Lower Bolton Lake

Monitoring Update July 28, 2015

Northeast Aquatic Research

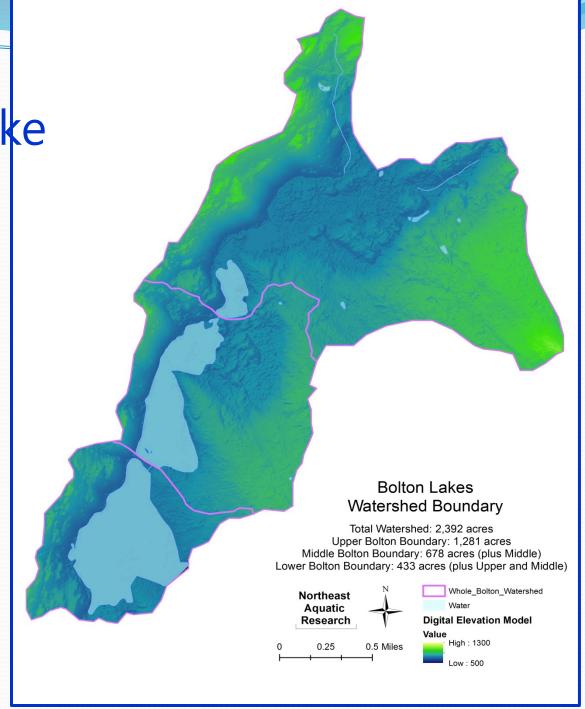
George Knoecklein Hillary Kenyon Sabina Perkins Elena Welch

Tonight's discussion:

- Drainage basin investigation
 - Inflow chemistry results
- Bluegreen or cyanobacteria levels
 - 2013-2014 and early 2015
- Update on LBL condition with 2015 data
 - Nutrient levels and water clarity
 - Dissolved oxygen
 - Naiad, other native plants,
- Fanwort, Variable-leaf milfoil and Curly-leaf pondweed

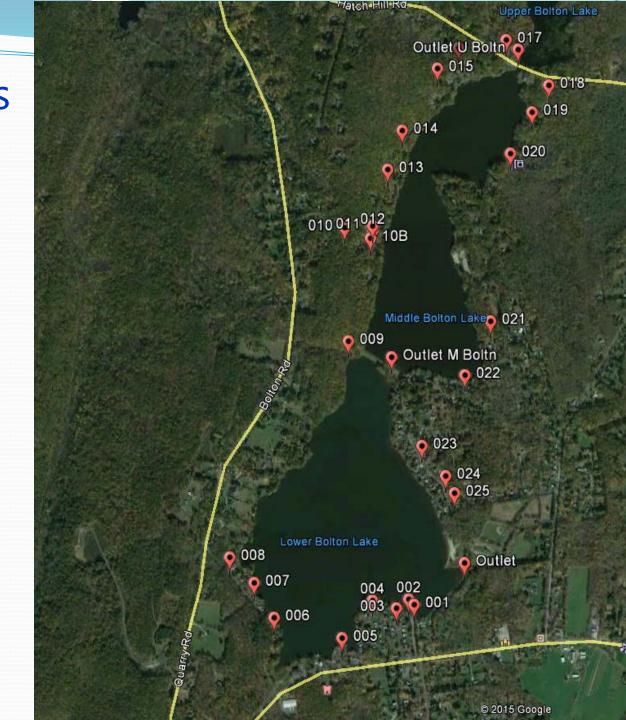
Lower Bolton Lake

Watershed and Drainage Basin

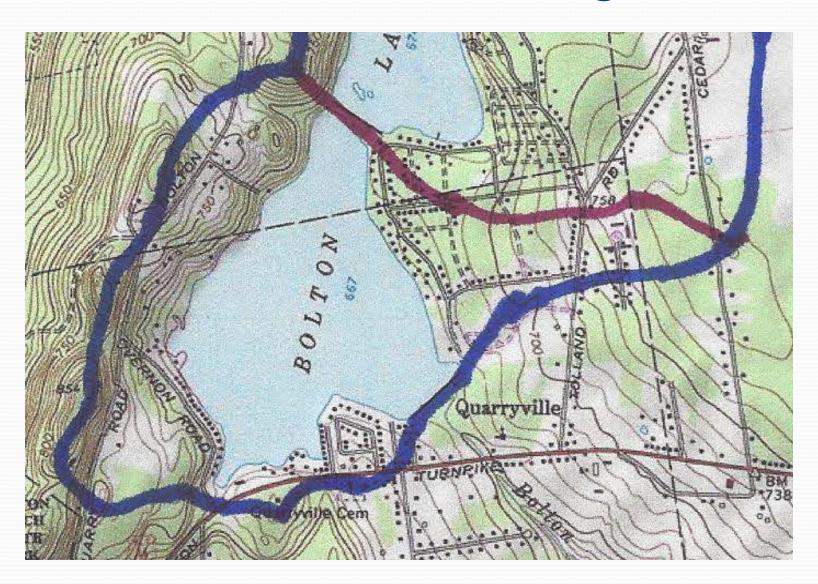


Monitored Inlets to Middle and Lower Bolton Lakes

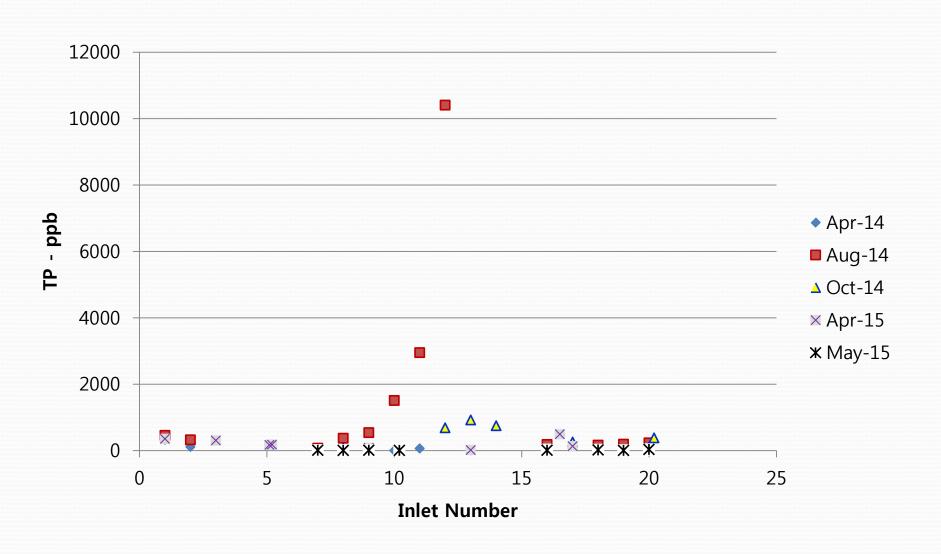
Inlets 1 – 9 and 23-25 flow into LBL Inlets 10-21 flow into MBL



