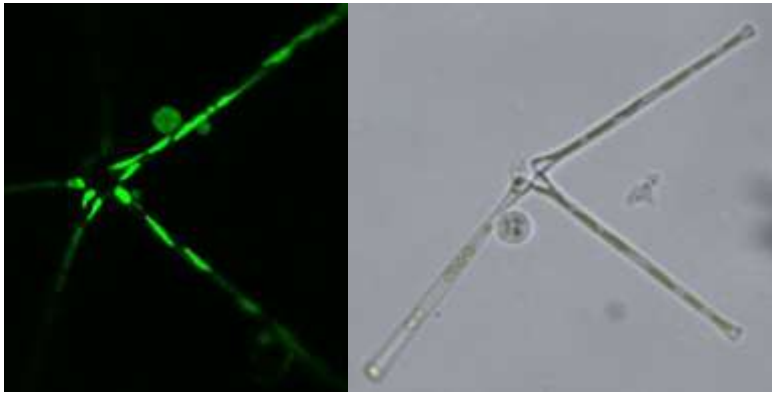
ROLE OF PHYTOPLANKTON PARASITES IN FOOD WEBS OF THE COLUMBIA RIVER ESTUARY



CMOP Center for Coastal Margin Observation & Prediction

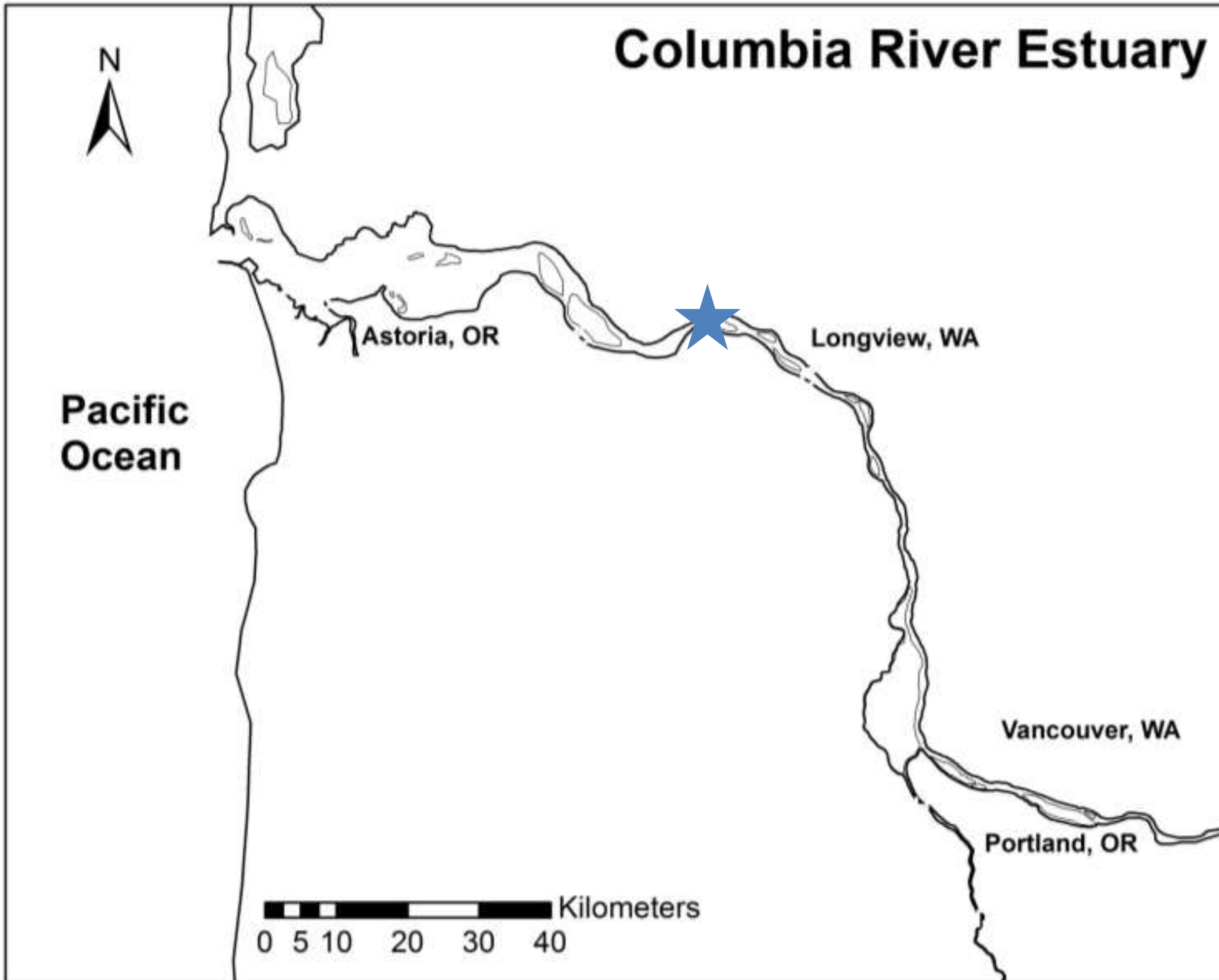
Michelle A. Maier, Joseph A. Needoba, and Tawnya D. Peterson

Oregon Health & Science University, Institute of Environmental Health, Center for Coastal Margin Observation & Prediction, Portland, Oregon

