



Coast Caen 2023



The 19th French-Japanese Oceanography Symposium



*University of Caen - Normandie
From the 24th to the 27th of October 2023*

Constraints and Adaptations to Global Change at the Land-Sea Interface – For a Shared Ecological and Energy Transition

Compilation of Abstracts



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Symposium



Constraints and Adaptations to Global Change
at The Land-Sea Interface –
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Under the patronage of the Japanese Embassy in France

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Opening Communications

Alain Nadaï *et al* – CNRS CIRED France

Osamu Matsuda – EMECS Japan

Following Offshore Wind Power (France) - a Science - Milieu - Society Observatory

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Keywords: windpower; interdisciplinarity; observatory; France

Abstract

In January 2021, the French Ministry for Ecological Transition and the Ministry for the Sea asked the French Energy Agency (ADEME) to assess, and follow in time, the impacts of offshore wind farms.

In February 2023, an interdisciplinary, observatory-type research device, gathering academics from social, environmental and engineering sciences, and coordinated by social sciences, has been set up in order to monitor the development of the first offshore wind farms and analyze their bio-socio-spatial ramifications.

This observatory approach is ambitious on several counts : it is interdisciplinary, it is being deployed on three maritime fronts to monitor six sites around France, and it aims at monitoring wind farms over the long term, from construction to operation and even dismantling.

Our presentation will introduce the observatory and its functioning, present some results from a 6-month survey (6 wind farm sites), and discuss the issues raised in positioning such a scientific endeavor in a time of rapidly upscaling offshore wind power development.

Concept of *Satoumi* and its Related Activities in Coastal Areas of Japan

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Keywords: Satoumi, biological productivity, biological diversity, environmental restoration, active conservation, human well-being

Abstract

Basic idea of *Satoumi* was first proposed by the late Professor Tetsuo YANAGI in 1998. Widely known definition of *Satoumi* is “a coastal area where biological productivity and biodiversity have increased through human interaction”. *Satoumi* activities can be classified into 7 types from the 2 major viewpoints. One is the place where *Satoumi* activity is made, for example, fishing village, urban area, river basin etc. and the other is the main group of people who participate in the activity.

Satoumi born in Japan is said to be grown up in the Seto Inland Sea, Japan. Main reason is that the sea had suffered from serious water pollution and environmental destruction during the age of high economic growth after WWII. Strong counteraction against environmental pollution and destruction which aimed at environmental restoration and remediation occurred in 1970s. Those were historical background of *Satoumi* which was born in the late 1990s and developed in 21st century. In this presentation, varieties of present *Satoumi* creation activities in Japan are to be introduced according to the type of *Satoumi*.

In many deteriorated enclosed coastal seas, only “passive (preventive) conservation” is not enough but “active conservation” such as *Satoumi* with human interaction is necessary. Among many types of “active conservation”, *Satoumi*, community-based “active conservation” with people’s participation, is vital to realize resilient coastal seas and to reconstruct better relationship between human and the coastal sea towards SDGs-based human well-being.

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Symposium

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Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

**Session 1: Vulnerability and Resilience to Coastal Ecosystems to
Global Change**

Keynote Session 1

Steven Degraer – Royal Belgium Institute of Natural Sciences

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Science-based Reflections on the (in) Compatibility of Offshore Wind Farms and Marine Biodiversity

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Keywords: Offshore wind farms; impacts; North Sea; Biodiversity; hard substrate; soft sediment; invertebrates; fish, birds and mammals.

Abstract

Offshore wind farms impact the marine environment. Several pressures are at the origin of these impacts, many of which have been studied particularly in the North Sea and since the early 2000'. These comprise e.g. the introduction of energy, the displacement of bottom disturbing activities and the introduction of artificial hard substrate. The pressures come at play each during a specific phase of offshore wind farm development. During the construction phase impulsive sound is known to affect wildlife up to several kilometers from the construction site. The impacts of electro-magnetic fields, the displacement of bottom disturbing activities and the artificial reef effect rather prevail during the operation phase. While most pressures exhibit a rather immediate effect onto the local biodiversity, the artificial reef effect passes through several successional stages that span several years. This presentation will focus on the impacts of the various pressure types onto the biodiversity – with a focus on hard substrate and soft sediment invertebrates and fish, seabirds and marine mammals – at short and longer term, and at single-turbine to regional scales. It will provide insights into generic and hence transferable patterns on how marine ecosystem structure and functioning are impacted. Taking advantage of the rich knowledge base, it will also address questions on how to best design offshore wind farms in an eco-friendly manner and touch upon the future of offshore renewables and biodiversity, reflecting on new techniques to produce electricity in the offshore realm and the co-location of other human activities inside offshore wind farms.

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Oral Communications Session 1

Amphitheatre MRSH

Wednesday, 25 October 2023 from 9.00 am to 4.10pm

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Impact of Changes in Marine Ecosystem on Ecosystem Service Delivery: A Systematic Map and a Meta-Analysis

Authors: C. Sylvie Campagne^{1,2}, Laurie-Anne Roy¹, Joseph Langridge², Joachim Claudet³, Rémi Mongruel⁴, Damien Beillouin^{5,6}, Éric Thiébaud¹

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Keywords: Coastal habitats; Biodiversity; Nature's contribution to people; Spatio-temporal dynamics; Human impacts; Management

Abstract:

Marine ecosystems endure numerous drivers of change all of which threaten ecosystem structure and functioning, and the provision of Ecosystem Service (ES). The knowledge on marine ES is hindered by a large heterogeneity of the scientific literature on the different marine ecosystems, ES, and across their correlates. Hence, a systematic map and a meta analysis were performed to highlight knowledge clusters and knowledge gaps on how changes in marine ecosystems influence the provision of marine ES.

The systematic map was based on all evidence documenting across scientific and grey literature sources. Starting with the identification of 41 884 articles, the screening process ended with a total of 653 articles. The main ecosystems studied are the pelagic ecosystems while the lowest number of articles are on deep-sea habitats and ice-associated ecosystems. Food provision is the major focus followed by climate regulation, recreation and tourism. Management effects were the most studied drivers of change followed by overexploitation and climate change.

The meta-analysis focused on how marine cultural services change due to drivers of change. Searching in the database of the systematic map, 76 articles were selected based on their types of ES values. The meta-analysis highlights the diversity of cultural services' values, the diversity of approaches used and the heterogeneity of cultural service changes between marine ecosystems and the drivers of change.

We presented the scientific evidence and gaps regarding the impact of marine ecosystem changes on ES provided with an in-depth analysis of cultural services that highlight the heterogeneity of ES changes and the crucial need for further analysis to guide conservation and protection actions.

Comparative Approach of Long-term Changes in Three Coastal Social-Ecological Systems Supporting Shellfish Farming (France)

Authors: Bruneau Audrey, Derolez Valérie, Gangnery Aline, Mongruel Rémi

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Keywords: Pacific oyster (*Crassostrea gigas*); time series analysis; ecology; ecosystem services; interdisciplinarity; system dynamics; trajectory.

Abstract

Coastal ecosystems provide a wide range of services to society, notably through the numerous activities they support. In France, shellfish farming represents a traditional use with a high socio-economic value for some ecosystems. The bays of Veys and Marennes-Oléron and the Thau lagoon are such examples accounting for nearly 60% of national oyster production. By comparing the evolutionary trajectories of these three socio-ecosystems (SES) over five decades (since the 70s), we aimed to build an interdisciplinary analytical framework that will enable to better understand the dynamic and interactive processes at play. Using an inductive approach including a multidisciplinary team of scientists (ecologist and social scientists) and local stakeholders, we described the ecological and social evolution trajectories of the studied sites. More specifically, we 1) studied the relationships between the state of coastal ecosystems and their ability to maintain the ecological functions essential to shellfish farming; 2) identified contrasted periods in the trajectory of the SES based on ecological and social characteristics; 3) characterized the ecosystem services bundles during these periods; 4) analyzed changes in the social demands for ecosystem services. Finally, our analytical framework allowed to identify phases of stability and disruption in the trajectory of SES, provided promising tools to assess conditions of adaptation and resilience of coastal SES supporting shellfish farming activities.

Massive Bloom of *Picochlorum* in a Mediterranean Shellfish-exploited Coastal Lagoon: A Synergy of Climatic Events Leading to a Cascade of Ecological Effects.

Authors: Franck Lagarde^{1*}, *Ariane Attela*¹, *Valérie Derolez*¹, *Nicolas Cimiterra*¹, *Elodie Foucault*¹, *Gregory Messlaen*¹, *Marion Richard*¹, *Masami Hamaguchi*², *Masakazu Hori*², *Angélique Gobet*¹, *Béatrice Bec*³

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Keywords: Mediterranean Lagoon, Massive Algal Bloom, Marine Heatwave, Cascading Effects, Extreme Events, *Picochlorum*, Phytoplankton Community Change, Climate Change, Warming, Anoxia.

Abstract

The hydroclimatic patterns of the year 2018 in France, symptomatic of global change, resulted in the loss of approximately 5,000 tons of cultivated shellfish within Thau lagoon. The synergy of climatic and ecological events was followed by an unexpected and massive bloom of the photosynthetic picoeukaryote *Picochlorum* spp. During winter. The *Picochlorum* bloom peaked at more than 1 billion cells l⁻¹ while *Picochlorum* is known for its high tolerance to environmental variability and its low retention efficiency by oysters.

During 2019, several environmental components were monitored: "water" (temperature, salinity, oxygen, and nutrients), "oyster" (growth and condition), "plankton" (abundance by flow cytometry, chlorophyll biomass, taxonomy, and e-DNA) and "macrophytes".

In 2018, heavy rainfall, summer anoxia, and shellfish mortality occurred consecutively, resulting in significant inputs of nutrients into the water column, which drove the *Picochlorum* bloom. *Picochlorum* spp. intermittently on monthly basis replaced typical nano- and microphytoplankton communities at the base of the shellfish food web. This massive bloom significantly reduced the productivity of the oyster aquaculture system, halting growth and causing weight loss in Pacific oysters from October 2018 to April 2019. After the anoxic event and the *Picochlorum* bloom, a decrease in the area covered by macrophytes (macroalgae and seagrass) was observed in 2019.

Although *Picochlorum* abundance decreased, the return to characteristic ecological functioning was not achieved in the spring of 2019 but after the four-summer heat waves of the dry year 2019.

Restoring an Urbanized Coastal Freshwater Marsh: Consequences on Contamination Dynamic?

Authors: Adélaïde Lerebours¹, Mireia Kohler¹, Lauriane Bergeron¹, Jeanne Latreille de Lavarde¹, Bénédicte Dubillot¹, Jérôme Jourde¹, Christine Dupuy¹, Elodie Reveillac¹, Marie Vagner², Carine Churlaud¹, Maud Brault Favrou¹, Hélène Agogué¹, Thomas Lacoue-Labarthe¹

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Keywords: freshwater marsh, contamination, restoration, trophic web, salinization

Abstract

Coastal wetlands provide important ecological and economical services but are also threatened by sea level rise and pollution. To preserve biodiversity while ensuring stormwater control, restoration initiatives of the coastal marsh of Tasdon at La Rochelle, France, took place in 2020. The objective of the study is to assess the impacts of restoring and reconnecting this freshwater marsh to the sea on contamination dynamic.

Several species representing the trophic web (algae, oligochaetes, crayfish, crabs, shrimps and fish) and sediment were collected. N and C isotopic ratios and trace metals (mercury (Hg), cadmium, lead and arsenic) were measured in each species and environmental variables (including salinity, particulate organic matter (POM) and chlorophyll a (Chl *a*)) were recorded in surface water. The results showed that, contrary to other metals, Hg concentrations significantly increased through the food chain both years and at higher levels in 2021 than in 2019. Following restoration and reconnection, the salinity, POM and Chl *a* increased by a factor 10, 4 and 5 respectively and the Hg levels in muscles of the European eel increased by factor 2. In parallel, new highly-contaminated fish species from saline waters such as the three-spined stickleback settled in the marsh in 2021. These results raise the questions of the influence of salinity and other environmental parameter changes on Hg bioavailability and transfer through the food web. Moreover, the intrusion of new species may enhance Hg levels. Finally, this pilot study provides new data on aquatic contamination dynamic under salinization and restoration scenarios.

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Modelling the Combined Effects of Ocean Acidification (OA) and Warming (OW) on the European Abalone *Haliotis tuberculata*

Authors: Paulo F. Lagos¹, Laure Pecquerie¹, Stéphanie Auzoux-Bordenave^{2,3}, Jonathan Flye Sainte-Marie¹, Sophie Martin^{2,4} and Sabine Roussel¹

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Keywords: Ocean Acidification, Ocean Warming, DEB model, European Abalone,

Abstract

Over the last years, substantial efforts have been made to conduct research aimed to predict the effect of global climate change. These efforts have identified ocean warming (OW) and ocean acidification (OA) as significant triggering agents of potentially abrupt changes in the marine environment that can have relevant consequences for marine ecosystems, including the loss of biodiversity. Our research aims to strengthen the understanding of the effects of multiple environmental stressors on marine species by filling important gaps in the knowledge of global change impacts on marine species and ecosystems, by combining, into a process-based model framework grounded on the principles of dynamic energy budget theory (DEB), all the available information across experimental studies addressing the effects of global climate change on a marine calcifying species. We use single- and multiple stressor data and real-time environmental measurements combined with future projections of sea surface temperature and partial pressures of carbon dioxide (pCO₂) to predict life-history traits of the European abalone. Model results indicate that as ocean temperatures and pCO₂ levels increase, the overall growth of abalone will be considerably altered, specially at larval stages, and the time to reach sexual maturity delayed. These consequences could render the European abalone susceptible to the effects of climate variability if the current climatic trend for the region continues to show increases in temperature and pCO₂.

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Trends in Chemical Contamination Based on French Mussel Watch Network to Study the Trajectories of French Coastal Ecosystems Supporting Shellfish Farming (1979-2018).

Authors : Audrey Bruneau¹, Florence Menet-Nedelec², Dominique Soudant³, Anne Grouhel⁴, Dominique Munaron⁵, Tania Hernández-Fariñas²

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Keywords: chemical contaminants, shellfish farming, evolutionary trajectories, observation and monitoring networks.

Abstract

Coastal ecosystems provide a wide range of services to society, notably through the numerous activities they support. Shellfish farming represents a traditional use with high socio-economic issues for such ecosystems. The RETROSCOPE project aims to analyse and compare the evolutionary trajectories of three socio-ecological ecosystems supporting shellfish farming (Baie des Veys - Normandy, Bassin de Marennes-Oléron - Poitou-Charentes and the Thau Lagoon - Occitanie), in order to assess conditions of their adaptability and resilience. The status of socio-ecological ecosystems regarding chemical contamination is one of the ecological components studied within the project. Thirteen contaminants monitored through the Chemical Contamination Observation Network (ROCCH) since the 1980s were selected: Cd, Cu, Hg, Pb, Zn, PCB 118, PCB 153, DDT, DDE, HCH gamma (lindane), total PAH, fluoranthene and benzo-a-pyrene. Their time series were analysed using dynamic linear models on two sampling points per site, from 1979 to 2018. Overall, chemical contamination decreased significantly over time. Metals concentration measured in shellfish flesh significantly decreased at all sites at the beginning of the study period (up to 1985-1990) except in the northern part of the Bassin de Marennes-Oléron. Except in the Baie des Veys, concentrations in organic contaminants (total PAH, benzo-a-pyrene, fluoranthene) measured in shellfish were characterised by significant increase until 2010. The first analyses of long-term data series offer perspectives for interpreting the evolution of anthropogenic pressures on the three socio-ecological ecosystems.

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Effect of Aquaculture-related Stress on Fish Health - Can Controlled Stressor act as Good Stress in Fish?

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Keywords: stress; environmental stressors; eustress; distress; aquaculture; fish.

Abstract

Fish are often exposed to various environmental stressors, such as pollutants and acute changes in temperature. The exposure of organisms to stressors may result in a series of biochemical and physiological changes. The stress induced by environmental stimuli in fish is thought to influence their fitness, productivity, and health. Accordingly, the control of stress is considered to be important in aquaculture. We found that physiological stress by handling caused by chasing and netting can affect the expression of growth-related genes, such as insulin-like growth factor and growth hormone receptor, in fish. In addition to physiological stress trials, we observed a decrease in the redox state in response to thermal stress or dietary antibiotics, oxytetracycline (OTC), in coho salmon (*Oncorhynchus kisutch*). The results indicate that both thermal stress and the dietary OTC induce oxidative stress, which would enhance oxidation in fish. Stress is often interpreted as having a negative impact on health. However, the effects of stress differ depending on the intensity of the stimulus, the condition of the recipient, etc. It has been recently suggested possible for animals to manipulate eustress (positive or good stress) and to avoid distress (negative or bad stress). Accordingly, manipulation of appropriately controlled stress treatment, such as mild physiological or thermal treatment, and the use of adequate concentrations of antioxidative supplements could be employed as eustresses to improve the health of farmed fish.

Spawning Migration Routes and Orientation Mechanisms of Anguillid Eels

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Keywords: Oceanic migration; Spawning migration; Orientation

Abstract

Freshwater eels (genes *Anguilla*) are catadromous fishes that spawn over deep water at tropical latitudes, with their larvae being transported to coastal waters before entering estuarine and freshwater growth habitats. However, the knowledge about the routes and orientations of their spawning migration has been limited except for some behavioral and numerical experiments. In this study, the particle tracking simulations were/are conducted for *A. anguilla* (AA), *A. rostrata* (AR), *A. japonica* (AJ), and *A. marmorata* (AM) in the Atlantic and Pacific Oceans. The particle tracking simulations in which virtual particles assuming silver-phase eels were programmed to migrate in the reanalysis data of ocean circulation models (JCOPE2M and JCOPE-FGO, JAMSTEC, Japan) were conducted. In addition, several scenarios for orientation were tested based on oceanic and geomagnetic environments using JCOPEs and the global geomagnetic model IGRF-12. The arrival rates of the virtual particles to their spawning area were compared in each scenario.

First, we conducted numerical simulations for AJ and AM in the North Pacific based on the magnetic orientation. The virtual particles from multiple locations, distributed along the coast of East Asia and Southeast Asia, reached their common spawning area around the southern edge of the West Mariana Ridge by following the horizontal gradient of geomagnetic intensity. We have applied the method to AA and AR in the Atlantic Ocean. Finally, we report the progress of the research.

Resilience of Marine Benthic Communities in an Area Highly impacted by Human Activities: The Case of the English Channel

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Keywords: English Channel, resistance, resilience, disturbance, climate change, benthic communities

Abstract

Multiple anthropogenic disturbances occur in the English Channel, an epicontinental and megatidal sea, which is among the most anthropized sea of the world: maritime traffic, civil engineering works, fisheries, sediment dredging and dumping, eutrophication, non-indigenous species introduction, pollution and contamination of the biological components. Nevertheless, an assessment of its ecological status is difficult due to natural hydrodynamic disturbances which generated diverse benthic abiotic conditions from muddy sand to pebble, and from the coastal zone, where there is a concentration of anthropogenic activities, to the offshore zone with moderate disturbances. Moreover, the Climate Change affects nowadays this marine ecosystem by altering abiotic factors: temperature, salinity, pH(acidification), sea level rise, and coastal erosion. However, in spite of these cumulative pressures, the macrobenthic communities exhibit from low to high resistance to stressors, but high resilience after a stressor is reduced or eliminated. Resilience refers here to the ability of a habitat to recover after a certain time following a disturbance. The effects of some anthropogenic disturbances: 1) hydrocarbon pollution of the benthic communities of the Bay of Morlaix; 2) estuarine isolation of the Rance during the construction of the tide power plant; 3) estuarine marinization of the Seine estuary; 4) dumping sediment in the eastern part of the bay of Seine; and 5) aggregate extraction in the eastern part of the English Channel, on the structure and functioning of some coastal marine ecosystems, had been chosen to illustrate the disturbance, resistance, and resilience responses of such benthic ecosystems.

Current Status and Causes of the Decline of Seaweed Beds in Japan.

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Keywords: seabed, decline and restoration, biopredators, Japan

Abstract

The study was conducted by interviewing officials in charge of seaweed bed restoration in local prefectures and from prefectural fisheries experimental stations regarding the recent decline of seaweed beds. Existing reports on the decline of seaweed beds were also analysed. On the coast facing the Sea of Japan influenced by the Tsushima Warm Current from Hakodate City to the Shakotan Peninsula in Hokkaido Island and in Tohoku Region of Honshu Island, and the Pacific coast in Tohoku Region, the decline of seaweed beds has been reported due to feeding damage by the northern sea urchin (*Strongylocentrotus nudus*). On the coasts facing the Pacific Ocean west of the Kanto region of Honshu Island to Kyushu Island except the northeast coast through Shikoku Island, it was found that seaweed beds have declined mainly due to feeding damage by sea urchins such as black long spine urchin (*Diadema setosum*) and purple sea urchin (*Anthocidaris crassispina*) and herbivorous fishes (*Siganus fuscescens*, *Calotomus japonicus* and *Kyphosus bigibbus*). On the coast of the Sea of Japan from central Honshu Island to northeast coast of Kyushu Island, feeding damage to seaweed by purple urchins has caused the decline of seaweed beds. Warming of seawater temperature in winter promotes feeding of herbivorous organisms and species composition of seaweed beds from temperate species to subtropical ones especially in Kyushu Island. The decline in sea urchin catches is partly due to a decrease in the number of fishermen and the ageing of the fishing industry. The study reports countermeasures taken.

