Commercial Fisheries

Understanding the influence of man-made structures in the marine environment

INSITE

Influence of man-made structures in the ecosystem

INSITE SUMMARY

The INSITE Programme was launched in 2014 as the first joint industry partnership between academia and oil and gas (O&G) operators in the North Sea. It delivers focused research to provide the independent scientific evidence base to better understand the influence of man-made structures (MMS) on the North Sea ecosystem.

The programme is contributing to the current global scientific consensus on the ecological and environmental implications of deploying MMS in the sea at scale, leaving non-operational MMS in situ, or removing non-operational MMS.

INSITE evidence supports the development of policy for and nature-positive approaches to decommissioning that can underpin the attainment of good environmental status and other policy actions relating to the sustainable management of UK seas.

CONTRIBUTORS

This policy brief was prepared by Howell Marine Consulting (HMC) using evidence gathered by contributing scientists and policy leads (below), as presented in the 'INSITEs Into Commercial Fisheries webinar' held on the 31st of October 2023.

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SYNOPSIS

This document summarises the key findings from the "INSITEs Into Commercial Fisheries" webinar held on October 31st, 2023. Commercial fisheries are currently the most widespread activity at sea and the effects of the industry go far beyond the health of fish populations. The fishing industry is essential in supporting livelihoods and ensuring food supply as a primary protein source. It is the most valuable food commodity traded worldwide. The effects of MMS and decommissioning options, have diverse impacts on environmental, economic, and sociological factors, all impacting commercial fisheries.

The EcoConnect project, showed that some fish species have seasonal abundance increases in areas of MMS. This is backed up by more recent FISHSPAMMS results that show MMS are often associated with elevated but localised fish densities, indicating MMS provide a niche habitat for fish populations in the North Sea. The FuECoMMS project investigates how carbon cycling and blue carbon varies in ecosystems around partially decommissioned MMS, especially within their 500m exclusion zone, where no fishing activity occurs, and fish appear to aggregate. Blue carbon stocks vary depending on sediment type around the partially decommissioned MMS but are significant in the exclusion zone.

INTRODUCTION

The effect of MMS on both fish populations and fisheries poses both challenges and opportunities for marine management. At present, critical attention is focused on navigational hazards, industry conflicts, competing interests, revenue loss and displacement. Additionally, it is imperative to acknowledge the changing landscape, including increases in hard substrata with consequent loss of soft sedimentary habitat, contaminants, and shifts in species ranges and abundance. However, offshore structures also offer potential benefits such as their creation of additional reef habitat in an ecosystem, leading to biodiversity enhancement, changes to carbon cycling, and the potential to act as nursery grounds, and thus, the possibility of enhancing fish stocks. Effective management and regulation are essential to ensuring harmonious coexistence between offshore developers and commercial fisheries. This is vital to maximising the positive contributions of these structures and supporting sustainable and responsible fishing practices.

INSITE science and wider efforts are contributing to the evidence base to better inform on fish ecology and habitat enhancement of MMS, supporting policies such as the Fisheries Act 2020, Marine Spatial Planning (MSP) and Marine Net Gain (MNG). This policy brief explores some of the effects of offshore structures on the fish movements, habitat utilisation and seabed sediment dynamics of the North Sea. The results obtained from studying ecosystem transformations under future scenarios will aid in development planning and guide decommissioning decisions to achieve the most favourable marine, fisheries, and restoration outcomes.

Marine Spatial Planning (MSP): the process for guiding sustainable use of marine resources and supporting informed decisions to understand the best locations for marine activities *e.g., effects of MMS on fish stocks, shifts in community types and changes in predator-prey interactions.* MSP integrates and balances all marine activities into a comprehensive plan that enhances sustainable resource use. Key policies include the Marine and Coastal Access Act 2009, the UK Marine Policy Statement (MPS) and the National Planning Policy Framework (NPPF).

Marine Biodiversity: encompasses species/habitat diversity and ecosystem functionality. Biodiversity is considered a valuable ecological component that can be enhanced through strategic compensation measures and MNG initiatives. Understanding how offshore structures impact biodiversity, such as shifts in community types, increases in biomass and changes in predator-prey interactions informs key biodiversity policies including the UK Fisheries Act 2020, Good Environmental Status (GES) and the Environmental Improvement Plan (EIP).

