



Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG



PHD PROJECT

by Jana Hinners

Consequences of alterable
phytoplankton traits
for ecosystem dynamics
in a changing environment

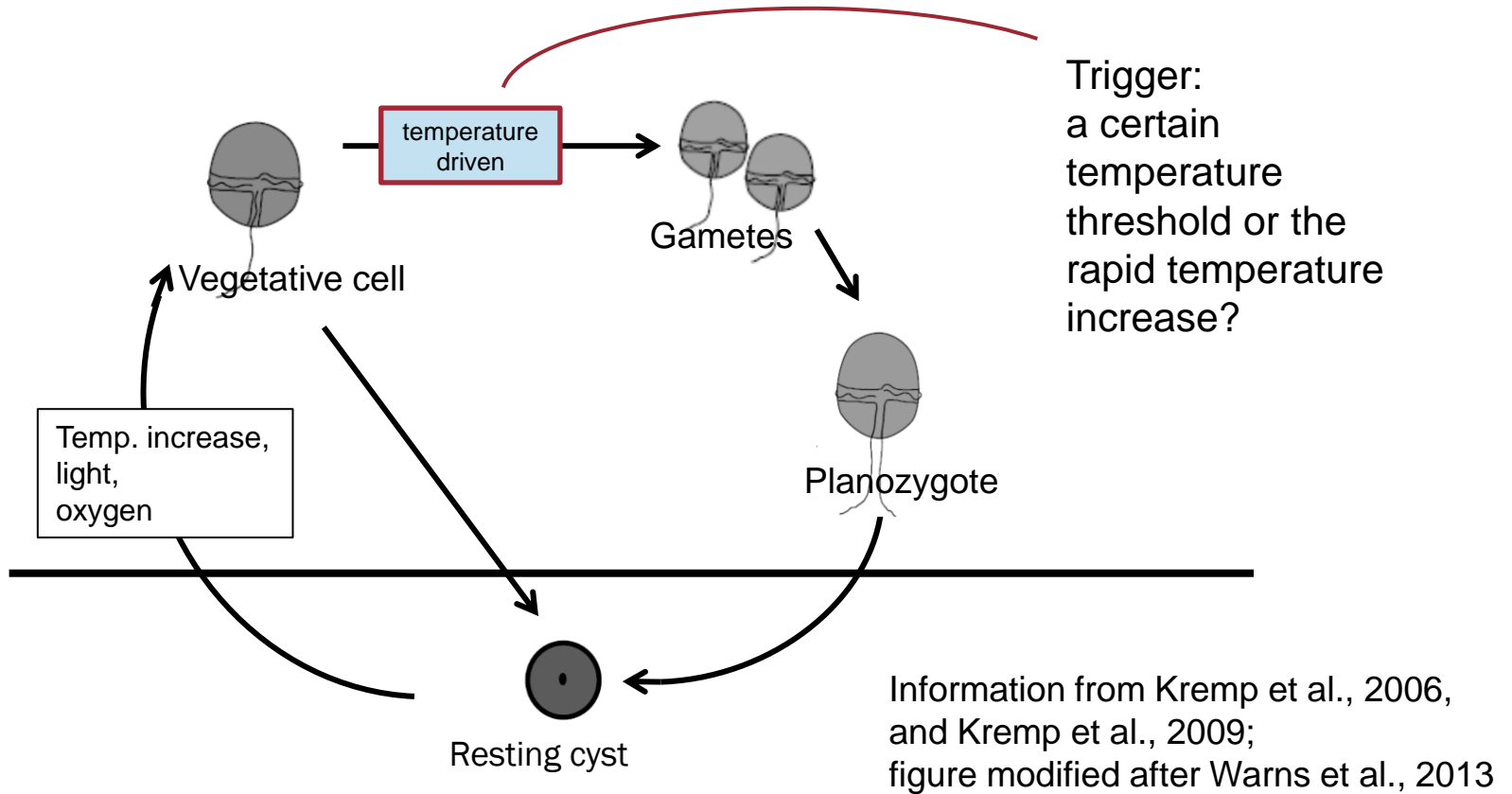
Subject of my PhD Project

- Evolutionary potential of phytoplankton
- Focus on dinoflagellates
- Investigation of:
 - life cycle dynamics
 - Dependencies of growth rate
- Experiments and modeling

Aims of my project

1. Temperature dependence of dinoflagellate life cycle
 - What is the exact trigger?
2. Evolutionary adaptation in dinoflagellates
 - Does growth dependence on temperature, salinity and nutrition change in time?
 - Changes on ecosystem functioning?

