Post-Doctoral Fellowship: Proposal Outline

Topic	Combined upper and lower trophic level modelling system to examine ecosystem responses to changing climate and human activities
Research Theme(s)	1) Climate Change 2) Ecosystem-based fisheries management 3) Marine spatial planning 4) Renewable Energy
Background and Rationale	Modelling approaches are often used to understand and simplify processes that occur within the physical, chemical and biological marine domain. To date, these modelling approaches have used either dynamic lower trophic level models (focused on physical and chemical processes and primary productivity) or upper trophic level food web models (including all major functional species groups) to explore the current drivers in the system and to assess how climate and human activities may affect ecosystems in the future. Many issues of concern to marine policy makers require a combined modelling approach where many scenarios can be parameterised and tested. This enables issues including invasive species, distribution and abundance changes in commercially important fish species, designation of marine protected areas and likely impacts from the roll-out of offshore renewable energy installations in our waters to be thoroughly investigated to inform future planning and management decisions. This proposal aims to provide the marine modelling framework for ongoing scenario testing of critical marine issues to inform the decision making process.
Scope of Research (Scientific/ Technical Challenge)	The overarching aim of this fellowship is to develop a new modelling framework that enables lower and higher trophic level models to be combined in a single analysis framework. This will allow stakeholders to explore various changes to ecosystems that can inform fisheries management decisions, marine spatial planning (including designation of marine protected areas) and the impacts of proposed offshore renewable energy developments on marine ecosystems (among others).

	The fellowship will address key research objectives as follows:
	- Set-up a dynamic lower trophic level model of the Celtic Sea(s) validated against all available physical, chemical and primary productivity data sets. - Feed critical data fields from the lower trophic level model into the Ecopath with Ecosim (EwE) model environment. - Make the upper trophic level model spatially explicit by implementing the Ecospace elements of the model system. - The EwE/Ecospace model will be configured based on the ecosystem function of the so-called "functional groups, rather than the normal practice of aggregating some species, while keeping others individually. - The model will also be set up with dummy functional groups that can be populated based on specific request for advice. - Define specific management and ecosystem (e.g. climate change) scenarios that stakeholders in government need to evaluate using this new combined modelling approach. - Conduct end-to-end model experiments based on the scenarios of interest to stakeholders and provide outcomes of experiments to these stakeholders - Document the model set-up so that it can be operationalised for routine use by policy makers in the years to come. - Publish the study results in the peer-reviewed literature for the wider scientific community.
Expected Impact(s)	The modelling framework will be available to policy makers in DAFM, DHLGH, DECC and other government departments to test various future scenarios for marine ecosystems under varying projected climate change and future human activities. The fellow will leverage previous activity in ecosystem modelling for the Irish Sea (Bentley et al 2018, a & b, 2019, a & b; 2020 & 2021) and make this available to the ICES community so that the research can be applied more widely. The modelling system developed will build national human capacity in end-to-end modelling and be available after the conclusion of the fellowship as a documented ongoing resource for the community. Specialised research of this nature provides a strong platform to leverage international collaboration and competitive research funding under programmes such as Science Foundation Ireland, INTERREG and the missions of Horizon Europe. The fellow will produce specific policy advice (using stakeholder defined issues of concern) and publish their research findings as widely as possible through peer-reviewed papers, conference presentations, articles, etc.

Outcomes	Various scenarios of ecosystem change examined and likely outcomes provided to policy makers in DAFM and elsewhere in government. This would particularly include spatial management of multiple ocean use (e.g. MPAs, offshore wind farms (ORE) and fishing) and also specific management measures envisaged for fishing, MPAs etc. Human capacity developed in end-to-end modelling, a critical gap in the ability to provide advice in an Irish context. Modelling system documented and available post fellowship to examine further scenarios as required.
Specific Collaboration	Formation of a management stakeholder group comprising DAFM (fisheries management and aquaculture), DECC (offshore renewable energy) and DHLGH (marine spatial planning and MPA designation). Where appropriate this might include wider stakeholders e.g. fishery organisations, ORE operators, and eNGOs, either separately or together with management stakeholders. Marine Institute - Ocean modelling team in OCIS and Ecosystem-based Fisheries Management team in FEAS, and potentially Marine Spatial Management team in MEFSS. The project will also collaborate with appropriate working groups in ICES, as well as STECF and other EU bodies. The EwE/Ecospace component will be developed in collaboration with experts in the University of Rennes, France and Natural England (Jacob Bentley – developer of the Irish Sea EwE model). Existing collaborations with ATU, University of Galway, and UCC will also be integrated into the project.
Location of Fellow	Marine Institute, Rinville, Oranmore. Postdoctoral fellow to work between OCIS (Oceans, Climate and Information Services) and FEAS (Fisheries Ecosystems Advisory Services) under the joint supervision of Dr. Glenn Nolan (Glenn.Nolan@Marine.ie) and Professor Dave Reid (David.Reid@Marine.ie).
Duration and Funding Available	4 years €100,000 per annum (i.e. total €400,000 maximum for duration of four years)

| References | Bentley, J. W., Serpetti, N., Fox, C., Reid, D.G., Heymans, J. J. (2018a). Modelling the food web in the Irish Sea in the context of a depleted commercial fish community. Part 1: Ecopath Technical Report. Oban, Scottish Association for Marine Science: 147.

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