BOOK OF ABSTRACTS

OCEANS & LAKES 2024

Assessing benthic biodiversity changes due to artisanal fishing pressure along the Kenyan coast

BY Iris Balthazar

MAIN SUPERVISOR: Marc Kochzius (Vrije Universiteit Brussel)
CO-SUPERVISORS/TUTORS: Filip Huyghe

As fisheries pressure and other anthropogenic pressures keeps building up, it is necessary to monitor the impact this has on biodiversity, especially in key environments like coral reef ecosystems. Coral reefs, crucial for sustaining fishers and the vulnerable coastal communities they are part of face threats from overfishing and climate change. This project assesses benthic biodiversity changes due to artisanal fisheries pressure in Watamu, Kenya. Utilising video belt transect surveys, current benthic biodiversity is analysed so that it can be compared with historic data from previously published articles and looking for gradients differing between the sample sites. The changes in biodiversity through time can be mapped and then used to implement into policies to conduct more efficient management plans for small-scale fisheries and Marine Protected Areas. By implementing scientific data, the aim of this project is to empower governmental bodies to foster the development of laws for sustainable fisheries management. The research objective is to contribute to reduce the effect of overfishing and enhancing small-scale fisheries (SSF) sustainability along the East African coast, helping to achieve both local and global goals for a secure future and to uncover drivers for biodiversity changes.

Keywords: Watamu, coral reefs, community structure, diversity, benthos, small-scale fisheries, marine park

Development and implementation of a protocol to assess fish abundance, richness and habitat interactions in the Mida Creek mangroves, Kenya

BY Thomas Barnes

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This study seeks to examine the efficacy of un-baited underwater video stations (UBUVs) in the development of a new protocol to assess fish and mangrove channel interactions. We seek to do this in alignment with constraints in cost, complexity and environmental degradation, to formulate in a protocol that can be cheap, easily replicable and non-destructive, unlike many of the already existing methods used to assess such environments. The protocol herein involved filming abundances and species richness of fish as a function of the number of roots, distance from the sea, relative depth (accounting for tides) and channel width in the Mida Creek mangroves, Kenya, whilst adhering to these constraints, and limiting bias. By comparing this study to a similar one in the same area, we found that the method was useful in making broader implications between different fish species and their environments given the constraints and predictors. We also found that this study depicted more accurate abundances and species richness that are more representative of the location. Finally, we make suggestions with the aim of optimising this protocol to allow for even more accurate representations of the interactions in Mida Creek, and argue for its potential in wider assessments made by organisations and institutes such as the IUCN.

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Carbon processing pathways of fecal pellets from the fouling organism *Mytilus edulis* in offshore wind farm sediments

BY Iona Birnie

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In this study, we experimentally traced labelled fecal pellet carbon from the most abundant fouling organism in offshore wind farms, the blue mussel *Mytilus edulis*, through different carbon pools in sediment cores from inside and outside an offshore wind farm. Offshore wind farms can impact the environment through various effects, such as colonisation of the foundations by fouling fauna, leading to habitat heterogeneity through processes such as biofouling drop-off, patchy organic matter enrichment and sediment fining. By changing the environment and enhancing carbon deposition on the sediment surface through fast sinking fecal pellets, the carbon cycle could be altered inside an offshore wind farm. We hypothesised that the cycling of mussel FP would differ in these two sandy ecosystems, and that more carbon is retained unprocessed in OWF sediments, making them a carbon sink.
The main differences in carbon cycling of FP organic matter that we found between these two areas are (1) a higher respiration in the REF location (2) a higher processing of FP into the sediment pools (macrofauna, meiofauna, DIC in the pore water) in OWF sediments and (3) a larger amount of FP remains unprocessed in the top layers of the sediment as TOC in OWF sediments. This confirms the hypotheses, meaning OWFs could act as a Blue Carbon reservoir.

Keywords: Offshore wind farm, stable isotope pulse chase experiment, 13C, carbon cycle, North sea.

Digital image analysis of by-caught fish and algae in coastal shrimp catches

BY Martina Bobeva

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The unintended capture of non-target species, or "bycatch," continues to pose a severe danger to marine biodiversity and the sustainability of fisheries. Shrimp fishery bycatch has led to severe ecological and economic issues, particularly in the North Sea. Bycatch Reduction Devices (BRDs) like sieve nets have been widely used and helped ease some problems. However, environmental factors like warming oceans and algal blooms still render BRDs useless. This study investigates how digital image analysis might be used to monitor and control bycatch in North Sea shrimp trawls more accurately and automatedly. In particular, the study aims to measure catch-bycatch ratios, analyze the amount of algal clogging, and determine whether non-target species are present in trawl nets. Digital image analysis offers a potential replacement for traditional observer-based assessments by converting analog images into discrete data points and facilitating complex and continuous data processing. The study assumes that digital image analysis will considerably improve the consistency and precision of bycatch monitoring in complex circumstances where human approaches are unsuitable. This study combines contour detection, color segmentation, and template matching techniques into a pipeline for picture analysis using Python. Concurrently, contour detection focused on differentiating fish shapes from non-fish shapes. At the same time, color segmentation identified green and brown pigments to categorize species, such as *Ulva spp*., *Electra pilosa*, and brown shrimp. Template matching was employed to identify specific features, such as fish eyes and crab shells, to increase species quantification. The findings suggest that digital image analysis can offer a scalable and less labor-intensive replacement for traditional techniques by increasing the accuracy of bycatch monitoring in shrimp fisheries. However, issues like algorithmic biases, uneven image quality, and inaccurate classification of complex patterns indicate areas that require further work. Further research should improve these techniques, use dynamic algorithms, and expand the species library to improve identification accuracy in various aquatic environments. Digital image analysis can significantly enhance sustainable fisheries management and reduce the ecological impacts of bycatch by addressing these problems.

Accumulation of micropollutants in Asian clams exposed along the Scheldt River

BY Musa Bonso Denboba

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Micropollutants are a significant issue of concern in the aquatic environment, requiring continuous monitoring to assess their distribution and environmental risk. This study investigated micropollutant concentrations, namely per- and polyfluoroalkyl substances (PFAS) and metals, in both the abiotic and biotic environment by exposing Asian Clams (*Corbicula fluminea*) at different locations along the Scheldt River, Belgium, and by collecting resident blue mussels (*Mytilus edulis*) from the Western Scheldt, Netherlands.

