Peach Lake's Journey from Septics to Sewers

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June 9, 2023
Lower Hudson Lakes Conference
NYSFOLA

Overview:

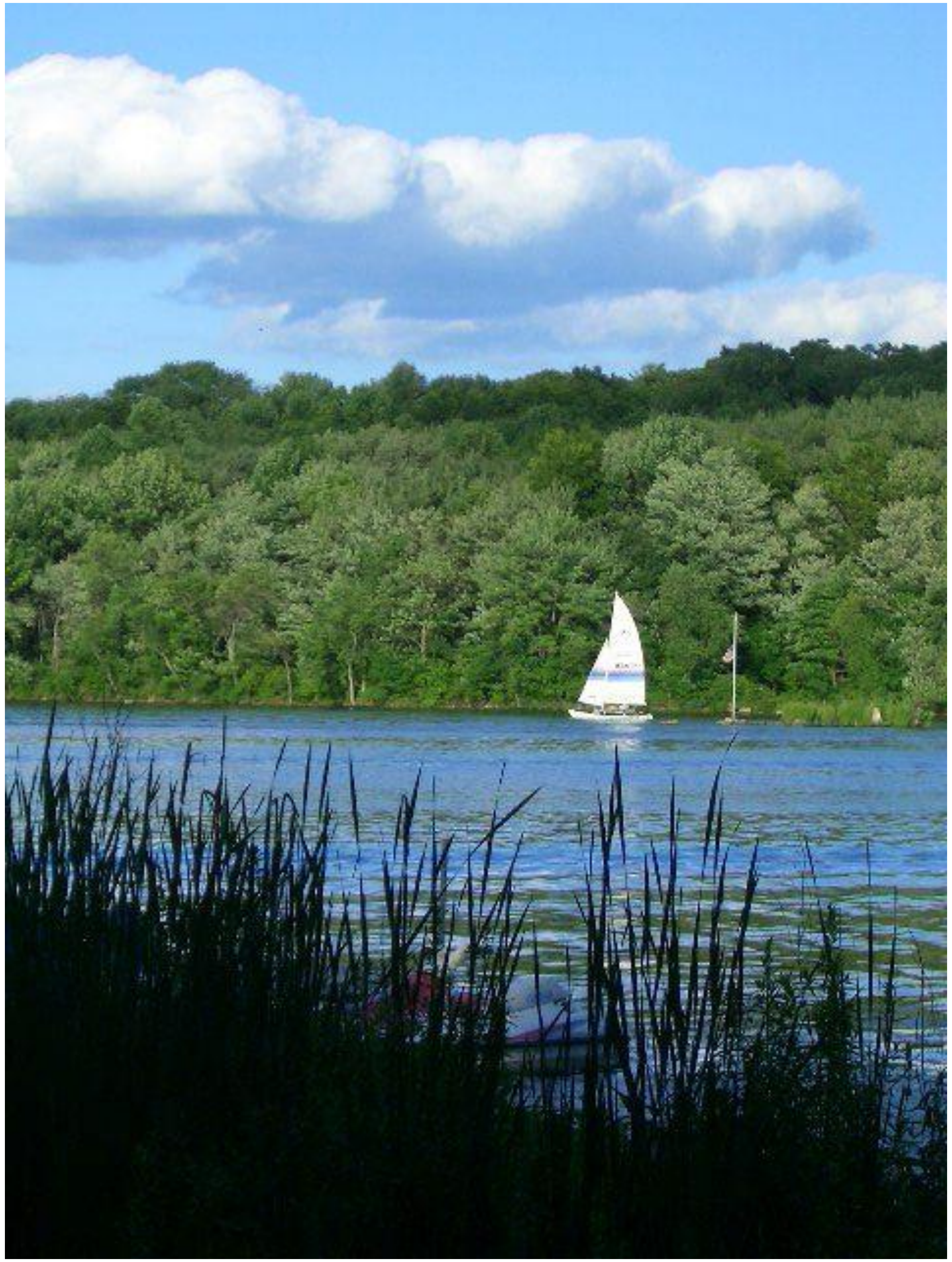
What determines a lake's productivity?

How has Peach Lake evolved over the last 70 years?

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

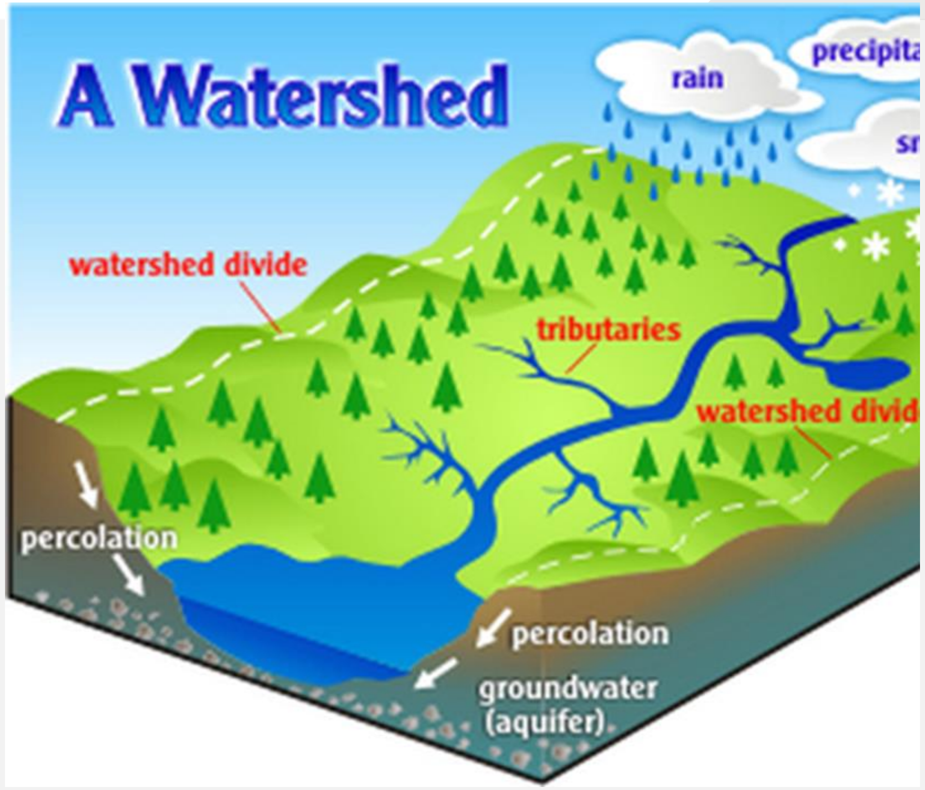
What are the 3 main lessons learned?

