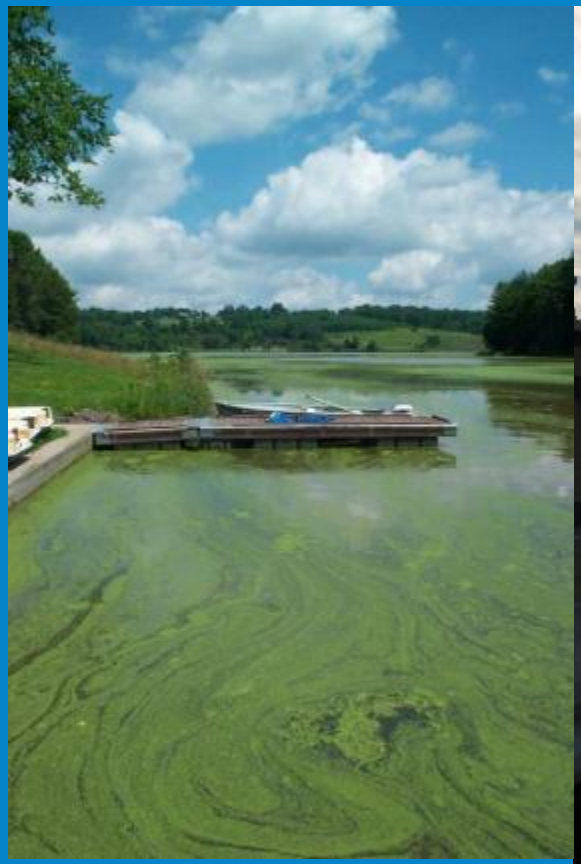
The Evolution of Lake Management: What can we learn from the past for a clear future?



Ken Wagner, PhD, CLM

Water Resource Services

Living Lake Management

A competent person could probably research this topic and come up with some insights, but NH LAKES was looking for some direct experience, and I have lived through the development of lake management

Spent a lot of time at lakes as a kid, 1960s

Aquatic science studies at Dartmouth, mid-1970s

NJDEP lakes unit, late 1970s

Natural Resource Mgmt Ph.D at Cornell, early 1980s

Water resource consulting, 1985-present

Treasurer, President, Journal Editor, NALMS, 1990-2017

Lake Management Over Time

Consider developments by decade in various aspects of lake assessment and management

Decade	Limnology	Monitoring Technology	Monitoring Conduct	Institutions/Programs	Management Focus	Economics
1970s	P as key limiting nutrient, relations between P, Chl-a, & clarity documented, trophic state indices	Lab measures from samples, field observations by professionals	Almost entirely professional monitoring, volunteer monitoring unfunded, untrusted	CWA enacted, USEPA develops lake program (Sec 314), states follow suit	Focused on in-lake actions, watershed point sources managed	Huge federal support for lake assessment and management
1980s	Watershed-land use connection explored, modeling of lake inputs and effects	More field measures of former lab parameters, rise in QA/QC programs	Some volunteer monitoring, heavy focus on professional oversight	Sec 319 NPS program added to CWA, USEPA and states team on lake assessment and mgmt, rise of vol. mon.	Shift toward watershed management, recognition of non-point source influence	Reduced but substantial federal support, state support increases
1990s	N and P synergy, other limits to productivity recognized, biological influences documented, including invasives	Improved detection limits, new contaminants, use of computers for data crunching & modeling	Sharp increase in volunteer monitoring, practices standardized	Loss of federal CLP support, focus on Sec 319 NPS, state programs take over or shift emphasis, major incr. in vol. mon.	Focused on watershed management, in-lake efforts downplayed except for invasive species	Financial burden shifted to states, some more responsive than others
2000s	Limits to watershed controls documented, climate change impacts recognized	GPS, satellite mapping, and online resources added to field, lab, and computer operations	Volunteer monitoring networks, support systems increase	Limited federal direction, state programs varied, more local focus	Potential need for both in-lake and watershed actions documented	Shift to more local funding, municipalities and lake groups cost-share with state
2010s	Assessent of internal loading advanced, documented as cyanobacteria driver	Automated field measures with telemetry of data, more detailed mapping capability	Volunteer monitoring as key data source, branching into new areas	Increased local focus, state programs widely divergent	More balanced management, lake-specific needs assessed	Unless a lake is truly public, most funding comes from local sources
2020s	Sharp increase in eDNA use for identifying species presence, large data sets used to evaluate trends	Entire platforms for data entry from multiple sources with analytics, increased drone use	Volunteer monitoring essential to water quality and invasive species assessment	Ongoing local focus, varied state programs, limited coordination at regional or federal level	Continued emphasis on holistic lake/watershed efforts	Mix of creative funding options, still focused locally with some state aid and federal pass-thru

