Peach Lake Restoration; Efforts over 24 Years

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Overview:

What determines a lake's productivity?

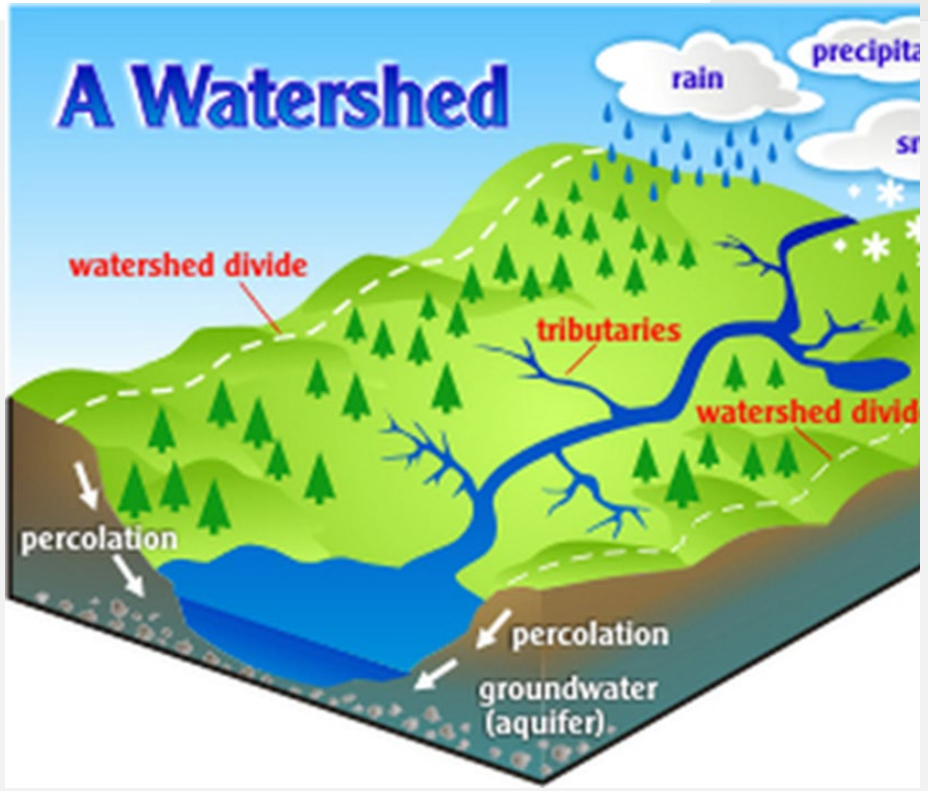
How has Peach Lake evolved over the last 70 years?

What have we done to improve the lake and how did we do it?

What are the 3 main lessons learned from our restoration experiences?

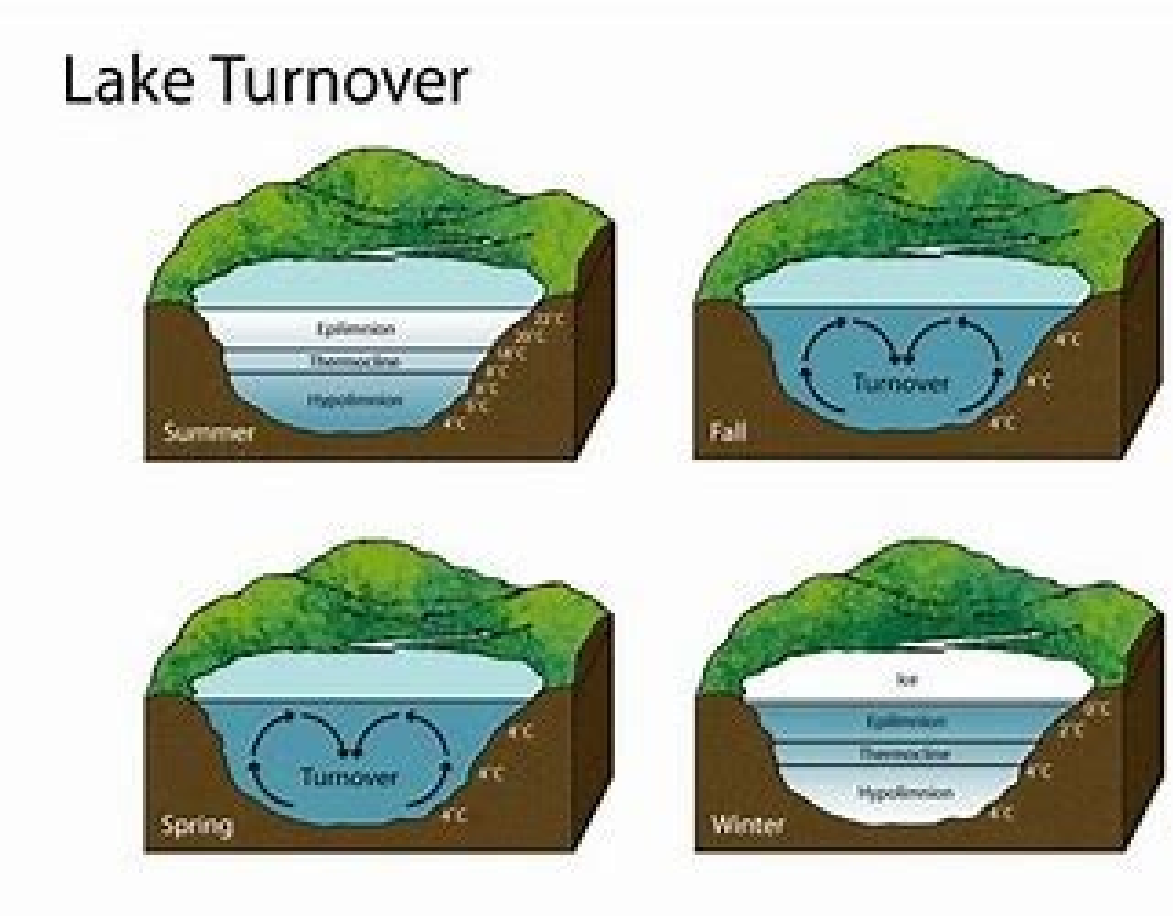
What determines a lake's productivity?
Primarily nutrient sources in the drainage basin