What are our future goals?



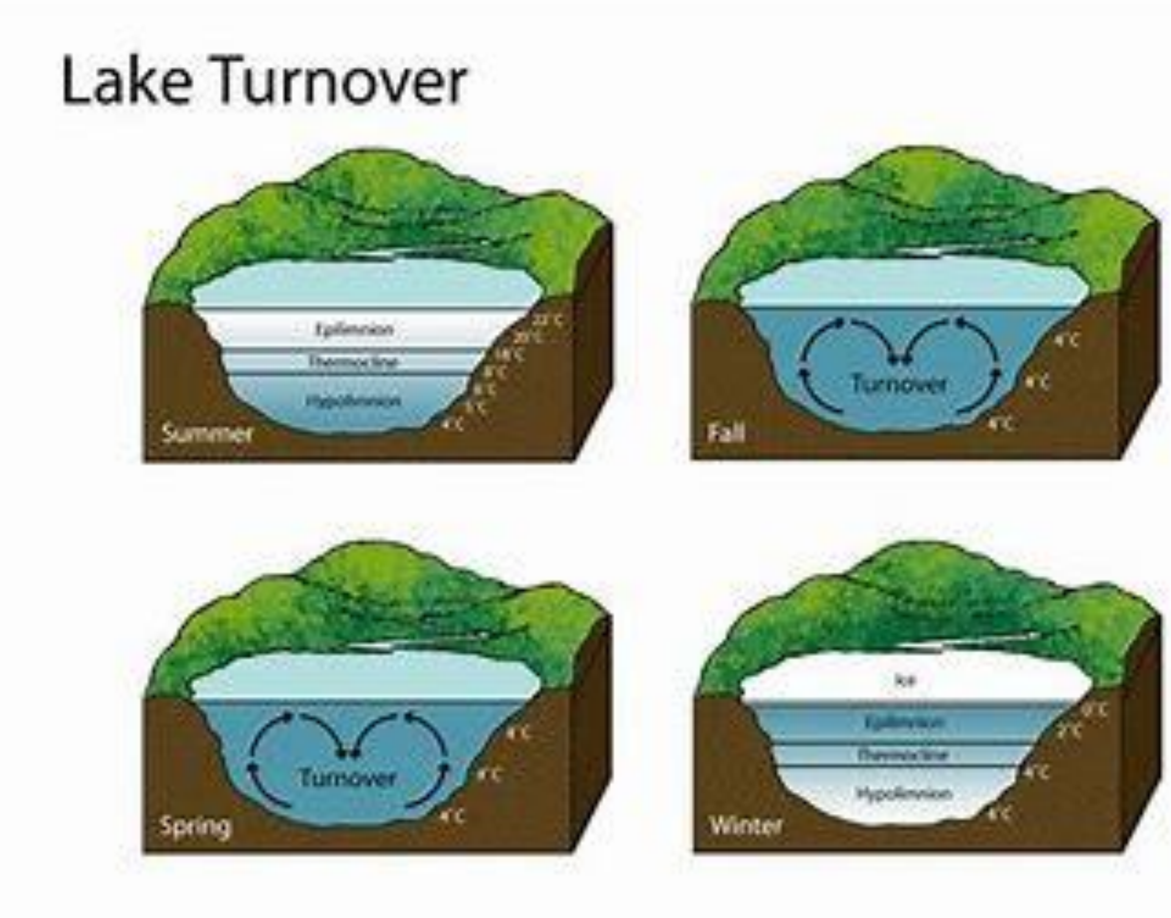
What determines a lake's productivity?
Primarily nutrient sources in the drainage basin

- 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):

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

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

mg/m^3	**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 cottages around the lake

Peach Lake offered an attractive vacation spot for NYC residents …

- 1930s – people start to flock to the country with the advent of the Model T

- 1940s – summer resort area with rental boats and entertainment at the pavilions; post WWII many 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 continue 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
- Gov't paid sewer system opportunity 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 ($CuSO_4$)
- Harvester
- Grass carp – need fencing to contain and DEC permit ($12-$20 ea.)
- Carp stocked in PL:
- 1996 (1650 fish)
- 1999 (300 fish)
- 2002 (500 fish)

Chemical, Mechanical, and Biological Treatments:

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

Importance of CSLAP!

