

# Phytoplankton monitoring in Central Puget Sound:

## Do we see any trends?

Gabriela Hannach  
Lyndsey Swanson  
Environmental Lab

### Science Seminar November 2018

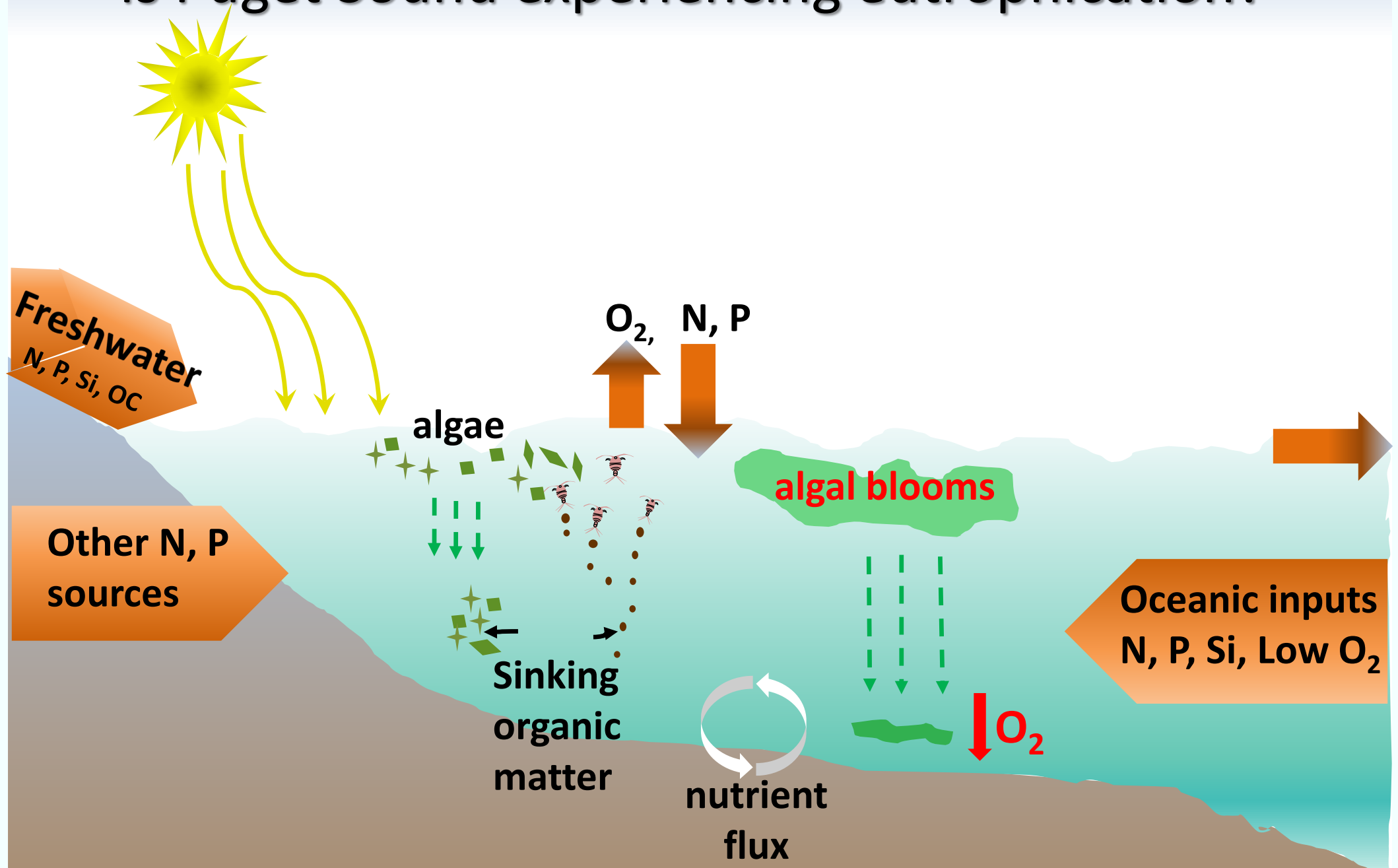
Water and Land Resources Division



**King County**



# Is Puget Sound experiencing eutrophication?



# What are the potential impacts of nitrogen enrichment on Puget Sound phytoplankton assemblages?

## Growth



Increased biomass production

## Seasonality



Longer growth period, fewer dips, more persistent blooms

## Total biomass



Increased cumulative biomass

## Species richness



May decrease if certain nutrients become limiting (e.g. silica)

## Species composition

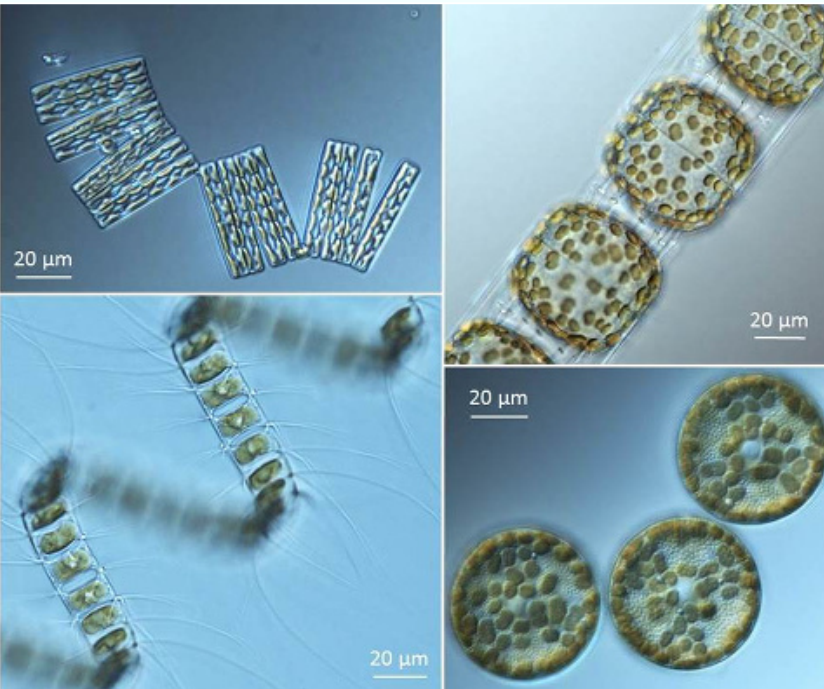


- Cell size
  - nutrient-rich environments favor larger cells
- Diatoms vs. dinoflagellates
  - diatoms may be Si-limited (lower Si:DIN)
- Autotrophic vs. heterotrophic
  - heterotrophic dinos may do well if food source is more abundant
- Increase in HABs (harmful species)

So...  
what is “phytoplankton”?