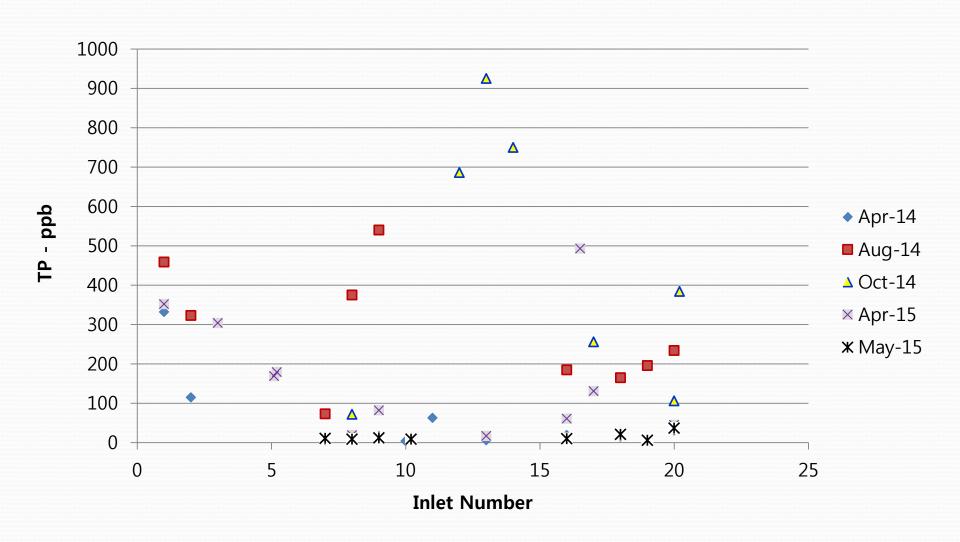
Lower Bolton Lake Drainage Basin



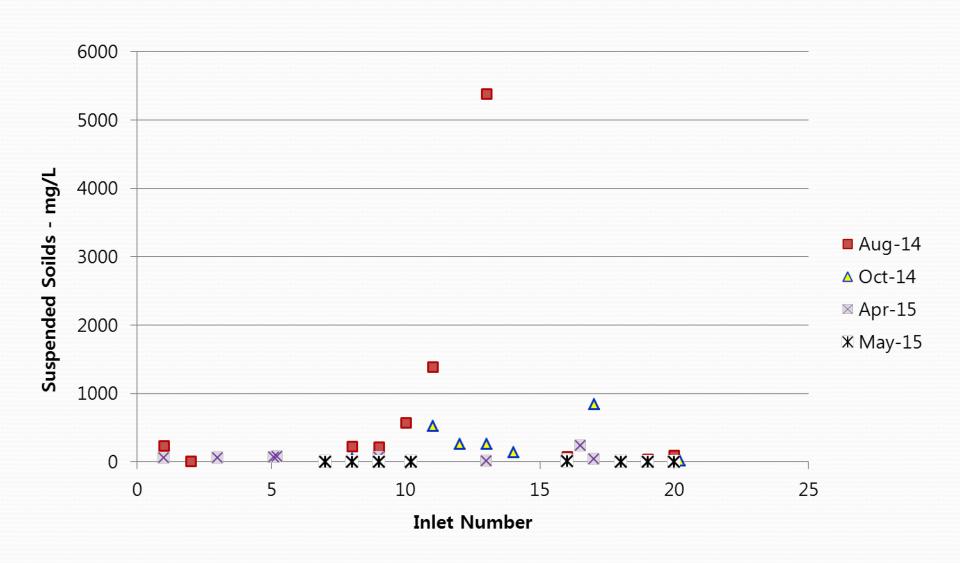
Phosphorus at inlets



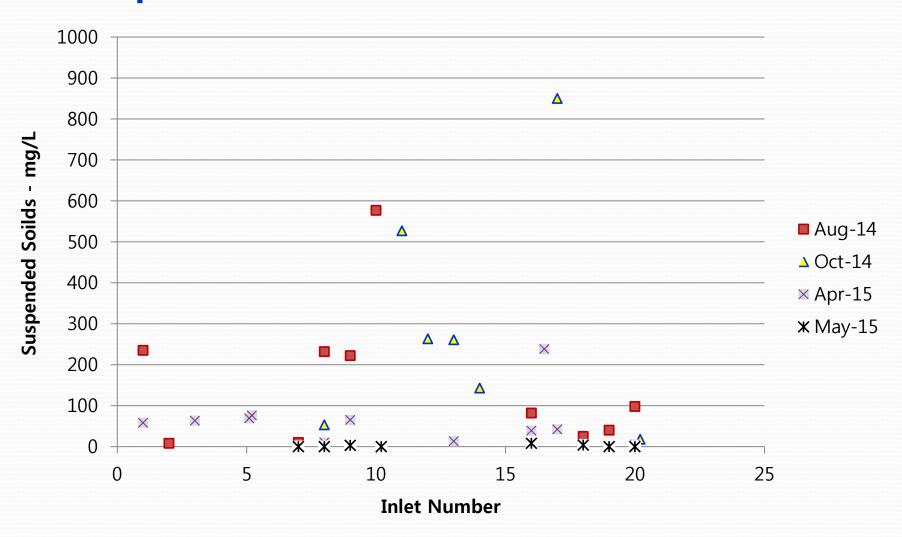
Phosphorus at inlets



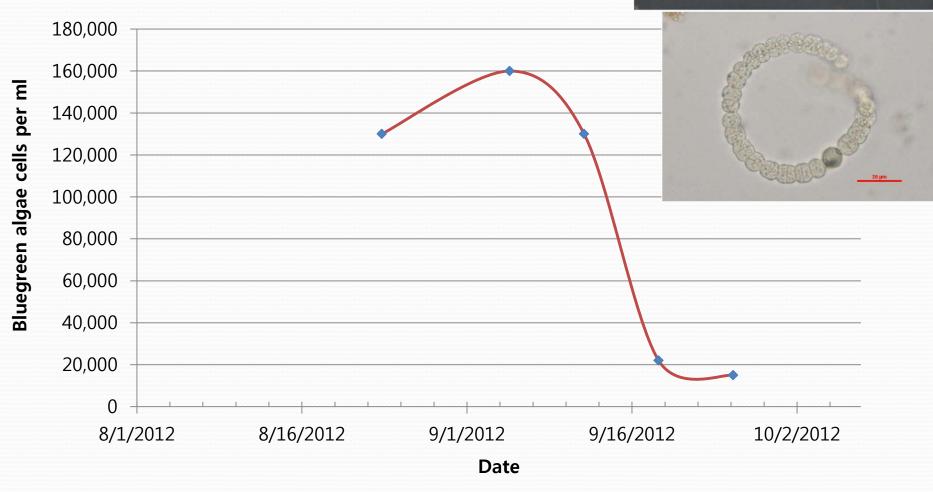
Suspended Solids at inlets



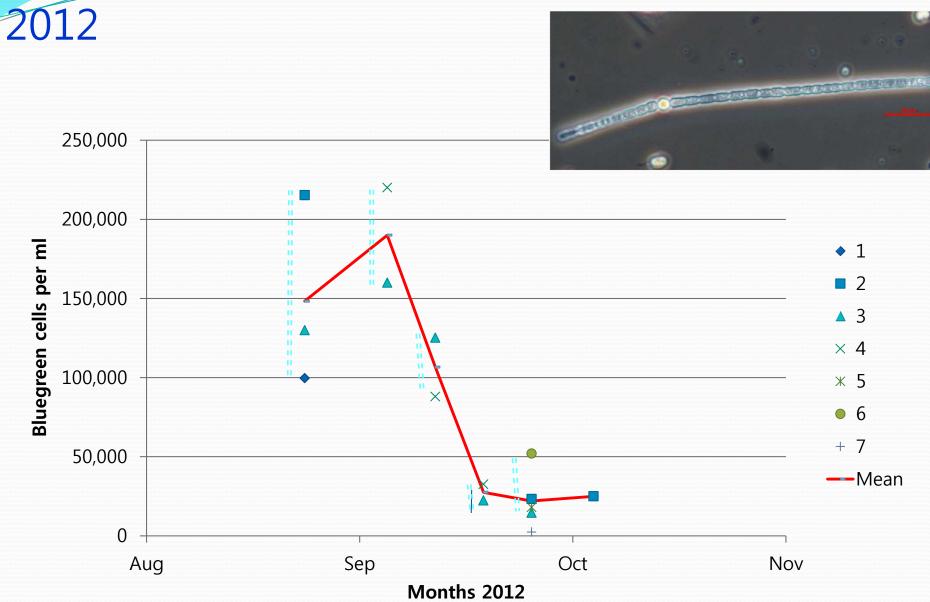
Suspended Solids at Inlets



Cyanobacteria in LBL



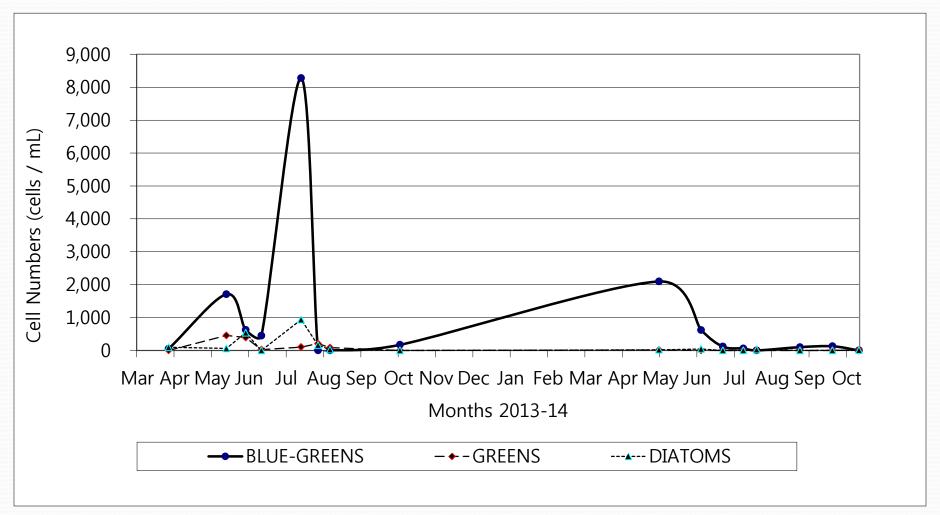
Variation in Cell number during bloom of