INSITE PROJECTS

PROJECT 1

EcoConnect (INSITE Phase I, 2015-2017)

(HIGH CERTAINTY)

The research examined if shipwrecks, wind turbines, cables and O&G structures influenced the abundance of three fish species: cod, plaice, and thornback ray. Statistical models compared fish distribution data from fisheries surveys and electronic tags.

KEY SCIENTIFIC FINDINGS

Using long-term data from two electronic tag types and longer-term data from previous Cefas projects, data on the movements of individual fish over ~20 years could be analysed. Data showed that depth and temperature were variables influencing movement.

All three species studied had seasonal increases in abundance in areas with abundant MMS, including O&G platforms and shipwrecks. Notably, plaice showed an increase in abundance in areas with O&G structures.

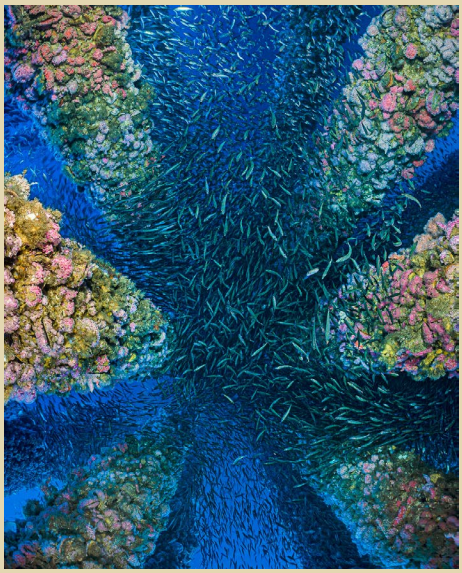

Image credit: Alexander Mustard (Underwater Photograpy)

PROJECT 2

Fish Spillover, Production and Aggregation at MMS (FISHSPAMMS) (INSITE Phase II, 2019-2024)

(HIGH CERTAINTY)

Collecting high spatial resolution data of fish densities and aggregations around MMS using ships and Uncrewed Surface Vehicles (USV) equipped with acoustic sonar equipment. This data is then being used to fine-tune a precise model of fish dynamics around MMS in the North Sea.

Additional evidence *Atlantic cod and larvae in the southern North Sea were attracted by low-frequency noise simulating that of operating offshore windfarms. Investigations into their diet composition indicate that cod use wind turbine piles with scour protection as feeding areas.*

KEY SCIENTIFIC FINDINGS

High-resolution sonar studies around MMS in the North Sea revealed precise data used to estimate energy and fish density, both individually and in schools. **The findings estimated that over 1.5 million fish aggregated around two decommissioned platforms. Comparisons with operating platform surveys, showed fish aggregation extended up to an average of 7 km from the platform,** indicating the long-range effects of increased fish densities, although with variability dependent on temperature and depth.

Note: An exploratory transect within an offshore windfarm, found fish school density to be 6 times higher compared to the surrounding 10 km area, and non-schooling fish density to be twice as high within the area of MMS.

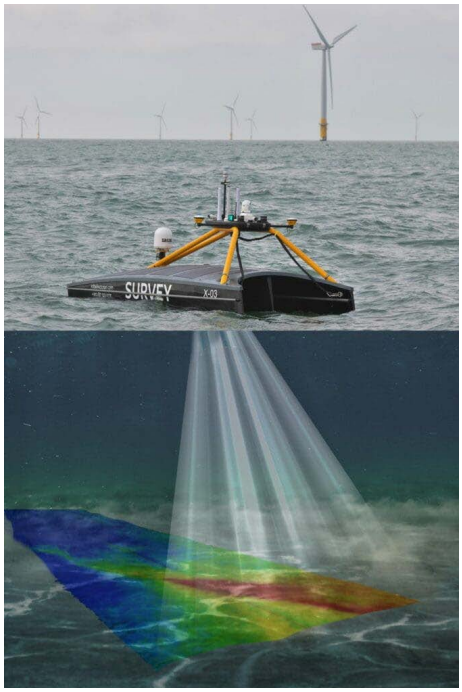

Image credit: Uncrewed surface vehicle (XOCEAN)

INSITE PROJECTS

PROJECT 3

Functionality and Ecological Connectivity of Man-Made Structures (FuECoMMS) (INSITE Phase II, 2019-2024)

(HIGH CERTAINTY)

Identifies the effects of MMS on carbon levels and storage, with consideration of ecosystem functions and the implications/ benefits of leaving MMS in place and the impacts of decommissioning.

