Proposed survey at Gwynt y Mor offshore windfarm – University of Hull and University of Southampton.

Survey aims

Our survey aims to establish the key drivers of benthic community structure, such as sediment characteristics, depth, near bed suspended solids, near bed water column properties, distance and bearing from turbines, distance and bearing from scour wakes, epifaunal community. At a limited number of sites (5-10 max), we would like to deploy an Autonomous Underwater Vehicle (AUV) to observe epifauna and sediment topography, and up to 4 hydrophones to monitor near-bed sound and vibration. Our survey design differs from the traditional BACI (Before After Control Impact) design, which aims to detect impact or change. Often offshore windfarms are located in hydrodynamically active areas with very high natural variability, making change over time and change in relation to anthropogenic activity difficult without extremely intensive sampling. Water quality and sediment/infaunal measurements are seldom collected simultaneously. Our, alternative design aims to establish which environmental parameters are driving benthic community structure and whether the windfarm has any influence. The survey will be conducted at windfarm scale and will be complimentary to high resolution sampling around individual structures which has already been completed by Bangor University as part of the Accelerate project (ECOWind-ACCELERATE - ECOWind).

We hope to carry out the survey work during the weeks of 15th September (AUV/epibenthic surveys) and 21st-30th September (grab sampling), with 2 surveys of approximately 5 days. We will be using the Thames Guardian (Thames Guardian - Vessel Charter | Briggs Marine) for the AUV work and the Mersey Guardian or the Severn Guardian(Mersey Guardian - Vessel Charter | Briggs Marine) for grab sampling, both operated by Briggs (Briggs Marine - Market Leading Marine Expertise). Hydrophones for acoustic measurements will be deployed for 12-28 days.

Survey location

Sampling locations will be agreed with the site owner and operator RWE (who are supporting this work) and will be inside the red box in Figs 1&2. Coordinates are given below and indicate the locations of other windfarm sites, which we intend to avoid. We acknowledge the overlap with the Liverpool Bay Marine Protected Area:

PointID	Long (DD)	Lat (DD)	Long (DM)	Lat (DM)
G1	-3.80111	53.496544	W003° 48.066'	N53° 29.793'
G2	-3.45037	53.573681	W003° 27.022'	N53° 34.421'
G3	-3.35915	53.424921	W003° 21.549'	N53° 25.495'
G4	-3.4159	53.412533	W003° 24.954'	N53° 24.752'
G5	-3.42206	53.431212	W003° 25.324'	N53° 25.873'
G6	-3.48133	53.424909	W003° 28.88'	N53° 25.495'
G7	-3.47419	53.403333	W003° 28.451'	N53° 24.2'
G8	-3.43895	53.407493	W003° 26.337'	N53° 24.45'
G9	-3.61676	53.36842	W003° 37.005'	N53° 22.105'
G10	-3.60802	53.382252	W003° 36.481'	N53° 22.935'
G11	-3.65398	53.392619	W003° 39.239'	N53° 23.557'
G12	-3.65939	53.384039	W003° 39.563'	N53° 23.042'

G13	-3.68714	53.390294	W003° 41.228'	N53° 23.418'
G14	-3.69254	53.379699	W003° 41.552'	N53° 22.782'
G15	-3.62978	53.365544	W003° 37.787'	N53° 21.933'
G16	-3.70883	53.348054	W003° 42.53'	N53° 20.883'