In our investigation, both short and long-chain PFAS were detected in each environmental matrix, although their degrees of dominance varied, suggesting differences in potential sources. In the water, the mean concentrations of PFBA at different locations and PFBS at Hansweert were dominant, with the highest mean ΣPFAS concentration at Hansweert (586 ng/L). In the sediment, long-chain PFAS, such as PFOA, PFNA, PFDA, PFDoDA, PFTrDA, PFOS, and 6:2 FTS, were identified at different locations with the highest mean ΣPFAS concentration (47.8 ng/g dw) detected at Hemiksem. However, the relative contribution of short-chain PFAS, specifically FBSA and PFBA, to the ΣPFAS concentration in the sediment was highest. Accumulated mean ΣPFAS concentration was highest at Steenplein (17.5 ng/g ww), while Zwijndrecht showed the highest concentrations of PFOS, PFOA, and PFTrDA. A negative correlation between accumulated concentrations and sediment concentrations and no correlation with water concentration was observed. Temporal comparisons showed a decrease in PFOA concentrations in both bivalves and water, whereas PFBA concentrations increased across all matrices compared to 2022. No consistent trend was observed for PFOS; however, the detected concentrations were below the biota environmental quality standards.

The distribution of metals generally showed a decreasing pattern from upstream to downstream in both abiotic and biotic environments, with some exceptions. Despite the decreasing gradient in water, a notable increase in concentrations was observed downstream at Hoedekenskerke in the Netherlands, indicating a potential source of pollution. Significant spatial differences were found for Pb, Cr, and Cu, with the highest concentrations at Zwijndrecht, Oudenaarde, and Hoedekenskerke, respectively. However, the observed concentrations in the water were within the EU and Flemish guideline limits. In sediment, the highest concentrations of metals such as Pb, Cr, Cu, Ni, Cd, and Ag were detected at Zwijndrecht and significant differences were found for Ag, Cd, and Pb among locations. The temporal investigation in an abiotic environment showed a general decreasing trend for Cd in water and a sharp decline for Zn, Pb, Cu, and Cd in sediment. Accumulated concentrations were highest for Zn and Cu at Schelle, Cd at Hoedekenskerke, Pb at Lillo, and Cr at Hemiksem.

To better establish the spatial and temporal relationships of micropollutants in the abiotic and biotic environment, we recommend conducting additional studies with larger sample sizes, more diverse locations, and across multiple seasons.

Living in the Extreme: Understanding the Resilience of Seaweed towards Heatwaves in a multi-stressor Seascape

BY Lara Dommitzsch

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Marine heatwaves (MHWs), a result of anthropogenic climate change, have a detrimental impact on marine ecosystems due to habitat changes up to local extinction. In this thesis the resilience of *Dictyota dichotoma* in MHWs in a multistressor landscape including nutrients and light was investigated. Collected samples from four European populations, ranging from Bergen to Tenerife, underwent controlled conditions of simulated MHWs with changing light and nutrient conditions. The effects of growth and respiration were measured. During the whole study a randomized design with randomly selected sporophytes in random light and nutrient conditions was maintained. Key findings indicate that *D. dichotoma* exhibit varying resilience to MHWs depending on the population origin. Additionally, light and nutrient compositions are affecting the RGR of the populations in different intensities. Physiological responses were affected so that high MHWs are impacting the ability of recovery. My thesis contributes to the understanding of multi-stressor landscapes during and after MHWs. Conservation and management potentials can be gained by this thesis in order to mitigate effects of MHWs on ecosystems.

Quantification of vegetation structure among life stages of mangrove forests

BY Rafaella Dueñas Olvera

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CO-SUPERVISORS/TUTORS: Maria Esther Espinoza Celi

Mangrove forest s play a crucial role in coastal protection, especially against tidal waves. In this study, we aimed to assess the variation in vegetations structure among life stag e s of mangrove forests located in a tropical delta focusing on the frontal surface area. The frontal surface area is the area of vegetation (mangrove roots) that is perpendicular to the flow of water . This parameter is used to determine the dragforce induced by vegetation, which is applied in hydrodynamic models to analyze wave attenuation. We applied a combination of techniques , LiDAR, and Structure from Motion (SfM) to capture complex root structure of five age groups 1) < 5 year ; 2) 5-10 years ; 3) (10-15] years ; 4) (15-20] years; > 40 -55] years . The methods include canning mangrove plots using a LiDAR sensor integrated into an iPhone 13 Pro, alongside capturing a minimum of 200 images per plot for SfM , and the masking of a dense point cloud. Our results showed significant differences in Frontal Surface Area Ratio between the oldest plots (> 40 -55 years) and younger plots. While the LiDAR SfM technique was effective for obtaining a detailed mangrove roots structure, it presented challenges in image alignment, background noise removal and visibility. Our findings contribute to an understanding on the variation of frontal surface area regarding mangrove age and suggest that future studies include validation of the technique and sedimentation analysis. The study emphasizes the use of lightweight and cost effective equipment to analyze detailed vegetation in challenging environments.

Characteristics of small scale fisheries. A case study from the perspective of fishers and traders from Watamu Marine Reserve (Mida Creek), Kenya

BY Polly Gast

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Small-scale fisheries (SSFs) are often subject to overfishing and poor management. However, healthy fish stocks in SSFs are crucial as entire communities depend on them for their livelihoods, as the fishing industry supports not only fishers but also traders. Improved communication between managers and the fishing community is needed to better manage marine areas. To assess the values and challenges occurring of SSFs, the characteristics of SSFs as perceived by fishers and traders of the Mida Creek, Kenya, were studied. This location was chosen since the Mida Creek is an important ecological area for biodiversity and as nursing ground. Despite the importance of the area little research has been done before. A total of 64 participants were interviewed to gain insight into the factors providing a sustainable fish supply, the favoured fish species and the encountered challenges were identified. Successful supply is depended on the size of the catch, the catch diversity, the kind of species, the fish size and the freshness of fish. Fish species with good taste, high value, high demand and easy to catch and prepare were favoured. Fishers and traders encountered problems such as low catch and supply, expensive gear and equipment, bad weather conditions, finding bait, getting and providing loans, dealing with Kenyan Wildlife Services and the lack of Beach management Units. The SSFs in the Mida Creek were characterized by poor financial capital and over-exploited fishing grounds.