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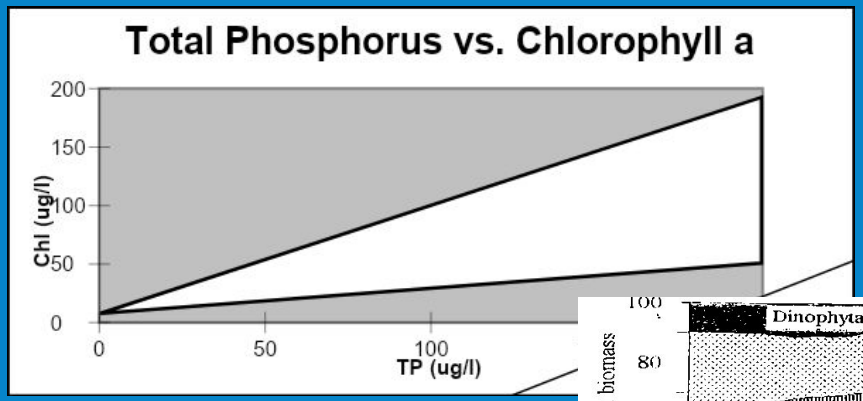

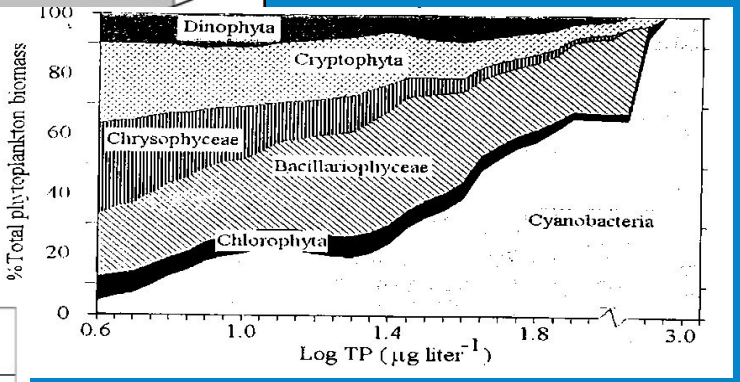

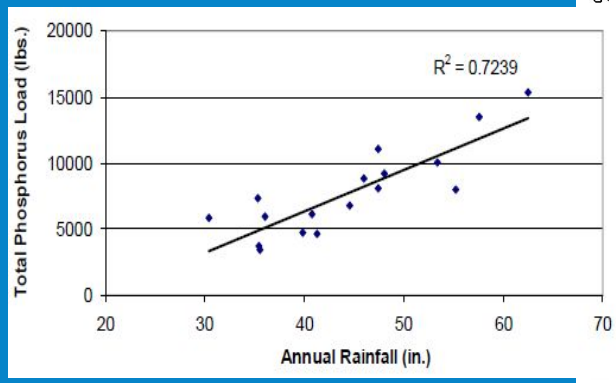

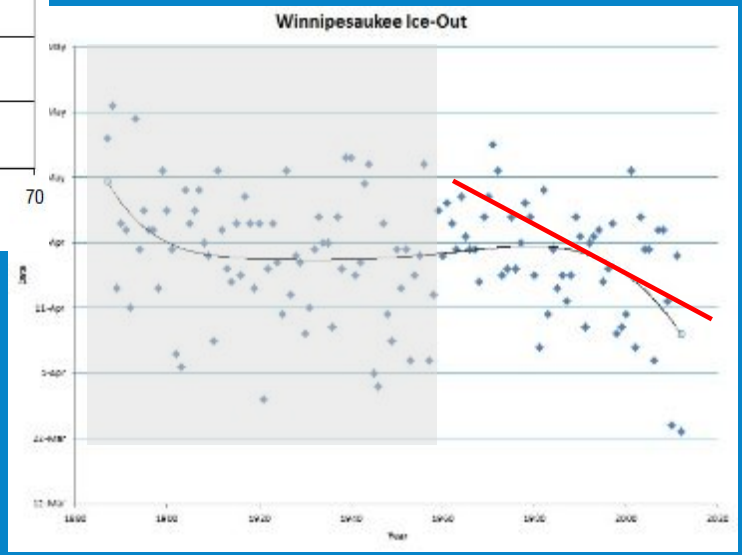

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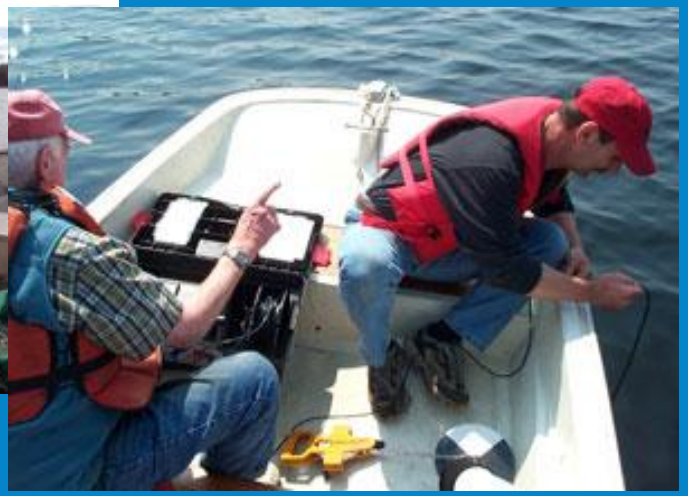

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United States Environmental Protection Agency

Office of Water Regulations and Standards
Criteria and Standards Division
Washington, D.C. 20460

EPA 440/5-80-014
August 1980

Water

EPA

Clean Lakes Program Strategy

Program Element	State								
	CT	MA	ME	NH	NJ	NY	PA	RI	VT
Law against AIS introduction	Y	Y	Y	Y	Y	Y	Y	Y	Y
Law requiring AIS management	N	N	Y	P	N	N	N	N	P
AIS response coordinator in place	Y	P[5]	Y	Y	N[1]	Y	Y	Y	Y
Overall AIS management plan	N	Y	Y	Y	Y	Y	Y	Y	Y
Overall AIS Rapid Response Plan	N	N	Y	Y	P[4]	Y	Y	N	P[2]
Species specific RRPs	N	P	N	N	N	P	N	P	N
Dedicated funding for RRP	N	N	Y	Y	N	P[3]	N	N	P[3]
Streamlined permitting for RRP	N	N	P[6]	P[6]	N	P[6]	N	N	P[6]

Y=Yes N=No P=Partial

1 AIS coordinator to be added soon
2 Lake Champlain Basin has plan, VT d
3 Lake Champlain Basin has fund
4 AIS plan allows for RRP, now coordin
5 No official coordinator but DCR acts
6 Mostly this means that there is a gen

The Massachusetts Guide to Algae and Aquatic Plant Management

Developed by Ken Wagner and David Mitchell under contract to the Massachusetts Department of Conservation and Recreation through Water Resource Services, Inc., with oversight and review from a panel provided by the North American Lake Management Society and the staff of the environmental agencies of the Commonwealth of Massachusetts.

