

STREAM

Isolation and Analysis of Marine Toxins - That cause shellfish-borne food poisoning



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STREAM Workshop – Waterford 11th May 2022





STREAM Work-package #5

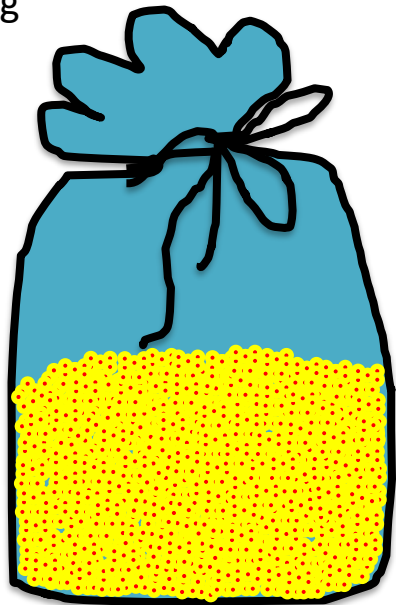
- Assess early warning systems for phytoplankton blooms - Castletownbere.
- Development and deployment of a SMART pump to preconcentrate marine toxins in seawater.
- Deploy SPATT bags
- Profile toxin levels from SPATT bags and from vertical hauls using LC-MS
- Deploy multiparameter sonde
- Precipitation Monitoring



An Early Alert System: SPATT

- Using in-situ adsorption sampling device to tell us that a harmful algal bloom is imminent.

Figure: SPATT bag



Differential Permeable Bag

Stationary Phase Resin
e.g. DIAION HP20, SEPABEADS SP700 or
Amberlite.

[Solid phase adsorption toxin tracking \(SPATT\): a new monitoring tool that simulates the biotoxin contamination of filter feeding bivalves.](#)

MacKenzie L, Beuzenberg V, Holland P, McNabb P, Selwood A.

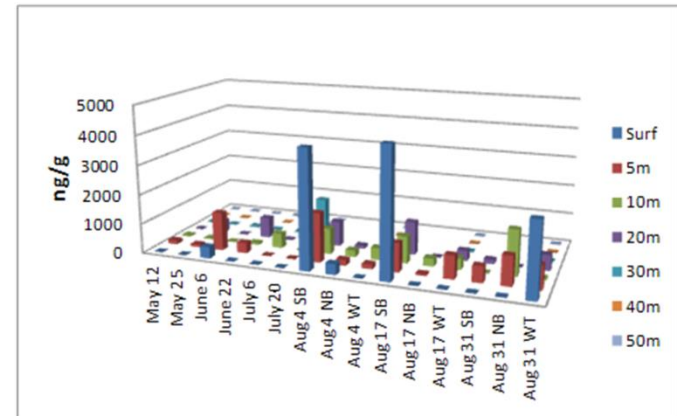
Toxicon. 2004 Dec 15;44(8):901-18.

Passive sampling method (SPATT)

