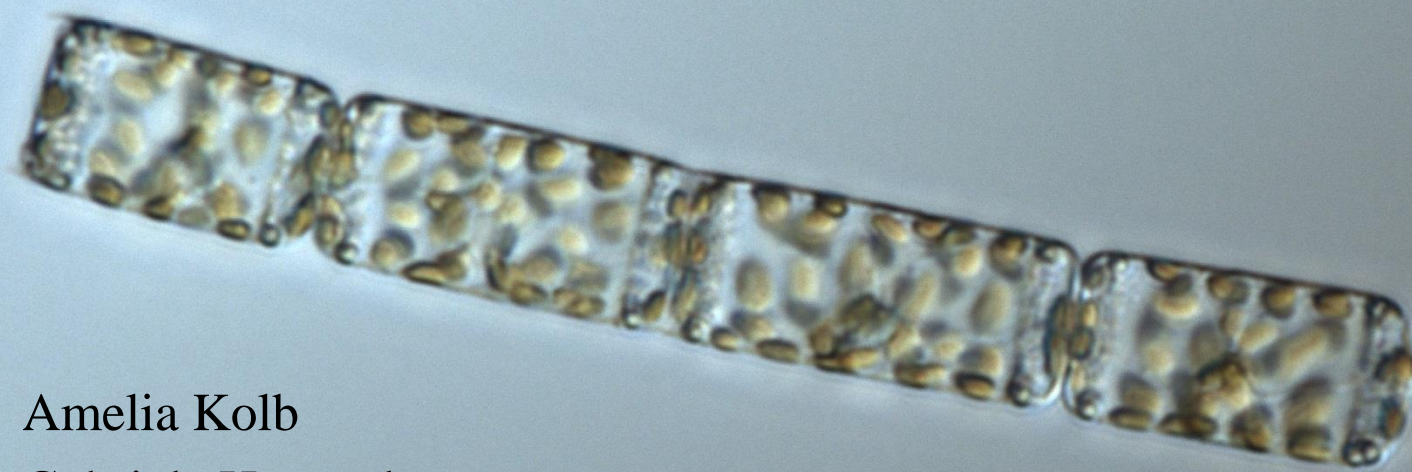


Going with the flow: assessing phytoplankton diversity with the FlowCAM



Amelia Kolb

Gabriela Hannach

Lyndsey Sandwick

10 μ m



50 μm

Photo: Gabriela Hannach

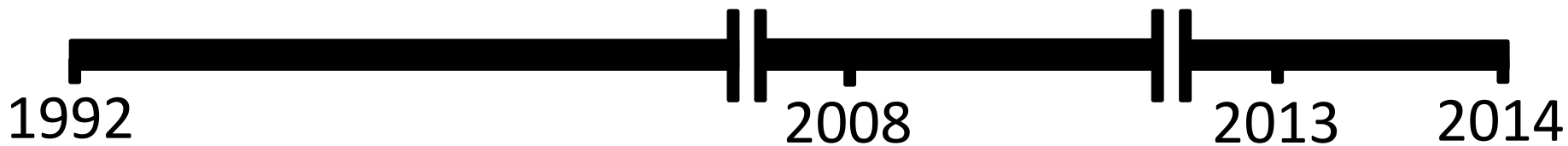
Total phytoplankton
biomass (chlorophyll/L)



