The Role of Zooplankton Grazing on Noxious Cyanobacteria Blooms in Vancouver Lake, WA

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VANCOUVER LAKE

Problem:

Noxious, summertime cyanobacteria blooms that force closure of the lake to swimming/water contact

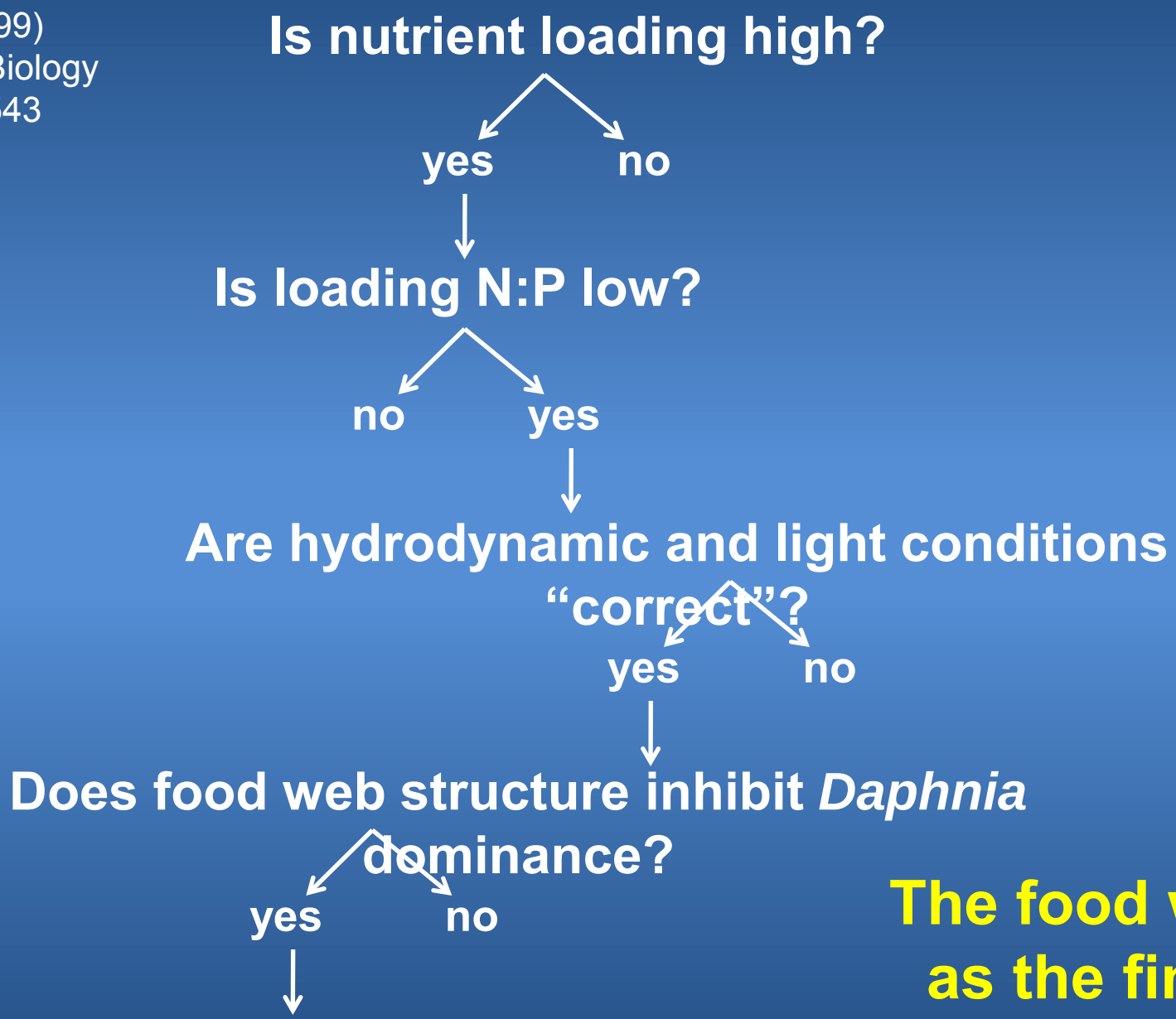
Vancouver Lake August 2008

Our key questions:

- What environmental factors influence the formation, persistence, and decline of cyanobacteria blooms?
- What is the impact of small (<0.2 mm) and large (0.2-2.0 mm) planktonic grazers on cyanobacteria blooms?

