The Million-Dollar Question:

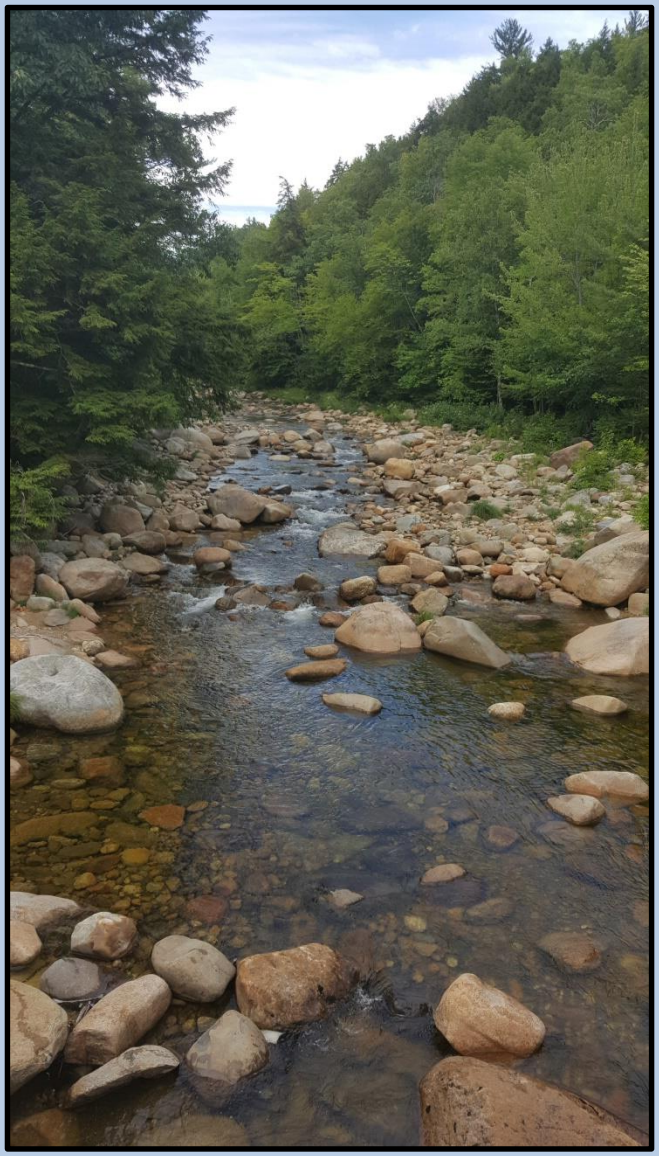
How are New Hampshire's Lakes and River doing?

2019 Water and Watershed Conference
Plymouth State University

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

David Neils
Chief Aquatic Biologist
NHDES

How are New Hampshire's Lakes and River doing?



Presentation Overview

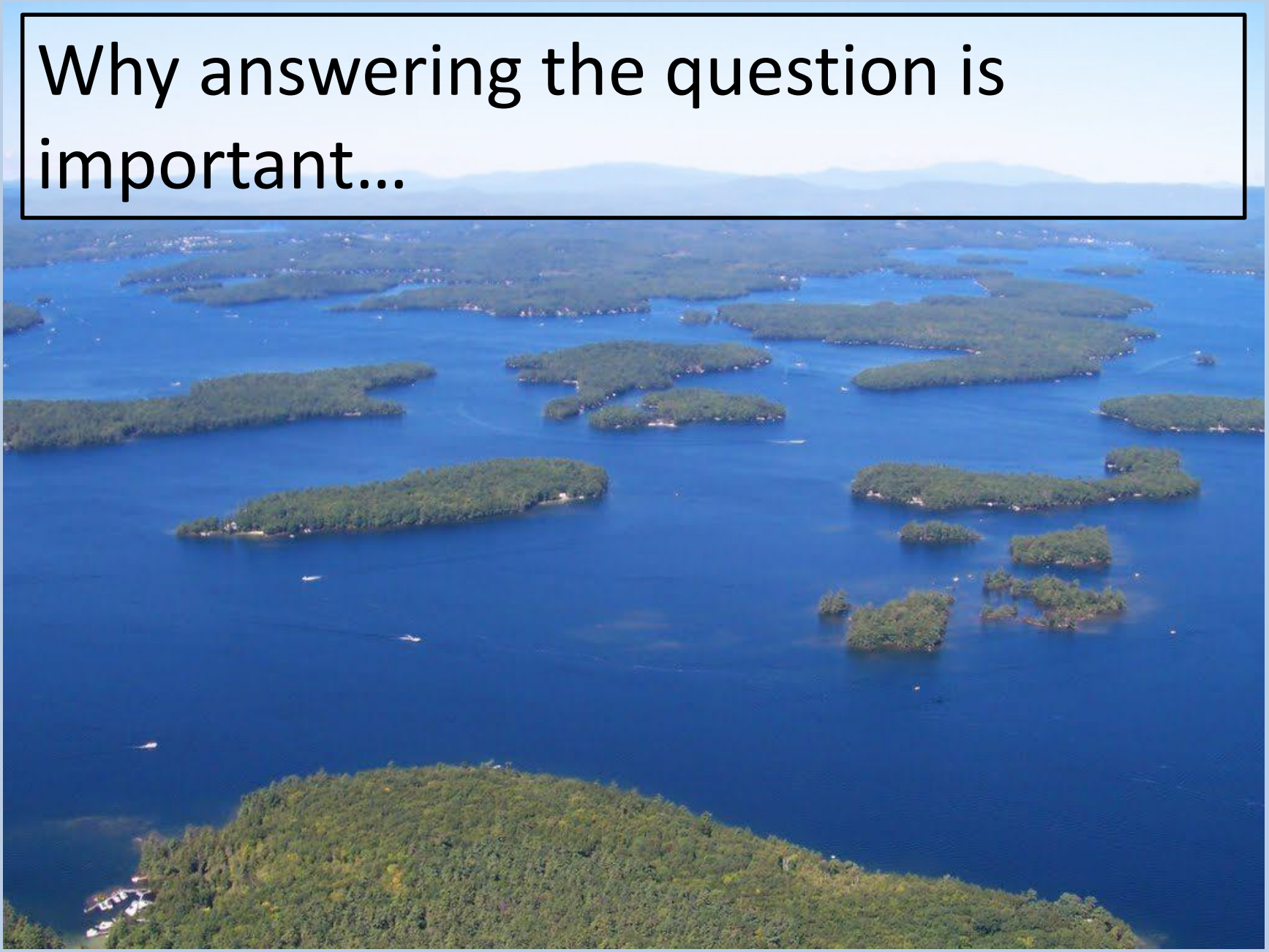
1) Background

2) Brief overview of DES monitoring strategy

3) Exploration of the status and trends of select indicators

4) Reasons for optimism

Why answering the question is important…




Dollars Invested


Resources Protected


Lives Connected
Newfound Lake Regional Association

Efforts by NHDES to monitor water quality are expansive

River monitoring programs:

- Volunteer River Assessment Program
- State River Status and Trend
- Biomonitoring

Lake monitoring programs:

- Volunteer Lake Assessment Program
- Lake Trophic Survey Program
- Exotic Species Program
- Freshwater Beach Program

Special Project Monitoring:

- Hg in fish tissue
- Acid precipitation
- Lake Modeling

Data in 2018 Assessment

Assessment Units (distinct 'waterbodies')	**8,833**
Sampling Stations	9,802
Parameters evaluated	196
Waterbody/ Use/Parameter combinations	91,342
Grab samples	4,347,047
Water Quality Standard Comparisons	3,840,045

NHDES Excels at Producing Reports for Individual Waterbodies

Outcomes of monitoring efforts:

- Biennial 305(b) / 303(d) Water Quality Assessment
- 180 VLAP Reports
- 40+ VRAP data reports
- 170 Beach reports
- Total Maximum Daily Load Reports (TMDLs)

Example: VLAP report

Volunteer Lake Assessment Program Individual Lake Reports

KOLELEMOOK LAKE, SPRINGFIELD, NH

MORPHOMETRIC DATA

Watershed Area (Ac.):	610	Max. Depth (m):	6.7	Flushing Rate (yr^{-1})	0.9
Surface Area (Ac.):	99	Mean Depth (m):	4.1	P Retention Coef:	0.71
Shore Length (m):	2,900	Volume (m^3):	1,623,000	Elevation (ft):	1387

TROPHIC CLASSIFICATION

Year	Trophic class
1980	OLIGOTROPHIC
1996	OLIGOTROPHIC

KNOWN EXOTIC SPECIES

The Waterbody Report Card tables are generated from the DRAFT 2016 305(b) report on the status of N.H. waters, and are based on data collected from 2006-2015. Detailed waterbody assessment and report card information can be found at www.des.nh.gov/organization/divisions/water/wmb/swqa/index.htm

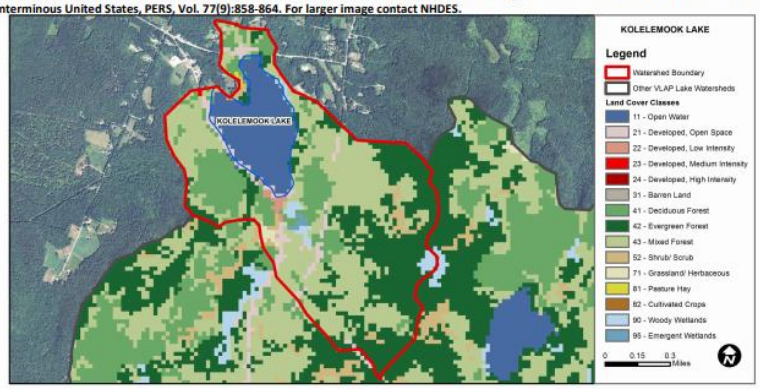
Designated Use	Parameter	Category	Comments
Aquatic Life	Phosphorus (Total)	Good	Sampling data is better than the water quality standards or thresholds for this parameter.
	pH	Slightly Bad	Data periodically exceed water quality standards or thresholds for this parameter by a small margin.
	Oxygen, Dissolved	Encouraging	Limited data for this parameter predicts water quality standards or thresholds are being met; however more data are necessary to fully assess the parameter.
	Dissolved oxygen satura	Encouraging	Limited data for this parameter predicts water quality standards or thresholds are being met; however more data are necessary to fully assess the parameter.
	Chlorophyll-a	Good	Sampling data is better than the water quality standards or thresholds for this parameter.
Primary Contact Recreation	Escherichia coli	Very Good	All sampling data meet water quality standards or thresholds for this parameter.
	Chlorophyll-a	Very Good	All sampling data meet water quality standards or thresholds for this parameter.