- CSLAP sampling at Peach Lake began in 2000
- Need to use your water quality in order to:
  - Identify the lake's trophic status
  - Define status for the priority waterbody list (PWL)
  - develop TMDL & effective remediation
  - present credible evidence to set priority for grant money
  - Develop public support for local government action
- CSLAP Cost: ~ $500/year – a great investment!
- paid by homeowners donations 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 for DEC & EPA)

TMDLs were required by the Clean Water Act

'The maximum annual phosphorus load (i.e., the annual TMDL) that will maintain the phosphorus water quality goal of 20 µg/L in Peach Lake is a mean annual load of 167 lbs/yr. '

TMDL is achieved with removal of septic systems

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	67
Margin of safety	---	72	---	---
TOTAL	286	167	---	---

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 $31,500,000 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 $815,000 grant 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)

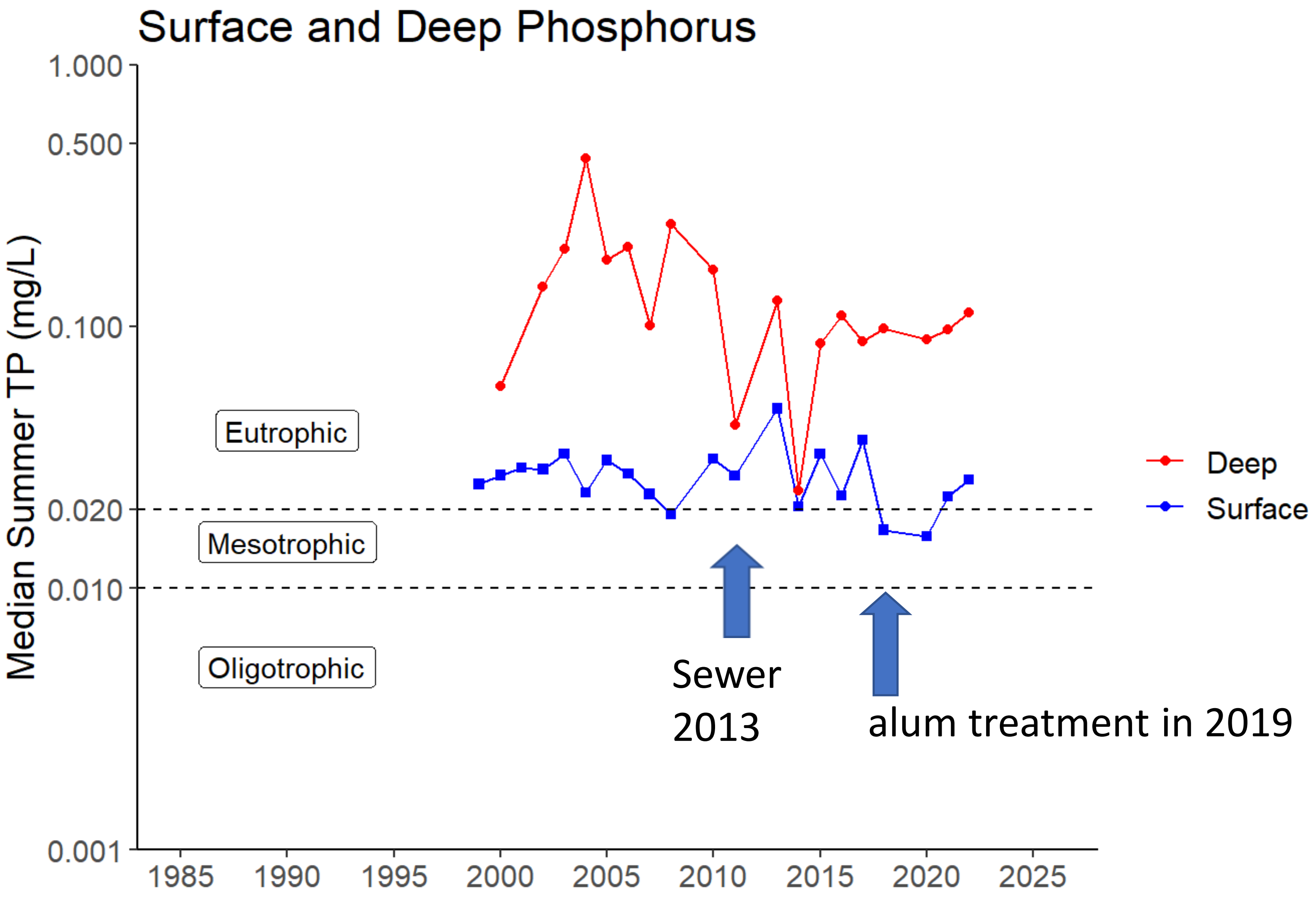
2018 NYS Harmful Algal Bloom (HAB) Summit at New Paltz

- 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!
- Applied as a slurry via a tank and diffuser off the back of a boat
- Effect is to bind phosphorus in sediments to prevent algal growth