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Discussing Larval Development and Life History among three *Polydora* Species (Polychaeta, Spionidae) inhabiting Mollusc Shells

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Keywords: Polydora, Polychaeta, Shell infestation, Larval development, Reproduction, COI, 18S rRNA

Abstract

Three *Polydora* species (Polychaeta, Spionidae), *P. websteri*, *P. onagawaensis*, and *P. hoplura* are known to inhabit commercially important mollusc shells and are reported globally. Given their widespread locations and similar morphology, comparative studies among these species are important for effective infestation management. In this study, biological characteristics including size, larval development, spawning period, and life span are compared among the three species and discussed. Larval development is a key factor which influence both dispersal capabilities and successful colonization. While *P. onagawaensis* suggests planktotrophy, *P. websteri* and *P. hoplura* exhibit polymorphism in larval development observed across different populations and even within a single female. Polymorphism in larval development, poecilogony, might have facilitated the successful establishment in various marine regions and environment. Recently, these three species had been reported to inhabit both cultured and wild oyster shells in Normandy, English Channel, north France, emphasizing the importance for future comprehensive studies, including not only biology but also studies from the viewpoints of aquaculture and invasive alien species in a very dispersive environment due to tidal currents. Additionally, molecular analysis was performed to obtain 18S rRNA and COI gene sequences for three species, which were then compared with previously reported sequences.

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Toward a Benthic Functional Diversity Approach of the English Channel Coarse Sediments

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Keywords: Benthos; Biodiversity; Biological traits; Marine renewable energies

Abstract

The English Channel is one of the most anthropized marine ecosystems in the world. It is exposed to both multiple anthropogenic activities (development of renewable marine energies, aggregate extraction, dredging and trawling) and natural disturbances (e.g. strong hydrodynamics, extreme events). These pressures occur in a context of climate change and modify the structure of benthic communities. One of the particularities of the English Channel is that it is composed of more than 80% coarse sediments.

Traditionally, these habitats have been mainly described using semi-quantitative tools and, more recently, studied from quantitative data to evaluate the functional response of these ecosystems to natural and anthropogenic disturbances. These data coupled with the analysis of biological traits of benthic macrofauna, will allow to better understand ecosystem functioning by linking abiotic parameters, community structure and traits distribution.

The two main objectives of this PhD thesis are: (1) acquire a better knowledge of coarse sediments of the Channel in a highly hydrodynamic environment; (2) couple traditional ecology studies (species diversity, abundances and biomasses) with functional diversity calculated from biological traits of species.

All the analyses will be based on the exploitation of different data sets describing the evolution of the diversity of coarse benthic communities exposed to various pressures.

Thus, this PhD thesis will provide a better understanding of the spatio-temporal organization of the functional diversity of the benthic macrofauna in the eastern English Channel. It will also provide a better understanding of the response of coarse sediment ecosystems to natural and anthropogenic disturbances.

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Sessile Communities in Under-Pressured Coastal Ecosystems: the Case of French Harbors in the English Channel.

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Keywords: Sessile communities; Biofouling; Harbors; Taxa diversity; Coating

Abstract

Harbors are coastal ecosystems under threat because of anthropogenic global change. Many pressures have been identified such as pollution by nutrient enrichment and contaminants, non-indigenous species, marine litter, and underwater noise pollution. The English Channel is part of the worldwide marine network, thus exposed to these threats. Few studies have described the state of micro and macroorganisms of French harbors in the English Channel. As part of a study on the biofouling (BIOSTEM project), a characterization of the sessile communities was done in three harbors located in the French part of the English Channel: Cherbourg (North), Granville (West) and St Vaast-la-Hougue (East). A coating frequently used in the marine industry (bio colonization-friendly coating) was immersed in these harbors to assess the development of sessile communities since May 2022, and retrieved at different immersion times. The developed biomass, the covering rate and the identification of the organisms were the parameters assessed to describe sessile communities. The first results showed a difference in taxa diversity between harbors and the immersion time. The coating was colonized after one month. The sessile community's development was also seasonally dependent. Cirripedia were found in every harbor, but the species were different. The invasive species *Austrominius modestus* was found in Cherbourg and Granville. Polychaeta, Ascidiacea, Hydrozoa, Bryozoa, Porifera were found in all harbors, as well as different Algae taxa. Ascidiacea developed rapidly on the coatings, and Porifera arrived after, suggesting an effect of the seasonality and of the time of immersion.

Cost-Effective Near-Shore Seaweed Monitoring for Blue Carbon Study

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Keywords: Blue Carbon, Sargassum, side scan sonar, uplifted camera

Abstract

The seaweed ecosystems are recognized to contribute to carbon sequestration. Satellite remote sensing is a standard method to determine vegetation's area cover; *in situ* observation is also required to identify species, distribution patterns, and biomass estimation. Developing cost-effective observation methods is an urgent task to promote blue carbon credits and offsets. This study discusses detecting and monitoring near-shore underwater vegetation using acoustic and optic methods.

Side scan sonar (SSS) could more efficiently cover expansive areas in shallow waters than other sonars. Consumer-grade sonars are now widespread, less expensive, and easy to deploy. We compared the performances of high-grade and consumer-grade SSS. We introduced uplifted cameras deployed on boats instead of aerial drones for optic methods.

We observed *Sargassum* forests at small beaches in Sanriku Ria Coast, the northern part of Japan. SSS scanned the sea floor of the beach to detect seaweed echoes running along the shore. The seaweeds were discriminated from the bottom by their acoustic shadows, and we pinpointed their locations and compared them with uplifted camera images.

To estimate the canopy heights, we measured the acoustic shadow lengths of the seaweeds. The acoustic reflections of seaweeds near the sonar were measured instead of their very short shadows. A biomass estimation method based on SSS measurements was proposed. But it requires elaborating truthing.

In conclusion, combining optic and acoustic measurements enabled us to use cost-effective monitoring methods on near-shore benthic vegetation, leading to precise biomass estimation for the blue carbon study.

Spatial variation of air-sea CO₂ flux in the Seto Inland Sea and analysis of contributed parameters

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Keywords: CO₂ fluxes, the Seto Inland Sea, spatial variation, contribution rate

Abstract

The behavior of pCO₂ (partial pressure of CO₂ in seawater) in the coastal sea is complicated. Since that is strongly related to ocean acidification, further studies on pCO₂ are required about the Satoumi conservation.

In this study, we analyzed the spatial variation CO₂ flux (air-sea CO₂ flux) based on observed pCO₂, PCO₂ (partial pressure of CO₂ in the atmosphere), T (sea temperature), S (salinity), and U (wind speed) over 16 years in the Seto Inland Sea and adjacent regions, which divided into 13 areas. To determine which parameter dominantly affects the CO₂ flux' removed U influence from CO₂ flux, we quantified the contributions of each parameter using three ways: correlation coefficient, RMSE, contribution rate.

CO₂ flux was consistently negative in spring, this indicated CO₂ was absorbed in ocean. In summer, except Osaka Bay, ocean emitted CO₂. A strong negative correlation between pCO₂ and CO₂ flux' was observed in summer, and this correlation was also evident in over half of the areas in spring. Compared to other parameters, the RMSE of pCO₂ was smallest across all areas in summer, almost all areas in spring. The combined contribution rate of pCO₂ and PCO₂ accounted for over 70% of the total variation in both seasons. The contribution rate of pCO₂ was the highest, accounting for over 50% across all areas in summer and 50% or less in spring. That of T was 10% or more in spring. Comparing the spatial contributions of each parameter, pCO₂ was the highest contribution in most areas.

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Distribution of CO₂ and N₂O Concentrations in Surface Seawater measured in the Seto Inland Sea and Shikoku Southern Offing

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Keywords: nitrous oxide, carbon dioxide, Seto Inland Sea

Abstract

We measured CO₂ from 1990 and N₂O from 2004 in the Seto Inland Sea. Results from five voyages in which both were measured on T/S Fukae Maru, were compared and discussed. Observations were conducted in March and September 2008, March and September 2009, and March 2010. CO₂ and N₂O concentrations were measured by the bubbling method, and intake water from a depth of 3 m was used. CO₂ concentrations were measured automatically every 15 minutes, and N₂O concentrations were measured by sampling water every hour. CO₂ concentrations in March were nearly identical for the three years. Levels of CO₂ concentrations in September differed between the two years, but trends in spatial variability were consistent. N₂O concentrations in March tended to be higher in the higher density years, but there was no significant trend in September. Correlations between CO₂ and N₂O concentrations and salinity, water temperature, and dissolved oxygen concentrations showed different trends in each year for CO₂, suggesting a significant biochemical influence on CO₂ concentrations. The correlations for N₂O in each year had a similar distribution shape, which shifted from year to year. This suggests that physical effects on CO₂ concentrations are significant.

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Posters – Session 1

Poster flash presentations the Tuesday 24th of October 2023 from 5.40 p.m to 6.45 p.m.

*Special poster session in the **Aula Magna** from 6.45 p.m to 8.30 p.m.*

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Integrating Climate Vulnerability Assessment into MPA Networks Design: A Conceptual Framework

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Keywords: Science-based Maritime Spatial Planning, Global Change, Vulnerability assessment, Connectivity, Marine Protected Areas, Ecosystem services

Abstract

Coastal areas shelter nowadays almost 40% of the world's population and most sea uses. This concentration of activities in particularly productive ecosystems leads to high socio-ecosystemic stakes, as multiple pressures are exerted on a rich endangered biodiversity providing fundamental services. Marine Protected Areas (MPAs) are envisaged as key tools for protecting ecosystems while providing multiple benefits for coastal populations. Meanwhile the COP15 objectives include to protect 30% of the oceans by 2030, MPA facing doubts about their efficiency under climate change and their interest for climate mitigation and adaptation.

The impact of climate change on the marine environment urges us to rethink our vision of co-management by fully integrating connectivity and climate vulnerability into MPA identification. The MSP4BIO project aims to improve science-based marine spatial planning to safeguard and restore biodiversity in a coherent network of MPAs in Europe. Within this project, we propose a methodology for integrating climate vulnerability assessment into the improvement of existing MPAs and the identification of new MPAs within marine spatial planning processes. This evaluation repose on several decision trees related to management objectives that will guide managers into the workflow from the identification of the purpose of the network to the decision process. The vulnerability assessment linked to each decision tree is based on a ranked list of traits of sensitivity, adaptability and exposure under climate change previously identified in an up-to-date bibliography screening.

The approach allows managers to identify most vulnerable areas at multiple levels to prioritize some management measure and helps to find trade-off between protection and sustainable exploitation. Our guidance is adaptable to different marine regions and conservation issues.

Influence of Macroalgae on the Physico-Chemical Habitat of the European abalone *Haliotis tuberculata*

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Keywords: global changes, ocean warming and acidification, physico-chemical habitat of abalone, *Haliotis tuberculata*, effect of macro-algae.

Abstract

The massive release of CO₂ into the atmosphere by human activities led to global changes such as ocean warming and acidification (OA), with subsequent effects on marine organisms and ecosystems. OA is known to have negative effects on shell calcification, especially in molluscs, and in particular the European abalone. In Northern Brittany, wild populations of abalone are found in boulder rocky shores, both in poor and rich (kelp)-macroalgal habitats. Highly productive ecosystems, such as Laminarian kelp forest are likely to mitigate coastal ocean acidification by increasing pH through photosynthesis. This study aimed to characterize the physico-chemical habitat of the European abalone *Haliotis tuberculata*, an important resource for growing French aquaculture and fishery. In this context, continuous monitoring of the main physico-chemical parameters of seawater (temperature, pH, dissolved dioxygen, salinity, pressure, light intensity) was carried out in two natural abalone habitats in Roscoff (Northern Brittany): a kelp forest and a boulder field covered with a few of red-algae. Our results demonstrated that the tides and the presence of kelp have a dual biological and physical influence on the daily variations in environmental parameters. In addition, the kelp forest is the site with the greatest daily variations, with peaks in pH at midday characteristic of the photosynthetic activity of the kelp. In summary, a positive effect of macro-algae was observed on the physico-chemistry of seawater allowing to mitigate the stress linked to OA.

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Why do *Ecklonia cava* ssp. *kurome* remain in deep water in Isoyake area off Eastern Kyushu, Japan?

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Keywords: *Ecklonia cava* ssp. *kurome*; Global warming; Herbivorous fishes; Isoyake; Seaweed bed

Abstract

Seaweed beds of kelp and sargassum are important habitats for fishery resources such as abalone and spiny lobsters. Recently, disappearance of these large seaweeds (known as isoyake in Japan) has been occurring around the world with the progress of global warming. The southwestern coast of Japan, which is strongly influenced by warm currents, is strongly affected by isoyake.

It is known that the progress of isoyake is not uniform, and that there are areas where seaweed beds are able to partially remain. In this study (financially supported by JPJ008722), line transect surveys and environmental measurements were conducted to elucidate the conditions necessary for maintenance of remnant beds of temperate kelp, *Ecklonia cava* ssp. *kurome* (kurome) in Oita Prefecture.

In 2018, kurome was distributed over a wide area of the reef, but by 2023 most of it had disappeared. We found that kurome remained near the boundary between the reef and sandy bottom in deep water (around 15 m). Water temperature vertical profiles indicated that the remnant kurome beds were located below the thermocline that forms during summer. The relative light quantum was 3.7-4.0% of the sea surface, which based on previous research is sufficient for kurome growth. Furthermore, the density of herbivorous fishes was lower in deep water than in shallow water. These findings suggest that conditions for the persistence of kurome communities in deep habitats are: light levels sufficient for kurome growth, low water temperatures maintained during the summer, and the habitat is less susceptible to damage by herbivores.

Rapid Estimation of Marine Benthos Abundance Using "sedimentary DNA": A Case Study of the Burrowing Decapod *Upogebia major* in Tidal Flats

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Keywords: Abundance, Tidal flats, Marine resources, sedimentary DNA, *Upogebia major*

Abstract

Understanding the sustainable utilization of marine resources and biodiversity requires monitoring organism distribution and abundance. Environmental DNA (eDNA) analysis has facilitated rapid monitoring implementation. The origins of eDNA research can be traced back to detecting invasive American bullfrog *Rana catesbeiana* DNA at a pond in France, leading to numerous ongoing studies aiming to estimate the distribution of organisms using eDNA detection rates. While, validating the consistency between abundance and eDNA concentration is essential when using eDNA as an abundance indicator. In Japan, fish species such as Japanese jack mackerel *Trachurus japonicus*, swimming in the sea, have been used to validate the relationship between catch and eDNA concentrations. Nevertheless, limited knowledge exists regarding benthos, which remains invisible due to being embedded in sediment. Furthermore, recent evidence suggested higher concentrations of DNA in sediments (sedimentary DNA; sedDNA). This study focused on the decapod *Upogebia major*, which creates burrows exceeding a depth of 2 m in tidal flats, measuring sedDNA concentration during peak and end of spawning periods. Generally, the number of burrows correlated with sedDNA concentration during the end of the spawning period. Interestingly, sedDNA was detected even in areas without burrows during the peak period, particularly in mound-like structures with deposited sand, exhibiting notably high concentrations. sedDNA analysis suggests the potential for estimating the current abundance of benthos, but it is influenced by seasonal and microtopographic factors. These findings can be applied to benthic stock analysis, including Asari clam *Ruditapes philippinarum*, which are important fishery resources both in France and Japan.

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

An Invasive Mussel in an Oyster-Farming Region: Arcachon Bay. What Changes for Ecosystems ?

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Keywords: *Arcuatula senhousia*, non-indigenous species, benthic habitat, impact assessment

Abstract

Since the 1970's, the introduction of non-indigenous species has increased and therefore become a major concern given their potential deleterious effects on native biodiversity and associated ecosystem functioning. In marine environments, the introduction of species due to oyster farming have been numerous. Among them, the Asian date mussel *Arcuatula senhousia* has spread and colonised a large number of ecosystems worldwide (e.g., West America, New Zealand, Italy). In the Arcachon bay, a coastal lagoon of the French Atlantic coast particularly used for oyster farming, the presence of *A. senhousia* has been confirmed since 2002. After a lag time of ca. 20 years, abundances of this species now seem to considerably increase. In this context, the ARCUATULA project aims to estimate the spatial and temporal extents of the colonisation of Arcachon Bay as a model ecosystem, and its effects on the ecosystem functioning. Population dynamics of *A. senhousia* are thereby studied through both (1) an extensive high-resolution spatial survey carried out every third years and (2) a monthly survey focused on three representative sampling sites, and the relationship of *A. senhousia* with others species (facilitation or competition) assessed through the study of associated assemblages. The contribution of this mussel to the nutrient demand and exchanges is also studied by measuring filtration and excretion rates in laboratory set up. The significance of *A. senhousia* colonisation for ecosystem functioning in the context of global warming is finally studied while measuring community-scale responses to simulated extreme climatic event (e.g., heatwaves) scenarios using a mesocosm experiment.

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

A Natural HighTech: the Great Scallop as a Sensor of Potential Effects of Submarine Cables

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Keywords: *Pecten maximus*, growth, behavior, turbidity, submarine cables

Abstract

Transmission cables from offshore wind farms and interconnectors in coastal areas are expected to grow rapidly in the coming years and may increase potential environmental impacts. Very little research has been conducted on the role of increased turbidity, noise and electro-magnetic fields linked to the installation of transmission cables on the seabed. Our project called OASICE evaluates the disturbances produced during and after seabed installations with a natural sensor: *Pecten maximus*, the great scallop. Bivalve shells are constructed through daily accretion of small striae of calcium carbonate (CaCO₃) mineral along the outer valve edges. The widths of these striae, which are visible at the shell surface, are apparently sensitive to variations in the environment of the individual scallop. We studied if this record of growth, the associated changes in elemental composition of the carbonate mineral in the stripes and the shell's behavior measured using accelerometers could be used to estimate an impact. During the work on the IFA2 interconnector, no mortality was observed at the monitoring stations but a slowdown in growth was identified. Also, the behavior of the shells had been disrupted due to high turbidity present in the environment. However, all of these responses were short-lived with a quick return to normal. Once the interconnect was in operation, no effect was measured on the growth or behavior of the shells living near the cable. In 2022, the same monitoring was carried out during the connection works of the future Calvados offshore wind farm.

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Large Scale & High-Resolution Mapping of Marine Benthic Habitats in Coastal Areas, a Tool for Marine Protected Area managers. The case of the Roches-Douvres Plateau, English Channel, Brittany, France.

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Keywords: Seascapes, Rocky habitats, Biodiversity, Management

Abstract

France has created in the last decade 546 marine protected areas (MPA), covering nearly 25% of the surface of the coastal seas of mainland France and overseas.

The advent of detection methods such as topobathymetric lidar makes it possible to produce digital terrain models covering depths reaching several tens of m in clear waters. Surveys carried out by multibeam sonar, side-scan sonar make it possible to draw maps independently of turbidity and depth and thus represent complementary tools to map marine habitats. The data obtained by both methods are processed using numerical models that enable to produce high resolution typological maps that must be coupled with field observations to understand and model the links between topography, complexity of substrates and biodiversity.

The poster here presents a map of the habitats of the Roches-Douvres plateau. This work is part of the "ecological restoration for the preservation and enhancement of territories" component of the France Relance plan announced by the government on September 3, 2020. The plateau, located between Paimpol and the island of Guernsey, covers an area of approximately 40km² for depths ranging from the surface to more than 50m. The mapping is based on the combination of (i) a lidar survey carried out in 2022 by SHOM, (ii) 537 km of multibeam sonar surveys, (iii) 100 underwater videos and sediment samples taken in June 2023 by the Dinard MNHN. The combined processing of bathymetric and topographic data enabled the production of a digital terrain model of the Roches-Douvres plateau. They were used to produce maps of marine habitats, at a resolution of 3m, using machine learning methods using artificial intelligence (neural networks and random forests).

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Environmental Vulnerabilities, Social Inequalities and Conflicts of Access to Fishery Resources Associated with Artisanal Small-Scale Fisheries in the Port of Mostaganame (Algerian coast, SW Mediterranean)

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Keywords: Small-scale fishing, artisanal, port, Mostaganem, vulnerabilities, inequalities, conflicts.