BEACH PRIMARY CONTACT ASSESSMENT STATUS

KOLEMOOK LAKE - TOWN BEACH	Escherichia coli	Good	Sampling data commonly meet water quality standards or thresholds for this parameter.

WATERSHED LAND USE SUMMARY

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States, PERS, Vol. 77(9):858-864. For larger image contact NHDES.



Land Cover Category	% Cover	Land Cover Category	% Cover	Land Cover Category	% Cover
Open Water	13.7	Barren Land	0	Grassland/Herbaceous	0.47
Developed-Open Space	3.88	Deciduous Forest	14.7	Pasture Hay	0.2
Developed-Low Intensity	0.64	Evergreen Forest	26.33	Cultivated Crops	0
Developed-Medium Intensity	0.07	Mixed Forest	35.94	Woody Wetlands	1.58
Developed-High Intensity	0	Shrub-Scrub	2.16	Emergent Wetlands	0.34

- We’ve spent hundreds of days collecting and processing samples
- Weeks reviewing and analyzing data
- Months writing reports and carefully considering conclusions
- WE are the EXPERTS…..

WE are ready to answer the
MILLION DOLLAR QUESTION, right?

Effectively explaining our work is important

New research shows explaining things to 'normal' people can help scientists be better at their jobs

S. Pelger, Lund University, Sweden, International Journal of Science Education, 2018

Science communication: It's not rocket science. (Photo: Pexels)

It's not Rocket Science

- Concise
- Understandable
- Memorable

The New Hampshire Surface Water Monitoring Strategy

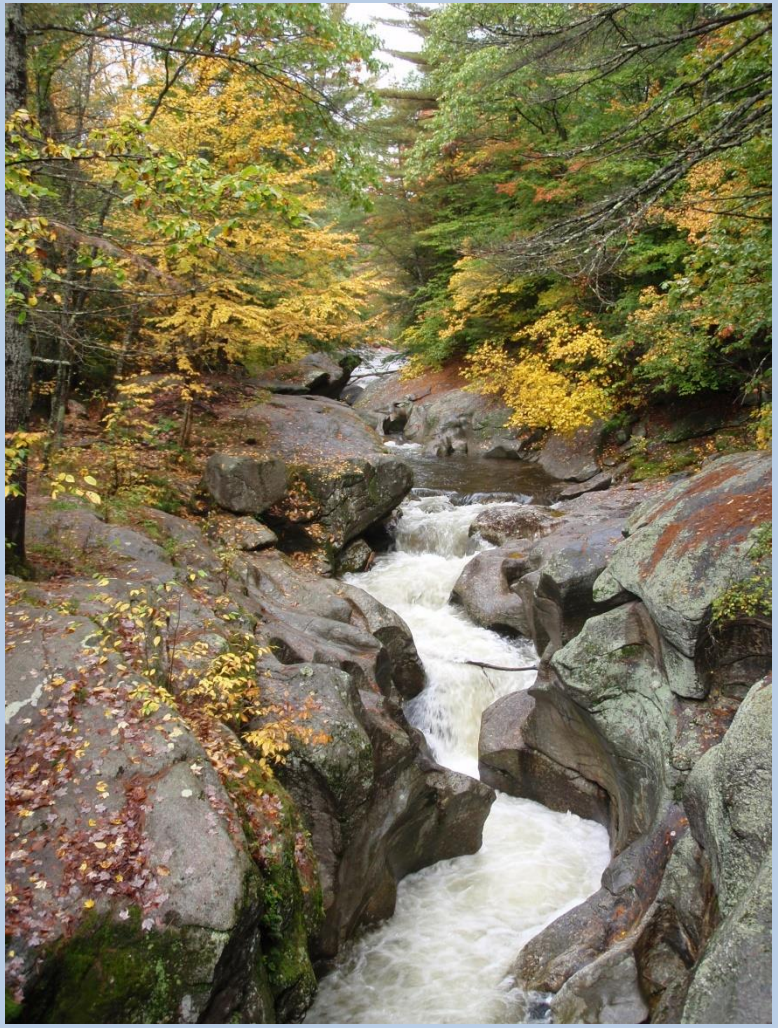
2016 - 2024

Primary goals:

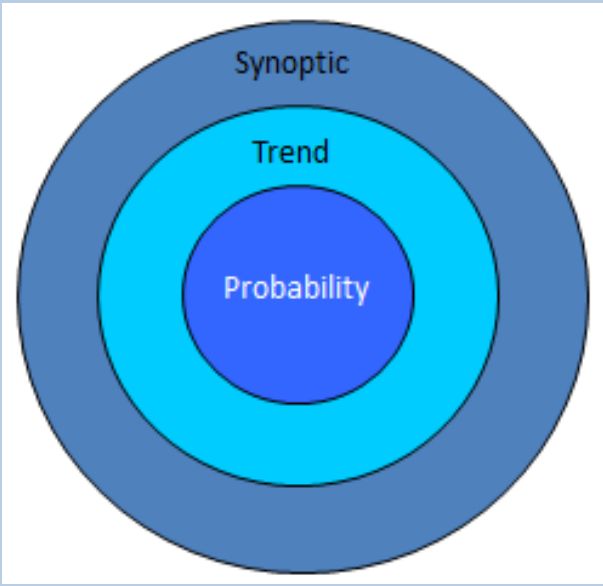
- Collected high quality data
- Informed water management decisions
- Communication to public

Practical Benefits:

- Coordinated approach to monitoring
- Evaluation statewide WQ conditions is prescriptive
- Schedule for reporting



<u>Design</u> is the backbone of the strategy



<u>Probability-based monitoring</u> – randomly selected sites

QUESTION ANSWERED: What percent are in Good, Fair, Poor condition?

<u>Trend monitoring</u> – repetitively sampled sites

QUESTION ANSWERD: Are conditions getting better or worse over time?

<u>Synoptic monitoring</u> – to create "data catalog"

QUESTION ANSWERED: What is the status of waterbodies A, B, C…?

Exploration of the status and trends of select indicators

Probability-Based Water Quality Surveys

R-WD-18-09

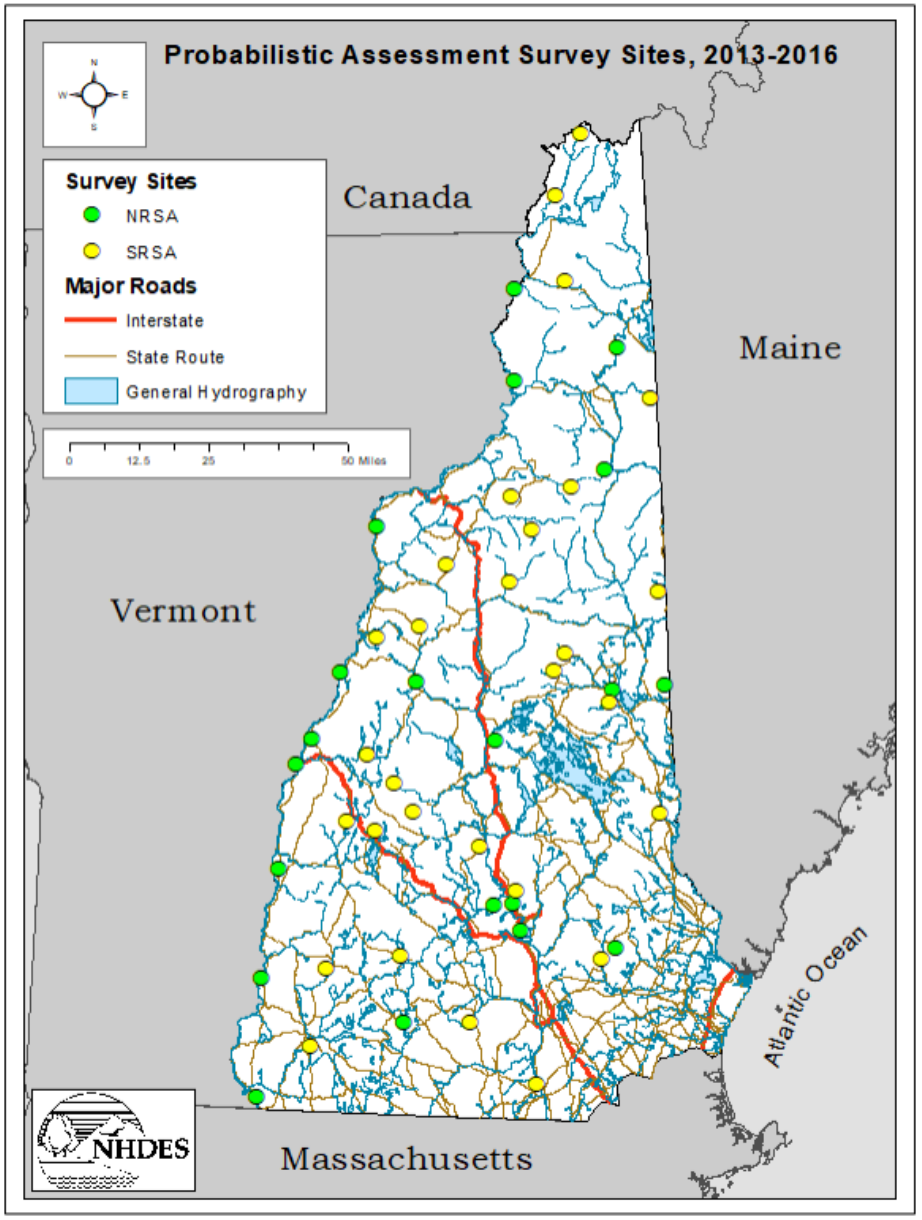
Assessing Aquatic Life and Primary Contact Recreation Designated Uses of New Hampshire's Rivers and Streams 2013-2017:

A statewide probability-based survey

Punch Brook, Franklin, NH (NHDES)

Rivers and Streams Probability Survey, 2013 - 2017

Figure 2: Probabilistic Assessment Survey Sites, 2013-2016



It's not perfect

~17,000 miles (NH river miles)

~6,900 miles included in assessment

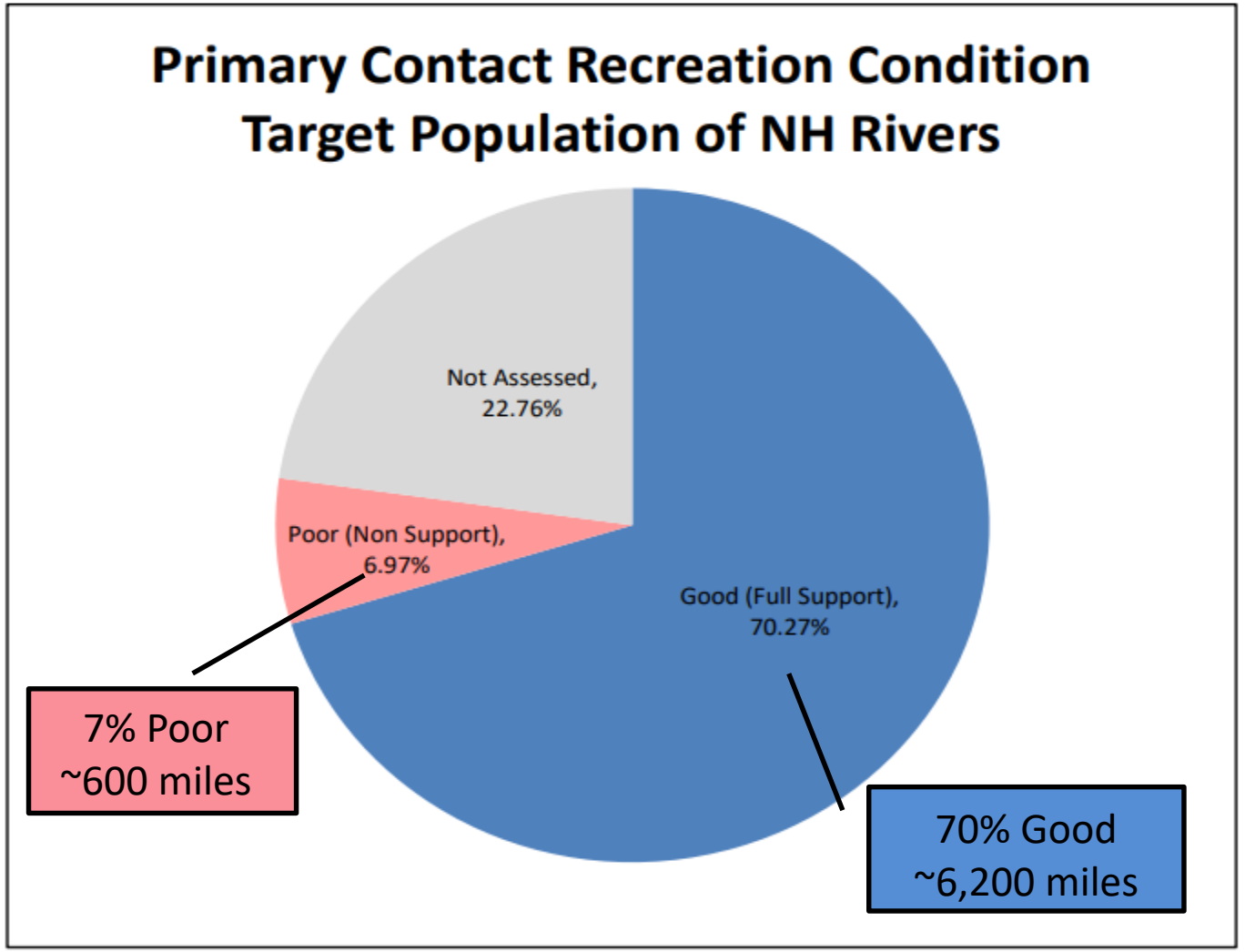
Reasons for exclusion:

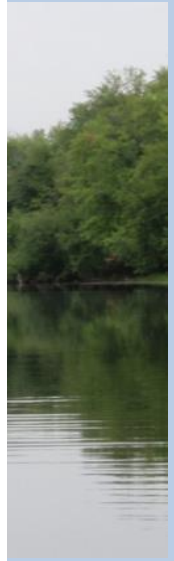
- Mapping errors
- Intermittent streams
- Inaccessible

How safe are NH rivers for swimming?


Lower Falls,

Figure 6: Primary Contact Recreation Condition Assessment





Indicator: Fecal bacteria (Enterococcus sp. & E. coli)

How healthy are the biological communities?

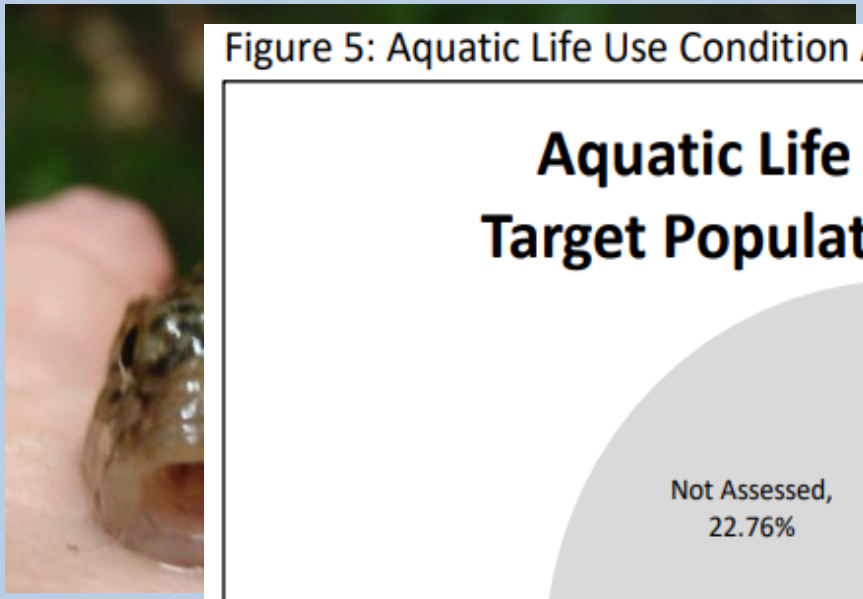


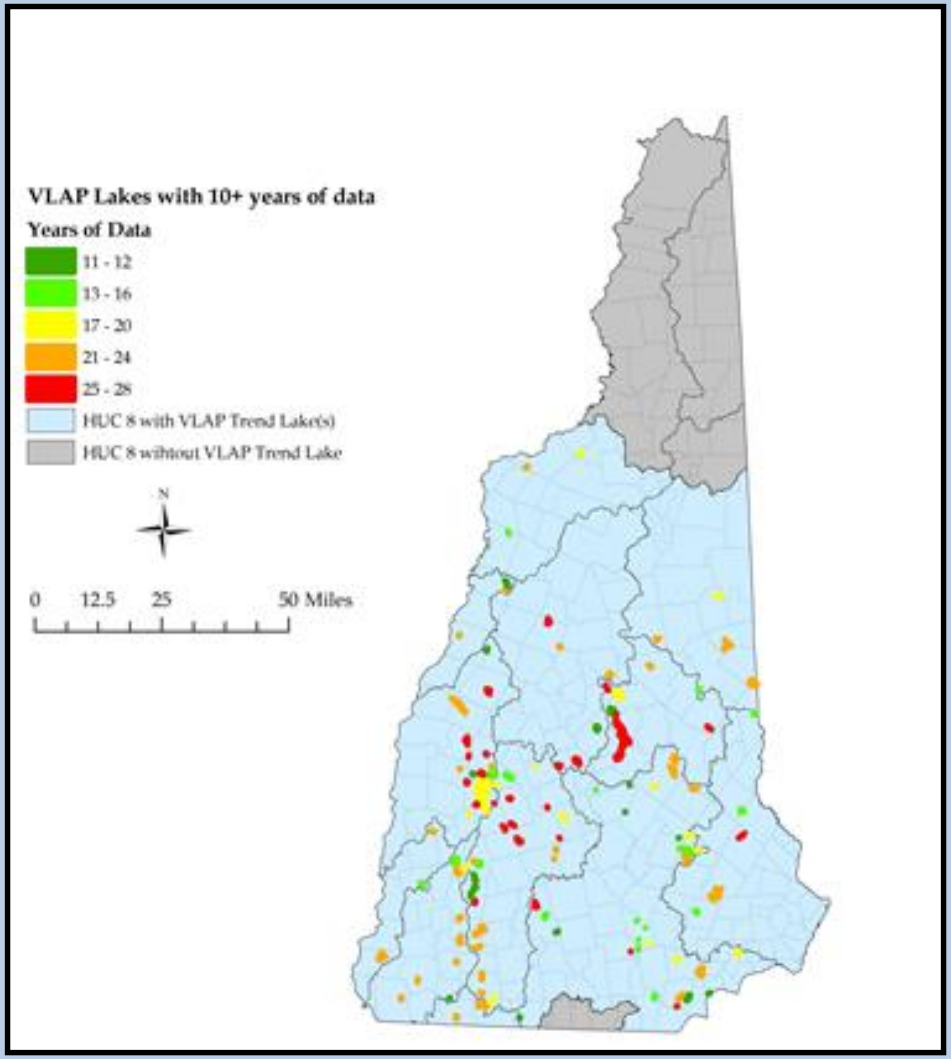
Figure 5: Aquatic Life Use Condition Assessment

