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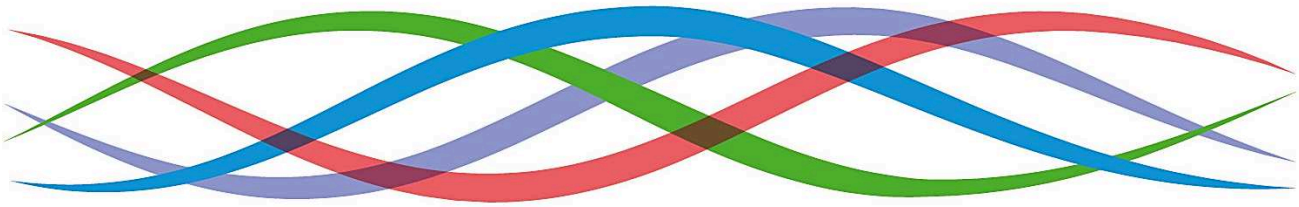

INTERDISCIPLINARY CONFERENCE

RISKS AND OPPORTUNITIES

IN MARINE

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SOCIO-ECOSYSTEMS

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Dorothy DANKEL, Bergen University, Norway: Transdisciplinary insights into Integrated Ecosystem Assessments: What they are, what they can be, what they should be

Transdisciplinary insights into Integrated Ecosystem Assessments: What they are, what they can be, what they should be

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Integrated Ecosystem Assessments (IEAs) are scientific frameworks that synthesize data to inform policy decisions. Today many science institutions develop and conduct Integrated Ecosystem Assessments as the integral tool of ecosystem-based management. However, the scholarship on the role of Integrated Ecosystem Assessments in policy and how these assessments can or cannot spur political actions remains at best fragmented, and the actual use of IEAs in policy processes is not fit for purpose. The state-of-the-art of IEAs is pointing strongly in the direction of a push towards a "technological lock-in" where quantitative modelling is the method of choice. Experiences show that once a technology process is locked-in, any efforts to reform will be an uphill battle (i.e. the use of gas-powered automobiles for personal transport). If IEAs are to be designed for high credibility, legitimacy and societal saliency, a combination of quantitative and non-quantitative disciplines needs to be integrated early-on in the process. Since a common framework for Integrated Ecosystem Assessments in Europe is still lacking, there is an urgency to define how they should work to reach the transdisciplinary potential with an impact on sustainable actions. How can procedures for IEAs, the core tool linking the implementation of policy objectives and knowledge for marine ecosystem-based management, be designed to be credible, legitimate and salient?

Keywords: integrated ecosystem assessment, transdiciplinary, interdisciplinary, humanities, social science, modelling

*Speaker

Chris BOWLER, IBENS, CNRS/ENS, Paris, France : TARA-OCEANS : TARA-OCEANS: Eco-systems biology at planetary scale

Tara Oceans: Eco-systems biology at planetary scale

Chris Bowler * [1], Consortium Tara Oceans *

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The ocean is the largest ecosystem on Earth and yet we know very little about the plankton that drift within. To increase our understanding of this underexplored world a multidisciplinary consortium, Tara Oceans, was formed around the 110-ft research schooner Tara, which sampled plankton at more than 210 sites and multiple depth layers in all the major oceanic regions during expeditions from 2009-2013 (Karsenti et al. Plos Biol., 2011). The presentation will describe the first foundational resources from the project (based on a first data freeze from 579 samples at 75 stations; see Science special issue May 22, 2015) and their initial analyses, illustrating several aspects of the Tara Oceans' eco-systems biology approach. The project provides unique resources for several scientific disciplines, capturing biodiversity of a wide range of organisms that are rarely studied together, exploring interactions between them and integrating them with environmental conditions to further our understanding of life in the ocean and beyond in the context of ongoing climate changes.

Keywords: Marine ecosystems, systems biology, biodiversity, plankton, Tara

*Speaker

Thierry CHOPIN, University of New Brunswick, Saint John, Canada: Responsibly farming waters with an ecosystem-based approach and taking advantage of the ecosystem services provided by Integrated Multi-Trophic Aquaculture (IMTA) practices

Responsibly farming waters with an ecosystem - based approach and taking advantage of the ecosystem services provided by Integrated Multi - Trophic Aquaculture (IMTA) practices

Thierry Chopin * [1]

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Aquaculture will play an increased role in tomorrow's food production systems. However, the Blue Revolution needs to become the greener Turquoise Revolution by developing innovative technologies and practices with increased environmental sustainability, economic stability and societal acceptability, such as Integrated Multi-Trophic Aquaculture (IMTA).
A major rethinking is needed regarding the functioning of an "aquaculture farm". Having to deal with different nutrients, different spatial and temporal recapturing strategies should be designed. This will certainly trigger a need for changes in regulations, as they were designed without IMTA in mind in most countries.

There is a renewed interest in the mariculture of seaweeds for their integrated cultivation, the ecosystem services they provide and novel uses. The value of the ecosystem services provided by extractive species should be recognized, accounted for and used as financial and regulatory incentive tools. The IMTA multi-crop diversification approach could be an economic risk mitigation and management option to address climate change impacts.

Perceptions should change: nutrients are not necessarily wastes and recycling, encouraged on land and in agriculture, should also be at sea and in aquaculture.

Business models should embrace the emerging Integrated Sequential BioRefineries (ISBR) concept to manufacture diverse products for a wide variety of applications.
Humans will soon not be able to continue thinking of mostly land-based agronomic solutions for securing their food, nor for providing many other derived products, but will have to turn, increasingly, to responsible aquanomy to manage their "aquatic fields".

Keywords: IMTA, aquaculture, responsible

*Speaker

Luc Van HOOF, IMARES Wageningen, Ijmuiden, Netherlands: Facing the future: can foresight studies help to integrate science and stakeholders?

Facing the future: can foresight studies help to integrate science and stakeholders?

Luc Van Hoof * [1]

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Feeding the world population by 2050 (and providing them with sustainable energy and jobs) is one of the main challenges of today; especially in the light of the scarcity of fresh water a marine or blue revolution is needed to feed 10 billion people by then. The marine environment surely offers a lot of opportunities, but the seas and oceans and the marine ecosystems are also under threat of unsustainable uses.

Central question in this is how we can attain sustainable use of ecosystem services, including the governance of marine and coastal areas. In the world of today the role and position of science in this process is rapidly changing. In order to meet the challenge of the future we need a more applied form of science in a trans-disciplinary way in which knowledge is being produced together with stakeholders in a complex field of responsibilities. So not only is an interdisciplinary mode of producing science of importance, the more crucial issue is that of entering a mode of co-creation of knowledge together with stakeholders such as the industry, NGOs, policy makers and civic society.
In his Keynote address Luc van Hoof will examine how the method of foresight studies can be used to reach a multi-disciplinary/interdisciplinary and participatory process of formulating answers to the challenges of the future.

Keywords: sustainable use of ecosystem services, governance of marine and coastal areas, interdisciplinary mode of producing science, co, creation of knowledge.

*Speaker

Structure and function of intertidal mudflats

Microphytobenthos spatial distribution around oyster reefs: a remote sensing approach

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Interest in the role of benthic microalgae and cyanobacteria assemblages – commonly referred to as microphytobenthos (MPB) – within intertidal mudflat ecosystems has increased during the last decade. In aquaculture-dominated ecosystems, they can represent the main food resource for many organisms (e.g. shellfish); however feedback processes between macrofauna communities and MPB are poorly known. In this study, we investigated the hypothesis of a top-down control between MPB and oyster communities in Bourgneuf Bay (Atlantic coast, France). Emphasis was placed upon the analysis of a Before After Control Impact experiment, which consisted in the removal of oysters from a natural reef. MPB spatial distribution and response to the experiment were analysed using satellite remote sensing. High spatial resolution (30m) time-series were built using Landsat and SPOT multi-sensor data (1985-2015). Using the Normalized Difference Vegetation Index as a proxy of chlorophyll a concentration, it was analysed to 1) characterize MPB seasonal variability and 2) estimate the impact of oyster removal on the spatial distribution of surrounding MPB biofilm. MPB showed marked seasonal variations with higher NDVI during spring and fall, in accordance with other studies on European mudflats. MPB biomass was generally higher around oyster reefs, forming clearly identified patches. However, MPB biomass around the reef where oysters were removed was significantly lower after the perturbation compared to a control reef. A few months after the experiment, MPB spatial distribution was also altered, therefore strengthening the hypothesis of the influence of oyster reefs on MPB development.

Keywords: Microphytobenthos, remote sensing, oysters, NDVI, spatial distribution, benthic microalgae, BACI, time series

*Speaker

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How remote sensing methods developed for the monitoring of chlorophyll a in highly turbid waters can help to study the resuspension of microphytobenthos from intertidal mudflats?

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Microphytobenthos (MPB) plays important roles in intertidal mudflats ecosystems, such as sediment stabilization and primary production. Remote sensing has been increasingly used to map MPB biofilms that develop during low tide at the surface of sediments. MPB is also resuspended in nearshore waters during ebb and flow, and remote sensing of chlorophyll a (Chla) in turbid waters can be used to complement the study of MPB in intertidal ecosystems.
In the present study, HySpex hyperspectral airborne and MERIS multispectral satellite data were used to investigate the spatial relationship (if any) between the Microphytobenthos Index (MPBI, Méléder et al, 2010) and the concentration of in-water Chla in two important intertidal sites of the French Atlantic coast: the Loire estuary and Bourgneuf Bay.

Because remote sensing methods usually applied to detect Chla in oceanic waters are inadequate in turbid coastal waters whose optical properties are actually closer to those of mudflats, we implemented algorithms that take into account the optical complexity of nearshore waters. Improvements were achieved in the atmospheric correction of MERIS data, as well as in the retrieval of in-water Chla concentration from marine reflectance.
This study is still in progress, but first results have already shown the continuity between high in-water Chla concentrations and the spatial distribution of MPB biofilms at the surface of sediments.

Keywords: Intertidal mudflats, Microphytobenthos, Chlorophyll a, Remote sensing

*Speaker

Hyperspectral imaging of the micro-algal diversity of oyster shells

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The wild oyster Crassostrea gigas has invaded western Europe in the last two decades creating oyster reefs in intertidal coastal areas. Recent studies showed the possibility to use hyperspectral remote sensing to map spatial distribution of wild oyster reefs. However, oyster spectral signatures systematically revealed intriguing chlorophyll absorptions bands at 632 and 673 nm. Our objective is to investigate the spectral diversity associated to oyster shells using spectroradiometric measurements combined to the determination of pigment composition by chromatography. Wild oyster shells were imaged using a HySpex VNIR 1600 imaging spectrometer in a laboratory. This sensor provides a spectral resolution of 4.5 nm in 160 contiguous channels between 400 and 1000 nm and a spatial resolution of 200 μm^2 per pixel. Vegetation indices and second derivative were calculated from spectra taken from 30 oysters growing horizontally in rocky areas. Pigments were extracted and measured by HPLC from crushed shells. Second derivative spectra showed specific feature peaks at dd548, dd650, and dd590, related to pigment absorptions of fucoxanthin, zeaxanthin and chlorophyll b respectively. Such pigments were detected and measured by HPLC in crushed shells and can be linked to the presence of diatom, cyanobacteria, and chlorophyte. Some reflectance spectra had absorptions bands characteristic of rhodophyte (e.g. phycoerythrin), but the hydrosoluble pigments were not detected by the HPLC protocol. This study reveals the microalgal diversity and biomass associated to oyster shells which may play a significant role in the primary production of a shellfish ecosystem.

Keywords: Oyster, microalgae, hyperspectral, pigments, microscale mapping

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High spatial resolution perspectives on an intertidal mudflat food web

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The high primary production of intertidal mudflats, especially of the superficial layer of microphytobenthos (MPB), provides a large potential food source to consumers, which include cultured oysters and invertebrates important as prey for fish and birds. Yet the trophic importance of MPB varies spatially relative to other resources, including phytoplankton and imported macrophyte material. Furthermore, the patchy distribution of MPB suggests, at least in places, that primary production can be in excess of in situ consumption. Here, MPB biomass may be exported and may support more distant food webs. An understanding of what may maintain these highly productive patches, and of the spatial interactions of MPB with local consumers, would thus help the management of mudflat aquaculture and fisheries. This study focusses on a representative locality within the Bay of Bourgneuf, the fourth most important bay in France for oyster aquaculture output. We have collected data at high spatial resolution and over multiple seasons, on community diversity and biomass, and use stable isotopes of carbon and nitrogen to reveal the pathways of organic matter compartments among consumers. Here we present preliminary data for one season. We describe spatial patterns in MPB and consumer biomasses and we quantify relationships between putative resources and consumers in a spatially explicit manner.

Keywords: food web, mudflat, stable isotopes, spatial analyses, MPB, benthic, invertebrates

*Speaker

Ecological status assessment in estuaries using diatom-based metrics: advantages, challenges and potential pitfalls

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Both the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD) require from EU member states to access the ecological quality of their water bodies based on physico-chemical and biological elements. Most member states have decided to use diatoms as proxies for the phytobenthos in rivers and streams, mainly because of a suite of well-developed and standardised methods are already in place and their relation to chemical environment is well-established. In estuarine and coastal waters, phytoplankton was selected as a main ecological indicator partly for similar reasons. However, in very turbid macro- or mesotidal estuaries, the phytoplankton based assessment metrics have not been particularly useful given that the link between nutrient concentrations and phytoplankton abundance and/or composition is often hidden by a light limited annual production. Moreover, a second biological element, that may be responsible for as much as 50% of total estuarine primary production, has been consistently ignored – the microphytobenthos (MPB). These transient diatom-dominated biofilms colonise the surface of intertidal flats during low tide and are, therefore, not affected by water turbidity. The current work explores the potential use of the MPB and, particularly, of its benthic diatom fraction as an additional biological element in the assessment of the ecological status in turbid estuaries. A review of the current state of MPB research will be presented, focusing on the advantages of using diatom-based metrics in estuarine systems as well as its challenges and potential pitfalls.

Keywords: Water Framework Directive, Marine Strategy Framework Directive, Ecological status, Diatoms, Microphytobenthos, Transitional waters, Intertidal flats

*Speaker

The secret life of benthic microalgae in tidal flats

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Despite being harsh environments, exposed to strong tidal currents and pronounced fluctuations in light, temperature and salinity, tidal flats teem with animal life. This is largely due to the presence of extensive biofilms of microalgae which inhabit the surface layers of tidal sediments. While the highly productive blooms of this so-called microphytobenthos are visible with the naked eye and even with satellites, many aspects of their biology and ecology are still shrouded in mystery. In temperate tidal flats, the microphytobenthos is dominated by highly diverse communities of diatoms. These communities are structured by environmental variability in e.g. hydrodynamic disturbance (creating silt-sand gradients), light climate and nutrients, which selects for growth forms that are each highly adapted to specific microhabitats. It is also increasingly becoming clear that various interactions between diatoms and other sediment biota such as bacteria and grazers also play an important role in structuring these microalgal biofilms. I will present examples of how the combined use of ecophysiological, molecular, imaging and chemical tools now enables us to advance our understanding of the complex diversity, biology and ecology of the microphytobenthos, and its functional role in tidal flat and coastal ecosystems.

Keywords: tidal flat, microalgae, microphytobenthos, diversity, function

*Speaker

Foraminifera and microphytobenthos responses to anthropogenic manipulation of a wild oyster reef

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Spatio-temporal distribution of foraminifera and microphytobenthos (MPB) related to sediment geochemistry was studied at the vicinity of two wild oyster reefs in an intertidal area of the French Atlantic coast. Partial release of organic and inorganic nutrients through oyster excretion enriches the nutrients fluxes leading to MPB bloom around the reef. In order to understand the consequence of the oyster input on the spatial structuration of the different benthic biological compartments, oysters from one of the two reefs were removed (5 tons) in July 2014, while the second one taken as a control, remained undisturbed. A time-series of satellite images has been analysed to describe the spatial structures of MPB around the reefs and it's dynamic. Around the reefs before and after the anthropogenic manipulation, we analysed the geochemistry of the sediment pore-water as well as the foraminifera. In this study, we show an impact of this anthropogenic manipulation on the early digenesis process and on the foraminifera and microphytobenthos compartments. Particular strong and quick responses of benthic foraminifera are recorded, suggesting the high potential of intertidal benthic foraminifera to monitor transitional marine environments. The decrease of the MPB biofilm around the reef where the oysters have been removed suggests the existence of a top-down control between MPB and oyster communities. This study shows that oyster reefs significantly modify the structure and functioning of adjacent intertidal sediment.

Keywords: oyster reef, microphytobenthos, foraminifera, geochemistry

*Speaker

Oceans and human health: toxic and pathogenic organisms

Exposure to the Paralytic Shellfish Toxins (PSTs) producer Alexandrium catenella increases the susceptibility of the oyster Crassostrea gigas to pathogenic vibrios.

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The multifactorial etiology of massive Crassostrea gigas summer mortalities results from complex interactions between oysters, opportunistic pathogens and environmental factors. In a field survey conducted in 2014 in the Mediterranean Thau lagoon (France), we evidenced that the development of the toxic dinoflagellate Alexandrium catenella, which produces paralytic shellfish toxins (PSTs) was concomitant with the accumulation of PSTs in oyster flesh and occurrence of C. gigas mortalities. In order to investigate the possible role of toxic algae in this complex disease, we experimentally infected C. gigas oyster juveniles with Vibrio tasmaniensis strain LGP32, a strain associated with oyster summer mortalities, after oysters were exposed to Alexandrium catenella. Exposure of oysters to A. catenella increased significantly the susceptibility of oysters to V. tasmaniensis LGP32. On the contrary, exposure to the non-toxic dinoflagellate Alexandrium tamarense or to the haptophyte Tisochrysis lutea used as a foraging alga did not increase susceptibility to V. tasmaniensis LGP32. This study shows for the first time that A. catenella increases the susceptibility of Crassostrea gigas to pathogenic vibrios. Therefore, in addition to complex environmental factors explaining mass mortalities of bivalve mollusks, feeding on neurotoxic dinoflagellates should now be considered as an environmental factor that potentially increases the severity of oyster mortality events.

Keywords: Harmful Algae, Environment, Interaction, Pathogens, Defense, Paralytic Shellfish Toxin.

*Speaker
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Early warning to reduce risks to human health due to toxic and pathogenic organisms

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Human health is affected by substances in marine waters in various ways. Health effects can be due to short term microbial pollution events or long term exposure to low concentrations of chemicals or micro-plastics in marine food stuffs. Plastics are emerging as a transport vector of toxic chemical contaminants and potential human pathogens pollution with increasing importance. Short term events of pathogenic organisms and algal blooms can cause diseases after bathing or shellfish consumption. Due to the short term and patchy nature of these events monitoring at weekly intervals or less is likely to miss the contamination events. Therefore early warning for bacterial pollution and algal bloom based on monitoring would require high-frequency measurements at many locations. With traditional methods this is very costly. Therefore alternative measurement methods are explored that would allow monitoring with sufficient spatial and temporal coverage at acceptable costs. Additionally to monitoring, the risk of microbial pollution can be estimated with models based on historic relations between data of contamination events and variables that can be measured more easily, such as meteorological and satellite remote sensing data. We have investigated these methods in several case studies world-wide. These include prediction of pathogenic pollution and algal blooms in bathing waters and aquaculture areas in the North Sea and Singapore coastal waters. Such early warning systems are expected to reduce threats to public health considerably.

Keywords: bathing waters, algal blooms, early warning

*Speaker

Changes of paralytic shellfish toxins in gills and digestive glands of the cockle Cerastoderma edule under post-bloom natural conditions

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Concentrations of the paralytic shellfish toxins C1+2, C3+4, B1, B2, dcGTX2+3, dcSTX, dcNEO, GTX2+3, GTX1+4, STX and NEO were determined by LC-FLD in composite samples of digestive glands and gills of Cerastoderma edule cockle. The specimens were sampled in Aveiro lagoon, Portugal, under natural depuration conditions (days 0, 8, 12, 14, 19, 21 and 25) after exposure to a bloom of Gymnodinium catenatum. Individual paralytic shellfish toxins indicated different pathways of elimination and biotransformation in digestive gland and gills. Toxin concentrations in gills were lower than in the digestive gland. Most of the quantified toxins in the digestive gland decreased during the 25 days of observation according to negative exponential curves, and only B1, B2 and NEO showed slight irregularities with the time. Concentrations of C1+2, C3+4 and dcGTX2+3 in gills decreased progressively with the time, however B1, B2 and dcSTX showed pronounced increases. Higher concentrations of those toxins in days 8 and 12 in comparison to the initial value (day 0) indicate conversion of other toxins into B1, B2 and dcSTX during those periods. It appears that inter-conversion of toxins occurs as G. catenatum cells are retained in gills before being transferred to other compartments.

