PhD Postgraduate Research Opportunity

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

Funding: Funding: This Cullen Scholarship will be administered by the Marine Institute and funded by the Institute under the Marine Research Programme with the support of the Irish Government.

Short description

A four-years (CULLEN) PhD scholarship is available to take part in a research collaboration between Galway-Mayo Institute of Technology (GMIT) and the Marine Institute (Galway), in Ireland. This full-time research opportunity will aim at validating and implementing 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. The project will involve field (e.g. participation to the annual HAB phytoplankton surveys aboard Marine Institute's research vessels) and laboratory components (e.g. development of targeted quantitative real-time PCR (qPCR) assays and metabarcoding analysis following High Throughput Sequencing (HTS)). It is envisaged that findings will generate high-impact scientific evidence that will feed into existing early warning systems on the short-term predictive forecasting of HAB events which impact on Irish aquaculture industry and ultimately human health.

Background and project details

Research topic

Ireland has a diverse and varied production of bi-valve molluscan shellfish species around its coast-line, 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 bi-valve 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. Many genera contain both toxic and non-toxic species, and in some cases, have both toxic and non-toxic strains at the intra-specific level.

Therefore, using traditional microscopy identification methods it is difficult to accurately forecast or predict the onset of an incoming toxin event to give adequate warning to the shellfish industry. 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. Thus, the rationale for the PhD research programme is to provide enhanced monitoring tools and novel molecular methods for the high throughput, fast analysis and reliable determination and differentiation of relevant toxigenic and harmful microalgae 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.

This structured four-year PhD scholarship will be 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. The scholar will engage and have access to the molecular laboratories of GMIT's Marine and Freshwater Research Centre (MFRC)(https://mfrc-gmit.ie/) and the phytoplankton unit in the Marine Institute (https://www.marine.ie/Home/site-area/areas-activity/marine-environment/phytoplankton-monitoring). It is expected that findings will generate high-impact scientific evidence that will feed into existing early warning systems on the short-term predictive forecasting of HAB events which impact on Irish aquaculture industry and ultimately human health.

The main objectives of the project will be 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 species/strain identification using a variety of different techniques including targeted quantitative real-time PCR (qPCR) assays and metabarcoding analysis following High Throughput Sequencing (HTS) of a range of source sample types (e.g. environmental or host specimens).

• Select and identify the most promising and suitable molecular methods for targeted species detection and review in detail the level of their specificity.

• Design, validate and implement 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.

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.

• Present findings at relevant national and international conferences

• 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.

Foreseen key responsibilities:

• Develop and apply appropriate sampling protocols

• Conduct field work for sample collection, including participation on the annual HAB phytoplankton surveys aboard Marine Institute's research vessels

• Conduct molecular laboratory procedures, including DNA extraction, gel electrophoresis, DNA/RNA quantification, PCR, qPCR, dPCR, library preparation for HTS, and Sanger sequencing for DNA barcoding;

• Execute analytical pipelines for the processing of metabarcoding using a range of second and third generation sequencing platforms (e.g. Illumina and Oxford Nanopore Technology);

• Establish and maintain a reference database for biological and genetic data;

• Maintain laboratory notebooks, research records and generate technical reports and data as required by the management team;

• Disseminate findings by means of conference/symposia contributions and publication in peer-reviewed scientific journals.

Requirements/Qualifications:

Minimum requirements:

• An Honours Degree (minimum 2.2 BSc) in Biology, Molecular Biology, or equivalent/relevant area.
• Some experience with basic molecular techniques such as Nucleic Acid extraction, PCR and gel electrophoresis.
• Expertise in either field and/or laboratory experimental design.
• Evidence of planning and executing concurrent tasks as an individual and as part of a research team.
• Must be fluent in spoken and written English.
• Proficiency in communication, initiative, flexibility and organisational skills.

Additional desirable requirements:

• Publication track-record and strong technical report writing and presentation skills.
• Experience in DNA-based field approaches, including sample acquisition and nucleic acid isolation.
• Experience in DNA-based laboratory approaches, including quantitative real-time PCR (qPCR) and sample preparation for High Throughput Sequencing (HTS).
• Experience with metabarcoding data handling/processing and associated bioinformatics.
• Experience working in a "clean room" environment and/or an accredited molecular laboratory (e.g. ISO17025 standard).
• Have a full (international EU) driving licence.

Project Duration: 4 years

Conditions:

• €18,500 Stipend per annum.
• Postgraduate fees for EU students will be covered by the project.
• In addition, any necessary travel, training and material costs incurred during the project will be covered.

Please Note: Candidates from outside the EU are eligible to apply but may be expected to provide evidence of sources of additional funds to cover excesses associated with Non-EU fees.

If either English or Irish is not the applicant's first language, evidence of English language proficiency is required for registration. Please refer to web link: English Language Requirements | GMIT | Galway Mayo Institute of Technology to view the minimum English language proficiency standards for entry to GMIT

Project Start Date: Not later than April 2022

Application Closing Date: Thursday 27th January 2022, at 12 Noon (IST, UTC+01:00)

Applicants should submit their:

- Curriculum Vitae (including 2 referees contactable prior to interview stage)
- Copy of transcript of results
- and a Personal Statement to: ***the Research Office e-mail address* ResearchOffice@gmit.ie *only*,**

Please ensure all documents are emailed as a single Word or PDF file.

The Personal Statement should not exceed 2 pages and should explain:
• How you meet the minimum and how you plan to meet the desirable requirements of the position
• What is your motivation and interest in the topic, with specific reference to details provided in this advert
• Why you would like to pursue a PhD research programme

For further information on the project please contact: Dr Luca Mirimin (luca.mirimin@gmit.ie)

Data Protection Statement

GMIT takes very seriously its legal obligations as set out in the General Data Protection Regulation 2016/679 (GDPR) and the Irish Data Protection Act 2018 to safeguard and protect your personal information in our possession. The personal information which you disclose to us in this form will only be used to assess your suitability; administer and register you for this scholarship. We will not keep your personal information for any longer than is necessary for those stated purposes. **For more details, please refer to GMIT's Student Privacy Statement:** http://www.gmit.ie/general/student-privacy-statement