Indi
Mac

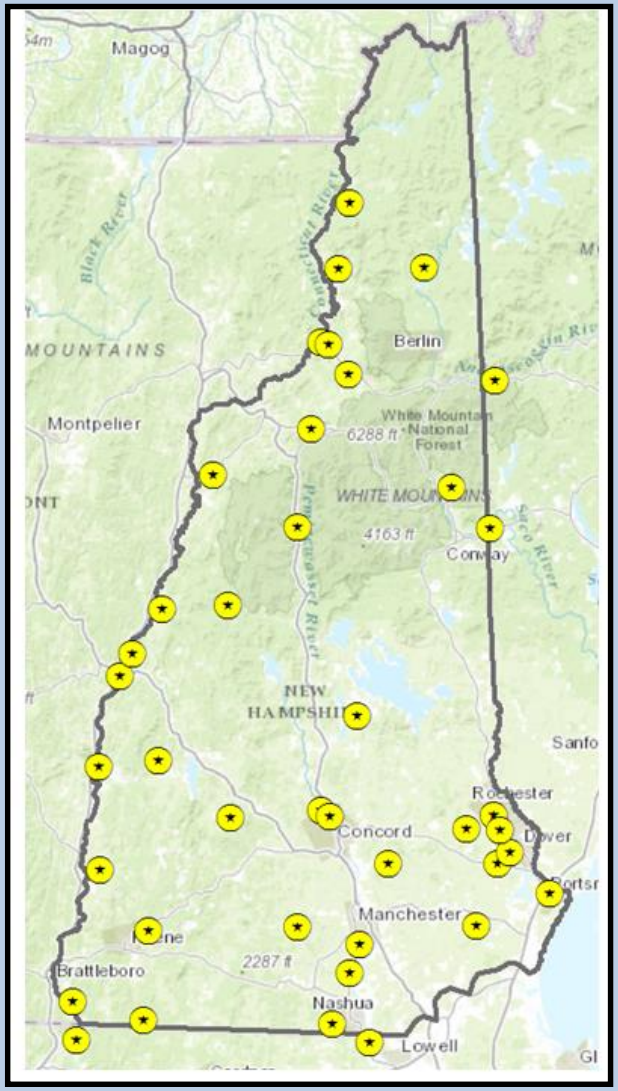
•Concise •Understandable •Memorable

Trend Monitoring Networks

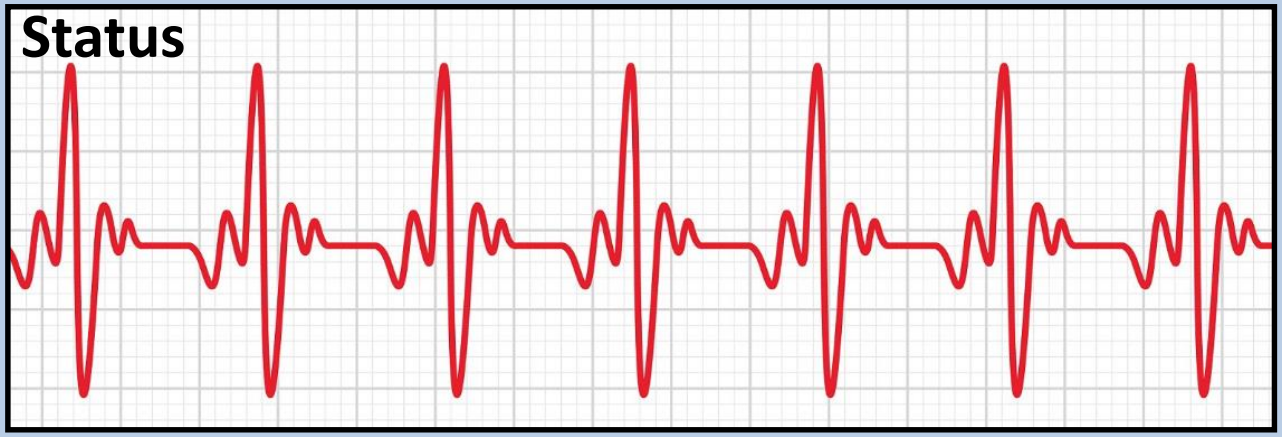
VLAP Lakes



River Monitoring Network



What are current conditions at repetitively sampled sites?



Are conditions getting better, worse, or staying the same?

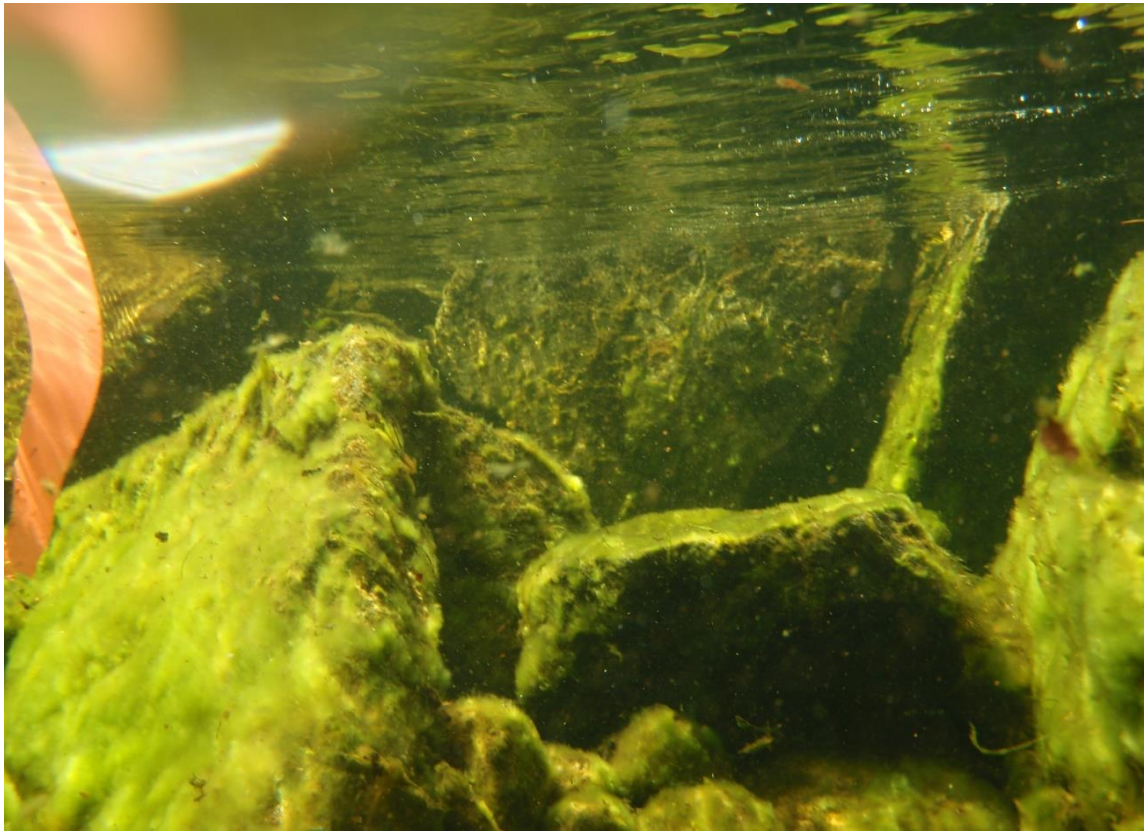
Nutrients

Nationally, excessive nutrients are problematic

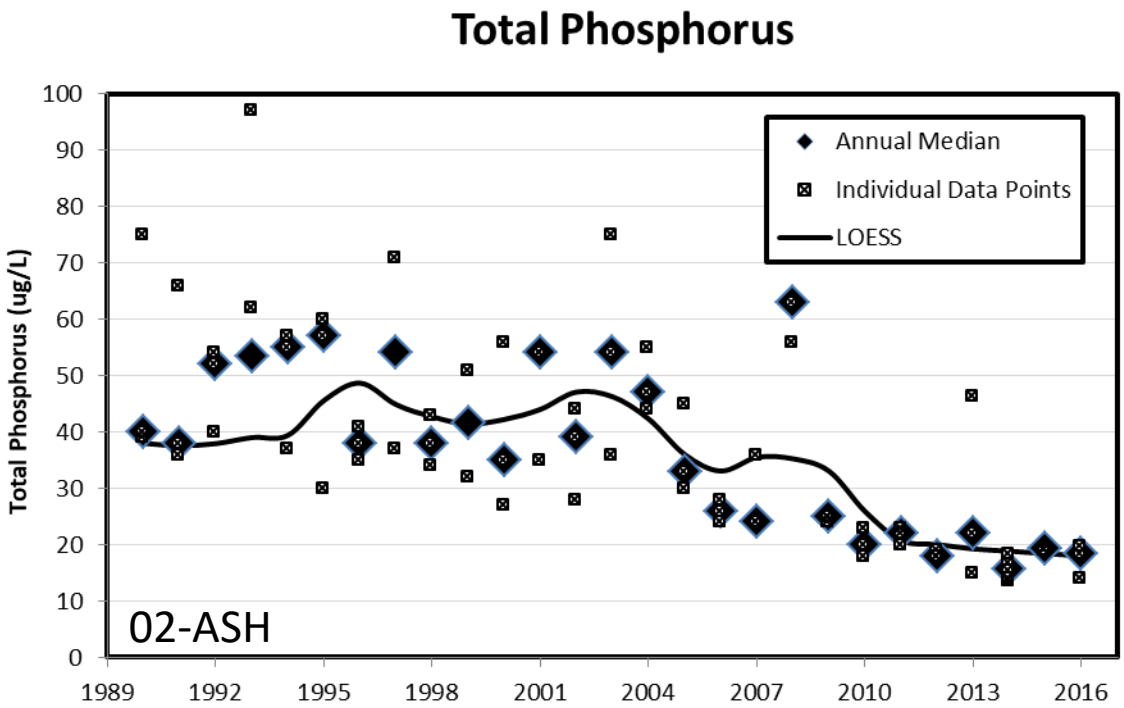
- 40% of lakes and 46% of river have high phosphorus

(Source: 2012 EPA National Lake Assessment; 2008-09 EPA National Rivers and Streams Assessment)

But what about NH?