Spatial and temporal analysis of marine biotoxins



Lough Hyne Marine Nature Reserve, West Cork, Ireland



The distribution of Okadaic acid (DSP) at 7 depths over 4 months

Based on method originally devised by MacKenzie *et al.* 2004

'Traditional' method - collect bulk samples of phytoplankton

Pumping water at specified depths into a phytoplankton dual net

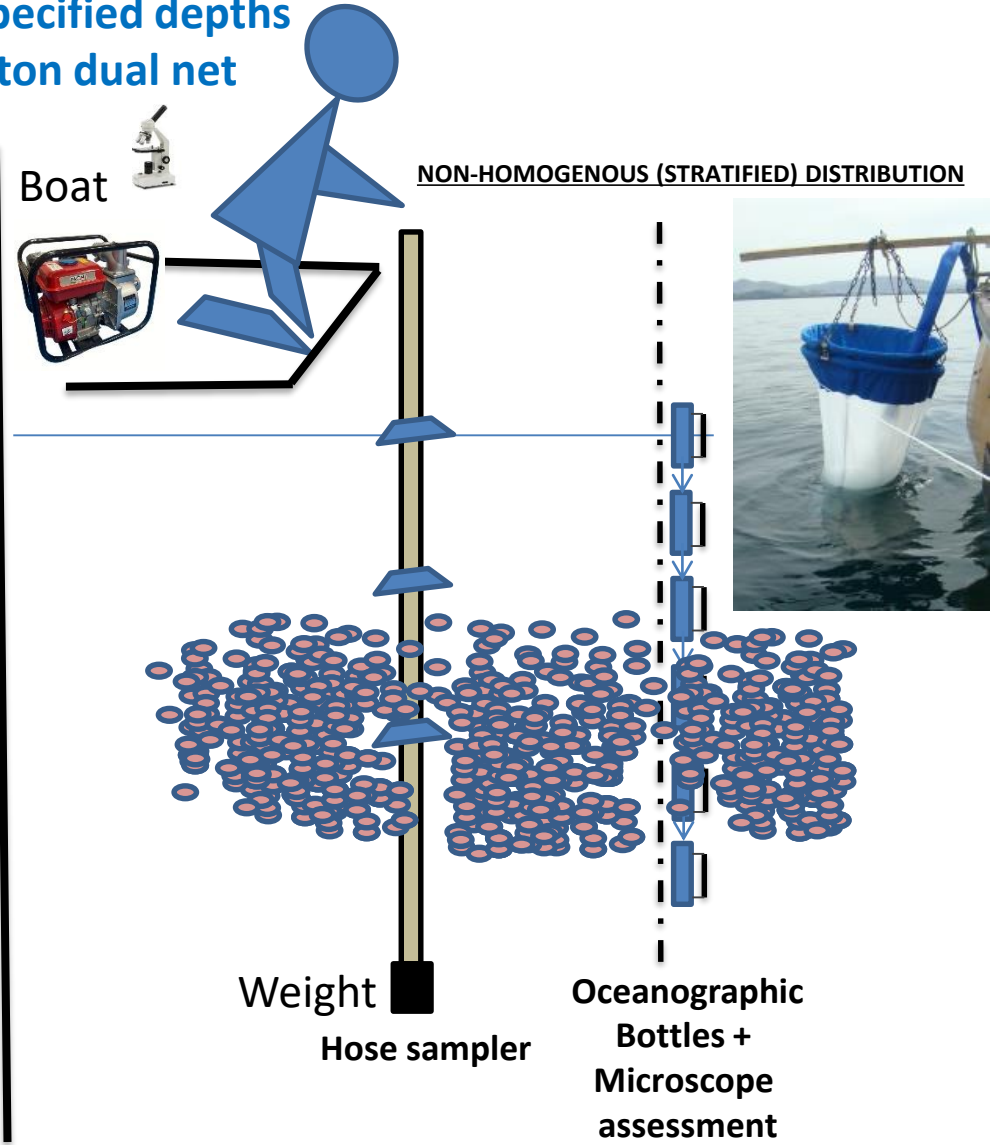
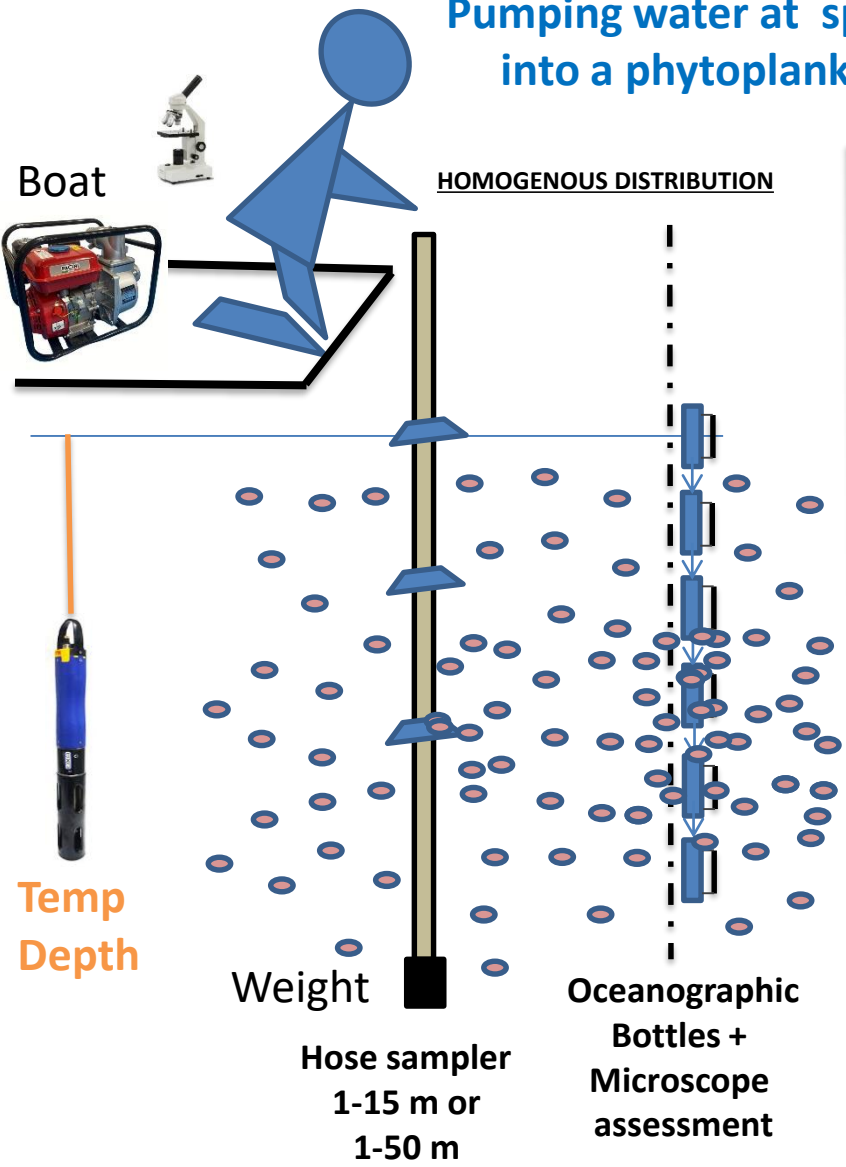