A Pathway to Noxious Cyanobacteria Blooms

Elser (1999)
Freshwater Biology
42: 537-543



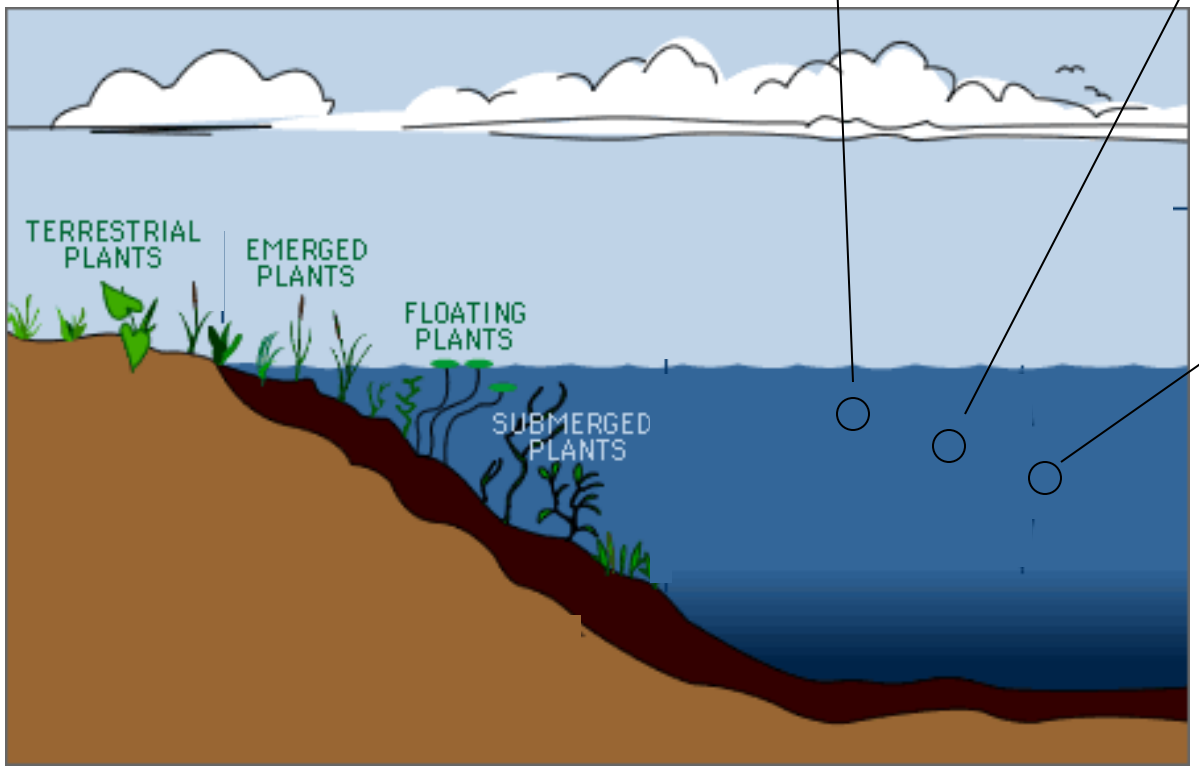
The food web as the final turn…

Plankton groups in lakes:

Phytoplankton { Algae & Cyanobacteria

Protozoans

Zooplankton



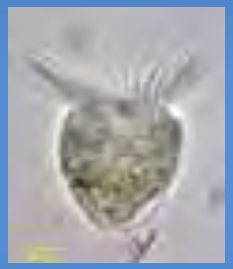
Potential trophic interactions in Vancouver Lake

rotifers

cladocerans

copepods

Zooplankton (large)



ciliates

dinoflagellates

Protozoans (small)