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Antarctic Nematode Diversity: Feeding Strategies, Ecological Insights, and Climate Change Implications

BY Jenny Alexandra Gaviño Alva

MAIN SUPERVISOR: Francesca Pasotti (Universiteit Gent)

This study provides a detailed examination of nematode communities in the shallow zones of the Gerlache Strait, West Antarctic Peninsula, focusing on the intricate relationships between environmental factors, trophic guilds, life strategies, and the presence of specific nematode genera. The research was conducted in the shallow waters of the Antarctic Gerlache Strait, a critical area within the Western Antarctic Peninsula (WAP) known for its rapid warming and significant ecological changes due to climate change. The Gerlache Strait's unique geography, with its interconnected fjords and bays, makes it an ideal location to study the impacts of environmental shifts on marine ecosystems. Conducted within the framework of the Belgica 121 (B121) expedition, which aimed to explore and assess biodiversity in the Gerlache Strait, this research aligns with the goals of understanding how Antarctic ecosystems respond to environmental changes. The study integrates multiple analytical approaches, including Principal Coordinates Analysis (PCoA), SIMPER analysis, and the Maturity Index, to offer a comprehensive assessment of habitat functionality in these ecologically sensitive and highly variable environments. The findings reveal that sediment characteristics, organic matter content, and environmental stability, which are increasingly affected by climate change-induced shifts such as warming temperatures and changing sea ice cover, are key drivers of nematode community composition. Families such as Chromadoridae and Desmodoridae, which dominate across several sites, may face changes in their distribution and abundance as environmental stability is altered by ongoing climate change, leading to potential shifts in benthic ecosystem structure. Notably, the genus *Molgolaimus* emerged as a prevalent opportunistic colonizer in disturbed environments, particularly in sites characterized by high levels of organic matter and anoxic conditions. In contrast, the absence or low presence of higher maturity nematodes, such as those in the c-p 5 category, and predator nematodes, suggests that these habitats are not fully stable, likely due to ongoing environmental disturbances and the high dynamism of the shallow Antarctic habitats, including climate change effects such as ice dynamics, temperature fluctuations, and salinity changes.

The study highlights the importance of integrating analyses of distinguishable genera, trophic guilds, and life strategies with environmental drivers to obtain a holistic snapshot of habitat functional status. This integrated approach allows a better understanding of the ecological status and resilience of nematode communities in Antarctic shallow water. Additionally, the research points to the need for future studies to incorporate the measurement of additional environmental factors, such as pollutants and other stressors, to assess better the impacts of anthropogenic activities and natural variability on these ecosystems. The results of this study provide a valuable baseline for future monitoring efforts, offering critical insights into the adaptive responses of nematode communities in one of the most extreme environments on Earth.

Keywords: Trophic guilds, life strategies, sediment characteristics, organic matter, climate change, habitat quality, Maturity Index, life strategy, meiofauna.

Effects of artificial provisioning on juvenile *Carcharhinus melanopterus* and *Negaprion acutidens* shark populations

BY Elke Herbots

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Sharks are not only charismatic animals but also economic and ecologic assets. This review will hold a closer look at their population statuses, trends and differences, followed by an assessment of reef shark characteristics (trophic ecology, social structures, spatial distribution and migration, reproduction) and how they experience anthropogenic influences. Special attention will be given to the effects of artificial provisioning, the unnatural feeding of sharks to attract them for ecotourism purposes, and its impacts on female reef sharks. This literature review provides the background information necessary to examine if ecotourism, more specifically shark provisioning, has any indirect effects on juvenile reef shark populations.

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Determination of the Physical and Chemical properties of the plastic pellets collected from roads in the port of Antwerp area, and on the banks of the Scheldt River.

BY Ojas Anil Mali

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CO-SUPERVISORS/TUTORS: Ronny Blust, Hanne Diels

This study analysed the physical and chemical properties of plastic pellets on the road and riverbank in the port area. Plastic pellets are the primary type of microplastics used in the preproduction of plastic items. This study was based on the plastic pellets sampled by Ms. Hanne Diels from 2022, 23, and 24 for 57 locations on the road in the port area and, in the year 2024, 24 locations on the riverbank of the Scheldt River. Plastic pellet loss in the port area has been a concern the EU has been looking into since 2017. There are directives and frameworks designed to curb the plastic pellet loss in the port area. This study aimed to analyse the weathering of plastic pellets collected on the road and riverbank locations. The change in physical characteristics like mass, shape, and diagnostic traits were evaluated for the plastic pellets. For chemical characteristics, the polymer type was identified using ATR-FTIR spectroscopy, and carbonyl and hydroxyl indices were calculated for the respective polymer type. The results indicate that the plastic pellets collected from the riverbank are significantly degraded compared to the plastic pellets on the road. Polyethylene (PE) was the most dominant polymer type identified in this study, with significantly higher values for CI and HI at the river. The exposure to differences in environmental conditions for the pellets collected on the riverbank and road affects the mass. It modifies the plastic pellets' shape compared to the pristine ones. Also, the degradation results in surface-level oxidation and the introduction of Carbonyl and hydroxyl groups in the polymer chain, affecting their chemical properties. This information allows a better understanding of how plastic pellets get degraded, depending on their sampling locations.

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Genetic population structure of the Bubble-tentacle anemone *Entacmaea quadricolor* in the Indo-Malay Archipelago.

BY Daniela Manrique

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The Bubble-tentacle Sea anemone (*Entacmaea quadricolor*) is one of the ten sea anemones species that host anemonefish. Their symbiotic relationships with zooxanthellae, which provides carbohydrates to the anemone for their nourishment and growth, has been well studied previously. Currently, sea anemone populations are facing two major issues: low tolerance to increasing water temperature, and overexploitation for the marine ornamental aquarium trade. Increasing water temperatures are leading to bleaching events across the Indo-Malay Archipelago (IMA). Their pelagic larval stage and (semi-)sessile adult life makes these invertebrates interesting candidates for a larval dispersal study, performed by assessing gene flow between populations. Here, we studied samples of 103 individuals collected at 10 sites across the IMA between 2004 and 2016. We investigated the genetic population structure and connectivity of *E. quadricolor* using six microsatellite loci as molecular markers. A clonal analysis was conducted in which we found 30 individuals that could be potential clones, therefore we remove them from the dataset. In our study, no genetic clusters were detected across the archipelago. Three out of the six microsatellite loci were in Hardy-Weinberg equilibrium (HWE). We found that the main source of allele variation exists among individuals from the same sampling sites (%) rather than between sites. This could indicate that the species forms one large panmictic population across the entire IMA, well connected by gene flow. However, due to the low sample size and the challenges encountered during the microsatellite loci amplification, we recommend the use of different genetic markers, such as genome-wide SNPs that could be a feasible alternative when working with sea anemones.

Keywords: Coral Triangle; population genetics; reef ecosystems

Conceptualizing and Assessing the Success of a Fishing Gear Exchange Program in Mida Majaoni and Uyombo, Kenya

BY Mohamed Mohamed Yusuf

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This study aims to assess the success of a Fishing Gear Exchange Program conducted in two landing sites in Mida Creek, Kilifi County, North Coast Kenya, an area prone to illegal monofilament nets and spearguns and determine what defines the success of these gear exchange programs from the fishermen's point of view. It specifically targets to determine how the Mida Majaoni and Uyombo Fishing Gear Exchange Program was conducted and to determine if the Mida Majaoni and Uyombo Fishing Gear Exchange Program is successful based on fishermen's perspective. Two sites were selected for this study; Uyombo, which is a Beach Management Unit in Kilifi County and Mida Majaoni, a fish landing site in Mida Creek, because Bahari Hai had conducted a Fishing Gear Exchange Program. The findings show that the project was of benefit to the fishermen, as they recorded an increase in their total catch, increase in fish size and the revenue obtained from fisheries. The project also helped in reducing destructive gears. This study forms a baseline where future Fishing Gear Exchange Programs will draw recommendations and areas for improvement, including focusing on building the capacity of the Beach Management Units and groups to manage and govern their resources well before giving them new fishing gear, having a proper Monitoring and Evaluation plan, and baseline socioecological, and fish length-weight data to monitor the impact of such programs.

