Going with the flow: assessing phytoplankton diversity with the FlowCAM

Amelia Kolb

Gabriela Hannach

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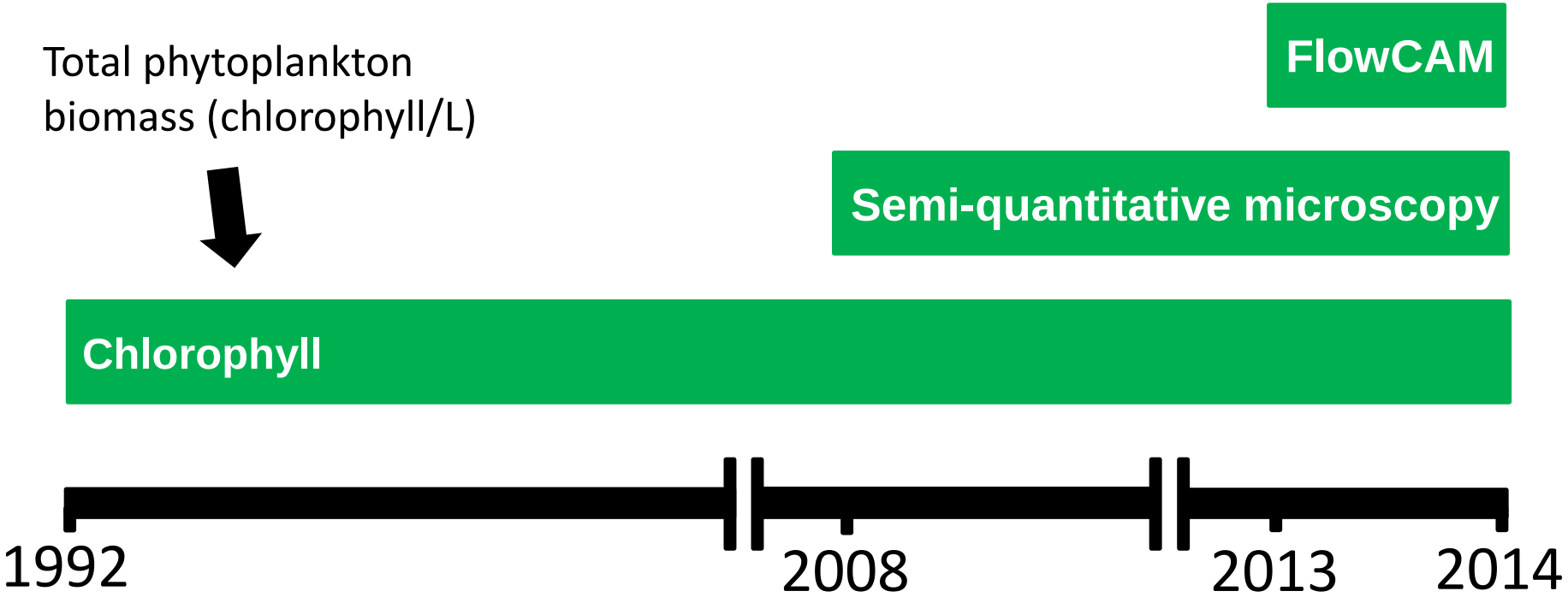
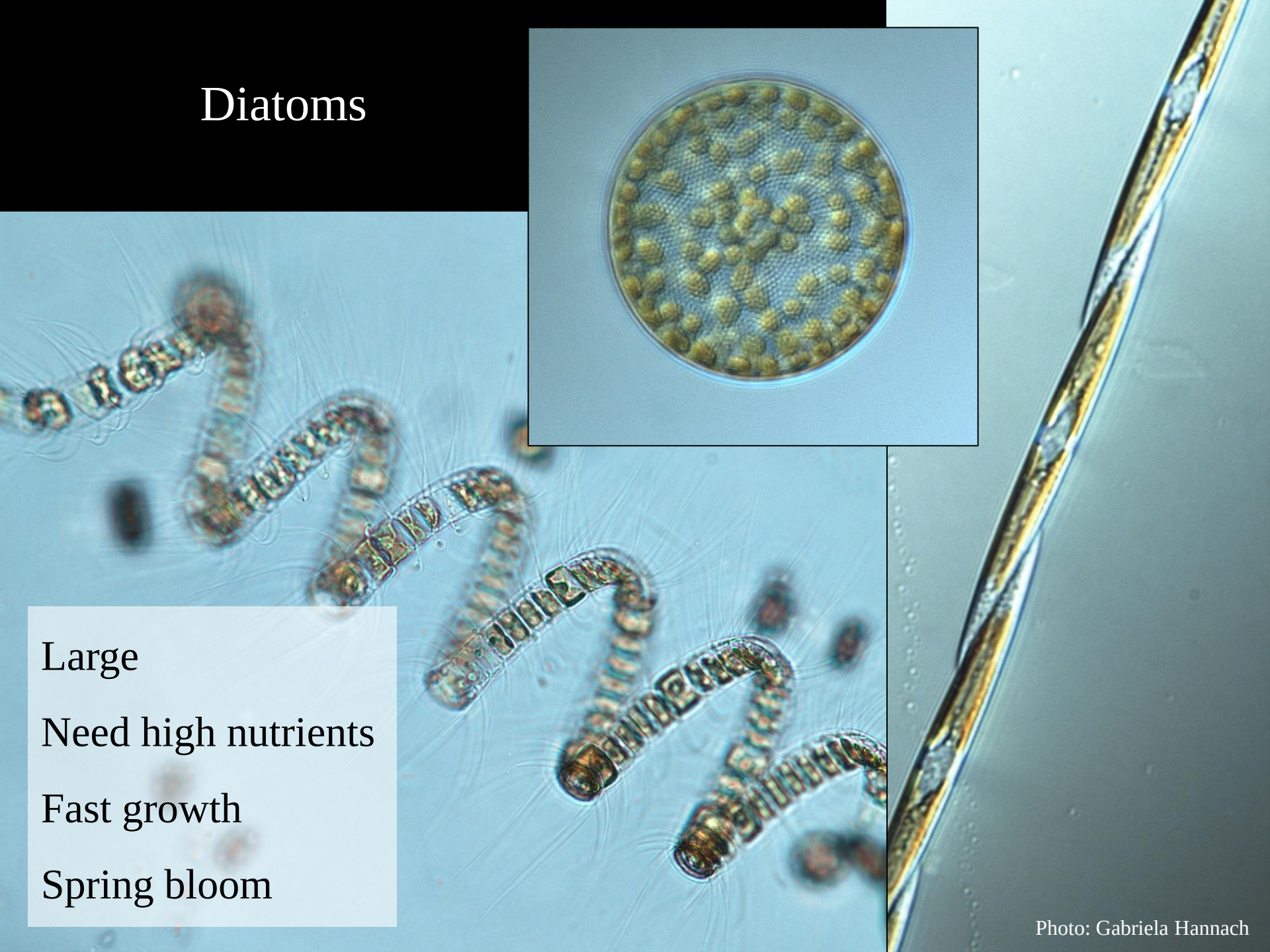
Photo: Gabriela Hannach

Photo: Gabriela Hannach


Total phytoplankton biomass (chlorophyll/L)
FlowCAM
Semi-quantitative microscopy
Chlorophyll
1992
2008
2013
2014