Figure: On-board Pump + Hose (dropped to various depths)

Previous Project_Active toxin sampling

Bio-harvesting of algal toxins

Sampling

Extraction

Clean-up

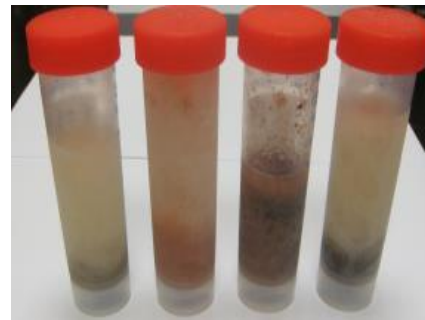
Detection
LC-MS

Chromato-
graphy

Ion-
suppression

Validation

Data
processing



Bio-harvesting of algal toxins



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Prof. John O'Halloran
UCC ERI and VP T&L



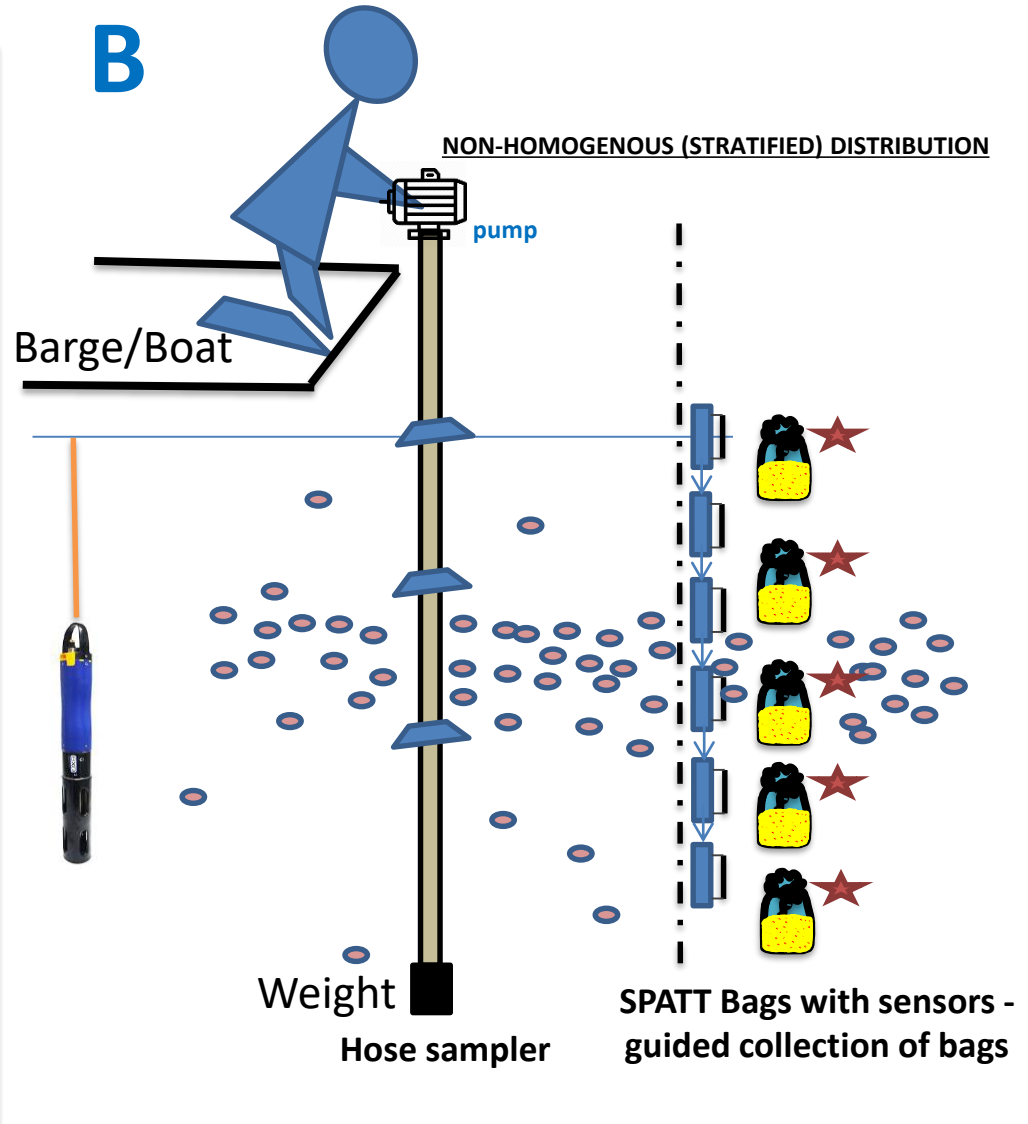
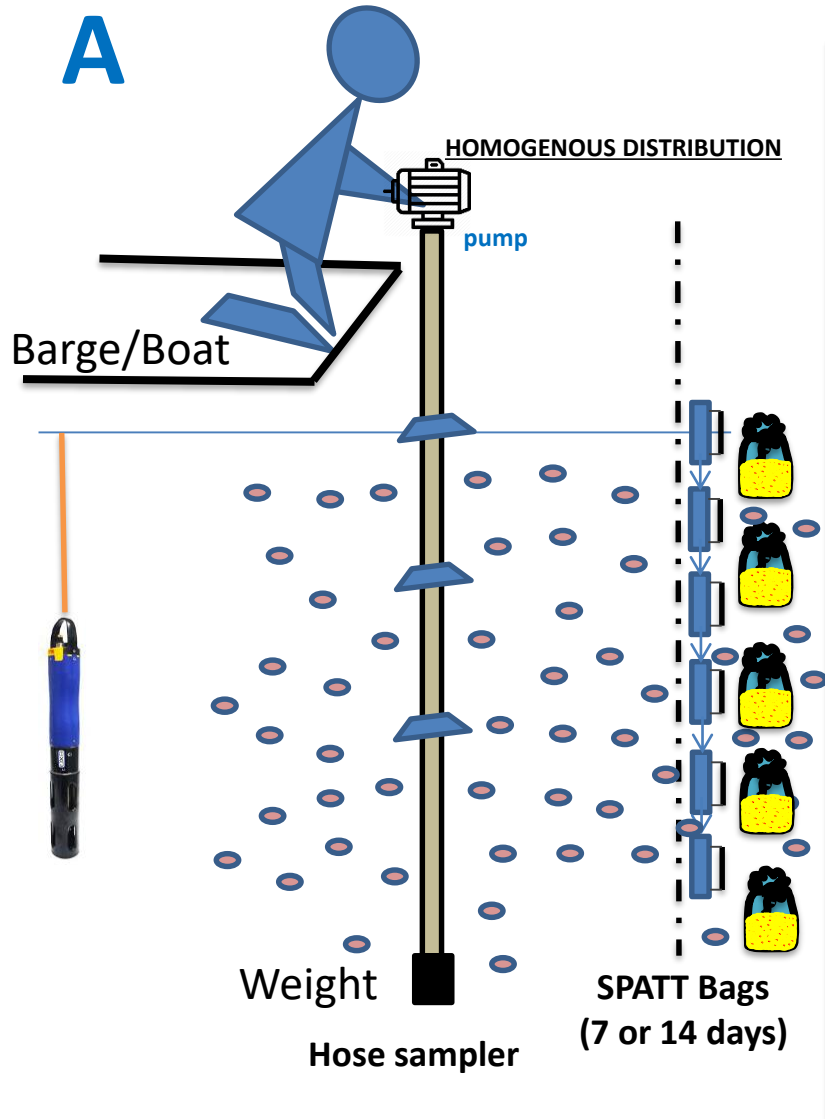
Dr Frank van Pelt
UCC



