Apr 6th, 9:15 AM - 9:30 AM

Long-term monitoring in Central Puget Sound: Are local climate anomalies impacting phytoplankton populations?

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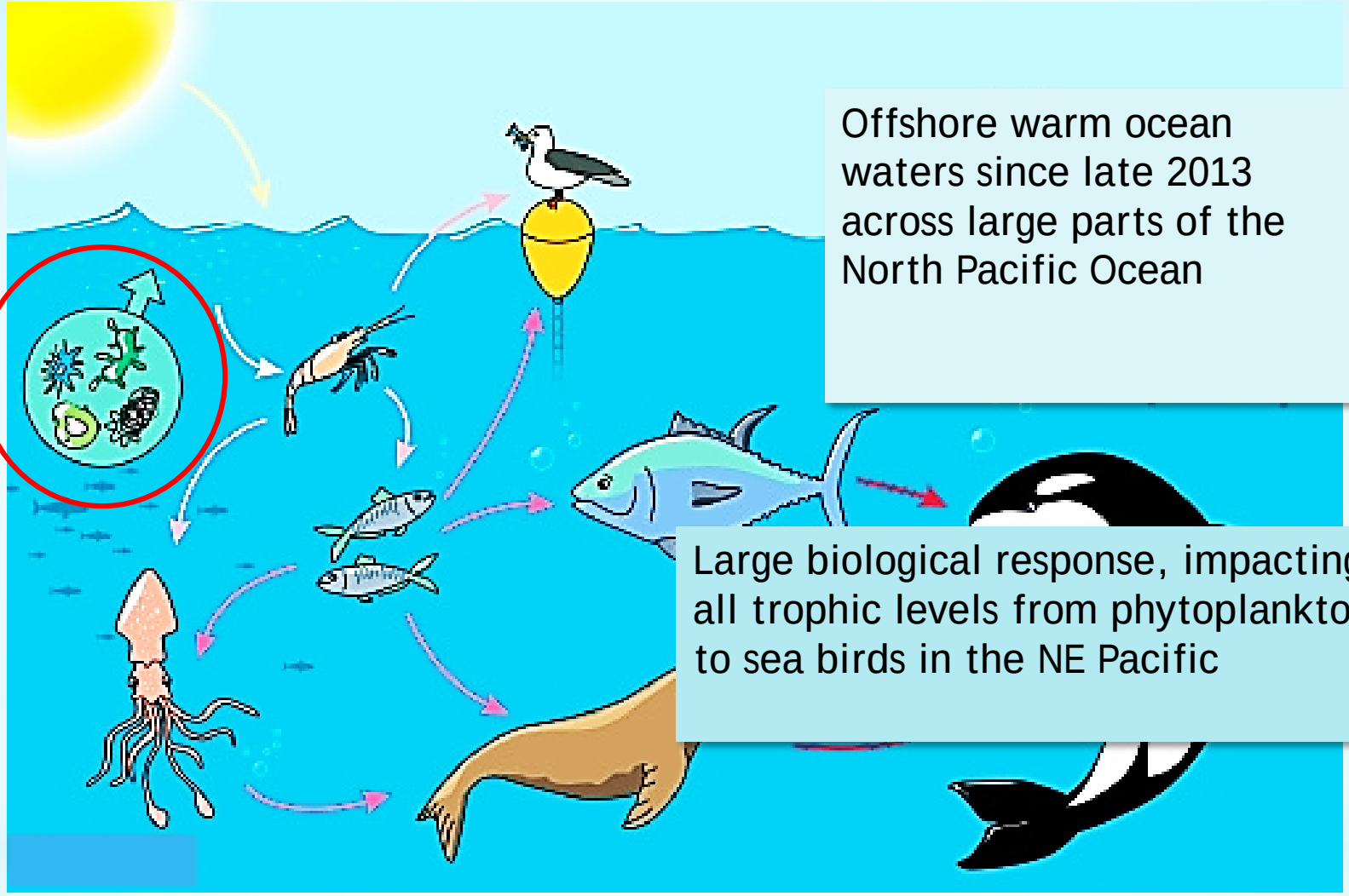


Offshore warm ocean waters since late 2013 across large parts of the North Pacific Ocean

Large biological response, impacting all trophic levels from phytoplankton to sea birds in the NE Pacific

- **What do we know about the biological effects of these recent climate events inside Puget Sound?**

10 Sampling Stations in the Central Basin

22 times per year

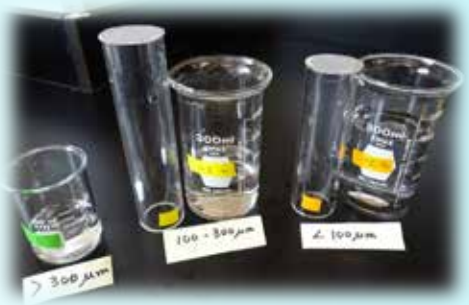
Phytoplankton (surface) – some zoo

Chlorophyll *a*

Nutrients

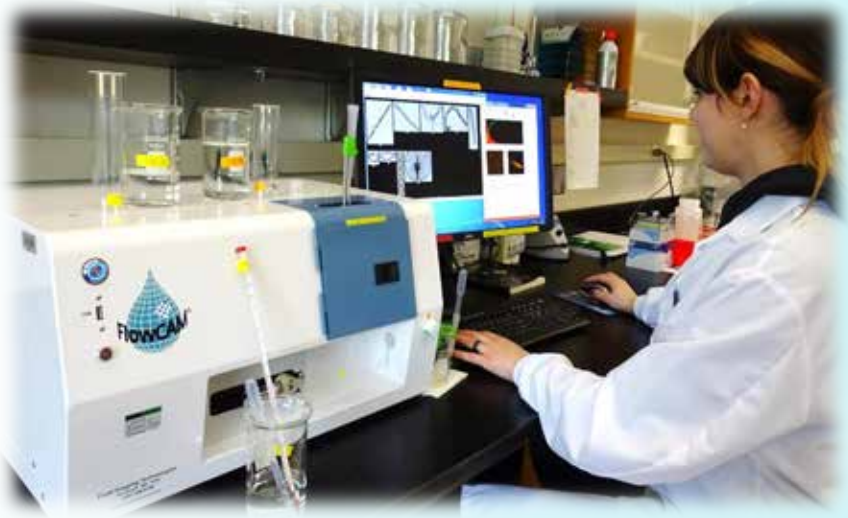
Physical parameters (CTD)

Phytoplankton Analysis



- **Microscopy** (since 2008)
  qualitative

- **FlowCAM** (since May 2014)



Particle size range:

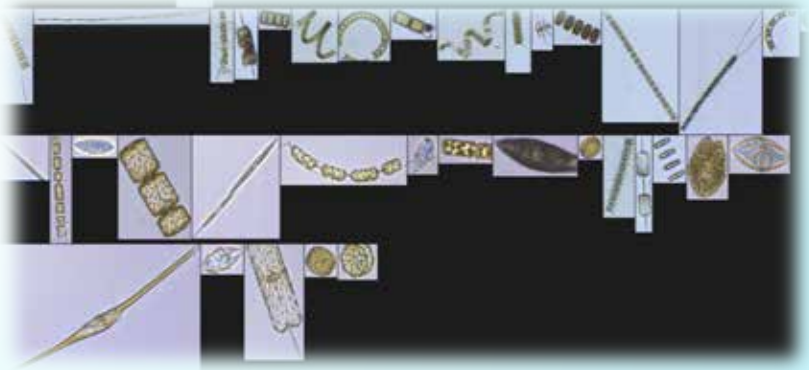
2 flow cell sizes/magnifications

Total range is 10–300 µm

Endpoints:

Abundance (Particles mL^{-1})

Biovolume (mm^3 L^{-1})

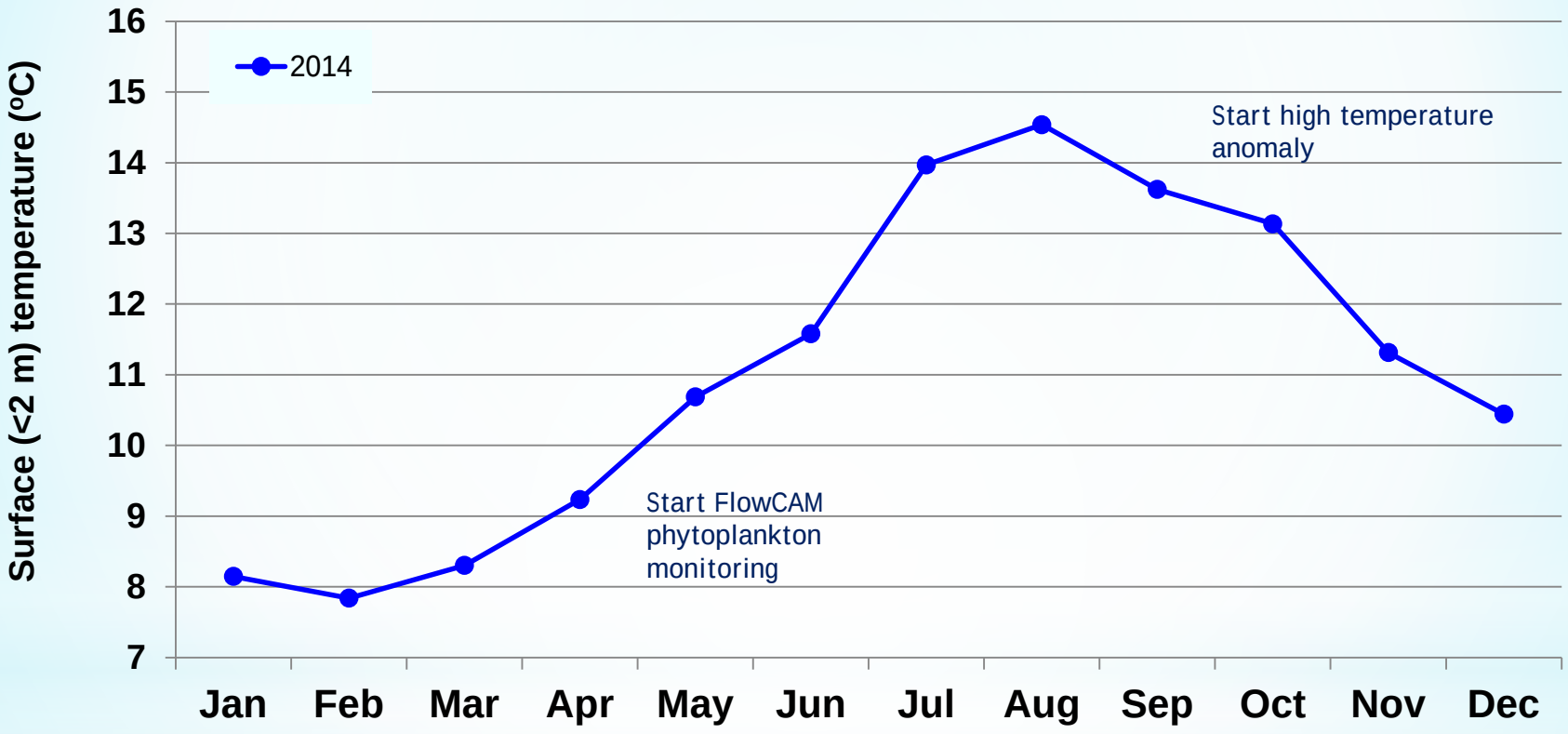


Biovolume to C biomass conversion

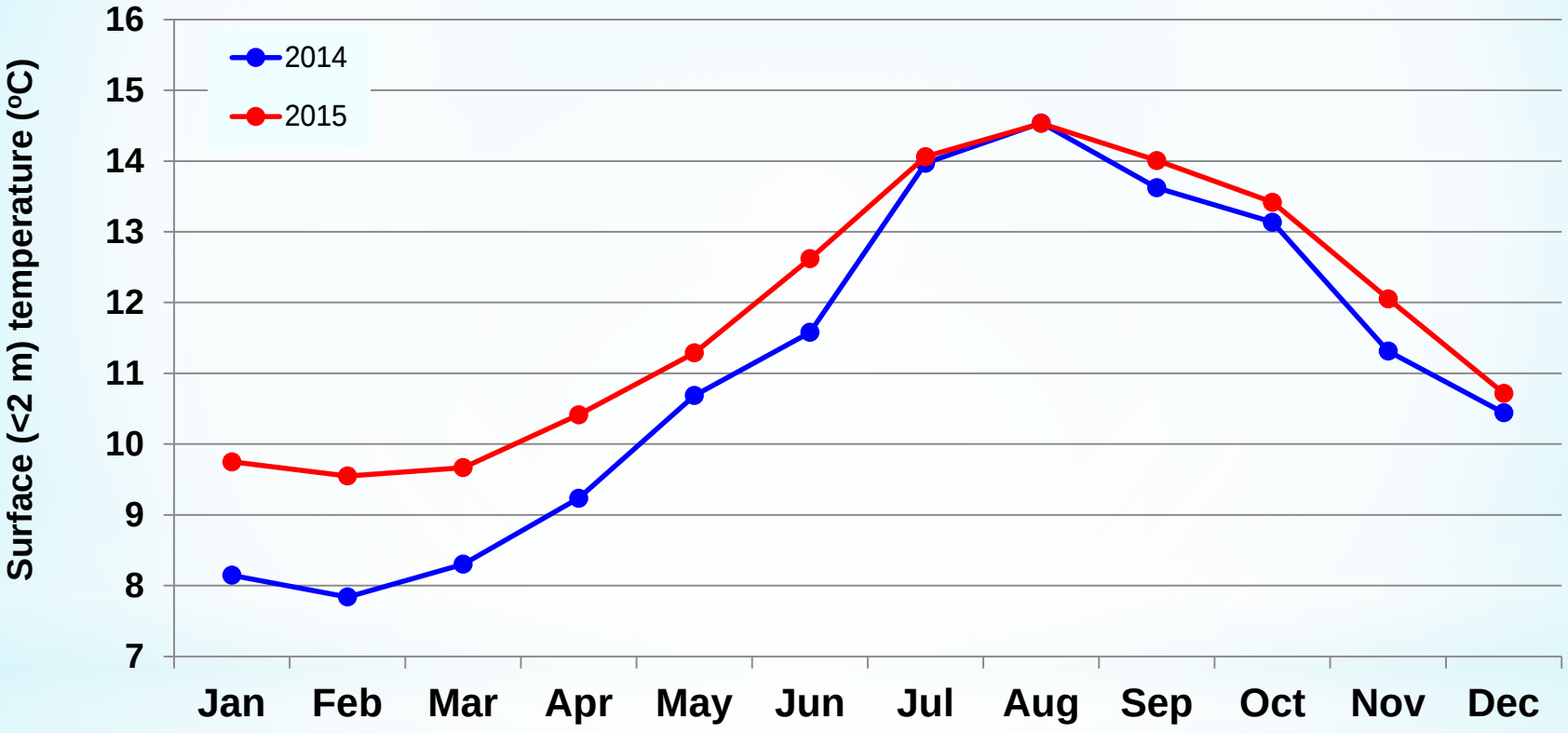
$$y = 127.67\ x^{0.4496}$$

Poster #92!