KEY SCIENTIFIC FINDINGS

Conducted seabed sampling at two partly decommissioned O&G platforms at various distances (50 m, 100 m, 200 m, 400 m) from the platforms and outside of the exclusion zone (800 m, 1600 m and 3200 m). Organic and inorganic carbon was sampled, and sediment accumulation rates were analysed.

Varied carbon levels were found at the two sites, primarily due to differences in sediment types (muddy sediments held more carbon than sandy sediments). Significant amounts of carbon were observed nearer the structures.

These observations may feed into the wider current debate around the effects of trawling on remobilisation of seabed carbon stocks:

Protecting the global ocean for biodiversity, food and climate (Sala et al., 2021)

Quantifying the carbon benefits of ending bottom trawling (Hiddink et al., 2023)

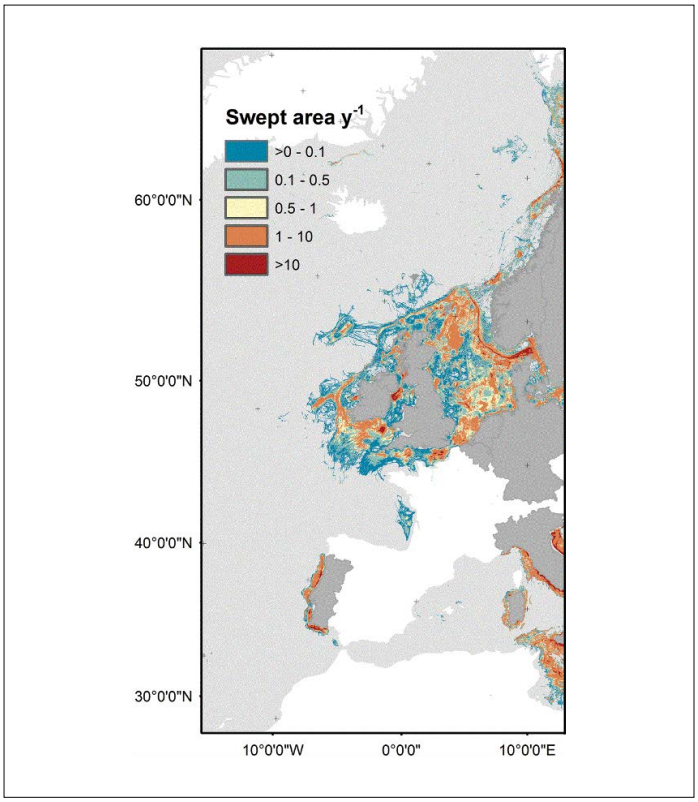

Image credit: The footprint of bottom trawling in European waters: distribution, intensity, and seabed integrity. Mean annual trawling intensity for 2010–2012 at the surface level (sediment abrasion <2 cm) was estimated from Vessel Monitoring System and logbook data from bottom trawl fleets (vessels >12m in length). Note a value of "1" indicates 100% seabed in that area has been swept over once by bottom contact gear in the two year period.