# Diatoms



No active locomotion - drift  
Often in chains, large  
Glass case → need silica

Autotrophic

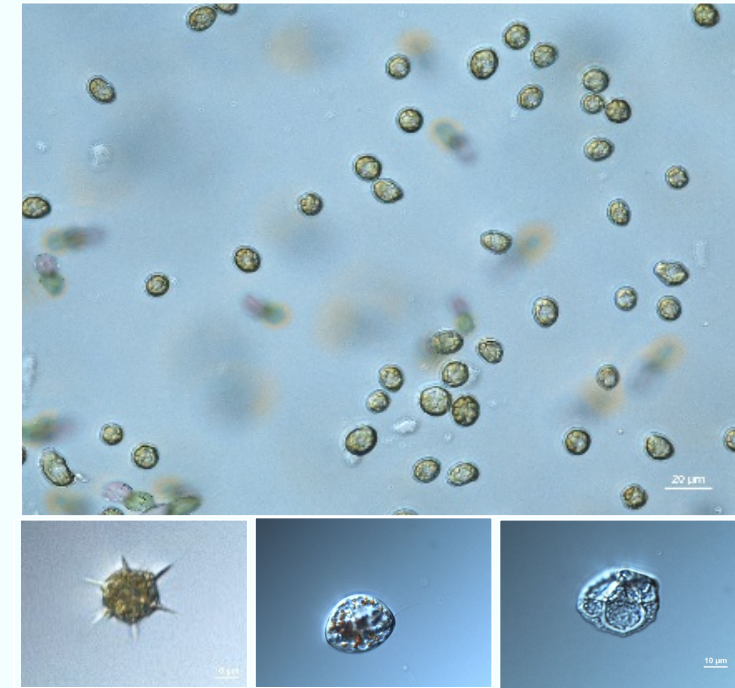
# Dinoflagellates



Flagella – swim up and down  
Usually single, often small

Autotrophic  
Heterotrophic  
Mixotrophic

# Other



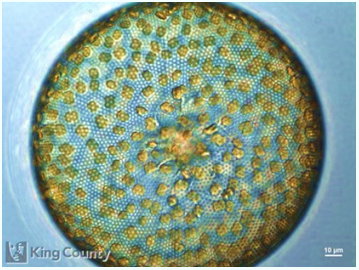
Mostly small flagellates

Autotrophic  
Heterotrophic  
Mixotrophic

# How can we quantify phytoplankton?

In food webs, **carbon biomass** is often considered the currency of energy transfer.

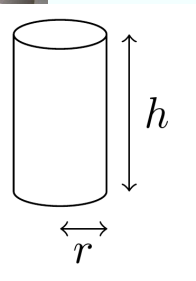
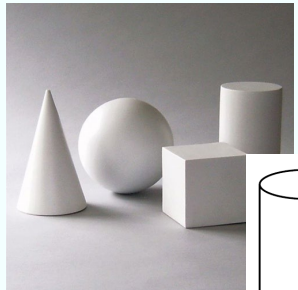
But ... it's difficult to measure. So... we use proxys.



**Chlorophyll *a***

**Abundance**

Not very good carbon proxys



**Biovolume**

Can be related to carbon and biomass → **Good proxy!**

Determined from morphometric measurements (images)

**FlowCAM  
imaging  
technology**

# Phytoplankton Analysis

- **Microscopy** (since 2008)  
qualitative
- **FlowCAM** (since May 2014)

Particle size range:

Total range is 10–300  $\mu\text{m}$

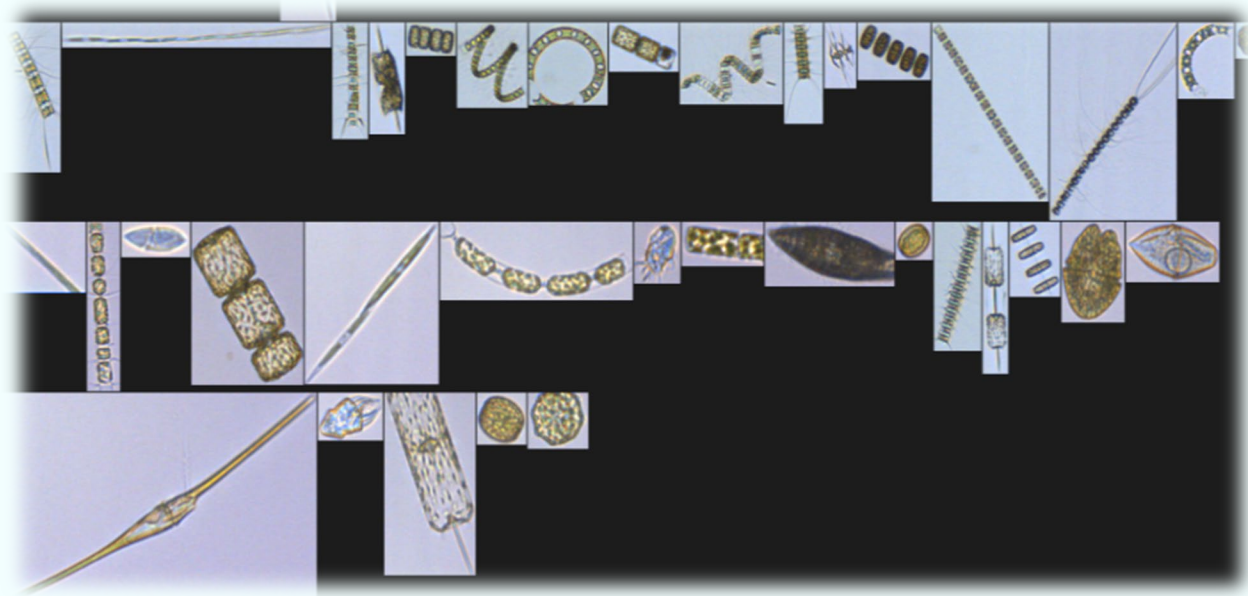
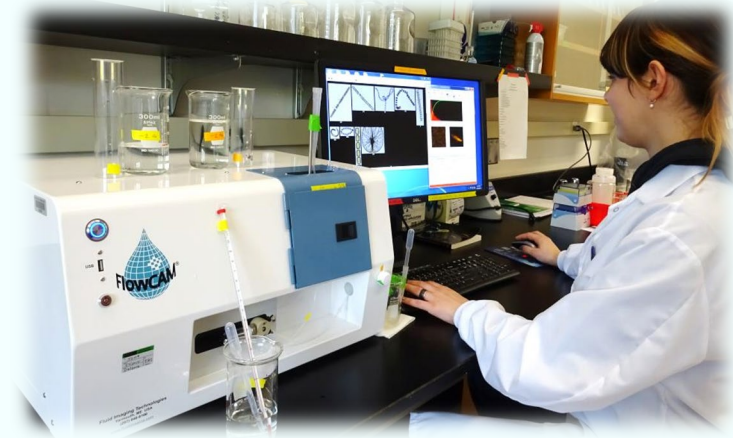
Endpoints:

Abundance (Particles  $\text{mL}^{-1}$ )