Keywords: Paralytic shellfish toxins, Cerastoderma edule, Gills, Digestive gland, Depuration, Biotransformation

*Speaker

Spatio-temporal patchiness of harmful phytoplankton and associated toxins in two coastal embayments in the Ebro Delta (NW Mediterranean)

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Insights into population dynamics of harmful algal blooms (HABs) on a species level are crucial for effective mitigation of adverse effects on human health, marine ecosystems and socio-economic resources. Knowledge of habitat preferences, species assemblages, cell behaviour and toxigenesis, as related to physico-chemical parameters, is thereby necessary to interpreting environmental scenarios leading to bloom formation and decay. Modelling and prediction are expected to derive from comparative studies of algal assemblages in similar or divergent ecosystems – the approach of the GEOHAB project on HABs in Fjords and Coastal Embayments. Accordingly, the main objectives in the present study were to reveal harmful algal proliferation dynamics in two Ebro Delta embayments in a comparative approach, and to determine if agricultural freshwater inflow creates microniches favouring their development. Two major stratification patterns were revealed during seasonal weekly cruises in Alfacs and Fangar bays, whereby HAB species were heterogeneously abundant over depth and time, with profound changes within weeks. Nevertheless, in both embayments there was clear temporal relationship between species abundance and water stratification. Under this scenario, Dinophysis spp. were assigned to stratified regimes, whereas Karlodinium spp. corresponded to lower stratification. Karlodinium spp. were associated with moderate salinity and increasing temperature in both embayments. The potentially toxigenic diatom Pseudo-nitzschia was heavily represented in Fangar Bay regardless of regimes. Association of species types with favoured habitat regimes is worthwhile for HAB surveillance in the Ebro Delta, and interpretation from long-term datasets may be transferable for development of habitat models for other regions.

Keywords: Harmful algal bloom Phycotoxins Algal bloom dynamics Seafood safety Plankton monitoring

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†Speaker

Do the Oceans really affect your health and wellbeing?

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Over the last 20 years there has been growing interest in interconnections between the oceans and human health. Microbial contamination of seafood leading to cholera outbreaks and other diseases, together with poisoning associated with algal toxins consumed with fish and shellfish, underpinned early concerns. This has been added to over time by numerous life-threatening chemical pollution incidents in the marine environment. More recently, the dangers posed by increasingly severe and more frequent extreme events has fuelled calls for mitigation and adaptive measures to protect the maritime population. Coastal flooding in particular has led not only to physical injury and loss of life, but also to long term mental health issues. In this lecture, a critical assessment of the continued evolution of threats from diseases arising in the marine environment will be presented alongside a consideration of the benefits that can be accrued for health and wellbeing by the adoption of coastal lifestyles. As an increasing proportion of the global population move to live in coastal areas, how can we assess and balance the risks to health, where and how often will impacts occur and how will the development of coastal urban settlements affect health and wellbeing outcomes in the coming years? These issues, together with their implications for policymakers and politicians, will be discussed. Finally, the future of oceans and human health research will be considered with regard to the needs of policymakers, and for support of governance strategies.

Keywords: oceans, health, wellbeing, pollution, climate change, policy.

*Speaker

Contribution à l'étude des microalgues épiphytes dans les eaux côtières du golfe de Tunis : Cas des espèces du genre Ostreopsis.

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Depuis quelques décennies, la distribution des Dinoflagellés potentiellement toxiques du genre Ostreopsis se propagent exponentiellement dans les eaux Méditerranéennes. Ces espèces sécrètent des composantes toxiques connues sous le nom de palytoxines (PLTX) ou de PLTX-like qui sont susceptibles d'avoir de graves conséquences sanitaires et environnementales dans les eaux côtières, particulièrement dans les zones balnéaires en période de blooms. La distribution de ces microalgues toxiques dans les eaux côtières du golfe de Tunis a été réalisée en 2014 et 2015. Elle a montré une variabilité dans les concentrations d'Ostreopsis, notamment dans le site de Salammbô, où la concentration maximale a atteint 22029 cellules/g FW en 2014 et 380241 cellules/g FW en 2015, due essentiellement aux conditions environnementales (Température, photopériode, exposition, etc.) et la nature du substrat. Etant donné que l'identification des espèces d'Ostreopsis incriminées dans ces blooms est toujours problématique dans certaines régions de Méditerranée, une analyse morphométrique des cellules d'Ostreopsis présentes sur le site de Salammbô a été réalisée. Elle a montré une variabilité dans la taille des cellules (DV: 16.88μm - 48μm; AP: 9.8μm - 19μm). Ce rapport n'a pas permis de trancher entre Ostreopsis ovata et O. siamensis qui sont les deux espèces actuellement connues en Méditerranée. Une analyse moléculaire a donc été réalisée en utilisant les séquences de la région ITS afin de discriminer l'espèce présente sur les côtes tunisiennes.

Keywords: Ostreopsis spp., Dinoflagellés, Morphologie, Golfe de Tunis

*Speaker

Research on azaspiracids - marine biotoxins adversely affecting the Irish shellfish industry

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76% of all aquaculture production in Europe is conducted along the Western seaboard and is an important contributor to the economy for these coastal communities. One of the limiting factors for the industry is the occurrence of biotoxin producing algae on which the shellfish feed. These algae can accumulate in shellfish to toxic levels (for human health) over a very short time period. Quality assurance of the product, full compliance with regulations and efficient product samplings are vital to ensure that any food safety risks are fully controlled and only product of the highest quality reaches the market.

Of particular concern to the Irish shellfish industry are the azaspiracids (AZAs). AZAs were discovered following a poisoning event in the Netherlands in 1995 after people consumed contaminated shellfish harvested in Ireland. The symptoms included nausea, vomiting, diarrhea, and stomach cramps. AZAs are cytotoxic, teratogenic to fish embryos and suspected lung tumour promoters. AZA1, -2 and -3 were identified as the source of the illnesses and have been regulated in shellfish since 2002.

Here we describe efforts made through nationally funded projects ASTOX and ASTOX 2 to

*Speaker

deal with these issues. AZAs were purified from shellfish and phytoplankton in order to produce certified reference materials (for accurate monitoring) and to assess toxicology both in vitro and in vivo. Further research investigated the source organisms and ecology leading to the identification of numerous new dinoflagellate species and toxins.

Keywords: marine biotoxins, azaspiracids, ecology, toxicology, monitoring, LC, MS, shellfish

Removal of toxical microalgae and their toxins in artificial seawater by a combination of sand filtration / ultrafiltration and nanofiltration with the aim of drinking water preparation

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Water resources decrease in some places of the globe and the significant increase of human population intensifies the need for fresh water. Two main technologies are implemented to produce water for human consumption from seawater: thermal and reverse osmosis (RO) (=membrane processes). RO technique is the most used (61% of the market in 2012). But the main issue with RO is its great sensitivity to (bio)fouling that impacts on the membrane lifetime and therefore on the process costs. Then seawater pre-treatments are the keys to limit (bio)fouling, particularly in presence of harmful algal blooms. Currently severe increases of algal

*Speaker

blooms events in coastal regions are mainly due to Human activities leading to Eutrophication. Their impacts are dramatic on Aquaculture activities (shells contamination), Halieutic activities (fish mortality) and also for Seawater desalination (need specific pre-treatments). The water quality produce by the pre-treatment need a low fouling index, SDI15 $<$ 3 to limit dramatical (bio)fouling._
We have designed for the first a novel artifical seawater pre-treatment in 3 steps : sand filtration (SF) + ultrafiltration (UF) + nanofiltration (NF) with the following efficacy for microalgae removal : SF + UF $>>$ SF and SF +UF+NF $>>$ SF+UF alone in terms of SDI15, TOC, and toxins removal, with also a total softening and a partial demineralization due to NF, limiting scaling of RO [2].
S. Plantier, PhD thesis, 2013, ECNantes, 241 p. ; [2] M. Pontié M., J.S. Derauw, S. Plantier, L. Edouard, L. Bailly, Desalination and Water Treatment, 51 (2013) 485–494

Keywords: Harmful algal bloom, toxins, seawater pre, treatment, drinking water, RO, sand filtration, ultrafiltration, nanofiltration

Performances of a seawater desalination plant made up of a sand filter, ultrafiltration and reverse osmosis membranes during a planktonic bloom.

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The production of salubrious seawater is required for aquaculture and desalination fields even in case of micro-alga blooms. The present work investigates the performances (selectivity and production ability) of filtration plants with respect to dissolved and particulate (toxins, cells, etc) organic pollution coming from micro-algae rich seawater. The granular filtration of Heterocapsa triquetra cultures containing 10 000 to 17 000 cells.mL-1 is carried out using a bilayer sand filter with bed depth of 1100 mm, in constant flow-rate experiments. The average removal rate of micro-algae cells are 90% and 68% for 5 m.h-1 and 10 m.h-1 respectively. The turbidity is removed by more than 71% for 5 m.h-1 and 57% for 10 m.h-1. By increasing the superficial velocity, the retention probability by diffusion remains negligible, while interception increases from 84.6 to 91.5%, and gravitational contribution decreases from 14.5 to 7.85%. The ultrafiltration (UF) at 100 L.h-1.m-2 on PVDF membrane (0.03 μm) of the colloid and soluble parts of suspensions, the particle part would be removed by sand filter pre-treatment, induces high membrane residual fouling (20% of total fouling) and fouling velocity (50.108 m-1.min-1). Nevertheless, the permeate could feed a spiral-wound reverse osmosis membranes. The rejection rates of the total organic carbon, aromatic compounds and carbohydrates are equal to 45%, 48% and 60% respectively. The pristine or fouled UF membrane did not much retained the Paralytic Shellfish Poisoning (PSP) toxins of Alexandrium minutum culture contrary to the SW30 reverse osmosis membrane even in case of pronounced ageing.

Keywords: Granular filtration, Ultrafiltration, Reverse Osmosis, Desalination, Micro, alga, Toxin, Remediation

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Characterization of nematodes (Anisakidae) and their prevalence in most consumed fish in France sampled in North East Atlantic and Mediterranean Sea

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To better define the impact of fish parasites on consumers' health and to improve the safety of fish products, we set up the French national Fish-Parasites network (ANR-10-ALIA-004). Among parasites frequently present in edible fish, nematode larvae belonging to the Anisakidae family occur in numerous fish and cephalopods. These larvae may induce digestive and/or allergic symptoms in human. One aim of this project was to identify nematode species and to determine their prevalence in fish sampled on the basis of risk ranking analysis. Among the 18 fish species sampled in North East Atlantic and Mediterranean Sea, only one wild species, Pleuronectes platessa was not parasitized at all. Whereas all the farmed fish (sea bass and Atlantic salmon species) sampled were found not infected. On a total of 1768 sampled marine fish, 43.3% of them were not infected by nematodes. Regarding infected fish, 28.6% were contaminated in viscera organs, 23% in both visceral organs and fillets, and 5.5 % were infected by nematodes only on fillets. The five fish species with the highest prevalence of Anisakidae in their fillets were by decreasing values, Molva dypterygia, Lepidorhombus whiffiagonis, Pollachius virens, Lophius piscatorius and Merluccius merluccius. The Anisakidae infestation was highly dependent from the fishing area. Nematodes were mostly identified as belonging to the genus Anisakis, mainly A. simplex and A. pegreffii. Species belonging to other genera such as Pseudoterranova, Contracaecum and Hysterothylacium were also identified. Anisakis simplex was found in fish from all the studied fish areas except the Gulf of Lion.

Keywords: Anisakidae, risk ranking, nematode, fish, prevalence

*Speaker

Human Enteric viruses in various environmental matrices in the Northwest of Morocco

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Introduction: It has been clearly established that bacterial standards were not predictive of human virus to assess recreational water quality and the sanitary quality of shellfish. Our study investigates DNA and RNA viruses' concentrations in marine samples and evaluates a potential virus marker of human contamination.
Materiel and methods: A total of 72 marine samples were collected between 2006 and 2008 in the Mediterranean coast of Morocco. The water samples were concentrated by glass wool method then analyzed for human infectious enterovirus by integrated cell culture-PCR (ICC/RT-PCR) and by qRT-PCR for other enteric viruses.

Results: Human adenovirus, polyomavirus JC, Norovirus GII and rotavirus A were detected in 63, 57, 43 and 36% of lagoon samples respectively. For Norovirus GI, only 10 % of samples were revealed positive. Human adenovirus was detected in 60% while polyomavirus JC and Norovirus GII were detected in 10% of samples. All samples were negative for hepatitis E virus and hepatitis A virus. The infectious enteroviruses were detected in 40 and 36% of lagoon and seawater samples respectively. Sequencing analyses showed that these infectious enterovirus sequences belong to coxsackievirus B1. Mussels samples were positive for Rotavirus (83%) and none of the Norovirus were detected. Sediments were positive for Rotavirus A (33%) and Norovirus GI/GII (17%).
Conclusion: The results highlight the importance of viral parameters for assessing microbiological quality of recreational beaches and shellfish, as well as the potential risk of waterborne infections.

Keywords: Adenovirus, coxsackievirus B, enterovirus, Hepatitis A virus, Hepatitis E virus, Lagoon, Mussels, Norovirus GI/II, Polyomavirus JC, Rotavirus A, Seawater, Sediments.

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Microalgae blooms in the Channel - Watershed impact on toxic phytoplankton development

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The Eastern Channel French coast, between Normandie and Picardie, is under the influence of the unbalanced nutrients brought by the Seine plume, which trigger some coastal eutrophication. Two phytoplanktonic toxic events (ASP) that occurred between 2004 and 2011-2012 in the eastern Channel impinged on the scallop fishery in the Bay of Seine and induced the partial or total closure of the fisheries. During these events, the species Pseudo-nitzschia autralis was systematically observed in the water samples. The presence of the ASP toxin (domoic acid) is concomitant to a nitrogen excess with regards to the silicium or the phosphorus. Moreover, experiments show the relation between siliceous deficiency and domoic acid production. Human activities (agricultural and urban) in this region have a direct effect on the functioning of the coastal marine ecosystem. Indeed, the nitrogen excess is potentially accountable for marine eutrophication. Chemical fertilizers are the principal source of nitrogen in the ecosystem. Nevertheless, it is possible to reduce these nitrogen fluxes by reorganizing the agricultural-food chain and limiting over-fertilization. During two workshops of participative science called "atelier du futur", different scenarios of modifications/evolution of agricultural practices were built with all the users of the watershed and of the coastal sea. The coupling of a watershed model and a marine ecosystem model enables a better understanding of the scenarios impact on the eutrophication levels and toxic production in the sea.

Keywords: toxic microalgae, Pseudo, nitzschia, watersheds, nutrient loads, scenarios, marine ecosystem, modelling, participative science.

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Climate change of coastal and marine socio-ecosystems: risks, mitigation and adaptation

Assessment of climate change effects on corrosion of harbour steel structures

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Marine infrastructure plays a crucial role in the sustainable development of society. Nowadays, economic constrains require lifetime extension of these structures. Consequently, they could be subjected to more severe conditions related to climate change. This work aims at quantifying the climate change effects on the behaviour of harbour steel structures. We focus on two mechanisms at different scale: corrosion (material scale) and structural behaviour (material and structure scale). Concerning corrosion, the methodology accounts for an experimental database used to propose a predictive model. A finite element model is after integrated to study the mechanical effects on the whole structure. The results show that climate change could accelerate corrosion processes. This effect is particularly alarming at the anchoring zone where the mechanical bending moment is maximal. On the other hand, we found that the sea level rise decreased the maximum stress. Consequently, a comprehensive assessment of existing steel structures under new climate change solicitations is paramount to minimise maintenance costs and failure risks.

Keywords: Climate change, corrosion, steel, existing structures

*Speaker

Regulatory maps and territory perception: key investigations after Storm Xynthia on French Atlantic coast

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This talk deals with the realisation, evolution and application of regulatory maps at different scales, in a post-Xynthia context, between Loire and Gironde estuaries. Firstly, the analysis focuses on the TRI scale (Important Flood Risk Areas, TRI i.e. Territoires à risque important d'inondation in French). According to the Directive 2007/60/EC of 2007, they were realised since 2012 in order to identify areas where stakes were the most important in case of coastal flooding. However, the delimitation of these areas can be questioned, especially in regard to impacted areas during storm Xynthia. At a finer scale, Risk Prevention Plans (RPP) are settled since 1995. They are regulatory maps which allows or forbid urbanisation in potentially flooded areas. These documents raise another question: how RPP take into account TRI maps? How RPP maps can evolve with TRI maps? How important is the difference between the reality of potentially flooded areas, and those delimeated in RPP or TRI? To deal with these questions, the situation of three areas will be analysed: Chateillon-Plage, La Faute-sur-Mer and Noirmoutier Island. In fact, all these questions involve social issues, such as the risk perception of the different stakeholders and inhabitants of those different territories. Participatory maps are a tool to analyse the perception that stakeholders and inhabitants have of their territories and how they assess coastal flood risk. Are the different regulatory maps in accordance with the perceived risk by the local stakeholders and inhabitants? How do they deal with the different regulatory maps?

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Keywords: Coastal flood, Regulatory Maps, Territory perception, Storm Xynthia, French Atlantic coast

Phaeodactylum metabolism converges to phosphoenolpyruvate formation during growth under different light conditions

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Gigatons of CO2 are yearly converted into organic compounds by photosynthetic organisms and diatoms are among the most important contributors in this process. Both the capacity of carbon fixation and the fate of fixed carbon are strongly impacted by the environmental factors. Because light can constitute a stressful factor when present in inadequate amount, various mechanisms have been developed by diatoms to adapt very efficiently to changing irradiance. The molecular mechanisms on which light acclimation in diatoms relies remain largely unknown. To obtain further information on these mechanisms, the impacts of different growth photon flux densities (30 (LL), 300 (ML), 1000 (HL) μmol m-2 s-1) were studied at the physiological, biochemical and molecular levels in the model diatom Phaeodactylum tricornutum. The integrated results indicate that the impact of ML and HL on diatom cells were similar but quite different from LL. In addition of light and growth phase could affect pigments concentration and primary metabolites. The trend of gene expression coding enzymes in central carbon metabolism pathways differed under LL, but the orientation of the metabolisms was toward either phosphoenolpyruvate (PEP) or pyruvate formation under all three light intensities. LL provided a condition for cells to accumulate chrysolaminarin and lipids, while ML mostly stimulated lipid synthesis. A significant increase in the amount of proteins was observed under HL. We concluded that PEP and pyruvate are key intermediates in diatom to synthesis valuable compounds such as lipids, proteins, aromatic amino acids and polyphenolics.

Keywords: carbon metabolism, stress physiology, diatom, light stress, metabolic reorientation

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Impact of CO2 supply on the orientation of carbon metabolism in the diatom Phaeodactylum tricornutum

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Atmospheric carbon dioxide is expected to rise from current levels of 400 μatm to 700-1000 μatm by the end of this century, beyond the levels of the past 800,000 years of glacial-interglacial periods. Additional CO2 into seawater could perturb the physiological processes of marine phytoplankton, including growth, photosynthesis and metabolic re-allocations. In particular, diatoms are biogeochemically important because they contribute up to 40% of the marine primary production and show relatively high carbon sequestration. The goal of this study was to evaluate the impact of the CO2 supply on the marine diatom Phaeodactylum tricornutum using a continuous turbidostat bioreactor. Two different pCO2 levels, 400 μatm (C-) and 1000 μatm (C+) were applied during a transition C+/C-/C+ of 60 days during which physiological (growth, photosynthesis, respiration, pigmentation) and molecular (RNAseq, qPCR) responses were followed. The results showed that growth rate and respiration were enhanced in C+. Parameters of the fluorescence showed that high CO2 supply could improve the efficiency of the photochemical and biochemical phases of photosynthesis as illustrated by the decrease of the non-photochemical quenching (NPQ), suggesting a reduced demand in dissipation of excess of energy. Molecular data indicate that 534 genes are up-regulated while 377 down-regulated in the C- condition. Carbon acquisition is particularly reinforced in C- through the activation of the CO2 concentration mechanism. Also several transcripts coding for proteins involved in cell cycle regulation were highlighted. The quantity of carbon accumulated in cells during the experiment seems to reflect a tendancy to restore the initial equilibrium.

Keywords: carbon dioxide, carbon metabolism, diatom, RNAseq, physiology

*Speaker

Providing for changing climate in bridge planning

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City of Helsinki will enlarge in surrounding archipelago during next ten years. Approximately 80 000 inhabitants are planned to move on the islands to live and work. New connection to downtown is planned over the sea. This connection needs, among the others, four new bridges with total length of 2 000 m, while the longest one is 1 200 m. Construction of this new connection will start during 2018.
Target service life for all planned bridges is 200 years. This is twice related to normal bridges and service lives dealt with national design codes. Finnish Meteorological Institute has made projections how Finnish outdoor climate will change by 2100. Climate will be harsher for concrete structures in many ways: precipitation will increase app. 30-40 %, and it will be mostly liquid also in winter, wind speed will be 10-20 % higher and storm events 3-4 times more often than today, sea level is forecast to be 1,6 m higher and carbonation of concrete will increase because of higher CO2 content in the air. The number of freeze-thaw cycles will decrease, but with higher amount of rain during winter, the total stress could be harmful for concrete.
This paper discusses how changing climate will be taken into account in construction planning of bridges with exceptionally long service life.

Keywords: climate change, concrete, service life, degradation

*Speaker

Scour and erosion investigation by jet erosion test and statistical analysis

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The risk management of dike, bank, bridge scour and road embankment require the assessment of the erosion of fine soils. Climate change could induce the increase of hydraulic loading and such structures are characterized by their great length and the large heterogeneities of the soils which compose them or their foundations. With the objective to contribute to the safety assessment of these structures, various researchers developed different testing devices for characterizing the sensibility of erosion of fine soils. Among these testing devices, the Jet Erosion Test (JET) is commonly used because it can simplify studies on low plasticity soils or on saturated soils. Another advantage of the JET is related to the possibility to use it on site, in order to measure the intact resistance. A new energy analysis of the test is developed, relating the total eroded mass to the dissipated fluid energy, and a new erosion resistance index is proposed. The erodibility is evaluated for twelve natural soil specimens which are compacted with the Proctor protocol. They represent a large range of erosion sensitivity. A wide dissipated hydraulic energy scale appears and a statistical analysis is carried out which gives a correlation of the erosion resistance index with three physical parameters. Thus, this method allows reducing the number of variables for the description of the erosion sensitivity.

