Implementing an Ambient Phytoplankton Monitoring Program in Puget Sound Central Basin

Gabriela Hannach
Environmental Lab

Kim Stark
Marine and Sediment Assessment

King County Department of Natural Resources
Seattle, Washington

Marine Ambient Program

- King County Marine and Sediment Assessment Group
- Long-term marine monitoring program - since 1995
- Water quality in the Central Puget Sound Basin
- Physical, chemical and biological parameters - monthly
- Marine Phytoplankton monitoring *NEW!! 2008*

Goals of Marine Phytoplankton Monitoring

Measure/predict impact of climate or regional stressors on community structure

- Assess relative abundance of major phytoplankton taxa during the bloom season
- Document the timing of seasonal shifts in major taxa
- Investigate relationships between physical/chemical parameters and species relative abundance
- Detect long-term changes in community composition

More Goals !

- Create an electronic image library of Puget Sound phytoplankton species
- Detect occurrence and environmental conditions that lead to blooms of HAB species in Puget Sound
- Expand the program and build extensive database

Sample Collection

3 Locations in the Central Basin

Point Jefferson

Long-term station

Open, North

Sample 2 depths

East Passage

Long-term station

Open, South

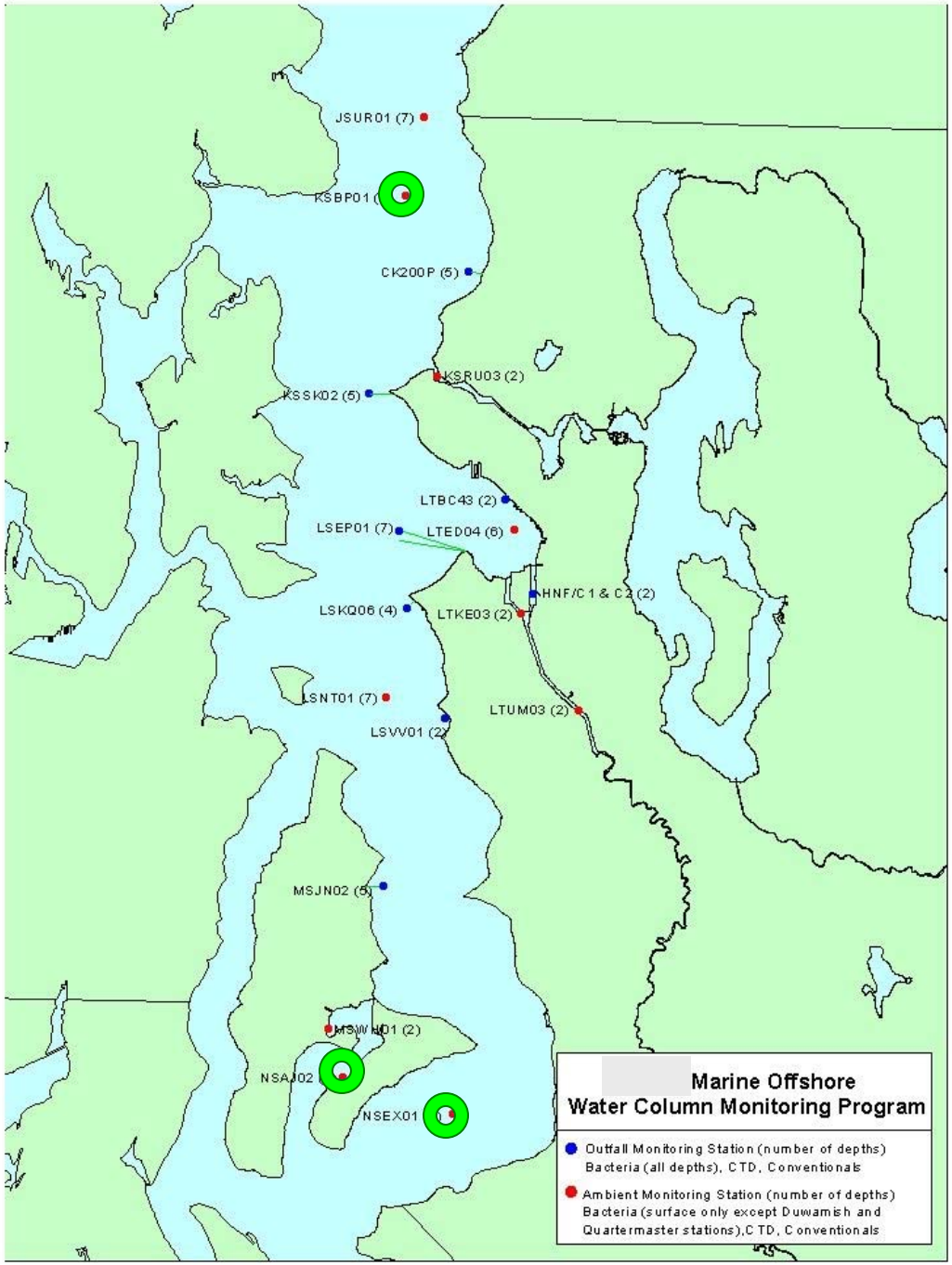
Sample 2 depths

Quartermaster Harbor

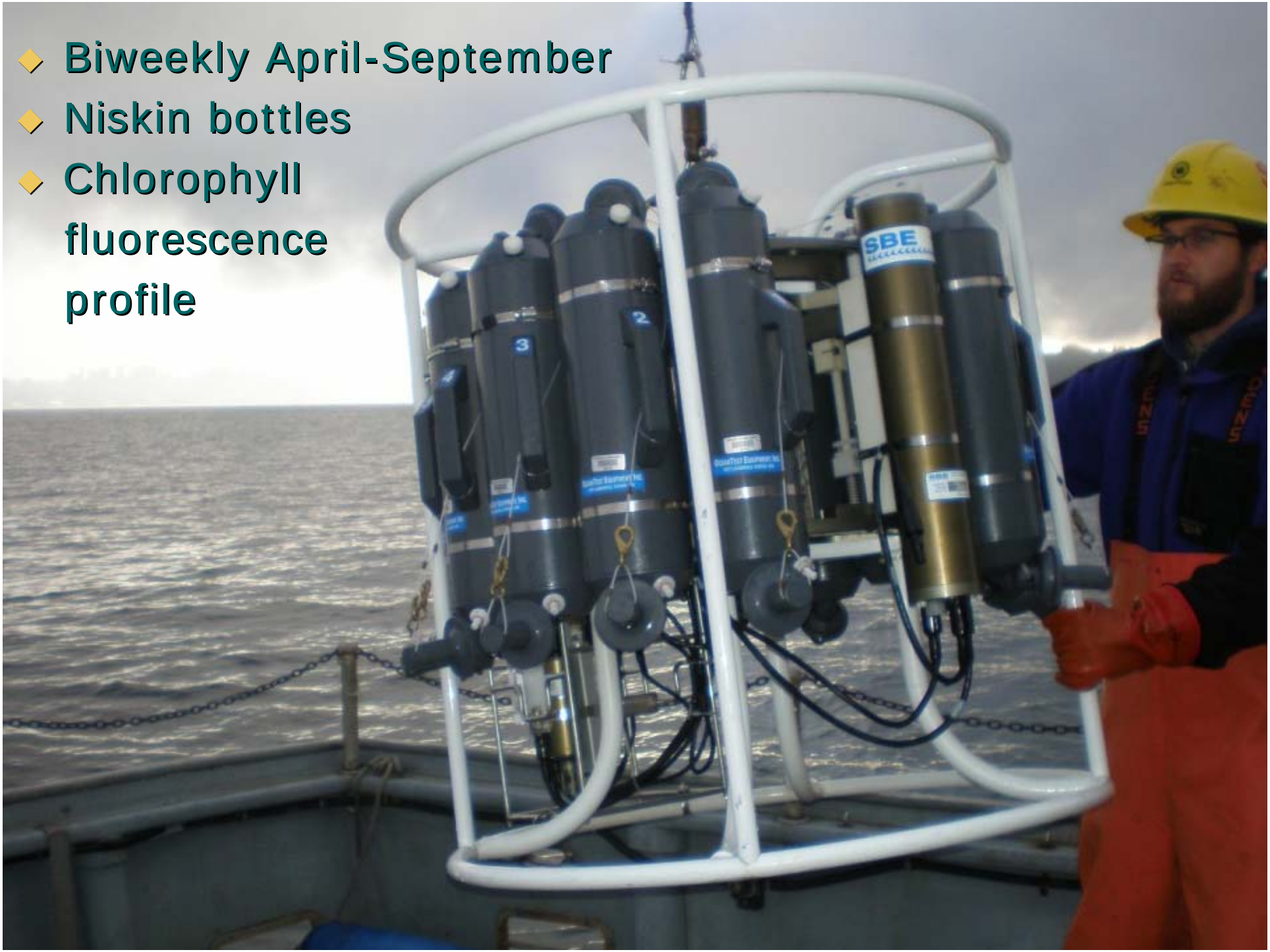
Shallow protected embayment with poor flushing

Sample 1 depth

Telemetered mooring


JSUR01 (7)
KSBP01
CK200P (5)
KSRU03 (2)
KSSK02 (5)
LTBC43 (2)
LSEP01 (7)
LTED04 (6)
HNF/C1 & C2 (2)
LSKQ06 (4)
LTKE03 (2)
LSNT01 (7)
LTUM03 (2)
LSVV01 (2)
MSJN02 (5)
MSWH01 (2)
NSA02
NSEX01
Marine Offshore
Water Column Monitoring Program
Outfall Monitoring Station (number of depths)
Bacteria (all depths), CTD, Conventionals
Ambient Monitoring Station (number of depths)
Bacteria (surface only except Duwamish and
Quartermaster stations),CTD, Conventionals

- Biweekly April-September
- Niskin bottles
- Chlorophyll fluorescence profile



Laboratory Methods

1. List of taxa

Species

Genus

Larger category

2. Semi-quantitative evaluation

<u>at genus level - based on cell #</u>

Present	<25%
Subdominant	25-50%
Dominant	>50%

Live Samples

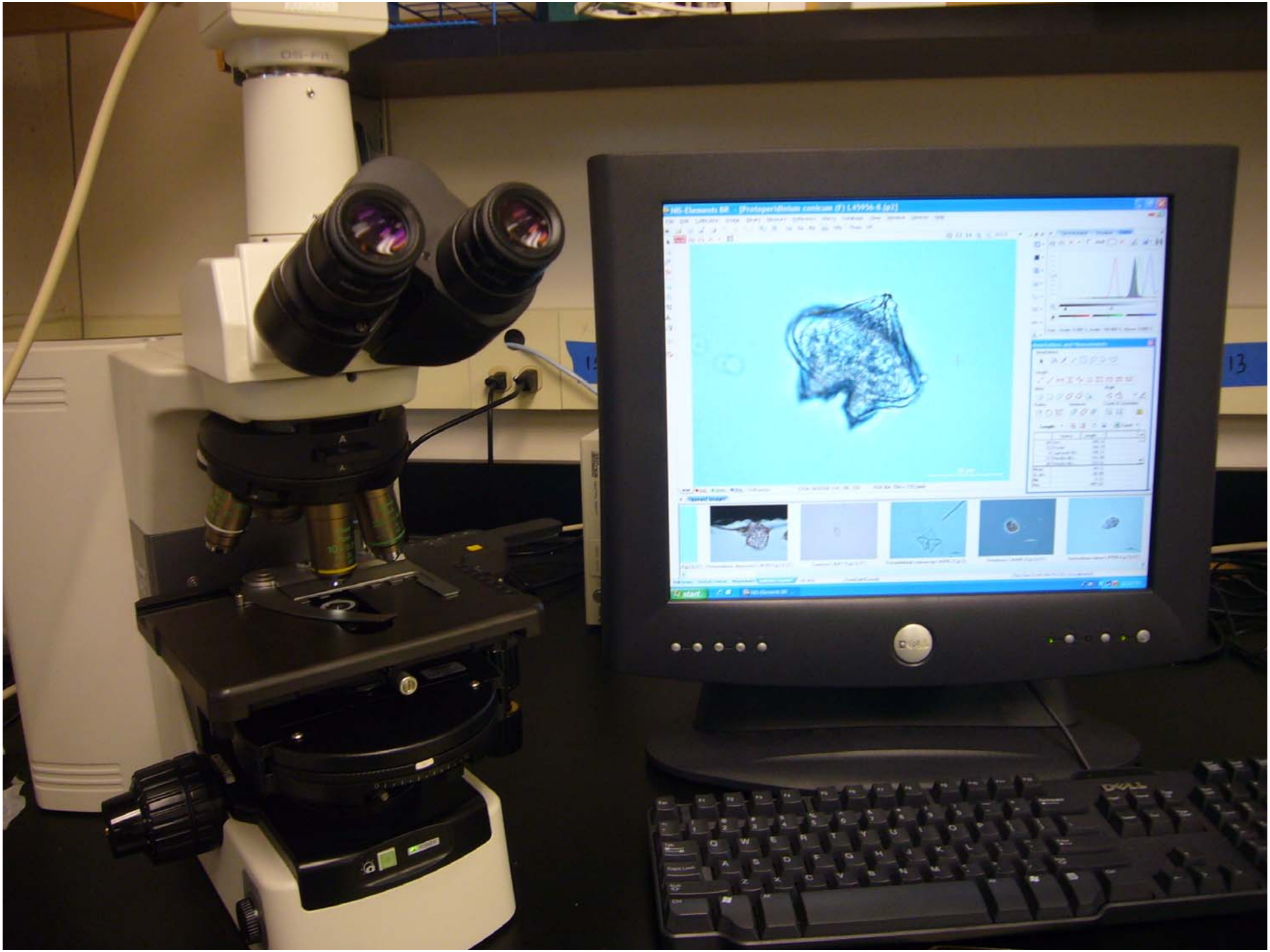
- Used for species identification
- Concentration by reverse filtration