Diatoms



Large

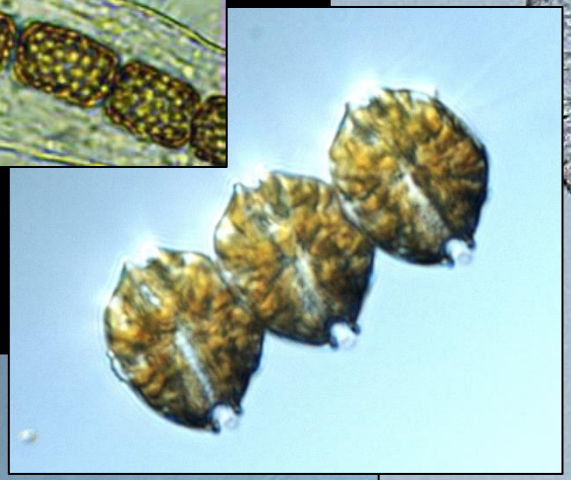
Need high nutrients

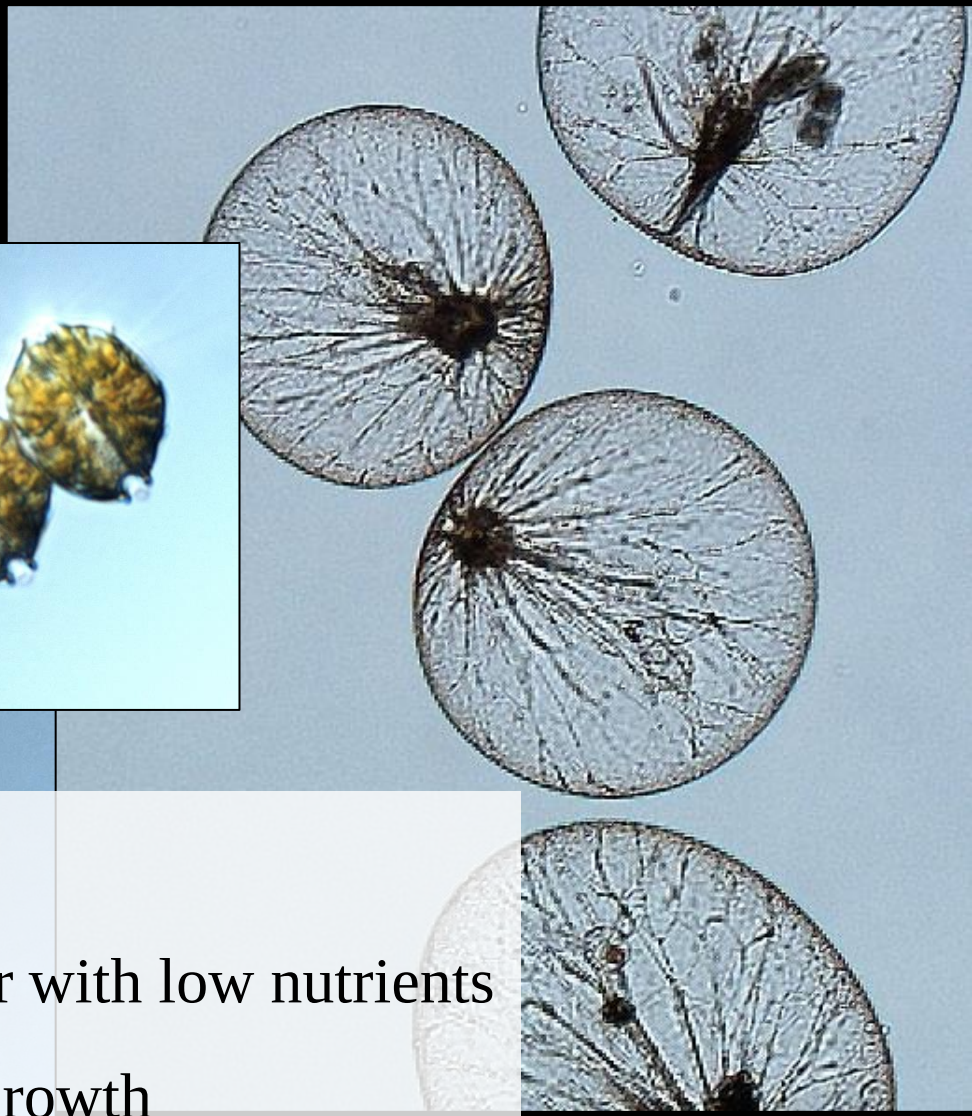
Fast growth

Spring bloom

Photo: Gabriela Hannach

Dinoflagellates





Smaller

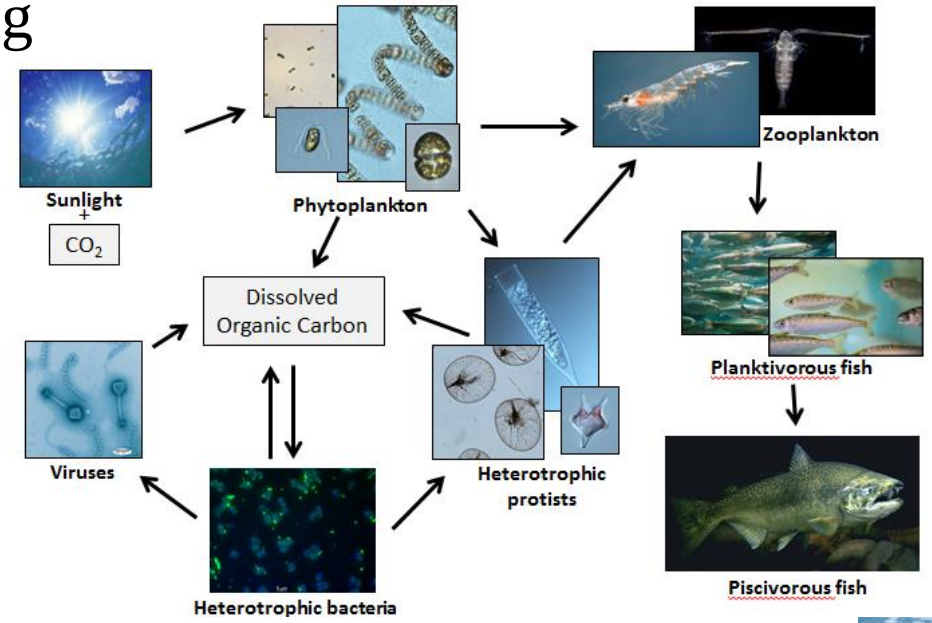
Do better with low nutrients

Slower growth

Photo: Gabriela Hannach

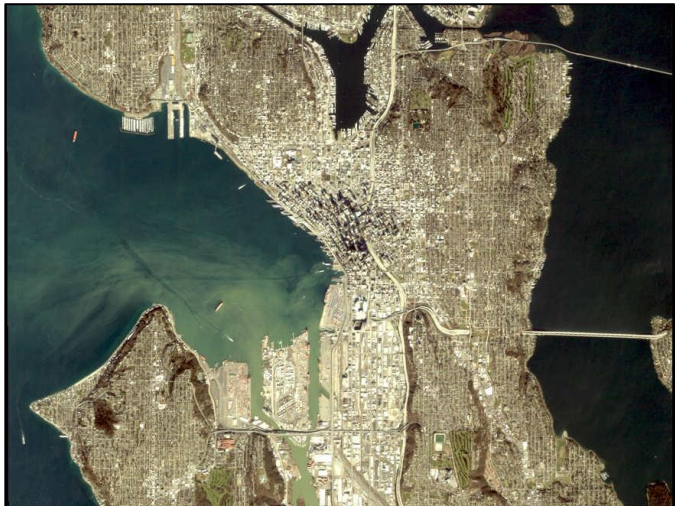
Knowledge of phytoplankton community composition…

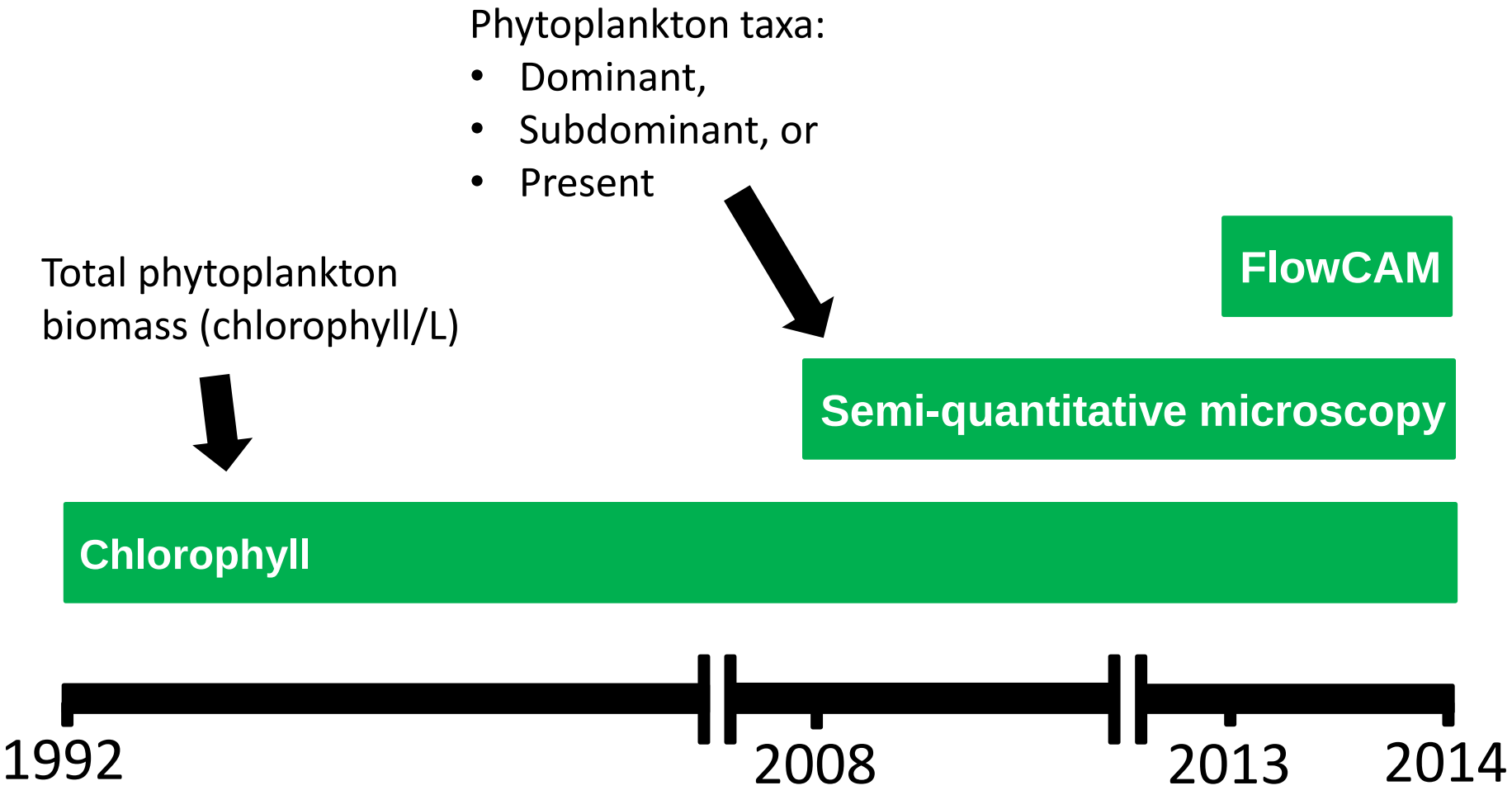
1. Improves understanding of marine food web