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Applying the IUCN Red List of Mangrove Ecosystems protocol with ecosystem data in Mexico and subsequent conservation strategies

BY Mary Vanessa Moll

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Mexico contains 6% of the earth's mangrove ecosystems, which are currently experiencing decline at a global scale. Decline means potential loss of individual species and puts the numerous ecosystem services mangroves provide at risk, including coastal protection, fish nurseries (allowing fish recruitment to other nearshore marine ecosystems and providing food and economic benefits to nearby communities), natural water filtration, and extensive carbon sequestration and storage. To maintain ecosystem services, ecosystems must be functional (i.e., not collapsed); therefore, the International Union for Conservation of Nature (IUCN) began developing the Red List of Ecosystems (RLE) in 2014 to assess the risk of ecosystem collapse at any spatial scale. The RLE recognises that multiple factors contribute to ecosystem health and that analysing and quantifying these factors aid in determining ecosystems that need conservation. The process for red listing an ecosystem focuses on five parameters: (A) reduction in geographic distribution, (B) restriction of geographic distribution, (C) environmental/abiotic degradation, (D) disruption of biotic processes and interactions (biodiversity loss), and (E) quantitative risk analysis (using multiple well-studied and understood factors to create an ecosystem model for predicting future ecosystem collapse). The red listing process allows for standardising the risk of collapse for analysed ecosystems using available data for any given area. The IUCN RLE has eight categories: (1) Collapsed (CO), (2) Critically Endangered (CR), (3) Endangered (EN), (4) Vulnerable (VU), (5) Near Threatened (NT), (6) Least Concern (LC), (7) Data Deficient (DD), and (8) Not Evaluated (NE).

The Global Mangrove Watch recently assessed mangroves according to the IUCN RLE at a global scale and found that most of Mexico's mangrove ecosystems are VU. However, they also recommend countries use sub-global assessments, if possible, which offer finer spatial resolution, detailed sub-grouping of ecosystem types, and more accurate RLE categorisation. Therefore, this study prioritises the use of relevant national datasets for a sub-global assessment, allowing for a more accurate assessment compared to the global assessment. Shapefile maps of mangrove extent for the late 1970s/early 1980s and 2015 were obtained from Mexico's Mangrove Monitoring System to determine the status of mangroves at national, regional, and state scales for Criteria A and B. Mapped soil degradation data for Mexico was obtained from the National Commission for the Knowledge and Use of Biodiversity and used to determine the RLE status at national, regional, and state scales for Criterion C. Suitable national data on biotic indicators could not be found for Criterion D; therefore, a global database of bird sightings was used. Academic and citizen-science occurrence data for birds associated with mangroves were obtained from eBird and used for Criterion D at the national, regional, and state scales. Assessment results show that Mexico's mangroves have an overall status of EN at the national scale. At regional scales, mangroves are found to be of LC in the Gulf of Mexico, EN in the Central Pacific and the Yucatan Peninsula regions, CR in the North Pacific, and CO in the South Pacific. Assessment at state-level reveals LC in Baja California Sur, Sonora, Nayarit, Chiapas, Tamaulipas, Veracruz, Campeche, and Quinta Roo; VU in Michoacan, Oaxaca, and Tabasco; CR in Baja California, Jalisco, Colima, Guerrero, and Yucatan; and CO in Sinaloa.

Governments and organisations in Mexico can use this assessment to determine areas at risk of collapse and prioritise areas for conservation.

Microplastics in estuarine environment : occurrence, quantification, and chemical characterization in *Corbicula fluminea* (Asian clams) exposed along the Scheldt estuary

BY Alain Mugisho

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CO-SUPERVISORS/TUTORS: Mathilde Falcou-Préfol

The contamination of aquatic environments by microplastics is a rapidly growing global issue, with potential consequences for numerous species and ecosystems. While there is a wealth of data on the presence and distribution of microplastics in oceans, regional studies on microplastic pollution in freshwater systems and related risk assessments remain limited and insufficient for a comprehensive understanding of this emerging threat. This study, therefore, focuses on quantifying and characterizing the microplastics ingested by *Corbicula fluminea* (Asian clams) exposed in the Scheldt estuary in Belgium, an area of significant ecological and economic importance. Additionally, we investigated the presence of microplastics in wild *Mytilus edulis* (blue mussels) and in the sediments of the estuary to better understand their distribution and accumulation in aquatic organisms, contributing to a deeper understanding of microplastic pollution, a critical environmental issue.

Eight sites were selected for this study: six for exposing Asian clams and two for collecting wild blue mussels. Samples of water, sediments, and physico-chemical parameters were collected at each site. In total, 40 bivalves (30 Asian clams and 10 blue mussels) and eight sediment samples were analysed. Microplastics were quantified and characterized in these samples using µFTIR and ATR-FTIR spectroscopy. The results revealed that the abundance of microplastics in the clams ranged from 1.6 to 884.6 MPs/g wet weight, and from 0.67 to 79.12 MPs/g wet weight in the mussels. In the sediments, the abundance ranged from 0.13 to 4.03 MPs/g wet weight. The dominant polymers were polyethylene terephthalate (PET) in the bivalves and polystyrene (PS) in the sediments. No significant correlation was found between microplastic concentrations in Asian clams, blue mussels, sediments, and the measured physico-chemical parameters.

These results highlight the need to expand sampling efforts across all environmental matrices to better understand the dynamics of microplastic accumulation and transport in the Scheldt estuary. Furthermore, integrating ecotoxicological studies is essential to assess the impacts on aquatic organisms and the potential risks to human health.

Keywords: Microplastics, Bivalves, *Corbicula fluminea*, *Mytilus edulis*, Exposure, Sediments, Scheldt estuary, Fourier-transform infrared spectroscopy, Quantification, Characterization

Environmental Assessment of the Presence of Trace Metals in the Drowned Land of Saeftinghe and Hedwige-Prosperpolder.

