Responding to Cyanobacteria Blooms in Florida Lakes: Results from Three Apparent Success Stories

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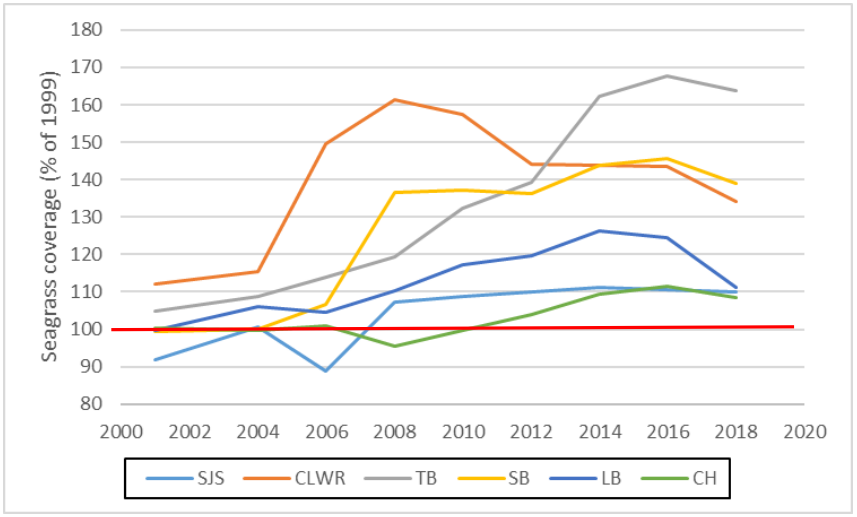
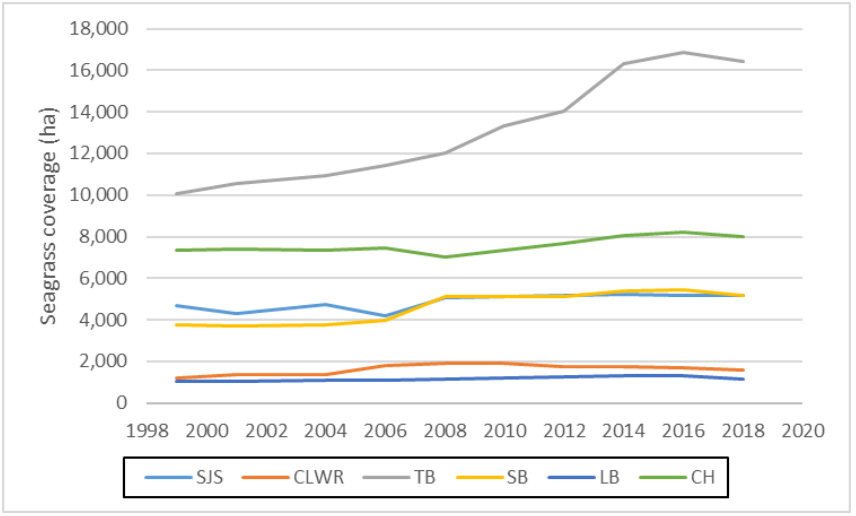
1 – ESA
2 – Charlotte County
3 – Pinellas County
4 - SWFWMD

In coastal systems in SW FL, some great success stories

All 6 systems healthier than 20 years ago



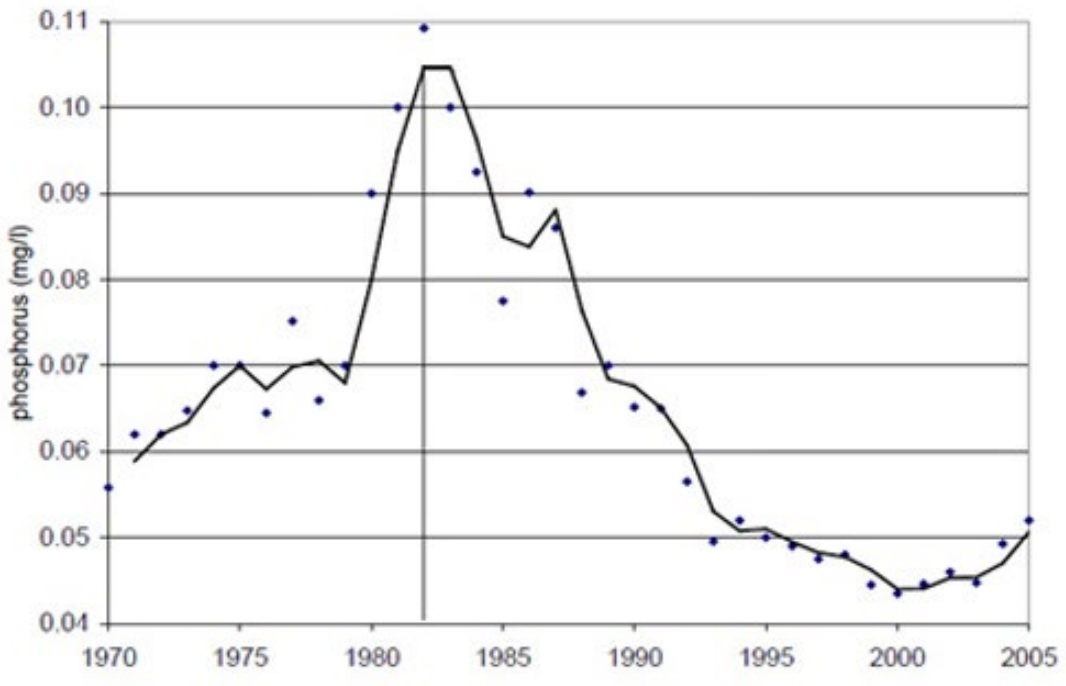
Seagrass increase of over 40 square miles in SW FL



What about lakes?

- Apopka demonstrably cleaner than 20 years ago
  - Massive efforts on multiple fronts
- Other less-well known examples
  - Lake Hartridge
  - Banana Lake
  - Lake Persimmon
  - Lake Trafford
- Today –
  - Sunshine Lake (Charlotte County)
  - Lake Tarpon (Pinellas County)
  - Lake Hancock (Polk County)

Why aren't more lakes doing better, since phosphorus concentrations have declined state-wide?



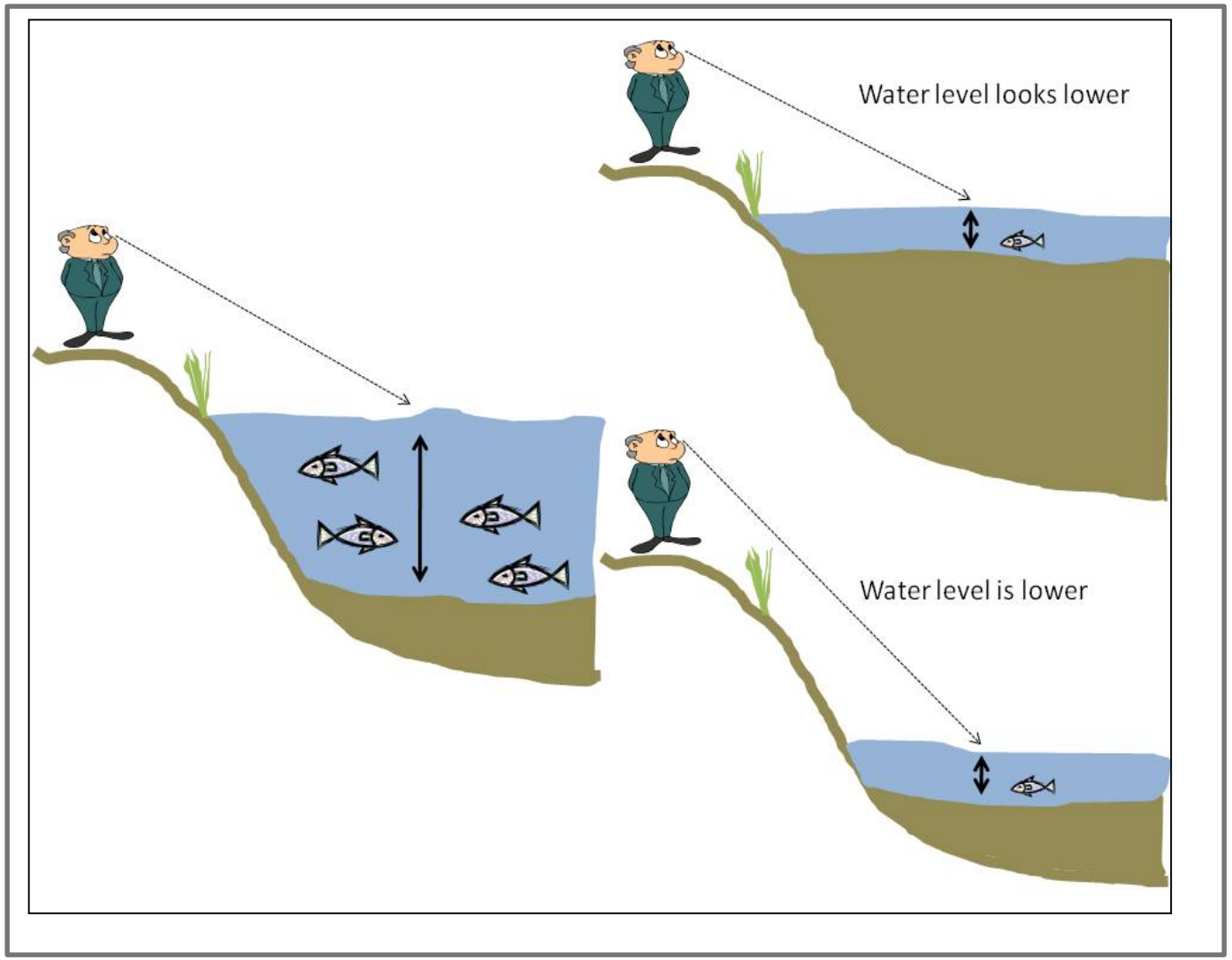
State-wide annual average TP concentrations (Figure from FDEP)