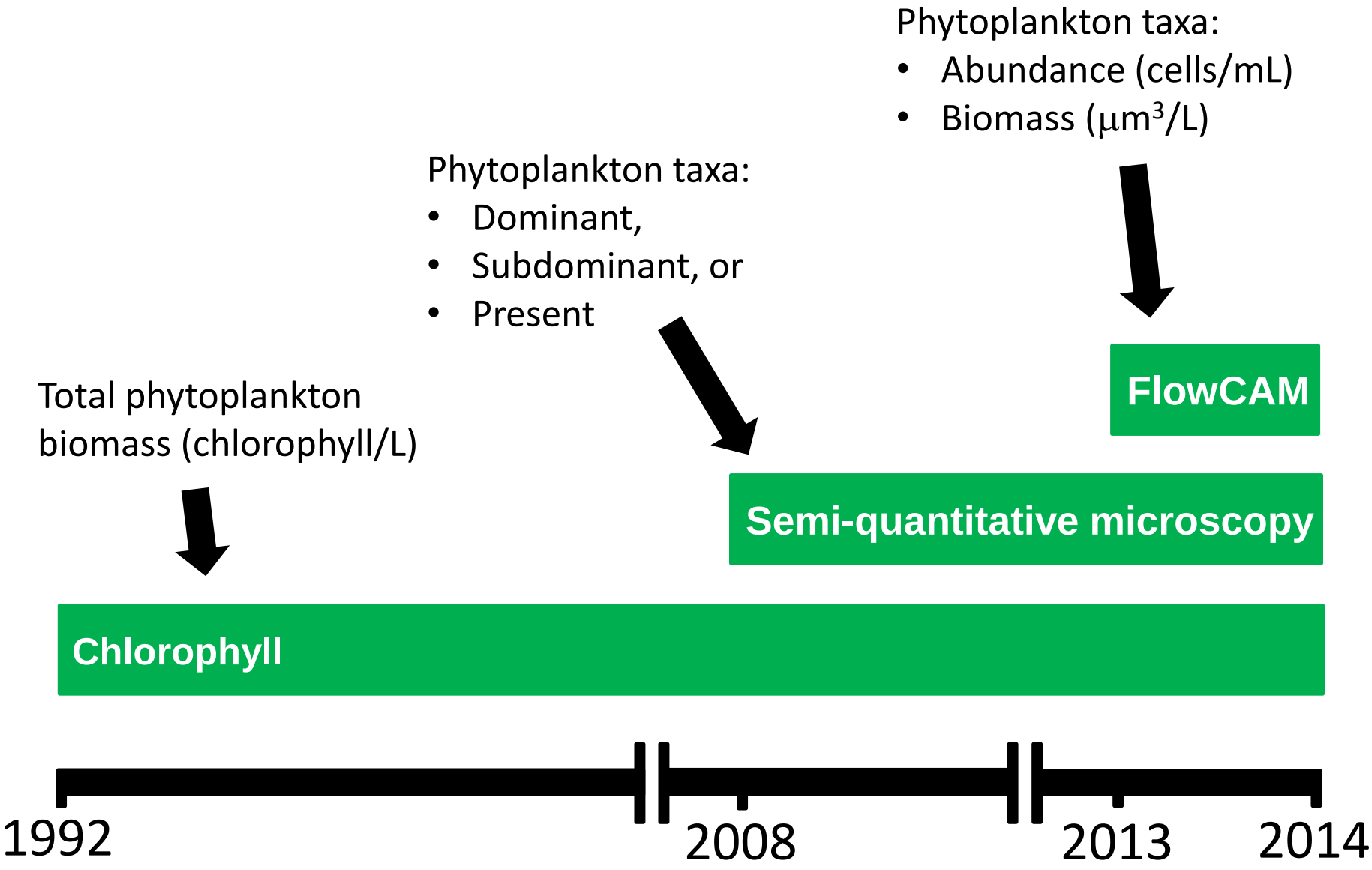


Piscivorous charismatic megafauna

2. Improves assessment of human impacts

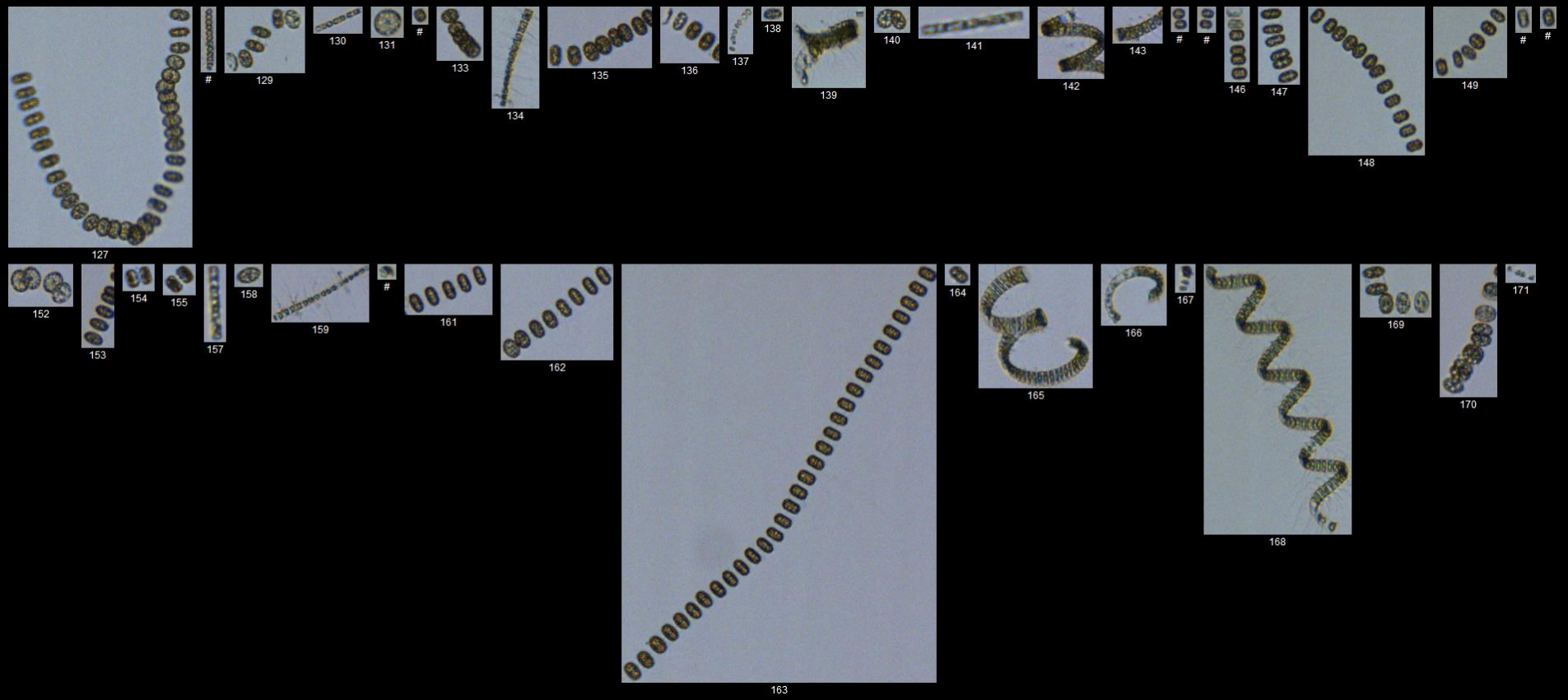



Phytoplankton taxa:
• Dominant,
• Subdominant, or
• Present
Total phytoplankton biomass (chlorophyll/L)
FlowCAM
Semi-quantitative microscopy
Chlorophyll
1992
2008
2013
2014


Phytoplankton taxa:
• Abundance (cells/mL)
• Biomass (μm³/L)
Phytoplankton taxa:
• Dominant,
• Subdominant, or
• Present
Total phytoplankton biomass (chlorophyll/L)
FlowCAM
Semi-quantitative microscopy
Chlorophyll
1992
2008
2013
2014

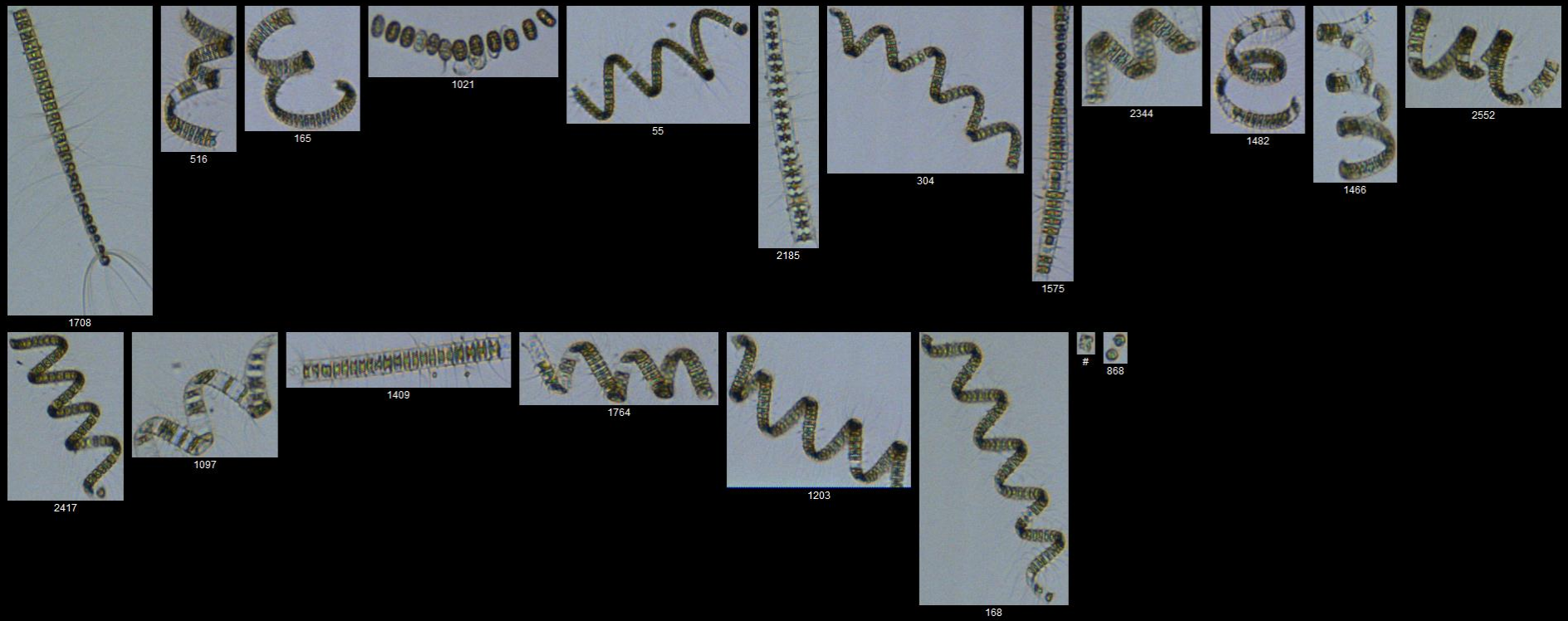
FlowCAM®
USB
Fluid Imaging Technologies
Yarmouth, ME USA
(207) 846-6100
www.fluidimaging.com
New 4x settings
15 mL/min
15 fps
Brightness = 50
recalibration = 2min
SW
DELL

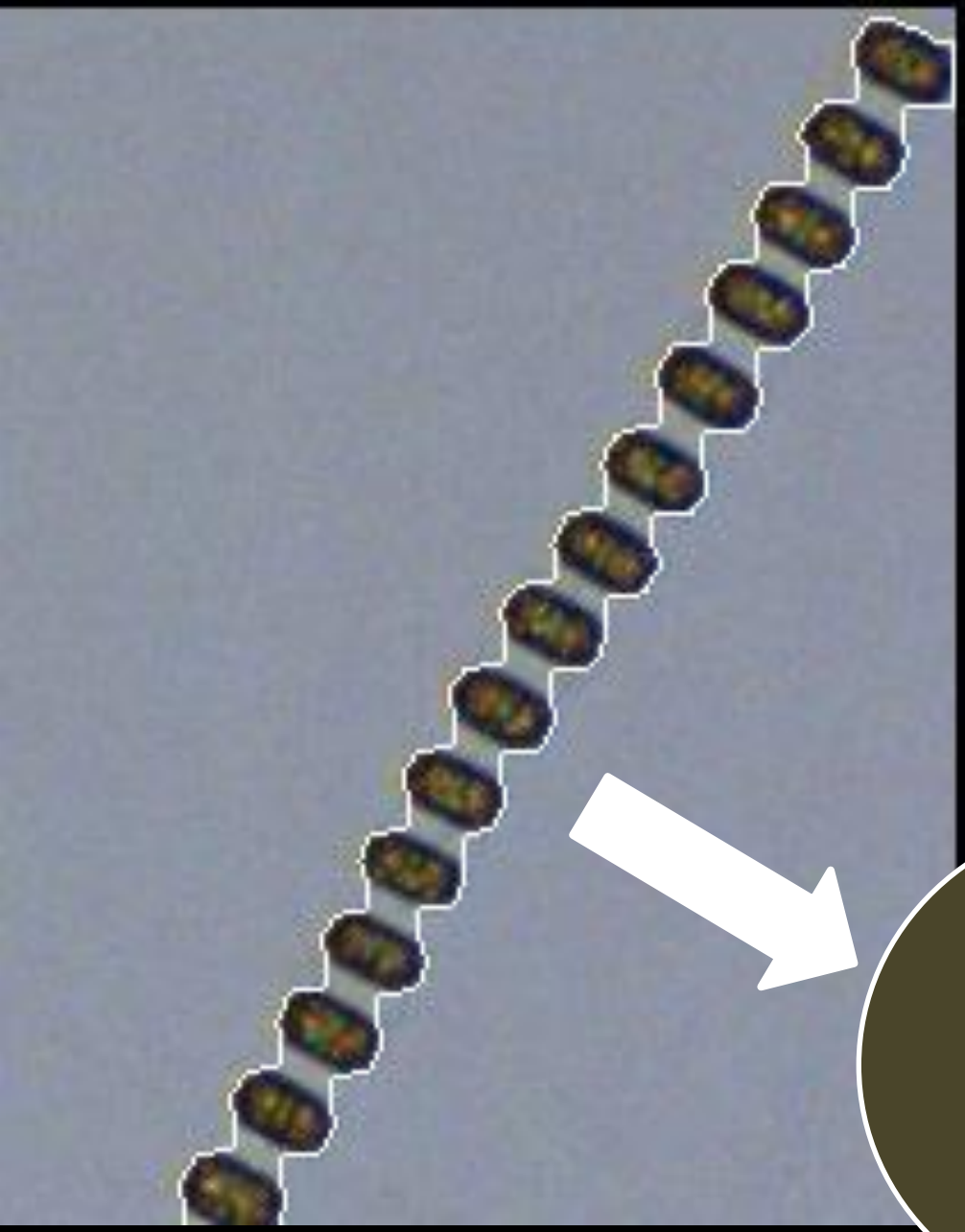
3 of 52 Z+ Z- Z1 Show Selected



9 of 9 | Z+ | Z- | Z1 | Show Selected

misc 10-25 um | Thalassiosira | Chaetoceros | misc diatoms | Pseudo-nitzschia | Skeletonema | Guinardia et al | Thalassionema | Ditylum | Protoperidiniumn