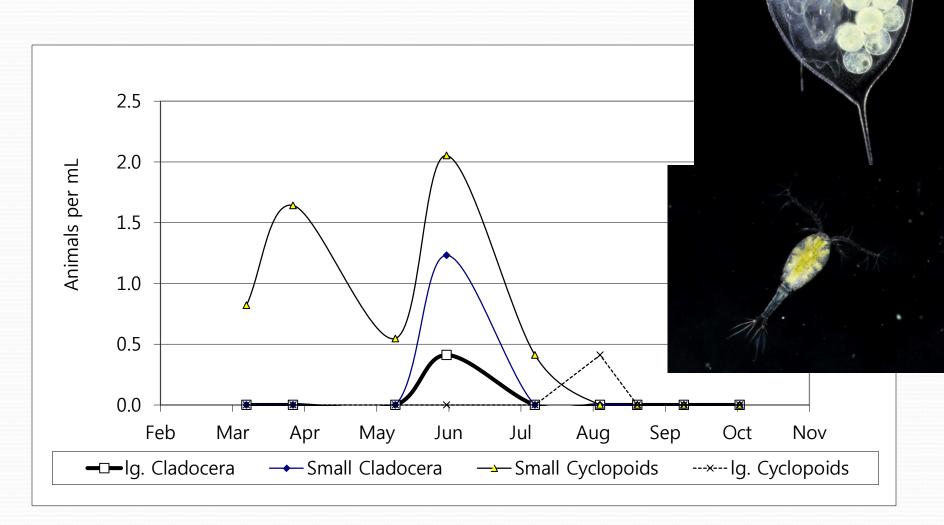
Microcystin results from September 2012

Date of Collection	Location	Microcystin (ppb)
9/5/12	Indian Notch Beach	< 1 ppb
9/5/12	Boat Launch- Lower Bolton Lake	< 1 ppb
9/12/12	Indian Notch Beach	< 1 ppb
9/12/12	Boat Launch- Lower Bolton Lake	< 1 ppb
9/19/12	Indian Notch Beach	< 1 ppb
9/19/12	Boat Launch- Lower Bolton Lake	< 1 ppb
9/26/12	121 Vernon Rd - Bolton	< 1 ppb
9/26/12	39 Vernon Rd - Bolton	< 1 ppb
9/26/12	Boat Launch- Lower Bolton Lake < 1 ppb	
9/26/12	Rosedale Beach - Lower Bolton Lake < 1 pp	
9/26/12	Upper Spillway - Lower Bolton Lake < 1 ppb	
10/5/12	17 Lakeside Circle - Bolton	< 1 ppb
10/5/12	39 Vernon Rd - Bolton	< 1 ppb
9/18/13	Lower Bolton Surface Scum	ND*

Phytoplankton Cell Numbers in LBL



Zooplankton numbers



ROTIFERS

"Wheel bearing animals" Many-celled with head crown of short hairs (cilia)