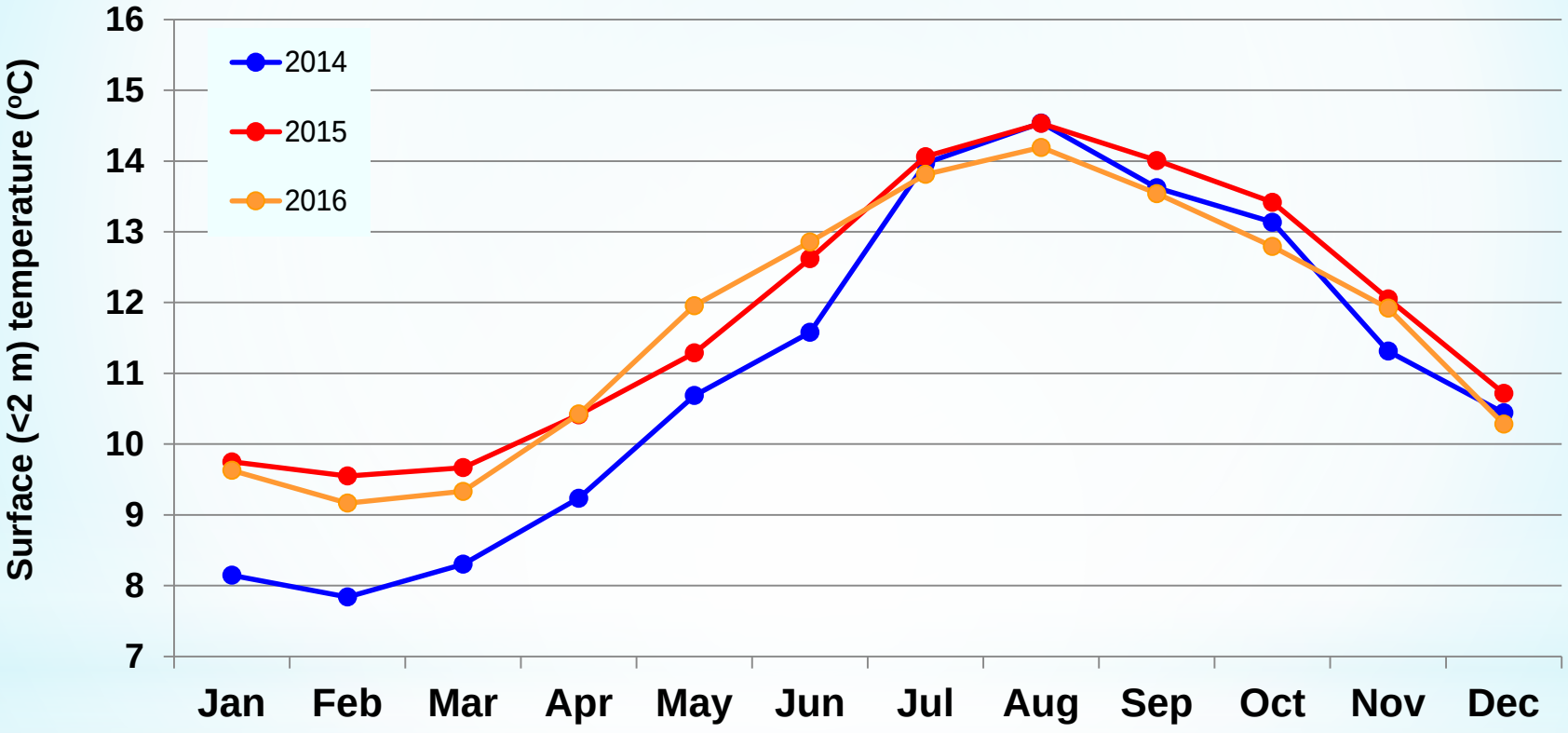
Central Basin combined surface temperatures



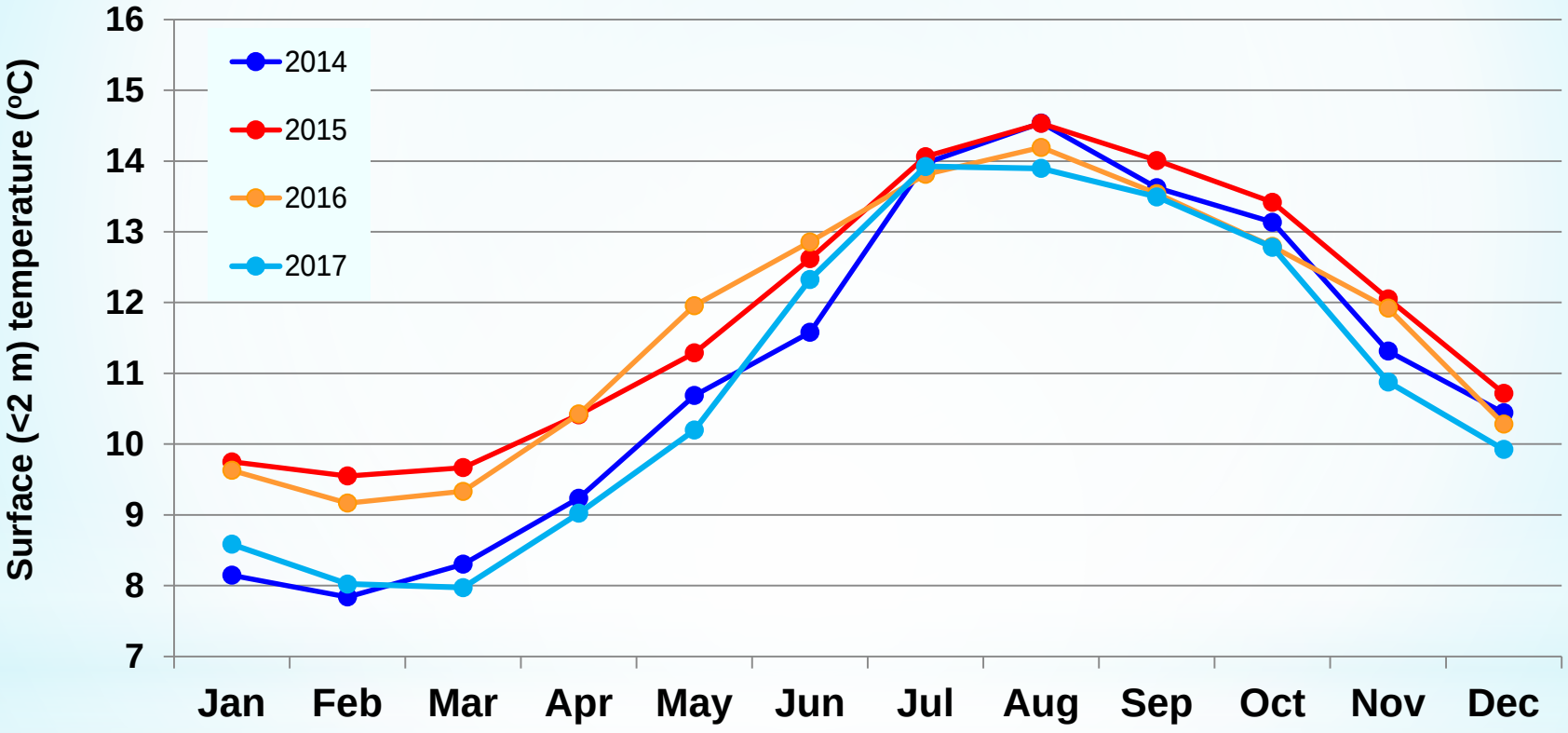
Central Basin combined surface temperatures