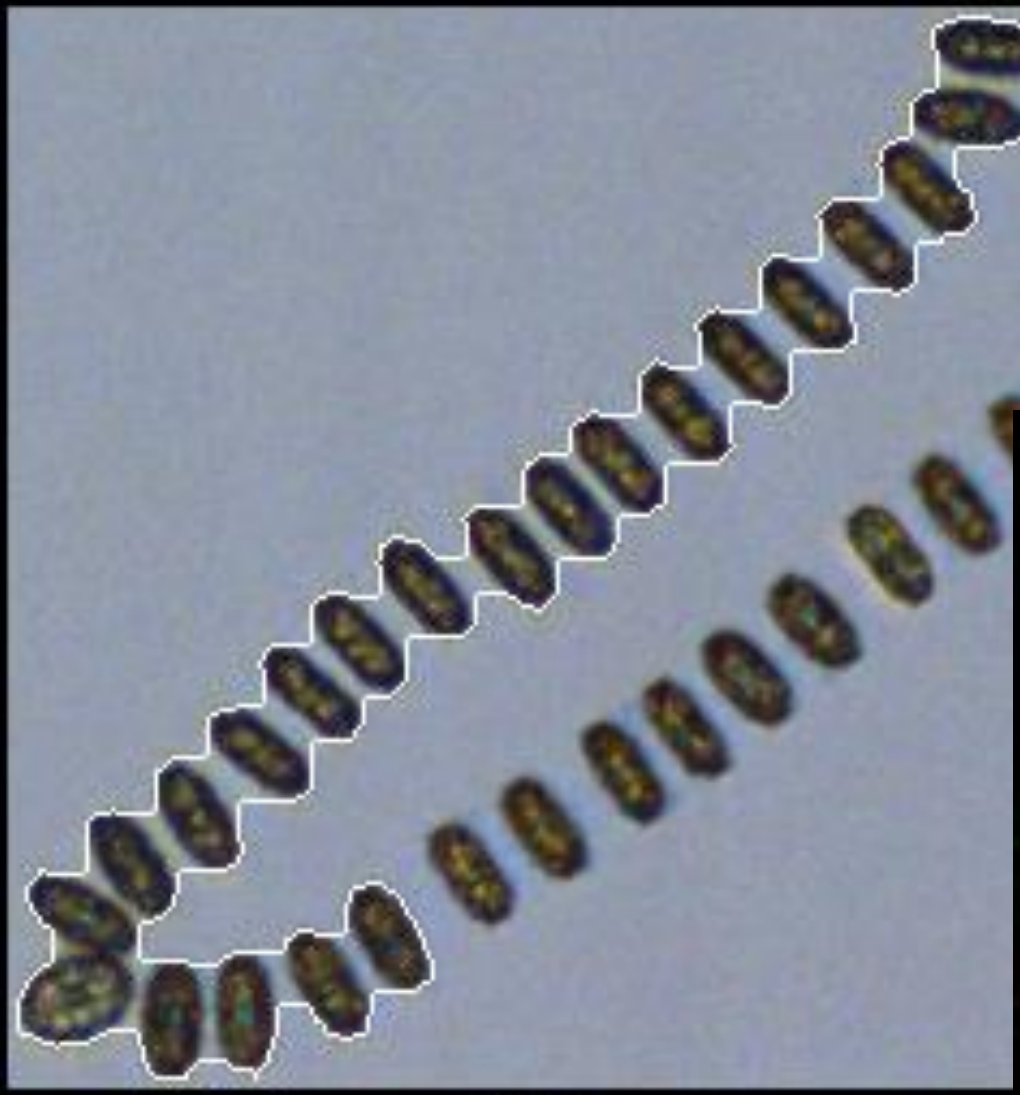




164

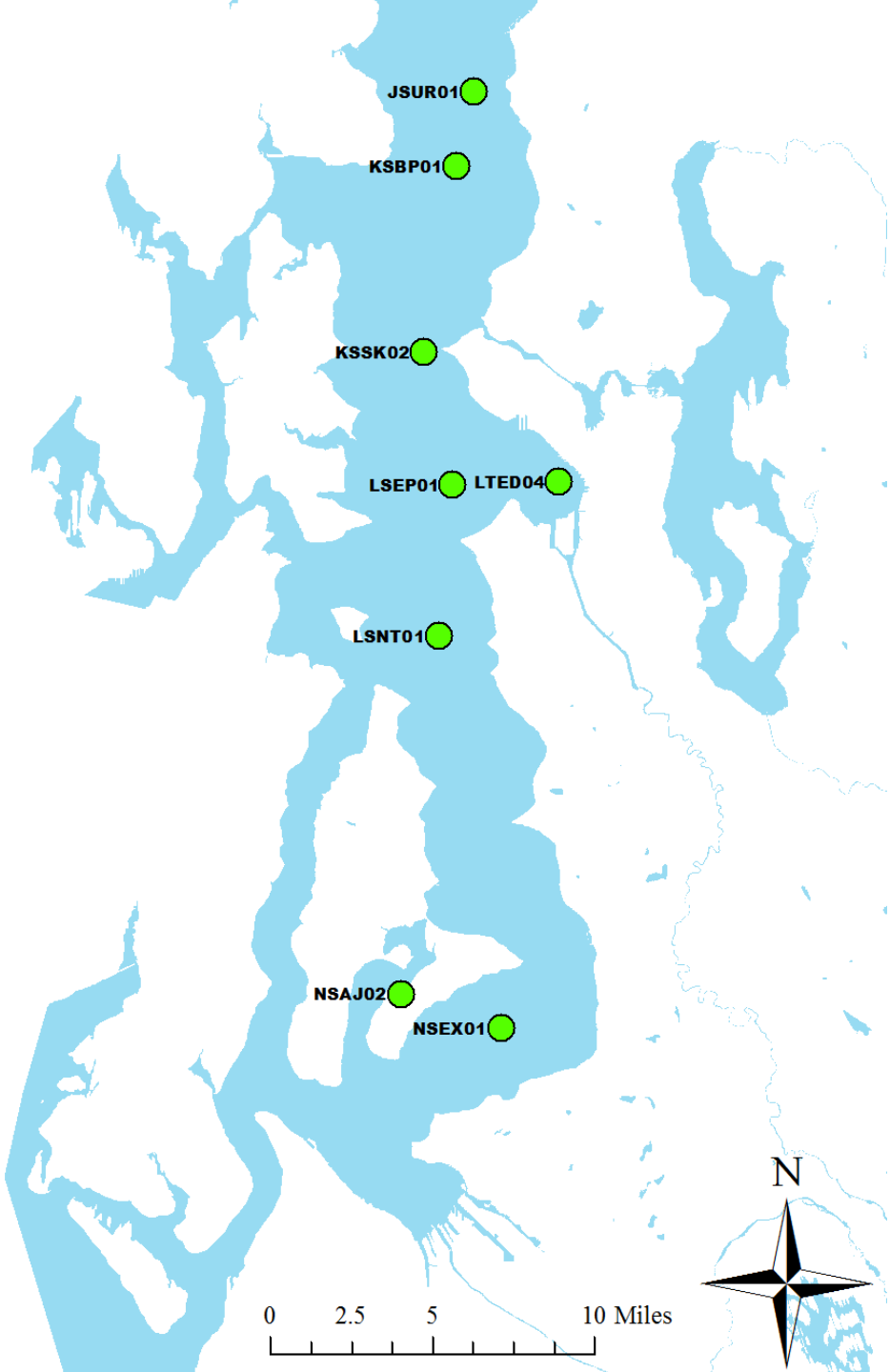
165

Biovolume
≈ Biomass



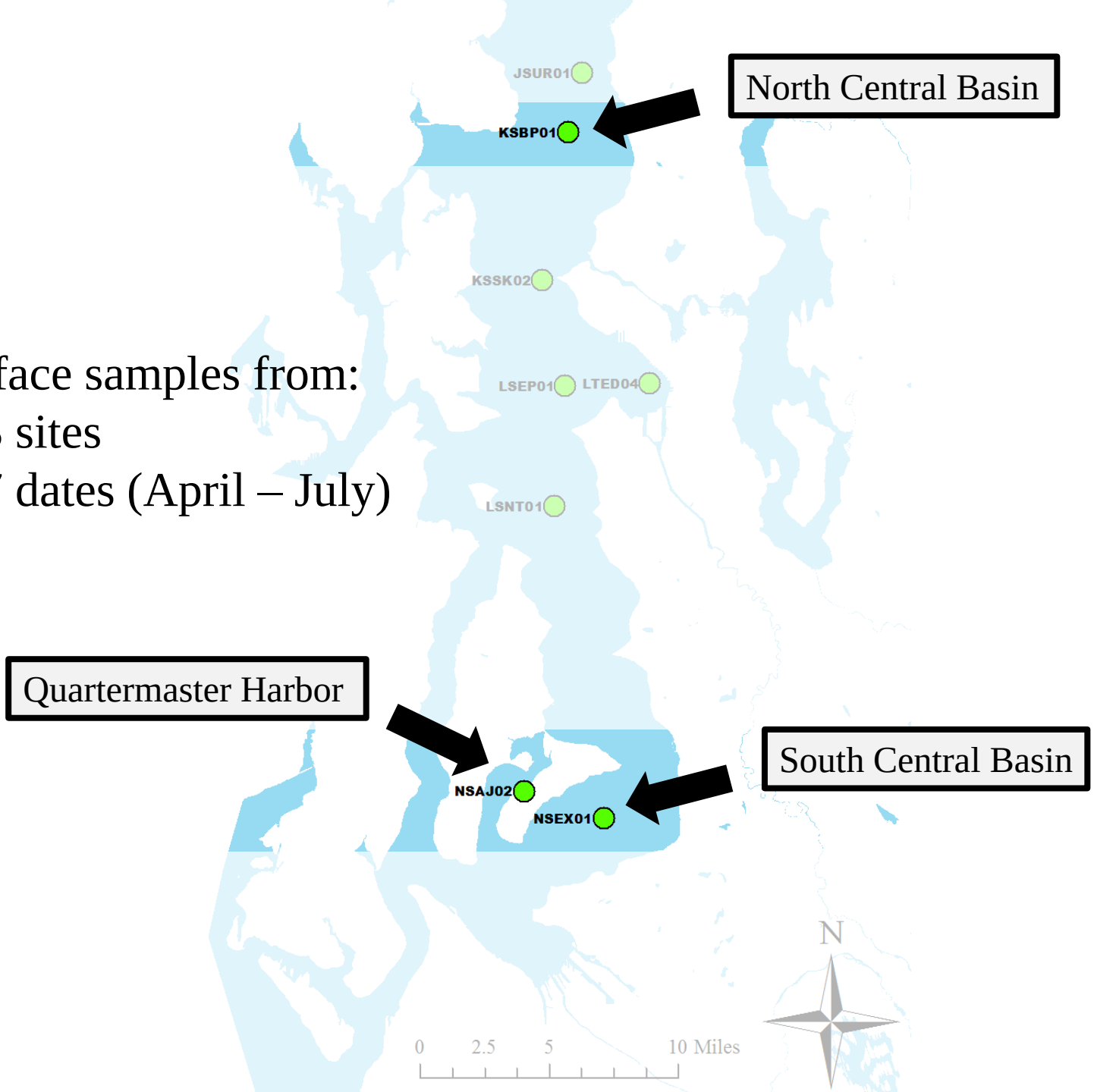
649

	Chaetoceros	*Alexandrium*	Misc. small dinoflagellate	etc (up to 57 more) →
Abundance (cells/ml)	124	2	20	…
Biovolume ($\mu m^3/L$)	10.8	0.0048	0.0315	…


JSUR01
KSBP01
KSSK02
LSEP01
LTED04
LSNT01
NSAJ02
NSEX01
N
0
2.5
5
10 Miles

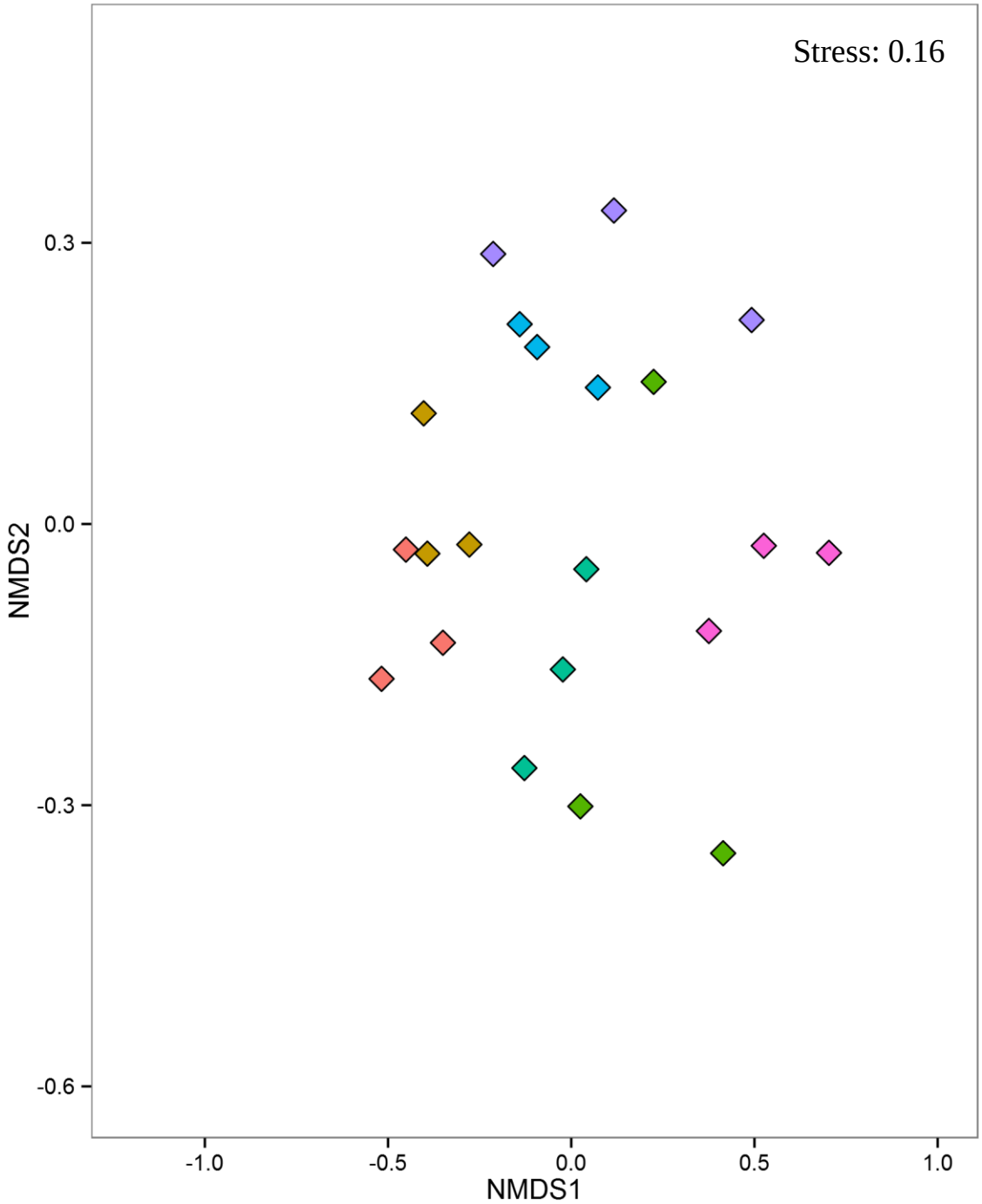
Surface samples from:

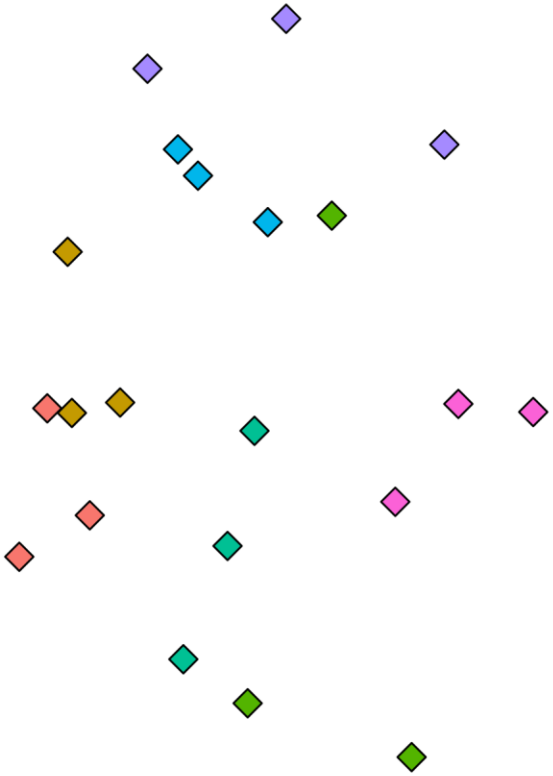
- 3 sites
- 7 dates (April – July)

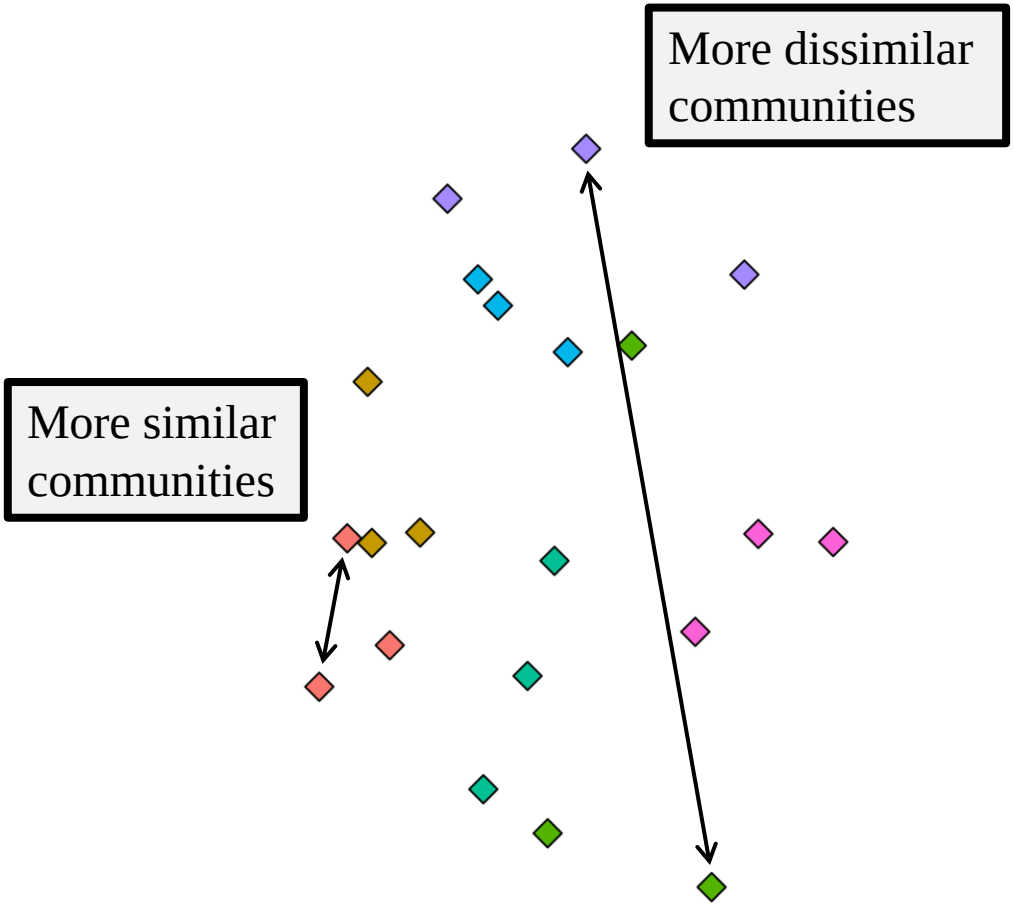


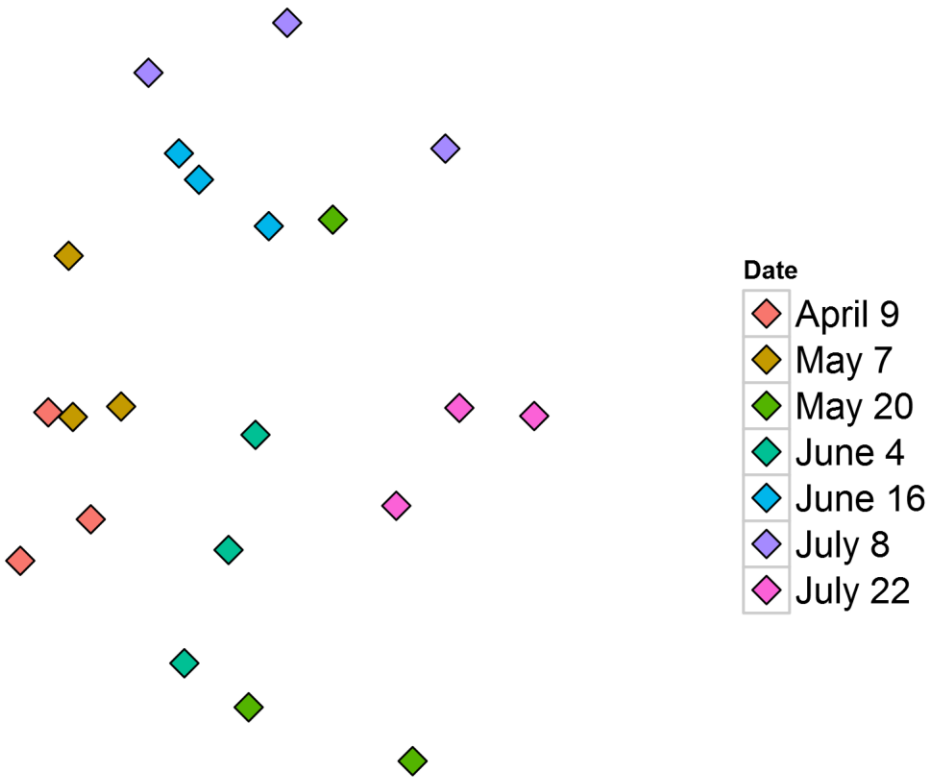
Non-metric multidimensional scaling (NMDS):

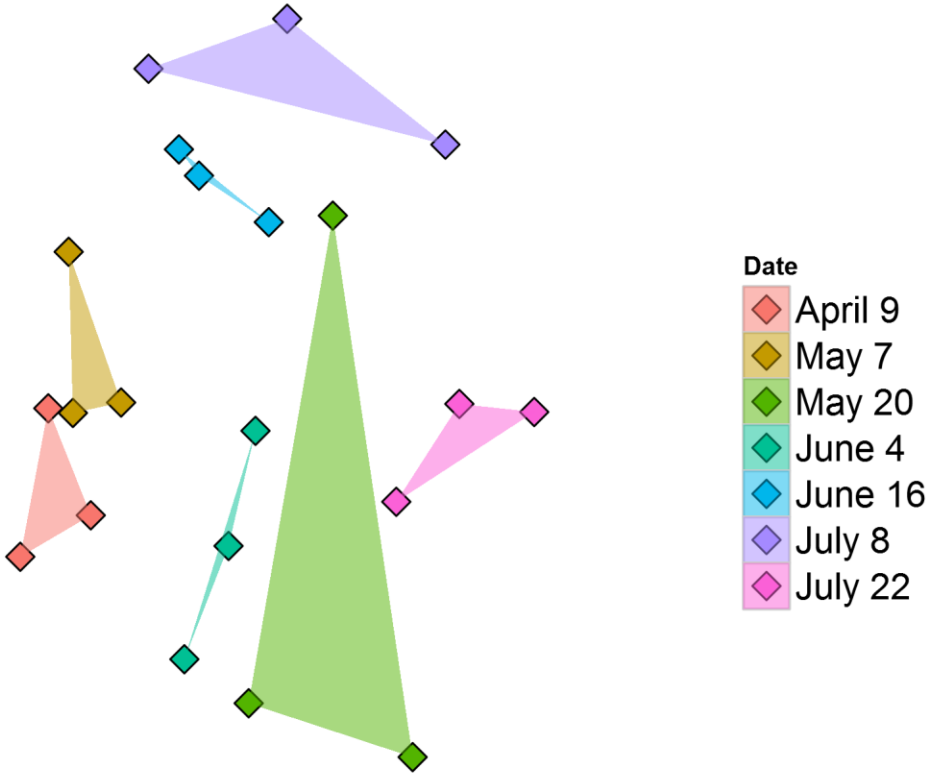
Creates a map of dissimilarity in taxonomic composition


