

# Patterns in Nutrients over *Dreissena-Cladophora* Impacted Shoreline

2010 Conference of the Lake Erie Millennium Network

April 27, 2010

Todd Howell  
Environmental Monitoring and Reporting Branch  
Ontario Ministry of the Environment



# Presentation Outline

---

## *Background*

- Lakebed over *Dreissenid-Cladophora* impacted shoreline
- Variability in Water Quality at the lake interface with the shoreline

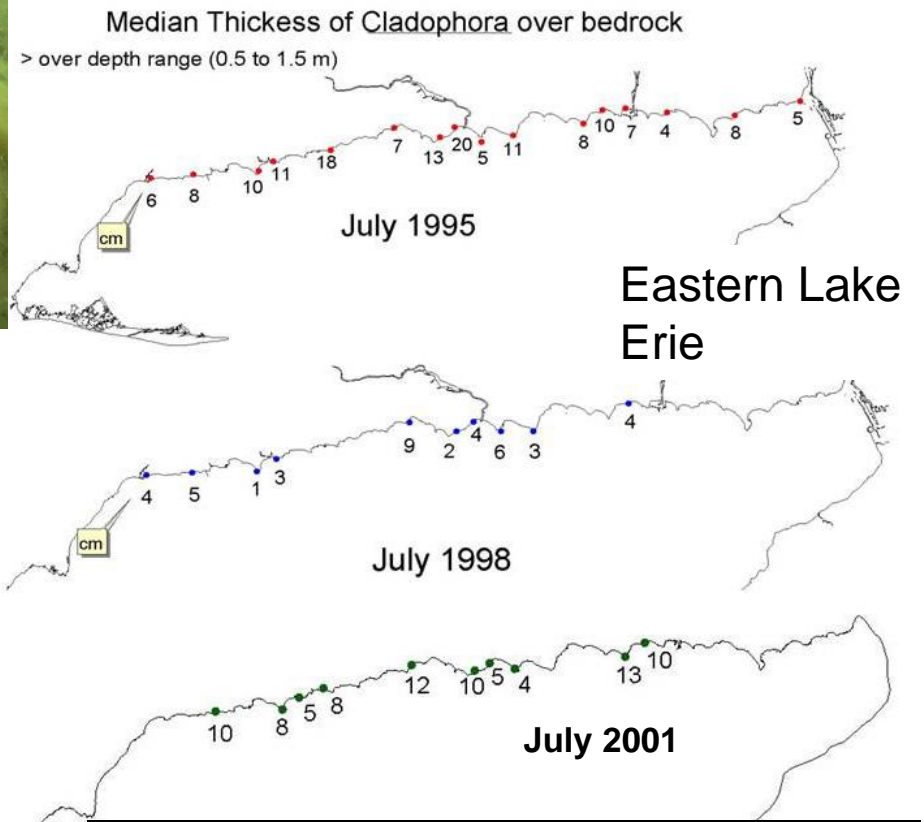
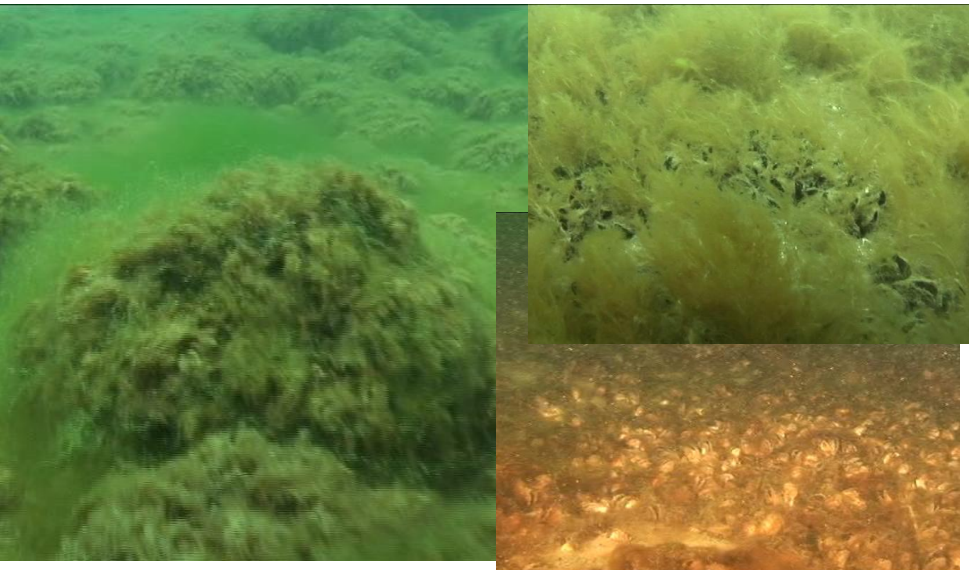
## *Patterns in Water Quality Over Shoreline with Dreissena-Cladophora “beds”*

- Distributions of Total Phosphorus Over Selected Nearshore Areas
- Distributions of Chlorophyll a as an Indicator of Water Quality Features

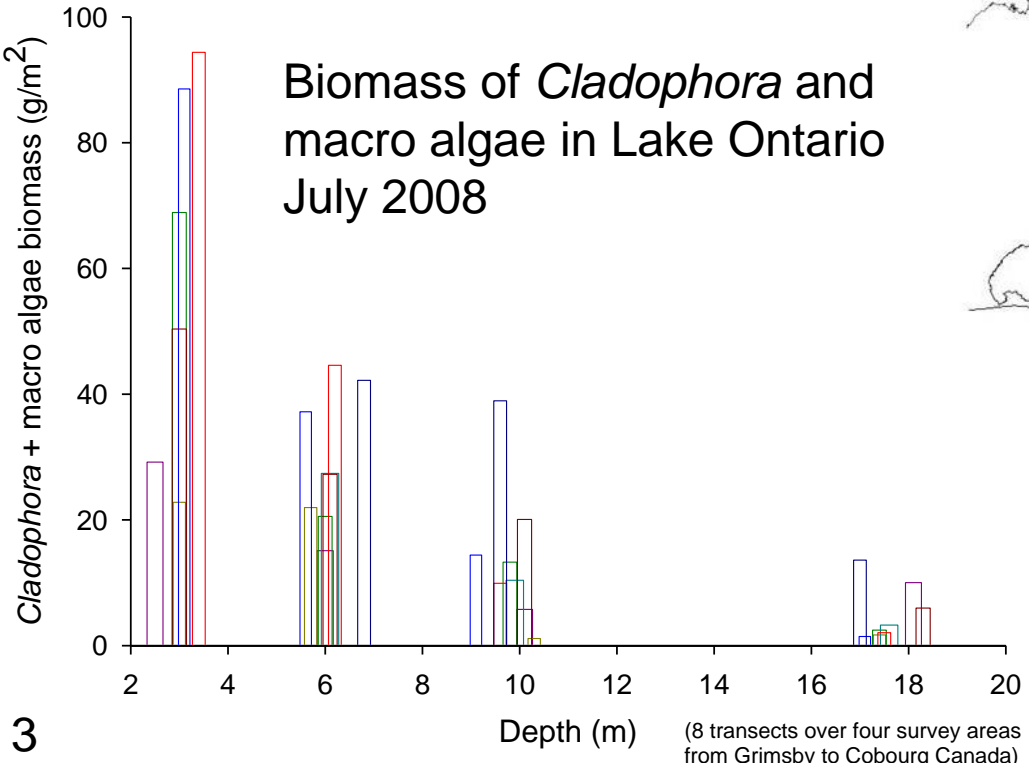
## *Questions around the interactions between the Dreissena-Cladophora association and the variability in nearshore water quality*

- How might *Dreissena-Cladophora* “beds” affect short-term and spatial variability in nearshore water quality?

*Dreissena* and *Cladophora* on Lakebed: widespread in Lake Ontario and Eastern Lake Erie



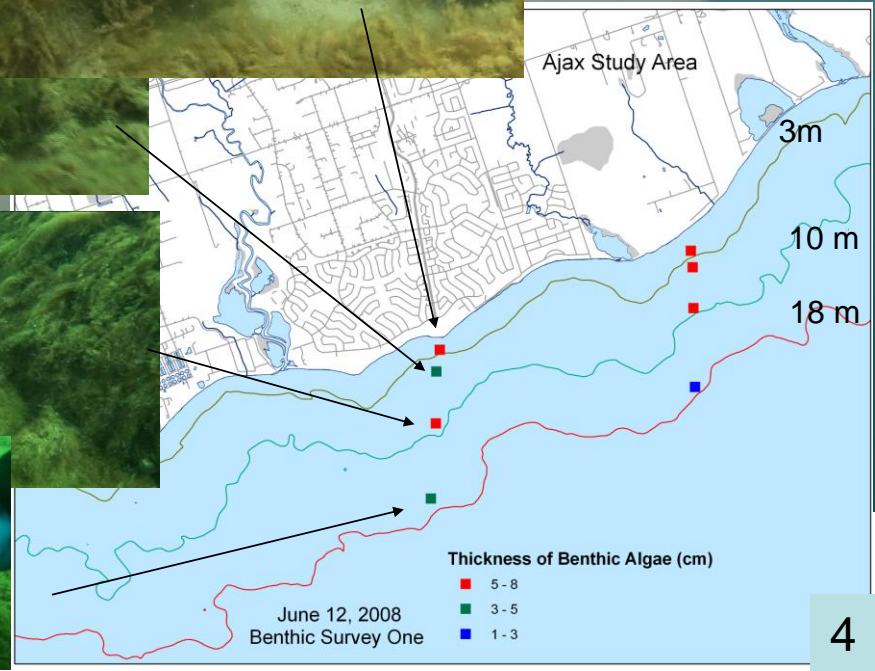
Biomass of *Cladophora* and macro algae in Lake Ontario July 2008



- Co-occurrence of *Dreissena* and *Cladophora* on stable substrate (to depths supporting *Cladophora* growth)
- To 18+ m depth in Lake Ontario and estimated as 8-9 m in Lake Erie
- Concentration of organic material and biological activity on the lakebed



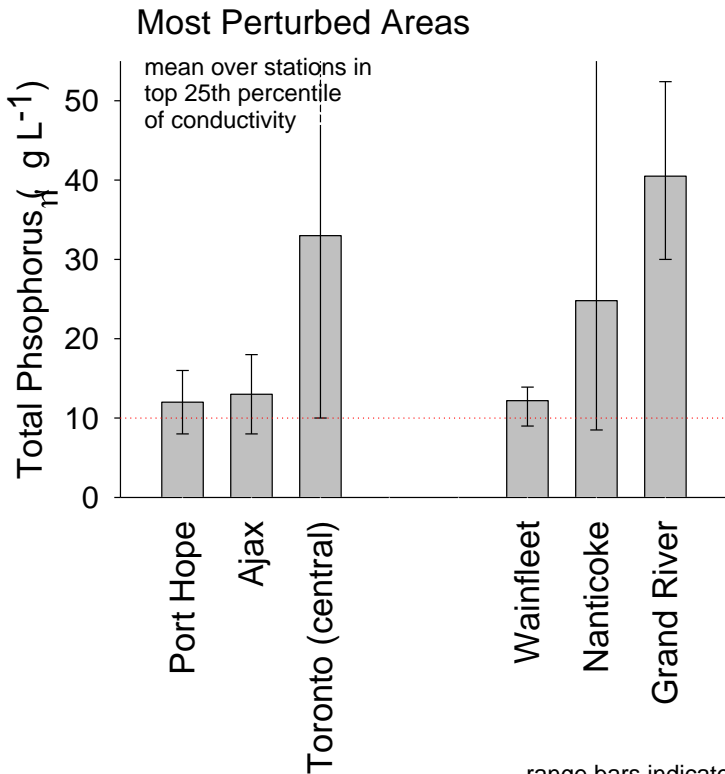
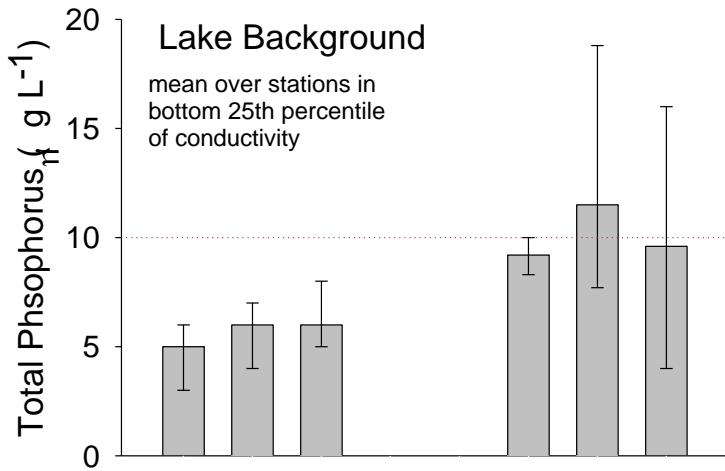
Shallow lakebed optimal for development of a *Dreissena* and *Cladophora* layer is in a zone subject to variability in water quality due to interactions with adjacent lands