diatoms

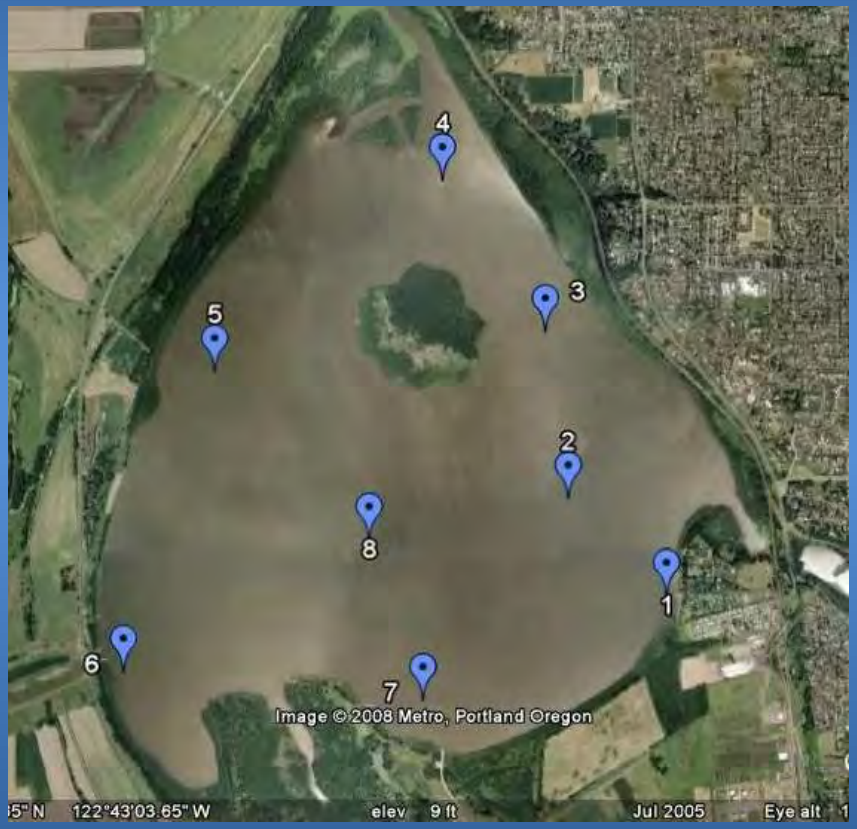
chlorophytes

cyanobacteria

Algae and cyanobacteria

Nutrients: NO_3, NO_2, NH_4, PO_4, SiO_4

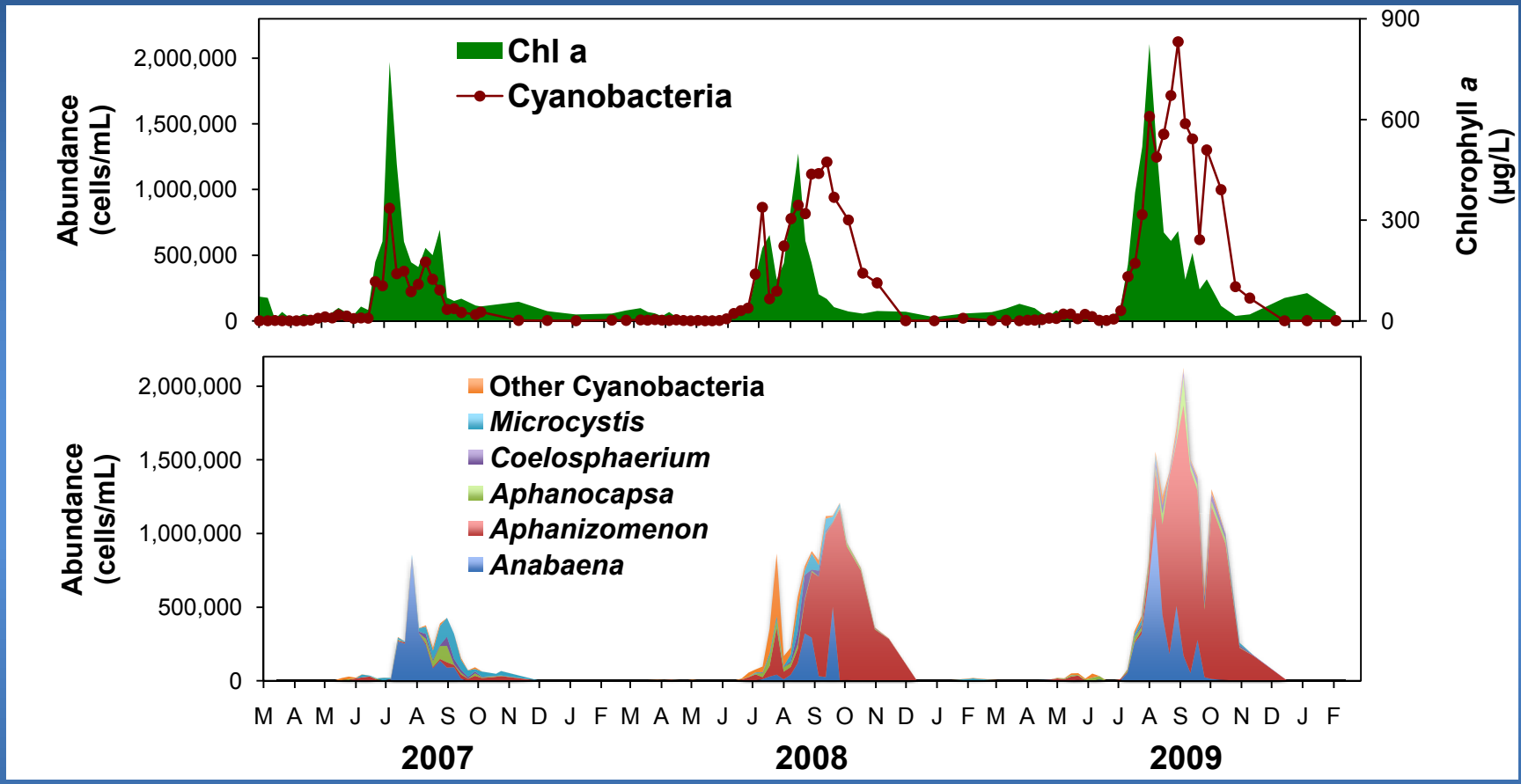
Vancouver Lake Sampling Locations



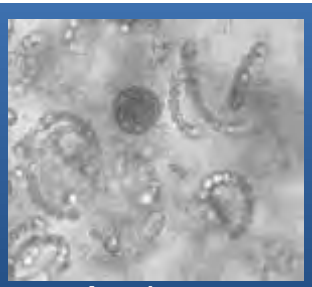
Station 1 (Sailing Club Dock)
Sampled ***monthly or weekly*** 2007-2010

