Best Aquatic Environment Poster Presentation at Environ 2023

Winner: Nicole Caputo, Atlantic Technological University Galway

Development & Implementation of molecular assays for the routine detection of toxigenic and harmful phytoplankton species in Irish coastal waters and sediments

Harmful Algal Blooms (HABs) are natural phenomena and refer to a rapid proliferation of certain phytoplankton species that can produce potent biotoxins and can cause discoloration of the water with ecological, economical and human health issues. Given the importance of these events and their role in coastal ecosystem services and food safety, legislative national monitoring programmes are in place worldwide. In Ireland, the national phytoplankton monitoring program is conducted by the Marine Institute, under the authority of Sea-Fisheries Protection Authority (SFPA) and the Food Safety Authority of Ireland (FSAI).

Diatoms and Dinoflagellates are the two main groups of toxic-producing microalgae; they are naturally ingested by filter-feeding bivalve molluscs (i.e. mussels, oysters, clams) and can lead to human intoxication and poisoning if the toxins exceed regulatory levels. The majority of shellfish production closures in Ireland are the result of phytoplankton species from the genera *Dinophysis*, *Azadinium*, *Alexandrium* and *Pseudo-nitzschia*. Human syndromes caused by members of these genera include: Diarrhetic Shellfish Poisoning (DSP);

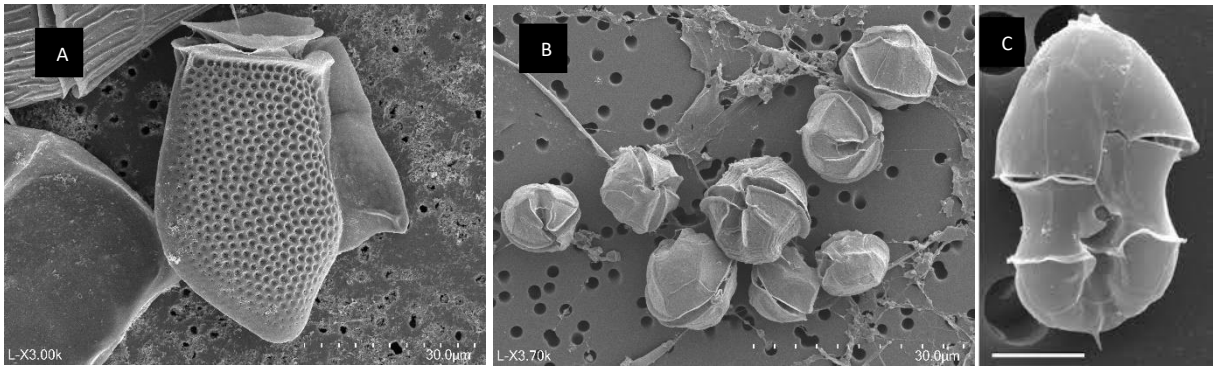

Figure 1. Scanning Electron Micrographs (SEM): Phytoplankton Species. (A) *Dinophysis acuta*, (B) *Alexandrium* sp., (C) *Azadinium spinosum* (scale bare 5 µm). Credits: A-B: Jonathan Kelly (Marine Institute, Ireland); C: Tillmann et al., 2009.

Azaspiracid Poisoning (AZP); Paralytic Shellfish Poisoning (PSP); Amnesic Shellfish Poisoning (ASP).

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, novel and advanced monitoring techniques are required to give adequate warning to the shellfish industry.

My PhD research focuses on expanding knowledge of the diversity of these species in Irish water and on developing new accurate molecular methods for the high throughput, rapid analysis and reliable determination and differentiation of relevant toxigenic and harmful microalgae species, which can be implemented into a routine monitoring programme. In particular, High-Throughput Sequencing (HTS), quantitative PCR (qPCR) and digital PCR (dPCR) are extremely sensitive methods that have been applied in recent years to identify and estimate species in environmental samples. Nevertheless, molecular applications are strongly influenced by the DNA extraction method used and the risk associated with the expansion of emerging toxin-producing species towards higher latitudes need to be assessed. I am working on comparative experimental studies and validation of target-specific assays to

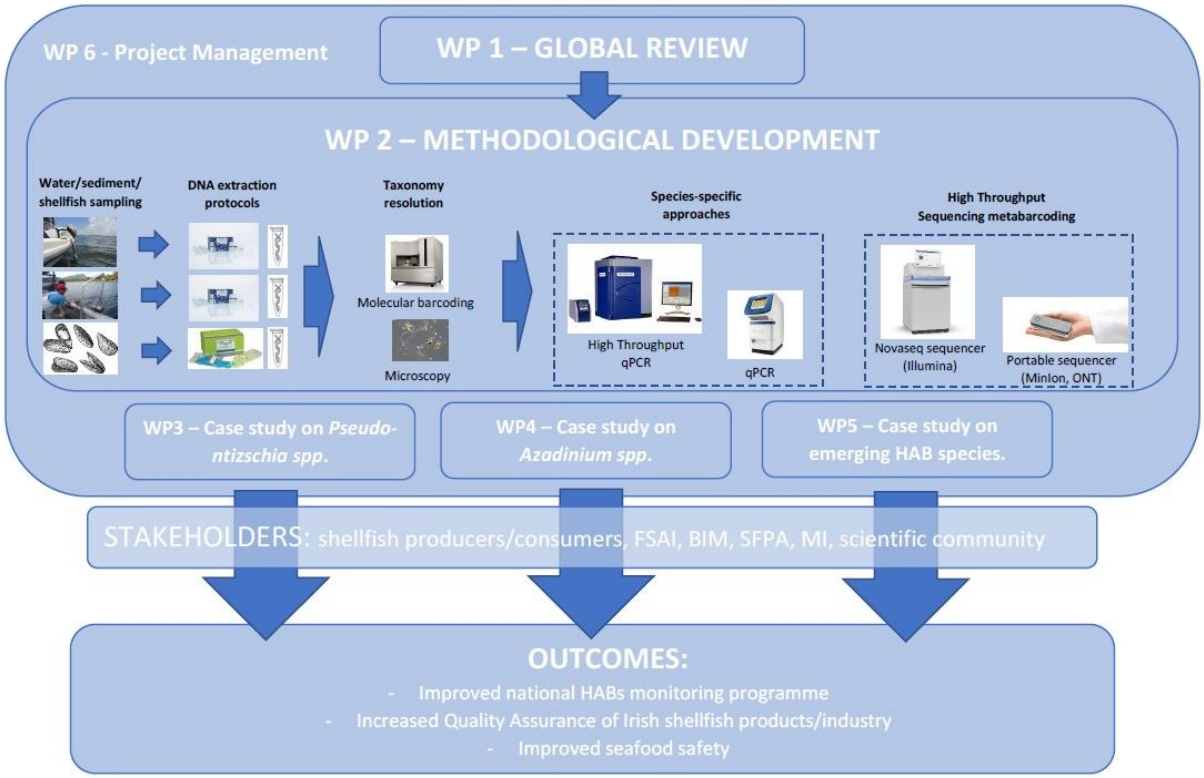

Figure 2. Overview of my four-year PhD project structure divided in six Work Packages (WP).

investigate the sensitivity and specificity of methodologies for real-time detection of phytoplankton species in the marine environment, with the final goal to improve national HABs monitoring and seafood safety.

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