Because other factors need to be taken into account (Terrell et al. 2000)

- Data from 127 Florida lakes (1967-1997)
- Overall decrease in phosphorus
- No overall trend in nitrogen
- But…overall increase in chlorophyll-a
- Altered hydrology and aquatic weed control efforts could be *more important* than nutrients alone
- Lake management – and management of cyanobacteria – requires more than nutrient management alone

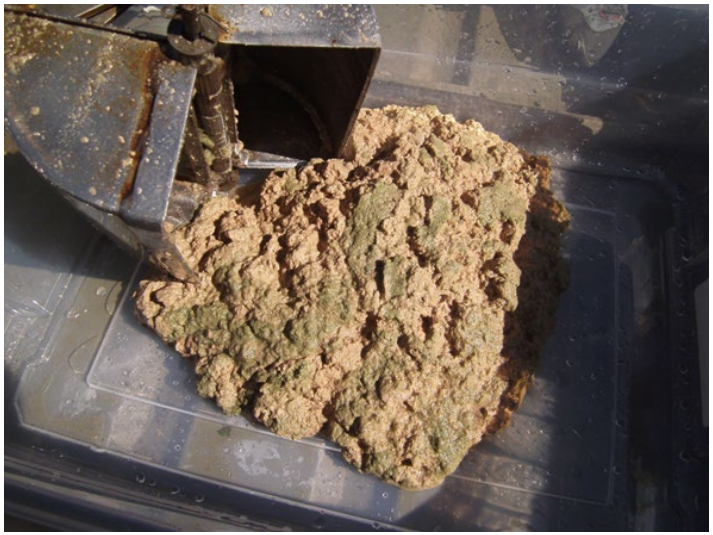
Sunshine Lake

Homeowners convinced the lake was lowered – actually filled up from the bottom



Logistically challenging field work

What is this stuff in the lake?



- Mixture of cyanobacteria
  - Predominantly *Aphanothece conglomerata*
- Can fix nitrogen from air and store phosphorus
- Can live as “plants” or as bacteria

County decided to dredge the lake – over budget (> $3 million) and twice as long as expected – **they don't want to repeat that effort**

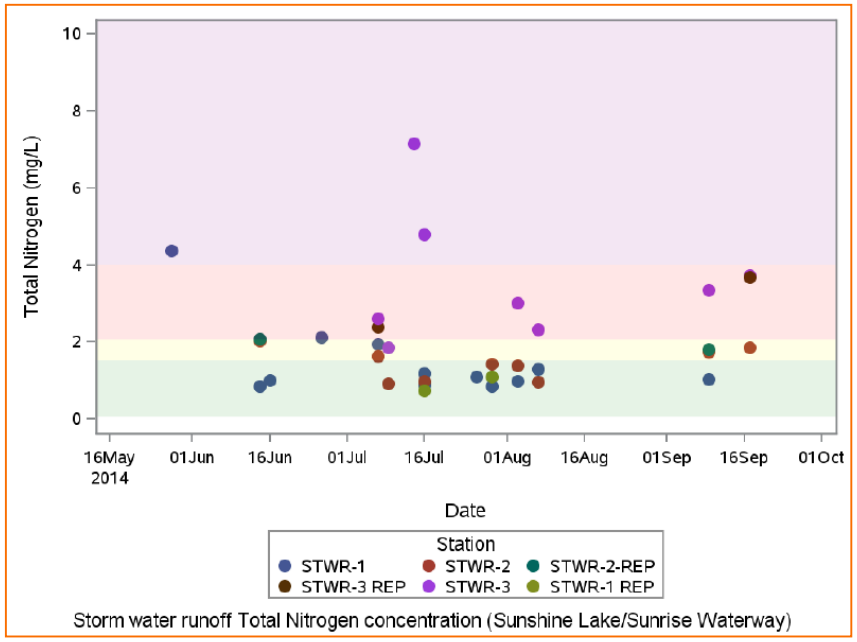
Management plan based on data collection

Existing literature to determine what is “normal”

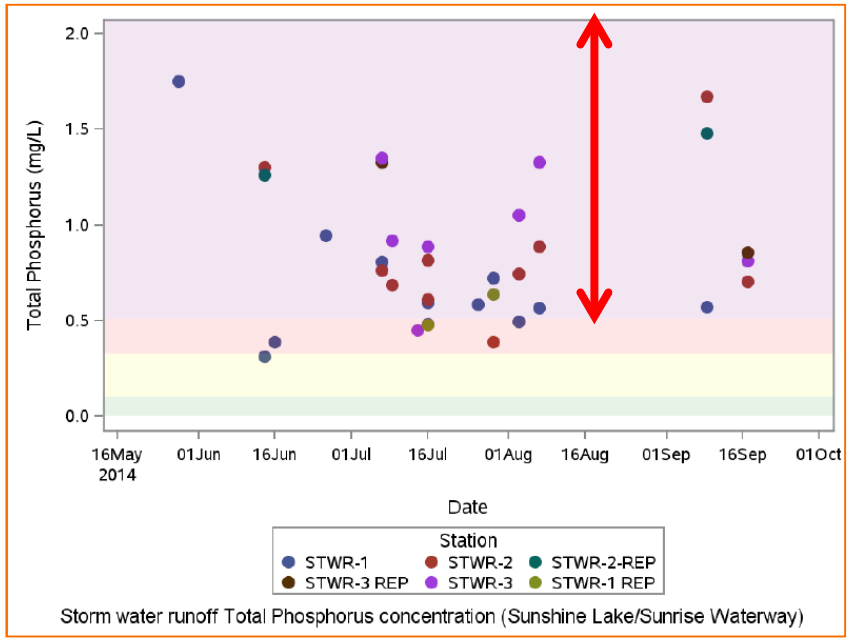
Stormwater	Normal Undeveloped	Lower Range Developed	Elevated Developed	Excessive Developed
TN (mg/L)	0.070 - 1.52	1.02 - 2.07	2.07 - 3.99	> 3.99
TP (mg/L)	0.002 - 0.100	0.102 - 0.327	0.327 - 0.510	> 0.510