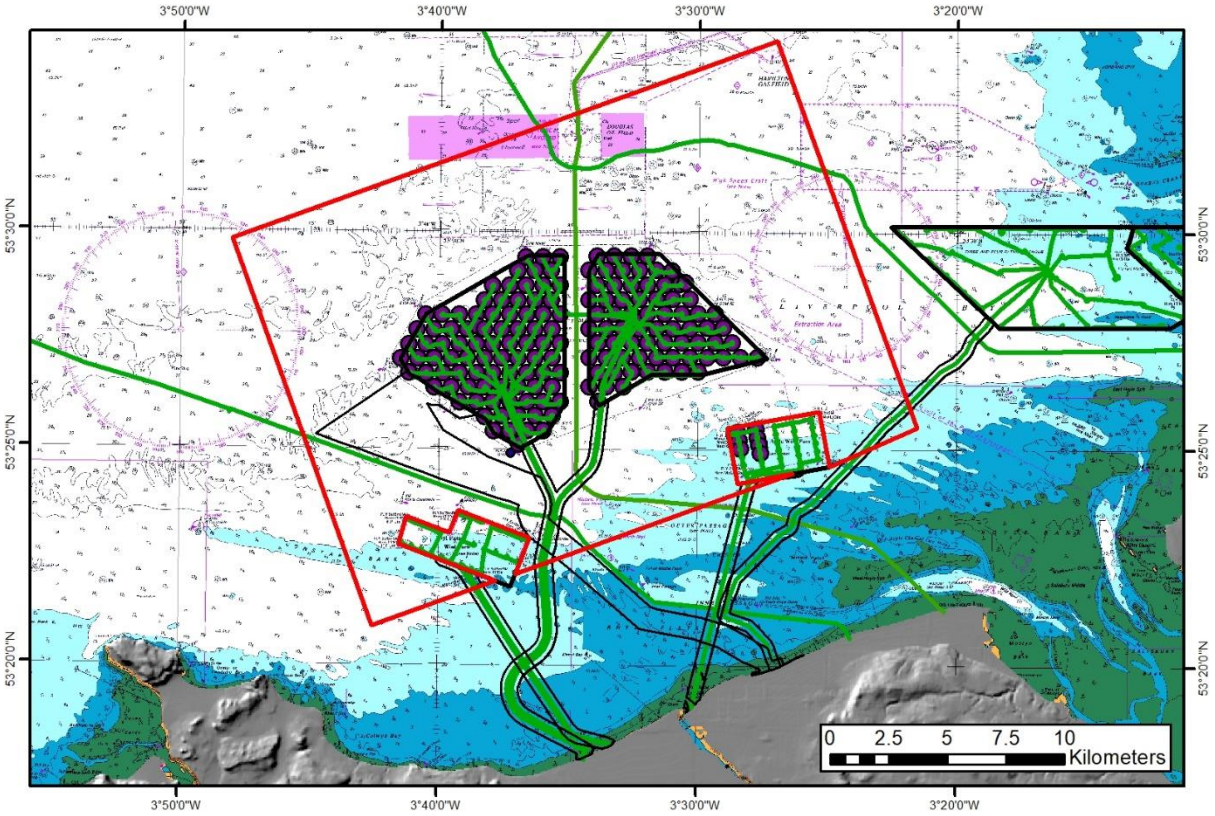
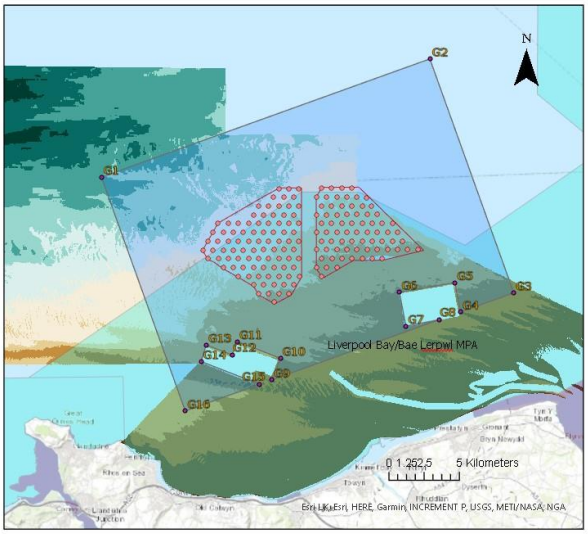


Figure 1. Proposed survey area

Gwynth y Mor Area of Interest (AoI) [include area in designated areas] – Points G1 to G16



Nearby Protected Areas

- Heritage Coast
- Marine Protected Area (OSPAR)
- Ramsar Site, Wetland of International Importance
- Site Of Special Scientific Interest (Uk)
- Special Protection Area

Bathymetry (m)

- 1.001 - 5.7
- 5.701 - 10.4
- 10.401 - 15.1
- 15.101 - 19.8
- 19.801 - 24.5
- 24.501 - 29.2
- 29.201 - 33.9
- 33.901 - 38.6
- 38.601 - 43.3
- 43.301 - 48

Coordinate of theAoI

PointID	Long (DD)	Lat (DD)	Long (DM)	Lat (DM)
G1	-3.80111	53.496544	W003° 48.066'	N53° 29.793'
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Figure 2. Proposed survey area showing overlap with designated sites and other windfarm activities

There are three main components of the survey work:

