

# UHI and Offshore Wind (OW)



Engineers, environmental and social scientists at UHI are working with multiple stakeholders to facilitate the next stages of deployment of offshore wind technology in Scotland, UK and internationally. These research activities ensure that project developers, regulators and other stakeholders have

access to the necessary technologies, baseline data, predictive models and evaluation methods to understand the significance and potential impacts of offshore wind developments on the surrounding marine system. Our goals include early identification of data gaps or potential conflicts to reduce risks and resource

requirements, as well as engaging with novel technology development for environmental characterisation, impact prediction and long-term environmental monitoring across large scales.



## Environmental monitoring using multiple technologies & sensors

UHI expertise in multi-sensor monitoring of animal distribution and behaviour uses drone / glider / RPA and specialised technology platforms (such as 'drifting ears') or vessel surveys, seabed platforms and sensor packages equally applicable to gliders / AUVs. Applications include baseline studies of animal distribution (fish, fish as prey, diving seabirds, marine mammals) to consider cumulative impacts and post-consent monitoring of changes and device-animal interaction, e.g., disturbance, displacement, habitat creation from artificial reefs, fish aggregation around structures, predators targeting OW structures for foraging. New models and methods are in development based on both vessel surveys and platform deployment including software and analysis. These techniques can be adapted to O&G combined with OW or wave / tidal.

## Bird interactions: Collision risk, modelling & displacement

UHI ornithologists specialise in quantifying and assessing the impact of displacement / avoidance of offshore windfarms by seabirds using state of the art tracking technology. The group has been actively involved in improving cumulative impact assessment and has been instrumental in revising and upgrading collision risk models for key species of concern.

UHI is also involved in research to upscale individual effects of wind energy development to investigate population-level impacts, and continues to develop new technologies, methods and models to streamline baseline characterisation of populations and post-deployment monitoring.

## Marine mammal interactions: Noise, displacement & entanglement

Understanding interactions of marine mammals (whales, dolphins, porpoises and seals) with offshore renewables – including both fixed and floating wind - is a significant research theme at UHI given the scale of offshore wind development planned over the next decade, the wide-ranging nature of many marine mammal species and the conservation status of many of their populations. The use of passive acoustic monitoring (PAM) has enabled increased understanding of natural soundscapes and vocalising species in wind farm sites, as well as evaluating the impacts of windfarm-generated noise leading to design of novel approaches to minimise or mitigate such impacts. Integration of PAM into marine robotics applications will further facilitate development of novel monitoring strategies. In addition, concerns over the possible entanglement of animals in moorings infrastructure has been an active research area.

## Marine Growth

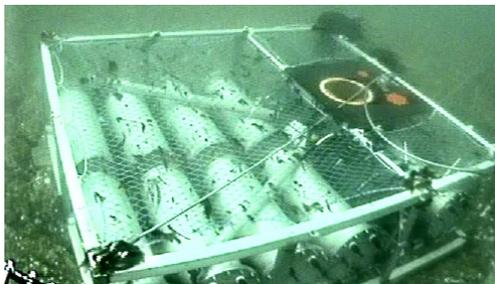
Structures placed into the marine environment are rapidly colonised by organisms such as seaweeds, mussels, anemones and corals (collectively 'marine growth'). Marine growth can make up a significant proportion of the weight of offshore structures (with important implications for the stability of floating structures and decommissioning) and forms the basis of a structure-based artificial reef. At UHI we have developed innovative methods for the assessment of marine growth by converting standard ROV footage into 3D models from which biovolume / biomass estimates can be made. We are currently developing machine-learning algorithms to automatically identify marine growth from 2D and 3D imagery and are working with industry / regulators to develop these into standard protocols for marine-growth assessment.



### Marine governance, planning & decision-support tools

Expansion of OW relies on understanding key risks and opportunities at different scales and developing approaches to working with stakeholders to address legislative requirements effectively and efficiently.

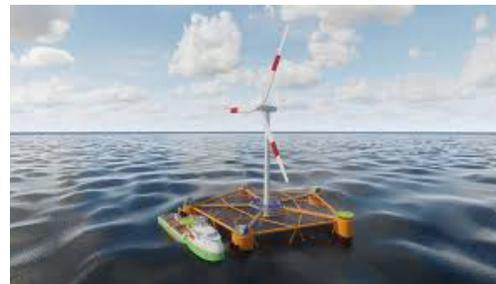
Uncertainty of impacts in the planning and consenting processes is a key challenge in expanding OW, particularly given novel technology and consideration of cumulative impacts associated with the rapid expansion of the sector. Integration of policy and governance expertise with cutting-edge research on key interactions (such as with marine mammals and birds) within UHI provides comprehensive decision-support capacity for OW. UHI also has expertise in developing GIS multi-criteria decision support tools which bring together disparate data sets, and consider data uncertainty to guide siting.



### Fisheries interactions: displacement & co-location

Interactions with existing activities in the marine system such as commercial fisheries are a highly significant consideration in all new offshore marine developments, including OW and associated cabling. The potential for displacement of fisheries and co-location with OW arrays relies on detailed understanding of the baseline conditions and consultation with all stakeholders.

UHI has experience of collection and analyses of fisheries data (vessel track data) to incorporate into decision-support tools to guide the placement of developments and inform Environmental Impact Assessment. In addition, UHI has expertise in baseline studies of fish distribution and post-consent monitoring of changes and device interaction, e.g., disturbance, displacement, habitat creation from artificial reefs, fish aggregation around structures and predators targeting ORE structures for foraging.



### Public perception, socio-economic impact, social licence & carbon footprint

Integrating assessment of socio-economic impacts into planning and decision-making for OW is needed at all development stages of planning, leasing, consenting and for all project developments. In addition predicting and managing potential conflicts with other marine space users (e.g., with fisheries) and the potential benefits of co-location of OW and other activities such as aquaculture, other renewables such as wave / PV into the OW footprint are required. Lifecycle sustainability assessment and carbon footprinting including social aspects – LCA and techno-economic assessment (TEA) – is increasingly required to fully understand the socio-economic consequences of developing new projects.



### Metocean measurement & modelling

UHI has expertise across in-situ measurement, remote-sensing and modelling approaches across scales (temporally and spatially) to inform renewable energy resource management, knowledge of metocean conditions, and flow-structure interactions (e.g., wakes). This includes wave-current interactions, and advanced understanding of turbulent flow, with implications for renewable energy device design, placement, mooring and operation. Oceanographic and hydrodynamic expertise includes wave measurement (radar, wave buoy, AWAC) and modelling (SWAN), together with wider hydrodynamic research (TELEMAC-3D, ADCP, ADV, wave-current interaction, etc.), with extensive marine sensing and measurement equipment available.

### Curriculum & CPD opportunities

UHI works with industry stakeholders and employers to create tailored sectoral provision across the supply chain, including Foundation, Modern and Graduate Apprenticeships, HNC/Ds, Undergraduate and Masters provision, Professional Development Awards and industry-specific CPD programmes.

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