River Nutrients – RMN Trends



Example: Ashuelot River, Swanzey

- Pre-2004 ~40-50ug/L
- Since 2010 ~20ug/L

Reason: 2004 treatment plant upgrades; 2007 new permit

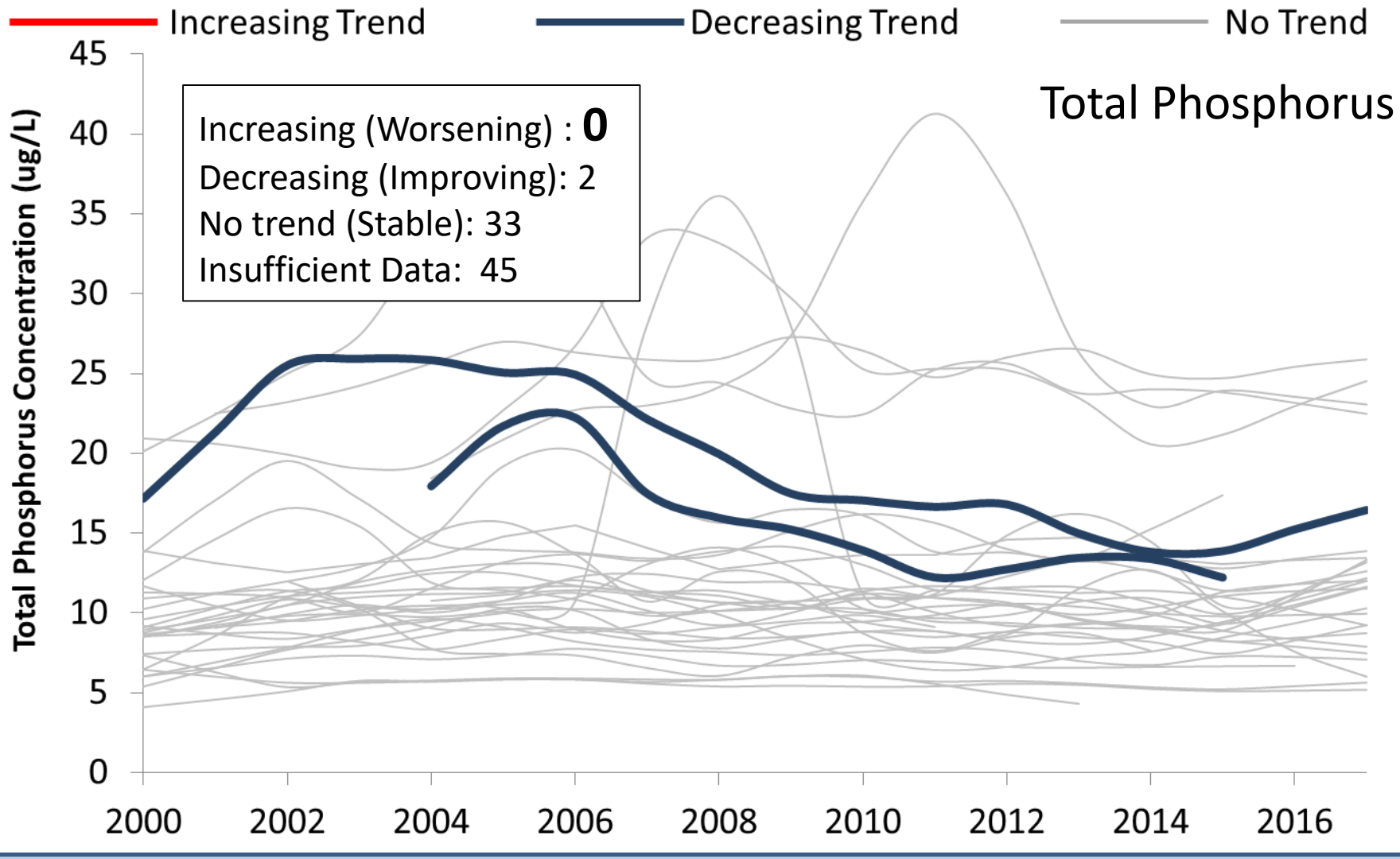
14 RMN sites had 10 or more years of data

- 8 sites no trend
- 6 sites decreasing (improving) trend
- 0 sites increasing (worsening) trend

