Comparative Limnology of the Eight Eastern Finger Lakes 2005 - 2011

John D Halfman
Environmental Studies Program
Department of Geoscience
Finger Lakes Institute

7th Annual Finger Lakes Research Conference
Research Focus:
Watershed ↔ Lake Interactions
Impact of Land Use & Bedrock Geology

Bedrock vs. Shales & Sandstones
Sedimentary Rocks

Limestone vs. Shales & Sandstones
Forested vs. Agricultural Landscapes
• Sampling Schedule
  – Since 2005
  – Monthly: May through Oct
  – At Least Two Deep-Water Sites

• Parameters
  – CTD Cast (SeaBird SBE-25)
    • Cond, Temp, Depth, Turb, Chlor, DO, pH
  – Secchi Disc Depth
  – Surface & Bottom Water Analyses
    • Total Phosphates
      – Since 2006
    • Dissolved Phosphates
    • Nitrates & Silica
    • Chlorophyll-a
    • Total Suspended Solids
    • Total Coliform & *E. coli* Bacteria
      – 2005 only
    • Major Ions (Na, K, Ca, Mg, Cl, SO₄)

Seneca Lake
  Since 1994
  4 (occasionally 9) Sites Streams

Owasco Lake
  11 Lake Sites & Streams
  2006 & 2007, 2011

Cayuga Lake
  9 Lake Sites
  2007 & 2008

Otisco Lake
  Added in 2008
Seneca Lake
2011

Temperature
10-20 m Thermocline
Specific Conductance
Epilimnion Dilution
Fluorescence & Turbidity
Surface Algae & Turbidity
Seasonal Surface Dilution?

Cayuga Lake 2011

Also detected in Seneca, Owasco, Skaneateles, & Otisco Lakes

Canandaigua Lake

Site 1

Site 2

Site 2
Seneca Lake - Salinity Decline

1997-2011 April CTD Data

2011 CTD Data
Groundwater Source of Salts

Chloride Data

Jolly 2006, 2007

Year Chloride Data
Inergy’s Storage LPG
Watkins Glen
Dissolved Oxygen
Fluorescence Subsurface Algal
Nepheloid Layers

Cayuga Lake
2010

Keuka Lake
2011

Site 1

Site 2

Also detected in Canandaigua, Otisco & Owasco Lakes
Chlorophyll-a, Secchi

Algae
Largest
Surface Water
Cayuga, Seneca, Honeoye, & Otisco
Smallest
Bottom Water
Skaneateles, Cayuga, Keuka, & Canandaigua
Phosphates
SRP & TP

2006 - 2011 Mean Total Phosphates

2005 - 2011 Mean Phosphate
2005 Finger Lake Survey
Water Quality & Its Protection

Finger Lake Water Quality

- Bacteria (2005 Only Total Coliform & E. coli)
- Algae (Chlorophyll-a)
- Nutrients (Phosphates (TP, SRP), Nitrates)
- Suspended Sediments (TSS)
- Water Clarity (Secchi disk)

Bush, 2006, Undergraduate Honors Thesis

Honeoye
Canandaigua
Keuka
Seneca
Cayuga
Owasco
Skaneateles
Water Quality Trends

Water Quality Relative Rank (53 Max)

- Honeoye
- Canandaigua
- Keuka
- Seneca
- Cayuga
- Owasco
- Skaneateles
- Otisco

Algae (Chlorophyll-a)
Nutrients (Phosphates, Nitrates)
Suspended Sediments (TSS)
Water Clarity (Secchi disk)
Correlation with Agricultural Runoff

Causation?

Agricultural Land

Exclude Honeoye

$R^2 = 0.98$

All

$R^2 = 0.05$

Mean Water Quality Rank

Honeoye
Canandaigua
Keuka
Seneca
Cayuga
Owasco
Skaneateles
Otisco

Agricultural Land Use (%)
Annual Precipitation

Five Years of Ranking

2005

2006

2007

2008

2009

Work in progress…
Wind Roses – Seneca Lake Buoy

Wind Speed / Direction
fraction of time with winds at indicated speeds
2011-01-01 - 2011-12-31

Wind Speed / Direction
fraction of time with winds at indicated speeds
2010-01-01 - 2010-12-31

Wind Speed / Direction
fraction of time with winds at indicated speeds
2009-01-01 - 2009-12-31

Wind Speed / Direction
fraction of time with winds at indicated speeds
2008-01-01 - 2008-12-31

Wind Speed / Direction
fraction of time with winds at indicated speeds
2007-01-01 - 2007-12-31

Wind Speed / Direction
fraction of time with winds at indicated speeds
2006-01-01 - 2006-12-31

data source: met_station@clarkpt

(data source: met_station@clarkpt)
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Owasco Lake Phosphates (TP)

**2006**

**Total Phosphate Annual Averages**

<table>
<thead>
<tr>
<th>Site</th>
<th>Total Phosphate (ug/L, P)</th>
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<tbody>
<tr>
<td>A</td>
<td>94</td>
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<tr>
<td>1B</td>
<td>125</td>
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<tr>
<td>C</td>
<td>608</td>
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**2007**

**Total Phosphate Annual Averages**

<table>
<thead>
<tr>
<th>Site</th>
<th>Total Phosphate (ug/L, P)</th>
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<tbody>
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<td>C</td>
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<td>2</td>
<td>20</td>
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<td>2B</td>
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<td>CC3</td>
<td>45</td>
</tr>
<tr>
<td>CC4</td>
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</tr>
</tbody>
</table>

Legend

- **Sample Sites**
  - Stream
  - Lake Surface
  - Lake Surface & Bottom

- **Roads**
  - Other Roads
  - State Highways
  - Streams
  - Owasco Lake

NYS Funds – Senator Nozzolio
Seneca Lake: Nutrient Loading

Dissolved Phosphate

Phosphate (ug/L, SRP)

Seneca Lake, Wilson, Kashong, Keuka Outlet, Plum Pt., Big Stream, Reeder, Kendig

118, 197, 145, 102, 120, 116

Seneca Lake Secchi Disk Data

Secchi Disk Depth (m)

Nutrient Loading?

Zebra Introduced

Zebra Die Off

Zebra & Quagga Rebound
Other Variability
YSI Buoy Data, Seneca Lake

Finger Lakes
Sample Dates

Temperature

Chlorophyll

data source: ysi_sonde@clarkpt