GlobalHAB symposium on automated in situ observations of plankton
Fiskebäckskil, Sweden 22-27 August 2022

SMHI

AUTOMATED HAB OBSERVATIONS IN SWEDEN

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Swedish Meteorological and Hydrological Institute
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Main types of HAB

Fish killing HAB

Pseudochattonella

Dictyocha/Vicicitus

Chrysochromulina/ Prymnesium

Karenia

Biotoxin producers

Dinophysis

DST

Alexandrium

PST

Azadinium

AZA

Protoceratium and *Lingulodinium*

YTX

Pseudo-nitzschia

AST

High biomass HAB

Cyanobacteria:

Nodularia

Nodularin

Aphanizomenon

Benthic HAB

Prorocentrum lima

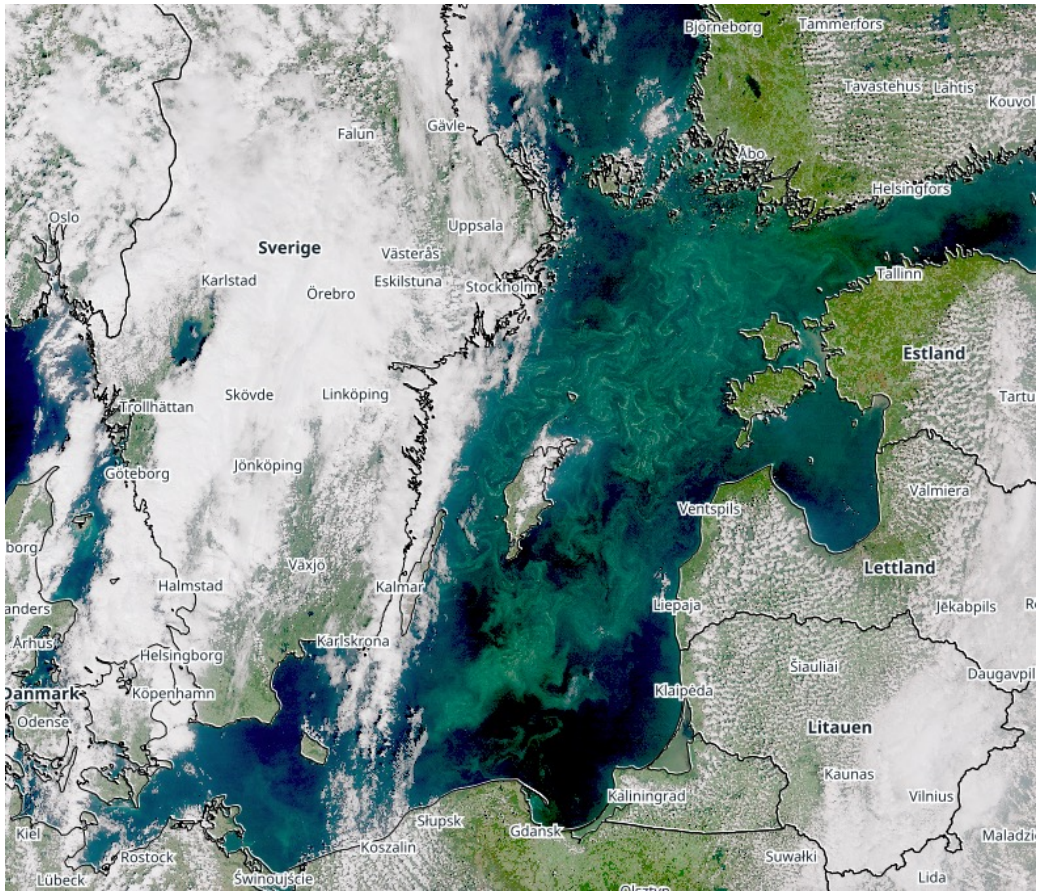
DST

Coolia monotis

Cooliatoxin

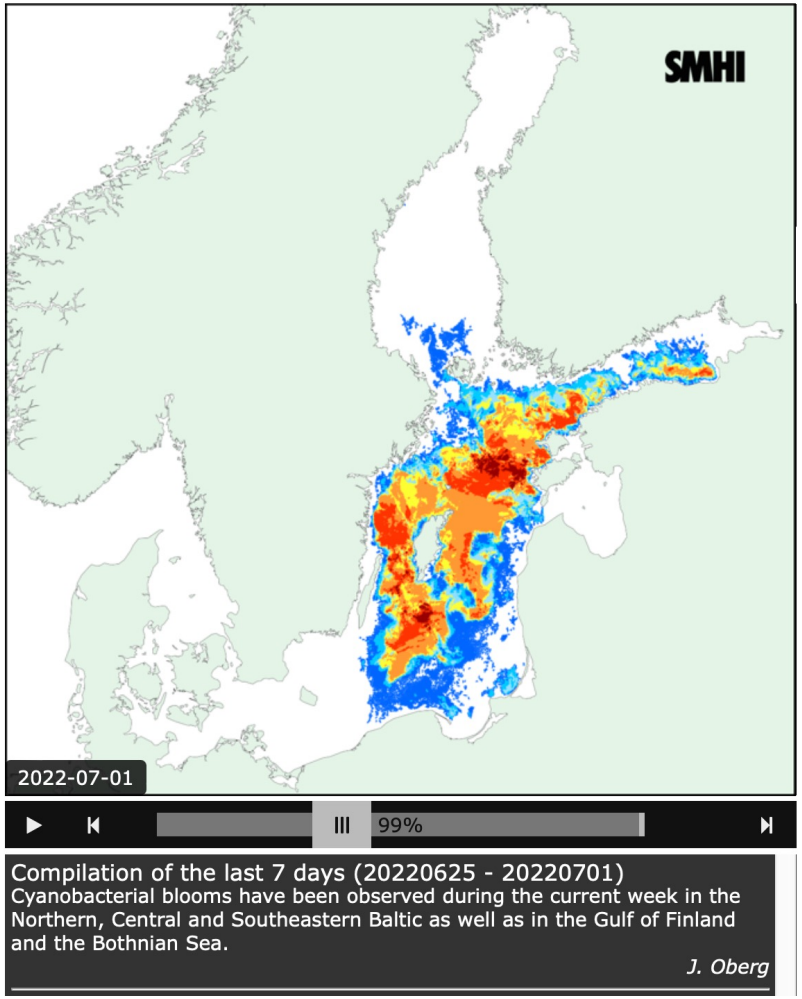
Satellite observations of cyanobacteria

- Service by SMHI in operation since 2002
- Several different satellites used, e.g.
  - Sentinel 3A + 3B/OLCI
  - Suomi/VIIRS
  - Aqua and Terra/MODIS
- Daily data
- Weekly composites