Draft, January 2025

Lake Management Over Time

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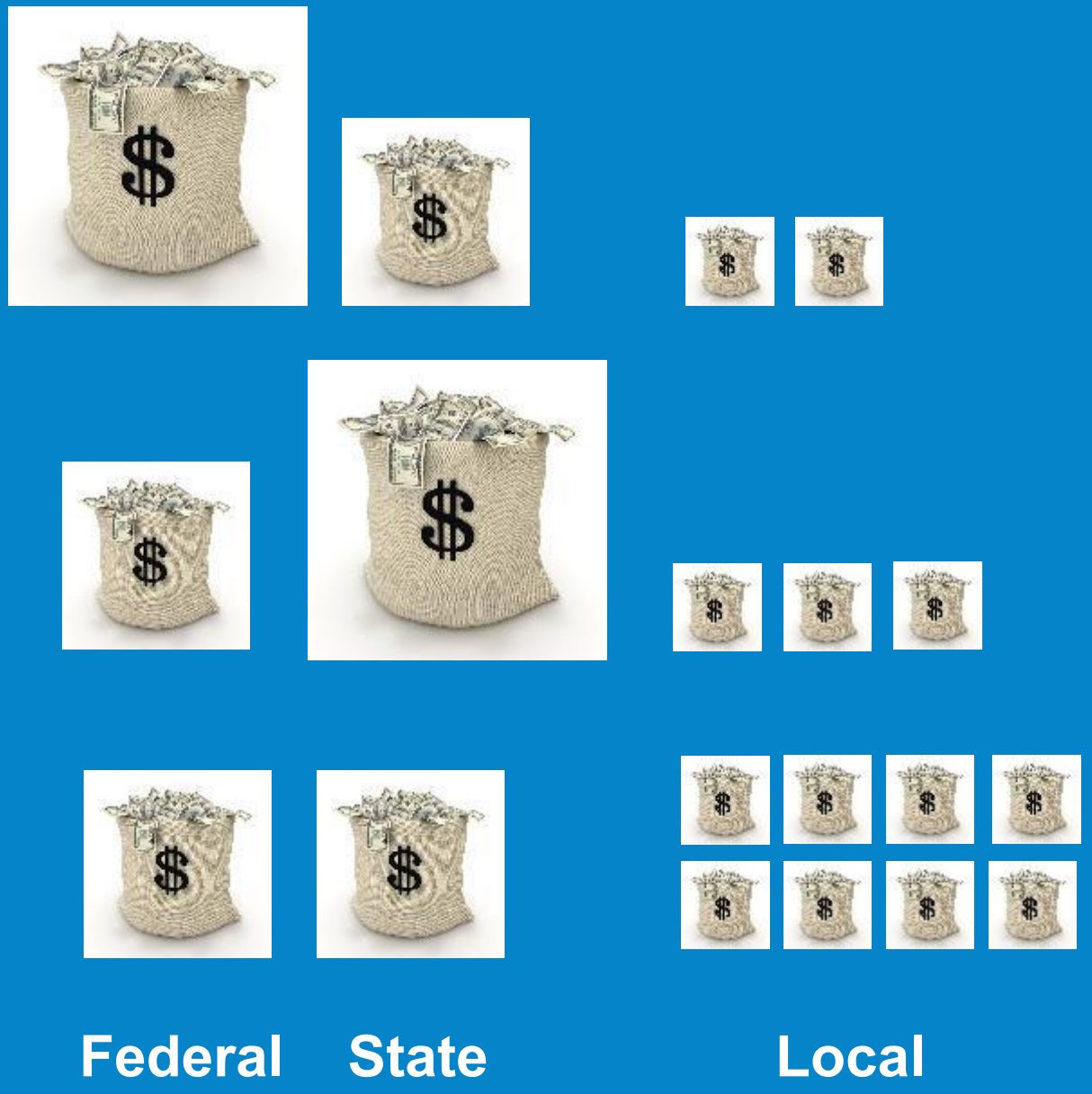

Additional Historic Influences

- Federal nationwide surveys
  - National Eutrophication Survey, 1970s
  - Ecological Monitoring and Assessment Program, 1980s
  - National Lake Assessment, 2007-present
- Secchi dip-in (late Bob Carlson and NALMS)

Despite politics and technical squabbling, these programs all point to the decline in lake quality over the last 50 years and implicate human actions (in the watershed) and inaction (failure to prevent problems).

Additional Historic Influences

- Economic studies of lakes
  - Documented loss of property value and tax base with eutrophication, cyanoblooms, invasive plant species
  - Economic gain from management almost always overshadows cost, often by >3:1
  - Barriers to action include high initial costs and lack of creative funding mechanisms
  - The cost of prevention is much lower than the cost of rehabilitation, but has less popular and political appeal

Timeline of NH Lake History (with help from Amy Smagula)

1940s	New Hampshire Water Pollution Control Commission formed (precurser to NHDES), Fish and Game surveys of NH lakes and ponds, mostly for fish habitat condition, depth soundings
1950s	NH Fish and Game surveys of lakes, mostly for fish habitat condition
1960s	Increased lake monitoring efforts, depth soundings
1970s	NH participation in National Clean Lakes Program, receiving federal funds for lake restoration; first in-lake aluminum treatment (Kezar Lake); start of NH Lake Trophic Survey Program to assess New Hampshire's lakes and ponds >10 acres
1980s	New Hampshire Department of Environmental Services formed in 1987; start of the New Hampshire Volunteer Lake Assessment Program

