Cullen Scholarship: Understanding connectivity and adaptation of wrasse species in Ireland (PhD Award)

Background

Wrasses (family Labridae) are a diverse and ecologically significant group of marine fish found in coastal environments along the Northeast Atlantic coast. These species play key roles in marine ecosystems, especially in inshore habitats. In recent years, species of wrasses have been targeted commercially to be used a cleaner fish in salmon farming.

Ireland is home to several species of wrasses: the Ballan wrasse (*Labrus bergylta*), the Goldsinny wrasse (*Ctenolabrus rupestrus*), the Corkwing wrasse, (*Symphodus melops*) and the Rock cook wrasse (*Centrolabrus exoletus*). While all species have been found to be effective in sea lice removal, only two species are more commonly used in Ireland for this purpose, Corkwing and Ballan wrasses. Despite the increasing commercial importance, the status (abundance and fishing mortality) of Goldsinny, Corkwing and Rock cook wrasses is unknown (Ireland's Marine Strategy Part 1 : Assessment of the Marine Environment), Furthermore, Ballan wrasse has been included in the OSPAR List of Sensitive Species and in the Celtic Sea area, the OSPAR area Ireland belongs to, this species has been listed as "declining" (Lynam et al., 2022).

Hence, despite their ecological importance, the population genetics of wrasses, particularly in the context of Ireland's coastal ecosystems, remains poorly understood. This gap in knowledge represents a significant opportunity to explore how environmental factors such as habitat connectivity, environmental conditions, and human impact (including exploitation) influence populations of wrasse species in Ireland, as well as to inform conservation strategies and sustainable management practices.

Only a handful of genetic studies have been carried out. Previous studies using mitochondrial DNA sequences found no structure at a local scale, but a break in the North Sea, between Ireland and the UK versus Scandinavian countries (Ballan wrasse: D'Arcy et al., 2013; Corkwing wrasse: Knutsen et al., 2013; Goldsinny wrasse: Jansson et al., 2017). More recent investigations carried out on Norwegian populations using more powerful genomic markers have instead showed that local structure is present in Goldsinny wrasse (Jansson et al., 2020; Jansson et al., 2023) and Ballan wrasse (Seljestad et al. 2020).

It is indeed widely accepted that genomic approaches like Whole Genome Sequencing are the ones available to detect structure and adaptation (if present) in wide populations of marine fishes (Andersson et al., 2024), as they have shown to be powerful enough to distinguish populations of widely distributed species like herring (Han et al. 2020; Farrell et al. 2022) and horse mackerel (Fuentes-Pardo et al. 2023). Finally, the data generated can reveal crucial information about a species, about how they can and will respond to change and anthropogenic impact through signatures of selection. Climate-associated adaptation has been revealed in marine taxa thanks to high-depth genomic sequencing, and they can "future-proof" management decisions (Layton et al. 2024), and for this reason such approaches should be used.

Proposal

We propose **a structured four-year PhD** on a full-time basis to investigate connectivity and local adaptation of wrasses of commercial importance in Ireland using genomic approaches. While not all wrasse species have to be included, Ballan wrasse should, given its "declining" status.

The project will aim to:

1. Investigate genomic differentiation among wrasse populations in various regions of Ireland's coastline.
2. Produce estimates of effective population size
3. Examine the influence of environmental factors and anthropogenic impact on wrasses' genomic diversity
4. If levels of differentiations are high, genomic data should be used to design a molecular tool that could be used for future management measures (i.e. SNP panel)
5. Provide data-driven recommendations for management strategies, with a focus on the preservation of wrasse biodiversity in Irish waters.

Location of Scholar and Training Provided at the Marine Institute

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

The scholar will be trained in the use of fisheries databases, and collation of biodiversity data. In particular, the scholar will be expected to participate in fisheries surveys and will receive the required training to do so.

Outcome

The expected outcomes from the project will produce the first ever detailed investigation on structure and adaptation of wrasses in Ireland. It is expected that the project will result in at least three high-impact peer-reviewed papers and could potentially be used to design a molecular tool that could be used in future investigations, like a panel of SNPs. The results will be relevant for management purposes and the future cycles of the Marine strategy Framework Directive.

Marine Institute Corporate Strategy 2023-2027

Under the strategic priority "Delivering impact through research and innovation" of the Marine Institute's corporate strategy Ocean Knowledge that Informs and Inspires, this research will address strategic initiative number 1 (*Deliver integrated, high-quality, and efficient services to meet the needs of our parent department, the Department of Agriculture, Food and the Marine (DAFM), with a focus on sustainable food production from the ocean, and implementation of the Common Fisheries Policy and Food Vision 2030*) and 4 (*Deliver on agreed commitments to the Department of Housing, Local Government and Heritage (DHLGH) related to OSPAR, the Marine Strategy Framework Directive, the*

Water Framework Directive and the National Marine Planning Framework) by improving the knowledge of species that are commercially exploited and are key biodiversity elements in Irish waters.

Specific Requirements

The scholar should have a primary degree in marine zoology and ecological science or bioinformatics 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 in R and the Linux environment. 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.

Financial Details

Scholarships will be up to €34,000 per annum (maximum funding PhD of €136,000 over four years). This amount comprises a maintenance award of €25,000 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, such as minor kit purchase e.g. camera) 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.

In addition, the cost of a laptop will be covered by the Marine Institute (purchased via the Research Funding Office).

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