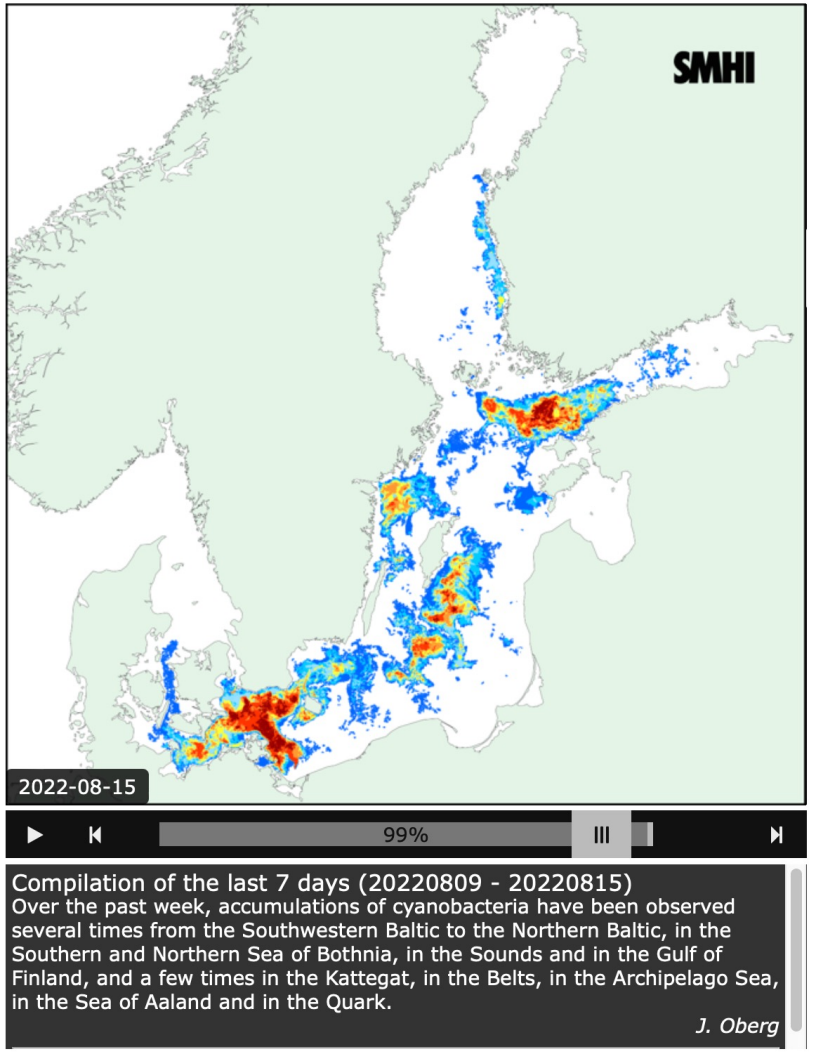


2 July, 2022

Satellite observations of cyanobacteria



25 June to 1 July, 2022



9 - 15 August 2022

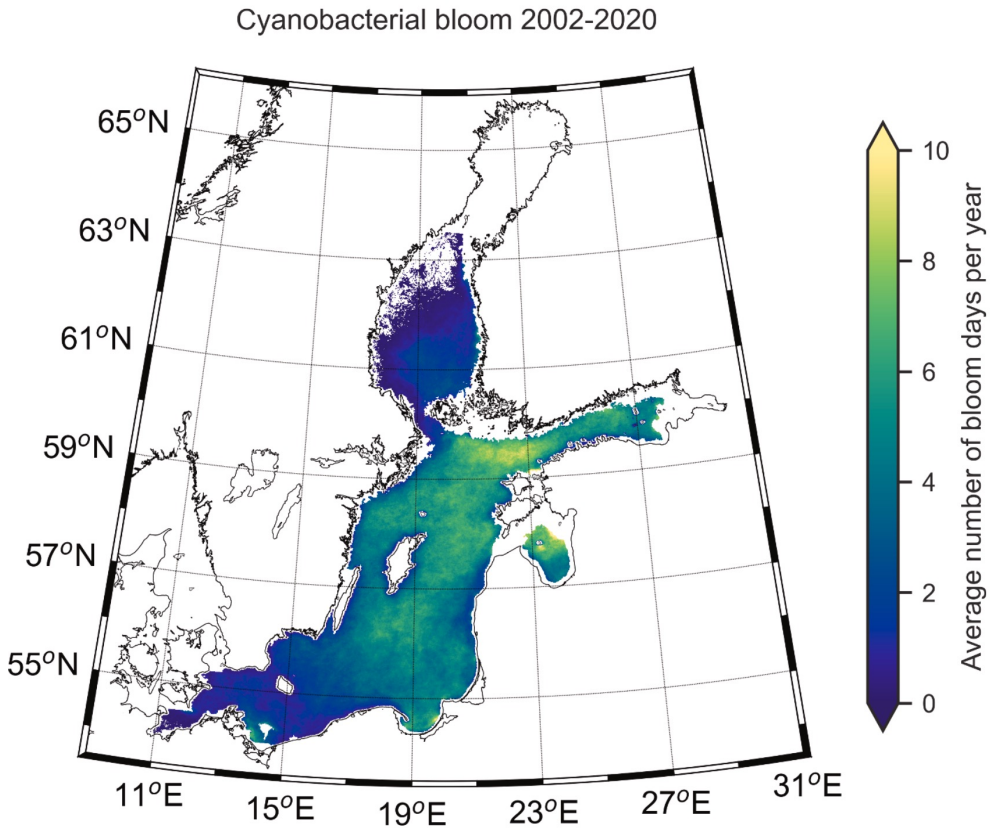
Recent publication

Harmful Algae
Available online 21 July 2022, 102291
In Press, Corrected Proof

Original Article

A suggested climate service for cyanobacteria blooms in the Baltic Sea – Comparing three monitoring methods

Bengt Karlson [a], Lars Arneborg [a], Johannes Johansson [b], Johanna Linders [b], Ye Liu [a], Malin Olofsson [a, c]



Karlson et al. Harmful Algae, in press

Bulletin on algae situation

- Phytoplankton analysed by microscopy
- Chlorophyll - proxy for total biomass
- Bulletin produced after cruise with R/V Svea

SMHI
Oceanographic Unit
No 4 April 2022

AlgAware

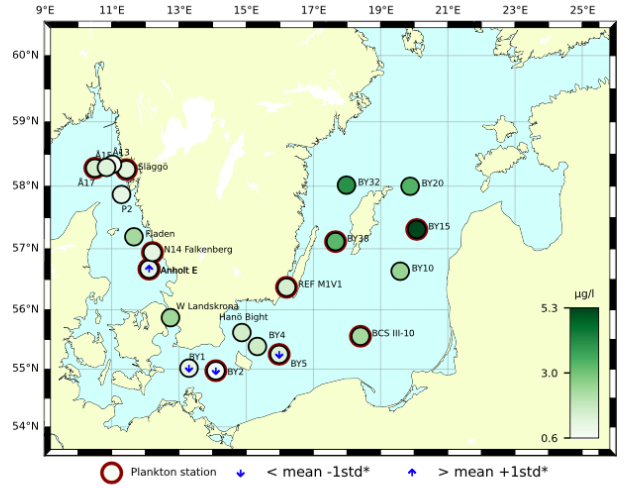
Dnr: S/Gbg-2022-69

ALGAL SITUATION IN MARINE WATERS SURROUNDING SWEDEN

Sammanfattning

I Skagerrak var både de totala cellantalen och biodiversiteten låga på Å17 medan diversiteten var högre på Släggö. På Släggö återfanns den toxinbildande dinoflagellaten *Dinophysis norvegica** i rätt höga cellantal. I Kattegatt, vid första provtagningstillfället på Anholt E, var vattnet stratifierat ner till 10 m, det djupet växtplankton tas på. Detta resulterade i höga cellantal. Vid andra provtagningstillfället hade vattnet blandats om och ett mer normalt växtplanktonsamhälle visade sig. N14 hade låga cellantal och diversitet. De integrerade klorofyllhalterna var normala på samtliga stationer, förutom vid det första provtagningstillfället på Anholt E, då de var högre än normalt.

Bland Östersjöstationerna var vårblomningen i slutskedet. Några typiska vårblomningsarter fanns fortfarande, såsom *Skeletonema marinoi* och *Peridiniella catenata*, men det var även mycket ”efter-blomningsarter” såsom Gymnodiniales och *Dinobryon* sp. BCSIII-10 var den enda stationen med den filamentösa cyanobakterien *Aphanizomenon flosaquae* och på samtliga övriga stationer återfanns den toxinbildande *Dinophysis acuminata**. De integrerade klorofyllhalterna var normala på samtliga stationer och visade på att vårblomningen var i sitt slutskede.



Abstract

In the Skagerrak, both cell abundance and diversity were low at Å17, the diversity was however higher at Släggö. At Släggö the toxin producing dinoflagellate *Dinophysis norvegica** was present in quite high cell numbers. In Kattegat, at the first sampling occasion at Anholt E the water was stratified down to 10 m, the depth at which phytoplankton are sampled. This resulted in high cell numbers. At the second sampling occasion the water column had been mixed, resulting in a more normal phytoplankton community. N14 had low cell abundance and diversity. The integrated chlorophyll concentrations were normal at all stations, except at the first sampling occasion at Anholt E, where they were higher than normal.

Among the Baltic stations the spring bloom was coming to an end. Some typical spring bloom species were still present though, such as *Skeletonema marinoi* and *Peridiniella catenate*. There were also a lot of “post spring bloom species” such as Gymnodiniales and *Dinobryon* sp. BCSIII-10 was the only station where the filamentous cyanobacteria *Aphanizomenon flosaquae* was present and at all other stations the toxin producing *Dinophysis acuminata** was found. The integrated chlorophyll concentrations were normal at all stations indicating the end of the spring bloom.

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R/V Svea Ferrybox

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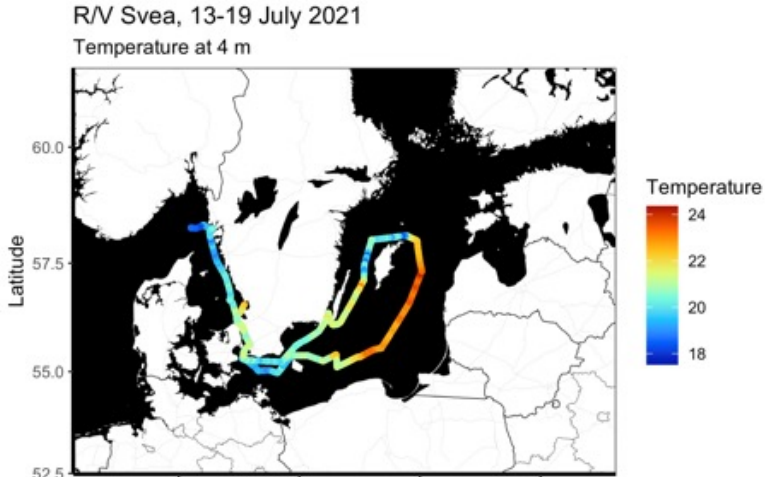
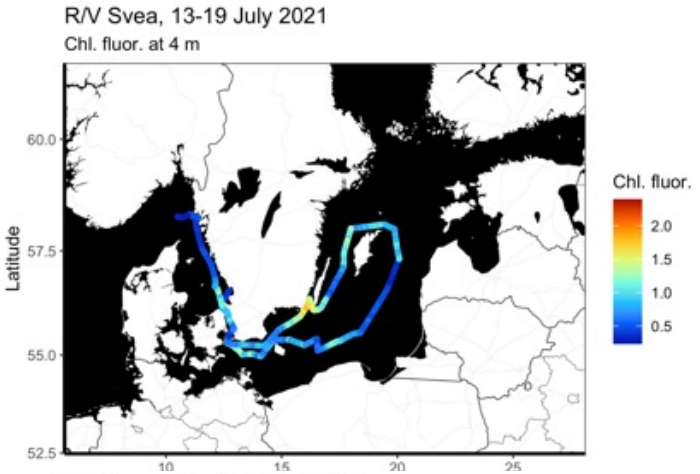
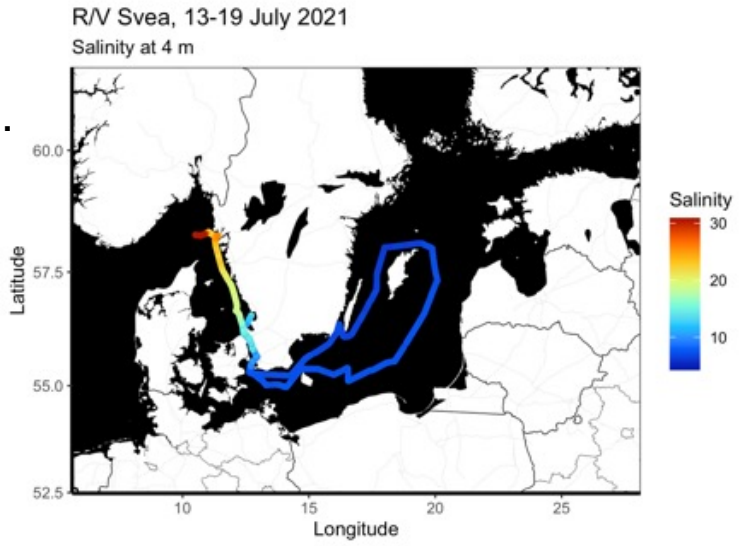
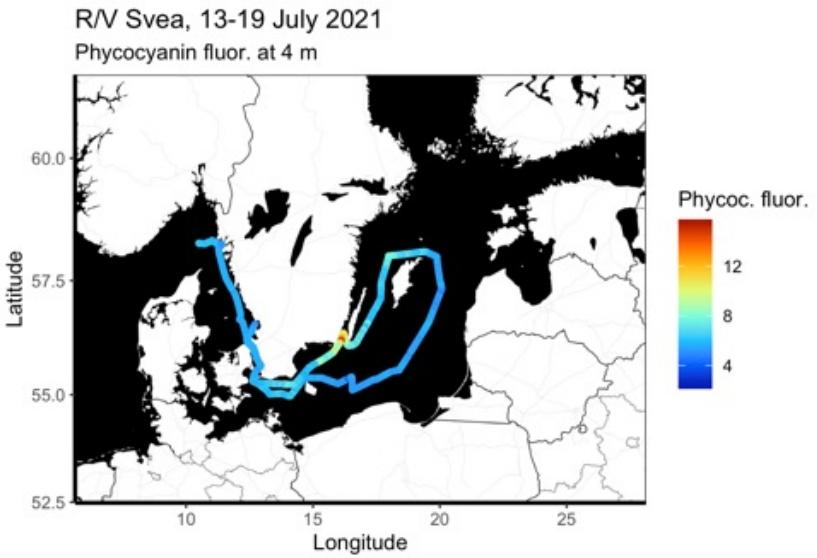
- Continuous flow of sea water
- Data collected every minute
  - Salinity
  - Temperature
  - Chl. fluor
  - Phycocyanin fluor.
  - Phycoerythrin fluor.
  - CDOM fluor.
  - pH
- Data collected every 10-20 min.
  - pCO_2
  - pH
  - Phytoplankton - IFCB
- Water sampling device