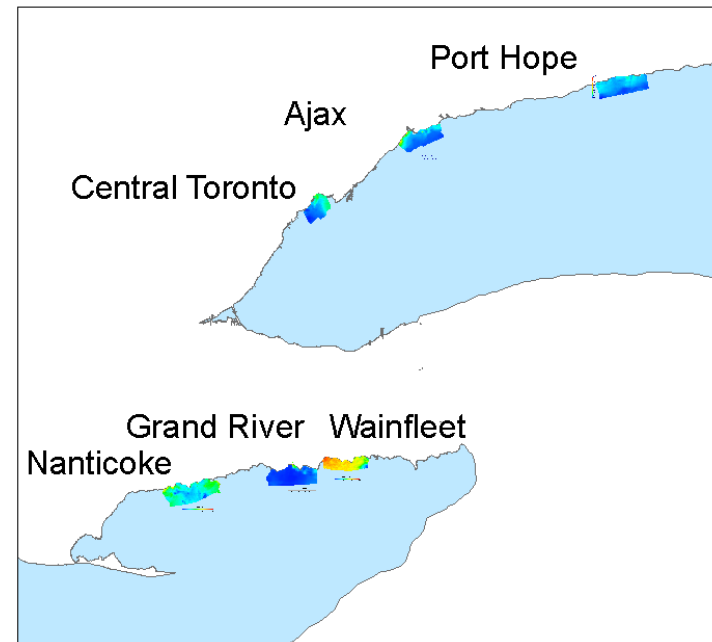
Turbidity Plume  
On Ajax Waterfront  
Lake Ontario

# Six Areas of Shoreline Used to Explore Patterns in TP and Chl a in the Nearshore

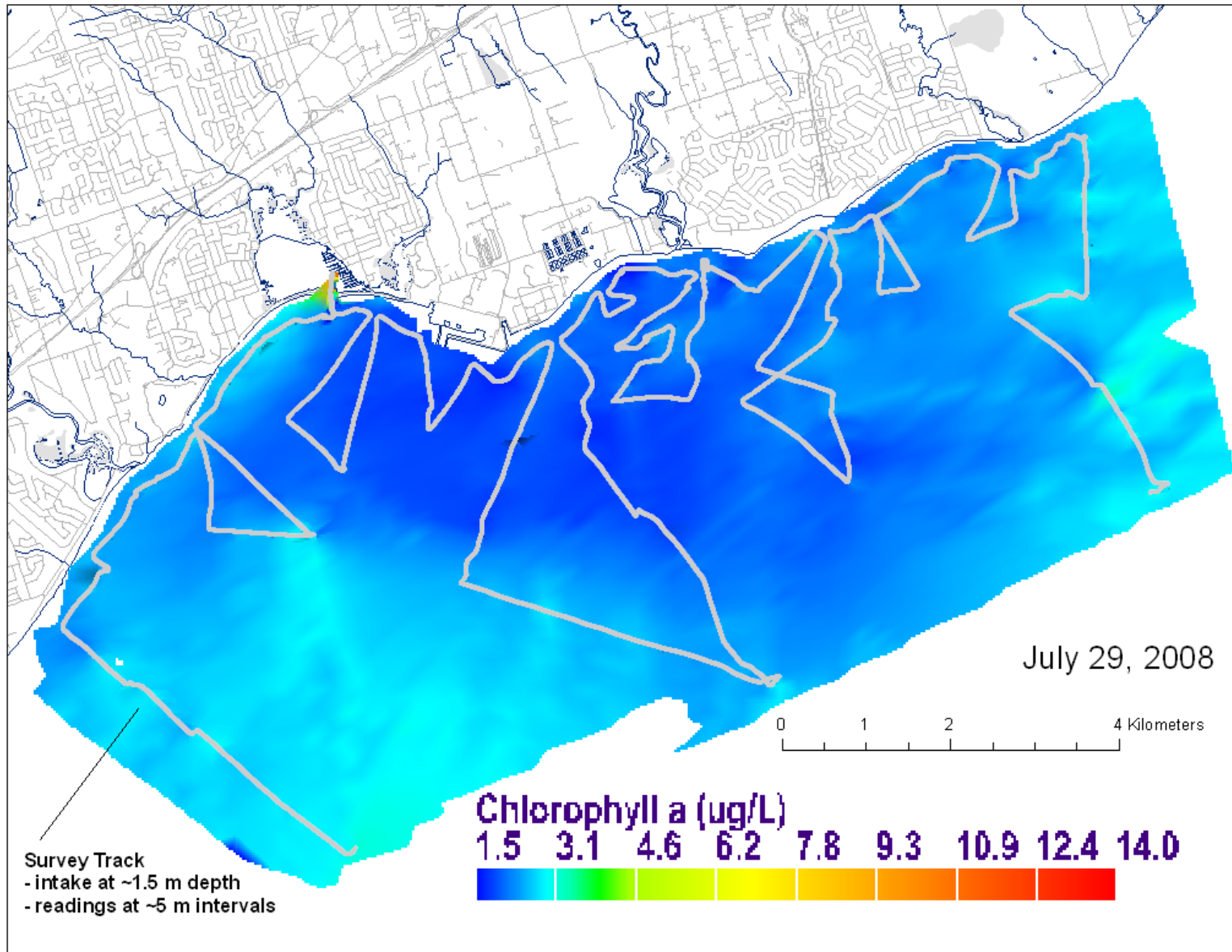
- all have areas of hard substrate with *Dreissena* and *Cladophora*
- locations vary in relative extent watershed influence
- **Eastern Lake Erie:** mouth of the Grand River, Nanticoke and Wainfleet. Surveys in 2001 and 2002
- **Lake Ontario:** central Toronto, Ajax, Port Hope. Surveys in 2008



range bars indicate min and max values of means over 4 to 5 surveys



# Similar Suite of Water Quality Measurements Made Over Areas

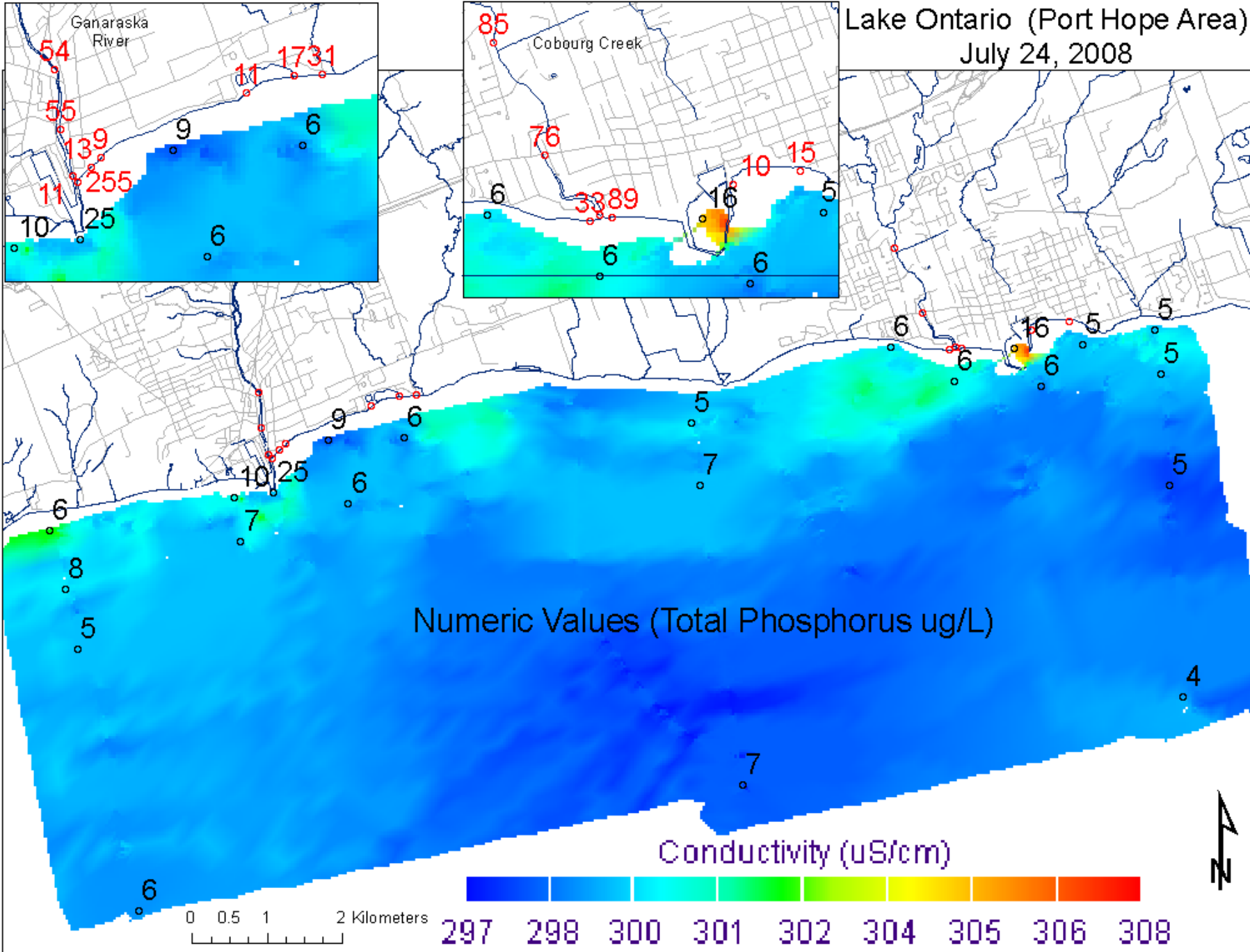


Field sensors:  
conductivity,  
temperature,  
turbidity or beam  
attenuation,  
chlorophyll a,  
and hydrocarbon  
fluorescence and  
nitrate (2008)

Point samples:  
lab analysis of  
nutrients,  
selected ions,  
and suspended  
solids

