, these areas are particularly impacted by all the components of Global Change. In particular, contamination by Persistent Organic Pollutants (POPs) significantly impacts the quality of nursery areas affecting growth and condition of juvenile fish. To study adverse effects of chemical pressure on ecosystems, a comprehensive knowledge of bioaccumulation mechanisms of pollutants in biota may be a prerequisite to predict internal concentrations under natural fluctuating conditions in growing individuals. In that way, we developed a toxicokinetic (TK) model whose uptake and elimination fluxes depend on biological traits dynamics (notably food ingestion and growth). To be able to predict these biological traits in dynamic environmental conditions (concerning particularly food quality, food availability and temperature) we used a mechanistic bioenergetic model based on the DEB (Dynamic Energy Budget) theory. First, we implemented this TK model to describe POPs bioaccumulation in the juvenile sole (considered as a key species for assessing nursery function in western European coasts) of the Seine and Gironde estuaries (two of the most important estuaries in Western Europe). We focused on CB153 and L-PFOS, 2 representative compounds of 2 different POPs families: polychlorinated biphenyls (PCBs) and perfluoroalkylated substances (PFASs). Then, a global sensitivity analysis highlighted that beyond the impact of TK parameters values (assimilation efficiency and elimination rate) on estimates of internal concentrations at maturity, diet composition and prey contamination have a major role in POPs bioaccumulation, far ahead of temperature, birth date, food availability and quality. Finally, Global Change scenarios were tested. Simulations showed that very contrasted contaminations could be observed in fish exiting nursery grounds mainly depending on changes in the prey community structure and prey contamination levels.

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S3.8. Mathematical Linkage of Active and Passive Samplers for the Determination of Anthropogenic Impacts on the Coastal Areas of Turkey

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Monitoring studies of Hydrophobic Organic Contaminants (HOC) were performed by simultaneous deployment of active and passive samplers on the north-west and west coasts of Turkey for the purpose of determining the anthropogenic effects on the coastal zones. In the present study, active sampling represents a geographically widespread mussel species, Mytilus galloprovincialis, and passive sampling represents the usage of semi permeable membrane device, SPMD, a standardized passive sampler. Results of HOC analysis for Polyaromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs) and Organochlorinated Pesticides (OCPs) were used for the mathematical linkage of active and passive samplers. Quantified data of HOCs in the active and passive samplers deployed on the following stations were used: 5 stations along the coasts of the Istanbul Strait, 3 marinas and 3 shipyards on the north-west and another 3 marinas on the west side of the country. First, concentration ratio model was used for the determination of HOC bioaccumulation in mussels in terms of uptake and depuration kinetic rates, without any need for the water concentration data. Afterwards, HOC concentration in the waters of the deployment sites were calculated by using the sampling rates of the passive sampler for each compound. Subsequently, three different regression analyses, ordinary least squares regression (OLS), principal components regression (PCR) and partial least-squares regression (PLS), were performed and compared in order to evaluate the distribution of HOC concentrations in active and passive samplers and to point out the similarities and differences of the deployment stations.

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S3.9. Foraging of Japanese eel between salinity zones revealed by stable isotope analyses

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Japanese eel (Anguilla japonica) utilize a broad range of habitats along the marine-freshwater ecotone during their growth phase in continental waters. Analysis of carbon and nitrogen stable isotopes was conducted on eels as well as potential eel food sources and used to predict recent foraging patterns of eels in Matsukawa-ura, a brackish water lagoon, and three freshwater tributaries. Values for δ13C of potential eel prey differed significantly between fresh- and brackish water and were used to classify three recent habitat use patterns of the 72 eels in this study: 1) freshwater foraging, 2) brackish water foraging and 3) habitat shifters. The results suggested that some eels recently or frequently shifted between fresh- and brackish water habitats while others show a higher fidelity to one salinity zone. This study demonstrated the plasticity of habitat use of eel and discusses the use of stable isotope analysis to infer such patterns. Furthermore, it underlines the need of consideration of freshwater and estuarine habitats and the connectivity between them for eel management and conservation.

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S3.10. Does estuarine morphology influence the connectivity with coastal area? A case study of energy fluxes exchange between habitats in Northeastern Brazil.

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Coastal habitats are interlinked by hydrological connectivity, defined as the exchange of energy, organic matter or organisms between habitats. The degree of this cross-habitat connectivity depends on landscape properties. We studied hydrological connectivity between three tropical estuaries and their adjacent coast in northeast Brazil. The chosen estuaries were geomorphologically distinct. In each estuary, we investigated the origin of the organic matter contributing to Eucinostomus argenteus diet with stable isotopes method. The diet of the silver mojarras inhabiting these estuaries is supposed to reflect hydrological connectivity since E.argenteus juveniles are abundant in estuaries and coastal lagoons while large individuals migrate toward deeper sea. The sampling of the basal food sources contributing to the diet was realized in the three estuaries and in their adjacent coast. Moreover, fish were captured in shallow and deeper coastal areas to understand better the species trophic position along its life cycle. We used standard ellipse area method to compare estuarine fish groups during both rainy and dry season and study niche width differences. Bayesian models were also applied to quantify the seasonal relative contribution of basal food sources from both estuarine and coastal environments in the silver mojarra diet. The participation of the coastal organic matter increased with the sea-connection degree (mouth width) of the estuary. Indeed, this landscape property regulates hydrological connectivity and thereby, indirectly controls various population dynamic traits and processes within and between ecosystems. Geomorphological features influenced seasonal patterns since the seasonal differences decrease with the size of the estuary. Niche width was also influenced by geomorphological characteristics since narrow sea-connection degree led to a greater diet plasticity. Estuarine morphology can consequently be a good proxy for hydrological connectivity since this landscape feature affects the intensity of energy fluxes between habitats. Anthropic alterations in estuarine morphology would thus interfere in coastal habitats functioning.

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S3.11. Characterization of current and future habitat suitability for 4 club rush species within the Belgian Sea Scheldt Estuary

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Estuaries are often used and maintained for shipping with modified river banks and altered habitats as a consequence. In the Scheldt estuary (Belgium/The Netherlands) one of the most vulnerable habitats on these river banks is pioneer vegetation with club-rush species. We focus on 4 species found in the Belgian Scheldt Estuary; *Schoenoplectus triqueter*, *Schoenoplectus tabernaemontani*, *Schoenoplectus x. kuekenthalianus* and *Bolboschoenus maritimus*. How environmental variables determine the distribution of these species and how climate change might affect distribution is not well known. For each species a distribution model was built and used to investigate distribution shifts using a management and climate scenario of 2050. This scenario includes an increasing tidal amplitude and a sea level rise of 40cm. Differences in plant morphology were analyzed to reveal the different plant strategies in response to different environmental variables. We conclude that *S. triqueter* and *S. x. kuekenthalianus* are more fresh water orientated species while *S. tabernaemontani* and *B. maritimus* are more brackish orientated. Inundation depth together with erosion sensitivity (slope, velocity and shear stress) are more decisive for the cross shore distribution. These variables also determine the plant morphology but the response differs between species. Generally tufts are more dense and have thicker and longer stalks when inundation depth and erosion sensitivity increase. A drastic reduction in future habitat range and growth probabilities for all 4 species was predicted in 2050. The freshwater species *Schoenoplectus triqueter* and *S. x. kuekenthalianus* are severely threatened while the brackish species *S. tabernaemontani* and especially *B. maritimus* still show sufficient probabilities of occurrence. One of the causes of this decline is the loss of a transition zone between high mudflats and tidal marsh. Especially as the upper reaches of the estuary are kept in a corset diminishing the ability of this freshwater species to shift with water level rise. Therefore managed realignments with a gradual lowering slope to the main channel are necessary to allow these pioneer species to reclaim river banks and prevent them from ‘drowning’.

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S3.12. Ecosystem approach for Marine Renewable Energy: What recommendations can be made from the Courseulles-sur-mer offshore windfarm case study?

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Marine ecosystems undergo multiple pressures from anthropogenic activities and climate change that affect structure and functioning of food-webs. Integrated ecosystem management emphasize the need for policy makers to understand and make decision based on holistic approach to consider all aspects of changes they may endure. This implies to subtract to the segmented vision of environmental impact assessment focusing on compartment individually.

In the context of Marine Renewable Energy (RME) expansion in France, the ANR TROPHIK project aimed to develop an integrated ecosystem approach to represent food web under cumulative pressures. Based on the understanding and quantification of trophic flows between compartments in the system, this approach considers the ecosystem as a whole and allows to apprehend
direct and indirect effects the implementation of new structures can have on the environment. Using the case study of Courseulles-sur-mer, the potential impacts of offshore windfarm on coastal food-web was studied with consideration for other anthropic activities and global warming induced changes. Several complementary modelling methodologies were used, developed and combined to improve and complete holistic assessment. Considering those results and in the optic of developing an ecosystem approach of Marine Renewable Energy, recommendations and perspectives of research were identified and reported from methodological use of trophic models to global recommendations for new RME implementation projects.

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S3.13. **Effect of belowground structure on coastal wetland ecosystem functioning and erosion resistance using X-Ray Computed Tomography**

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Coastal wetlands provide a number of ecosystem services such as protection against flooding and storms, freshwater storage, water quality enhancement and carbon storage. Better knowledge of wetland functioning is needed to protect these habitats from anthropogenic pressures and climate change. In particular, further research is needed on the belowground sediment structure and spatial distribution of voids and roots, as these structural components play an important role in critical aspects of wetland functioning such as water infiltration and resistance to erosion.