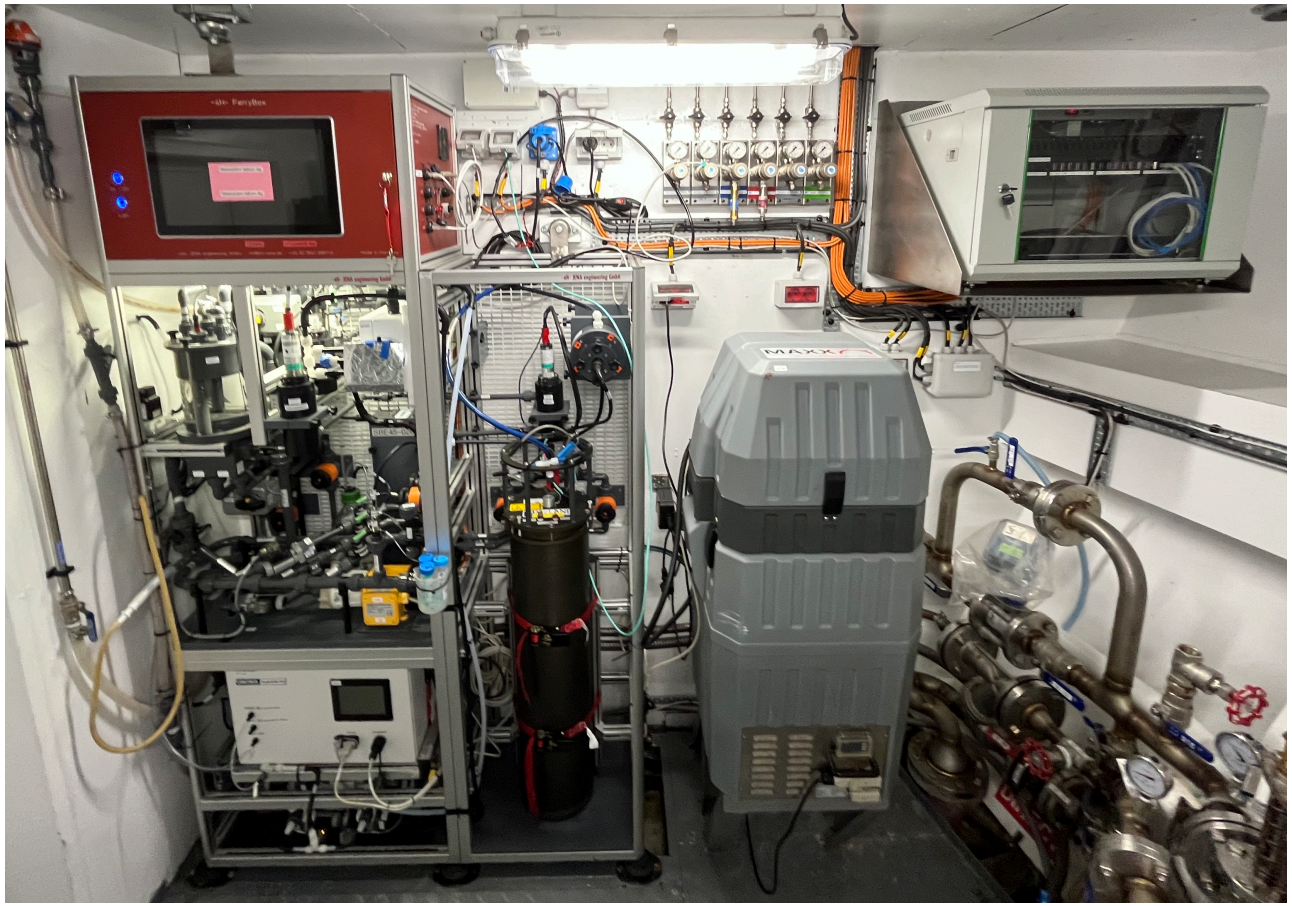




IFCB on R/V Svea

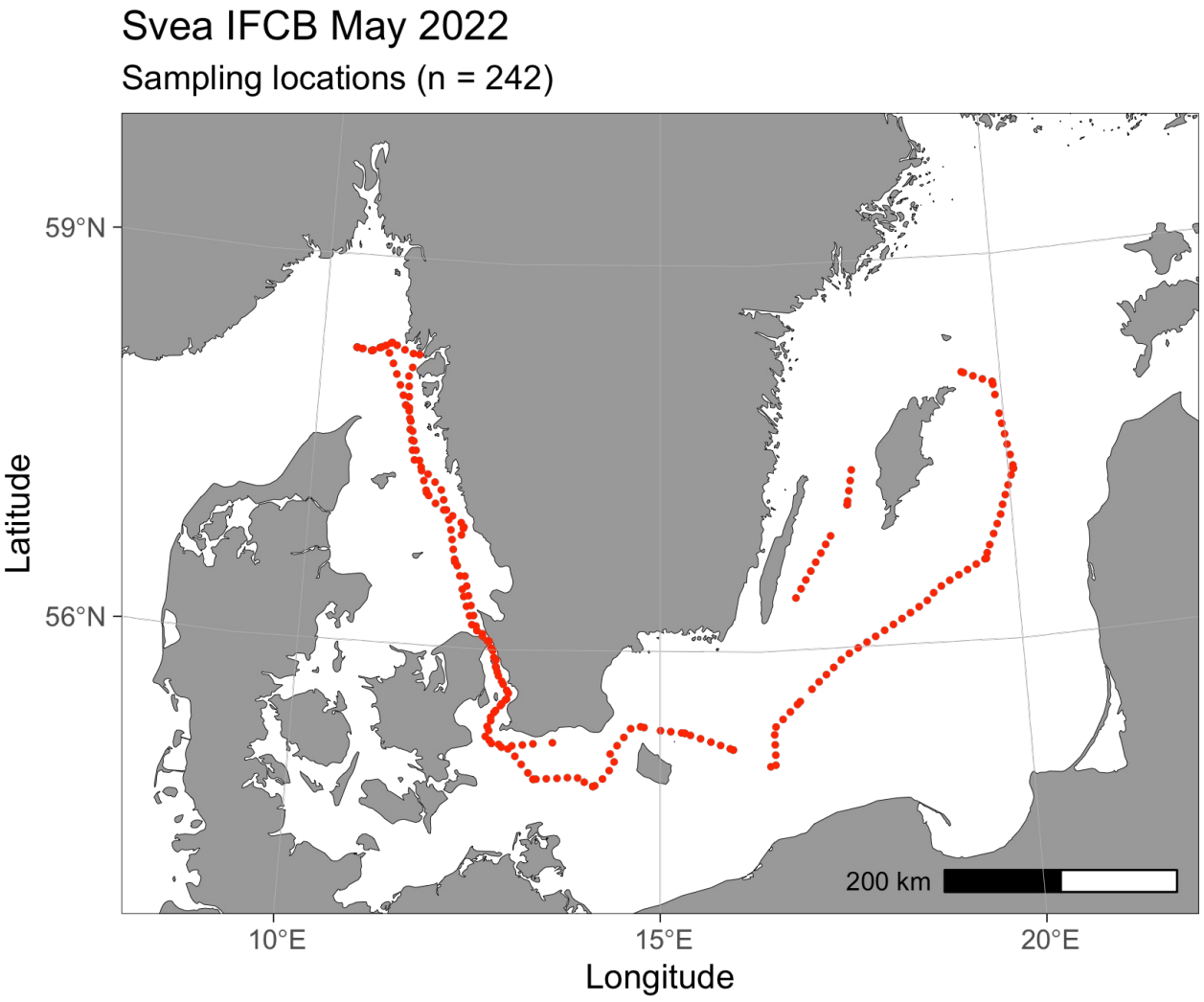
SMHI

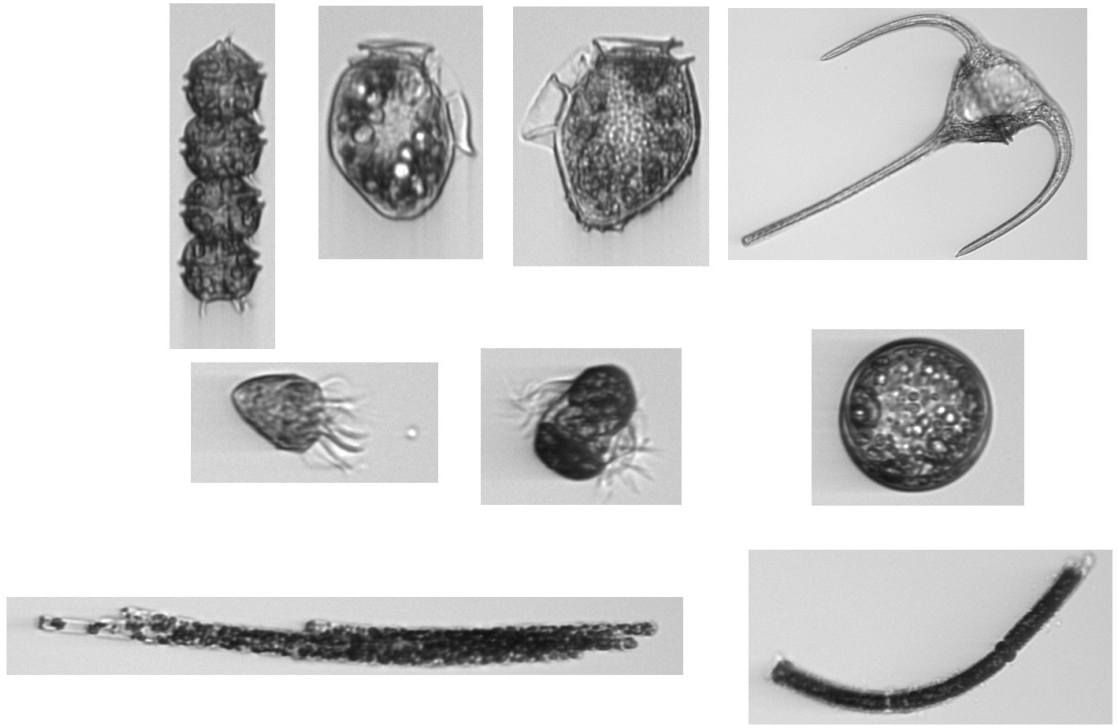
- IFCB part of FerryBox underway system
- Continuous flow of sea water
- Sampling every 20 minutes
- Latitude and longitude in hdr-file