Stormwater runoff

Total nitrogen

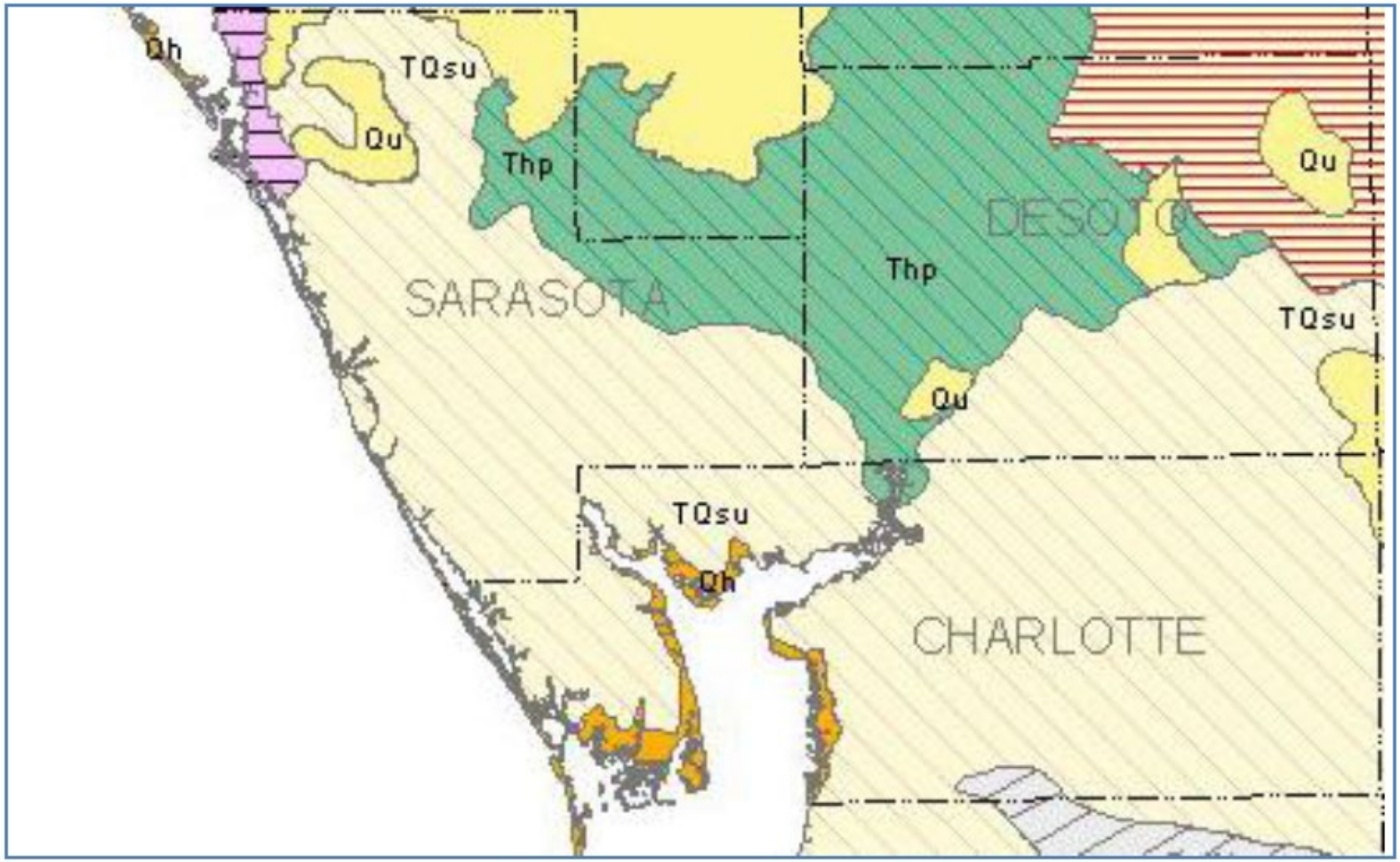


Total phosphorus



What's with all the phosphorus??

Surface Geology



Proposed remedial actions

- Focus on lake itself
- Whole lake circulation
  - Mix water column, enhance sequestration of P in sediments
- Raising the lake level
  - **Supplementing inflows with lower nutrient source water**
- Floating treatment wetland islands
  - **Beware of turtles!**

Whole-lake circulation device

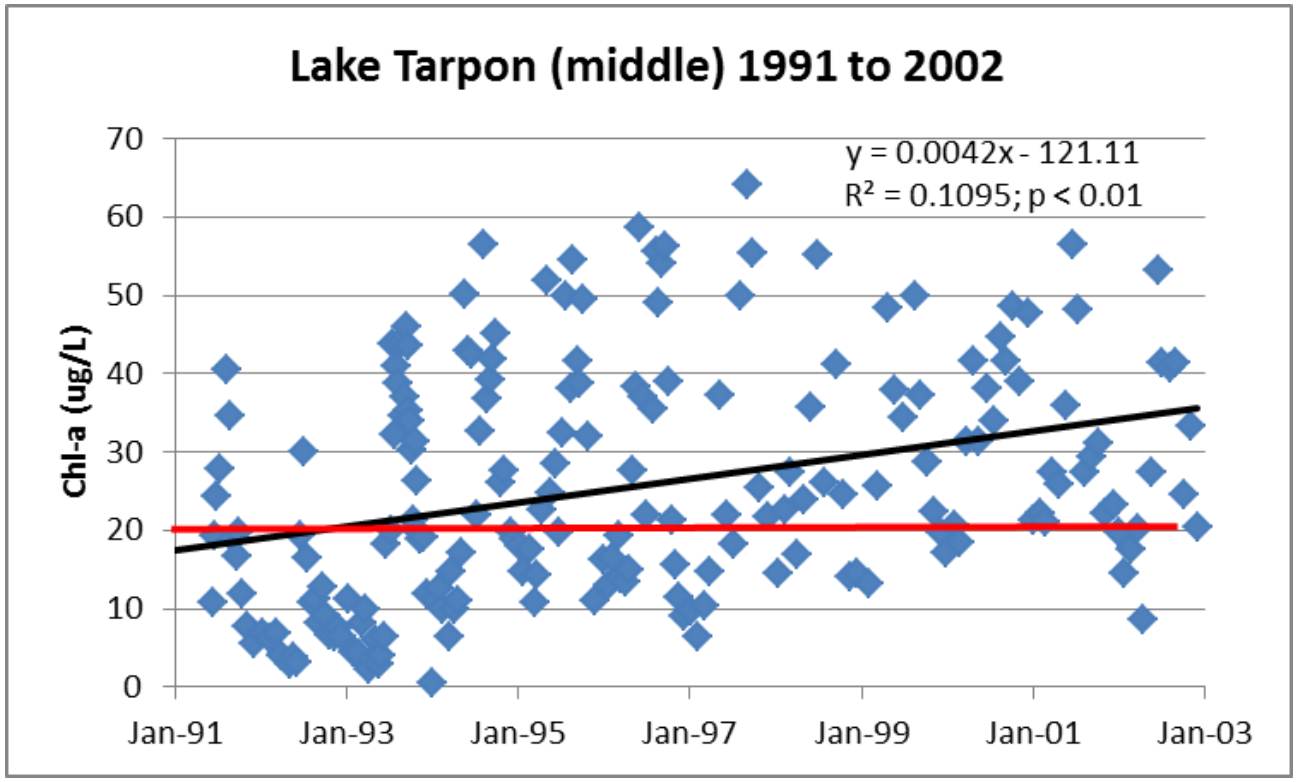
It worked – no recurrence of cyanobacteria mat, and not impaired for Chl-a or nutrients, using NNC

Before

After

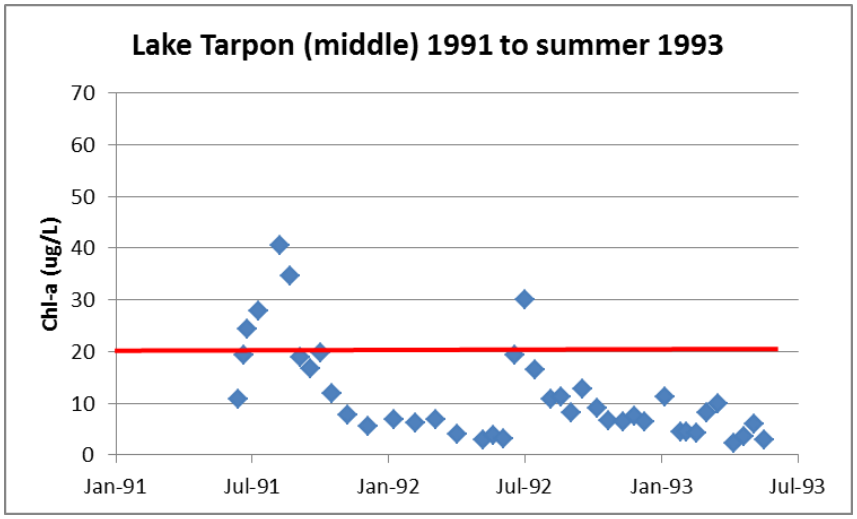
Lake Tarpon

Massive cyanobacteria blooms in the 1980s, and earlier conclusions of an “increasing trend in chlorophyll-a”

