Can we develop operational indicators for coastal phytoplankton composition?

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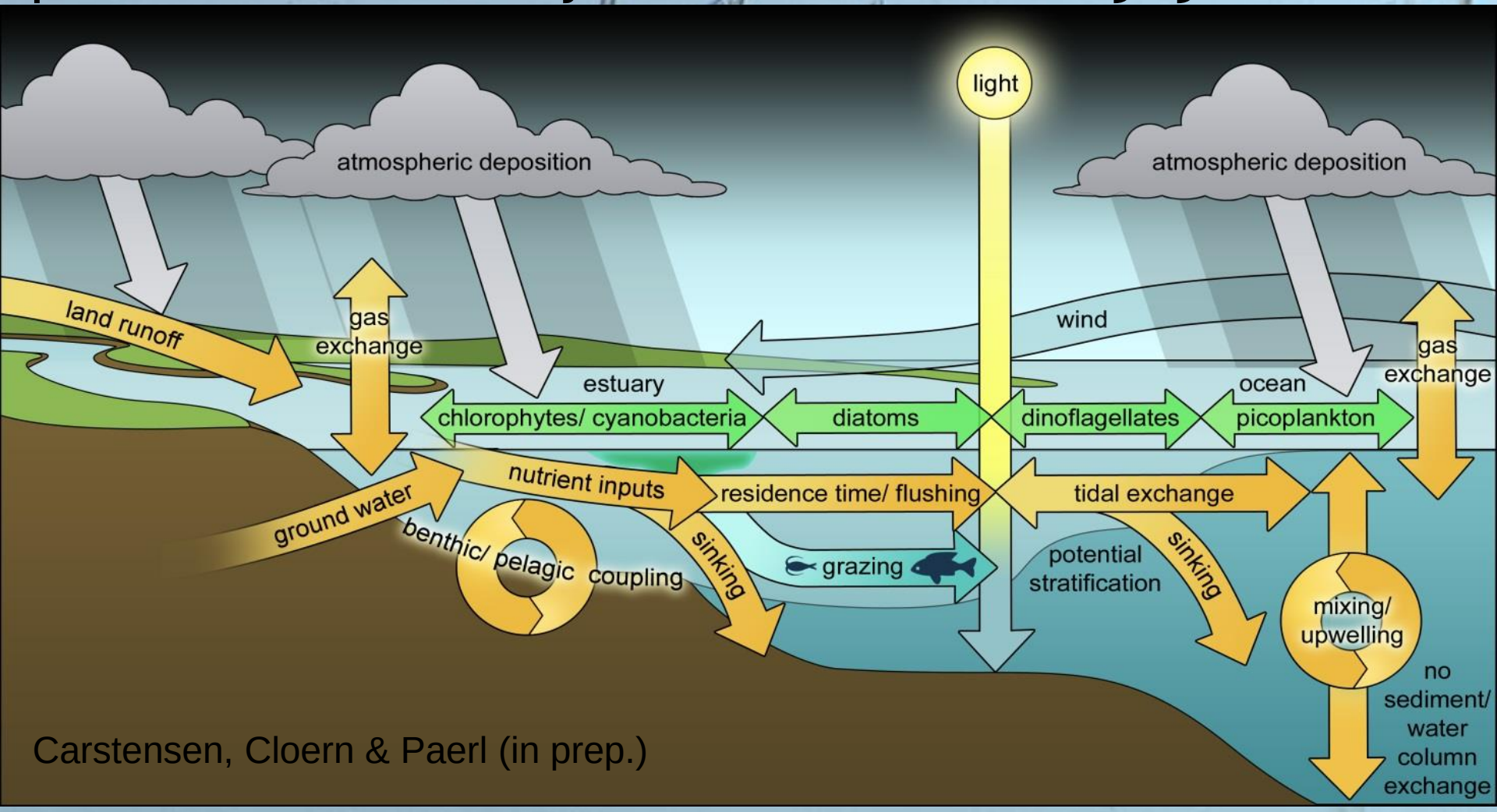
With contribution from SCOR WG137 and support from by:

DEVOTES

WATERS

cocoa
Nutrient cocktails in the coastal zone of the Baltic Sea

The coastal zone is a dynamic and productive ecosystem with strong gradients



Carstensen, Cloern & Paerl (in prep.)

Outline for this presentation

- A global analysis of phytoplankton composition
  - Results from SCOR WG137
  - Linking phytoplankton composition to nutrient pressure and other environmental factors
- Other studies of linking phytoplankton composition to nutrient pressure
- Proposed ranking of factors governing phytoplankton composition
- Conclusions on operational indicators for coastal phytoplankton composition

Dominant forms of taxa

Diatoms, e.g. *Skeletonema costatum*

Dinoflagellates, e.g. *Peridiniella catenata*

Cyanobacteria, e.g. *Planktothrix agardhii*

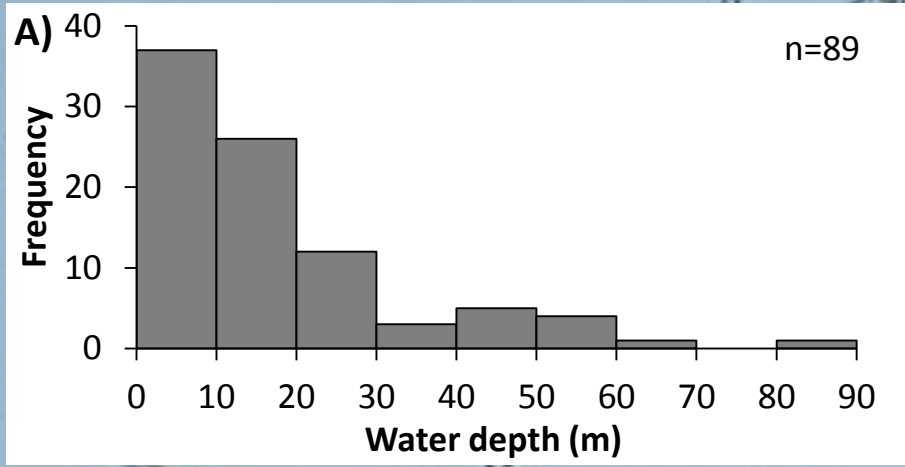
Chlorophytes, e.g. *Chlamydomonas spp.*

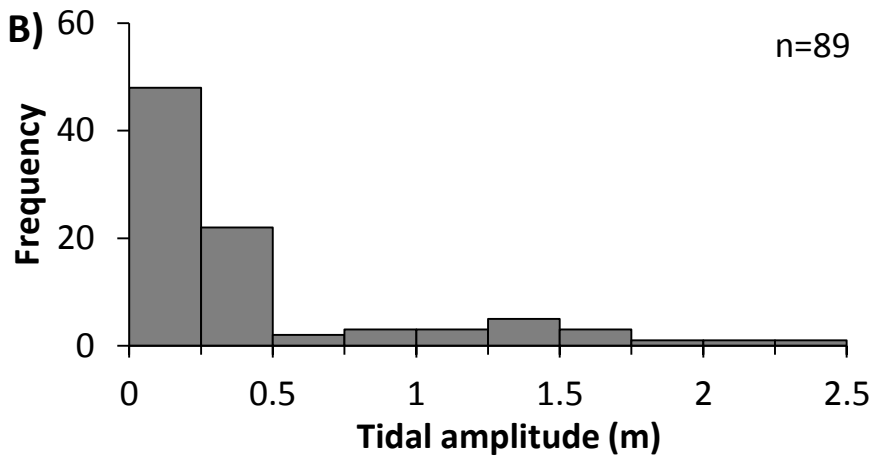
SCOR137: An unprecedented large data set

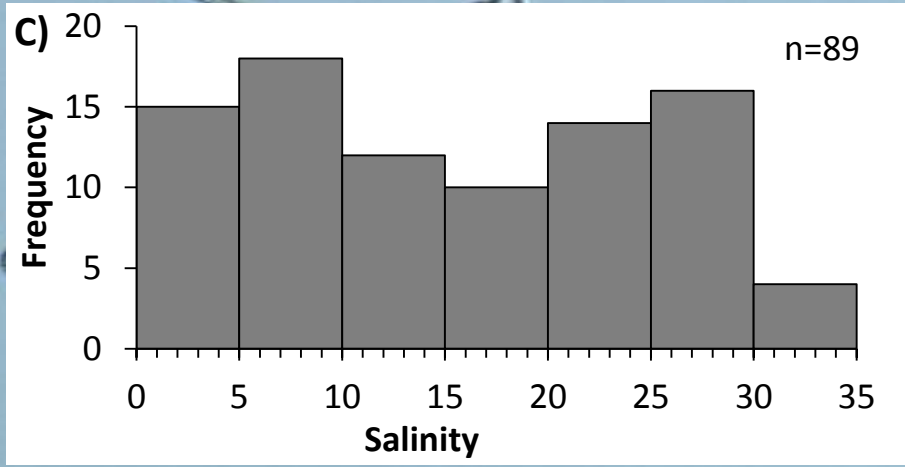
Area	# of stations	Period	# of samples
Chesapeake Bay	21	1984-2009	7197
Danish waters	18	1979-2014	7611
Dutch waters	14	1990-2011	5645
Finnish waters	12	1966-2010	4542
German Wadden Sea	1	1999-2012	1002
Gulf of Riga	4	1976-2012	905
Neuse River Estuary	4	2000-2013	624
Patos Lagoon Estuary	2	1993-2011	421
San Francisco Bay	4	1992-2013	735
Swedish waters	9	1983-2012	1571