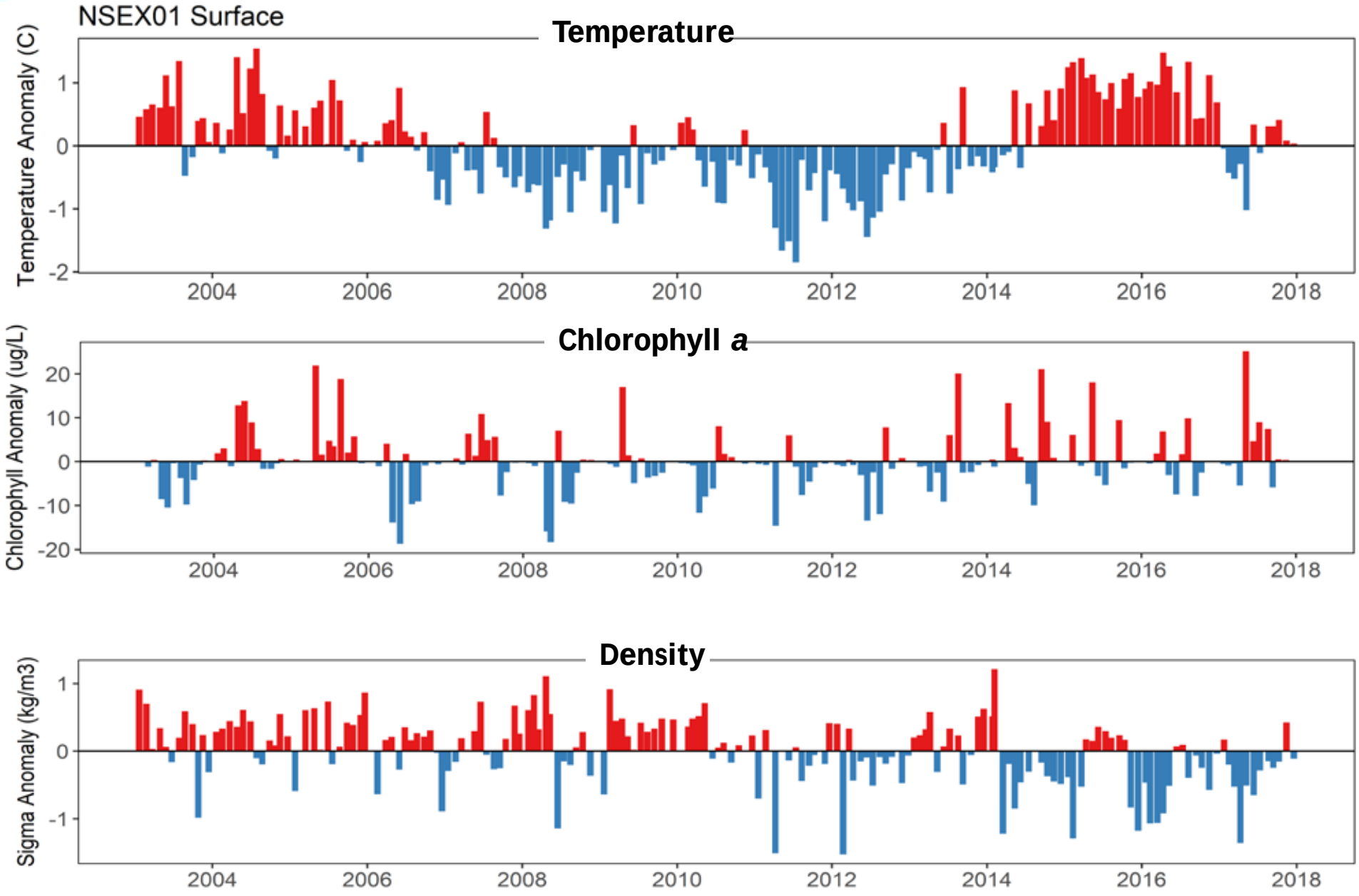
Central Basin combined surface temperatures



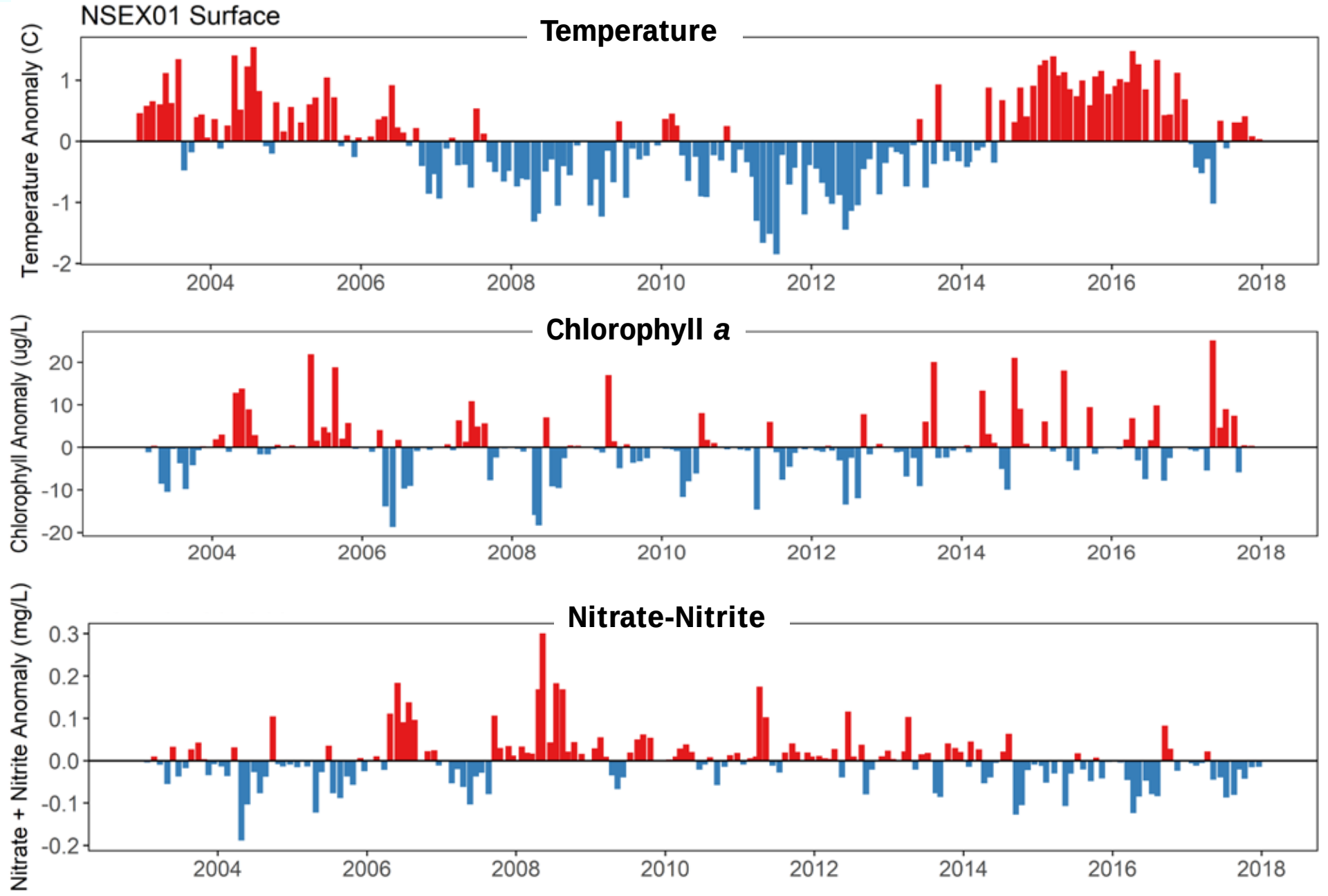
Central Basin combined surface temperatures