Stress: 0.16
0.3
0.0
-0.3
-0.6
NMDS2
-1.0
-0.5
0.0
0.5
1.0
NMDS1




More dissimilar communities
More similar communities


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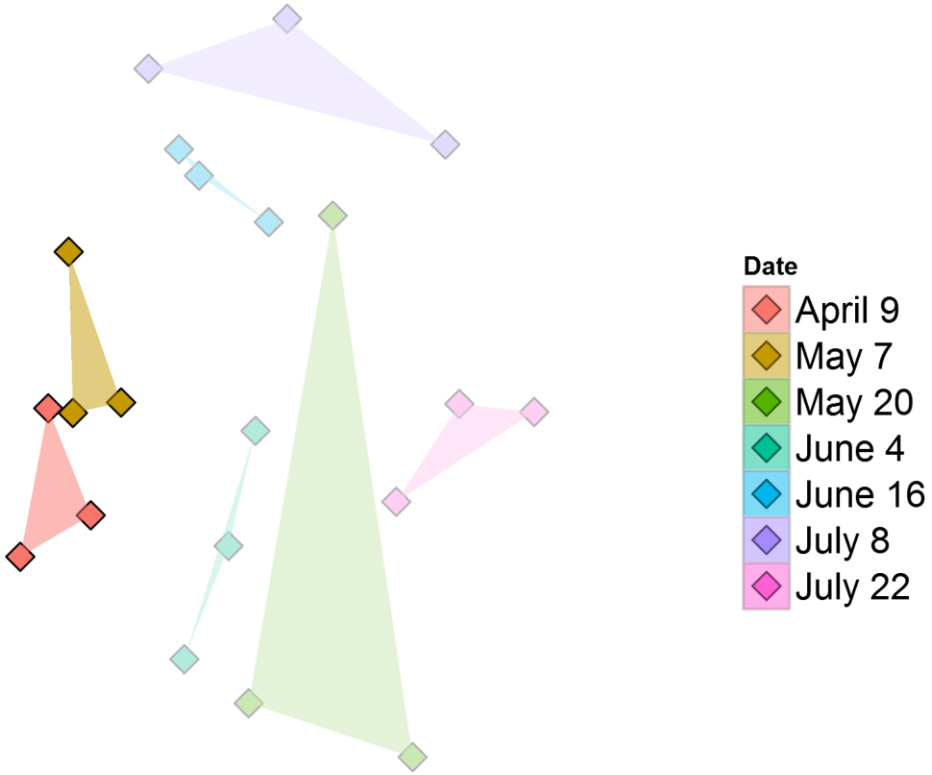
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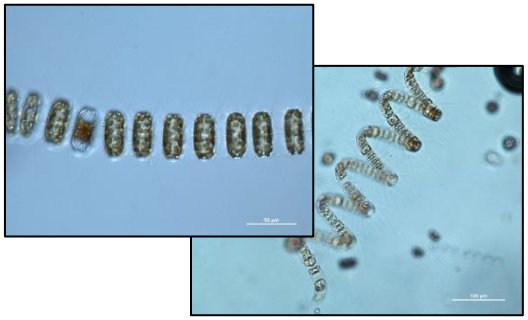
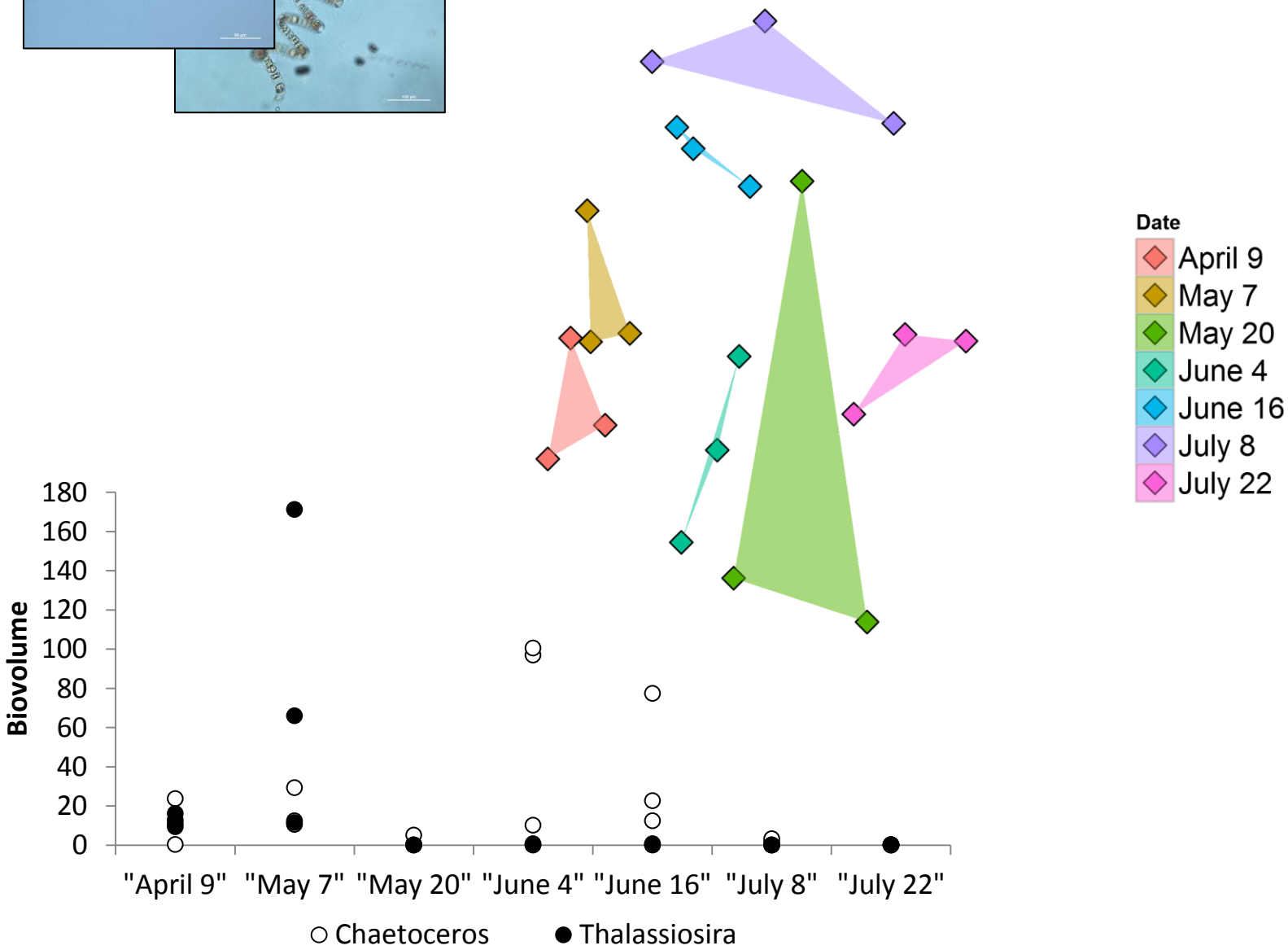
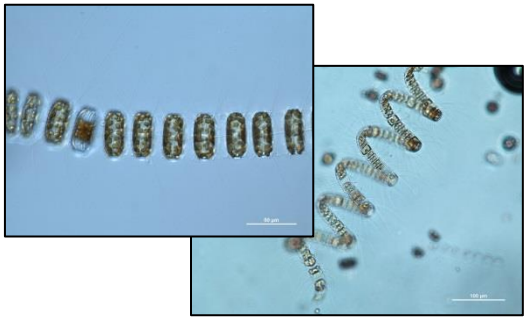
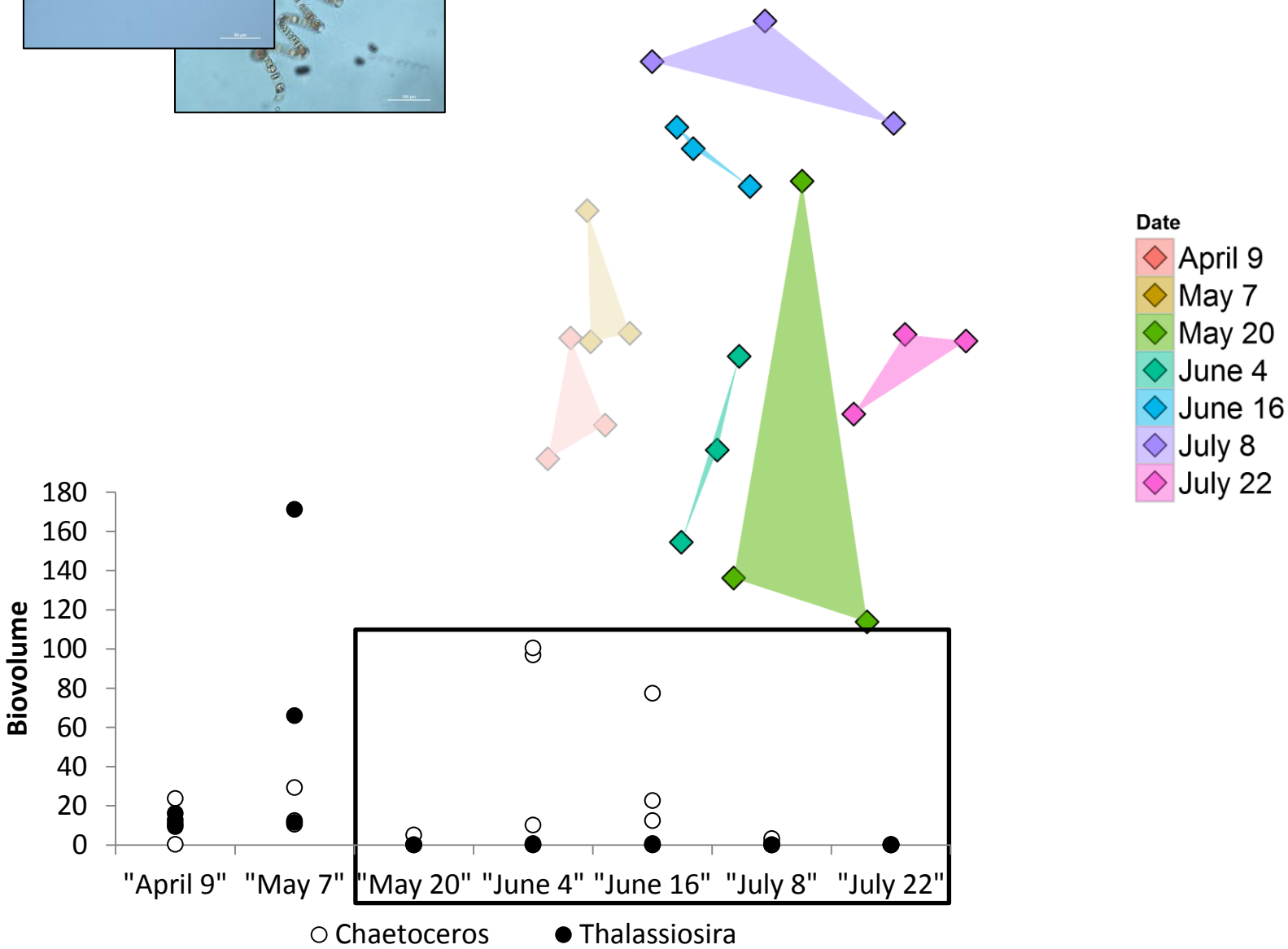



Date
April 9
May 7
May 20
June 4
June 16
July 8
July 22
Biovolume
180
160
140
120
100
80
60
40
20
0
"April 9"
"May 7"
"May 20"
"June 4"
"June 16"
"July 8"
"July 22"
Chaetoceros
Thalassiosira

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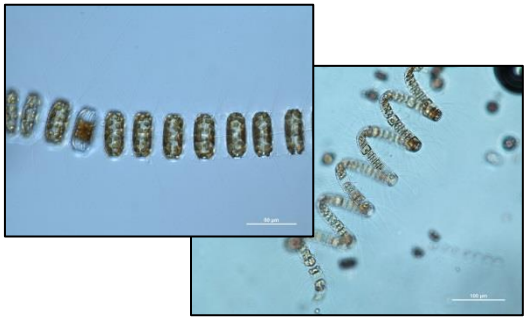