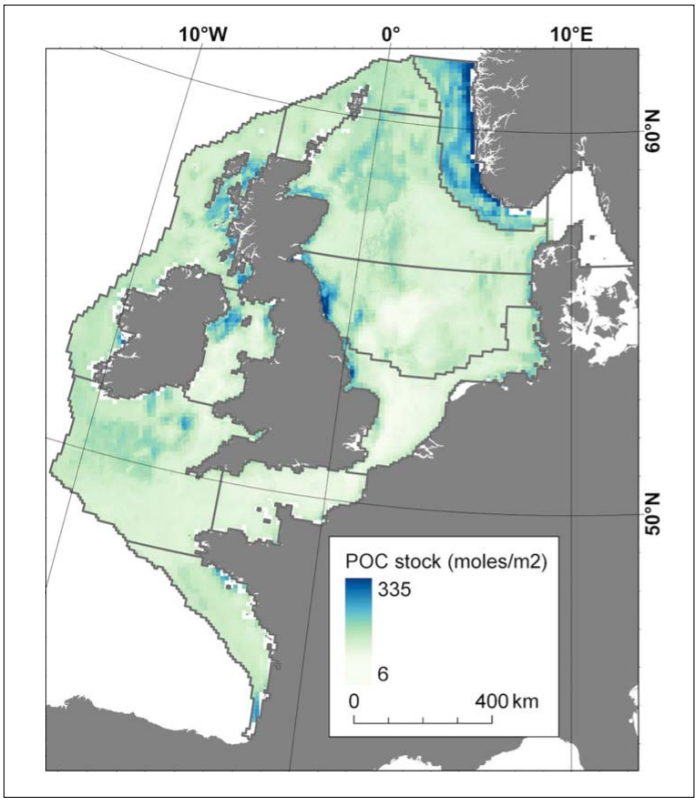

Image credit: The benthic concentration of particulate organic carbon, modelled POC data and a suite of predictor variables. Carbon on the Northwest European Shelf: Contemporary Budget and Future Influences.

POLICY CONTRIBUTIONS

POLICY 1

The UK Fisheries Act 2020

INSITE research findings can facilitate the standardisation of data collection for fisheries management and inform best practices for commercial fishing in the areas where MMS remain partially or fully intact. INSITE can also contribute to supporting marine planning and providing information for Fisheries Management Plans (FMPs), as well as highlighting areas to consider cumulative effects.

POLICY CONTRIBUTION

EcoConnect (HIGH CERTAINTY)

The study determined that artificial structures lead to localised, and seasonal increases in fish densities for cod, plaice, and the thornback ray. These findings were in accordance with site-specific measures and seasonal adaptability, considering various environmental variables. This information plays a crucial role in shaping regulations that address habitat alterations and assessing their potential impact on future fish densities and development activities.

EcoConnect provides essential baseline data on the movement and distribution of commercial fish in relation to environmental variables, O&G infrastructure, shipwrecks and underwater cables, contributing to the ecosystem evidence objectives of the Fisheries Act.

By building on the EcoConnect data with MMS locations, tag data and environmental variables, there is potential to assess fish habitation in certain areas, including MMS sites. This data can inform future scenarios under varying temperature and climate conditions affecting migratory pelagics, i.e., tuna. This may shape the direction of future fisheries and management strategies and can help in achieving further bycatch, precautionary and climate change fishing act objectives.

POLICY CONTRIBUTION

FISHSPAMMS (MEDIUM CERTAINTY)

This study demonstrated the potential of O&G infrastructure and wind farms as MMS structures that support locally increased fish densities, with consideration of catchment areas and the potential for MMS networks to have large-scale influence. This highlights the potential **need for a transformation of new stock and assessment methods along with further information on production vs aggregation at MMS sites.** FISHSPAMMS contributes to the Fisheries Act objectives of achieving sustainability and understanding ecosystems, by providing innovative approaches to quantify fish densities and spatial distribution patterns around MMS.

Ongoing research: The FISHSPAMMS project aims to estimate the size of fish within proximity to MMS, and outside the access limits. Such information could inform on whether fish are producing or exclusively aggregating around MMS, informing fish populations and assessments around MMS. ***By applying the FISHSPAMMS fish size and quantification models, it may be possible to assess the extent to which spillover from MMS could benefit fisheries interactions.*** This data could contribute to FMPs aiming to reduce bycatch below the minimum conservation reference size and support the Fisheries Act 'bycatch objective'.

Additional evidence: A study carried out in the Pacific Outer Continental Shelf Region found that **O&G platforms in California have been documented to have the highest secondary production of any marine habitat studied. Over 78% of this production remains even after partial decommissioning and augmenting the seafloor habitat around partially removed platforms with additional structures i.e,. rocks, can further enhance production.** *However, complete removal of some platforms in California, has demonstrated adverse impacts on numerous fish populations, particularly species associated with the complex hardscape habitat of platform structures. This suggests that there is importance in considering alternative decommissioning methods.*

POLICY 1

POLICY CONTRIBUTION

FuECoMMS (MEDIUM CERTAINTY)

The results of this study contribute to the ecosystem, scientific evidence, and climate change objectives of the UK Fisheries Act 2020, helping to aid the current understanding of the impacts of construction activities on food webs and carbon seabed dynamics. **The research demonstrates that sediment type is an important contributing factor influencing carbon dynamics in an ecosystem.** It is not currently known how the absence of fishing activity within the exclusion zone around partially decommissioned structures affects the carbon dynamics in these areas.