Abstract

This study aims to provide a comprehensive analysis of conflicts related to access to fishery resources at various scales in the artisanal small-scale fisheries of Mostaganem Port (Salamandre), which is recognized as a crucial fishing infrastructure in Western Algeria. The average annual production of this port between 2000 and 2022 amounted to 6800 tones. Moreover, the sustainable development of fishing activities is challenged by the compounded impact of ecological vulnerability and social inequalities. As a consequence, significant segments of fishermen face socio-economic vulnerability due to the perceived archaic method of sharing overall returns, a practice rooted in the institutionalization of Mediterranean fisheries knowledge during the late 19th century. This ancient system, introduced to the region by Italian and Spanish fishermen, primarily relies on quota sharing, which varies across different categories of fishermen involved in various stages of fishing activity, including shipowners, captains, fishermen, net menders, cleaners, and porters. Our geographical study employs a multidisciplinary approach based on the principles of the ecosystem approach to the management of marine resources, integrating human, environmental, political, and economic aspects. To accomplish this, we conducted several field surveys utilizing a questionnaire administered to stakeholders engaged in maritime fishing activities at Mostaganem Port. These surveys were further augmented by numerous semi-structured interviews conducted with a diverse sample of the fishing community. The ultimate objective is to provide an accurate diagnosis of the complex power dynamics that have been insufficiently explored by researchers in the Maghreb region, especially among Algerian researchers.

Adaptation Options for Vessels Highly Dependent on a Limited Number of Species Under Climate and Political Changes. Case of New Aquitaine (France) Southern Fleets –

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Keywords: global changes, Bay of Biscay, fisheries, adaptive management, Brexit

Abstract

The European Union has developed a consistent regulatory framework to ensure sustainability of the exploitation of natural resources in the Northeast Atlantic. This regulatory framework is now applied to marine ecosystems impacted by climate change. Modifications in species distribution raise questions for the enterprises about fishing rights and geographical fleet redeployment that is also constrained by vessel autonomy and safety.

For New Aquitaine vessels, European hake and anglerfish species accounted for almost 50% of the landed value. Among them, three fleets are particularly dependent on these species. The evolution of total annual catches by fleet and rectangle over the period was analyzed. A standardized principal component analysis was applied, followed by hierarchical clustering on the principal components. It leads to 3 or 4 groups of rectangles by fleet with similar evolutions.

In a context of new maritime borders resulting from the Brexit, we considered two adaptation scenarii for fishers facing these evolutions: whether vessels would continue fishing the same species (scenario 1) or not (scenario 2).

For scenario 1, new rules and organizations exist; keeping the same species is likely to take place in a more unstable political context. In addition, regulatory considerations relating to landings differ between EU and UK (traceability, customs). For scenario 2, new financial mechanisms are needed to support adaptation. As production and market are connected, new political work is needed to create new markets (local or global level), which could be collectivized. This preliminary work contributes to the debate on equitable and sustainable fisheries management.

Session 1: Vulnerability and Resilience to Coastal Ecosystems to Global Change

Session 2: Development of marine renewable energies and impact of socio-ecosystems

Oral communications Session 2

Amphitheatre MRSH

Wednesday 25, October 2023 from 4.10.p.m to 5.10 p.m. and Thursday, 26 October 2023 from 8.30 a.m. to 10.30 a.m.

Assessment of Wave-Induced Turbulence in a Complex Macrotidal Environment, an Observational Study Using ADCP Data

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Keywords: Alderney Race, data analysis, marine turbulence, ocean waves, Acoustic Doppler Current Profiler.

Abstract

Loading on submerged marine structures is greatly influenced by turbulence in the water column. Rapid fluctuations of the dynamical pressure or profile shears in turbulent kinetic energy (TKE) can cause additional fatigue damage to water turbine blades. Accurate knowledge of the TKE vertical distribution is therefore crucial for engineers as they design, dimension and operate submerged structures. Furthermore, marine renewable energy converters such as water turbines are often deployed in energetic environments featuring strong tidal currents and exposed to powerful swell and storms. Wave breaking and wind stress are then expected to greatly increase the TKE. However due to the difficulty of gathering complete set of data in such conditions those surface processes have been poorly documented in harsh environments. The goal of the present research is to fill this gap by challenging the turbulent dissipation scaling laws observed so far in weakly energetic sites against ADCP data from a measurement campaign (2018) in one of the most tidal energetic site in Western Europe, the Alderney Race. We are notably interested in identifying the depth at which the wave-affected layer transporting the direct injection of turbulent kinetic energy transitions to a wind stress log layer where shear production balances dissipation. Due to the difficulty of finding a correct estimation of the turbulent dissipation caused by the anisotropy of turbulent eddies in Alderney Race, direct comparison of TKE profiles against an analytical law is also carried out. The dependence of the fitting parameters towards mean wave and tidal parameters is studied.

An Ecosystem Approach for Studying the Impact of Tidal Farms: a French Case Study

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Keywords: English Channel, biofouling effect, reef effect

Abstract

As the EU's commitment to renewable energy is projected to grow to 20% of energy generation in the next years, the use of marine renewable energy is increasing. The tidal power potential in Europe is estimated at 10 GW.

The Hydroquest tidal turbine prototype was connected to the electrical network in 2019 at the Paimpol-Bréhat test site. This implementation facilitated an investigation on the benthic communities associated with these artificial structures. By systematically scraping different points along a vertical depth gradient after the turbine's dismantlement, the study was able to assess the composition of these communities in very high tidal current environment. A total of 118 taxa were identified, mainly consisting of peracarid crustaceans and decapods.

The objective of FLOWATT project is to investigate the benthic communities of the Alderney Race on a wider spatio-temporal scale. The project consists on monitoring benthic communities both prior to construction and during the operational phase. An experimental structure will be deployed by installing panels near the sea-bottom to observe the dynamic of hardbottom communities colonisation with *in-situ* samples and digital imagery to explore potential variations in structure and functionality resulting from the interaction between the environment and the submerged structures.

Tidal turbines effects will be also studied in relation to connectivity and stepping-stone effect on non-indigenous species or climate migrants. Due to the various studies, it would probably be possible to achieve the homogenisation of monitoring protocols to be able to compare the results on a global scale.

Impact of the Construction of the MRE Platform in the Semi-Enclosed Bay Bordering the English Channel (“Rade de Cherbourg”) on Benthic Habitat and Geomorphology

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Keywords: Marine Renewable Energy (MRE), Harbour expansion, Changes to the seabed, Benthic macrofauna communities, Impacts.

Abstract

The Cherbourg roadstead has been radically altered by the installation of industrial infrastructures (major dredging and reclamation works in 2015 and 2016 to allow the passage of deeper-draught ships and the creation of a new quay: 39 ha). A research program was carried out before and after the transformation of the port platforms to improve knowledge of the roadstead and assess its impact. Three complementary environmental approaches were used: (1) morphological changes based on a comparison of bathymetric data; (2) changes in sediment cover based on granulometric data; and (3) the impact on macrofauna benthic communities.

It appears that the new construction is the cause of a morphological change in the seabed, leading to the creation of multi-metric "hollows" and "humps", responsible for a general change in hydrodynamics and widespread silting of the Grand Rade (+14% silt). To the east, more than 10% of the well-sorted, unimodal sandy seabed has silted up after the extension. This siltation reduced the exceptional diversity of benthic habitats and has led to a drastic reduction in fragile species (amphipods) and an increase in opportunistic species, probably altering the entire structure of the food web.

Impact On Marine Biodiversity from Offshore Wind Power Converter Station Platform

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Keywords: Biodiversity, Marine biodiversity, Marine ecosystem, Offshore wind power, Offshore wind power platform, Offshore power converter station, High voltage direct current, decommissioning of offshore platform, Impact on marine biodiversity

Abstract

Transmission of electrical power to shore is a fundamental aspect of offshore windfarm development, enabling renewable energy connections to meet the increasing decarbonized electricity demand. State-of-the-art technology for high power transmission over long distances is high-voltage direct current (HVDC), with numerous advantages such as low operational losses, transmission reliability, and small footprint. While the implementation of an offshore converter station in the transmission system enhances the advantages of a greener energy system, it is essential to acknowledge that it may also have some impact on marine ecosystems. This encompasses both alternative current (AC) and direct current (DC) transmission. In response to the growing demand in biodiversity net gain from legislations and customers, this study aims to identify positive and negative impacts on oceanic biodiversity throughout the life cycle of converter platforms and use the obtained findings to understand how the existing environmental benefits from HVDC systems can be further enhanced. Based on a literature review, adverse effects on biodiversity could come from acoustic disruptions and sediment dispersal during construction and decommissioning phases with potential risks of water contamination, habitat and species disturbance and habitat destruction. Positive effects include the emergence of artificial reefs during operation phase, that should preferably remain after decommissioning. However, further empirical research is required to understand the full impact on biodiversity and how to capture it in the design, operation and decommissioning of offshore converter stations.

The research methodology includes literature review, interviews of consortium stakeholders, and a case study on the offshore wind platform in Dogger Bank, UK.

Monitoring the Habitat Use and Movements of Mobile Species in a Context of Offshore Wind Energy Development

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Keywords: Offshore wind energy; Acoustic telemetry; Habitat use, Movement patterns

Abstract.

In France, offshore wind energy development is rapidly expanding with over 13 projects of offshore windfarms (OWF) currently in progress. OWFs can act as artificial reefs for certain fish communities with species exhibiting high residency patterns for these new habitats. In addition, underwater power cables within OWFs generate electromagnetic fields that may affect the behaviour of electro- and magneto-sensitive species (e.g. sharks and rays). Considering the ecological functions and socio-economic importance of fish communities, these effects need to be assessed through comprehensive and long-term monitoring. Currently, empirical evidence is sparse as the sampling design of traditional surveys used in OWF regulatory impact assessment is not usually sufficient or adapted to detect and quantify these effects. The collaborative FISHOWF project uses acoustic telemetry to identify how mobile fish species use and connect different habitats across OWF development areas in the Channel, Atlantic and Mediterranean Sea. This project relies on dedicated receiver arrays deployed within OWF (St Nazaire, St Brieuc, and Calvados OWF), combined with the region-wide acoustic telemetry networks FISHINTEL (Channel), CONNECT-MED & RESMED (Mediterranean) to monitor occupancy patterns and movements of over 400 fish/crustaceans (including sea bass, pollack, lobster, sharks and rays). Here we will present 1) the specific goals of the FISHOWF project, 2) the challenges encountered for the deployment of our acoustic arrays within OWF and, 3) our preliminary results on fish occupancy and movement patterns within OWF (in construction and operational). Results will be used to better assess the effect of habitat modifications induced by OWF implantation from the seafloor to the surface.

In Vitro Evaluation of Exposure of Early Life-History Stage (ELHS) Marine Fishes to Electromagnetic Fields (EMF).

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Keywords: Electromagnetic field, marine fishes, AC&DC currents, in vitro long-term experimentation

Abstract

The rapid growth of marine renewable energy (MRE) installations means that submarine power cables are growing in number, with increasing potential to impact marine biodiversity, especially via electromagnetic fields (EMF). The 2-year CEMFISH project aims to study the impact of different offshore electromagnetic fields on the early life-history stages of marine fishes. The study was conducted at Marseille marine station, which enabled long term (3 month) experimentation. Four levels of EMF (0, 10, 100 and 500 micro-Tesla), corresponding to levels observed in situ at different distances from cables at MRE installations, were tested during 12 continuous weeks in four different experiments. Those levels correspond to 50 Hz fields in Alternating Current (AC). In addition, two experiments were conducted with Direct Current (DC) exposures at three levels (0, 100 and 500 micro-Tesla). Fish survival, growth and stress were surveyed over the experimentation period. Three different species were studied: seabass (*Dicentrarchus labrax*), European eels (*Anguilla anguilla*) and European salmon (*Salmo salar*); eels and salmon are known to be sensitive to EMF. Every week, body length and mass, and stress (based on measurement of opercular beat rate (OBR)) were measured. Seabass and European eels were studied in AC and DC currents. European salmon were studied only in AC currents. Fish sizes ranged from 20 mm at the start of experiments, to more than 100 mm after 12 weeks of growth. Results show no significant differences observed for fish survival, growth or stress between all levels of EMF for the three fish species. We found some slightly significant results for growth rates that we consider to be artefacts of the experiment. However, other studies should be conducted to explore the effects of EMF on migration and orientation behaviour of salmon and European eels to determine population-wide implications.

Session 2: Development of marine renewable energies and impact of socio-ecosystems

Methods for Modeling Marine Food Webs and Studying the Cumulative Impact of Climate Change and Offshore Wind Turbines on Their Functioning.

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In collaboration with:

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Keywords: Ecology, Linear Inverse Modelling, Ecospace, Ecological Network Analysis, cumulative impacts

Abstract

Marine ecosystems are complex systems, subject to strong local and global pressures. In the English Channel and the North Sea, the effects of climate change are already visible in the distribution of many species. In addition, the occupation of space is linked to many human activities. In particular, the construction of offshore wind farms is booming.

Food webs are formed by the different intricate food chains. Their characterization allows us to understand the complexity of ecosystem functioning and its changes under different pressures. For this purpose, the emergent properties of these networks are characterized by numerical indices called ENA (Ecological Network Analysis).

The methods of estimating flows in food webs before/after the simulated impact (OWF or climate change), as well as the analysis of changes in the values of ENA indices will be presented. These methods are based on a mean square meter (LIM-MCMC) or on 2D approaches (Ecospace). We propose the use of these methods for studying the cumulative impacts of Offshore Wind Farms and climate change effects on the distribution of species. The results show that the reef effect associated to the turbines may bring a better resilience of the system. However, these results only consider trophic interactions and not all impacts.

An Ecosystem Approach for Studying the Impact of Offshore Wind Farms: The Dieppe-Le Tréport Case Study

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Keywords: Ecological Network Analysis, ecopath model, marine renewable energy, offshore wind farms, sampling strategy, trophic web, ecosystem

Abstract

The worldwide demand for renewable energy development is increasing rapidly, motivated by the challenge to reduce fossil fuel emissions in accordance with political imperatives to combat global climate change. Following the European Environmental Impact Assessment (EIA) Directive 85/337/EEC, several studies have been undertaken to identify the environmental conditions and ecosystem functioning at selected sites prior to OWF construction. However, these studies are generally focused on the conservation of some species and there is no holistic approach for analyzing the effects arising from OWF construction and operation. The goal of this study is to promote a sampling strategy to collect data on the different ecosystem compartments of the future Dieppe-Le Tréport (DLT) OWF site, adopting an ecosystem approach, which could be applied to other OWFs for the implementation of a trophic network analysis. For that, the collection of new data on biological compartments (phytoplankton, zooplankton, suprabenthos, meiofauna, benthos, demersal fishes, marine mammals and seabirds) are essential. Two cruises (winter: February 2022 and summer: September 2022) allowed to estimate the contribution of each zoological group in two main benthic habitats: coarse sand and medium clean sands, located on the site. In addition, isotopic analyses of the different biological compartments from phytoplankton to seabirds were also done as well as, stomach contents on demersal fish. These studies will offer a more integrated approach and will allow to characterize the trophic web functioning of the future OWF and in the vicinity of the OWF before the construction.

Vulnerability and Spatial Competition: The Case of Fisheries and Offshore Wind Projects

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Keywords: Vulnerability, Socio-Economic Impact, Heterogeneity, Fishery, Offshore Wind Farm

Abstract

Professional fishing activities are subject to spatial pressures. The cohabitation between a traditional fishing activity and development of the offshore wind energy industry raises questions about space sharing and rules of use. This paper proposes to adapt the vulnerability methodology developed to deal with global threats of climate change to this example of local, non-climatic change using the case study of a floating wind turbine project between Groix and Belle-Ile (France). To understand and compare the potential impact of the different artisanal fishing activities, the method aims to conceptualize vulnerability with the identification of social, economic, and environmental key pressures and address them in a composite index. Although the smallest fishing units appear to be the most vulnerable, this effect is associated with a high sensitivity to the area near the coast. This research also highlights the importance of transparency and clarity during the construction of the composite index to avoid misinterpretation. This case study supports the relevance of applying the vulnerability method on a local scale to facilitate dialogue between stakeholders and reduce negotiation costs.

Session 2: Development of marine renewable energies and impact of socio-ecosystems

Posters Session 2

Poster flash presentations the Tuesday 24th of October 2023 from 5.40 p.m to 6.45 p.m.

*Special poster session in the **Aula Magna** from 6.45 p.m to 8.30 p.m*

Towards a Unified Modelling of Wave-Current-Turbulence Interactions in Three Dimensions: Application to Alderney Race (France) and Gregory Sound (Ireland)

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Keywords: Numerical modelling; Large eddy simulation; Leray model

Abstract

As tidal turbines are to be implemented in the highly energetic sea of Alderney Race (France), the aim of the study is to define a way to simulate its turbulent water regime and those of the similar site of Gregory sound (Ireland), in interaction with the ocean waves.

The goal is to include a compatible 3D turbulence model in the existing formulations to develop a unified model for wave-current-turbulence interactions that is realistic in terms of numerical resources. This will be achieved by integrating the original LES turbulence models of Leray- α and Navier-Stokes- α (LANS- α) to sets of equations modeling wave-current interactions in 3D.

This is being done using the CROCO numerical modeling system (<https://www.croco-ocean.org>) applied to the coastal ocean, in which the algorithms for the turbulence filtering procedures are to be implemented. The conclusions until now are the following: i) the Leray filter re-energizes the flow, ii) the model allows the coarser resolution to simulate the finer one, with a relevant reduction of the computational costs, and iii) among the values of filter widths, the more efficient for a relatively small increase of the computation time, is the filter width of 5.

The next steps involve building a realistic test case on a regional coastal scale, and eventually running the model for simulations for the study sites.

Species Connectivity Between Offshore Wind Farms in the Bay of Seine - MARS3D and ICHTHYOP Coupling

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Keywords: Environmental Fluid Mechanics, Marine Renewable Energy, Larval dispersal, Eulerian-Lagrangian coupling

Abstract

Offshore wind farms (OWFs) modify the hydro-sedimentary environment on a local scale and possibly regional scale. Around their foundations, wind turbines are colonized by numerous benthic-pelagic species, creating a reef effect. The presence of these species, which released large number of planktonic larvae in presence of hydrodynamics features due to uid-structure interactions, increases larval dispersal and retention between OWFs, impacting the connectivity of species. So, this study is focused on hydrodynamic impacts of OWFs on larval dispersal and species connectivity for the Bay of Seine (France), where three OWFs are under development, using numerical modelling. An ocean circulation model, MARS3D, under met-ocean forcings (tide/wind/temperature) is combined with a Lagrangian model, Ichthyop, for simulating the behavior of four benthic species known to colonize wind turbine foundations. Hydrodynamic forcings from MARS3D are computed in three-dimensions using three nested grids and with the sub-grid scale parameterization of Rivier et al. 2016 1 to account for the hydro-sedimentary effects of wind turbine foundations. First results have shown that the parameterization, initially developed for monopile foundations, can reproduce uid-structure interactions for gravity-based using a regional model. The velocity immediately behind foundations is reduced and the turbulent intensity in the wake is increased. The distance between the foundations within the three OWFs keeps the wake-foundation interactions low. Larvae are dispersed within the OWFs, particularly along the turbulent wake, and retention effects are being investigated.

Preliminary Geophysical Characterisation of MRE Zones

Authors: Edith le Borgne, Loïc Moutoussamy , Yann le Faou, Julie Bignon, Blandine le Cour Grand Maison , Marie Laurent , Herman Gauduin , Emeline Geba

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Keynote: Marine Renewable Energies (MRE), geophysical reconnaissance, morpho-sedimentary surveys, echosounder, side-scan sonar, magnetometer

Abstract

The development of marine renewable energies requires precise knowledge of the environment for site selection. The French government has therefore entrusted Shom with the geophysical reconnaissance of the siting and connection zones for future offshore wind farms, as defined in the Pluriannual Energy Program. The studies carried out are divided into four successive phases.

Initially, Shom provides a general description of the knowledge and physical characteristics of the study region for the public debate organized by the French government.

Studies are then carried out on the areas selected at the end of the debate. The state of knowledge from Shom databases or external sources is established, and bibliographical studies are carried out for various fields of expertise: bathymetry, sedimentology, currents, tides, swell, hydrology, anthropic objects.

Geophysical reconnaissance of these areas is then carried out by means of a morpho-sedimentary survey using the hydrographic vessels and launches operated by Shom. The resources deployed include multibeam and single-beam echosounders, a sediment penetrator, side-scan sonar and magnetometer to detect obstructions and metallic objects respectively. Sediment samples are taken to determine the surface nature of the seabed. Measurements of currents, water levels and swell specified by Shom are also carried out under the responsibility of Météo-France.

The data collected provides a complete characterization of the area: digital terrain model, sediment nature and thickness maps, granulometry, acoustic imagery, analysis of currents and sea states.

Various zones have already been covered in mainland France, corresponding to 2,500 km² covered and 300 sediment samples taken.