OHSU OREGON HEALTH & SCIENCE UNIVERSITY

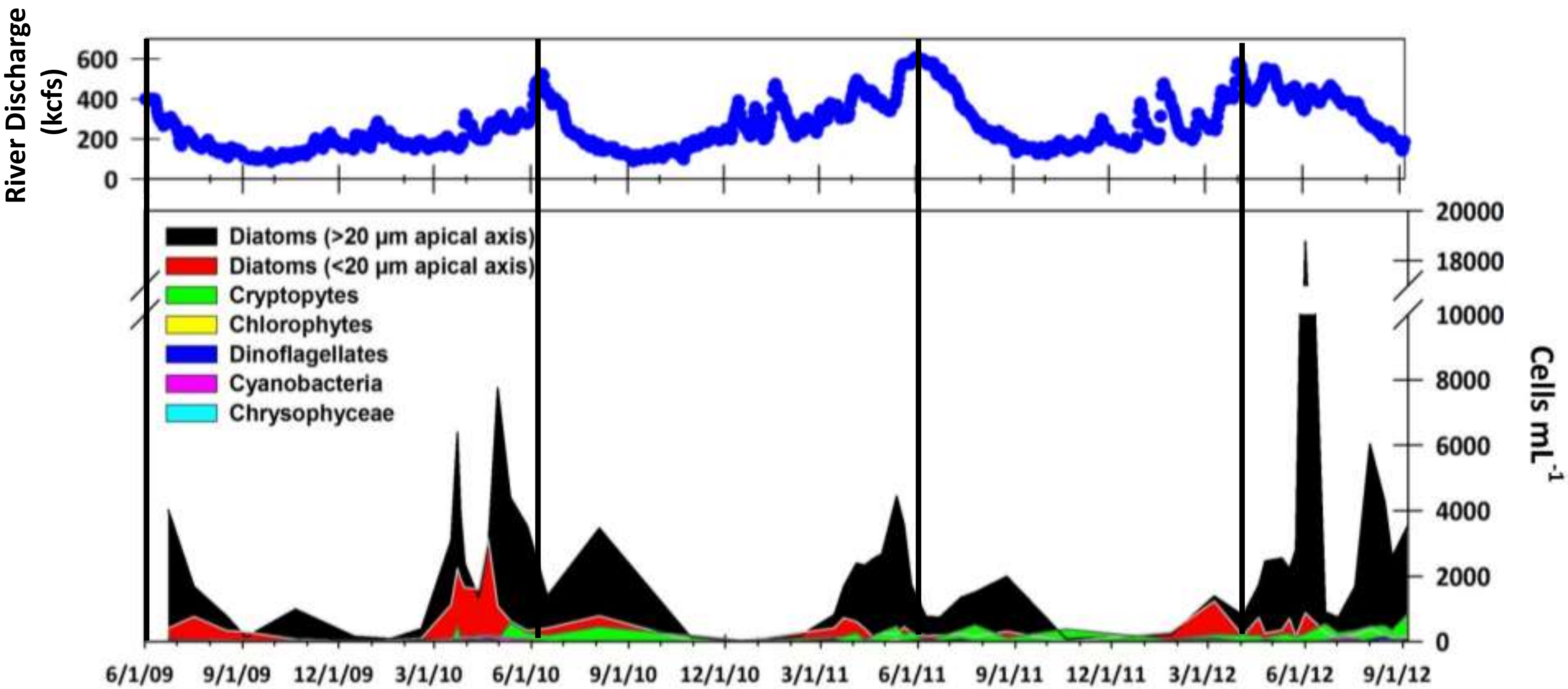
2014 Columbia River Estuary Workshop

Beaver Army Terminal

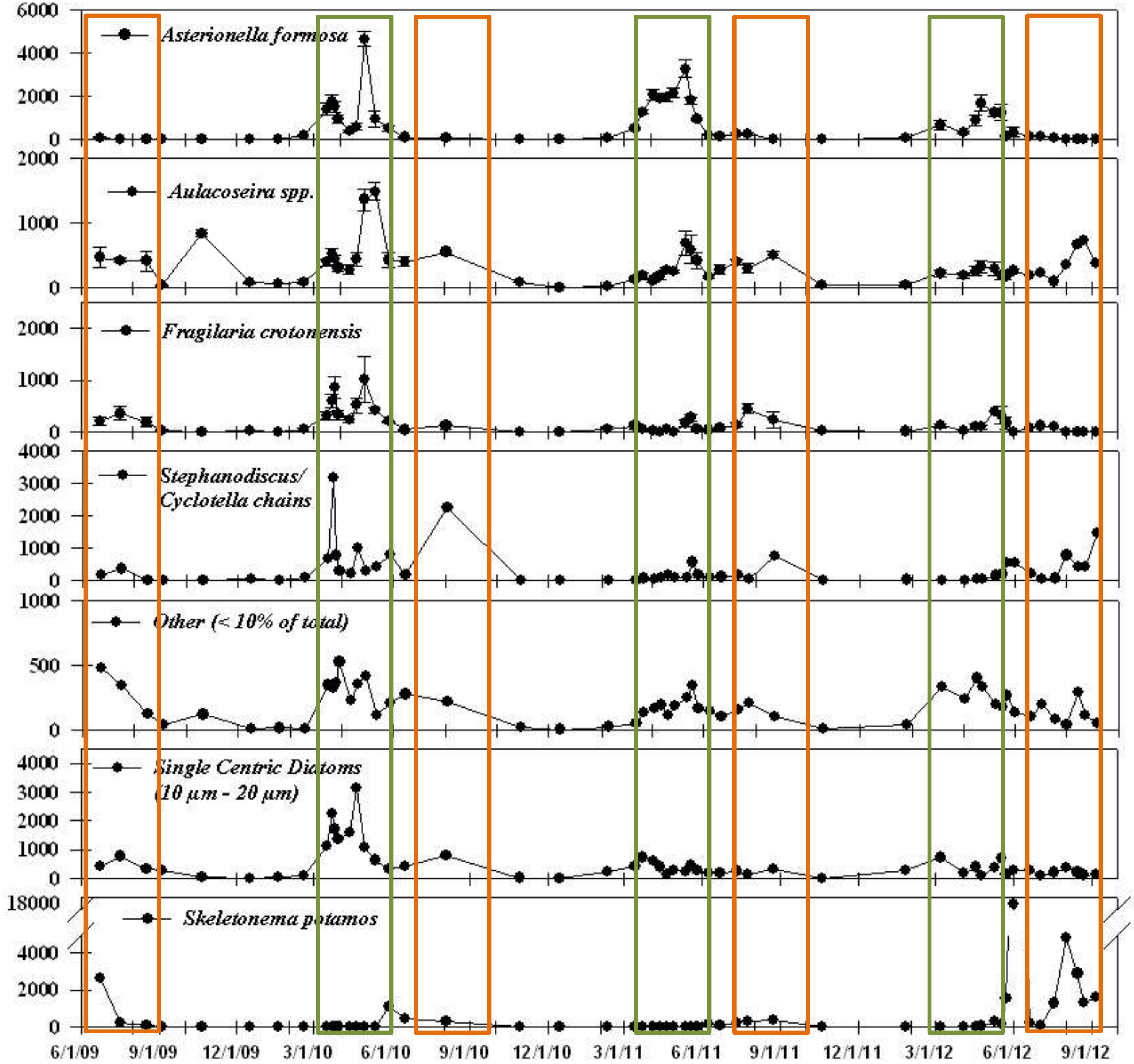


Columbia River exhibits phytoplankton blooms captured by in situ sensors

blooms dominated by diatoms

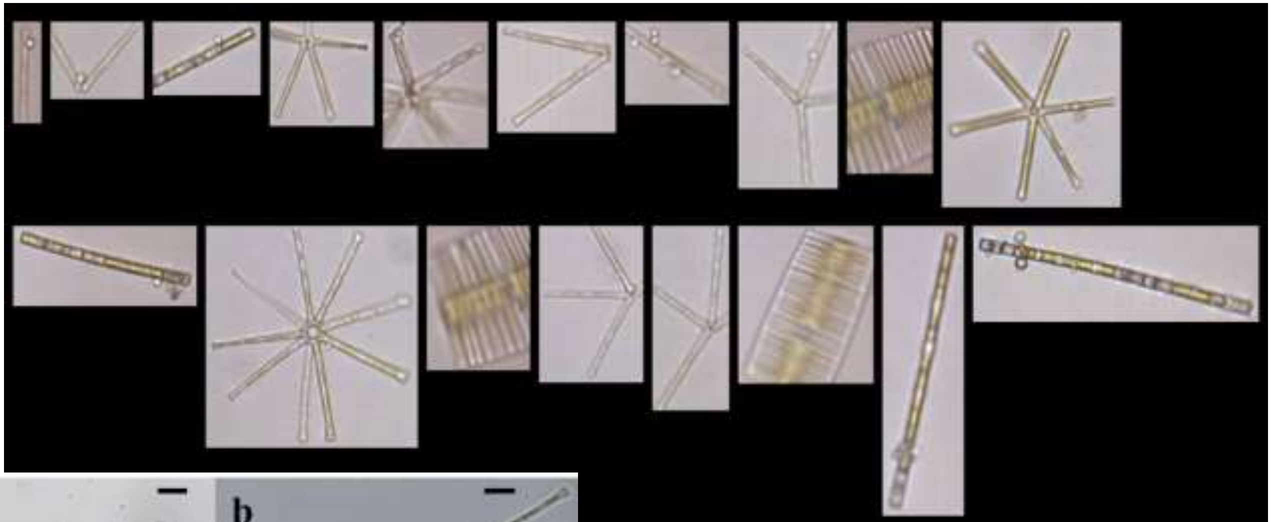


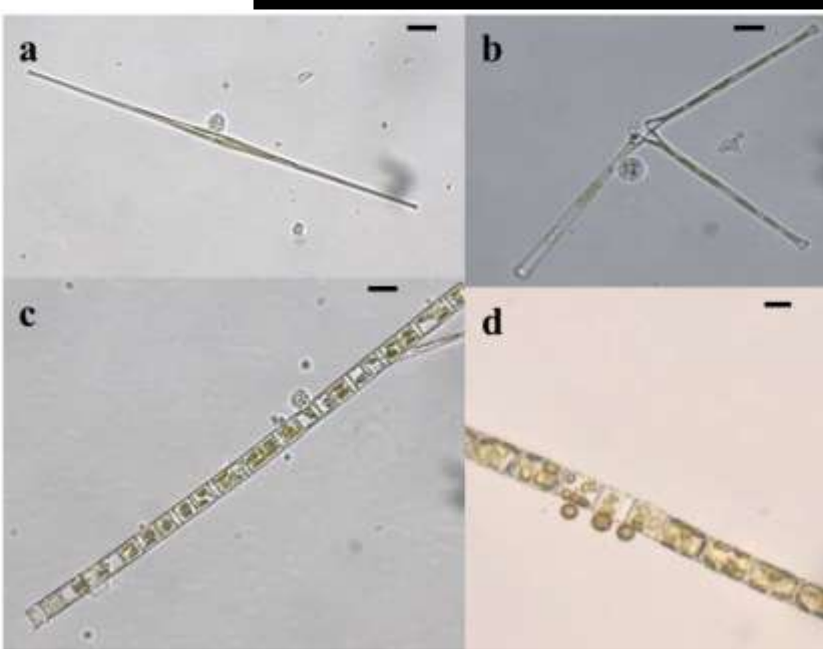
cells mL^{-1}

