Using a multi-instrument seabed frame to record underwater interactions between diving seabirds, prey, hydrodynamics and turbine structures

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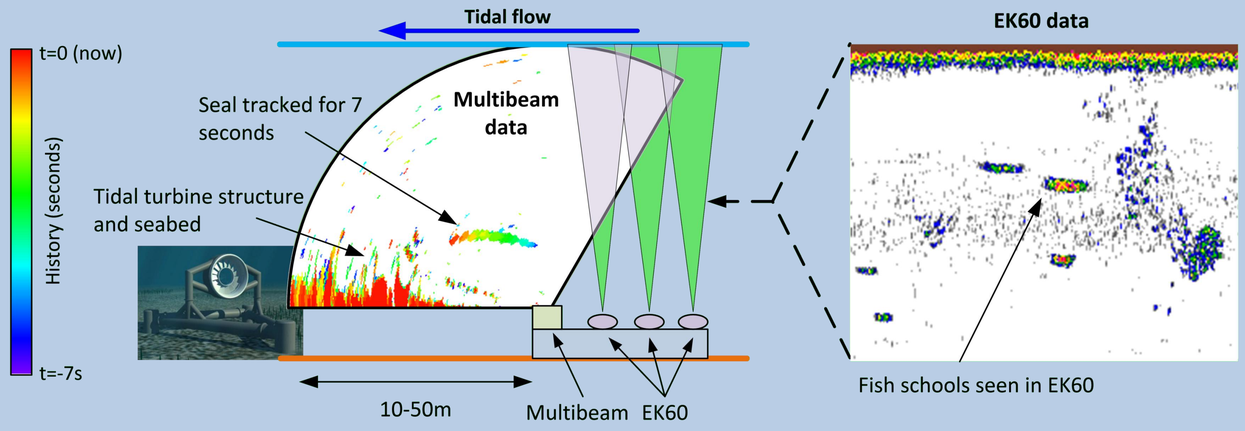
- Despite developments in biologging technologies, it remains largely unknown how seabirds adapt their diving strategies in response to fine spatiotemporal variations in hydrodynamics and prey behaviour. How individuals respond to novel anthropogenic structures is also unknown.
- We present preliminary results from the FLOWBEC multi-instrument seabed frame which uses sonar to simultaneously capture dive profiles, prey behaviour and hydrodynamics at fine spatiotemporal scales during foraging events near turbine structures.

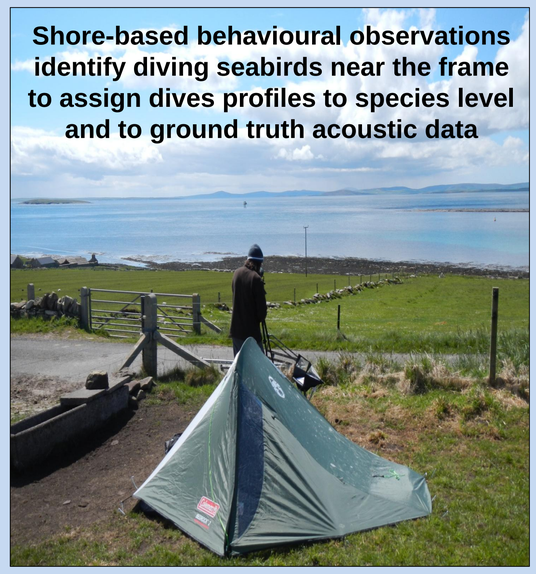
Methods

FVCOM 3D Hydrodynamic Models and Marine X-Band Radar provide concurrent information on fine-scale hydrodynamic processes

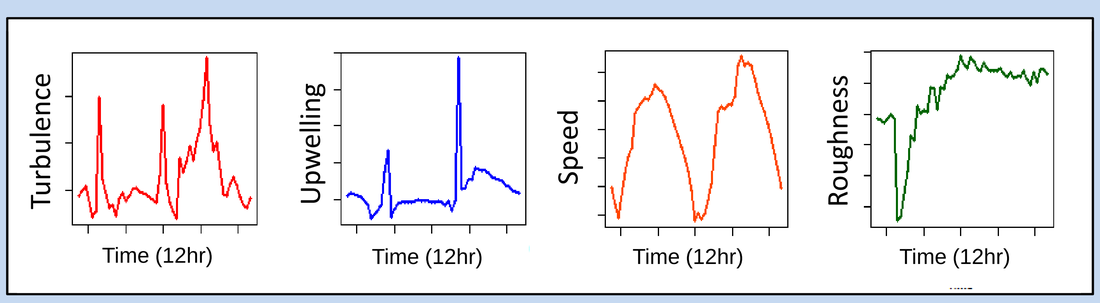
An EK60 multi-frequency echosounder and a multibeam sonar are synchronised to record seabird dives and prey behaviour/characteristics within the water column.



Shore-based behavioural observations identify diving seabirds near the frame to assign dives profiles to species level and to ground truth acoustic data