Keywords: scour, erosion, jet erosion test, cohesive soils, energy, statistical analysis, water flow

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Modeling chloride transfer under climate change conditions. Contribution to the reliability assessment of service life for reinforced concrete structure

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Climate change and global warming effects occur in various forms: rising seawater, and changes on temperature and relative humidity. Climate change has complex consequences, especially in the long term, might lead to an acceleration of degradation processes of concrete structures. In order to better understand how changing climate might affect concrete infrastructure, we need to combine accurate data and mathematical models that describe correctly the mechanism of transport of aggressive agents and corrosion propagation. Experimental and numerical studies in the literature found that the weather conditions influence the chloride penetration, which lead to earlier corrosion of reinforced concrete. To deal with these problems, structures should be adapted from the design phase against climate change. The knowledge of transport phenomena allows civil engineers to make a good decision in maintenance strategies of structures. This present work thus focuses on the development of a numerical model for the prediction of service life of reinforcement concrete in tidal zone under climate change and global warming. A realistic numerical model of chloride transfer, accounting for intrinsic concrete properties such as permeability and capillarity, is thus developed. The first results show that the chloride transfer is accelerated under wetting-drying cycles and is also influenced slightly by daily climate change (temperature and relative humidity). The use of a simplified model such as Fick's law can underestimate chloride ingress, which might lead to a bad prediction of corrosion initiation. The results also suggest the elimination of some terms of the chloride transfer equations for certain climate configurations.

Keywords: climate change, chloride transfer, corrosion, reinforced concrete, reliability

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Risk Analysis of Infrastructure Networks in Response to Extreme Weather including the Effects of Climate Change

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In recent years, a variety of extreme weather events, including droughts, rain induced landslides, river floods, winter storms, wildfire, and hurricanes, have threatened and damaged many different regions across Europe and worldwide. These events can have a devastating impact on critical infrastructure systems. In response to this the European Union has funded a research project focused on **R**isk **A**nalysis of **I**nfrastructure **N**etworks in Response to Extreme Weather (RAIN). The RAIN vision is to develop a systematic risk management framework that explicitly considers the impacts of extreme weather events on critical infrastructure and develops a series of mitigation tools to enhance the security of the pan-European infrastructure network. The project quantifies the complex interactions between weather events and infrastructure systems. The outputs of RAIN aid decision making in the long term, securing new robust infrastructure development and protection of existing infrastructure against changing climates and increasingly more unpredictable weather patterns. This is achieved through developing an operational analysis framework that considers the impact of individual hazards on specific infrastructure systems and the coupled interdependencies of critical infrastructure through robust risk and uncertainty modelling. The framework considers cascading hazards, cascading effects and time dependent vulnerability in developing practical software tools and guidelines that provide support to European infrastructure managers in the event of an extreme weather event occurring to minimise the impact of extreme events by developing mitigation and response strategies. This paper will present the RAIN project.

Keywords: Risk Analysis, Infrastructure Networks, Extreme Weather

*Speaker

The effect of climate change on freeze-thaw durability of concrete structures in Finland

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Lahdensivu presented in his Doctoral Thesis (Durability Properties and Actual Deterioration of Finnish Concrete Facades and Balconies, 2012) that without proper air-entrainment outdoor concrete structures have needed average of 307 freeze-thaw cycles (threshold value: t $\leq$ -5 ∘C) after a rain event in southern Finland and 388 cycles in inland for incipient freeze-thaw damage to occur. The difference between figures can be explained by the greater amount of wind-driven rain (WDR) before the freeze-thaw cycle on coastal areas.
As a consequence of climate change it has been shown that by the end of the century, the amount of WDR is going to increase 30 % at southern Finland and 40 % at inland. At the same time the amount of freeze-thaw cycles after a rain event are decreasing significantly at both locations which indicates freeze-thaw durability-wise longer service life for outdoor concrete structures. However, the latest studies show that while the amount of freeze-thaw cycles is decreasing, the amount of WDR before the cycles is also increasing significantly.
The WDR at winter time in Finland is highly orientated on west to south-east directions which can be seen also by the degradation rate observations of concrete facades and balconies based on condition assessments. In this study, the changes at WDR before the freeze-thaw events and the effect of climate change on them depending on the structure orientation are calculated to estimate the changes of climatic stress level on outdoor concrete structures.

Keywords: climate change, freeze thaw attack, wind driven rain, concrete

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Impact of Climate Change on Reliability of Electric Power Distribution Systems Subjected to Hurricanes in Coastal Regions

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Coastal communities are vulnerable to the impact of extreme weather events such as hurricanes. Such events have caused extensive damage to infrastructure such as power distribution systems over the years. Investment in the power sector is considered a long-term investment due to the service life of the assets. It is, therefore, imperative for utility companies to consider the uncertainties inherent in such long-term investments that will impact return on investment as well as customer satisfaction. One such uncertainty is the potential impact of climate change on hurricane hazard in coastal areas. There is, therefore, a need for a framework to assess the risk as well as investigate various adaptation strategies for power distribution systems subjected to hurricanes with consideration of the potential impact of climate change. This paper presents a framework for evaluating the impact of climate change on power distribution systems subjected to hurricanes. The framework includes a time-dependent hurricane simulation modeling that considers the effect of climate change, system reliability evaluation with time-dependent component fragility, various adaptation strategies, and life cycle cost analysis to study the cost-effectiveness of such strategies. The framework is demonstrated using a notional power distribution system of a city assumed to be located in the hurricane-prone east coast of Florida in the U.S.

Keywords: Climate change, Hurricane simulation, Adaptation, Life cycle cost, Reliability, Power distribution systems.

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Blue growth from marine bioresources and biotechnologies

Can microalgae biodiesel be a part of the solution to meet the sustainability objectives in transport sector in France by 2030 ? A range based Multi-Actor Multi-Criteria Analysis

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France set an ambitious target of a mix of 15% of renewable energy in transport sector by 2030, mostly based on the contribution of first and second generation biofuels. According to Ribeiro et al. (2015), microalgae biofuels might represent from 1 to 5% of the worldwide fuel consumption by 2030 but French government do not include it as a relevant option. Based on this observation, a participatory decision-making framework, namely the range-based MAMCA, has been deployed to address the following question: Can microalgae biodiesel be a part of the solution to meet the sustainability objectives in transport sector in France by 2030? The deployment of biofuels is at the crossroad of agricultural, energy and environmental policies. Consequently, dealing with biofuel policy requires addressing complex problems featuring multiple interests and perspectives, conflicting objectives, different forms of data and information, high uncertainties and the need to account for evolving socio-economic systems. The proposed method explicitly considers the different and occasionally conflicting stakeholders' values at an output level of aggregation, which in our case study includes feedstock producers, biofuel producers, refining industry, fuel distributors, end-users, car manufacturers, government, NGOs and associations. By means of a Monte Carlo analysis, the method also provides an exploratory scenario approach by considering the uncertainty about the context evolution and the biofuel impacts that include economic, social, environmental, technical and legal issues. Microalgae biodiesel proves to partly suit the stakeholders' values; consequently, the paper proposes an implementation pathway for the deployment of microalgae biodiesel in France by 2030.

Keywords: Microalgae biodiesel, multi, criteria analysis, multi, actor analysis, decision making

*Speaker

Characterization of the lipid fraction of grinded stressed Parachlorella kessleri and formulation of a representative synthetic mixture, to initiate the study of lipids concentration by membrane filtration

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Nitrogen starving Parachlorella kessleri can accumulate lipids up to 45% (w/w) of the dry matter (Montalescot, 2015), mainly triacylglycerides (TAG). Those lipids can be recovered using a mechanical cell disruption process followed by membrane filtration, but the surface properties of lipid droplets stabilized by the polar compounds deeply impact the oil separation. In order to study the influence of the interfacial phenomena on the lipids fractionation by membrane processes, a synthetic mixture, based on the lipids profile of different suspensions of disrupted P. kessleri has been defined.

The total fatty acids profile from the microalgae samples was obtained by GC-FID. Lipids were mainly composed by oleic (22-35%), linoleic (20-27%), linolenic (21-22%) and palmitic (14-20%) acids. The analysis of the polar fraction by HPTLC let to the identification of phosphatidylcholine-PC (27-31%), phosphatidylethanolamine + phosphatidylglycerol + sulfoquinovosyldiacylglycerol PE+PG+SQDG (25-34%) and digalactosyldiacylglycerol-DGDG (9-17%).

The synthetic mixture, an o/w emulsion composed by water, neutral and polar lipids (2% w/w of lipids), was obtained using a high shear roto-stator homogenizer. It was used to test several hydrophobic and hydrophilic membrane materials (PES, PVDF, PAN) ranging from microfiltration to ultrafiltration cut-off. Membranes of interest were chosen considering their performances in terms of permeate fluxes and oil retention. First results showed for most of the tested membranes a high oil rejection. Coalescence of oils droplets seems to appear beyond 10% (w/w)

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of oil in the retentate. To get the information on how the interfacial phenomena influence the lipids separation by membrane processes further filtration tests are required.

Keywords: microalgae, membrane filtration, lipids fractionation, lipids profile

Determination of the biochemical composition of proliferative macroalgae by IR spectrometry

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Some species of brown algae belonging to the family Sargassaceae are plentiful on the coasts of temperate and tropical environments and their proliferation is hardly to be mastered still nowadays. It raises environmental problems with regard to the native biodiversity and to the grounding of these seaweeds on beaches, hampering several economic activities. One way of fight against these seaweeds is the collection then the valuation of these seaweeds, which produce potentially active substances.

The study aims at understanding the effect of the seasonality and the geographical localization on the biochemical composition of the introduced brown macroalga Sargassum muticum in order to mastering the ways of valuation. The evolution of the biochemical composition of seaweeds is followed by biochemical assays and by Infra-Red spectrometry analysis.

IR spectroscopy is a non-invasive technique which allows characterizing biochemically a raw biological sample, according to the signals registered for the main chemical functions present within the analyzed matrix. This simple and fast technique constitutes an alternative to the biochemical assays that are sometimes long and too complex, at the condition to identify correctly the molecules contributing to the bands of vibration constituting these IR spectra.

We so collected every month during two years the samples of macroalgae on various sites in South Brittany. Analyses by IR spectrometry were performed on freeze-drying samples of seaweeds. The multivariate analysis of the data suggests that relations exist between environmental parameters (sunshine durations, temperatures, exposure of the site) and the biochemical composition of the samples.

*Speaker

Keywords: Infra Red spectrometry, biochemical composition, proliferative macroalgae, Sargassum muticum

Seaweed liquefaction and R-Phycoerythrin recovery by the use of an ultrasound-assisted enzymatic hydrolysis process: The case of the alien Grateloupia turuturu

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Among the numerous processes used in marine biotechnologies, enzymatic hydrolysis exhibits a great potential to improve extraction of bioactive compounds from seaweeds. In recent years, several articles in various research areas put forward the improvement and simultaneous stimulation of the enzymatic hydrolysis by ultrasound (UAEH). Indeed, the use of ultrasound in conjunction with enzymes can increase the yields of extraction of valuable biomolecules from plants, compared to conventional methods. Currently, there are very few works on this combined process on seaweeds, particularly wet ones.
Our work is focused on underexploited, proliferative alien red seaweed found on Brittany coasts, Grateloupia turuturu. The goal of our study is to develop an UAEH process using 4 industrial enzymes and an original ultrasonic flow-through reactor. The experiments of simultaneous combination enzymes/sonication (UAEH), sonication and enzymatic hydrolysis were conducted in triplicate, two temperatures were tested (40-22 ∘C).

Our results highlight the great potential of UAEH in seaweed liquefaction rather than enzymes or sonication alone. After 4 hours of this treatment at 40 ∘C, up to 90 % of primary material was recovered into soluble phase. Biochemical analyses of those resulting phases revealed enrichment in carbon and nitrogen compounds, more precisely, carbohydrates and amino acids.
This original and innovative process is clearly an efficient procedure for the liquefaction of wet seaweeds, enabling the recovery of valuable components.

*Speaker

Keywords: seaweed, enzymes, sonication, process, liquefaction

The emergent Multi-use Offshore Platform (MOP) concept : an real opportunity for offshore aquaculture

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Multi-use offshore platforms combining renewable energy, aquaculture and transportation facilities can be considered as a challenging way to boost blue growth. This new offshore modular platform concept to support marine and maritime activities combined in circular economy will be presented and illustrated by the French Guyana case study. It intends to collocate in a sustainable way, logistical activities with marine renewable energy, offshore service supports and offshore aquaculture. Concerning aquaculture, MOP concept is considering an integrated approach, from juvenile breeding and fish feed production to farm support, in situ biomass transformation and reefers transshipment onboard the platform.
Within 10 nautical miles around the MOP, an important marine space can be dedicated to integrated multi-trophic aquaculture, with several farms operated and supported from the platform. The MOP facilities will also support fisheries activities, providing replenishment, catering, maintenance and facilitating fishing waste treatment. Micro-algae cultivation could be also associated with the Mop's infrastructures. Integration of offshore aquaculture within a circular economy on the open sea built around platforms remains to establish. In case of success, conflicts of uses bound to littoral aquaculture would be got over and ocean could probably make a bigger contribution in front of stakes in the food transition.
This original way of aquaculture development is based on recent collaborative research works, within European projects such as FP7 Tropos or H2020 Blue Growth framework. It is an ongoing multi-actors process that is addressing the 6 Pestel analysis axis together, with a present focus on multi-disciplinary methodology and barriers identification.

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Keywords: MOP, offshore aquaculture

Geographical analysis for the integration of a microalgae production and biorefining unit in "Pays de la Loire"

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Microalgae are photosynthetic species able to transform carbon dioxide, for example from combustion processes, into biomass and valuable molecules (lipids, proteins, antioxidants, polysaccharides etc.).
The team "Marine bioprocesses and separations" of GEPEA laboratory has been developing an integrated approach to valorise microalgae, from the culture to the biorefinery, for several years. A new collaboration was build with geographers (LETG-Nantes) to explore the French geographic areas where an industrial microalgae production and biorefining unit could be built.

A database on the scale of metropolitan France was realized including the parameters for the culture of microalgae (light, water, carbon dioxide, nitrogen, phosphorus, heat, available lands). Three sizes of production unit were taken into account to identify potential zones of installation. Maps were then produced to compare the most interesting sites. This first work was followed by a second, to study more details on the coast of Pays de la Loire. Besides the choice of the site, new criteria were added: regulatory requirements in the installation, perception of the project by local actors (local authorities, public, neighbourhood) that must be known to prepare a local integration.

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Keywords: microalgae production and biorefining, geographical study, mapping

Enhancement of R-phycoerythrin extraction from Mastocarpus stellatus by the use of enzymatic hydrolysis

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R-phycoerythrin (R-PE) is the major phycobiliprotein in the red algae. R-PE can be exploited for pigment extraction and utilization such as natural colorant. Mastocarpus stellatus, abundantly found in French Brittany coasts, is known as a rich source of carrageenan and protein. In this study report, Mastocarpus stellatus is also investigated as a potential source of R-PE. The algae pretreatment is one of the important stage of the extraction procedure and determine the final extraction yields. In this study, the highest algal conditioning is achieved from freeze-dried seaweeds and grinding with liquid nitrogen. Indeed, R-PE extraction from the algal freeze-dried increased more three times than the wet algae. R-PE extraction from most seaweed is difficult due to the presence of large amounts of anionic cell-wall polysaccharides. Based on the algal cell wall degradation, enzymes are able to improve the extraction of R-PE. According to our results, action of enzymes degrading these polysaccharides is effective for the extraction R-phycoerythrin from M.stellatus. Using algal freeze-dried and different cell-wall-degrading enzymes have brought about the most interesting results for R-PE yield than algal thawed, especially using the enzyme xylanase. This preliminary step is then followed by the optimization of hydrolysis condition (enzyme substrate ratio, temperature and pH) by the mean of experimental design. After using the method response surface methodology, the R-phycoerythrin of algal freeze-dried extraction yields is 2.2 times greater than without enzyme treatment, 1.8 times greater than without optimization which could be considered as a good potential for the valorization of this biomass.

Keywords: R, phycoerythrin, Mastocarpus stellatus, Enzyme xylanase, Extraction

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Algal Biofuels on the verge of deployment: What's Left and What's Next ?

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Algae are ubiquitous primary producers with rapid growth. They only need light, mineral nutrients and water to generate biomolecules through photosynthetic capture of atmospheric CO2. In the last decade, algal biomass has received a steadily increasing attention. Originally, this interest stemmed from the promises that microalgae hold as a potentially sustainable renewable raw material for biofuels and biobased chemical intermediates. The scientific and technical challenges related to domestication and large-scale production of algae have become a hot topic throughout the world for many fundamental and applied research projects. Several industrial ventures have also bloomed in many countries. Some faded in their early years of operation, others have reoriented their business towards specialty markets with higher added value. Nevertheless, a limited number of them are still focused on producing algae for fuel and chemical purposes. Although located in diverse regions of the world, these few projects that still stick to their original "algae-to-biofuel" rationale share several common points. Within our presentation, the technical options for cultivation, harvest and conversion of algae into biofuels will be reviewed and compared, with emphasis on those which are still considered as potentially viable in the long term. Future research needs and opportunities will also be highlighted.

Keywords: Algue, biocarburant, biotechnologie, chimie, renouvelable

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Optimization of the hydrodynamics in a high volumetric productivity photobioreactor

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The photobioreactors technology can be intensified by reducing the thickness of the flat photobioreactors (Souliès, 2014). This operation will allow to reduce the amount of water used for the process and in the same time to decrease the operating costs. In these high volumetric productivity photobioreactors, the hydrodynamics is unusual because of the confinement and the rheological behavior of the liquid phase (Souliès, 2014). Another problem to solve is the significant biofilm development on the surface of PBR (Krohn-Molt et al., 2013) which is responsible for the decline in light intensity passing through the PBR. The consequence of this phenomenon is the productivity decrease.

As a consequence, this work focuses on:

-understanding the role of bubbles on the parietal phenomena in confined bubble contactors, using electrochemical measurements, particles image velocimetry and shadowgraphy.

-hydrodynamic optimization to limit the development of biofilm on the surface of photobioreactors and reduce the stop frequency for the cleaning of such systems.

The electrochemistry experiments showed that injection of air through a capillary (slightly oscillating small bubble) was better than a T-injection (confined large bubble). Indeed, we noticed that for the same inlet air flowrate in confined bubble contactor, fluctuations and the average shear stress were higher with a capillary injection which is expected to prevent the development of biofilm. Having characterized the parietal phenomena for different hydrodynamic conditions, they were then tested on a culture of Chlorella vulgaris to verify if they can delay the onset of biofilm on the channel walls.

Keywords: Intensification, hydrodynamics, biofilm, photobioreactors, bubbles, high productivity

*Speaker

Algae within Galician farmlands: popular knowledge and science for sustainable development

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Algae washed ashore have been traditionally used in Galicia (NW Spain) as fertilizers for agriculture purposes, with emphasis on coastal and close by farmlands. This large use responds to: first, the rural knowledge on the positive effects of algae on farmlands due to their soil-improving properties (e.g. protection against erosion and overcompaction, and improvement in water-retention capacity) and crops-growth-enhancing properties (e.g. richess in nutrients and biostimulation power); second, the high abundance of algae in Galician shores. This nothwithstanding, algae have nowadays become a non-exploited resource in Galicia, being sometimes considered as simple waste. As against this regard, some researchs have recently found out evidences supporting the high value of algae as organic fertilizers. Taking into account the lack of organic fertilisants in the market, algae may constitute a highly remarkable resource for an enduring sustainable exploitation in Galicia.

Methods
Aiming towards a multidisciplinary approach, three different targets were surveyed: two soil scientists studying the potential value of algae as efficient organic fertilizers; an historian studying the role, relevance, and social implications of algae within Galician farming areas throughout its history; two peasants still using algae as farming fertilizers.

More info
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Keywords: Agriculture, algae, green economy, organic fertilizers, popular wisdom.

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New marine molecules

Chemical characteristics and potential biological activities of a novel sulfated polysaccharide isolated from blue-green microalgae (Arthrospira platensis)

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Polysaccharides synthesized by microalgae can be used as the functional ingredients of food or drugs. Here, we isolated a novel sulfated polysaccharide from marine blue-green microalgae Arthrospira platensis, and its physicochemical characteristics and biological properties were investigated. The sulfated polysaccharide was extracted by papain digestion followed by cetylpyridinium chloride and ethanol precipitation and was subjected to anion exchange chromatography. Physicochemical characteristics of sulfated polysaccharide were determined using size exclusion chromatography combined with multi-angle light scattering (SEC-MALS), viscosimetry and infrared spectroscopic analysis. Monosaccharides analysis revealed that sulfated polysaccharide was composed of rhamnose, xylose, mannose and uronic acids. The antioxidant potency of sulfated polysaccharide was evaluated by several different in vitro systems, including DPPH free radical scavenging (73.84% at 200 μg/ml), hydrogen peroxide-scavenging (67.92% at 150 μg/ml), reducing power (12.63% at 300 μg/ml) and β-Carotene bleaching inhibition ((54.62% at 450 μg/ml). ACE-inhibitory activity of sulfated polysaccharide was also investigated (45.51% at 500 μg/ml). Further, the anticancer activity was tested against HeLa and HCT116 cell lines by

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MTT assay and the maximum antiproliferative capacities of 53.17% and 69.64% were recorded at 200 μg/ml, respectively. In vitro anticoagulant assay indicated that sulfated polysaccharide effectively prolonged the activated partial thromboplastin time and thrombin time. The anticoagulant property of the sulfated polysaccharide was mainly attributed to powerful potentiation thrombin by heparin cofactor II. These results indicated that the isolated sulfated polysaccharide from A. platensis had potent antioxidant, antihypertensive, antiproliferative and anticoagulant activities, and could be a promising candidate for future application as dietary ingredients.