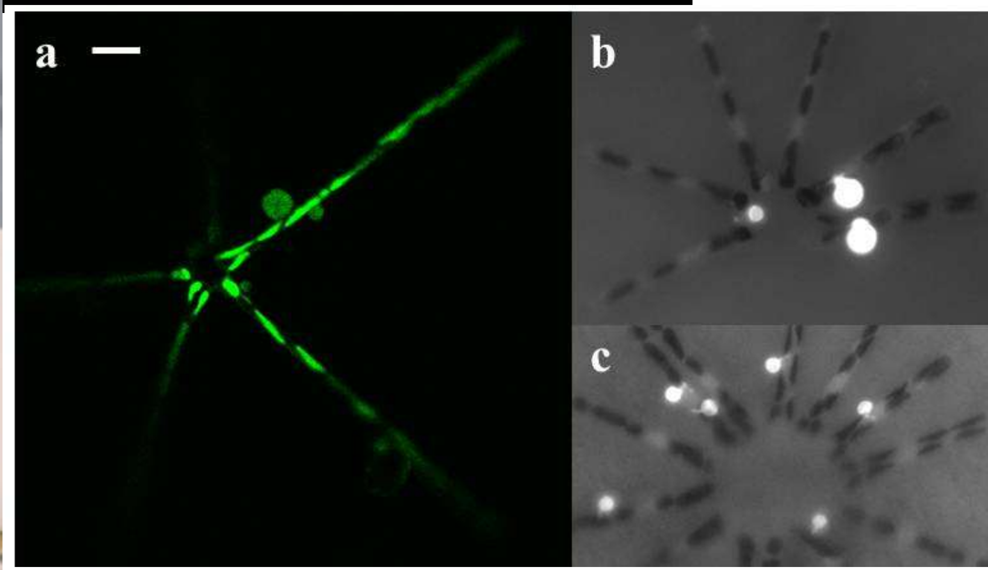


Asterionella formosa
Aulacoseira spp.
Fragilaria crotonensis
Stephanodiscus/
Cyclotella chains
Other (< 10% of total)
Single Centric Diatoms
(10 µm - 20 µm)
Skeletonema potamos
6/1/09
9/1/09
12/1/09
3/1/10
6/1/10
9/1/10
12/1/10
3/1/11
6/1/11
9/1/11
12/1/11
3/1/12
6/1/12
9/1/12

Abundance of fungal parasites on phytoplankton (‘chytrids’)