  1 or 5 µm mesh ~50x

Preserved Samples

For archiving and semi-quantitative analysis

Settling in Formalin



Nanoplankton Counting Chamber

Photograph: K. Newell

The author has a Ph.D. in marine botany from the University of Washington and learned phytoplankton as a Fulbright student at the University of Oslo, Norway. For the last four decades, she has studied marine phytoplankton primarily in the Arctic and North Pacific oceans. Dr Horner has been associated with the School of Oceanography at the University of Washington since 1974 where she has worked on a variety of projects ranging from the biology of polar phytoplankton and ice algae to the taxonomy and ecology of harmful algal blooms.

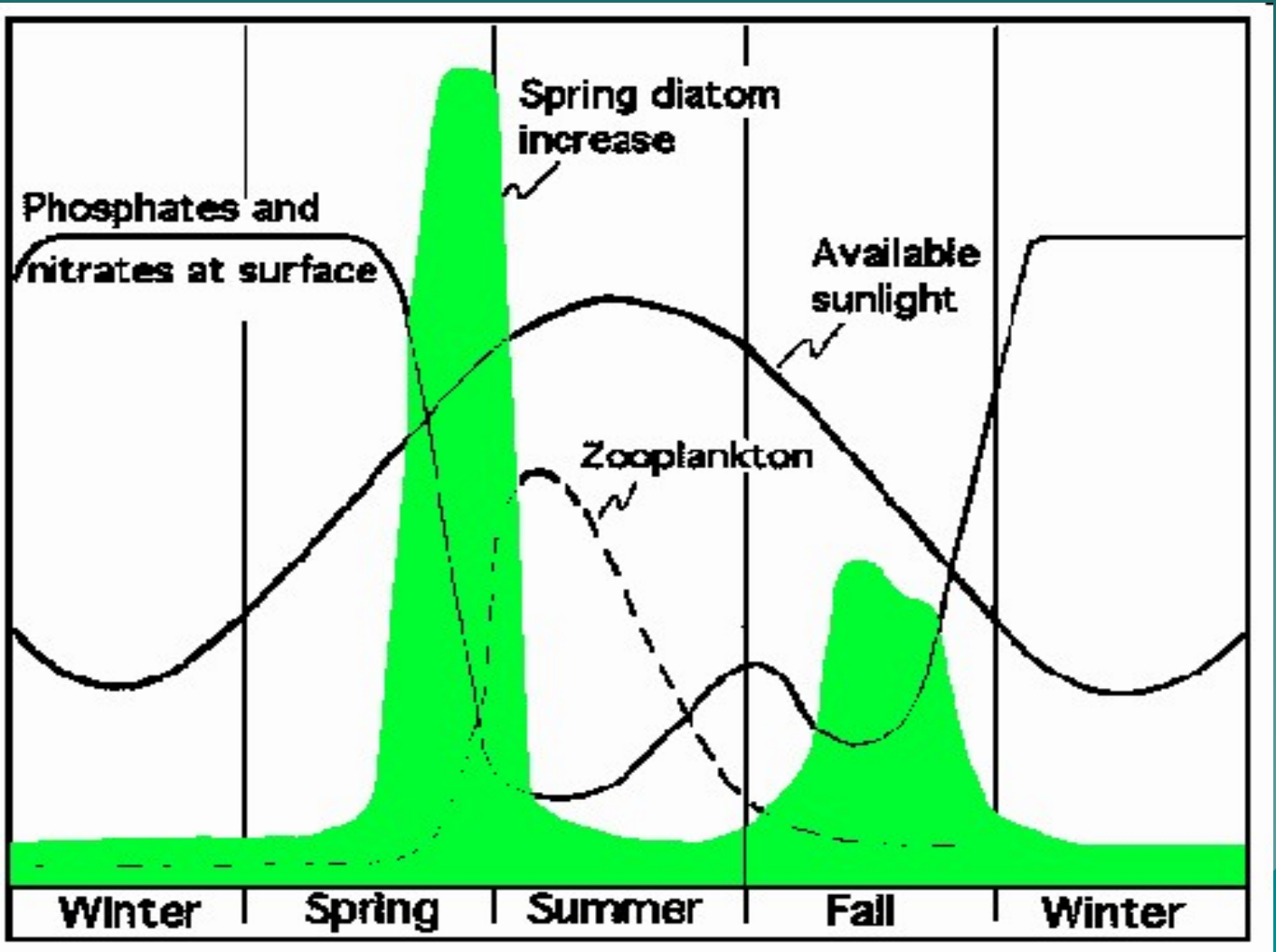
Dr Horner is a member of the Phycological Society of America, the British Phycological Society, the International Phycological Society, the International Society for Diatom Research, the International Society for the Study of Harmful Algae, and is a Fellow of the Arctic Institute of North America.