Simulation Through Deep Learning of Seabirds' Behaviour: Evaluating the Impact of Offshore Windfarms

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Keywords: Seabirds – Offshore windfarms – Deep Learning – Simulation - Renewable marine energies – Ecological Impact Assessment

Abstract

In the past twenty years, the increasing number of offshore wind farms (OWFs) in Europe have raised the question of their potential impacts on seabirds. OWFs might create a barrier effect, change the habitat, and even induce a direct mortality through collision. To help reduce those effects, current impact assessment methods lack the predictive power to be reliable during the projects' planning and the implementation of the mitigation hierarchy, either being too simple or needing data. The main objective of this PhD is to develop an innovative tool for the prediction of the impact of OWFs on seabirds, starting with the study of the northern gannet (*Morus bassanus*) and the lesser black-backed gull (*Larus fuscus*). A previous PhD developed a deep learning model (GAN, Generative Adversarial Network) trained with GPS data to simulate tropical seabirds' trajectories (A. Roy, 2022). The present work will build upon this tool in three steps: (1) using and upgrading the GAN to simulate European seabirds' trajectories, (2) conditioning its architecture to take into account environmental features (e.g., bathymetry, wind) and human activities/infrastructures (e.g., OWF, fishing), and (3) testing the predictive power of this tool, focusing on OWF's impacts on seabirds. Currently, the GAN has been trained with different colonies' data, and is able to generate trajectories specific to each, which is promising for future and more complex conditioning. Following this work, this tool aims to assess the impact of OWFs projects but could be extended to the study of other human infrastructures or environmental conditions.

Session 2: Development of marine renewable energies and impact of socio-ecosystems

The Cultural Interface Between Human Needs and Nature's Integrity: The Case Study of Beaussais' Marsh

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Keywords: Art, Brittany, Landscape, Seascape, Sea-level rise, Adaptation, Sustainability

Abstract

Since 1950, Earth's degradation led to global awareness along with the unsustainability of the human use of the biosphere, hydrosphere and atmosphere. Worldwide institutes and research centers have therefore built some science-policy platforms, such as IPCC, IPBES, etc., and objectives, such as Sustainable Development Goals, Aichi Biodiversity Targets, Planetary Boundaries, etc. The coastal fringe constitutes a life-size laboratory to experience Nature's alteration due to anthropogenic land-sea artificialization and pollution and to experiment innovative approach to (re-)connect *Homo sapiens* species with its *milieu*, such as 里海 (literally, the "sea-village"), Future Earth Coasts, etc. The Nature-Culture continuum usually creates the consensus to provide a conceptual framework for addressing today's ecological crisis. However, the role of the Culture remains too vague or site-specific, hindering its broad-scale transferability.

We propose here a conceptual scheme networking the *Homo sapiens*' fundamental needs (according to Maslow's pyramid), representing the socio-economy, the thinking's disciplines (art-science-philosophy), drawing the socio-culture, and the "remaining", embodying the Nature, especially the non-human Earth's living system. This triptych is represented as a three-layer sphere: socio-economy \subseteq socio-culture \subseteq Nature, where can vary both the bulk of the sub-spheres' society and the porosity/depth of their boundaries. Beaussais' marsh (in Brittany) consists of a meaningful case study because it has been the theatre of a recent ecological restoration, in the form of a depolderization, what fostered a 20-m wooden sculpture creation. The artwork hence interfaces the inner socio-economy's need to adapt to climate change (sea level rise) with the Nature's reconquest (salt marsh ecosystem services).

Forcing the CMS (Coupled Mode System) with Realistic Sea States

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Keywords: Wave modelling, wave-current interactions, wave spectrum, Fourier transform, Coupled-Mode System

Abstract

Accurately simulating the interaction between waves and currents in coastal and offshore environments is essential for correctly estimating the forcing and operational conditions on marine structures, such as tidal converters. Moreover, it has wide-ranging applications, from navigation to understanding coastal morphology. The Coupled-Mode System (CMS) is a recently developed phase-resolving numerical wave model that better considers the effects of sheared current and bathymetric variations. However, to ensure the model's reliability and applicability to real-world scenarios, it is crucial to enable a forcing of the CMS with random time series that resemble realistic sea states. Previous studies and use of the CMS primarily relied on monochromatic waves, which are easier to reproduce experimentally and can be validated against analytical solutions. The goal of the present research is to develop a methodology to force the CMS with realistic conditions and evaluate the behavior of the code for identified test cases. Time series of the sea surface elevation and wave-induced velocities are deduced from wave spectral data obtained through observations or hindcast datasets. The consistency of this transformation is verified by comparing wave parameters from both time series and spectra. The generated time series are then employed as input for CMS simulations. To evaluate the accuracy and performance of the forced CMS, several test cases are considered, including a flat bottom with a uniform, or linearly sheared vertical current profile. The results are compared with analytical solutions to assess the validity and reliability of the model.

New Tools to Evaluate the Effects of Magnetic Fields from Submarine Power Cables on Marine Fauna

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Keywords: animal behavior, artificial magnetic fields, submarine power cables, benthic species

Abstract

In recent years, the desire to exploit marine renewable energies has grown and offshore construction projects have multiplied. The electricity produced is transported to the coast by a network of underwater cables generally buried in the sediment. However, these cables emit high intensity alternative AC or direct DC magnetic fields (up to 30 times higher than the geomagnetic field), whose potential effects on marine fauna are still poorly understood. Many marine organisms use the Earth's magnetic field to guide their movements at small and large scale. In this context, the objective of this thesis was to explore the behavioral responses of benthic organisms when exposed to magnetic fields of similar intensity to those theoretically emitted by submarine cables. According to a multi-model approach targeting various taxonomic groups, experiments were conducted in a controlled environment on the thornback ray *Raja clavata*, the velvet crab *Necora puber*, the blue mussel *Mytilus edulis* and the razor clam *Ensis magnus*. Artificial magnetic fields were emitted thanks to a device, named the *Magnetron*, based on the principle of Helmholtz coils, with computer monitoring allowing the control of the generated intensities. Behaviors of high ecological value were studied: camouflage behavior in rays, sheltering, feeding and movement behaviors in velvet crabs, filtration and bioturbation activities in mussels and razor clams, respectively. Overall, exposures to artificial magnetic fields did not cause significant behavioral changes in any of the four species. Present work is the first to evaluate magneto-sensitivity in bivalve mollusks and provides valuable data for future research. It is now necessary to evaluate the effects of medium- and long-term exposures and to explore the sensitivity of young life stages.

An Ecosystem Approach for Studying the Reef and Reserve Effects of Offshore Wind Farms: The Fécamp Platform

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Keywords: marine renewable energy, offshore wind farms, sampling strategy, trophic web, isotopic analysis, hard substrate

Abstract

The English Channel is subjected to a high and growing number of anthropogenic disturbances (e.g., fishing, aggregate extraction, dredging, port activity and spoil deposition). It is also a hotspot for future Offshore Wind Farm (OWF) development in France. The DRACCAR project is the first French offshore research platform dedicated to offshore wind energy. The aim of this project is to improve the understanding of the interactions between offshore wind energy and the environment, to optimise the design of wind turbines and to co-construct a permanent observation network of the maritime coasts.

Six topics are thus studied: ecosystem approach; marine megafauna; fishery resources, biofouling and benthos; wind; structure behaviour and hydro-sedimentary processes.

This poster presents the sampling strategy to collect data on the different ecosystem compartments of the Fécamp offshore platform in the Fécamp OWF site, adopting an ecosystem approach for the implementation of a trophic network analysis. This will allow to understand the reef and/or reserve effect of this offshore structure on a gravel habitat. For that, the collection of data on biological compartments (bacteria, phytoplankton, zooplankton, suprabenthos, soft bottom benthos, hard substrate benthos, algae, demersal fishes) are essential. Seasonal patterns will be studied during 2024 to estimate the contribution of each zoological group, with isotopic analyses and stomach contents on demersal fish. Additionally, steel panels will be installed at different distances from the platform wake with colonization to study the spatio-temporal dynamics of biofouling.

Pattern of Fish Community on Two Artificial Structures in French Atlantic Coast

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Keywords : Artificial reef, fish community, Underwater visual census, Habitat enhancement, Citizen-based monitoring

Abstract: (flash video presentation)

A range of management approaches are being used to conserve biodiversity in the face of escalating anthropogenic disturbances that have profound impacts on coastal marine ecosystems. These approaches include the implementation of fishing gear restrictions, the setting of fishing quotas, the designation of protected areas and the creation of artificial reefs (ARs). Two different artificial structures were installed at three different sites along the French Atlantic coast between 2010 and 2015. Volunteer divers carried out standardised monitoring using underwater visual censuses to study the effect of structure type on fish communities and species richness. A total of 65 surveys were conducted by volunteer divers at the two structures between 2018 and 2022. The analysis shows that one of the structures has a significantly higher species richness. However, community abundance is similar between the two structures. Further analysis shows that location plays a significant role in shaping fish communities. We found that fish communities on ARs differ depending on the proximity of the ARs to a natural rocky habitat. In the face of increasing anthropogenic disturbance, these conclusions provide valuable insights to guide artificial reef placement and management strategies.

Session 2: Development of marine renewable energies and impact of socio-ecosystems

Session 3: Coastal evolution and submersion of coastal territories

Session 3: Coastal evolution and submersion of coastal territories

Keynote Session 3

Dano Roelvink – IHE Delft

Towards Predicting Decadal Shoreline Change Trends on a Global Scale

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Keywords: shoreline change, coastline evolution, change in biodiversity, transport mechanism, sandy beaches, 1D approach

Abstract

Presently available first-pass global assessments of future shoreline change indicate that most of the world's coastlines will experience shoreline retreat through the 21st century, potentially leading to massive loss of beach area and biodiversity in the coastal zone. This, in turn, would impact the safety against flooding and local economies.

Understanding and predicting coastal planform change (i.e. coastline position as viewed from above) is severely limited by incomplete or insufficiently tested models, incomplete nearshore wave conditions and satellite-derived shorelines that are often unreliable at a local scale.

For modelling coastal planform evolution very promising approaches were recently developed and are being tested at many sites (e.g. Roelvink et al., 2020¹). The main data required are (satellite-derived) coastlines, for initialization and calibration, and nearshore wave conditions. While ERA5 provides data at 60 km resolution, transformation to nearshore is required and needs very efficient methods, currently being validated, for detailed application at a global scale.

The main transport mechanism for sandy beaches is alongshore wave-driven transport; for mud coasts, the transport is dominated by wind-driven alongshore flows, where tides and waves regulate the suspension of fine sediment. Wave-driven flow can also contribute to this transport. A novel 1D approach to simulate the evolution of mud/mangrove coasts is currently under development.

In the lecture we will discuss the components of a methodology to predict shoreline change *anywhere* and outline the path towards predicting is *everywhere*.

Roelvink, D., Huisman, B., Elghandour, A., Ghonim, M. & Reyns, J. Efficient Modeling of Complex Sandy Coastal Evolution at Monthly to Century Time Scales. *Frontiers in Marine Science* 7, doi:10.3389/fmars.2020.00535 (2020).

Session 3: Coastal evolution and submersion of coastal territories

Oral communications Session 3

Amphitheatre MRSH

Thursday, October 26 2023 from 10.30 a.m to 5.10 p.m

Ship-Borne Wave Gauge Using GNSS Interferometric Reflectometry

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Keywords: GNSS, reflectometry, wave height, wave period

Abstract

Due to land subsidence caused by the 2011 off the Pacific coast of Tohoku earthquake, the intertidal zone changed to a subtidal zone in Mangoku-ura Lagoon, a major Asari clam production site of northern Japan, and fishermen were unable to collect clams. Therefore, the local government created a new artificial tidal flat using mountain sediment from 2013 to 2016. Most of the clams were washed away or buried in the sediment and died as a result of the giant tsunamis, but the surviving parents spawned, and in 2014, juvenile clams could be seen on the flats. The juveniles have since grown, many of them reaching a shell length of 30 mm or more, and fishermen began catching clams from 2017. Despite annual changes in catch, locally produced clams were collected and shipped to market every year until 2023.

However, in Mangoku-ura, where the land subsided by 80 cm when the earthquake occurred, 60 cm of land uplift has occurred in the past 10 years. Due to the continuous annual uplift, some of the tidal flats have become increasingly uninhabitable for organisms including clams. It is necessary to carry out large-scale construction work to return tidal flats that are already in the supratidal zone to the intertidal zone, but this work may damage the ecosystem of the tidal flats that have been stabilized. Careful reconstruction from a scientific perspective is necessary. We must not forget that the effects of the massive earthquake on fisheries and marine ecosystems are still ongoing.

Investigating the Dynamics of Extreme Wave Energy Transfer during Propagation towards Coastal Zones

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Keywords: Extreme waves, Hydrodynamic conditions, Wave energy, Physical modeling, Wave flume

Abstract

The coastline of Normandy faces significant erosion due to severe hydrodynamic conditions, including powerful tidal currents, strong turbulence, and extreme waves. Climate change and rising sea levels further exacerbate these challenges, necessitating a deeper understanding and development of models for the transformation of extreme waves as they approach the coast.

This study employs physical modeling in a wave flume to investigate the behavior of extreme waves, their evolution, harmonic interactions, and energy dependencies. The wave flume was designed to replicate in-situ systems accurately, matching slope, wave frequencies, and other relevant parameters. Various wave spectra, including Jonswap7, Jonswap3.3, Pierson-Moskowitz, and Gaussian, were utilized, covering a broad range of wave amplitudes. Multiple wave trains were generated to account for varying storm durations. Wave gauges positioned at distances ranging from 4m to 14m from the wave generator facilitated comprehensive monitoring of wave characteristics and their propagation along the wave flume. The analysis incorporates wavelet transform to identify frequency components of the wave signal. By investigating the energy of each frequency component along the wave flume, potential correlations between the dissipation of dominant frequency components and zones of higher energy dissipation are explored. This observation suggests that energy dissipation is associated with specific frequency components or frequency ranges, providing valuable insights into the underlying mechanisms driving wave energy dissipation.

By enhancing our understanding of the transformation and propagation of extreme waves, this study contributes to the development of more accurate models for predicting wave behavior near the coast. Such models can help guide coastal engineering and management techniques in order to reduce erosion, safeguard coastal infrastructure, and ensure the safety of coastal residents.

3D Hydrodynamics of a Macro-Tidal Estuarine Environment Under Wave and Tide Forcings

Authors: Guillaume Croguennec¹, Anne-Claire Bennis^{1,}, Martial Boutet¹, Gaetano Porcile¹, Pierre Weill¹, Franck Dumas², Sophie Le Bot¹, Laurent Leballeur², Marc Pezerat²*

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Keywords: estuarine environment, macro-tidal dynamics, wave-current interactions, 3D numerical modeling, bay of Somme

Abstract

The sandy estuaries along the English Channel have been silting up for over 10 years. Former geoscientific studies, which assessed sediment stocks, showed that the sedimentary material came from the marine rather than the fluvial part due intense cross-shore dynamics. To understand how the sedimentary material was brought from the coastal sea from estuary, a three-dimensional coupled numerical model was first set up, before simulating hydro-sedimentary processes. This study was applied to the bay of the Somme, located in the northern France along the English Channel. This estuarine environment is forced by semi-diurnal tides and ocean waves, that move the predominant fine and coarse sands. The sands moving from coastal ocean, a numerical validation was carried out at coastal, nearshore, and bay sites using several datasets from *in-situ* field campaigns. Good agreement was found between model and data in the coastal zone regarding to bottom and surface current, sea surface height and mean wave parameters. Vertical profiles of current were also well simulated, especially their modulation by ocean waves. The nearshore simulations reproduced the wave set-up and wave set-down, as well as the cross-shore dynamics with simulated undertow and streaming, and the longshore dynamics showing the longshore current generated by oblique incident ocean waves. Inside the bay, a modulation of the tidal wave is observed, as expected. The water filling and draining of the bay are well represented and follow the tidal phase: the ebb flow drains the bay while the flood flow fills it. These simulations were performed under calm and storm conditions, enabling us to identify the contribution of ocean waves to the hydrodynamics. The next step is to build the hydro-sedimentary model to assess the impact of hydrodynamics on sediment transport and the morphodynamics of the bay

Coastal Storm Surge and Extreme Sea Level Simulation Using Machine Learning

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Keywords: Mean Sea Level (MSL), change MSL, LSTM neural network

Abstract

There has been significant progress in understanding the mean sea level (MSL) change on both global and regional scales. Coastlines are also potentially prone to episodic high-intensity sea levels or extreme sea levels (ESLs) and coastal flooding; however, the understanding of these short-span (hours-days) events, driven by the combination of MSL, tides, storm surge, and waves is very limited. Only a few tide gauges of the global coastline have a long record of high frequency (minute-hours) sea and many tide gauges pose large data gaps. This limits a better understanding of storm surges along densely populated coastal belts. Historic storm surge estimation from the model-based studies and global reanalysis had considerable uncertainty due to the lack of proper validation and biases along the Indian Ocean coastlines. Here, we provided an AI/ML-based data-driven reconstruction (IOSSR) of high-frequency (hourly) storm surges along the Indian Ocean Coastline.

Using the Long Short Term Memory (LSTM) neural network with predictors includes hourly MSLP gradient, 10m wind speed, and 2m air temperature, we reconstructed the high frequency (hourly) storm surge data along the TG locations in the Indian Ocean coastlines from 1979 to 2021. Validation of hourly surges and monthly extremes shows our data performing fairly well with a mean RMSE of less than 7 cm (<13% mean relative RMSE) and a mean correlation of 0.73. Simulation of extreme surges during cyclone events are outperforming presently available global surge reconstructions.

Improving Coastal Ocean Circulation Modelling through Refined Representation of Wave-Current Interactions

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Keywords: Wave-current interactions, coastal circulation modelling, spectral wave modelling, macrotidal hydrodynamics, storm waves and winds.

Abstract

This study introduces an improved coupling between a three-dimensional ocean circulation model (CROCO) and a spectral wave model (WAVEWATCH-III) to upgrade the representation of wave-current interactions in coastal environments. Previous implementations of such model coupling used monochromatic approximations for wave-induced terms in the ocean dynamic equations, such as Stokes drift, Bernoulli head, near-bottom wave orbital velocity, and wave-to-ocean energy flux. In this study, we implement and evaluate the exchanges of these fields computed from the spectral wave model and directly provided to the ocean circulation model.

Numerical experiments are conducted for a coastal configuration of the Bay of Somme. The comparison between spectral and monochromatic computations of wave-induced terms reveals a significant impact on the hydrodynamics at the coastal scale of these newly exchanged fields, especially during waves and winds opposing tidal flows. The new implementation improves the agreement of computed current with measurements, particularly at the free surface and close to the seabed. The spectral computation reduces the wave-induced deceleration of the tidal vertical profile.

Among the wave-induced spectral fields, the surface Stokes drift and near-bottom wave orbital velocity have the most pronounced effects. The spectral surface Stokes drift increases advection towards the free surface, while the near-bottom wave orbital velocity shifts the profile closer to the seabed. Neglecting these spectral terms in favour of their monochromatic counterparts leads to an underestimation of ocean surface currents, particularly in tidal settings subject to storms as the Bay of Somme.

By incorporating these advancements, our model provides a better understanding of the complex interplay between tides, winds, and waves in the circulation of coastal seas. The implications of this research extend to the study of air-sea interactions and sediment transport processes

Cross-Shore Suspended Sediment Transport in the Upper Shoreface

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Keywords: Suspended sediment transport, shoreface, short-waves, undertow IG waves

Abstract

At seasonal to decadal timescales, the shoreface transitioning between the surf zone and the shelf plays a fundamental role in the morphological evolution of adjacent shorelines (e.g. Hamon-Kerivel et al. 2020). The driving mechanisms of sediment transport across the upper shoreface have been however poorly examined to date because of the scarcity of field measurements beyond the inter-tidal area, which is mainly due to instrumentation difficulties. Here we present some recent results investigating the cross-shore suspended sediment transport from synchronized time series of bottom pressure, current velocity and suspended sediment concentration measured in a macro-tidal and low-sloping shoreface, under storm waves and fairweather conditions. Depending on the tidal phase and the incoming wave height the measuring apparatus was alternatively located in the shoaling zone and in the outer surf zone. The analysis of field observations first revealed that steady currents dominate suspended transport with a notable contribution of the wave driven return current under storm wave conditions. Cross spectral analysis further indicates that short waves globally induce an offshore-directed transport under energetic conditions associated with crest-to-trough phase lag effect. The contribution of infra-gravity (IG) waves, which reaches as much as 20% of the total transport shows contrasting directions depending on whether IG waves are bound to the short-wave groups or propagate as free waves. These results highlight the processes governing the crossshore sediment transport beyond the inner surf zone and further advocate for a comprehensive description of the wave-driven hydro-sedimentary dynamics all across the nearshore area.

Solutions to Preserve Gorgan Bay Against Level Decrease in the Caspian Sea

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Keywords: Caspian Sea level, decrease of Volga River discharge, impact of decrease on the surrounding environments

Abstract

The Caspian Sea, the world's largest closed sea with area of 370,000 square kilometer, has experienced significant fluctuations in its water level, over the past century. The changes in the Caspian Sea level (CSL) have been a matter of concern for the countries surrounding it, as the fluctuation affects their economies and environment. In recent years, the decrease in Volga River discharge, which is the main inflow to the Caspian Sea, has been identified as a major cause of the sea level drop, along with the effects of global warming. The decrease in the CSL has resulted in various impacts on the surrounding areas, including the drying of wetlands, shallowing of ports access channels and basins, and changes in the hydraulic behavior of channels connecting the Caspian Sea to adjacent bays.