BY Kseniya Mulhern

MAIN SUPERVISOR: Lieven Bervoets (Universiteit Antwerpen)
CO-SUPERVISORS/TUTORS: Lies Teunen

While increasing storm surges and sea level rise in combination with embankments and channel dredging have exacerbated flood risks in estuaries, nature based solutions (NBS) are finding their way to make flood resilience more sustainable. Still a young, but promising concept, it provides the ability to integrate tidal marsh restoration together with nature-based flood protection. In return, restored marshes deliver even greater benefits. Specifically acting as a sink for trace metals carried out in the estuaries. In this study we evaluated the natural and depoldered (NBS) tidal marshes in their ability to sequester trace metals. To assess the metal concentrations we examined surface sediment, cores and plants in the natural habitat and surface sediment in the restored marsh. Results show no significant difference between adjacent natural and restored habitat in total metal concentration in the surface sediment, with the exception of elevated levels of Cd in the restored marsh. Complex analysis of poorly developed restored sites did not yield concrete analysis. But made a significant contribution in realizing the importance of creating site-specific SQGs to better realize the toxicity and timely remediation of various environments. The restored site also demonstrated the potential to accumulate sediment in a pattern similar to a natural site, and thus demonstrates that inundation plays a fundamental role in making it possible. Nevertheless it is still unclear what the consequences are for metal availability, behavior and long-term spatial distribution in the restored area. Despite a decrease in historical metal pollution levels, continuous monitoring and evaluation of the restored and adjacent natural sites are essential for future effective management and restoration strategies.

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IMPACT OF MARINE AGGREGATE EXTRACTION ON FISH DIET IN THE BELGIAN PART OF THE NORTH SEA (BPNS)

BY Jomarie Mundas

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Over the past decennia, marine aggregates have become the alternative to the decreasing availability of sand and gravel from land sources. Despite its economic importance, physical and biological impacts on benthic fauna have been observed and become the focus of most research studies. However, little is known about the effect of this anthropogenic activity on the higher trophic level, particularly on the fish diet. In this study, we investigated the impact of marine aggregate extraction on the diet of four fish species that are commercially or environmentally significant (common dragonet, plaice, dab, and whiting) in the Belgian Part of the North Sea (BPNS). To achieve this, we collected individuals from the four fish species by trawling along three fishing tracks in a highly impacted extraction zone in the BPNS, known as the Thorntonbank. Additionally, three non-impacted tracks which served as reference tracks, were also trawled. Using stomach content analysis (SCA), this study revealed that sand extraction had a similar impact on the diet of benthic fish (common dragonet, dab, plaice), while the diet of bentho-pelagic fish (whiting) was relatively unaffected. Benthic fish fed opportunistically on the most abundant prey, *Lanice conchilega* in IMP zone, adjusting their diet to the changes in the benthic communities brought by aggregate extraction. Whiting was able to escape the impact because of its ability to feed both on benthic and pelagic zone, feeding on larger and more mobile prey such as Ammodytidae, Gobiidae, crustaceans, and mollusks. Although SCA has its limitation, this study provides a snapshot of the diet of fish in IMP and REF on a very short term. Further research using stable isotope analysis (SIA) or fatty acid is needed to determine whether these zones will be a valuable feeding grounds in the long term.

Keywords: marine aggregate extraction, stomach content analysis, benthic fish, benthopelagic fish, *Lanice conchilega*

How many sensitive (endangered, threatened, or protected; ETP) elasmobranch and teleost fish species survive after being discarded from commercial and small-scale fisheries?

BY Nour el Imene Naili

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This systematic review investigates the discard survival rates of endangered, threatened, and protected (ETP) elasmobranchs and teleosts in European commercial and small-scale fisheries. The study aims to assess how survival estimates vary across species, gear types, and experimental procedures while identifying factors that influence discard survival outcomes. A total of 40 studies, ranging in quality scores from 16% to 84%, were reviewed, with research ranging from the 1990s to 2020s. Over time, study quality and methodological consistency have improved, reflecting advancements in fisheries management frameworks, particularly in response to the European Union's 2014 landing obligation and discard ban.

The studies reviewed were scored based on four primary methods to estimate discard survival: vitality assessments, captive observations, combinations of both, and tagging. Vitality assessments alone proved limited in capturing long-term survival, with recent studies increasingly adopting combinations of methods that provide more accurate and comprehensive survival estimates. The results demonstrate significant variability in discard survival rates, ranging from 0% to 99.44%, driven by species-specific traits, geographical ranges, and methodological approaches. Elasmobranchs generally exhibited higher survival rates compared to teleosts, highlighting the need for species-specific management strategies.

The findings emphasize the importance of reliable, species- and context-specific discard survival data for establishing fisheries management policies, including exemptions to the landing obligation, stock assessments, and prohibited species legislation. The review also highlights the importance of methodological advancements, particularly the incorporation of tagging and longer-term monitoring, in improving the accuracy of discard survival estimates. The study concludes by supporting the standardization of discard survival protocols and continued research to refine our understanding of post-discard mortality, which will be essential for ensuring the sustainable management of ETP species in European fisheries.

Impact of mussel aquaculture on Macrobenthos and sediment habitat in the Belgian Part of the North Sea.

BY Angeline Wanjala Nyambu

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This study investigates the impact of offshore mussel aquaculture on macrobenthic communities and sediment habitats in the Belgian Part of the North Sea (BPNS). Mussel farming, a rapidly expanding sector, is recognized for its potential environmental impacts, particularly on the benthic ecosystems beneath and around aquaculture installations. This study was conducted at the Westdiep farm, part of a Natura 2000 area, over a 3 years period from 2021 to 2023, with samples collected on a north-east gradient at various distances from the farm.

The results did not indicate any significant changes in sediment properties but there was an observed increase in total organic carbon (TOC) in 2022 along the sampling gradient that was followed by a decrease in 2023. There was a significant change in the density of macrobenthic communities between 2021 and 2023. This study focused on two macrobenthic communities along the sampling gradient; *Abra alba* and *Nephtys cirrosa* communities in the BPNS. Temporal analysis shows some differences between the pre-installation, post-installation, and post-harvest phases. However, the observed changes in TOC and macrobenthic communities cannot be attributed to the farm's presence. This is because of other factors that might be influential including; inter annual variability in macrobenthic communities in the North sea and temporal variability in TOC that is associated with runoff from river Ijzer which is in close proximity to the farm.

The study highlights the importance of monitoring and managing aquaculture practices to mitigate adverse effects on marine ecosystems, emphasizing the need for sustainable aquaculture development in marine protected areas. This research contributes valuable insights into the ecological dynamics associated with mussel aquaculture and provides a foundation for future studies aimed at balancing aquaculture expansion with environmental conservation in marine ecosystems.