A TAXONOMIC GUIDE TO SOME COMMON MARINE PHYTOPLANKTON

Rita A. Horner

Biopress Limited

Typical Seasonal Pattern



Some Results/Observations

- Number of species
- Dominant taxa
- Harmful species?

List of taxa in LIMS

DIATOMS-CENTRIC

Actinoptychus senarius
Asteromphalus heptactis
Aulacodiscus kittonii
Cerataulina pelagica
Chaetoceros (Hyalochaete) sp.
Chaetoceros (Phaeocerus) sp.
Chaetoceros affinis
Chaetoceros concavicornis
Chaetoceros convolutus
Chaetoceros curvisetus
Chaetoceros danicus
Chaetoceros debilis
Chaetoceros decipiens
Chaetoceros diadema
Chaetoceros didymus
Chaetoceros laciniosus
Chaetoceros lorenzianus
Chaetoceros radicans
Chaetoceros similis
Chaetoceros socialis
Chaetoceros teres
Chaetoceros vanheurckii
Corethron hystrix
Coscinodiscus centralis
Coscinodiscus concinnus
Coscinodiscus curvatulus
Coscinodiscus granii
Coscinodiscus marginatus
Coscinodiscus oculus-iridis
Coscinodiscus sp.
Coscinodiscus wailesii
Dactyliosolen fragilissimus
Detonula pumila
Ditylum brightwellii
Eucampia zodiacus
Guinardia delicatula
Guinardia striata
Hemiaulus hauckii
Lauderia annulata
Leptocylindrus danicus
Leptocylindrus minimus
Melosira moniliformis
Odontella longicruris
Paralia sulcata
Rhizosolenia setigera
Skeletonema costatum
Stephanopyxis nipponica
Stephanopyxis palmeriana
Thalassiosira aestivalis
Thalassiosira anguste-lineata
Thalassiosira eccentrica
Thalassiosira nordenskioeldii
Thalassiosira pacifica
Thalassiosira punctigera
Thalassiosira rotula
Thalassiosira sp.
unidentified centric

DIATOMS-PENNATE

Asterionellopsis glacialis
Cylindrotheca closterium
Navicula sp.
Nitzschia acicularis
Pleurosigma sp.
Pseudo-nitzschia sp. (large)
Pseudo-nitzschia sp. (small)
Thalassionema nitzschioides
Tropidoneis antarctica
unidentified pennate

DINOFLAGELLATES

Akashiwo sanguinea
Alexandrium catenella
Alexandrium sp.
Amylax triacantha
Ceratium fusus
Ceratium sp.
Dinophysis acuminata
Dinophysis acuta/norvegica
Dinophysis fortii
Dinophysis rotundata
Dinophysis sp.
Dissodinium pseudolunula
Gonyaulax sp.
Gymnodinium sp.
Gyrodinium sp.
Gyrodinium spirale
Heterocapsa triquetra
Minuscula bipes
Nematodinium armatum
Noctiluca scintillans
Oxyphysis oxytoxoides
Polykrikos schwartzii
Prorocentrum gracile
Prorocentrum micans
Protoceratium reticulatum
Protoperidinium brevipes
Protoperidinium conicum
Protoperidinium depressum
Protoperidinium excentricum
Protoperidinium leonis
Protoperidinium oceanicum
Protoperidinium sp.
Protoperidinium steinii
Pyrophacus horologium
Scrippsiella trochoidea
diplopsalid dinoflagellate
gymnodinioid dinoflagellate
unidentified dinoflagellate (<25 um)
unidentified dinoflagellate (>25 um)

CHRYSOPHYTES

Meringosphaera mediterranea

EBRIDEAN

Ebria tripartita

PRYMNESIOPHYTES

Phaeocystis sp.

RAPHIDOPHTYE

Heterosigma akashiwo

SILICOFLAGELLATES

Dictyocha fibula
Dictyocha speculum

OTHER

unidentified nanoflagellates

2008-2009 Dominant Taxa

1. Chain forming diatoms

Chaetoceros - many spp.

Thalassiosira - many spp.