This paper reviews the impacts of the CSL fluctuations on surrounding areas, particularly its effects on the hydraulic behavior of the channels connecting Gorgan Bay to the Caspian Sea. Gorgan Bay with area of 400 square kilometer is a very important environmentally preserved area which hosts millions of migrating birds in its adjacent wetlands

In order to investigate the hydraulic characteristics of the natural channels connecting the Caspian Sea and Gorgan Bay, a comprehensive study was conducted utilizing monthly measurements obtained from a CTD instrument, a current meter, and three tide gauges. This field data, complemented by meteorological observations and satellite data, served as inputs for the development of a numerical model. Multiple designs for extending the primary natural channel were analyzed using the established numerical model. The conclusive findings revealed that a 2700-meter-long channel, featuring varying widths ranging from 150 meters to 450 meters, and fortified against sedimentation by a protective wall constructed from repurposed timber poles, ensures the continuous operation of the crucial connecting channel. The future condition of Gorgan Bay was predicted using 2 and 3 dimensional numerical models, indicating that the water quality, particularly the salinity, was improved for water levels down to 1.5 meter lower than the present CSL.

Assessment of the Impact of Dredge Disposal Sediment: Towards a Multicriteria Index

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Keywords: D2SI, Multi-criteria index, dredging disposal, benthic macrofauna, sediment bathymetry

Abstract

The effects of marine sediment deposits in the context of harbor dredging are generally poorly described by the ecological indices available to date, at least for part of the configurations of dredged sediments / nature of the reception sites. In order to better assess these effects, the INDICLAP projects aims were to develop an indicator able to describe the changes of the benthic environment due to sediment deposits. Initially inspired by the faunal index of Roberts et al. (1998) then reworked in Dauvin et al. (2018) and Baux et al. (2020), the indicator has been largely revised to a multicriteria indicator, based on the calculation of several indices and the establishment of scores. This indicator takes into account the evolution of the benthic macrofauna, the sedimentary changes during the deposits, the morphology and the bathymetry of the deposit zone via a comparison of crossed pairs of impacted or under-influenced stations and control stations. For each of the three criteria mentioned, a score is established. The weighted sum of the indices gives a final score, making it possible to establish the level of impact of the pressure exerted. This indicator, named D2SI for '*Dredge Disposal Sediment Index*', was calibrated on three sites undergoing very significant sediment deposits in the eastern part of the Bay of Seine (Normandy, France). However, to refine the calibration, it would be necessary to calculate the indices on other dumping sites with different pressure levels, and potentially other pairs of type of dredged sediments/type of recipient habitat.

Granulate Extraction Effects on the Benthic Coarse Sand Community: The GIE-GMO Site

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Keywords: gravel, bay of Seine, benthos, BACI approach

Abstract

The seabed of the English Channel (EC) corresponds to an extensive network of paleo-valleys, partly filled at the present-day with coarse sediments, reaching sometimes several metres thick, which represent an important source of accessible aggregates. The extraction of these aggregates is currently experiencing significant growth along the French coast of the EC. Despite coarse sediments constitutes approximately 80% of the superficial composition of the EC, very few quantitative studies have been conducted on the benthic community which colonise these habitats. This lack of quantitative data and studies is primarily attributed to the challenges associated with sampling in this area, mainly due to its hydrodynamic conditions. In this context, the aim of this study was then to analyse the spatio-temporal evolution of benthic communities in relation to aggregate extraction. To achieve this, a Before-After Control-Impact (BACI) approach was employed. Thus, samples were collected before extraction between 2007 and 2010, then, two samplings were made during aggregate extraction in 2018 and 2023. The extraction activity was limited to a single strip within the concession, responsible of the refinement of the coarse sand. In 2023, two video acquisitions were carried out to assess the effects of marine aggregate extraction on the benthic community. Although the benthic diversity on the site appeared similar in 2023, a notable decrease in benthic abundance was observed. Techniques investigating the sediment-benthos relationship have also been applied to determine whether sediment reworking has had an impact on “grain size-sensitive” species, particularly those preferring coarse substrates.

Development of a Continuous Measurement System for Small Microplastics Using a Micro-Raman Spectrophotometer

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Keywords: Microplastics, Raman spectroscopy, marine pollution

Abstract

Microplastics (MPs) are ubiquitous throughout the world and their potential impacts are a growing concern. The conventional method of collecting MPs in the marine environment has been to use neuston net with a mesh size of approximately 350 μm . However, this method has been found to be unable to capture small MPs (SMPs) that are smaller than the mesh opening of the net. Furthermore, the detection of MPs using infrared spectroscopy requires analyzing individual particles in a dry state, which not only demands substantial efforts but also poses the risk of damaging the particles. To solve these issues, a system that can continuously detect the concentration of SMPs with a micro-Raman spectrophotometer was developed. This system consists of one component for sorting and concentrating SMPs from seawater, and another component for analyzing SMPs with a micro-Raman spectrophotometer. In this study, we focused on the analysis with Raman spectroscopy, including determination of optimal measurement conditions for SMPs solution and development of a method to estimate the concentration of SMPs. The performance of this method was calibrated and validated by evaluating the detection rate of SMPs and estimating the concentration of known concentrations of SMPs solution. The results showed a detection rate of 89% for MPs with a diameter of 100 μm , and positive correlation between concentration and the number of detected peaks. This suggests that efficient analysis of SMPs solutions is possible, and the approach presented in this study will be useful for investigating the distribution and environmental fate of SMPs.

Multidisciplinary Study to Highlight Interaction Between Anthropogenic Disturbance and Natural Coastal Sedimentary Processes.

Complementarity of geochemical and granulometric methods and proposal of a new spatial geostatistical approach

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Keywords: Geochemistry, Multi Sediment Trend Analysis (MSTA), Grain-Size Trend Analysis (GSTA), Geographic Information System (GIS), Bay of Seine, Dumping site.

Abstract

Traditional geochemistry studies use mapping techniques and multivariate analyzes to highlight spatial distribution of chemical concentration parameters. Granulometric parameters are used to study sedimentary transport, especially through Grain Size Trend Analysis (GSTA) approach integrating mean, sorting and skewness parameters. Within the increasing pressure of human activities on marine coastal ecosystems, the study of sedimentary disturbances remains a challenge. The Bay of Seine is highly anthropized by harbour activities and dredging sediments from The Havre Harbour and their deposition on subtidal area. To understand sedimentary mechanism, a geochemical and sedimentological study was conducted at the beginning of 2016. Sediments from 179 subtidal stations and 16 stations in the harbour basins and in the Seine, estuary were studied. Geochemical elemental composition (18 calibrated elements) was obtained through X-Ray Fluorescence spectrometry and infrared spectrometry (TOC). On this dataset, multi-treatments were applied and the results compared: mapping spatial distribution of the concentrations of each chemical element; PCA analyzes and selection of the information-bearing parameters and mapping of the PCA results; application of the "classical" GSTA approach on the granulometric parameters, "Innovative" integration of the chemical parameters and PCA results in the GSTA approach. The results show the need of multidisciplinary research and the interest of geochemical tracers to study coastal sediment dynamics and to highlight the impact generated by anthropogenic activities. The geochemical GSTA approach confirms the sedimentary dynamics and appears more robust than the methods conventionally used. To generalize this approach, an adaptation of the concepts is currently being developed: the MSTA (Multi sediment trend analysis).

Ten Years After the Great East Japan Earthquake: Environmental Changes in Clam Production Sites and Future Prospects

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Keywords: Great East Japan Earthquake, Asari clam, *Ruditapes phillipinarum*, population dynamics, artificial tidal flats, land subsidence and uplift

Abstract

Due to land subsidence caused by the 2011 off the Pacific coast of Tohoku earthquake, the intertidal zone changed to a subtidal zone in Mangoku-ura Lagoon, a major Asari clam production site of northern Japan, and fishermen were unable to collect clams. Therefore, the local government created a new artificial tidal flat using mountain sediment from 2013 to 2016. Most of the clams were washed away or buried in the sediment and died as a result of the giant tsunamis, but the surviving parents spawned, and in 2014, juvenile clams could be seen on the flats. The juveniles have since grown, many of them reaching a shell length of 30 mm or more, and fishermen began catching clams from 2017. Despite annual changes in catch, locally produced clams were collected and shipped to market every year until 2023.

However, in Mangoku-ura, where the land subsided by 80 cm when the earthquake occurred, 60 cm of land uplift has occurred in the past 10 years. Due to the continuous annual uplift, some of the tidal flats have become increasingly uninhabitable for organisms including clams. It is necessary to carry out large-scale construction work to return tidal flats that are already in the supratidal zone to the intertidal zone, but this work may damage the ecosystem of the tidal flats that have been stabilized. Careful reconstruction from a scientific perspective is necessary. We must not forget that the effects of the massive earthquake on fisheries and marine ecosystems are still ongoing.

Session 3: Coastal evolution and submersion of coastal territories

Posters Session 3

Poster flash presentations the Tuesday 24th of October 2023 from 5.40 p.m to 6.45 p.m.

*Special poster session in the **Aula Magna** from 6.45 p.m to 8.30 p.m*

Before/After the Submersion Process Using Planetscope Monthly Time-Series at High Spatial Resolution: The Case Study of Beaussais' Marsh

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Keywords: Nature-based Management, Megatidal, Breach, Salt marsh, CubSat

Abstract

Coastal risks are increasing at unprecedented rates given the combination of hazards' (storm/cyclone, sea level), human exposure's and vulnerability's (coastal urbanization) rises. Along with the erosion, submersion requires strong attention of the stakeholders tasked with coastal urban planning. However, the monitoring of such a sudden event generally intervenes a posteriori and locally. Post-event airborne imagery helps mapping the spatial amplitude concurrently with the destruction magnitude. Even if some satellite imageries leverage time-series long enough to cover pre-event information, they mostly suffer from either a coarse spatial resolution, hindering coastal objects to be detected, or a coarse temporal resolution, impeding cloud-free imagery to be monthly acquired at high spatial resolution. The advent of the Planetscope constellation could successfully address the meaningful a priori monitoring at both high spatial and temporal resolutions. Beaussais' marsh in Brittany suitably illustrates the novel use of the Planetscope imagery to track the changes in land/sea-scape before and after a breach in a dam. The breach aperture happened in March 2020 during spring tides, since letting the seawater re-investing the 200-year-old polder. A continuous time-series has been created from January, 2020 to June 2023, at the month lag (48 imageries), provided with a 3-m pixel size to monitor the changes in land/sea-use/land/sea-cover. This exhaustive chronology of the entire area at high spatial resolution has originally enabled to reveal steps in this submersion process: dam undermining, proximal submersion, distal submersion, mud sedimentation and lower salt marsh colonization, downstream salt marsh "canyoning", mud sedimentation and middle salt marsh colonization.

Index for Assessing and Predicting the Ecological Potential Quality of a Coastal Site in a Context of Depoldering

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Keywords: Nature based Solutions through coastal systems, Restoring tidal dynamics and estuarine ecosystems, Managed Realignment Schemes, Megatidal, Salt marsh, vegetation transformation, depoldering

Abstract

Depoldering absorbs storm flooding and prevents coastal squeeze. This choice of coastal management leads to a radical transformation of landscapes, uses, habitats and species.

As part of the Life Adapto program, a systematic review was carried out to study the consequences of depoldering on biodiversity (synthesis of 255 scientific articles out of the 4,476 listed worldwide). Depoldering is generally accompanied by a reduction in plant species richness, an increase in invertebrate richness, and an abundance of fish and shorebird. Many factors are involved in the establishment of species communities. A number of different factors (biotic, edaphic, anthropogenic, etc.) can explain the variability of results at different sites.

From there a multimetric indicator has been developed to assess and predict the evolution of the ecological potential of a coastal site in a context of marine reconnection. It is based on an approach by habitats. The first tool is a biological capacity matrix that evaluates the importance of different habitats of a defined typology for different parameters of diversity, patrimoniality and functionality. The second tool is a mapping of current habitats by supervised classification of remote sensing images and a predictive mapping of future habitats by characterizing current and future submergence durations. A radar diagram then shows the potential evolution of each matrix parameter in the event of depoldering or rising sea levels.

This indicator can be used to assess the potential effects of past or future depoldering. A methodological guide and the steps to follow to implement it have been created.

Utilizing UAV and LiDAR Technology for Coastal Erosion Study: Importance of Sensor Calibration and Methodology Proposal

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Keywords: Coastal erosion, Unmanned Aerial Vehicle, Lidar, digital terrain model (DTM)

Abstract

Coastal erosion is a global problem that necessitates a comprehensive understanding of its causes and impacts to develop suitable protection and adaptation strategies. This study examines the increasing utilization of UAVs (Unmanned Aerial Vehicles) and LiDAR (Light Detection and Ranging) technology in coastal erosion research. UAVs serve as flexible and cost-effective platforms for gathering high-resolution geospatial data along coastlines. By integrating drones with LiDAR sensors, detailed digital terrain models (DTMs) can be generated, facilitating precise analysis of topographic changes occurring along the coast. However, given the diverse range of stakeholders and technologies involved in employing drones and LiDAR for coastal studies, meticulous sensor calibration is crucial to ensure measurement accuracy. LiDAR sensor calibration involves correcting systematic errors, validating measurements, and comparing them with accurate ground references. Special attention must be given to data quality to minimize errors and uncertainties in the findings. The methodology developed in this study aims to showcase the cohesive and effective application of the UAV-LiDAR combination in coastal erosion studies. It encompasses key steps such as mission planning for data collection, sensor selection, rigorous calibration protocols, data analysis, and cross-validation with other information sources.

In summary, the utilization of UAV technology combined with LiDAR holds significant potential for coastal erosion research. However, precise sensor calibration is paramount to obtain accurate and dependable measurements. The proposed methodology will promote standardized practices for data collection and analysis, fostering a deeper understanding of coastal erosion and contributing to the implementation of sustainable adaptation measures.

Spatial and Temporal Monitoring of Dune System Evolution Using Drone-Based Lasergrammetry: The Case Study of Anse Du Guesclin (Brittany)

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Keywords: Dune, LiDAR, UAV, Lasergrammetry, Evolution, Volume

Abstract

Coastal risks, such as marine submersion and erosion, are now burning issues for stakeholders, due to the increasing occurrence and intensity of climatic phenomena. The coastal fringe hosts 75% of the world's population, requiring the development of innovative, agile but accurate, monitoring methods.

Unmanned Aerial Vehicle (UAV) is now essential for monitoring sedimentary changes using passive photogrammetry at the decimeter and daily resolutions. Recently, UAVs have been fitted with active LiDAR (Light Detection And Ranging) sensors, increasing both accuracy and precision through the lasergrammetry.

The Anse Du Guesclin's dune (Brittany) has been subjected to human activities for the last seven decades. The construction of a road and associated parkings, in 1960s, has prevented the natural movement of sediments and the establishment of dune vegetation, despite restoration attempts in the 1980s.

A point cloud analysis of four UAV-borne LiDAR surveys, carried out since 2022, has enabled the analysis of sediment changes in surface and volumes between campaigns.

First results have revealed an interannual difference in volume estimated between the point clouds of +7 292 m³ and -2 637 m³. At the seasonal scale, a gain of +2 359 m³ and a slight loss of 884 m³ are observed during the accreting summer period. On the other hand, in the winter season, which is prone to eroding storms, a gain of +8 848 m³ and a loss of -1 034 m³ were estimated. On an inter-annual or seasonal scale, analysis of the volumes of the entire point cloud (ground+non-ground) has demonstrated the positive geo-ecological morphodynamism of the site.

Open Access Data on Marine Dunes of the French Continental Shelf

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Keywords: Bedforms, dunes, GIS, open access data

Abstract

A vast amount of hydrographic data has been collected over the last 300 years by the French Hydrographic Service (Shom), heir to the world's first official hydrographic service (1720). From these data, bathymetry products have been used to identify various dynamic bedforms, such as sandbanks and submarine dunes. These bedforms are frequently found in environments with sufficient sedimentary availability of sand or gravel, and where currents regularly exceed 0.7 m.s^{-1} . In certain areas, such as the Pas de Calais Strait, the characterization of these sedimentary structures is essential as they can affect navigation (shoals) and their mobility makes them important to be monitored in order to update nautical charts. It was against this backdrop that Shom's sedimentology department began mapping these bottom forms, through the Dunes I (2006-2010) and Dunes II (2013-2017) projects. More recently, as part of the ANR-ITE DUNES project (2019-2022), the product has been upgraded and is available as open access data. The information used to develop this product of more than 30,000 elements (dunes) comes from the processing of side-scan sonar and multibeam echosounder (MSE) data digitized manually from 2006 to 2022.

The aim of this poster is to introduce scientists and industrialists to this product, which, with the development of offshore wind farms in coastal areas, could be interesting both for studying the impact of implantations on the dynamics of this type of seabed, and for anticipating derisking operations or targeting areas of interest for environmental studies.

Session 3: Coastal evolution and submersion of coastal territories

COAST Caen 2023
19th French-Japanese Oceanography Symposium

Forum

Amphitheatre Pierre Daure

COAST Caen 2023

19th French-Japanese Oceanography Symposium

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19th French-Japanese Oceanography Symposium

Opening remarks

By Eric Feunteun – chairman Scientific and Technical Committee

Session F1: Exploitation of living resources – Necessity and constraints

Session F1

Amphitheatre Pierre Daure

Tuesday October, 24 2023 from 4.40 p.m to 6.00 p.m and Wednesday October, 25 2023 from 8.30 a.m to 10.50 a.m.

Sensitivity of Fishing Fleets to Climate Change if only to Get out of Port – Case Study of Maritime District of Bayonne

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Keywords: fishing fleets, climate change, fishing trip, decision tree, random forest, Bayesian network.

Abstract

The drivers of change affecting fishing activity can be biological, environmental, regulatory and/or socio-economic. Regarding climate change, most studies focus on modifications in the water body characteristics and their effects on halieutic resources (and consequently on their exploitation). Few studies look at the direct effects of meteorological condition changes on the ability of fishing vessels to carry out their activities. In this context, we considered fishing trips of vessels from the maritime district of Bayonne (SW of France) and addressed the following question: what are the mechanisms governing the choice of a fishing trip (or not) that are related to the environment or socio-economic considerations?

We focused on vessels of less than 20 m implementing different fishing gears and likely to be more sensitive to weather changes belonging to specific fleets defined by an existing fleet typology co-constructed by professionals and scientists.

Per fleet, we then focused on existing links between the fishing trip activity indicator and others characterizing meteorological and market conditions. First, machine learning tools (decision trees, random forests,..) were used to describe and highlight some phenomenon. Then a model-based approach using bayesian networks was intended based on available historical data or other information using a collaborative approach.

In order to benefit from empirical knowledge (identify the elements to be taken into account and finally to share the diagnostics), fishermen were involved in the process. Identification of exposed and sensitive fleets aims to improve adaptation strategies for the fishing sector.

Overcoming Data Limitations in European hake (*Merluccius merluccius*) Modelling Spatio-Temporal Distributions

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Keywords: Inter-annual and seasonal distributions, life-stage environmental dependency, *Merluccius merluccius*, CPUE, and Oceanographic surveys

Abstract

In the Mediterranean Sea, the most common tools employed by fishery managers are effort reduction mechanisms and spatio-temporal closures. However, for many species, critical information on seasonal zones of aggregations by life-stage are missing. Efforts to rebuild collapsed stock biomass therefore pose a unique challenge in that spatial-temporal placement of individuals belonging to ontogenic stages between juvenile and adult are largely unknown, with larger individuals increasingly missing from standing populations. In order to identify spatio-temporal closures that benefit collapsed stocks more appropriately, we illustrate 1) how the use of commercial logbook, VMS, discard, and sales data can be used to extrapolate CPUE in order to identify zones of aggregation using binned length classes of hake (*Merluccius merluccius*) in the Gulf of Lion, 2) how resulting CPUE model strength can be assessed through direct comparison of CPUE obtained from oceanographic survey information (MEDITS), and 3) how CPUE binned length classes can be transformed into CPUE by age and sex to assess seasonal phenological phases via decomposition of annual, monthly, and seasonal Empirical Orthogonal Functions (EOFs). Seasonal distributions were validated through comparison of spatio-temporal distributions identified in an independent one-time seasonal direct sampling survey.