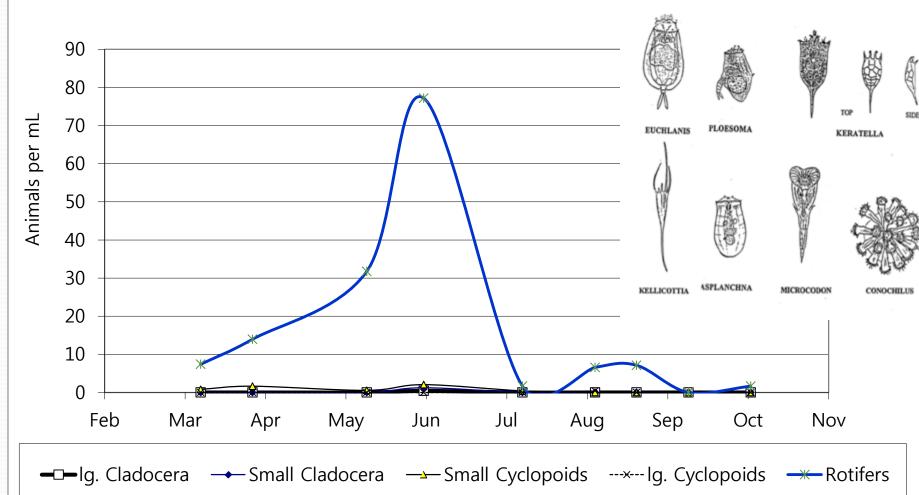






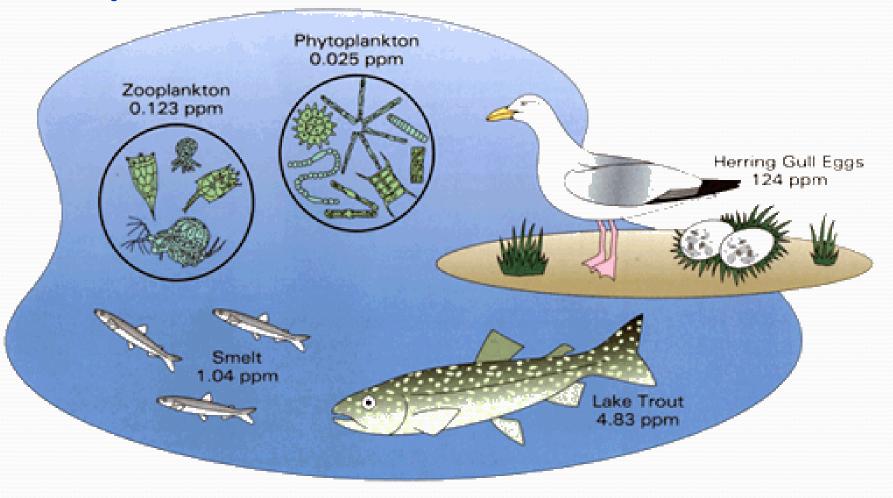
TESTUDINELLA

SYNCHAETA

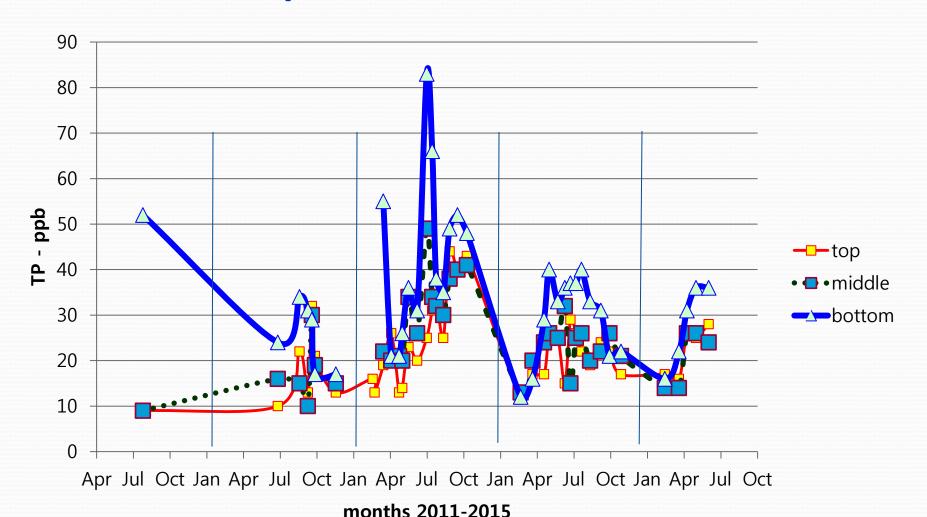


Rotifer Zooplankton

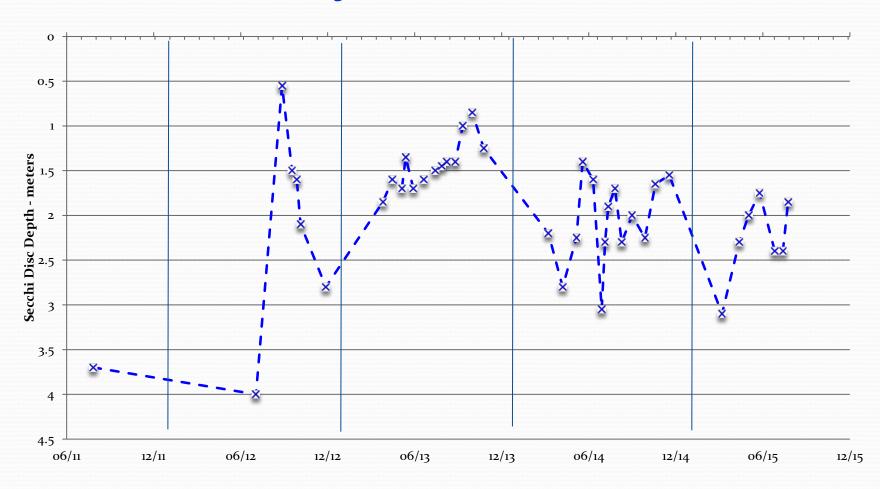
Aquatic Food Web



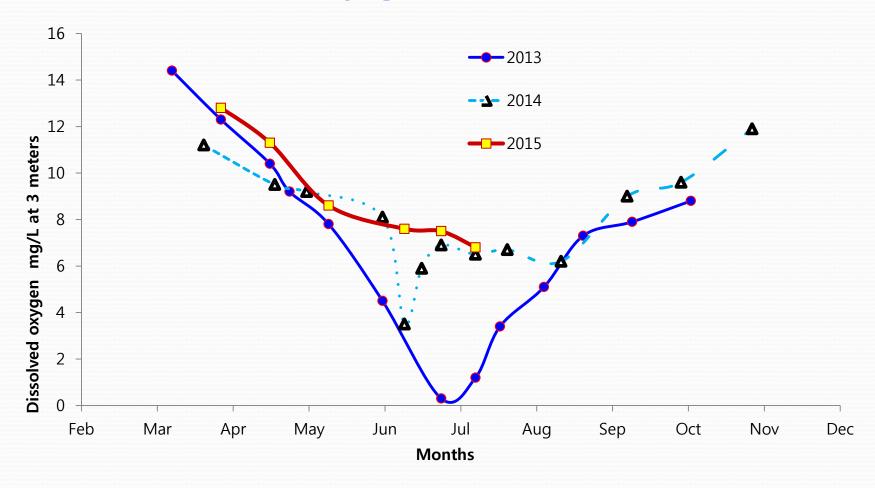
Total Phosphorus Trend



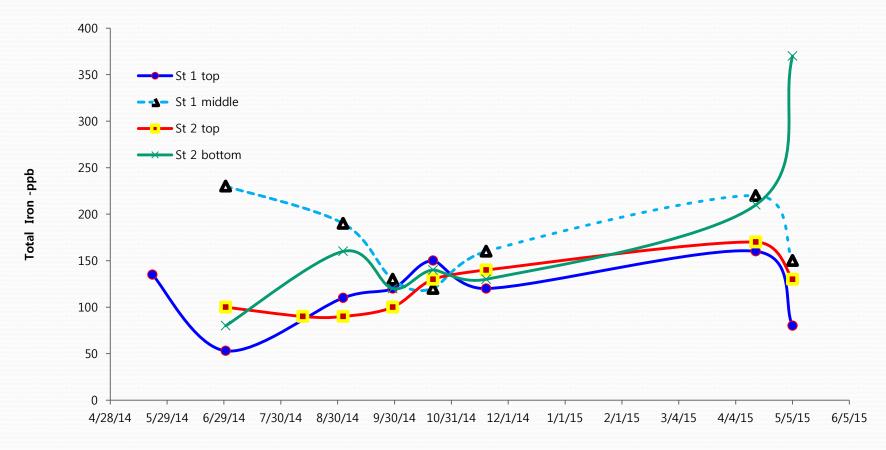
Water Clarity Trend



Dissolved Oxygen



Total Iron in the water column



Aquatic Plants

- Very little naiad growth but it is present
- Other plants include:
 - Large leaf pondweed

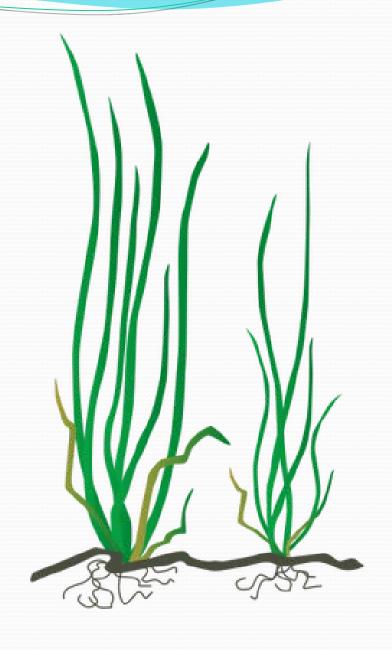




Aquatic plants

Tape-grass





Aquatic plants

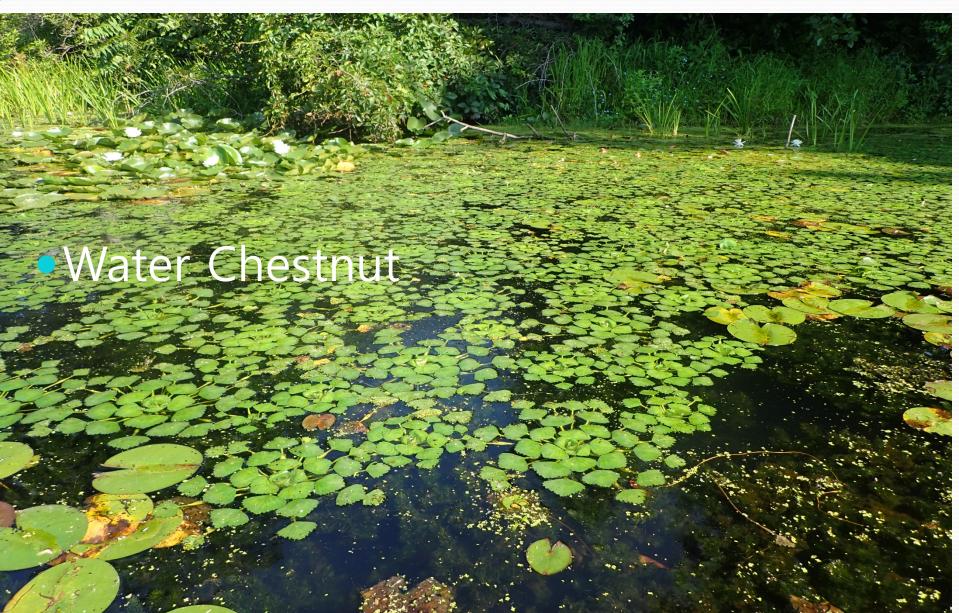


Aquatic Plants

Curly-leaf pondweed



Aquatic plants



Aquatic Plants

Fanwort

None seen in LBL yet this year



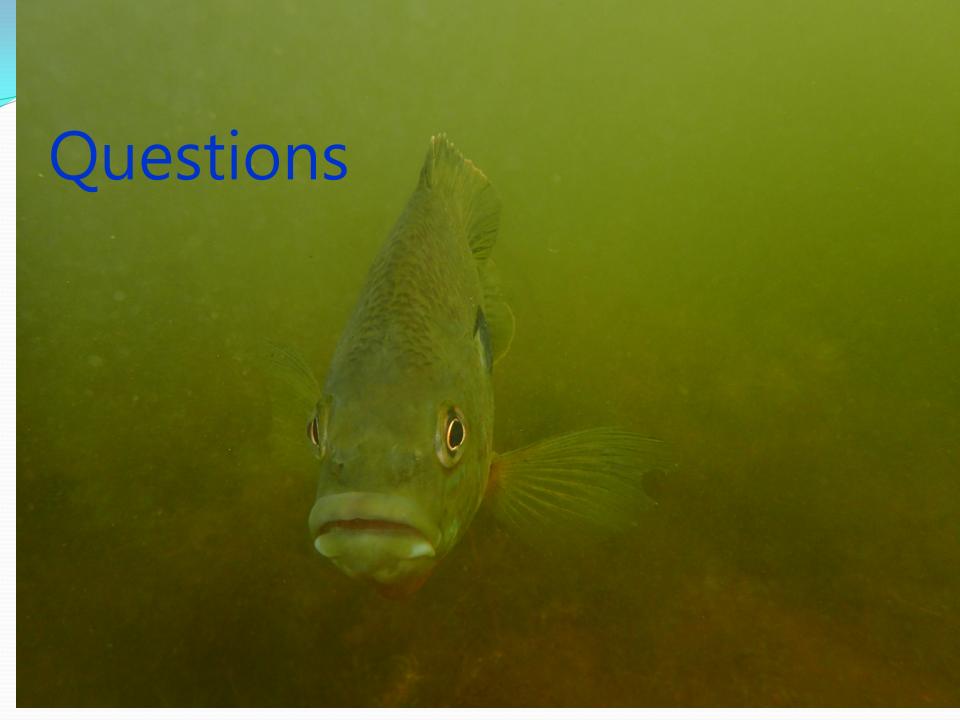


Variable Leaved Milfoil

 None seen in LBL yet this year





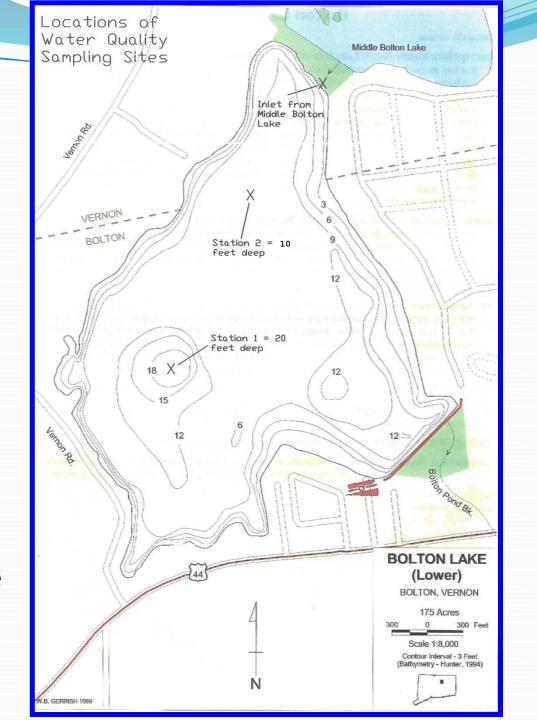






Lake Visits

- 2014
 - Station 1
 - Deep water =
 - Top, middle, bottom
 - Station 2
 - Shallow water =
 - Top, bottom
 - Outflows from Middle, Upper, and Lower Bolton Lake
 - Several inlets around the two lakes were monitored

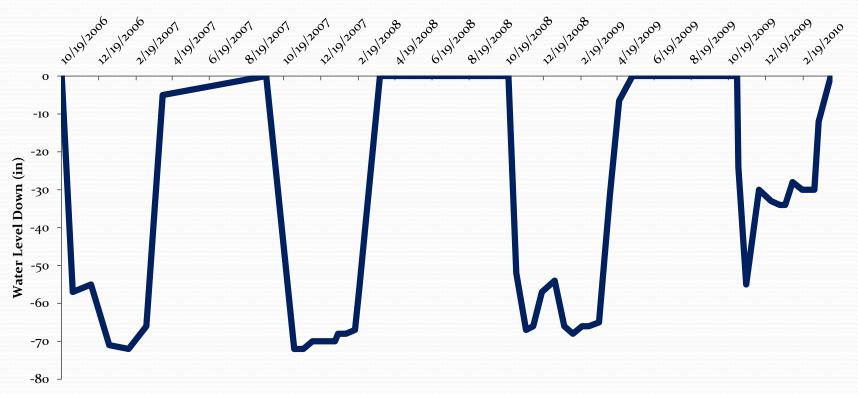


Brief history of LBL

- 1. WQ data collected in April and September 1979 by CAES
- 2. Deep (60-70 inches) drawdowns of Middle Bolton Lake during winters of 2006-7, 2007-8, and 2008-9 (see next)
- 3. WQ collected on July 27, 2011; and July 3 2012; by NEAR
- 4. In 2011, NEAR mapped 12-15 acres of floating naiad (see following)
- 5. Bloom of blue-green algae in late August 2012
 - Clarity declined from 4 m in early July to 0.5 m in late August
 - NEAR started frequent lake samplings on August 27, 2012
- 6. Sonar herbicide applied May 30, 2013
- 7. Follow-up Sonar booster and copper sulfate applied to deeper water on June 27, 2013

