

Cullen Scholarship: Celtic Sea acoustic data analytics for improved habitat mapping & ecosystem assessment

(PhD Award)

Background

Key to supporting benthic habitat modelling, ecosystem assessment, and predicting biodiversity distribution under future climate change scenarios, is the ability to effectively and efficiently process, analyse, and calibrate acoustic mapping data. Accurate bathymetry and seabed character mapping radically improve modelling capability and reliability. Recent advances in novel processing and analytics techniques including machine learning, have the potential to make a step-change in outputs derived from seabed mapping activities, increasing their application in benthic habitat mapping and ecosystem assessment & management.

Ireland is fortunate in having one of the most extensive acoustic and biological data resources globally, acquired through decades of seabed mapping (PAD, INSS & INFOMAR) as well as fisheries stock assessment surveys. This has been augmented recently by the EEZ-scale SeaRover reef habitat video data asset (2017-2019), providing invaluable groundtruthing data to assess and calibrate the existing acoustic data.

Additional value can be extracted from available data through;

- (1) Research focus on recent international developments in novel approaches to hydrographic acoustic data analytics & processing, and application of learnings to Irish data resources.
- (2) Strengthening Irish acoustics research collaboration and capacity, leveraging knowledge and support from partners in ongoing initiatives.

Proposal

We propose a **structured four-year PhD project** on a full-time basis to address:

- What novel techniques can be applied to Irish hydrographic acoustic data holdings to automate and/or improve analytics and processing efficiency?
- How can acoustic data analytics outputs best inform Celtic Sea groundtruthing requirements for benthic habitat mapping and integrated ecosystem assessment?
- How can existing groundtruthing data be most effectively used to calibrate (or train) acoustic mapping analysis.
- Assessment of the scalability of the approach and workflows developed to inform other regional Atlantic mapping studies (e.g. Mission Atlantic Case Studies), and/or basin scale mapping & modelling.

To achieve these goals, state of the art novel techniques for processing and analysis of multibeam bathymetry & backscatter data will be assessed, including machine learning. Processing flows will be developed and applied to Celtic Sea data. Existing benthic imagery & sediment groundtruthing data resources including those collated and analysed through EMFF project activity will be assessed to investigate connectivity with processed acoustic data, and improve/train processing outputs in test case areas. Determination of regional groundtruthing requirements will be established to allow future process application to be expanded throughout the Celtic Sea area mapped to date, and to strategically inform other regional mapping approaches, including Mission Atlantic Case Studies.

Outcome

Harnessing Our Ocean Wealth Action 23 focussed on completion of INFOMAR mapping and developing associated 3rd level capacity. The latter is in part successfully progressed through the recent development & delivery of an INFOMAR specific seabed mapping MSc module. This proposal seeks to strengthen related Irish research capacity and improve our understanding of how state of the art acoustic data analytics & processing techniques can underpin efforts in benthic habitat mapping, integrated ecosystem assessment, and marine resource management through a targeted PhD scholarship.

The expected outcomes from the project will be:

- Improved understanding of the relationship between acoustic derived mapping products and actual benthic habitat, improving modelling and predictive capacity.
- Improved national research capacity in hydrographic acoustic data analysis, and novel technique based new workflows and data products.
- Targeted advice and strategic guidance to Government departments on how to deliver cost effective groundtruthing effort, informing baseline habitat mapping and ecosystem assessment, as well as helping to discharge future EU monitoring requirements.
- Scientific publications to disseminate the research findings to the scientific community.

Links to MI Strategy

This proposal falls principally under Strategic Focus Area 3 - Research & Innovation, developing research capacity to support ongoing national and international operational and research programmes. This links to Strategic Focus Area 2 – Forecasting Ocean and Climate Change, specifically through improving our ability to determine seabed character, and in turn improving our benthic habitat, oceanographic & ecosystem modelling capacity. Improving knowledge of the connectivity and interdependence of seabed type, benthic habitat, and oceanographic and environmental bottom conditions will better support future modelling and scenario prediction ability, as well as resource management.

Specific Requirements

The scholar should have a primary degree in maths, natural science or engineering. Experience in the collection and/or analysis of acoustic/hydrographic data sets would be a significant advantage.

Financial Details

Scholarships will be up to €27,500 per annum (maximum funding of €110,000 over four years). This amount comprises a maintenance award of €18,500 (Irish Research Council rate effective 1-Jan-21) to the student as well as payment of fees to the host higher education institution (HEI). The maximum fees payable to the HEI will be €6,000 per annum. The scholarship award also includes a budget of up to €3,000 per annum for eligible research costs (travel & subsistence, publication costs, consumables and other costs e.g. laptop) for the sole use of the student, and are payable on a reimbursement basis direct to the host institution where the postgraduate student (scholar) is registered. There are no overheads payable on the scholarship. Publication costs are intended to cover publications on which the scholar is listed as first author and are published under Open Access.

Marine Institute Co-Supervisor

Thomas Furey, Ocean Climate and Information Services (OCIS) thomas.furey@marine.ie

Alternative contact for queries funding@marine.ie

Project Partnership & Collaboration

The proposal aligns with preliminary MI commitments in support of the H2020 Mission Atlantic project, and aligns with and will be complimentary to ongoing collaborative activities including;

- Joint Geological Survey Ireland & Marine Institute delivery of the DECC funded INFOMAR programme.
- UCC Celtic Sea geomorphology mapping & NUIG habitat modelling research.
- H2020 Mission Atlantic partner activities in St. Andrews & Plymouth Universities, UK, and University of Sao Paulo, Brazil (fisheries acoustics, and machine learning applied to benthic imagery and hydrographic data respectively).
- Atlantic Seabed Mapping International Working Group activities including University of New Hampshire's acoustic mapping expertise and Nippon Foundation-GEBCO Seabed 2030 network and activities.