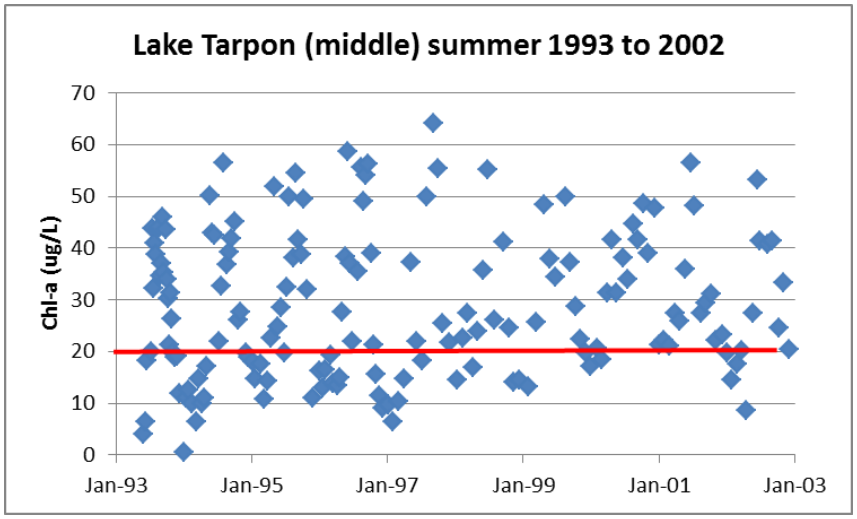


Actually, it's a phase shift after 1993

Pre-1993, Chl-a exceedance only in July and August

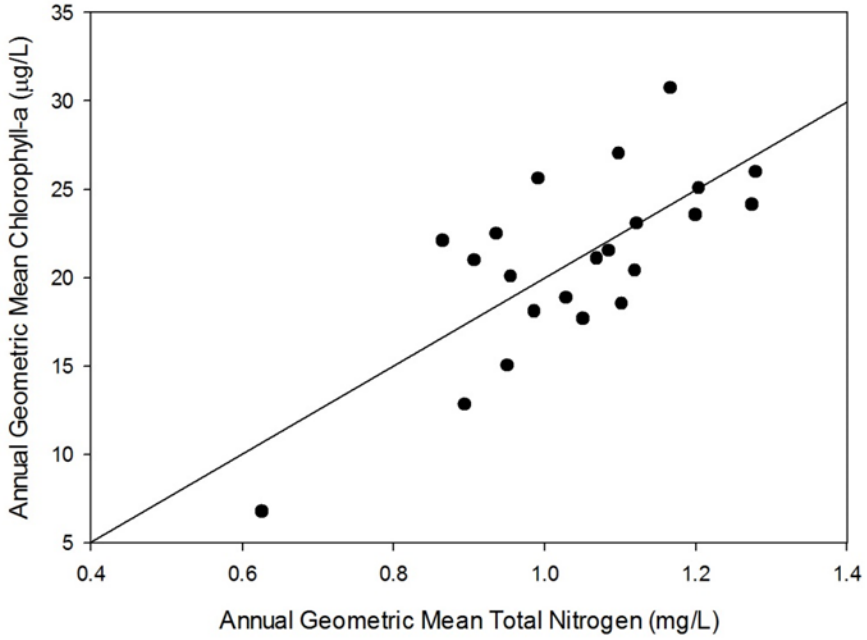


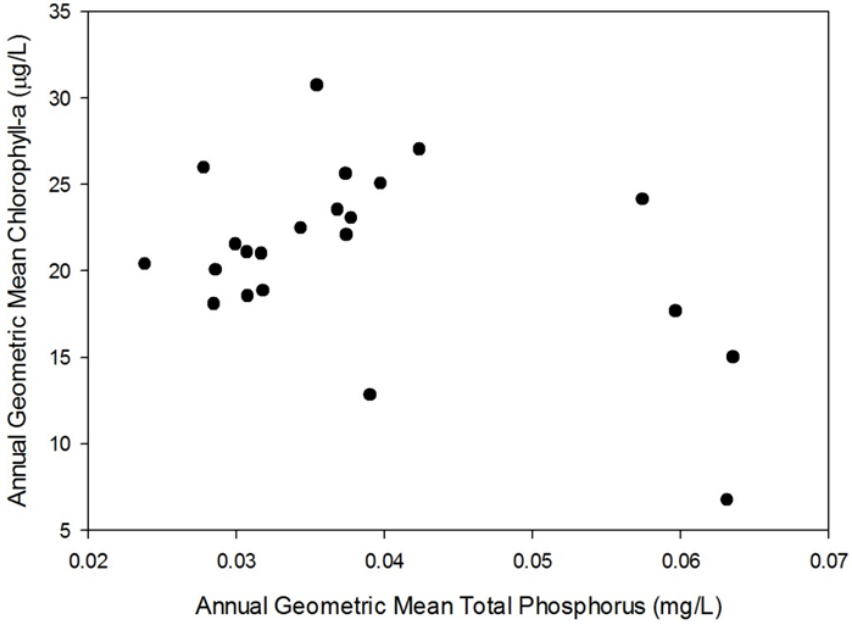
1993 to 2002, Chl-a exceedance in every month, and no trend over time



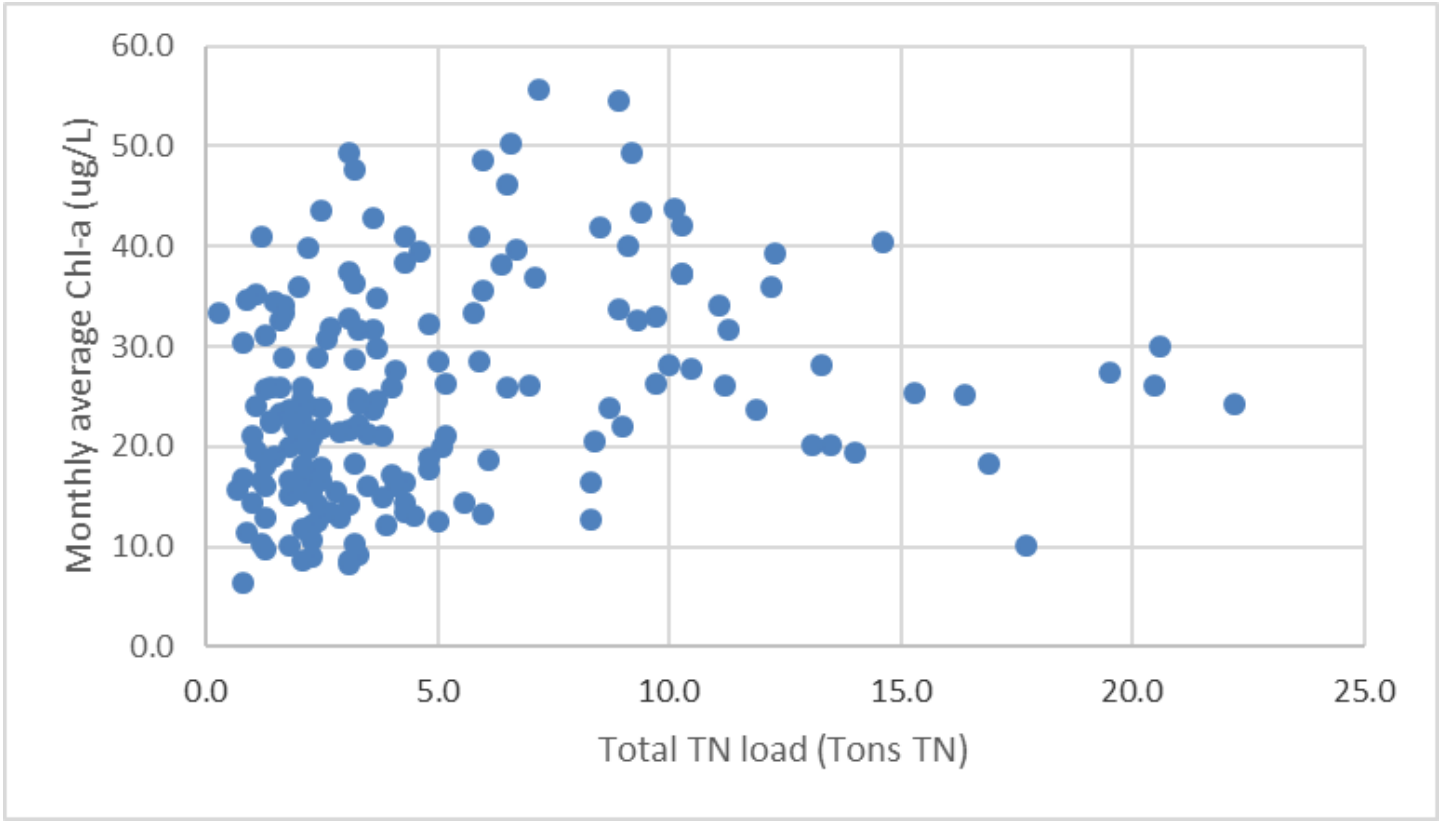
What happened in 1993? 500 acres of Hydrilla treated with herbicides