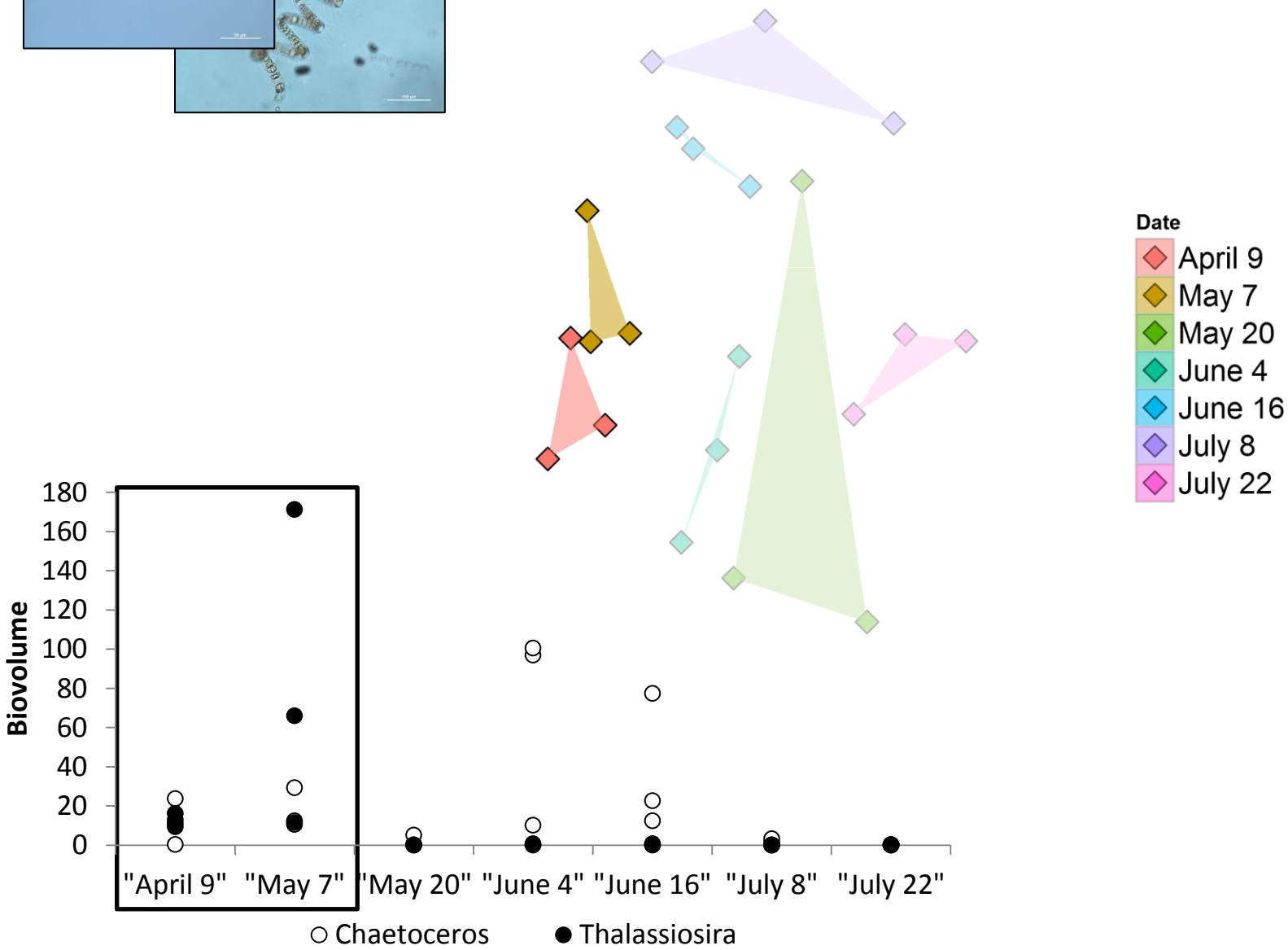
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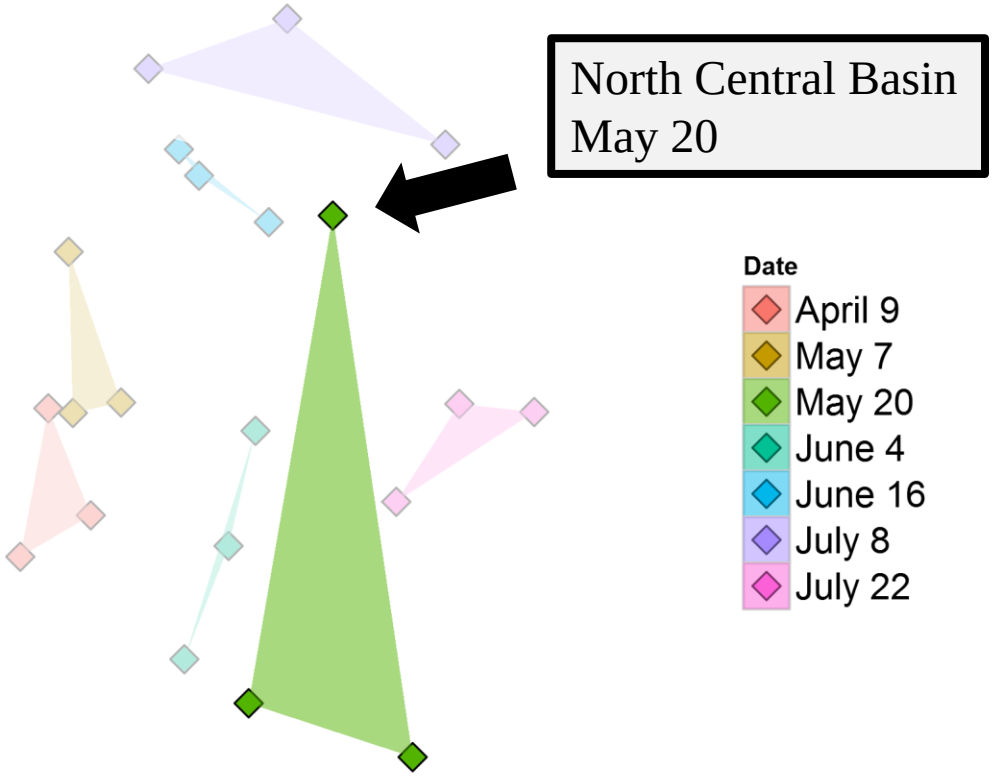
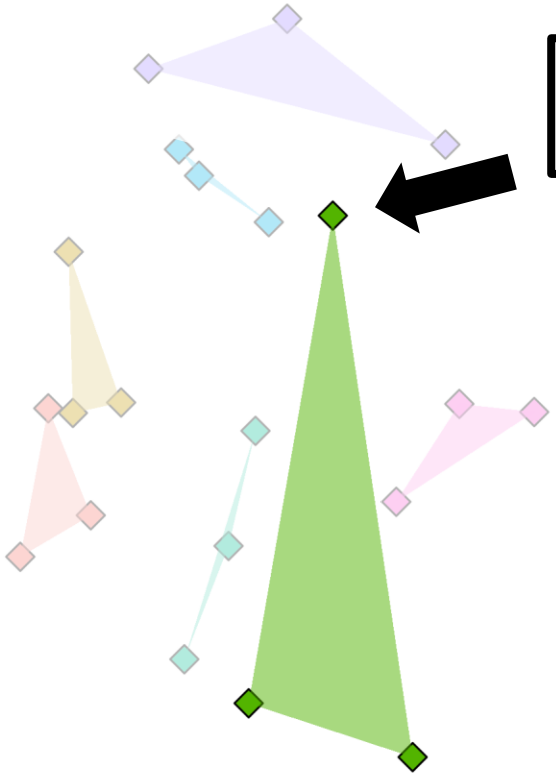
"July 22"
Chaetoceros
Thalassiosira

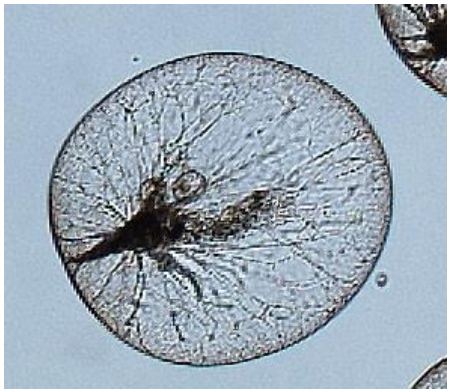

North Central Basin
May 20
Date
April 9
May 7
May 20
June 4
June 16
July 8
July 22

Noctiluca



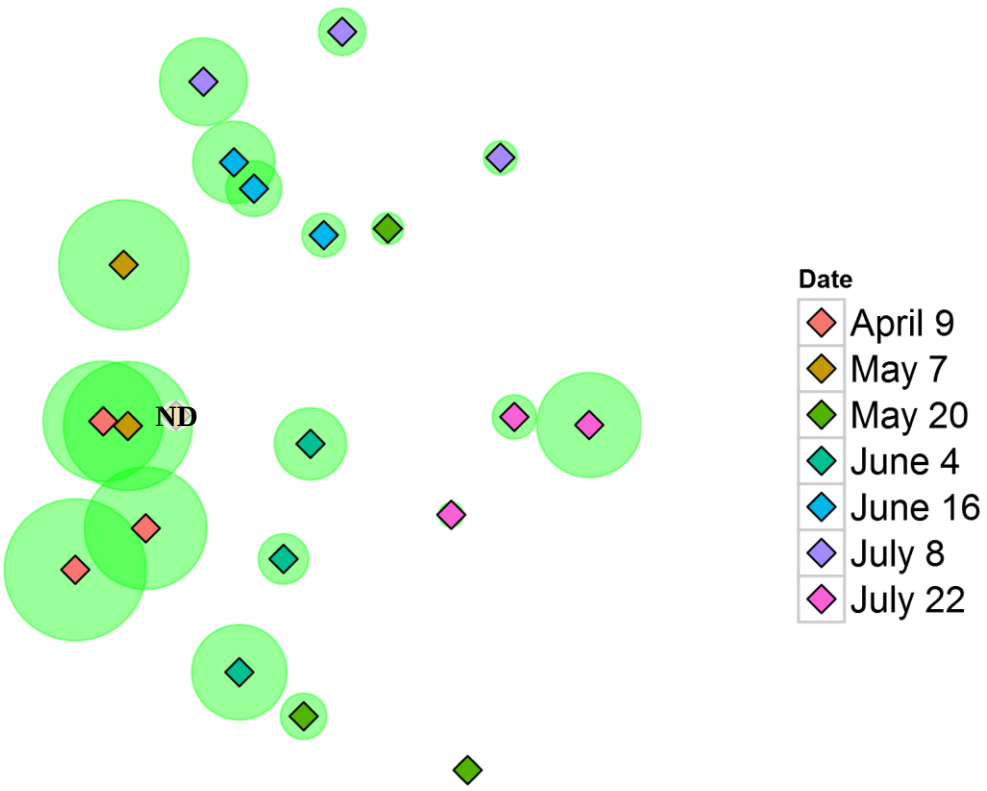
North Central Basin
May 20

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

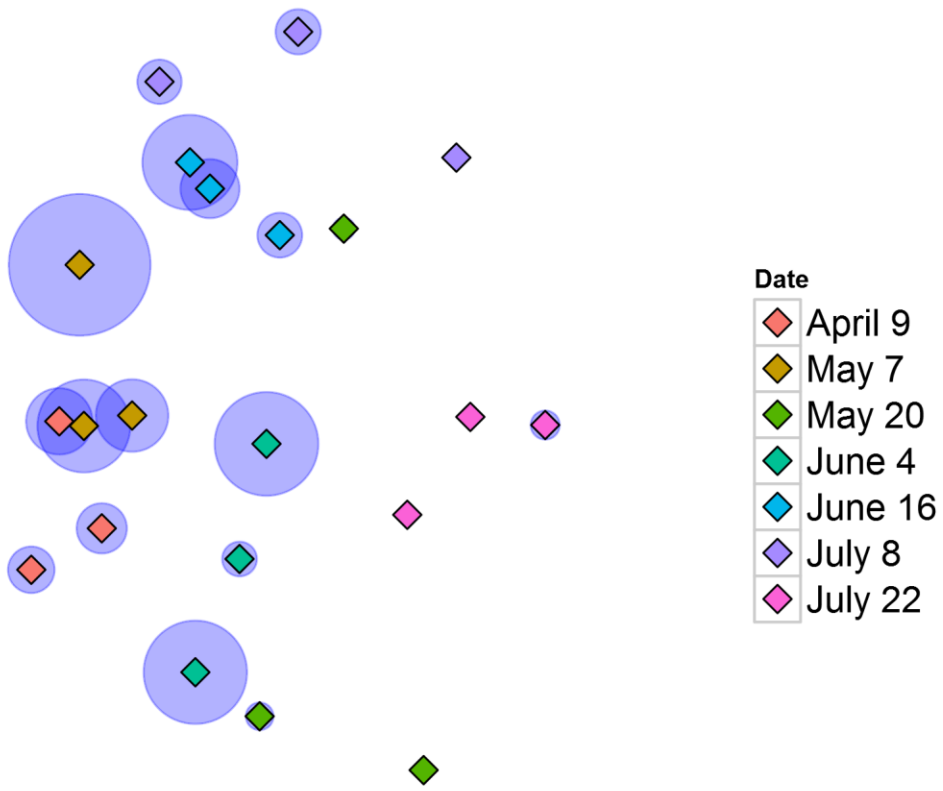


?