Anomalies 2003-2017 - East Passage



Anomalies 2003-2017 - East Passage



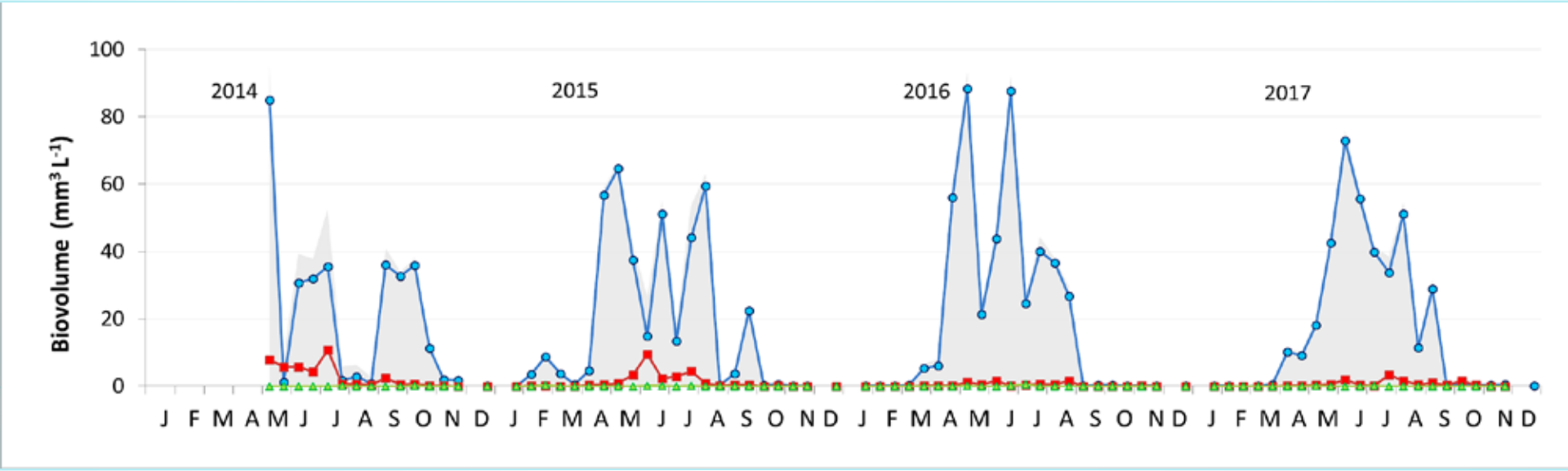
What could be some effects of these climate anomalies on phytoplankton?

- Biovolume (C biomass)
  - Seasonality pattern
  - Total biovolume

- Taxonomic composition
  - Seasonal succession
  - Relative abundances
  - Cell size

Drivers: Physiology (e.g. temperature tolerance limits)
Ecological interactions (e.g. grazing rates)

Seasonality of major taxonomic groups



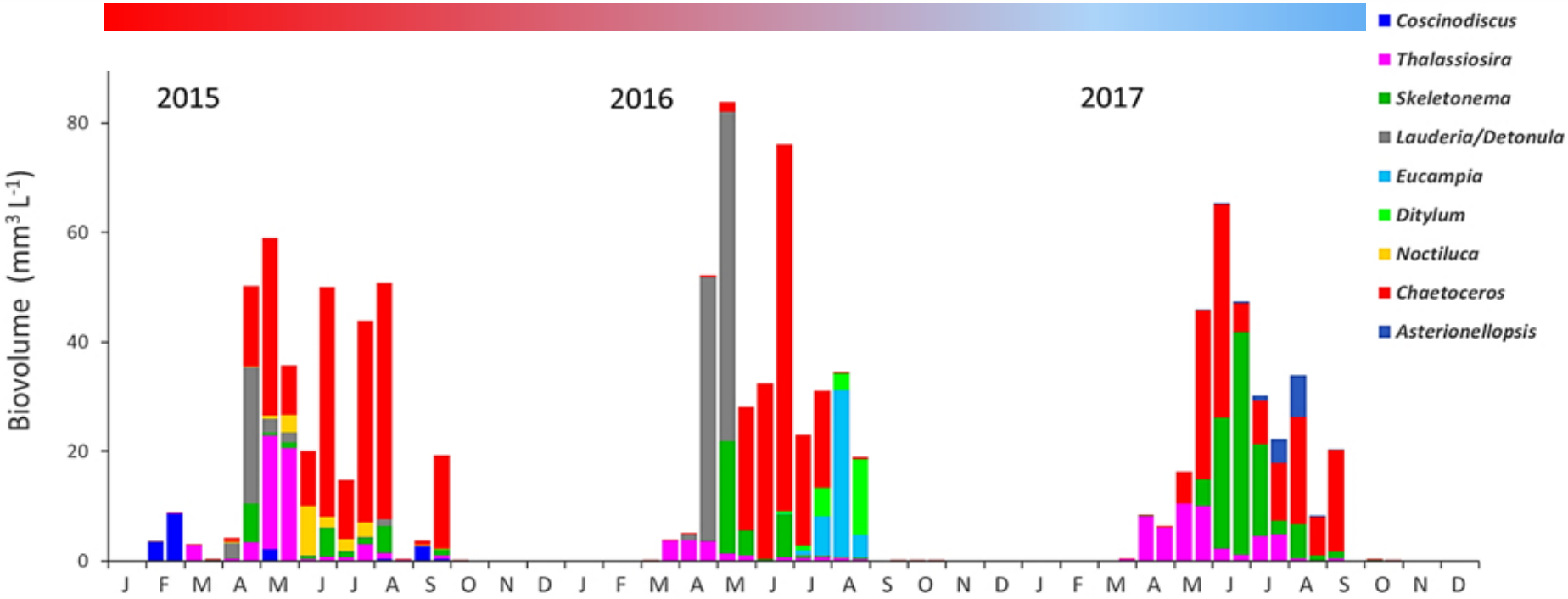
Biovolume means of 6 offshore stations

- Year to year variations in seasonal pattern
- Diatoms always dominate – typical of estuarine areas