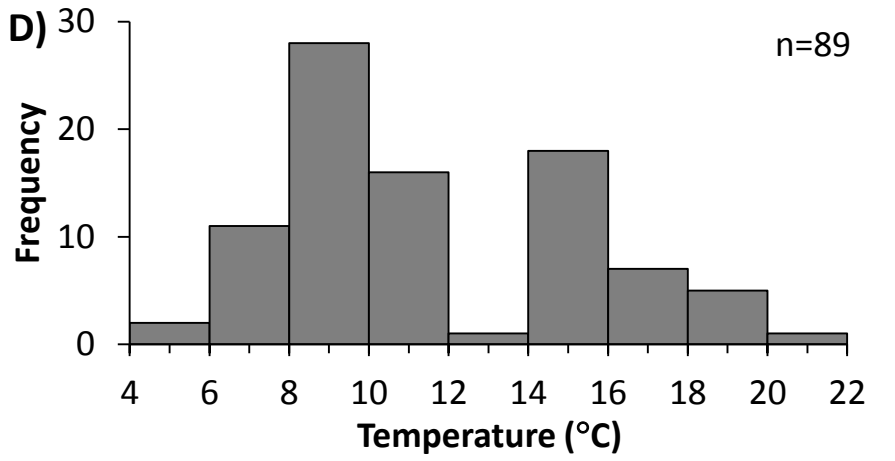
89 sites and >30000 samples in total

Diversity of coastal ecosystems - physics

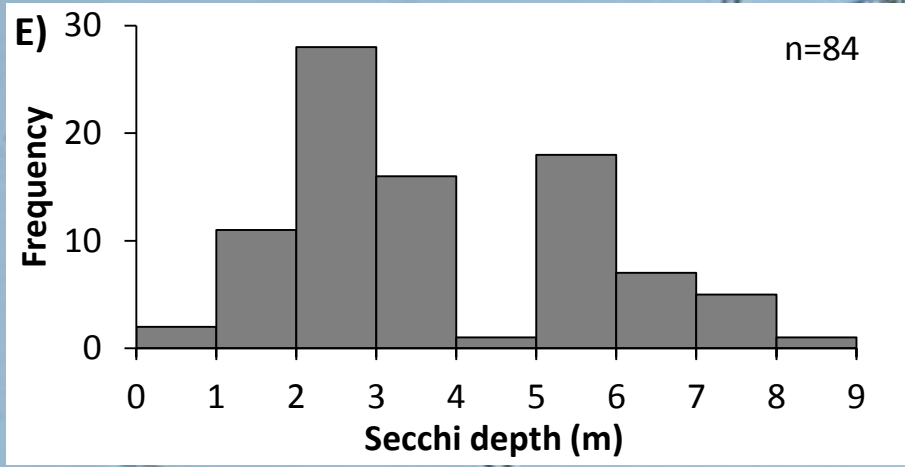


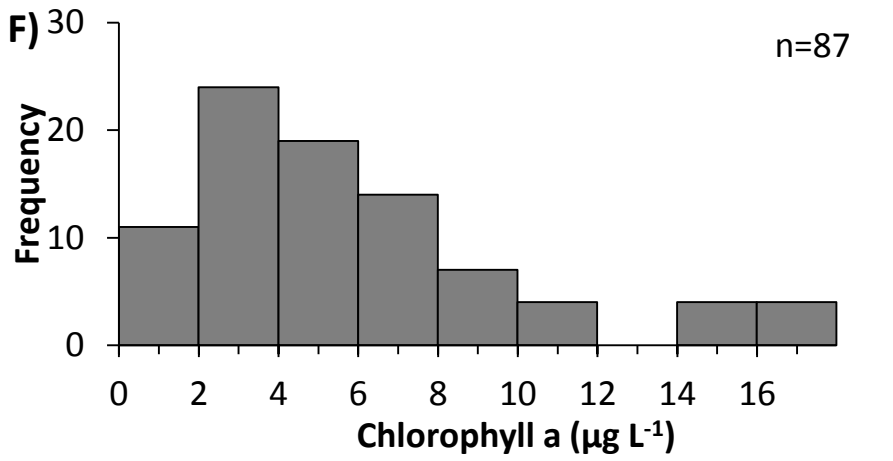


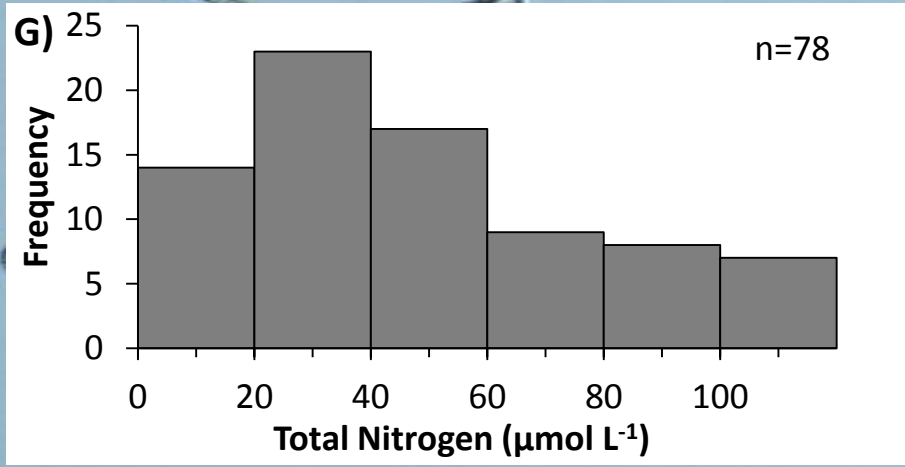


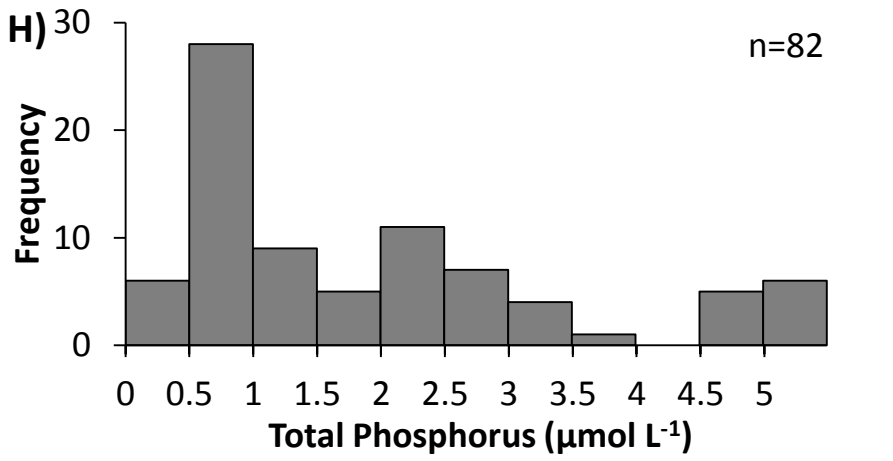


…. and chemistry

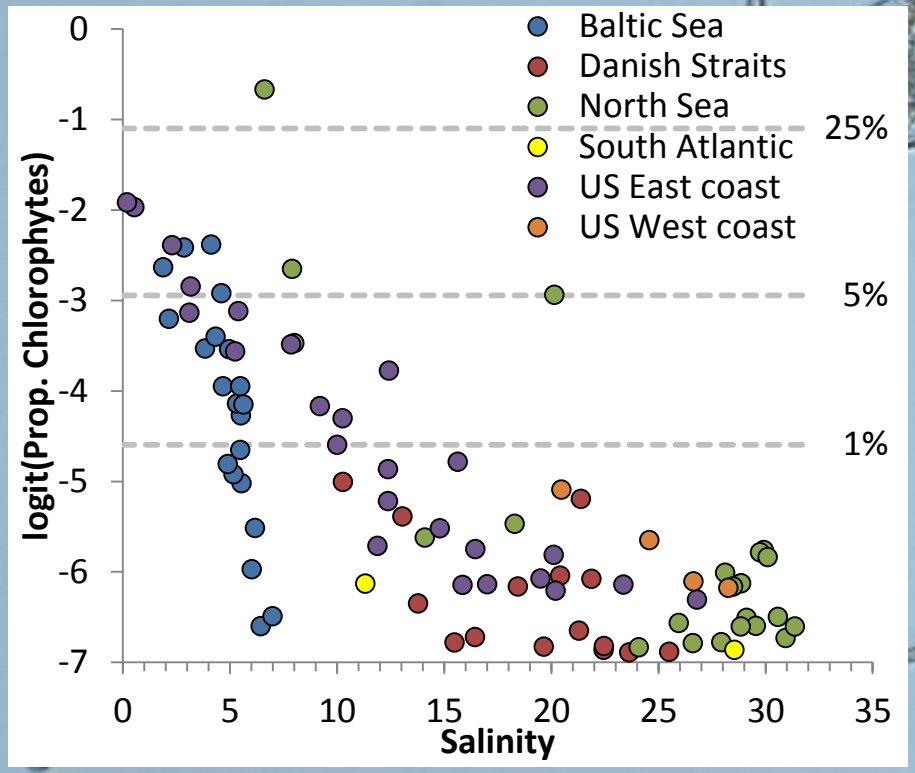


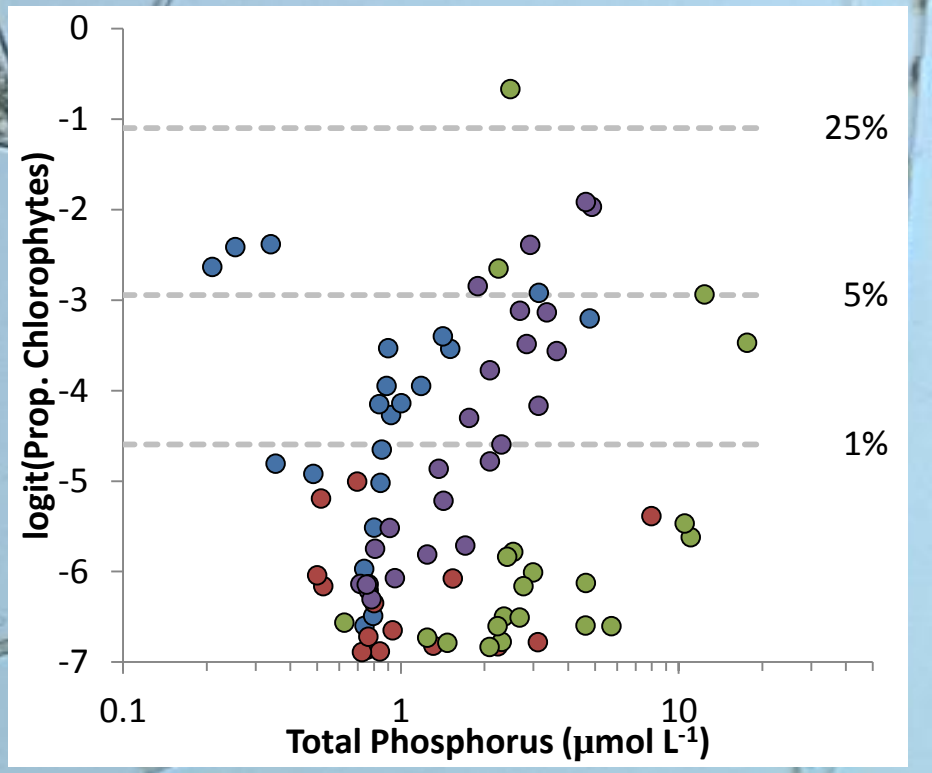






Environmental factors regulating the proportion of chlorophytes





Carstensen, Cloern & Paerl (in prep.)