Skeletonema

Detonula

Rhizosolenia

Leptocylindrus

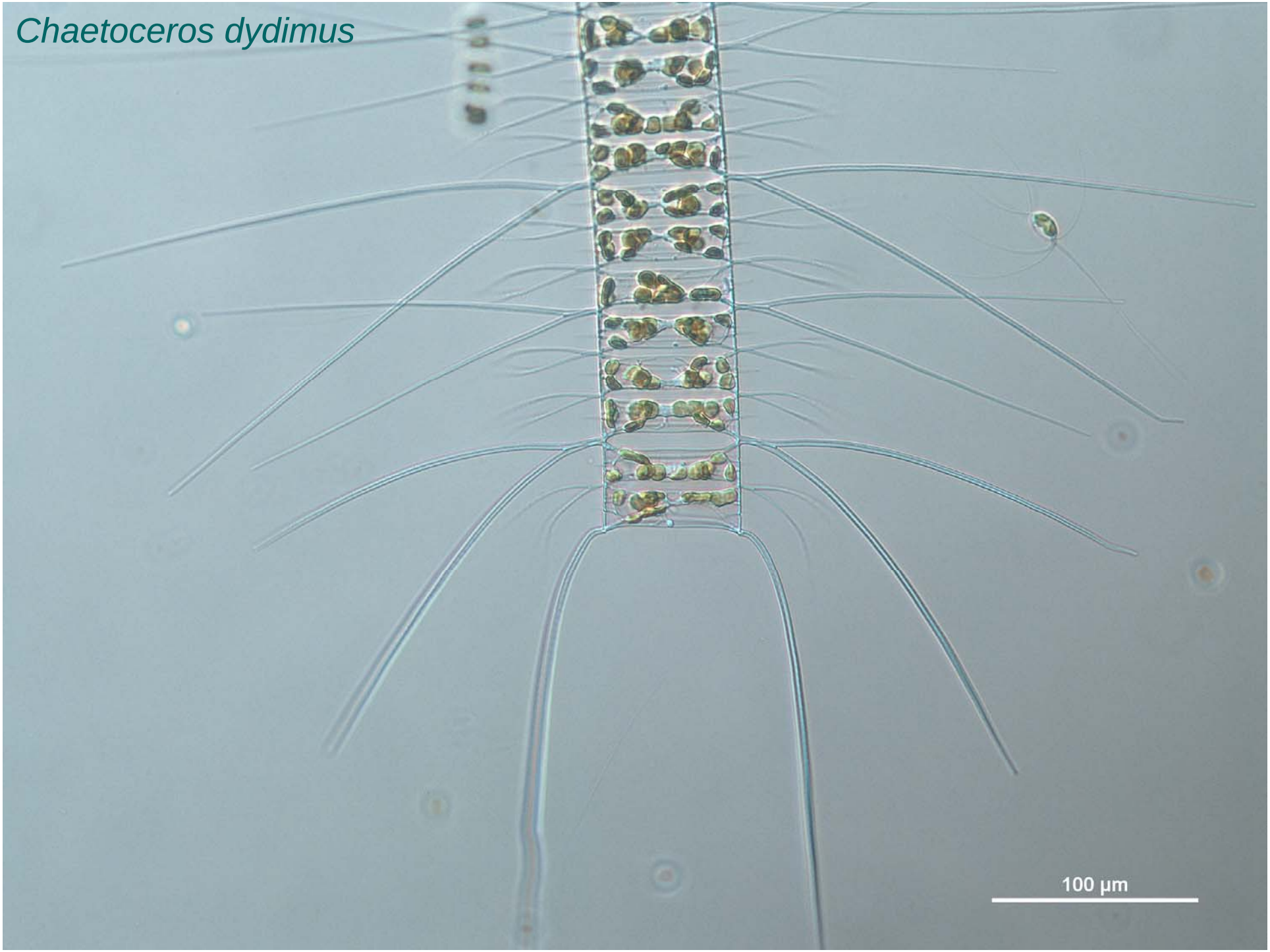
Dytilum

Eucampia

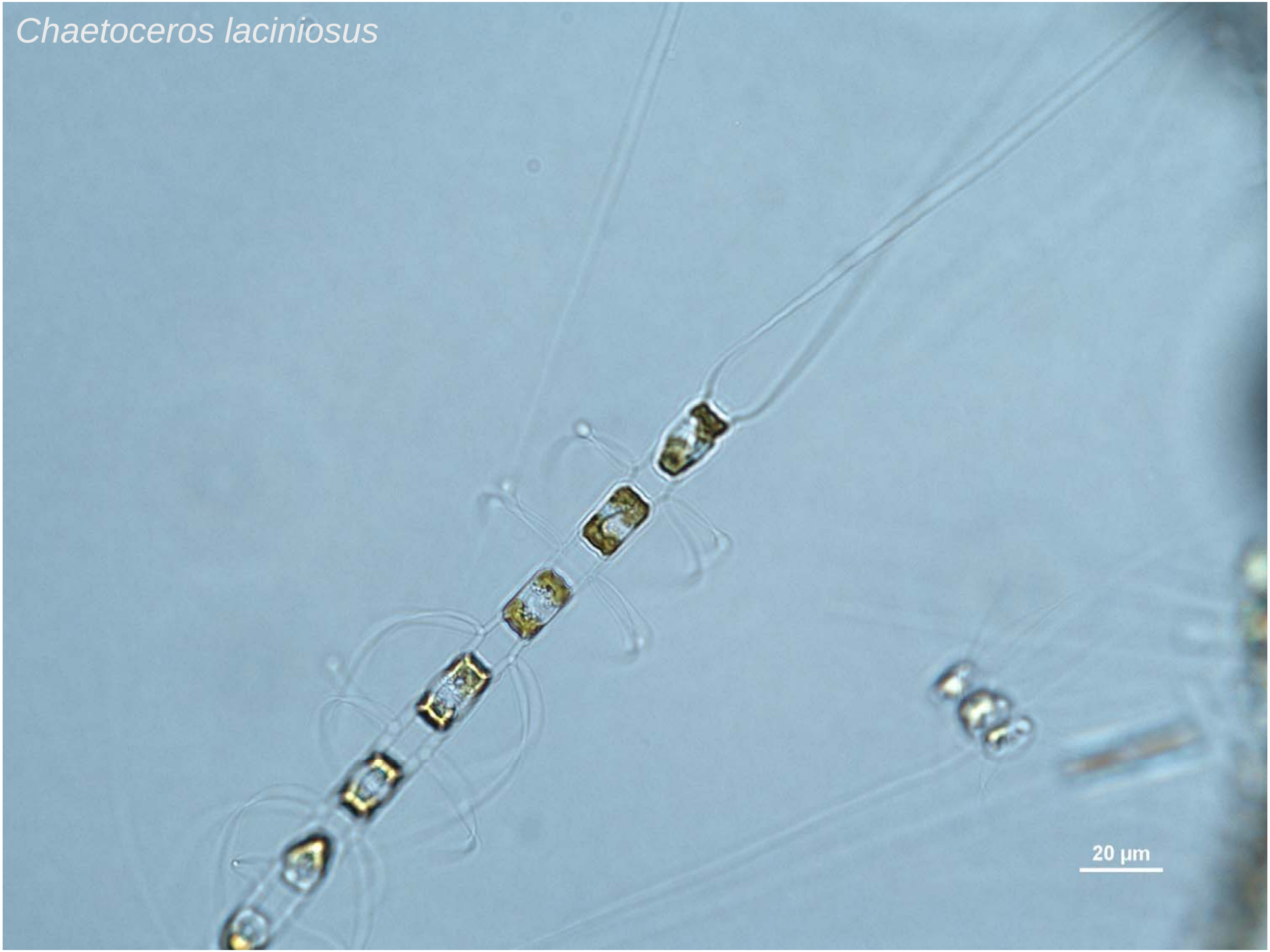
Thalassionema

Pseudo-nitzschia (HAB)