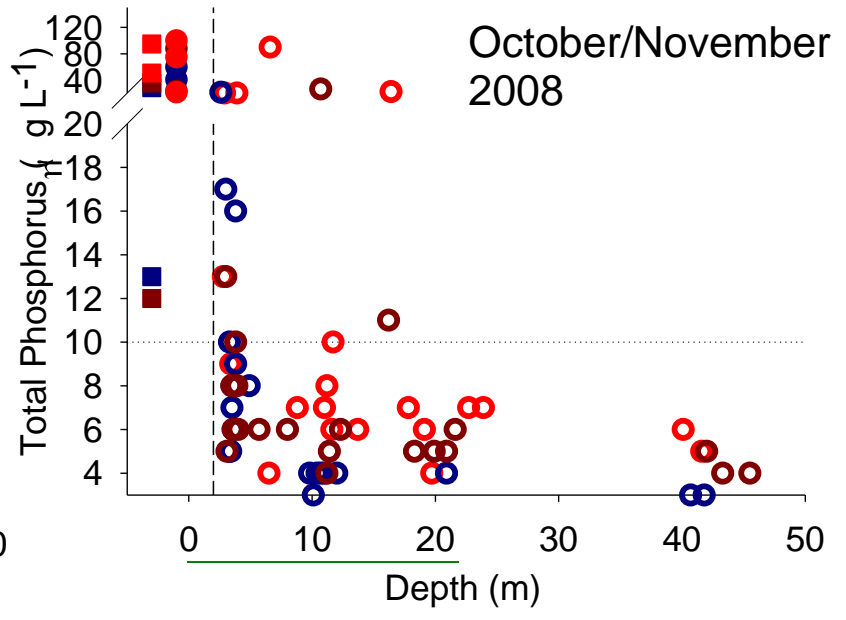
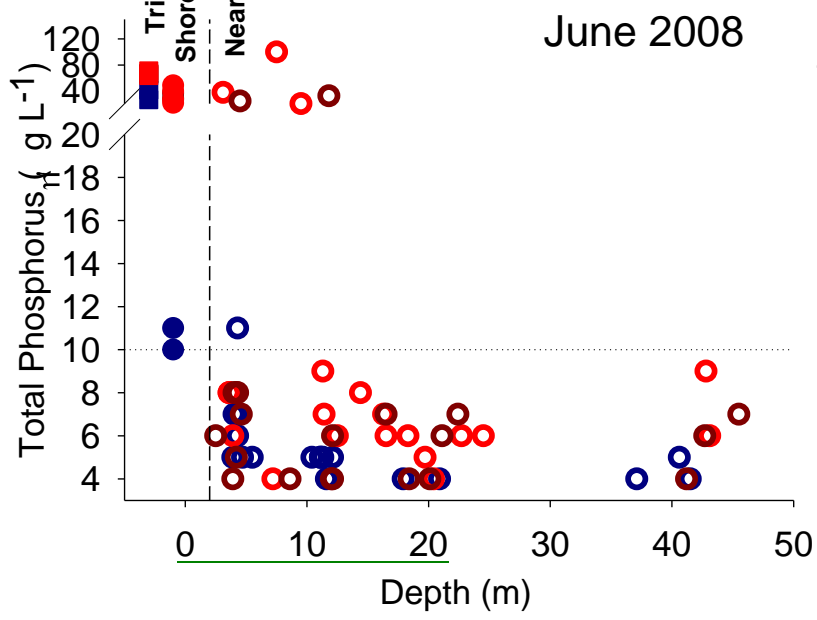
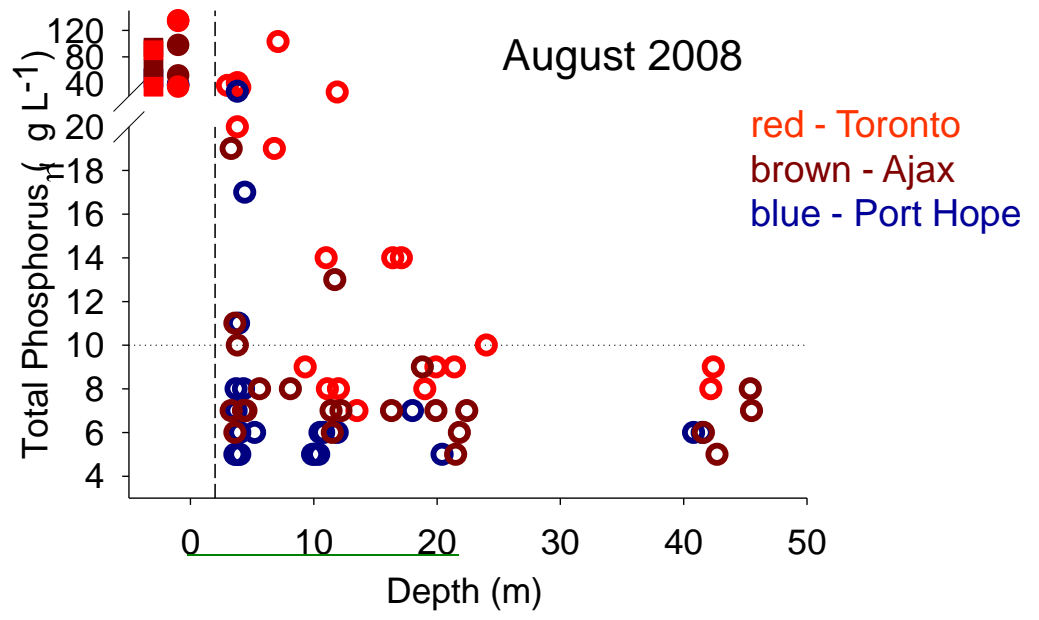
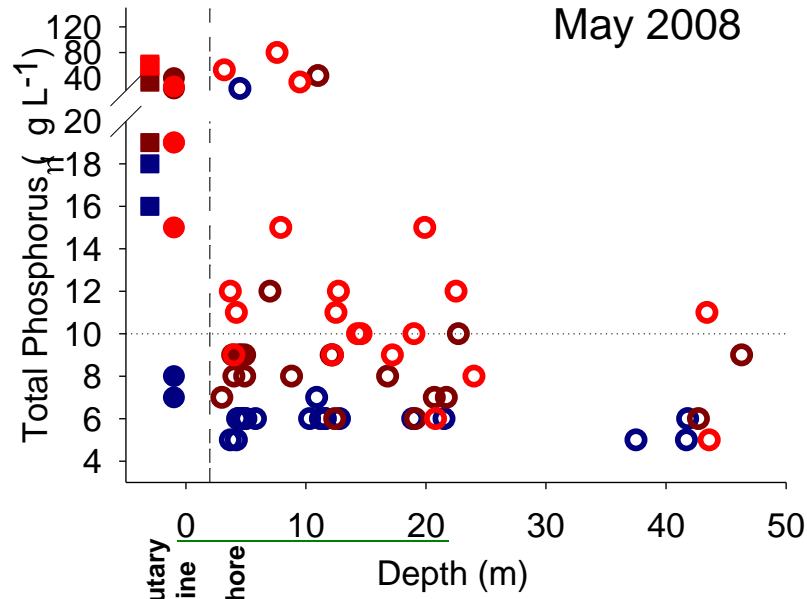
Survey effort:  
10-15 km of  
shoreline  
extending ~5km  
offshore

Lake Ontario (Port Hope Area)  
July 24, 2008



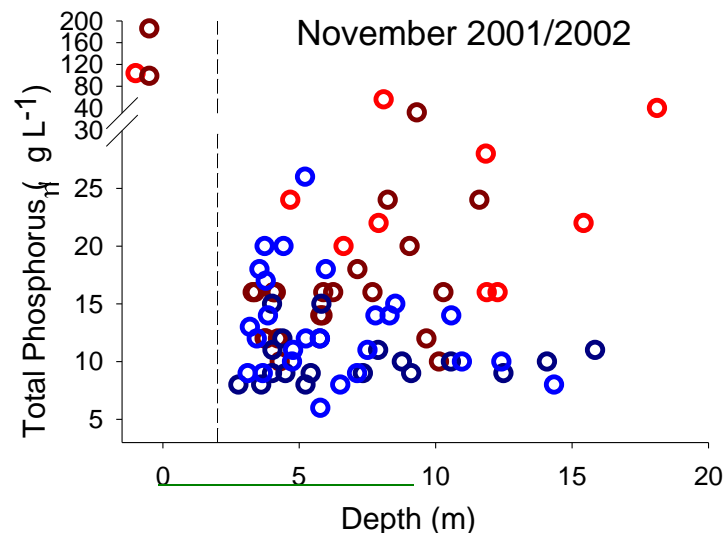
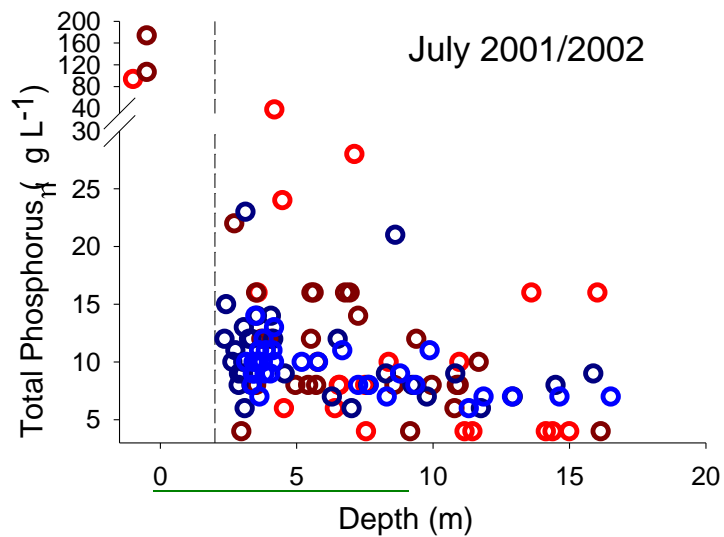
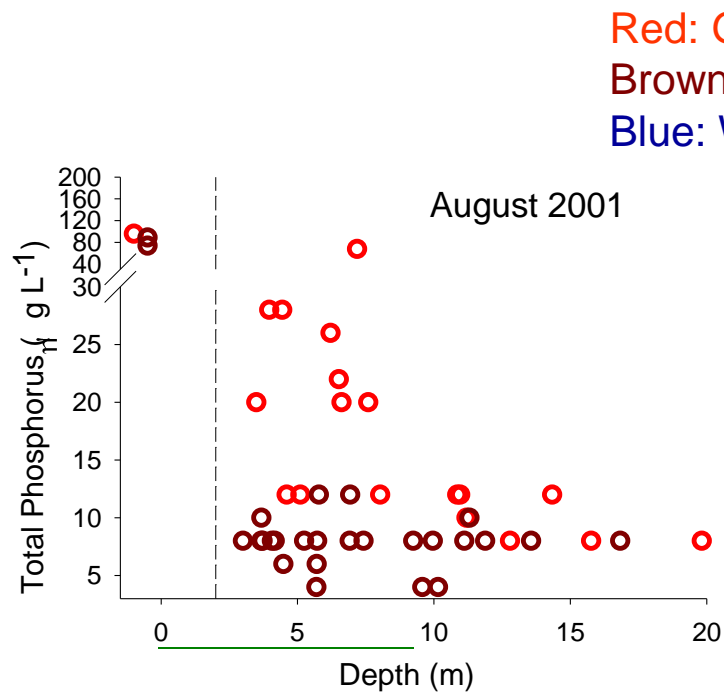
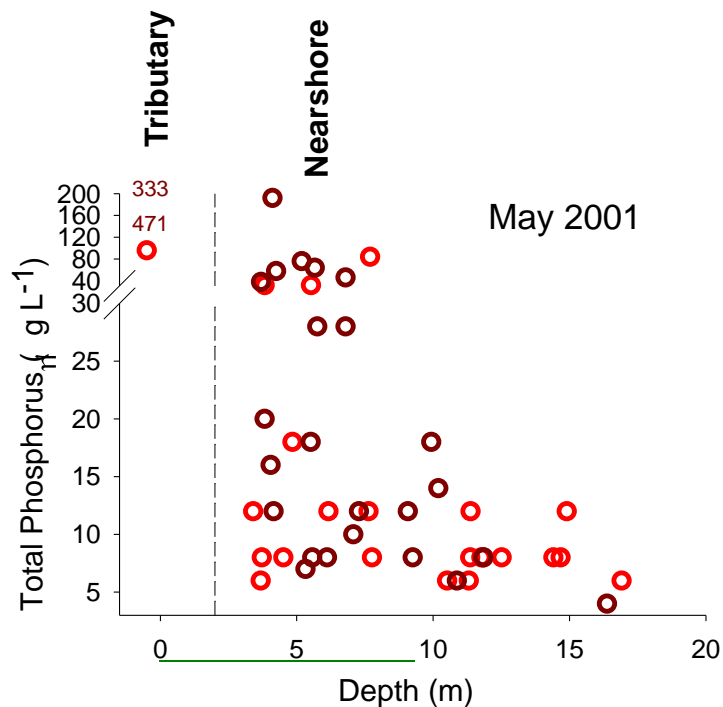