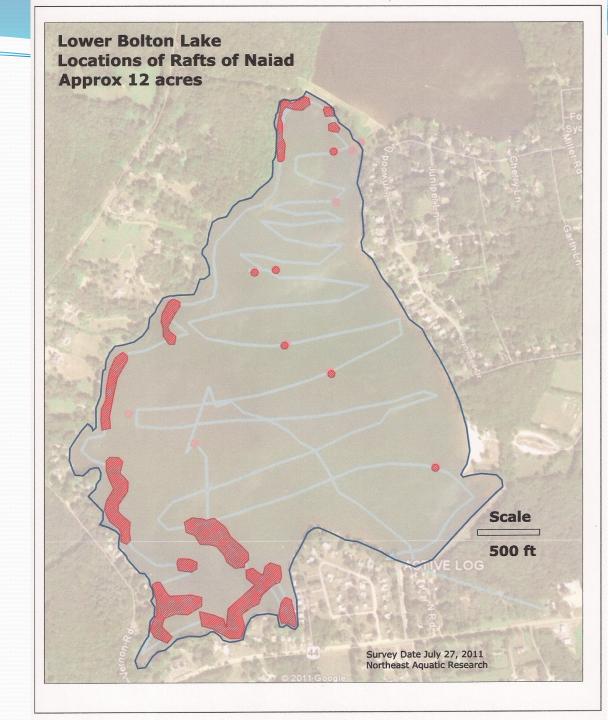
Winter Water Level Drawdown of Middle Bolton Lake

Middle Bolton Lake Levels During Deep Drawdowns 2006 - 2010



Southern Naiad in Lower Bolton Lake July 27, 2011

Similar, if not worse, conditions existed in 2012



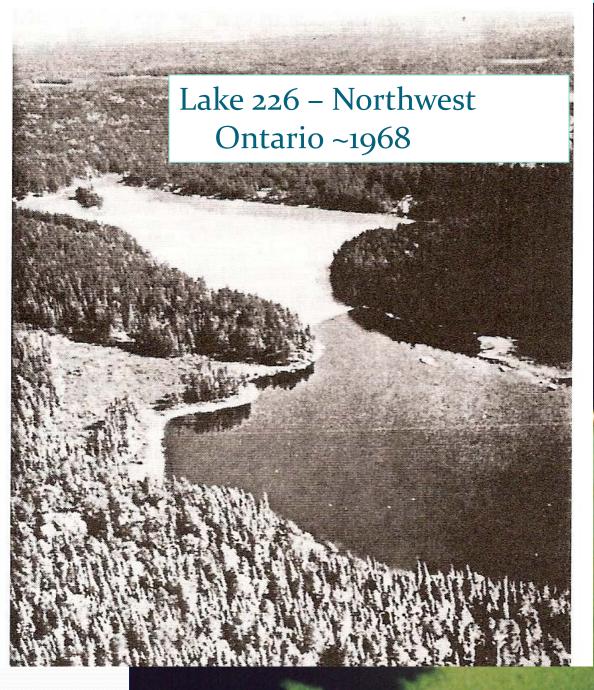
Nutrient levels

- Important nutrients are:
 - Phosphorus
 - Nitrogen
 - Ammonium
 - Nitrate
 - Organic (that is nitrogen bound in carbon bonds)
- All other requirements that plants and algae have are readily available

Limiting Nutrient Concept

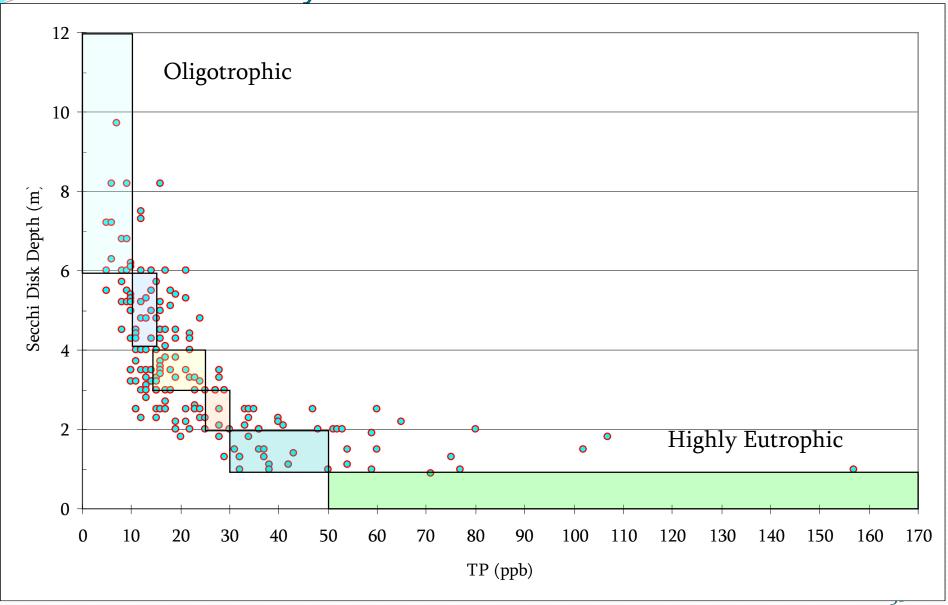
When all growth requirements are met except one than growth will depend on the availability of that one missing factor

Element	Plant Content %	Average Supply %	Ratio of content to supply
Oxygen	80.5	89	1
Hydrogen	9.7	11	1
Carbon	6.5	0.0012	5,000
Silicon	1.3	0.00065	2,000
Nitrogen	0.7	0.000023	30,000
Phosphorus	0.08	0.00001	80,000
Potassium	0.3	0.00023	1,300

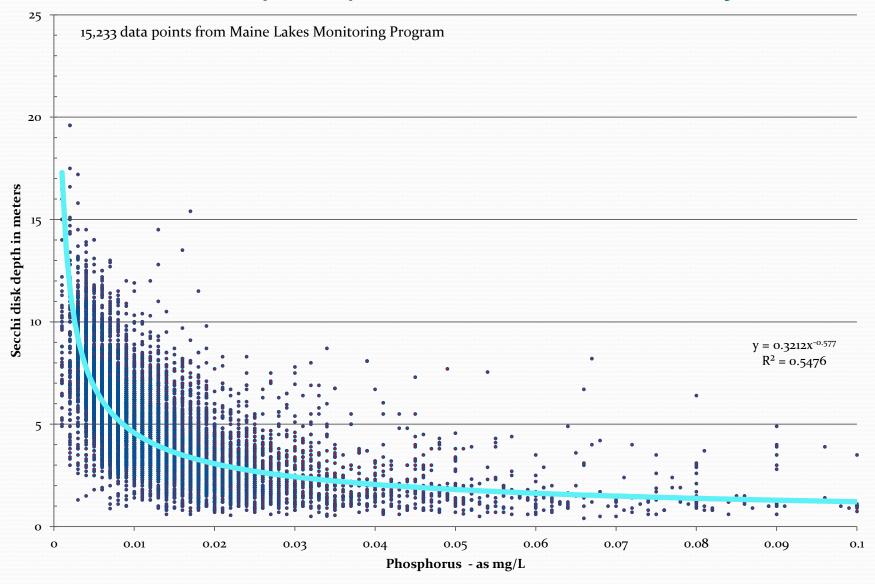




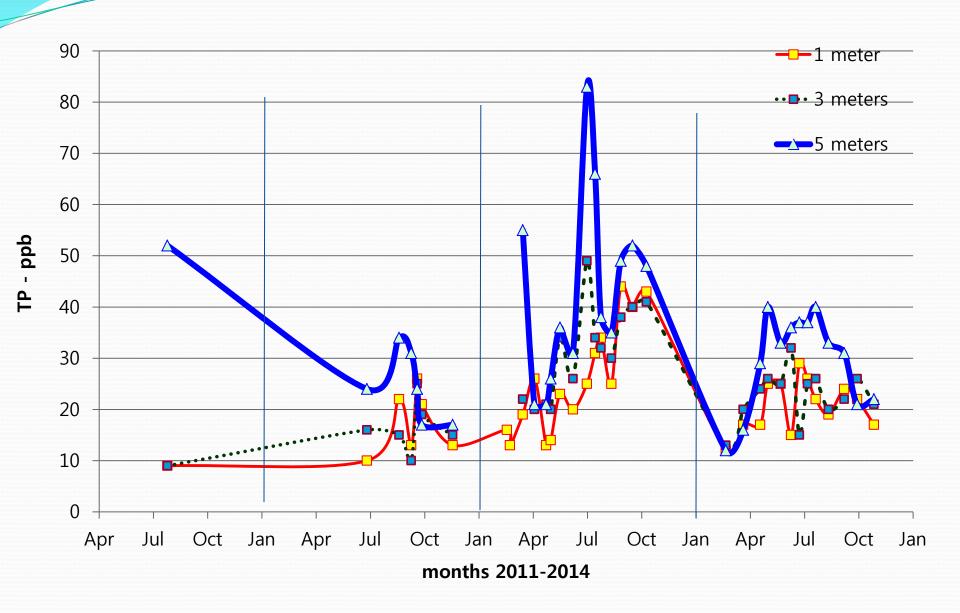
CT DEP trophic categories and paired T Phosphorus And Water Clarity