Dinoflagellate life cycle



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Identifying Evolutionary Adaptation

1. Experimental evolution

- Lohbeck et al, 2012: *E. huxleyi* adapts to acidification (batch culture, 500 generations)
- Lennon & Martiny, 2008: Cyanobacteria adaptation to viruses (chemostat)
- Yoshida et al., 2004: Green-algae adaptation to predation (chemostat)

2. Evolution archived in sediment

- Hallström et al., 2011: 100 year old diatoms locally adapted
- Ribeiro et al., 2013: Adaptation to salinity changes not found in sediment core
- Our study!

Experimental Part

Ellegaard et al., 2013:

Use of the sediment archive to study past populations of protists

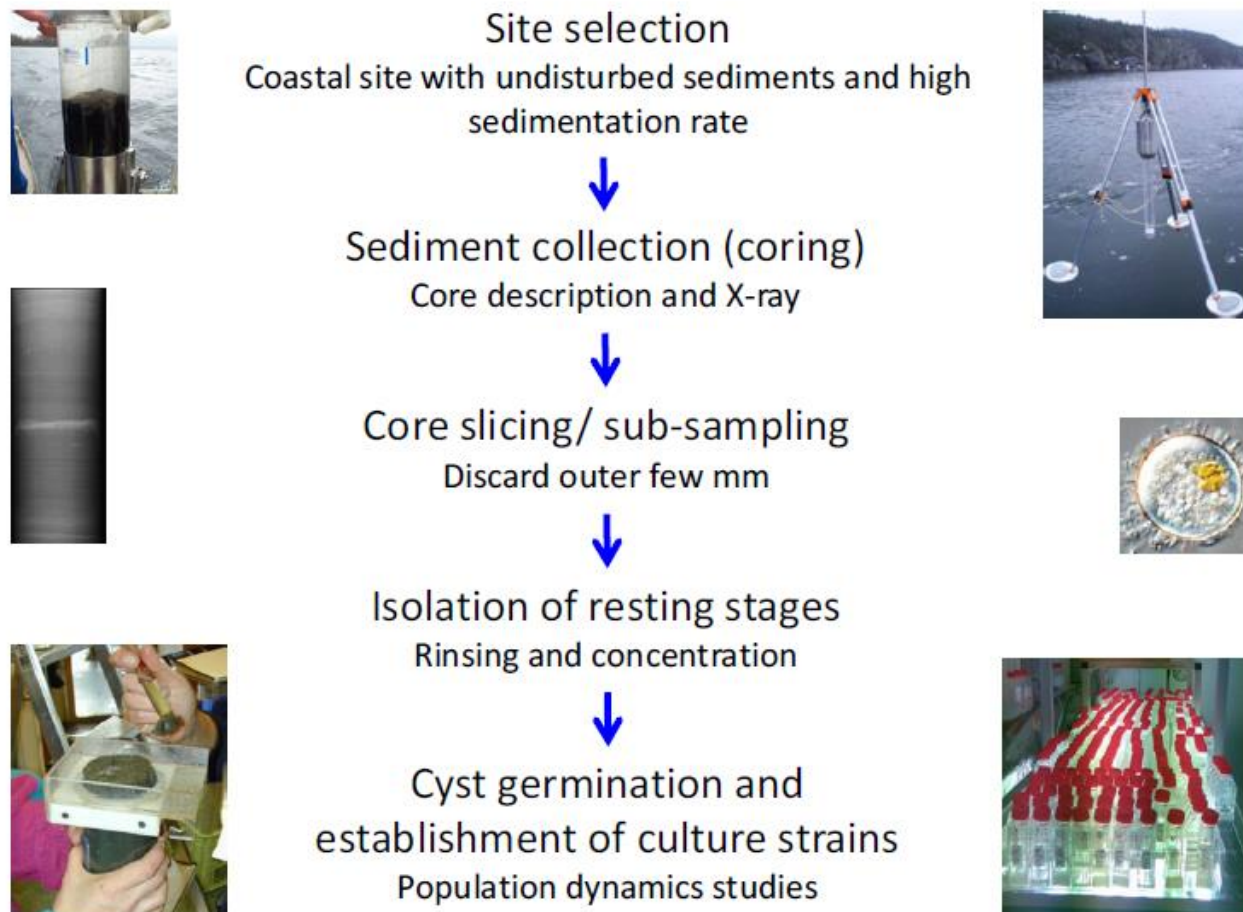


Figure 1. Flow diagram of methodology for obtaining time series of living protist cultures from sediment cores.