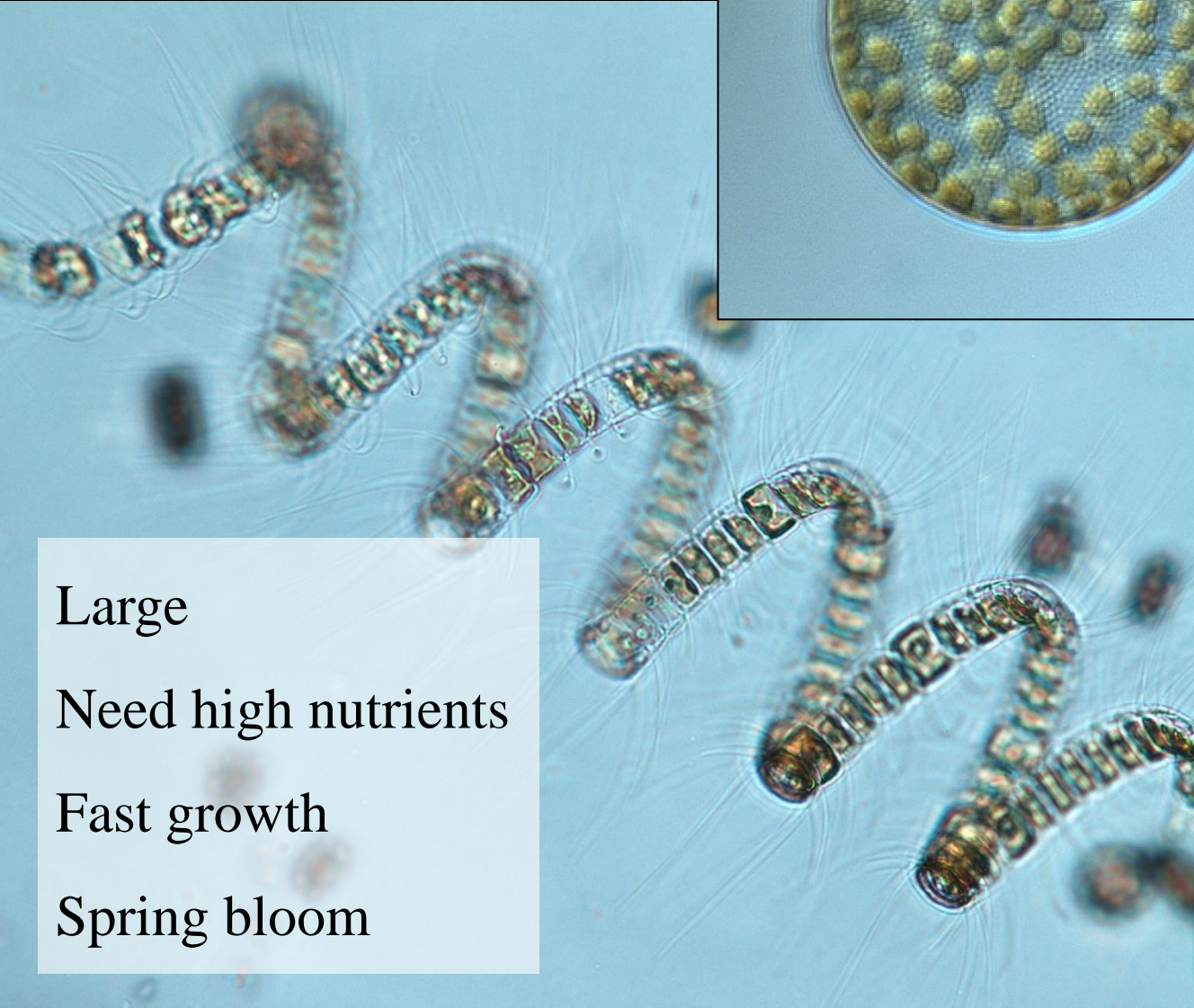
FlowCAM

Semi-quantitative microscopy

Chlorophyll



Diatoms



Large

Need high nutrients

Fast growth

Spring bloom

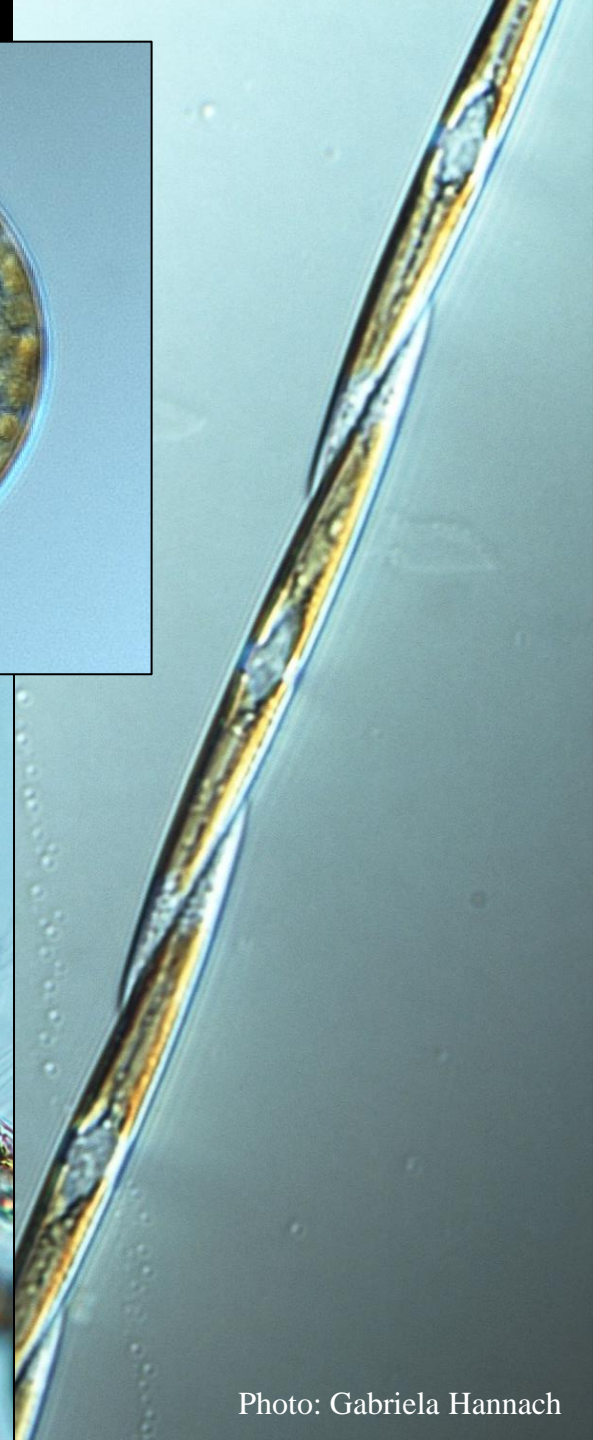
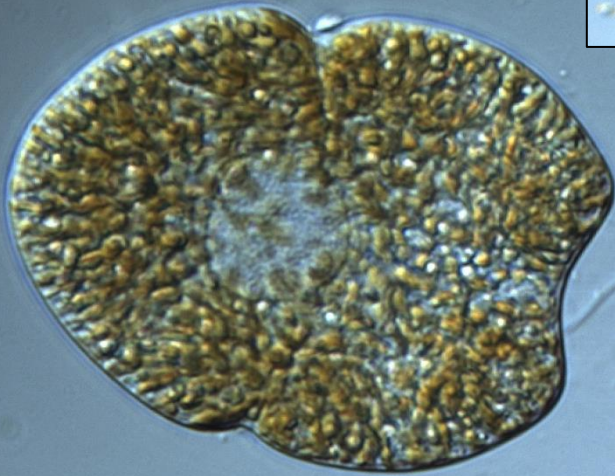
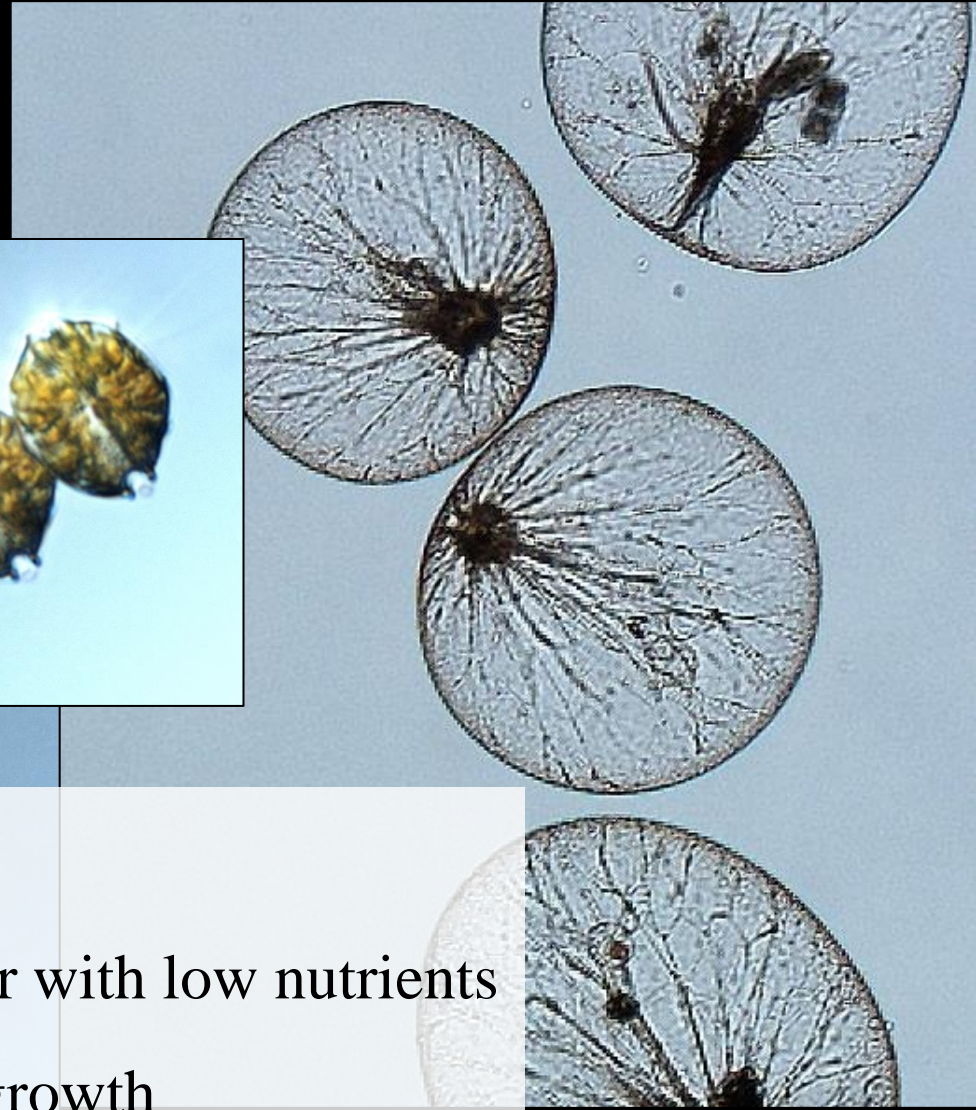
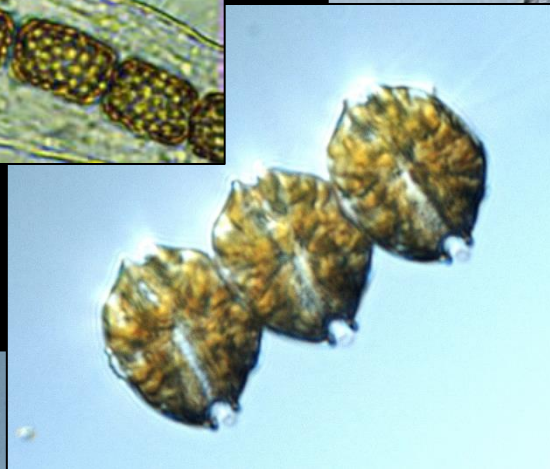


Photo: Gabriela Hannach

Dinoflagellates



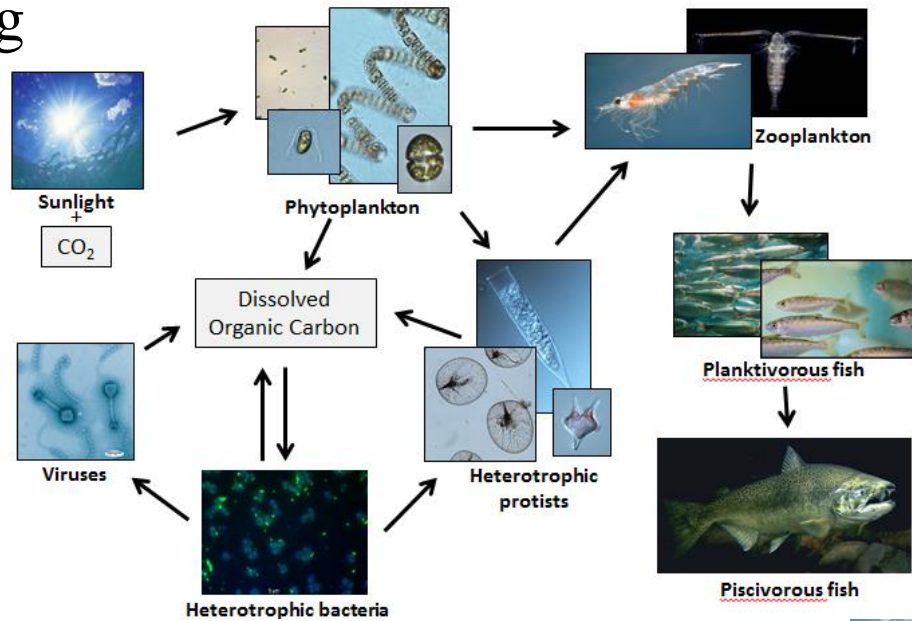
Smaller

Do better with low nutrients

Slower growth

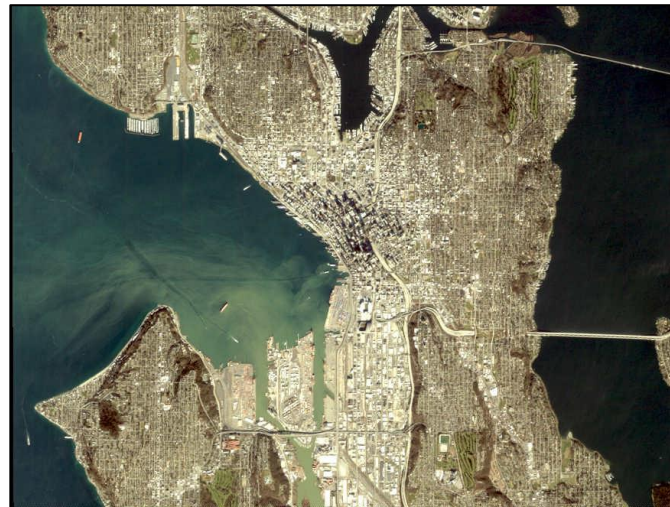
Knowledge of phytoplankton community composition...

1. Improves understanding of marine food web



Piscivorous charismatic megafauna

2. Improves assessment of human impacts



Phytoplankton taxa:

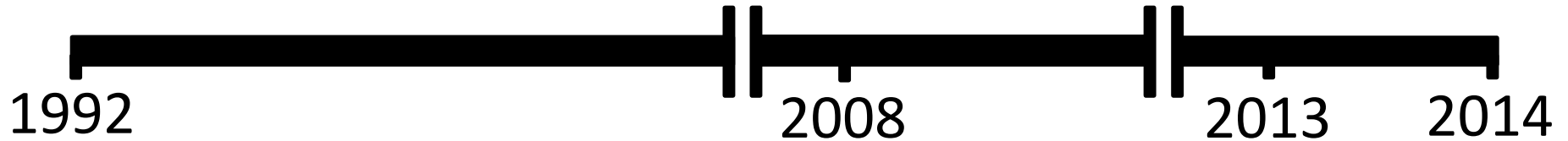
- Dominant,
- Subdominant, or
- Present

Total phytoplankton
biomass (chlorophyll/L)

FlowCAM

Semi-quantitative microscopy

Chlorophyll



Phytoplankton taxa:

- Abundance (cells/mL)
- Biomass ($\mu\text{m}^3/\text{L}$)

FlowCAM

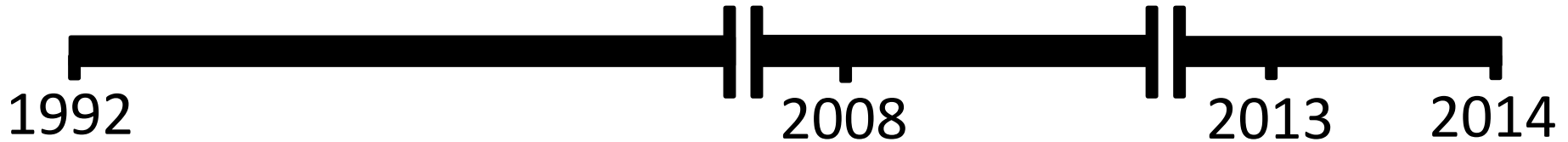
Phytoplankton taxa:

- Dominant,
- Subdominant, or
- Present

Semi-quantitative microscopy

Total phytoplankton
biomass (chlorophyll/L)

Chlorophyll



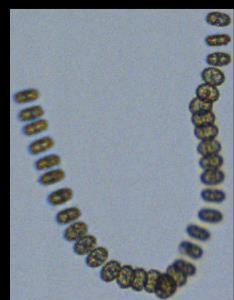
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New 4 x settings
1.5 mL/min
15 fps
Brightness = 50
Recalibration = 2 min

Fluid Imaging Technologies
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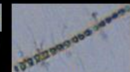
155



157



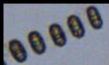
158



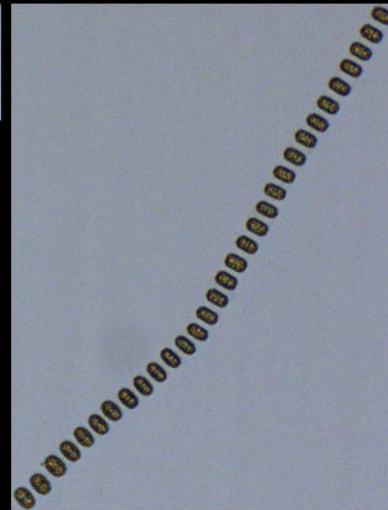
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161



162



163



164



165



166



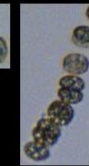
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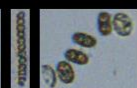
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170



171



129



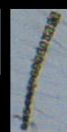
130



131



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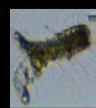
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137



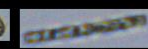
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142



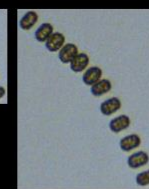
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147



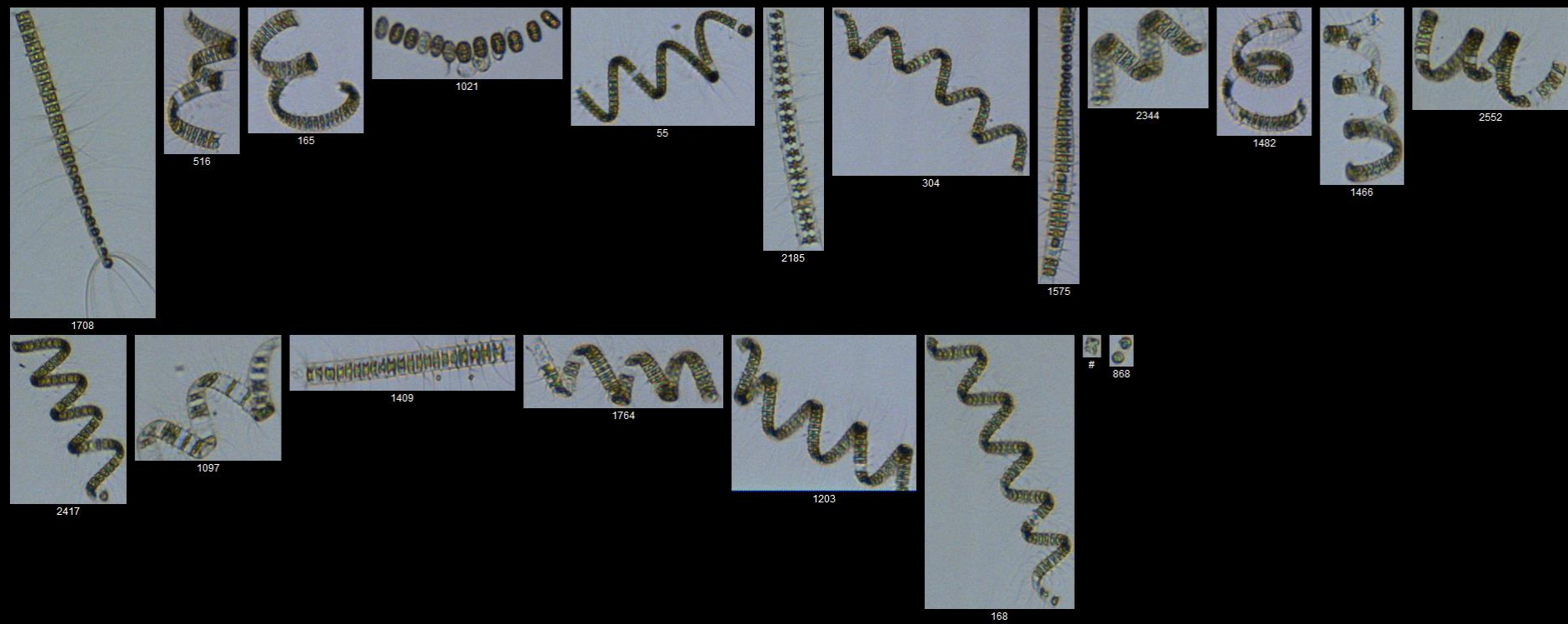
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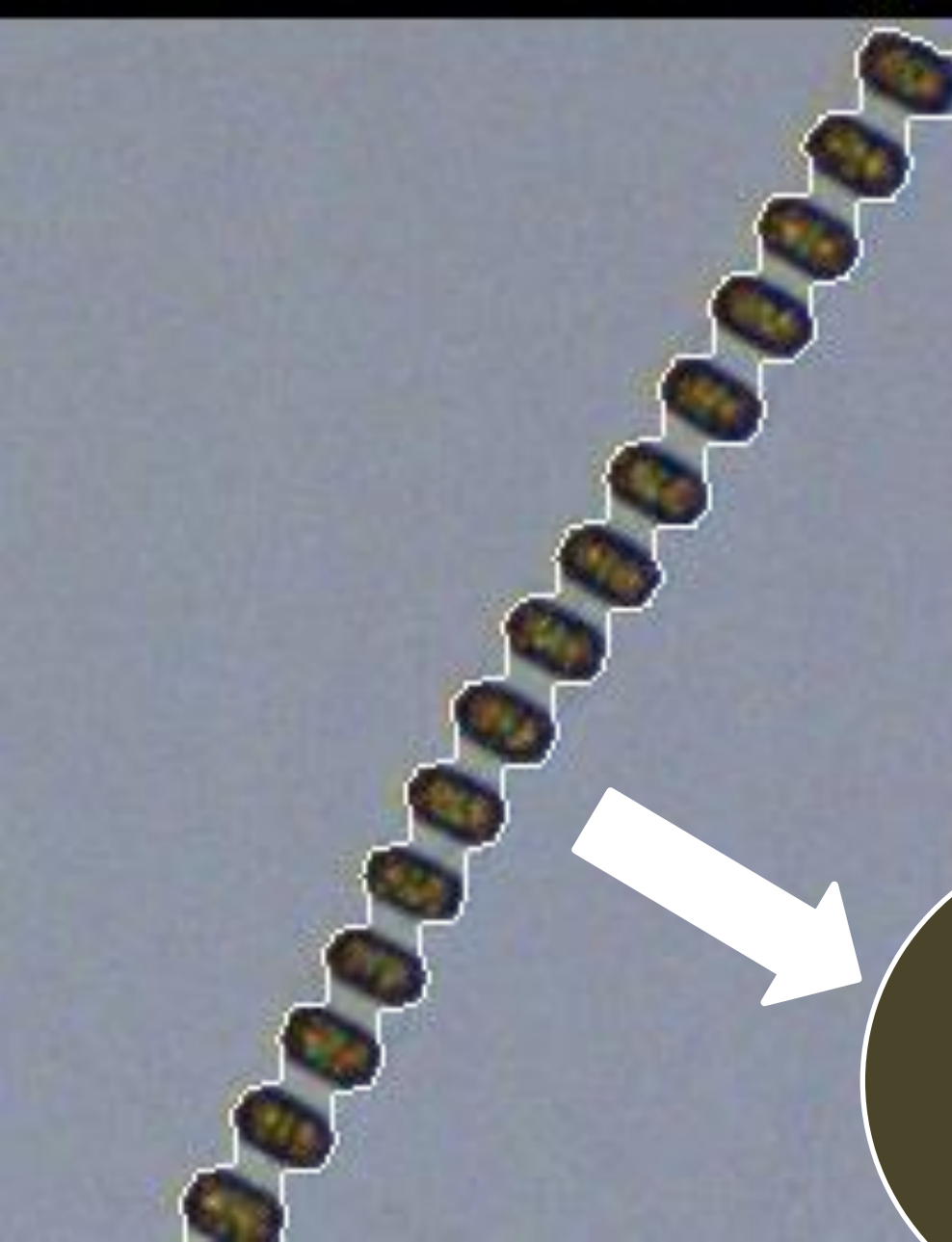