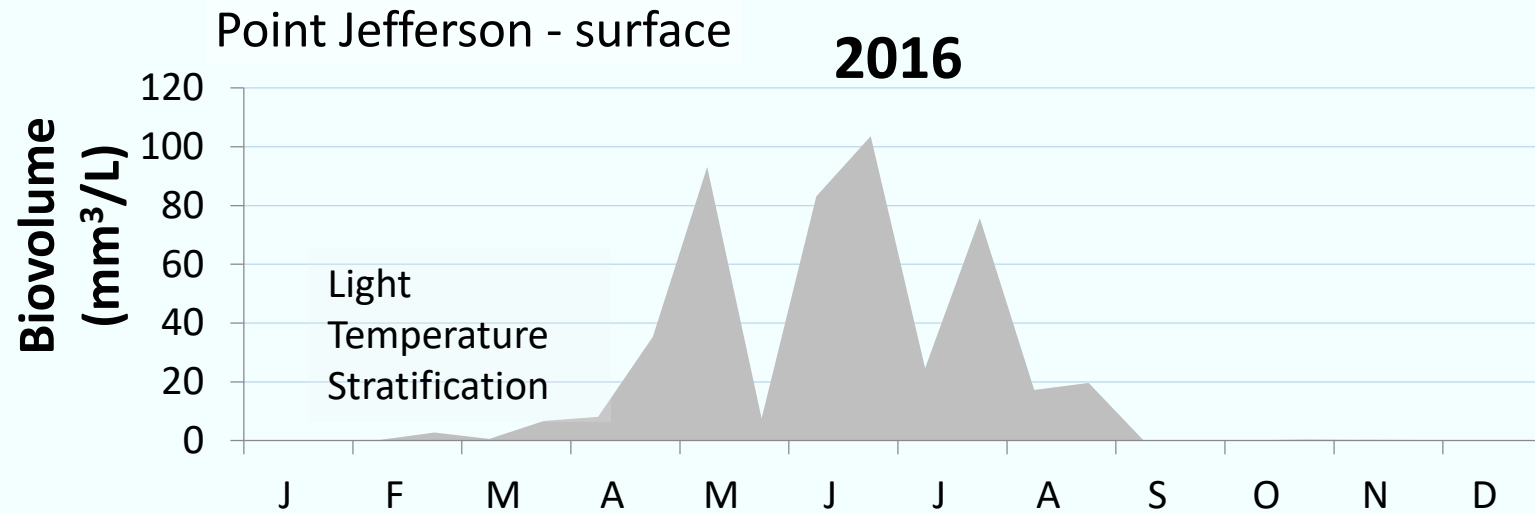
Biovolume ( $\text{mm}^3 \text{L}^{-1}$ )