Stations 1 – 8
Sampled ***quarterly*** from RV *Sea-Coug*
2007-2008

Cyanobacteria Abundance and Composition
March 2007 – February 2010

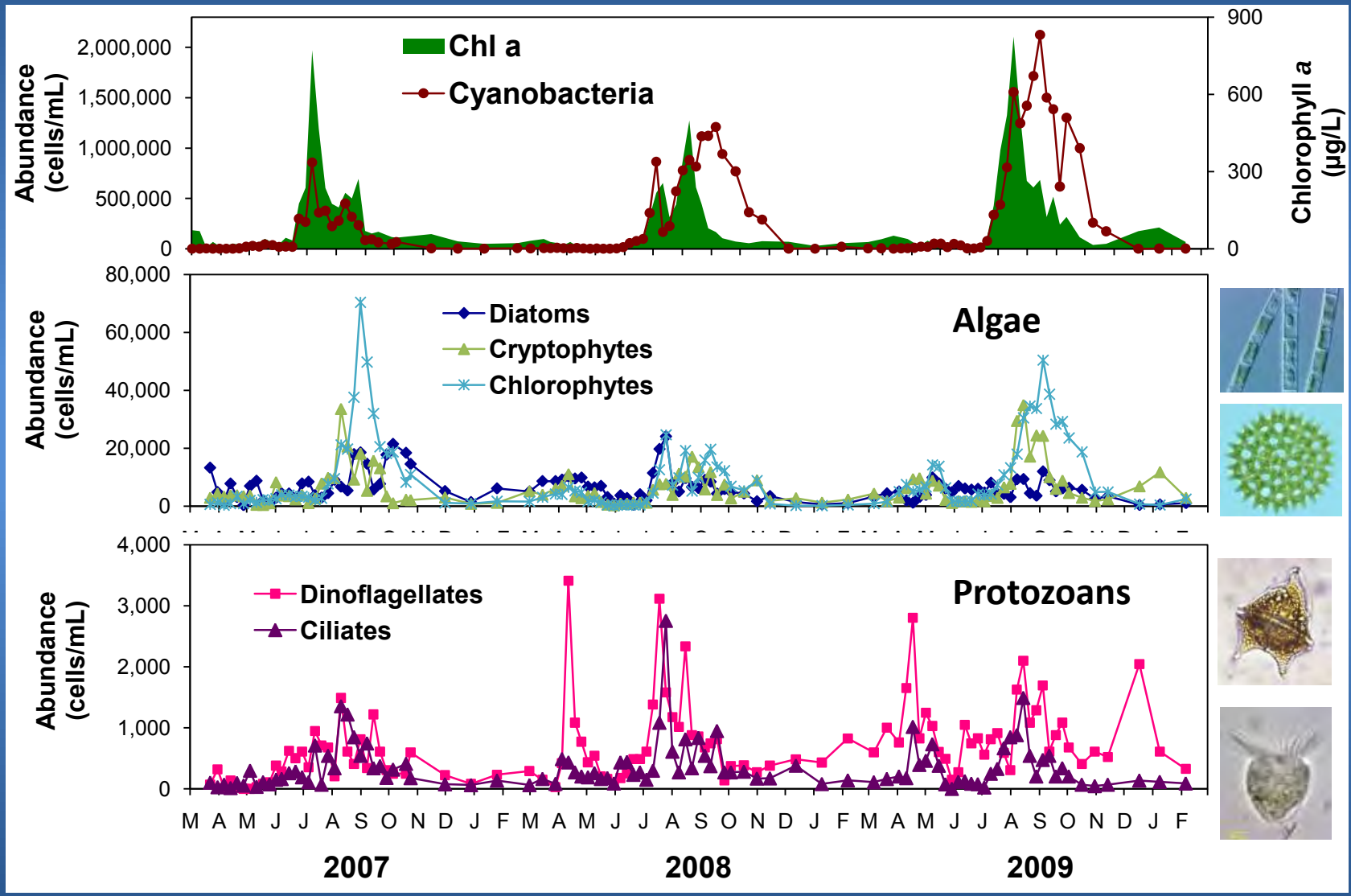


Aphanizomenon



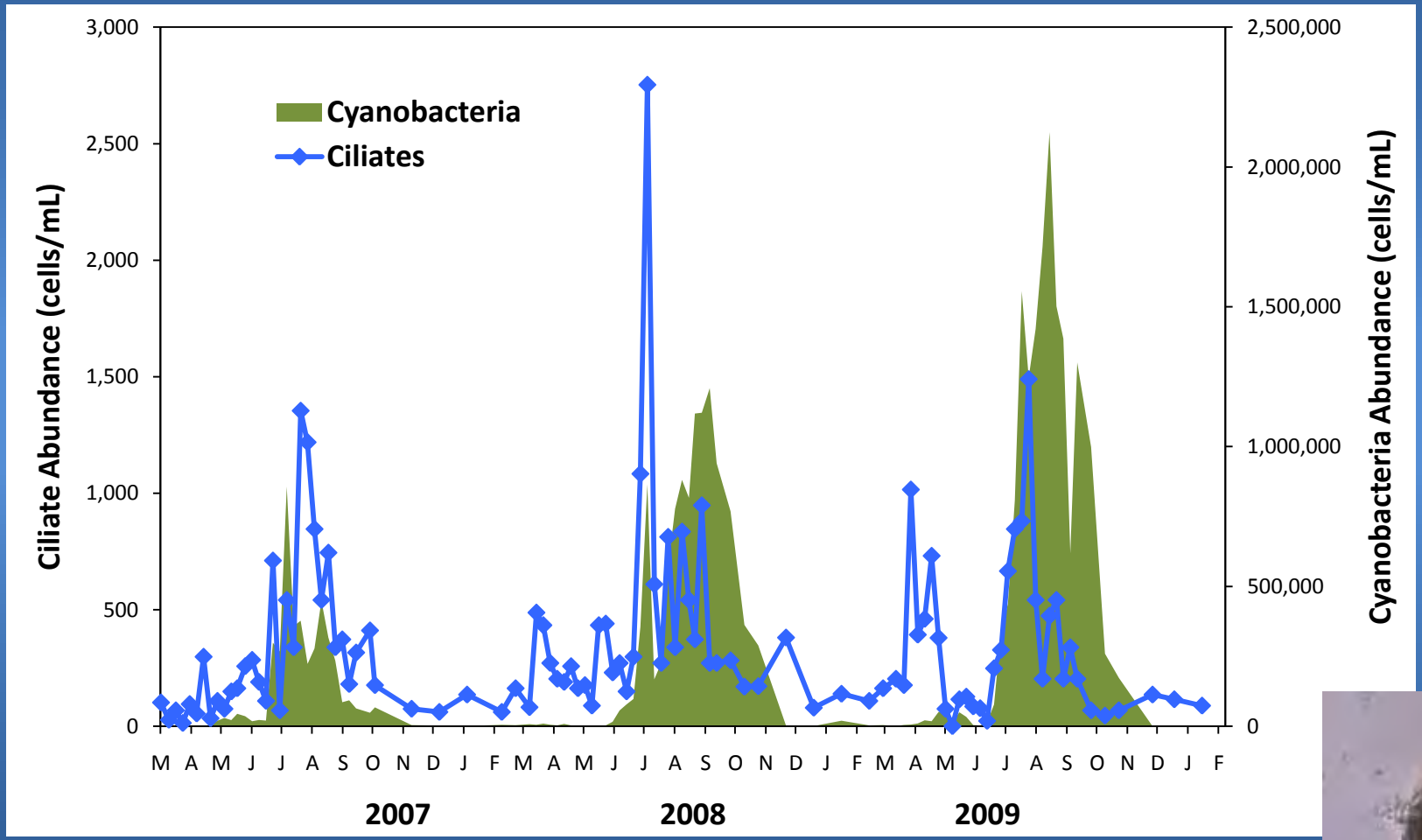
Anabaena

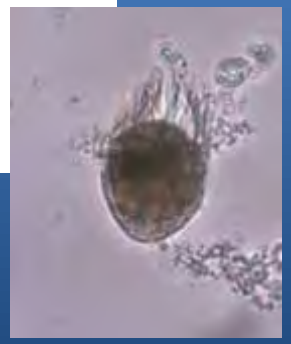
Phytoplankton-Protozoan Abundance
March 2007 – February 2010