Dr Moira McCarthy
UCC

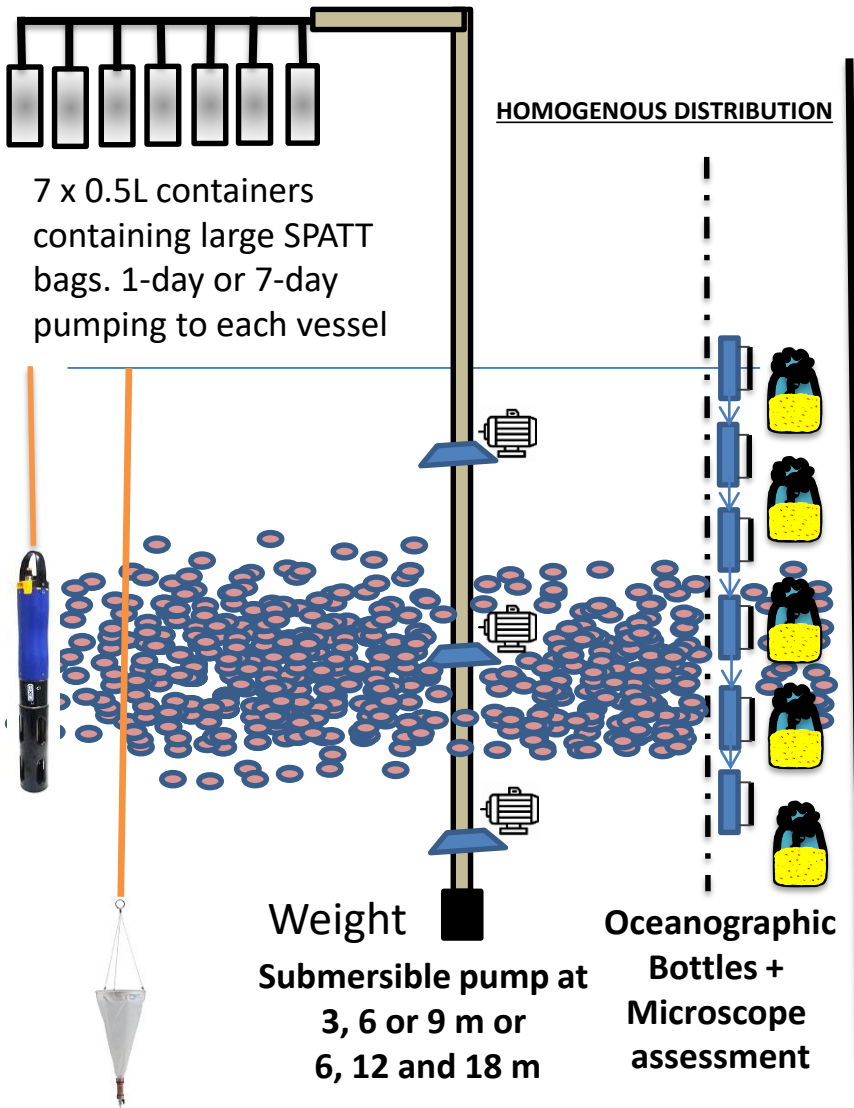
Submersible pumping device for the active accumulation of marine biotoxins on adsorptive resin.
A: Pre-filter; B: 50 µm filter; C: 4-way connector with taps; D: Resin-filled polyethylene columns.