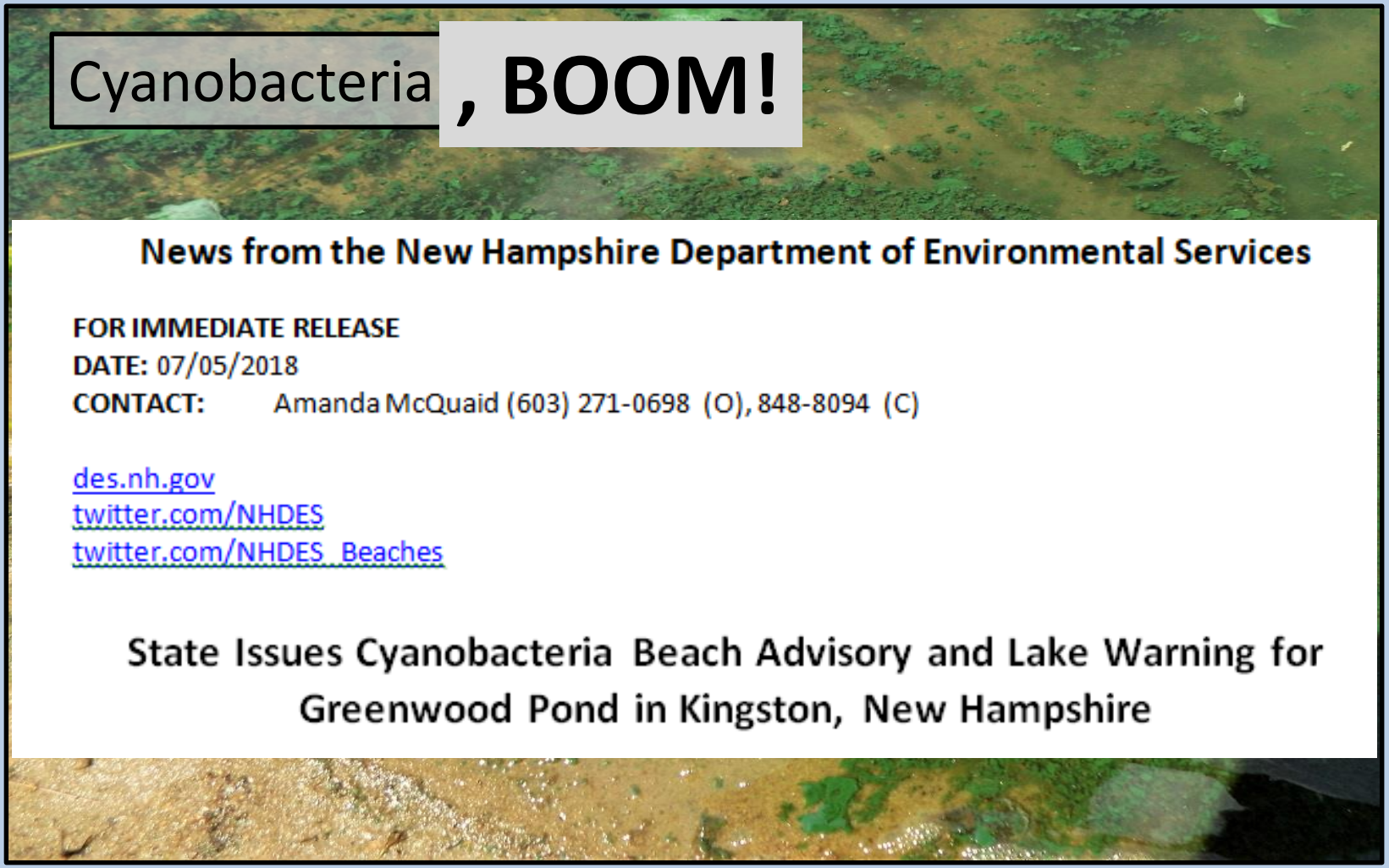
Statewide

- Median = 14ug/L
- 75% of data less than 22ug/L
- National median = 36ug/L

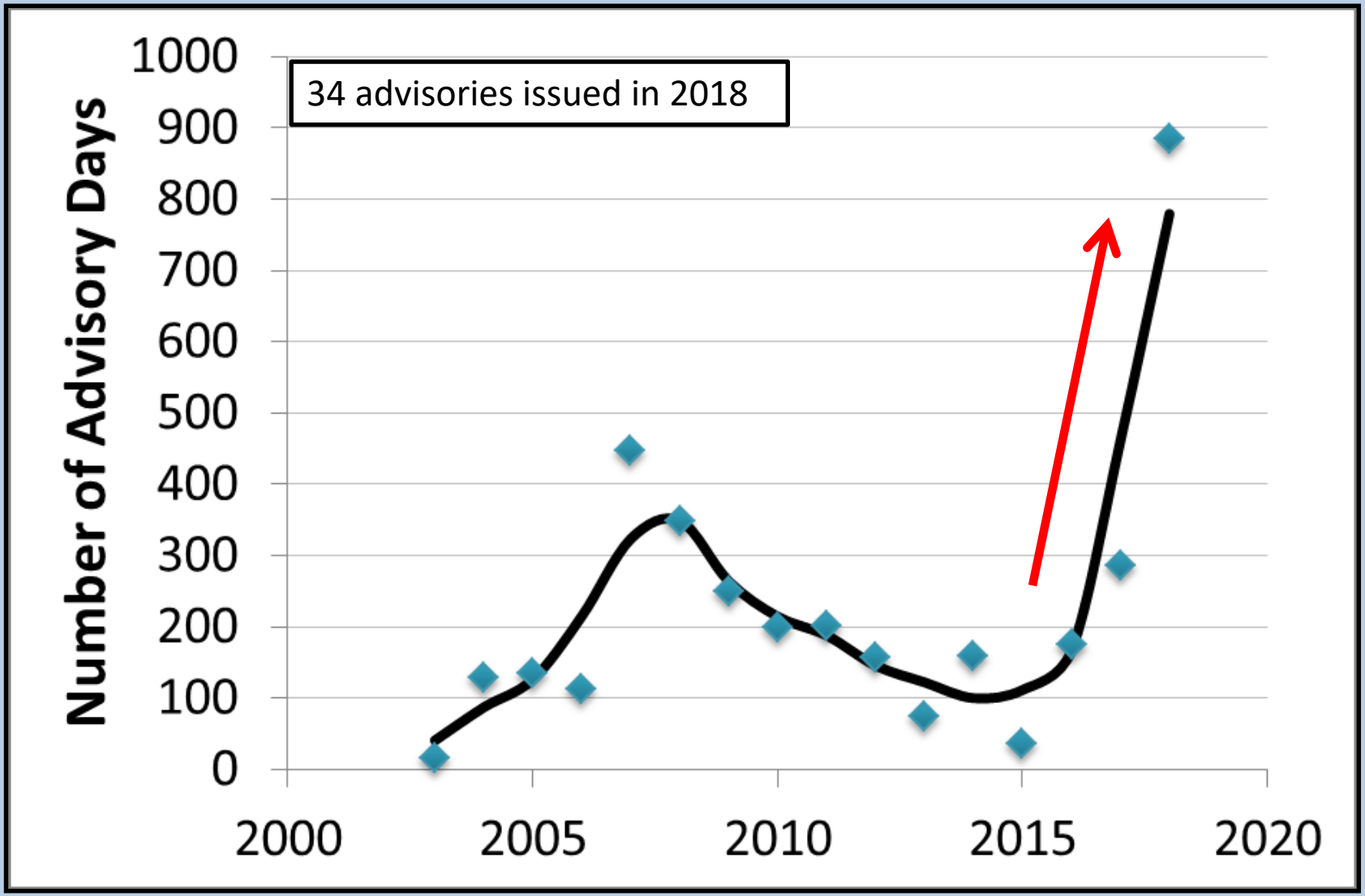
Lake Nutrients - Trends



Biological Response to High Nutrients

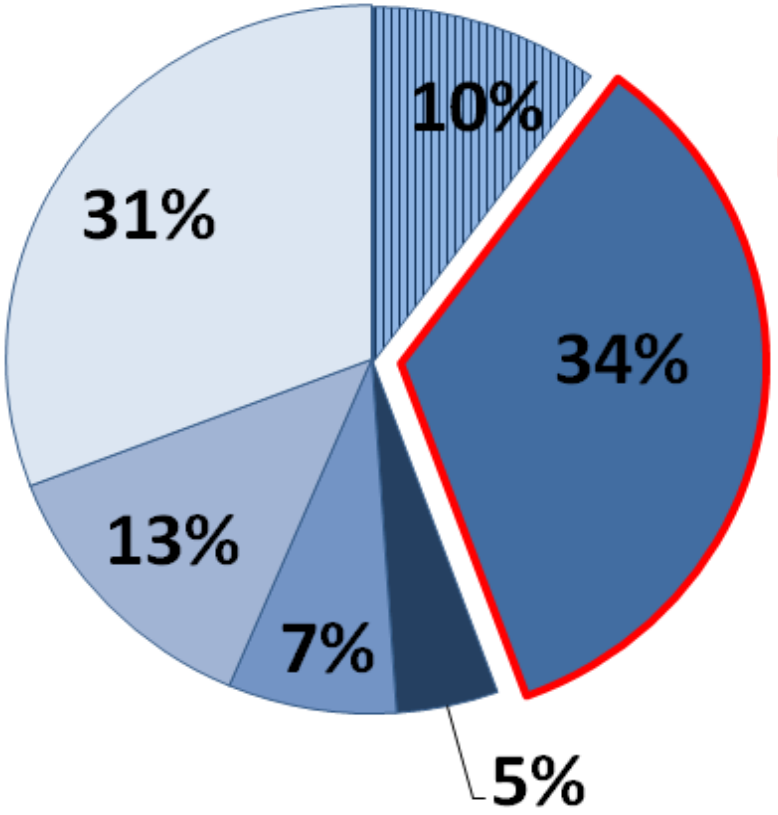


Lost Recreational Opportunities



Excessive nutrients can be “gift” from the past

- 6 consecutive years of blooms

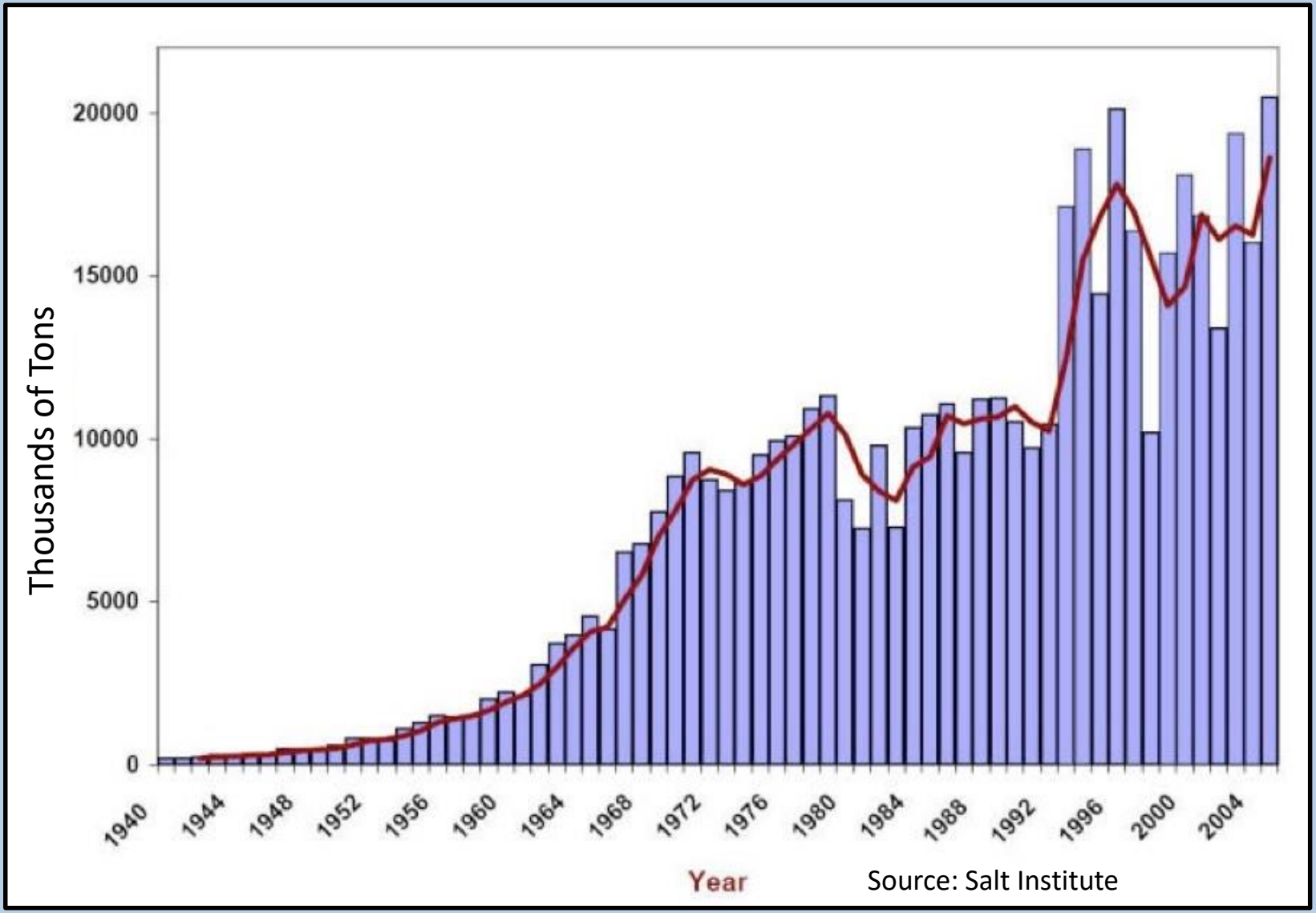


TP Inputs	%	TP (lbs/yr)
Atmospheric	*10*	8.4
Internal Loading	*34*	28.4
Waterfowl	*5*	3.7
Septic System	*7*	6.2
Watershed –Northern	*13*	10.6
Watershed - Southern	*31*	25.6
TOTAL	***100***	**82.9**