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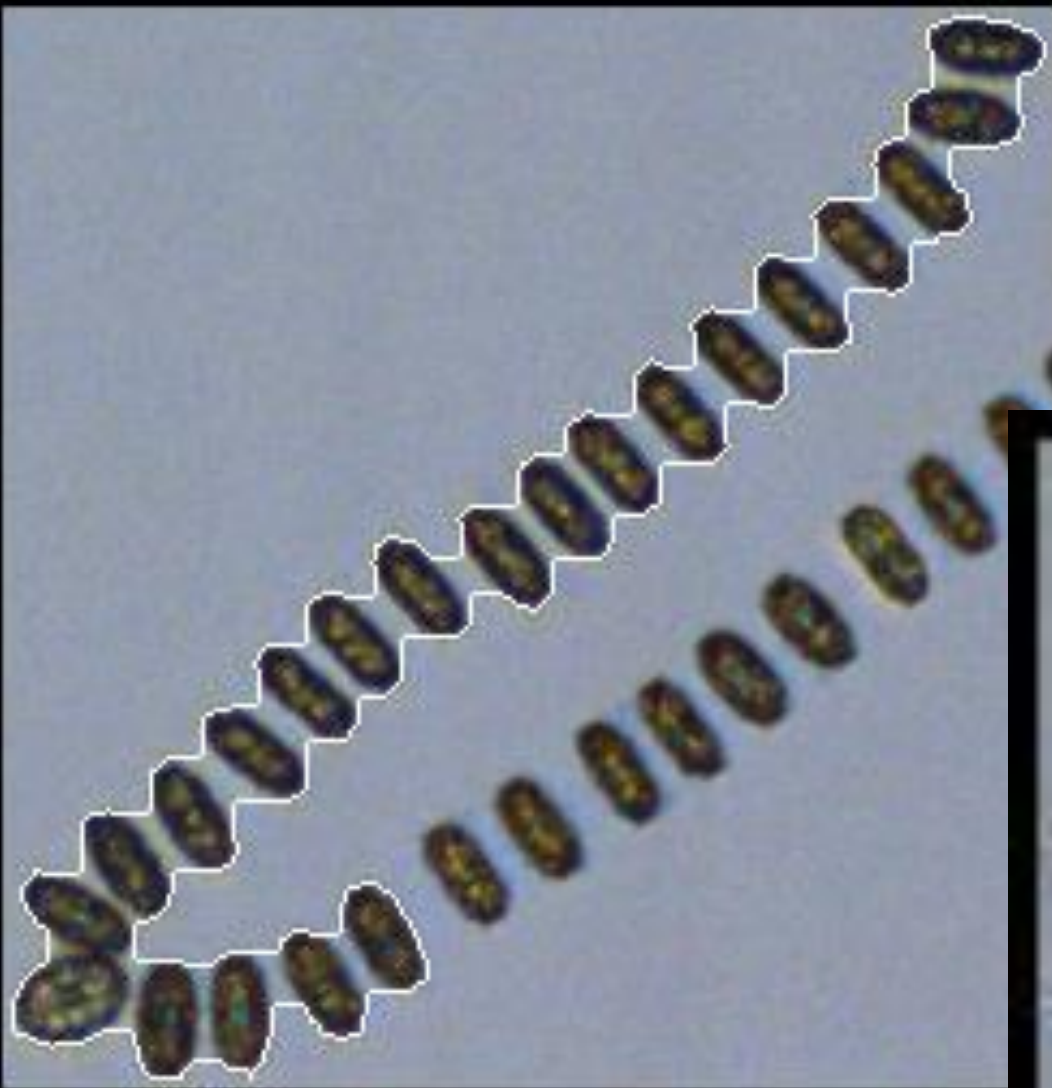


164



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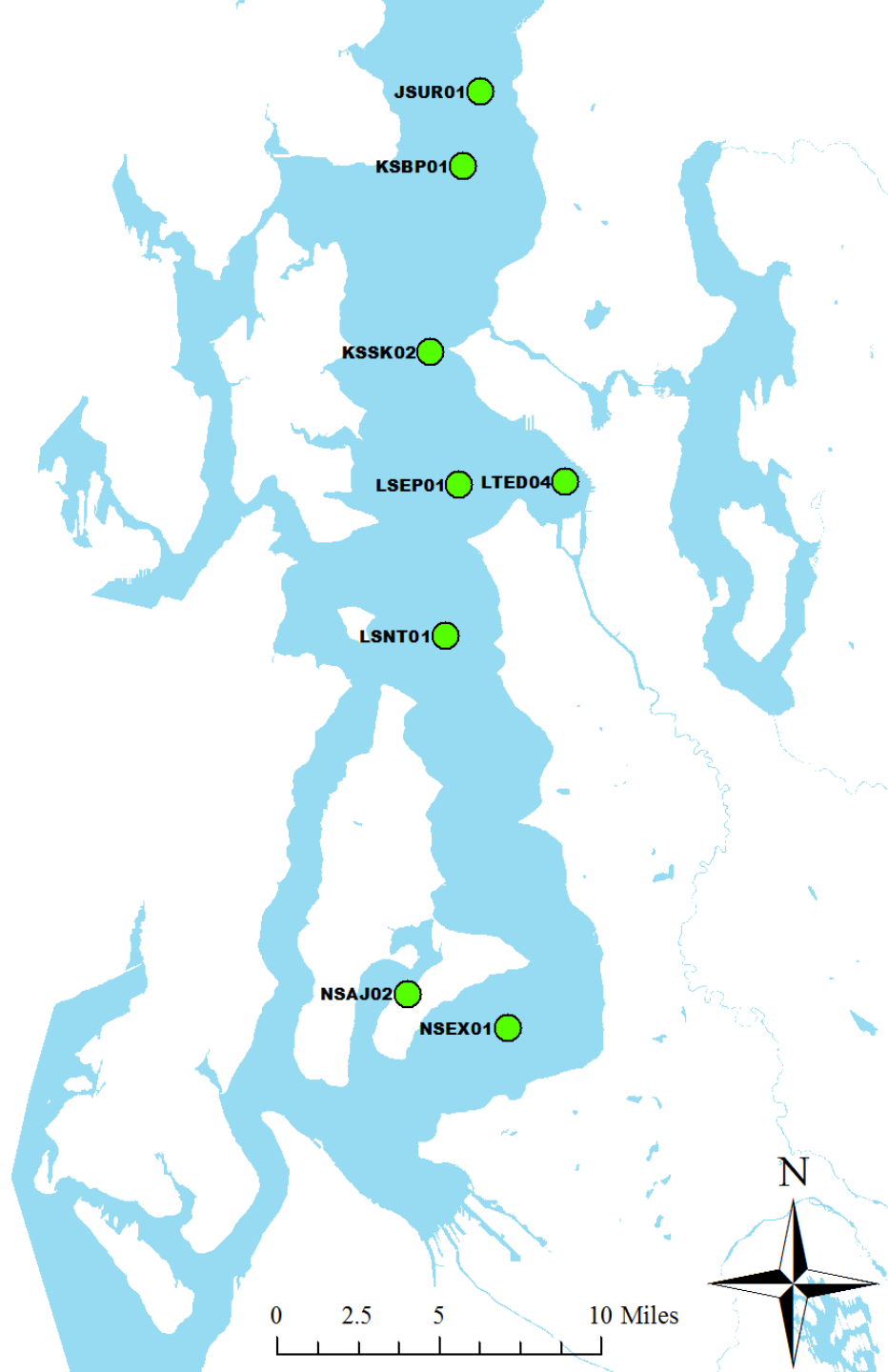
Biovolume
 \approx Biomass



649



	<i>Chaetoceros</i>	<i>Alexandrium</i>	Misc. small dinoflagellate	etc (up to 57 more) ➔
Abundance (cells/ml)	124	2	20	...
Biovolume ($\mu\text{m}^3/\text{L}$)	10.8	0.0048	0.0315	...