- Nutrient loading, particularly phosphorus
- Water residence time (Tw)
  - PL's Tw is about 2 - 3 years
- Depth and shape (morphometry); PL is 28' or 7m deep
- Lake trophic conditions are identified by primary productivity:
  - Low to high = dystrophic, oligotrophic, mesotrophic, eutrophic, hypertrophic
- Plant (primary) productivity determines the food and habitat base for the rest of the food chain from zooplankton to game fish



Peach Lake is a typical dimictic lake, i.e., turnover is 2x per season
- this influences nutrient circulation and blooms

- **Spring** – ice melts and cold water sinks to the bottom pushing nutrients to the surface; stratification and algal growth begins; warm surface water floats above 4C water
- **Summer** – the upper layer continues to warm making stratification very stable (no nutrient exchange with deep water)
- **Fall** – surface begins to cool and sink creating an overturn; this refreshment of nutrients is often followed by an algal bloom
- **Winter** – uniformly cold at 4C to bottom; ice is colder but floats



How do limnologists analyze lakes in order to manage them?

- We quantify water and nutrient inputs and outputs as budgets
- Adjust inputs (loading) to achieve desired outcome (TP lake concentration):

$$P_\lambda = P_j / (1 + V\sqrt{Tw})$$

- Peach Lake (PL) is eutrophic in the context of chlorophyll and Secchi depth mean values (based on 100 lakes) (Vollenweider and Kerekes, 1980)

mg/m³	Oligotrophic	Mesotrophic	Eutrophic	PL median
Phosphorus	8	27	84	23
Chlorophyll	1.7	4.7	14.3	8.6
Secchi Depth	9.9	4.2	2.5	1.5

The Peach Lake Story:
In the beginning….

- First 10,000 years – oligotrophic lake; drinkable without treatment

- 1920s – oligotrophic; pristine environment; only a few summer camps around the lake

Each decade brought greater development pressure to the Lake…

- In the 1920s, Peach Lake offered an attractive vacation escape from the heat and fumes of NYC
- 1930s – people start to flock to the country, made possible by the Model T
- 1940s – PL was a summer resort area with rental boats and entertainment at the pavilions; post WWII many summer cottages were built
- 1950s – some year-round residents (< 50%); still a beautiful vacation spot

(photos from: M Cooper, L Janus)

The population grows and weeds take over!

- 1960s – year-round residents increased; too many septics, (also golf courses and farms) led to eutrophication
- 1970s – nutrients from septics and stormwater continued to increase eutrophication; swimming less desirable due to algae and macrophytes
- 1 lb of phosphorus supports 500 lbs of algae!
- 1980s – Save Our Lake in Danger “SOLID” group formed; P. Roland report ‘Peach Lake Limnology’
- Nate Jacobsen report recommended sewers
- sewer system opportunity, paid for by the gov’t , was lost due to lack of public knowledge and interest!

