Monitoring seasonal dynamics of selected harmful algae in the North Sea using molecular methods

Introduction of a fully automated biosensor

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Content

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• Biosensor
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Introduction

• Monitoring of harmful algae
  – Microscope

• Other potential methods
  – RNA microarrays (Taylor et al., 2014)
  – DNA chromatography chip (Nagai et al., 2016)
Introduction

- PhD project part of EnviGuard
  - `Development of highly specific and precise in-situ measurement device for man-made chemical contaminants and biohazards (microorganisms and toxins from biological sources) which are currently hard to measure`'
  - Modular system
  - Calibration of biosensor for harmful algae
Toxic Algae in the North Sea

- **Dinophysis**
  - Occurrence around Helgoland (Löder et al., 2012)
  - Low levels of Dinophysis toxins found in German Bight (Krock et al., 2013)

- **Alexandrium sp.**
  - Occurrence around Scotland (Toebe et al., 2013)
  - Harmful blooms at Orkney Islands

- **Protoceratium reticulatum**
  - Hoppenrath (2004) found cells at Helgoland using light microscopy
Biosensor principle

- Electrochemical detection of harmful algae
  - Reaction takes place on disposable sensorchip
  - Based on sandwich hybridisation.
    - Capture and reporter probe
  - First used by Metfies et al., 2005

![Diagram of biosensor principle]
Biosensor

• ALGADEC (Diercks et al., 2011)
  – First semi-automated device
  – Size of a small suitcase
  – Using a PalmSens interface
  – Measuring time: approx. 2-2.5 hours
Biosensor

• AutoFiM and BioSens
  – Fully automated biosensor
  – Modular system consisting out of
    • AutoFiM → filtration, sample preparation
    • BioSens → detection
AutoFiM

- Fully automated sampling
- Water reservoir of 5 liter
- Can store up to 12 filters
- Possibility to add preservative/lysis buffer
- Ultrasonic device to break down cells
• Sampling reservoir
• Filtration
AutoFiM

• Ultrasonic device
BioSens

- Fully automated biosensor
- Easy to remove cassette with biochips
- Based on ALGADEC
BioSens

• Overview
BioSens

- Chipcassette
• **Measuring chamber**

![Measuring chamber image]
AutoFiMBioSense

- Computer
Calibration

• Calibrate with different toxic algae
  – Counted culture
  – Filter
• Run tests with spiked samples
• Test with field samples
• Sampling locations

- Cuxhaven
- Wilhelmshaven

https://www.google.nl/maps

German Bight

Orkney Islands

Scapa Flow

North Sea
Calibration

Negative control

Sample

Current/µA vs. Time/s graph for Negative control and Sample.
• Averages
  – Negative = -2,28 µA
  – Sample = -2,35 µA
  – Difference = 0,07 µA

• Interested in the difference
  – Dependent on biomass
Outlook

• Further testing and calibration of Biosensor
• Field testing starting in March 2017
  – Helgoland
Thank you for your attention!
 Acknowledgements

Many thanks to.....

• Michaela Gerriets
• Dennis Gowland
• Andreas Görke
• Dr. Kristin Hardge
• Robin Klenk
• Dr. Alexandra Kraberg
• Kerstin Oetjen
• Anna Plesniar
• Swantje Rogge
• Dr. Urban Tillman
• Dr. Christian Wolf
References