IFCB part of FerryBox underway system

Some results from cruise in May 2022



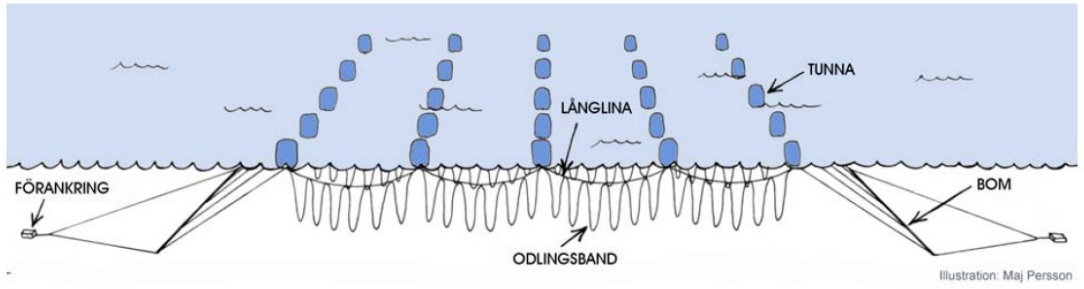


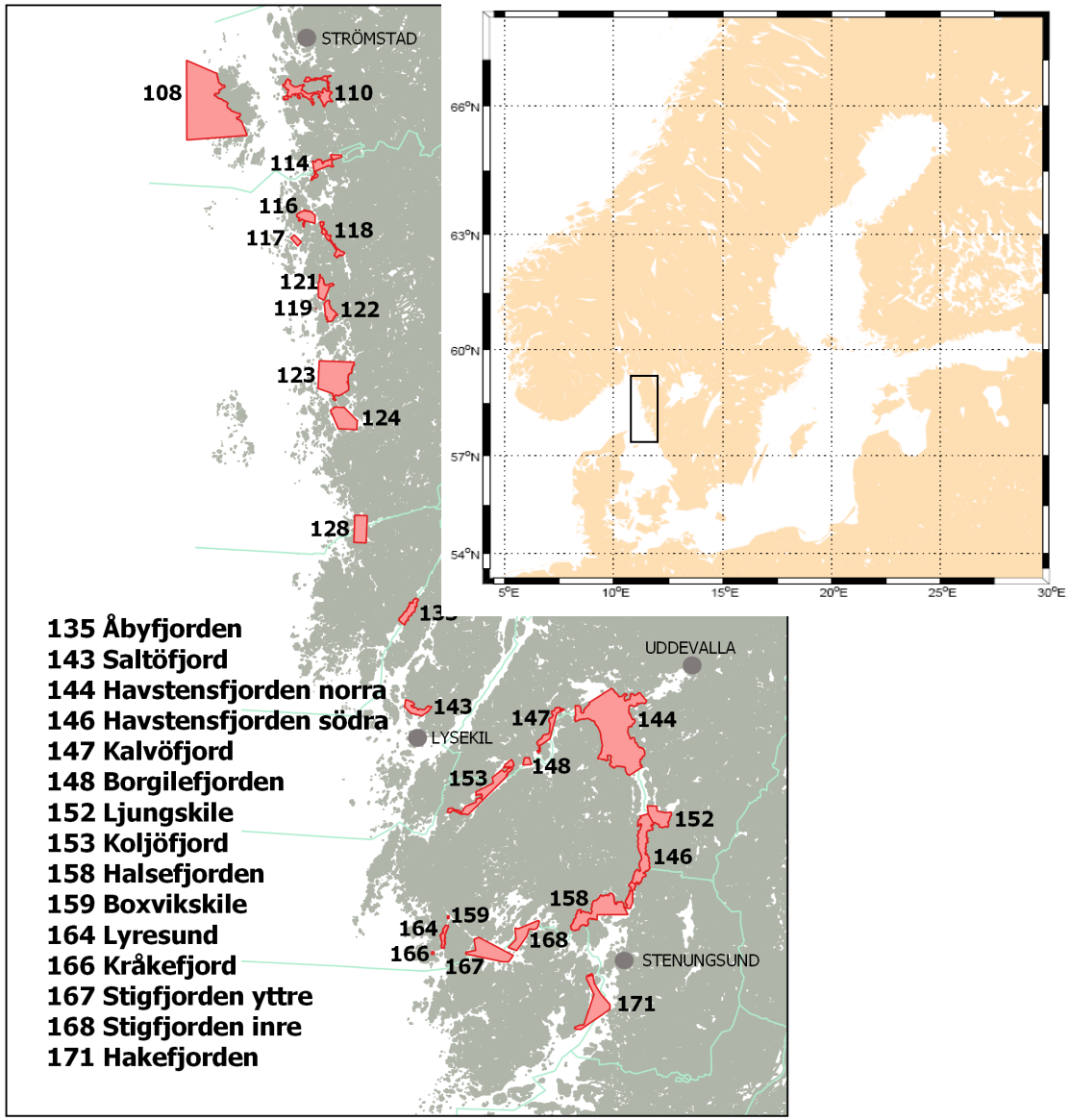
Photos of plankton from the Imaging FlowCytobot. Left to right:

Top row: *Pedinella catenata*, *Dinophysis acuminata*, *Dinophysis norvegica* and *Tripos muelleri*, middle row: *Strombidium* sp., *Mesodinium rubru*m and an unidentified diatom, bottom row: *Aphanizomenon flos-aquae* and *Nodularia spumigena*. The scale in the images varies.

Shellfish harvesting in Sweden

A mussel farm at Tångesund, Sweden. Photo Bengt Karlson





www.livsmedelsverket.se

Study at musselfarm in Tångesund in 2016

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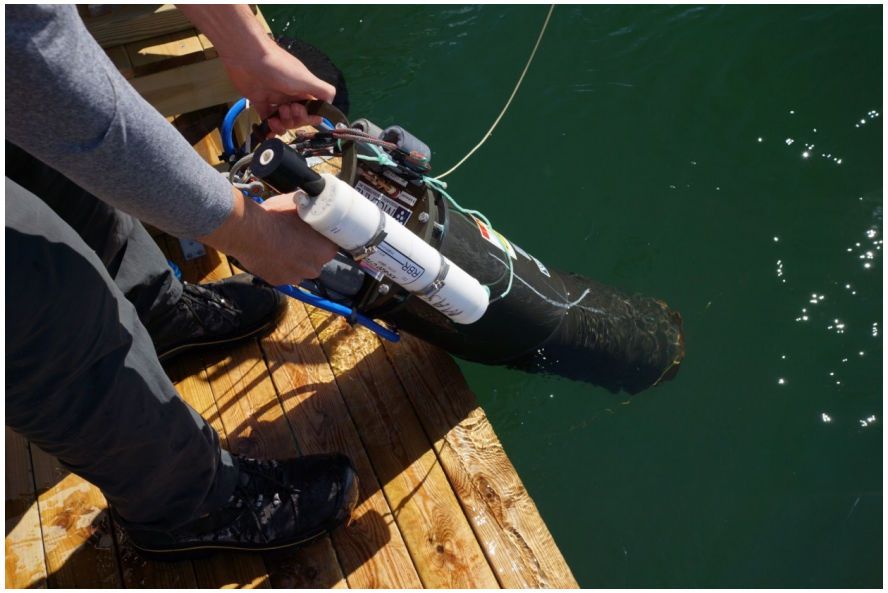
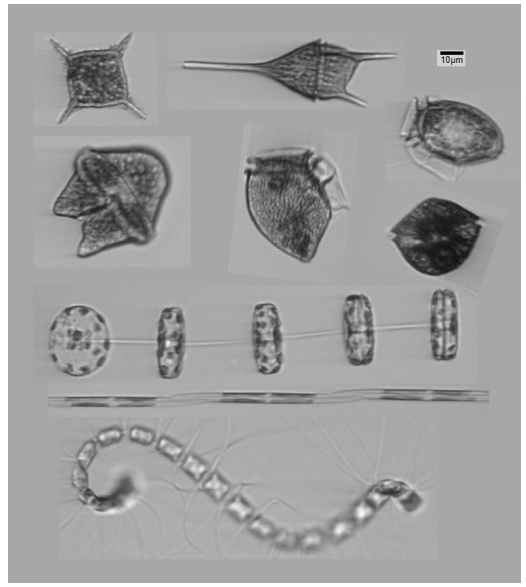