The war on weeds started with treating the symptoms…

Chemical, Mechanical, and Biological Treatments to reduce macrophytes:

- Endothal
- Copper sulfate (CuSO4)
- Harvesters
- Grass carp –($12-$20 ea.), need fencing to contain and DEC permit
- Carp stocked in PL:
- 1996 (1650 fish)
- 1999 (300 fish)
- 2002 (500 fish)

Chemical, Mechanical, and Biological Treatments, cont.:

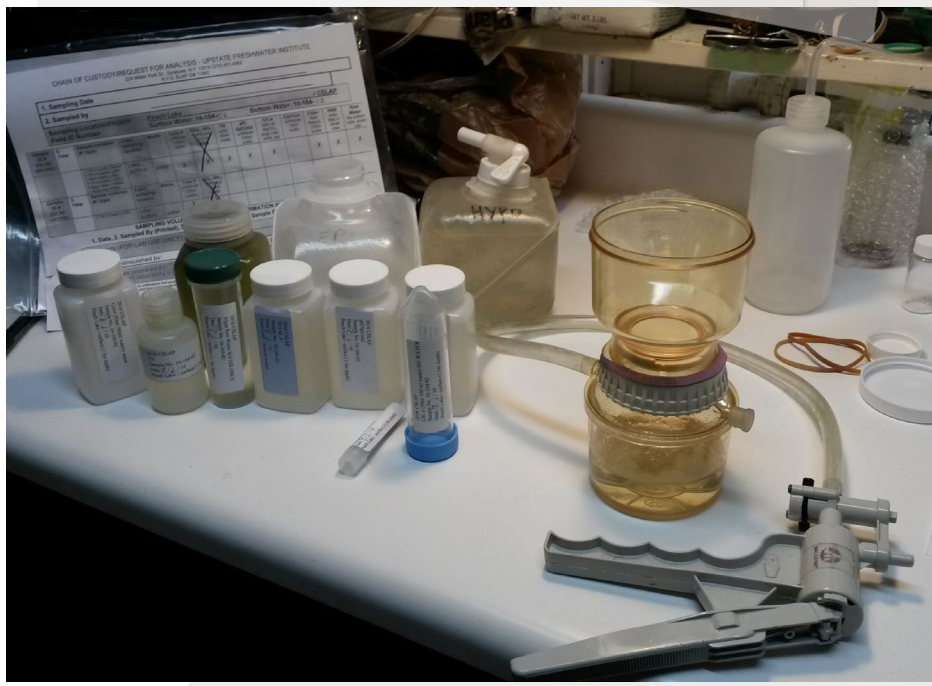
- Costs can usually be covered by individuals and homeowners associations
- grass carp were stocked to reduce milfoil, but this resulted in more blue-green algae
- Pros: effect is immediate
- Cons: these approaches do not address the cause of excessive weed growth and must be repeated frequently; the problem is not solved

Take a ‘High Level’ view of the Problem…

- What are the nutrient sources within the watershed?
  - Septic systems
  - Farms
  - Stormwater
  - Golf courses, lawn fertilizers
- How can they be eliminated or mitigated?
- Set priorities according to magnitude of nutrient source
- Is the sequence important?
  - Yes! Tackle external sources first prior to ‘in-lake’ remediation
- Talk to local gov’t officials about potential grants and financial support; check State Revolving Fund (SRF) grants

Importance of CSLAP!

- CSLAP sampling at Peach Lake began in 2000 (24 years)
- You need water quality data to:
  - Identify the lake's trophic status
  - Define status for the priority waterbody list (PWL)
  - Develop a Total Maximum Daily Load (TMDL) to define effective remediation
  - Present credible evidence to justify grants
  - Develop public support for local government actions
- CSLAP Cost: ~ $500/year – a great investment!
- paid by homeowners associations to the Peach Lake Environmental Committee



Sewer System planning…

- ~ 2000 PLEC surveyed homes to find out opinions about sewers
- Q: How much would people be willing to spend? A: $100/month

- 2004 *Peach Lake Wastewater Study* by Stearns and Wheler ($150K from Westchester and Putnam Counties requested NYCDEP Water Quality Improvement Program (WQIP) funds)

- *2008 Map Plan & Report (MPR) by Stearns and Wheler* ($200K)
  - MPR required by State Comptroller for sewer (or other) district formation to ensure costs to residents are within limits (<$1K/y)

- *2009 Total Maximum Daily Load (TMDL) for Phosphorus in Peach Lake by Cadmus Group*
  - (prepared for EPA and DEC to meet the Clean Water Act, 1992 since Peach Lake was on the 303d list)
  - https://www.dec.ny.gov/docs/water_pdf/tmdlpeachlk09.pdf

TMDL for TP in Peach Lake

(Table 6. Cadmus, 2009)