# Tributary-Shoreline-Nearshore Total Phosphorus Gradients In Lake Ontario



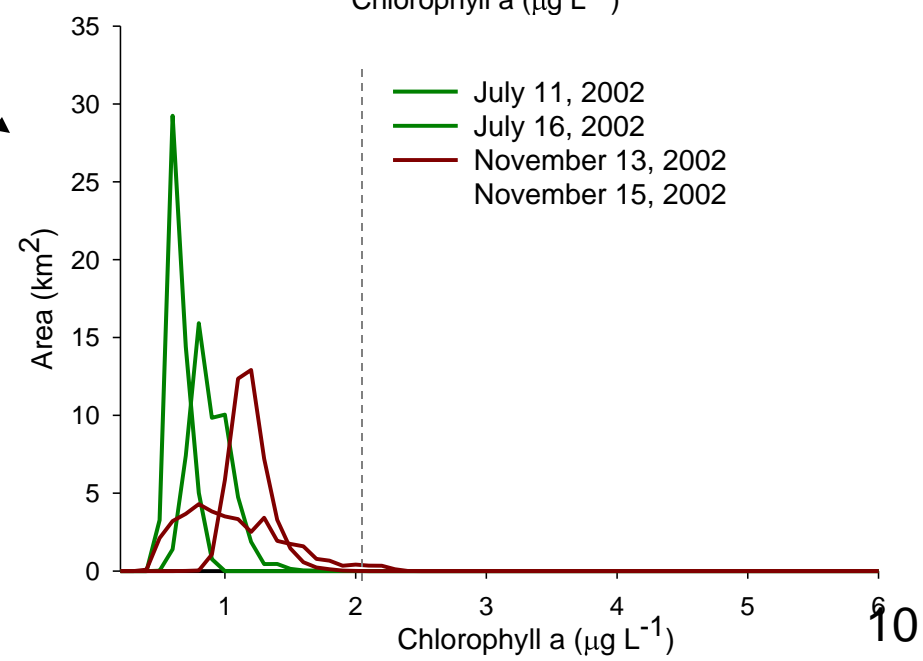
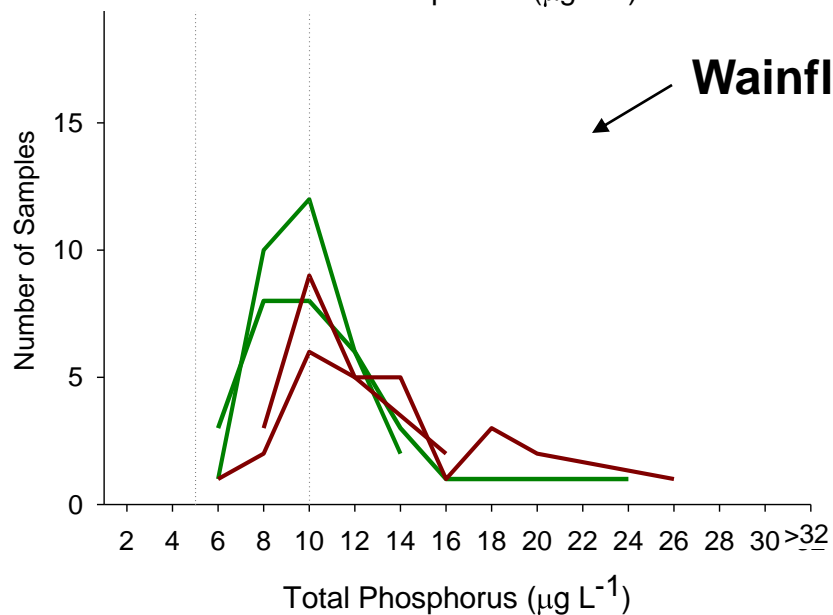
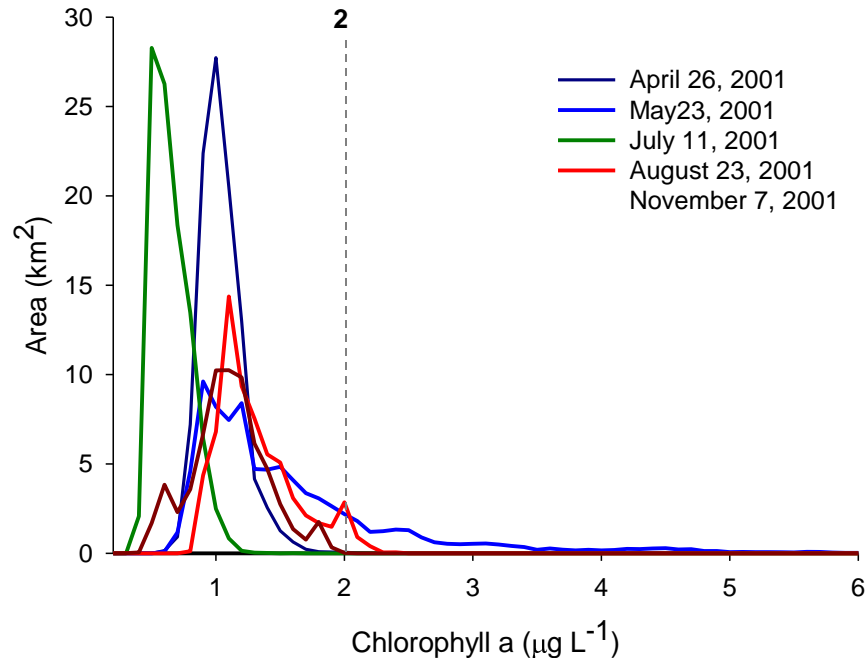
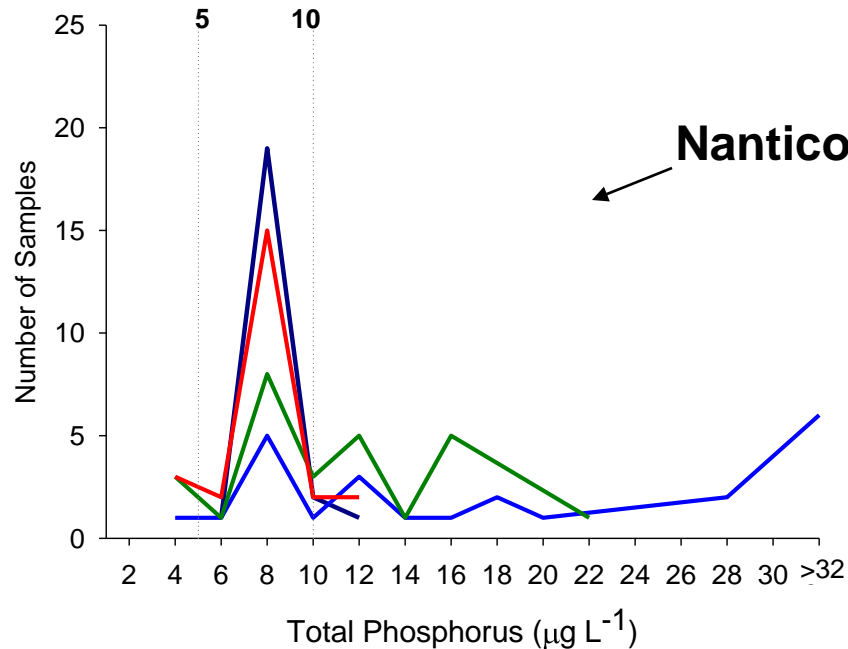


# Tributary-Nearshore Total Phosphorus Gradients In Lake Erie

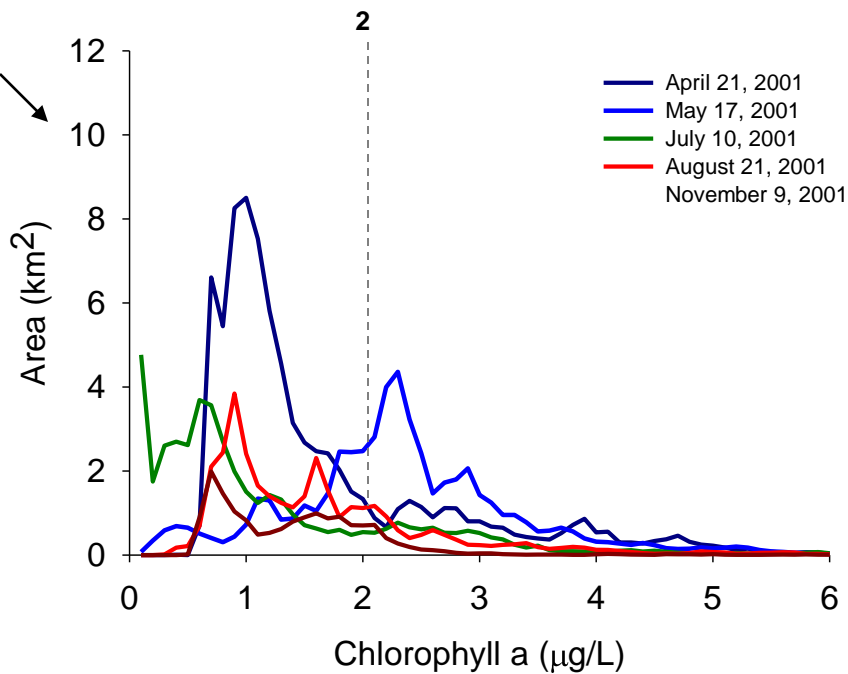
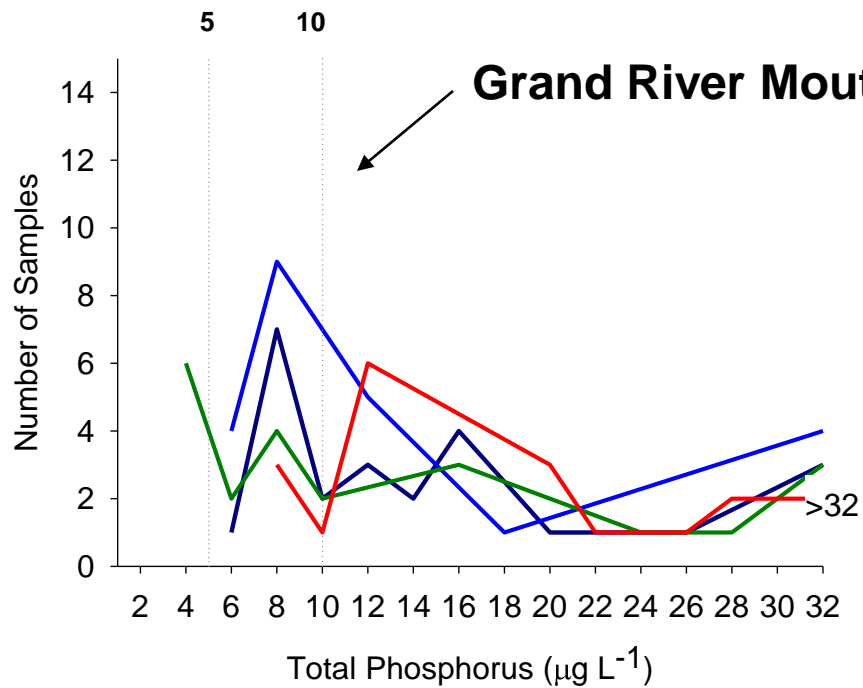