Biovolume to C biomass conversion

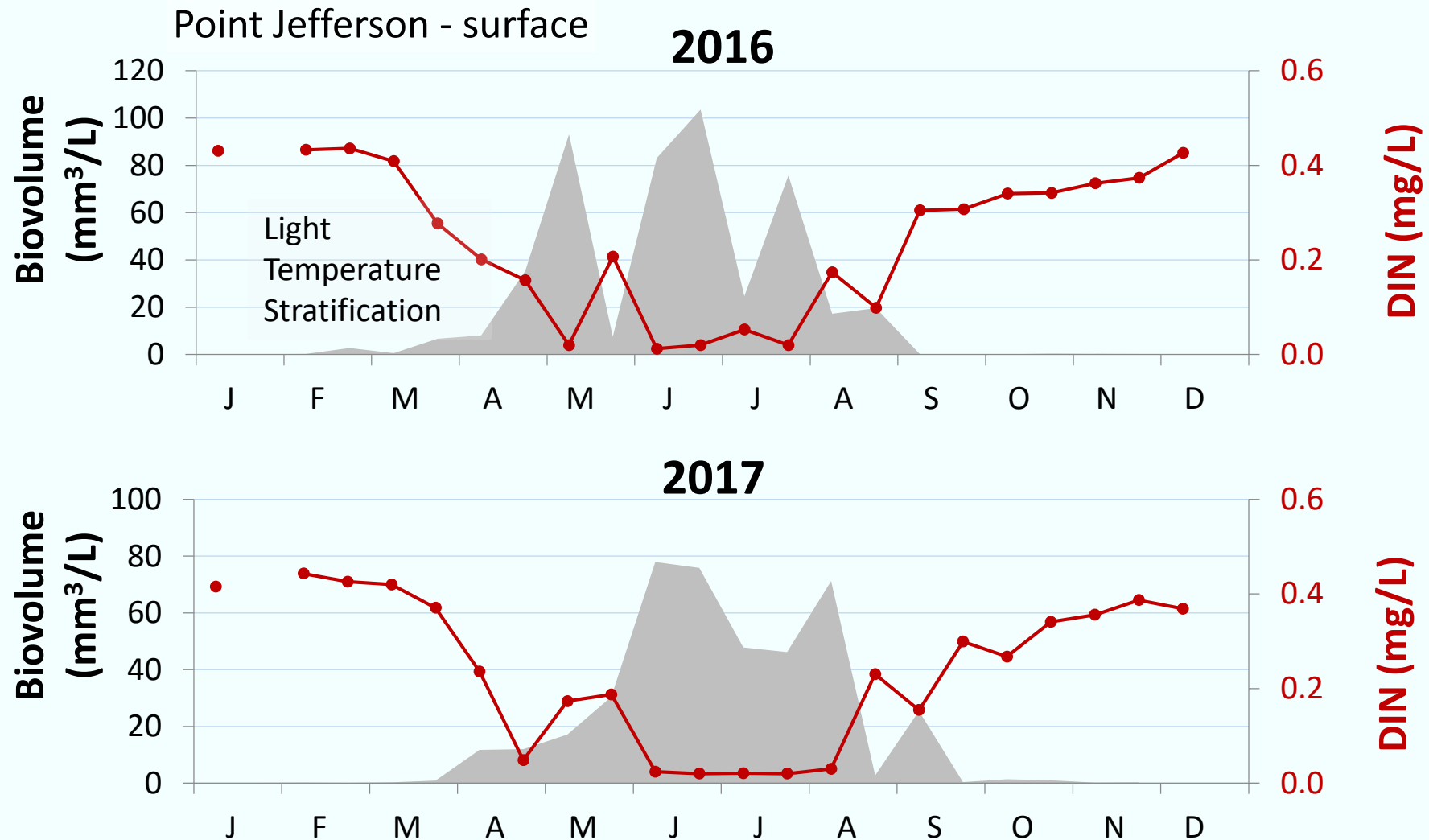
$$y = 127.67 x^{0.4496}$$



# How does seasonal phytoplankton growth relate to nitrogen levels in the water?

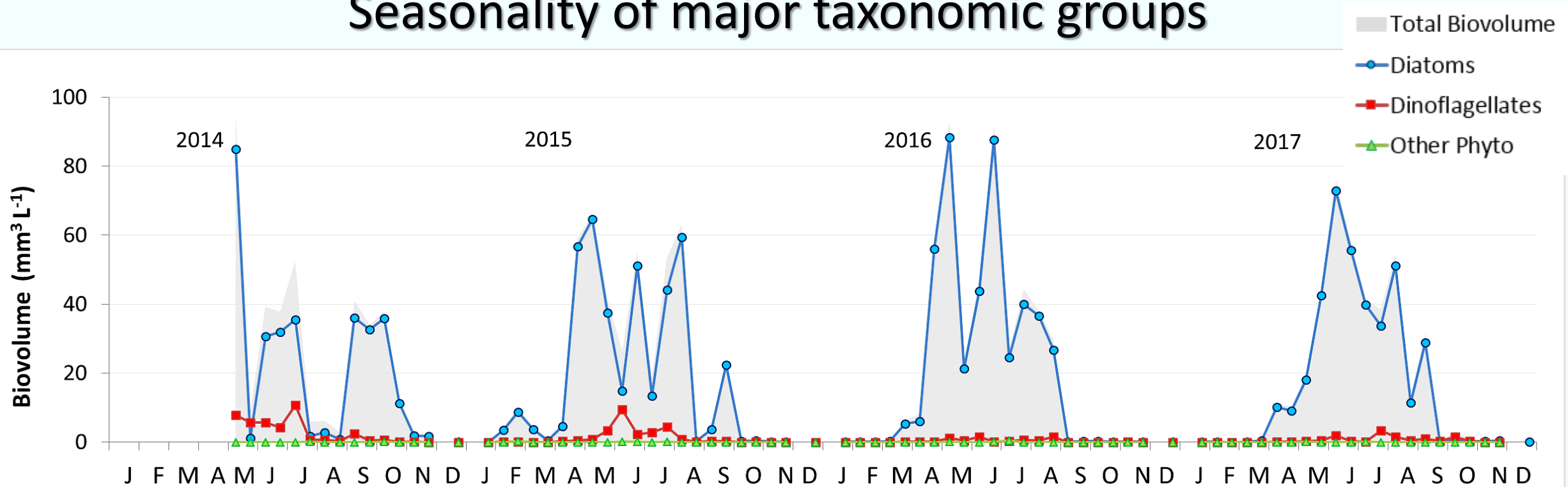


# How does seasonal phytoplankton growth relate to nitrogen levels in the water?



# Central Basin

## Seasonality of major taxonomic groups

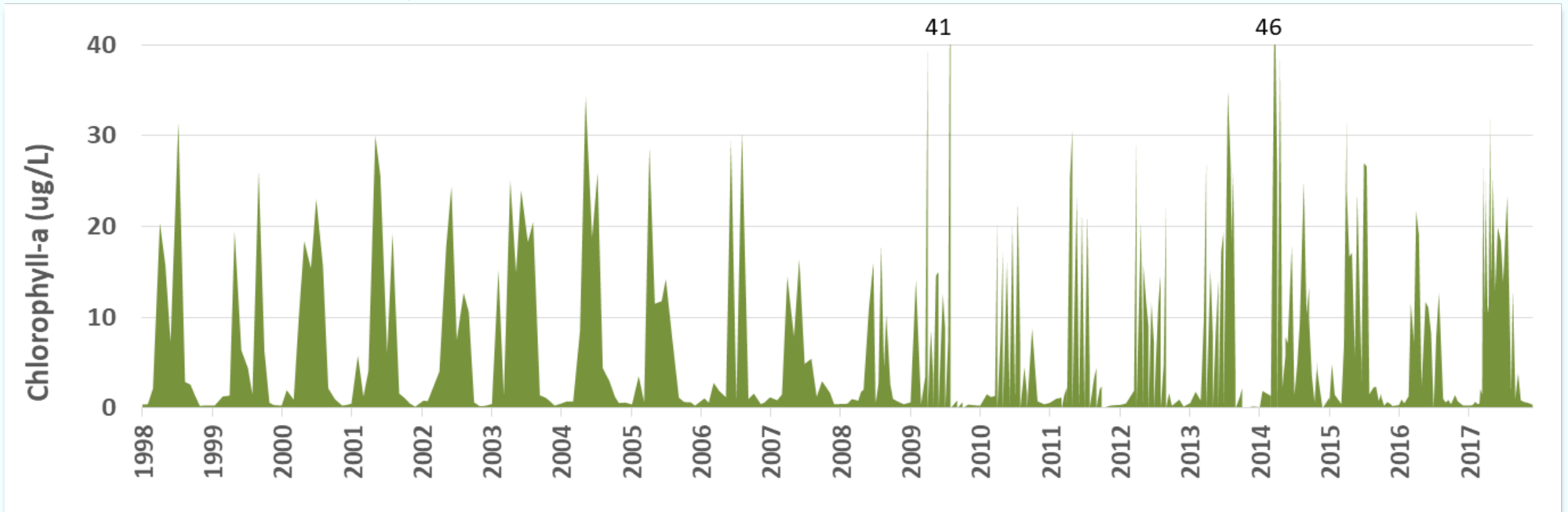


Biovolume means of 6 offshore stations

- Diatoms always dominate – typical of many estuarine areas
- Seasonal pattern varies year to year with environmental conditions

# Long-term record: Chlorophyll *a*

Point Jefferson last 20 years



- Concentrations and timing of spring bloom are generally similar over past 20 years → no long-term trends

# Historical data for South Central Basin (1982-1984)

Similar pattern to  
current data

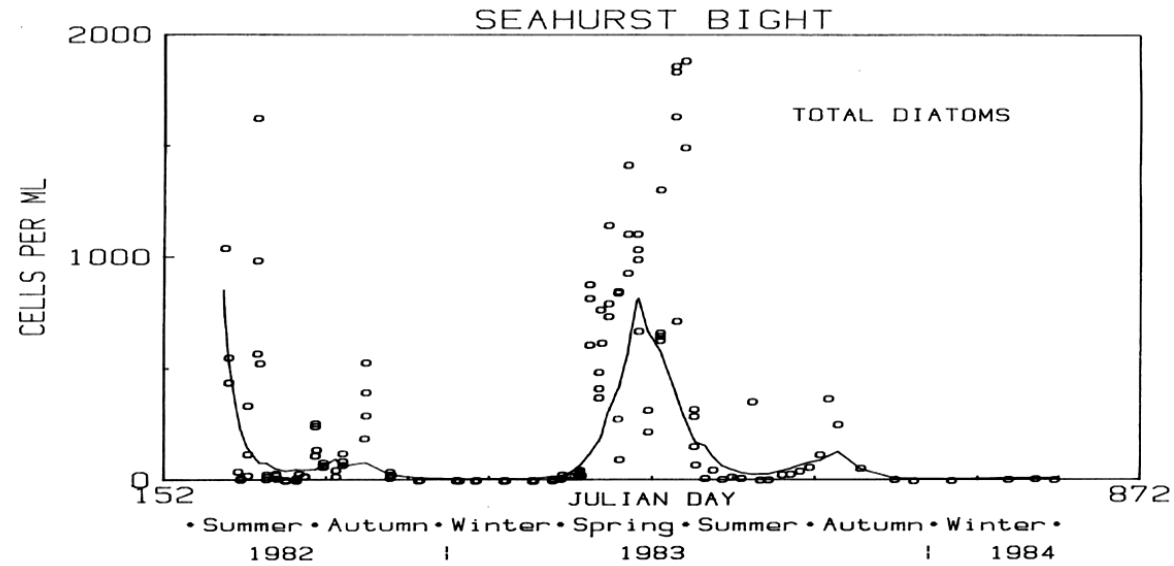


Figure 4.24a. Total diatom numbers from 50% light depth in Seahurst Bight with smooth distribution.