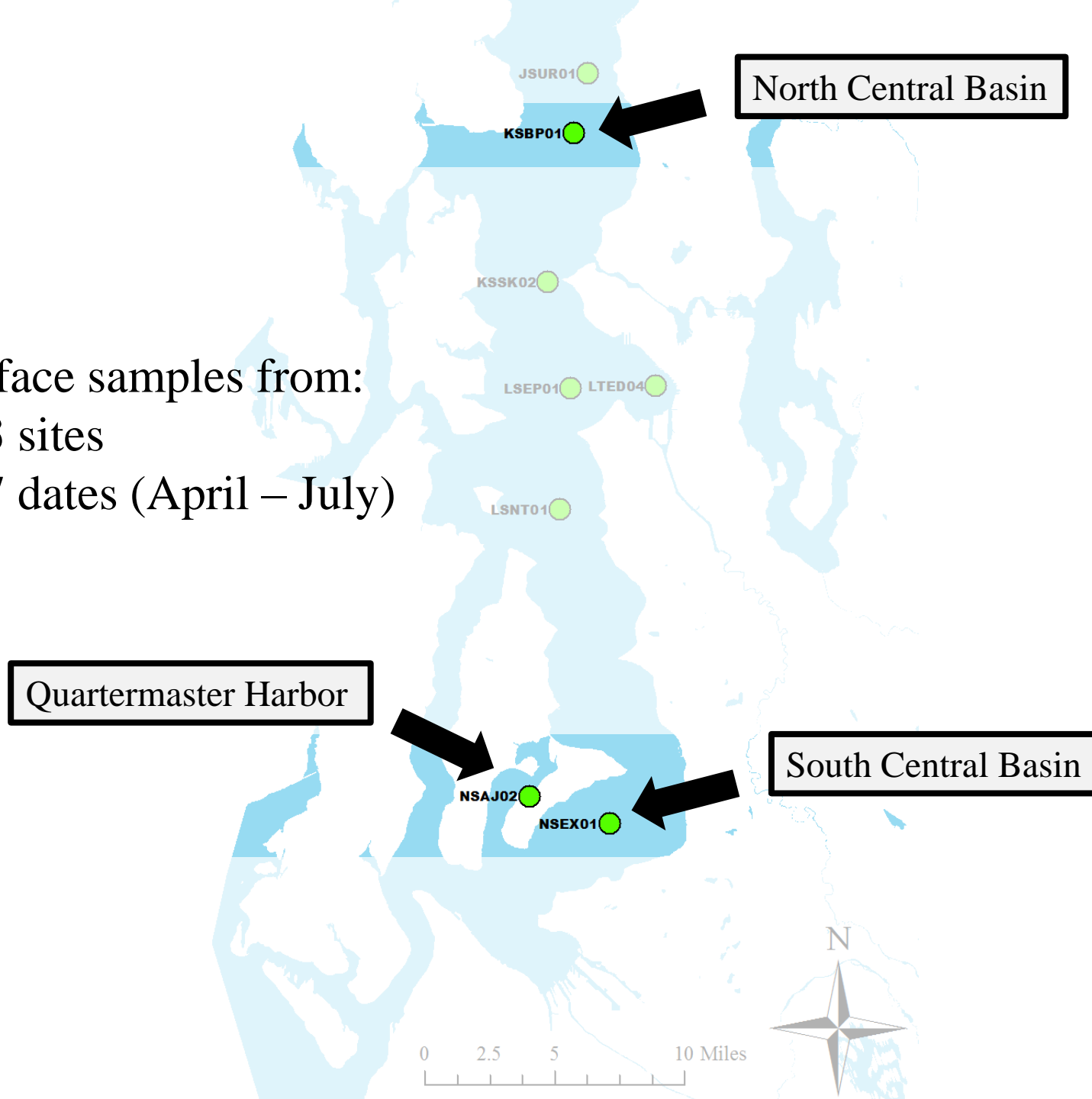


0 2.5 5 10 Miles



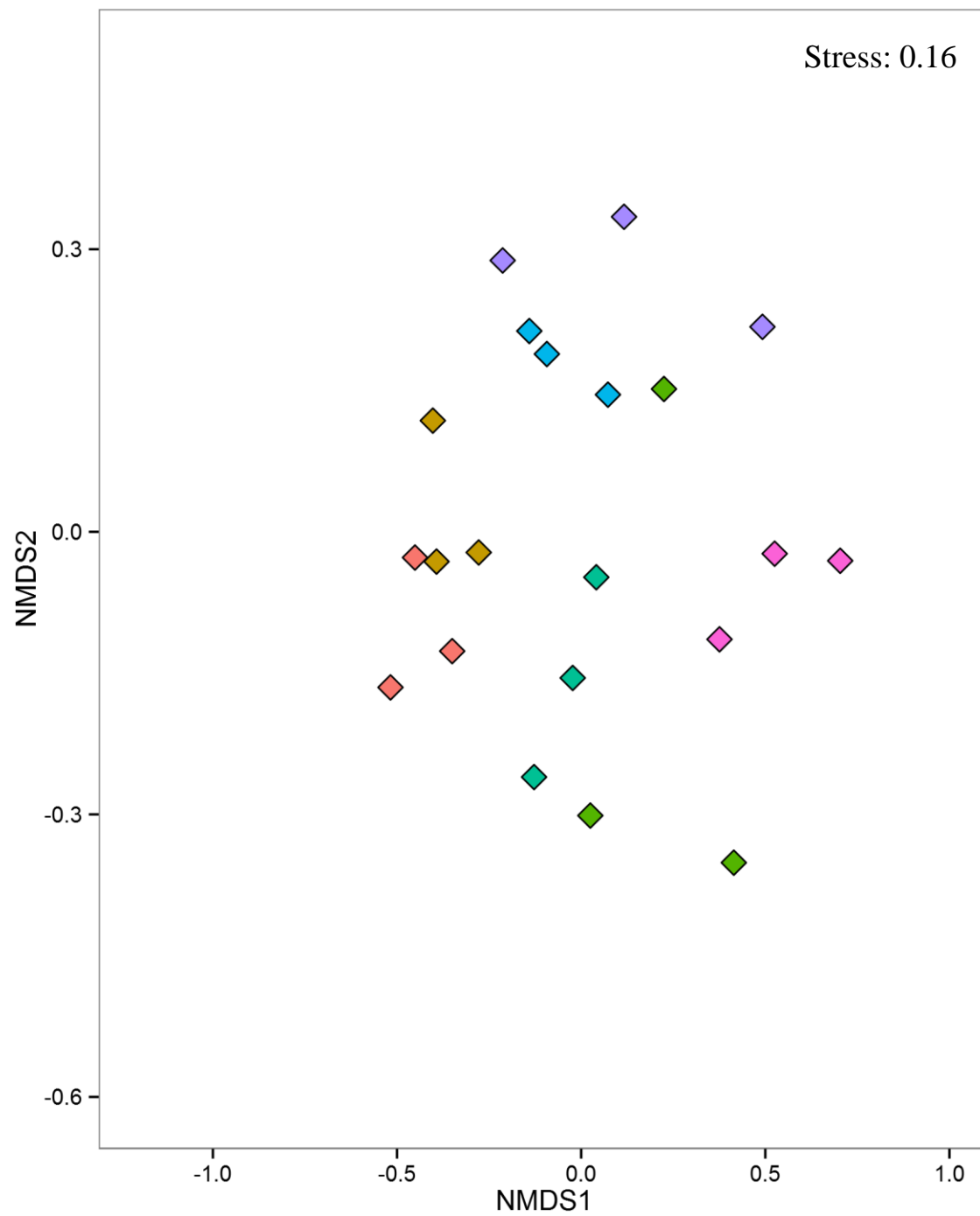
Surface samples from:

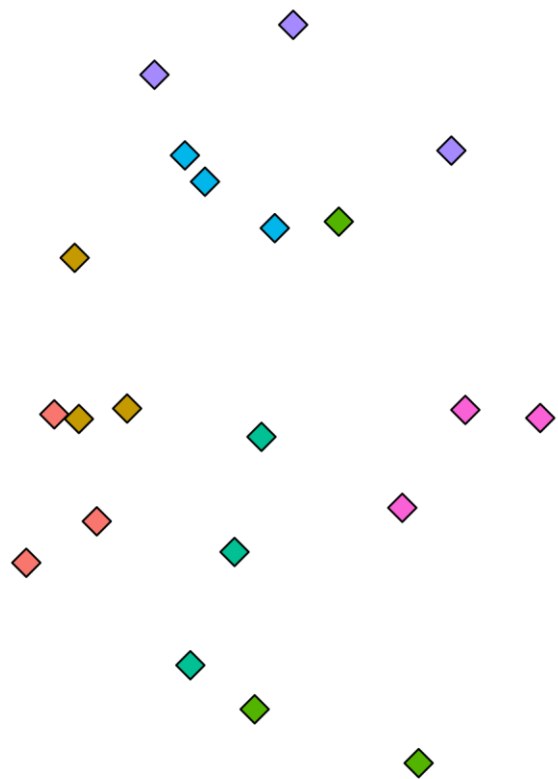
- 3 sites
- 7 dates (April – July)

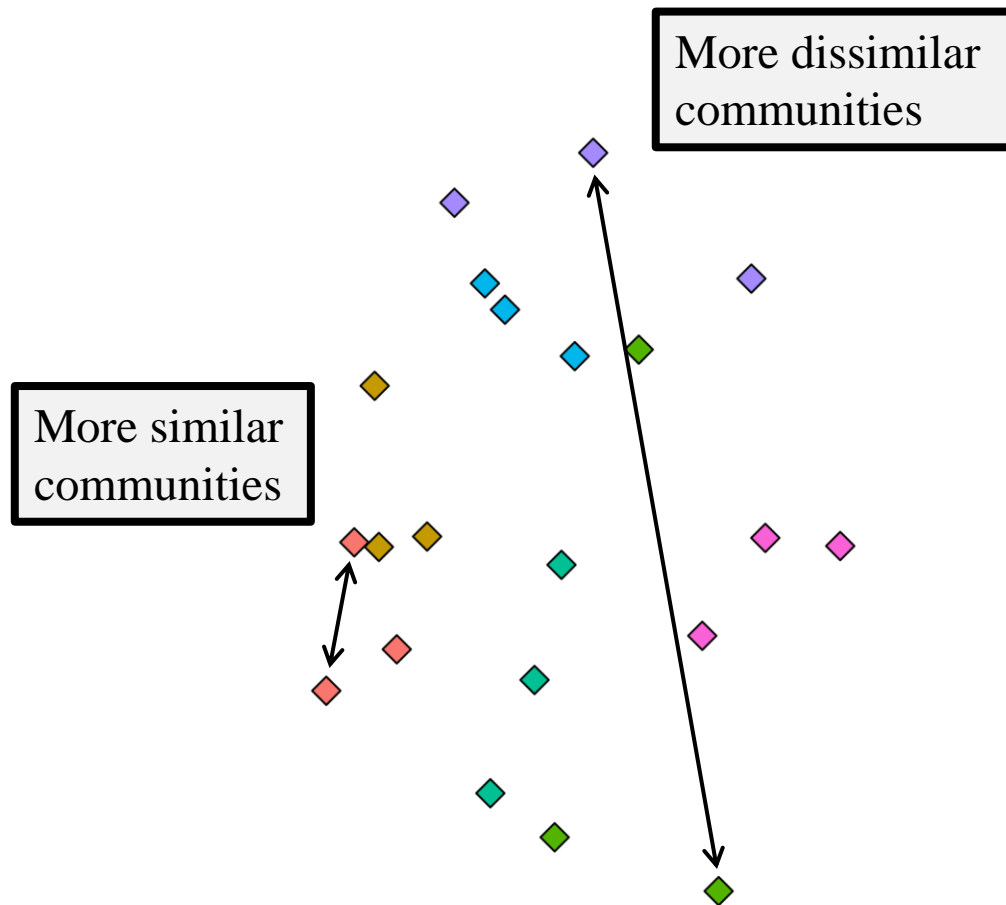


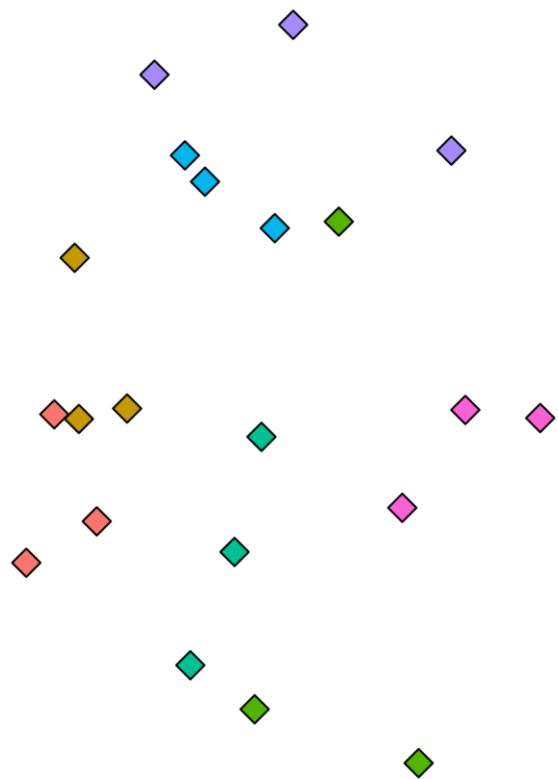
Non-metric multidimensional scaling (NMDS):