The NERC-RESIST project explores how subsurface and surface structural characteristics of UK coastal wetlands affect their erodibility under tidal forcings, in order to provide coastal engineers with improved guidance for conservation schemes. In order to link internal sediment structure to erodibility, X-Ray CT scans were undertaken on large sediment cores recovered from two coastal wetlands (Tillingham, Essex; Warton, Lancashire) that are currently experiencing contrasting rates of lateral erosion. X-Ray CT scanning is a non-destructive imaging technique that allows a quantified analysis of 3D sediment properties, pore-space and root structure. After scanning, the cores were exposed to a variety of realistic wave energy conditions at the EU-Hydraulab+ flume facility in Hannover, Germany, and high-resolution structure from motion imagery were collected to identify patterns of wave-induced erosion.

This presentation will illustrate how key sediment structural properties, particularly the topology and spatial distribution of voids and root structures revealed by 3D X-Ray CT imaging, relate to observed patterns of water infiltration and sediment erosion. At the scanning resolution considered, significant differences are observed in the structure and spatial arrangement of roots and voids depending on sediment type and aboveground vegetation, with consequences for infiltration rates and erosion resistance. This research provides new insight into the structural complexity of wetland substrates, and how belowground structure can impact wetland functioning.

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Water Framework Directive has required to all European member states an overall assessment of the ecological quality of the water bodies located on their territory. French Guiana is an Overseas Department/Region (DROM) located in the northern and amazonian part of South America. Due to its specific neotropical conditions (climate, geography, hydrology...) various biotic indices such as the Fish Index, benthic invertebrates index or diatoms index have been scaled for freshwater bodies. However no transitional waters indices were developed up to now. Moreover, the various indices used in Metropolitan France cannot be transposed in this territory. Preliminary studies concluded that building a fish index for the transitional water bodies was achievable and relevant. As a result, several fishing campaigns were initiated on 9 transitional water bodies during 2015-2018.

The current objectives of this study is to analyse sampling data in order to elaborate a suitable fish index for French Guiana estuaries. To do so, we first calculated several candidate metrics representing estuarine functionality for the fish community. Then, we gathered data set dealing with multiple anthropogenic pressures affecting transitional water bodies in French Guiana. In order to study the relation between metrics and pressures, we used predictive modelling (GLM) to select which metrics was the most relevant to incorporate in the new multimetric index. We decided to follow a multimetric approach to consider multiple pressures and cover different functionalities of estuary.

We described the fish structure of seven transitional water bodies at different scales. We calculated the frequencies of guild modalities, and the rates of structural and functional dissimilarity between all estuaries. These results support the idea of creating a unique index for all water bodies. The calculation of candidate metrics and the use of predictive modeling allowed us to define a limited number of metrics relevant to the construction of the final index.

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Session 4 - Adaptation, habitat restoration and management

Knowledge on species adaptation to global changes is scarce for coastal systems, despite its importance to predict future ecosystem structure and functioning. Similarly, habitat restoration costs and benefits are poorly known for estuarine and other habitats. Management tools and plans are critical to cope with strong anthropogenic impacts that typically occur in these areas. In this session, participants are invited to address these topics contributing to point out the main guidelines of successful management schemes.

Keynote: Kris Decleer

Kris Decleer is a Senior Scientist in the Ecosystem Management Unit of the Research Institute for Nature and Forest (INBO) in Ghent. He is a founding board member of the Society for Ecological Restoration, and also served on the Board of Natuurpunt, one of the largest conservation NGOs in Belgium. He is a guest lecturer in restoration at the University of Antwerp. His main topics of research are ecological restoration and nature management, spatial planning and integrated water management, with an emphasis on wetland restoration.
S4.1. Climate change in estuaries: sensitivity analysis and adaptation strategies for biodiversity in the Scheldt estuary (Belgium)

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Estuaries are particularly vulnerable to projected climate change impacts such as sea level rise, global warming and changes in precipitation patterns. Predicted changes in these key physical drivers will directly affect hydrogeomorphological interaction processes (flow velocities, sediment supply) which regulate the estuarine environment and ultimately determine the natural capital and its services, biodiversity, and the ecological and conservation status required by the EU water framework and habitats directives. In this study we explore conservation and management actions in a framework where the estuarine habitats are positioned in a climate sensitivity scheme. Two ‘axes of concern’ are suggested to establish a climate sensitivity score for the Scheldt ecosystem: estuarine habitat degradation (based on percentage to goal of intertidal marsh area, marsh connectivity and sensitivity to disturbance) and vulnerability to climate change (based on presence of habitat gradients, water velocity and wave action). We apply the climate sensitivity score to the different salinity zones of the Scheldt estuary in the present situation and in a future scenario with implementation of the planned management strategies (2050). Based on a comparison of present and future sensitivity we can advise policy makers and site managers to prioritize focus zones and types of adaptive (species or habitat specific) measures that will most likely reduce the ecosystem’s sensitivity to climate change. We emphasize the need for adaptive measures to improve climate resilience in estuarine populations and ecosystems.

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S4.2. Lanthanum accumulation, elimination and Lipid and DNA damage in glass eels (Anguilla anguilla) under a warming scenario

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Rare earth elements (REEs) comprise elements from lanthanum to lutetium that together with yttrium and scandium are considered by the European Union as Critical Metals and are emergent contaminants of great economic interest and concern as they are of critical importance for numerous groundbreaking environmental technologies and high-technology products. Transfer to aquatic ecosystems is expected to increase, however, little information is known about their potential impacts in marine biota, which highlights the urgency towards understanding the biogeochemical behavior and ecotoxicology of REEs.

Considering the endangered conservation status and the economic relevance of the European eel (Anguilla anguilla) and the vulnerability of early fish life stages to contaminants, we exposed glass eels, through water, to an ocean warming scenario (OW; Δ +4°C; 18°C and 22°C) and to an environmentally relevant concentration (360 ng.L-1) of lanthanum (La), one of the most abundant REEs, for 5 days (plus 5 days of depuration). The major aim of this study was to assess the accumulation and elimination of La in eel’s body parts (head, viscera and body) under a warming scenario and evaluate lipid peroxidation, heat-shock response, DNA damage (body) and the quantification of acetylcholinesterase (head).

The results revealed that lanthanum-exposed glass eels under OW accumulated significantly higher concentrations than control organisms. This accumulation was tissue-dependent and peaked in the first days in contact with the contaminant. Accumulation was higher in the viscera, followed by the skinless body and ultimately in the head, possibly as a protective mechanism to cope with La neurotoxicity. Heat shock response was thermo-regulated with exposed glass eels to OW + La producing significantly higher heat shock proteins. Evidence of lipid and DNA damage was found, which were supported by alterations in acetylcholinesterase levels in the head. Further investigation is needed towards understanding the biological effects of REEs.

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Estuaries support a variety of ecological and economic interests. Many commercially important fish species spend their juvenile stages in estuaries, where they benefit from favourable conditions for increased growth and survival. However, they are confined to areas with increased water residence times and exposure to sewage discharges and non-point sources of chemical contamination. The BIOPHARMA project aims to develop an integrative framework for assessing population-level effects of exposure to pharmaceuticals as pollutants of emerging concern in the estuarine environment, scaling up from individual effects on fish.

Estuarine distribution and concentration of several pharmaceutical compounds, in various environmental compartments and throughout trophic levels, are essential to underpin exposure concentrations and determine environmentally relevant scenarios. Effects of pharmaceuticals on individual growth rates and the metabolic mechanism of action will be inferred from exposure tests on selected species. Biomarker responses will also be key to assess deleterious effects associated with short and long-term exposures.

To model the dynamic nature of individual-level metabolic responses to pharmaceuticals, a model based on dynamic energy budget (DEB) theory will be used. Moreover, metabolic effects at the population level, combined with effects on feeding efficiency, behaviour or competition will be analysed using an individual-based model (IBM).

This presentation provides a summary of the results achieved so far and the next steps in the path to evaluate potential changes in the key nursery function of estuarine areas, understand environmental distribution and improve risk assessment of the impacts of these emerging contaminants. The project will contribute towards improved management of environmental quality in estuarine ecosystems.

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S4.4. Ecological restoration in estuaries: from global perception to nearly operational tools

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Estuaries are both naturally complex and human-impacted environments where restoration initiatives may suffer from the lack of ecological knowledge and methods to set restoration objectives. Despite a growing number of published feedbacks, it remains difficult to establish a clear link between measured effects and restoration efforts. In this context, facing multiple failures at the French scale, the French Agency for Biodiversity has initiated since 2015 a three-step work aiming at building a fully comprehensive framework for ecological restoration in estuaries. It first provided a worldwide literature-based approach to understand among others the importance of considering not only structural but also functional attributes when restoring a system. The second part of the work proposed a structured reflexion on the use of predictive tools given the damaged or lost ecological functions to set the most possible accurate restoration objectives. Their use is discussed in the light of different estuarine functioning (hydromorphosedimentary, biogeochemical, as a support for different species life cycle and whole ecosystem trophic functioning), ecological problems and ecological knowledge, data and skills requirements. Thirdly, a technical guide will recap and illustrate the different parts of this work with concrete actions in order to provide the keys for successful restoration and management schemes.

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S4.5. Towards science-based environmental engineering: design and evolution of creek networks in restored coastal wetlands

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Coastal wetlands are being degraded at a rapid pace worldwide, resulting in the loss of critical ecological benefits including biodiversity, flood protection and carbon storage. Managed realignment (MR) schemes are being implemented in the UK and worldwide to mitigate for these losses by opening agricultural lands to tidal influence to create new wetland habitats. However, the design of these schemes requires further scientific guidance, especially for complex features like creek networks. Creek networks form the interface between the marsh and the open water, and therefore play a crucial role in wetland functioning by distributing water, sediment, nutrients and seeds through the site.