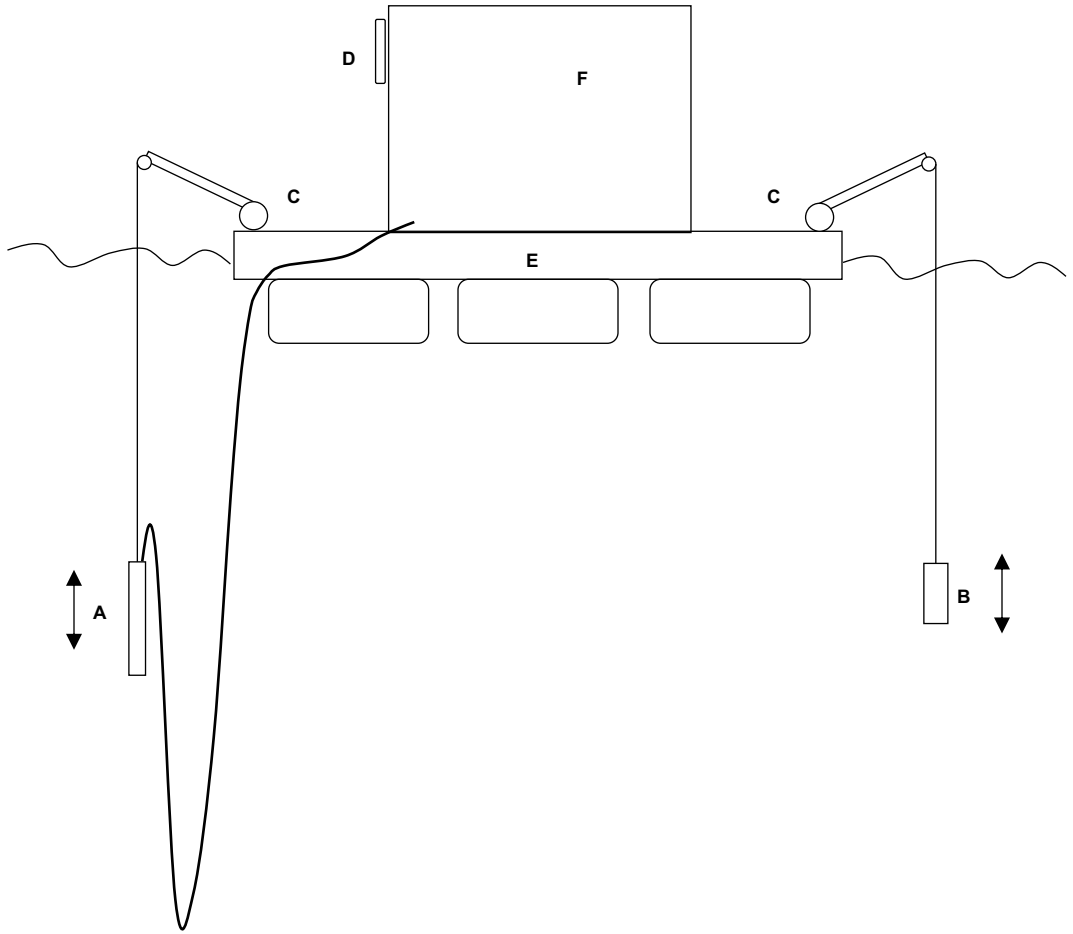
IFCB from WHOI

Raft with instruments

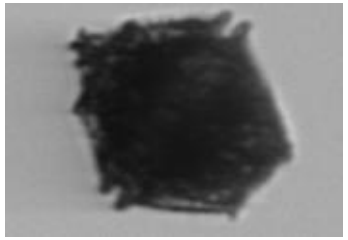


Examples of images from IFCB

Vertical profiling with IFCB



Lingulodinium polyedra producer of yessotoxins



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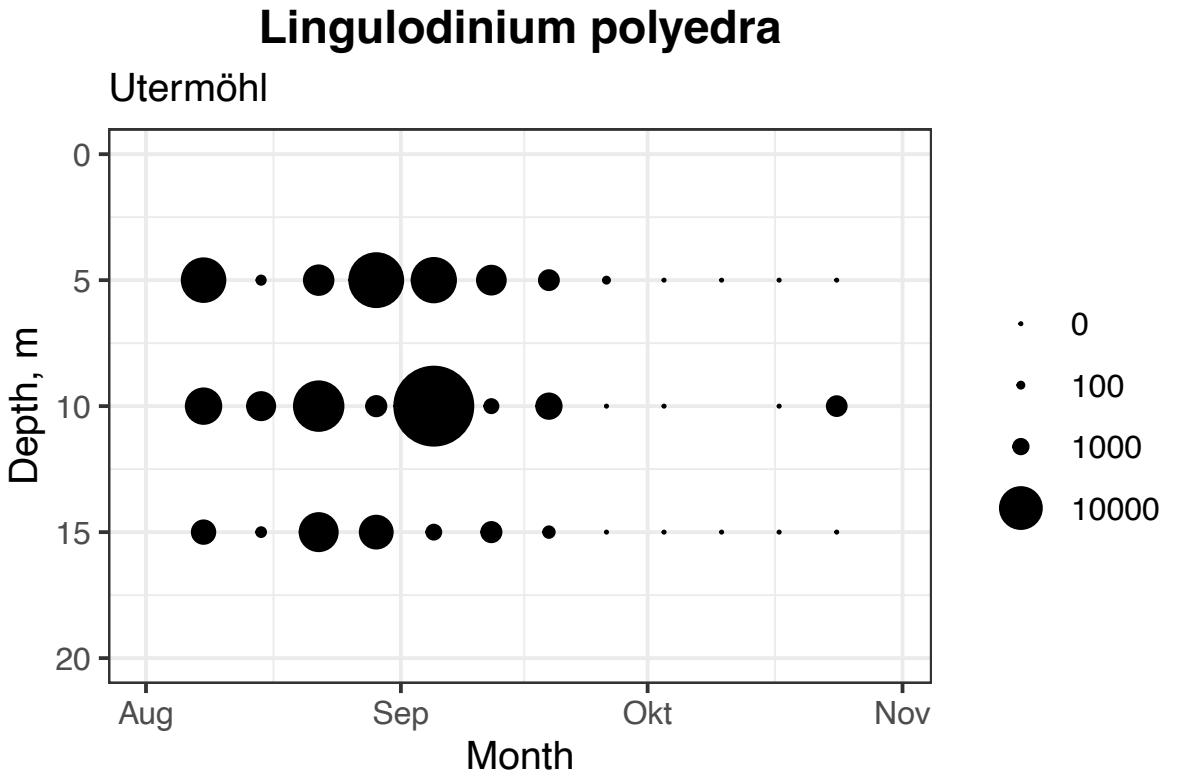
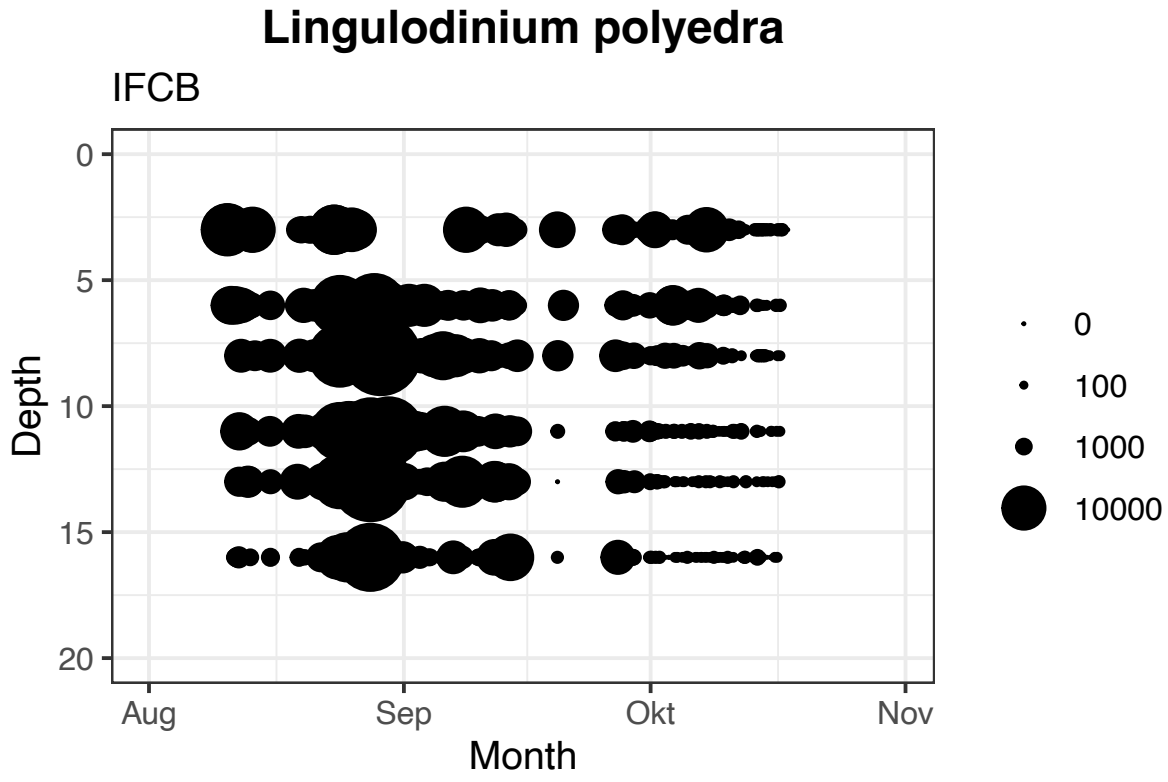
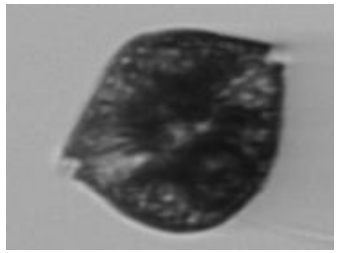