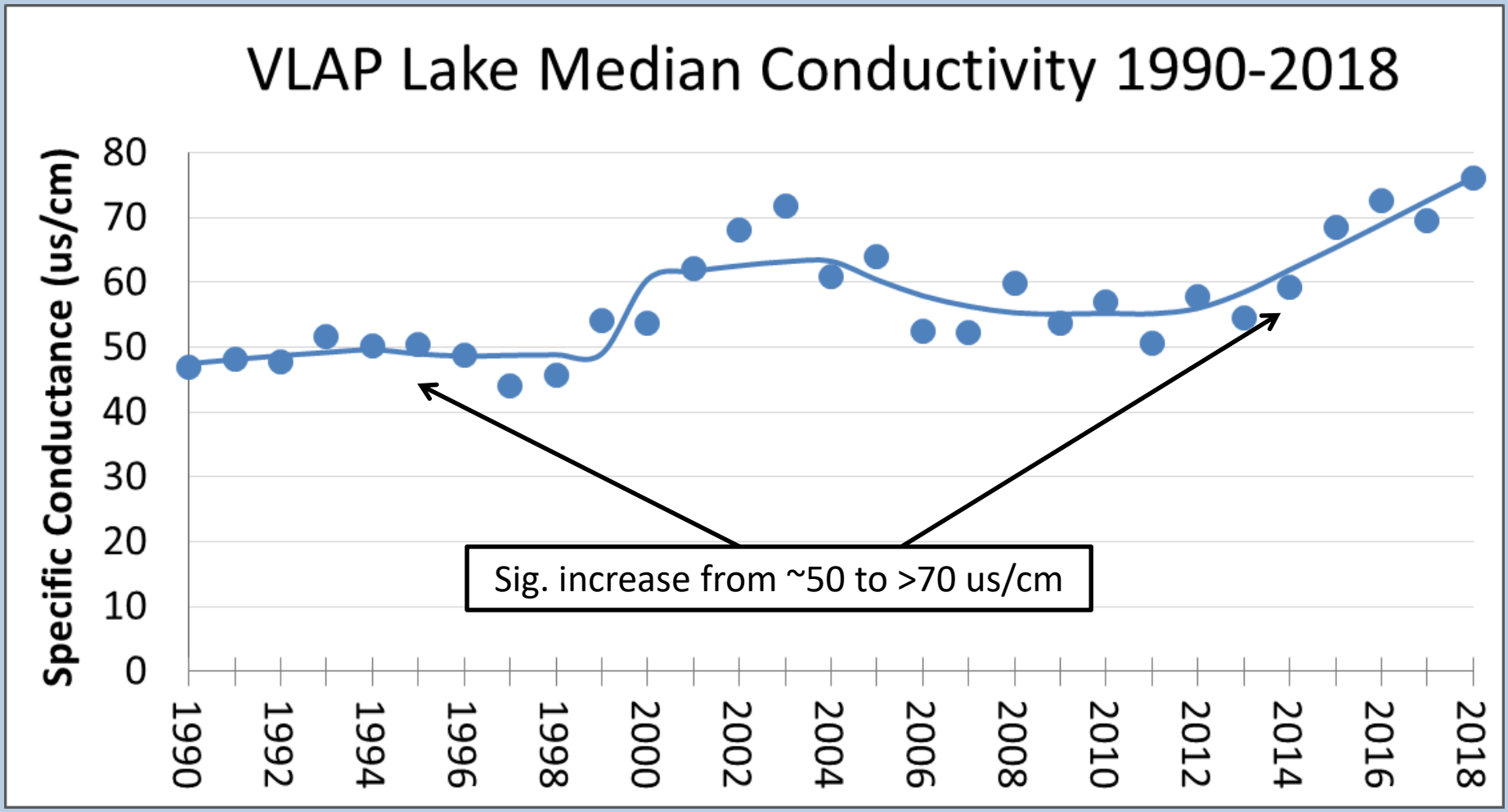
Photo courtesy of UNH LLMP

Chloride

Salt use in the US

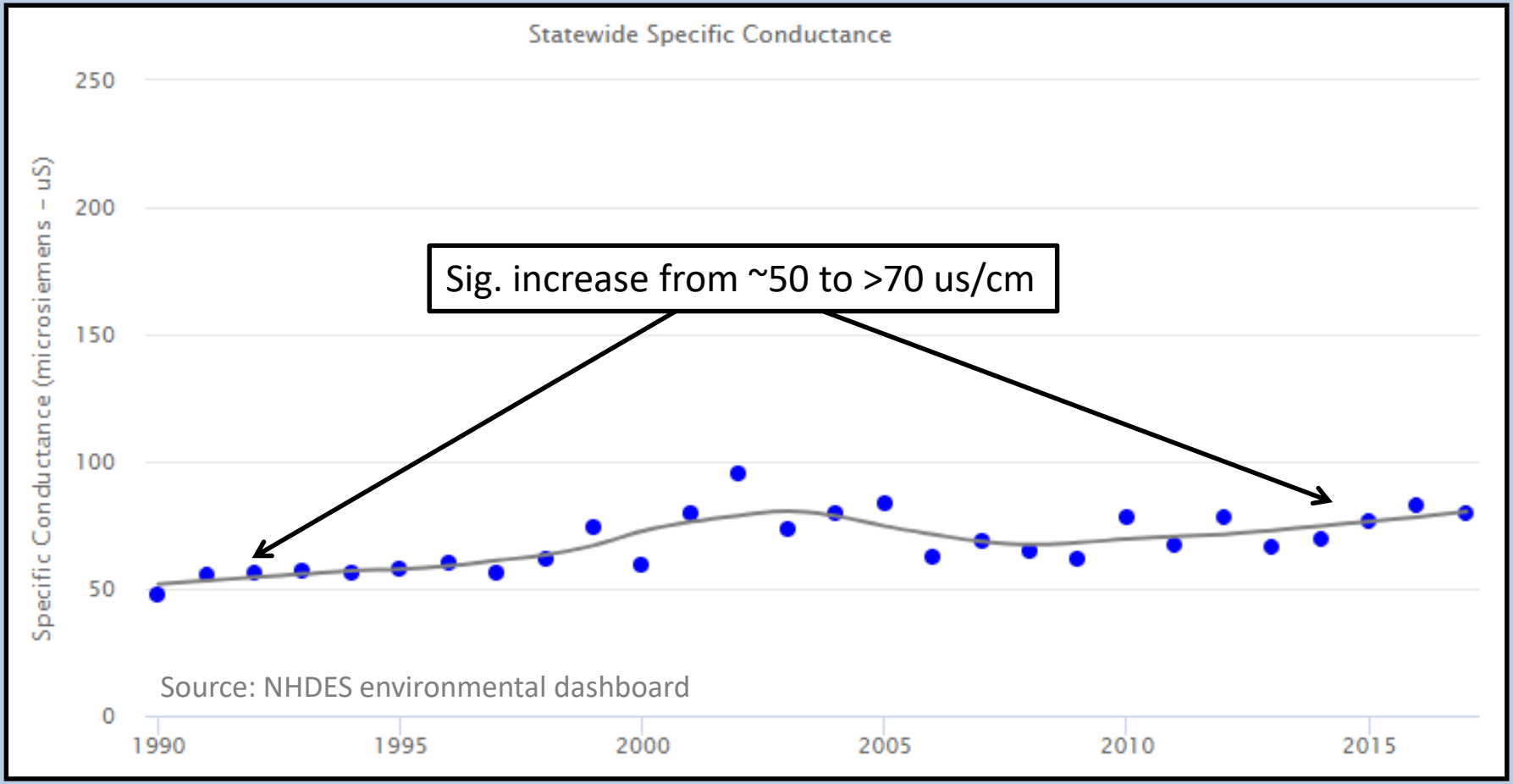


Lake Specific Conductance - Trend



Statewide Median = 60us/cm; ~75% data <100us/cm

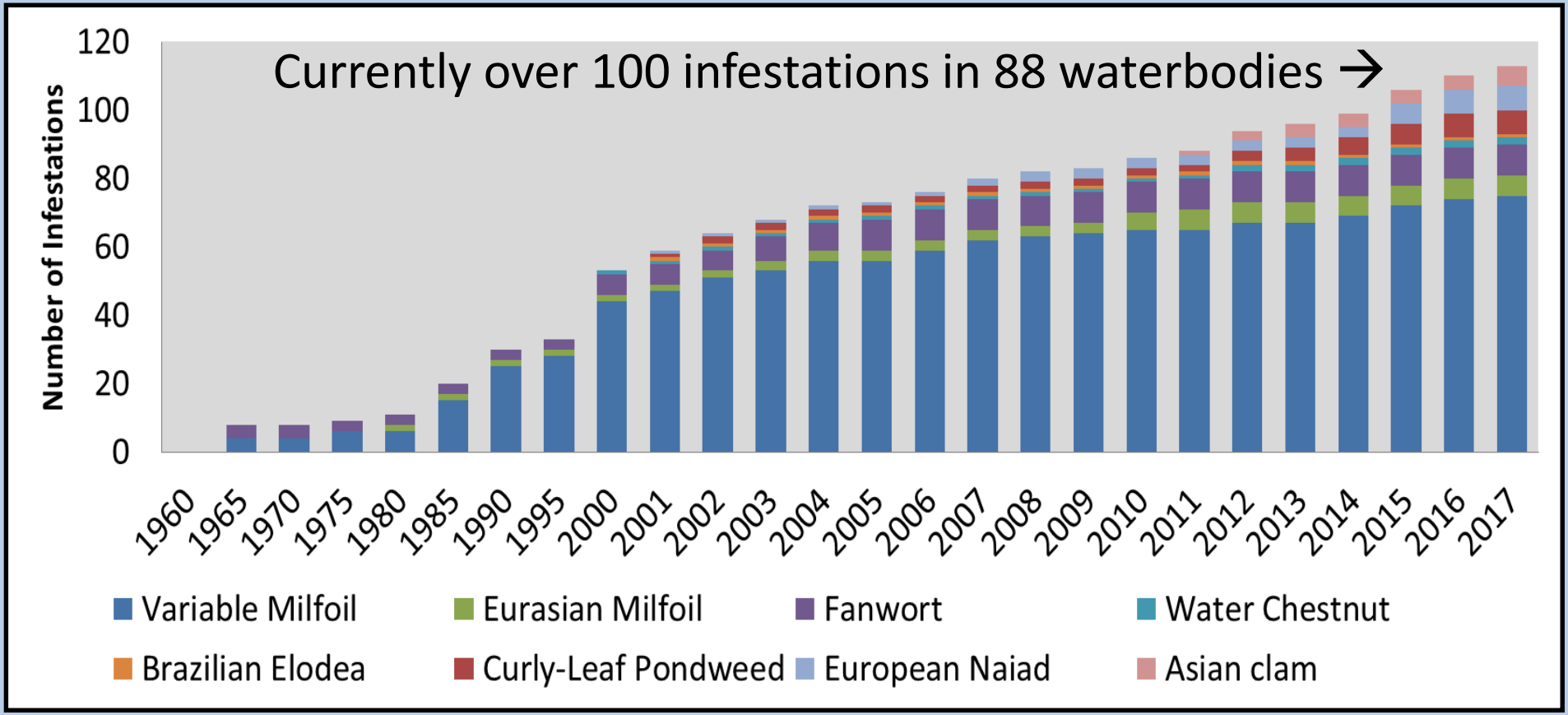
River Statewide Sp. Conductance - Trends