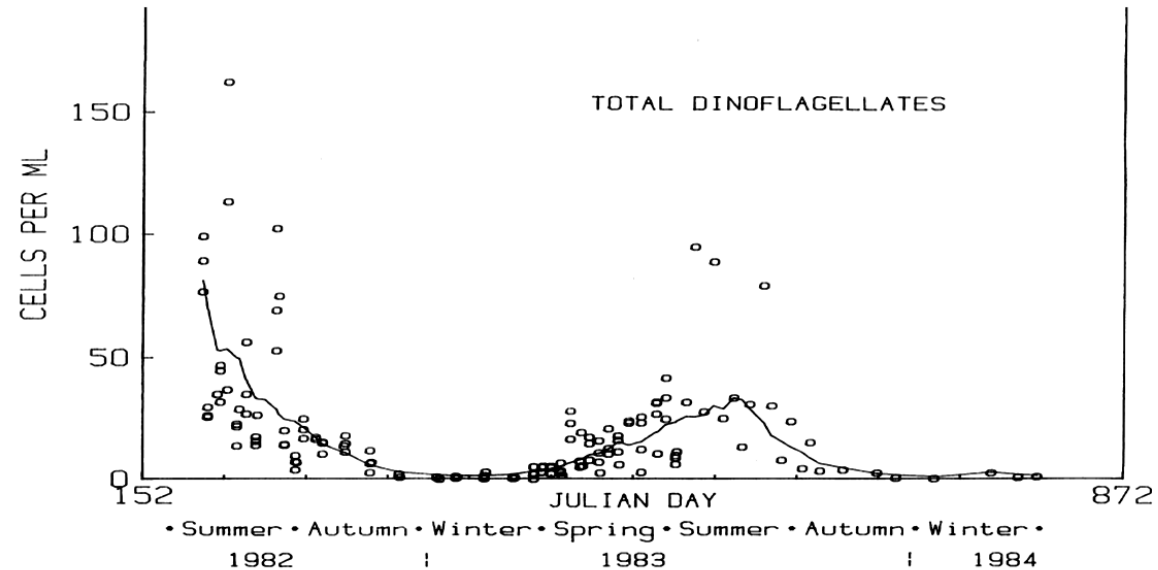
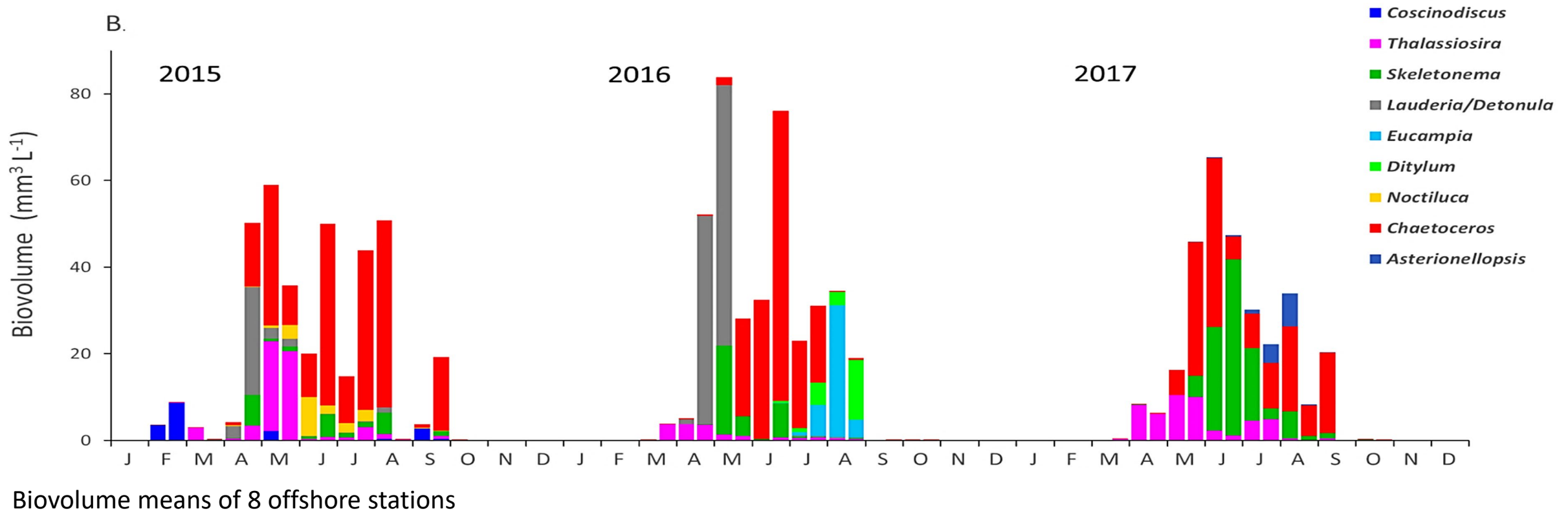


Figure 4.25a. Total dinoflagellate numbers from 50% light depth in Seahurst Bight with smooth distribution.