Biomass conversion: 100 $mm^3\ L^{-1}$ ~ 1000 µg C L^{-1}

Seasonality of 6 top taxa for each year

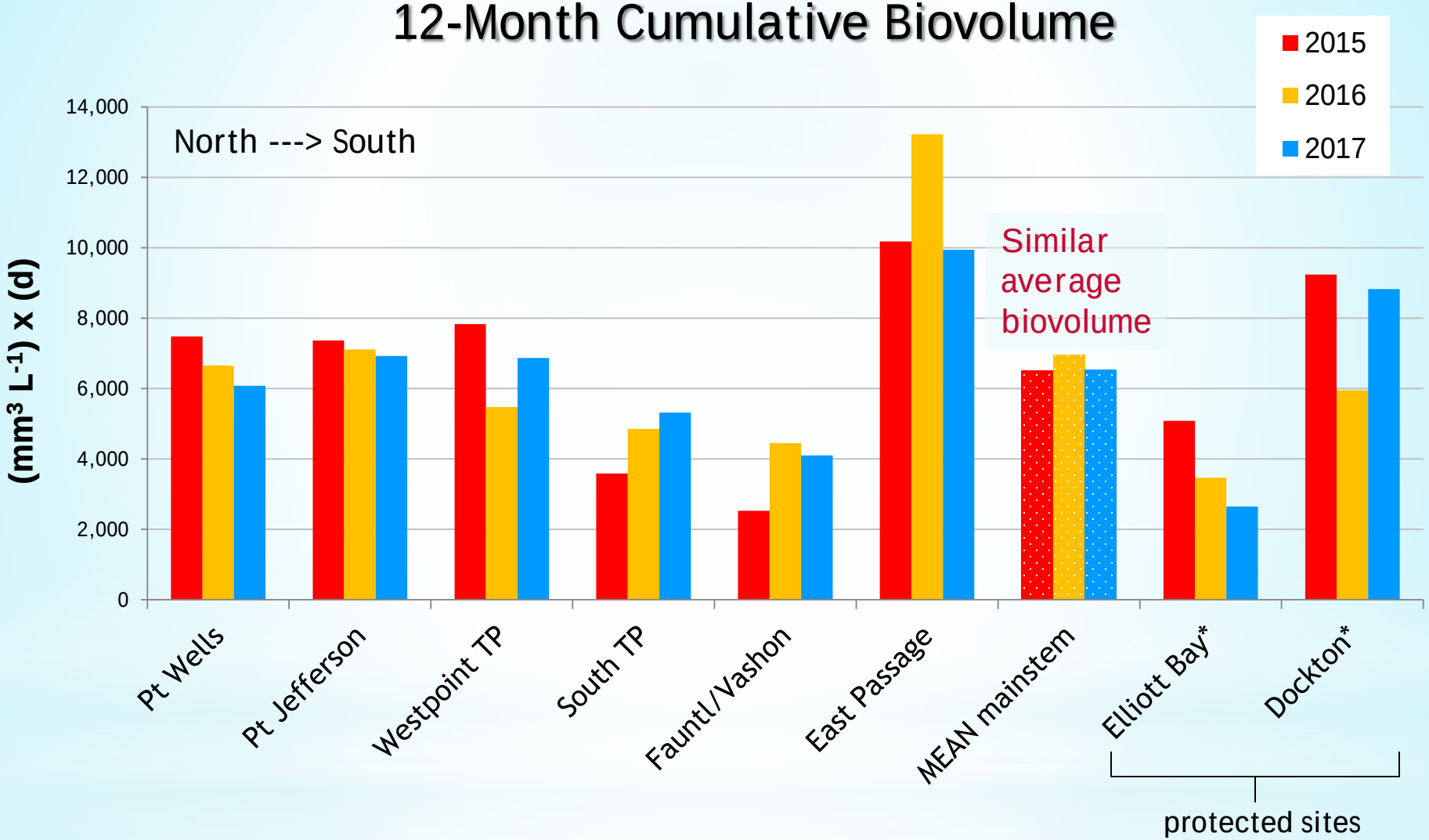
Temperature



Biovolume means of 8 offshore stations

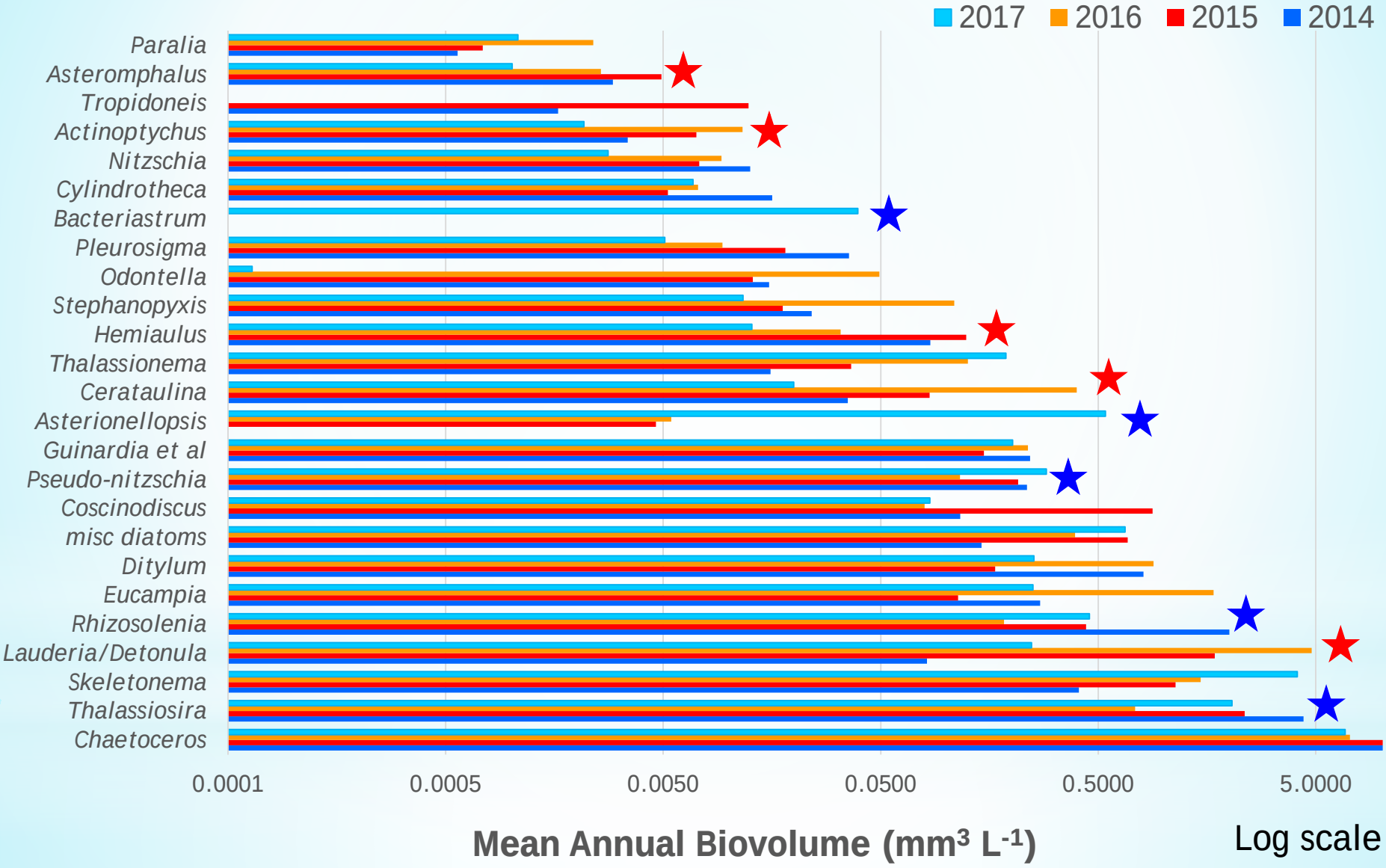
- Characteristic seasonal succession (mostly chain-forming diatoms)
- Year to year variations are the norm
- Some taxa are abundant every year, others unpredictable