Red: Grand River  
Brown: Nanticoke  
Blue: Wainfleet

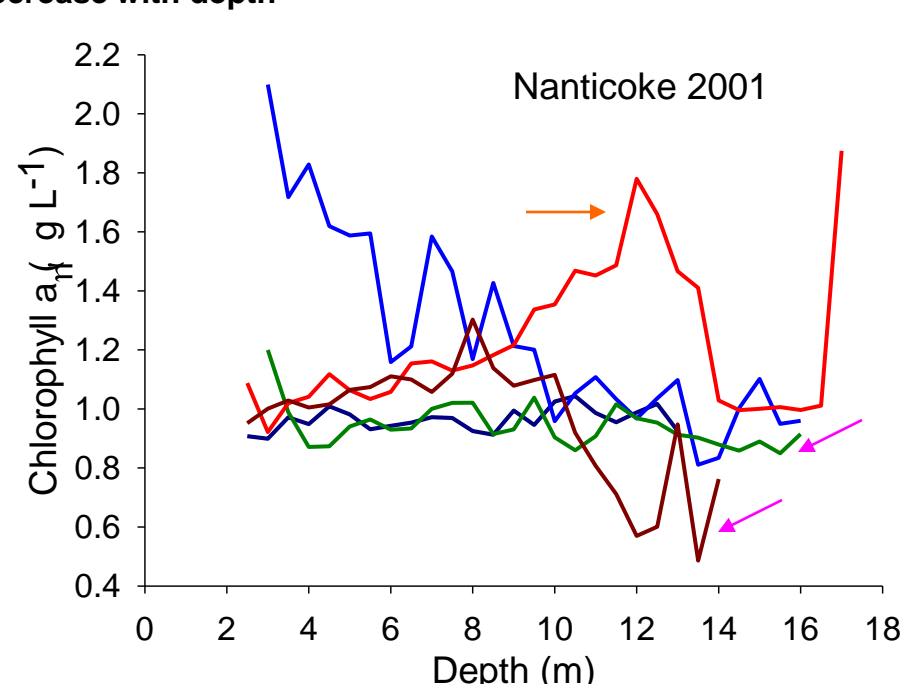
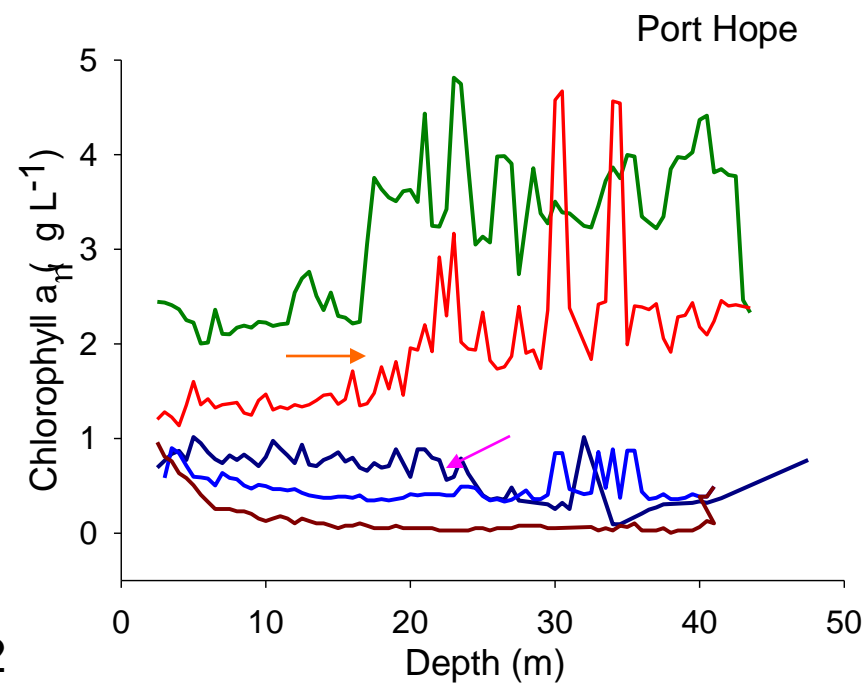
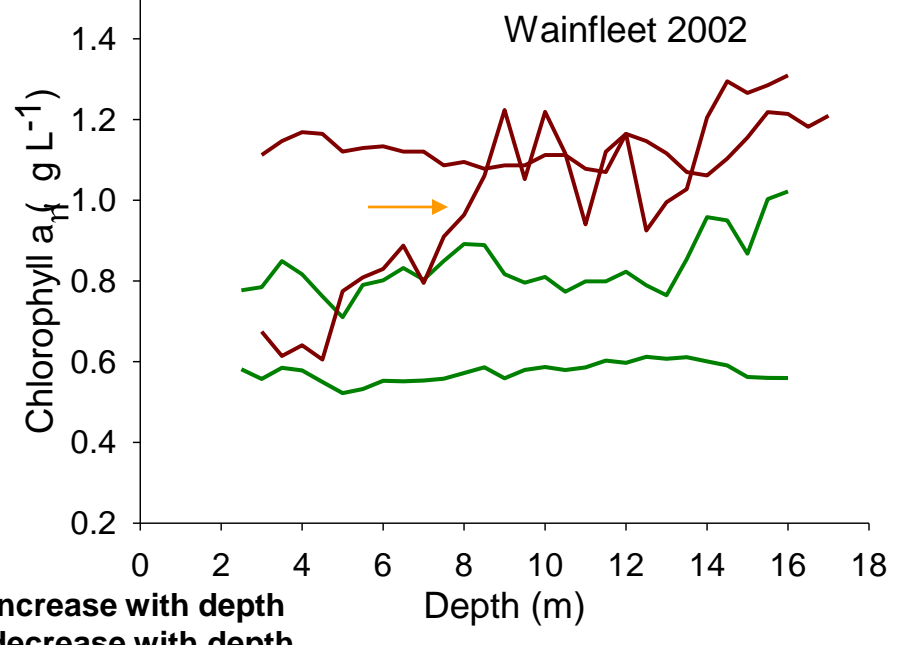
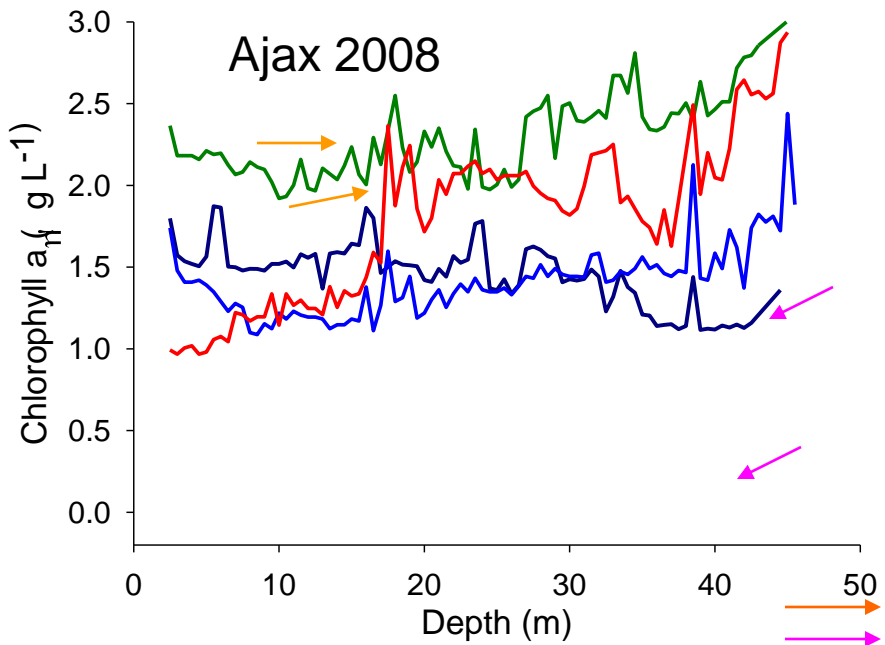
# Frequency Distributions of Total Phosphorus (by numbers of samples) and Chlorophyll a (by surface area) over nearshore study areas



# Frequency Distributions of Total Phosphorus (by numbers of samples) and Chlorophyll a (by surface area) over nearshore study areas



# Median Chlorophyll a Levels over Nearshore as Function of Lake Depth





## The *Dreissena-Cladophora* Association as a Factors Potentially Influencing Short-term and Spatial Nutrient Patterns and Broader Water Quality Features

---

- Removal of plankton, particulate material and particle-associated substances from water column by filter feeding by *Dreissena*
- Removal and release into water column of nutrients and organic material associated with seasonal cycle of growth and dieback of *Cladophora*
- Periodic re-suspension of organic rich material associated with beds

## Conclusions

---

- **Recognizing that lake nutrient levels are sufficient to sustain the *Dreissena* and *Cladophora* layer**, it is likely that the variability in phosphorus (*and other water quality features*) observed over the nearshore additionally affects the productivity and function of the *Dreissena* and *Cladophora* layer
- However, point-in-time spatial patterns in water quality provided only limited insight on the question of how the *Dreissena* and *Cladophora* layer may be affecting short-term and spatial variability in water quality in the nearshore.
- Increased understanding of the interactions between the *Dreissena* and *Cladophora* layer and water quality in the nearshore garnered through experimental work is needed to assess the significance of local nutrient loading on nutrient cycling and severity of algal shore fouling