This research explores whether creek networks in MR schemes evolve to adopt similar morphologies to those found in natural, mature coastal wetlands, and infers which design choices encourage or impede this evolution. Using lidar elevation maps and newly-developed creek mapping algorithms, we compare creek evolution within 10 MR schemes in the UK with the natural range of creek characteristics found in 13 natural mature coastal wetlands. In addition, 2 century-old accidentally realigned sites are used as a proxy for long-term MR evolution.

The MR creek systems considered grew in length, area and volume over 5 to 20 years after implementation. However, the newly formed creeks tended to concentrate around the breaches, leaving entire areas empty of creeks and poorly drained. MR creeks also have a lower sinuosity due to inherited drainage ditches, and a flatter substrate compared to their natural counterparts. Substrate properties are an underestimated factor of MR success, as the overcompacted, flat soil inherited from the previous agricultural land use may hinder creek development and negatively impact the health of the restored coastal wetlands.

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S4.6. SMARTSEDIMENT: ready-to-use and tested spatially explicit GIS tool to estimate effects of smart sediment management strategies on ecosystem services

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The SMARTSEDIMENT project (EU Interreg) investigates the ability of smart sediment management strategies to contribute to sustainable management of the Scheldt delta (Belgium, Netherlands) for maintaining biodiversity and protecting ecosystem services (ES). At the start, the most relevant ES for the context of estuaries and sediment management were selected: food provision (fish, shellfish and crustaceans), water and space for navigation, provision of raw materials (sand), water quality regulation, climate regulation (carbon storage), regulation of flood risk, recreation. Additionally, effects on habitat and biodiversity are also considered. To make use of the state-of-the-art knowledge on estuary functioning, a conceptual model was developed. This model allows to get insight into the different effect chains from the sediment management strategies on the selected ES. Following the conceptual understanding of management effects on the selected ES, calculation rules were developed to quantify these effects based on best available knowledge and data. Next, the calculation rules were implemented in a Q-GIS plug-in (open access). After finishing the demo tool, the tool was validated by analyzing current sediment management practices in the Scheldt delta and comparing the outcome with monitoring results. In the last step, scenarios for new smart sediment management strategies were analyzed with the tool to investigate its potential impact on ES. The GIS tool allows managers and decision-makers to investigate and demonstrate the effects of different sediment management strategies on the delivery of ES on the management site and in the whole system. The underlying methods are transferable to other estuaries and deltas.

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S4.7. Phyto- and zooplankton in a recovering estuary: expected and non-expected changes

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Since 1996, phyto- and zooplankton communities in the Scheldt estuary have been monitored monthly (bimonthly during the growing season) using microscopic observations and HPLC analysis of phytoplankton pigments. In addition, environmental parameters have been collected simultaneously. Grazing activity of the dominant copepod, Eurytemora affinis, was quantified using incubation and gut pigment content analysis.

Phytoplankton in the Scheldt estuary follows a seasonal pattern with the first bloom from April to June, characterized by mostly diatoms, and the second and more diverse bloom from August to September, characterized by diatoms and chlorophytes. We observed that, due to earlier summers, the spring bloom occurred earlier in the last years. In addition, a decreasing general trend has been observed for Chlorophyll a and b, which may respond to the reduction in nutrients concentration because of the improvement of the water quality. Phytoplankton in the Scheldt is also characterized by the strong salinity gradient, being generally at higher abundances upstream, in the freshwater zone.

Until 2007, the brackish water zooplankton community was dominated by calanoide copepods (mainly E. affinis). The freshwater community was more diversified, with several taxa of cyclopoid copepods and cladocerans. Since 2007, E. affinis developed strongly in the freshwater party, becoming dominating, while cycloid copepods diminished in abundance. The development of E. affinis in the freshwater part was explained by a threshold effect of diminishing NH4 and increasing O2 concentrations following restoration of the estuary. Among the phytoplankton taxa, E. affinis feeds selectively on diatoms, but its grazing activity does not seem to impact strongly on the phytoplankton community. It is at present not clear why the cyclopoid community decreased in parallel to water quality improvement and to which degree phytoplankton represents a bottleneck for zooplankton development.

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S4.8. The level of enforcement and fishing effort displacement by the management areas network in central Chile are key drivers of benthic resources status

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Small-scale fisheries in Chile are currently regulated by a system of dedicated areas for the exploitation of benthic resources (called Management Areas, MAs) that alternate with areas open to fisheries (OAs). This system has proved successful in increasing abundance and richness of benthic organisms and fish within the MAs. However, problems linked with poor MA enforcement and fishing effort displacement caused by the allocation of large sections of the coast to MAs are becoming evident and are potentially linked to increasing poaching. To address these issues, we assessed the state of benthic resources (i.e., keyhole limpet) in relation with the level of enforcement and fishing effort displacement in a set of MAs in Chile. Keyhole limpets were sampled in 10 paired MA and OA areas where size frequencies were obtained. The amount of catch below the minimum legal size (i.e., 6.5 mm) provided information on the state of the resource at each site, with high percentages of undersize individuals indicating a poor state of the resource. These percentages were contrasted with the paired OA area as no-enforcement reference. Information on the level of enforcement for each MA was obtained through face-to-face interviews with fishermen, and MAs were ranked from well to poorly enforced. The level of enforcement was weighed by context variables of the MA, like distance from fishing village, access by main roads, and number of MA held by each fishermen association. Fishing effort displacement was assessed as the unit of OA area per MA in each site. Socio-geographical variables were explored through random forest approaches as explanatory data for evidences of poaching based on the biological data. This multi-disciplinary work aims to address relevant issues for fisheries management, including key factors that condition the enforcement of fishing regulations and the consequent good status of target resources.

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S4.9. Why coastal lagoons are so productive?

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Coastal lagoons are considered to be among the most productive ecosystems in the world. The range of annual primary production in most of them fluctuates from around 50 to more than 500 g C m⁻² year⁻¹, the higher limit being of the same order of magnitude as that of the upwelling areas. Many lagoons can be considered to lie within the range of eutrophic conditions (300-500 g C m⁻² year⁻¹) or even hypereutrophic (>500 g C m⁻² year⁻¹). In some coastal lagoons, production can exceed 2,510 g C m⁻² year⁻¹ and 51,005.96 wet weight Tons km⁻² year⁻¹. The high productivity of coastal lagoons makes them subject of exploitation by many marine fishes and invertebrates, that use them as nursery areas and feeding grounds for developing during the early phases of their life cycle, and most lagoons support important fisheries or maintain intensive and extensive aquaculture exploitations. In a general view, the high levels of biological production of coastal lagoons can be explained by some of their common features as shallowness and strong influence of terrestrial systems. Shallowness favors that the photic zone extends to the lagoon floor in most areas and that wind can promote the resuspension of nutrients and organisms from the bottom. The narrow interaction with land makes that these ecosystems usually also receive substantial amounts of nutrients. But trophic status variables can only explain less than 43% of the fishing yields, and further than the trophic status of the lagoons, several works showed that the biological productivity of coastal lagoons can be explained by their geomorphological features such as the positive influence of shoreline development and the negative influence of depth. In this work we propose that although nutrient inputs and light can be the main limiting factors for photosynthetic based biological productivity and therefore enhance productivity of algae and increase fishing yield up to a certain limit, the productivity of lagoons is mainly promoted by more general physical forces associated to physical and chemical gradients.

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S4.10. Estuarine restoration in the Schelde: the concept of controlled reduced tide.

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It started in 2006 with the small scale pilot Lippenbroek (10 ha): a former polder that was subjected to ebb and flood using a sluice system with a controlled reduced tide (CRT). Today, more than 400 ha of this type of estuarine restoration is implemented and for the coming decade another 1000 ha is planned or already under construction. The concept is fairly easy: a low laying polder is connected to the estuary with a high inlet and a low outlet. This guaranties an adaptation of the tidal height to the elevation of polder, without reducing the springtide neap tide variation and thus creating a wide range of inundation frequencies. But do these artificial marshes deliver the same ecosystem functions as the natural ones? More than 10 years of intensive monitoring in Lippenbroek demonstrates the potential of a CRT. Monitoring results in the newly created sites also indicate the benefits of this new restoration technique.

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S4.11. From diversity of drugs consumption to relevant instruments to reduce micropollutant pollution: a study applied to Arcachon Bay.

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The study is focused on drug consumption practices and their relationship with micropollutant residues. We present the results of consumers and health professionals surveys applied on Arcachon Bay. Diversity of practices is the key result of this work. We analyse the consequences of this diversity in terms of public action.

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Session 5 - What do we expect from decision- and policy-makers for estuarine and coastal management?

Examples of processes involving scientific knowledge and management decision are expected. How to communicate scientific results to be better understood by stakeholders? What policy-makers need from scientist in order to be efficient? We are interested in the relations between scientist and decision makers to improve the management, conservation, restoration of estuaries and coastal areas.

**Keynotes: Mike Elliott & Victor de Jonge**

Mike Elliott is Full Professor at the University of Hull and was Director of the Institute of Estuarine and Coastal Studies from 1996 until 2017. He has adjunct and research positions at universities and research institutes in Europe, South Africa and Australia. Mike Elliott is a marine biologist with a wide experience and interests and his research, advisory and consultancy includes estuarine and marine ecology, policy, governance and management. He is a past-president of the international Estuarine & Coastal Sciences Association (ECSA) and is Editor-in-Chief of the journal Estuarine, Coastal and Shelf Science.