Translating the blue economy concept into actionable solutions for sustainable coastal management in Kenya

BY Maimuna Mbwana Nzori

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Blue Economy (BE) is an emerging concept entailing sustainable use of the oceans while integrating ecological conservation, economic growth and social equity. Globally, the concept is gaining traction and rapidly expanding with many countries embracing it , in an attempt to achieve sustainability. However, there is no universally agreed definition of the term BE hence, conflicting understanding and interpretations among various BE actors and stakeholders arise in most cases. There are also concerns over potential imbalances over ecological, social and economic considerations during implementation of most BE initiatives. Focusing on fisheries and tourism sectors in Kwale County, Kenya, this study seeks to map the understanding of the BE concept from the perspective of locals and experts and assess the socioeconomic and ecological impacts of BE initiatives to the local communities using Focus Group Discussions (FGDs) and a two-round Delphi (expert-based) survey. The findings reveal that local communities have a good understanding of the concept which is greatly influenced by their occupations and level of sensitization and awareness of the concept. They support the BE initiatives and have a positive perception of the impacts of the implemented BE initiatives in their area, which is attributed to their inclusion, economic benefits and environmental protection. The experts held similar opinions as locals regarding the positive impacts. However, contrasting opinions emerged regarding the negative impacts of subsequent phases of the ongoing Shimoni fishing port. This is influenced by the lack of the necessary capacity and knowledge among local community to properly understand the Environmental Impact Assessment (EIA) documents of proposed projects given the high thresholds to master the EIA jargon as well as meaningful engagement in decision-making. The study highlights that institutionalization and implementation of BE is driven by national local context in Kenya while prioritization of BE sectors in Kenya is influenced by national priorities, strategic goals and resource availability. On the other hand, the success of BE initiatives is influenced by the availability of funds. Key challenges hindering growth of BE include limited capacity and skills, insufficient coordination among key BE stakeholders and unsustainable use of marine resources. It is clear from the study that BE in the local context is still elusive rather than practical in achieving sustainability in the usage of the ocean and its resources. Harnessing the potential of BE in Kenya is deemed feasible if: integrated collaborative management among resource users , managers and authorities is enhanced ,capacity of local communities is built inclusive and meaningful engagement of relevant stakeholders is promoted and effective governance, legislations and regulations are put in place through coordinated multistakeholder approaches .

Keywords: Blue Economy, Delphi survey, Focus Group Discussions, experts, local communities, socioecological impacts, sustainability, economic impacts.

ESTIMATING THE IMPACT OF BOTTOM FISHERIES ON ECOSYSTEM FUNCTIONING IN THE BELGIAN PART OF THE NORTH SEA

BY Nicholas Okeyo Otieno

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Bottom fishery impacts on benthic macrofauna and functional diversity, sediment biogeochemistry and bottom sediment habitat characteristics are apparent and counterproductive to the functioning of ecosystems despite its significant contribution to the global catches. To effectively comprehend the magnitude of fishery induced impacts on the ecosystem functioning, data on the macrofauna functional diversity and vulnerability to depletion by bottom fishing gears is imperative considering that the behavior of these benthic macrofauna drive the benthic ecosystem functions. Most studies have focused on the general impacts of bottom fisheries on the structural components of seabed creating a knowledge gap on the exclusive impacts of bottom fisheries on the ecosystem functioning. This study aimed to estimate the impacts of bottom fisheries on the ecosystem functioning by a modelling approach that was implemented in *Bfiat* and *Btrait* R-packages in open-source R framework. Results from the Belgian part of the North Sea indicated that bottom fisheries contributed to the depletion of important benthic macrofauna, reduction of bioturbation and bioirrigation potential across all habitats and depth zones. High fishing intensities and deep fishing gear penetration resulted in depletion of macrofauna densities which consequently led to the reduction in the bioturbation and bioirrigation potential. Substratum depth distribution and macrofauna traits such as lifespan, recovery rate and swimming ability emerged very critical in determining the vulnerability of benthic communities to bottom fishing. There is need for fishery management approaches to address fishing-induced ecosystem collapse through extensive sensitization on the prevailing and potential adverse impacts of their fishing gears on the functioning of ecosystems. Relevant ministries can adopt gear exchange program by issuing eco-friendly fishing gears and gradually impose heavy taxation on various types of commercially available non-ecofriendly fishing gears to discourage deployment by fisher community and minimize environmental degradation.

Keywords: biogeochemistry, bioirrigation, bioturbation, bottom fishery, ecosystem functioning, functional diversity

Study of meiobenthic communities in a sub-polar Antarctic fjord: Andvord Bay

BY Rajeshwari Paul

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Despite the frequent prevalence of glacio-marine fjords in high latitudes, they have been primarily studied in the Arctic context rather than the Antarctic. Arctic fjords are marked by substantial sedimentation and meltwater inputs which significantly diminishes its benthic abundance and diversity from outer to the inner fjord regions, as proximity to glaciers increase. On the contrary, glacio-marine fjords of the Western Antarctic Peninsula (WAP) are influenced by weak meltwater and sediment inputs from their adjacent glaciers, which ensure low turbidity and hence high phytoplankton productivity in the fjord's confines. This renders Antarctic fjords in their preliminary stages of climate warming which can provide researchers an adequate setting to study and predict future changes in polar climate and ecosystems. As compared to macro- and megafauna, meiofauna research with respect to marine ecosystem studies, was vastly neglected in the past primarily due to difficulties in sampling. However, they are an indispensable component of benthic communities not only because of their high diversity and ubiquitous presence, but also because they aid in nutrient cycling, perturbation of sediments which allows oxygen to penetrate to deeper sediment layers, and remineralization of organic substances. In this study, we characterized the meiobenthic communities of Andvord Bay, a sub-polar glacio-marine fjord of the WAP. We observed their varying patterns of abundance and diversity along a down-fjord gradient extending to the continental shelf, across the two seasons (austral summer and winter), and between the sediment layers of the deep WAP seabed. This study re-established that WAP fjords are benthic abundance and diversity hotspots unlike their adjacent continental shelves. It concluded that meiofaunal abundance and diversity vary significantly between the stations and sediment layers however, not between the seasons. Furthermore, substantial differences in community composition was found between stations and sediment layers indicating major contributions of WAP meiobenthic organisms to the gamma diversity of this region.

Enhancing the nutritional value of *Ulva australis* for food purposes, and exploration of effects of abiotic factors on maturation and sporulation

BY Sarah Poelmans

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Seaweeds are valued for their highly nutritious biochemical profile, including vitamins, minerals, and antioxidants. While they are a staple food in Asia, applications of seaweeds in Europe remain mainly limited to the extraction of compounds, used in the food, cosmetics and medical industries. Increasing interest in seaweed cultivation in Europe is driven by its rapid growth, low environmental impact, and alignment with United Nations Sustainable Development Goals. Among the compounds, antioxidants are of significant interest to their ability to neutralize reactive oxygen species (ROS), thereby preventing cellular damage. ROS are generated under conditions of oxidative stress, such as exposure to high light intensities. For companies aiming to develop products with high antioxidant content, it is crucial to have a comprehensive understanding of physiology and ecology of target species, for effective life cycle management and optimization of biochemical composition. This study investigated the effects of abiotic factors (temperature, culture medium, and tissue fragment size) on maturation and sporulation in Ulva spp., and the impact of light intensity on pigments concentrations and total antioxidant activity in Ulva australis to optimize cultivation conditions for a maximised content of these compounds.