Effects of Fishing Gear on the Seabed of the East Channel and the Normand-Breton Gulf (English Channel)

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Keywords: fisheries; trawl; dredge; benthos; English Channel; sustainable fisheries

Abstract

The English Channel is a highly anthropized sea which suffers high fishing intensity for many decades. The IPREM project aimed to assess the impact of the trailing arts on the benthic habitats of this megatidal sea largely covered with sand and coarse sediments. The effects reflected physical structural and morphological modifications of the sediment such as the digging of furrows and the homogenization of the bottoms, and at the biological level by a mortality of the epifauna. The impacts depend on the penetration of the gear into the sediment, the extent of the area swept per fishing hour but also the repetition of the passage of the gear and the nature of the bottom. Impact indices calculated and mapped by fishing gear reveal that the impacts of the bottom otter trawl and seines are the highest, followed by beam trawls and dredges. The fact that the English Channel is a highly hydrodynamic sea confers a stronger resistance of benthic communities without significant temporal changes reflecting assemblages of species resistant to strong fishing pressure. In conclusion, fishing effort is undeniable but the quantification of its effects is still uncertain. Information is lacking on the reference state of habitats and the levels up to which benthic communities are resistant and resilient to fishing intensity. The thresholds beyond which ecosystems could suffer irreversible damage are not yet established. Filling the gaps will help guide the measures needed to reduce the impact are nevertheless necessary and must be supported on the basis of scientific works taking into account the interests and needs of fishing professionals.

Impact of Environment on English Channel squid (*Loligo spp.*) Recruitment Strength and Spatial Location

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Keywords: squid, *Loligo forbesii*, *Loligo vulgaris*, English Channel, fisheries, biomass indices, predictive model, hydro-climatic variables

Abstract

The highest squid landings in the Northeast Atlantic come from the English Channel, making it one of the most valuable resources exploited by demersal fisheries operating in this area. This resource consists of two short-life species (not distinguished by fishers): *Loligo forbesii* and *Loligo vulgaris* which differ in the timing of their life cycle. For *L. forbesii*, the recruitment peak occurs in July while for *L. vulgaris* recruitment peak occurs in October.

Abundance and distribution of cephalopod species, such as long-finned squids (*Loligo spp.*), depends on favorable environmental conditions. Those conditions are paramount for growth and successful recruitment. This study investigated the role of environmental variables (bottom temperature, salinity, current velocity, phosphate and chlorophyll concentrations) on recruitment biomass indices (in July for *L. forbesii* and October for *L. vulgaris*) computed from French bottom trawlers commercial data (2000-2021).

Two different models were obtained to forecast *L. vulgaris* and *L. forbesii* biomass indices during the recruitment. These models explain a high percentage of variation in biomass indices and can be used to forecast the abundance (in terms of biomass) and spatial distribution of the resource. Such forecasts are potentially useful tools to guide fishery managers although models fitted at the beginning of cohort exploitation will require season management procedures.

Dynamics of the Shrimp *Palaemon serratus* Populations in Normandy, France: From the Knowledge of its Biology to its Sustainable Fishery

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Keywords: shrimp dynamics, life cycle, recruitment, trophic regime, sustainable fishery

Abstract

The shrimp *Palaemon serratus* (Pennant, 1777) is a common species in Normandy rocky shores. Professional and recreative fishermen have developed several techniques to harvest this target species: landing net, trap and trawl. For two decades, the populations show high temporal fluctuations and tend to decrease. During the GeDuBouq project (2020-2023), four sites has been chosen to acquire data on the biology and dynamics of the species in Normandy. A two-year survey of the population at two sites (Grandcamp-Maisy and Blainville-sur-Mer) shows that the species reproduces during winter and spring with the presence of larvae at the end of spring; then the juveniles recruit in summer and rapidly grow to reach a total length of 5 cm (the minimum size authorized to fish) at the beginning of the autumn. The longevity is estimated to 2-5 years. At Blainville-sur-Mer, shrimps can be parasitised by bopyrid isopod, *Bopyrus squillarum* with a mean prevalence of 6% throughout the survey. Using isotopes and stomach contents at four sites (the two sites mentioned above plus Chausey and Antifer), an omnivorous regime has been identified with prey differences at Grandcamp-Maisy under estuarine conditions. Few professional vessels fish *P. serratus* in Normandy with a quantity of disembarkation reaching ~ 22 tons in 2020. Conversely, the quantity of harvesting by recreative fishermen remains unknowledge in spite of numerous fishermen in some Normandy spots. The results obtain in this study can help the French maritime administration to adapt the season of shrimp fish outside the period of ovigerous female presence.

Stock-Enhancement of the European Abalone: A Transdisciplinary Approach to Evaluate the Practical Feasibility

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Keywords: stock-enhancement, abalone, transdisciplinary approach, behaviour, genetic, pathology, ecology, economics

Abstract

Wild abalone stocks have significantly declined in France at the end of the 1990s following massive mortalities due to the pathogenic bacteria *Vibrio harveyi*. Stock enhancement, which consists in increasing or maintaining fisheries of wild populations, and re-introduction that aims at implanting juveniles in order to re-establish disappeared stocks, present opportunities to develop new management tools for more sustainable *Haliotis tuberculata* fisheries. The OURMEL project was thus carried out to develop innovative processes for the implantation of young abalone produced in hatcheries. The first objective was to reduce post-transfer mortality by evaluating predator responses and preimplantation stresses due to transport and handling. The second objective consisted at minimizing the impact of implantations on existing wild populations by checking the health status and genetic diversity of transplanted juveniles. The last part of the project aimed at describing biotic and abiotic parameters of favorable environments for *H. tuberculata*, to carry out implantation trials on a semi-commercial scale, and to evaluate the economic feasibility of abalone stock-enhancement programs. Even if great progress were made, there are still many barriers to removed such as the post-implantation survival rate. The stakeholders, including scientists and representatives of the socio-professional community, developed a responsible methodology based on the recommendations for marine stock enhancement programs (Blankenship and Leber, 1995).

Is Information about Fish Farming Sufficient for European Consumers?

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Keywords: fish farming, consumers, information

Abstract

Our research focus on awareness and information needs about fish farming for consumers. In Finland, France and Spain, a quantitative study by online survey (415 – 420 people per country) in 2021 was performed.

Consumers have a fairly low knowledge of fish farming: 47% say they know “a little” about fish, 33% say they do not know it at all, and the fraction declaring they know it “well” or “very well” is 14% in Finland, 20% in France, 24% in Spain.

The analysis of existing sources of information about fish farming shows important differences between countries, TV playing a prominent role in France and somewhat in Spain, while in Finland the sources are multiple. Most respondents stated that the received information is ‘neutral’, more frequently in Finland (59%) and Spain (46%), less in France (34%). The second qualification is “mostly positive” in Spain (23%) and Finland (18%), while it is “mostly negative” in France (25%).

The information available on fish farming is deemed insufficient by most respondents (Finland 54%, France 61%, Spain 60%). Most respondents consider receiving information about fish farming would be useful. The total ‘very useful’ and ‘useful’ is 84% in Spain, 70% in Finland, 67% in France. Needed information include many topics, with various levels of interest for these topics according to countries, as vary also the preferences of consumers for channels of information.

This research is part of the EU H2020 programme AquaIMPACT.

Intermediaries Toward Resilient Supply Chain of Fishery Products: The Case of Fish Wholesale Markets in Japan under the COVID-19 Pandemic

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Keywords: intermediaries; wholesale markets; time series analysis; pandemic; Japan

Abstract

In light of unforeseen supply and demand shocks, such as pandemics, comprehending the dynamics of trade volumes within the fishery sector becomes imperative to ensure a reliable food supply. However, previous studies have primarily concentrated on the edges of the supply chain and price formation research, leaving a gap in understanding the middle point of the supply chain and quantity trend. Therefore, this study aims to fill this gap by investigating the impacts of the COVID-19 pandemic on the arrival volumes of fishery products at the Tokyo Metropolitan Central Wholesale Market, a key intermediary market in the distribution network.

Employing an autoregressive integrated moving average (ARIMA) model, we analyze daily wholesale trade volume data for various fishery products to capture the change in arriving quantity during the pandemic. Our research not only highlights the specific impacts of the COVID-19 pandemic on incoming volumes but also examines the resilience of the wholesale market system in supporting a stable supply chain of fishery products despite unexpected supply and demand disruptions.

This study provides valuable insights for policymakers and stakeholders to enhance resilience of food supply chain and foster sustainable food security in the face of global uncertainties. By gaining a deeper understanding of the intermediaries of the supply chain of fishery products, this research contributes to a more comprehensive approach to addressing vulnerabilities of food supply chain.

History and Prospects of French-Japanese Collaboration and Friendship in Oyster Farming

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Keywords: oyster culture, oyster disease, seed oyster, tsunami, microscopes, plankton nets

Abstract

Oysters are an important fisheries resource for Japan and have cultured since the beginning in the *Jomon* period around 14000 BC to 3000 BC and now used as a winter ingredient in many dishes. In recent years, the culture of eating them in raw condition has spread. In France, oysters have been cultured in Roman times and were eaten raw. Today, they are an important ingredient of the Christmas feast.

In the 1960s, an oyster disease spread and caused devastating damage for their culture in France. In response, disease-resistant seed oysters were sent from Sanriku, Miyagi, Japan, to save French oyster farming from crisis.

Forty years later, oyster farming on the Sanriku coast of Japan was devastated by the tsunami. Oyster farmers and researchers on oyster farming from all over France provided farming materials and research equipment for collecting natural oyster spats such as microscopes and plankton nets, to save Sanriku oyster farming from the oyster farming crisis.

In the future, researchers and oyster farmers from both countries will hold exchange meetings to compare their techniques and continue their studies, with the aim of achieving sustainable resource management that reduces the ecological footprint.

Session F1: Exploitation of living resources – Necessity and constraints

**Session F2: Towards Sustainable Fisheries and Aquaculture
activities – MOU Ifremer-FRA: Coastal Ecosystem and Bivalve
Production**

Session F2

Amphitheatre Pierre Daure

Wednesday October, 25 2023 from 10.50 a.m to 4.00 p.m

**Session F2: Towards Sustainable Fisheries and Aquaculture
activities – MOU Ifremer-FRA: Coastal Ecosystem and Bivalve
Production**

**Introduction to Session 2 and Opening
Comments**

By Ichiro Nakayama – President Fisheries Research and Education Agency Japan.

Facilitators: Satoshi Watanabe (FRA) and Franck Lagarde (Ifremer)

**Session F2: Towards Sustainable Fisheries and Aquaculture
activities – MOU Ifremer-FRA: Coastal Ecosystem and Bivalve
Production**

Progress on the 1st MOU Between Ifremer and FRA: Challenges Toward Sustainable Oyster Aquaculture and Seagrass Management under Oligotrophication with Climate Change

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Keywords: Seto Inland sea, Mediterranean Lagoon, *Crassostrea gigas*, *Zostera marina*, warming, anoxia, natural spats collection, Nutrients, environmental DNA

Abstract

In the 1st MOU between Ifremer and FRA which was signed in 2015 to promote research in fisheries science and related technologies, research cooperation topic 1 entitled “Integrated coastal management and ecosystem” had targeted inland sea areas where recent oligotrophication with climate change was obvious. The oligotrophication has changed the coastal pelagic production and promoted the return of benthic macrophytes such as seagrass beds in shallow coastal areas. Therefore, we started research on coastal integrated management that combines oyster farming and seagrass beds, which is an important fishery using pelagic primary production and effective ecosystem foundation species, respectively. The French-Japanese project in the Seto Inland Sea/Hiroshima Bay and the Mediterranean Sea/Thau lagoon, where the effects of oligotrophication and climate change have become apparent, aimed to 1) evaluate oyster farming methods using seagrass beds that mitigate the effects of oligotrophication and climate change on the ambient environment, oysters, and the local communities, 2) clarify the feeding environment of oyster larvae and establish natural spats collection, and 3) understand environmental microflora and phytoplankton fauna under oligotrophication, using environmental DNA and metabarcoding. The results of project were able to make meaningful outputs, so oyster farming using natural spats and blue carbon functions in eelgrass beds are conducting in both the Thau lagoon and Japan, respectively.

**Session F2: Towards Sustainable Fisheries and Aquaculture
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Production**

Recent Trends in Oyster Aquaculture in Japan and Sustainability Research

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Keywords: Consumer demand, Local Ecological Knowledge, Oyster shucking, Production system, Seed production, Sustainability

Abstract

Japan is a major producer of oysters, and the fourth-largest producer globally in 2019. However, oyster production in Japan has experienced a downward trend over the past 20 years. Japanese oyster aquaculture uses natural seeds and the instability of seed production has become a subject of concern. Additionally, shucked oyster (oyster meat) is a major export of Japan, for which oyster farms are required to employ part-time workers to remove the shells from the oysters. However, the demand for shucked oysters has declined in recent years, and local oyster producers are finding it difficult to secure workers for shucking due to a shortage of labor. These factors are threatening the existing business model. The production of unshelled oyster is an attractive measure for dealing with these threats and to take advantage of the opportunity presented by a diversification of domestic consumers' diets and the government's promotion of exports. To address these industrial needs, Japan Fisheries Research & Education Agency, in collaboration with local research institutes, has initiated research projects, including the development of low-cost seed production technology for unshelled oysters, a production system of unspawned oysters destined for oyster bars, and an analysis of domestic consumers' preferences for unshelled oysters. Changes in the production environment and outbreaks of oyster diseases due to climate change are other threats to the sustainability of oyster aquaculture. Research that combines scientific knowledge with oyster farmers' knowledge on local ecosystem can aid in responding to rapid environmental change.

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Northward Expansion of the Paramyxean Ovarian Parasite *Marteilioides chungmuensis* in the Pacific Oyster in Japan

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Keywords: Pacific oysters *Crassostrea gigas*, Parasitic protozoan, Spat, *Marteilioides chungmuensis*, Culture.

Abstract

Pacific oysters *Crassostrea gigas* infected with an ovarian protozoan parasite *Marteilioides chungmuensis* often develop nodule-like ovaries, resulting in loss of marketability due to the unesthetic appearance. Outbreaks of this disease were limited in oyster farms in south-western Japan, but new occurrence has been recognized in Hokkaido the northernmost Japan since 2021. An epidemiology survey conducted in Hokkaido revealed that infection was limited in oysters grown from wild spats brought from Miyagi, and oysters grown from the local hatchery spats were not infected. Infection have never been reported in Miyagi, but these results suggested that the parasite are already present in Miyagi. Since Miyagi is the second largest oyster culture area and the most important spat supply area in Japan, it is urgently required to understand how the parasite invaded and established population in this area. Fortunately, the survey showed that infection of the parasite has not expanded to local oysters in Hokkaido. This is probably because the parasite may not be able to complete its life cycle in cold water area in Hokkaido, but the possibility cannot be ruled out that the parasite may in future establish population in this area due to climate changes.

**Session F2: Towards Sustainable Fisheries and Aquaculture
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Long-Term Changes in a Coastal Social-Ecological System supporting Shellfish Farming (Thau lagoon, France): Highlighting Regime Shifts and Their perception by Inhabitants

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Keywords: social-ecological system; regime shifts; timelines; trajectory; ecosystem services; shellfish farming; social perception.

Abstract

Coastal ecosystems provide a wide range of services to society, but they are subject to many stressors threatening their sustainability. To achieve resilience, coastal social-ecological systems (SES) require adaptive management based on integrated interdisciplinary approaches to understand: (1) SES dynamics, i.e., the ecological and social changes that comprise regime shifts, (2) and the perception of these changes by inhabitants.

For the purpose of analyzing long-term ecological and social changes, we propose an original methodology combining a chronosystemic timeline approach and time series analyses based on indicators from the “Drivers-Pressures-State-Impacts-Responses” framework and ecosystem services (ES) evaluations. This methodology was applied over a 5-decades period (1970-2018) on the Thau lagoon (Mediterranean Sea), where managers clearly prioritize traditional activities of shellfish farming and fishing. Inhabitants’ perception of changes in ES were investigated with a specific survey (n=476 respondents) and were then compared with the results of scientists’ and experts’ evaluations of ES.

We showed that the dynamic of the SES was driven by a succession of interactions between sanitary or ecological crises and management adaptations, and allowed to the identification of regime shifts between three contrasting periods. The perception survey showed that local residents had a fairly sound knowledge of the long-term changes in ES, but evidenced some inconsistency regarding shellfish production, biodiversity and regulation of water nutrient abundance. This interdisciplinary approach will help identify the conditions required for identifying the regime shifts and increasing the resilience of coastal SES and help stakeholders to face new challenges related to global climate change.

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New Challenges for Clam Resource Recovery in France and Japan under the Second MOU Between Ifremer and FRA

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Keywords: Manila clam, *Ruditapes philippinarum*, Palourde clam, *Ruditapes decussatus*, coastal environment, population decline, spat collection

Abstract

Ruditapes philippinarum (Manila clam) is indigenous to East Asia, and it is one of important fisheries resources in Japan. It was accidentally introduced from Japan to the Pacific Coast of the United States with Pacific oyster spats for aquaculture purpose more than 100 years ago. It was further introduced from the U.S. to European countries such as France, Italy, Portugal, and England, partially as a substitute for the dwindled indigenous *Ruditapes decussatus* (grooved carpet shell or Palourde clam). Fisheries production of *R. philippinarum* is on a decreasing trend in many of these countries, especially Japan. National fisheries production of *R. philippinarum* in Japan peaked at 169,621 t in 1983 and has been on a continuous and drastic decreasing trend (4,916 t in 2021). Causes of the decline and possible countermeasures have been investigated and discussed in the Manila clam study group consisting of Japan Fisheries Research and Education Agency (FRA) and Prefectural government researchers in Japan over the past decades. *Ruditapes* spp fishery production is also decreasing in France, particularly in Mediterranean Thau lagoon, where the indigenous population collapse is underway. As part of a collaborative study under the second Memorandum Of Understanding signed between Ifremer and FRA in 2022, we are planning to exchange knowledge and technology obtained in both countries to prove into the problems associated with the decline of *Ruditapes* spp and to make diagnoses to help future ecological restoration by environmental and resources managers.

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Mediterranean Oyster Farming on the Road to Sustainability: Regionalized Spat Collection in Lagoons as a Climate Change Adaptation Solution

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Keywords: Oyster Aquaculture, Larval Development, Mediterranean Lagoon, Oligotrophication, Global Change, Heatwave.

Abstract

The effects of environmental changes are particularly noticeable in the Mediterranean lagoons where ecosystems present multiple uses: shellfish farming, fishing and tourism. Following the mortality crisis observed in the Pacific oyster juveniles in France in 2008, the local oyster industry responded by improving its autonomy in spat supply. Scientific observations gathered over the last ten years have made it possible to lay the foundations of the ecological functioning of larval development in the Thau lagoon, defining main ecological drivers and environmental factors. However, the oligotrophication but also the temperature increases and the modifications of rainfall regime related to global changes, unfold a changing hydroclimatic landscape.

Using contrasted hydroclimatic years, our work has highlighted the factors favorable or unfavorable for *C. gigas* recruitment. Hydrodynamic connectivity and abundances of nanophytoplankton and diatoms such as *Chaetoceros spp* contribute positively to create favorable environmental windows to recruitment, in contrast to high biomasses of picophytoplankton, *i.e.* cyanobacteria, picoeukaryotes, flagellates and ciliates. Nanophytoplankton seems to be a crucial factor in the larval cycle of *C. gigas*, but climatic hazards such as heat waves and heavy annual rains alter its ecological functioning. This type of scenario favors picoplankton and competitors of oysters, the picoplanktonophagous tubeworm *Ficopomatus enigmatus*, which completely alters spat development. Despite these difficulties, the local oyster industry relies on this resource for its zootechnical and economic advantages. The native oysters show better survival qualities to the OsHV1- μ var and provide an opportunity to test adaptation to climate change (potential resistance to higher temperatures and salinities).

**Session F2: Towards Sustainable Fisheries and Aquaculture
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Phytoplankton Community Structure and Dynamics Affecting Bivalve Recruitment in Hiroshima Bay, Japan

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Keywords: *Cyclotella* spp., Food for Larvae, Metabarcoding analysis

Abstract

Hiroshima Bay is the largest farming area for Pacific oyster in Japan. Oyster farmers in this bay use spats collected in the wild for the farming. Spat collection is a key process for sustainable farming, but availability of settling larvae is often low in this bay. Lack of food was thought to be one of the causes for the low oyster larvae availability, but there was no scientific evidence. In order to clarify the relationship between quantity (biomass) and quality (species composition) of <10 µm phytoplankton, a potential food for larvae, and success or failure of larval settlement, we conducted field observation from 2018 to 2020. The results showed that successful larval settlement was achieved when D-shaped larvae was exposed to chlorophyll *a* concentration of <10 µm phytoplankton greater than 5 µg L⁻¹. Metabarcoding analysis of <10 µm phytoplankton also indicated that increase in diatom *Cyclotella* spp. in sea water led to a successful larval settlement. Recently, we established culture strains of three *Cyclotella* species and examined the effect of temperature on their vegetative growth in the laboratory. A suitable temperature range for vegetative growth of each *Cyclotella* species was found to be 25-30°C, which corresponded well with the water temperature when *Cyclotella* was dominant in the field. Since 2021, we have searched for diatoms as food for clam larvae in the Hiroshima Bay. The results will be also presented on the day.