(A) Spatt Bags & (B) SPATT Bags with printed sensors



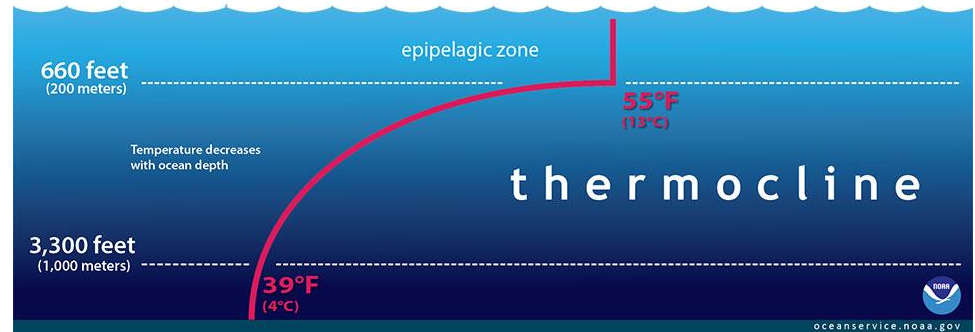
'Modular Bulk Sampling' method on BIM barge (Castletownbere) to collect bulk phytoplankton

BIM Barge



1. Modular Bulk Sampling: Pumping water at 3 specified depths

Elie Fux et al. 2010 Toxicon "Production of diarrhetic shellfish poisoning toxins and pectenotoxins at depths within and below the euphotic zone" – Section 2.3.1 - Water samples were obtained every 3 h at the maximum chlorophyll layer located just above the thermocline using the profiler's peristaltic pump and filtered over a 200 μm and a 20 μm mesh. The depth of the layer varied from 22 to 34 m depending on the time of the day (SW coast of Ireland).