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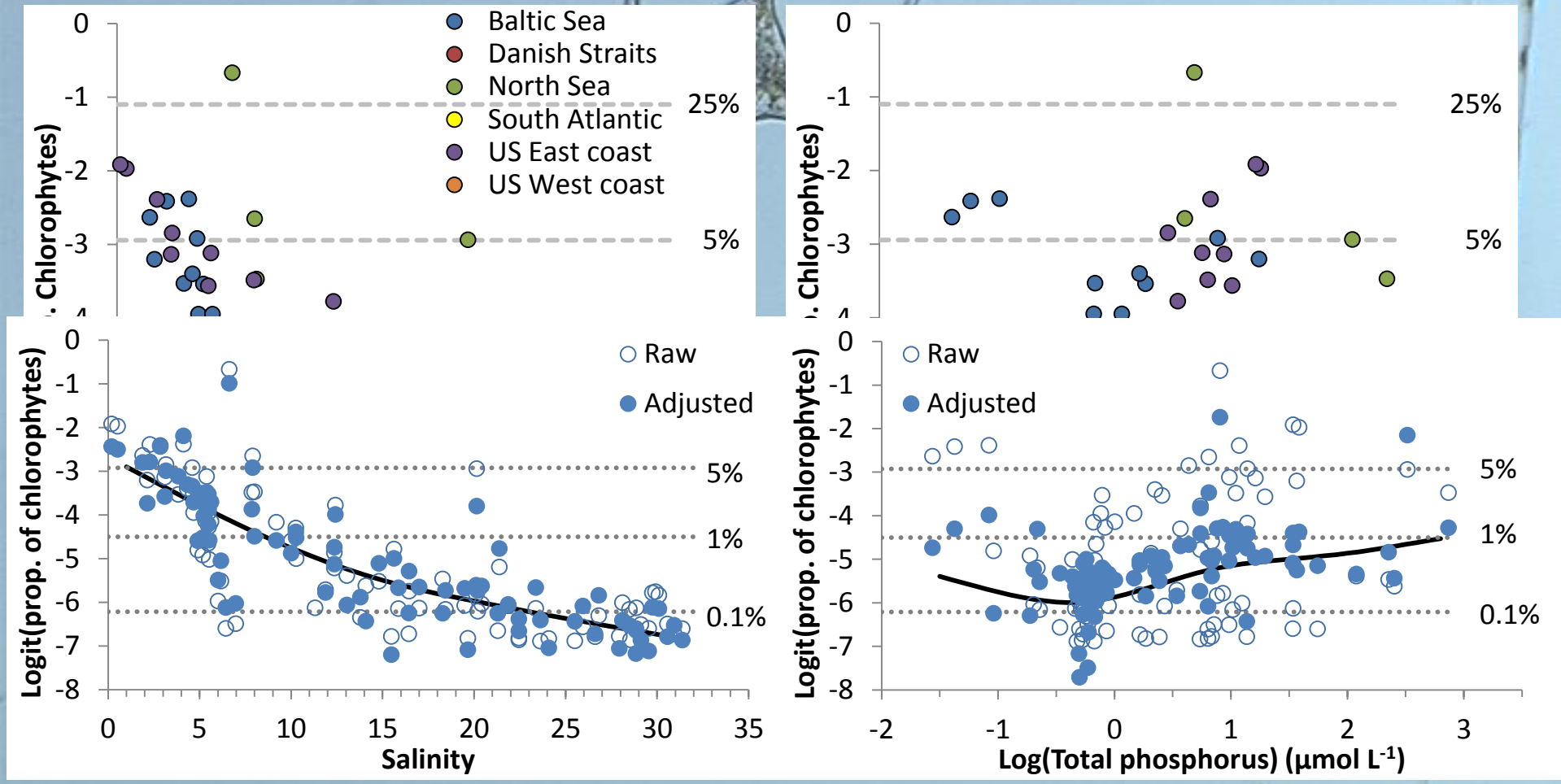

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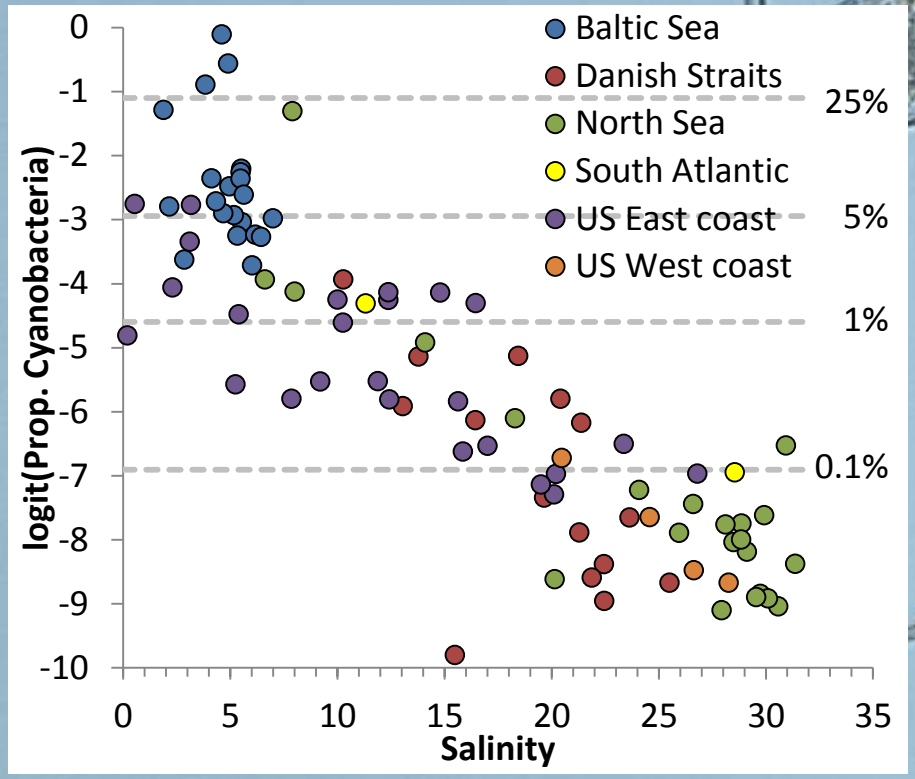
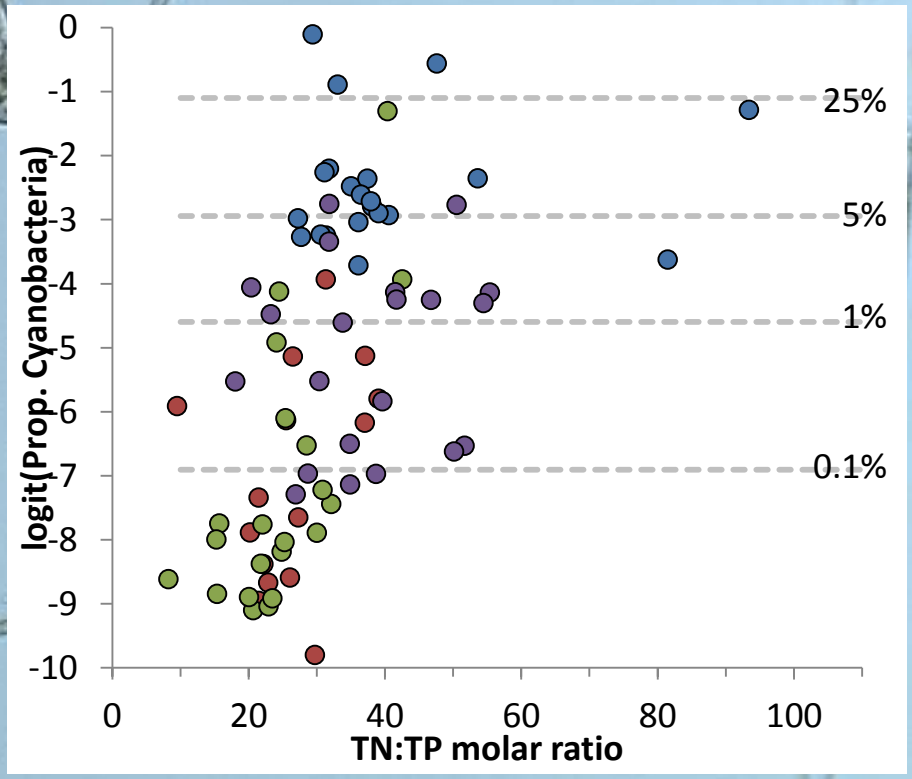
Environmental factors regulating the proportion of cyanobacteria