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***In situ* Trophic Ecology of Benthic Marine Suspension Feeders**

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Keywords: Flat oyster reefs; gut content analysis; feces analysis; metabarcoding; 18S rRNA; 23S rRNA

Abstract

Food sources and their acquisition by suspension feeders have long been studied, as they are key to the success of exploited species (e.g., recruitment, growth) and to the structuring of natural communities. Several methods are frequently used, like direct observation of digestive tissues/faeces, stable isotopes or lipids (fatty acids, sterols), with some limits on prey identification and taxonomic resolution. Suspension feeders are very plastic but food sources mainly rely on phytoplankton and resuspended phytobenthos with a relative preference for diatoms. In recent years, the use of molecular methods (metabarcoding) has grown considerably, allowing a better capacity to identify degraded preys and a better taxonomic resolution, enhanced by ongoing improvements in sequencing techniques, helping to reduce costs. Temporal match between observation of preys in seawater and in predators is also improved because only depending on digestion time. However, their application to benthic marine suspension feeders is still limited (about 10 publications) and several technical steps remain critical. In 2023, we conducted a first experiment on a natural benthic community associated to reef structures formed by flat oysters, *Ostrea edulis*. The first objective was to solve technical aspects (e.g., quality of DNA extraction and amplification, choice of primers and molecular markers). A second objective was to investigate trophic ecology and food sharing among the community formed by the flat oyster and three other species: the variegated scallop (*Mimachlamys varia*), the red tubeworm (*Serpula vermicularis*) and the long-clawed porcelain crab (*Pisidia longicornis*).

**Session F2: Towards Sustainable Fisheries and Aquaculture
activities – MOU Ifremer-FRA: Coastal Ecosystem and Bivalve
Production**

Increasing Biological Knowledge of the *R. philippinarum* Population from Arcachon Bay (SW France) For a Better Sustainable Management.

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Keywords: biological traits; Manila clam; regional regulation; Bivalves

Abstract

Initially introduced for aquaculture purposes in the 70's on French territory, Manila clam (*Ruditapes philippinarum*) is now a neofaunal and economically important resource for professional fishermen within Arcachon Bay (SW of France). In recent years, its exploitation represents around 200-300 tons per year, involving around 40 licenses (related to enterprises) with an estimated value of just over one million euros. To manage this resource, a collaborative process associating scientists and professional fishermen has been implemented since 2003. It includes several actions such as co-organized monitoring surveys, research programs and working groups. The present work reviews the biological in-depth knowledge acquired throughout the years about this population. It allows for a better understanding of the population's dynamics in the Arcachon Bay. Biological characteristics include reproduction (cycle temporality and maturity), growth (linear growth and morphological patterns), mortality and physiological status (including diseases).

In Arcachon Bay, the reproductive cycle (number of spawning events and period) and maturity (size at first sexual maturity – SL_{50}) of Manila clam are similar to those described from other sites in France. However, this local population displays particular growth patterns. The linear growth slows down after about 30 millimeters. Clams are also less elongated and more globular than those from other sites in Europe, suggesting the poor physiological health of some individuals. Some specificities can be related to environmental conditions and are detailed.

Such biological knowledge is a prerequisite to ensure appropriate resource management based notably on conservation measures as for example the Minimum Conservation Reference Size.

**Session F2: Towards Sustainable Fisheries and Aquaculture
activities – MOU Ifremer-FRA: Coastal Ecosystem and Bivalve
Production**

Multidisciplinary Approach of the Population Dynamics of the Non-Indigenous Species the Mamilla Clam *Ruditapes philippinarum* Along the Western Coast of Cotentin (Normandy, France)

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Keywords: larval dispersion, recruitment, clam displacements, sustainable fisheries,

Abstract

Since its introduction in the 1970' in Chausey (western English Channel), the Mamilla clam *Ruditapes philippinarum* shows an important population increase along the western coast of Cotentin. A distribution mapping in 2015 highlighted the presence of four main patches of abundance representing 10% of the intertidal zone. Yearly count of recreational fishermen estimates the presence of 6,000 fishermen per day (all activities) during spring tide with an estimate of clam catches of 120 t against 8 t by professional fishermen. To identify the origin of such clam population, several hypotheses have been tested to identify the larval source, the larval dispersion and the recruitment sectors within a hydrodynamic MARS 3 D model simulating the hydrodynamic of the area. Then the Ichthyop code is used to simulate the dispersal of clam larvae after a month of planktonic life, with different wind directions, during the June-July period. A part of the larvae which is transported offshore, numerous larvae participate to the recruitment of clams of the western coast of Cotentin population. This explains the maintaining of important clam stocks in spite of annual harvesting mainly by raking the sediment habitat. Moreover, several experiments (2014-2018) show that about 20% of clams show moderated local displacements which can participate to colonise the harvesting areas. The raking harvesting could also contribute to the clam displacement in removing sediment and clams in large area. All these features are favourable to maintain a sustainable fishery in this area with low abundance but in a large intertidal zone.

**Session F2: Towards Sustainable Fisheries and Aquaculture
activities – MOU Ifremer-FRA: Coastal Ecosystem and Bivalve
Production**

**Session F2: Towards Sustainable Fisheries and Aquaculture
activities – MOU Ifremer-FRA: Coastal Ecosystem and Bivalve
Production**

**Session F3: Coastal Fisheries and Emerging Activities: The Case of
Marine Wind Farms.**

Session F3

Amphitheatre Pierre Daure

*Wednesday October, 25 2023 from 4.00 p.m. to 5.10 p.m. and Thursday October, 26 2023
from 8.30 a.m to 10.30 a.m.*

Session F3: Coastal Fisheries and Emerging Activities: The Case of Marine Wind Farms.

EDF Renewables' Offshore Wind Development Perspectives in Japan

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Keywords: Offshore wind, floating offshore wind, Japan, renewable energy, responsibility, fisheries

Abstract

EDF Renewables is an international energy company which develops, builds and operates renewable power generation plants. As a major player in the energy transition worldwide, EDF Renewables deploys, within EDF, competitive, responsible and value-creating projects. In every country, our teams show their commitment to local stakeholders every day, adding their expertise and capacity for innovation to the fight against climate change.

Established in June 2022, EDF Renewables Japan K.K.'s team is composed of a team of experts in offshore wind, willing to support Japan's goals in terms of renewable energy, and more specifically in offshore wind power with a 10 GW objective for 2030 and 30 to 45 GW in 2040.

In Japan, EDF Renewables is willing to develop floating offshore wind projects. The company has been developing offshore wind projects for more than 10 years. It has established in more than 20 countries, and developed offshore wind projects in 11 of them. Also, EDF Renewables is currently building one of the first floating offshore wind project in the world, using Tensions Leg Platform technology for the first time: Provence-Grand-Large.

Developing competitive, responsible and value-creating projects is EDF Renewables' DNA. We are a long term-player, committed to working very closely with maritime actors and protecting biodiversity. Consultation with fisheries and boating start from the very beginning of our projects. Among our project, the Calvados offshore wind farm is the 2nd offshore wind farm under construction in Normandy, and one of the first 4 in France. It comprises 64 offshore wind turbines with a total output of around 450 megawatts. Protection of the environment is at the center of the project.

Session F3: Coastal Fisheries and Emerging Activities: The Case of Marine Wind Farms.

Regulatory and Planning Aspects of Wind Energy Projects

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Keywords: Offshore wind, marine spatial planning, cumulative impacts, governance, France

Abstract

Over the past decade, the French government has carried out a political strategy to develop offshore wind energy sector. This strategy has been reinforced by the acceleration of the planning of offshore wind farms (OWF), with a target of 2GW allocated per year from 2025 to reach 18GW commissioned by 2035. With the envisioned acceleration of OWF sector in France, a growing concern is emerging on the potential cumulative impacts of OWF development on the environmental and socio-economic systems with a need to assess these potential impacts at different scales, from local (OWF) to regional (maritime façade). Various regulatory instruments compel OWF developers to include the cumulative impact assessment in their environmental impact assessment (EIA). But how does the regional scale deal with this issue, considering the important role of this scale in defining future OW acceleration areas? The main objective of this communication is to draw up the functioning of French governance of maritime activities through the prism of maritime spatial planning. From the analysis of the implementation of two main EU Directives (i.e. MSFD and MSP), and French national experts' recommendations on the assessment of cumulative impacts at sea, the results of this study provide a clearer understanding of both regulatory and operational issues related to the prioritization of socio-economic and environmental objectives in a context of energy transition at sea. In the current work, a focus has been made on the case study of the English Channel and southern North Sea French administrative façade.

Session F3: Coastal Fisheries and Emerging Activities: The Case of Marine Wind Farms.

Evolution of the Coastline and Extraction of Marine Aggregates: A Review of Current Knowledge and Practices in France.

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Keywords: Marine aggregates; exploitation; erosion of coastline

Abstract

Metropolitan France has large resources of marine aggregates, which are now exploited in addition to terrestrial aggregates. Such projects nevertheless generate concerns among French civil society and the exploitation of this resource is felt to be one of the causes of the coastal erosion in France.

These phenomena of erosion of the coastline are increasingly followed by the local populations who see coastal urbanization, strongly developed as close as possible to the sea, threatened with each storm: the sedimentary stocks no longer seem to be sufficient to replenish beaches and protect coastal issues.

However, the exploitation of marine aggregates in France is subject to strict and supervised regulations with which the profession has complied and adapted as it evolves. Recently, the National Union of Aggregates Producers (UNPG), through its marine aggregates commission, wished to make available to all a scientific, technical and educational document, assessing the possible links between the extraction of marine aggregates and evolution of the coastline. To do so, the UNPG has entrusted Artelia and Cerema with the task of drafting this study, which summarizes scientific knowledge on the various hydrosedimentary processes that can have an impact and presents feedback on the North Sea, Channel and Atlantic coasts on which concessions are in operation.

The communication will summarize the content of this study and its main conclusions, with particular emphasis on the methodology implemented to avoid any impact on the coastline (Sequence: Avoid-Reduce-Compensate).

Session F3: Coastal Fisheries and Emerging Activities: The Case of Marine Wind Farms.

The GIS ECUME: A Multidisciplinary Consortium to Assess Cumulated Impacts of Human Activities in the English Channel

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Keywords: human activities, cumulative effects, coastal waters, sustainable development

Abstract

With ecosystems worldwide being increasingly exposed to a multitude of human activities, assessing the cumulative impacts of anthropogenic activities has become an emerging challenge in terms of both environmental regulation and scientific research.

The Scientific Interest Group GIS ECUME (“Groupement d’Intérêt Scientifique Effets Cumulés en Mer”) was constituted in November 2020 with the objective to develop a scientific approach and methodology for assessing the cumulated impacts of human activities in Normandy, one of the most anthropized zones in the world (marine aggregates, marine renewable energies, submarine cables, harbour dredging and deposition of dredged sediments, fishing activities and notably trawling).

The group’s scientific priorities are to assess the cumulative impact of these activities on hydro-sedimentary dynamics, underwater noise, as well as the artificial reef effect of submerged structures and the social acceptability of human activities at sea. Coordinated by Caen University, the group assembles the main academic research institutions (Universities of Caen, Rouen and Le Havre) and project holders (UNICEM, CRPMEM, RTE, HAROPA PORT, Ports de Normandie, EODC, EOHF) with regard to the above-mentioned human activities at a regional scale.

By promoting a close interaction between professionals and researchers, GIS ECUME facilitates the establishment of research projects as close as possible to the activities, which has led to the launch of the first research projects on the sedimentary interactions of marine aggregates extractions and the deposition of dredged sediments in the Seine Bay, as well as on the acoustic impact of human activities at sea on fisheries resources.

Session F3: Coastal Fisheries and Emerging Activities: The Case of Marine Wind Farms.

Contributing to Scientific Knowledge in the Context of an Industrial Project: the Éolien en Mer SIG

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Keywords: offshore wind, marine environment, impact assessment, collaboration

Abstract

The authorizations of construction of Dieppe Le Tréport offshore windfarm include a commitment to set up a Scientific Interest Grouping (SIG).

The Éolien en Mer SIG, launched in February 2020, is made up of 26 partners, including universities, public institutions, associations and private companies. It is composed of a Scientific Council and a Steering Comity and has its own dedicated budget.

Its main objectives are to review the mandatory environmental monitoring of the windfarm, to improve knowledge of the Eastern Channel with environmental and socio-economic studies and to disseminate the results.

In 2020, members of the SIG evaluated the protocols of the environmental reference state of the windfarm and will review the results in 2023.

The SIG follows a specific process to decide studies to finance. The subjects of interest are identified by the Scientific Council. Workshops are organized with national experts to define key objectives, innovative aspects, avoid redundancy with other projects and determine meaningful scale. Calls for tender are then launched, or a targeted set-up of the study is done if only few people work on the subject.

Before construction, the studies and partnerships focus mainly on top predators, defining long term methods using environmental DNA and prediction of the ecosystems through food webs model. During construction, socio-economic and underwater noise impacts will also be investigated.

The Éolien en Mer SIG appears as an innovative way for public and private cooperation and continues exchanges with different organizations to improve knowledge on the impact of offshore windfarms.

Session F3: Coastal Fisheries and Emerging Activities: The Case of Marine Wind Farms.

Co-Existence of Offshore Wind and Other Users of the Sea: 20 Years of Learning what to do (and not do!)

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Keywords: co-existence, best practices, conflict management, offshore wind

Abstract

For the past 20 years, RWE has developed, constructed and operated offshore wind projects, with a total installed capacity of 3.3GW across 19 windfarms in the UK, Germany, Belgium, Sweden and Denmark, and almost 18GW in development across Europe, the US and Asia Pacific.

The experience gained through these projects have enabled RWE to develop and implement best practices for managing conflicts and enhancing co-existence of activities, notably fishing. This paper aims to share these best practices, by focusing on examples from multiple geographies at different phases of project development, including:

- Negotiating fishing cooperation agreements to manage fishing operations during construction and operation of the Rampion windfarm;
- Adaptive scheduling of construction activities for the Rampion windfarm to protect spawning of key commercial fish species, from increased underwater noise;
- Developing a reskilling program with the Baltic II windfarm for volunteer fishermen to validate competences to work in the offshore wind industry;
- Contributing to maintaining healthy fish and shellfish stocks through the funding of a wild lobster hatchery through our Sofia windfarm to support the local fishing industry and raise awareness on marine protection.

Commissioning of a pilot-scale multi-use platform at our Karehamn operating windfarm to support aquaculture activities for blue mussels and seaweed and monitor the potential multi-user conflicts arising from this pilot installation.

This paper also present RWE's views on remaining and upcoming challenges associated with predicted sector growth, in particular floating wind; and the opportunity for multistakeholder cooperation to transition to fully integrated co-usage solutions.

Session F3: Coastal Fisheries and Emerging Activities: The Case of Marine Wind Farms.

Ecosystem services spatially linked to environmental and socio-economic stakes in the context of offshore wind farm development.

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Keywords: Marine planning; offshore wind farms; ecosystem services mapping; co-uses.

Abstract

By modifying ecosystems, landscapes and the spatialization of human activities, offshore wind farms act as a major changing factor of coastal socio-ecosystems. As new fixed infrastructures in a perpetually dynamic environment, offshore wind turbines also pose serious maritime planning challenges. These issues raise questions: how can the development of offshore wind energy be reconciled with the maintenance of existing human activities? How can the impact of offshore wind farms on socio-ecosystems be spatialised, and at what scale(s)?

In response, we hypothesize that the concept of ecosystem services is an interdisciplinary tool that helps to spatialise the issues at stake in the context of offshore wind energy. The aim of this contribution is therefore to propose a theoretical mapping of the impacts of offshore wind farms on ecosystem services. The approach is based on a literature review, field surveys and working groups with researchers from different disciplines to specify the supply and demand areas of various ecosystem services. On this basis, spatial changes related to offshore wind farm development are examined in two study areas in France (“Banc de Guérande” and “Calvados” projects). The comparative analysis highlights how offshore wind energy is reshaping users' relationships with the sea and revealing the specific local features of the studied offshore wind socio-ecosystems. Such an approach illustrates the importance of integrated maritime planning of offshore wind farms that consider the “multi-services”, the multi-scales of analysis and consider all the ecosystem and societal processes that link offshore wind farms to society.

Session F3: Coastal Fisheries and Emerging Activities: The Case of Marine Wind Farms.

How to Reflect Local Voice in Offshore Wind Energy Projects

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Keywords: Offshore wind energy, local stakeholder, legal counsel, participation, social aspect

Abstract

Since the enactment of “Act on Promoting the Utilization of Sea Areas for the Development of Marine Renewable Energy Power Generation Facilities” in 2019, the planning of offshore wind power projects has been started in Japan. The legal councils established in each region depend on the act are expected to play an important role in reflecting regional intentions in the selection and detailed design of offshore wind power projects. It is important for the mayors who participate as regional representatives to gather the voices of the local communities. However, there is no sufficient discussion on what kind of management method is appropriate. In this study, we will organize the speakers, the number of times they comment, and the content of their comments (environmental, social, and economic impacts) in the minutes of the legal councils held to date, and then ascertain the extent to which the content was reflected in the specifications for selecting the project developer. Furthermore, interviews will be conducted with the participants of the legal councils to evaluate the validity of the results of the analysis of the minutes of the meeting. The results of these analyses will provide insight into how the legal councils should be managed.

Session F3: Coastal Fisheries and Emerging Activities: The Case of Marine Wind Farms.

Interdisciplinarity and Coastal Management: Innovations also Originate From Unconventional Approaches.

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Keywords: interdisciplinarity, wave energy, octopus farming, digital twin, fisheries management

Abstract

Research and development in relation to coastal management are primarily conducted by well recognized academic institutions and other organizations, publicly and/or privately funded. This a highly interdisciplinary, multiscale, field of investigation and implementation, and perhaps not surprisingly, sources of inspirations or practical developments can originate from research disciplines, sometimes “blue sky research”, or institutions that are not readily associated with coastal management.

Several examples are given illustrating how researchers in unrelated fields can contribute to knowledge in coastal management, energy generation, coral preservation, or aquaculture either serendipitously or as a deliberate intent to extend their research work applications by personal or institutional motivation.

No effort can be spared to better understand coastal ecosystems and their dynamic of evolution, considering the acuity, the sheer complexity and the huge stakes involved. Actively browsing across different disciplines and different “levels” of research is part of this effort, as well as reaching out to, and interacting with researchers not readily associated with coastal management.

**Session F3: Coastal Fisheries and Emerging Activities: The Case of
Marine Wind Farms.**

**Session F4: The Satoumi Concept and the Management of
Commons: An Integrated Approach, a link between Land and Sea
and between Nature and Culture
Session co-organized by EMECS and SFJO**

Session F4

Amphitheatre Pierre Daure

Thursday October, 26 2023 from 10.50 a.m. to 5.10 p.m.

**Session F4: The Satoumi Concept and the Management of
Commons: An Integrated Approach, a link between Land and Sea
and between Nature and Culture**

Session co-organized by EMECS and SFJO

Opening Remarks

By O. Matsuda (EMECS) and Y. Henocque (SFJO France)

**Session F4: The Satoumi Concept and the Management of
Commons: An Integrated Approach, a link between Land and Sea
and between Nature and Culture**

Session co-organized by EMECS and SFJO

Sustainable Development Goal 14 as a Local Integrated Management Tool

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Keywords: SDG14, interactions between human and marine resources, global commons

Abstract

SDG 14 – Life Below Water – focuses on conserving and sustainably using the oceans, seas and marine resources, including coastal zones at the land-sea interface, for sustainable development. This goal draws attention to human interactions with these resources, especially in coastal cities and territories. Local and regional governments have a key role to play in approaching marine life, particularly with regard to the impact of urban growth and of solid and liquid waste discharges into coastal areas and the oceans. They have adopted policies, plans, incentives and strategies to protect the global commons. More specifically, they are responsible for a series of actions that address at least five of the SDG 14 targets, which are : 14.1 (Marine pollution), 14.2 (Management, protection and restoration), 14.5 (Conservation), 14.7 (Small Island States and Low Developed Countries), and 14.b (Small-scale fishing). As the effects of human activities and urbanization transcend city boundaries, special attention is also paid to the policies implemented by regional governments, intermediary cities and small towns to apply territorial approaches to ecosystem conservation.

**Session F4: The Satoumi Concept and the Management of
Commons: An Integrated Approach, a link between Land and Sea
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Session co-organized by EMECS and SFJO
Coral Reef Satoumi in Okinawa, Japan

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Keywords: Okinawa, Red-soil pollution, Coral culture, Mozuku seaweed, Consumer coops

Abstract

Onna Village is located on the northern west coast of Okinawa Island, the most southern part of Japan. The population is about 10,000, but 2.8 million tourists visit the village attracted by the beautiful sea including coral reefs. One of the most serious environmental problems in Okinawa is “red-soil pollution” from the land, affecting fisheries, aquaculture, and tourism. The fishers in Onna Village are monitoring the pollution by themselves, by measuring the red-soil in the sea floor sediment not the unstable red-soil in the water. Onna Village Government developed the prior consultation system, which has worked very well, to prevent the pollution. The fishers devised an innovative coral culture technique. A seaweed-processing company and 28 consumer coops throughout the country collaborated with the fisheries cooperative to culture 24,000 corals by 2015 (now more than 40,000). If a member of the consumer coops buys a pack of Mozuku seaweed, the main product there, one to two yen would go to the Mozuku Fund in the fisheries cooperative. By 2015 the money of over 10 million packs had gone to the Fund and was used for culturing the corals. The 24,000 corals were estimated to provide 2.8 billion coral larvae to the surrounding water and to be inhabited by 670,000 diverse fish, increasing the biodiversity. Also, some portions of the cultured corals were used for outplanting in the surrounding water. By 2016, 120,000 corals were planted in a 3-ha area. This was the first coral planting of this scale in the world.