1. **Marine benthic survey using a Hamon grab to characterise the benthos inside and outside of the windfarm site**
    - We hope to sample 81 stations, broadly arranged as a 9x9 grid, adjusting station location to ensure a range of sediment/community types (Based on baseline survey information), depth, proximity scour wakes and turbine location. We are working closely with RWE (who have offered their support for the survey) and will ensure that all sampling is carried out at a safe distance from subsea cables and any other infrastructure. We will consult with local fishers to avoid conflict with their activities.
    - Grab samples will be immediately transferred to mesocosms on deck (30x30x30cm Perspex boxes), topped up with water and will be maintained on air until the vessel returns to port. They will be unloaded and transported to the laboratory at the University of Southampton on a daily basis.
    - The samples will be maintained in the laboratory for up to 3 weeks. Fluorescent particles (luminophores) will be added as an inert tracer to determine the rate of bioturbation (sediment mixing by infauna) as a measure of ecological function which is currently poorly understood in offshore habitats and, in particular, in windfarm sites. Bromide flux will be measured as a proxy for nutrient flux.
    - At the end of this experiment, a sub-sample will be taken for particle size distribution analysis, organic content and organic carbon analysis. The remaining sample will be sieved through 0.5 and 1mm sieves to match protocols used by marine monitoring organisation but also to provide higher resolution infaunal data to better explain variation in the benthos and bioturbation rates.
    - We will deploy a CDT to measure near bed suspended solids, temperature, salinity, chlorophyll, nutrients immediately before each grab sample is collected.
    - Survey work will be carried out within the 12h daily working limit stipulated by Briggs. We will need to work around the tides (potentially involving early morning or evening work) but there is no intention or need to work over night.
    - On completion of the project, we will be happy to share our data.
    - **If you require more detail, please contact Dr Krysia Mazik, University of Hull. K.Mazik@hull.ac.uk**

2. **Epifaunal survey at 5 sites, including around turbines and scour protection, open sea bed and over cables. Again, this will be with the support and approval of RWE.**
    - Deployment of Autonomous Underwater Vehicle (AUV), Smarty200 at 5-10 sites to collect epifaunal data and high resolution information about the nature of the substratum (type and microtopography)Autonomous Underwater Vehicle SMARTY200 | Southampton Marine and Maritime Institute | University of Southampton
    - We are hoping to deploy the AUV during the week of 15.9.25, using the Thames Guardian (Thames Guardian - Vessel Charter | Briggs Marine).
    - We intend to survey at 1.5 m altitude, increasing altitude to 2 m if initial safety tests show that we can obtain clear enough imagery at the higher altitude. Our planned travel speed at 1.5 m altitude is 0.2 m/s

      Equipment specifications are:

Data processing

Advanced post-processing pipelines can deliver the following data and information products with a rapid turnaround (days):

- Colour corrected and undistorted geotagged imagery[1]
- 3D bathymetry and texture mapped imagery (geotiff, GIS compatible)[2]
- Automated classification of images into user defined classes using self-supervised and efficient semi-supervised machine learning [3,4]

Net Weight	70kg (in air) -1kg (in water)	Mapping altitude	1.2m to 4.2m
Dimensions	2.0 x 0.3 x 0.3m	Velocity	0.25m/s (mapping) 1.5m/s (max.)
Depth rating	200m	Swath, Resolution@2m	Swath 1.8 m, Resolution 0.5mm
Endurance	10h, 8km		
Energy	1.9kWh (Li-ion)		

Table 1. Smarty200 system specifications

Localisation and avoidance	DVL-INS and depth with optional USBL (Sonardyne Sprintnav-mini and AVtrack nano with Micro-ranger 2 USBL) Forward looking Micron (Tritech)	Navigational accuracy ~3% distance traveled with true north seeking gyro compass. 500kHz DVL with bottom tracking from 0.5-200m. Micro-ranger 2 USBL compatible with 1000m range and localisation accuracy 5% of range between AUV and surface USBL head with real-time position update. Forward looking mechanical scanning sonar (700kHz) with horizontal beam 35deg and range 0.3-75m.
Communication	AVtrack nano Surface iridium satellite	9600bps, at up to 1000m range in water 1200bps, global communication via satellite

Table 2. Mapping, navigation and communication specification

- Survey work will be carried out within the 12h daily working limit stipulated by Briggs. We will need to work around the tides (potentially involving early morning or evening work) but there is no intention or need to work over night.
- **If you require more detail, please contact Dr Emma Curtis, University of Southampton, e.j.curtis@soton.ac.uk**

3. **Sound and vibration**
    - Deployment of hydrophones at up to 4 sites (background noise and vibration characterisation) for 12-28 days. The timing of this exceeds the 2 week survey period identified for benthic and epibenthic work.
    - The timing of this survey will be confirmed subject to availability of hydrophones and multi-channel recorders.