Alexandrium pseudogonyaulax producer of goniodomin



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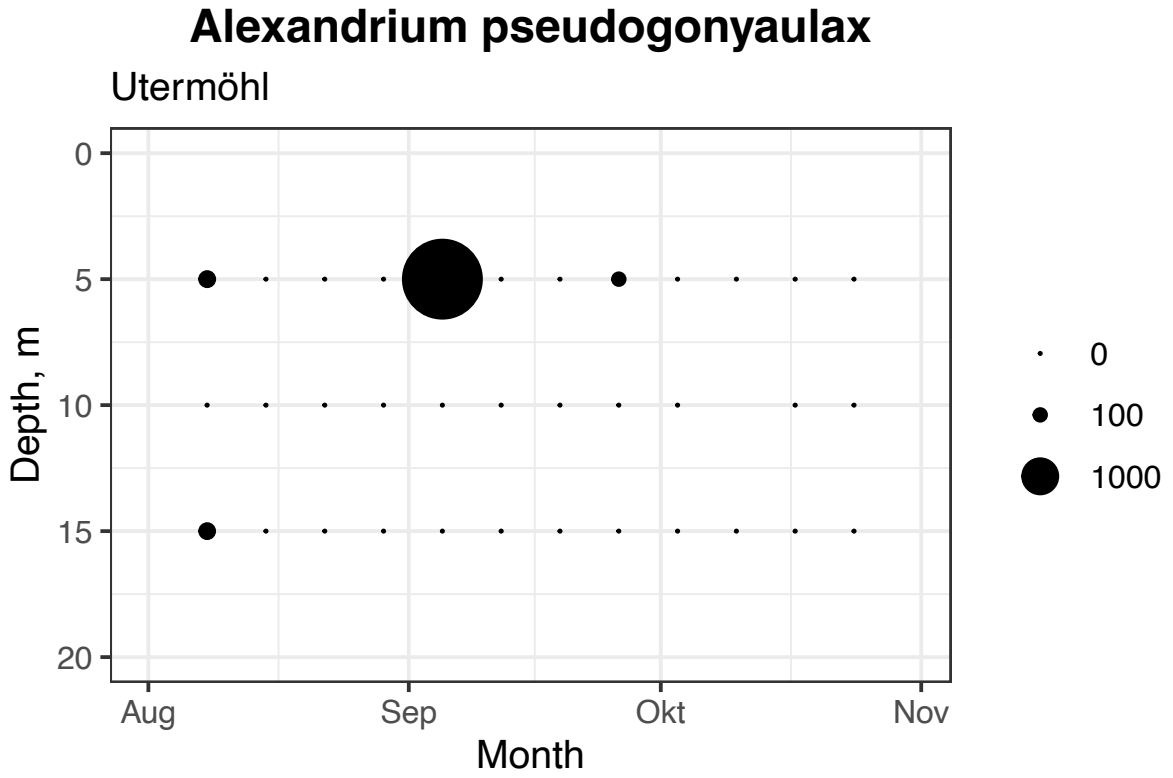
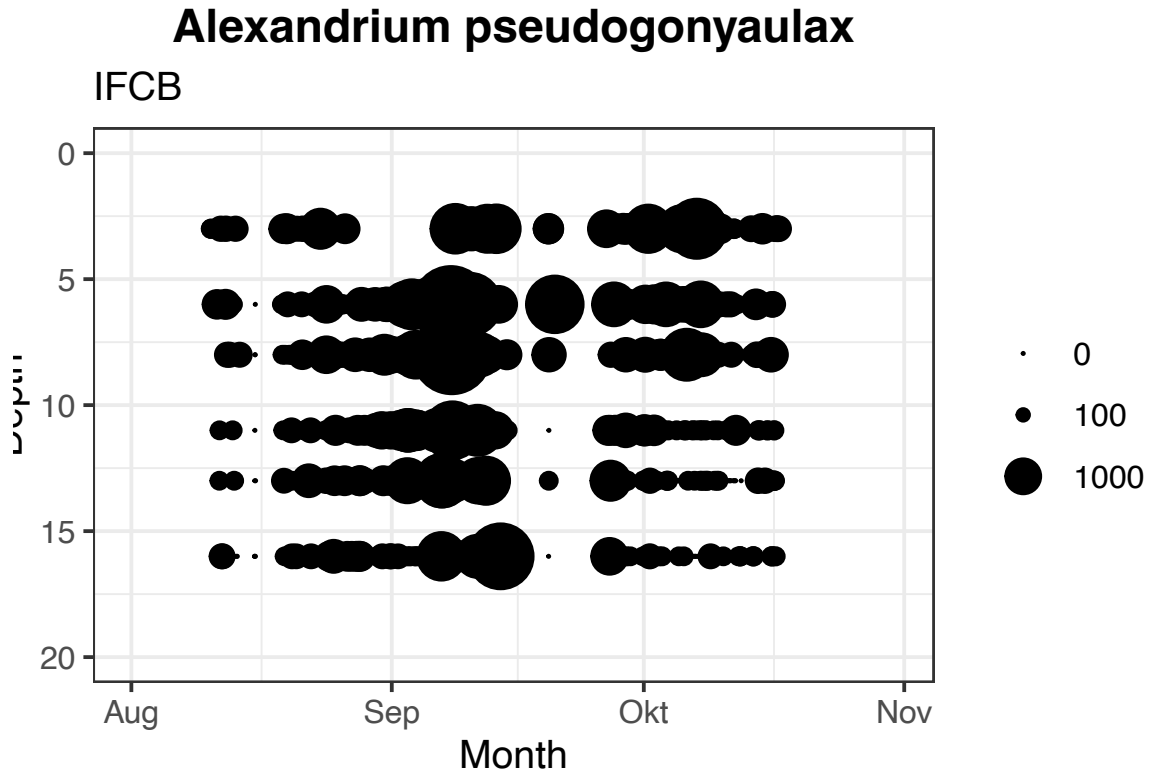
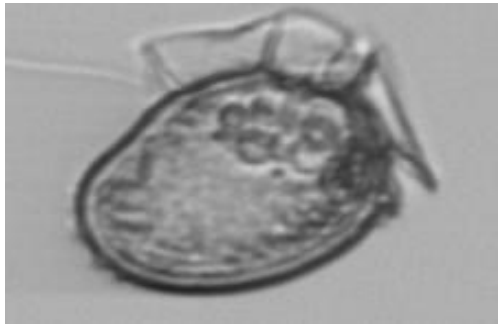




Dinophysis acuminata producer of DST



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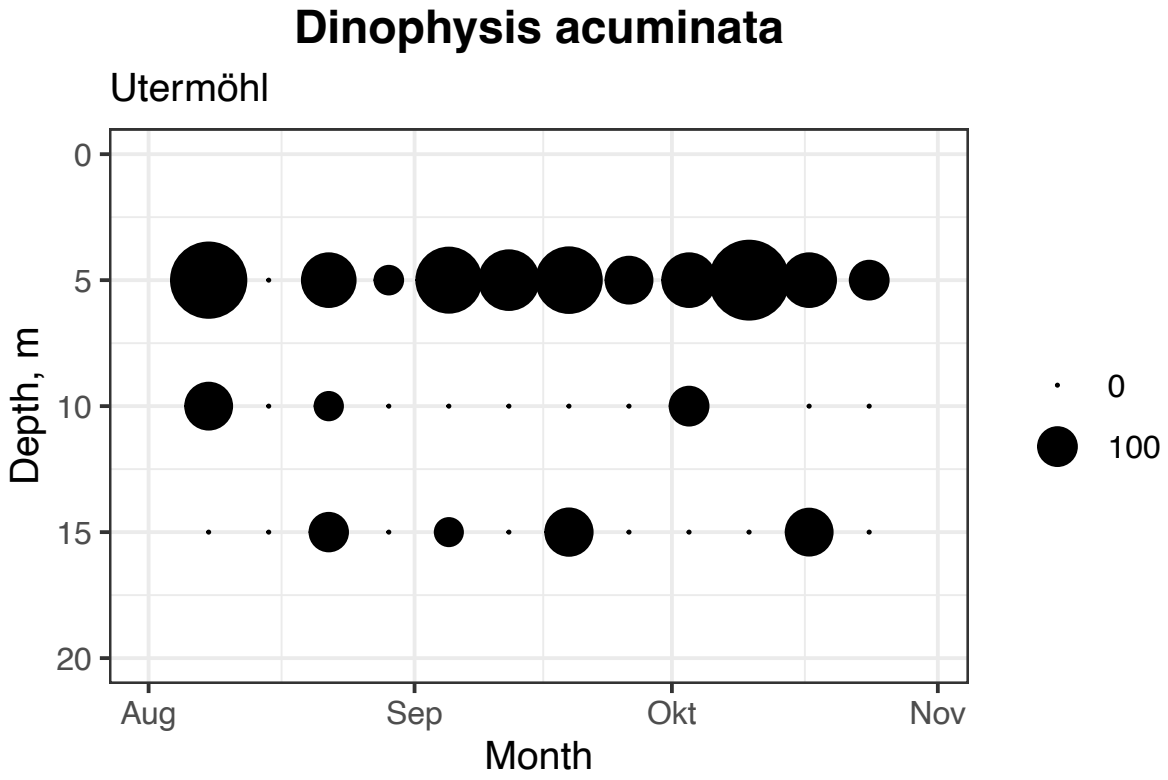
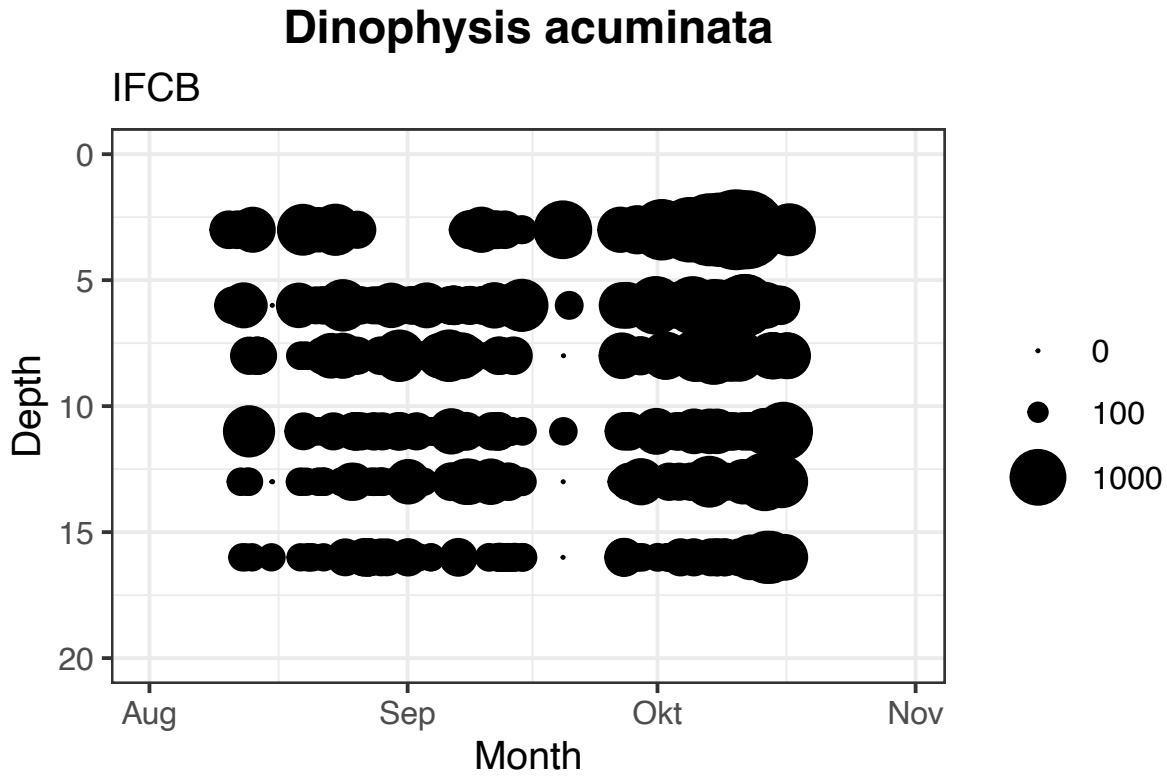
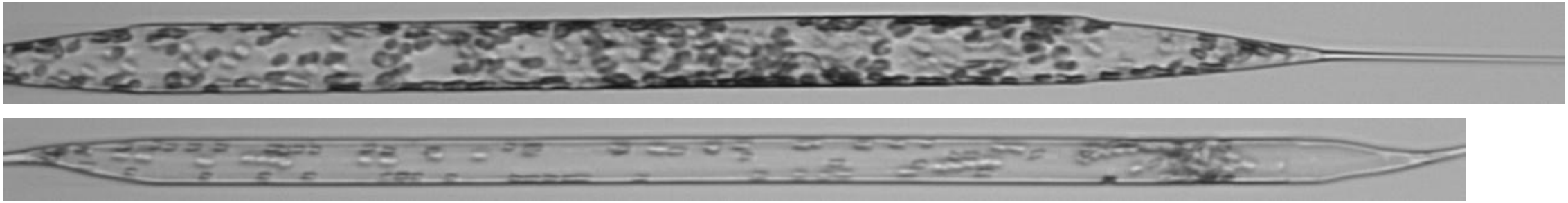