Keywords: Arthrospira platensis, Sulfated polysaccharide, Chemical characteristic, biological activities.

Lipidomic approach to explore chemodiversity in Acremonium marine-derived strains

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Lipids are involved in cell recognition mechanisms, transmembrane signaling, growth and cell differentiation. Therefore, they are considered as particularly interesting biologically active molecules. Interest in oleaginous microorganisms (yeasts, bacteria, algae and fungi) is currently increasing because they are considered as a renewable source of lipids through fermentation process. Among these organisms, marine-derived fungi represent an undeniable and under-explored source of potential lipids for health and nutrition. Recent studies have reported the isolation of antitumoral cerebrosides – a class of glycolipids – from marine-derived fungi. After a large screening within our marine-derived fungal collection, 13 Acremonium sp. strains were selected and grown on Dextrose Casein Agar medium. Lipid crude extracts were separated into lipid classes using open silica gel column chromatography, and the glycolipid-enriched fractions were profiled by GC-MS as-well-as by HPLC-IT-TOFMS using lipidomic approaches. Moreover, these fractions have biological activities when evaluated on KB cells. One strain, Acremonium sp. MMS540, showing the lowest IC50, was chosen to conduct an OSMAC approach using six different culture media. Promising activities (IC50 between 7 and 48 μg/mL) were observed for the six glycolipid-enriched fractions. Lipidomic approach was performed to correlate chemical diversity and biological activity.

Keywords: Lipidomic, glycolipids, chemodiversity, cerebrosides, biological activity, Acremonium strains, KB cells

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Novel benzoyl analogs from the dinoflagellate Gymnodinium catenatum: importance of these emerging toxins in seafood safety regulatory programmes

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Gymnodinium catenatum is a chain-forming naked gymnodinoid dinoflagellate, notorious for formation of harmful algal blooms (HABs) and production of paralytic shellfish toxins (PSTs), including a wide array of neurotoxic analogs of saxitoxin (STX). G. catenatum is distributed globally, but occurs primarily in temperate and sub-tropical waters. Blooms of this dinoflagellate have caused poisonings of marine fauna and human consumers of mollusks that have accumulated toxins via suspension-feeding upon the plankton. Increased search efforts, linked to improved detection and structural elucidation techniques, have led to discovery of new groups of STX analogs, named GC or benzoyl analogs, in G. catenatum. We fractionated extracts of bulk G. catenatum cultures by column chromatography and analyzed semi-purified extracts by hydrophilic interaction liquid ion chromatography coupled with tandem mass spectrometry (HILIC-MS/MS) and nuclear-magnetic resonance (NMR). We confirmed the presence of 15 of the 18 theoretical benzoyl analogs, in G. catenatum isolates from the Pacific coast of Mexico. Although this group of toxins has been recorded in many strains worldwide, this is the first record of such high richness of these analogs. To date G. catenatum is the unique source organism of benzoyl analogs but they can also accumulate in shellfish. Mammalian toxicity is unknown but some studies suggest neurotoxicity. Benzoyl analogs are not routinely monitored in shellfish and this might be a risk in seafood safety programmes that rely exclusively on chemical analytical methods. Research on these emerging toxins to determine bioactivity, chemical properties, and ecological and human health risks, is therefore imperative.

Keywords: Gymnodinium catenatum, paralytic shellfish toxins, benzoyl analogs, toxicity.

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PharmaSea: increasing value and flow in the marine biodiscovery pipeline

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PharmaSea focuses on obstacles in marine biodiscovery research, development and commercialization and brings together an interdisciplinary team of academic and industry researchers to address and overcome these. PharmaSea is demonstrating how to widen the bottlenecks and increase the flow of ideas and products derived from the marine microbiome towards a greater number of successes in a number of application areas.
Despite the tremendous potential of marine biodiscovery, exploitation, particularly at a commercial scale, has been hampered by a number of constraints. These relate to access, organism genetics, compound isolation, structure elucidation, early validation of bioactivity and best mechanisms of flowthrough into exploitation. PharmaSea is solving these bottlenecks by developing essential actions beyond the state-of-the-art and linking them with best practice and pragmatic approaches. The pipeline structure established within PharmaSea processes a wide genetic basis including marine microbial strains from extreme marine environments to produce new products with desirable characteristics for development by commercial partners in three market sectors, health (infection, inflammation, CNS diseases). The global aim of PharmaSea is to produce two compounds at larger scale and advance them to pre-clinical evaluation. To address relevant challenges in marine biodiscovery related to policy and legal issues, PharmaSea is bringing together practitioners, legal experts, policy makers and other stakeholders, focusing on the feasibility of harmonising, aligning and complementing current legal frameworks with recommendations and ready to use solutions tailored to marine biodiscovery.

This presentation will cover aspects of the PharmaSea project, operation and the most recent results emerging from the pipeline.

Keywords: Marine biotechnology, marine biodiscovery, marine microbiology, bioactivity

*Speaker

UPLC-MSE : a fast and convenient method for profiling phytoplankton metabolites : application to the identification of pigments and structural analysis of metabolites in Porphyridium purpureum.

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A fast and high-resolution UPLC-MSE analysis was used to identify phytoplankton pigments in an ethanol extract of Porphyridium purpureum (Pp) devoid of phycobiliproteins. In a first step, 22 standard pigments were analyzed by UPLC-MSE to build a database including retention time and accurate masses of parent and fragment ions. Using this database, seven pigments or derivatives previously reported in Pp were unequivocally identified: β,β-carotene, chlorophyll a, zeaxanthin, chlorophyllide a, pheophorbide a, pheophytin a, and cryptoxanthin. Minor amounts of Divinyl chlorophyll a, a chemotaxonomic pigment marker for prochlorophytes, were also unequivocally identified using the database. Additional analysis of ionization and fragmentation patterns indicated the presence of ions that could correspond to hydroxylated derivatives of chlorophyll a and pheophytin a, produced during the ethanolic extraction, as well as previously described galactosyldiacylglycerols, the thylakoid coenzyme plastoquinone, and gracilamide B, a molecule previously reported in the red seaweed Gracillaria asiatica. These data point to UPLC-MSE as an efficient technique to identify phytoplankton pigments for which standards are available, and demonstrate its major interest as a complementary method for the structural elucidation of ionizable marine molecules.

Keywords: carotenoid, chlorophyll, dereplication, divinyl chlorophyll a, galactosyldiacylglycerol, gracilamide, mass spectrometry, MSE, phytoplankton, pigment, Porphyridium purpureum, UPLC

*Speaker

A Bioactive Bacterial Exopolyaccharide from Deep-Sea Environment: Modification, Characterization and Chondrogenic Potential for Cartilage Regenerative Medicine

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In cartilage tissue engineering, differentiation of mesenchymal stem cells into chondrocytes is crucial to obtain successful cartilage regeneration. Differentiation can be promoted by various biological agents, including polysaccharides. In particular, glycosaminoglycans (GAG) were shown to participate in many biological processes likely through interaction with proteins, such as growth factors, proteases and chemokines. Sulfate and carboxylic groups in GAG structure are key factors for interaction setting. Marine deep-sea hydrothermal bacteria producing exopolysaccharides (EPS) were recently shown to be a promising source of new GAG-like molecules useful for cartilage repair. In order to enhance the biological activity of the marine EPS and to provide GAG mimetic compounds, structural modifications are however required. In the present study, a new one-step sulfation process was developed in order to design GAG-mimetic compounds able to enhance the chondrogenic differentiation of mesenchymal stem cells, considered as an attractive source of cells for cartilage engineering. Firstly, native GY785 EPS was produced under controlled conditions by fermentation of a non-pathogenic marine bacterium Alteromonas infernus. This high molecular weight EPS of low sulfate content (3 wt%) was subsequently depolymerized to obtain low molecular weight derivatives (GY785 DR). The obtained derivatives were then oversulfated using a new sulfation method performed in ionic liquid. In comparison, the sulfation was also carried out in dimethylformamide, a classical organic solvent. The two oversulfated derivatives were characterized and some biological analyses have been initiated in order to compare the potential of these two derivatives for cartilage regeneration.

Keywords: Marine exopolysaccharides, glycosaminoglycan, like, sulfation, tissue engineering

*Speaker

Case studies in ecosystem exploitation, assesment and management

Systems engineering methods and tools for a sustainable exploitation of fisheries

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In contributing to the implementation of the new European regulations for a sustainable exploitation of fisheries, simultaneous actions covering both socio-economic and technological aspects are needed.

From a socio-economical perspective, the active involvement of the different stakeholders is essential, among other reasons to gain a deeper understanding of fisher's reasons for discarding. Involvement includes participation in the development of rules to encourage compliance and to minimize illegal exploitation of the resources.

From a technological perspective, complementary measures must be oriented on the one hand to avoid or minimize unwanted catch and to limit its waste by making the best possible use of the biomass.

Based on the lessons learnt from previous life projects BEFAIR/FAROS, in this talk, I will adopt a systems engineering perspective, to discuss different technological solutions that can contribute to a sustainable management of fisheries. Methods combine a variety of ecological and data-driven models to monitor the state of a given fishery. This may include a description of species abundance within a given fishing area and time slot, species interactions or the effects of environmental conditions or fishing effort by gear on the spatial and temporal scales.

On-line monitoring techniques can guide fishing efforts towards areas with low probability of unwanted catch. Such approach in combination with selectivity techniques can contribute to the minimization of biomass waste. However, the selection of the most convenient technology must confront a cost/benefit analysis and take into account the particularities of the fishing fleet or area as well as fishermen concerns.

Keywords: sustainable, exploitation, fisheries

*Speaker

Integrated management in Irish estuarine and coastal systems - exploring potential pathways

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The management of Irish estuarine and coastal ecosystems is largely carried out in an ad hoc, fragmented manner. The majority of existing Irish environmental law is often derived from international conventions and European directives and is mainly sector specific. Currently there is no overarching national coastal or marine policy in Ireland. This is further complicated by the fact that there is no single body with overall responsibility for Irish estuaries and coasts. In Ireland, there are at least thirty-four different government departments and organisations with responsibility for estuarine, coastal and marine management issues across different territorial scales. This may result in ineffective decision-making and duplication of functions.
IMMERSE involves developing an Integrated Environmental Management and Monitoring system (EMMS) for Irish estuarine and coastal ecosystems. Based on a review of integrated environmental management processes and practices, a proposed framework of EMMS was devised. The framework was refined through participatory evaluation processes within two Irish case studies, the Shannon Estuary and Dublin Bay. Clearly, the implementation of an integrated approach within a national policy vacuum will prove challenging. Without appropriate legislation, designated governance and institutional responsibilities, it will be difficult to facilitate an integrated approach to management and monitoring within a shared resource. To account for institutional and government inertia, IMMERSE developed a number of 'transition to integration' pathway options. These options consider delivering integration within short, medium and long-term legislative and governance change. This is considered a more appropriate and realistic approach to achieving integrated management within an evolving Irish context.

Keywords: estuary, coastal, marine, integrated management, ecosystem, governance, spatial planning

*Speaker

Ecosystem-based marine spatial planning; developments globally, and in the Northeast Atlantic

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Marine Spatial Planning (MSP) is seen as a practical way to implement marine ecosystem-based management. Development varies globally, with Europe and Australia in the lead. The U.S. is lacking integration between legislation and executive levels and is lagging behind in development, but some regions, e.g. the Northeast and the Pacific states, are forging ahead with regional planning efforts. Research projects and UN institutions like UNESCO have developed guidance both to develop the science base for MSP and plan development. Norway was an early implementer of MSP, with integrated management plans in place since 2006. Three regional plans have been implemented in Norway, two of which have been revised. The Norwegian experiences show the importance of political leadership, buy in and integration across sectors and between government levels in successful EBM and MSP.

Keywords: Marine spatial planning, ecosystem, based management, Norway, Barents Sea, integration, governance

*Speaker

ODEMM Pressure Assessment in the Celtic Seas.

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In order to deliver holistic ecosystems-based marine management, managers must know the factors affecting the ecosystem if they are to manage them. Here, we present a risk assessment framework, based on the ODEMM (Options for Delivering Ecosystem-based Marine Management) approach for the Celtic Seas. The framework traces the multiple sectors affecting the marine environment, the numerous pressures they create, and the ecological characteristics affected by them. Scores are assigned via an expert panel and cross-check methodology which detail the extent, overlap, degree of impact, persistence and resilience for each pressure pathway, based on pre-determined thresholds. From this information, pressure matrices are created that can be used to calculate scores to indicate an overall impact risk score and expected recovery timeline estimates. Further, this information can be used to create easily interpretable and understandable tools for communicating complex messages in a simple format to non-scientists such as policy-makers and stakeholders. These methods can be used to visualise important information such as how particular sectors cluster together, which allows the understanding and insight that often multiple sectors cause a similar array of pressures and so they must be targeted together if long-term solutions are to be found. Together, these tools can be used to help enlighten stakeholders and enable policy-makers to make informed decisions. In light of the complex landscape of ecosystem-based management and the Marine Strategy Framework Directive, these tools have a real benefit in the simplicity of their understanding.

Keywords: ODEMM, risk assessment, Celtic Seas, Ecosystems, impacts, pressures, communication tools

*Speaker

Managing fisheries in the context of an integrated marine policy: the importance of spatial issues

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A variety of conservation policies now frame the management of fishing activity and so do also the spatial planning of different sectorial activities. These framework policies are additional to classical fishery management. There is a risk that the policies applying on the marine system are not coherent from a fisheries point of view. The spatial management of fishing activity at regional scale has the potential to meet multiple management objectives, on a habitat basis. Here we consider how to integrate multiple objectives of different policies into integrated ocean management scenarios. In the EU, European Directives and the CFP are now implementing the ecosystem approach to the management of human activity at sea. In this context, we further identify three research needs:

- Develop Management Strategy Evaluation (MSE) for multiple-objective and multiple-sector spatial management schemes
- Improve knowledge on and evaluation of functional habitats
- Develop spatially-explicit end-to-end models with appropriate complexity for spatial MSE

The contribution is based on the results of a workshop of the EraNet Cofasp.

Keywords: Integrated ocean management, multiple management objectives, ecosystem approach

*Speaker

Understanding the behavior of policy decision makers through participatory experiments, a role playing game to explore management of the Atlantic Bluefin tuna fishery

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The Atlantic and Mediterranean Bluefin tuna fishery has been considered as the archetype of an overfished and mismanaged fishery. While this crisis has been widely communicated by the media, it has also demonstrated the role of public awareness and the importance of the interactions between science and management. We investigate the policy making process associated with this regional fisheries management, using an innovative socioeconomic experiment based on a role-playing game.
We propose a computer-based experimental approach to explore the effects of key factors on the cooperation process in a complex straddling stock management setting. The approach is based on a 'standard' multi-gear, age structured bio-economic model which explicitly represents the decision making process. Each participant plays the role of a stakeholder of the International Commission for the Conservation of Atlantic Tunas and represents a national fishing industry involved in the fishery, deciding on a policy for the coming year. In a context where lobbies influence the public opinion for conservation or exploitation, the participants must deal with the uncertainty in the scientific advice about the stock status, to develop their contribution to the fishery and to set common management plans for the stock during the negotiation process in a commission session. The model is set as an experiment which specifies lobbies' interventions, as well as the uncertainty associated with scientific advice, according to a factorial plan. The context of the experiment induces the incentives
for exploitation and collaboration to achieve common sustainable harvest plans at the Atlantic Bluefin stock scale.

Keywords: Participatory simulation, Role playing games, Fisheries management, Policy making, Atlantic Bluefin Tuna

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Importance of rays and sharks for French fisheries and resulting fisheries impacts on populations

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Many ray and shark species are bycatch of fisheries using different gears but due to their life history they are generally more sensitive to overfishing compared to the target species. Using detailed haul-by-haul catch observations from an onboard fishing vessels observation program we investigated spatial patterns of ray and shark bycatch as well as their contribution to fisheries revenues by gear type. The same data were also used to estimate population abundances. A crucial issue for these data is that not all individuals present will be caught by the fishing gear. This is commonly referred to as catchability and will tend to increase between-haul variability, and lead to excess zeros. Hence we included catchability in the models. To account for spatial trends and the non-random nature of the observation locations, we used spatial grids where grid cell size decreased with increasing number of observations. Estimated population time trends were then compared between species.

Keywords: Sensitive species, onboard observations, contribution to revenues, fishing impact

*Speaker

Competition between a non-native cultured oyster and a commercially fished native oyster affects their trophic niche

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The introduction of non-native aquaculture species may alter recipient communities by displacing native species through predation or competition, thereby impacting ecosystem processes. In Europe, introduction of the non-native oyster, Crassostrea gigas (Thunberg, 1793), led to concerns regarding their impact on declining native oyster, Ostrea edulis (Linnaeus, 1758), populations. Recent studies show that C. gigas and O. edulis occupy similar habitats and may compete directly for food resources, which could have detrimental effects on the recovery of O. edulis. This study aimed to compare the trophic niche of both species, using stable isotope analysis, and test whether one species is competitively superior to the other. The presence of C. gigas and O. edulis was manipulated in the field and we tested whether C. gigas and O. edulis occupied similar trophic niches and whether this differed with oyster age, habitat or individual orientation to the substratum. We found that both species overlapped their trophic niches despite having different feeding strategies (generalist/specialist). However this study also showed that when both species were reared together and food availability was high, the stronger competitor shifted its trophic niche to evade the cost of direct competition with an inferior competitor. These differences in feeding strategy could have an effect on plankton communities and further affect the ecosystem community.

Keywords: Stable Isotope Analysis, Crassostrea gigas, Ostrea edulis, Life stage, Orientation, Subtidal, Intertidal

*Speaker

The determination of Diplodus annularis otolith shape in Tunisia (Kelibia and Bni Khiar) studied by using Discriminant Factor Analyses

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The aim of this research is to investigate by using otolith shape, the stock structure of *Sparidae* (*Diplodus annularis*) in the Tunisian coasts (Kelibia and Bni Khiar). Otolith shape was determined by using Fourier analysis. The mathematical analysis of the otolith shape was achieved by the Discriminant Factor analysis (D.F.A). The basis of this method is the detection of the phenotypic polymorphism between the two populations of fish, between pairs of otoliths from each station and between the pairs of otoliths of different stations. In the same population, the P-value (left-right) is statistically significant ($p < 0.05$) for the males originating from Beni Khiar (case of left-right asymmetry); however, the p values for the distances were not significant ($P > 0.05$) for the females (case of left-right symmetry). The same result was found for Kelibia's population (an asymmetry detected for the males and symmetry for the females). The comparison between both lots of fish revealed a clear difference between the otoliths (Left-Right) of males and females ($p < 0, 05$). The asymmetry (Left-Right) of otoliths revealed here indicates that the two populations have a different morphology of otoliths and belongs to different fish stock.

Keywords: Otolith, shape, stock, Diplodus annularis, Kelibia, Bni Khiar

*Speaker

Stock discrimination of Mullus barbatus barbatus for two marine populations (Sidi Raiis and Hawaria) by analysis of otolith shape in Tunisia

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Otoliths are small calcareous concretions in the inner ear of teleost fish; they represent the organs of hearing and balance. Their interest in fish identification and determination of species identity and stocks has been shown by many studies.
Using otolithometry tool, this work aims to compare this heterogeneity in the Tunisian marine waters (Sidi Raiis and Haouaria) of two populations of Mullus barbatus barbatus, this comparison is based on elliptic Fourier analysis followed by Discriminant analysis (AFD) of the otolith morphology (the sagittae).

Statistical analysis showed significant differences between the pairs of otoliths (G and D) and of the two stations with a p-value $< 0{,}0001$.The results also show that the axis F1 absorbs and separates 39.76% both of populations Sidi Raiis than Haouaria while the axis F2 absorbs 15.22% between males and females.
In conclusion, these results show a clear difference in otolith shape of *Mullus barbatus barbatus* two stocks harvested in two different Tunisian media, which allowed us to confirm the role of Otolith as a great discriminating.

Keywords: Mullus barbatus barbatus, Otolithe, shape, Sidi Raiis, Haouaria

*Speaker

Multidisciplinary researches in Marine Renewable Energy

Risk due to biofouling for offshore wind turbines: a multidisciplinary and probabilistic approach

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Biofouling on offshore structures is shown to have various harmful effects. Various tests were performed in the 70's and 80's, investigating different typology of marine growth, cylinder diameter and hydrodynamic conditions. They result to a better understanding of biofouling effect on hydrodynamic forces and highlight the key relationships and the invariants. Amongst the conclusions, there was a huge scatter in the results due to the complexity and instabilities of the flow around the structure.