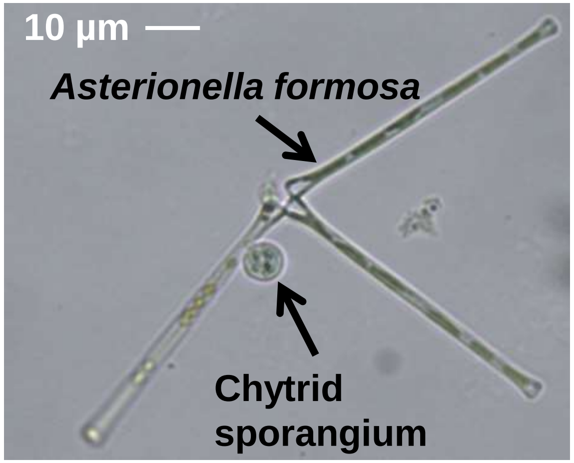


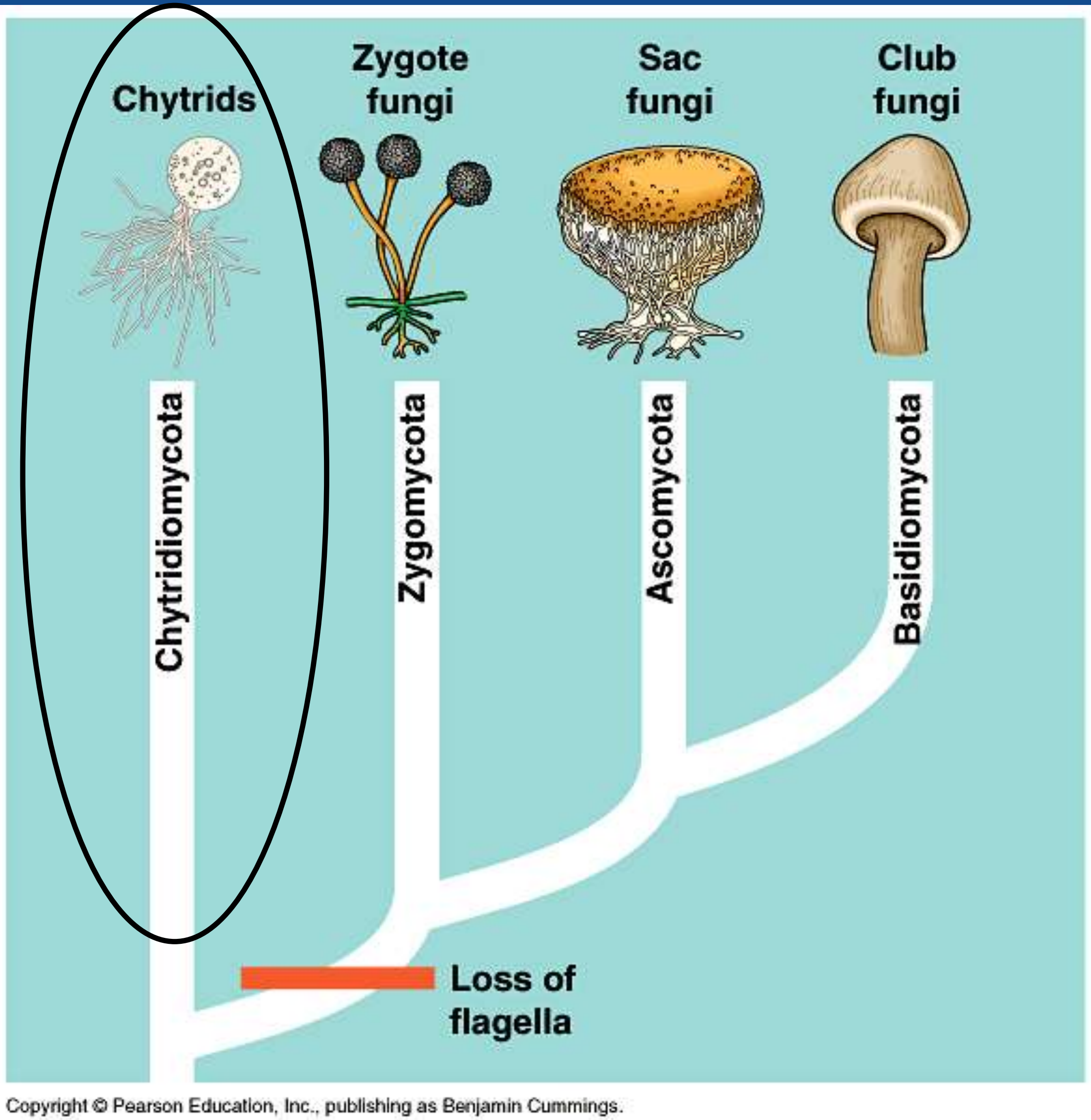


Scale 10 µm

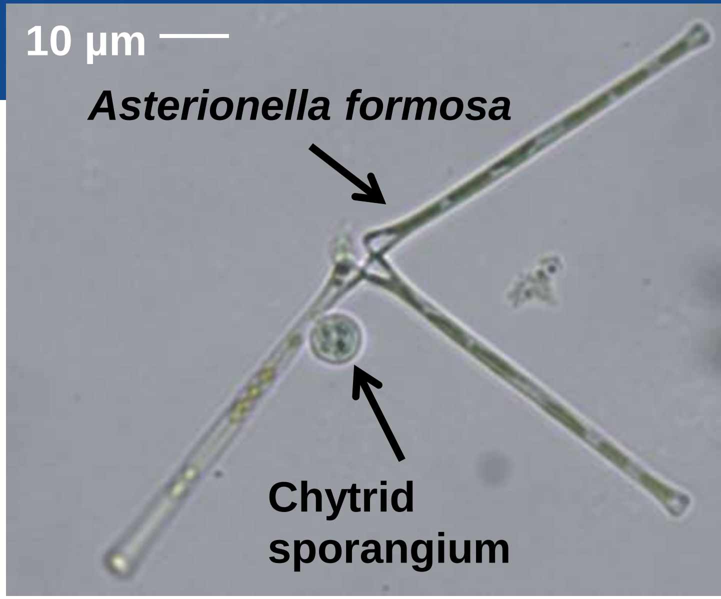
Chytrids in aquatic systems

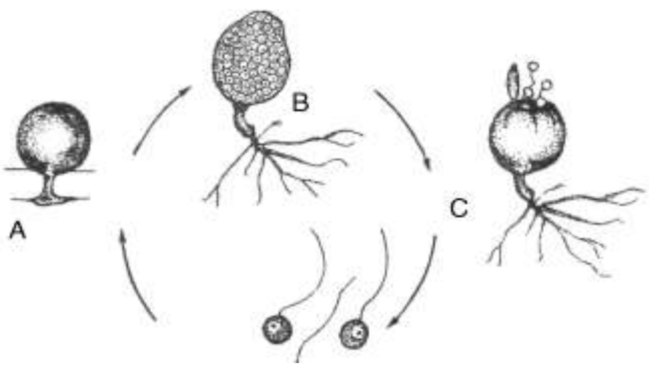
- Saprotrophs
- Parasites



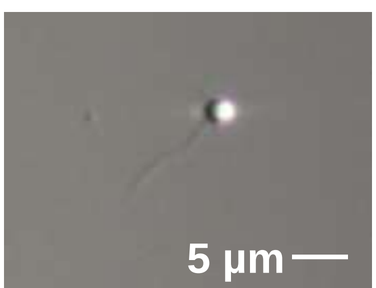


http://www.bio.utexas.edu/faculty/sjasper/Bio301M/fungiplants.html