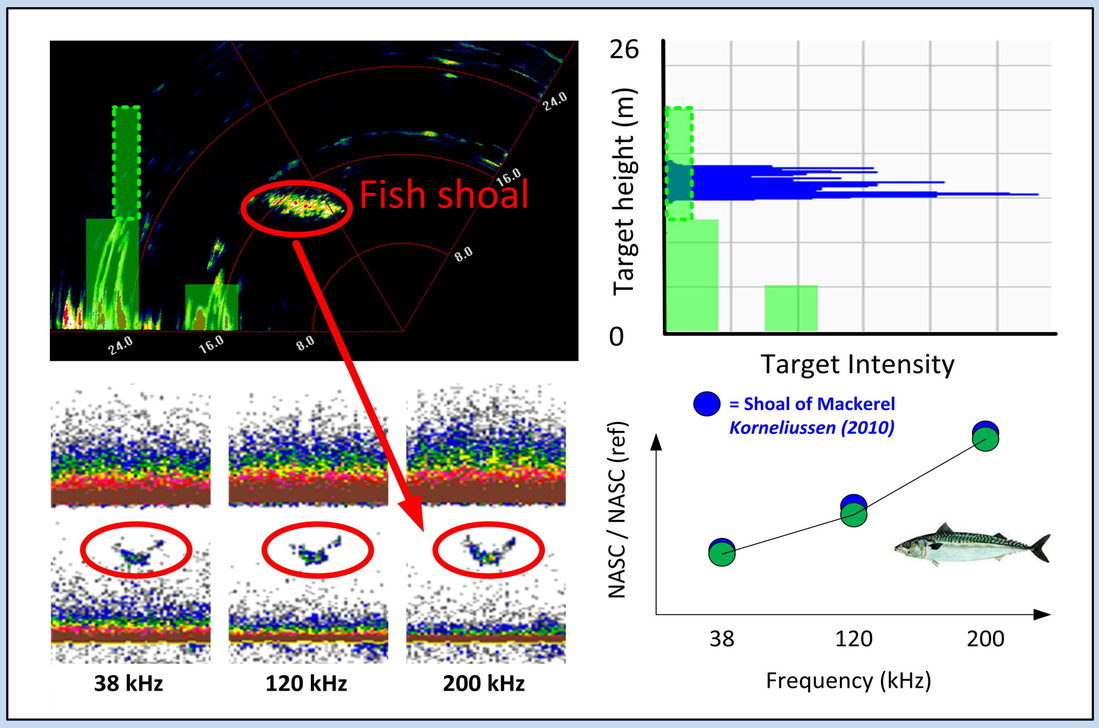


Hydrodynamics



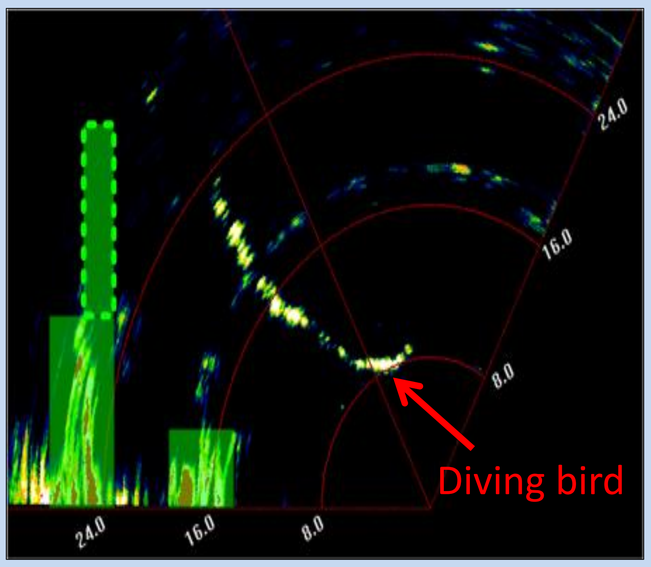
FVCOM 3D Hydrodynamic Model and Marine X-Band Radar outputs showing concurrent measurements of (left to right) turbulence, upwelling, speed and surface-roughness over the FLOWBEC frame.

Prey

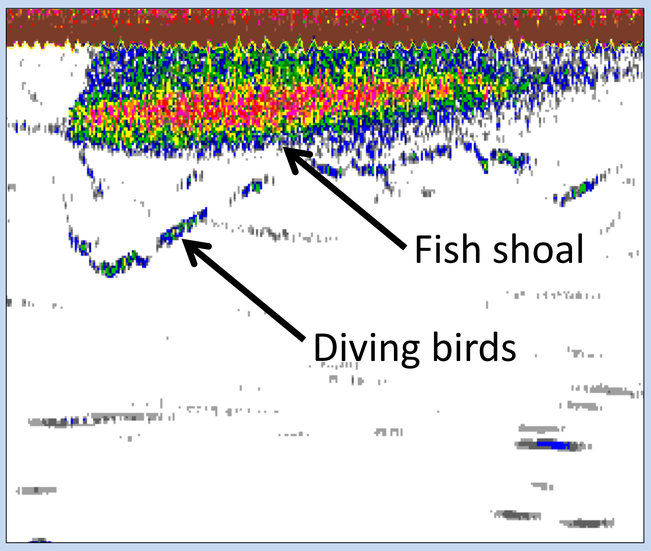


Echosounder and multibeam images of a shoal of fish around a tidal stream turbine reveal shoal depth distribution and morphology. The turbine structure is shown in green and the final blade radius in dashed-green (turbine blades not present in this deployment). The 38, 120 and 200 kHz frequency response graph (bottom right) suggests this is a shoal of mackerel.

Seabirds



A multibeam image of a seabird dive near a tidal stream turbine. The turbine structure is shown in green and the final blade radius in dashed-green (turbine blades not present in this deployment). Dive depths and profiles can be tracked, allowing hypothesis testing and quantitative analysis. This can provide direct empirical evidence of interactions between seabirds and turbine structures.



An echosounder image of a large aggregation of common guillemots and razorbills foraging on a fish shoal. Individuals are seen diving beneath the shoal of fish, possibly herding them towards the water surface to aid capture. Such data can therefore provide insights into predator prey interactions and also interactions among seabirds during foraging activities.

- Preliminary analysis shows that it is possible to extract simultaneous information on seabird and prey characteristics using hydroacoustic methods.
- When coupled with fine spatiotemporal hydrodynamics and shore-based observations, this method provides a powerful tool to investigate seabird diving behaviour.
- This method can provide direct empirical evidence of interactions between deep diving seabirds and turbines.

Acknowledgements

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