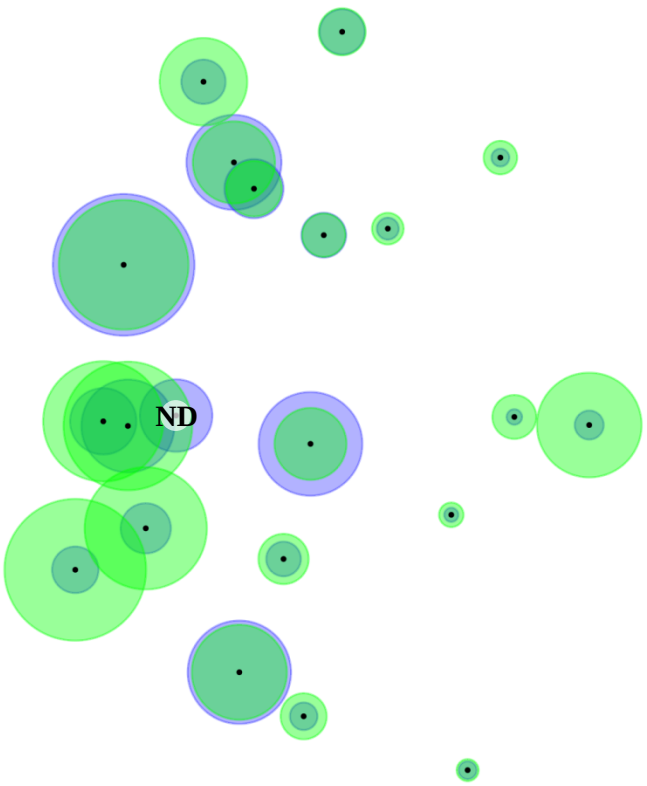
Total Extracted Chlorophyll



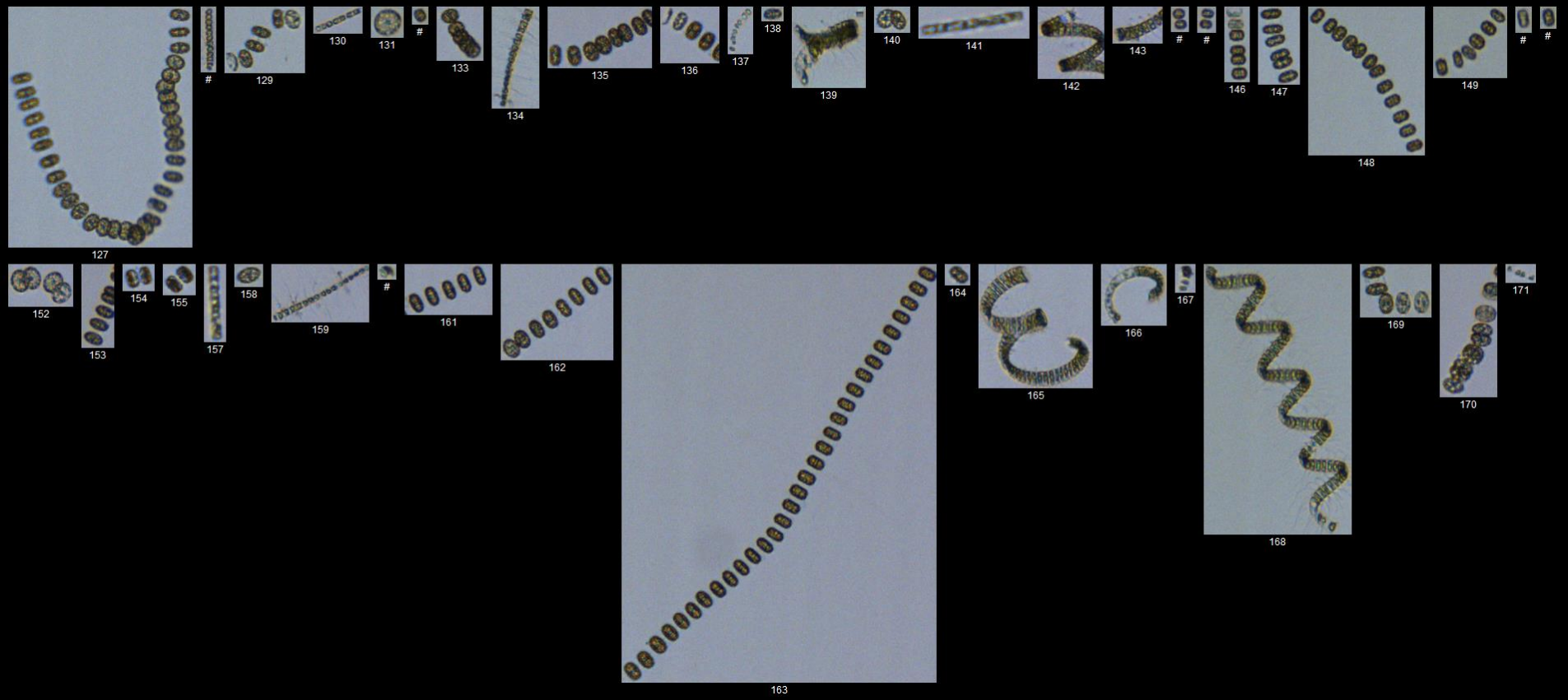
Total FlowCAM Biovolume ($\mu m^3/L$)



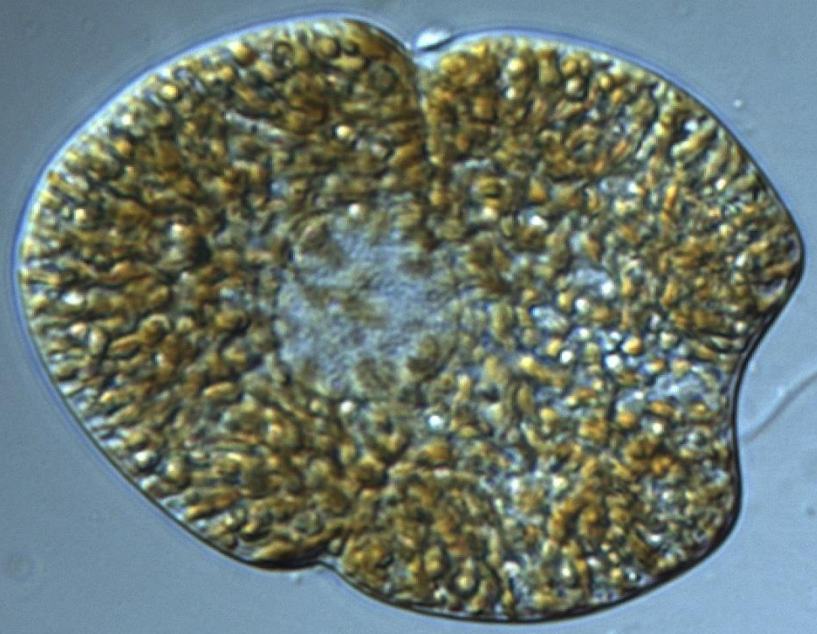
Biovolume vs. Chlorophyll



3 of 52 Z+ Z- Z1 Show Selected



Acknowledgements



KCEL Aquatic Toxicology:

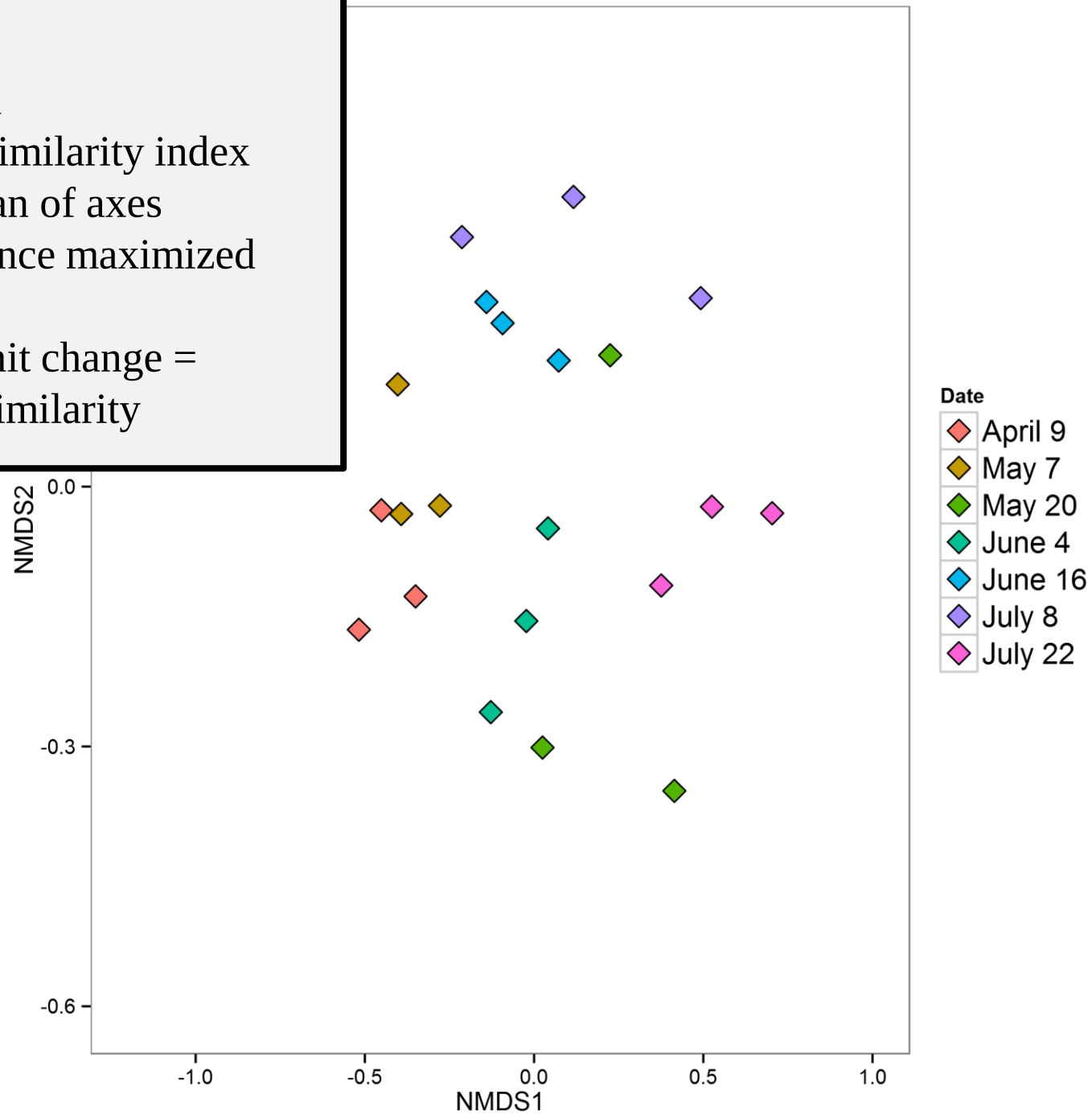
- Gabriela Hannach
- Lyndsey Sandwick

KCEL Field Science Unit:

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

Marine and Sediment Assessment:

- Kim Stark
- Wendy Eash-Loucks

Photo credit: Gabriela Hannach

- Stress: 0.16
- $\sqrt{\sqrt{y}}$ 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