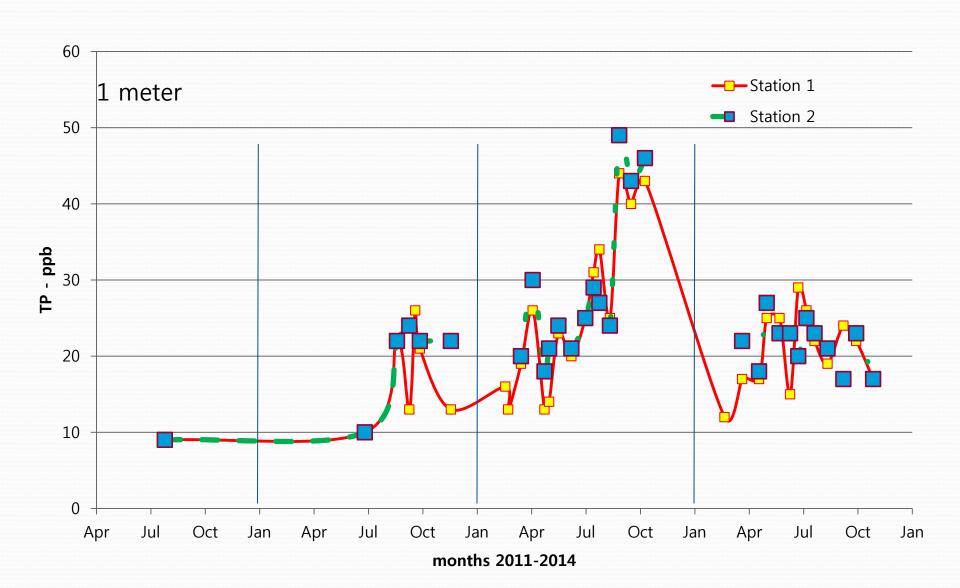
And even more phosphorus vs water clarity data



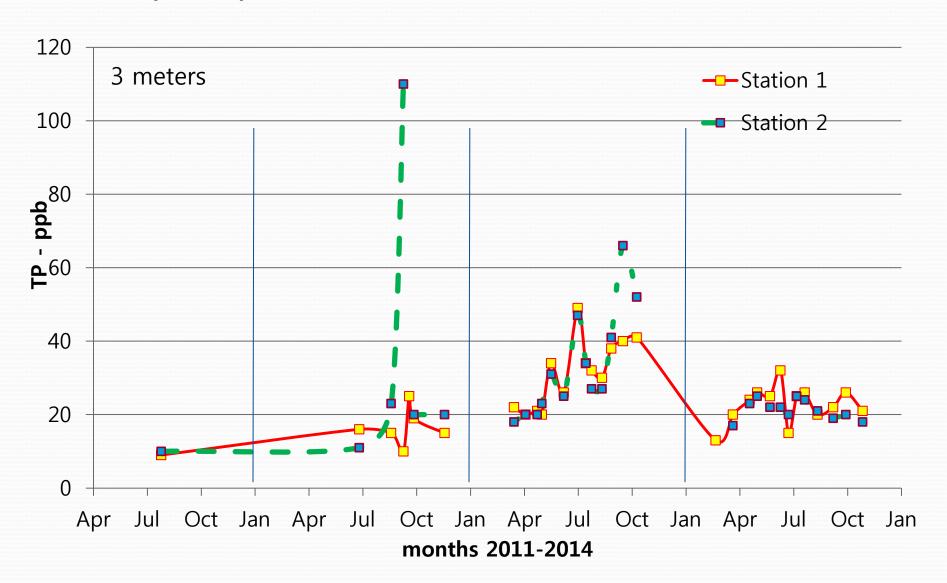
Total phosphorus trends in LBL



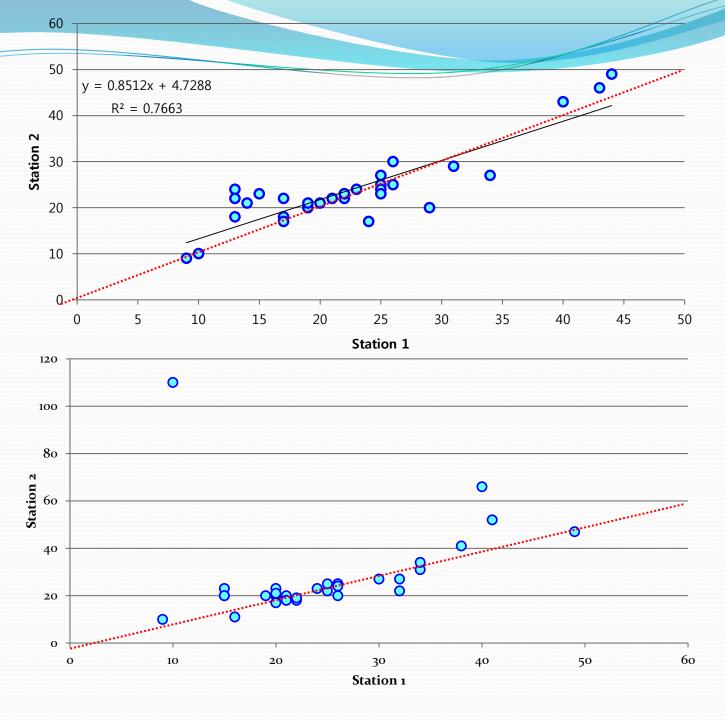
Phosphorus at two stations



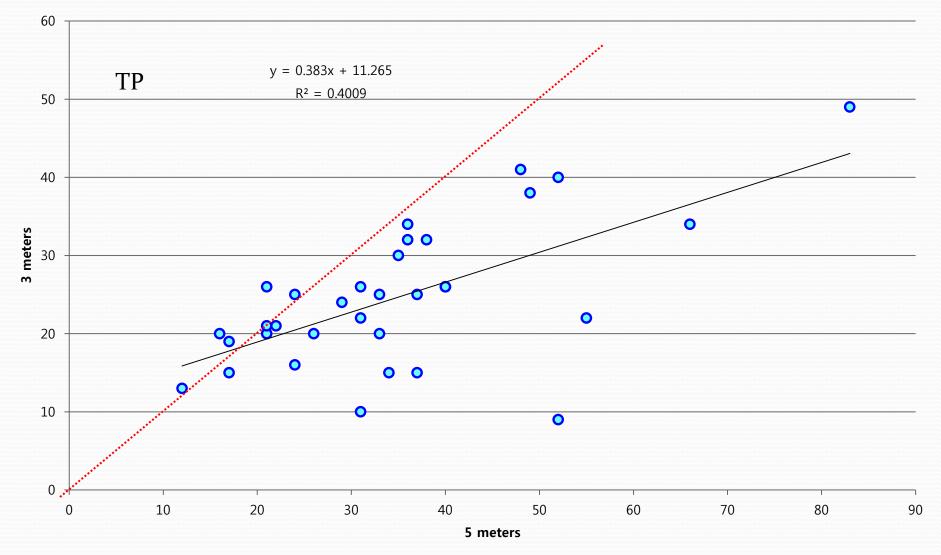
More phosphorus at two stations



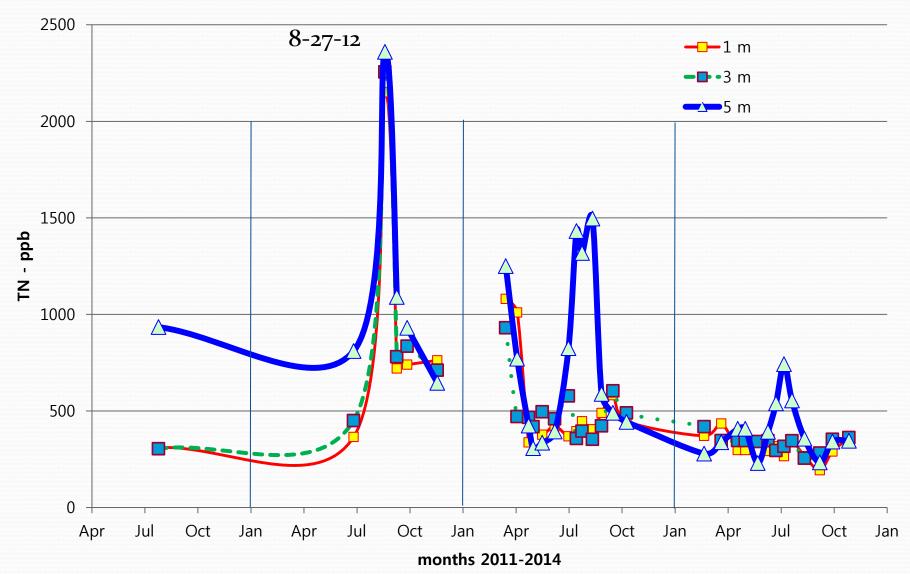
Analysis of phosphorus differences at two stations