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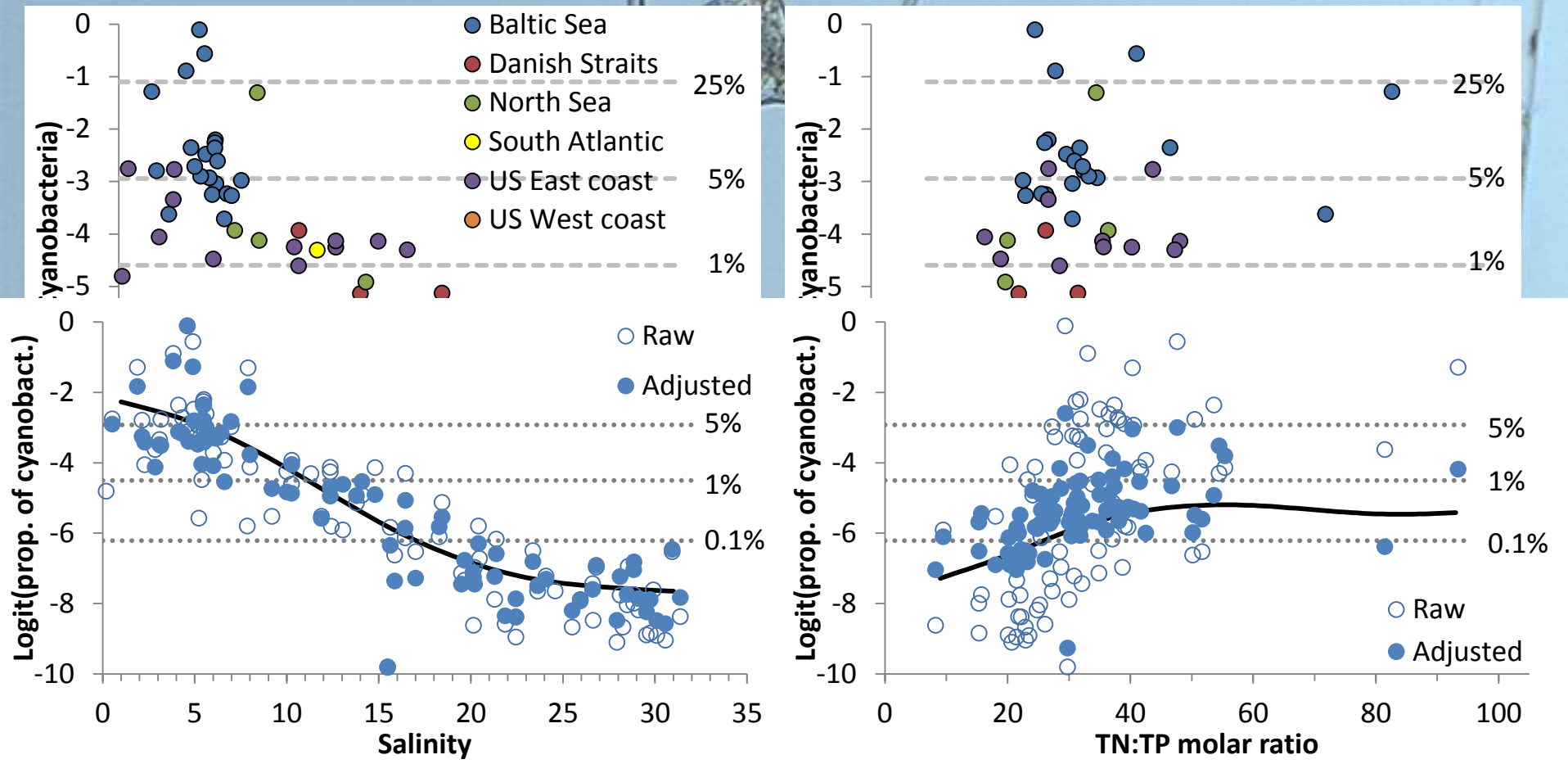

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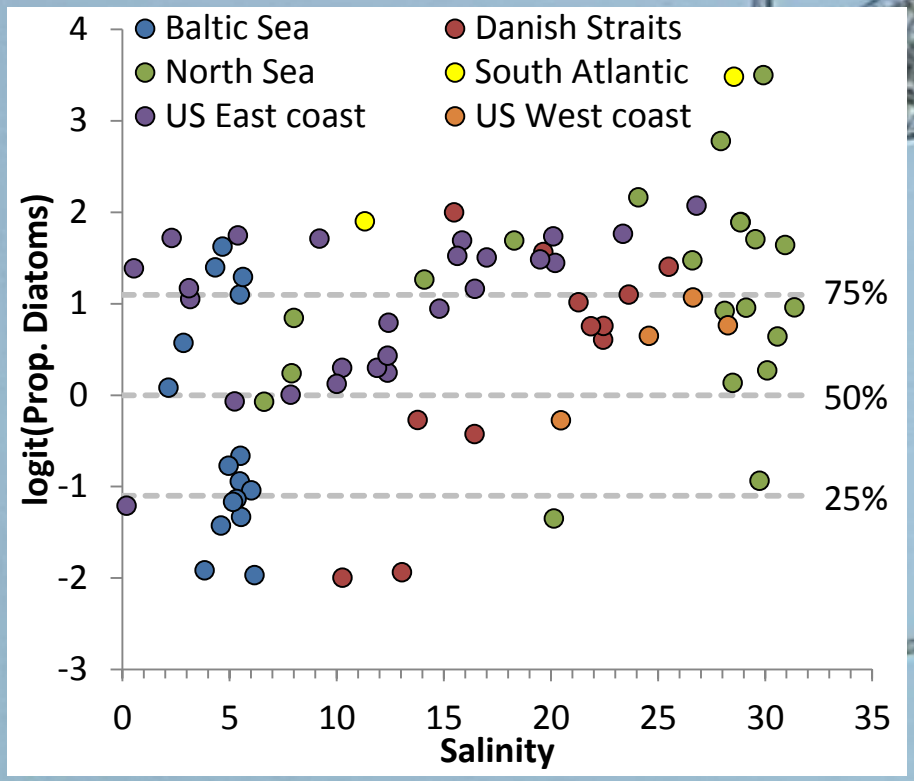
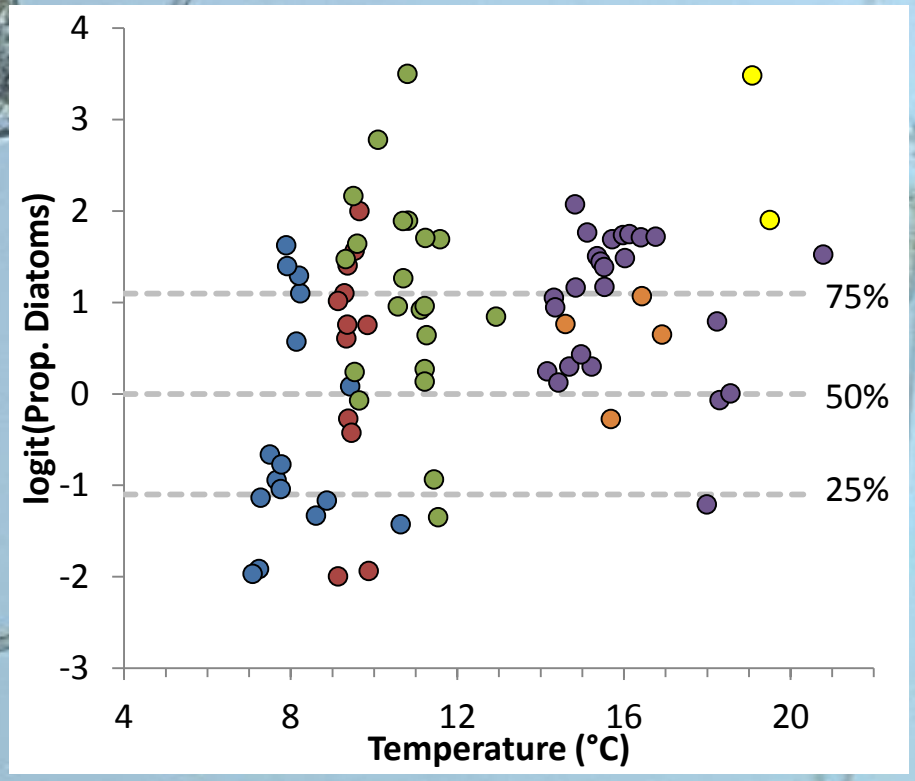
Environmental factors regulating the proportion of diatoms





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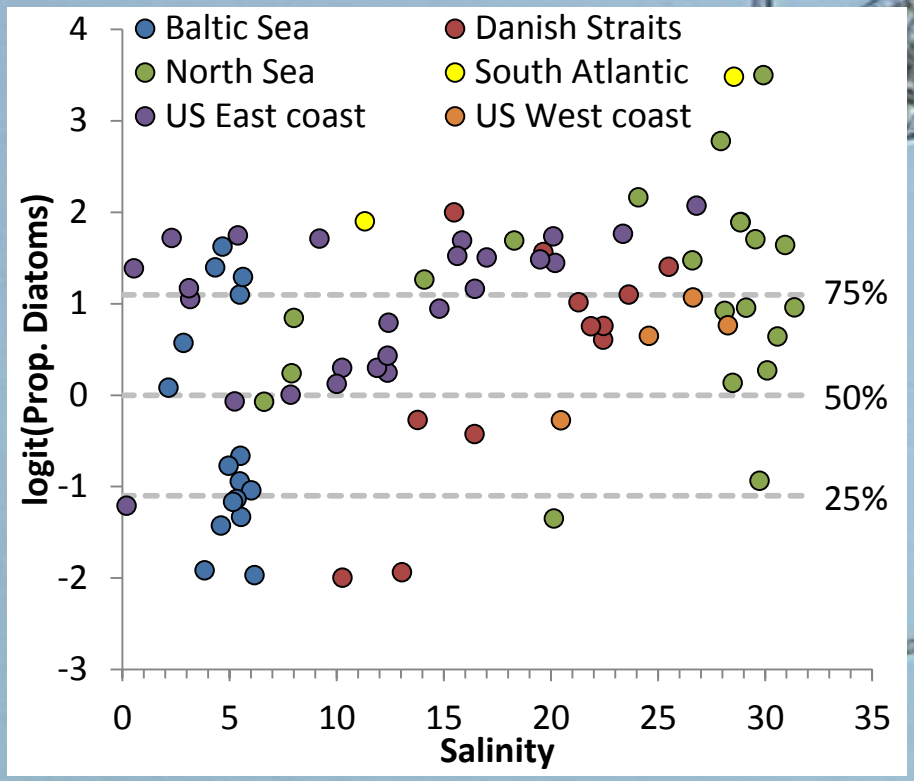