Only few studies consider the global modeling of the loading in a probabilistic context and none of them considers the modeling of the growth process. Indeed, there exist few database or they were not used to this goal. That necessitates a multidisciplinary study. Indeed, biocolonization of offshore structures is a complex phenomenon with two major but distinct domains: marine biology whose processes are modeled with biomathematics methods and hydrodynamic calculations. This paper aims to connect these domains by proposing a stochastic model for the biofouling growth and continues with a probabilistic modeling of the drag coefficient in presence of marine growth. To calculate the hydrodynamic forces on colonized structures under environmental conditions, determination of the physical characteristics of the colonized surfaces: average thickness (Th) and surface roughness (k) are essential.
This study shows that developed model is consistent with RBI approaches and how the maintenance strategies could change depending on the depth of the subsea equipment. The BDR (Biofouling Design Ratio) is introduced as well. That leads to discuss the required safety level in various depth.

Keywords: biofouling, offshore wind turbines, probabilistic modeling, drag coefficient, average thickness, surface roughness

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Cost reduction in the offshore wind industry and sharing lessons across the offshore energy industries

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Offshore energy industries are widely dispersed across the technology and industry development stages from the mature oil and gas industry, to the maturing offshore wind industry, down to the pre-commercial/commercial ocean energy industry. It is vital for these industries to integrate and learn from each other and adapt this information to develop their own competitiveness.
LEANWIND is an FP7 project which connects the transport sector with the energy sector to provide solutions to reduce the cost of offshore wind energy. These solutions are both technological and procedural and can be novel technology or new uses for existing technologies.
The work in this project can provide interesting insights relevant for both the offshore wind industry and the less developed ocean energy industry.

Keywords: Offshore wind energy, ocean energy, cost reduction

*Speaker

Safety and Security of Marine Renewable Energy Structures and Fields During the Operation and Maintenance Phase (From a Legal Perspective)

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Marine Renewable Energy structures are both subjects and vectors of threats or risks: piracy, terrorism, environmental, occupational, cybernetic, legal (contracts, insurance) risks, risks on the navigation, the investment, for the resource or the marine biodiversity... During the different phases of a MRE project (conceptualisation, development, operation and maintenance, decommissioning), every risk is considered, assessed, mitigated... according to logic specific to the stakeholders (insurers, financiers, developers...). Sometimes in agreement, sometimes discordant, they yet all comply with existing legal frameworks.
While every risk or threat is considered at a very early stage, there are still questions surrounding the operation and maintenance phase, given the very recent development of offshore farms and, as a result, the lack of experience feedback. Based on a preliminary study of maritime security and safety legal standards applicable to MRE fields and structures, this paper intends to address, or at least discuss the respective competence and responsibilities of the involved actors (developer, operator, state authorities...), using the example of offshore wind farms.

Keywords: MRE, risks, law, responsibility

*Speaker

Assessment of Hydrodynamic Loading based on Measurements of Marine Growth Shape and Roughness Characteristics Obtained from Stereo Imaging

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Marine growth colonisation is a complex phenomenon that has many negative impacts on offshore structures such as loading excess, increased drag, corrosion, and masking structural damage. Its random nature means that modelling the environmental loading is a complicated task. Structural engineers need access to information such as the species composition, percentage cover, weight, thickness and surface roughness. This paper tested a protocol for obtaining quantitative in-situ measurements of marine growth using a stereo based imaging system and consequently investigated how the environmental loading based on these measurements, as calculated from Finite Element (FE) analysis, differed from loading calculated using ground-truth measurements. The study was carried out in two phases. Firstly, the stereo system was applied to a controlled specimen covered with artificial marine growth in order to examine how well the shape and macro-roughness characteristics could be recovered. Secondly, a range of virtual 3D slender cylinders were generated which had varying controlled diameters and roughness characteristics. These cylinders were photographed in a simulated underwater setting using a virtual stereo rig to investigate how the stereo protocol worked on a large scale. Calibration of forces for single frequency waves was carried out in an FE environment and the hydrodynamic loading was calculated for simple sea-spectra for both reconstructed cylinders and controlled cylinders. The agreement between results validated the protocol and showed that stereo based systems are well-suited as a stand-alone tool for obtaining marine growth measurements, and ultimately, have value as tool for the cost-effective safety management of offshore structures.

Keywords: Marine Growth Assessment, Hydrodynamic Loading, Stereo Imaging, Finite Element Analysis

*Speaker

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Coastal and marine management: uses, communities, planning

Specificities of marine spatial planning in Tropical Areas

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In tropical marine ecosystems implementing a marine spatial planning (MSP) have specificities. According to the IOC-Unesco, MSP aims at conciliating human uses and conservation. In tropical areas, MSP faces a critical challenge, the sea grabbing. The political instability in various countries, particularly in Africa, and the economic power of transnational companies affect power relationships. An increasing surface of ocean is affected by activities. The current effort to better organise these activities at sea in western Africa and Brazil illustrates this new framework. In such context it is important to determine whether MSP can intensify the problem of ocean grabbing. Such question is directly related to the role of governments in the implementation and definition of MSP. Adapting MSP to tropical countries can also be a way to question and improve this process that have been developed by and for developed countries. In particular MSP could better account for traditional knowledge and uses, and ecosystem dynamics. !

Keywords: marine spatial planning, environmental law

*Speaker

How to cope with hard working conditions in the fishing sector: artisanal fishermen and their wives

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Workers in the artisanal fishing sector are subject to hard working conditions. Among these, our paper, which is based on interviews with fishermen in ports of Britany and Pays de la Loire Region and their wives, will focus on their absence from home for longs periods or/and at unusual times, as they have a strong impact on their family life and demand some special family arrangements. After Word War II, the development of a flourishing fishing sector, especially in the Pays Bigouden in Brittany, created a pattern of "accepted painfulness", according to which fishermen's wives agreed to cope with their husbands' absence and the responsibilities it implied, because they found some counterparts: a large income and a high local social status as non working women. In the eighties, different crises in the fishing activity and social transformations such as the generalization of women's activity caused this pattern to disappear and new kinds of arrangements to develop, which we can describe as a "rejected painfullness" and a "negociated painfulness" patterns.

Keywords: fishermen, working conditions, family

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Governance of marine protected areas and stakeholder participation, the social acceptance of the natural marine reserve of Reunion faced to the sharks' risk

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Since 2011, fifteen attacks of bull and tiger sharks occurred in the natural marine nature reserve of Reunion or in the surroundings. As it has increased the abundance of reef fish, the MPA is accused by social networks to attract sharks. In 2015, 7 years after a first assessment o the social acceptance of the MPA, it was asked to IRD to repeat this exercise. This Communication focuses on the social acceptance of general public. The survey was conducted when a promising young surfer of Reunion was fatally attacked by a bull shark. In this context, the risk was too high of a very low return rate. It was therefore decided to shift the target and to involve geography students from the University of Reunion. We have asked them to investigate one hand, their peers on campus and on the other, their families. A total of 495 people were interviewed, half on the campus of Saint, half among the students family. The results showed that social acceptance of RNMR was much better than what was expected. Clearly, social networks are not representative of the general public opinion.

Keywords: social acceptance, MPA, participation, sharks' risk

*Speaker

The renewal of fishermen professional training.

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This contribution focus on " the renewal of fishermen professional training ". More exactly, it is the anticipated socialization (specially the familial one (?) and the cultural integration to the fisherman profession during the trainning in maritime high school and fishing schools that will be the main focus of our contribution. Beyond that, the transformation of fishing related jobs will also be approached. In that purpose, we posted an online questionary designed for pupils from different maritime schools in Les Pays de la Loire and Bretagne. Interviews to the heads of schools and pupils have been held. In a first part, and through a socio-historical approach, we'll discuss what can be seen as a " secondarisation " if not a " tertiarisation " of the course (particularly with the Bac-pro and BTS setting-up). The second part, based on the investigation, will deal with the pupil's perception of the training (..), pointing the differences between the courses and focusing on pupils expectations concerning the new ways of professional acculturation. Finally, we will bring the discussion on : the differences which take shape between les Pays de la Loire and la Bretagne ;on the traditional trainings transformation (...) and on the consequences they can have on the occupational insertion and evolution of fishing related jobs.

Keywords: training, socialization, fishing schools, occupational integration

*Speaker

The declining price anomaly in sequential auctions with asymmetric bidders

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The declining price anomaly for sequential sales of identical commodities challenges auction theory which predicts constant prices within a day. Among hypotheses explaining the phenomenon stands the dual value of goods including a risk premium in early transactions. We consider that asymmetric bidder groups and shortage periods may also affect the daily price pattern. This hypothesis is tested through various econometric models (OLS, MG, FE, LSDVC) on a fish market (Nephrops norvegicus sold alive in Lorient, France). The overall risk attitude is doubled in our case study with the presence of asymmetric buyer groups in the bidding process and their distinct marketing strategies. Our results show that one of the groups (supermarkets) bid more aggressively for a longer period of daily sales when they decide to target this species for discount selling campaigns. This strategy pushes them to outbid other competitors until they can obtain the required tonnage for their own retail shops, and such a strategy delays the time of price decline compared to other buyer groups.

Keywords: auction, declining price anomaly, asymmetric buyers, fish market

*Speaker

Towards an ecosystem-based management approach at sea: The potential for cross-learning between maritime and terrestrial spatial planning

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This paper aims to highlight the differences and similarities between marine and terrestrial approaches to governance through the example of spatial planning. Coastal and marine models of governance have been primarily shaped by the socio-ecological characteristics of marine ecosystems and the traditional importance of common rights historically guaranteed under the Law of the Sea. The bio-physical characteristics of the marine environment and the regime of property rights in force in marine areas explain why marine and terrestrial forms of spatial planning have developed under separate legislation and different institutional responsibilities. The present work questions the sharp separation between maritime spatial planning (MSP) and terrestrial spatial planning (TSP) by highlighting the potential for cross-learning between these two areas of governance. Delivering integrated management through an ecosystem-based approach is one of the major challenges faced by those that plan and manage marine activities. In this respect, MSP could learn from integrated management techniques already developed in land use planning such as zoning and stakeholder participation. In addition to the potential for cross-learning, the expansion of offshore renewable energy technologies in coastal areas demands more integration between the planning systems in operation on land and sea. If full integration is not be achievable, this research emphasises the real need for better coordination between marine spatial planning and terrestrial spatial planning, given the renewed focus on the growth potential of maritime sectors, and consequent need for effective and efficient planning systems.

Keywords: Maritime spatial planning – terrestrial spatial planning – ecosystem, based approach – zoning – stakeholder participation

*Speaker

Coastal erosion in the south of Ouvea island (New Caledonia) : Contribution for an integrated coastal zone management.

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A study of the morphodynamic evolution of coastline Lekine - Ouvea (New Caledonia), has been realized by using diachronic analysis of aerial and satellite imagery over the period dating from 1954 to 2012 within the QGIS 2.6 software.
We observe a significant accretion of the two opposite sand arrows favoured by : 1) moderate and homogeneous general hydrodynamic condition of the lagoon 2) gravelly-muddy sand mobilized by longshore drift 3) quick vegetation growth on coast which fixe sediment.

We note that the artificialization of the area since the 1970s has directly impacted the site. These coastal arrangement are responsible of a local erosion. Erosion indicators like : 1) beachrock outcrop 2) coastal vegetation damage 3) active bluff erosion.

This artificialization is not the only explanation for all forms of erosion identified. We must consider the meteorological forcings such as "west of blows" and tropical cyclones associated with marine conditions. These items are used to link the geomorphological conditions with this portion of the study site. Coastline orientation and proximity of the active passes promote maritime entries in the lagoon Faiawa during paroxysmal events.
In this presentation we will present our methodological approach and results to understand the hydro-sedimentary dynamics. We will propose technical solutions to minimize the dysfunctions observed in an area classified world heritage of humanity and to monitor their effectiveness.

Keywords: New Caledonia, Ouvea, coastal erosion, diachronic analysis, ICZM

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Fuzzy planning and soft spaces: Drawing up guidelines of a methodology to help the implementation of transboundary Marine Spatial Planning in the English Channel and the North Sea

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In the second half of the 2000s, many institutions and international organisations, like UNESCO and European Commission, prescribed Marine Spatial Planning (MSP) as a necessary tool to manage maritime spaces. Accordingly, there has been a significant shift with marine governance in European Union. Some north European countries put in place early a national legal framework for MSP, under the impulse of a European MSP roadmap in 2008, like UK with the Marine and Coastal Access Act in 2009. Implement MSP in France took longer because of traditional reserves about zoning and because of a confusion with the translation of planning as zoning. These national plans need to be coordinated, specificly in the English Channel and the North Sea in this case. Todays, fuzzy planning and soft spaces attract renewed interest, especially in urban and regional planning studies. These concepts help to take account of uncertainty on the development of human activities as far as uncertainty on the functioning of complex ecosystem. They can therefore be usefull for marine management. This presentation try to learn lessons from different international experiences of fuzzy planning to suggest an appropriate methodology for maritime spaces, which integrates stakeholders in a fuzzy planning process in order to help the implementation of transboundary MSP in the English Channel and the North Sea.

Keywords: Marine spatial planning, Transboundary planning, Governance, Marine policy, Fuzzy planning, Soft spaces

*Speaker

Co-construction and assessment of fisheries management scenarii using the ISIS-Fish model within a geoforesight approach of coastal and marine Bay of Biscay socio-ecosystem

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Anticipating shifts and assessing risks is a key issue for fisheries management. Foresight is a recent approach developed to carry out participatory approach and derive consensual management scenarios. Including a geographical dimension within foresight approach comes out as a relevant feature to deal with spatial features and to make easier and more concrete discussion with stakeholders. The Bay of Biscay is a marine area where various human activities are simultaneously present (fisheries, wind farm, sediments extraction, etc.) that can lead to spatial access conflicts. Within the Coselmar regional project, we have implemented a geoforesight pilot approach to anticipate risks linked to changes in governance of coastal fisheries in Biscay Bay. Therefore, several workshops driven by geographers and involving socio-professional stakeholders, scientists and politicians have been organized to co-construct scenarii of the future of the socio-ecosystem.
Fisheries scientists have provided some quantitative knowledge simulating futures of the dynamics of the fisheries using the ISIS-fish simulation tool and considering multiple species management plans of the demersal mixed fisheries proposed by European commission. These workshops were first an opportunity to improve our understanding of the fisheries exchanging on the model itself and on its outputs. Finally, the scenarii delivered by the foresight were simulated at the scale of the fisheries using ISIS-fish. Results were reported to the group enabling common analysis and providing fruitful discussions for decision-making of fisheries management.

Keywords: Geoforesight approach, Management scenarii, Spatial, Simulation tool, ISIS, Fish model,

*Speaker

Fishermen perceptions regarding the establishment of a Marine Protected Area in Kuriat islands in Monastir (Tunisia)

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Several studies have shown that the success of the establishment of a marine protected area (MPA) relies on effective resources improvements and local population's and stakeholders' supports (Ramos et al, 2013; Mikalsen and Jentoft, 2008; Yandle, 2003; Chuenpagdee et al, 2011; Chuenpagdee et al, 2013; Pita et al, 2013; Pollnac et al, 2001; Mikalsen et al, 2007 ; Helvey, 2004 ; Gray et al, 2013 ; Christie, 2004). The proposal of the Tunisian environmental authorities for the establishment of a marine protected area (MPA) in Kuriat islands in Monastir (Tunisia) is characteristic of this issue. In order to address the specific situation of this developing country, we have conducted a multiple factor analysis (MFA) and a hierarchical cluster analysis (HCA) from a direct survey of fishermen during four periods between November 2009 and February 2013.
According to preliminary surveys, our questionnaire has been formed of three main parts. The first part concerns the socio-economic data of the fishermen, the second deals with their perceptions of the environment and the third part deals with perceptions of the MPA.

The MFA conducted on a survey of 272 observations showed a strong connection between the second and third part, between the first and the third part, and a weak link between the first and the second part. The results highlight the heterogeneity of individuals, which are grouped into three classes according to the socioeconomic characteristics of fishermen, their perceptions of the environment and their views on the MPA.
Key words: MPA, Natural resources, Tunisia, Governance, MFA.

Keywords: Marine Protected Area, Natural resources, Tunisia, Governance, Multiple Factor Analysis.

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Aquaculture concessions on Isla Grande and the Mar de Chiloé (Los Lagos region, Chile): spatial development and usage compatibility

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In the areas declared suitable for aquaculture (Áreas Aptas para la Acuicultura), there was a rapid development of aquiculture and salmon farms from 1985 (prior to the 1991 law on fisheries and aquiculture) and, since 2000, mussel farming, in an attempt to find alternative production and income sources for local artisan fishermen. The first aim of this paper is to quantify and map, using spatial and aerial remote sensing, as well as statistics, the spatial evolution of the aquaculture concessions (number and surface area). The evolution and geographic distribution (e.g. concentration areas) of the two types of production are analysed. We try to relate production levels, with their ups and downs, to levels of spatial occupation in the coastal-marine area (inner waters and territorial sea).The second aim is to evaluate how compatible these concession are with other uses, whether current or potential, in the same area. In the case of the salmon farms, we analyse whether the impact on the marine environment is such that at least some should be moved in order to prevent further degradation. In the case of mussel breeding we determine whether the spatial continuity of the concessions, creating a barrier between the sea and the coast (e.g. the borders of the Canal de Dalcahue) could restrict or prevent other coastal uses such as nautical activities or traditional fishing (Management zones). Finally, on the basis of other international models, integrated planning is proposed as a means of ensuring that all the various uses are compatible.

Keywords: aquaculture, concessions, spatial development, usage compatibility, Chile, Chiloe

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A pragmatic approach of interdisciplinary integration: the COSELMAR adventure

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COSELMAR is a multidisciplinary research project, funded by a French regional program. Involving eleven regional research teams, plus national and international partners, COSELMAR includes a large range of disciplines, from social sciences to engineering sciences. The main purpose is the understanding of the marine and coastal socioecosystem of the Bay of Biscay to anticipate and manage risks. Interdisciplinarity is inherent to the study of socioecosytem. However, the challenge for the COSELMAR team, like in most project involving multiple research fields, was actually to achieve this integration and to switch from multidisciplinary researches (collection of multiple works, progressing more in parallel than in interaction) to transdisciplinary approaches. In this paper we study the ongoing path to this transdisciplinarity. We first identify the main issues: complexity, multiple scales, multiple disciplinary cultures, integration process. Then, we present the different steps and tools developed to overcome them: building a common glossary, identifying shared questions and issues, developing bridges and working links (seminars, knowledge integration platform), foresight. Finally, we study how foresight can achieve transdisciplinarity, both in the integration and transfer of the results of COSELMAR and the design of a future project.

Keywords: transdisciplinarity, interdisciplinary research, integration, socioecosystem, foresight

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The Disparities Arising in the Policing of Consumptive and Non-Consumptive Marine Activities

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The South African marine environment is utilised for both consumptive and non-consumptive activities and for those activities to continue sustainably it is important that these activities be monitored and policed. South Africa's environmental legislation is structured to do just that; outlining specific regulations for all consumptive and non-consumptive activities that can be conducted in the marine environment. Some disparities have been observed regarding the policing of consumptive and non-consumptive marine activities, and these disparities were analysed by means of several case studies and semi-structured key informant interviews. Case studies covered both consumptive (abalone poaching and IUU fishing) and non-consumptive activities (the sardine run and tiger shark diving) currently being conduct in the marine environment. Key informant interviews collected opinions from legal practitioners who felt that the legislation was solid but poorly implemented; and non-consumptive operators who felt that the legislation was implemented in a way that made it difficult for non-consumptive and ecotourism activities to thrive. The poor implementation has resulted in a situation which seems to promote consumptive crimes instead of curbing them.

Keywords: Policing, Marine Legislation, Implementation

*Speaker

Géoprospective as a research approach and as an empowerment lever. An experimentation on the fisheries of Bay of Biscay (France)

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Foresight is an collaborative "attitude" which consists in considering a long-term set of possible changes, strategies and future. Foresight has to be placed in the field of collective action and in the field of participatory methodology.
In foresight exercises, space is often reduced to a simple localisation support. However, usual applications deal with territory and environment where spatial dimensions are multiple and determinant. It is the reason why géoprospective ("spatial/geographical foresight") is the geographers proposition to complete the Future studies offering. Space is then simultaneously an agent of changes and a subject of conjecture. Recent géoprospective works have mostly permitted to develop spatially-explicit tools to simulate scenarios. It raises new issues about modalities of the public participation to the simulation or about the integration of non-quantifiable and spatial parameters.
Thus, géoprospective is not a stabilised process and our proposition is to test it. An application to Bay of Biscay fisheries presents a triple interest. First of all, stakeholders participation to fisheries science and management has an increasing value. The research can be based on this social demand and can help the fishermen communities empowerment. Then, decision-support tools are generally simulation tools in fisheries management. Models and drivers are prerequisite. It seems pertinent to re-discuss them and to rethink their use in a governance context. Finally, ocean and sea are fuzzy and 3D spaces. They are less known than continental spaces. So, this work is an invitation to innovate in spatially-explicit methodology. Moreover it contributes to improve maritime and geographical knowledge.