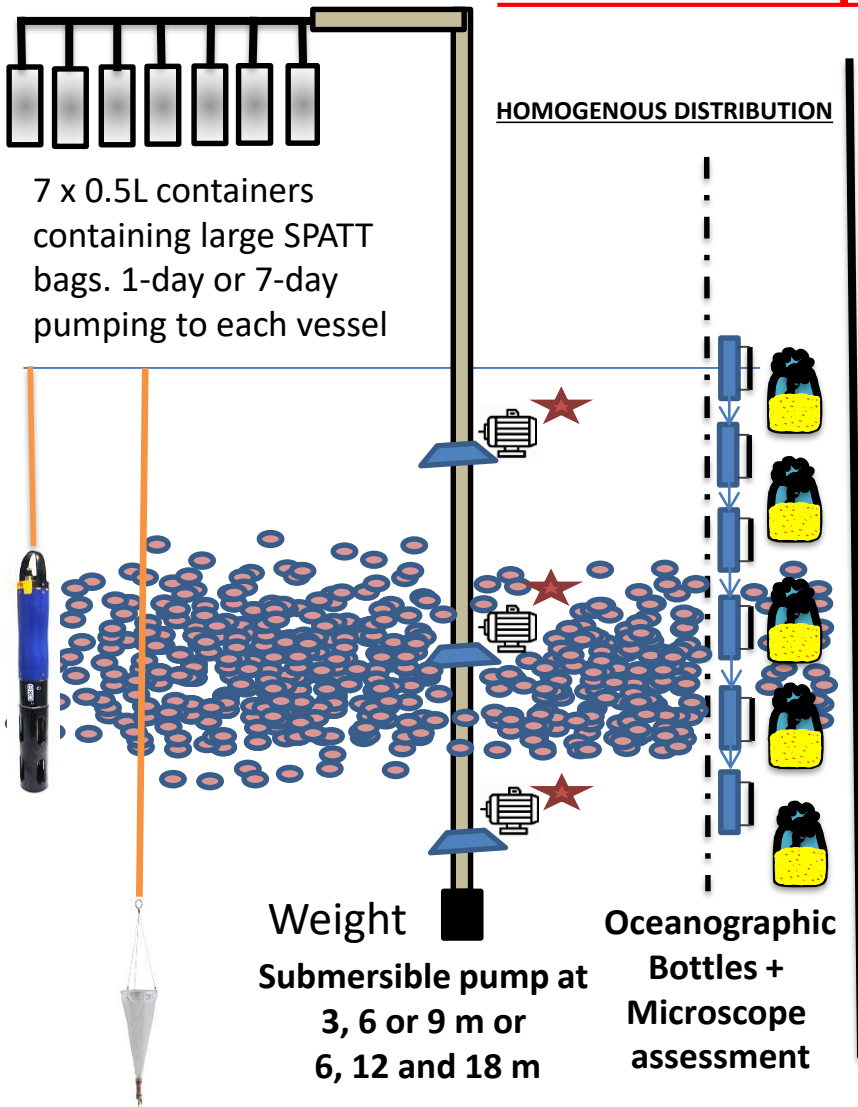


2. SPATT bags – 3 g of adsorbent each
3. Water samples collected for LC-MS analysis
4. Phytoplankton vertical hauls
 - Once every two weeks



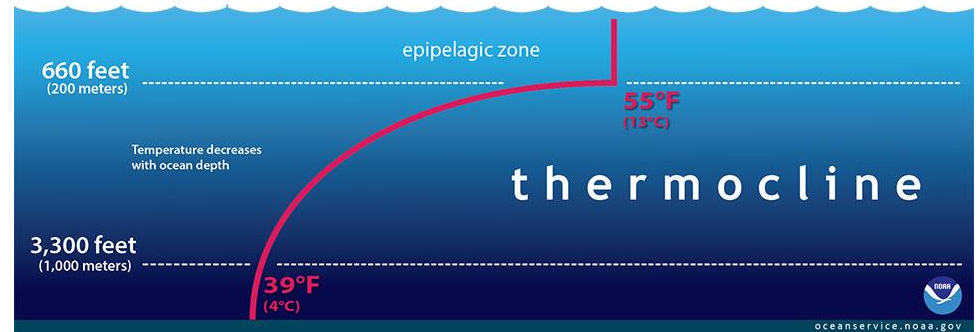
'Modular Bulk Sampling' method on BIM barge (Castletownbere) to collect bulk phytoplankton – submersible pumps with sensors

BIM Barge



1. 7-day Rig: Pumping water at 3 specified depths

Elie Fux et al. 2010 Toxicon "Production of diarrhetic shellfish poisoning toxins and pectenotoxins at depths within and below the euphotic zone" – Section 2.3.1 - Water samples were obtained