Experimental Part

Ellegaard et al., 2013:

Use of the sediment archive to study past populations of protists

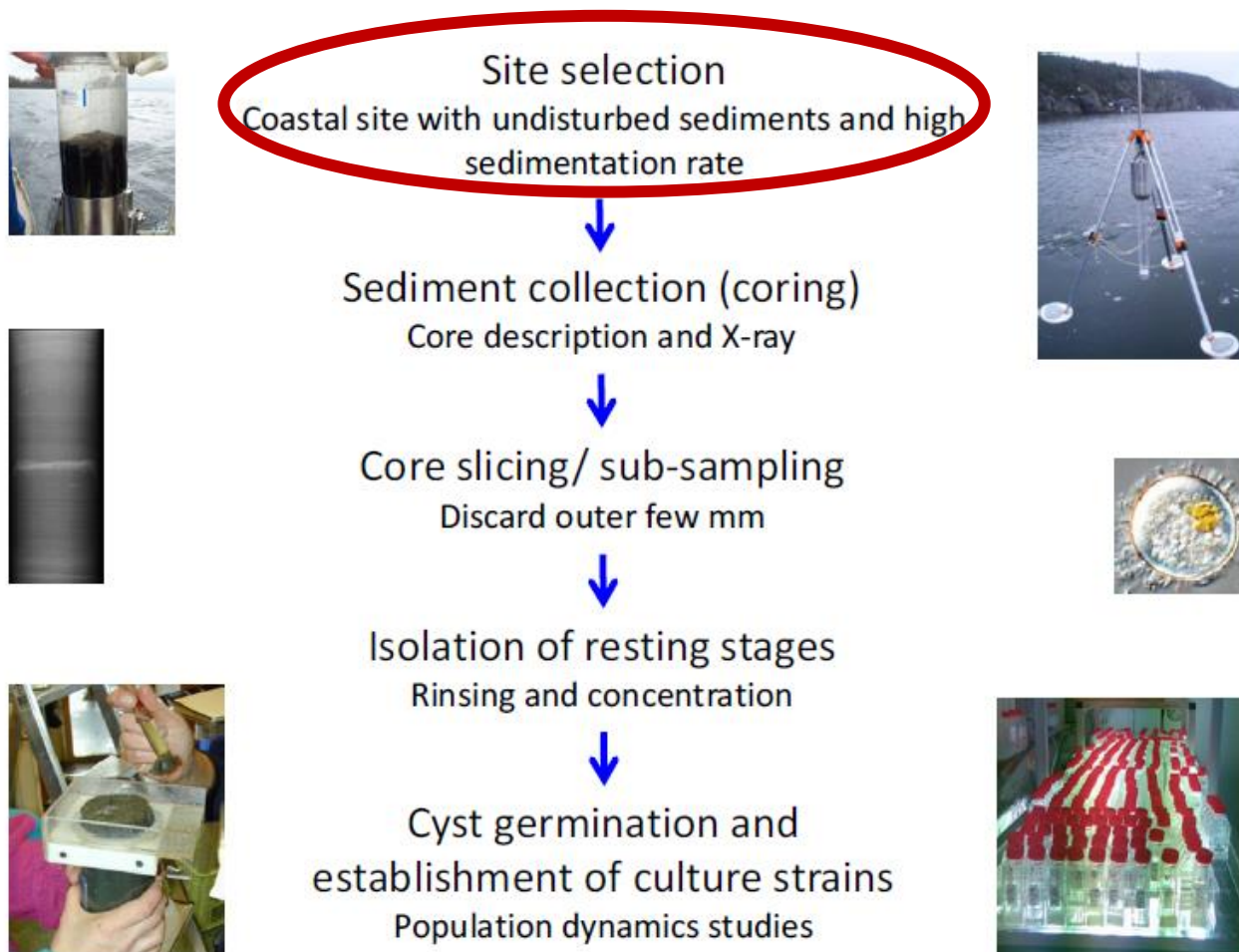


Figure 1. Flow diagram of methodology for obtaining time series of living protist cultures from sediment cores.