Harmful algal blooms reduced by alum treatment…

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

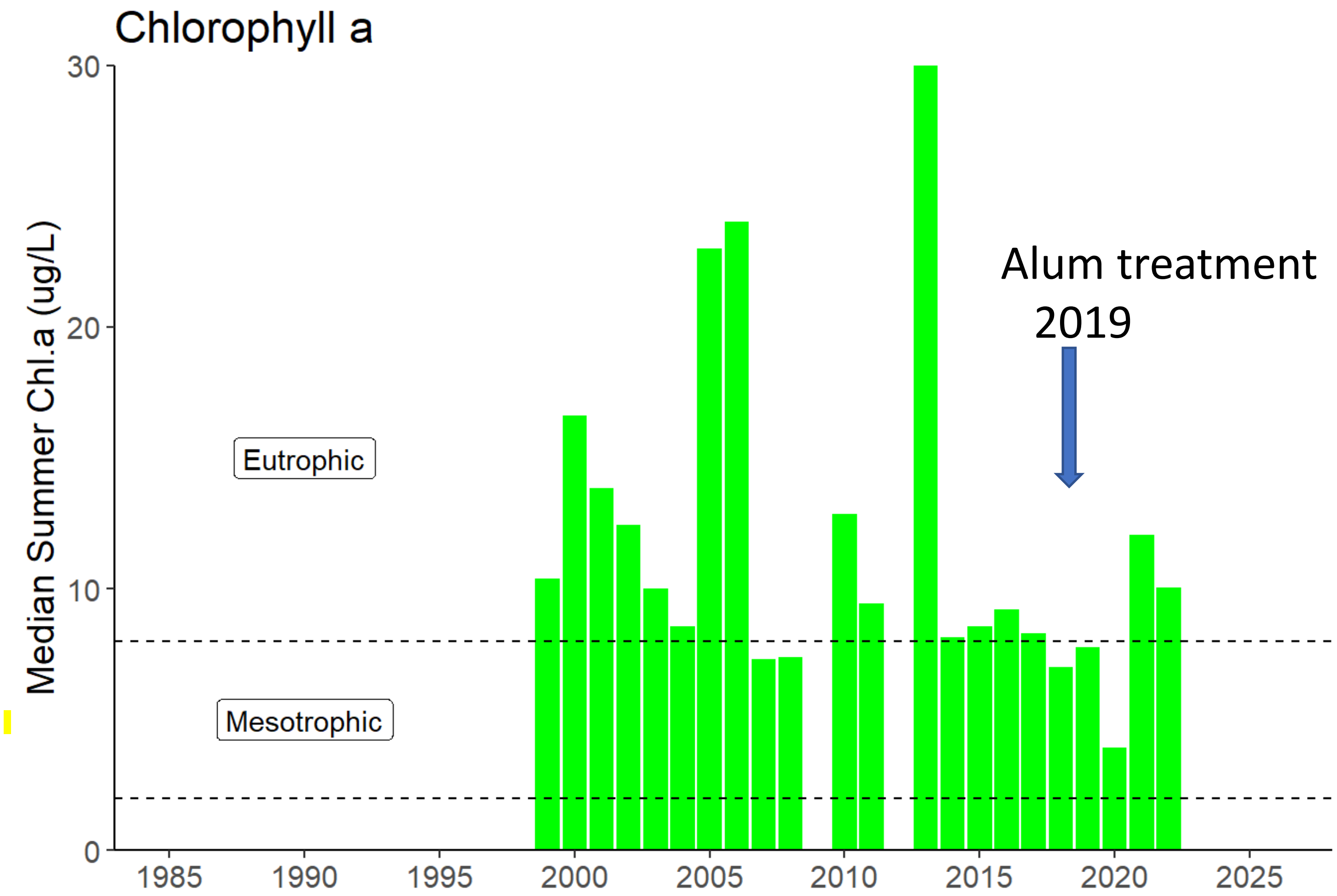
What happened to phosphorus levels?