Nitrogen-limited lake



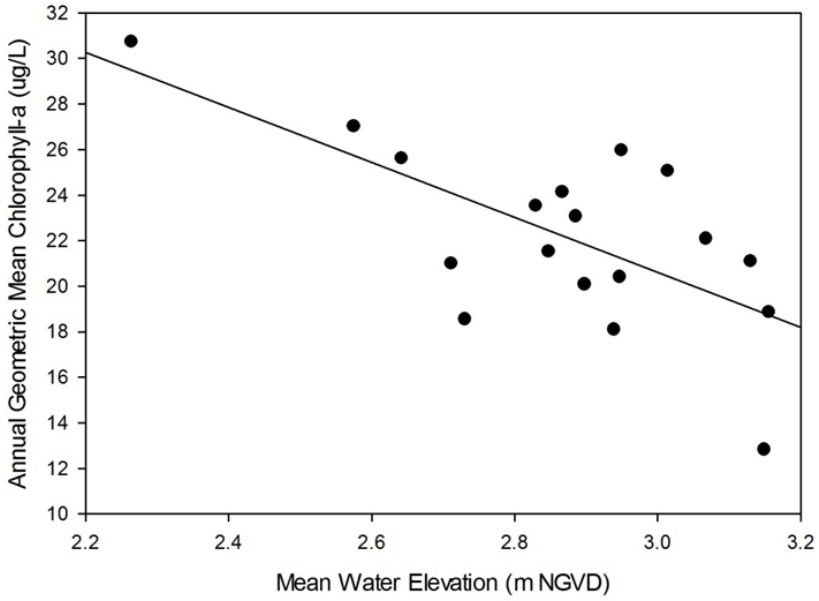


But Chl-a not related to external nitrogen loads

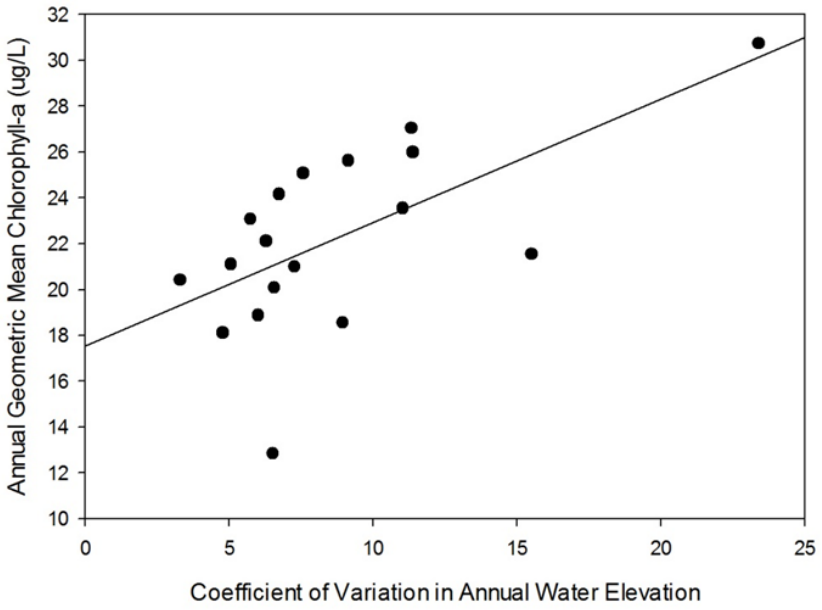


What does influence Chl-a levels?

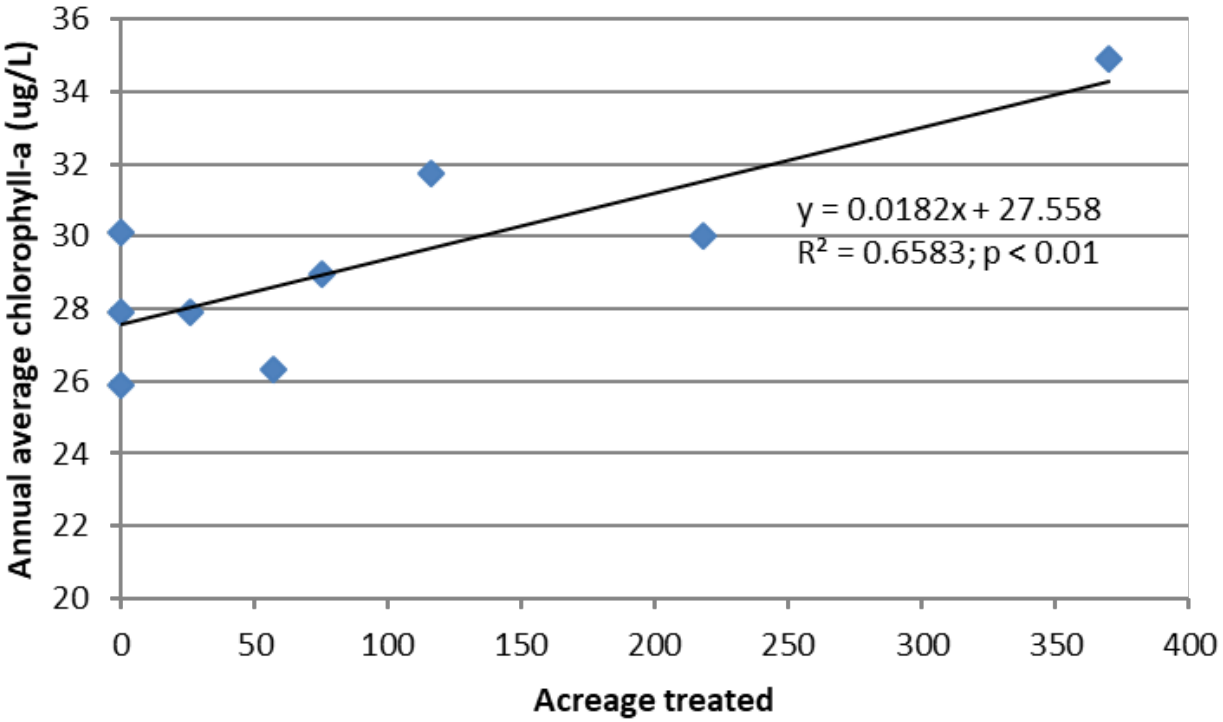
Inverse with water elevation



Positive with variation in lake level



How about Hydrilla control efforts?



Lake management paradigm

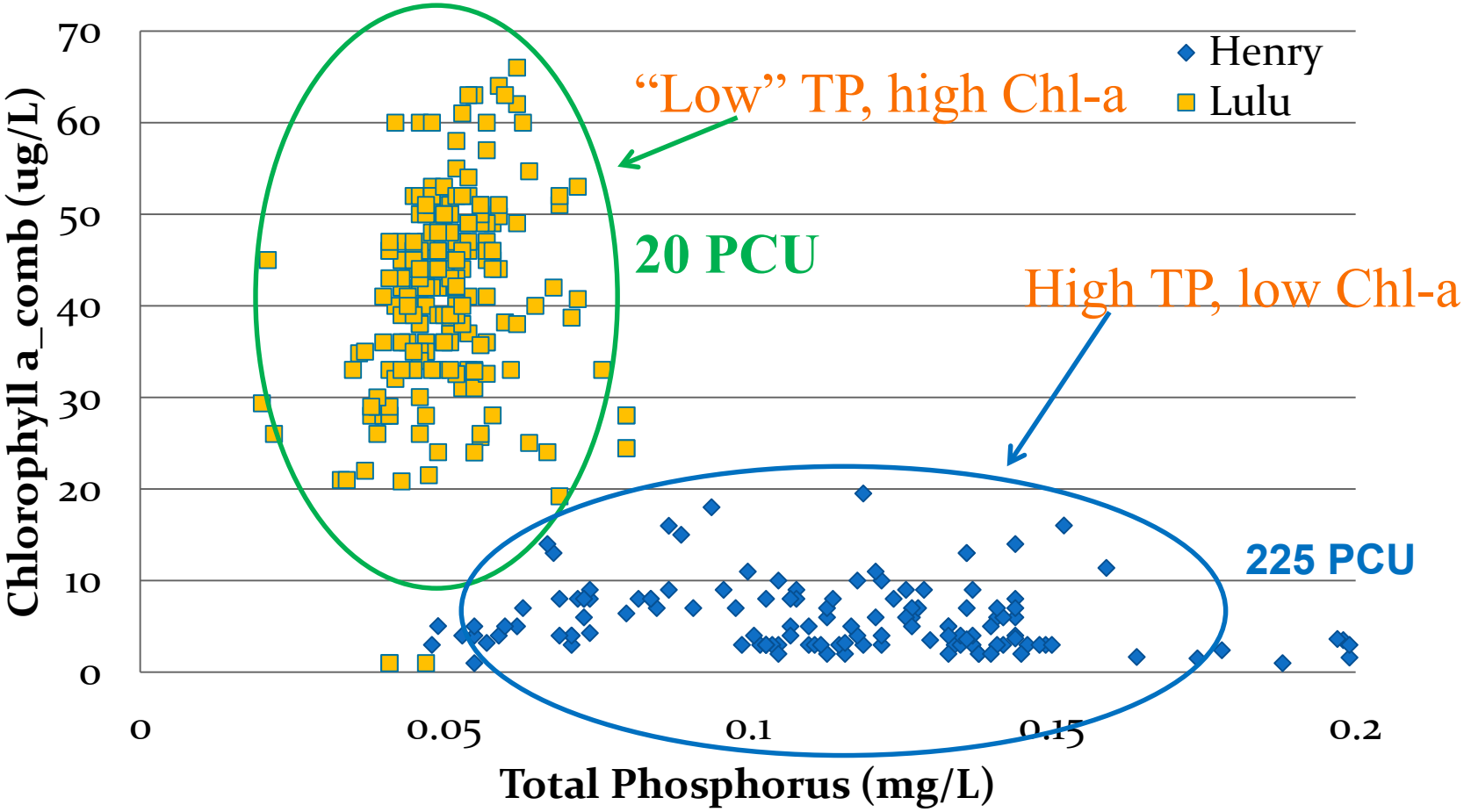
- Maintain high water level
  - Keeps deeper waters from becoming new habitat for Hydrilla
  - Keeps lake in contact with adjacent wetlands
- Reduce variability in lake level due to human activity
  - No need to supplement lake, but no need for artificial lowering
- Manage Hydrilla populations
  - Reduced abundance expected via not lowering lake
  - When found, minimal use of herbicides
- Targeted stormwater retrofits
  - Focus on dry retention