TMDLs were required by the Clean Water Act

The loading goal of 167 lbs/yr was the load needed to achieve a lake concentration of 20 µg/L

The reduction goal of 191 lbs/yr TP is nearly achieved with removal of septic systems (188 lbs/yr) via the sewer system

SOURCE (LBS/YR)	CURRENT	ALLOCATED	REDUCTION goal	% REDUCTION
Agriculture	20	20	0	0
Developed land (no regs)	33	31	2	6
Septic systems	188	0	188	100
Natural forest	20	20	0	0
LOAD ALLOCATION	262	72	190	73
Developed land (MS4 regs stormwater)	24	23	1	5
Point Sources	0	0	0	0
Waste Load Allocation	24	23	1	5
LA + WLA	286	95	191 (= 119 + 72)	67
Margin of safety	---	72	---	---
TOTAL	286 (load in 2009)	167 (target load)	(difference is 119 lbs)	---

The Sewer System installed in 2012 – 2013!

- effective remediation of nutrient sources begins…

- Town of North Salem formed a Sewer (Tax) District to fund the $31.5 M sewer project
- Low pressure system with grinder pumps at 484 homes
- 90K GPD treated by microfiltration
- P removal step (paid by NYC because location within NYC watershed)
- Caution! Power outage resulted in a load surge - this caused an explosive overflow of sewage that ran through one house!
- Grease clog caused major blockage and expensive repair ($90K)

2008 Peach Lake Stormwater Pollution Study by Hahn Engineering

- 8 years later (2016) Contech Jellyfish filters installed
- Jellyfish are filters that reduce silt and nutrients
- In 2016 the North Salem officials secured a grant of $815 K from the NYS DEC, and the East of Hudson Watershed Corporation
- 8 Contech "Jellyfish" catch basins around the lake to remove additional phosphorus
- Need maintenance (done by Town)

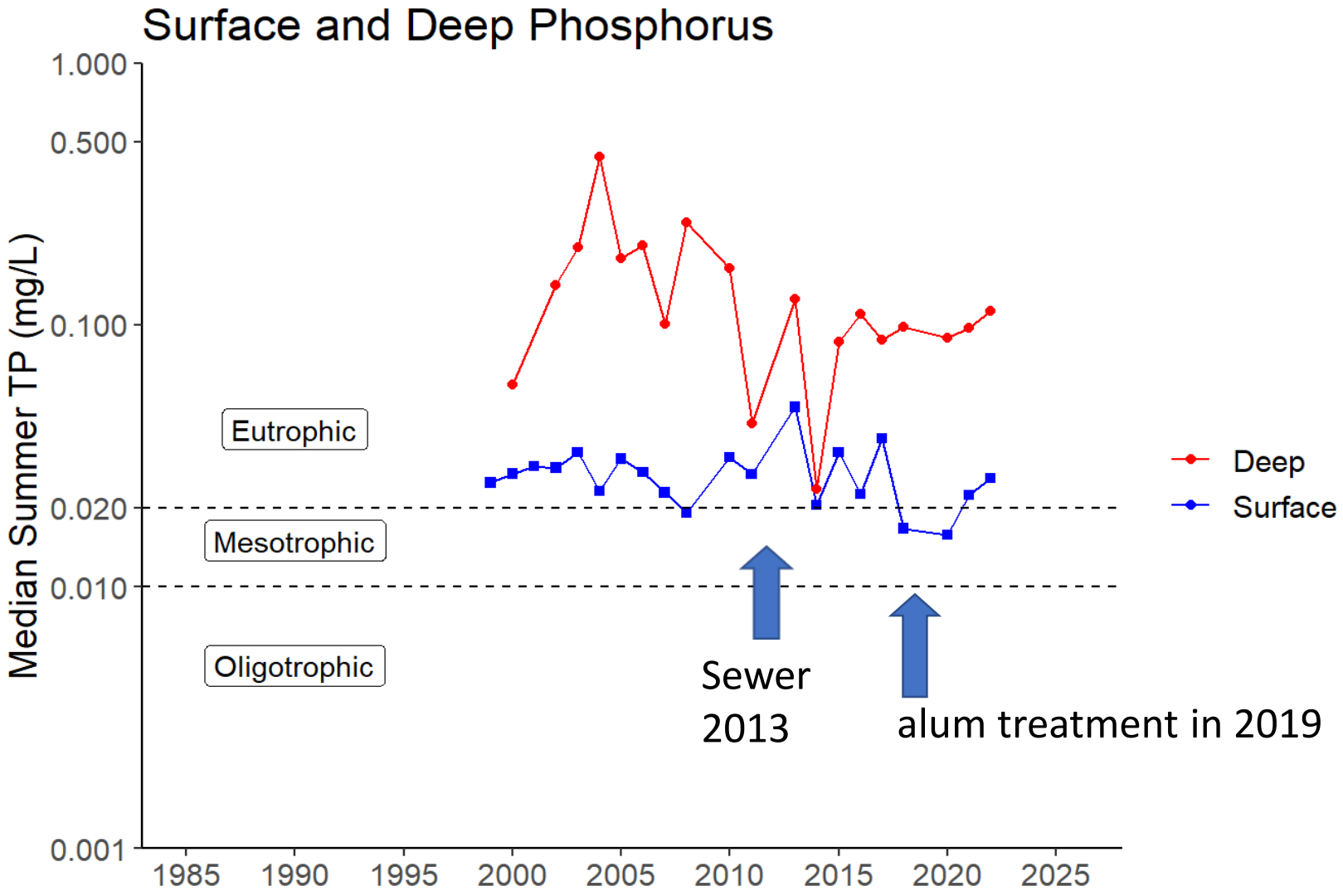
2018 NYS Harmful Algal Bloom (HAB) Summit at New Paltz

