Knowledge Transfer Report

Project Title:
Creating an Autonomous and Deployable Sea Monitoring System

MARIABOX
Synopsis:
This project involves the development of a highly-sophisticated marine sensing technology capable of real-time detection priority biological toxins and chemical pollutants, as well as standard routine water characterisation (Temperature, pH, Conductivity and dissolved oxygen).

Abstract
The MARIABOX Project (MARINE environmental in-situ Assessment and monitoring tool BOX) was coordinated by the Cyprus research and Innovation Center (CyRIC). The aim of the project was to develop a buoy-based platform which could monitor biological toxins (microcystin, saxitoxin, domoic acid and azaspiracid) and chemical pollutants (naphthalene, perfluorooctanoic acid, camphechlor and total heavy metals) in marine water. This platform was then deployed at EU pilot locations (Ireland, Spain, Norway, and Cyprus) taking account of local environmental conditions (monitoring also temperature, pH, conductivity and dissolved oxygen). This novel sensor platform could then be used in providing a forecasting tool for the aquaculture industry across Europe.
Overall Impact of MARIABOX:

- Provide a large increase in the temporal and geographic coverage from in-situ marine sensors to enhance the European contribution to Global Monitoring of the Oceans.
- Increase availability of standardised in-situ data that is suitable for integration within key marine observation, modelling and monitoring systems and reduce ocean modelling uncertainty.
- Reduce cost of data collection system in support of fisheries management.
- Advance competitiveness for European Industry’s & particularly SME’s within the Marine sensing sector
- Enable better cooperation between key sectors (Manufacturing Industry, ICT, Maritime Industry, Marine Science, Fisheries etc.)
- Support implementation of European Maritime Policies.
- Promote new discoveries leading to better understanding of the seas
- Protect the production of aquaculture in the European Union (estimated to be worth €4 billion in 2015)

Knowledge Need

The volume of aquaculture production in the European Union was estimated to be 1.3 million tonnes in 2015, worth €4 billion. Harmful algal bloom events, which result in the release of highly potent toxins, and chemical waste can devastate aquafarming produce resulting in the loss of millions in equity. Therefore, viability of the European aquaculture industry is largely dependent on the strengthening of current risk and impact prediction tools to offer advice in asset management. On top of this, the real-time data produced can assist in investigation and understanding of harmful algae bloom events.

Knowledge Output

The MARIABOX project has delivered a number of different scientific and technical results throughout its four years. Key outputs associated with this project include:

- Development of a fully-automated smart buoy with on-board data processing, biosensors storage and management, both long and short distance communication utilities, and integrated power strategies for up to 6 months targeted deployment.
- Highly-integrated novel centrifugal-microfluidic biosensor technology with sensitive engineered antibodies and chemical pollutant detection strategies for the detection of up to 8 analytes hazardous to the aquaculture environment.
- Sophisticated designs were developed providing know-how to enable the building of multi-analyte platforms that are scalable and manufacturable.
Knowledge Transfer Act and Target Users

The target users are the stakeholders of both individual, governmental agencies (e.g. Marine Institute) and industrial aquafarming within the European Union. Potential end-users and future stakeholders were targeted through the attendance and dissemination of project representatives, including the running of three workshops, ten conference presentations and six (with two further pending) scientific publications.
Knowledge Output Pathway

Measured Impact
The measured impact of this project was determined on the number of individually and collectively marketable assets produced during the course of the project.

Firstly, four novel and highly selective antibody clone libraries produced for the detection of toxin, of which had not been previously been constructed.

Secondly, a microfluidic platform which incorporated complex microvalving strategies for high precision sample and reagent manipulation with capabilities for triplicate testing of eight analytes per disc.

Thirdly, these in combination with the MARIABOX platform, resulted in an industry focused, fully autonomous and deployable asset.

Next steps
Following the project, an individual, project-specific 'Key Beneficiaries Impact Assessment' was performed, thereby allowing successful knowledge transfer and avenues of collaboration can be fully investigated. This is outlined in the figure below:
Project Funding

**MARIABOX** | MARINE environmental *in-situ* Assessment and monitoring tool BOX

FP7 – OCEAN - 2013 | Project ID: 614008 **Value:** €7.1 Million (European Commission contribution € 5.2 million)

Timeline: Feb 2014 – Feb 2018

Consortium Management Leader

Cyprus Research and Innovation Center Ltd | CYRIC | Nicosia, Cyprus | [www.cyric.eu](http://www.cyric.eu)

Social Media

Twitter: @mariaboxfp7 Website: [http://www.mariabox.net/](http://www.mariabox.net/)


Key Dissemination Elements

- **Novel Microfluidic Analytical Sensing Platform for the Simultaneous Detection of Three Algal Toxins in Water**
  (https://pubs.acs.org/doi/abs/10.1021/acsomega.8b00240)

- **MariaBox: First prototype of a novel instrument to observe natural and chemical pollutants in seawater**

- **Detection of naphthalene in sea-water by a label-free plasmonic optical fiber biosensor**

- **A centrifugal microfluidic-based approach for multi-toxin detection for real-time marine water-quality monitoring**

- **Convenient ‘one-step’ extraction method for autonomous sensing of marine algal toxins**

- **A High Sensitivity Biosensor to detect the presence of perfluorinated compounds in environment**
Partners

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2. **DCU Water Institute**, Prof. Fiona Regan – Fiona.regan@dcu.ie School of Chemical Sciences, School Of Biotechnology, School Of Physics, Dublin City University (DCU), Glasnevin, Dublin 9, Ireland

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