A comprehensive assessment of the effects of fishing on carbon stocks around a MMS can be achieved by gaining insights into carbon dynamics before and after construction and decommissioning. **Early findings suggest that MMS sites do not act as carbon sinks but rather become areas of improved cycling of carbon within foodwebs (biological carbon cycling), rather than depositional/burial areas (geological carbon cycling).**

However, this does depend on the type of MMS and it is important to recognise that what might work at one site, will not necessarily work at another. Further information on how the absence of fishing activity around partially decommissioned MMS relates to food web functions will build a better understanding of carbon dynamics and help advise on decommissioning options that better support environmental and fisheries challenges.

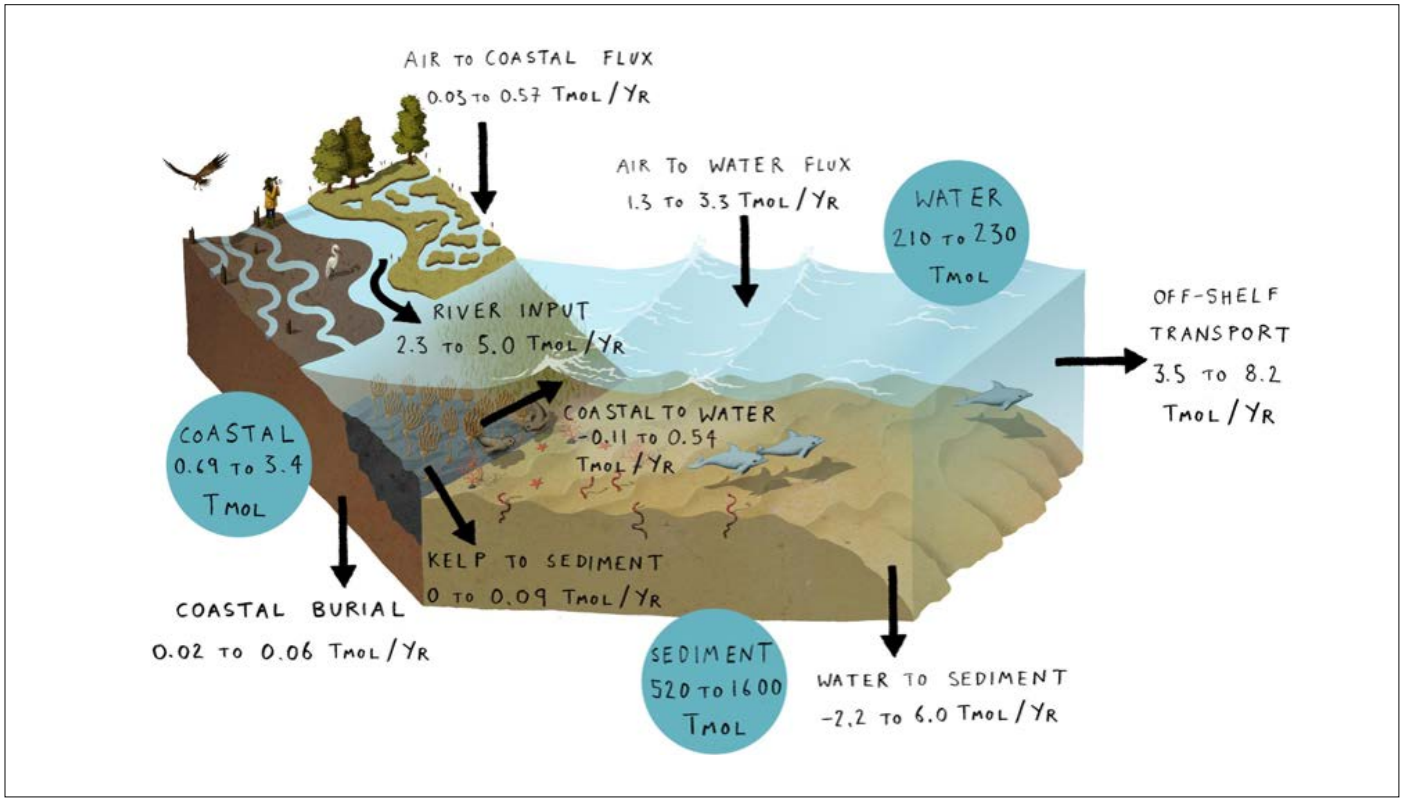

Image credit: A summary of the carbon budget of the northwest European shelf. Stocks (blue) are given in units of Tmol (1012 moles of carbon) and flows (black arrows) are given in units of Tmol year– 1. Carbon on the Northwest European Shelf: Contemporary Budget and Future Influences.