The effects of temperature (ranging from 12 to 20°C) and different culture media (mPES, F/2, seawater) were evaluated by placing 5-mm discs taken from the edges of thalli into 6-well plates and 100mL Erlenmeyers flasks respectively. Additionally, the impact of tissue fragmentation was assessed by placing square fragments (4cm², 1cm², 0.25cm²) into 100ml Erlenmeyers flasks and exposing them to the same temperature and light conditions. No significant factor has been identified to influence the induction of maturation. However, a trend was observed with increased induction when the cultivation temperature deviated from the optimum growth temperature. For media and fragmentation, further research is required.

Furthermore, the effect of light intensity (300, 200, 100, 50 µmol photons m-2s-1) on growth, pigment content and total antioxidant activity on two *U. australis* strains was examined over 14 days. The first strain, collected in France and designated as the S-strain, was observed to easily sporulate while the second strain, from the Netherlands and referred to as the V-strain, remained in a vegetative state. Growth, pigments and total antioxidant capacity (TAA) were measured after 3, 7, 10 and 14 days. TAA was assessed using a ABTS assay, while pigments (Chl-a, Chl-b, and carotenoids) were quantified through spectrophotometric analysis. Growth increased with light intensity peaking at 18.92 ± 0.66 % day-1 after 7 days for the S-strain and 16.76 ± 0.8% day-1 after 9 days for the V-strain under 200 and 300 µmol photons m-2s-1, respectively. The S-strain showed decreasing levels of pigments with higher light intensity: Chl-a by 30%, Chl-b by 33%, and carotenoids by 28% between the 3rd day and the 14th day. Antioxidants also decreased by 20% at higher intensities over the same period, significantly influenced by light treatments. The V-strain showed increased pigments over time, with Chl-a, Chl-b, and carotenoids rising by 27%, 25%, and 70%, respectively, between the 3rd day and the 14th. Light treatment significantly affected TAA together with the experimental duration, but not the pigments concentrations.

These results emphasized the need for tailored cultivation protocols based on strain-specific responses to light intensity, particularly for optimizing antioxidants levels and pigment production.

Overall, this thesis advanced on our understanding of inducing maturation and sporulation in *Ulva* as well as the effect of light intensity on the various physiological responses in *U. australis*.

Genetic population structure of the fluted giant clam *Tridacna squamosa* throughout the Indo-Malay Archipelago

BY Rachel Purington

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Giant clams of the family *Tridacna* are an integral part of the reef ecosystem by recycling nutrients in the water known as the "giant clam loop", which involves excretion of materials as a food source for others, water filtration, production of calcium carbonate that acts as a building block for coral reefs and increased surface area of the reef to provide more niche habitats for other species. *T. squamosa* is one of the most commonly found species of giant clam in the Indo-Pacific and grows up to 40 cm in length with a mantle of various colors such as green, blue, brown, orange and yellow. In this region, the shells are used and sold as dishes and jewelry, while the whole animal is sold as live decoration for aquariums and collectors due to their colorful mantels, and in some places the meat is believed to be an aphrodisiac.

The International Union for Conservation of Nature has listed the giant clams as "vulnerable", and they are included in Appendix II of the Convention for International Trade in Endangered Species of Wild Fauna and Flora. The ivory trade in China has supplemented the demand for exotic natural materials with giant clam shells, even though they are a protected species by the Chinese government, to maintain local artisan livelihoods. The harvest of giant clams is extremely damaging to the substrate and removes them as a valuable food and water filtration source. Increasing levels of ocean temperature and CO2 concentrations have been shown to alter the CaCO3 composition of the shells, reducing overall shell growth and density, as well as negatively affecting their immune system, reproduction and survival rates.

Current marine protected area management needs to be reassessed due to increased tourism and overlap with fishing zones and consider the development of mariculture research and restoration projects for giant clams in the Indo-Pacific region to satisfy market demand without furthering the natural stock depletion.

Using genetics instead of morphology to identifying the giant clams will help track dominant genetic and phenotypic traits between populations of different areas. The potential for phenotypic plasticity among the subpopulations requires the need for conservation efforts to be customized in certain areas to improve efficacy. This is especially important for restocking efforts of giant clams to avoid introducing diseases and foreign genetic material.

The F-Statistics show 51% of inbreeding among the subpopulations and 54% of the total inbreeding is due to drift within the subpopulations. PCoA shows no geographic pattern which makes the dataset 4 panmixic. Low Fst values (0.05) and low numbers of migrants per generation (Nm=4) can be explained by the paradox of recent range expansions or frequent population extinction and recolonization that can homogenize genetic variation among the populations. Larger datasets and more loci are necessary to improve the statistical power of the F-Statistics to definitively show distinct population structures in the Indo-Malay Archipelago, if they exist.

MEASURING THE LEVELS OF OCEAN LITERACY IN ISLA FUERTE, COLOMBIA BY IMPLEMENTING THE BLUE SURVEY 2.0

BY Laura Marcela Rengifo Molina

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CO-SUPERVISORS/TUTORS: Diana Di Nitto, Evelyn Paredes-Coral, Sergio A. Restrepo-Moreno

Colombia is a Latin American country known for its rich biodiversity. Bordered by the Pacific Ocean and the Caribbean Sea, the country is home to unique ecoregions like Isla Fuerte. Isla Fuerte is located within the Coralline Archipelagos Ecoregion and is nationally recognized for its well-preserved coral reefs. Despite its marine richness, the island and other Colombian marine ecosystems are facing significant threats due to human activities and poor marine resource management. Additionally, low levels of ocean literacy are hindering sustainable practices and positive attitudes toward ocean health. To address this and have an initial approach, a survey was conducted to evaluate ocean literacy among individuals engaged in various activities in Isla Fuerte. This study surveyed 176 individuals using the Blue Survey 2.0, which assesses dimensions like knowledge, attitudes toward ocean sustainability, attitudes toward ocean use, ocean-friendly behaviour, and personal interest. The results showed that demographic and job-related factors significantly influence ocean literacy levels. Specifically, age, gender, and job affiliations influenced the respondents' ocean literacy levels. For example, female respondents demonstrated lower interest and weaker sustainable attitudes towards the ocean compared to males, while workers in small- to medium-sized enterprises and self-employed individuals in marine occupations exhibited higher personal interest and better attitudes and behaviours towards the ocean. These differences may be influenced by socio-cultural factors limiting women's interaction with the ocean. Professionals and workers frequently exposed to the sea showed greater interest in and commitment to ocean health and sustainability, likely due to their deeper connection with the sea developed during their labour activities.

Keywords: Ocean Literacy, Oceans Decade, Ocean Sustainability, Ocean Literacy Dimensions, Blue Survey, Colombia, Isla Fuerte, Ocean Knowledge, Marine Education, Coastal Communities.

