Foras na Mara
Marine Institute

Cullen Scholarship: Development & Implementation of novel molecular assays for the routine detection of toxigenic and harmful phytoplankton species in Irish coastal waters and sediments
(PhD Award)

Background

Ireland has a diverse and varied production of bi-valve molluscan shellfish species around its coastline, encompassing over 100 classified shellfish aquaculture areas for the production and harvesting of marine bi-valve molluscan species, including mussels, pacific and native oysters, clams, cockles, razor clams and scallops.

Marine biotoxins are naturally occurring and are produced by a small number of phytoplanktonic species, referred to as Harmful Algal Bloom species (HABs), which are ingested by filter feeding bivalve molluscs, where these biotoxins can accumulate within the tissues of the shellfish. If these intoxicated shellfish are consumed, the ingested toxins can give rise to several associated human illness syndromes when above regulatory levels.

Current methodologies for the determination and enumeration of HAB species for routine monitoring programmes rely on light microscopy, however, many of the toxigenic causative species which comprise the Irish marine biotoxin profile, can only be identified to genus or group level. As many genera contain both toxic and non-toxic species, and in some cases, have both toxic and non-toxic strains. Therefore, it is difficult to accurately forecast or predict the onset of an incoming toxin event to give adequate warning to the shellfish industry, with traditional microscopy identification methods for HAB identification.

Rational for the proposed research to be undertaken is to provide enhanced monitoring tools and novel molecular methods for the high throughput, fast analysis and reliable determination and differentiation of toxigenic and harmful species which can be incorporated into a routine monitoring programme to alert industry and competent authorities of the onset or impending occurrence of a HAB event occurring in commercially important aquaculture production areas.

Currently, due to the expanding knowledge of the diversity of these species, strain and toxin production differences, and also recent toxin events in new production areas, there is an increasing demand for novel molecular methods to be developed, validated and implemented.

Proposal

We propose **a structured four-year PhD project** on a full-time basis to research, validate and implement novel molecular assays for the identification and quantification of toxic/harmful algal species and strains into routine methods to support and complement the existing statutory monitoring programmes, where the results and information will feed into existing early warning systems on the

short term predictive forecasting of the onset of forthcoming HAB events which impact on aquaculture production and harvesting.

The project will aim to:

- Conduct a global review of the suitability of the existing molecular methodologies in place for the detection of HAB and emerging novel toxin species, and assess their suitability for the Irish toxin profile and the current knowledge regarding diversity of HABs species.
- Comparison of different methodologies and their technical specifications for detection and speciation from a variety of different techniques including Next Generation Sequencing (NGS), eDNA, genetic biomarkers, metabarcoding and PCR assays.
- Select and identify the most promising and suitable molecular methods for targeted species detection and review in detail the scope their specificity.
- Design, validate and implement new and existing assays for species and strain detection and quantification. The designed assays should reliably detect, quantify and distinguish between species/strains.
- Compare molecular and sequence identification with taxonomic identification by microscopy (light, epi-fluorescence, SEM) on species of interest.

Outcome

The scholar will engage and have access to the molecular laboratories of the phytoplankton unit in the Marine Institute and will have opportunities to participate on the annual HAB phytoplankton surveys aboard Marine Institute's research vessels.

The expected outcomes from the project will be:

- The validation and implementation of molecular methods for the detection and quantification of HABs species in Irish coastal waters and sediments into a routine monitoring programme.
- The assays designed will have a high sensitivity to detect and quantify toxigenic species at very low cell densities.
- The re-design of existing molecular assays for the species differentiation of *Pseudo-ntizschia* spp. To further distinguish between ribotypes of specific toxigenic species, i.e. *Azadinium spinousm*, *Azadinium poporum* and *Alexandrium minutum*.
- Development of methods should be in place for the future detection of emerging novel HAB species; *Vulcanodinium rugrosum, Ostreopsis* spp., *Gambierdiscus* spp., and also those phytoplankton species which are implicated in finfish and benthic mortalities.
- Peer reviewed publications detailing the methodologies and results of developed assays, and also publication of the detailed biodiversity profile of HAB species and strain differences.

Links to MI Strategy

This proposal falls within *Strategic Focus Area 1 – Scientific Advice and Services*, specifically the strategic initiatives of meeting the needs of decision makers, delivering integrated quality services and strengthening stakeholder relationships. The proposal also aligns to *Strategic Focus Area 3 – Research*

& Innovation, which aligns to our provision of scientific advice and services in the area of food safety and biodiversity.

Specific Requirements

The scholar should have a primary degree/post graduate qualification in a biological or molecular science discipline, with an interest, or ideally previous experience in biodiversity, molecular design and assay development, techniques and their application. The host institute should have a proven track record in molecular methods and/or research.

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.

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