Creates a map of dissimilarity in
taxonomic composition

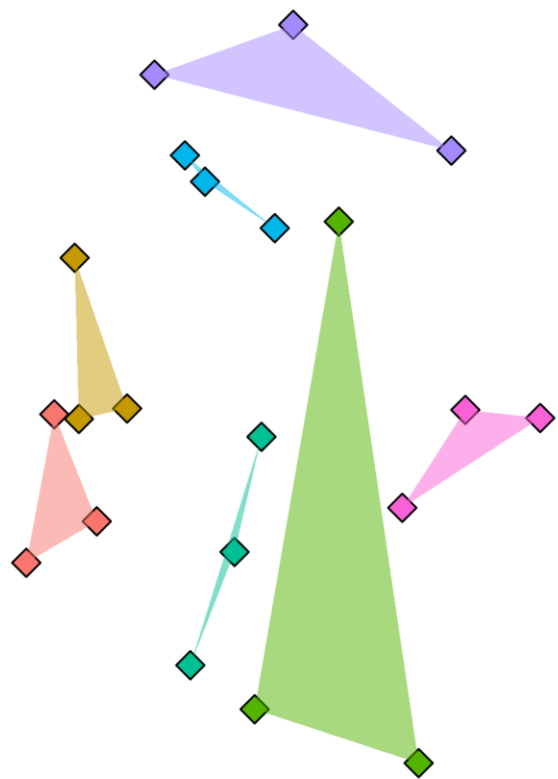


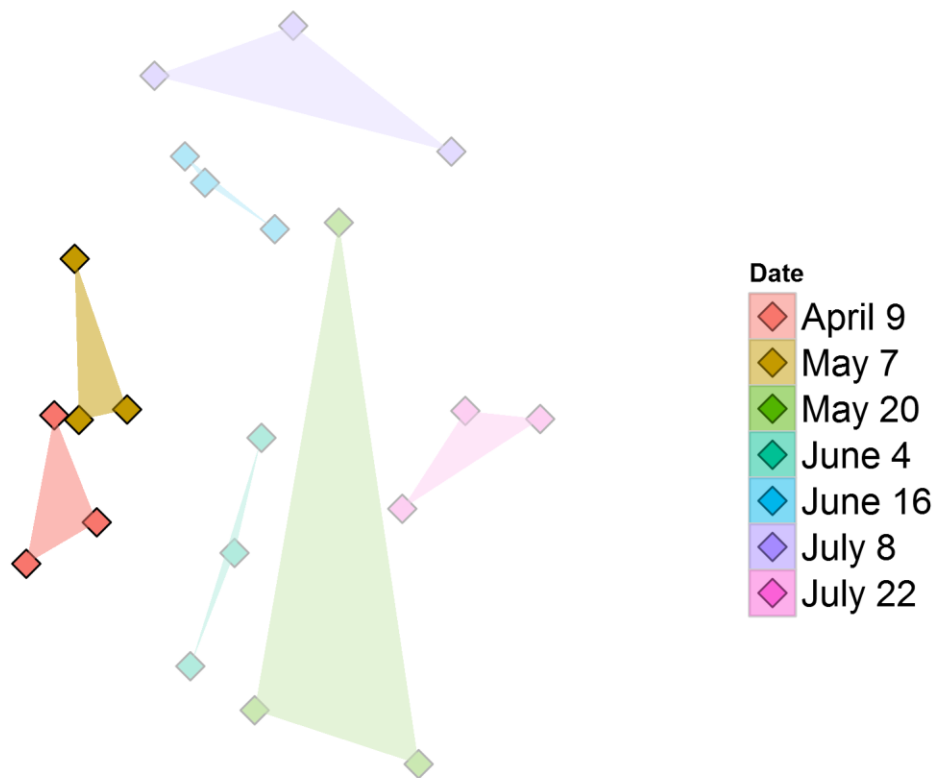


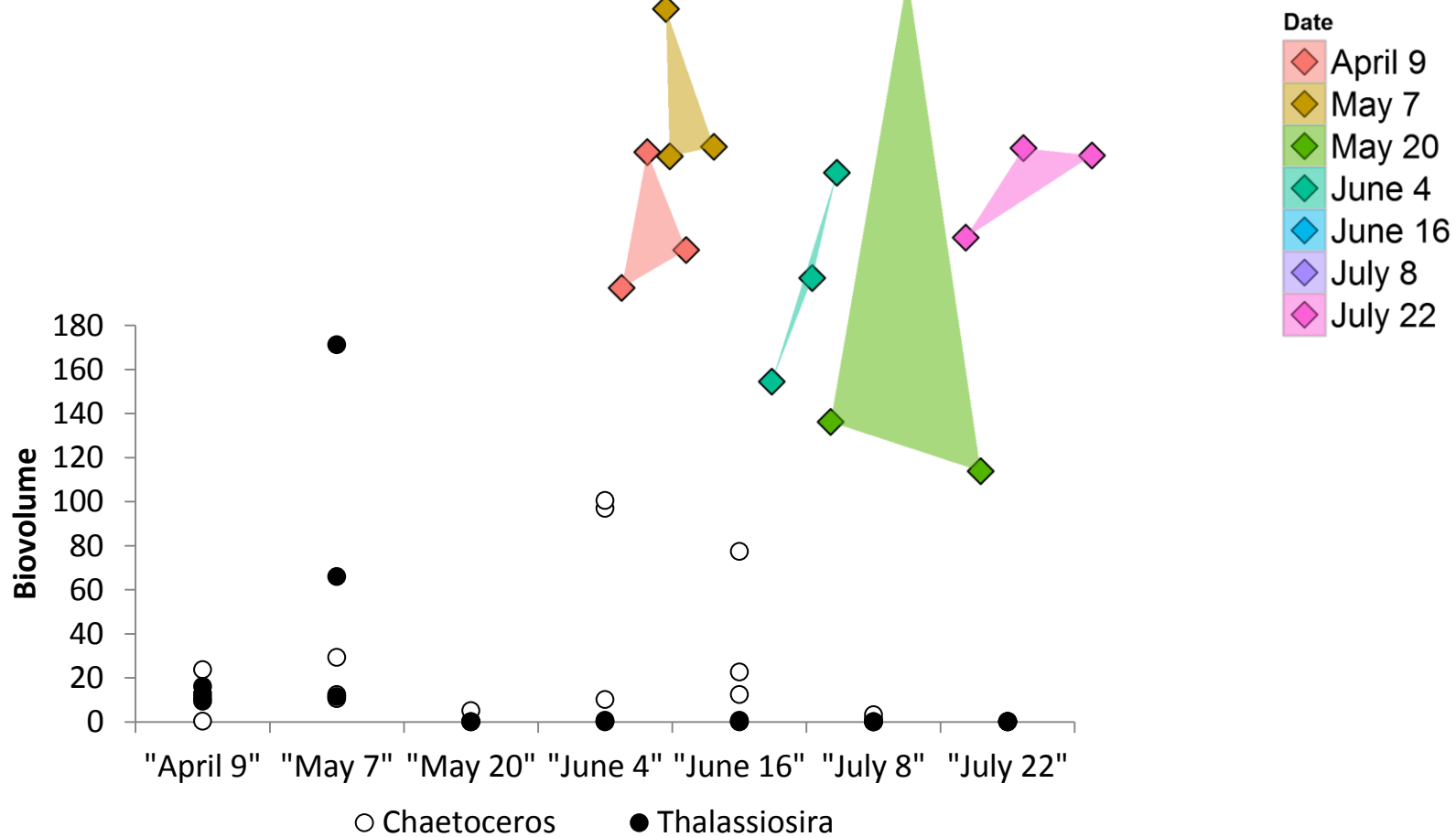
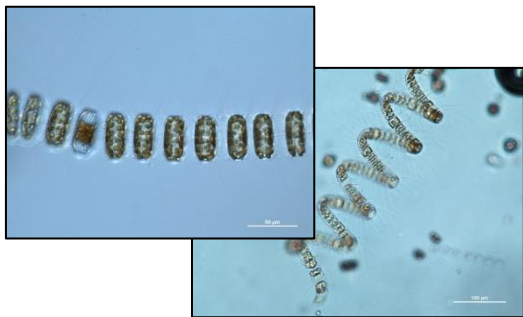


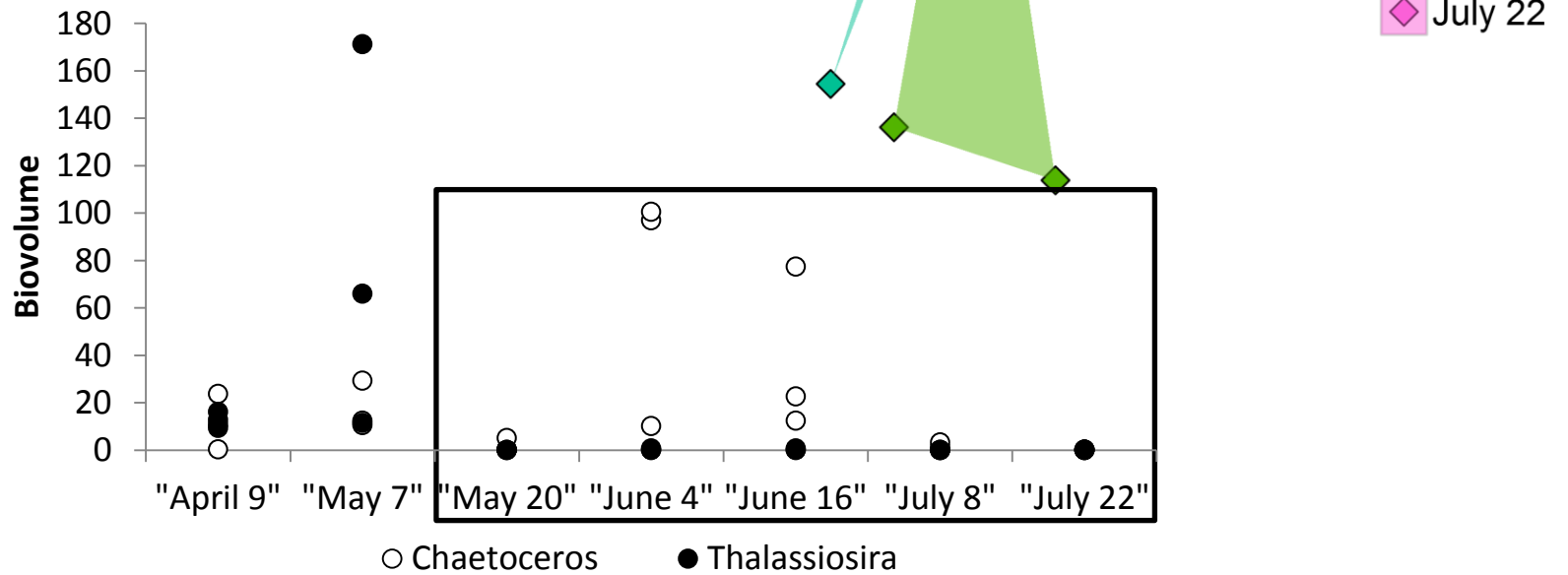
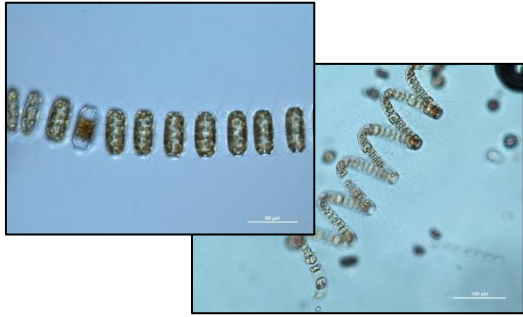