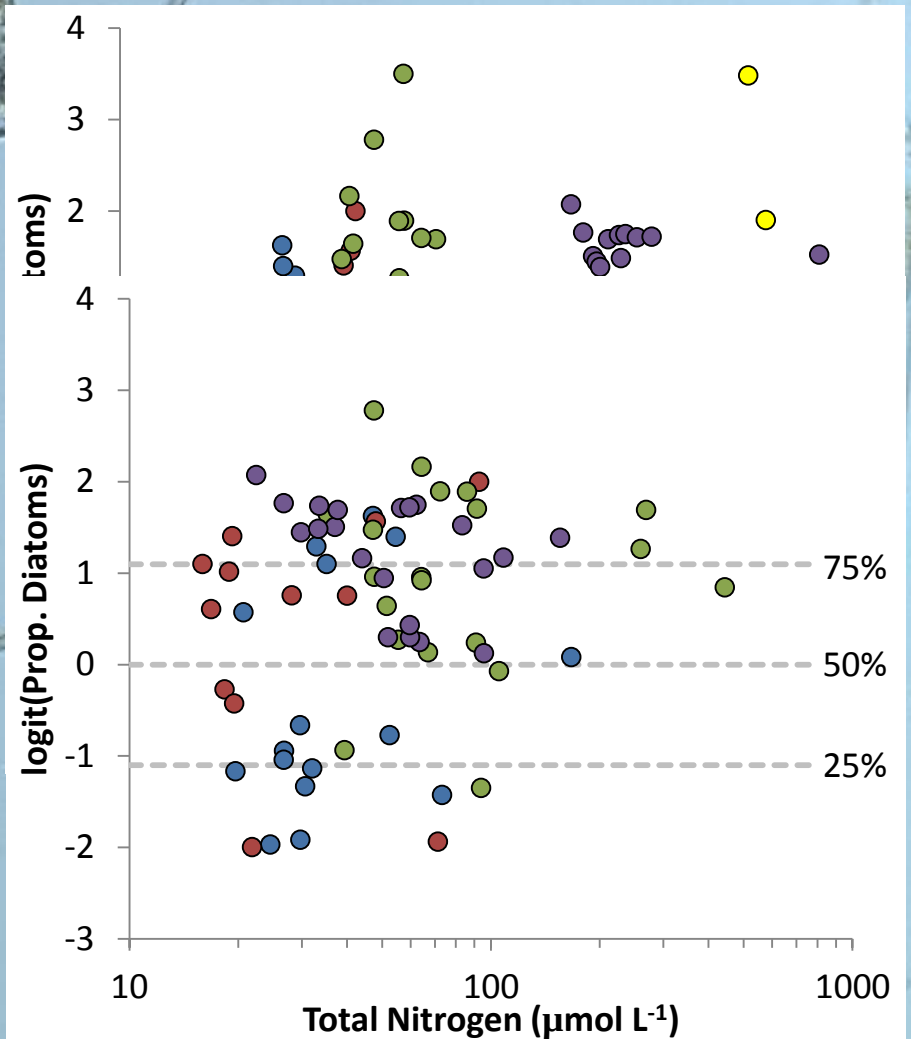

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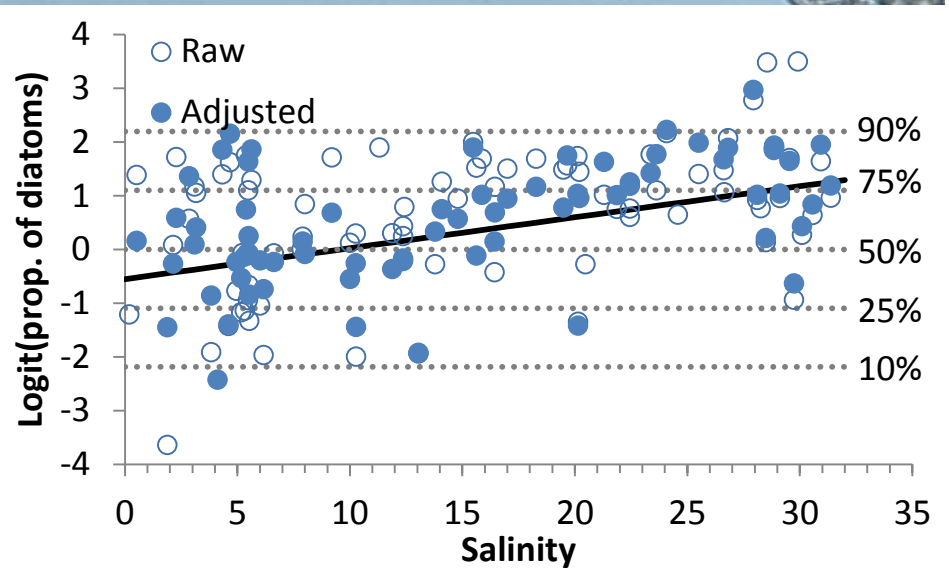