POLICY CONTRIBUTIONS

POLICY 2

Marine Spatial Prioritisation (MSPri), Marine Conservation and Marine Planning

The Marine and Coastal Access Act 2009 mandates Marine Plans to provide a transparent decision-making framework for potential investors and marine users. In this evolving landscape, fisheries face new economic and commercial challenges driven by fuel price increases, shifting stock locations, and adaptations to climate change. INSITE can help in identifying conservation priorities, areas of high ecological significance for highly protected marine areas, fisheries, renewables, and recreation and guide decision-makers towards maximising co-location between sea users.

POLICY CONTRIBUTION

EcoConnect (HIGH CERTAINTY)

There is an increasing need for spatial data to inform how marine spatial use changes over time from development to marine fauna. The EcoConnect **tagging data provide insights for identifying spatial areas of ecological significance for fish populations including around varying types of MMS and therefore assessing potential associated effects alongside other spatial data.**

Understanding fish movements and aggregations at a species level alongside temperature, habitat type and depth can allow for model predictions of future habitat occupancy and climate-adaptive management strategies. Such information can contribute to developing optimal co-location management measures and support how nature-inclusive designs for offshore development are implemented. This may be applied, for example at offshore wind farm sites, however, for the best alignment of conditions to promote wind farm deployment and colocation with fisheries wider considerations should also include biodiversity enhancement and conservation initiatives.

POLICY CONTRIBUTION

FISHSPAMMS (MEDIUM CERTAINTY)

Understanding fish population dynamics can improve the understanding of additional impacts, such as changes in the abundance and distribution of birds and marine mammals.

This knowledge can inform decisions on offshore structure design, placement, and management, therefore aiding marine spatial planning. These results can support maximising the co-location of different users by identifying areas where fisheries can benefit from possible spill-over effects if reproducing at MMS sites.

Additional evidence: *Ørsted to install artificial reefs for cod recovery at Borssele 1 & 2 and monitor using acoustic telemetry and tags and will provide knowledge on how MMS can actively contribute to improving the natural habitats of species in the Dutch sector of the North Sea.*

The FISHSPAMMS outputs can support the placement of co-location sites for marine activities, as well as inform fisheries and sustainable resource management measures in these sites. The project can help to advise on how future fisheries monitoring is carried out in areas where there is restricted access to survey grounds – could surveys be stratified to monitor new MMS hotspots using uncrewed vehicles?

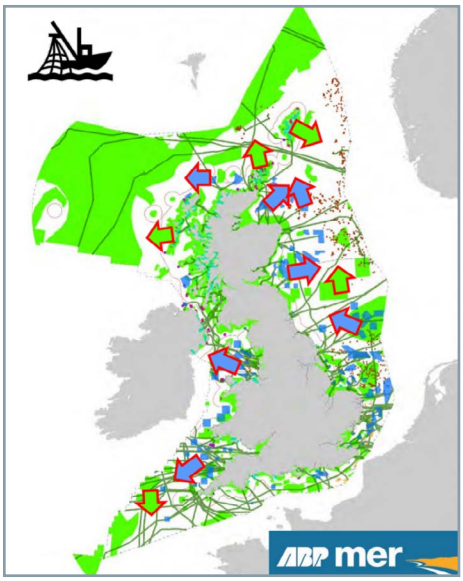

Image credit: Spatial Squeeze in Fisheries (Blue) locations of operational MMS and (Green) Marine Protected Areas.

POLICY 2

POLICY CONTRIBUTION

FuECoMMS (HIGH CERTAINTY)

Data from the sediment surveys adjacent to MMS will be used to inform of potential ecosystem changes and wider carbon cycle impacts during operation and post-decommissioning in the North Sea.