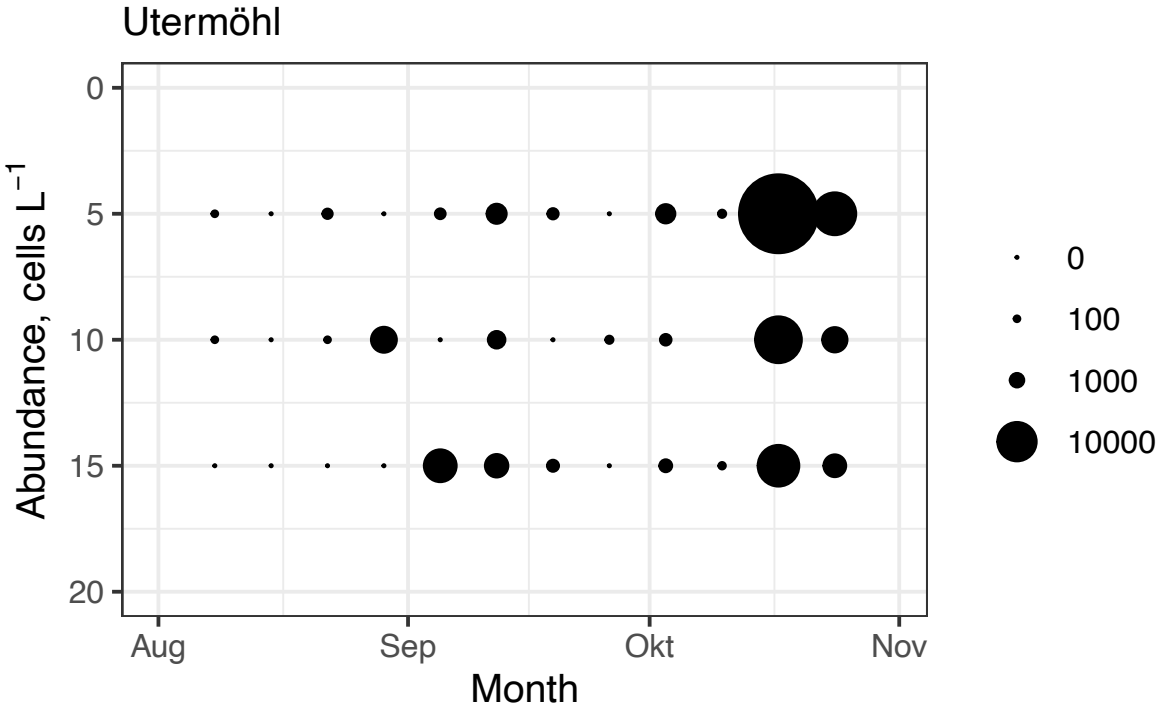


Rhizosolenia and Pseudosolenia
no toxins

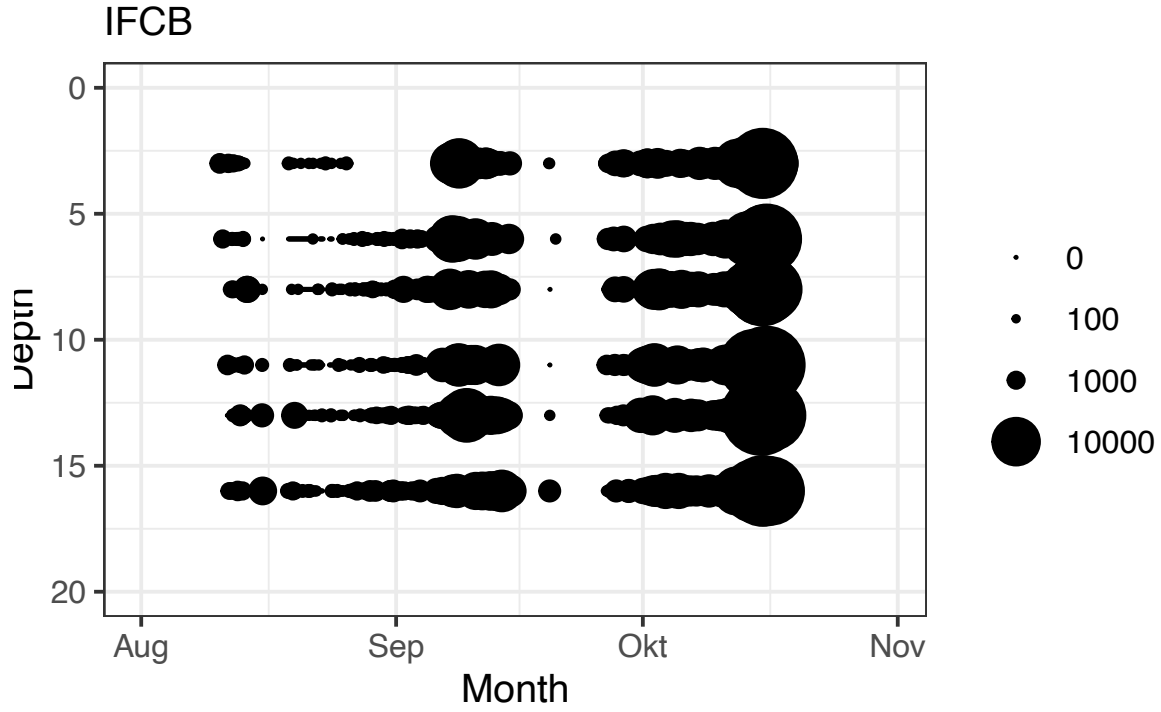
SMHI



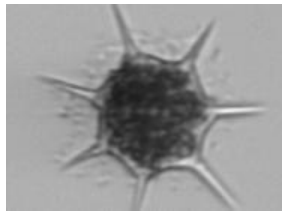
Pseudosolenia calcar–avis

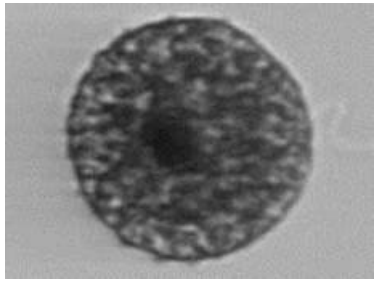


Rhizosolenia/Pseudosolenia



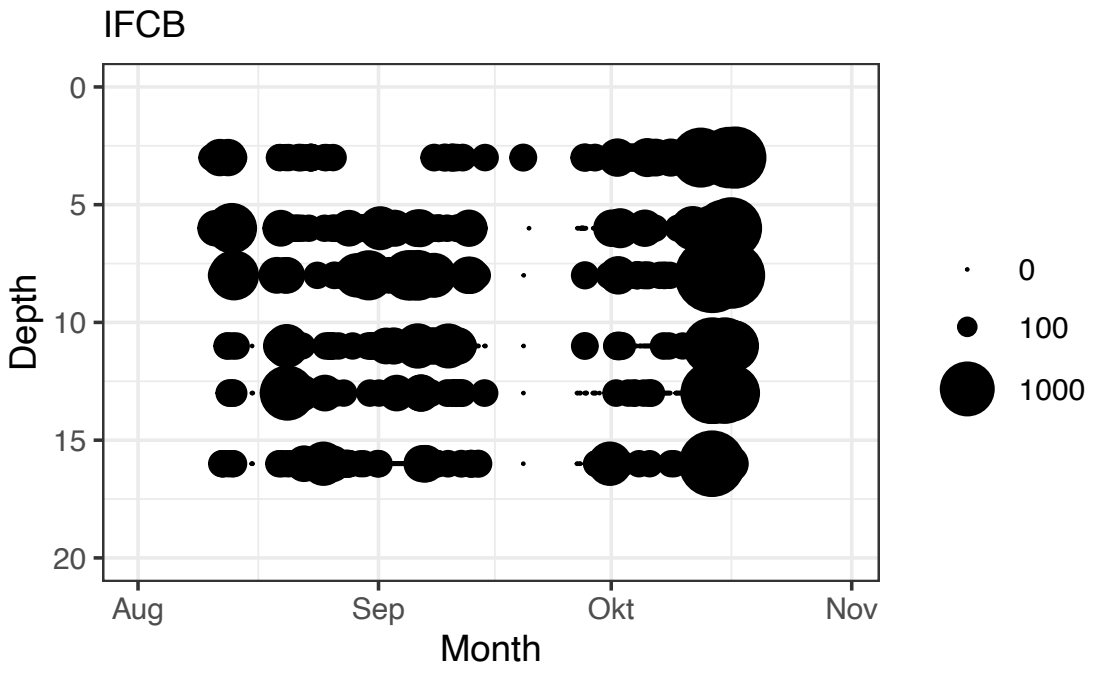
Dictyocha - naked stage



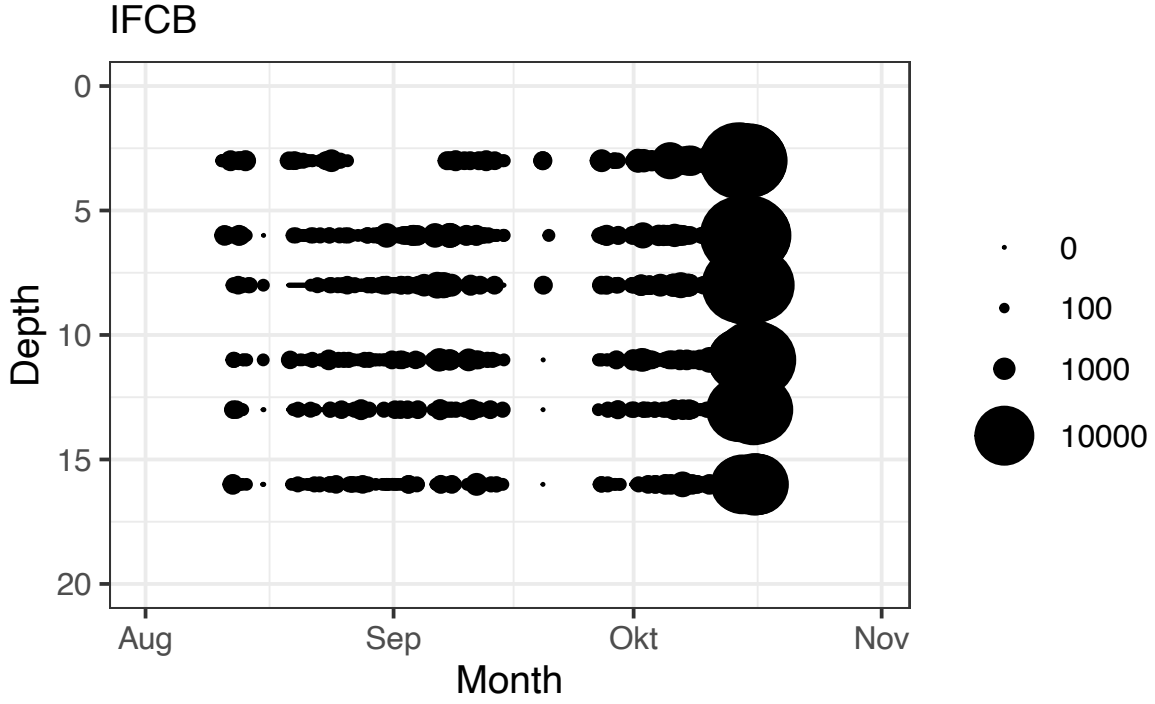


cf. Naked *Dictyocha* sp.

Dictyocha speculum

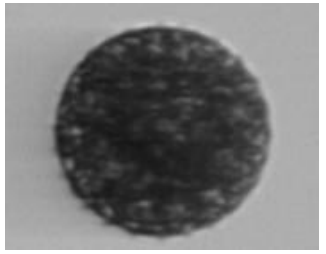


Dictyocha naked



Dictyocha spp. fish killer

Similar to
Vicicitus globosus



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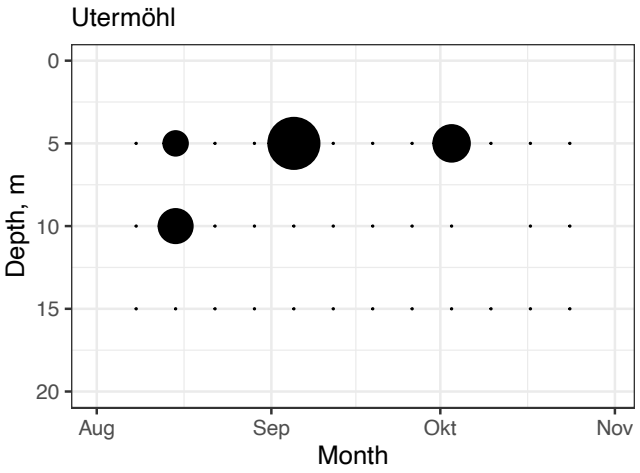
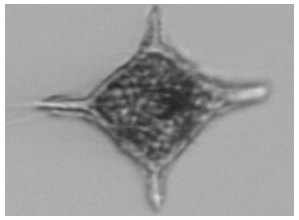
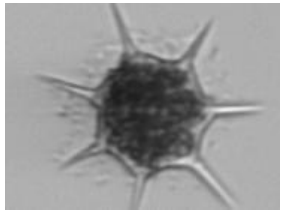
Dictyocha fibula

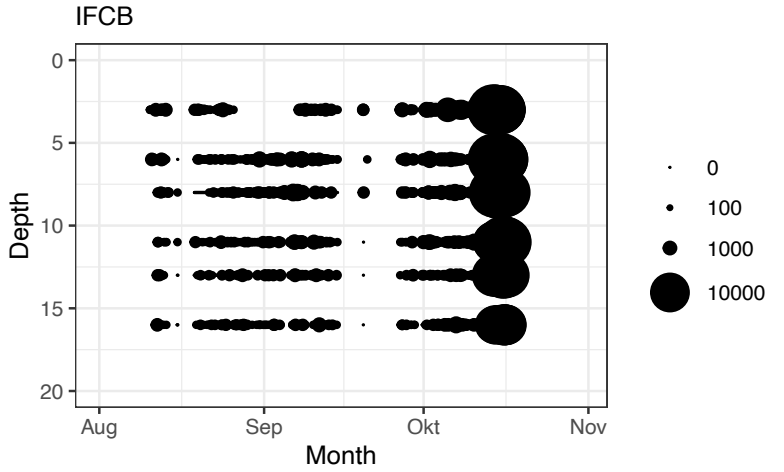




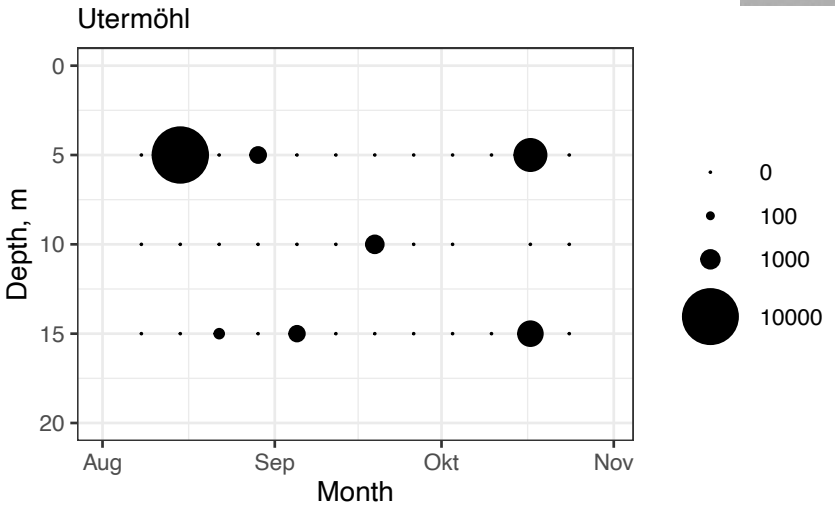


Dictyocha speculum is a synonym of *Octactis speculum*

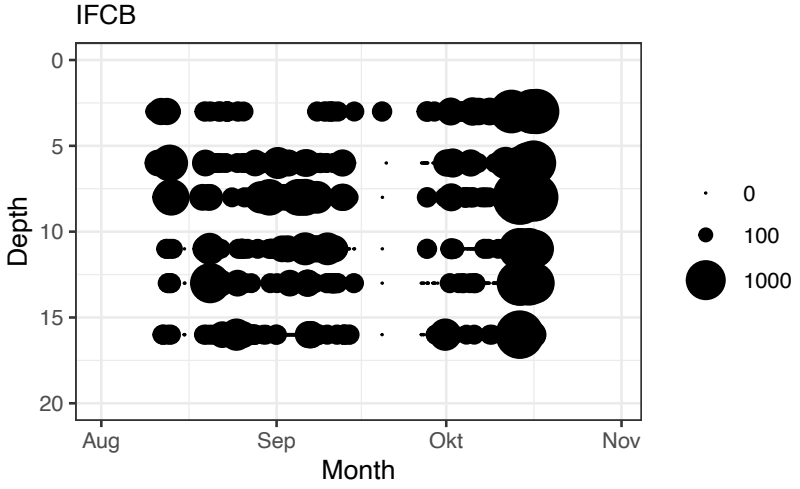
Dictyocha naked