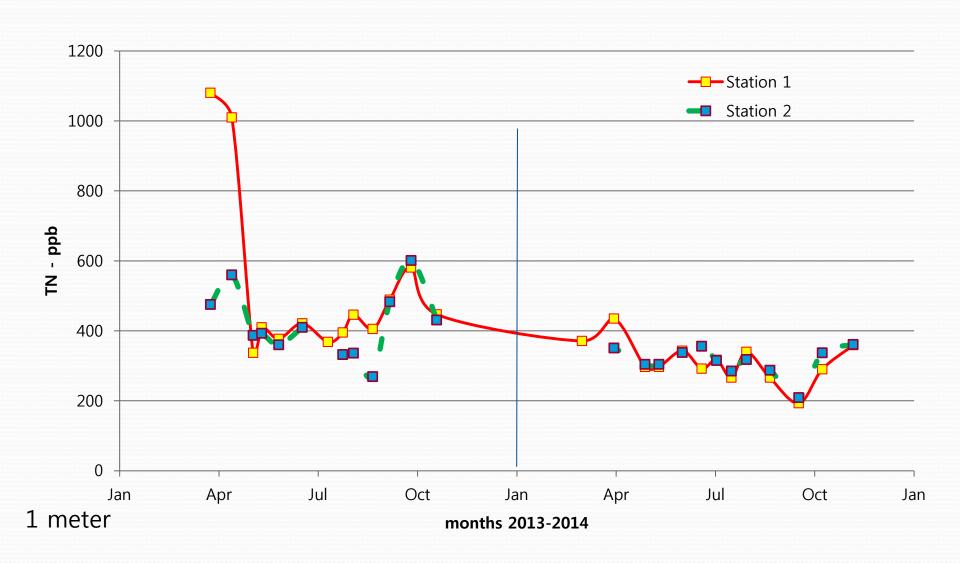
Phosphorus in deep water at Station 1



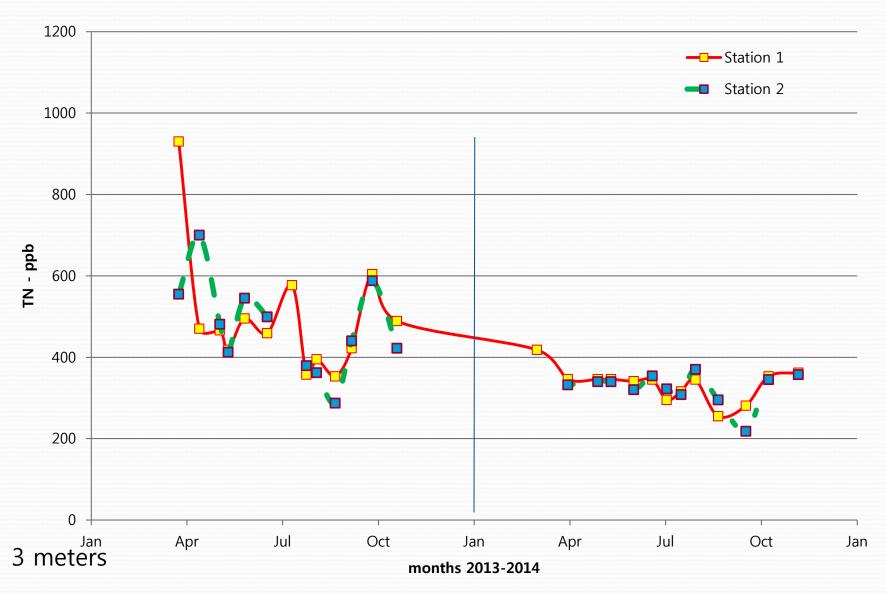
Total Nitrogen in LBL



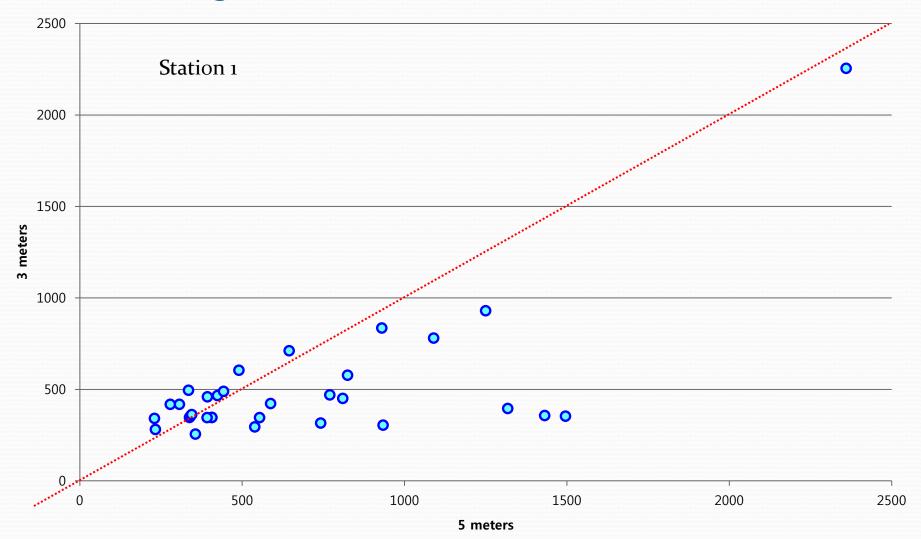
Total Nitrogen at two stations



More total nitrogen at two stations



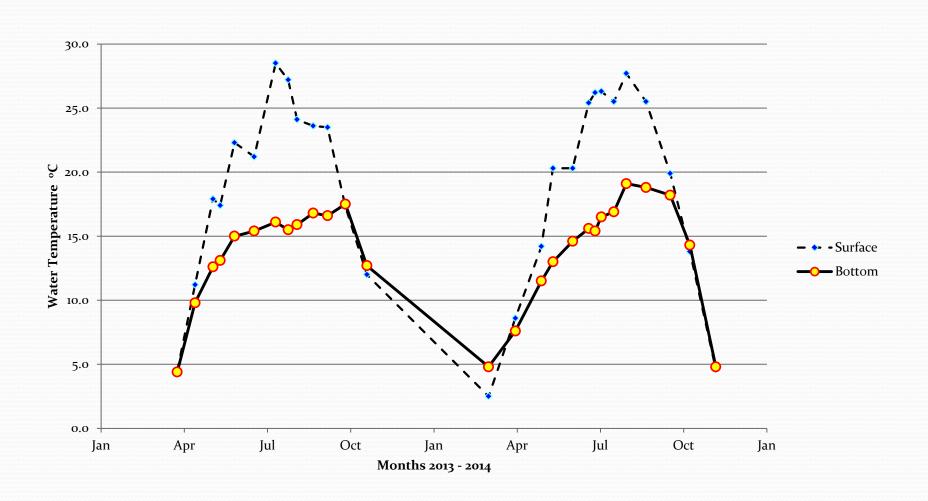
Total Nitrogen at 3 and 5 meters



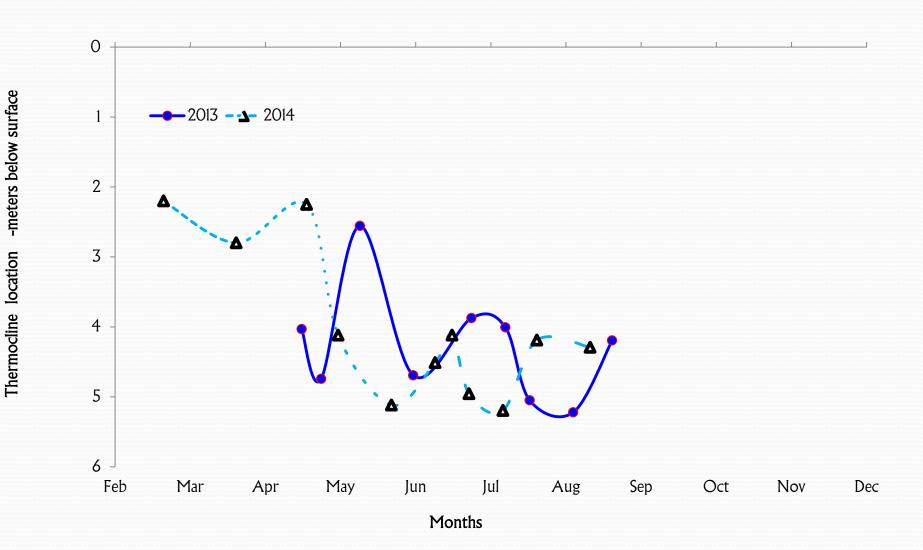
Water temperature, dissolved oxygen, and water clarity