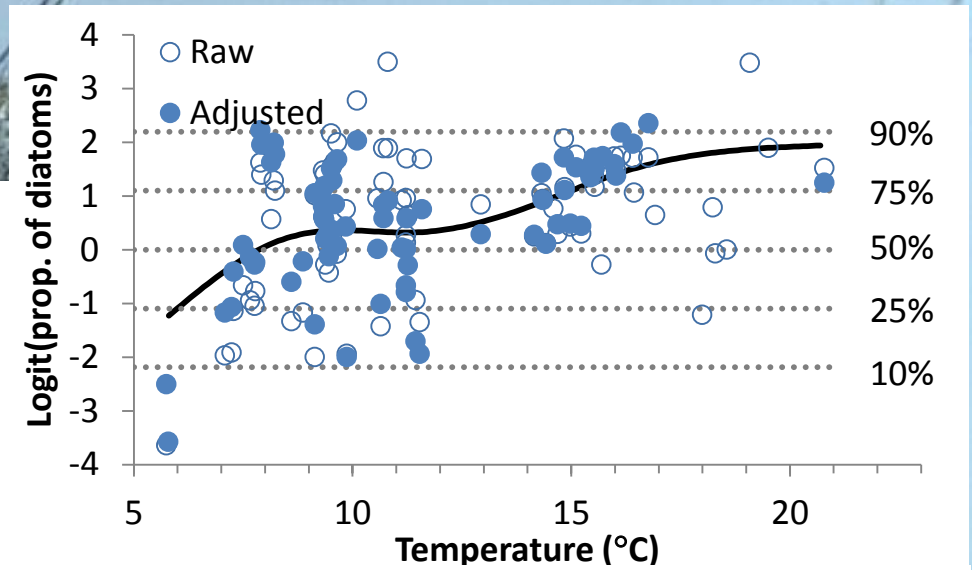

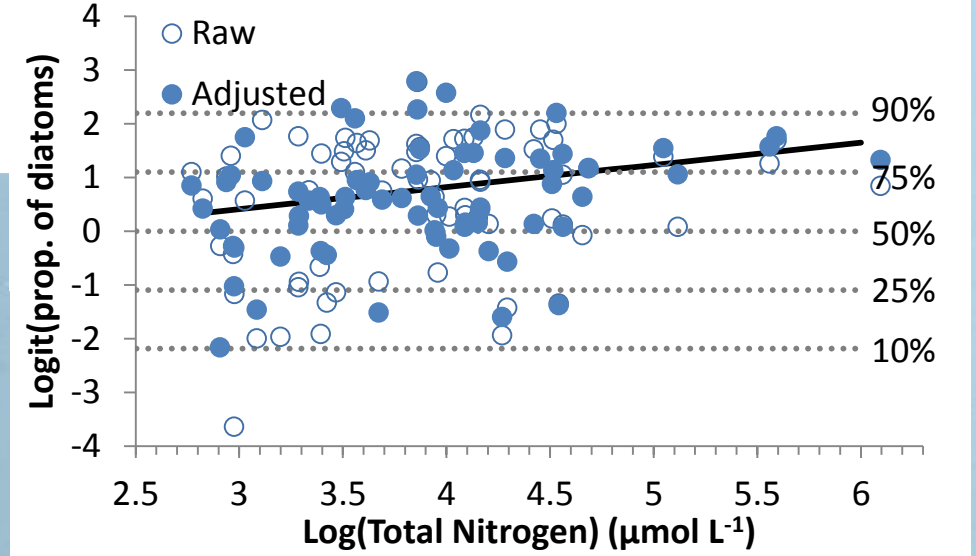

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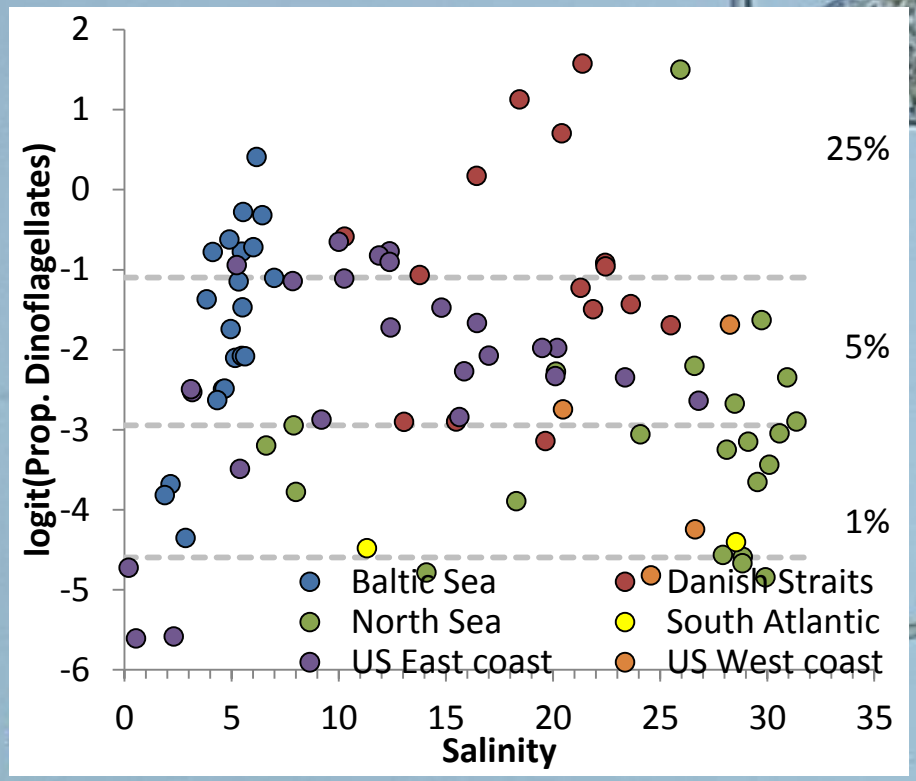
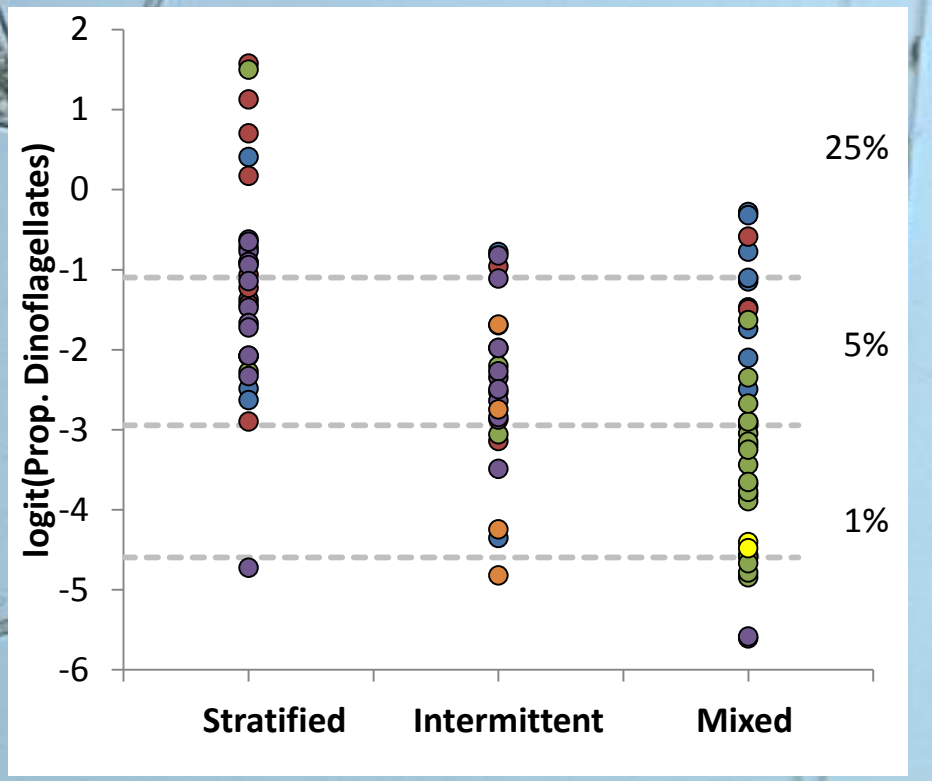
Environmental factors regulating the proportion of dinoflagellates





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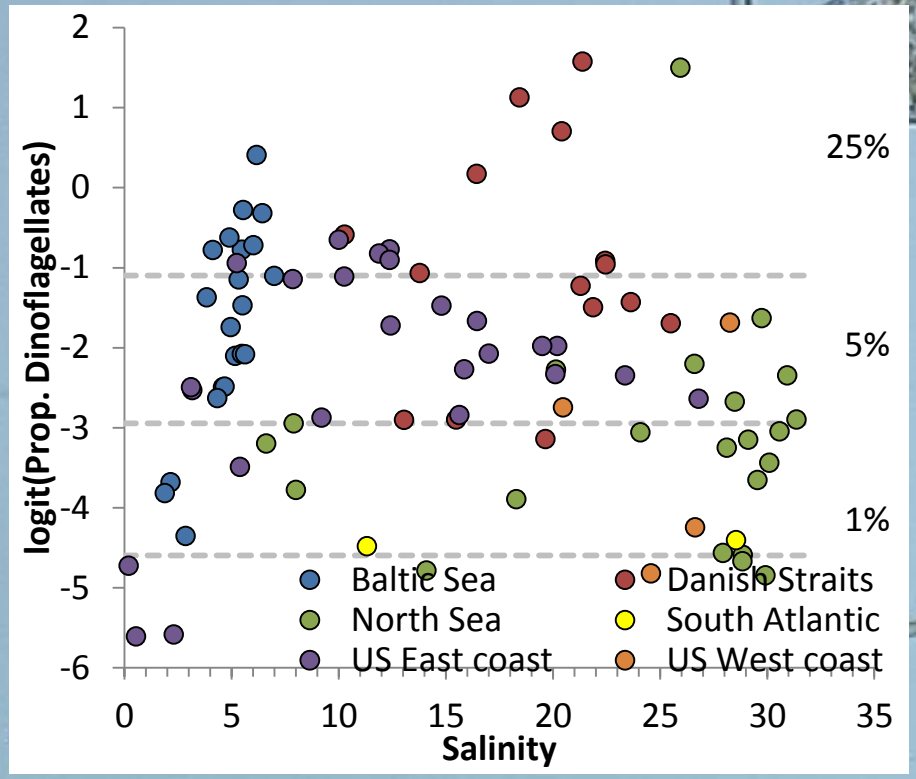

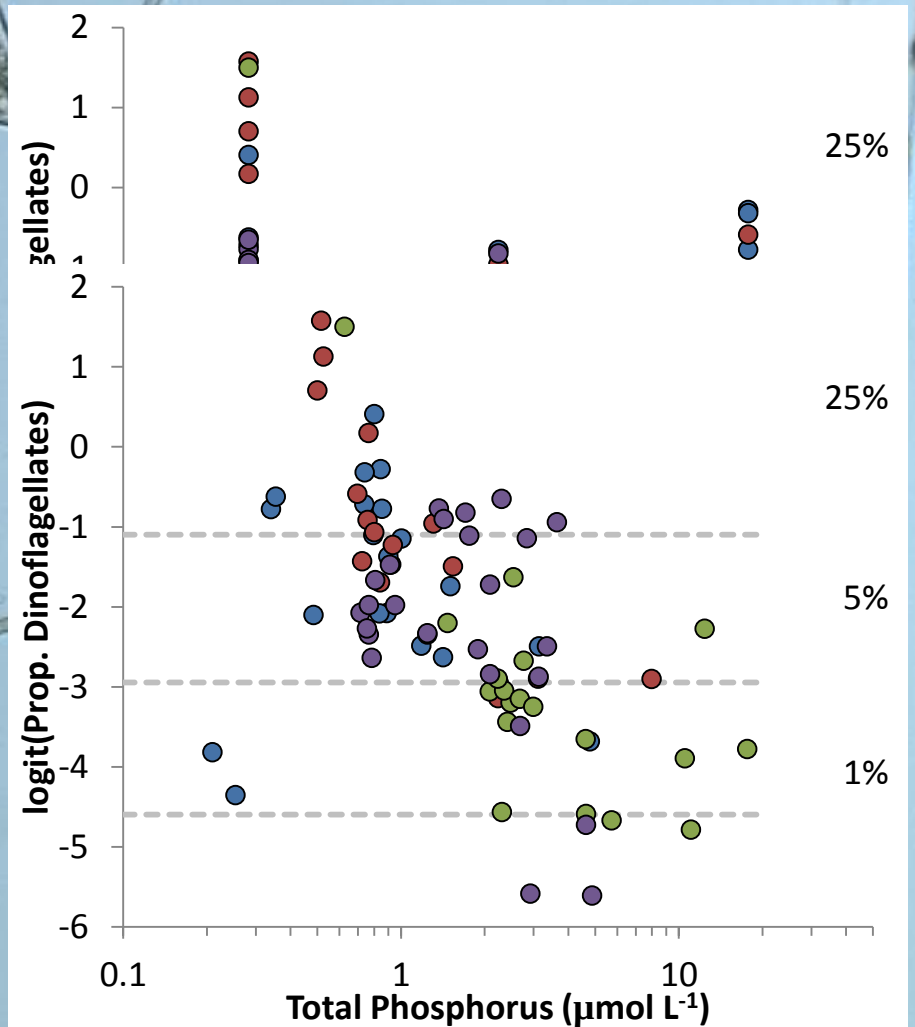

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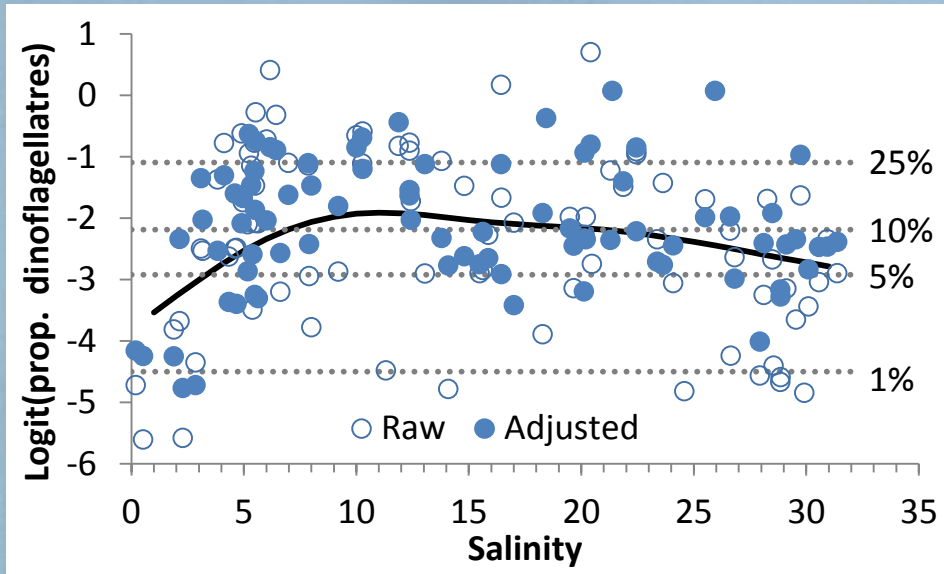