# Seasonality of 6 top taxa for last three years

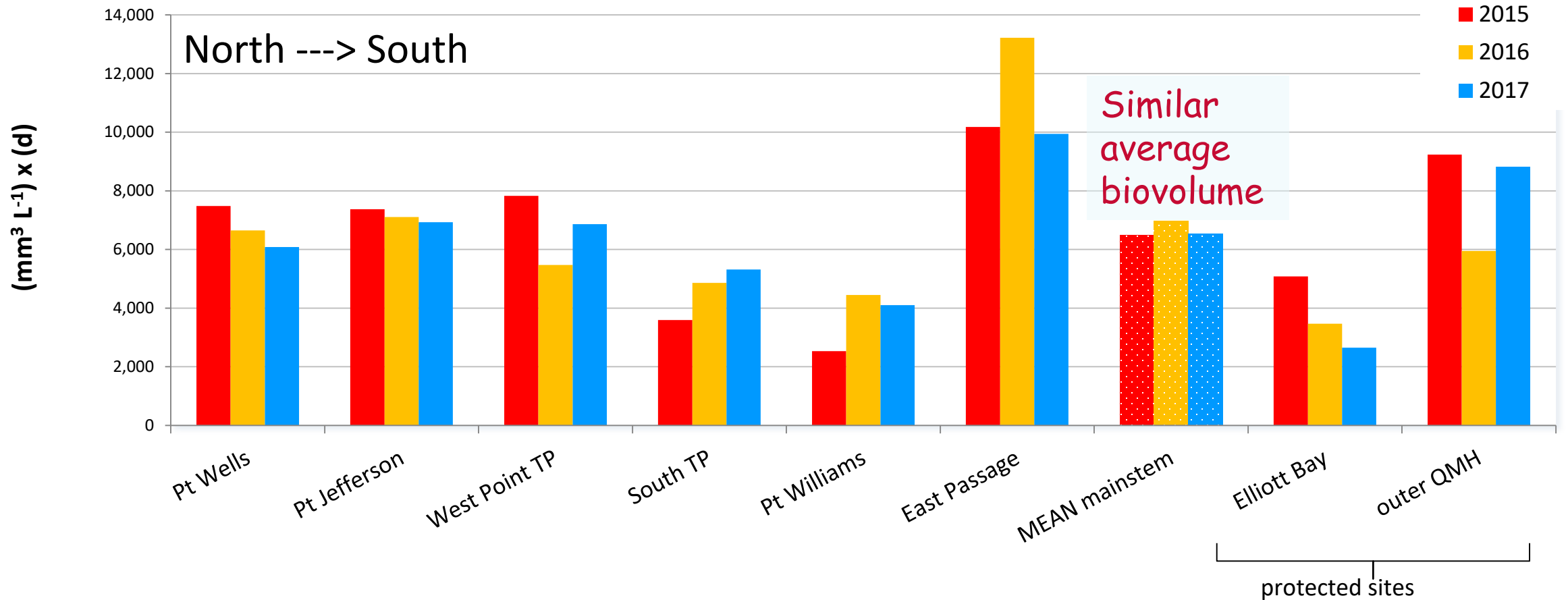


- Characteristic seasonal succession (mostly chain-forming diatoms)

*Thalassiosira* spp. → Other Diatoms → *Chaetoceros* spp

- Year to year variations are likely the norm
- Some taxa are abundant every year, others unpredictable

# 12-Month Cumulative Biovolume

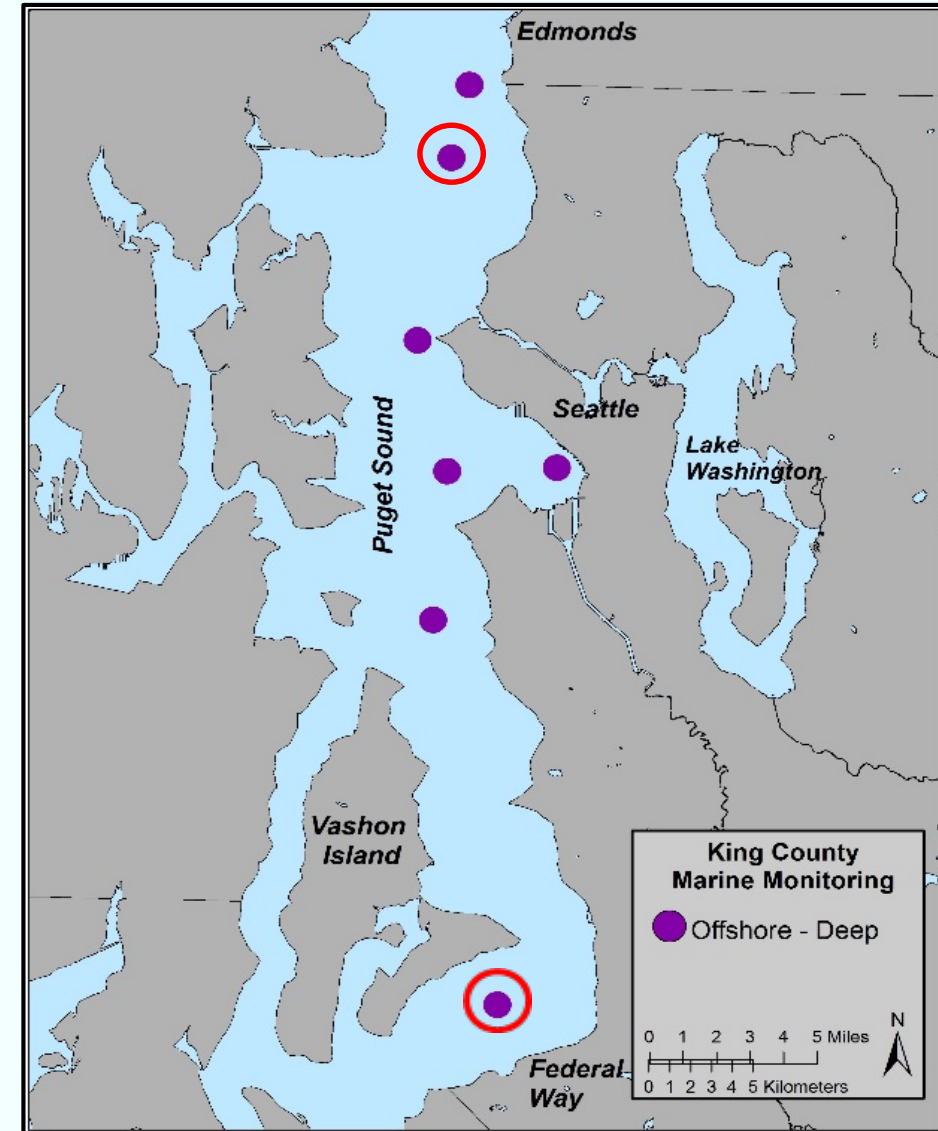


- Consistent spatial pattern in total biomass – the Central Basin is not homogenous
- Central Basin annual totals are similar year to year – no indication of changes/trends in phytoplankton biomass (but very short time series)