Chytrid zoospore

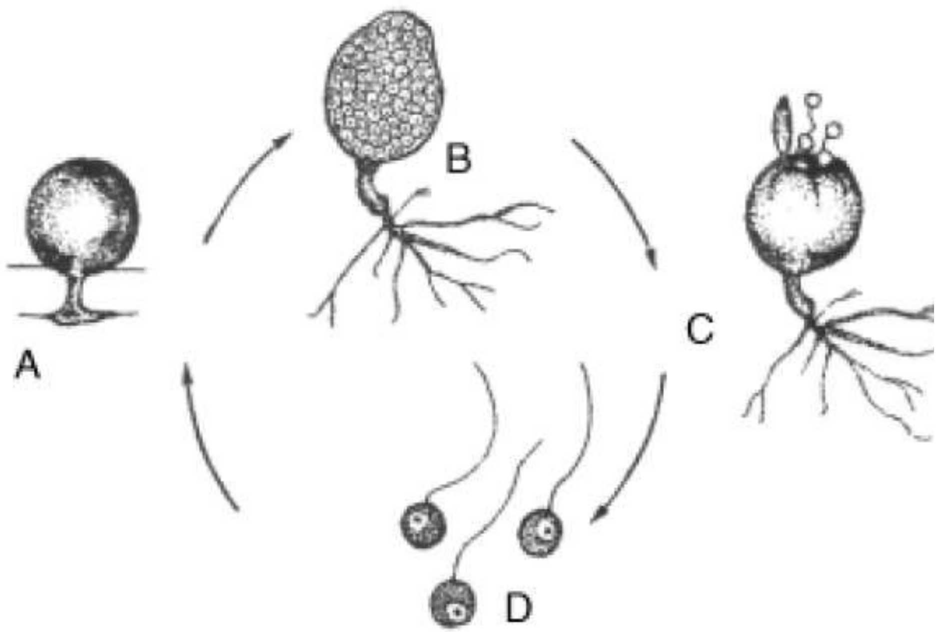


Parasitic chytrids of phytoplankton

- Parasitism can lead to spring bloom decline in lake ecosystems (Ibelings et al., 2004)
- Few chytrids reported and studied in river systems
- Chytrids may play an unrecognized role in the food web by efficiently shunting carbon from large diatoms to zooplankton.