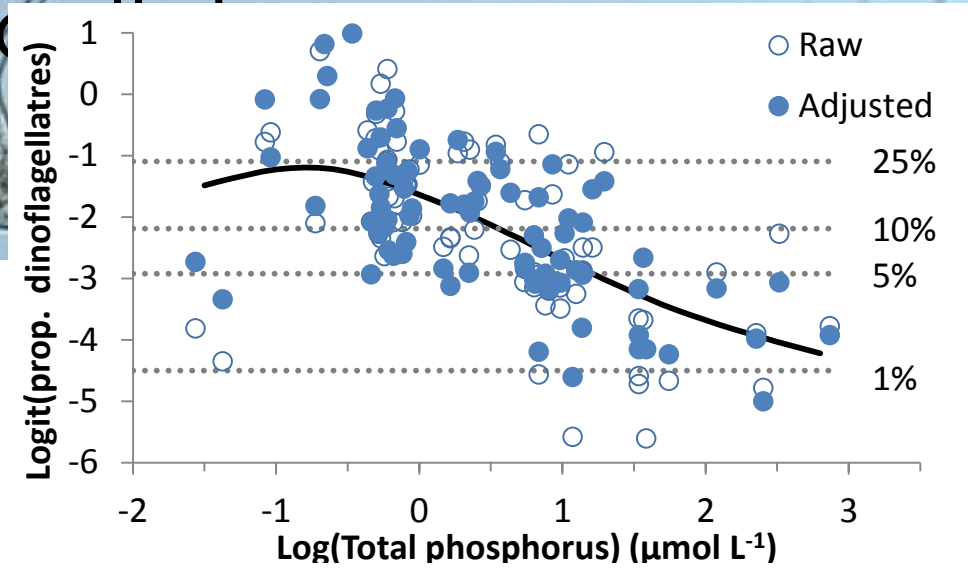

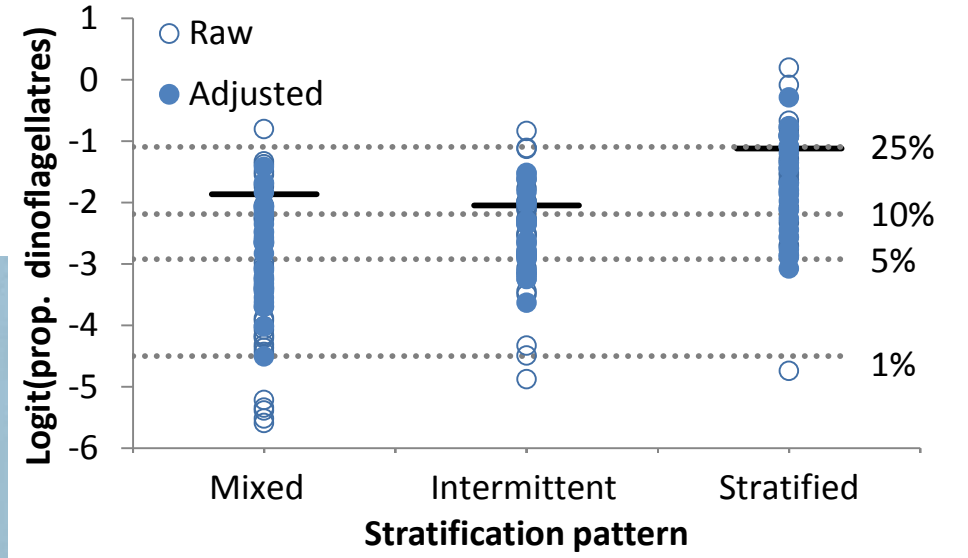

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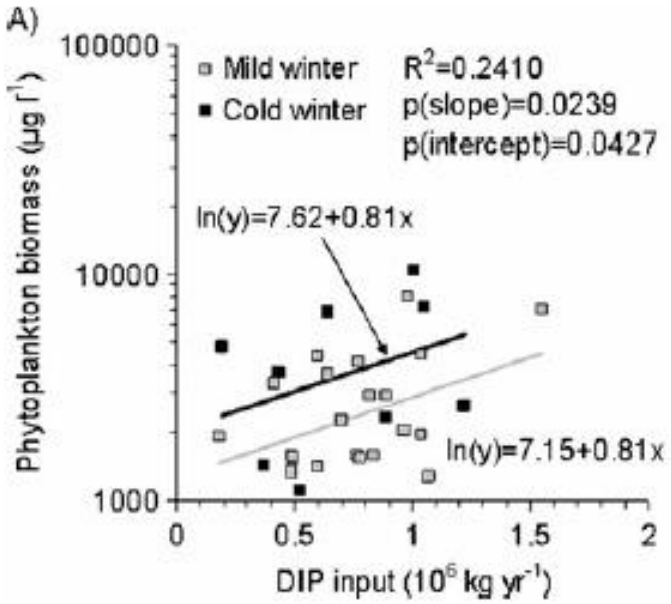
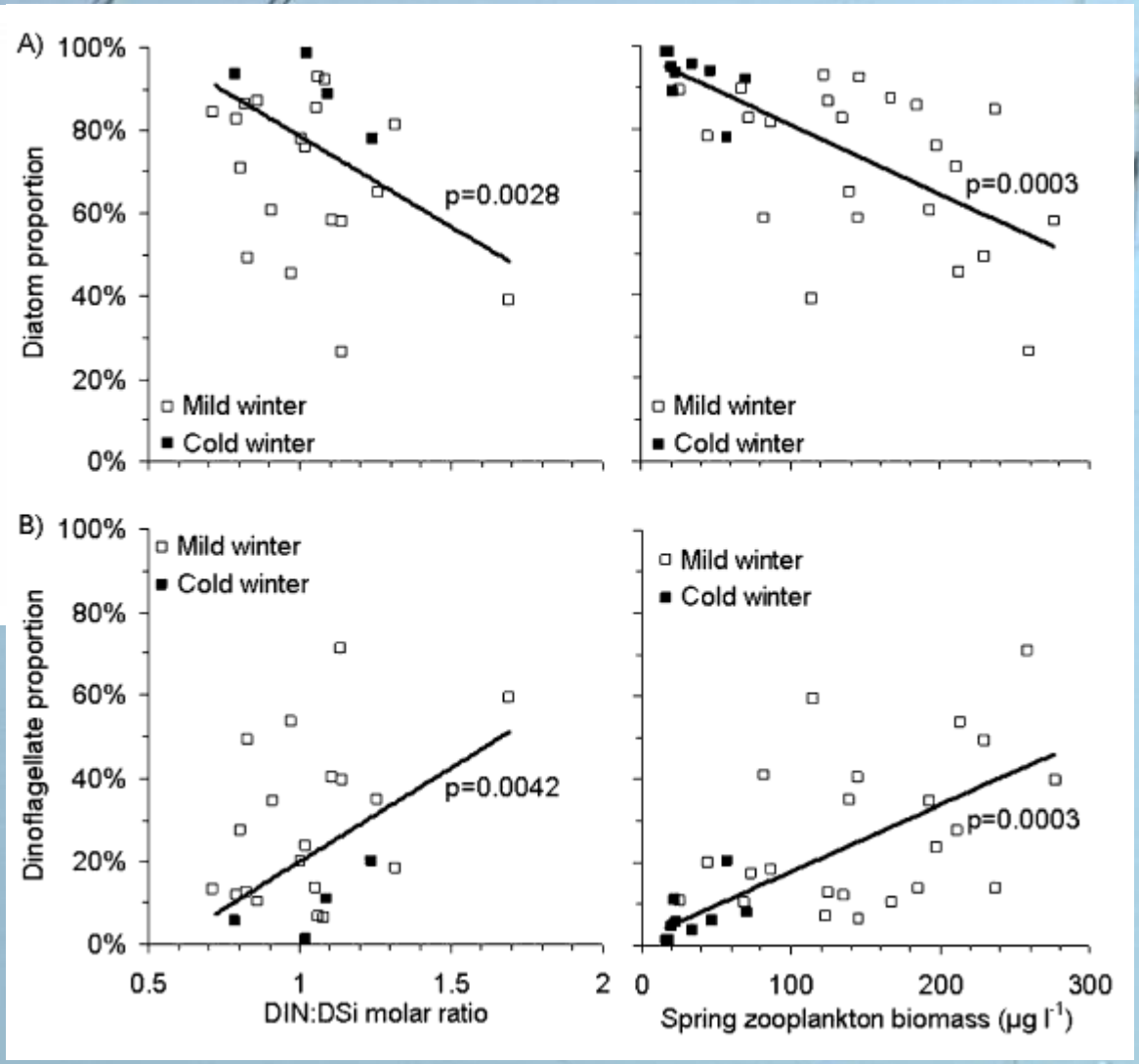
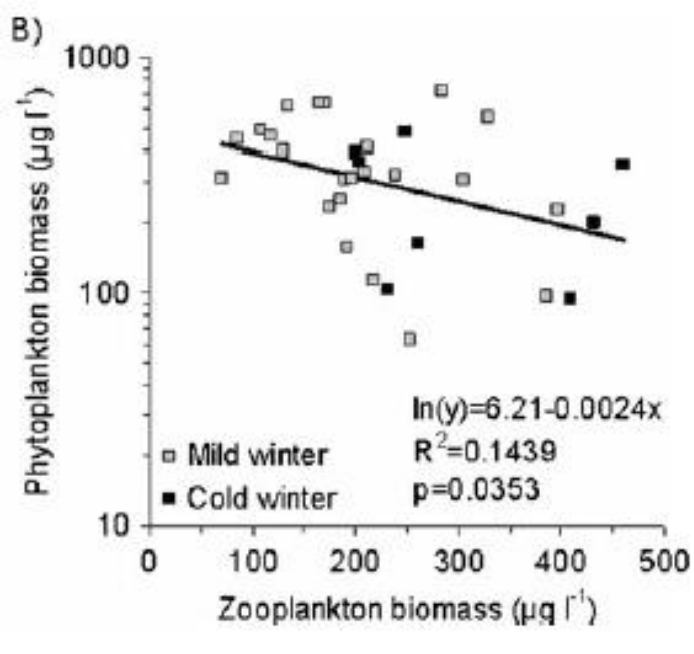
Considering interannual variations - spring