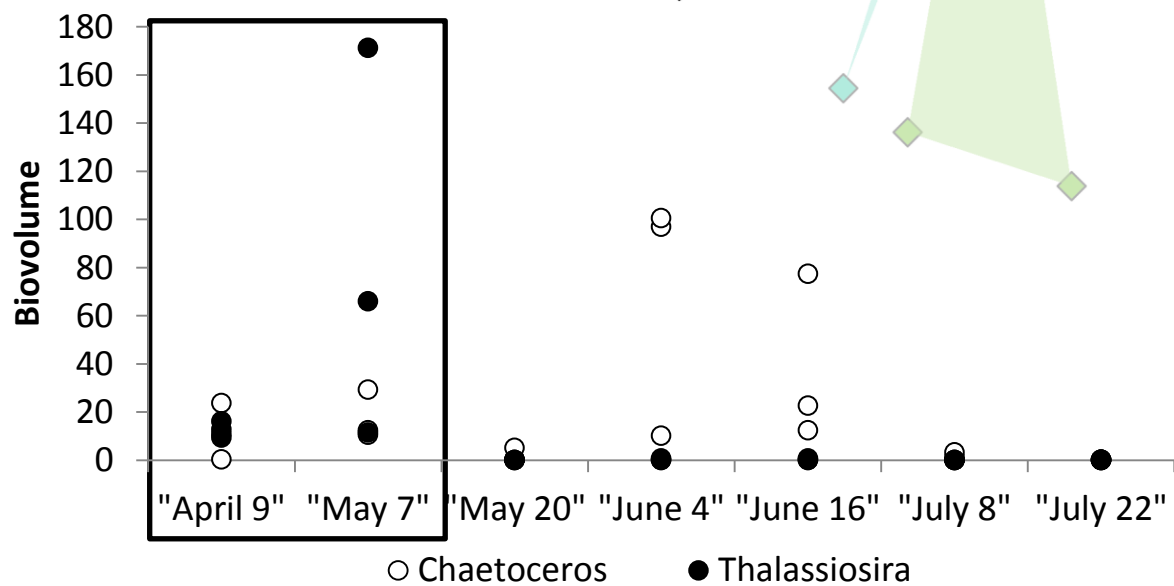
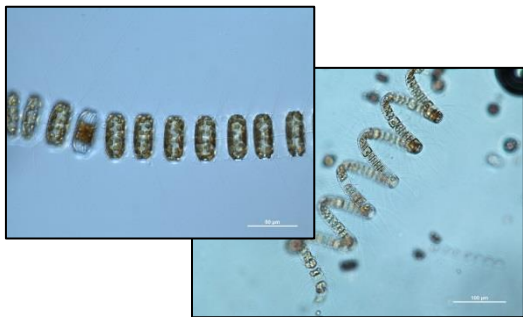
Date	
	April 9
	May 7
	May 20
	June 4
	June 16
	July 8
	July 22

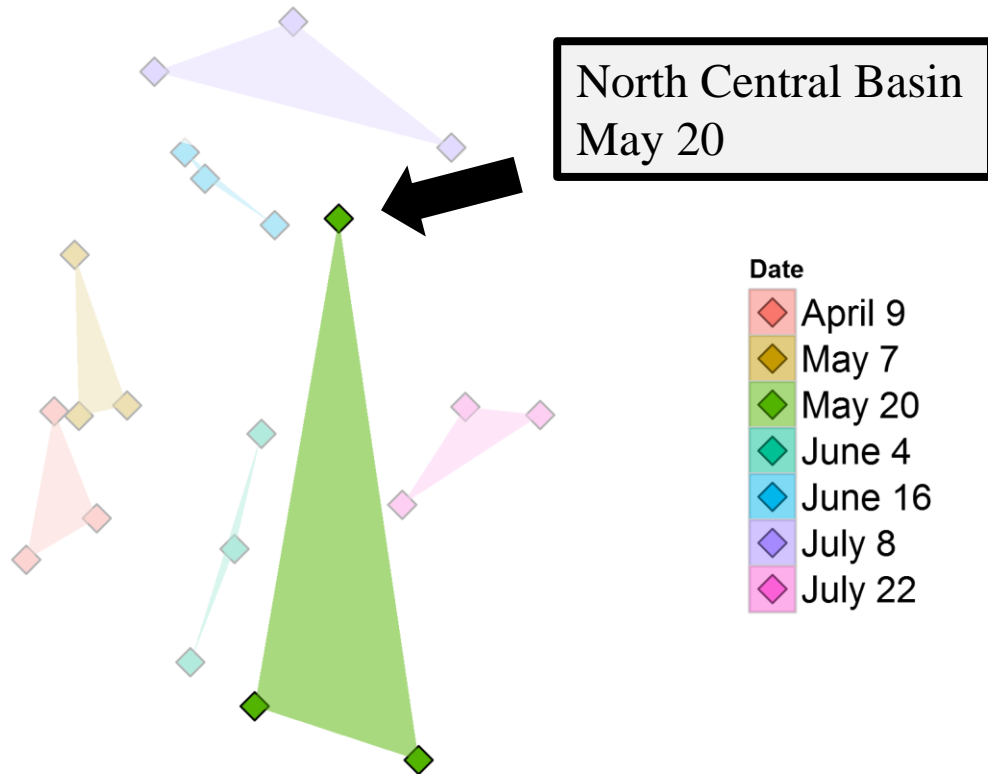






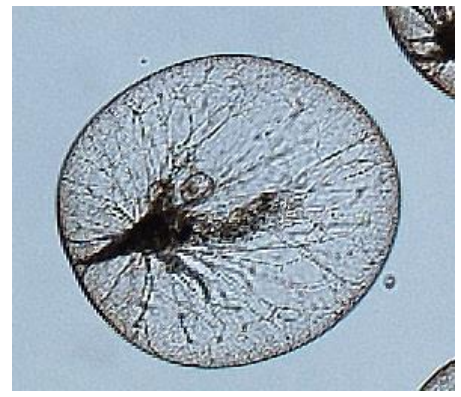
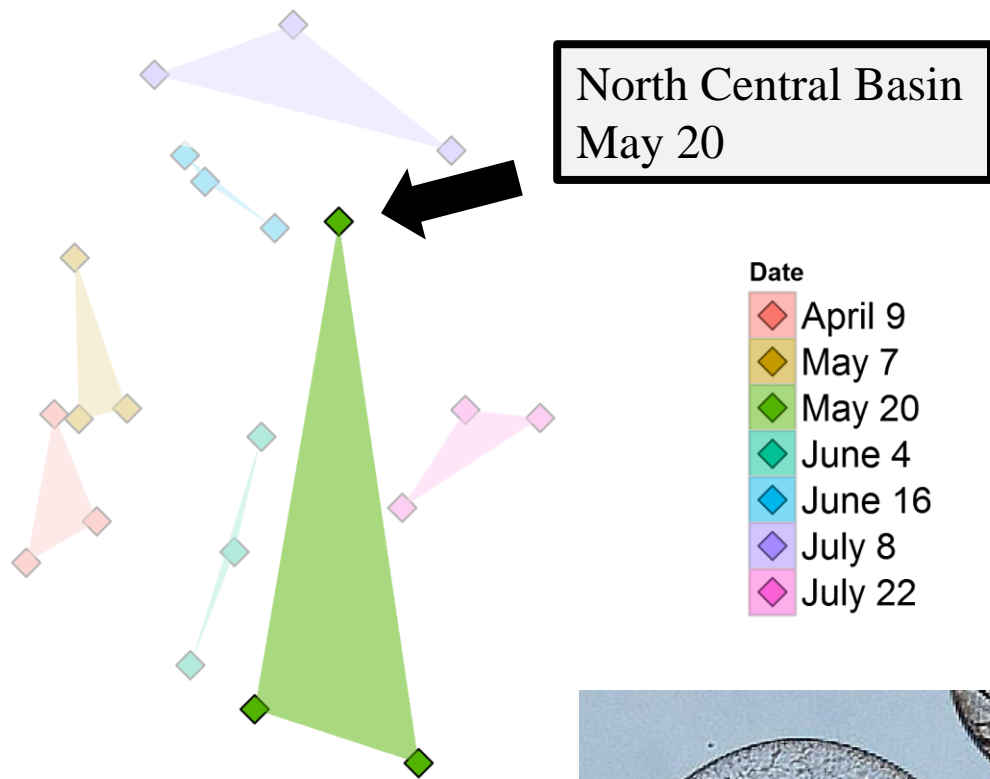