Along with being able to predict future impacts and make assumptions on carbon stocks across different sediment types, this knowledge makes it possible to pinpoint areas where the presence of offshore structures may alter the functioning of carbon cycles. Additionally, what the potential knock-on effects to ecosystems are, and on what temporal scale which ultimately can aid Marine Planning and MSPri goals.

Ongoing research: *The FuECoMMS project aims to look at impacts on the wider fish populations which inhabit these MMS systems and the associated possible contaminant effects and can therefore also be used to inform on the health of fish stocks and fisheries management strategies.*

Future research opportunities: Whilst FuECoMMS is currently looking at the contaminants and impacts on biodiversity in the seabed, modelling depth and temperature changes at MMS sites could inform future management plans. Using biomarker approaches could help to give ideas of where the carbon has come from, i.e., informing on relative proportions that make up carbon stock to further understand carbon dynamics.

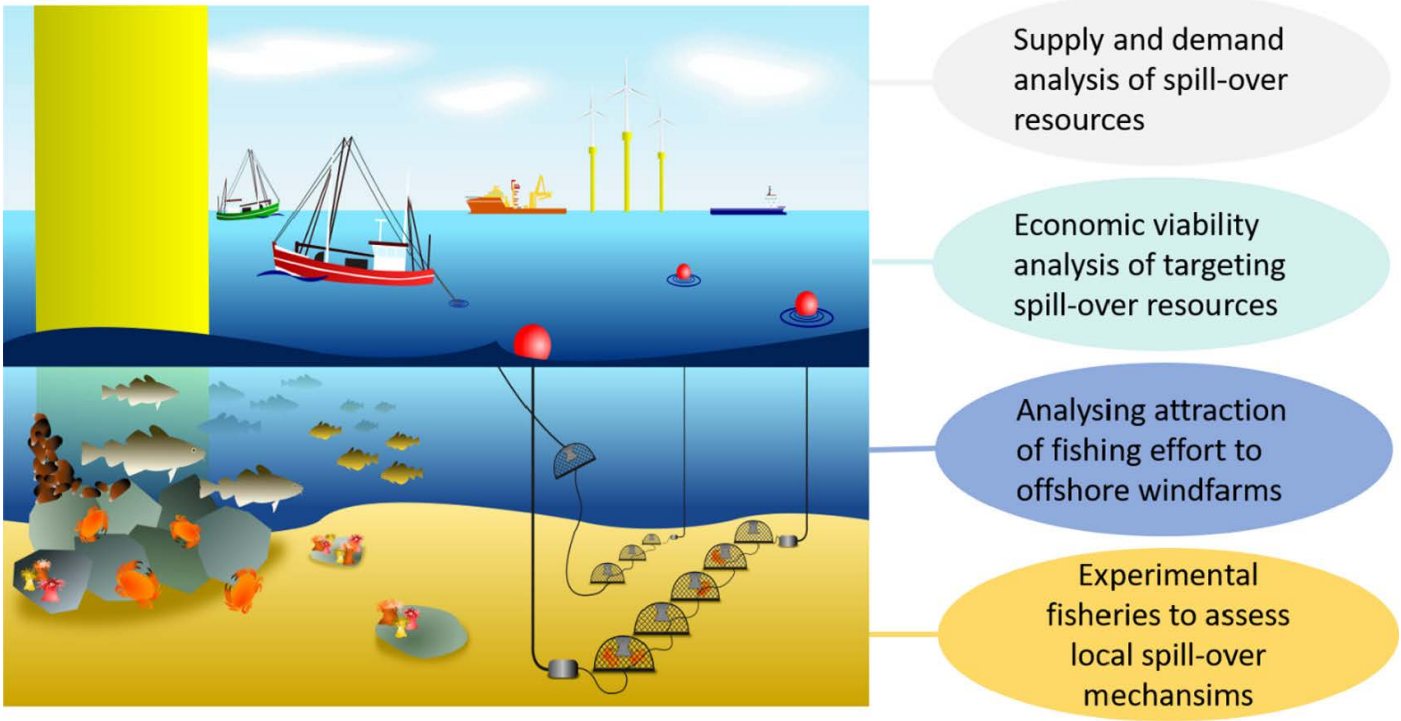

Image credit: Sustainable co-location solutions for offshore wind farms and fisheries need to account for socio-ecological trade-offs