

Cullen Scholarship: Priority Fishing Areas in a changing climate and in the context of major constraints on ocean area use by MPAs and OREs (PhD Award).

Background

Fishing in Ireland has for many years had access to the bulk of the waters in our Exclusive Economic Zone (EEZ). In recent years this has been increasingly challenged by the establishment of Marine Protected Areas (MPAs) and recently Offshore Renewable Energy (ORE) sites. With the adoption of the 30 by 30 plans to protect 30% of habitats by 2030, and the substantial proposed expansion of OREs, especially in the Celtic Sea, this issue has become much sharper. It has also led to increasing discontent among fishers (<https://www.rte.ie/news/ireland/2023/0301/1359525-fishers/>). This can be seen as essentially a Marine Spatial Planning (MSP) issue. For both MPAs and OREs the spatial requirements are subject to a substantial and relatively clear planning process. However, the same is not true for fisheries, where the use of areas is dependent on the fish distribution, management measures and markets, and to a large extent without any formal designation process.

One potential mitigation would be the identification of the most important areas for fisheries in terms of catches, economic value, and social importance. This would provide a basis for any negotiations for the establishment of ORE sites or MPAs. Simply expressed, it would be advisable not to place a windfarm in an area that is critical for fishery sustainability. This type of approach was recently suggested in the UK as “Fishery Protection Zones”. Very recently, these have been recast as “Seafood production areas” <https://fishingnews.co.uk/news/loss-of-grounds-major-threat-to-industry-future/>. Prof. Mike Kaiser of Heriot-Watt University said in that article “*We need to identify those areas which are important seafood production areas. At the moment we are happy to identify which areas are fit for purpose for wind farms, tidal power and so forth, but nobody is talking about the necessity to identify key areas for fishing.*” This project will set out to identify such Seafood production areas for Irish waters. This would make use of data held by the MI on vessel distribution from satellites (VMS Vessel Monitoring System) combined with information on catches and landings to map hot spots in terms of catch per unit, overall catches, revenue, profits etc. (Calderwood et al 2019).

This historic hot spot mapping can then be used either directly or using the approach developed by Calderwood et al (2019) of using consistency in hot spot observations, i.e. how often they were observed over a number of years. These would then be candidates for Seafood Production Areas. One obvious complication would be that consistency in previous years may not predicate consistency in the future. Fish distributions can change affecting management strategies (Baudron et al 2020; Fernandes et al 2019) and particularly in the context of climate change (Fernandes et al 2020). Changes in fish distribution would be expected to lead to concomitant changes in fisheries distributions. At the same time, we should expect that ORE developments will not likely change their location, being fixed installations. Equally, while MPAs would not have the same links to fixed installations, they would be unlikely to change at the same pace as the fisheries distributions, if at all. So the possibility exists that fish abundance hotspots posited from the recent past may shift in the future to overlap with MPAs or ORE installations.

So in planning for Seafood Production Areas it would be advisable to consider likely shifts in fish distributions in the future, particularly those driven by climate change. Tools for predicting climate change driven changes in fishery distributions are being developed currently in the EU Horizon Europe project SEAwisE (Shaping Ecosystem Based Fisheries Management), in which the MI are partners, and with a case study in the Celtic Sea, where this proposed project will be focused. A

similar approach is present in Nogues et al (2022), using an Ecospace model to predict the effects of windfarms, fishing and climate change on fish and fishery distributions. The MI has been given access to an Ecospace model for the Celtic Sea (Hervann et al 2022), and plans to adapt this for the purposes of this project.

Proposal

We propose a **structured four-year PhD** on a full-time basis to evaluate the potential for identifying Seafood production areas in the Celtic Sea, and for future proofing these in the context of climate change driven changes in fish and fishery distribution. The project will aim to:

1. Map the historic pattern of fishing effort in the Celtic Sea in terms of catches, catch per unit effort, revenue, profit, and social sustainability etc., using MI data holdings, and economic data from BIM. Social indicators for fisheries are also being developed in the SEAWise project mentioned above, and will be applied within this project.
2. Identify hotspots for the above metrics, and identify where these are consistent across recent years. This will include considering the different types of gear used e.g. otter trawls, beam trawls and seines. The study will focus on these mobile gears.
3. Determine how distributions and hotspots of fish are likely to change in the context of climate change and how fisheries would likely change in response. This would apply the methods developed in SEAWise to predict such changes.
4. Analyse how these changes would interact with actual or proposed MPA and ORE sites. This would essentially be an overlap analysis, and could be carried out using a GIS based approach.
5. Propose approaches to Marine Spatial Planning that would identify the optimal allocation of space to MPAs, OREs and fishing.