Chaetoceros debilis
100 µm


Chaetoceros dydimus
100 µm

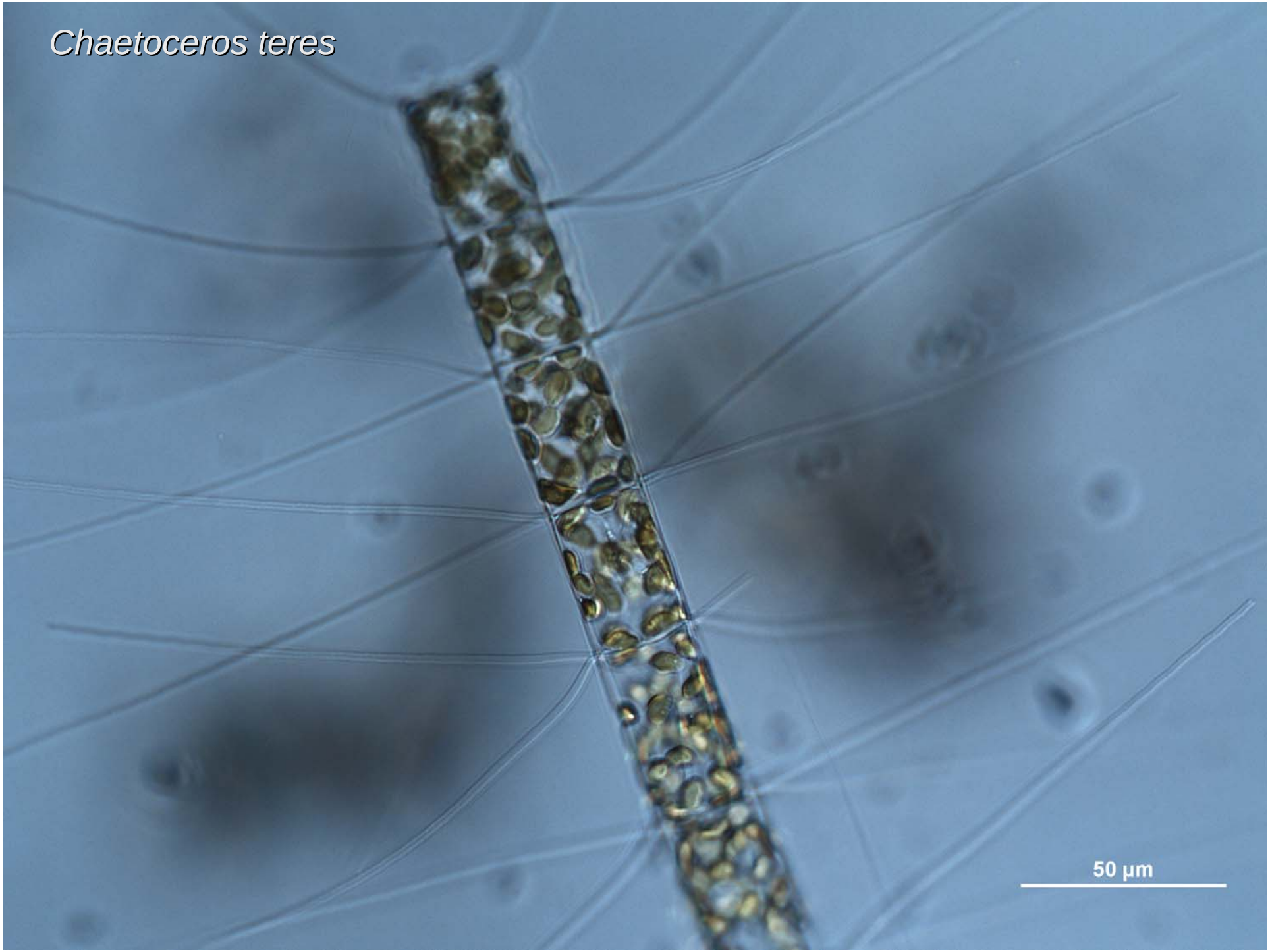
Chaetoceros diadema
50 µm


Chaetoceros laciniosus
20 µm

Chaetoceros radicans
50 µm

Chaetoceros similis
50 µm

Chaetoceros socialis
100 µm


Chaetoceros teres
50 µm

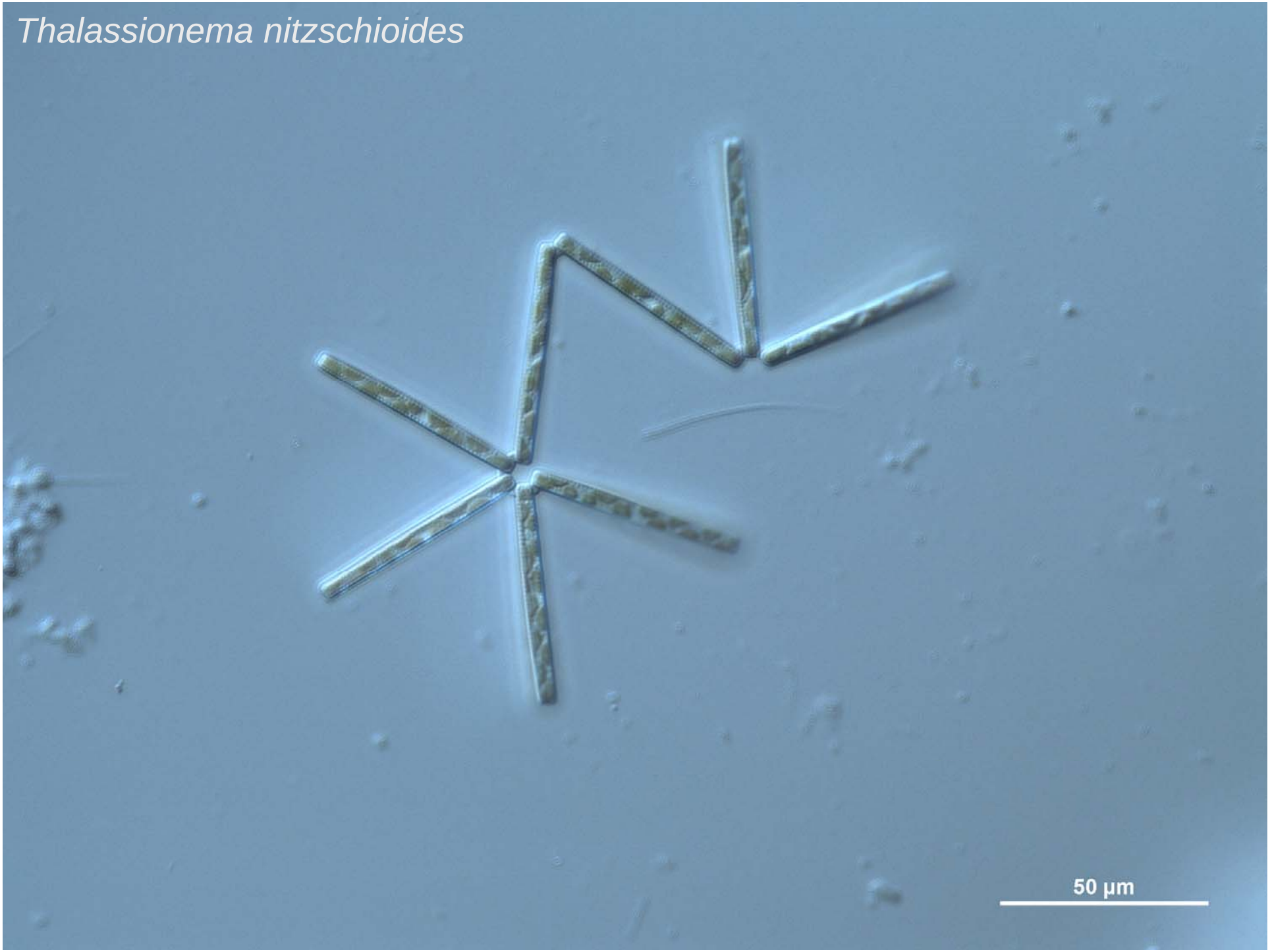
Thalassiosira anguste-lineata
50 µm

Thalassiosira nordenskioeldii
50 µm