Keywords: Spatial foresight, participatory research and management, simulation tools, fisheries governance, Bay of Biscay

*Speaker

Behind the "Blue" of maps a hidden world: stakes for a "just sea" in the Marine Spatial Planning context

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In this first decade of the 21st century, Marine Spatial Planning (MSP) is the new paradigmatic norm concerning the marine environment management. In this context, MSP is it the "new frontier"? Much more than this, we think that MSP is in fact a new post-modernist social construction of the sea, which can serve different visions of this one (with national shades). Historically a political process as all planning approaches, spatial turn and neoliberal rationality "doing-world" has devoided of his substance. MSP, thus, has only addressed by the technico-technical planning spectrum with two main tools: zoning and mapping by Geographic Information System (GIS). These tools rationalize and normalize sea space with a particular vision: an absolute and non-human space. The risk is to believe that sea space is an "empty lands", allowing ocean grabbing. This situation produces indirectly a "missing layer": the human and social dimensions which are largely undocumented and unmapped in the MSP, and more globally, in ocean neoliberalization context. These dimensions are materialized by practices territories, affects and values felt, knowledge linked. But before to be "missing", these dimensions are simply invisible. So behind the "Blue" of maps, there is a hidden world, stakes for a "just sea". The "missing layer" is one of the possible ways to transform MSP in an argumentative and political process. We will see how make visible the invislbe between two fieldworks: St. Lawrence Gulf (CA) and Bay of Biscay (FR).

Keywords: Marine spatial planning, "missing layer", ocean grabbing, social seascape

*Speaker

Between opening and endogenous logics, a more structuring organisation in the future with heritage-based regulations? The professional group of fishermen in traditional fishing

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Limiting or even preventing access to a fishery resource is one of the greatest threats for the professional group of fishermen. The closing down of fisheries and limitation of fishing boat trips since the 1980s and 1990s have impacted on employment charts with demographic troughs still existing today. Indeed, the profession would still suffers from a lack of attractiveness generating difficulties to recruit seamen, to embark or to have a career in this trade. Employment and recruitment in this lagging labour market face an additional obstacle created by government action for the preservation of fish stocks. Thus, one of the social transformations under study in this context is the introduction of a more relevant heritage-based regulation, when so far, state and corporate designed regulations alone organised access to the profession, career evolutions including installation. Beyond certifications, access to resources – fishing vessels and their equipment, licenses and quotas set on precedents – is what organises and shapes the profession today. In this new negotiated organisation, the autochthony capital would provide a significant input. In other words, the presentation will analyse tensions between protection and opening, European policy and local actions and their effects on the professional group of fishermen. It will present the hypothesis of the introduction of heritage-based regulation in combination with local government plans.

Keywords: professional group of fishermen, heritage, based regulations

*Speaker

"They dig deep squares", toilers of the sea vs defender of nature, facts and effects of environmental gouvernance

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The state of fishery resources is a key issue that shapes coastal and port activities. Traditionally, fishermen adapted to situations by diversifying their practices and fisheries; they opted for a more diversified and versatile activity. Nowadays, their profession heavily depends on the implementation of regulatory measures based on bioeconomic considerations. These measures generate controversies regarding the qualification of personnel, the legitimate knowledge of the state of fishery resources, the right to fish and the necessary measures.
Thus, the environmental approach underlying the European fisheries policy reportedly jeopardizes these workers close to nature. It may seem paradoxical, but only on the surface, because the notion of environment is a category of perception, representation and analysis that does not correspond to that of fishermen who would rather consider the sea as their work space. This category of analysis (environment) therefore transforms the framework of their professional world in which the sea and its fish (and shellfish) face nature and the environment. The prevalence of these last terms illustrates the tensions and legitimacy conflicts already identified in nature-related professions, precisely because nature operates as a jurisdiction.
The presentation will acknowledge the categories of perception and analysis of the situation, adaptive practices of fishermen compared to the requirements and measures imposed for the preservation of fishery resources

Keywords: environmental gouvernance, fishermen in traditional fishing

*Speaker

The Shifting Sea: Lively Space, Immersed Planning

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Extending the notion of spatial governance from the land to the sea raises questions about the extent to which practices which have developed in the context of stable and settled terrestrial environments can be transferred to physically dynamic marine settings which are much less amenable to human control and development. For marine spatial planning (MSP) to produce a framework of spatial use requires reflection on its conceptual base and application. Taking as a starting-point recent progress in planning thought, this paper explores an approach to MSP that seeks to be more responsive to the characteristics of the marine environment and its governance. Theories of 'soft space', along with wider post-structuralist reinterpretations of urban and regional territories, provide the basis for understanding the sea as space-being-planned and developing an approach to marine spatial planning that responds to the sea's inherent liveliness. The resulting framework is used to interpret recent MSP initiatives and suggest a more 'immersed' approach to MSP practice.

Keywords: spatial governance, marine spatial planning, soft space

*Speaker

The socio- economic space of marine fisheries as a tool of sociological understanding of actor games in the CFP

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The CFP is the result of many "talks" that brings together different actors (producer organization representatives, elected members of regional fisheries committees, fisheries scientist experts , NGO and "civil society" representatives, EU Commission members, etc.) involved in matters relating to the management of marine resources. Using an interpretative model, our presentation aims at highlighting the strategies adopted by these actors in order to influence in their favor the European regulations related to the fishing industry.
This model, referred to as "socio-economic space of marine fisheries" is designed by using three types of capital - economic, political and symbolic - from which actors are situated. The position of an actor in this social space is the result of a "capital portfolio" that will be more or less important at the occasions of these "talks".

The "deep-sea fishing" file will be used as an empirical support for the understanding of the model. On the occasions of "talks" on this issue, the actors have mobilized different types of capital (economic and symbolic), they have moved closer to some other actors in order to enter into alliances and they have mobilized their political capital in looking for support from elected representatives who may put forward in 'Brussels' their interests. Henceforth, the CFP may also be considered as a temporary compromise of these games of actors

Keywords: CFP actors, governance, alliance between actors, mobilisation, economic, symbolic and political capital.

*Speaker

How the coastal fishing industry can lead the recovery of an overfished stock? The example of the spiny lobster.

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There are many examples to illustrate the intervention of a politico-administrative authority to protect fish stocks threatened by overfishing (EU common fisheries policies for example). But what if the fishing professionals themselves set the objective to recover an overexploited stock, as it is the case for the spiny lobster (Latrouite Lazure and 2005)? The Red Lobster Reconquest Program (RLRP), launched in 2014 is its illustration.
Starting from a research-action approach focused on the Actor Network Theory (Callon 1986) and on the management of the "commons", professionals of spiny lobster fishing and sociologists who assist them have organized their action programs following two main hypotheses. On one side, it is the communities of lobster fishermen themselves, cause of and party of the weakening of the supply, are actors of their own resilience. On the other hand, tight networks in this professional sector are not only mobilized but also strengthened due to the emergence of a common aim i.e. the stock recovery and its sustainable use.

The program launched in 2014 is designed to unfold over several years on the French Atlantic coast at first but cooperation is already being developed with fisheries in the UK, Jersey, Ireland and Spain.

The presentation will report on the overall program based on participant observations of two sociologists as well as numerous thorough interviews conducted with various actors involved in the program (socio-technical network): fishermen and their representatives, scientists, wholesalers fish merchants, administration, elected representatives, NGOs ....

Keywords: fishing industry, overfish stock, spiny lobster, commons management, fishermen communities, network, international cooperation

*Speaker

Risk perception and risk management

Disease risk perception and management in Pacific oysters: the Farmer's story.

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Pacific oyster aquaculture in New Zealand and in New South Wales (NSW), Australia has suffered mortality outbreaks since 2010. Known as Pacific Oyster Mortality Syndrome (POMS), this condition involving Ostreid herpesvirus type 1 microvariant (OsHV-1) has highlighted the complexity of ongoing disease management in the marine environment.
To capture oyster farmers' perception of disease risks and their management decisions, twenty-two face-to-face interviews were conducted in NSW and in New Zealand. Participants were chosen to maximise diversity of views and practices in the Pacific oyster farming industry in both countries. The study group included both growers who had experienced POMS on their farm and those who had not. The questionnaire was organised in five sections: participant characteristics; experience with OsHV-1 mortalities; support during the disease crisis; risk management strategies; and state of preparedness.

This collaborative research identified potential strategic directions that could be integrated in business risk management plans for the shellfish farming industry. It also indicated that farmers, scientists and governments will be more successful if they work in partnership to develop practical and effective measures to manage diseases as well as pests in the aquatic environment.

Keywords: Shellfish disease, Pacific oyster, perception, risk management, strategies, questionnaire

*Speaker

Economic appraisal of vulnerability reduction scenarios to coastal flood risk: how to save human's life in spending less money?

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Storm Xynthia hit French Atlantic coast in February 2010. It led to an important coastal flood which was responsible for the death by drowning of 41 people. Reports of the storm show that the consequences of Xynthia were the result of "dangerous situations": the aging population of coastal towns, urbanisation of low-lying areas, and architectural maladaptation of houses to coastal flood risk.
This presentation deals with the way to reduce these dangerous situations.

First, a methodology to evaluate the vulnerability of houses to coastal flood for inhabitants is proposed. It exposes the way to assess the potential number of death in case of coastal flood.

Secondly, an economic appraisal is conducted to compare different strategies to reduce vulnerability: (i) protection with dikes, (ii) adaptation of residential houses, (iii) prevention and warning, (iv) resettlement. Through the use of Cost-Efficiency Analysis (CEA), the relevance of each of the measures is evaluated through the number of human lives protected.

This analysis shows that dikes are not a viable solution in the only goal of protecting human life. In contrast, it recommends focusing more on prevention and warning measures which are less expensive and can lead to an important efficiency.

Structural solutions, like adaptation of residential houses and resettlement, are most expensive but could offer great benefits in protecting human life, depending of the level of vulnerability. The study suggests it could be useful to mix structural and non-structural solutions in order to protect human life against coastal floods.

Keywords: coastal risk, coastal flood, vulnerability, mortality, climate change, economic appraisal,

*Speaker

cost, efficiency analysis, single, storey houses

A tool to locate potential death areas due to coastal flood: the V.I.E. Index

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Storm Xynthia is the deadliest coastal flood event known in France since 1950's. In February 2010, Xynthia was responsible for an important coastal flood which led to the death by drowning of 41 people. The most specific characteristic of this event is that 93% of the deaths were located inside houses, which contribute to trap inhabitants.
Though Storm Xynthia occurred during the night, surprising people's during their sleep, it suggests that houses could present some characteristics which can increase vulnerability of people in case of flooding: location in low–lying flooding areas, closeness to dikes which can break, predominance of single-storey constructions which do not provide the possibility to escape through the roof.

In consequence, French State implemented a resettlement scheme, mapping constructions which were considered too dangerous for people. However, this scheme was realized only on Storm Xynthia's impacted areas.

Nonetheless, it subsist other areas with similar characteristics on French Atlantic coast: low-lying urbanized areas, protected by dikes, with predominantly single-storey.

This poster proposes a simple prospective's tool to identify danger areas for the population through characteristics of houses. The Vulnérabilité Intrinsèque Extrême index (VIE – LIFE index in english) is based on four criteria: (i) potential water depth per house, (ii) distance between dikes and houses, (ii) architectural typology and (iv) closeness to rescue point.
The index is useful to realise an initial assessment of vulnerability of seven cities on French Atlantic coast. It allows confirming the high exposure of Xynthia's affected territories and to identify other vulnerable areas.

Keywords: coastal risk, coastal flood, vulnerability, mortality, climate change, economic appraisal, single, storey houses.

*Speaker

Oyster farming value chains in light of sanitary hazards

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Since the mid-2000s, the French oyster industry has faced hazards of various origins. The results of a field survey conducted under an ANR Agrobiosphère program (entitled "Gigassat") have highlighted productive changes in the oyster farming industry in the bay of Bourgneuf and the Mor Braz area (south of Brittany). Beyond this observation, one may wonder to what extent technological and biotechnological developments as well as environmental risks participate in the reorganization of production. In order to study this dynamic, we have relied on the theoretical concept of Porter's value chain (1986) in the context of a value chain analysis. The survey covered different topics such as the perception of oysters mortality causes, adaptation strategies in terms of supply, abandonment of offshore farming areas in favour of foreshore areas and economic performance in oyster farming. The analysis of oyster farmers' operational activities raises questions about the existence of various types of value chains at the beginning of the period, which should be seen in the context of technological innovation, natural advantages and interactions with other actors. The survey also shows that in a context of sanitary crisis, some oyster farmers question the configuration of their value chain from a survival perspective whereas others maintain it. This work contributes to the identification and characterization of the various trajectories adopted by farms within the same sector in the face of environmental changes.

Keywords: Shellfish farming, risk, management, value chain

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Use of an agent-based model to reduce loss of life from coastal flood events

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The justification for carrying modelling to estimate loss of life and evacuation times to reduce the risks posed by coastal floods is sometimes questioned. However, there is a need to develop approaches which justify the expenditure on adaptation measures and improved emergency planning. This paper focuses on two case studies where an agent-based model was implemented to evaluate both the number of fatalities from coastal floods and to inform emergency management practices. The agent based model, known as the Life Safety Model, represents people's interactions with a flood and provides estimates of fatalities, as well as the time that is required for them to evacuate the area at risk.

The first case study evaluated the impact of coastal surge flooding on the town of Brunswick, Georgia in the USA. Climate change will increase mean sea levels by up to one metre and will increase the population at risk in Brunswick by 20% for a category 4 hurricane. The modelling shows that managed evacuation could significantly reduce the number of fatalities.

The second case study was Canvey Island, which is located in the Thames Estuary in the UK. Canvey Island is protected from coastal inundation by flood defences. In 1953, the island was inundated by a flood that breached the defences and led to the 58 deaths. A number of emergency management interventions (e.g. safe havens and flood warnings) were tested to see if the loss of life in 1953 could have been reduced.

Keywords: coastal flood risk, loss of life, emergency management

*Speaker

Adapting in the Anthropocene: a comparative case-study analysis of societal responses to mass mortalities of bivalves in coastal waters

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In many parts of the world, commercial bivalves, harvested or cultured, have been struck by mass mortality episodes due to climatic and/or anthropogenic stressors whose causes and consequences are not always clearly understood. This has particularly been the case during the last few decades, and such outbreaks resulted in a range of responses from fishers or farmers. In the present study, six commercial bivalve fisheries affected by mass mortalities from different parts of the world were analyzed using the I-ADApT (Integrated Marine Biogeochemistry and Ecosystem Research - Assessment based on Description and responses and Appraisal for a Typology) Framework. Specifically, I-ADApT was used to assess the impacts or consequences of these perturbations on the natural, social and governing systems, and the consequent collective and individual responses of the stakeholders (users, managers, states) to these events. The comparative analysis provided a basis for the appraisal of adaptive responses and their likelihood of success by combining the characteristics of their natural, social and governance settings. Common stressors increasing the vulnerability of bivalve ecosystems to mass mortalities were identified (e.g., increasing sea surface temperature and salinity, nutrient-enriched waters, acidification), but cannot themselves explain why social responses may succeed or fail to sustain the local farming or fishing industries. Social capital of the local communities and governability were key factors of resilience and adaptation to environmental changes affecting marine bivalve systems.

Keywords: IMBER, ADApT, bivalve, mass mortality, response, resilience

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The accident was that his boss drowned in the boat": sociocultural approaches to hazard and safety onboard traditional fishing vessels

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ENIM's classification has identified four types of occupational hazards for seafarers: maritime work accidents, work-related illnesses, illnesses at sea and other illnesses. This institutional definition of hazards does not include the perception of hazardous situations in the practice of the fishing profession. When asked about their daily lives, seafarers give quite a different description of their work. Is it precisely because risk is inherent in their profession that they do not mention it? Not referring to it does not necessarily mean not being aware of it. Quite the opposite: the presence of risk is so obvious that it is now automatically integrated in its representation and practices.
The contingent necessities when working at sea – constantly moving work space, with metal tools and the necessity to work quickly – generate an adapted representation of risks and different definitions of what is a dangerous situation.
The presentation will consider these socially conditioned behaviours when facing risk. We will analyse the testimonies and practices put in place to prevent certain risks, then see how risk management contributes to shaping a professional activity pattern.

Keywords: Occupational accident, sociocultural approaches, fishermen in traditional fishing

*Speaker

Profitability and competitiveness of fisheries companies. *1980-2000, fishermen harshly tested*

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Accidents and mortality at work in the maritime-fisheries sector in France remain very high compared with others lines of business.
We assume that the reorganisation of working time crew of the fishing vessels (partly linked to the development of advanced bases) and its intensification on board (as the daily increase in tows) are connected to this verdict.
Moreover, we consider risks taken by crews, in the 80's to the 2000's, were the price to pay by many fishing business companies for their continuation.
An explanation to this situation is wages features specific to fishery such as payment by giving employees a share of the profit, and sailors' commitment in their job.
Our communication use primary cross-referring data (sailors interviews and on-board observations in South Brittany) and secondary ones (reports and balance sheets, medical communications ...).

Keywords: Key words: profitability, work intensification, risk taking at work, fishery accidentology

*Speaker

From the ecology to the societal impact of harmful algae (COSELMAR PHYCOTOX)

Multidisciplinary and coordinating initiatives to prevent and mitigate the impacts of HABs

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Harmful Algal Blooms (HAB) are complex phenomena naturally occurring in many aquatic environments that have negative socio-economic consequences for human beings. HABs are caused by a combination of natural and anthropogenic factors, and will likely be modulated by global change although its direct effects still require further research. Realistically, HABs cannot be eliminated, but intense research combined with monitoring and coordination with society and policies at different levels from local to international scales are providing useful tools to prevent or mitigate their impacts.
A local case study constitutes the multidisciplinary approach in the Mediterranean locality of Sant Andreu de Llavaneres (38km North of Barcelona). There, a study joining epidemiology and ecology, in combination with meteorologists and chemists is advancing towards the understanding of the Ostreopsis cf. ovata blooms dynamics and their real impact on human health. This research group is integrated into the RAMOGE consortium, which coordinates actions to prevent exposure to Ostreopsis spp. outbreaks in the Mediterranean coasts of Italy, Monaco and France.

At a larger scale, we will explore the last advances of the multi-institutional and multidisciplinary effort to face the impacts of Karenia brevis blooms in the Gulf of Mexico and Florida. Finally, we will strengthen international collaboration and coordination to advance HAB research through the joint IOC and SCOR programmes GEOHAB (2000-2014) and GlobalHAB (2016-2025). GlobalHAB will include new research priorities such as food and water safety and security, human and ecosystem health, ocean observing systems, and climate change.

Keywords: Hamrful Algal Blooms, Human Health, Multidisciplinary International Research

*Speaker

Citizen Participation in Observing Phytoplankton Seawater Discolorations

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A citizen observation program of water discolorations (Phenomer) caused by phytoplankton proliferations was launched in 2013 throughout the coastal waters of Brittany (France), in parallel to the ongoing phytoplankton monitoring network (REPHY). Beyond communication and outreach objectives, Phenomer aims to explore the possibility to acquire scientifically valuable data on Harmful Algal Blooms (HABs) through extending the survey area of coastal waters by means of citizen alerts. A theoretically infinite number of sampling points (public observations) could contribute to identify i) HAB frequency and recurrence; ii) the distribution and extension of water discolorations; iii) the biogeography of causative taxa. The first three years of project running have contributed towards answering these hypotheses. Citizen observations have shed light on the extension and duration of water discolorations phenomena. In 2013 and 2015, Noctiluca scintillans red discolorations were observed over large distances, and in 2014, Lepidodinium chlorophorum created impressive long-lasting green discolorations, being at times associated to massive fish mortalities. New HAB risks were identified for the first time in Brittany. A bivalve mortality event coincided with a dark-brown phytoplankton bloom characterized by the dominance of the toxic raphidophytes Heterosigma akashiwo and Pseudochattonella verruculosa. Phenomer shows the value of citizen science programs in con-

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tributing towards managing and monitoring marine coastal areas at risk from HABs, whilst also providing the basis for the realization of new research projects on harmful microalgae. In addition, the primary motivations of volunteers were studied via phone surveys, revealing the genuine desire for volunteers to be involved in scientific research.

Keywords: HAB, citizen science, harmful algal bloom, phytoplankton, water discolorations, coastal water

Challenges and future needs in the control of algal toxins under the perspective of the EU Reference Laboratory for marine biotoxins

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The increased occurrence of natural, toxic events in the marine environment due to the presence of algal toxins has also increased the socio-economic impact in several coastal areas worldwide. The transition from animal tests to chemical methods for the control of these toxins has been an important achievement, and the result of the efforts of a number of scientists working in the field for many years, looking for the replacement of the long standing mouse bioassay. Lipophilic marine biotoxins have been the responsible for an important change in the EU Legislation. Paralytic shellfish poisoning toxins are supposed to be the next step, but in the meantime important work is being undertaken to resolve methodological and implementation issues. This transition requires the revision of regulation that needs to have a strong scientific support, based on updated toxicological and epidemiological data. All the above mentioned issues underline that we are now in a different era in the control of marine biotoxins, the transition from the biological to the chemical risk, a challenging transition for the EU Reference Laboratory and its EU Network. The main challenges of this transition are going to be discussed in this presentation, also relevant issues of concern for the marine biotoxins network will be emphasized, as well as present and future needs. Such needs are also influenced by the emergence of new or existing toxic compounds in different geographical areas, and potential threats, with special focus on emerging toxins in the EU, will be also presented and discussed.