Victor de Jonge is a Senior Scientist with a wide expertise in oceanography and marine ecology and has an extensive experience in the science and management of estuaries and coastal areas, marine and estuarine pollution, eutrophication, coastal engineering, system rehabilitation, development of alternative tools to improve the currently used EU Directives. He is an honorary Professor of the University of Hull and had previously several positions in different institutions in the Netherlands and integrated a large number of advisory boards. Victor de Jonge is the Editor-in-Chief of journal Ocean & Coastal Management.
Policy makers and managers dealing with complex ecological problems expect simple and straightforward answers from the experts in the field. In addition they also expect clear instructions on how to approach and solve the problem related to the issue they are responsible for. This means that e.g. the statistics in use by scientists work counterproductive to these decision makers because even the lowest significance level is enough reason to reject the solution because of lacking proof. Working with policy makers and managers is thus problematic because scientists need to leave their own scientific comfort zone and need to be clear about what is feasible and what is not. Unambiguous answers are only possible when a tool is providing one single value that at the same time matches the general requirements of indicators of being specific, measurable and replicable. During this presentation a very small set of applicable, integrative and full ecosystem based indicators will be presented. This set is suitable to assess the general ‘structure’ and the general ‘functioning’ of an ecosystem. The indicators will be explained in a way decision makers should be able to understand.
A systems analysis approach for integrated estuarine, coastal and marine management: accommodating natural and human features

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Marine and estuarine management requires an excellent understanding of the interacting, interrelated and interdependent sub-systems comprising ecological, societal and management complexity. Hence, system mapping should encompass the pathways of information (skills/capabilities), energy (including time), money and materials required to achieve a successful overall and agreed vision. It relies on knowing what aspects can be managed and why and how, and conversely what aspects are outside the control of the manager. The proposed Systems Analysis focusses on understanding and protecting the estuarine and marine system and especially the connectivity between the various elements. The analysis links 14 component sub-systems in a cycle. The Underpinning Framework Sub-system (1) follows the DAPSI(W)R(M) concept (whereby Drivers require Activities which create Pressures; these in turn effect State Changes and Impacts (on human Welfare) which require Responses (using management Measures)). This then leads to the Issue Sub-system (2) which is vision-related and includes causes and consequences of pressures to be managed showing the repercussions of natural and anthropogenic changes. The Ecological Sub-system (3) links the fishes, their prey and the environment and then links to the Socio-ecological Sub-system (4) showing ecosystem services and societal goods and benefits. This then leads to the Socio-economic sub-system (5) relating to macroeconomics. The Resources and Delivery Sub-system (6) considers who does what and how do they do it whereas the Provenance Sub-system (7) underpins the fit-for-purpose science and a defendable evidence base. The Governance Sub-system (8), incorporates policies and politics plus the Legislative Sub-system (8A) and the Administrative Sub-system (8B), using horizontal and vertical integration of the management organogram respectively to accomplish the vision. The Communication (8C) and Stakeholder Sub-systems (8D) require informed dissemination across the stakeholder typology (of formal and informal actors). Finally, the Achievement Sub-system (9) (including scale) and the Feedback Sub-system (10) uses monitoring to indicate the success of marine management.
S5.1. A pluridisciplinary approach associating stakeholders to better understand a bivalve population functioning

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Initially introduced for aquaculture purposes in the 80’s, Manila clam (Ruditapes philippinarum) is now a neonatural resource within Arcachon Bay (SW of France). Its exploitation by professional fishermen represents around 300-450 tons per year and involves around 60-70 licenses depending on the year. The management of this species relies on both European and regional scale decision. In 2000, a partnership between professionals and scientists was established in order to implement a sustainable management of this resource. Since then, a co-organized biannual survey has been performed to assess clam stock. Workings groups and research programs were concomitantly developed.
Initially stakeholders requested this survey only to assess clam stock in the bay. Nowadays, an integrative approach of the population functioning is privileged which is particularly relevant for population with high spatial and temporal distribution variations.

The main considered drivers are diseases including constant infection by Perkinosis but also the discovery of a recently described pathology - BMD (Brown Muscle Disease), other environmental factors (i.e. trophic resources, hydrodynamic conditions, temperature...) and professional fisheries. Alternatively, the survey method is currently improved to ameliorate the sustainable management of this resource. New spatially balanced sampling design showed promising results increasing the efficiency of this survey. New variables such as sediment grain-size and occurrence of other bivalve species are now acquired.

This communication aims to introduce how the different disciplines are combined to understand the dynamics of Manila clam population within its environment and how stakeholders are involved. Successes and failures will be identified, as well as point of improvement for future research.

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S5.2. Participatory system dynamics to improve synergies between rural and coastal areas

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The European funded COASTAL project (2018-2022) aims to improve land-sea synergy by identifying the economic, social and physical interactions and feedback structures governing the dynamics of the land-sea system at different spatial and temporal scales. We use a participatory system dynamics methodology to establish a transparent framework linking science, local knowledge, social considerations and policy options, enhancing discussion of issues surrounding the development of coastal-rural territories.

The approach is applied to different European case studies to describe the processes, insights and measurements of success in order to provide business roadmaps and policy solutions, focusing on economic growth, marine spatial planning, and environmental protection. The case study of the Charente river basin and its Pertuis sea coastal zone faces major concerns regarding water quantity and quality (water shortages and pollution by pesticides and nitrates). Hinterland activities (agriculture with field crops and Cognac vineyards and domestic uses) impact the water resource that itself influences coastal activities downstream (shellfish farming, tourism). The activity of two medium ports of the area greatly relies on the agriculture production of the basin and any changes in land use will impact activities and employment in several sectors.

The multi-actor approach with stakeholders, scientists and decision makers enables mental mapping of the feedback structures of the land sea system and provides a solid basis for evidence-based analysis of business and policy strategies, systems modelling, and a platform for knowledge exchange. We present the results of the sectorial and inter-sectorial collaborative workshops, providing a common view of the territory with its evolution and relevant feedback structures which are feeding the dynamic modeling of the land sea system. Qualitative trajectories help to define a dynamic model that will subsequently allow interactions to be quantified.

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S5.3. Circular economy as an opportunity to provide new tools to reconcile socio-economic development and coastal ecosystem management

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Integrated coastal zone management (ICZM) has long been seen as the governance tool to implement a sustainable development of coastal areas, to integrate environmental and socio-economic issues of coastal ecosystems, recognized as very complex socio-ecological systems (SES). Despite numerous worldwide ICZM initiatives, their success remain limited. Indeed, the huge present challenges that coastal and estuarine zones meet, require additional tools and alternative approaches to further explore resilience of coastal SES. Among those, the Circular Economy (CE) concept and associated sciences and tools (such as industrial ecology approaches) have been emerging for the past decade as an economic alternate model, in opposition to the linear economy, in the public debate. It is now proposed as a potential new approach to reconcile socio-economic and environmental aims, focusing on resource sparing and better use. It is proposed for a sustainable blue bioeconomy in Europe, although the concept is still uncertain in its real definition and scope.

On a case study offered by a fishery-dependent coastal region in France, this work explores how the CE can actually be implemented, providing new opportunities to face sustainable coastal development and a better use of marine resources. Tools such as material flows of the marine bioresource, coupled with socio-economic parameters are deployed at the scale of this SES, in its marine and terrestrial compartments. Indicators such as fish resource material productivity and intensity coupled with employments are computed, allowing the construction of scenarii to enhance fish resource use, resource sparing, on a more circular economic local model. Such integrated dynamic approach shows that these CE tools coupled with others, such as Life Cycle Analysis, could provide local actors and decision-makers with useful information. It could also open new opportunities to ICZM initiatives to expand, and better link economic coastal actors to other stake holders on a local scale.

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S5.4. Illegal fishing as a side-effect of co-management of benthic fisheries in Chile

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In Chile, a pioneer system of Territorial Use Rights for Fisheries (TURFs) for the co-management of coastal benthic resources has been in place since 1997. Under this system the undersecretary of fisheries assigns exclusive harvest rights to artisanal fishing unions in certain areas of the coast, creating a coastal mosaic of open-access areas (OAs) and TURFs. Previous studies have shown that Chilean TURFs, when well enforced, are effective for the management of target benthic resources and for the conservation of non-target species. However, illegal fishing inside TURFs, and in adjacent OAs, is an unsolved problem that seriously compromises the success of this management scheme and the sustainability of the managed resources. In order to assess if these illegal fishing activities may be related to the spatial allocation of TURFs, we explored the hypothesis that illegal fishing is enhanced by the reduction in OAs availability (due to the increase in the spatial density of TURFs). We focused on the noncompliance to the minimum legal size (MLS) regulation of two model resources - Chilean abalone (loco) and keyhole limpets, in 11 MAs and adjacent OAs of central Chile. We found that half of the catch of loco in OAs (where this fishery is banned) was below the MLS; the illegal fraction of the catch was composed of smaller loco individuals in OAs from areas with a high spatial density of TURFs. We also observed that the size of both the global and illegal catches of keyhole limpets were higher in TURFs and in areas with high availability of OAs. This is the first time that a negative outcome of Chilean TURFs is directly addressed, which will allow improving the effectiveness of this management approach and hence safeguard the sustainability of small-scale benthic fisheries in the country.

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The need to work on estuaries at the national level was felt with the advent of Water Framework Directive (WFD). To implement this directive, there was little pre-existing information or, on the contrary, very concentrated knowledge focused on the three major French estuaries (Seine, Loire and Gironde). When the WFD was set up in the early 2000s, researchers working on estuaries and lagoons did not form a well identified and structured community. It was then difficult to mobilize researchers on operational and regulatory research topics concerning the French State. Some researchers have begun to create disciplinary networks to respond to managers' requests within sometimes very short deadlines and in a complex context of multi-stress effects. In metropolitan France, estuaries have been considered as anthroposystems for centuries (conditioned by the uses "transportation route" and harbour activities essentially), while in overseas territories (e. g. French Guiana), these are large quasi-pristine ecosystems under the major influence of the Amazonian inflows from the North Brazil Current. Between reshaped and heavily contaminated estuaries and "wild" estuaries, the metaphysical question of "reference" to which to tend is posed.