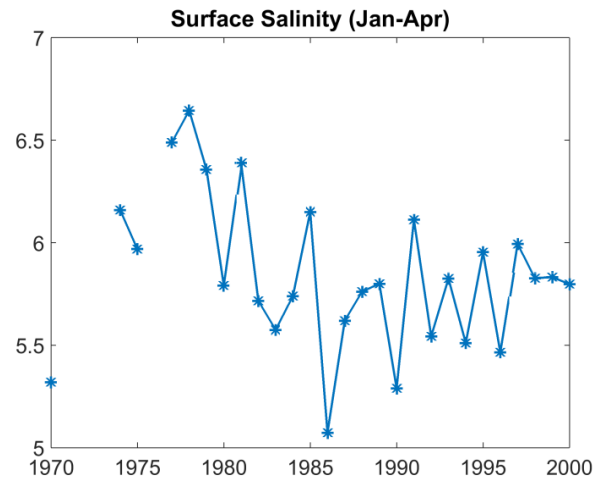
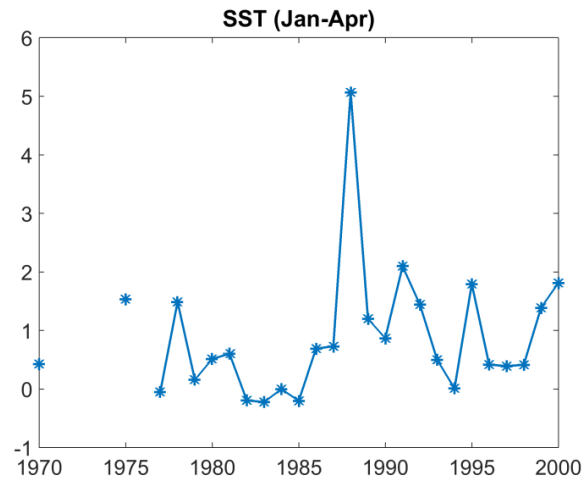
Changing environmental conditions

Sampling site: Gulf of Finland

- Anoxic sediment
- No bioturbation

Surface temperature and salinity at location LL7, Gulf of Finland,

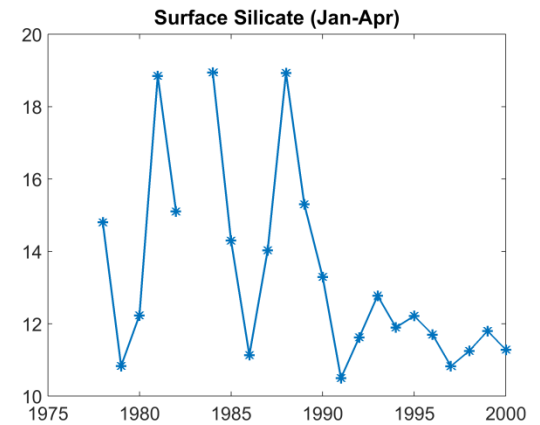
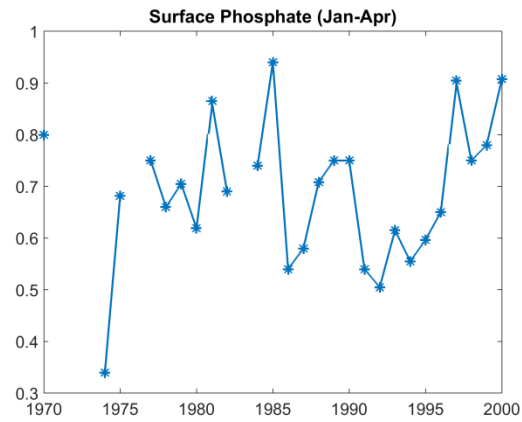
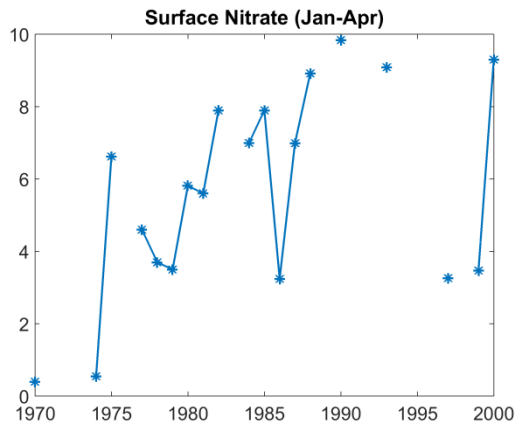
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Changing environmental conditions

Nitrate, Phosphate and Silicate at location LL7, Gulf of Finland,

data source: BED



Experimental Part

- ✓ Germination of dinocysts from 2 layers (1cm and 16cm depth)
 - ✓ Dating of core material
 - ✓ Establishing cultures
-
- Gentle acclimation to different temperatures: 4°C / 6°C
 - Growth experiments for temperature range 1-12°C
 - Measurement of cell number and size, nutrient concentration, POC/PON
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- Growth experiments for salinity range 0-10 psu
 - (Competition experiments with dinoflagellates & diatoms)

Modeling Part

- mathematical formulation of relationship between growth and environmental factors
- mathematical formulation for possibility of adaptation using subcompartments and transfer velocities (approach from Beckmann & Hense 2004)
- (Modelling competition of diatoms and dinoflagellates)

Research questions

- Changes in phytoplankton characteristics between past and present?
- Possible to formulate changes in a biological meaningful way?
- Explanation for shift from diatom- to dinoflagellate-dominated blooms?
- Alterations of ecosystem functioning due to changes in phytoplankton?