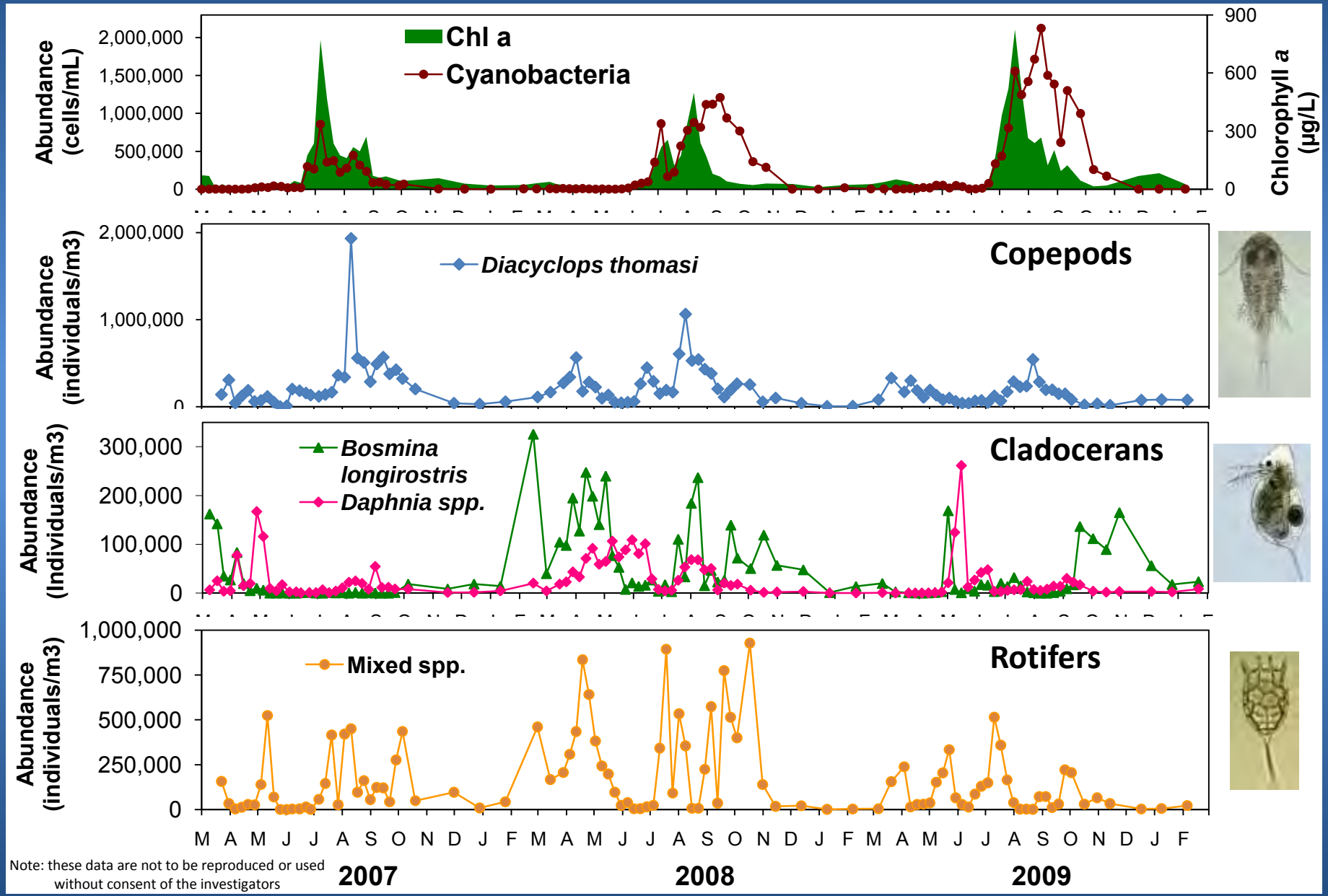
Note: these data and the interpretation of these data are not to be reproduced or used without consent of the investigators