# Acknowledgements

---

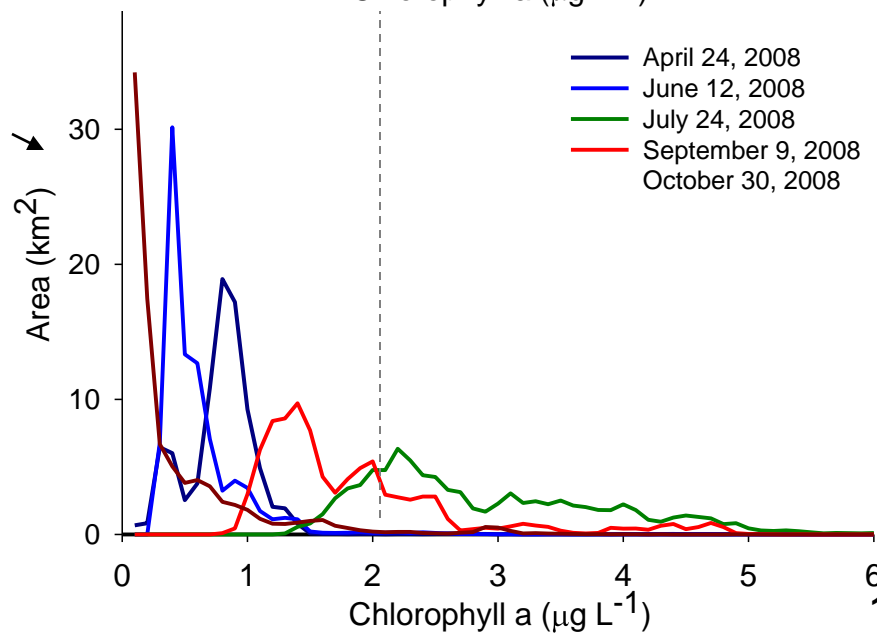
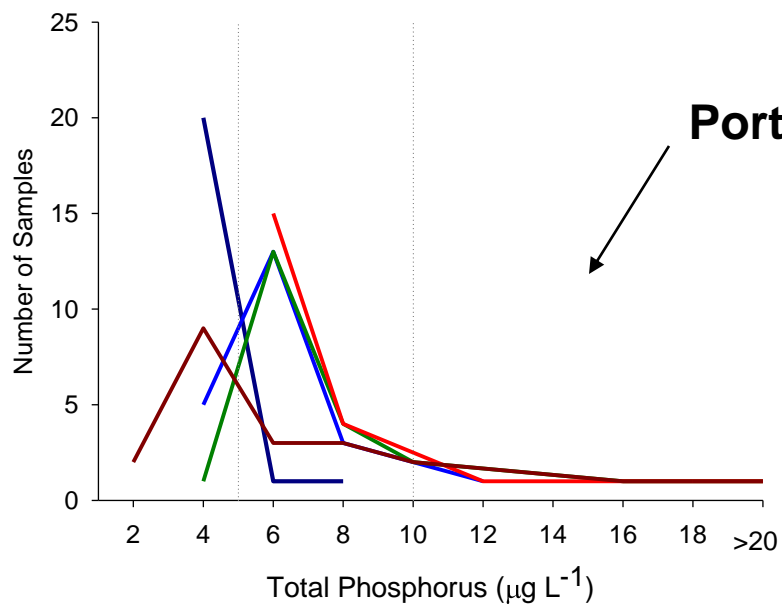
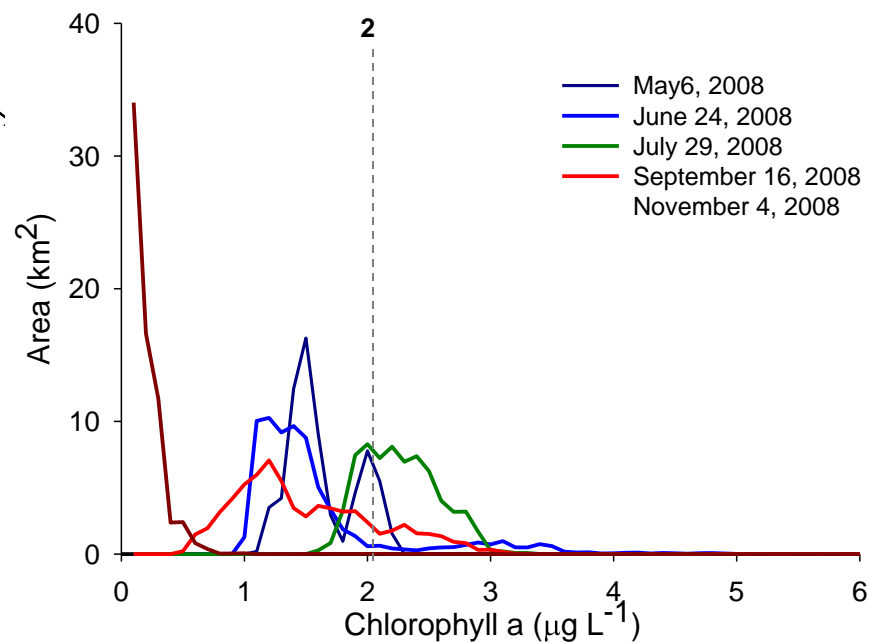
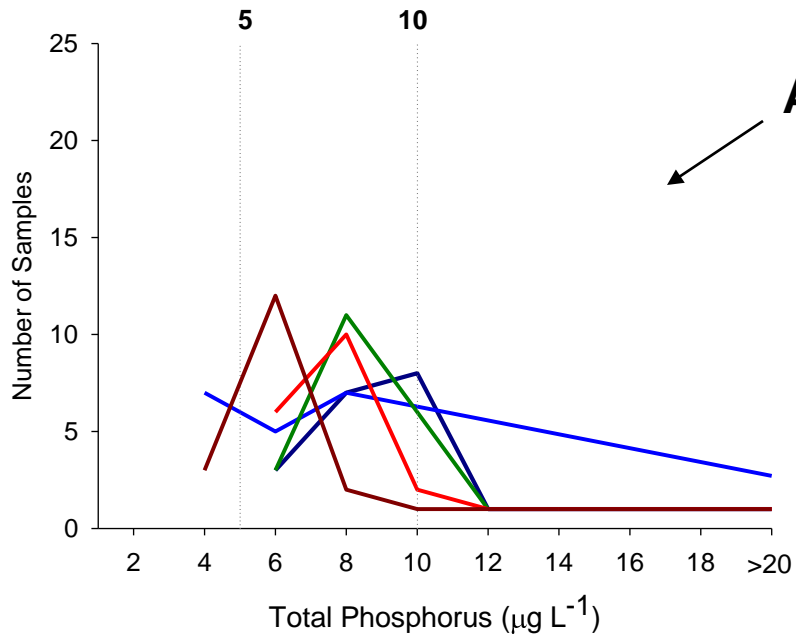
- Greg Hobson, Wendy Page and John Thibeau (MOE-EMRB)
- Vi Richardson and Bruce Gray (Environment Canada)
- Krista Chomicki (University of Waterloo)
- Gary Bowen (Toronto Region Conservation Authority)

The invaluable field support of the MOE-EMRB Great Lakes field group is acknowledged

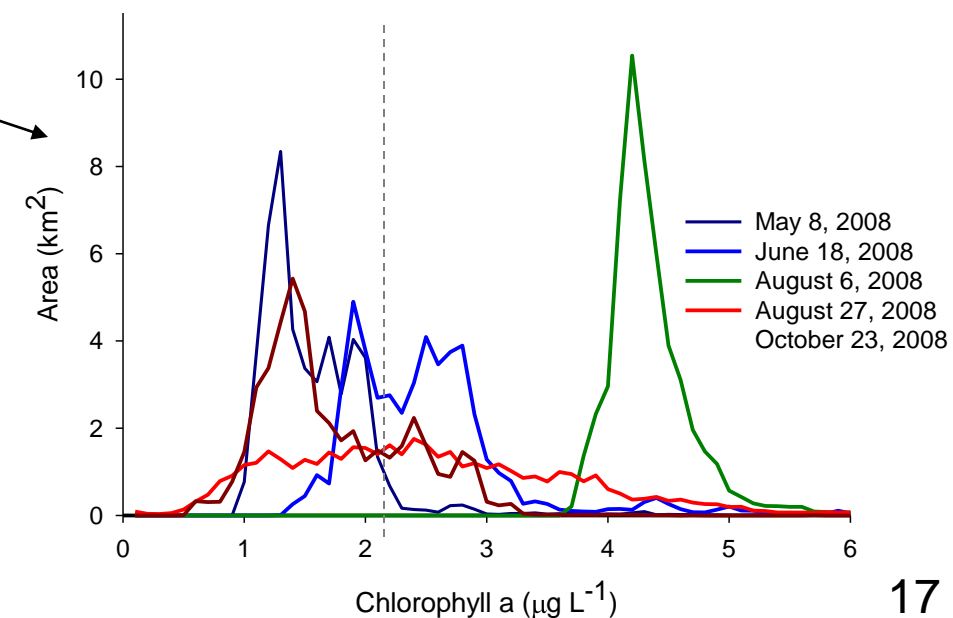
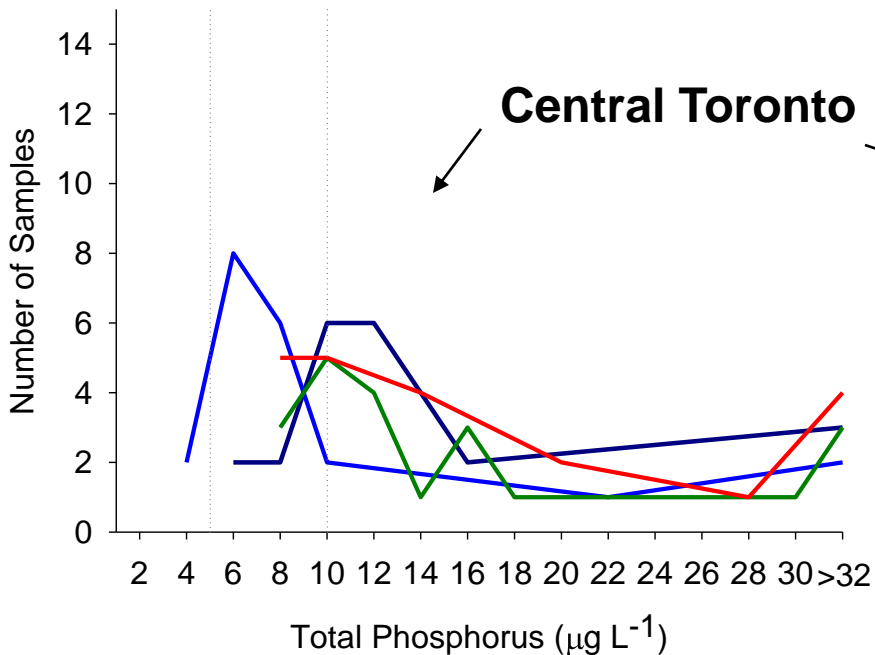
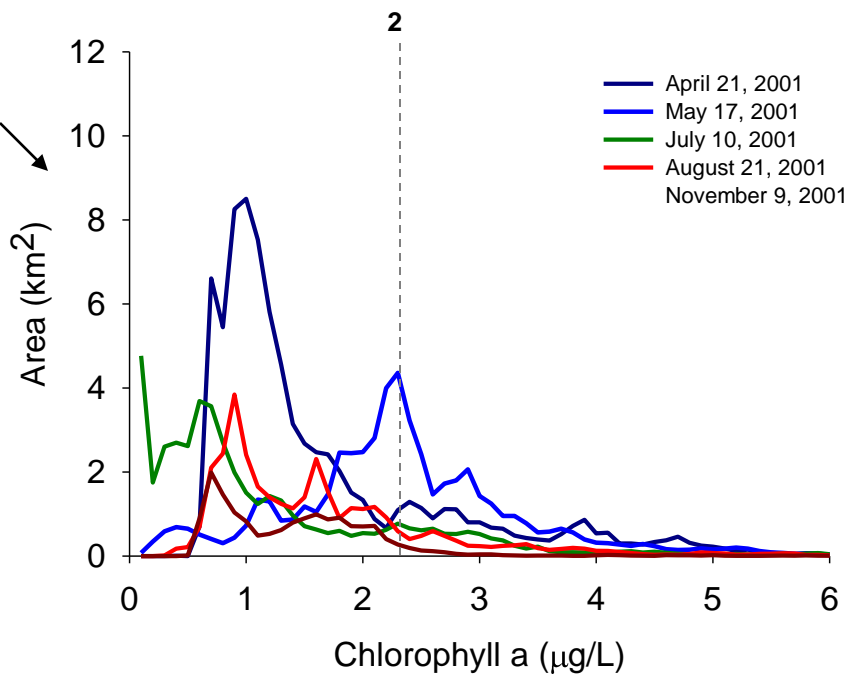
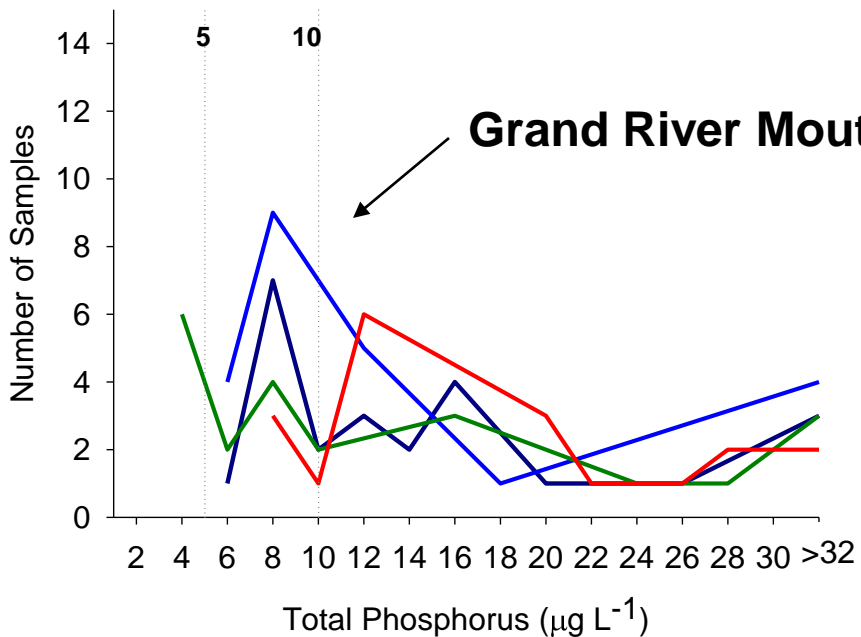