Method statement for making acoustic measurements at Gwynt-y-mor windfarm

The acoustic recorder system will comprise a lander with a self contained, battery power autonomous recorder (RS-ORCA). This is shown diagrammatically in Figure 3 with photographs in Figure 4.

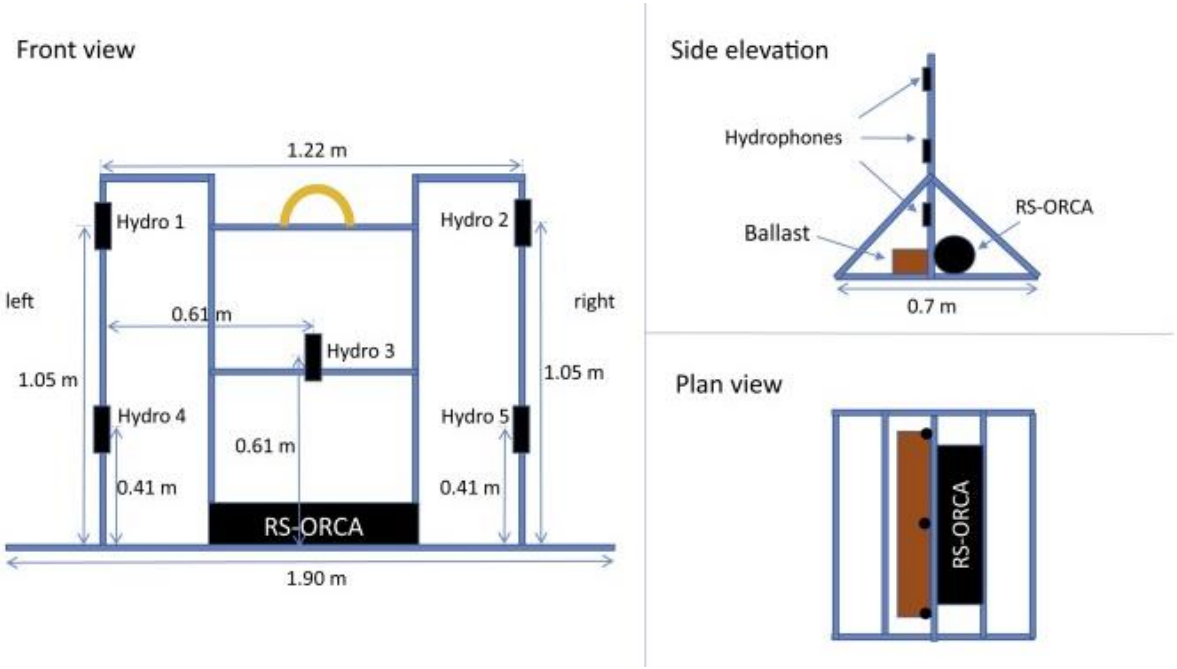
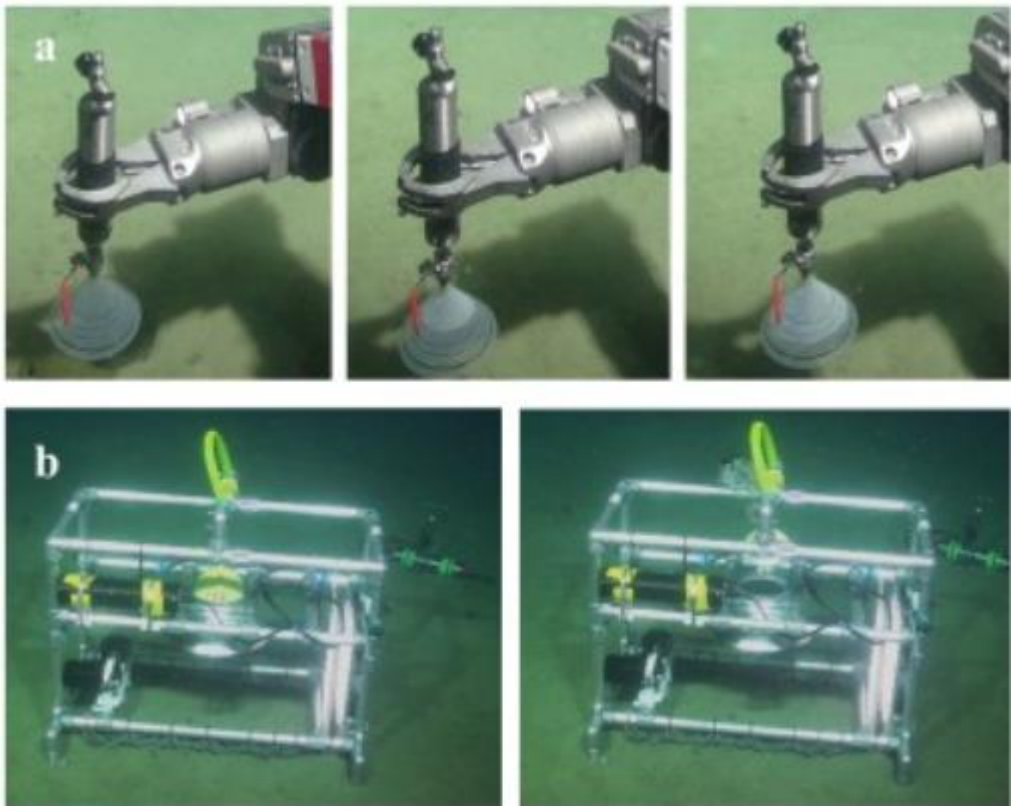