Role of chytrids in carbon cycling

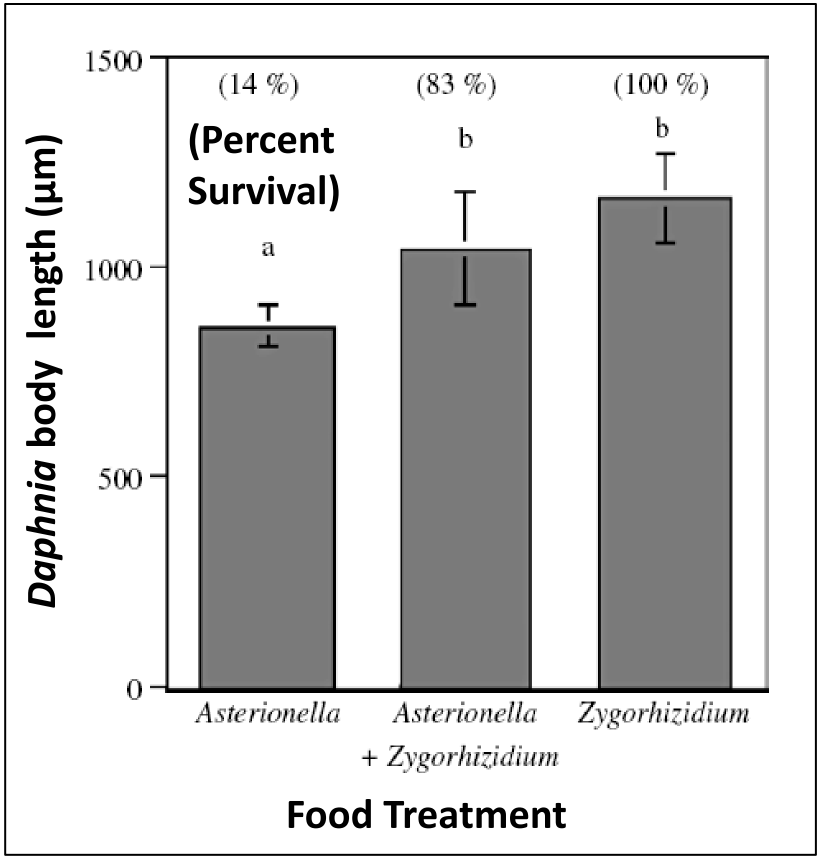
Doggett & Porter, 1996



Chytrid zoospores

Grazed

www.micromagus.net/microscopes/pondlife_cladocera.html



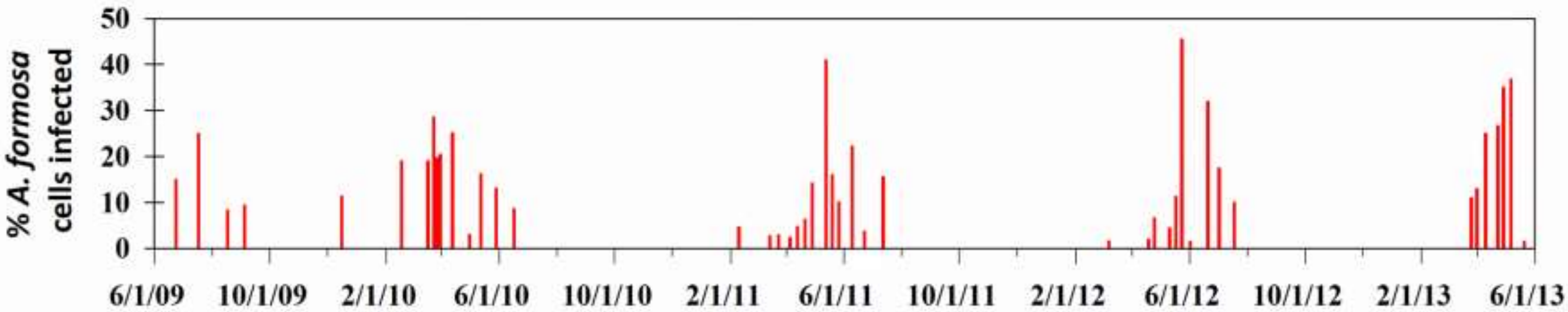
Kagami et al., 2007

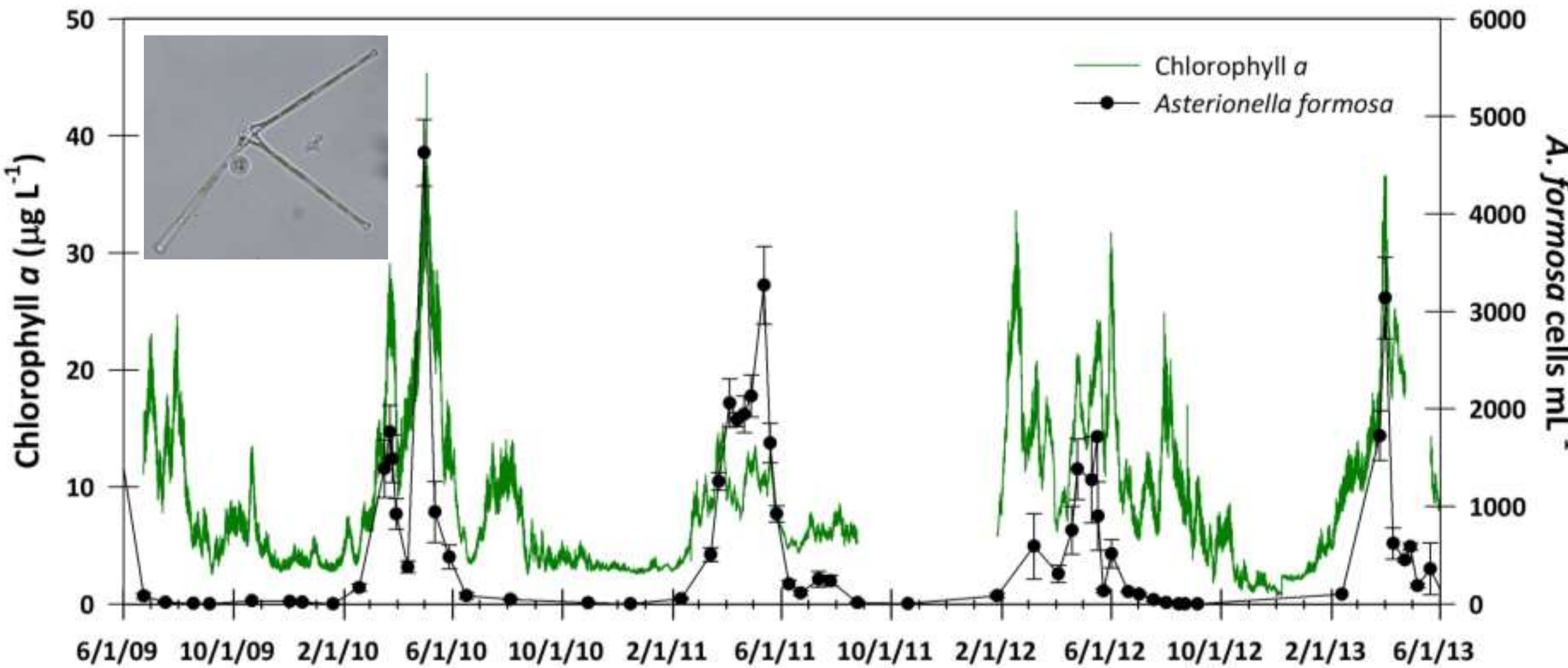
Study Objectives & Methods

1. Describe the seasonal dynamics of chytrid infections on diatoms in the Columbia River → **2009-2013**
   - Prevalence of infection → **Enumerate sporangia**
   - Zoospore abundance → **Specific qPCR assay**
2. Estimate the contribution of chytrid parasites in the Columbia River food web → **Convert abundances to particulate organic carbon**