Cyanobacteria vs. Ciliate Abundance

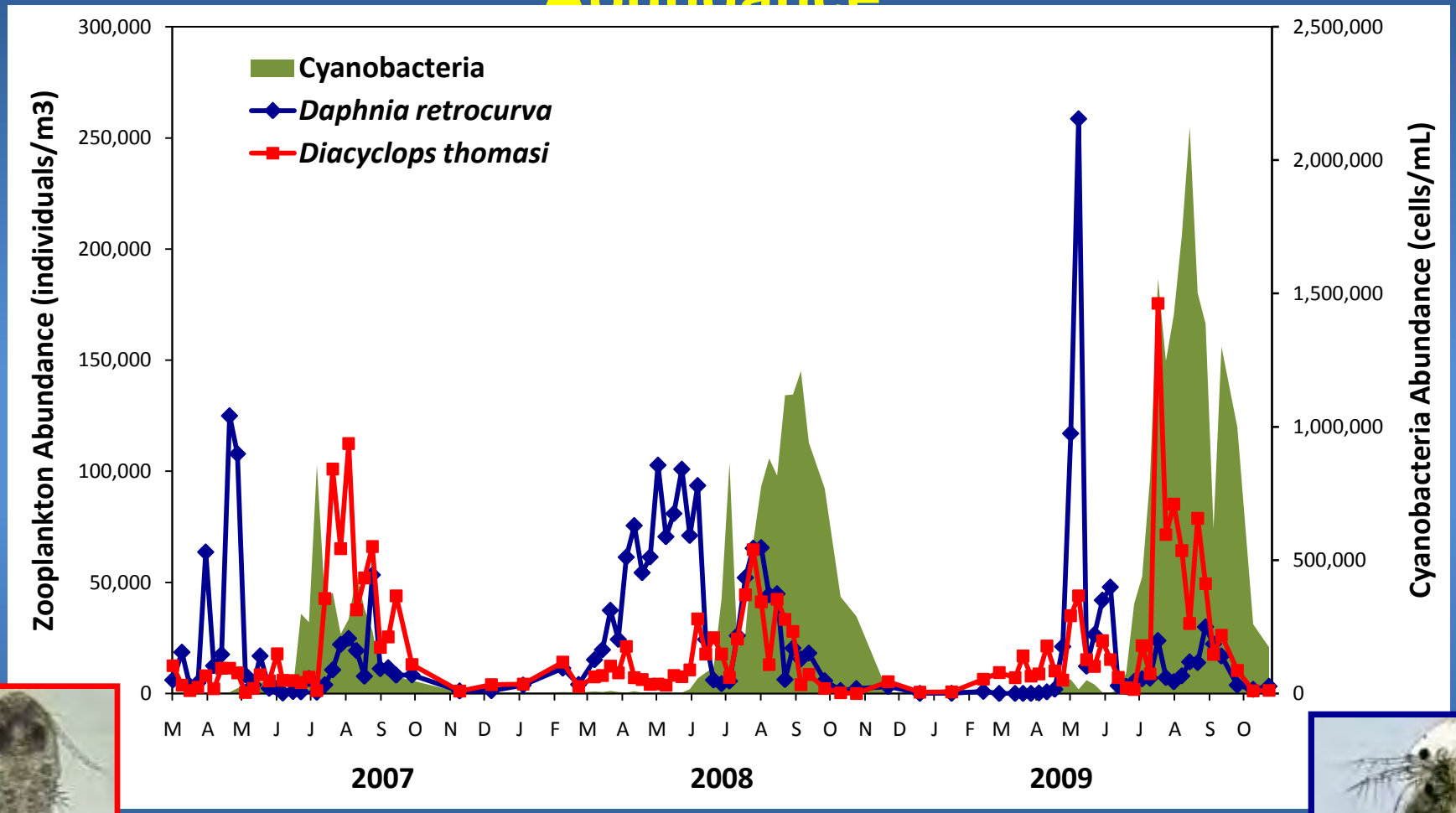




Zooplankton Abundance
March 2007 – February 2010



Cyanobacteria vs. Copepod-Cladoceran Abundance



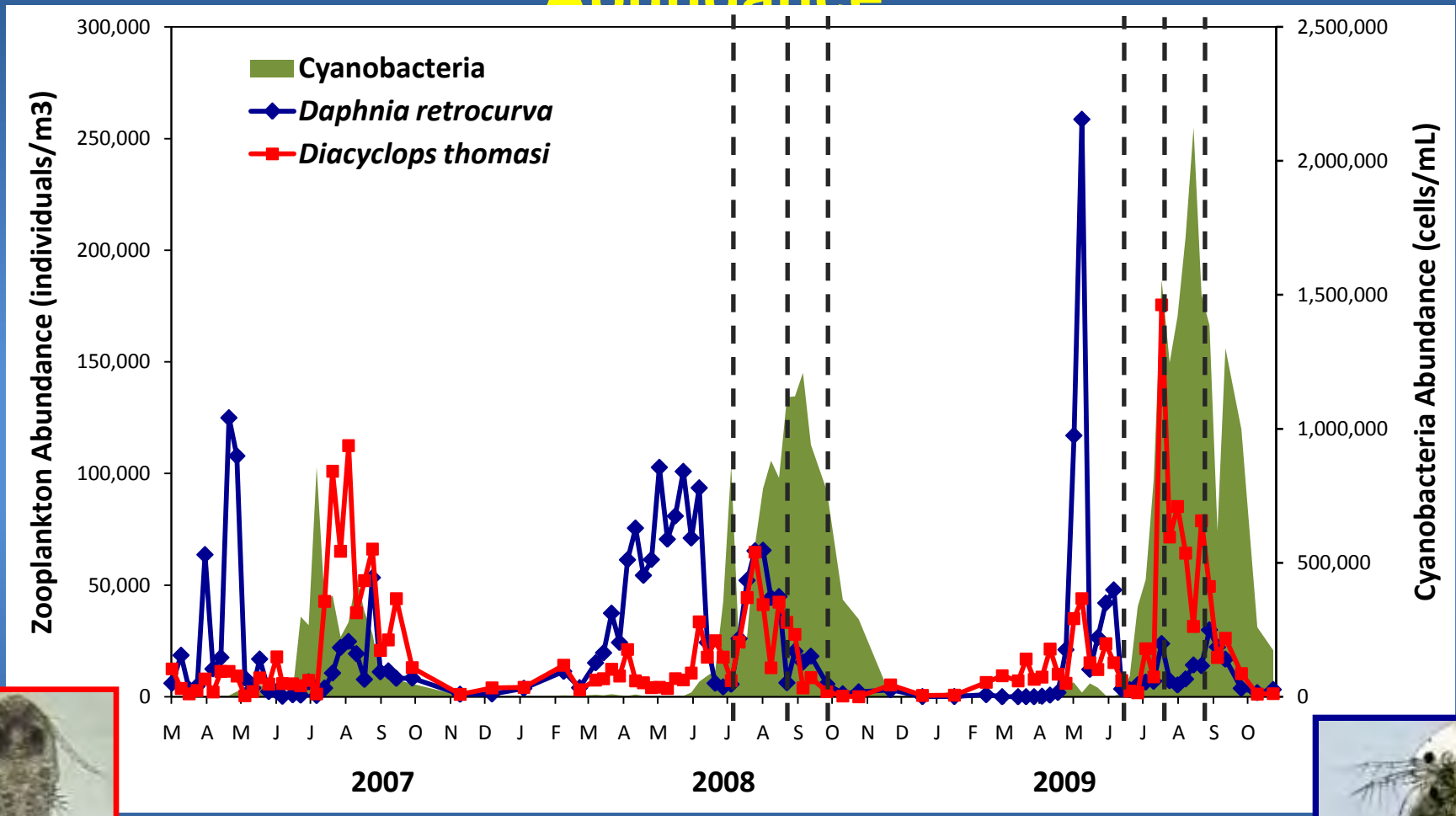
Grazing impact of protozoan plankton ("small" grazers):