Skeletonema costatum

Ditylum brightwellii
100 µm

Rhizosolenia setigera
100 µm


Thalassionema nitzschioides
50 µm

Pseudo-nitzschia sp. (domoic acid)
50 µm

2008-2009 Dominant Taxa

2. Solitary diatoms

Cylindrotheca

Coscinodiscus

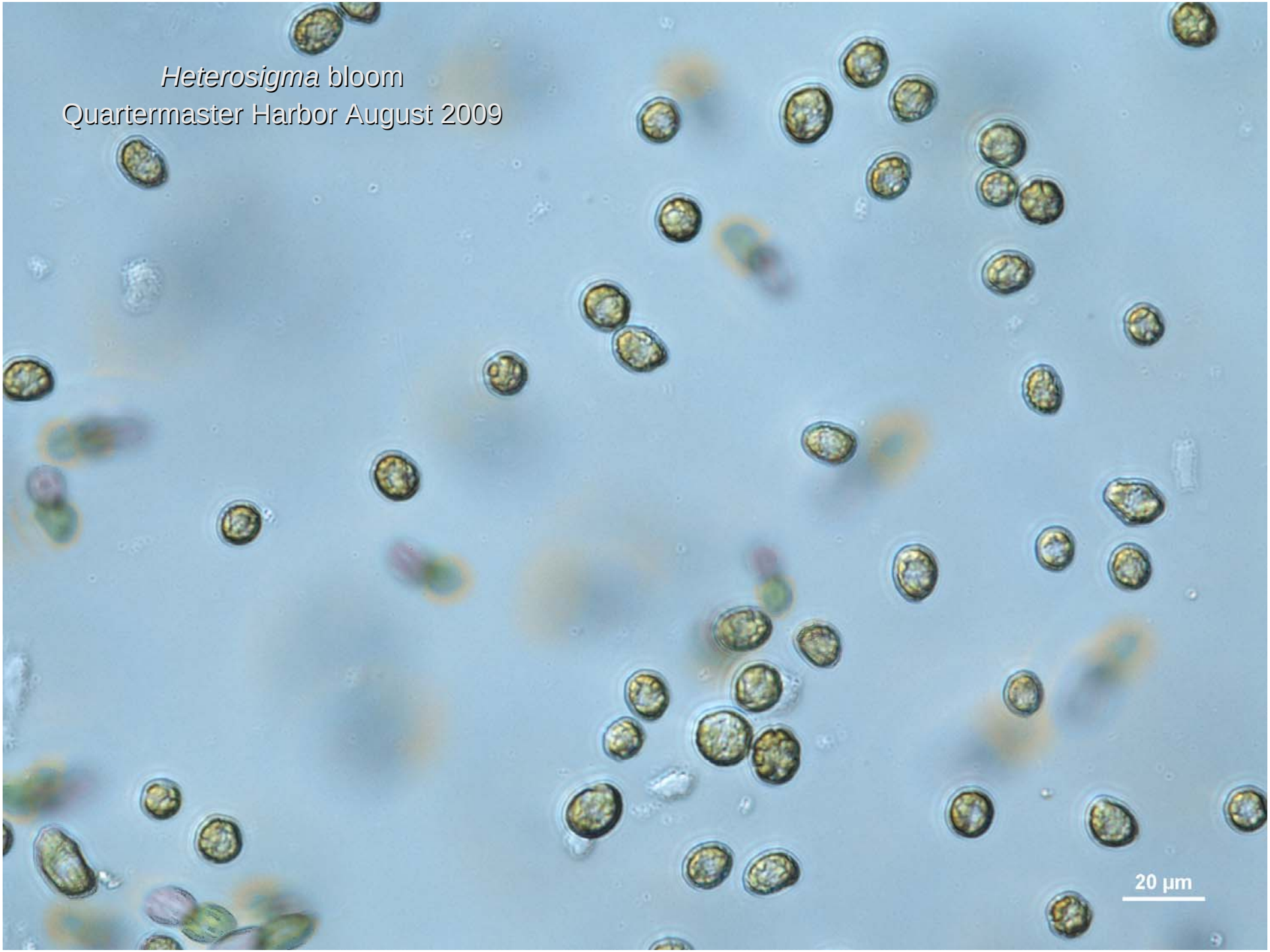
Coscinodiscus wailessii

2008-2009 Dominant Taxa

3. *Heterosigma akashiwo*

Raphidophyte (small flagellate)

