Development of seabird based sampling strategies for the determination of plankton communities with special focus on HAB species

Bernd Krock & Susan Waugh
1. Planktonic response to climate change in the Southern Ocean
Present plankton community

The Southern Ocean is dominated by a Diatom – Phaeocystis community

How will they respond to climate change?
This species is the main silica sinker of the world ocean

Will its distribution range substantially change by 2100?

Distribution models – *Fragilariopsis kerguelensis*
Biogeographic scenario projections

- **Occurrences**
  - Taxon observations
  - Environmental data grids

- **Niche**
  - Niche model (hypervolume in env. variable space)

- **Distribution**
  - Project niche upon map layers of environmental variables

Legend:
- • flerg_pangaea
- ▲ flerg_obis
- ● flerg_obif
Distribution models – *Fragilariopsis kerguelensis*

- **January**
  - Present
  - Projection for year 2100 (rcp45)
  - Projection for year 2100 (rcp85)

- **July**
  - Present
  - Projection for year 2100 (rcp45)
  - Projection for year 2100 (rcp85)

Will its distribution range substantially shrink by 2100?
With decreasing diatom abundance there may be a shift to a Flagellate dominated community including Harmful Algal Bloom (HAB) species
Climate change indicator

Antarctic Peninsula

The West Antarctic Peninsula is one of the fastest warming areas on Earth.

Antarctic peninsula is a good model system to study changes in plankton community.

Antarctic surface temperature trends for 1957-2006
Author: NASA Earth Observatory
2. Dinoflagellates and Phycotoxins
Climate change indicator

Why are phycotoxins interesting apart from their toxic effects?

Phycotoxins can be used as chemotaxonomic markers which are (relatively) easy to sample/detect.
HAB species in the Arctic

- **Dinophysis spp.**
- **Protoceratium reticulatum**
- **Amphidoma languida**
- **Alexandrium ostenfeldii**
- **Pseudonitzschia spp.**
- **A. tamarense**

Toxins:
- Okadaic acid
- Pectenotoxins
- Domoic acid
- Azaspiracids
- Spirolides
- Saxitoxins
- Dinophysistoxins
- Yessotoxins
- Pectenotoxins
- Domoic acid
Global distribution of PST

Saxitoxins
Global distribution of azaspiracids
3. Passive sampling strategy for phycotoxins (and other chemotaxonomic markers)
Phycotoxin sampling

Organic lipophilic (hydrophobic) polymer

Needs to be preconditioned (wetting with organic solvent e.g. methanol)

Rinsing with water

Must not become dry before application

Solid Phase Adsorption Toxin Tracking (SPATT)

MacKenzie et al. (2004), Toxicon 44 (8), 901-918.
Phycotoxin sampling

King George Island

Fildes Bay, King George Island, Antarctica

Map: www.wikipedia.org
First preliminary results

SPATT

Plankton Net Haul

Dinophysis (norvegica ?)

Pectenotoxin-2
4. Seabirds as sampling platforms?
Seabirds as sampling platforms

Why are seabirds interesting as sampling platforms?

1) Seabirds easily access otherwise difficult to reach areas

2) Seabirds actively search areas with high primary productivity
Seabirds as sampling platforms

A first pilot study was performed in November 2014 in New Zealand in cooperation with the Te Papa (Natural history museum of New Zealand, Dr. Susan Waugh)

Why New Zealand?

1. There is already ongoing Penguin field work
2. NZ has set up a very dense phytoplankton monitoring which supplies reference data
3. Almost all known classes of phycotoxins occur in NZ waters
Seabirds as sampling platforms

Little Blue Penguin
(Eudyptula minor)
Seabirds as sampling platforms

GPS-logger
Seabirds as sampling platforms
Seabirds as sampling platforms

TIC: from Sample 5 (123trip) of HighSea15305.wiff (Turbo Spray)
Max. 400,0 cps.

Gymnodimine A
Pectenotoxin-2

TIC
Penguin SPATT
Seabirds as sampling platforms

Pectenotoxin-2 (polyketide)

Gymnodimine A (cyclic imine toxin)
Seabirds as sampling platforms

Implications:

1. Method works
2. Detection of low background level possible (no plankton bloom at this time/location)

Applications:

1. Assessment of phycotoxin distribution in remote areas
2. Plankton composition (by chemotaxonomic markers)
Summary

1. Ecological niche models predict that diatom abundance will be declining with increasing temperature in the Antarctic region.

2. There may be a shift from a Diatom-Phaeocystis dominated plankton community to a Flagellate dominated community in the Southern Ocean including HAB species.

3. Phycotoxins can be used as proxys for a changing plankton community.

4. Seabirds may be interesting sampling platforms for phytoplanktonic chemotaxonomic markers in remote areas.
Special thanks to...

Bánk Beszteri (AWI, DE)
Stefan Pinkernell (AWI, DE)
Nicole Trefault (U Mayor, CL)
Rodrigo de la Iglesia (PUC, CL)

... and for your attention!
Any Questions?