What monitoring strategy/assessment system, what actions to restore estuarine key features? Here are the questions addressed to the Inter-Estuaries Mission (MIE), created as a science-management interface since 2012. This national structure is organized in two forums: the Steering Committee (bringing together the main stakeholders) and its multidisciplinary Scientific Council.

A common language had to be developed in order to co-build together a common vision of the functioning of estuaries and to assist in the decision-making process for the selection of effective adapted actions to ensure the "good functioning" of these systems. The tools deployed within the MIE to organize applied research around the questions posed by management needs are presented.

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S5.6. Shaping adaptive governance in estuarine cities: Bordeaux Metropole and Gironde estuary facing global change

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Estuarine cities and its hinterlands are in the frontline of the effects of global changes. Today, viewed globally, most of the forecast scenarios show that these territories will be shape by two main forces in tension: economic and demographic attractiveness and socio-ecological vulnerability. Metropolization processes lead to a further concentration of economics, human and technical resources and to a significant pressure on ecological resources and natural area. These pressures on natural resources (water, air, biodiversity, landscape...) strengthen socio-ecological interdependencies between metropolis and its hinterlands but also influence strategies and pathways of territorial development. Thus, these areas and its mode of governance can be considered as relevant laboratories to question the global changes adaptation public policies construction. How estuarine cities are facing those new risks? How environmental issues are integrated to urban and rural planning? Highlighting climate risks engage which types of estuarine territorial governance?

To answer to those interrogations, this communication will introduce the research program “Urbest” and will submit the results of our interdisciplinary study (sociology, political sciences, ecology, economy and hydrogeology) realise on the case study of Bordeaux metropolis since 2016. More precisely, the identification of the political and ecological footprint of Bordeaux Metropolis on its hinterland enables us to focus analyse on three main sectorial issues (three case studies) participating in global changes: (i) contribution of the metropolis to the restauration/degradation of biodiversity; (ii) management of flood and submersion risks in the metropolitan territory and beyond; (iii) research and distribution of drinking water supply resources.
This presentation will explain the construction of adaptive policies to face global changes from these three case studies. In a first instance, we will describe and spell out the specific analytical framework build in Urbest research project: the 5i model. Toward, the distinction of socio-ecological interdependencies in five types of interdependencies, this model enables to make them visible and analysable through an integrative approach - involving the various disciplines of the project. As a second step, this intervention will aim to deconstruct adaptation solutions of Bordeaux metropolis to deal with global changes. Following the configuration in five dimensions of our model, we will introduce: (1) – the ecological interdependencies (ecosystemic dynamics); (2) – the cognitive interdependencies (ideas/knowledge); (3) – the institutional interdependencies (organisations); (4) – the instrumental interdependencies (instruments); (5) – the strategic interdependencies (interests). In conclusion, we will submit some socio-ecological pathways (scenarios) of estuarine cities, based on the result of our interdisciplinary research, in order to help them facing global changes.

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S5.7. Building a Trust for estuarine science

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The Coorong (Kurangk) is a 140,500 hectare, wave-dominated estuary. It is the final drainage point for the Australian Murray Darling Basin, which covers 14% of the Australian continent, travelling through four states and a territory. The Coorong is a wetland of international significance, recognised by multiple international agreements. While many Australian's recognise that a large portion of their food comes from the Murray Darling Basin and school children are awed by the majesty of the Coorong through iconic films and stories, most Australians have little tangible experience of this wonderland, particularly at its remote, low populated extremities.

In a classic "Tragedy of the Commons" very few voters directly identify with the health of the system and their impacts on it. For most, the decline of this wetland is a concern, but something of an abstract reality, resulting in conflicting political priorities. For the Ngarindjeri (the Traditional Owners of the estuary) and stakeholders with far more recent cultural ties to the site, the Coorong is home and its decline has a tangible impact on their wellbeing.

Stakeholders are exhausted, from trying to get their voices heard and the scale of the anthropogenic impacts recognised. The complexity of the estuary, the remoteness of the site and ongoing water or climate politics make it a confusing space to occupy. To ensure long-term monitoring and provide a scientifically rigorous voice for the estuary, a group of stakeholders have banded together, to form a soon to be legislated Environmental Trust. We believe this will help transform the adversarial debate around the Coorong into a collective conversation around the restoration of plenty, for all.

While still in its infancy, this presentation will look what has been done, what will be done and what it should look like in maturity.

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S5.8. Analysis of water-related rules in Local Master Plans around Portuguese estuarines areas – assessing the prospects for water-wise territories

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The different types and intensities of land use, as well as their vulnerabilities with regards to climate change effects such as flooding, droughts or water pollution, are prone to affect the resilience of territories. Spatial planning at the local level, especially in the vicinity of environmentally sensitive areas, such as estuaries, assume an important role for the protect of water and the associated values and services. The sustainability and resilience of water in estuarine areas often depends upon adequate land-use strategies able to promote water-wise uses and communities. The related land use permitting rules are also key tools for the implementation of water protection since they may deter particular land use types or intensities less suitable with the quantity or quality of water resources in place. Municipal master plans define the spatial development model, the zoning system and related permitting rules. Their environmental targets usually include the protection of water resources, among other environmental values of the territory. Supported by a set of rule-related analytical factors, this article analyses the land use regulations adopted by a set of local master plans on the surrounding territories of Ria de Aveiro and River Mondego estuary, two estuarine areas of the central coast of Portugal and assesses how their regulatory approaches cover the protection, use and valorization of water resources. The results reveal a fragile incorporation of Ria de Aveiro’s water issues and similarly as well in case of Mondego estuary into the land use regulations of the municipal master plans. It also reveals a limited scope of the ruling approaches, being essentially prohibitive and, consequently, offering limited room for innovation and new land use practices. The analysis of the water-related rules showed that Municipal Master Plans around both estuarine areas are still to be fostered if water-wise territories are to become a relevant aim.

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S5.9. From Management Practice to a Vision for estuary resilience, case of the Upper Sea Scheldt (Flanders, Belgium)

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The Upper Sea Scheldt is a fresh water estuary at the upstream extreme of the Scheldt estuary. As many estuaries it is confronted with challenges of climate change, human activities, spatial claims, leading to unfavourable changes in hydro-dynamic and morphological conditions, putting enormous stress on present ecosystem and nature values. The Sigma plan introduced estuarine nature restoration combined with safety against flooding due to combined rainfall run-off events with storm surges, in a context of sea level rise. De Vlaamse Waterweg devised the Sigmaplan based on scientific and engineering studies, including a Cost Benefit Approach taking ecosystem services into account. Since the second half of the 2000s this is being put in practice, by constructing flood control areas, using nature based solutions, restoring both wetland and estuarine nature areas. A monitoring programme is put into place to monitor the effects (MONEOS). The success of the project is largely the result of the collaborative approach of the waterway manager, together with the nature agency, and participation of stakeholders such as the agricultural sector, territorial planners, inhabitants, ... The Sigma plan largely ignores the challenges posed by climate change and new economic prospectives on the estuarine river habitats and biodiversity. In order to cope with the challenges in the river, such as the increase in tidal range and dynamics (affecting the estuarine habitat), the increase of suspended sediment affecting the water quality (as the basis for primary production and support to the food web), the integration of the river in the European inland navigation network, ... yet another way of management is required. In order to define the needs for such management new scientific studies, pilot interventions, monitoring and stakeholder has been launched by the De Vlaamse Waterweg. Expertise based on numerical models, measurements from monitoring in pilot projects are combined to build a vision for a next generation management. The presentation will focus on the approach on building the vision.

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S5.10. Adapting to coastal risks by managed retreat: insights from French case studies

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In the last decade and especially since storm Xynthia (2010), coastal adaptation to sea level rise has grown on the French political agenda. Among the different adaptation options, managed retreat, involving a resettlement of assets and activities subject to coastal risks, is the subject of intense debates and several policy initiatives. Based on a multi-level and interdisciplinary analysis of managed retreat incentives and controversies, the presentation will provide empirical insights on current institutional and social processes surrounding managed retreat in France. Indeed, although no major operations have taken place so far, several actions are being carried out to engage local authorities in the implementation of managed retreat strategies. After providing an overview of these initiatives at the national level, we will particularly focus on a policy experiment launched by the French Ministry for the Environment (2012-2016) in order to study legal, financial and sociopolitical feasibility of managed retreat in a few pilot areas. We will highlight the main lessons learned from case studies in the region of Nouvelle-Aquitaine (southwestern France), the way they are questioning the French institutional setting dealing with coastal risks management, as well as some innovative approaches and tools that emerged from that process (in terms of land property rules, zoning and urban planning, etc.). Moreover, little is known about residents’ attitudes and preferences towards managed retreat measures and possible incentives. Thus, we will also present an economic assessment of inhabitants’ preferences for different relocation strategy attributes. Based on a survey addressed to households in the south-east of France, the results are analyzed in terms of territorial solidarity, spatial heterogeneity and risk perception by comparing individual willingness to pay for relocation between the shoreline residents and the hinterland population.

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Poster presentations
P1. Mapping Resilience, the Morpho Sedimentological Map of San Vincenzo (Tuscany, Italy).

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The San Vincenzo coastal area (Livorno, Tuscany – Italy) morpho sedimentological map represents a quantitative research on assessing and manage coastal erosion risk, through the computation of sedimentary stock. The presented method links the geomorphic mapping guidelines, issued in 2017 by Regione Toscana, and the Italian Geo thematic cartography procedures (CARG). A mobile, medium to fine sand, bar system has been recognized between the isobaths 3.5 and 5.5; Its main sedimentological characteristics are: Sorting (phi) 0.3 - 0.5, Grain size (phi) 2, and Fine fraction between 0 and 1 %. The seabed sets on a beach rock that results alternatively covered and exhumated by bars. Although shoreline displacement shows an equilibrium during the long term, several criticalities occur in the short term. Furthermore, the sorting map shows few limited areas of sediment discharge, resulting as a probable weak erosive action of the main channels. To integrate the different features and procedures provides an exhaustive overview on the main coastal processes at San Vincenzo. It highlights a lack on the sampling locations, especially near the sedimentary discharge sites, as well as at a basin scale, to deeper investigate sediment supply processes. Moreover, the geodatabase allows us to analyze the anthropogenic impact on the coastal dynamics and the resilience potential as a PhD project.