every 3 h at the maximum chlorophyll layer located just above the thermocline using the profiler's peristaltic pump and filtered over a 200 μm and a 20 μm mesh. The depth of the layer varied from 22 to 34 m depending on the time of the day (SW coast of Ireland).



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ACTIVE SAMPLING IMPLEMENTATION

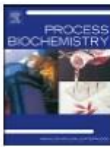
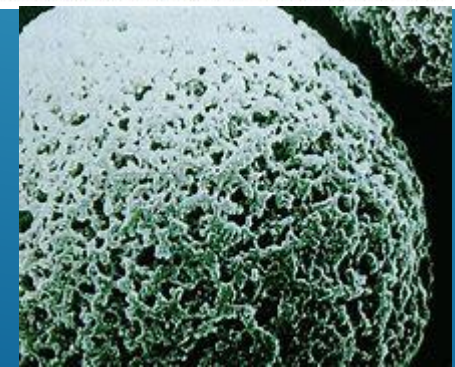
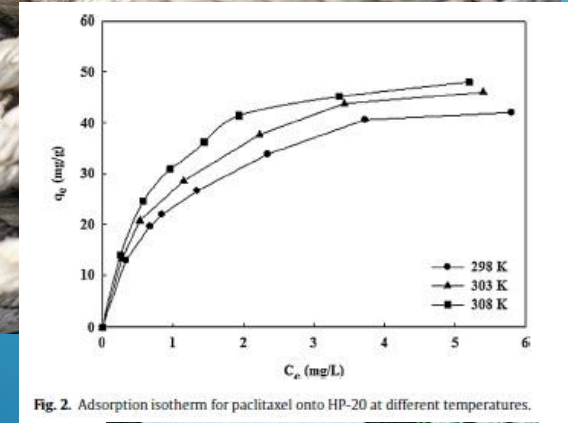
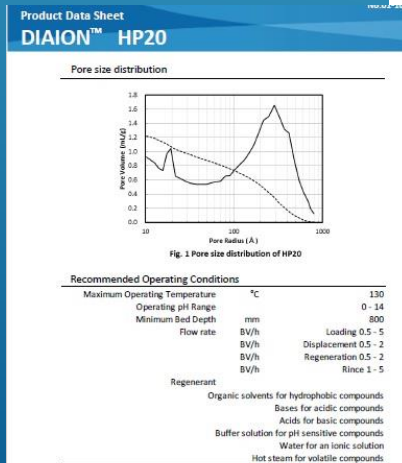
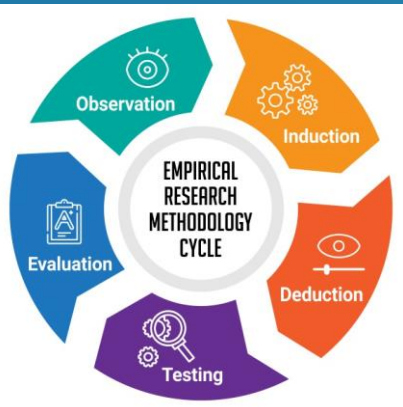
- DESIGN RATIONALE
- EXAMPLE TOXIN COLLECTION DEVICES