12-Month Cumulative Biovolume



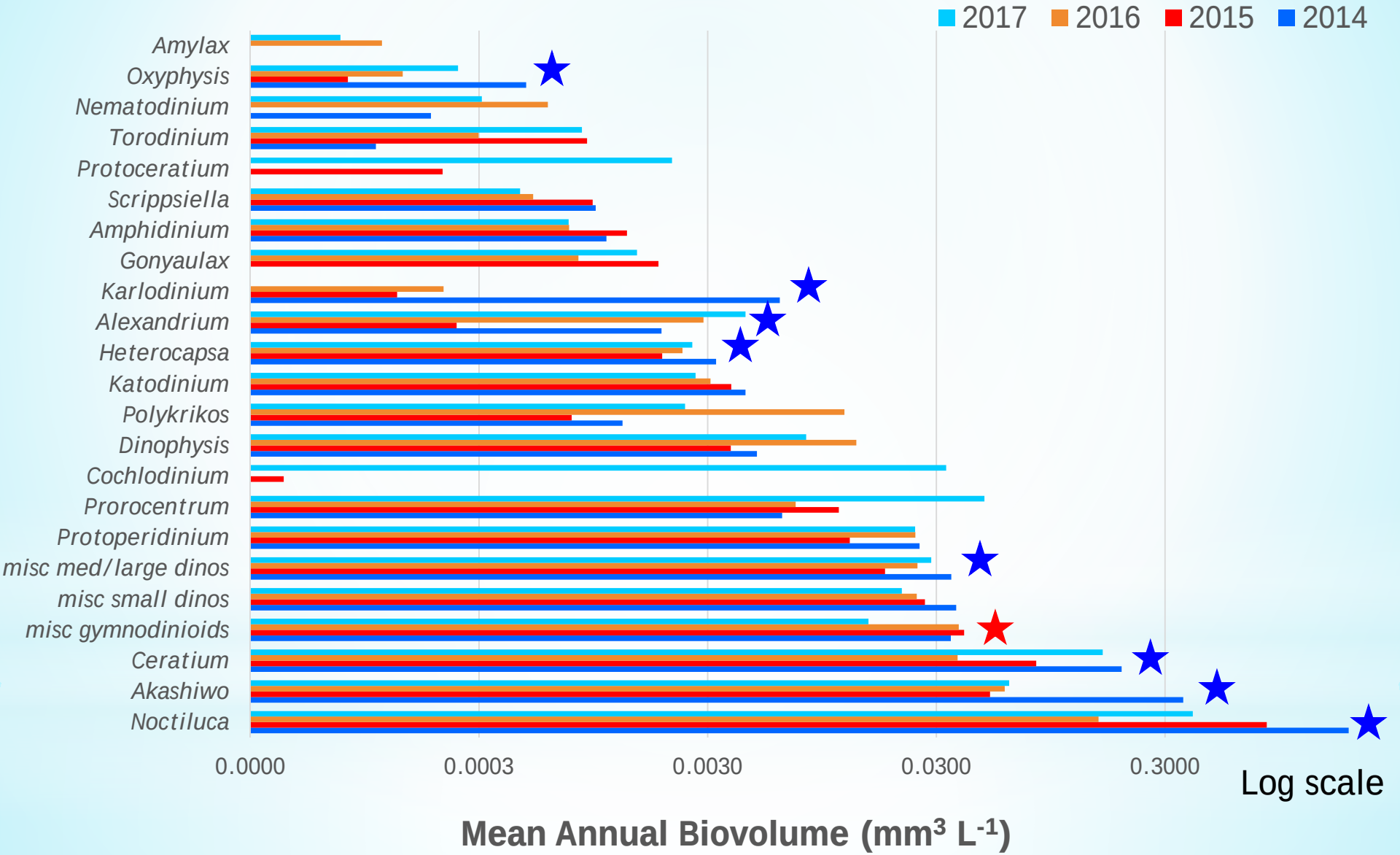
- Spatial pattern in total biomass
- Central Basin annual totals are similar year to year