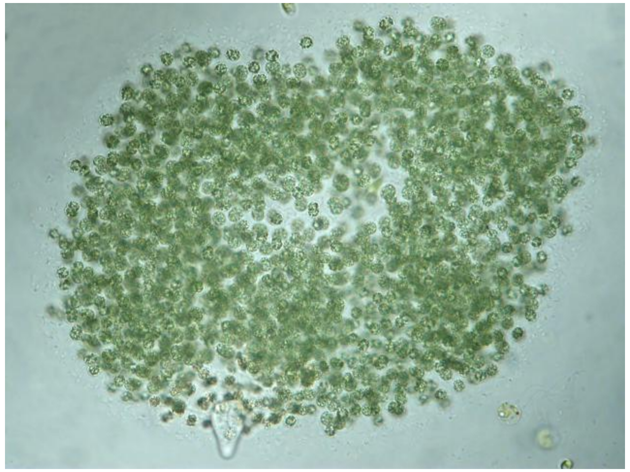


Chlorophyll in Peach Lake – past 22 years

CSLAP data

Sewer system 2013



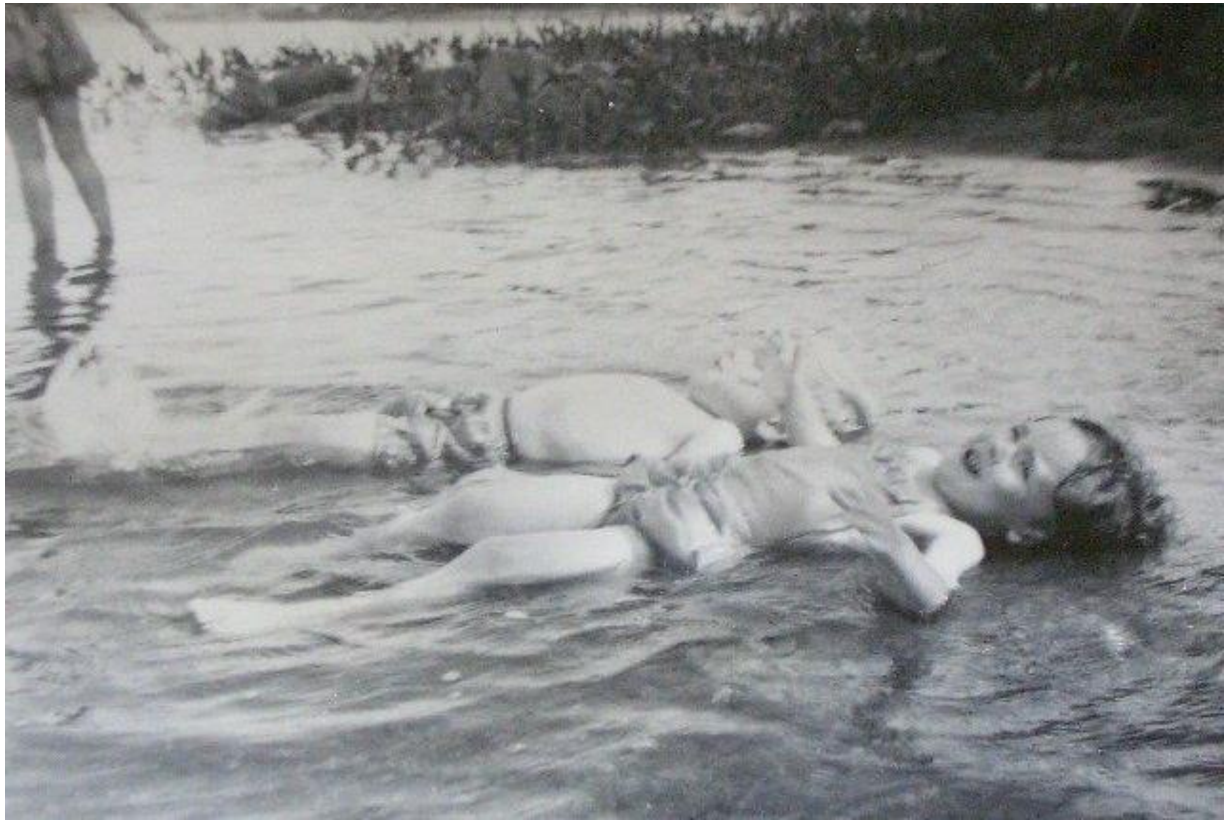


Microcystis

Dolichospermum (Anabaena)

The good part! Swimming has been restored!

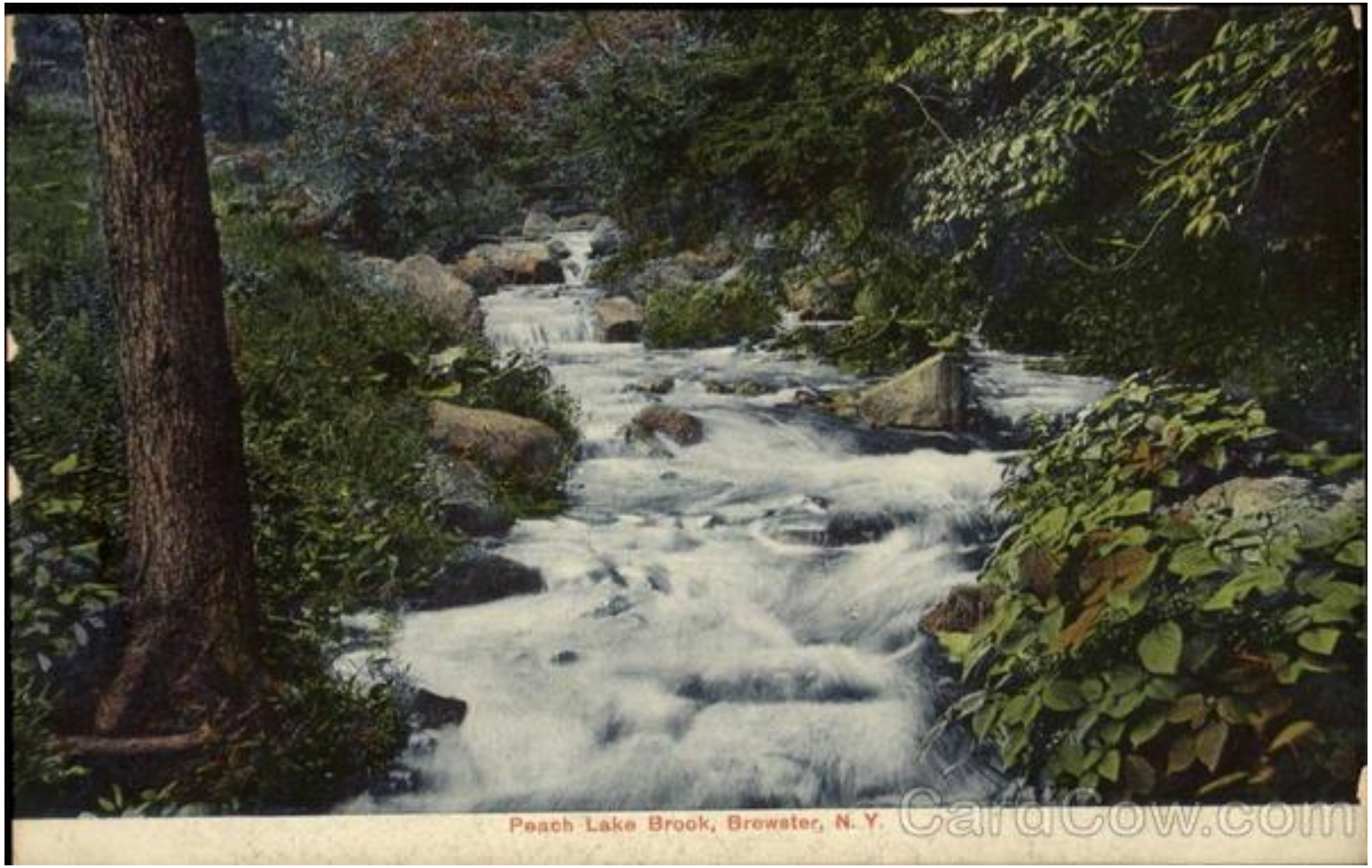
(me in Peach Lake 1954)



(PL in 2020)

Peach Lake Brook
postcard circa 1930?