Acknowledgments:
The present report represents some findings of the Interreg MAREGOT- Project between Italy, France and transboundary regions in the Mediterranean Sea.

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P2. The project LESSisMORE: LESS discards and LESS fishing effort for BETTER efficiency on the small-scale fisheries

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Small scale fisheries (SSF) are a large component of the EU fleet. In Portugal, SSF hold great tradition and importance representing 83% of the fleet in 2017. A well-managed fishery is expected to use gears that will catch most of the available species at sizes that will not undermine fishery sustainability. Understanding the type of gears and the factors that influence their use is also vital to determine the interaction between social and ecological change. The two fundamental causes of high discards are the use of unselective fishing techniques and the failure to restrict fishing effort. Estimating discards is essential for assessing the full impact of fisheries upon fish populations and upon the ecosystem, and this was identified as one of the main shortcomings of the Common Fisheries Policy. Data on commercial fisheries discards in EU waters is scarce and the estimates have, in general, low precision. As so, discards represent an important and poorly documented source of fishing mortality, contributing to the overfishing of fish stocks. Most of the scientific research on EU discards has been focused on large-scale fisheries, assuming that SSF’s discards are lower than those associated with industrial fishing. As a result, there is a lack of knowledge on many biological, environmental, socioeconomic, management and policy aspects of SSF, mainly regarding discards. The LESSisMORE project aims the identification of the most favourable locations for catching target species while reducing discards and fishing effort at the same time, which brings ecological and economic benefits. To achieve this goal we quantify discards and fishing effort; build predictive models to identify the best conditions for fishing, with low fishing effort and low discards; assess the socioeconomic impact of the decrease in fishing effort, discards and the implementation of the landing obligation; increase the value of discarded species.

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P3. RShiny as a tool for interactive visualization of nutrients in the Scheldt estuary

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The Scheldt estuary has become a closely monitored estuary, in large part due to the MONEOS monitoring program. This Flemish-Dutch collaboration was set up to check and uphold the ecosystem functioning of the estuary. It continuously generates data on many biotic and abiotic parameters, and a large number of nutrients present within the estuary. These large quantities of nutrient data are stored within a data portal on the ScheldeMonitor website (www.scheldemonitor.org). This website also provides a series of data products, made to display noteworthy analyses on data stored in the portal. Part of these products are a set of contour plots, in a PDF format, that visualize the distribution of select nutrients across the estuary for a specific time range.

To replace these static plots, Flanders Marine Institute made an interactive tool that can be incorporated into the existing website. The tool was made using R programming and the RShiny package, allowing an interactive and user-friendly approach. Users can select categories, parameters, years, spatial range and even specific datasets they wish to visualize. Additionally, the selected data is also displayed in a raw data frame, and as a scatterplot that highlights the data gaps. All these visualizations are free to use and download. At this time, more than 400 types of nutrients are available for visualization. In future stages, adaptations on this tool will be added as well, visualizing other types of parameters measured by the MONEOS program, both biotic and abiotic.

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In recent decades, the world has experienced the adverse consequences of uncontrolled development of multiple human activities. Emerging pollutants include a wide range of man-made chemicals (such as pesticides, cosmetics, personal and household care products, pharmaceuticals) used worldwide. In 2013, EUROSTAT statistics showed that in the previous decade (2002-2011) over 50% of the total production of chemicals was composed by environmentally harmful compounds, of which over 70% have significant hazardous environmental impact. Among these, several concerns have been raised regarding the ecotoxicological effects of the Pharmaceuticals and Personal Care Products (PPCPs), and, at present, there is an open discussion on how to best assess their effects efficiently.

Marine microalgae are promising biomonitor organisms, having simultaneously a high ecological importance as base of marine food webs, and acting as bioindicator of disturbance under natural conditions and extreme contamination events. Specifically, phytoplankton is probably the first compartment to be affected by contaminants, showing a high surface-to-volume ratios, responding quickly to suspended toxicants with high uptake rates, and therefore can provide sensitive and effective biomarkers of contaminant stress. Additionally, phytoplankton are the major marine producers of many complex biomolecules, including fatty
acids present in diverse lipid classes. Photosynthetic organisms can synthesize linoleic and linolenic acids, which belong to omega-6 and omega-3 classes, respectively, and are essential fatty acids (EFA) for vertebrates. Additionally, fatty acids have also a potential as toxicity biomarkers. Formerly these biomarkers were typically based on antioxidant enzymatic activities and their specific feedback to contaminant-generated reactive oxygen species (ROS). Only recently non-traditional biomarkers, such as photochemical processes and variables and fatty acid profiles have been included in ecotoxicology and impact assessment studies. In particular, fatty acid profiles (including fatty acid species, unsaturation degrees and relative abundance) proved to be sensitive to environmental disturbances and contamination under laboratory conditions, pointing out its possible role under environmental chronic exposure to contaminants.

In this work, we explore the application of fatty acid profiling to discriminate diatom cultures exposed to different PPCPs at different doses, as well as its statistical resolution and classification efficiency while applied in an Integrated Biomarker Response (IBR) index for application in future ecotoxicological surveys.

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P5. Lagoon micro-habitats and spatio-temporal distribution of the associated juvenile fish population in a mediterranean lagoon.

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In the temperate zone, many demersal fish species of commercial interest are known to use coastal lagoons (rich environments at the land-sea interface) at the juvenile stage. The use of lagoons by fish is often described at the lagoon scale, considering lagoon as a homogeneous habitat. However, observed at a smaller scale, lagoons are composed of a great diversity of micro-habitats with varied physicochemical parameters, three-dimensional structure and food quality. This smaller scale of study is particularly interesting in the study of the recruitment of fish juveniles which usually happens in benthic coastal environments called nursery and is characterized by a maximal growth but also known to be the most critical in terms of survival. Thereby the evaluation of lagoon micro-habitats nursery quality could be a support for reflection on the management of fisheries resources dependent on lagoon environments. In order to deepen the understanding of the relationship micro-habitat / fish juvenile population in those environments, a monthly spatio-temporal monitoring was implemented from March to October 2019 on six stations in the Mediterranean Prévost lagoon, located in the Gulf of Lion. The six stations selected correspond to six contrasted types of lagoon micro-habitats spread out over the entire lagoon. Concerning the habitat characterization, selected microhabitats, more or less far from sea water inlet and fresh water sources, are contrasted in terms of physicochemical parameters (temperature, oxygen, salinity), three-dimensional structure (substrate, slope, depth, vegetation complexity) and vegetation cover. Concerning juvenile fish, the population is sampled with four complementary methods. At this time 14 fish species have been observed, and presented a non-homogeneous distribution among microhabitats.

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Salt marshes located at estuaries are frequently the recipient of high nutrient runoff, but also of particulate and dissolved organic matter as well as plant litter. This nutrient load makes salt marshes some of the most productive ecosystems on the planet. Being highly productive, there are large amounts of biomass produced that will generate large amounts of decaying litter. Along with this, in highly industrialized estuaries, there is also a great input of metals that are accumulated in the salt marsh sediments, making these ecosystems key zones not only for the biogeochemistry of the estuary, but also for metal cycling. These metals retained in the sediment present various forms depending on the bounds they establish with different sediment components. This is also a dynamic process much influenced by sediment conditions and external factors (hydrodynamics, weather and seasonal variation) but also by the vegetation that colonizes an area. These transformations include metal precipitation reactions by metallic sulfides and redox reactions causing changes on the metal species and its associations. Previous works has found a strong seasonal variation of plant biomass in these ecosystems together with a variation in metal concentrations in plant tissues, indicating a possible similar variation in the metal biogeochemistry. The Spartina genus (the cordgrasses) is one of the most successful halophytes (species that can survive and complete their life cycle under saline conditions), being present in a wide range of latitudes across the globe. Yet, the invasion by the non-indigenous species (NIS) Spartina patens in Mediterranean ecosystems represents a serious threat to biodiversity. This specie colonizes the upper middle marsh competing with the native Halimione portulacoides for space and resources. Due to the very different root systems and metabolism between both species, this introduction has significant biogeochemical implications, namely in terms of metal speciation and availability, changing the natural bioremediation capacity of the marsh. In the present study we address the biogeochemical modifications in terms of metal speciation introduced by the colonization of the NIS S. patens.

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Seagrasses are present in all latitudes, presenting key ecological functions in all of them, making them comparable to highly productive terrestrial ecosystems (i.e. rain forests and mangroves), namely as carbon sinks and biodiversity sanctuaries. Nevertheless, the coastal location of these ecosystems makes them specially vulnerable to anthropogenic pressures. Approximately 65% of the world seagrass ecosystems are now at risk due to human activities, with already some estimations pointing out to losses of approximately 30% since the 1980s. Among others, these ecosystems are especially prone to dredging activities and hydrodynamic shifts, nutrient and chemical runoff from urban and agriculture areas, commercial/recreational human activities (e.g. fishing, boat groundings) and inevitably climate change derived impacts. Living in coastal and transitional systems, make seagrasses prone to a highly dynamic environment, challenging their ability to survive. Due to these constrains, collapses are often observed in seagrass prairies, although the reasons behind these events are not always disclosed. Considering an anthropogenic disturbance estuarine gradient, the present work aims to evaluate the phylogenetic relationships between different seagrass patches along with its chemodiversity (ionome and fatty acid profiles), crossing this information with a collapse timeline obtained from years of monitoring. With this approach it is intended to disclose if the different seagrass patches have different genetic backgrounds making them prone to different collapse drivers and how this genetic diversity is linked to the patches chemodiversity, as potential tools for future biomonitoring programs.