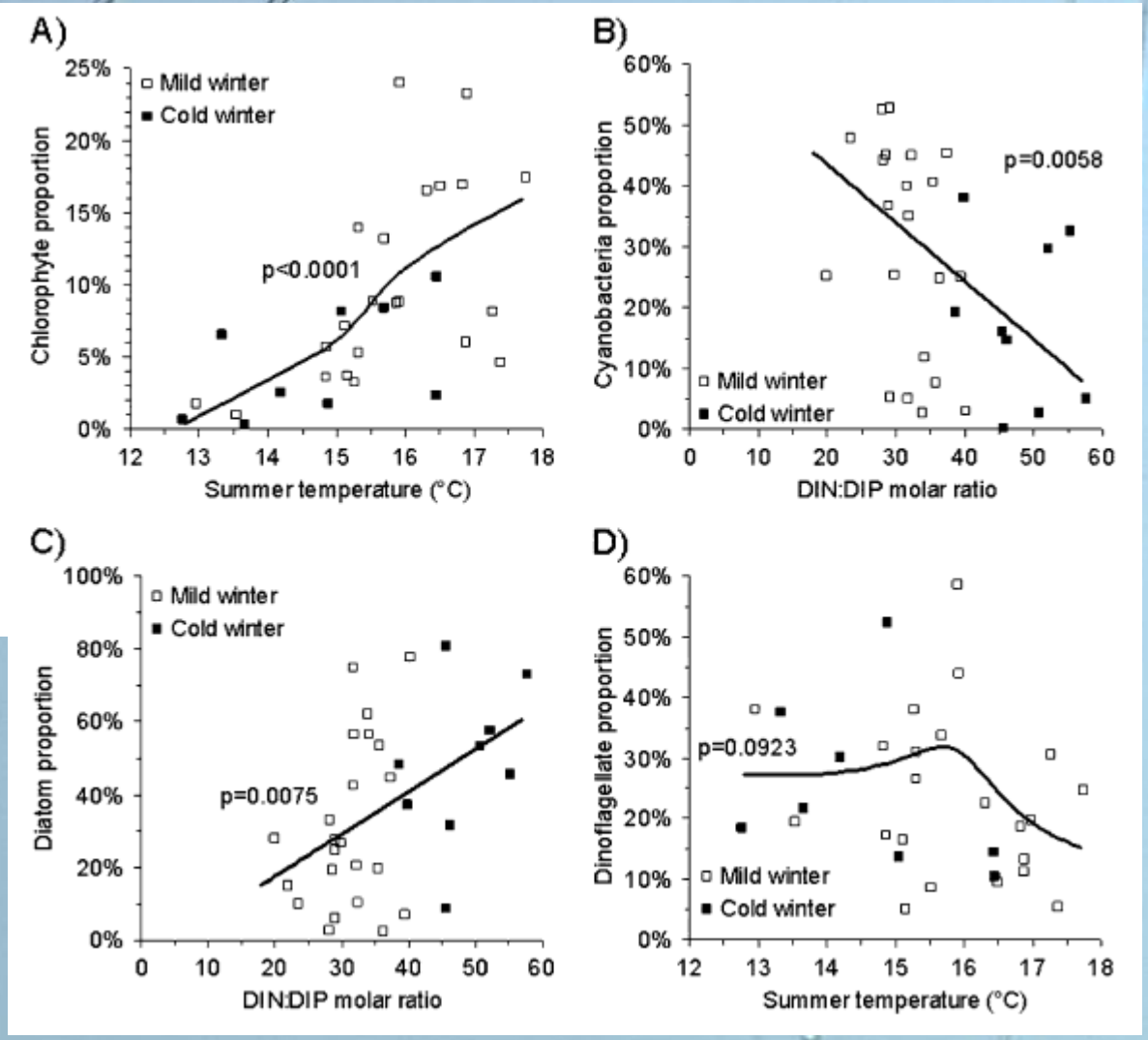




Jurgensone et al. (2011)
Estuaries and Coasts

Considering interannual variations - summer

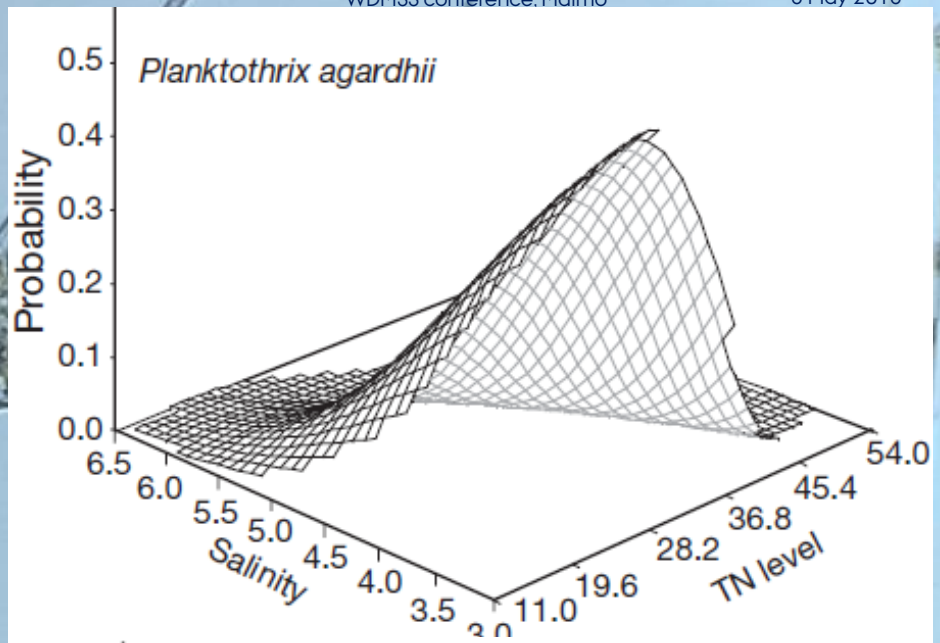


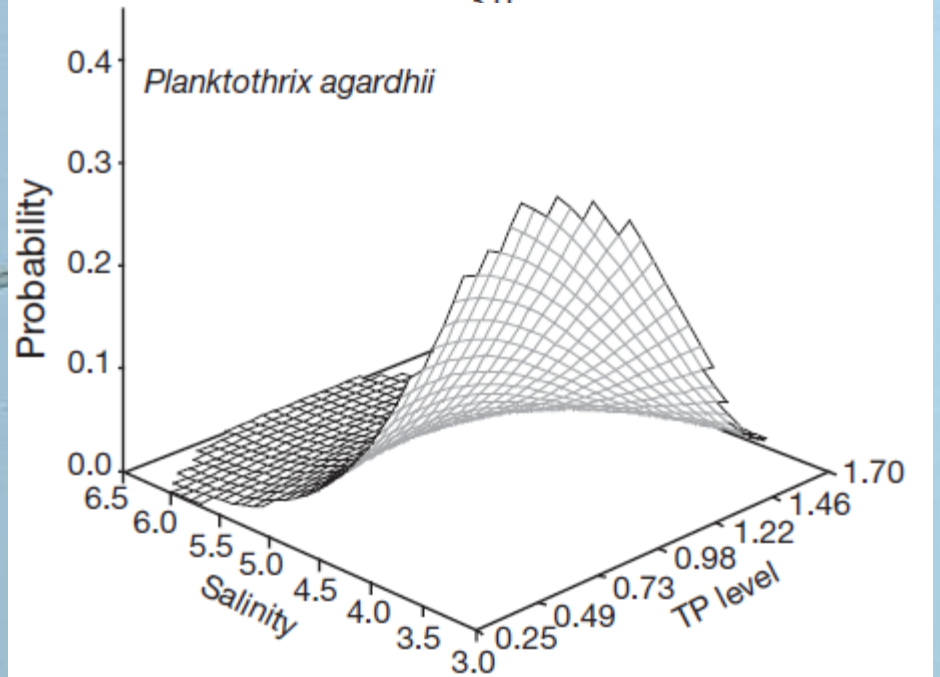


Jurgensone et al. (2011)
Estuaries and Coasts

Do some species respond specifically to nutrient levels?

- **76 taxa investigated**
- **~50% responded to changing nutrient level**
- **4 taxa changed their probability of presence by >30%**
- **1 taxon allowed for distinguishing a 20% change in nutrients (N=50)**





Carstensen & Heiskanen (2007)
Marine Ecology Progress Series

What is controlling the phytoplankton composition?

- A general biomass increase is the most prominent response to nutrient enrichment

1. Phenology and physical factors (salinity, temperature and stratification) are most important
2. Changing nutrient ratios can lead to shifts between diatoms, cyanobacteria and other species
3. Nutrient enrichment can promote chlorophytes (in low salinities) and diatoms relative to other species, particularly dinoflagellates

Can we develop operational indicators for coastal phytoplankton composition?

- Salinity and mixing patterns are the most important factors governing the coastal phytoplankton community,
- and large-scale in nutrient pressure also play a role,
- …. but there are no 'litmus' indicators for phytoplankton community composition
- Operational indicators that can discriminate between realistic pressure levels are not available at present …… and may not be possible at all!