- Probably at the outlet to East Branch Reservoir
- Shows fast flow
- no blockage by weeds or fallen trees



Current issue: 2022 Peach Lake Brook (outflow) clogged

- 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 obtained ARPA & tax revenue funding of $150K from Putnam County
- $2,200 used for an ecological survey of the existing vegetation
- Funding could have been jeopardized if homeowners had not formed a committee to plan long-term brook maintenance
- gov't "clawback" of ARPA funds may still be a threat


Scott and Gerrard clearing large debris April 2023

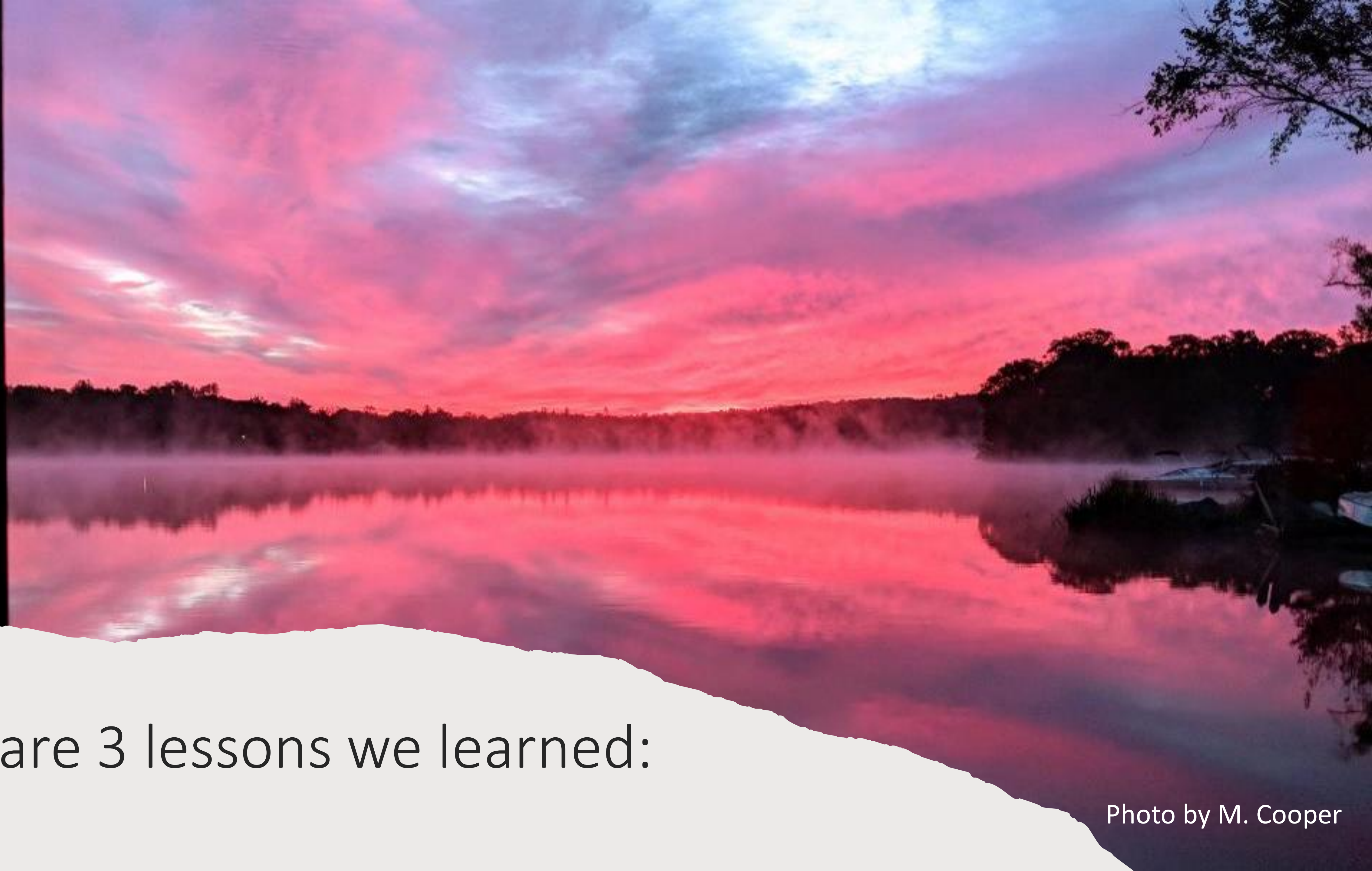


Photo by M. Cooper

Here are 3 lessons we learned:

Lesson 1: Sequence of nutrient control is important…

- Work 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 significantly reduced since 2000
- clearing the outflow will allow better flushing and will relieve flooding of low-lying properties

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

- Grass roots organizations and public support are essential; engage your local talent and expertise
- Clear statement of goals and rationale
- Gather factual, quantitative information and long-term data; organize it
- 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 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 grassroots 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 projects
- STICK WITH IT! (It’s worth it)