Keywords: marine biotoxins, regulatory issues, analytical methods

*Speaker

GdR PHYCOTOX: an integrated research network on harmful algae from the ecology to societal impacts

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A French research network on HABs, currently led by Ifremer and CNRS, regroups 25 laboratories (> 100 scientists) in mainland France and overseas around five research themes:
- Identification and characterization of algal toxins

- Ecology, diversity, modeling and physiology of HABs and implications in toxin production

- Impact and transfer of phycotoxins in marine ecosystems and food webs

- Sanitary impacts and risk evaluation

- Socio-economic impacts

The research encouraged through this network is largely interdisciplinary, comprising life sciences, mathematics, chemistry and social sciences.

Recent, interdisciplinary, collaborative national projects include topics such as HAB ecology, chemical diversity and toxicity of algal toxins and their effects on the socio-ecosystem, HAB-parasites, passive sampling, innovative automated techniques and citizen-based science for the detection of HABs. Networking and collaborative projects are also directly promoted by the GDR activities and resources, including small prospective projects in ecology, taxonomy and toxicity of selected species and participation in international congresses.
Communication tools to improve internal networking and visibility to the international scientific community and societal stakeholders include three annual scientific conferences held since 2014. A bilingual website (FR-EN) has been created to display the individual participating laboratories and their activities, as well as the activities of the network (www.phycotox.fr): meeting announcements, job and internship postings, publications and general background information. Membership with an international professional society (ISSHA) has been multiplied by four.

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Thanks to this networking effort and following a competitive bid, ISSHA has awarded France to be the host for the 2018 HAB conference

Keywords: Phycotox

Risk-Monitoring, Modelling and Mitigation (M3-HABs) of benthic microalgal blooms across the Mediterranean regions

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The pan-Mediterranean project M3-HABs regarding monitoring of harmful algal blooms, with particular reference to the benthic dinoflagellate Ostreopsis, started in 2014 in the framework of the ENPI-CBCMED Programme. The specific objective of the project was to provide a common strategy for monitoring benthic toxic microalgae, through the development of new, more efficient and common procedures and protocols, making the process mostly cost and time effective, allowing for most efficient monitoring designs, increasing the knowledge on environmental drivers affecting Ostreopsis blooms and translate this into a forecasting tool, and improving the general awareness of the risks related to Ostreopsis. The following results were obtained: a larger awareness of the risks associated with the Ostreopsis blooms, an appropriate diffusion of cautionary measures set up, the production of common monitoring protocols, the development of new technologies for species-specific identification and counting and the build-up of prediction models in order to prevent and reduce risk factors for the environment, human health and economic activities. The project improved the establishment of solid networks along Mediterranean coasts to cope with Ostreopsis emergencies, providing the target groups common and intercalibrated protocols, in order to have comparable samplings in space and time through the Mediterranean Sea.

Keywords: Benthic HABs, Dinoflagellate, Ostreopsis, Mediterranean Sea

*Speaker

Mixotrophic cultures of Dinophysis sacculus and D.acuminata isolated from French coastal water

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Several dinoflagellate species of the genus Dinophysis produce potent lipophilic toxins, and have been implicated as the causative organism of Diarrhetic shellfish poisoning in coastal French water since 1983. We isolated cells from seawater collected in Arcachon bay and established mixotrophic cultures of Dinophysis sacculus and Dinophysis acuminata fed with the ciliate Mesodinium rubrum. Dinophysis acquired its capacity of photosynthesis by retention of the organelles that hosts the ciliate after feeding on the free-living cryptophyte Teleaulax amphioxeia. LC-MS analysis of Dinophysis sacculus cultures showed trace amount of OA (0.9 pg.cell-1) and moderate level of PTX2 and analogs (33,5 pg eq.PTX2.cell-1) comparable even higher than those measured in natural picked cells (0.1 pg and 5.1 pg.cell-1 respectively). The toxin profile of Dinophysis acuminata cultures should be analyzed by now and compared with that of Dinophysis sacculus.

*Speaker

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Keywords: Dinophysis, Kleptoplastidie, Diarretic Shellfish Toxins

Flash presentations

Development of a bacterial sensor for early detection of toxic algae bloom using synthetic biology techniques

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HAB-related detection systems have been routinely designed based on structure-specific technologies,
such as antibodies. At Kaitek Labs, we propose to shift this paradigm towards effect-based detection

through bacteria and simple microorganisms, mimicking the initial idea behind mouse bioassay and

biological tests.

Bacteria have a natural capacity to gather and process information about its surroundings. This

computer-like function has been overlooked for many years, and never before has there been an

initiative that makes use of such capacity. By giving this natural functionality both a purpose and a

human interface, we can turn bacteria into information gathering machines, capable of expressing their

findings to human users by simple organoleptic changes.

RTDK, or Red Tide Detection Kit, is an example of this bacterial computer or new generation biosensor

approach. Using Synthetic Biology tools, our team has been capable of devising metabolic pathways that

allow a cell culture to measure the amount of a certain targeted toxin (our initial target is Saxitoxin) in a

sample, and then turn either red or blue to inform the results to the user.

*Speaker

This test will be easy to apply, and will display results in no longer than an hour. It will also be applied in

situ, eliminating the necessity of special laboratories and also making it possible for someone with no

background on biology to understand the results. The user interface will be as simple as a pregnancy
test: a color change will indicate contamination, no further indications needed.

Keywords: HAB detection, bacterial sensor, HAB monitoring, PSP, synthetic biology

Effects of climate change and eutrophication on domoic acid production by Pseudo-nitzschia species – context and objectives

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Over the past decade, several coastal countries including France have experienced an increasing and major problem related to harmful algal blooms of the diatom Pseudo-nitzschia. The genus Pseudo-nitzschia includes some toxic species capable of producing domoic acid (DA), a neurotoxin responsible for the amnesic shellfish poisoning syndrome (ASP). Impacts of these blooms present many risks ranging from serious ecological and economic damages to threats to public health. These threats include human illness from ingesting contaminated shellfish, especially scallops that can accumulate DA for more than a year. It can also cause the death of marine mammals and seabirds. Based on literature, abundance and frequency of Pseudo-nitzschia blooms seem to be associated with eutrophication and climate change. Hence, several studies reviewed the effect of these changes on the production and accumulation of DA, including the change in pH, temperature, salinity and the availability of different source of nitrogen. However, studies show varying results and this is usually justified by the wide inter-species variability and even intra-strain variability of Pseudo-nitzschia. Therefore, further studies are needed to elucidate the effect of climate change and eutrophication that may promote growth and DA production by additional Pseudo-nitzschia species and strains isolated in France. So the aim of this thesis is to study the impact of several changing factors such as salinity variation, ocean acidification (pH) and nutrient availability in order to understand the physiology of the toxic Pseudo-nitzschia strains and the role of DA in the cells.

Keywords: Pseudo, nitzschia, domoic acid, algal physiology, climate change, eutrophication

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A 15-years MODIS time-series to study the spatio-temporal dynamics of microphytobenthos in the Loire estuary

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Estuarine intertidal sediments are colonized by photosynthetic micro-organisms grouped under the generic term of microphytobenthos (MPB). These assemblages form transient biofilms at the sediment surface and have important ecosystem functions. MPB biofilms are well known to exhibit high micro-scale patchiness, while few studies have examined their meso- and macro-scale spatio-temporal dynamic.
In this work, the inter-annual variations of MPB biomass were investigated in a poly-haline mudflat of a north-European estuary (Loire), using satellite remote sensing. To this, a daily surface reflectance product derived from the moderate-resolution imaging spectroradiometer (MODIS) was used.

A selection process was first applied to bring out the most relevant images for this analysis, which successively considered (i) the emerged surface of mudflats and the cloud cover within the region of interest at the time of acquisition, and (ii) the images quality. At the end, 268 daily MODIS scenes were selected over a period from 2000 to 2014.

The Normalized Difference Vegetation Index (NDVI), a proxy of MPB biomass, was then calculated from two MODIS spectral bands at red and near infrared wavelengths, and 250 m * 250 m pixels corresponding to MPB biofilms were identified by NDVI values between 0 and 0.35.

Inter-annual biomass variations are described as well as a seasonal trend characterized by two blooms period in late winter/early spring and autumn.
The influence of natural and anthropogenic factors will be analyzed in order to explore the opportunity of using microphytobenthic communities as a bio-indicator within the Water Framework Directive.

Keywords: Microphytobenthos, NDVI, remote sensing, MODIS, time, series, inter, annual variation, seasonality

*Speaker

A comparison of chitin purification performance of an enzymatic process on four crustacean cuticles

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A one-step bio-refinery process for crustacean cuticles was investigated. Its originality lies

*Speaker

in a simple rapid (6 h) biotechnological cuticle fragmentation process that recovers all major compounds (chitins, peptides and minerals). The process consists of a controlled exogenous enzymatic proteolysis in a food-grade acidic medium allowing chitin purification (solid phase), and recovery of peptides and minerals (liquid phase).
This study is based on a comparison of four crustacean cuticles (shrimp Litopeneaus vannamei, lobster Homarus gammarus, invasive swimmer crab Polybius henslowii and invasive longnose spider crab Libinia dubia) on purity degree of chitin, on demineralization and deproteinization rates of solid phase after 6 h in presence of ASP enzyme at 40∘C in formic acid diluted in 50 ml. An appropriate quantity of acid, depending on raw material mineral content, was added for each experiment for an initial dry weight of 5 g of raw material. Quantities of minerals and proteins of 5 g raw material were respectively 1.17 and 1.78 g for shrimp, 3.10 and 1.01 g for lobster, 3.11 and 0.96 g for swimmer crab and 3.54 and 0.29 g for spider crab. Final pH after 6 h were similar and between 3.4 and 3.6. In all cases, a similar demineralization rate after 6 h (between 96.7 % and 99.2 %) was observed. Best deproteinization rate (95.2%) was obtained for shrimp. At the opposite, 76.3 % was observed for spider crab. A dependence between deproteinization rate and ratio proteins on minerals of the raw materials seems to appear.

Keywords: chitin, purification, enzymatic, crustacean cuticles

Etude des phycotoxines lipophiles dans les mollusques bivalves de l'Atlantique nord marocain

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Bivalve molluscs Moroccan coast are often subject to prohibitions collection and exploitation due to their contamination by marine toxins (PSP, ASP and LSP). At the Atlantic northern Morocco, the watch areas are most affected by the LSP of toxic episodes.
This study describes on one hand, the spatiotemporal evolution of toxins LSP at the Atlantic fringe of El Jadida, Essaouira and at the Moulay Bousselham lagoon, and on the other, the comparison of contamination by this type of toxin in the monitored species, such as mussels, oysters and clams in the three years (2013 to 2015).

It appears from this study that the fringe of El Jadida - Essaouira is an area at risk for it often has periods of prohibition of mussel's exploitation during the three years (2013-2015) following the appearance lipophilic toxins (LSP) with large concentrations. The summer and autumn seasons are critical times of shellfish contamination lipophilic toxins (DSP).
This study also revealed the presence of new groups of lipophilic toxins (emerging) who have never been identified in Morocco and which are identified and quantified by the physico-chemical method LC-MS / MS. Similarly, it was observed that the mussels concentrated more this toxin (LSP) that other shellfish species.

Keywords: Bivalve molluscs, toxins LSP, Moroccan coast

*Speaker

The OstreoRisk project: a multidisiciplinary approach to understand the impacts on human health of the Ostreopsis cf. ovata blooms

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Blooms of the benthic dinoflagellate Ostreopsis cf. ovata are recurrent in Sant Andreu de Llavaneres beach (40 km North of Barcelona), NW Mediterranean. In this locality, the outbreaks of the microalgae have been related on one side, to massive macrofauna mortalities. Furthermore, respiratory symptoms and general malaise in people exposed to marine aerosols are reported yearly along the summer-fall proliferation period. Similar negative impacts have also been observed in other Mediterranean coastal zones along the last 20 years, coinciding with the presence of Ostreopsis spp. blooms. This organism of tropical origin produces a potent toxin, palytoxin (PLTX) and analogues, and in these areas Ostreopsis has been related to human intoxication -sometimes fatal- by ingestion of contaminated marine food. Overall, its blooms, that seem to be expanding in temperate waters, constitute a health and environmental emergent problem. Within the OstreoRisk project (2015-2017) we are trying to shed light on the dynamics of the O. cf. ovata blooms and their links with the human health symptoms. Here, we will present our progresses achieved with a multidisciplinary approach, combining ecology, meteorology, toxicology and public health in the Sant Andreu de Llavaneres hot spot.

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Keywords: Ostreopsis ovata, public health, phycotoxins, harmful algal blooms

Membrane filtration of microalga extract for recovering Polysaccharides: effect of the membrane characteristics and the ionic environment

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Numerous intra- or extra-cellular molecules coming from microalgae as well as those released in the culture medium, such as proteins, polysaccharides, lipids could find applications in cosmetic, nutraceutic, human health, foof, feed, etc... Membrane ultrafiltration is an efficient process that can be used for the recovery and the purification of molecules without high molecule damages. Nevertheless, the ultrafiltration of biological extracts can be difficult due to the membrane fouling particularly in the presence of salts which promote the agglomeration of the molecules and change the interactions between the molecules and the membrane surface.
This study investigates the influence of operating conditions of micro/ultrafiltration on the performances of purification and concentration of Spirulina's extracts. Special emphasis is paid on the influence of the ionic environement (nature and concentration of the ionic species) on the recovery rate and concentration of polysaccharide and protein, the process productivity and the characterisation of the fouling.

Keywords: microalgae, ultrafiltration, Polysaccharides

*Speaker

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How does varying photoperiod affect the physiology and toxicity of the diatom Pseudo-nitzschia?

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Pseudo-nitzschia species form pluriannual blooms over the French coasts during the light-evolving seasons of spring and autumn. Such blooms may contain domoic acid-producing Pseudo-nitzschia species or non-toxic ones, which represent a potential threat for seafood contamination and human disease. One major question is how the photoperiod variation may affect the physiology of toxic and non-toxic species of Pseudo-nitzschia. Therefore, we assessed in batch cultures, how decreasing or increasing the photoperiod may influence the photosynthetic activity, pigments, primary metabolites and toxin production in the toxic P. australis and the non-toxic P. delicatissima cells. We observed similar physiological responses to photoperiod change for the toxic and non-toxic species suggesting that toxicity is not influencing the remaining P. australis metabolism. Surprisingly, increasing photoperiod leads to an earlier population decline whilst reducing photoperiod leads to a new growth phase. For both species, the population decline is characterised by a decrease of photosynthetic activity (Fv/Fm, ETR), the loss of photosynthetic system integrity (Chl-a degradation into chlorophyllids and an increase of accessory pigments), the setting of photoprotective mechanisms (increase of xanthophyll content and the NPQ fraction) and for P. australis, an increase of toxin production. In contrast, reducing photoperiod leads to restarting cell division, maintaining the pool of Chl-a and for P. australis, limiting toxin production. Hence, Pseudo-nitzschia cells seem to adapt their metabolic activity by "shifting to a lower gear" supporting growth but not toxin production. Finally, domoic acid appeared to be produced continuously by P. australis, following an antagonist pattern to cell growth.

Keywords: Pseudonitzschia, domoic acid, pigments, photosynthesis, photoperiod

*Speaker

Role of nitrogen sources in diatom-oyster trophic relationships

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The purpose of the present study is to test if the trophic relationships between diatoms and oysters, two major primary and secondary compartments in the coastal ecosystem, may be regulated by the nitrogen forms available in their environment? The effect of different nitrogen sources was investigated on three benthic diatom species (Entomoneis paludosa, Halamphora coffeaeformis, Phaeodactylum tricornutum) grown in culture and their assimilation by the oyster Crassostrea gigas. Eight dissolved forms, either inorganic (nitrate and ammonium) or organic (urea, arginine, taurine, glutamine, serine and glycine) induced significant but diverse effects on diatom's growth. In particular, all algal species showed the best growth with taurine, an amino acid largely excreted by oysters in the environment. The retroaction of oysters on algal growth was also investigated by culturing the diatoms on extracts of oyster's feces and pseudofeces used as nitrogen source. These products sustained the diatom's growth and increased the algal biomass when provided in addition with nitrate, thus stimulating the top-down regulation between the two compartments. The filtration of the microalgae by the oyster seemed more dependent on the diatom species than the nitrogen source used for their growth.The nitrogen source however may modify the composition of the diet through species-dependent stimulation of microalgal growth, and for all diatoms, the oyster's filtration rate was higher when their nitrogen source for growth was respectively ammonium, urea and nitrate. This study shows that the retroactions between diatoms and oysters are complex, and that nitrogen forms can be important regulators of the system

Keywords: microphytobenthos, Crassostrea gigas, nitrogen, growth, trophic relationships

*Speaker

New Immuno-chromatography strips for the simple detection and quantification of the toxic marine microalgae, Alexandrium minutum

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In Europe, Alexandrium minutum is one of the main species responsible for paralytic shellfish poisoning and regularly impacts the shellfish aquaculture industry. Morphological similarities between different Alexandrium species make an accurate identification problematic. Therefore, alternative methods are needed for environmental monitoring. The assay should be rapid, discriminative, quantitative and inexpensive. In this context, two lateral-flow-immunoassay (LFIA) are presented here to detect and quantify A. minutum whole cells. The assays both rely on two distinct monoclonal antibodies directed against different surface epitopes of this organism and are used in a sandwich format. The capture is done by a first antibody spotted as a test line onto a nitrocellulose membrane whereas the second antibody is labelled with superparamagnetic nanobeads or colloidal gold particles that are subsequently used to detect the signals. Cell quantification is done either by densitometry or by measuring the magnetic signal. We demonstrate that whole algae can diffuse through the nitrocellulose strip. Either frozen or living cells can be quantified directly in a seawater sample. LFIA specificity was assessed by using a panel of other dinoflagellates species. Calibration curves and the detection limit were determined using seawater spiked with known amounts of a culture of A. minutum cells. Both types of LFIA tests were subsequently used on environmental samples that were previously characterized by light microscopy counting. In conclusion, these specific and handy LFIAs are capable of detecting and quantifying toxic A. minutum cells in seawater samples in less than 30 minutes, which is optimal for rapid on-site testing.

Keywords: Alexandrium minutum, lateral, flow, immunoassay, detection, quantification, monitoring

*Speaker

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Evaluating the potential of anaerobic digestate from urban wastewater for marine microalgae production.

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The PHYCOVER project offers to improve urban wastewater treatment. The project aims to develop an integrated treatment process for the production of biogas, together with nitrogen (N) and phosphorus (P) recycling through the production of valuable microalgae: Tisochrysis lutea for aquaculture feed and Nannochloropsis gaditana for lipid production.
Therefore, the nutritional capacity of four anaerobic digestion effluents (digestates) has been assessed on microalgae cultures yields and productivity with a particular attention to N and P inputs. The first step consisted in assessing the dilution range of digestates to optimize microalgae growth. The experiment has been performed with a standardized N/P ratio. This approach allowed testing the "matrix effect" of digestates, regardless of N and P relative availability. Results showed that the two species grew well on all digestate sources. However, T. lutea demonstrated reduced growth performances under high concentrations of digestates, while N. gaditana did not. The second experiment was designed to assess both N and P removal yield and microalgae productivity. Results highlighted differences in productivity between microalgae/digestates pairing, pointing out specific needs for the two species and differential inhibition effects of digestates.
These results may reveal differences in microalgae ability to cope with the matrix of digestate and nutrients uptake. Present research brings out the potential of anaerobic digestate to couple eutrophication nutrients removal and recycling, as well as by-products valorization for green chemistry and aquaculture industry.

Keywords: anaerobic digestate, microalgae production, eutrophication nutrients removal

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Growth and biochemical composition of a microphytobenthic diatom (Entomoneis paludosa) exposed to shorebird (Calidris alpina) droppings

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Intertidal mudflats are important feeding areas for migrating and wintering shorebird species. The objective of the present work was to experimentally evaluate the effect of Dunlin droppings on the growth and biochemical composition of the microphytobenthic diatom, Entomoneis paludosa. Various culture media were used going from plain artificial seawater to F/2 culture media containing variable nitrate concentrations (0; 50 or 882 μM-NO3) to which bird dropping extract was added or not. The faeces extracts contained inorganic nitrogen (9.1 μM-NH4), inorganic phosphorus (8.2 μM-PO4), traces of silicate (0.2 μM-Si), organic nitrogen in the form of urea (16 μM-N) and other dissolved organic nitrogen (120 μMN). Faeces extract in artificial seawater was sufficient to sustain E. paludosa growth (up to 6.8 cell divisions in 9 days). A significant growth rate increase (+20%) and higher biomasses were observed when faeces extract was added to inorganic media enriched with 50 μM-NO3. Bird droppings had a significant effect in E. paludosa final biochemical composition with the addition of faeces extract to a culture medium containing 50 μM-NO3 increasing E. paludosa protein content and decreasing carbohydrate content. Pigment content per cell increased with the addition of bird dropping extract but ratios of light-harvesting and photo-protective pigments to chlorophyll a were unaffected. E. paludosa grown with faeces extract showed high cellular nitrogen and carbon contents, close to those obtained when cells were grown in F/2 medium. This study showed that shorebird droppings, through the addition of dissolved material, can significantly affect microphytobenthic diatom growth and biochemical composition.