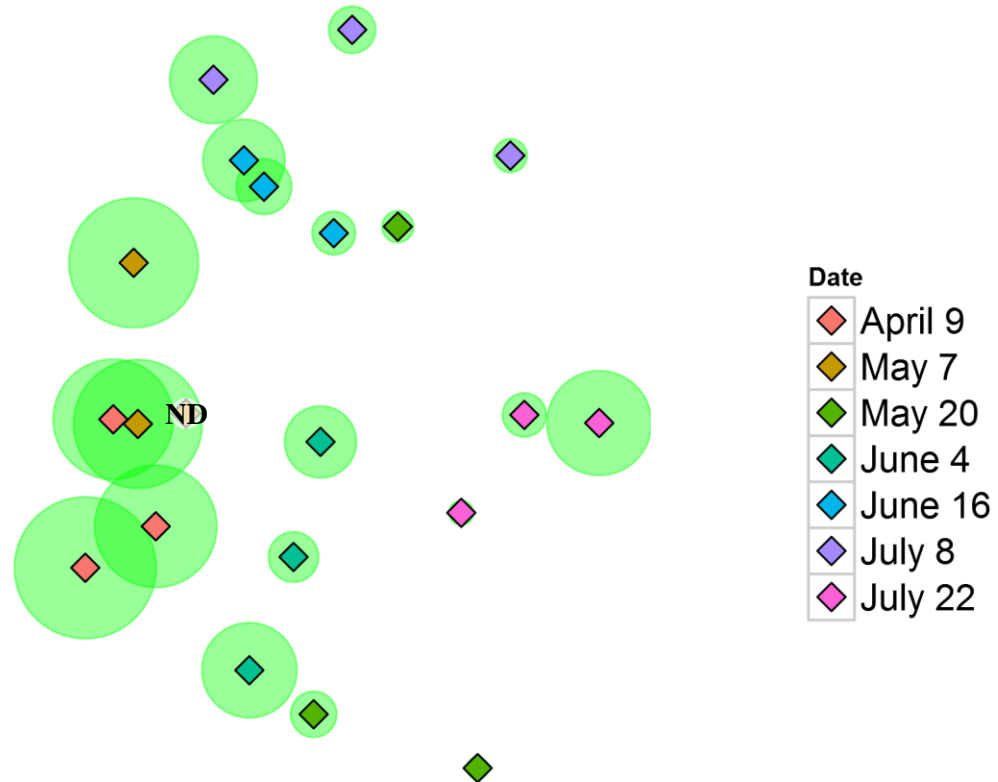
Noctiluca



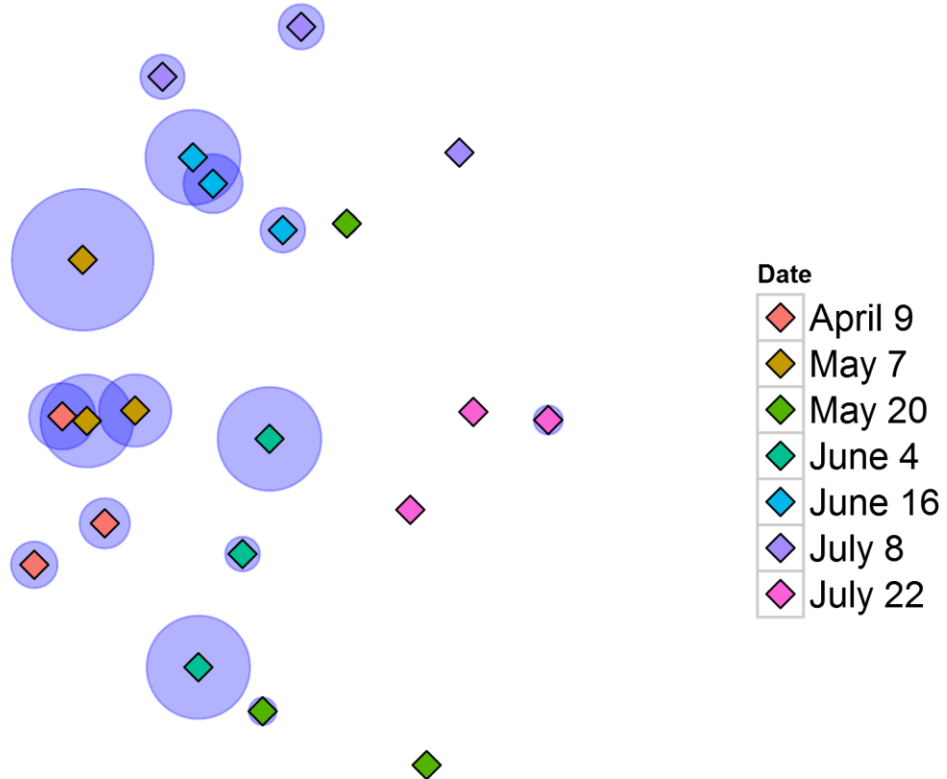


?

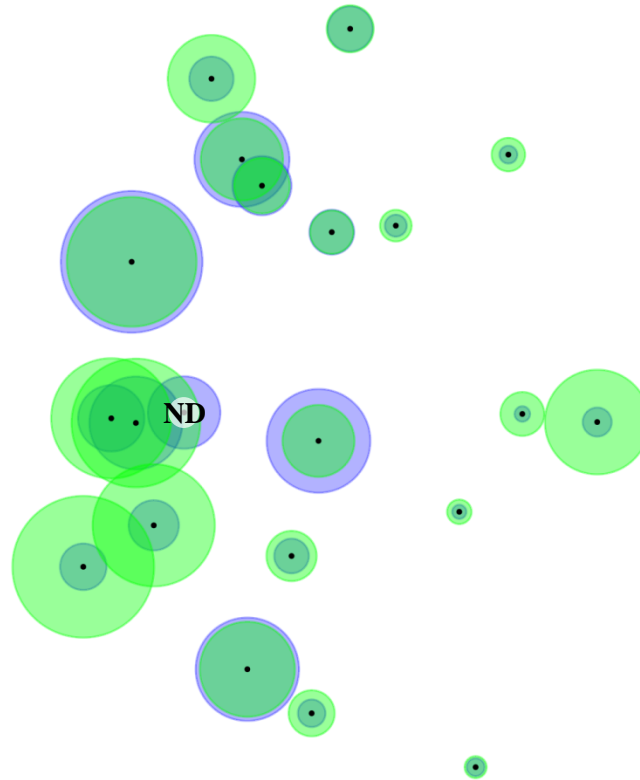
Total Extracted Chlorophyll

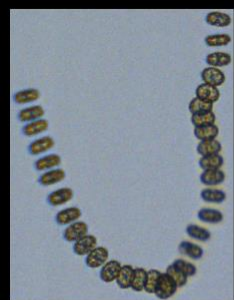


Total FlowCAM Biovolume ($\mu\text{m}^3/\text{L}$)



Biovolume vs. Chlorophyll





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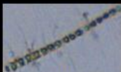
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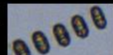
158



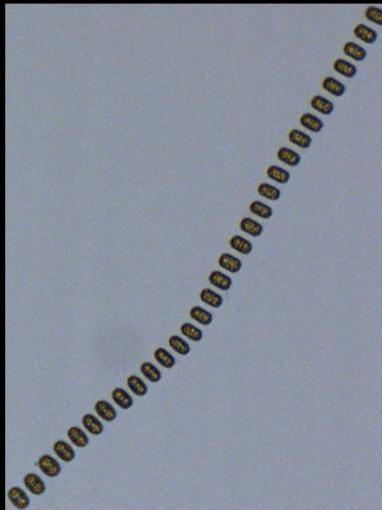
159



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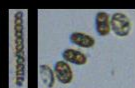
169



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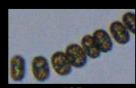
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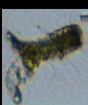
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137



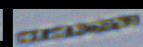
138



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142



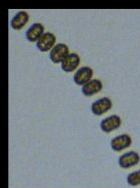
143



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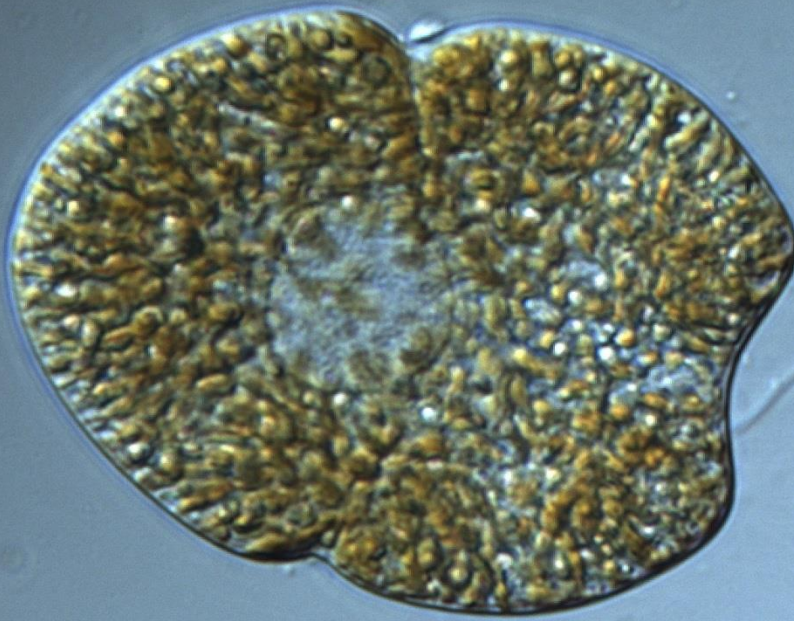


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Acknowledgements



KCEL Aquatic Toxicology:

- Gabriela Hannach
- Lyndsey Sandwick

Marine and Sediment Assessment:

- Kim Stark
- Wendy Eash-Loucks

KCEL Field Science Unit:

- Bob Kruger
- Jim Devereaux
- Stephanie Hess
- Christopher Barnes
- Marc Patten
- Jean Power

- Stress: 0.16
- \sqrt{y} transformed
- Bray-Curtis dissimilarity index
- Centered on mean of axes
- Rotated so variance maximized on 1st axis
- Scaled so one unit change = doubling of dissimilarity