# Frequency Distributions of Total Phosphorus (by numbers of samples) and Chlorophyll a (by surface area) over nearshore study areas



# Frequency Distributions of Total Phosphorus (by numbers of samples) and Chlorophyll a (by surface area) over nearshore study areas



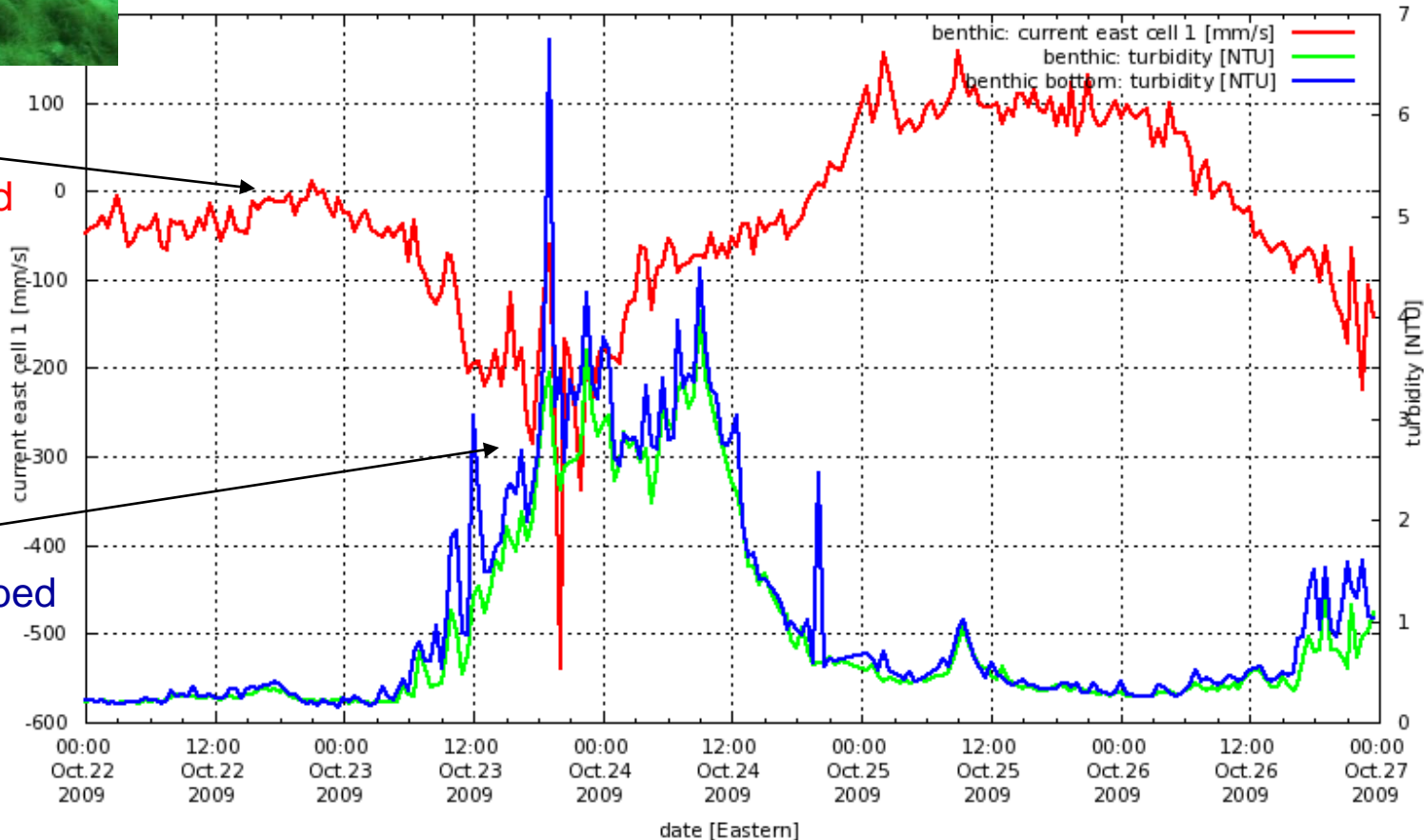
# Considering the Likely Build-up of Organic Material On the Lakebed in *Dreissena* and *Cladophora* Impacted areas, do Re-suspension Events Introduce More Organic, possibly Nutrient Rich Particulate Material into the Water Column?



Re-suspension event detected by Sensors deployed in area of *Dreissena* and *Cladophora* (depth ~18m)

Current Speed Above the Lakebed (east component)

Turbidity above the lakebed



# Are Ecological Conditions In the Nearshore Continuing to Change?

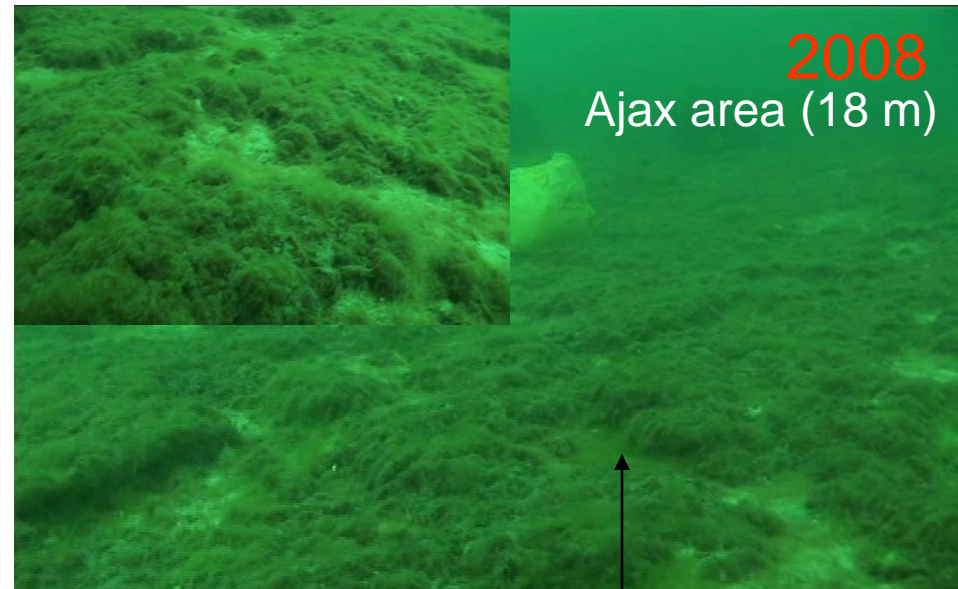
2008

Grimsby (18m)



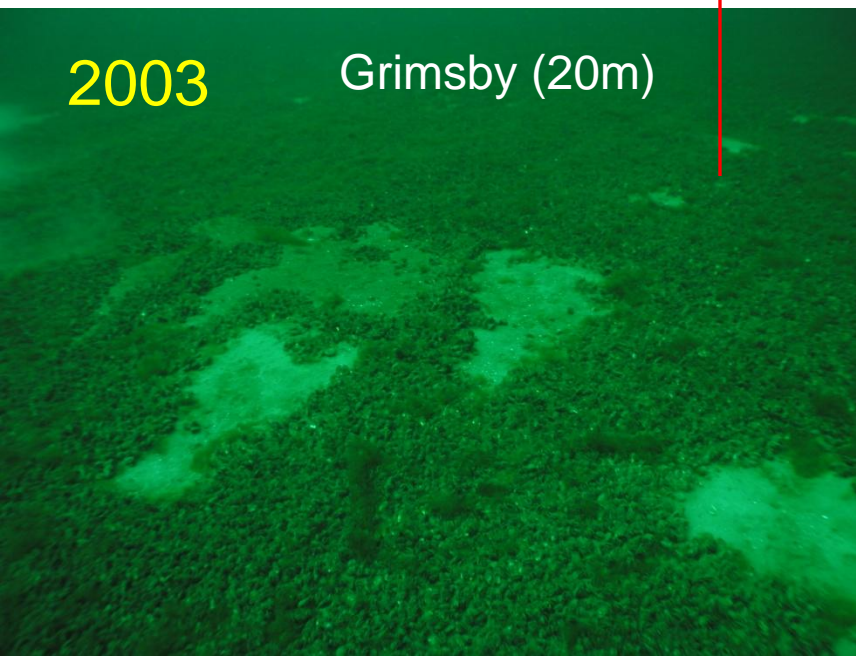
2008

Ajax area (18 m)



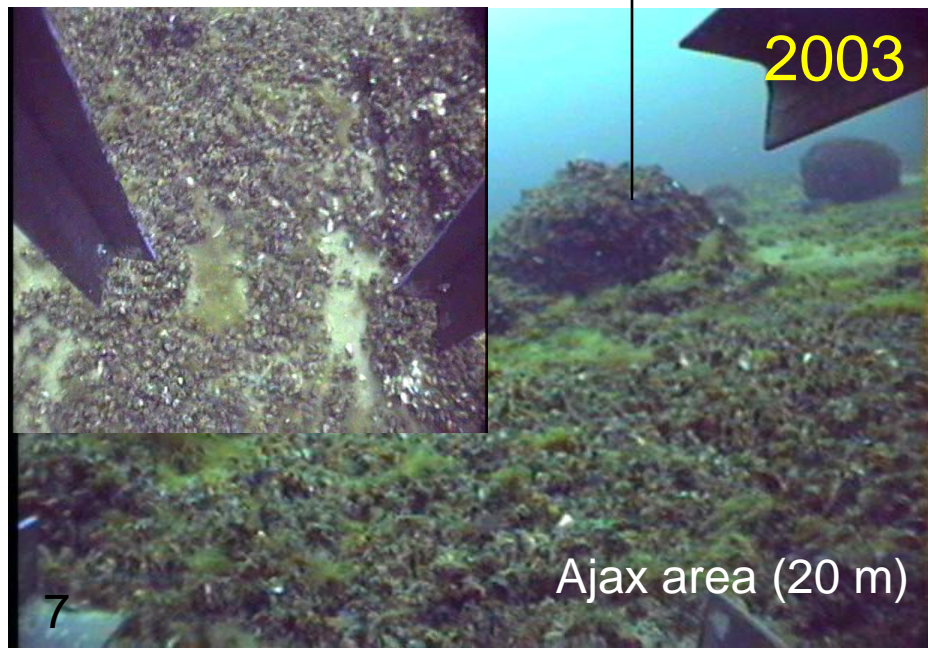
2003

Grimsby (20m)



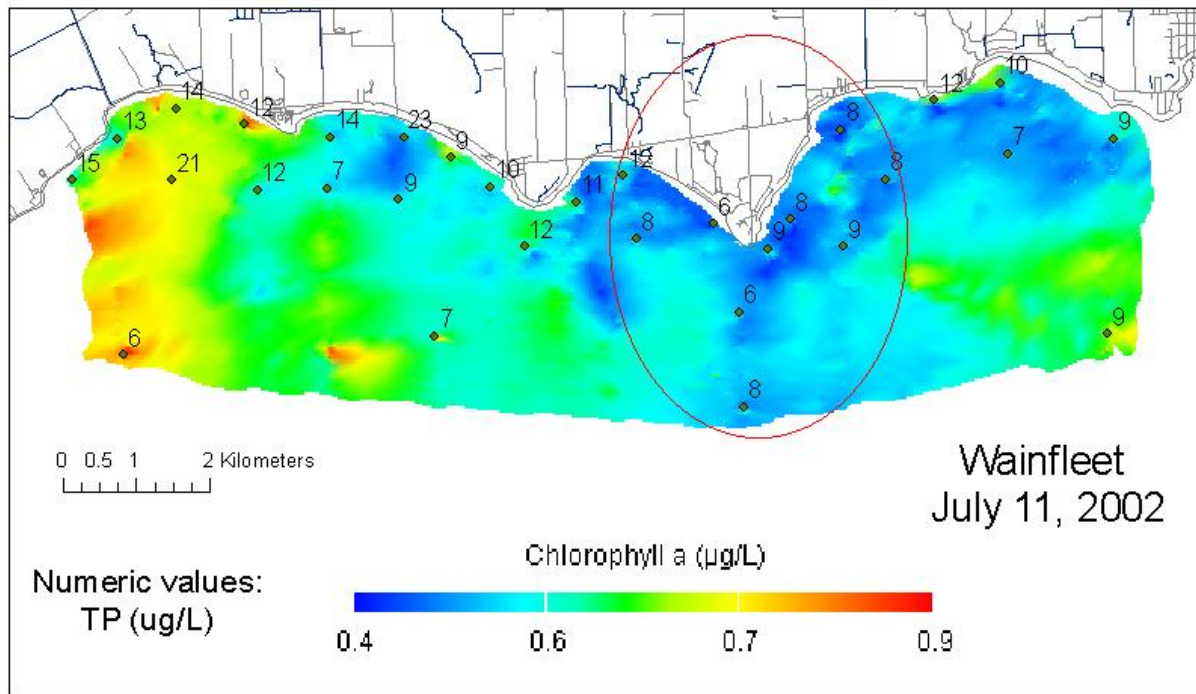
2003

Ajax area (20 m)