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P8. Quantification of land-sea nutrient fluxes operated by migratory fishes in a climate change context: how a mechanistic species distribution model can be useful?

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Diadromous (land-sea migrating) fishes are declining because of cumulative pressures across their life cycle, leading to threaten the ecosystem services they provide to human communities. The situation becomes even more complex in view of the ongoing climate change acting as an additional pressure to which species must adapt.

In this context, large-scale modelling works were performed to provide guidelines on how conservation plans should take into account this new variable which is climate change.

The most recent attempt, and also the most advanced, was the construction of a mechanistic species distribution model called GR3D for Global Repositioning Dynamics for Diadromous fish Distributions. The model, calibrated for the Allis shad (Alosa alosa) in Western Europe allows users to estimate population status in a globally changing environment. However, even if simulations from this complex model are realistic and interpretable, more works are needed to initiate a profound change in the foundations of migratory species management under climate change.

Quantitative estimates of ecosystem services associated to diadromous fishes are scarce, particularly for services other than food provision. As such, the nutrient and carbon subsidies brought by these species from the marine habitat to the continental domain must be computed to better understand the role of these species in the continental ecosystem functioning. As such, the development of a new routine in GR3D could help estimating such service at large spatial scale and under past, present and future climatic conditions. Hence, confronting maps of future species distributions with those of upcoming losses and gains of ecosystem services could hold the key towards more efficient management measures in a climate change context. The species of interest will be the Allis shad and its American counterpart, the American shad (Alosa sapidissima), that could both benefit of such model-based estimates in terms of species and habitat management.

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Estuaries are dynamic ecosystems and their biological communities are strongly affected by environmental variability occurring at a wide range of time scales. The El Niño is a coupled ocean–atmosphere phenomenon naturally occurring at the interannual time scale affecting biological communities worldwide. Understanding how this global phenomenon affects ecosystems attributes is fundamental to the management of biological communities. In some cases, El Niño events have been associated with higher species richness in marine and coastal ecosystems. We hypothesized an increase in food-chain length of fish assemblages in estuaries under influence of El Niño events. We investigated this hypothesis at Patos Lagoon, the largest coastal lagoon (~10,000 Km²) in South America, where strong El Niño events are associated with higher rainfall and river flow in its estuarine zone (~1,000 Km²). We used a 9-yr dataset of carbon and nitrogen stable isotope ratios of fishes, macroinvertebrates, primary producers, and particulate organic matter collected in a shallow embayment of Patos Lagoon estuary. We estimated consumer’s trophic positions (TP) using a recent Bayesian approach that incorporates individual variability and propagating sampling error of trophic isotope discrimination, isotopic baselines and consumers and posterior estimates of parameters. A key step before estimating consumer’s TP using stable isotope analysis is the establishment of an appropriate isotopic baseline. Hence, we tested the sensitive of our TP estimations to different ways to generate isotopic baselines. As expected, our results showed that both species richness and trophic richness (i.e. the number of trophic guilds) were higher during El Niño events. Food-chain length ranged from 2.45 to 4.60 along the studied period, but against our prediction, did not show positive correlation with high rainfall and river flow associated with El Niño events. These findings suggest food-chain length in the studied estuary is resilient to environmental variability and natural climatic perturbations.

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The Manila Clam (Ruditapes philippinarum, Adam & Reeve 1850) is native to the Indo-Pacific but in the last decades it was introduced worldwide, driven mainly by the shellfish market industry. This highly productive species was also introduced in several Portuguese coastal systems.

A high increase in the abundance of this bivalve species in the Tagus estuary has recently been observed, which led to a sharp increase in the number of harvesters and fishing effort, mostly illegal. An estimate of more than 1700 harvesters was obtained in 2015, with an annual catch estimate of 6000 to 1700 tonnes and an annual income of 10 to 23 million €, representing a very important contribution for the regional and national economy.

The management of the harvesting and commercialization of this species in Portugal has been difficult due to a high number of illegal harvesters and harvesting techniques, absence of designated long-term purification areas, as well as the lack of specific regulation.

This scenario highlighted the need for an adequate governance and management model for the sustainable exploitation of the Manila clam in Portugal. An integrated analysis of the legal and institutional framework and of the available land management tools was carried out in the studied areas, aiming at a better harmonization of these legal instruments with the situation on the ground. This integrated approach also included the analysis of management models applied in other countries.

The management model used in Italian estuarine systems seemed very promising since a free fishing system was replaced by a concessions system designed to regulate market supply and mainly to convert harvesters in clam farmers. The implementation of the management model in Portugal would require that appropriate purification and industrial processing centres would be available due to the classification of the Tagus estuary production area as class C.

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P11.  Fatty acid composition as natural tracers of estuarine habitat use

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It is widely accepted that diet associated to habitat quality drives individual survival and reproduction success. Fatty acid (FA) composition is a valuable natural marker of nutritional condition, used to define and characterize trophic relationships, as well as to express connectivity and reconstruct habitat use. Moreover, both laboratory and field trials have demonstrated that fatty acid composition is also a powerful bioindicator of disturbance and environmental contamination for multiple biota. Here, we evaluated the variation in FA composition and trophic markers (FATM) along food webs of salt marsh areas in differently contaminated sites of Tejo estuary. Tissues of the macroinvertebrates ragworm Hediste diversicolor, bivalve Scrobicularia plana, and green shore crab Carcinus maenas; as well as of fishes common goby Pomatoschistus microps and juvenile seabass Dicentrarchus labrax were analysed by gas chromatography and trophic and dietary tracers such as DHA/EPA, PUFA/SFA, C16PUFA/C18PUFA were used to compare among sampled areas and sites. A similar approach was undertaken for halophytes, including distinct native and invasive cordgrass species, and macroalgae inhabiting the different salt marshes. Results clearly reveal spatial variation in FA composition among sites per species, such that FA clearly identified collection habitat, as well as discerned trophic related variations throughout the food web. Moreover, results sustain that nutritional status markers are sensitive to the surrounding environment and reflect environmental contamination in estuarine food webs. Overall, results are discussed in the context of a restoration project and an integrated evaluation of the effects of the bioinvasion of the cordgrass Spartina patens in the Tejo estuary. We are interested in understanding if the renown physical and biological alterations that take place in saltmarshes due to S. patens invasion, and consequential elimination of its neighbor native species, Halimione portulacoides and Sarcocornia fruticosa, affect habitat quality and energy flows through the trophic web. Primarily, if habitat quality could be reduced to the extent of having detrimental effects on the nursery role of these areas for juvenile fish and macroinvertebrates, limiting growth or the accumulation of energy reserves for future emigration.

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P12. **Long-term effects of exposure to pharmaceuticals in a top predator fish**

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Pharmaceutical compounds are continuously released into the aquatic environment, resulting in their ubiquitous presence in various estuarine and coastal systems. These compounds are designed to produce effects at very low concentrations and target specific biological pathways, which are often evolutionary conserved. Thus, there is growing concern whether these compounds elicit deleterious effects on aquatic organisms. In this context, long-term effects of exposure to three different pharmaceutical compounds on juvenile meagre *Argyrosomus regius* were studied. Fish were exposed for 28 days to environmental concentrations (300 ng/L to 30 µg/L) of one of three pharmaceuticals: fluoxetine (antidepressant), propranolol (antihypertensive) and diclofenac (non-steroidal anti-inflammatory agent). Multiple biomarker responses were analyzed in liver, muscle, heart and brain tissues, namely antioxidant and biotransformation enzymes activity (CAT, SOD, EROD, GST), biomarkers of effects (DNA damage, LPO), of energetic metabolism (LDH, IDH, ETS), and of neurotoxicity (AChE). The potential for pharmaceuticals to bioconcentrate in fish tissues was also investigated and a metabolomic analysis was performed to screen for affected metabolic pathways. Results provided new insights into the effects of pharmaceuticals’ exposure in meagre and are discussed within the context of ecophysiology, and the effects environmental contamination may have on top predator fish species.

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P13. Preserving landscape connectivity facing urbanization in the estuarine metropolitan area of Bordeaux: a participatory modelling approach for improving relations between scientists and stakeholders.

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Estuarine cities, due to their interface position between land and sea, are areas of particular interest for the preservation of biodiversity. This is particularly true for Bordeaux Métropole, characterized by a strong relationship with the Gironde estuary, a dense hydrographic network and interactions with its forested and agricultural environments. However, its growing urban development is actively contributing to the destruction and fragmentation of natural habitats, which are a major driver of biodiversity decline. In this context, efforts to preserve landscape connectivity are an important issue. Several modelling approaches, such as landscape graphs, are used to assess landscape connectivity and are supposed to constitute supports for a decision-making in land-use planning and biodiversity conservation. However, few studies envisage such modelling approaches by involving local stakeholders. In response to this, we propose to integrate the modelling of ecological networks into a companion modelling approach involving local stakeholders about the issue of preserving ecological connectivity facing urbanization in the estuarine metropolitan area of Bordeaux.

The aim of this work was first to co-construct a process for identifying landscape connectivity and estimating the impacts of different development scenarios of Bordeaux Métropole on this connectivity. It also aimed to study the knowledge-sharing between scientists and stakeholders, and how they perceive and use information from the spatial modelling of the ecological networks. Our hypothesis is that this knowledge-sharing mechanism will renew the logic of governance and land-use planning, from an adaptive governance to an anticipatory governance of urbanization choices’ impacts on biodiversity.