- Dilution experiments every two weeks from May-October in 2008 and 2009
- Measured feeding rates of protozoans on chlorophyll-containing cells (algae and cyanobacteria)

Grazing impact of crustacean zooplankton ("large" grazers):

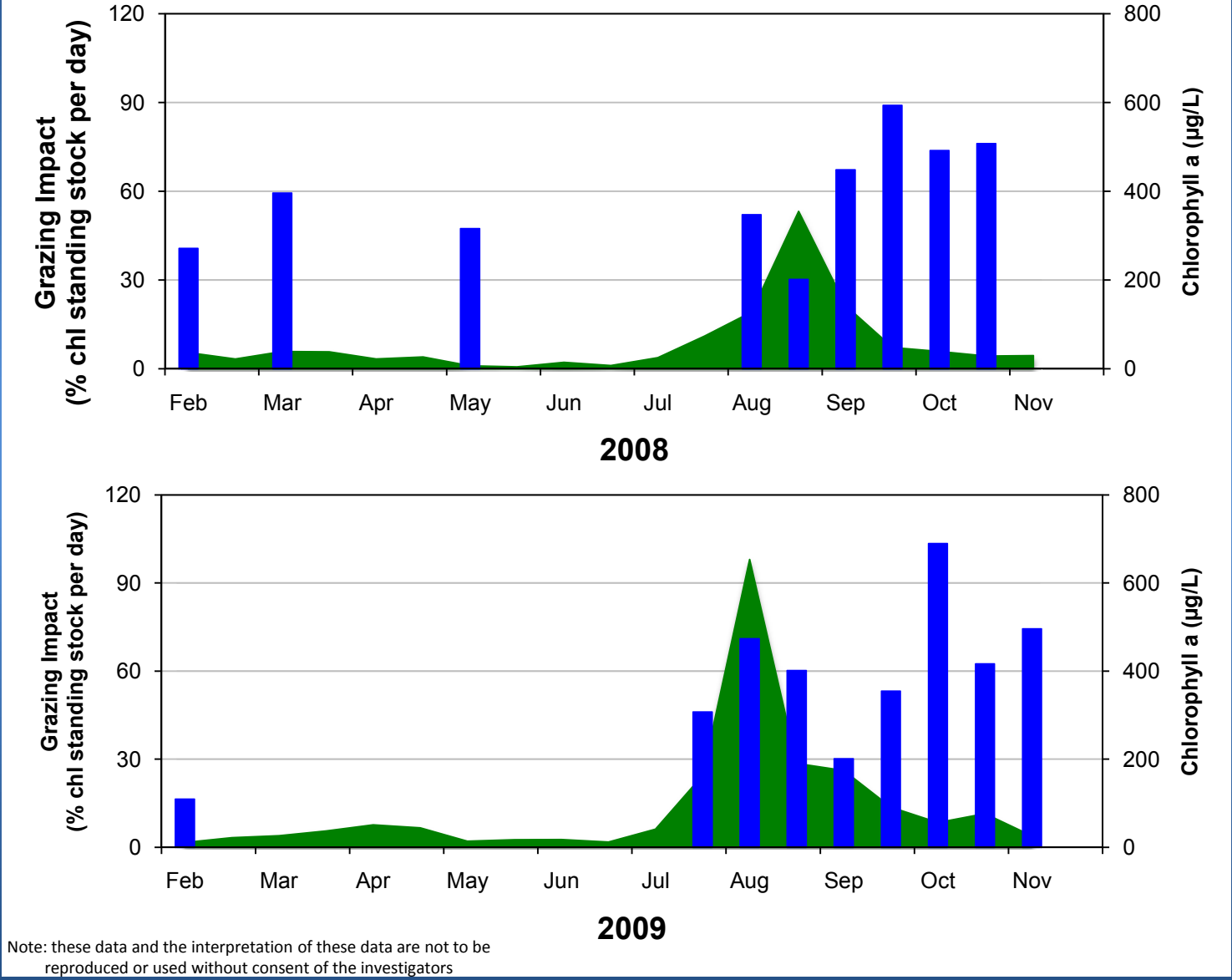
- Incubation experiments before, during and following late summer blooms in 2008 and 2009
- Measured feeding rates and diet preferences of copepods on all available planktonic prey (algae, cyanobacteria, protozoans)