Did it work?

- No recurrence of cyanobacteria blooms since initiating current control schedule for lake level
- Hydrilla less than 3% of current SAV in the lake
- Water quality non-trending over last 20 years
  - Not impaired for TN or TP using NNC
  - “impaired” for Chl-a, but paleolimnology work suggests in-line with historical conditions
- Currently listed as one of Florida’s top ten bass fishing lakes
  - (http://myfwc.com/fishing/freshwater/sites-forecast/sw/lake-tarpon/)

Lake Hancock

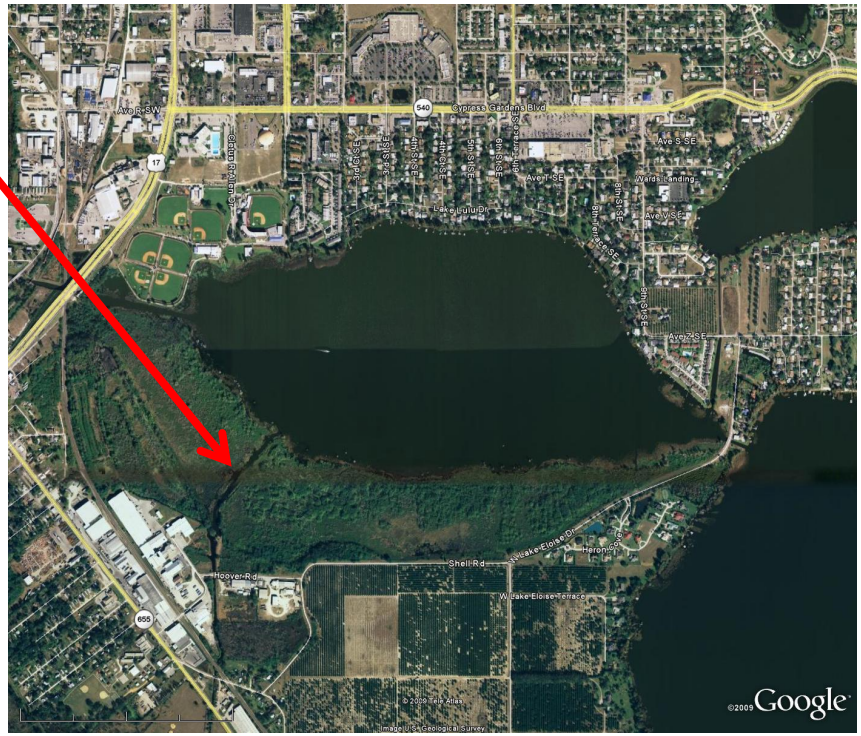
For some lakes, reducing algal levels might have more to do with “tannins” than nutrients



Lulu is 4 ½ feet lower than it used to be, Henry is not.
Lulu is disconnected from its historical swamp shoreline.

Lake Henry

Lake Lulu



Stormwater retrofits aren't focused on water quality impacts associated with altered hydrology

How to improve Hancock?

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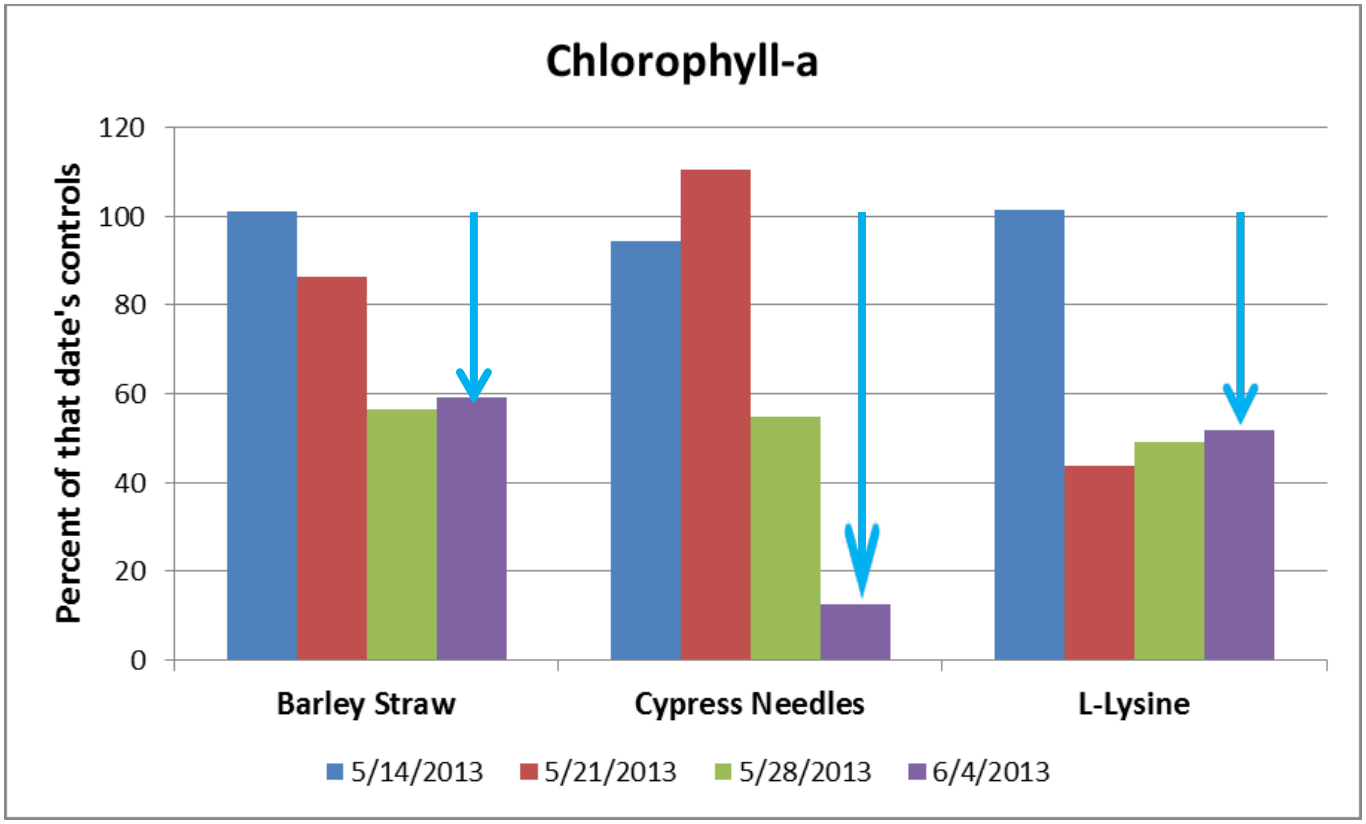
CHARLOTTE HARBOR NEP 2014 WATERSHED SUMMIT PROCEEDINGS