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DESIGN PHILOSOPHY

- SMALL WORKBOAT/TRAILER-LAUNCHED BOAT USE CASE
- TETHER, ANCHOR, POWER CABLE AND HOSE MANAGEMENT
- POWER SUPPLY CONSIDERATIONS
- EMPIRICAL APPROACH TO DESIGN
- ADSORBENT MEDIA HANDLING:
 - ACTIVATION
 - ELTUTION



Isotherm, kinetic and thermodynamic characteristics of adsorption of paclitaxel onto Diaion HP-20

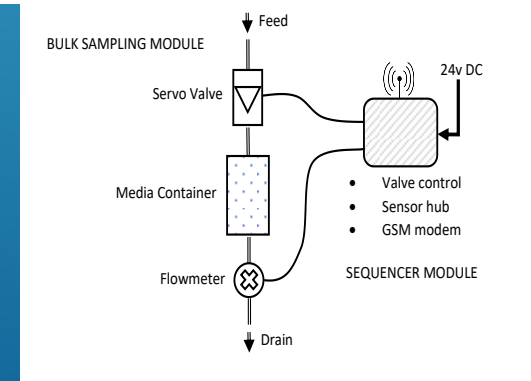
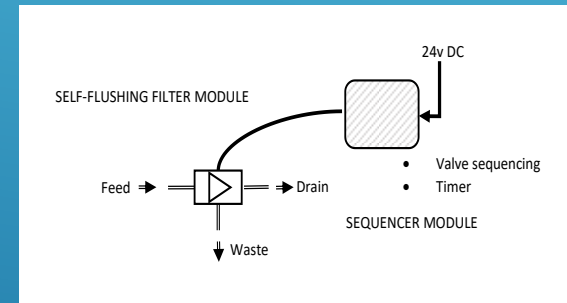
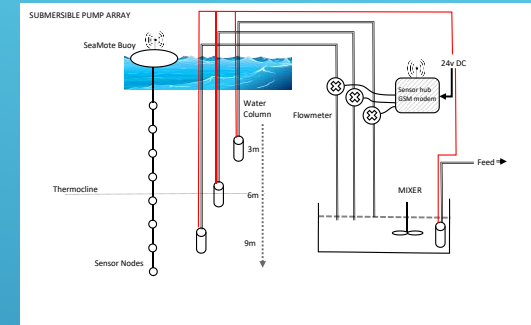
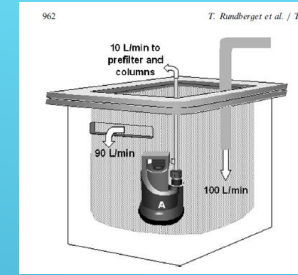
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ACTIVE SAMPLING IMPLEMENTATION

- PRE-CONCENTRATION
- MODULAR BULK SAMPLING
- INTEGRATIVE ADSORPTION VESSEL
- HIGH-FLOW BULK SAMPLING
- SUBMERSIBLE CONCENTRATOR



THANK YOU FOR YOUR ATTENTION!