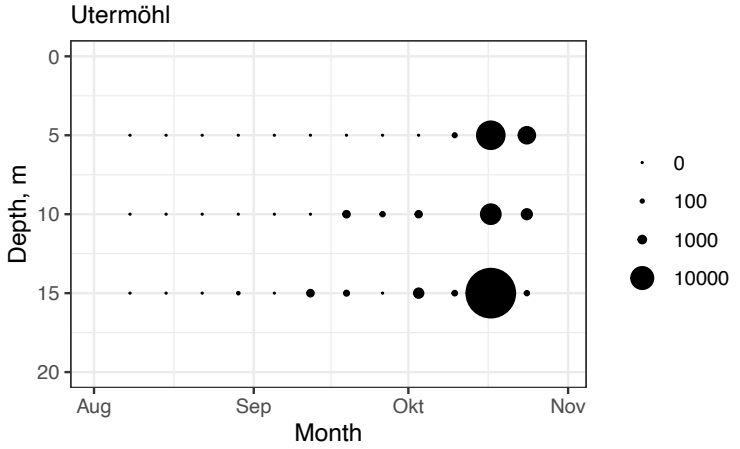
Dictyocha speculum



Dictyocha speculum



Dictyocha naked stage



Summary

- Satellite remote sensing for high biomass blooms, mainly cyanobacteria
- Bio-optical sensors in FerryBox systems, buoys and on research vessels
- Imaging FlowCytobot
  - Provides detailed information at species or genus level
  - Cell abundance and biovolume/biomass
  - Study at mussel farm using profiling setup revealed previously unknown natural variability
  - New IFCB deployed on R/V Svea
    - Cruises carried out in May and July 2022
    - Obsrvations of cyanobacteria successful - largea colonies overlooked?
    - Fully operational in 2023?

Acknowledgements

- Mike Brosnahan, WHOI
- Colleagues at SMHI, e.g. Ann-Turi Skjevik, Kristin Andreasson, Malin Mohlin, Fredric Ragnar and Anders Ekner
- JERICO-NEXT, JERICO-S3
- Lifewatch
- Swdish Biodiversity Daa Infrastructure (SBDI)
- Swedish National Marine Monitoring Program
- And others