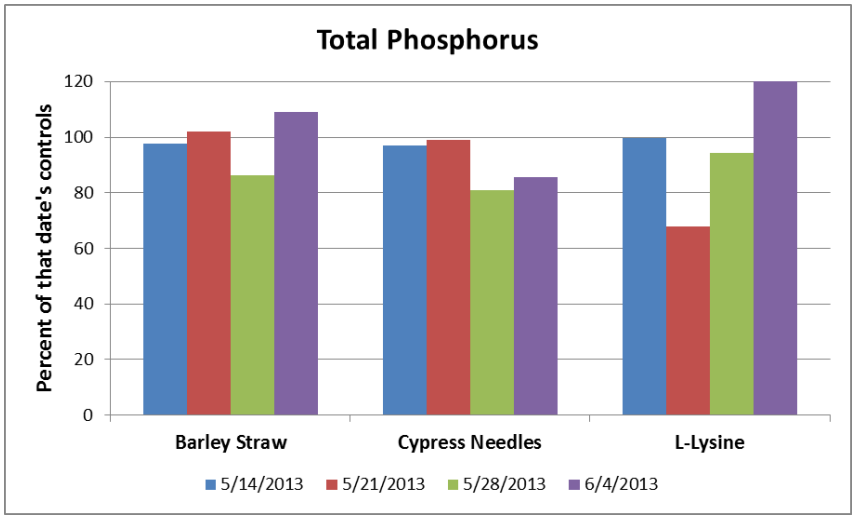
Our vision in action

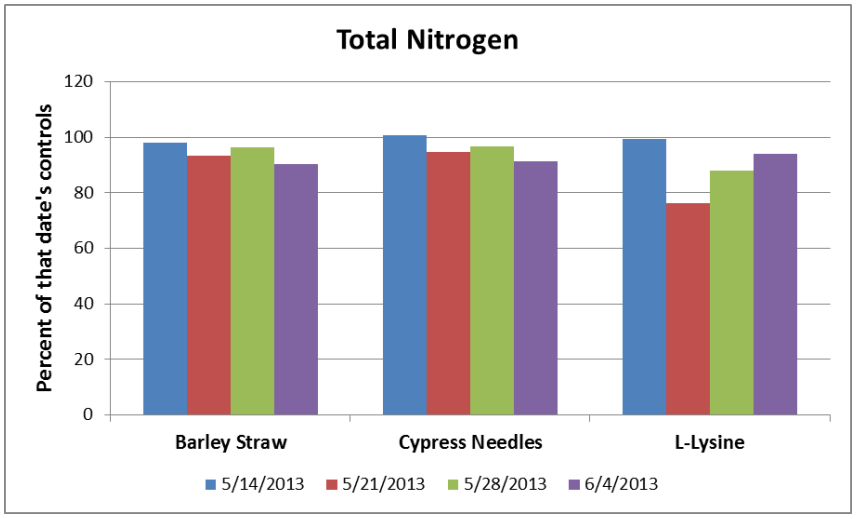
Wetland compounds can reduce Chl-a levels…



Most immediate response from L-lysine, **greatest longer term response from cypress needles**

Without concurrent reductions in N or P

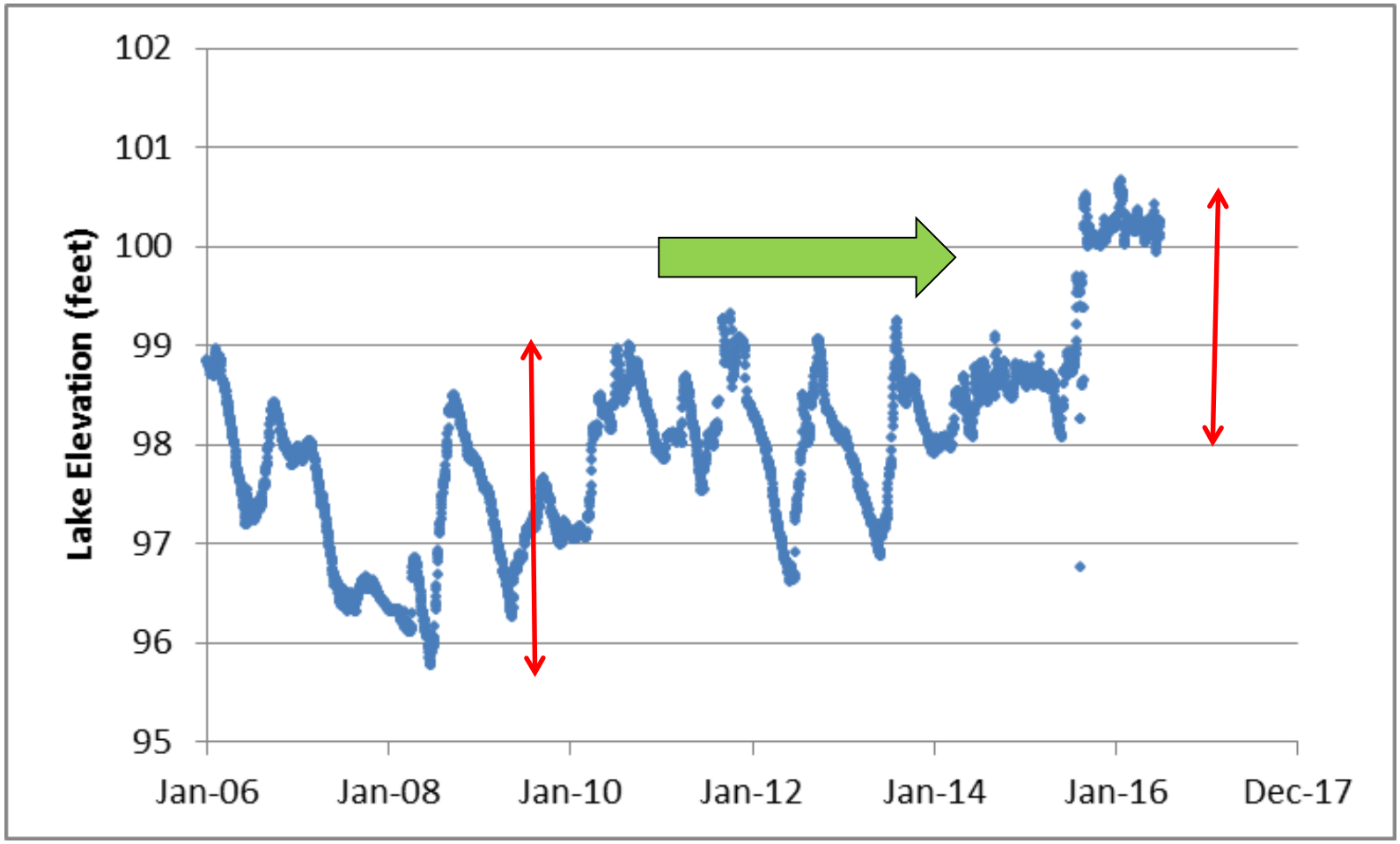




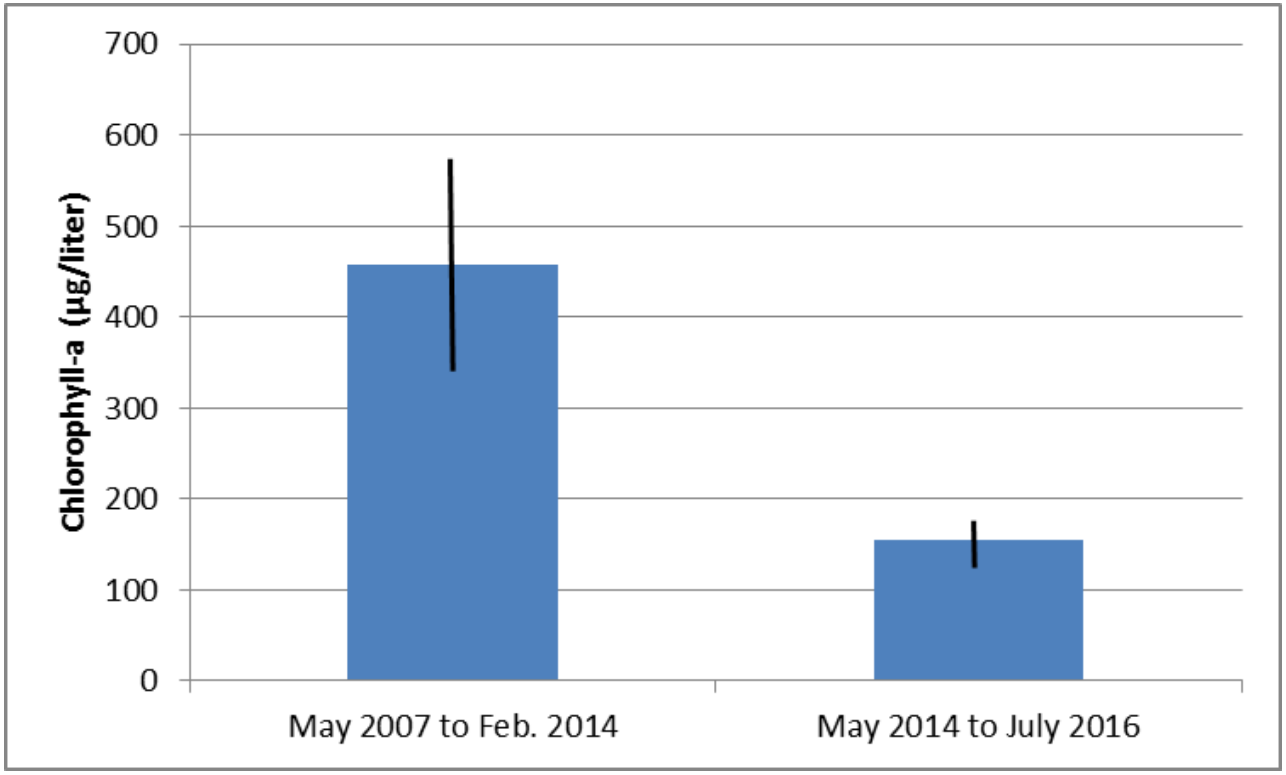
However…

- Do we really want to base lake management on an aquarium study?
- Fortunately, an ecosystem-level experiment is already being run