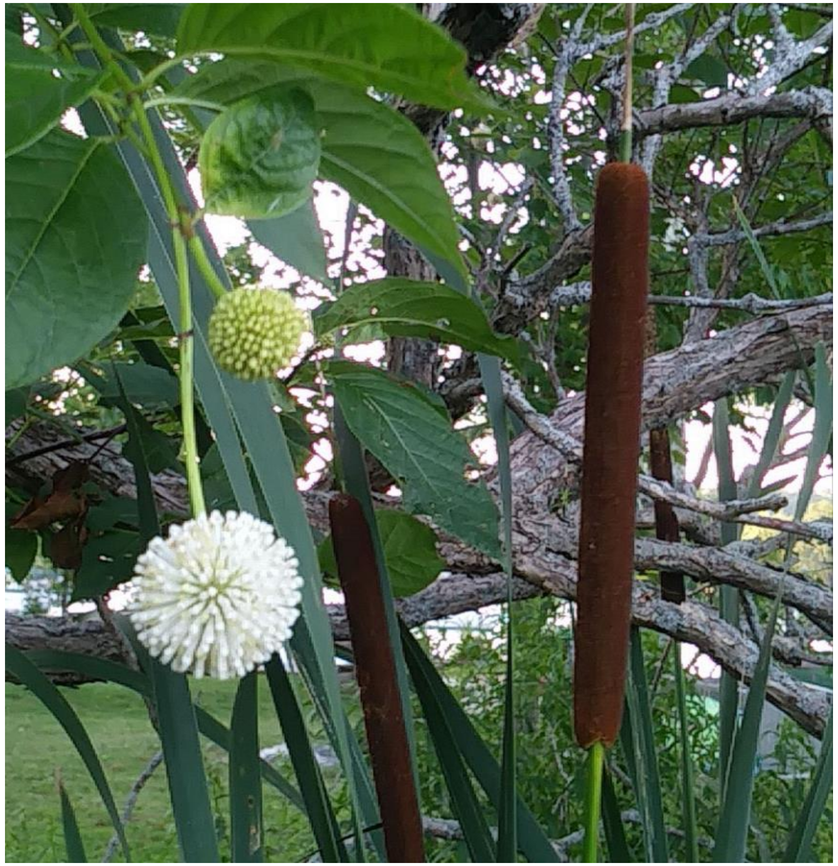
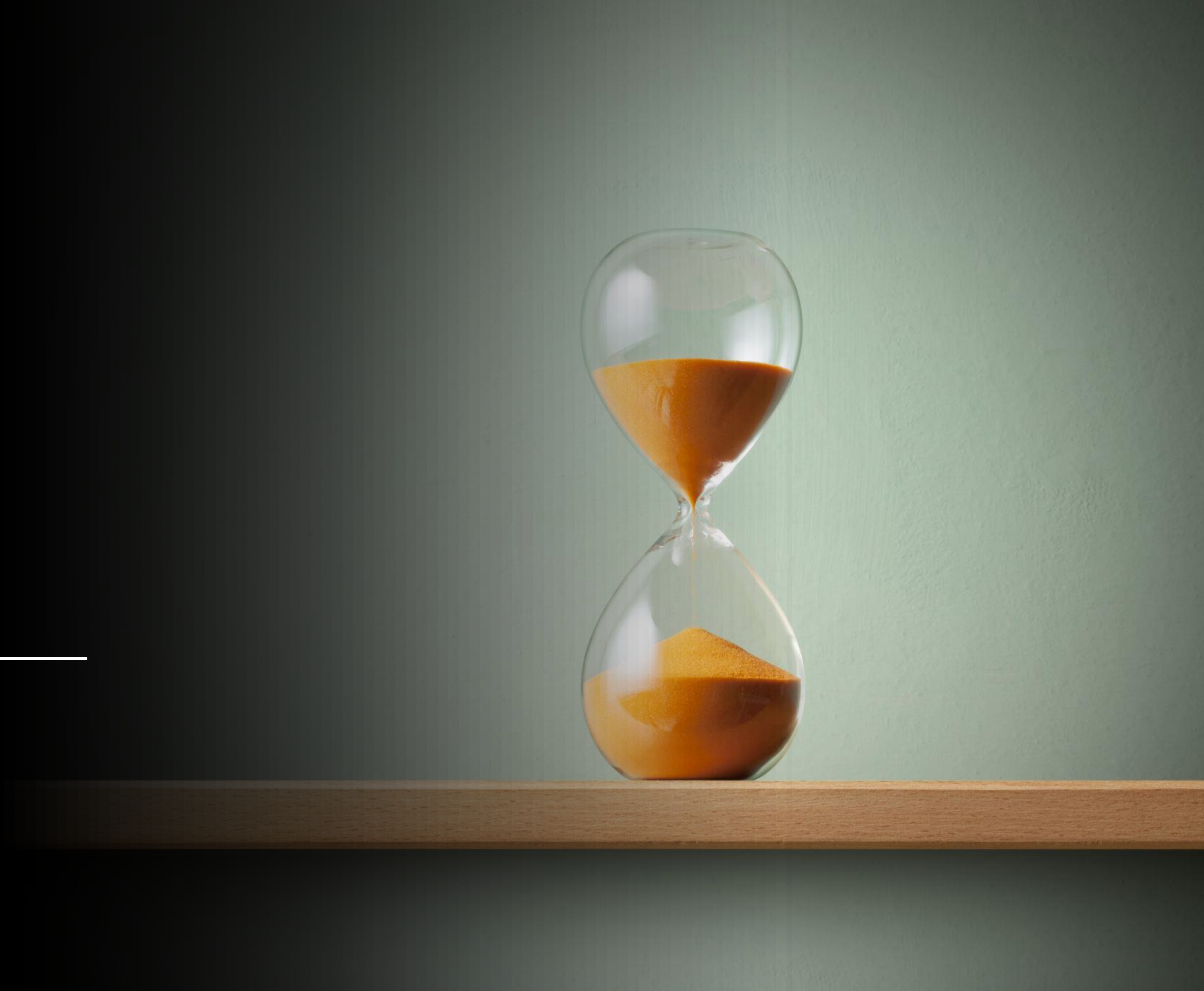


Photo by C. Cooper

If time permits….