Cyanobacteria vs. Copepod-Cladoceran Abundance

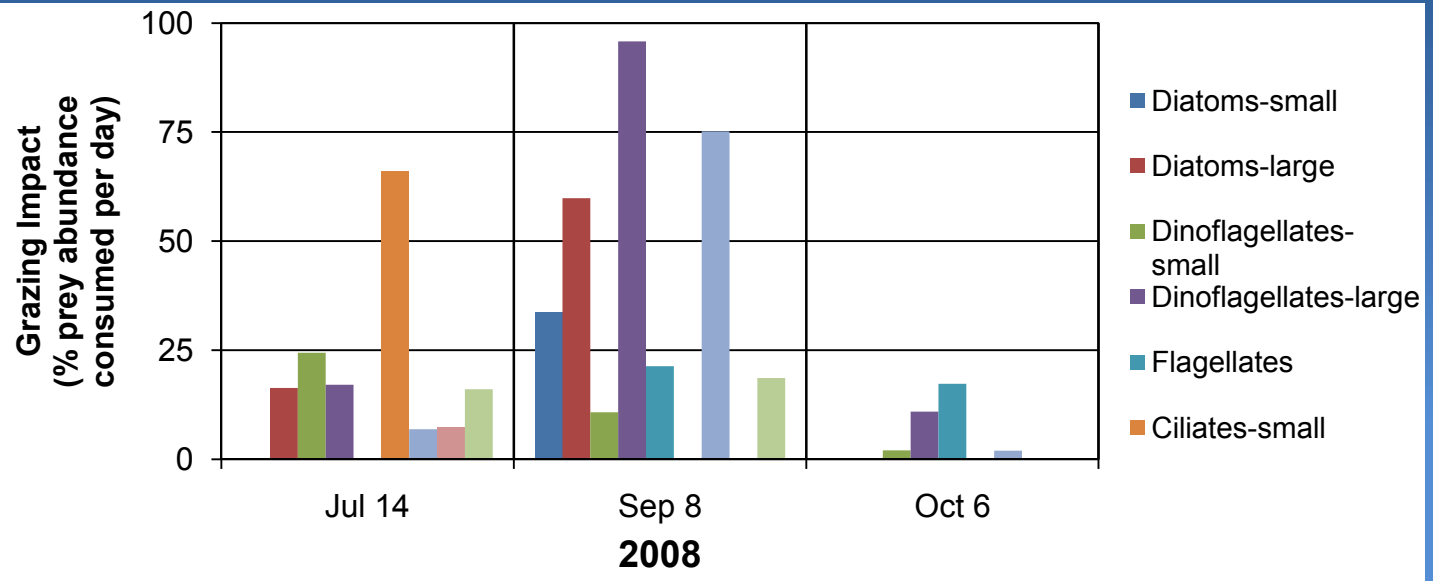


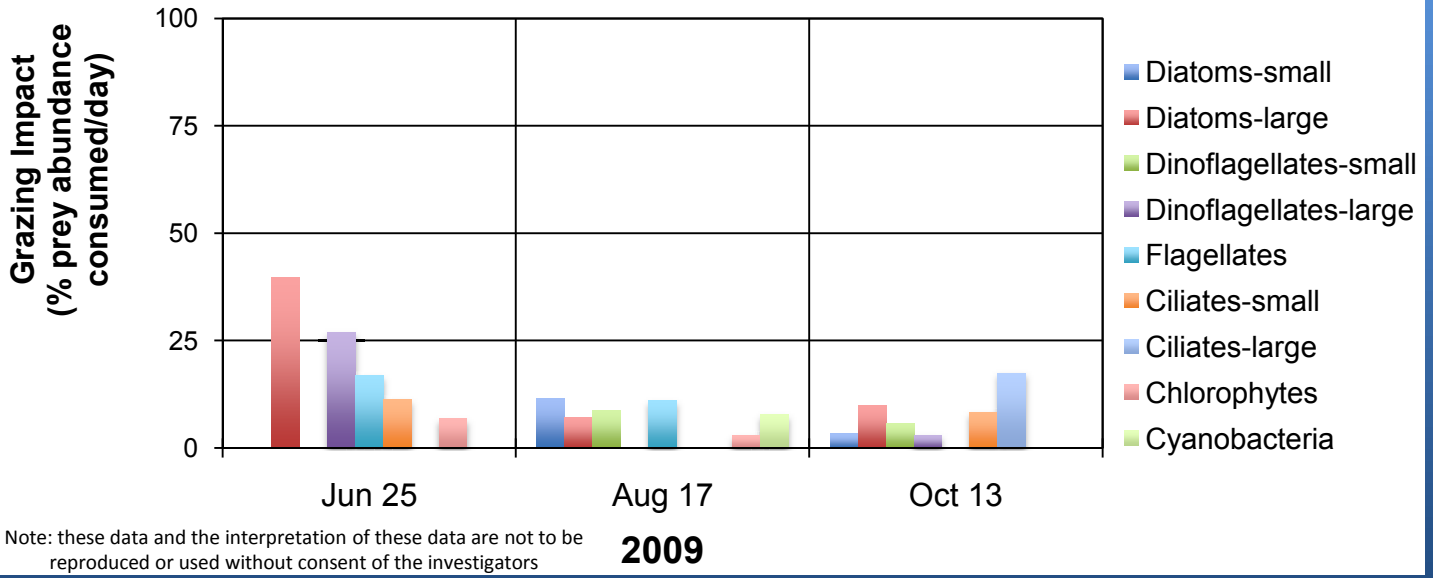
– – – – – – **Dates of incubation experiments**

Protozoan Grazing Impact
2008 – 2009



Copepod Grazing Impact
2008 – 2009





Summary (2007-2009)

- Very little spatial variability of phytoplankton, protozoans or zooplankton
- Cyanobacteria had extended summer blooms with extremely high abundance in 2007, 2008 and 2009
- Protozoan grazers (e.g. ciliates and dinoflagellates) may be influencing cyanobacteria blooms
- Both microzooplankton and mesozooplankton have high grazing impact on algae and cyanobacteria
- Likely modulating timing and magnitude of cyanobacteria blooms

Recommended Future Studies

- Cyanobacteria
  - continued collection for taxonomic identification
  - molecular genetic techniques for assessing toxin production and gene expression
  - higher frequency (daily) sampling with moored instruments
- Food web studies
  - role of higher trophic levels, e.g. fish and macroinvertebrates
  - biomanipulation as possible control of cyanobacteria blooms tested using experimental manipulation (e.g. enclosures or limnocorrals) and computer modeling