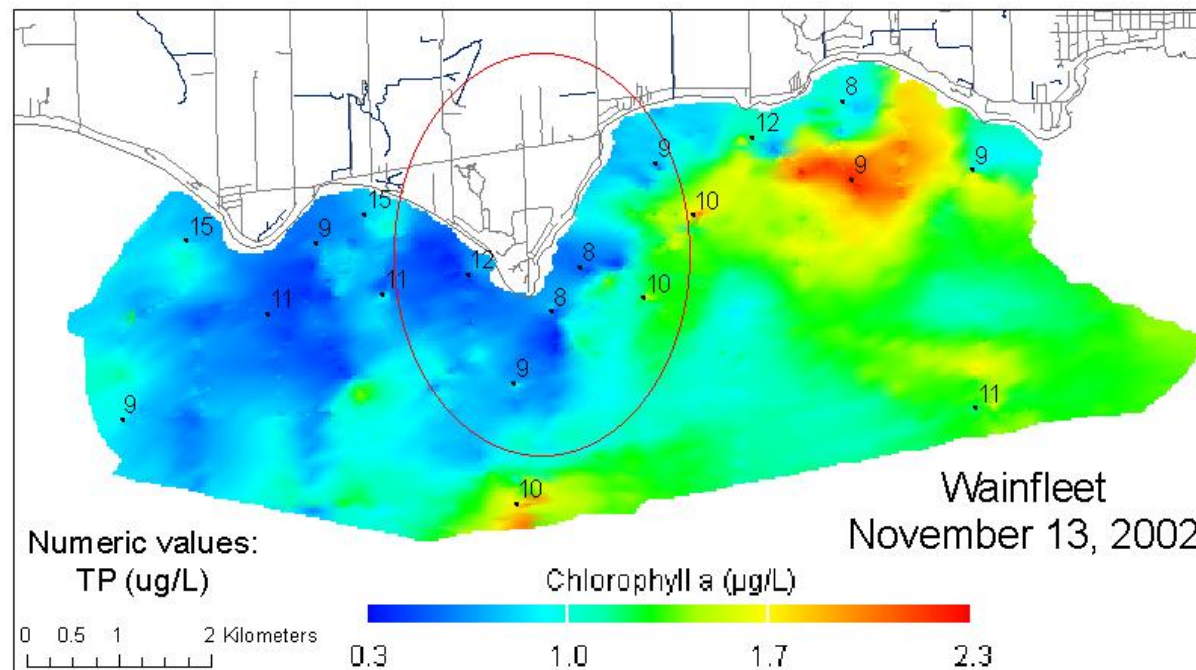


## Low Chlorophyll a levels?

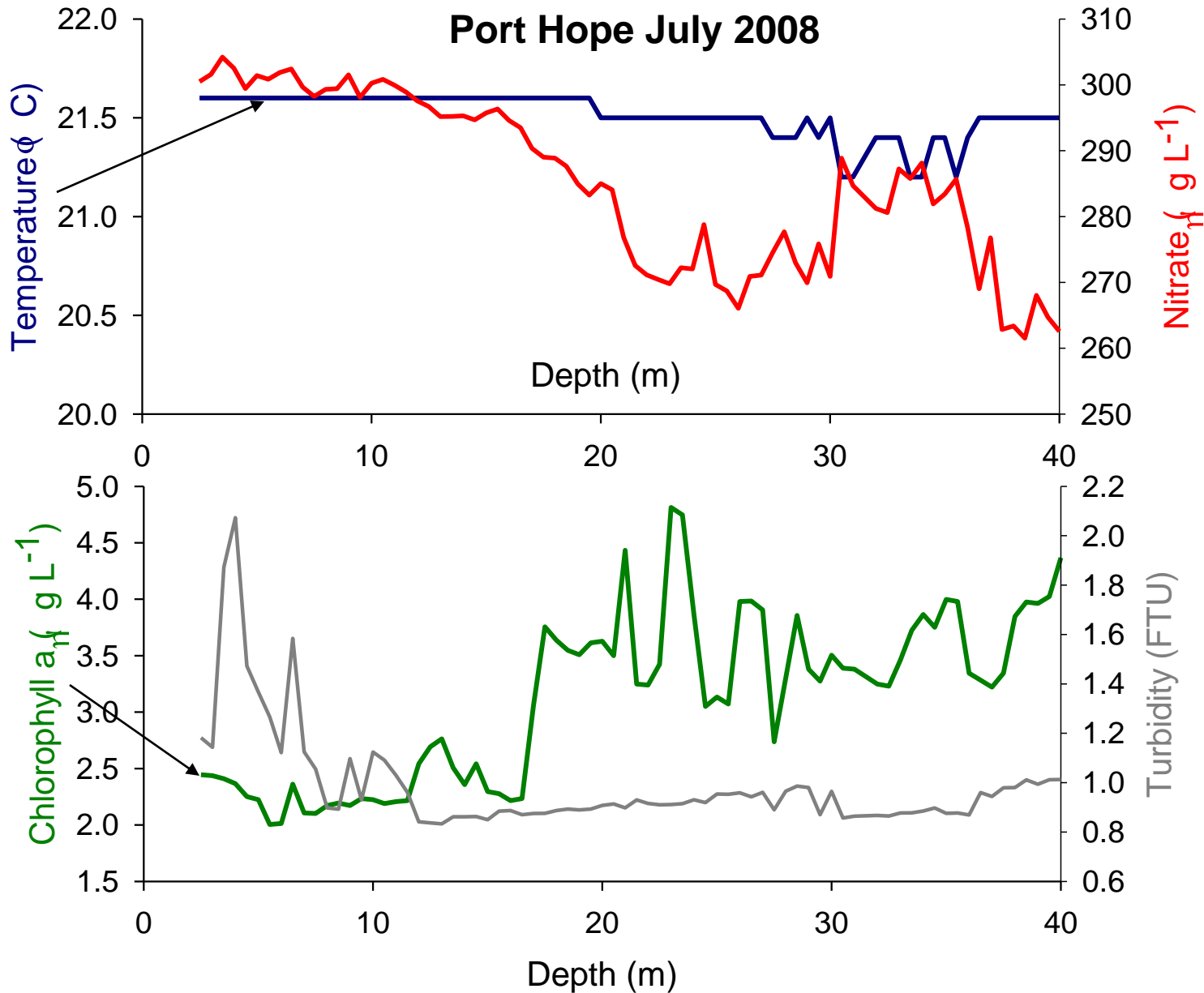


- suspected local depression of chlorophyll a levels over area rocky lakebed identified by ellipse

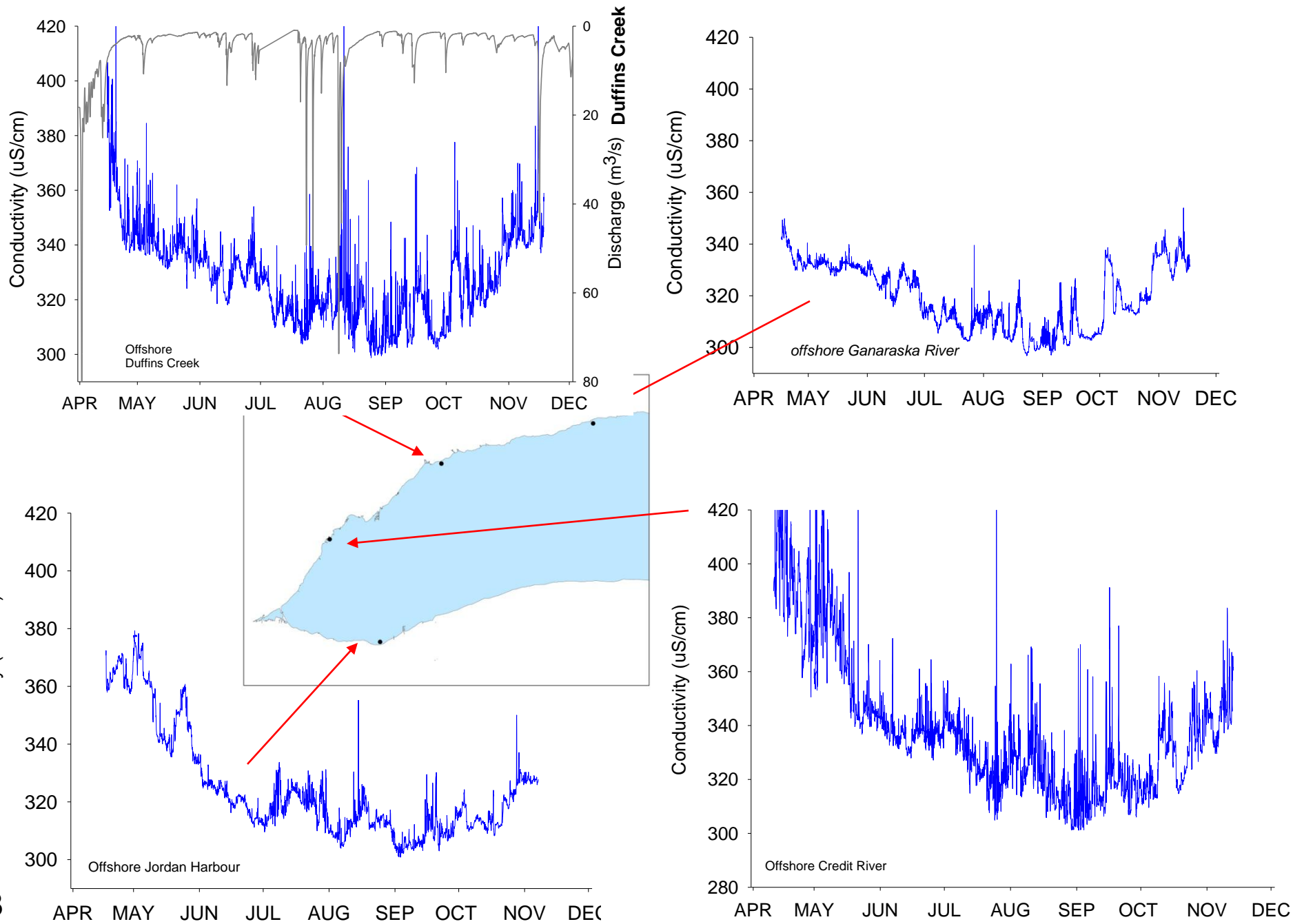
- however, chlorophyll a concentration distributions over areas of rock substrate were not discernibly different from the area as a whole



# Depressed Chlorophyll a at Shallow Depths



# Temporal Variability in Conductivity Near Tributary Mouths in Lake Ontario in 2008



# Variability in Water Quality As Suggested by Conductivity as a Tracer of Shoreline Inputs