Project support

This project will be supported by EBFM team staff within FEAS/MI. Support on the VMS and catch mapping will be available from Dr Hans Gerritsen. Support on the hotspot consistency analysis will be provided by Dr Julia Calderwood. Support on the Ecospace analysis will be provided by Dr Jacob Bentley (Natural England), and Prof Didier Gascuel (U. of Rennes, France). Dr Dan Howell (Institute of Marine Research, Bergen, Norway) will also provide support on EBFM approaches. The project will also be supported by partners in the SEAWise project as appropriate, but particularly for the tools for predicting climate change driven changes in fishery distributions. If the proposal is successful we will also develop our links with Prof. Michel Kaiser School of Energy, Geoscience, Infrastructure and Society, The Lyell Centre. Collaboration with the relevant Fishery Producer Organisations (Irish S & W FPO, and Irish S & E FPO) will be incorporated, both POs have long and successful collaborations with the EBFM team at MI.

Location of Scholar

The scholar will be based for circa 50% of their four years at the Marine Institute HQ Rinville, Galway.

Outcome

The aim of this project is to develop the knowledge needed to identify the core areas for fishing. This will initially be from maps of activity, CPUE, catches, revenues etc. While these outputs will be provided as conventional hotspot maps (average catch etc.), it will also be presented in terms of multiannual consistency – where the best catches occur predictably. This information is essential for Marine Spatial Planning in parallel with MPA and ORE developments. Additionally, the project will provide evidence of how these hotspots may change in response to climate change, and finally how both the current and projected hotspots will overlap with planned MPA and ORE developments.

Links with the Marine Institute Strategic Plan 2023-2027

This proposal falls principally under the Strategic Priority: Climate and Biodiversity, **Meeting the Climate, Biodiversity and Food Security Challenges** by providing integrated scientific advice and services to inform government on the optimum location and spatial extent of marine protected areas (MPAs) in Ireland's maritime area for ocean protection and restoration (e.g. through biological, physical and economic assessments).

The project also links to the Strategic Priority: **Deliver Impact Through Research**. The project is expected to have considerable potential impact as the substantial expansion of MPAs and OREs increasingly encroaches on traditional fisheries areas.

The project also links to the Strategic Priority: **Inspiring Stakeholders and Society**. All stakeholders in the expansion of ocean use (ORE, MPA, fishing etc.) are interested in this type of analysis. In particular, the fishing industry is experiencing low morale and hope for the future. Providing them with the type of information needed to maintain their "core areas" will likely be an "inspiration" based on recent informal discussions with individual skippers and representatives.

Specific Requirements

The scholar should have a primary degree in marine environment and ecological science and ideally a master's level degree in a similar appropriate field. The scholar should be computer literate and able to carry out statistical analyses with appropriate software, ideally R. They should have a strong interest in marine conservation, biodiversity, and the protection of our important marine ecosystems, as well as the human use of these ecosystems, particularly sustainable fisheries. Additionally, experience in working with fishery stakeholders and marine ecosystem modelling would be valuable (preferably using Ecopath with Ecosim, and maybe Ecospace).

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. Scholars can also supplement this funding by applying to the Marine Institute's Networking & Marine Research Communication Awards annual call.

*There is a national review underway of the PhD annual student stipend payment, which is expected to result in a rate increase, and the Marine Institute will adjust the total funding accordingly following the completion of this review.

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References

Baudron, A.R., et al (2020). Changing fish distributions challenge the effective management of European fisheries. *Ecography* 42: 494-505. <https://doi.org/10.1111/ecog.04864>

Calderwood, J., Robert, M., Vermard, Y., Radford, Z., Catchpole, T.L., & Reid, David G. (2019). Hotspot mapping in the Celtic Sea: An interactive tool using multinational data to optimise fishing practices. *Marine Policy*: <https://doi.org/10.1016/j.marpol.2022.105389>

Fernandes, J. A., L. Rutterford, et al. (2020). Can we project changes in fish abundance and distribution in response to climate? *Global Change Biology*. 26.7: 3891-3905. <https://doi.org/10.1111/gcb.15081>

Fernandes, P. G. and N. G. Fallon (2019). Fish distributions reveal discrepancies between zonal attachment and quota allocations. *Conservation Letters*. 13:3 . <https://doi.org/10.1111/conl.12702>

Hervann, P.-Y., D. Gascuel, et al. (2020). The Celtic Sea Through Time and Space: Ecosystem Modeling to Unravel Fishing and Climate Change Impacts on Food-Web Structure and Dynamics. *Frontiers in Marine Science* 7(1018). <https://doi.org/10.3389/fmars.2020.578717>

Nogues, Q., E. Azañón, et al. (2022). "Spatialized ecological network analysis for ecosystem-based management: effects of climate change, marine renewable energy, and fishing on ecosystem functioning in the Bay of Seine." *ICES Journal of Marine Science*. 79, 1098–1112. <https://doi.org/10.1093/icesjms/fsac026>