EXPLORING HUMAN AGENCY THROUGH THE LENS OF CAPITAL ASSET AND POWER DYNAMICS IN THE ARTISANAL FISHING COMMUNITIES OF TAMBOLONGAN AND POLASSI ISLANDS, INDONESIA

BY Nuzulia Sari

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Effective conservation of ecosystems requires an understanding of how communities use their natural resources. It is crucial to recognize the role of individual agency in accessing, participating in, and benefiting from livelihoods for achieving lasting and fair outcomes. This study explores how capital asset and gender relations impact the expression of agency in coastal communities of Tambolongan and Polassi islands, Indonesia. The evaluation of various aspects in artisanal fishing communities is guided by the concept of operationalizing agency, emphasizing preconditions (capital assets and resources) and power dynamics reflected in people's engagement in coastal and marine livelihoods. The study was conducted using a household survey among 150 participants and spatial mapping of control and access over resource distribution with a Focus Group Discussion.

The study revealed the preconditions pillars in both islands are characterized by limited available options and a lack of diverse livelihood combinations, with heavy reliance on wild capture fisheries and agriculture in both communities. Almost half of the surveyed community members (44%) were engaged in capture fisheries, and the second highest proportion of livelihoods was related to agriculture sector. Examining power pillars showed that men predominantly have exclusive access, control, and ownership of coastal and marine resources, evident in their extensive involvement in both offshore and onshore fishing activities and active participation in fishing associations. In contrast, women have limited involvement in post-harvest and gleaning activities related to fishing but play a significant role in ensuring economic stability at the household level through participation in fish trade and managing the income generated by their husbands. This situation presents an opportunity to empower women's agency within fishing communities.

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Investigating the Temporal Biomass Dynamics of the Southern Bight of the North Sea Ecosystem through a Food Web Model

BY Taylor Soroka

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The Southern Bight of the North Sea is an intensively fished area with many stressors placed upon it. An Ecopath with Ecosim food web model was created for this area for the period 1991- 2022 to analyze how the ecosystem has changed over time. Over this period, total biomass was reduced by 14.8%, commercial biomass was reduced by 13.7%, the trophic level of catch slightly decreased by 2.7%, the trophic level of community minimally increased by 1.7%, and total catch greatly decreased by 76.4%. With those parameters in mind, the health of the Southern Bight of the North Sea's ecosystem is in jeopardy of worsening without proper management. The effects of Brexit fisheries policies on the EU and a tipping point scenario were tested through future management scenario-based simulations until 2050. The simulations tested how a reduction in quota of cod by 3.0%, herring by 1.7%, mackerel by 2.5%, and sole by 10.2%, as set by the EU-UK Trade and Cooperation Agreement, would affect the ecosystem. Additionally, a substitution of catch of herring, mackerel, cod, and sole with sprat, sea bass, whiting, and plaice respectively, was tested to convey a possible change in fishing behavior. The results of the Brexit simulations revealed that the quota losses coincide with maintaining constant fishing efforts from 2022-2050, while the substitution of catch did produce significantly different outputs. The Brexit policies alone were found to have minimal effects on the Southern Bight of the North Sea ecosystem, but the resulting fishermen's behavior will influence the health of the ecosystem. The tipping point scenario revealed that a 30% annual increase in fishing efforts would cause all fished species to reach their tipping point by 2050. Future management of the area should implement ecosystem-based management techniques that account for all influencing factors on the environment of the Southern Bight of the North Sea.

Keywords: Ecopath with Ecosim, food web model, Brexit, ecosystem-based management

Shifting Macrobenthic Traits in Offshore Wind Farms in the Belgian Part of the North Sea – a Long-term Biological Traits Analysis

BY Almaru Ten Napel

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A long-term and spatially diverse macrobenthic dataset of sites within the Belwind and C-Power offshore windfarms (OWFs), within the Belgian Part of the North Sea (BPNS), was used to assess if OWF presence also induce similar shifts in macrobenthic biological trait compositions, as seen for shifts in taxonomic community structures.
It was expected that the previously found increased taxonomic richness surrounding turbine sediments would also reflect in an increase in functional trait richness. This was indeed found to be the case, although exclusively temporally, less so for Belwind. Nevertheless, Belwind does seem to show similar shifts in biological trait compositions compared to C-Power. This was unexpected, as previous studies have consistently found that possible macrobenthic impacts are less pronounced or absent for Belwind compared to C-Power. For both OWFs, results indicate a directional shift in functional trait compositions from FAR to CLOSE sites and for C-Power, additionally, to VERY CLOSE sites. With closer proximity to turbines, a clear increase in traits associated with coastal communities was seen. These traits often also correlate with environments of fine-grained sand and increased organic matter content (as generally found in benthic coastal environments). Together with an increased functional richness, this would indicate an increased niche differentiation; most likely due to the utilisation of the increased organic matter content found with closer proximity to turbines. Due to this gained evidence of possible impacts that was previously not found – especially regarding Belwind – this study thus highlights the importance of implementing biological trait analyses when assessing for anthropogenic impacts and should likewise promote further investigation within the topic of OWF impacts.

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RECONSTRUCTING THE HYDROCLIMATE HISTORY OF WESTERN UGANDA FROM FOSSIL MOLLUSC AND OSTRACODE ASSEMBLAGES IN THE SEDIMENTS OF A CURRENTLY SALINE CRATER LAKE

BY Esther Wambura

MAIN SUPERVISOR: Dirk Verschuren (Universiteit Gent)

This study investigates the paleolimnological history of Lake Ntambi, a deep crater lake in western Uganda, to understand how its aquatic ecosystems have changed over the past 17,700 years in response to climatic and environmental variations. The research aims to reconstruct past hydroclimate history patterns and assess how these changes have influenced local biodiversity and ecological dynamics. We analyzed sediment cores retrieved from the deepest point from Lake Ntambi, focusing on fossil assemblages of aquatic snails and ostracods to provide a detailed record of past environmental conditions and how this changes reveal the changes in the aquatic habitats. The core samples span a period of 17,700 years, and the study utilized both taxonomic identification and statistical analyses to interpret changes in species composition of macroinvertebrate communities. The extensive sediment record provides a detailed view of historical environmental conditions and ecological shifts. The results reveal significant fluctuations in fossil assemblage composition, correlating with shifts between freshwater and saline conditions. Fossil records show a marked decrease in diversity during periods of high salinity, while freshwater phases supported a richer array of species.

Additionally, the study identified distinct patterns of species distribution linked to varying hydrological conditions and climatic events, such as during the Little Ice Age and mid-to-late-Holocene droughts. In conclusion, this research highlights the potential of Lake Ntambi's fossil assemblages as indicators of past climate and environmental changes, providing insights into how tropical lake ecosystems respond to long-term climatic variability. These findings contribute to a broader understanding of ecological resilience and change in East African lake systems, highlighting the importance of high-resolution proxy data for improving our understanding of historical climate dynamics and ecological resilience.