Figure 3: Diagram showing the acoustic lander. 5 hydrophones, labelled Hydro #, connected to a recorder. The frame is made of galvanized steel piping.

The lander will be deployed from the work boat (Thames Guardian Thames Guardian - Vessel Charter | Briggs Marine) and lowered using an A-frame. It will be marked with a surface buoy, which will be attached to the frame and used for retrieval of the system. The recorder will collect data autonomously for the duration of the deployment, which is anticipated to be 12 days, but permission is sought for a period of up to 28 days, to cover the possibility of longer deployment were this to prove feasible.

The complete system is retrieved from the seabed, leaving no material behind, once again using the work boat. The acoustic data collected will allow the estimation of the noise from the windfarm and the use of multiple hydrophones will allow the estimation of the particle motion, the component of a sound field to which fish and invertebrates are most sensitive.

- 

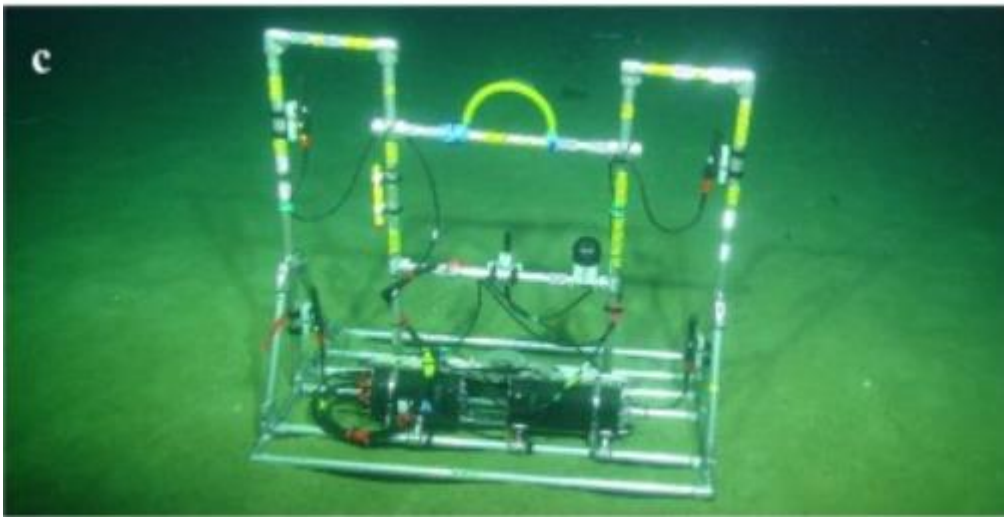
- 

Figure 4. The acoustic lander

- **If you require more detail, please contact Prof Paul White, University of Southampton, p.r.white@soton.ac.uk**