HAB


Heterosigma bloom
Quartermaster Harbor August 2009
20 µm

2008-2009 Dominant Taxa

4. Dinoflagellates

Protoperidinium spp.

Prorocentrum gracile

Ceratium fusus

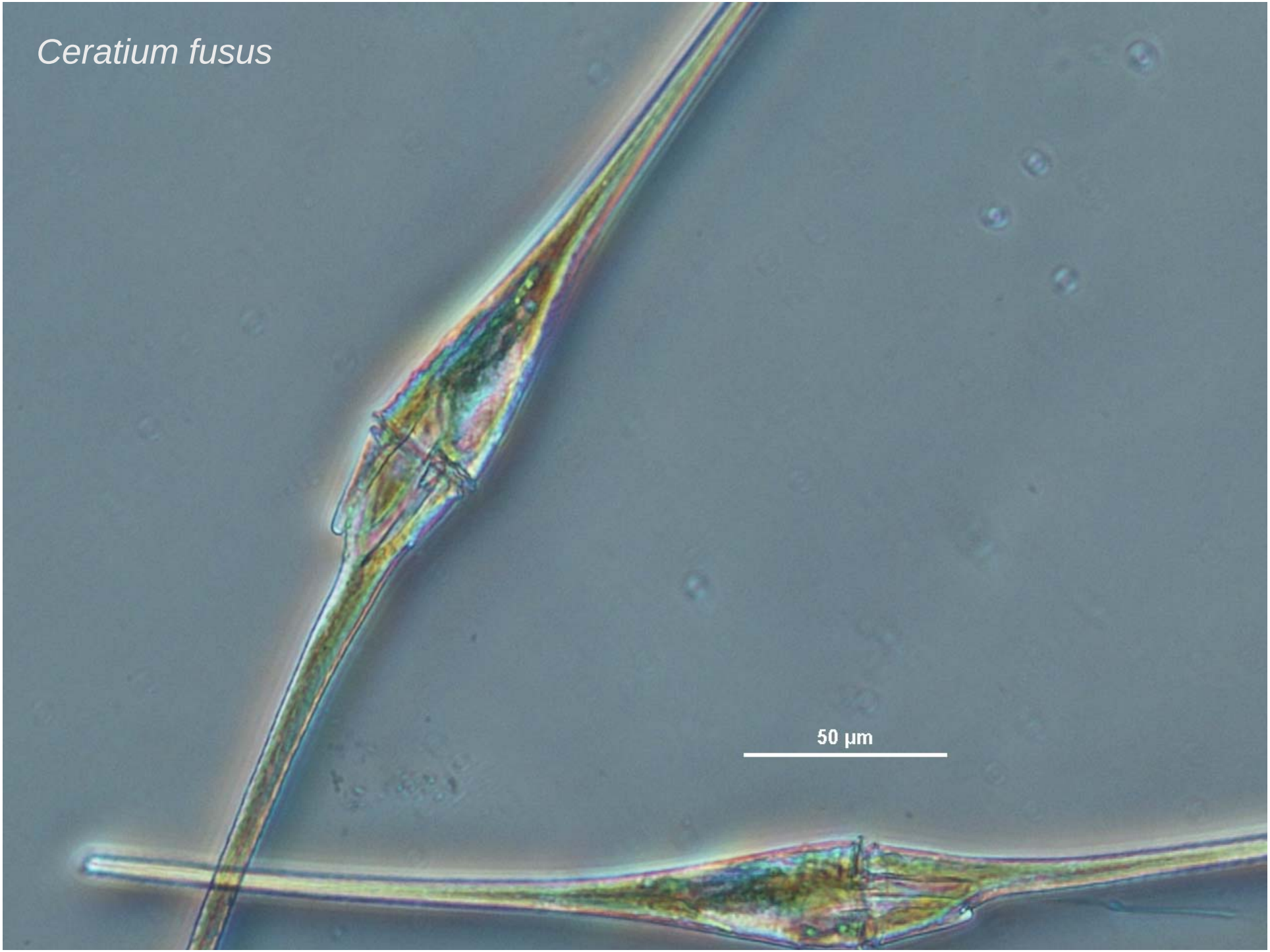
Akashiwo sanguinea

small unidentified spp.

Alexandrium catenella (PSP)

Akashiwo sanguinea

Protoperidinium spp.


Ceratium fusus
50 µm

Alexandrium catenella (PSP)
10 µm

Other Taxa of Interest

or just
more cool pictures

Noctiluca bloom

Noctiluca scintillans
100 µm

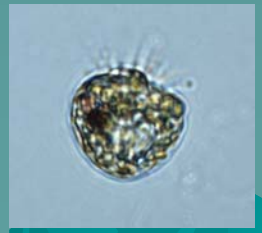
Dinophysis acuminata (DSP)

Dinoflagellate cyst

Gyrodinium sp.
50 µm

Gyrodinium spirale
50 µm

And what about the Zooplankton??



Some Conclusions

- **Challenges**
  - **Sampling design: is it representative?**
  - **Year to year variation**
  - **"Correct" identification**
- **Use of technology?**
  - **Flow-Cam for quantitative data**
- **Important effort!**
  - **No other routine monitoring programs in the Sound**

Acknowledgments: All involved staff + taxpayers