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The Allis shad is a migratory amphihaline fish species present in many European estuaries. This species was very abundant in the Gironde system, but from the 2000 the population crashed without clear reasons. The quality of the environment during embryonic development is one of the factor that could contribute to this crash. During the embryonic development of fish, processes are implemented so that the individual can form properly. Possible anomalies occurring during these developmental stages can cause immediate damage to the embryo but also impact the survival and future of the larva after hatching. This work presents the different stages of embryonic development of, the Allis shad *Alosa alosa*. We describe and characterize the different stages of development from egg fertilization to larval hatching. The steps described are based on pictures from a Dino Lite digital microscope.

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P15. A numerical modelling tool for management connectivity, fishing yields and conservation in regional MPA networks

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Marine protected areas are a very powerful management tool since they can make compatible, if properly managed, the protection of biodiversity and the integrity of the populations exploited by fishing, with the economic performance due to the tourist appeal and diving activities and the increase of the fishing yields in the adjacent zones. However, these effects take place on a small spatial scale (tens of km), which makes it advisable to establish reserve networks along the coast. The optimal design of these networks will depend on the biology of the species, the characteristics of the habitat inside and outside the reserves, the size of the reserves and the distance between them. In addition, connectivity between populations is essential to maintain their genetic structure and ensure their viability in the medium and long term, which adds an additional variable to be taken into account. To facilitate the design of MPA networks at regional scale (hundreds of km), a tool has been designed, based on numerical models considering population growth, the density-dependent movement of fish through the displacement of their home-range and on the effect of habitat complexity on it.

The time-dependent numerical model allows us to evaluate short-range coastal habitats (<200 km), offers a “realistic” and “non-bias” approximation of fish movements (i.e. flux), follows a logistic growth, lets to know the fishing catches (spatial and time variability) and can be adapted to many scenarios and reserves. The first results of the model will be presented in the congress.

Our model could help to manage a well-connected network of MPAs in order to achieve the objectives of DMEM by simulating the effects of new reserves and micro-reserves along the coast with the final scope of reducing human impacts.

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Monitoring to assess climate change impacts on the structure and functioning of a sandy coastal marine fish assemblage

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The coastal fish assemblage of a sandy area adjacent to the Tagus estuary has been surveyed weekly from 2007 until 2018, based on catches of the beach seine fisheries operating in this area. Environmental parameters such as wind direction and strength, air and water temperature, moon phases, moment of the day (day/night), season, tidal height and distance to coastline were always registered. The main target species of this fishery are small pelagic fishes, such as sardine, mackerel and Atlantic horse mackerel, but more than 60 other species are regularly caught. Through the years several changes have been observed in the biomass of the target species and in the groups of species captured by this gear. In this work, we evaluate the impacts of climate change in the structure and functioning of this coastal assemblage. Sea surface temperature was analysed along the series. Years were classified as "hot" or "cold" taking into consideration mean values of SST along the series. Fish species richness and fish abundance for the most common species were compared between these two periods. Functional traits and ecological guilds were assigned to each species and the assemblage composition compared between warmer and cooler years. Monitor this fishing activity can help understand the variation of species assemblages in the study area through time and relate it with global changes and environmental parameters.

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P17. Governing the ecological transition of maritime activities: what importance for coastal-rural interdependencies?

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The material dimension of coastal management (socio-economic, geographic, institutional) is key to understanding how the ecological transition of maritime activities is governed. Resource and land-use pressures and conflicts have a strong role to play shaping governing processes, posing challenges for integrated maritime policy. European and French public policies too structure change, sometimes pulling in what seems like opposite directions: e.g., policies for blue growth can confront marine strategies for ecological transition. Nevertheless, whereas many of these issues have been addressed in the scientific literature, few studies have paid strong attention to the role of coastal-rural territorial interdependencies influencing maritime governing practices. Such interdependencies may take many forms, e.g. between actors promoting ‘terrestrial’ versus ‘maritime’ territories, between actors across a ‘merritoire’, or other interrelations between actors, nature and artefacts.

This poster tackles this issue head on, presenting results of a qualitative research study which we are carrying out within the project COASTAL. The main objective of the project COASTAL is to contribute to integrated coastal-rural planning in both case study regions and the wider EU territory. Working within this project, our study draws on concepts and theories from political science and geography. More specifically, we focus on the governing of the ecological transition of port activities and ports, sea fishing and shellfish farming in the Charente, SW of France.

The poster will present results on: i) actor visions and strategies for the ecological transition of their sector; ii) actor representations of governing practices and public policy challenges; iii) the importance they give to coastal-rural interdependencies in governing. Our results emerge from qualitative methods including: documentary analysis, semi-directive interviews and use of intermediary objects understanding territorial interdependencies. Overall, the poster shows that an understanding of actor political work can offer new insights on integrated and sustainable coastal management.

This study has benefitted from finance from the H2020 project COASTAL.

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Coastal and estuarine marshes are interface ecosystems with specific ecological functionalities supporting diverse ecosystem services for human societies. Among those ecological functionalities, estuarine marshes are considered important habitats for juveniles of numerous fish and crustacean species, which find in these habitats favorable feeding and growth conditions. However, coastal and estuarine marshes have been highly impacted by human activities over the last centuries, in particular in Europe, where more than 15,000 km² of those marshes were dyked since the XIth century. In the current context of climate change impacts on coastal ecosystems, in particular projected elevated risks of marine submersion, an emerging issue is the costs associated to the management of dykes, that are being increasingly exposed to severe damages. Therefore, the possibility of re-opening those marshes to re-create flood expansion zones is being questioned, as well as potential benefits of this management option in terms of ecological functionalities of estuarine and coastal marshes. In the Gironde estuary, the ‘île Nouvelle’ represents a unique experimental site where stakeholders agreed upon a flexible management of dykes, with several management units ranging from a depolderized marsh area where tidal exchanges were restored in the north, to a fully managed and dyked marsh area in the south. Informed by previous ecological and social surveys undertaken from 2011 to 2014, the recently launched INOTOP project aims at addressing the potential ecological benefits of tidal restoration in terms of nursery functionalities for fishes in the norther estuarine marsh, and to address the associated potential gain in terms of ecosystem services. An important component of the project lies upon the production of mediation supports for stakeholders and the public, to better understand the rationale of the management options being weighted in this very peculiar study site, and what benefits societies may retrieve from estuarine and coastal marshes restoration.

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P19. Differential tissue accumulation, elimination and oxidative stress response of the European glass eel (Anguilla anguilla) under carbamazepine exposure at different salinity regimes

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Environmental pollution caused by releasing of pharmaceuticals into aquatic ecosystems has been recognized as a major worldwide issue. Among the most common pharmaceuticals, carbamazepine (CBZ) is a widely prescribed anticonvulsant and mood stabilizer drug, that has been frequently detected in aquatic environments. Due to its low elimination efficiency, CBZ is frequently found in wastewater treatment plants (WWTPs) influents and effluents, surface- and groundwaters and even in treated drinking water. This raises serious concerns about their potential harmful impacts to aquatic biodiversity and ultimately to humans, by food intake. In order to study the tissue bioaccumulation and elimination potential of CBZ, the European glass eel (Anguilla anguilla) was exposed to different salinity regimes (fresh- and brackish water), during a 21-day period. The glass eel is considered a sentinel species due to its high susceptibility to contaminants and high economic and ecological importance, since it reflects quite well the environmental health and integrity of aquatic systems, from freshwater to the open sea.

We analyzed the cellular and oxidative stress responses of glass eels’ tissues through quantification of DNA and lipid damage, ubiquitin, acetylcholinesterase, and glutathione-S-transferase. Accumulation was higher in brackish water (salinity 15) and varied between tissues, being considerably greater in the viscera and muscle of CBZ-exposed glass eels. Low CBZ-elimination capability was evident for both salinities. Lipid damage, through quantification of malondialdehyde levels, occurred under CBZ-exposed glass eels in brackish water. The production of ubiquitin decreased for both tissues, independent of the salinity treatments, revealing eventual protein damage. In the brain, the acetylcholinesterase activity, as a biomarker of neurotoxicity, declined in CBZ-contaminated brackish water, suggesting for a potential mobility impairment. These results emphasize the higher risk of CBZ uptake by glass eels in coastal waters than in freshwater and greater incidence of cellular and oxidative damage.

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P20. Improving distribution models accuracy of estuarine fish species: do sampling bias, species ecology and threshold selection play a role?

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Species distribution models (SDMs) relate presence/absence data to environmental variables, allowing to predict species environmental requirements and potential distribution. They have been increasingly used in fields such as ecology, biogeography and evolution, and often support conservation priorities and strategies. Thus, it becomes crucial to understand how trustworthy and reliable their predictions are. Model-based uncertainty may be reduced by taking into account the influence of biased sampling imprecision in species location, and species ecological characteristics. To investigate the effect of using different datasets representing seasonal and spatial sampling bias and of several threshold selection criteria on models' accuracy, SDMs were built for four estuarine fish species with distinct use of the estuarine systems. Accuracy of models created from a spatially biased sampling was overall higher than accuracy of models created with a seasonally biased sampling or with the multi-year database created and this pattern was consistently obtained for marine migrant species, which use estuaries as nursery areas, presenting a seasonally and regular use of these ecosystems. The ecological dependence between these fish species and estuaries may add difficulties in the model building process, and needs to be taken into account, to improve their accuracy. Higher values of accuracy measures were registered with the threshold that maximizes the sum of sensitivity and specificity, and the threshold where the predicted prevalence equals the observed, whereas the 0.5 cut-off was unreliable, originating the lowest values for these metrics. The present study highlights the need for a thorough analysis of the critical underlying issues of the complete model building process to predict the distribution of estuarine fish species, due to the particular and dynamic nature of these ecosystems.

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