- NYS announced $ 65M would be used to study control of HABs
- 12 lakes across NY vulnerable to HABs were prioritized for study
- Peach Lake qualified because of long term CSLAP data!
- Alum was applied as a slurry via a tank and diffuser off the back of a boat
- Effect is to bind phosphorus in sediments to minimize algal growth

Harmful algal blooms reduced by alum treatment…

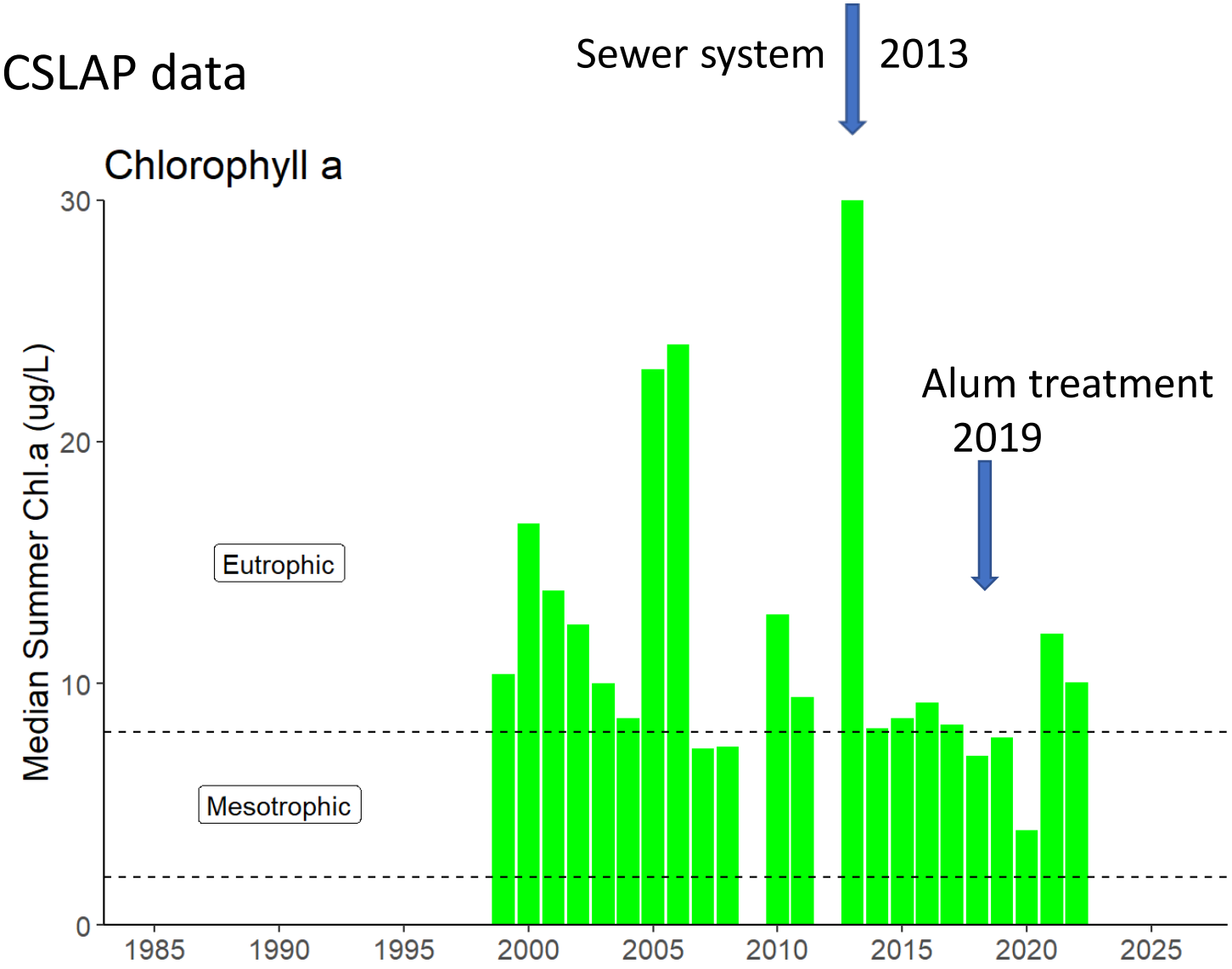
- CSLAP and other data showed nutrient levels, algae, clarity, and oxygen improved
- Internal loading diminished by alum treatment
- Peach Lake study and remediation cost estimated at ~$500K
- paid by NYS as part of the HAB Study
- 2019 Alum (aluminum sulfate) treatment – estimated to last for 5 years; low dose improved only 1 year
- Deep (hypolimnetic) withdrawal for watering golf courses could also help remove nutrients from the lake