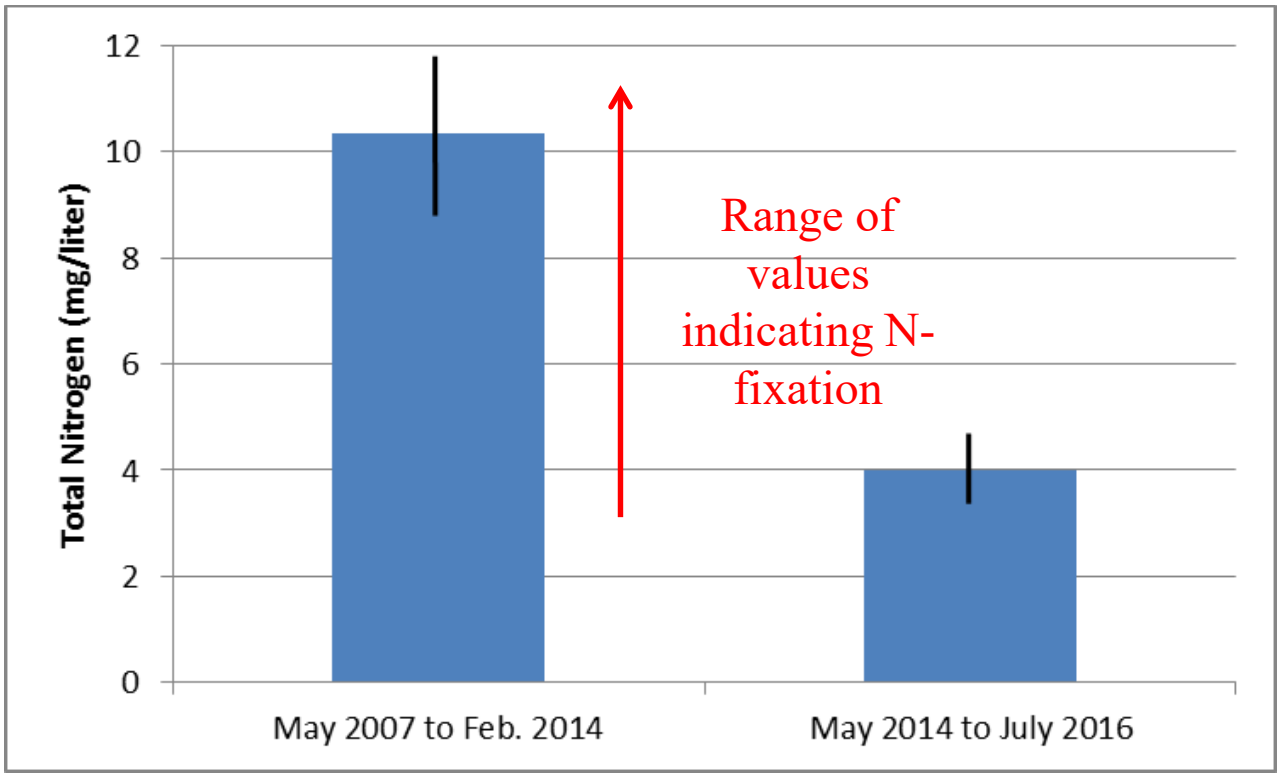
Lake Hancock lake level modification project



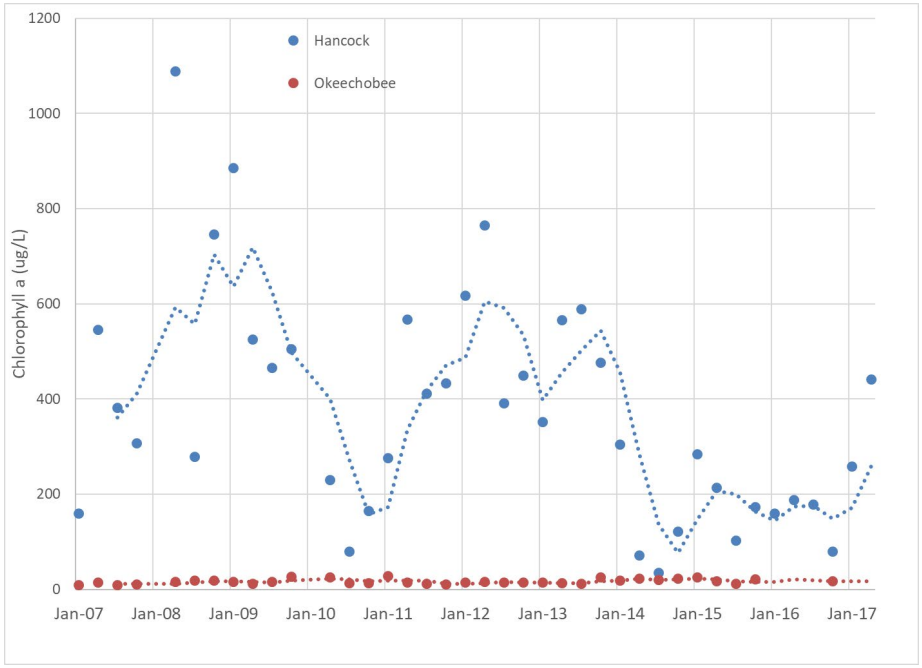
Short term response - decrease in chlorophyll-a of 66% (p< 0.01)

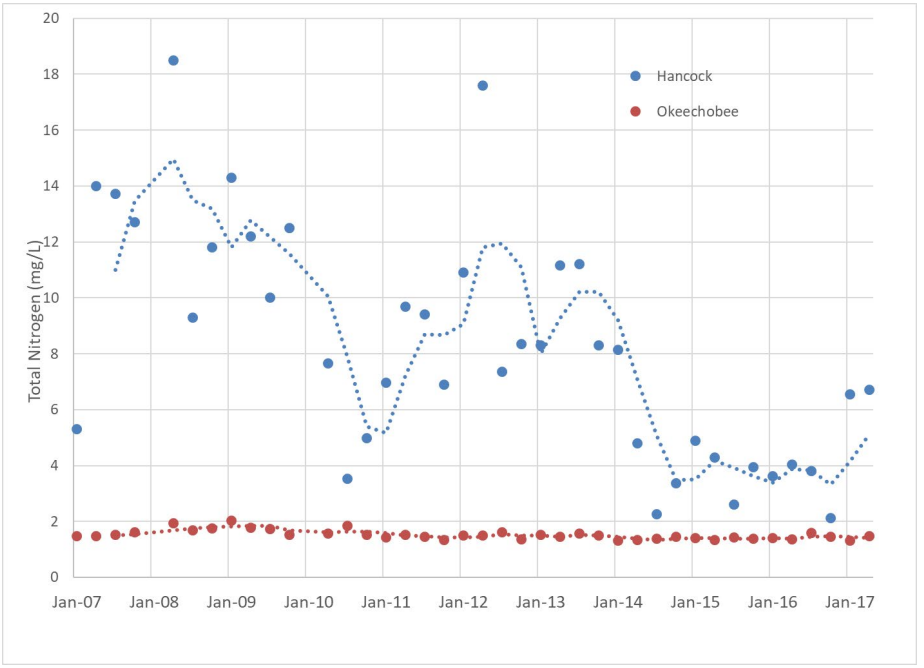


Short term response -decrease in TN of 61% ($p < 0.01$)



Continued benefits over time…





Can we reduce cyanobacteria in lakes?

- If it can be done in Hancock, it can be done
- Reduce point source loads
- But, equal effort into quantifying and acting upon internal loads
- Hydrologic restoration when needed
- Alternative techniques for invasive aquatic species control
- Let science take the lead, not a complex water quality model or preconceived notions

Questions?