All Diatom Taxa



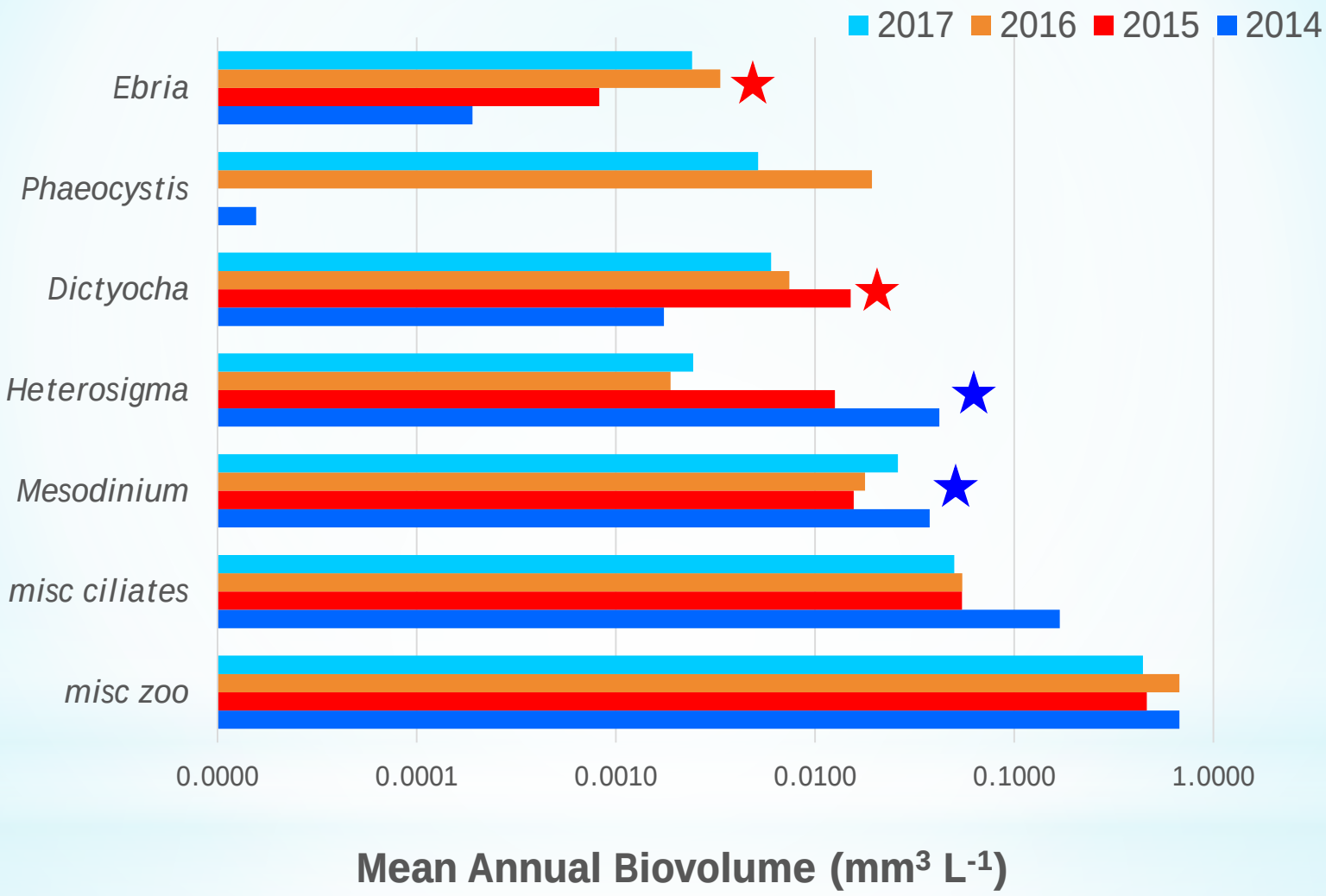
2014 data May-Dec, all others Jan-Dec

All Dinoflagellate Taxa



2014 data May-Dec, all others Jan-Dec

Other misc. microplankton



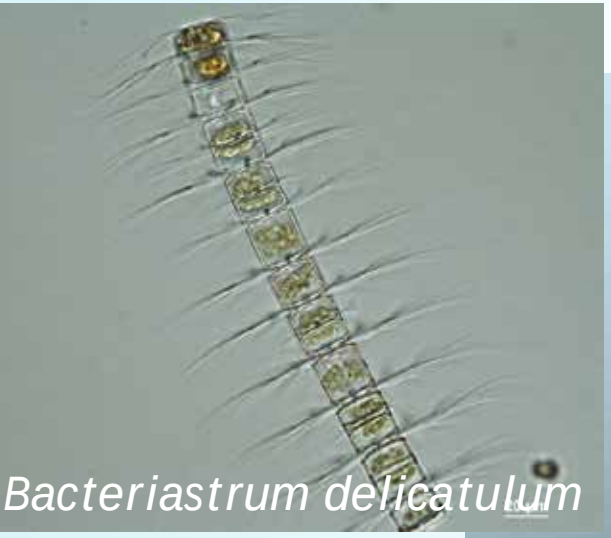
2014 data May-Dec, all others Jan-Dec

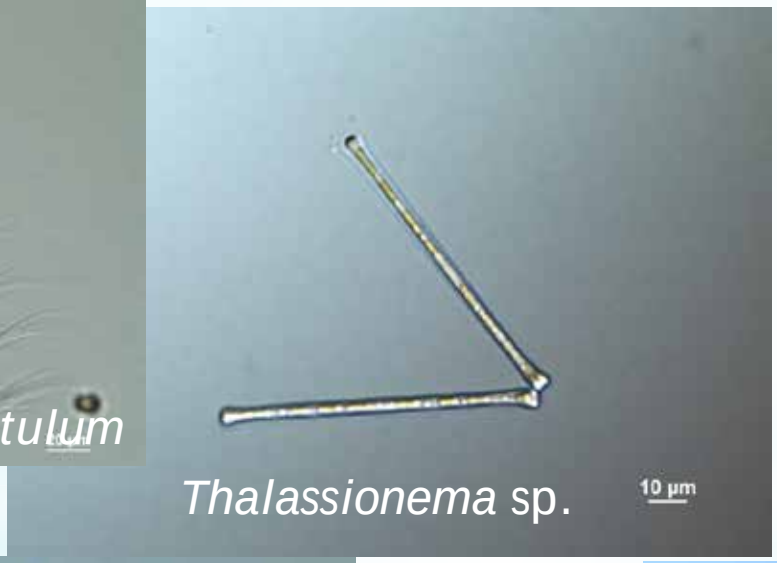
Some “new” common taxa in 2017

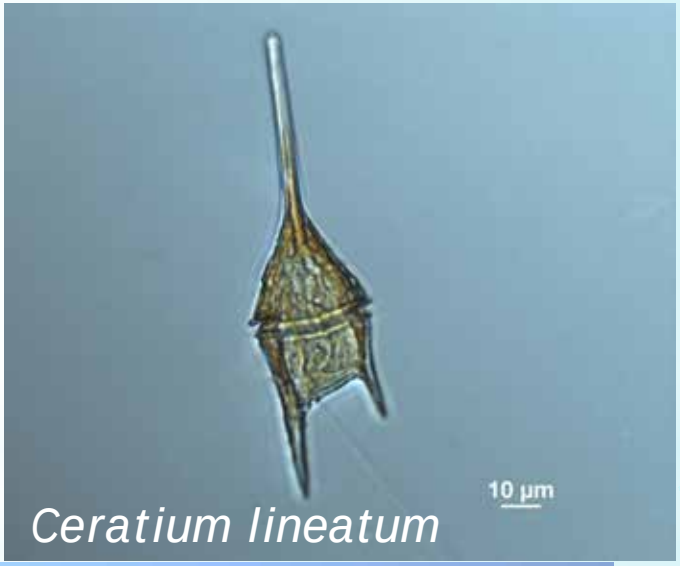
Previously very uncommon or absent from our records

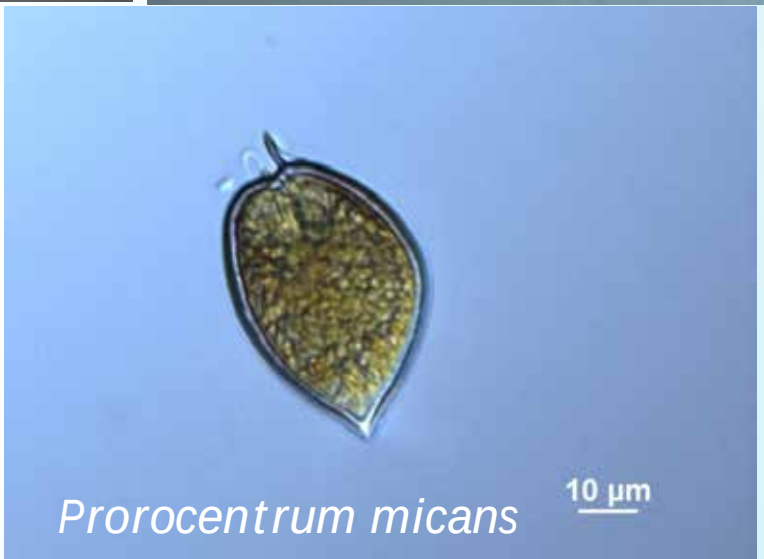
DIATOMS

DINOFLAGELLATES









Conclusions

- Environmental anomalies
  - Increased temperature: late 2014-2016
  - Lower surface density -> increased stratification: 2015-2017
  - Lower nutrients: late 2014-2017

- Biovolume (C biomass)
  - Chlorophyll anomalies suggest small increase in phytoplankton growth 2014-2017 relative to previous 6 years
  - But… total annual biovolume remained the same 2015-2017
  - Biovolume seasonality 2014-2017, inter-annual differences but no clear pattern

- Taxonomic composition
  - Changes in taxonomic composition likely
  - Diatom taxa increased/decreased, but many dinoflagellates decreased during the two warmer years
  - No increase of harmful species

Inherent system variability - difficult to detect biological changes in short time period

Many thanks to the Environmental Lab Field Unit for year round sample collection

Rain or shine...

Wind or calm...