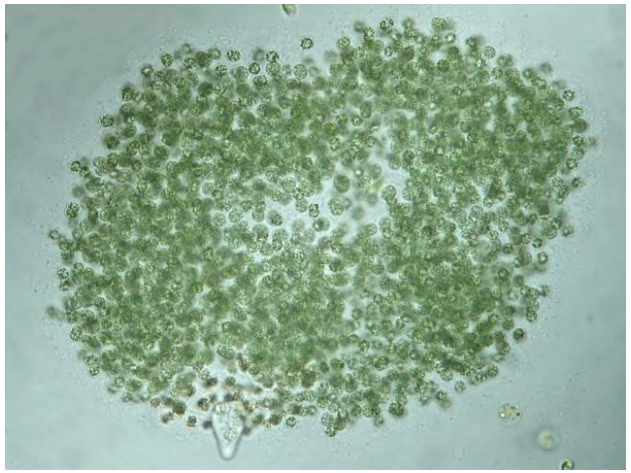
What happened to phosphorus levels?



Chlorophyll in Peach Lake – past 22 years

CSLAP data





Microcystis

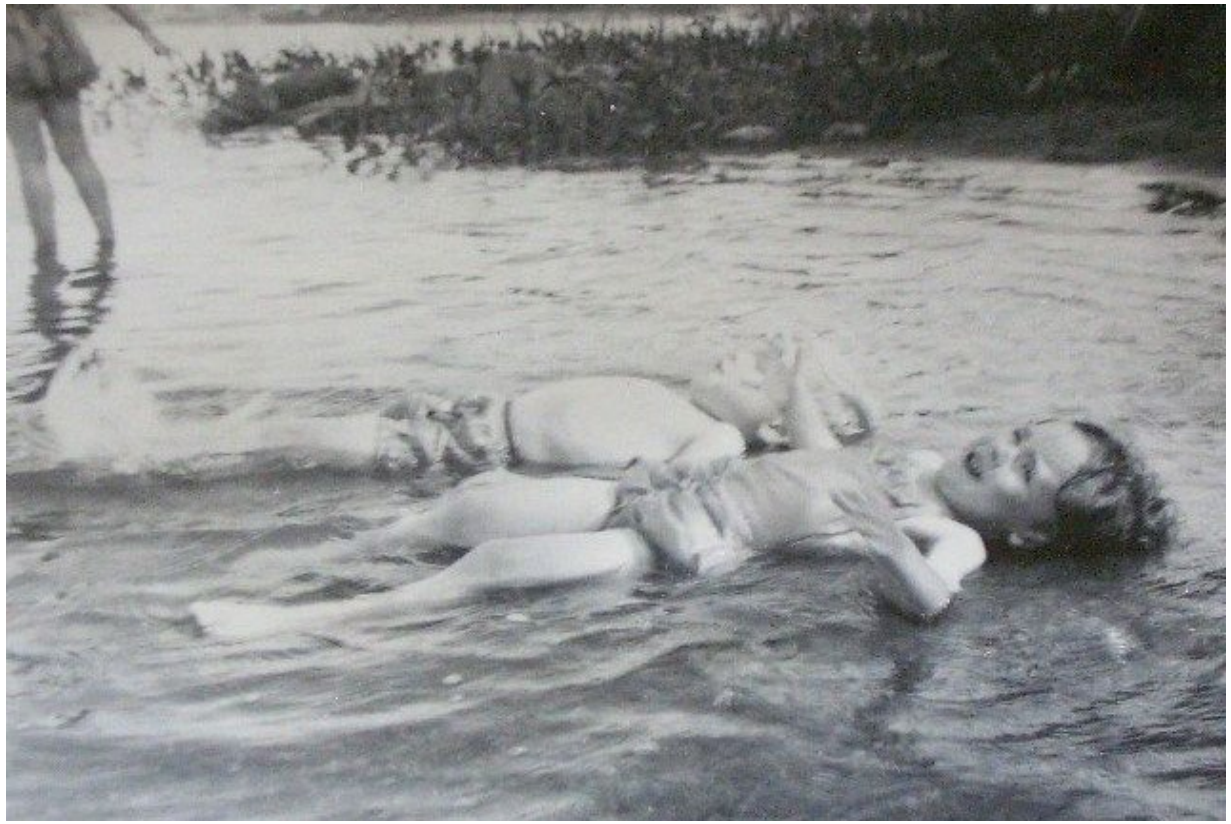
Dolichospermum (Anabaena)