**Session F4: The Satoumi Concept and the Management of
Commons: An Integrated Approach, a link between Land and Sea
and between Nature and Culture**

Session co-organized by EMECS and SFJO

Restoring the European eel (*Anguilla anguilla*) and its Habitats in France: a Social, Economic and Environmental Dynamic Similar to the Sato-umi concept

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Keywords: European eel, *Anguilla anguilla*, climate change, participatory science, Sato-umi.

Abstract

Since the late 1970s, the European eel has seen its population decline sharply throughout its range. Classified on the IUCN Red List of Threatened Species and in Appendix II of CITES, the species is struggling to recover despite the introduction of a Europe-wide management plan (Eel Regulation 1100/2007), as a result of insufficient consideration of all the pressure factors affecting the species and its functional habitats.

In the context of climate change, which will be marked by an increasing scarcity of water resources, how will the future of this species affect interests considered to be priorities: agriculture, drinking water needs, tourism?

To preserve this species in a non-residual state, we need to put in place a management and restoration policy for the species and its habitats that makes better use of the knowledge and know-how of the communities that live off its exploitation.

Concrete examples show the contribution of professional fishing communities at local and regional levels in assessing eel populations, evaluating the impact of predator species and in transferring eel populations at different stages of their development.

This participatory dynamic of local and regional professional fishing communities is similar to the Sato-umi concept in Japan, which aims to reconnect human communities with Nature with a view to sustainable exploitation, restoration and conservation of the goods and services provided.

Session F4: The Satoumi Concept and the Management of Commons: An Integrated Approach, a link between Land and Sea and between Nature and Culture

Session co-organized by EMECS and SFJO

Satoumi Created by Eelgrass Beds and Oyster Farming

Author: Takehiro Tanaka

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Keywords: eelgrass, oyster, Satoumi, Satoyama, diverse actors

Abstract

Research on eelgrass beds in Japan began with the "Fish Growth Survey in Eelgrass beds" conducted by the Okayama Prefectural Fisheries Experiment Station from 1922 to 1925. Eelgrass beds are known to be the "cradle of the sea" with many roles and functions, such as promoting material cycle, suppressing water temperature rise, supplying dissolved oxygen, absorbing nutrients, and absorbing and accumulating carbon dioxide. Eelgrass beds and oyster farming have a symbiotic relationship. Oyster shells nurture eelgrass beds, which in turn nurture oysters. In the Hinase area of Okayama Prefecture, there were approximately 590ha of eelgrass beds until the 1950s, but by the 1980s the area had plummeted to about 12ha. Fishermen in the Hinase area began planting eelgrass seeds in 1985, and through various efforts, the area has recovered to over 250ha by 2015. Environmental factors related to eelgrass vegetation include water temperature, salinity, ground surface, light flux transmission, waves and currents, bottom sediment, and seafloor migration. Important elemental technologies leading to large-scale eelgrass bed restoration include "Technical guideline on the Zostera bed construction" and "Guidelines for the Effective Use of Oyster Shells." Today, not only fishermen, but also children, urban residents, people living in Satoyama, people engaged in agriculture, and various other stakeholders inside and outside the community find value in interrelationships centering on fishermen, and are joining forces to protect the local sea, transcending regions, generations, and positions. Hinase Town's "Satoumi creation" will serve as a model for what coastal zone management should look like in the future.

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Challenges to Sustain Traditional Recreational Clam Picking “SHIOHIGARI” in Japan: Transition of Social-Ecological Systems over 100 Years

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Keywords: wild clam catch, reclamation, shellfish toxin, seafood safety, fisheries cooperatives

Abstract

As is appeared in the Ukiyo-e drawings during the latter Edo period around 1850's, recreational clam picking called SHIOHIGARI has been a popular activity along shorelines which can be enjoyed from adults to children in Japan. However, the SHIOHIGARI faces a crisis of its succeeding to next generation. This study aims at clarifying causes of the crisis through analyzing transition of social-ecological systems surrounding the “SHIOHIGARI” with focus on clam picking parks along Osaka Bay. Research methods were: (i) analyses of statistical data over 100 years on wild clam catch, (ii) interviews to fisheries cooperatives operating clam-picking parks, and (iii) analyses of newspaper articles on SHIOHIGARI over 100 years. Major findings are: (i) wild clam catch of Osaka prefecture rapidly decrease during 1950's, 30-year precedent to its decrease throughout Japan, (ii) due to reclamation around 1970's, fisheries cooperatives had to abandon natural tidal flats where they had operated recreational clam picking parks, (iii) because of frequent detection of shellfish toxin surpassing regulatory limit since 2002 along Osaka prefecture, some fisheries cooperatives operating recreational clam picking parks had to close the parks to prevent shellfish poisoning cases, and (iv) based on newspaper articles, the SHIOHIGARI these days are mainly for coastal environmental education for children, whereas the SHIOHIGARI around 1900's was more like a big spring festival enjoyed by both adults and children. As above, variety of social and environmental change has influenced the SHIOHIGARI, which has cumulatively made it difficult to sustain.

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Education of Fishermen and Marine Fish Farmers in France: The Need for Change in the Face of Ecological Challenges.

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Keywords: Maritime vocational education; ecological crises

Abstract

France has a network of maritime technical colleges that provide initial and continuing training for fishermen and fish farmers. Through historical evolution and current issues, we will seek to understand how these vocational training establishments constitute an important tool for the development of the fishing and aquaculture sectors in a context of ecological crises.

Maritime vocational training, like all vocational training, pursues varied and sometimes contradictory objectives. Depending on the sector and level of education, the emphasis may be more on specific technical skills, or more cross-disciplinary. The target audience is also different, depending on whether it is young people in initial vocational training or adults in continuing education. This system is more or less integrated into general educational policies. So, despite their strong specific features, maritime high schools must also be like all vocational high schools.

We can see that environmental education involves both general school curricula and specific vocational courses. As far as these specific courses are concerned, there is a constant rebalancing between the scientific demands of understanding and studying the environment, and the priority given to production techniques and practical know-how.

Maritime education, like other fields (such as agricultural education), needs to consider ecological crises in different ways.

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Junior and Senior High School Students' Challenge to Solve the Problem of Marine Litter in the Seto Inland Sea -Through the Practice of Citizen Collaboration through “Civic Tech”-

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Keywords: Seto Inland Sea, Marine litter, Civic Tech, Citizen collaboration.

Abstract

The club at the school where I work is engaged in marine litter collection and awareness-raising activities with the aim of solving the problem of marine litter in the Seto Inland Sea. Collection activities can reduce the current accumulation of marine litter. Awareness campaigns can reduce future marine litter.

However, many citizens who participate in awareness-raising activities are elderly people, and their awareness of problem solving is very high. In order to solve these problems, it is important to create a mechanism that involves citizens who cannot participate, that is, people who are indifferent to problem solving.

Therefore, junior and senior high school students took on the challenge of searching for solutions from the daily lives of citizens and their residential areas. Furthermore, from the perspective of "Civic Tech", we created a smartphone app that citizens can use, and through collecting garbage data, we challenged the awareness that citizens who dispose of garbage can become solvers. This is not 100 steps of one citizen, but 1 step of 100 people, and it is a big force that citizens are facing in the same direction.

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Relationship Between Small Microplastics (SMPs) Contamination and Feeding Habits of coastal Marine Organisms in Tokyo Bay (Japan)

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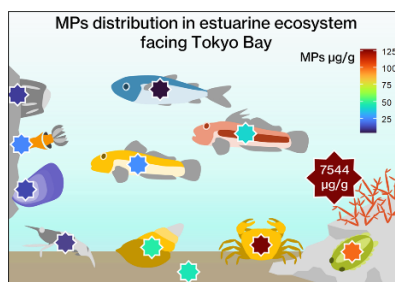
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Keywords: Ocean, plastic litter, microplastics (SMPs), detection and measurement, algae feeding organisms, food-web.

Abstract

Plastic litter unintentionally discharged into the ocean by humans is dispersing into the marine environment and marine ecosystems as fine particles. Tokyo Bay is Japan's most densely populated sea area and is at high risk of plastic litter release. However, the quantitative biological contamination status of small microplastics (SMPs), especially those with a particle size of less than 100 μm , has not yet been clarified due to technical challenges.

In this study, we addressed technical issues related to the detection of SMPs, especially improving the accuracy and the efficiency of measurement time and quantified the SMPs in 11 marine organisms and sediments in the estuary facing Tokyo Bay using the developed method and micro-FTIR. This is the first attempt to monitor ecosystem SMPs on this scale in Japan and is still a rare case worldwide. As a result, we found that the high concentration of SMPs (approximately 7.5 mg/g and 170 times higher than sediment) in the algae at the site, and the species with the highest SMPs intake were indeed consuming the algae by diet analysis. Therefore, this shows that algae-feeding organisms tend to ingest SMPs, in contrast to previous findings that filter-feeding organisms are particularly likely to ingest SMPs. Therefore, this suggests that algae could function as ecosystem engineers that capture SMPs suspended by tides and currents in coastal areas and transport them into the food web.



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Environmental Education and Link Between Nature and Culture.

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Keywords: Satomi, inter and transdisciplinary approaches, marine research

Abstract

In Japan, *Satomi* activities emphasise nature, productivity, biodiversity, and human interaction. It also requires inter and trans-disciplinary approaches whereby researchers, stakeholders, community, and government, play essential roles. However, one challenge for *Satomi* and other socio-ecological activities to thrive is how interdisciplinary research is progressing in marine science research in Japan. I will present a case study on interdisciplinary and marine research in the context of Japan by proposing five action steps or ways forward for successful interdisciplinary marine research based on a survey questionnaire with 40 marine researchers in seven Japanese universities and four research institutes. These proposals include 1) engagement with society and policy, 2) changing Japan's hierarchal organisational structure, 3) better institutional resources, 4) hearing more from Japanese female researchers, and 5) better integration between disciplines. Based on our participant's response, knowledge integration, less bureaucracy, improving management and assurance that all researchers have an equal voice is relevant in the Japanese research context and can help change top-down research tendencies currently present in many Japanese institutions. We emphasise Japan's unique culture and social characteristics and its strong relationship with the ocean to better understand how interdisciplinary research can be applied to *Satomi* activities and beyond, which can serve as a model for other regions.

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Co-design of the Sustainable Seafood System Through Participatory Approach: A Case Study of Sagami Bay Area, Japan

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Keywords: Small-Scale Fisheries; supply chain; Bayesian Network Modelling; co-design

Abstract

Fishing communities are facing severe challenges such as resource depletion, climate change, aging and shrinking industry, which are common in most developed nations, including Japan. Among the potential solutions to tackle such situation, building the responsible seafood system at local scale is considered effective and significant, which was particularly highlighted during the Covid-19 pandemic (Stoll et al. 2021; Sugimoto et al. 2022). This study introduces the ongoing project which attempts to establish a co-designed sustainable seafood system with fisheries coop, fishing marina, NGO, local government, and scientists, using Kanagawa prefecture, located close to the Tokyo metropolitan area and also holds rich connection with the sea through fishery as well as the other various recreational use. We collected the fish catch data during 1986 to 2021 and sales path of those products in Kotsubo fisheries coop. Then we visualized the local supply chain using Bayesian Network Analysis, to be utilized as a “communication tool” to trigger the co-design of sustainable seafood system. Network analysis allowed us to quantitatively evaluate the inter-relationship among the nodes of fishers, fishery resources, buyers, and retailers, which could also trigger the dialogue between fishing industry and local citizens, among diverse stakeholders. We will show the way how co-design proceed, what is the barrier for such process, and discuss how our approach works effectively to overcome the barriers, which could be also applicable to other regions in Japan and other countries.

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Visualization of the Overarching Value Network Connecting People and Sea

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Keywords: SES (socio-ecological system); BTM (bi-term topic modeling); network analysis; NLP (natural language processing)

Abstract

Recently, there has been a growing call for the incorporation of coastal and marine social-ecological systems (SES) in discussions about the sustainability of coastal and island countries, given their close connections between people and the sea and coastal environments. These connections are not simply linear or direct; rather, they form a complex and intricate network mediating values and benefits between them. Gaining a comprehensive understanding of this network, which has yet to be fully understood and explored, is imperative to develop effective strategies that promote the sustainability of coastal and marine SES. To address this challenge, sentence completion survey, which has been developed as a projective test in the study field of psychology, was used in this study to explore individuals' attitudes and opinions how people recognize the values of sea. By integrating biterm topic modeling (BTM) and network (structure) analysis, this study succeeded to aggregate and visualize the network of individuals and sea connected through various values of sea people recognized. As one outcome, it was revealed that the respondents recognize several clusters of beneficiaries; the respondents themselves, their intimate others, those who are engaged in fisheries and maritime transportation, culture and philosophical concepts, countries in the world, and the Earth. Also, the study found that there are some significant hub structures with fish/seafood. Finally, the study discusses the potential of this value network as a visualization method for implementing evidence-based policy making (EBPM) toward the sustainability of SES from the social science side.

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Closure communications

Amphitheatre Pierre Daure

Wednesday Octobre, 27 2023 from 9.00 a.m to 11.20 a.m.

Dr Philippe Cury – *IRD Sète- UMR MARBEC*

Professor Eric Feunteun - *MNHN – EPHE-PSL*

Dr Hiroyuki Nakahara – *Kanagawa University – Research Institute for Marine and Port studies.*

Rethinking Sustainability in a Changing Ocean

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Keywords: planetary limits, ocean, overexploitation, climate change, pollution, Ecosystem approach to fisheries, SDGs

Abstract

Ocean is facing many challenges that compromise future marine life. Climate change, overexploitation, economic concentration, biodiversity loss and pollution jeopardize resilience of marine ecosystems and their productivity. This presentation will review and explain several of those impacts and their interactions. The ecosystem approach to fisheries has been developed for almost 25 years with contrasting results throughout the world with relatively poor results at the European level. Since 2015 the agenda 2030 with 17 SDGs defines sustainability in a comprehensive, democratic and fair manner. This presentation will illustrate how this agenda can be promoted at the European and International level for fisheries and marine life by promoting new objectives and a vision for marine fisheries. To achieve sustainability in a global and challenging context we will need to rethink exploitation and conservation of marine life as well as the reasons for our poor responsiveness to actual and future global marine transformations.

The Eel Paradox. Holistic Management of Migratory Fish. Impossible Mission?

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Keywords: *Anguilla* sp., Contamination, Global change.

Abstract

The European eel is one of the 16 species of anguillids known in the world and whose ancestors would have appeared more than 60 million years ago, that is to say a little before the disappearance of the dinosaurs. This longevity is based on a successful biological cycle: catadromy. Eels reproduce at sea, often very far from the coast. The eggs give birth to leptocephalus larvae which are oriented by sea currents towards coastal environments. Young eels colonize continental aquatic environments where they settle and grow for 5 to 20 years on average. They then return to the sea to reproduce. Its life cycle has been the subject of scientific questions and controversies since Aristotle more than 2400 years ago. Recent research has made it possible to better understand the biological cycle, marine migrations, orientation mechanisms, but we still have no certainty about the breeding area and behavior, as no eggs or adults have ever been sampled in the natural environment.

The European eel has gone through over the millennia of existence, major ecological crises, changes in climatic and oceanic regimes, it has witnessed the birth and development of humanity. Once abundant to the point of being considered a nuisance, the European eel has declined so much in the past 40 years that it is now classified as critically endangered by the IUCN. The European management plan, which was promulgated in 2010, mainly targeted the reduction of fishing effort and, to a lesser extent, the restoration of ecological continuity. The effects have been limited as the European eel population as signs of recovery remain uncertain.

During his presentation, Eric Feunteun will present the recent discoveries on the biological cycle of the eel and on the causes of its decline which are essentially linked to the effects of global change: change in ocean regimes, contamination by organic and metallic pollutants and loss of habitats. Management perspectives will be presented.

Co-Existence Between Offshore Wind Farm and Fisheries: Experiences in Japan

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Keywords: Co-Existence, Consensus Building, Offshore Wind Farm, Fisheries, Japan

Abstract

Coastal fisheries are actively being done around Japan for many years. On the other hand, offshore wind farm projects are being rapidly planned in recent years to realize carbon-free society. However, sometimes it raises a kind of conflicts between wind farm developers and fishermen, and co-existence is the most desirable solution for both sides. In Japan, some proposals on this topic are publicized by an ocean-related organization in 2013 and 2015, showing some alternative menu in the case of fixed type turbines and floating type turbines respectively. In 2019, Act on Promoting the Utilization of Sea Areas for the Marine Renewable Energy Power Generation Facilities was enacted, which contains a guideline of consensus building procedure. Upon this legal framework, some local councils are organized which contain the representatives of fisherman's cooperatives in order to develop consensus on co-existence policies. Some agreed opinions indicate a certain percentage of developers' revenue might be allocated to the fisherman's cooperatives, and the others describes certain amount of money upon the size of the capacity of the project would be contributed to the Fisheries Promotion Fund which would be newly built for this purpose. In the light of these many arguments, the author reports on the experience in Japan and the results of his analysis.

Conclusions

Amphitheatre Pierre Daure

Wednesday October, 27 2023 from 11.20 a.m to 12.30

Presidents SFJO France et SFJO Japan: Dr Patrick Prouzet and Professor Teruhisa Komatsu

EMECS: Professor Osamu Matsuda

President FRA Japan: Dr Ichiro Nakayama

Chairwomen Scientific Committee: Professor Anne-Claire Bennis

Chairman Scientific and Technical Committee: Professor Eric Feunteun

Chairman Organizing Committee: Professor Jean-Claude Dauvin.

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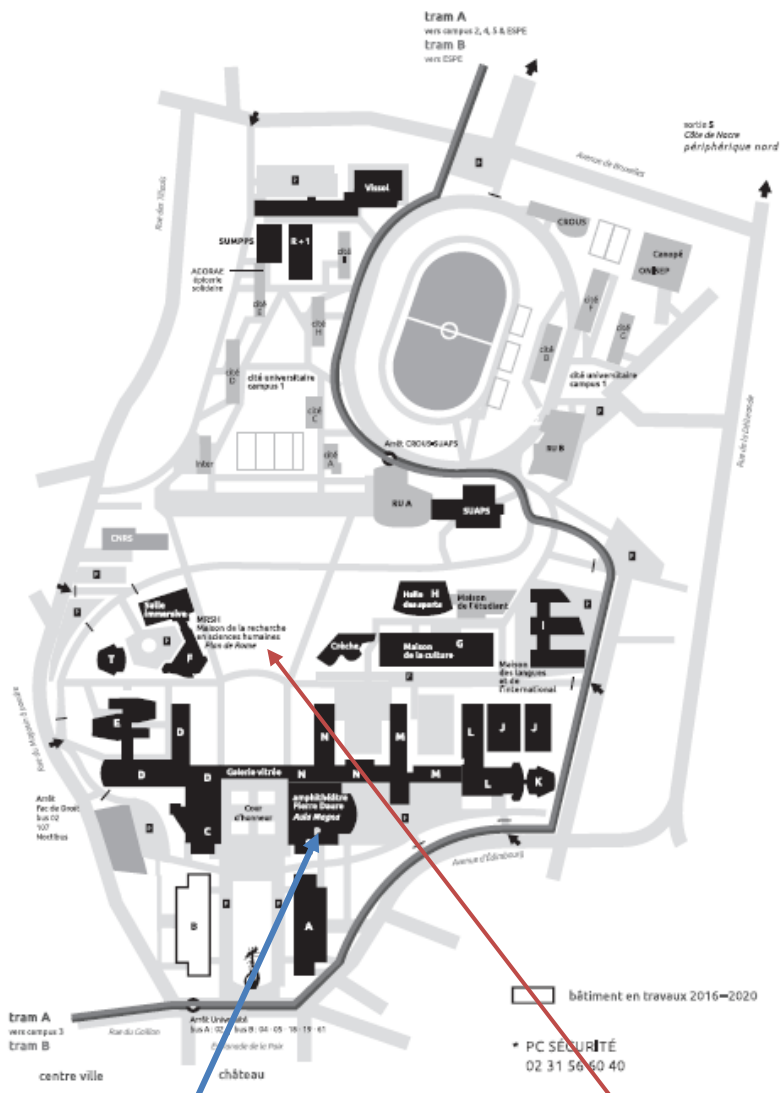
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