- Water temperature shows the degree and position of any stratification
- Dissolved oxygen shows location of anoxic water and super-saturation
- Water clarity gives the indication of water column phytoplankton or other suspended material

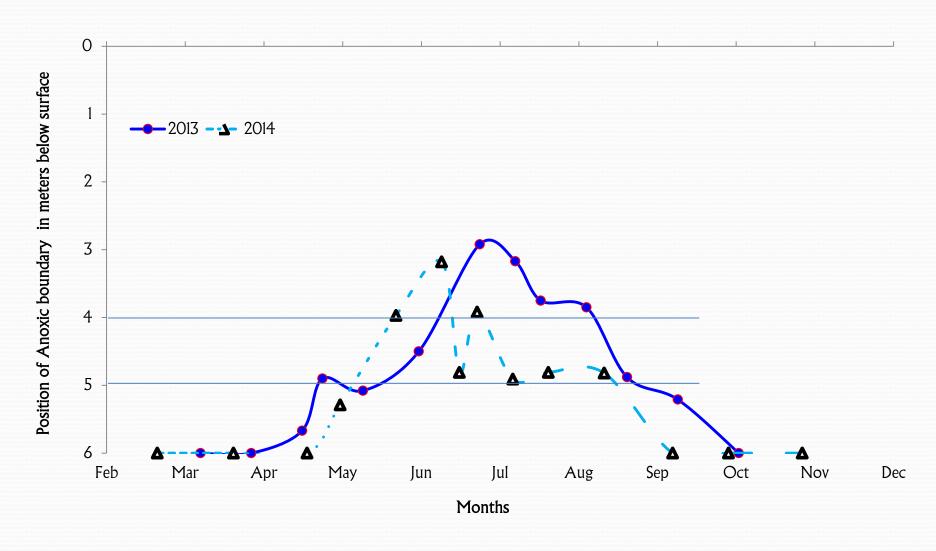
Water Temperature



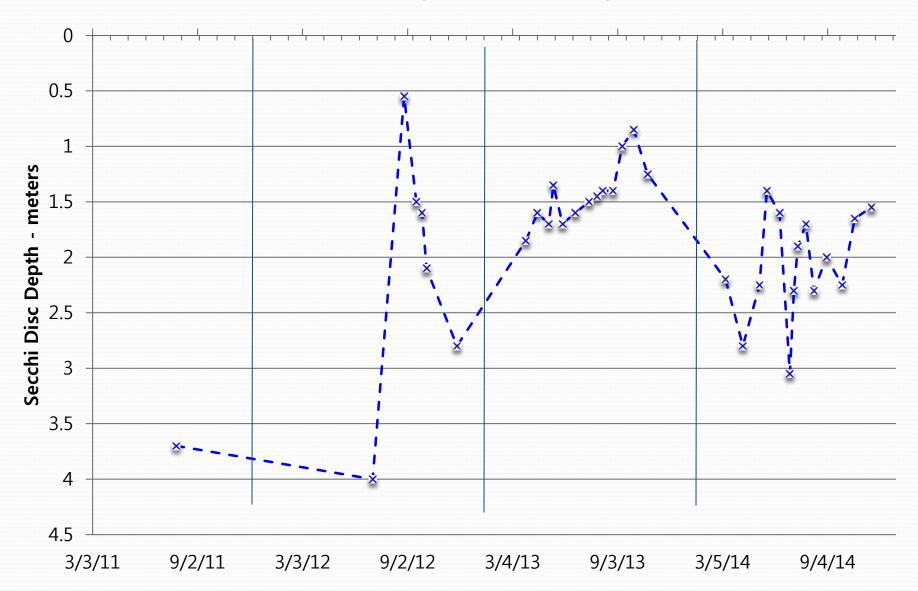
Position of a Thermocline in LBL



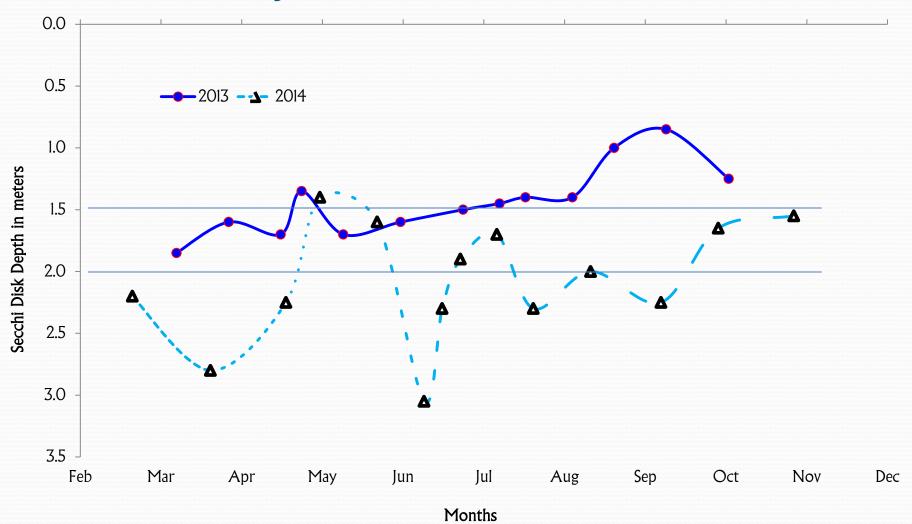
Anoxic Boundary in LBL



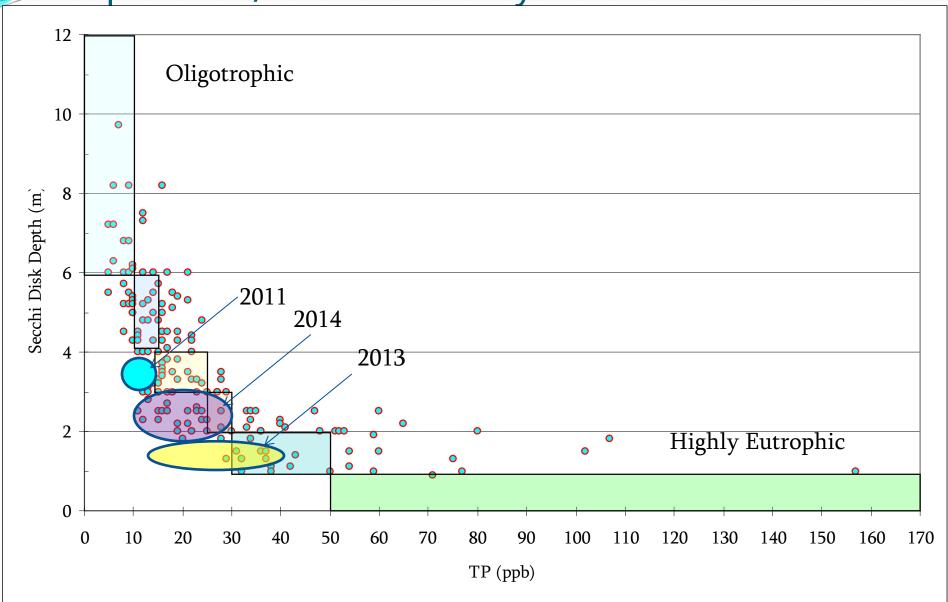
LBL water clarity history



Water clarity in LBL



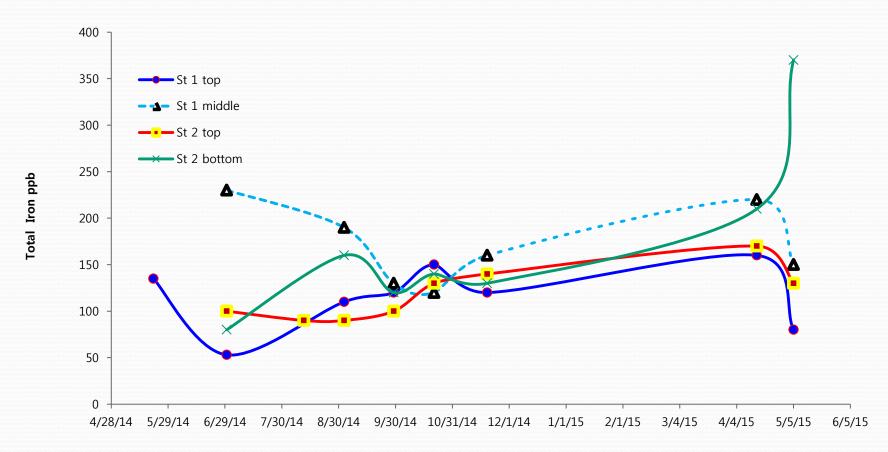
Phosphorus / Water Clarity revisited



Summary

- Both Phosphorus and Total Nitrogen are trending down
- Water clarity has improved
- Dissolved oxygen has improved
- Location of LBL on the phosphorus / clarity model shows LBL was essentially a different lake in 2014 over 2013
- Internal phosphorus loading is evident in 2013, much less so in 2014
- Internal nitrogen loading severe in 2013 but much less so in 2014
- Evidence suggests that surface phosphorus is differ may be influenced by sources other than deep water

Total iron in LBL



Aquatic plant 2014 survey results

- Very little southern naiad in the lake – note blue areas on the map.
- Large beds of macroalgae were found along most of the east and north shores
- Other natives are also returning
- No Fanwort found in the lake during 2014