No alum permits are allowed in NY! What can you do?

- Alum is currently considered a “pesticide” by DEC because it binds nutrients essential for plant growth
- EPA does not register alum as a pesticide, and DEC cannot issue a pesticide permit for alum
- Ken Belfer at Mohegan Lake suggested language to amend the ECL to legalize use of “nutrient inactivants” (alum, sodium aluminate, etc.) as is routine in most other states
- Get a copy of the Resolution letter, send it to your NYS Assemblyman and ask them to become a co-sponsor of the amendment.

The good part! Swimming has been restored!

(me in Peach Lake 1954)



(PL in 2020)

Our most recent project:
the Peach Lake Brook clean-out…
?

- postcard circa 1930
- Picture is probably near the outlet to East Branch Reservoir
- Shows fast flow
- no blockage by weeds or fallen trees

2022 Peach Lake Brook (outflow) was clogged by vegetation

- Problem: Low-lying properties flood
- Homeowners raised $17 K to fund a pilot study to test the method of clearing PL Brook Study
- PLEC lobbied local Town government for funding to clear full length of outflow
- Town of Southeast obtained ARPA & tax revenue funding of $150K from Putnam County
- $2,200 used for an ecological survey of the existing vegetation
- Funding required a committee to plan long-term brook maintenance
- (gov’t “clawback” of ARPA funds was a threat)

Scott and Gerrard clearing large debris April 2023

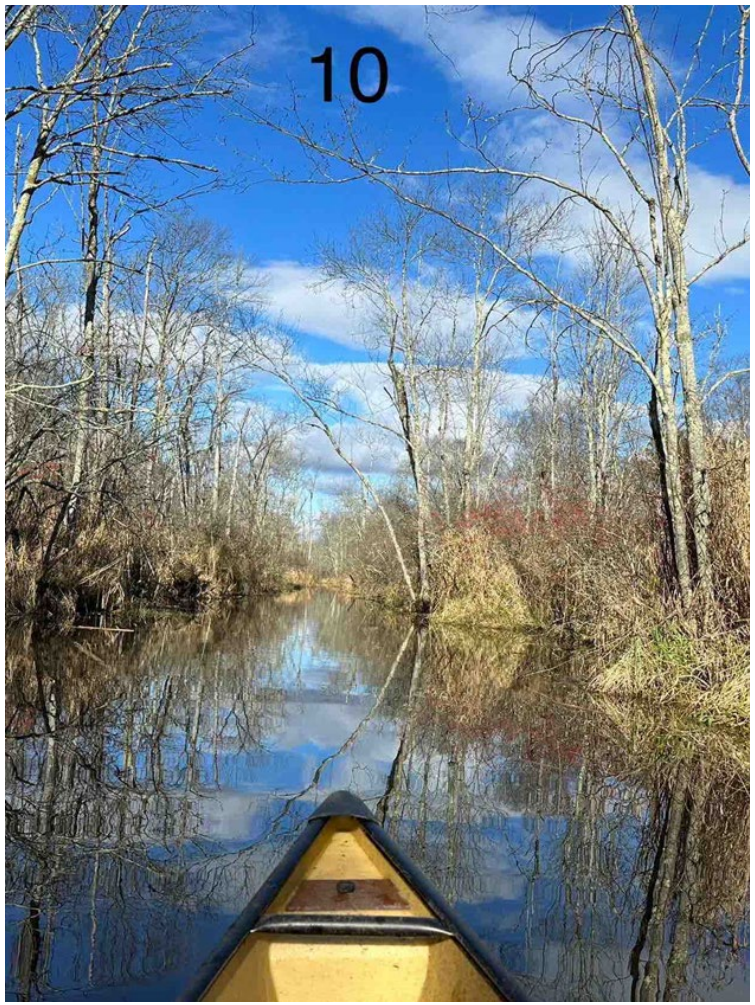
Peach Lake Brook was cleared in 2023

- Lake height data was recorded in LOCSS
- Demonstrates effect of clearing outlet
- Better flow allows flood water to dissipate quickly; lake remains at a lower level

Peach Lake Brook Survey Before & After Hydro Raking

Site 10: ~1000 feet from Peach Lake

September 4, 2023



November 27, 2023

LAKE OBSERVATIONS
BY CITIZEN SCIENTISTS & SATELLITES

Nicole White, CLM – Little Bear Environmental Consulting, LLC - https://littlebearenvironmental.com/

What lessons did we learn?