# Has phytoplankton species composition changed in the last 10 years?

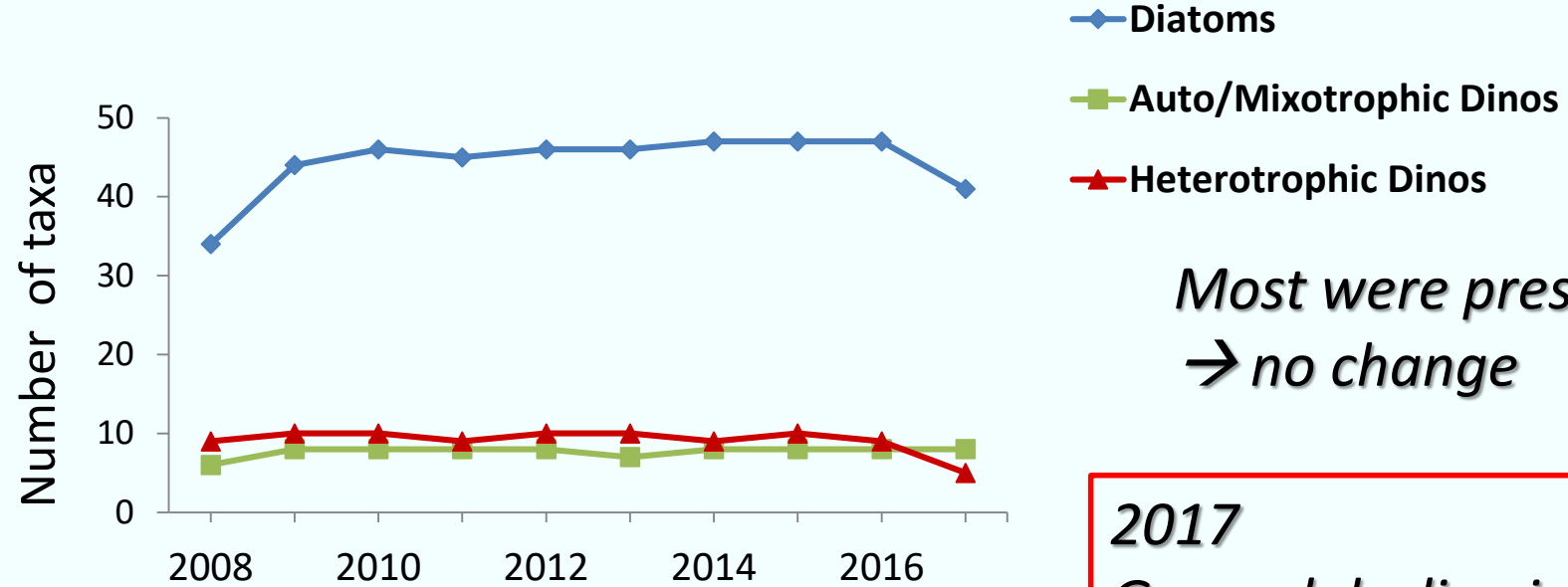


- 2008 – 2017 microscopic observations in central basin
- Presence / Absence at Pt Jefferson and/or East Passage



# Number of taxa identified 2008-2017

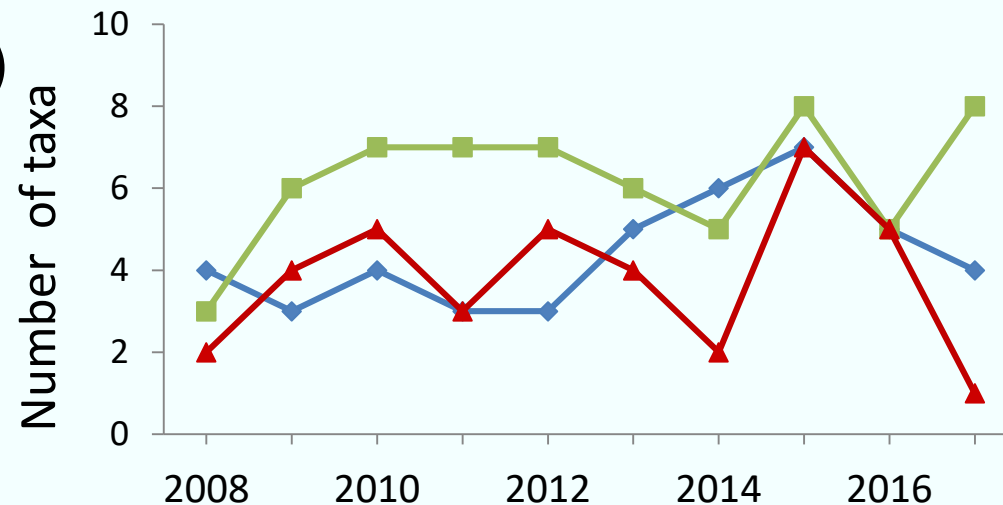
## Common Taxa (65)