Some lake management, but more organizational and study-oriented

Timeline of NH Lake History (with help from Amy Smagula)

1990s	NH LAKES formed in 1992. State Clean Lakes Program formed (as federal funding/support waned), start of New Hamsphire Exotic Species Program and Shoreland Protection Program, Lakes Management and Protection Program (LMPP) formed to address the competing uses of the state's water resources. Created the Lakes Management Advisory Committee (LMAC) to advise NHDES on statewide lake issues. Participation in lake paleolimnology studies.
2000s	NHDES Biology Section merged with Watershed Management Bureau as watershed efforts increased; Lake Trophic survey suspended then reinitiated with new focus and expanded data collection. NH LAKES launches statewide courtesy boat inspections to prevent spread of AIS
2010s	Enhancements to state surface water quality standards, anti-degradation provisions, Cyanobacteria Program formed. Initiated the NHDES Lake Mapper App, which allows for easy access to all reports/data/information we have on our state's lakes and ponds
2020s	Created statewide Cyanobacteria Mitigation Plan with expansion of cyano-HABs program, toxicity testing, and Cyanobacteria Mitigation Fund. Balancing watershed management in tandem with in-lake management. Fully updated the New Hampshire Nonpoint Source Management Program Plan that outlines strategies for reducing pollution to receiving waters .

Lots of action in NH

What are the problems faced by lakes?

- **Infilling with sediment**
- **Excessive nutrients, other contaminants**
- **Algal blooms, especially cyanobacteria**
- **Excessive plants, especially invasives**
- **Invasive animals, including invertebrates**
- **User conflicts**

Except for newly discovered contaminants, none of these are new!

Leading Cause of Water Quality Impairments in New Hampshire Now

Stormwater accounts for 50% of water quality impairments in New Hampshire. It brings in:

- Nutrients
- Sediments/organics
- Chlorides
- Emerging contaminants
- Miscellaneous debris

Internal loading important, not thoroughly evaluated in NH yet, but more groups addressing this P source in light of link to cyanobacteria

Have available management techniques changed?

Yes! Wider variety and more understanding of uses and limitations.

- New products, like types of herbicides, benthic barriers, P inactivators, bacterial products, watershed pollutant “traps”
- Major advances in oxygenation, P inactivation, herbicide use
- Learned limits of watershed techniques & oxygenation/circulation, value of prevention like source controls and boat inspection

Do we better understand key processes that determine lake condition?

Yes! While there is always more to learn, we have a much better feel for key drivers in lakes

- Climate change effects on many lake features and induced variation
- Land use impacts on contaminant loading
- Internal loading and related sediment features
- Cyanobacteria ecology and bloom formation
- Invasion ecology, hybridization of plants

We knew very little about any of these 50 years ago

What does the past tell us about how to manage in the future?

Monitoring is essential, we have the tools to do it well, and it doesn't take a boatload of professionals to generate needed data

- Spend money on getting the needed data
- Support organizations that collect useful data
- Become a volunteer monitor

What does the past tell us about how to manage in the future?

Watershed management may protect a lake, but in-lake management is necessary to rehabilitate

- It is not an either/or situation, but how much of both is needed
- Significant inputs from urban or agricultural land are difficult to prevent
- Invasive species are an in-lake problem and cyanoblooms may require in-lake solutions





What does the past tell us about how to manage in the future?

Public funding is likely to be very limited; do not expect someone else to fix your lake

- **Economics favors lake management but there are barriers to overcome**
- **Think in terms of protecting and enhancing property value**
- **You get what you pay for**




What does the past tell us about how to manage in the future?

The ounce of prevention really is worth a pound of cure; avoid problems for lower overall cost

- **Use early detection and rapid response to prevent invasive species establishment**
- **Manage the watershed to limit inputs**
- **Evaluate internal loading and monitor cyanobacteria to allow prompt response**

What does the past tell us about how to manage in the future?

Regulatory agencies are set up to avoid harm, not to solve problems; they protect, not repair. Institutions that promote proactive management and responsive rehabilitation need support.

- **Get involved with your lake; local champions initiate action and sustain success in lake management**
- **Get involved at local to state level in efforts to promote sound management**
- **Resist the politics of rehabilitation over prevention**
- **Vote for people and programs that help lakes**

NHDES

NH LAKES

University of New Hampshire

The End


After that, we might need another one of these…
SANDWICHES
Ouvert Jour
QUESTIONS?