Lesson 1: Good data is essential…

- it will reveal the most effective sequence of nutrient control projects

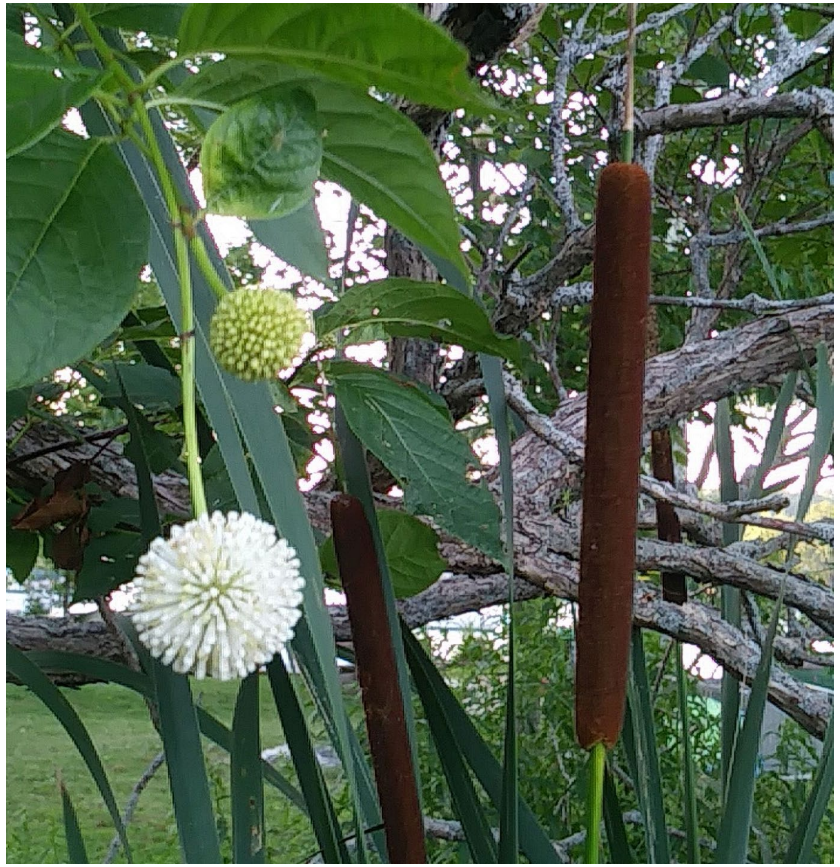
- We worked from the landscape to the lake:
- First, control of external nutrient loading was done via sewer system and some stormwater mitigation (Jellyfish)
- Second, internal loading minimized by alum
- algae and macrophytes have been reduced since 2000
- clearing the outflow will allow better flushing and will relieve flooding of low-lying properties

Lesson 2: Success is when preparation meets opportunity! How can we prepare?

- Clearly state goals and rationale
- Grass roots organizations and public support are essential to engage your local government
- Gather factual, quantitative information and long-term data
- Peach Lake would not have benefitted from the NYS HAB study and alum treatment if we had not had CSLAP data, been on the Priority Waterbody List, and had advocates at the HAB Summit
- Become aware of the NYS State Revolving Fund grants for design and construction of water and wastewater infrastructure
- Be aware of Town and State initiatives that align with your needs – they may provide support

Lesson 3: Projects take decades, so be “in it” for the long haul…

- Evaluate the magnitude of the project and approximate cost
- Define the steps of the process to get to the endpoint
- Gather data and use it to educate others, write news articles
- Get public support via education and events
- Develop a small-scale study of the problem and its proposed solution; possibly 2 steps using a small ‘pilot study’ for “proof of concept”
- Search out potential grant opportunities to find appropriate pathways
- engage local gov’t for support in obtaining grants or forming districts to finance big projects
- STICK WITH IT! (It’s worth it)



Acknowledgements:

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  Scott Cerosky, Gerrard Caporale, Dave Bruen, Paul Wicha


Thank You for your attention!
Photo by M. Cooper