*Most were present every year  
→ no change*

**2017**  
*General decline in # of taxa*

## Less common Taxa (33)

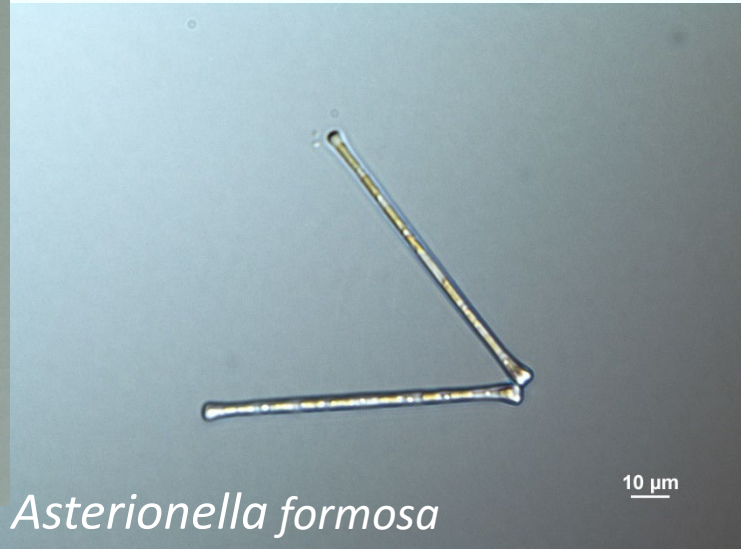


*Present 1-7 of 10 years  
→ no trend*

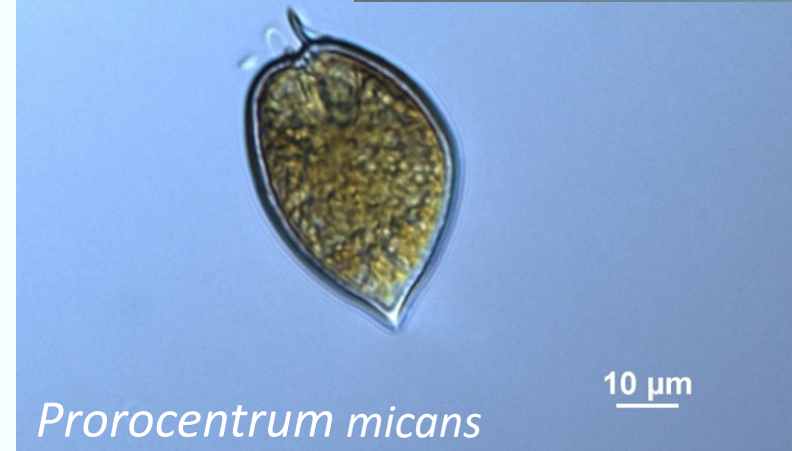
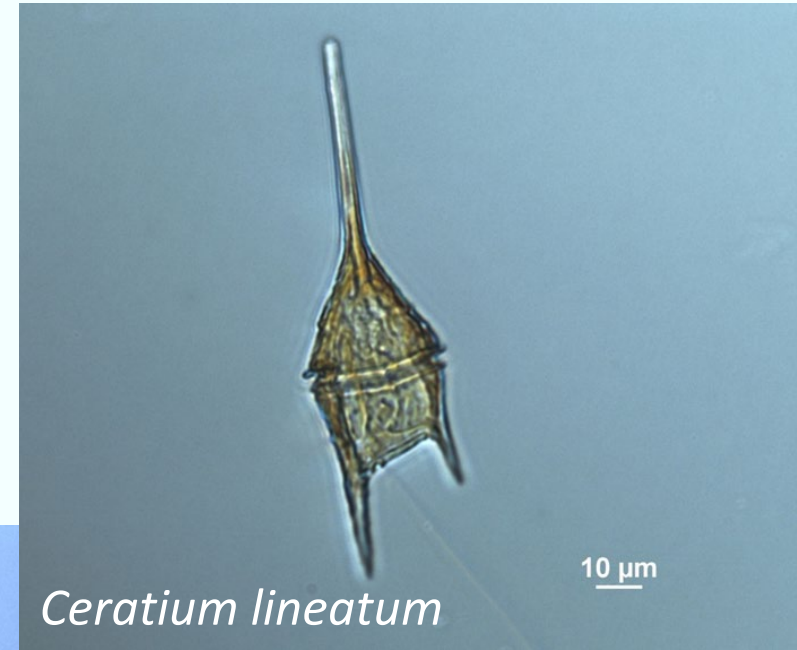
# Some “new” common taxa in 2017

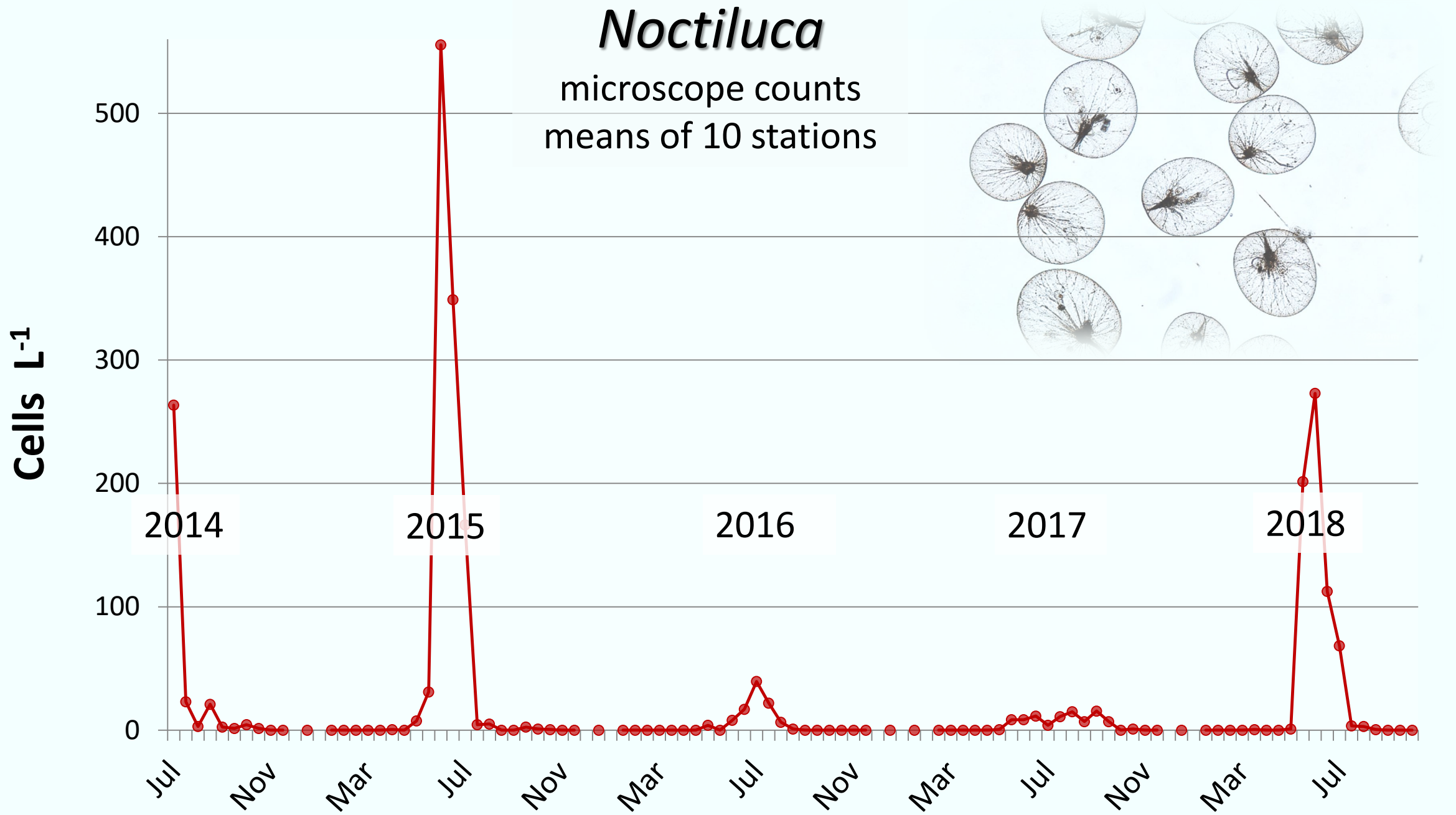
Previously very uncommon or absent from our records

## DIATOMS



## DINOFLAGELLATES





# *Noctiluca* blooms

## Three Tree Point



May 1975



June 2018

*Photo: C. Krembs, Ecology*



June 1975

*1975 photos: Metro*

## North of Des Moines marina



May 1975



May 1975

# In Summary...

- Puget Sound phytoplankton is dominated by diatoms, as is typical of nutrient-rich estuarine areas
- Phytoplankton draw down most of the ambient nitrogen during the peak growth season
- Seasonal patterns in phytoplankton biomass can vary year to year with environmental conditions (e.g. stratification)
- Inter-annual differences in bloom timing, magnitude and species composition make it difficult to assess trends (need longer time series!)
- 10-yr record of central basin taxa shows a large group of common taxa present every year, but some changes in 2017
- *Noctiluca* observations go back a long time, but there is no long-term data record



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# Thank you.

Special thanks to the Environmental Lab Field Science Unit

Gabriela Hannach  
gabriela.hannach@kingcounty.gov - 206 477 7120

Environmental Lab Scientist  
Water and Land Resources Division  
King County Department of Natural Resources and Parks