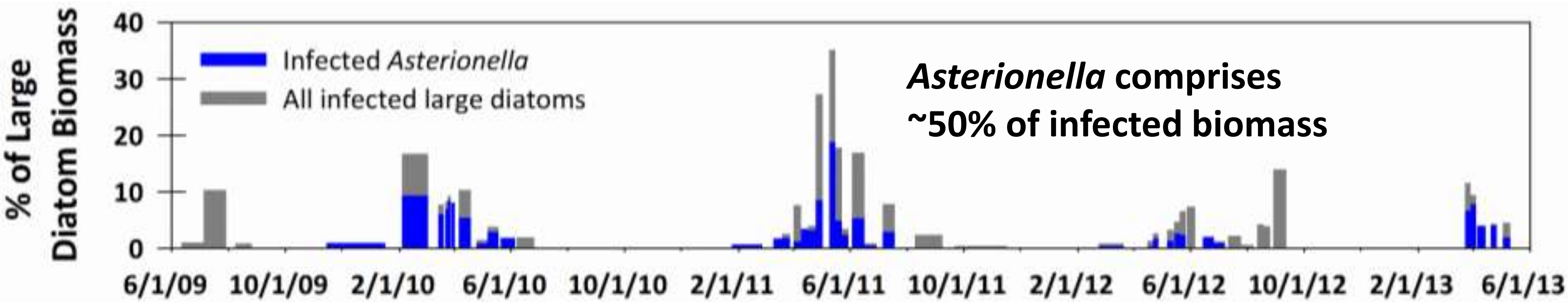
CMOP

Spring blooms dominated by *A. formosa*

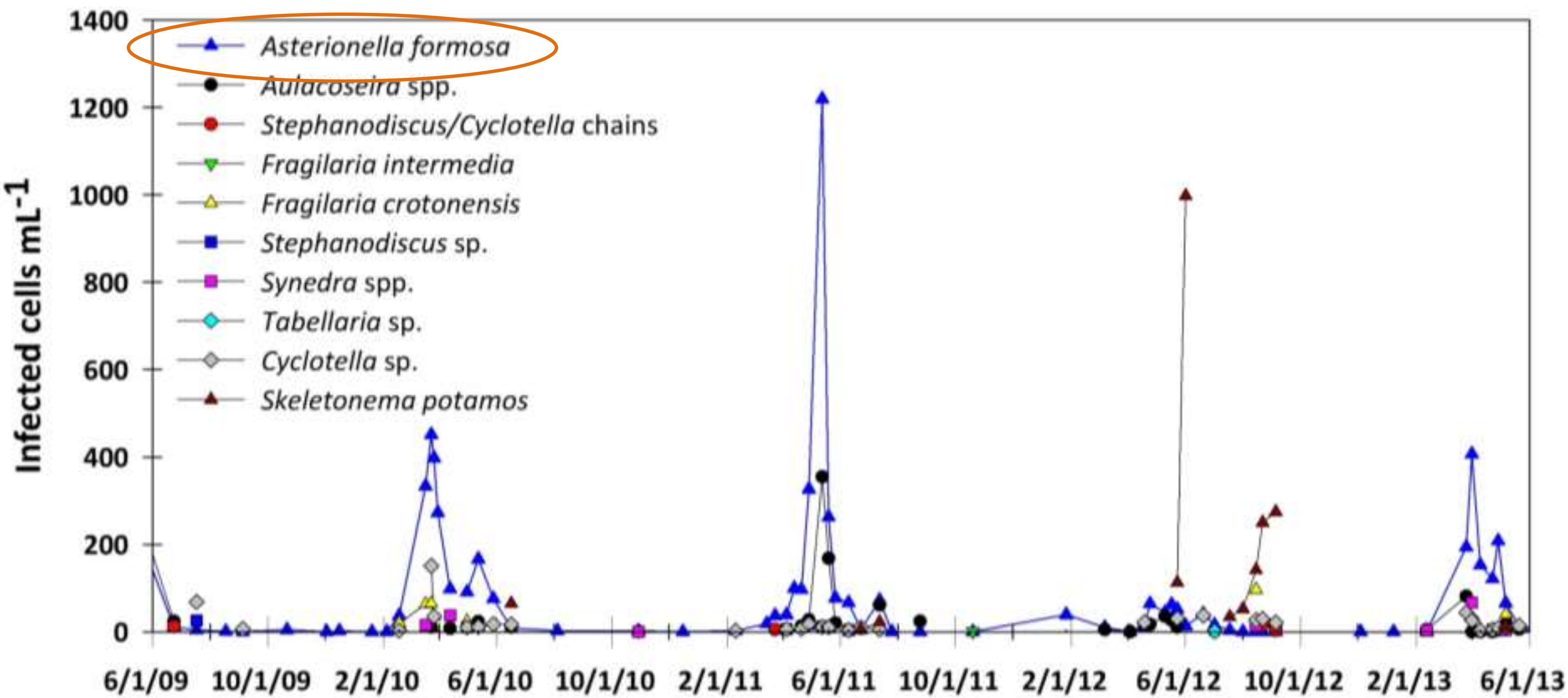




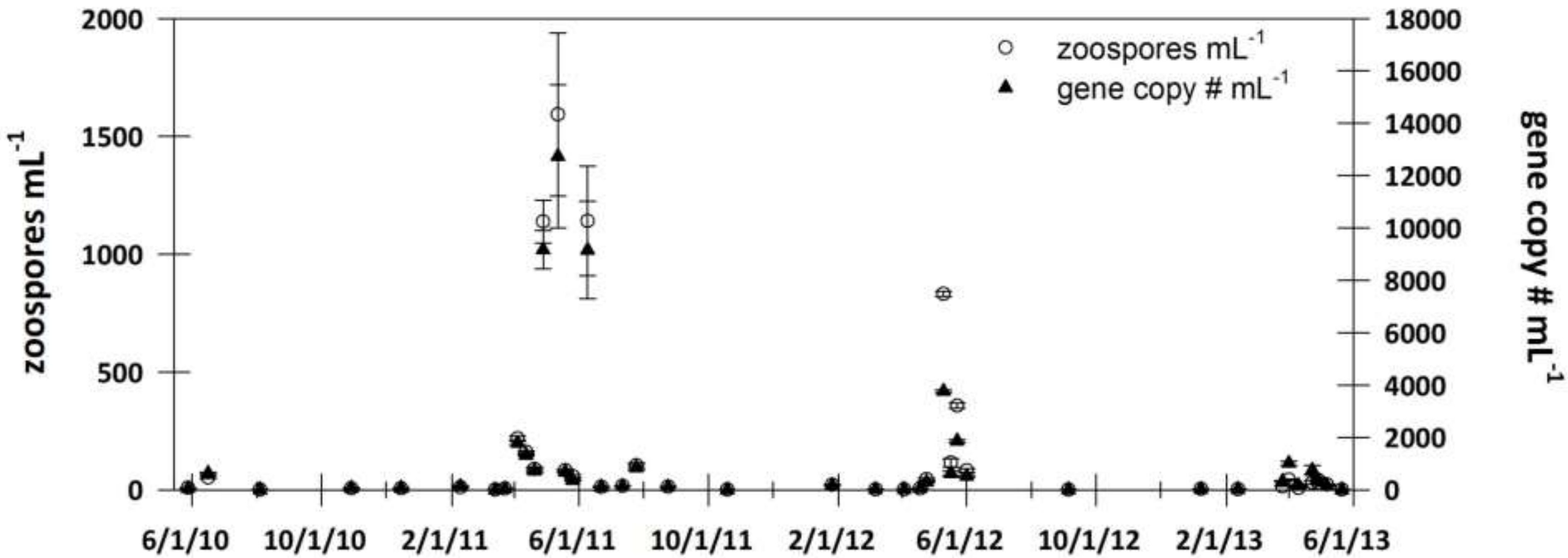
Highest infection prevalence in spring



Asterionella **comprises ~50% of infected biomass**



Estimation of zoospores in the Columbia River



Kagami et al. 2007	zoospore
carbon (pg cell^{-1})	10.7 ± 1.7
nitrogen (pg cell^{-1})	0.60 ± 0.1
phosphorus (pg cell^{-1})	2.40 ± 0.0
C : N ratio	18.4 ± 1.3
C : P ratio	4.45 ± 0.7

~15% of *A. formosa* carbon biomass available in the form of zoospores.

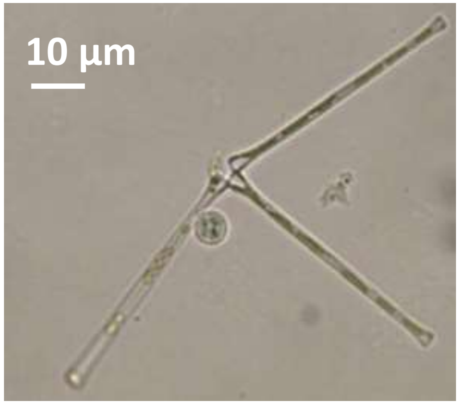
Fate of zoospores in the environment in spring

A. formosa accounts for up to 65% of large diatom carbon biomass

(124 µg C L^{-1})

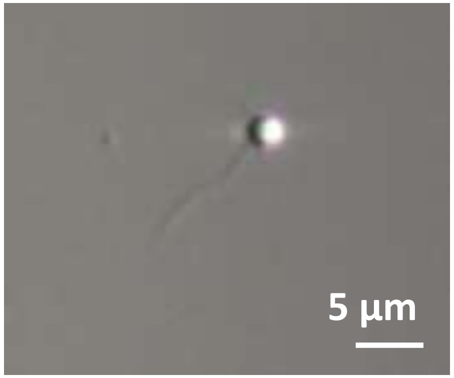
~40 % of *A. formosa* cells infected

(46 µg C L^{-1})



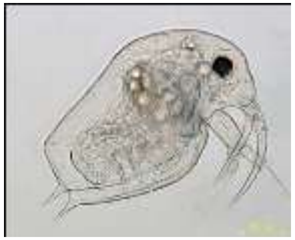
~15% of *A. formosa* carbon biomass available in the form of zoospores

(17.1 µg C L^{-1})



Reinfection

Grazed



Turchin 2003; http://www.micromagus.net/microscopes/pondlife_cladocera.html

Key Findings

- Increased water retention time & decreased turbidity compared to natural river flows has allowed diatoms to bloom & potentially opened a niche for chytrid parasites
  - Multiple diatom species found infected in the Columbia River in spring & summer
- Infections do not reach epidemic proportions
  - 30-40% of dominant diatom infected each spring
  - Chytrids may prevent spring blooms from reaching maximum potential
  - Spring freshet leads to the decline of host diatoms & parasites
- The base of the food web is complex
  - Chytrids may provide an unrecognized route for the transfer of organic matter into local food webs
  - Up to 30% of the phytoplankton biomass infected in spring
  - At least 15% of *A. formosa* carbon biomass released into zoospores, however, quantification of all chytrid species/strains may be greater

Future directions

- Quantify additional parasitic chytrid zoospores in the Columbia River
- Evaluate grazing of zoospores by dominant zooplankton
  - Assess zoospore reinfections on diatoms in the presence of grazers
- Describe environmental parameters that influence chytrid infectivity in the Columbia River

Questions?