Keywords: Dunlin, microphytobenthos, mudflat, guano, carbon, nitrogen

*Speaker

Light history effect in Haynesina germanica kleptoplast photoprotection mechanisms and PSII quantum efficiency

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Some benthic foraminifera have the ability to incorporate functional chloroplasts from diatoms (kleptoplasty). Our objective was to investigate kleptoplast functionality and photoprotection mechanism in a benthic foraminifera (Haynesina germanica) exposed to different light regimes using spectral reflectance, epifluorescence observations, oxygen evolution, PAM fluorometry and pigment analysis.
Haynesina germanica kleptoplasts were functional for more than one week and showed net oxygen production with a compensation point at 24 μmol photon m-2 s-1 and a production up to 1000 pmol O2 cell-1 day-1. Haynesina germanica Fv/Fm slowly decreased from 0.65 to 0.55 in 7 days in darkness; however, it quickly decreased to 0.2 under HL (70 μmol m-2 s-1). Kleptoplast functional time was estimated between 11 and 21 days in darkness and between 7 and 8 days at HL. A functional xanthophyll cycle was also observed on fresh specimen of H. germanica exposed to different short term light regimes. The ratio Xanthophylls/Chlorophyll a strongly increased after 30 min under low (25 μmol m-2 s-1, 1.81$\pm$0.07) and high light regimes (300 μmol m-2 s-1, 1.93$\pm$0.08), whereas the ratio stayed low in the darkness (0.52$\pm$0.05) and almost came back to its initial value (0.54$\pm$0.03) after a very low light period (30 min, 5 μmol m-2 s-1, 0.90$\pm$0.09).
These results showed that kleptoplasts are unlikely to be completely functional over a long time, thus requiring continuous chloroplast resupply from foraminifera food source. Their spatial and vertical distributions might thus be linked to their microalgal preys and to access to light.

Keywords: Foraminifera, kleptoplasty, diatoms

*Speaker

Growth and biochemical responses of the benthic diatom Entomoneis paludosa (Bacillariophyceae) to dissolved inorganic and organic nitrogen in culture

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Benthic diatoms are dominant primary producers in intertidal flats. This study investigated the effect of different nitrogen sources and concentrations on Entomoneis paludosa growth and photophysiological response. Six nitrogen sources, either inorganic (nitrate and ammonium) or organic (urea, arginine, glutamine and glycine) supplied at two concentrations (40 and 400 μM-N) induced significant effects on growth, carbon, nitrogen, pigment content and maximum PSII quantum efficiency (Fv/Fm). Entomoneis paludosa grew under all nitrogen sources albeit showing differences in lag phase, growth rate and cell yield. Inorganic nitrogen, urea and arginine induced higher growth; whereas, glycine did not support high biomass. Fv/Fm showed variability dependent on nitrogen source and C/N ratio. Fv/Fm varied between 0.55 and 0.65 at 400 mM-N with the highest values observed in glycine, glutamine and urea; whereas, nitrate, ammonium and arginine induced lower Fv/Fm. All cellular components decreased in the 40 μM-N treatments, with nitrogen and pigments being lower than carbon content. Light-harvesting pigment ratios Chl c/Chl a and photoprotective pigment ratios (diatoxanthin + diadinoxanthin)/ Chl a increased, while fucoxanthin/Chl a ratios were unaffected by N-limitations. Entomoneis paludosa was capable of quickly adapting and use a wide variety of nitrogen sources. This adaptability may contribute to microphytobenthos diatom ecological success in mudflat ecosystems.

Keywords: Microphytobenthos, pigments, amino acids, nitrate, urea, ammonium, fluorescence, PAM

*Speaker

Bacterial community structure of the marine diatom Haslea ostrearia

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The marine diatom Haslea ostrearia produces a water-soluble blue-pigment named marennine of economic interest (e.g. in aquaculture for the greening of oysters). Up to date the studies devoted to ecological conditions under which this microalga develops never took into account the bacterial-H. ostrearia relationships.
In this study the bacterial community was analysed by PCR-TTGE before and after H. ostrearia isolation cells recovered from 4 localities, to distinguish the relative part of the biotope and the biocenose and eventually to describe the temporal dynamic of the structure of the bacterial community.

The bacterial structure of the phycosphere differed strongly from that of the bulk sediment. The similarity between bacteria recovered from the biofilm and the suspended bacteria did not exceed 10% (vs. $>$ 90% amongst biofilms). The differences in genetic fingerprints, more especially high between two H. ostrearia isolates showed also the highest differences in the bacterial structure as the result of specific metabolomics profiles. The non-targeted metabolomic investigation showed that these profiles were more distinct in case of bacteria-alga associations than for the H. ostrearia monoculture. At the scale of a culture cycle in laboratory conditions, the bacterial community was specific to the growth stage. When H. ostrearia was subcultured for 9 months, a shift in the bacterial structure was shown from 3-months subculturing and the bacterial structure stabilized afterwards (70-86% similarities).
A first insight of the relationships between H. ostrearia and its surrounding bacteria was shown for a better understanding of the ecological feature of this diatom.

*Speaker

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Keywords: biofilm, ecology, metabolic fingerprinting, microalgae, phycosphere, TTGE

Temporal dynamics of seagrass beds and microphytobenthos in Marennes-Oléron bay using time-series MODIS data.

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Marennes-Oléron Bay is a shellfish ecosystem with large intertidal mudflats colonized by microphytobenthos and Zostera noltei seagrass beds. In the Eastern part of the bay, microphytobenthos forms biofilms colonizing the sediment surface at low-tide, while seagrass are mainly found in Western part. Seasonal and interannual variations of these two primary producers have been described over a 15-year period using time-series of daily Terra MODIS 250-m images. 380 MODIS scenes were selected between 2000 and 2015 and the Normalized Difference Vegetation Index (NDVI) was calculated, as a proxy of vegetation biomass. Specific thresholds of NDVI were applied to map microphytobenthos ($0 < NDVI < 0.35$) and seagrass beds ($0 < NDVI < 0.7$). Microphytobenthos-NDVI showed a high interannual variability, which was less pronounced for seagrass beds. The drivers of the microphytobenthic interannual variability remains to be elucidated. At the scale of the year, the two types of vegetation presented marked seasonal fluctuations. The well-known unimodal seagrass beds development with its characteristic maximum growth in summer was well described over the time-series. Significant correlation was obtained between field biomass measurements and NDVI values, confirming the consistency of the seagrass-NDVI signal. Microphytobenthos was characterized by a main bloom between late winter and early spring followed by a summer decrease and another smaller bloom in fall. This seasonal cycle should be now analyzed over a broad latitudinal range. This study shows that in spite of its low spectral/spatial resolution, the high frequency MODIS images can bring significant information on the spatio-temporal dynamic of intertidal primary producers.

Keywords: microphytobenthos, seagrass beds, intertidal mudflats, NDVI, time series, MODIS

*Speaker

Genopoptaille project: moving stock assessment into the future

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At the ecosystem level, sustainable exploitation of fisheries resources depends not only on the status of target species but also on that of bycatch species, some of which are even more sensitive to exploitation. This is the case for a number of elasmobranchs (skates, rays and sharks) species whose abundance declined during the 20th century. Further, the biology of elamobranchs is still poorly known and traditional fisheries stock assessment methods using fisheries catches and scientific survey data for estimating abundance are expensive or even inapplicable due to the small numbers observed. The GenoPopTaille project attempts to apply to the case of the thornback ray (Raja clavata) recent genetic-based methods for absolute population abundance estimation as well as characterizing its genetic diversity and population structure in the Northeast Atlantic. The poster will present the objectives, challenges and progress made so far by the project.

Keywords: Census population, effective population size, thornback ray, Raja clavata

*Speaker

Challenging Marine Litter with Urban Litter: Open Litter Map

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In the 1970's marine litter was recognized to have a global distribution which now costs an increasing _˜11 billion to coastal and marine economies annually. Terrestrial plastic pollution is also now a ubiquitous global phenomenon and in Europe, plastic pollution consitutes _˜80% of the source of marine litter. To stop plastic reaching the ocean and to prevent re-occuring litter deposits, new means are needed to reveal and communicate terrestrial litter distribution and abundance with the public. In addition to changing public behaviour, new insights are needed to improve public service implementation and to measure the effectiveness of future policy changes. This can be achieved by analysing the pre-marine terrestrial geo-characteristics of litter through a hyper-spatial resolution Citizen Science initiative (Open Litter Map). The Citizen Science process also provides a platform to bring stakeholders together to collaborate on common goals such as a MSP and should be considered as part of a MSP. Although terrestrial (i.e. urban) litter constitutes _˜80% of the source of marine litter, our understanding of litters' spatial or temporal distribution remains significantly underdeveloped. Signifncatly more work is needed to reveal plastic pollution and to communicate the increasing problems of litter and plastic pollution with the public.

Keywords: Open Litter Map, Plastic Pollution, Urban Litter, Marine Litter, Marine Debris, Citizen Science

*Speaker

Preliminary metabolomic approach on structure of the bacterial community of the marine diatom Haslea ostrearia

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The marine diatom Haslea ostraria produces a water-soluble blue-pigment named marennine of economic interest. But the lack of knowledge of the ecological conditions, under which this microalga develops in its natural ecosystem, more especially bacteria H. ostrearia interactions, prevents any optimization of its culture in well-controlled conditions.
The structure of the bacterial community was analyzed by PCR-TTGE before and after the isolation of H. ostrearia cells recovered from 4 localities, to distinguish the relative part of the biotope and the biocenose and eventually to describe the temporal dynamic of the structure of the bacterial community at two time-scales.

The differences in genetic fingerprints, more especially high between two H. ostrearia isolates (HO-R and HO-BM) showed also the highest differences in the bacterial structure as the result of specific metabolomics profiles. The non-targeted metabolomic investigation showed that these profiles were more distinct in case of bacteria-alga associations than for the H. ostrearia monoculture

Here we present a Q-TOF LC/MS a metabolic fingerprinting:

- to investigate differential metabolites of axenic versus non axenic H. ostrearia cultures.

- to focus on the specific metabolites of a bacterial surrounding associated with the activation or inhibition of the microalga growing.
The Agilent suite of data processing software makes feature finding, statistical analysis, and identification easier. This enables rapid transformation of complex rawdata into biologically relevant metabolite information.

Keywords: Haslea ostraria, co, culture, microalgae, marine diatom, TTGE, high resolution mass spectrometry, untargeted metabolomics

*Speaker

Future coastline prediction of Mahanadi Delta using Digital Shoreline Analysis System (DSAS): A Fractal Dimension Index (FDI) approach

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Mahanadi delta, the second largest delta in the Indian subcontinent is gradually losing its coastal lands mainly due to sea-level rise and erosion. To comprehend the coastal dynamics of the delta and to forecast the future, Digital Shoreline Analysis System (DSAS) coupled with Fractal Dimension Index (FDI) have been used on the historical shorelines. From 1990 onwards, the historical shorelines of the delta have been extracted from the satellite imageries using semi-automated classification technique. The historical shoreline alteration trend has been calculated using Endpoint Rate (EPR) method. From the historical trend, the future coast lines have been predicted. FDI of the shorelines of the delta have been calculated, an empirical relation with FDI and the rate of erosion has been established and from this the future trend of the coastline derived from EPR method have been validated. Using EPR, shorelines of the Mahanadi Delta have been predicted for the next three decades. The result shows significant loss of area near Puri, Konarak, Saharabdei, Naugaon, Uttampur.

Keywords: :Digital Shoreline Analysis System (DSAS), Fractal Dimension Index (FDI), Erosion, Endpoint Rate (EPR), Mahanadi Delta

*Speaker

Effect of prey consumption and light intensity on toxin production of Dinophysis sacculus and D. acuminata

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Some species from the marine dinoflagellate genus *Dinophysis* are known to be causative agents of Diarrhetic Shellfish Poisoning events. In French coastal waters this phenomenon was first reported in June 1983 and was studied *in situ* since then. It is only from 2006 that their maintenance in culture was made possible. Among this genus are mixotrophic species that can realize photosynthesis by hosting chloroplasts they steal from ciliates they feed on. Two *Dinophysis* species, *D. sacculus* and *D. acuminata*, have been isolated last spring from Arcachon bay and their toxicity was confirmed by LC-MS. Two different ciliate strains of *Mesodinium rubrum* harboring cryptophyte organelles will be used to test if *Dinophysis* toxin production might be prey-dependent. Moreover, dinoflagellates will be placed under different light treatments (40 and 120 μmol photons m-2 s-1). *Dinophysis spp.* growing rates will be calculated for determining the stationary phase from which samples for toxin and pigment analysis will be collected. Retention times of the kleptoplasts will finally be estimated and compared in both light treatments.

Keywords: Diarrhetic Shellfish Poisoning, Dinophysis, Kleptoplastie

*Speaker

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Lithium selective extraction from old Tunisian sea waters using nanofiltration membranes

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We will focalize on the main role play by hydration for selective elimination (partial or total) of Ca2+/Mg2+ vs Li+ in presence of Na+, Cl-, with different nanofiltration membranes under different operating conditions (molecular weight cutoff, ionic strength, transmembrane pressure, membrane material, fouling agents).
The possibility to **separate lithium from salt lake brines from Tunisians Chott**s, using NF and low pressure reverse osmosis membranes was studied. NF90 membrane compared to the XLE appeared more efficient for Li+ extraction due to its higher hydraulic permeability to pure water and also for a 0.1 M NaCl solution, its lower critical pressure (Pc = 0), its higher selectivity between monovalent ions (40%) obtained at low operating transmembrane pressure (below 15 bar). NF90 exhibited 100% rejection of magnesium in a first step separation from brine diluted ten times as only 15% for Li+, with a final separation between Mg2+/Li+ of 85%. The permeability to the diluted brine was 0.7 L.h–1.m–2.bar–1 usable to size full scale experiments in the future in order to extract lithium i.e. battery industry. In a second step we have succeeded to separate totally Li+ and Na+ by a dialysis separation with NF90. We obtained a total separation between Li+ and Na+ with few membranes tested with a 5 times higher diffusion flux (4.42 10–7 mol.s–1.m–2 at 20 ∘C with NaCl 0.1 M) for the NF90 vs XLE, [1].
Somrani A. Pontié M. et al. (2013) Desalination, 317, 184-192.

Keywords: brines, lithium extraction, nanofiltration, reverse osmosis

*Speaker

Bioguided fractionation of Gambierdiscus extracts

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The benthic dinoflagellate *Gambierdiscus* produces ciguatoxins (CTXs) and maitotoxins (MTXs), the most potent marine toxins known to date. CTXs bio-accumulate and cause Ciguatera Fish Poisoning (CFP). Recently, an increasing number of species has been discovered in this genus, and CFP has been reported from areas previously not considered endemic, namely the Canary Islands. Little is known about CTX and MTX congeners produced by microalgae, especially by strains outside the Pacific Ocean. Moreover, other toxic compounds were recently identified, e.g. gambierone. For isolation purposes, it is necessary to up-scale laboratory cultures of *Gambierdiscus* and develop a purification procedure capable of detecting previously undescribed compounds. Several strains of *Gambierdiscus* from the Pacific and North-Eastern Atlantic Oceans were screened for their toxicity using an ouabain/veratridine neuro-2a (N2a) assay and a human erythrocyte lysis assay (ELA). One strain from the Canary Islands showed particularly high toxicity but did not contain known ciguatoxins. For selected strains, algal cells were extracted with methanol. Crude extracts were partitioned between dichloromethane (DCM) and aqueous methanol (aq. MeOH) in order to separate lipophilic compounds (e.g. CTXs) from hydrophilic and amphiphilic compounds such as MTXs. Extracts were purified via successive fractionation steps, using different separation principles such as size exclusion and polarity. For each step of the purification, fractions were screened in parallel for toxicity using MTT and calcium influx *in vitro* assays and analyzed by high resolution mass spectrometry (Q-Tof 6550, Agilent). Data-mining was carried out to simplify data complexity and to correlate MS data to toxicity.

Keywords: Ciguatera Fish Poisoning, Gambierdiscus, ciguatoxins, maitotoxins, HR LCMS, LH20, size exclusion chromatography, normal phase chromatography, reverse phase chromatography, neuro2a assay, erythrocyte lysis assay

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Metrology for supporting the reliability of oceanic measurements

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Large variety of oceanic observables are regularly monitored with a dense coverage of oceanic sites. Europe spends annually 1.4 billion for marine data collection, which represents a real effort in terms of financial investment. As a feedback, relevant and reliable results of measurements and tests are expected. Moreover, because of slow changes, most of these parameters require long term studies, up to decades and more. Therefore, it is essential that the data collected are comparable over space and time. Data comparability rely on three sine qua non conditions: (i) establishing metrological traceability of the measurement results, (ii) verify the reliability and accuracy of measurements using appropriate reference materials and (iii) estimate the uncertainty of final measurement result.
However, due to the complexity of the marine environment and the high number of parameters, it is difficult to cover all of them with appropriate reference materials (RM). To compensate the lack of RM the participation in interlaboratory comparisons programs is a useful tool to demonstrate the effectiveness and the quality of the analytical methods. But, in this case, there is a strong need for independent reference values given by a National Metrology Institute to ensure the detection of possible bias in the consensus value. The aim of the presentation is to deliver a critical point of view concerning the quality of measurements performed in seawater. Based on LNE's (Laboratoire National de Métrologie et d'Essais) experiences, the following topics will be discussed: definition of the measurand, instrument calibration, measurement protocols, uncertainty sources.

Keywords: accuracy, metrology, uncertainty, calibration

*Speaker

Extraction of molecules from brown macroalgae Sargassum muticum by enzymatic hydrolysis improved by the use of surfactants

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Sargassum muticum is a proliferative brown alga constituting a large amount of biomass. This alga is not very exploited despite it contains several substances of interest (i.e. phlorotannins, polysaccharides, proteins, etc). Extraction of all these molecules without damaging any valuable component of the alga comes closer to the concept of biorefinery. The use of enzymatic hydrolysis provides a soft and specific extraction method that meets this objective. Enzymes are used to hydrolyze the cell wall of macroalgae releasing interesting molecules. But the structural complexity of the cell wall as well as the presence of cellulose fibers, sulfated fucans and alginates linked to the proteins and phenolic compounds is an obstacle to overcome. We followed different strategies to solubilize phlorotannins, proteins and polysaccharides from Sargassum muticum. We compared organic solvent extraction to enzymatic extraction with a marine specific enzyme (alginate lyase) and commercial enzymes. The use of 5% Dry Weight (DW) of an enzymatic mix containing a commercial beta-glucanase, a commercial protease and the alginate lyase led after 3 hours of hydrolysis to the solubilization of 2.43% DW polysaccharides and 0.52% DW phlorotannins. These results, though better than aqueous extraction, have been further improved by using surfactants. Surfactants seem to affect both the solubilization of extracted molecules and the enzymatic action resulting in a better efficiency of the enzymatic hydrolysis. For example, the use of 0.5% volume of an anionic surfactant with 10% DW of the enzymatic mix allowed to reaching the value of 2.63% DW of solubilized phlorotannins.

Keywords: Proliferative macroalgae, Sargassum muticum, enzymatic hydrolysis, surfactants

*Speaker

Exopolymers recovery from culture supernatants of micro-algae using membrane techniques: fouling mechanisms

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Strains of cyanobacteria such as Arthrospira platensis are able to synthesize and release exopolysaccharides (EPS) into their culture medium. Membrane processes could be interesting for the recovery, concentration and purification of these exopolymers. Nevertheless, culture media are highly complex environments which strongly foul the membranes, particularly by the presence of EPS. Therefore, the present work deals with the understanding of the membrane fouling mechanisms during culture supernatants filtration. It is assessed against the physico-chemical factors, the supernatants composition and different hydrodynamic conditions in order to optimize and to propose a viable and sustainable EPS recovery process.
In this investigation, A. platensis, well-known as Spirulina, is cultivated in semi-continuous mode in a flat panel Air-lift photobioreactor (PBR, 130 L) and is subjected to light stress to enhance its EPS production. The first part of the presentation will focus on the separation of the cells from supernatants as well as the supernatants characterization. A method of separation was made so as to be able to retrieve an almost cell-free medium rich in EPS. Thus, different centrifugation and sieving tests are carried out on crops. Another type of extract was obtained, rich in intra and extracellular polysaccharides from protocol of cells disruption.

Then, results on polysaccharides recovery by membrane techniques, from polysaccharides rich extracts will be presented. A part will concern the study of fouling mechanisms in relationship with the medium composition.

*Speaker

Keywords: EPS, polysaccharides, micro, algae, cyanobacteria, culture supernatants filtration, membrane fouling

Biodiversity of dinoflagellates in the coastal waters of Kuwait

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Micro-algae are important as primary producers and serve as food for filter-feeding bivalve shellfish such as oysters, mussels, scallops and clams. Occasionally, in response to favorable changes in environmental conditions, these algae can form blooms, which are termed "red tides" or more appropriately harmful algal blooms (HABs). The blooms may be either toxic or noxious which can be classified to be caused by three different groups of species (Hallegraff, 1993) viz. (1) species which produce harmless water discolorations but the dense bloom can cause indiscriminate kills of fish and invertebrates due to oxygen depletion (2) species which produce potent toxins causing a variety of gastrointestinal and neurological illnesses to humans and (3) species which are not toxic to humans but harmful to fish and invertebrates by damaging or clogging their gills. HABs, therefore, can cause negative effects to aquaculture, human health, economic, fisheries and tourism. This paper focuses on the potential HAB species identified at the shellfish growing area, describes their distribution and their impacts based on occurrences in other countries on public health, aquaculture and the fisheries industry.

Keywords: dinoflagellates. toxic .

*Speaker

List of participants

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- Bardouil Michèle
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