Future goals for Peach Lake?

1. Maintain the **outflow channel** to reduce flooding
2. **Protect** what remains of the **wild shoreline habitat**;

   this is the nursery for all native plants and animals that make the lake interesting
3. **Improve the sport fishery**, but keep the algae and aquatic weeds to a minimum for swimming and boating
   - note that a sport fishery requires higher plant density so goals can conflict
4. Further quantify TP sources; plan financing for **future alum treatment**?
5. Other goals?
   - **Communicate** more with residents
   - **Prevent invasives**: zebra mussels, spiny water flea, etc.
   - **Minimize road salt** applications

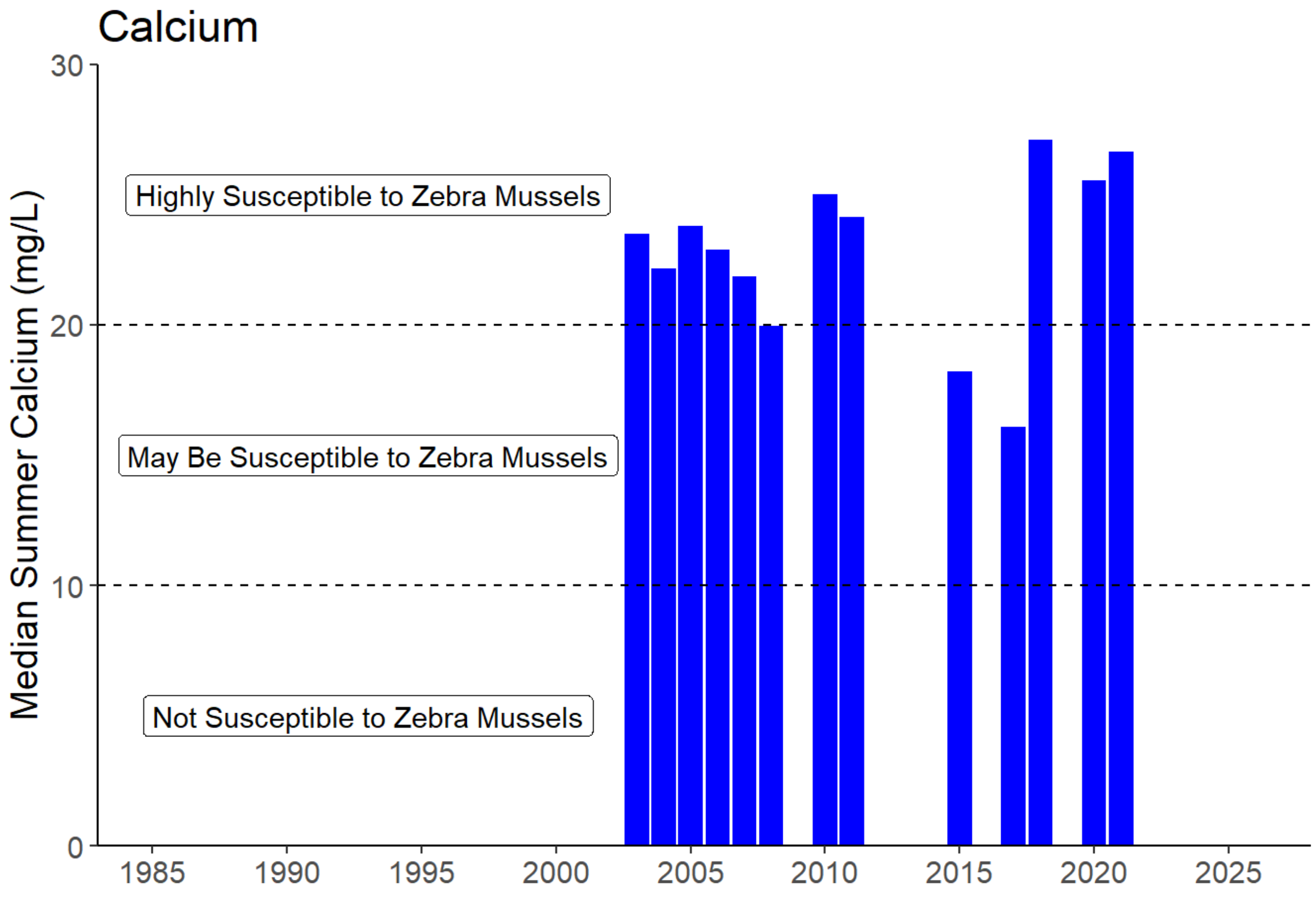
Peach Lake – Lake Scorecard from CSLAP

Trophic condition indicates we still need time and maybe more alum!

Water Quality Indicators	Average Year	2022
Phosphorus	Eutrophic	Eutrophic
Chlorophyll A	Eutrophic	Eutrophic
Secchi	Eutrophic	Eutrophic
Lake Perception	Poor	Fair
Harmful Algal Blooms	Poor	Fair
Aquatic Invasive Species		Present

Peach Lake is Suseptible to Zebra Mussels so we need to prevent this!

Data from CSLAP



Rising conductivity in Peach lake due to road salt

- observed world-wide in northern areas

- Data from CSLAP