Statewide Median = 71us/cm; ~75% data <128us/cm

Aquatic Invasive Plants: Infestations & Management

NH Exotic Plant Species Infestations 1960 - 2017



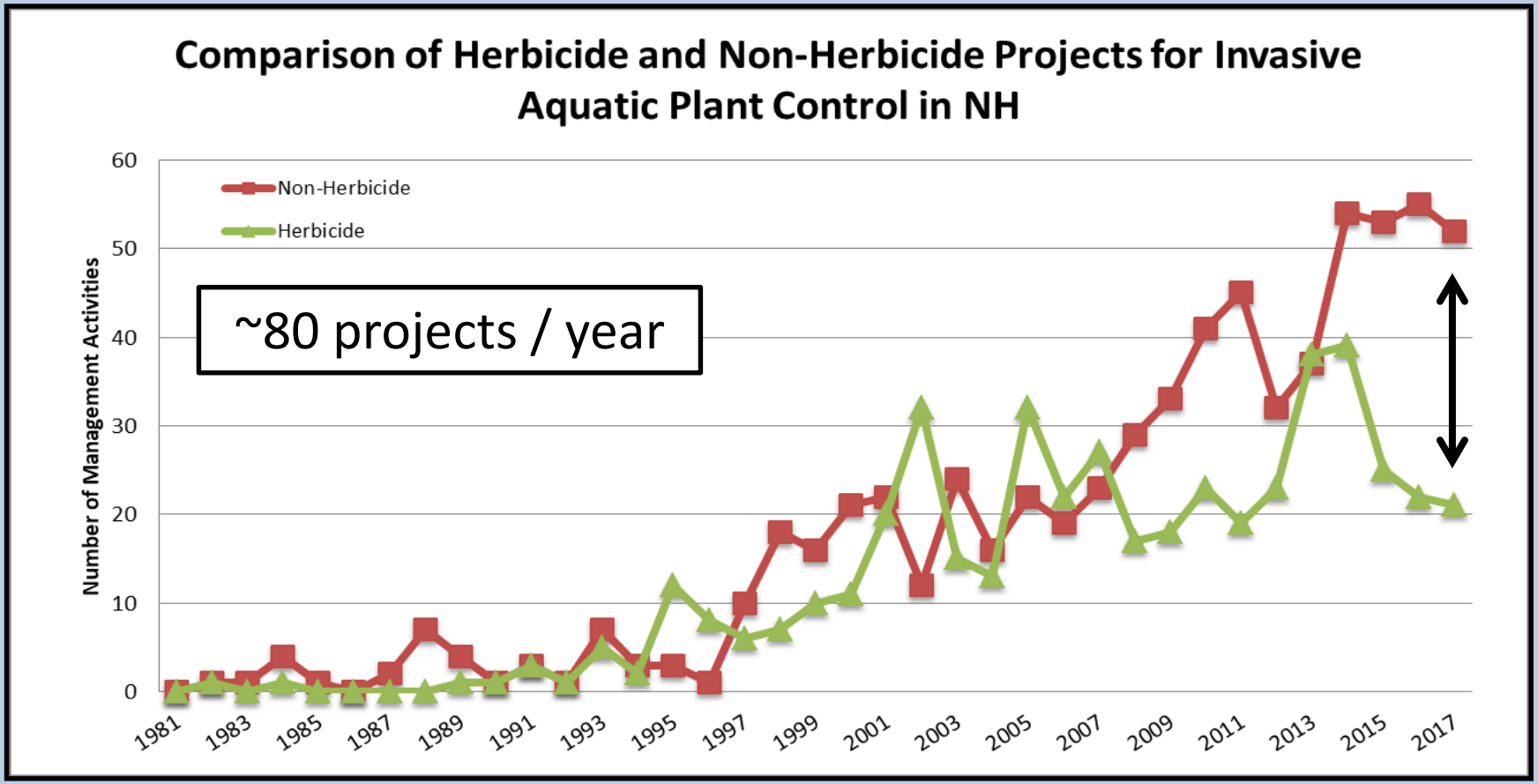
~1,500 – 1,700 acres infested statewide

NHDES Exotic Plant Species Management

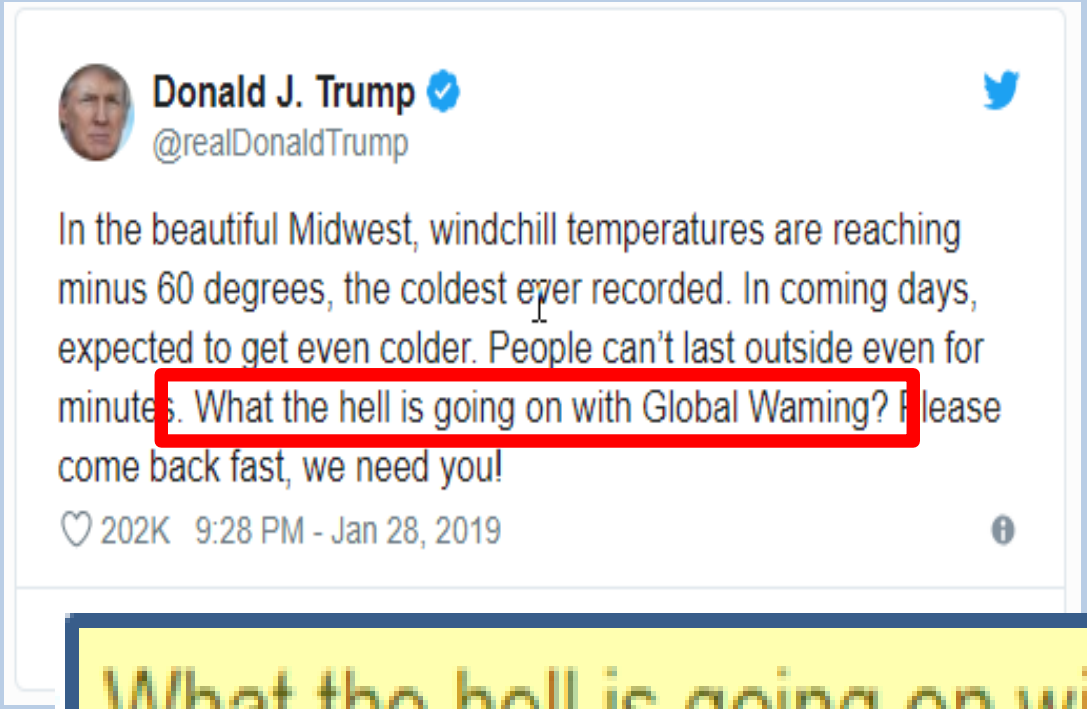
Exotic Species Program Funding / Grant Funds

- $9.50 fee per boat registration
- ~$890,000 raised annually
- ~$400,000 awarded for control activities; total project value $1 million
- ~$280,000 awarded for prevention

NHDES Exotic Plant Control Efforts

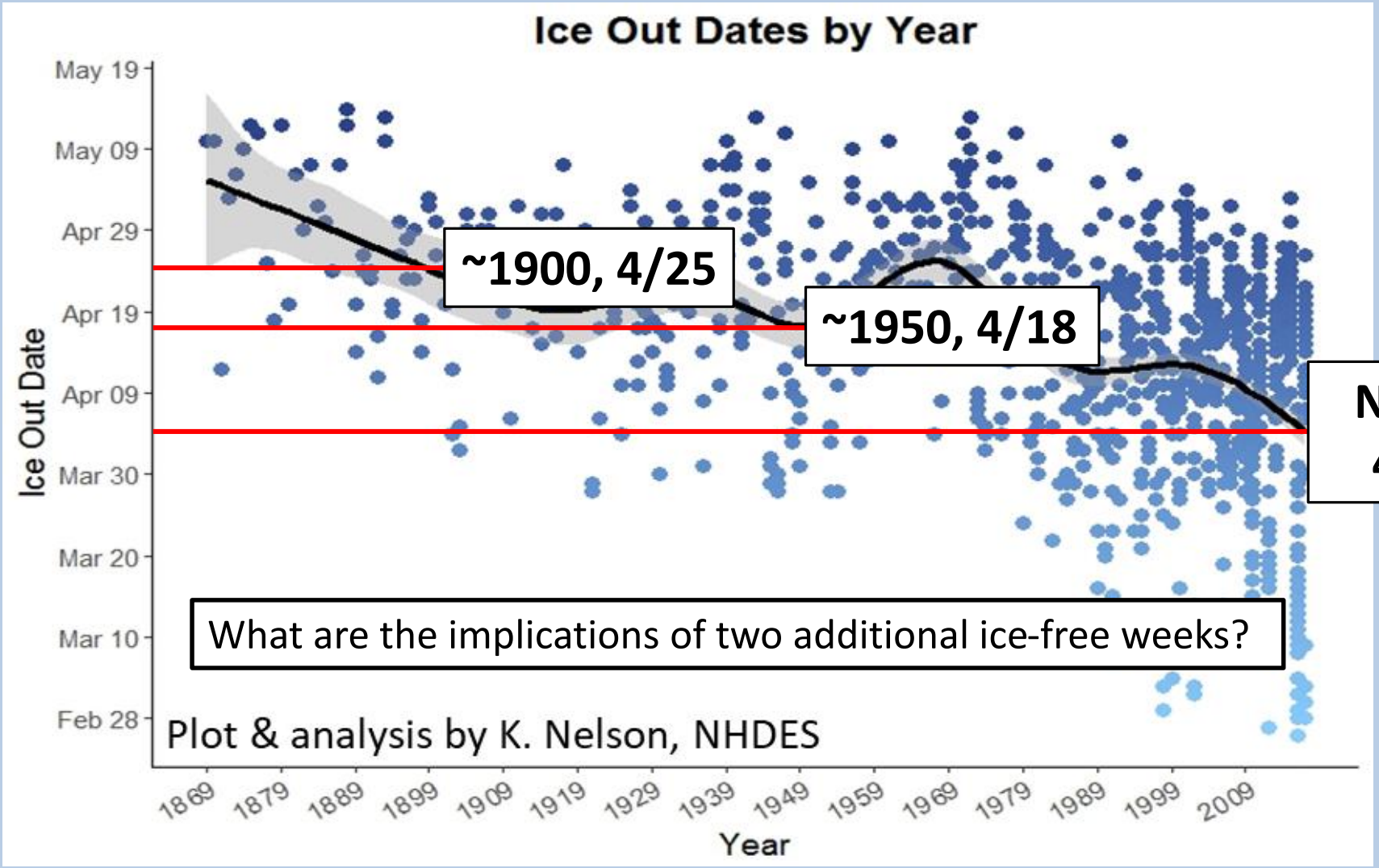


Evidence of Climate change in NH surface waters



What the hell is going on with Global Waming?

Evidence From NH Lakes That Our Climate is Changing



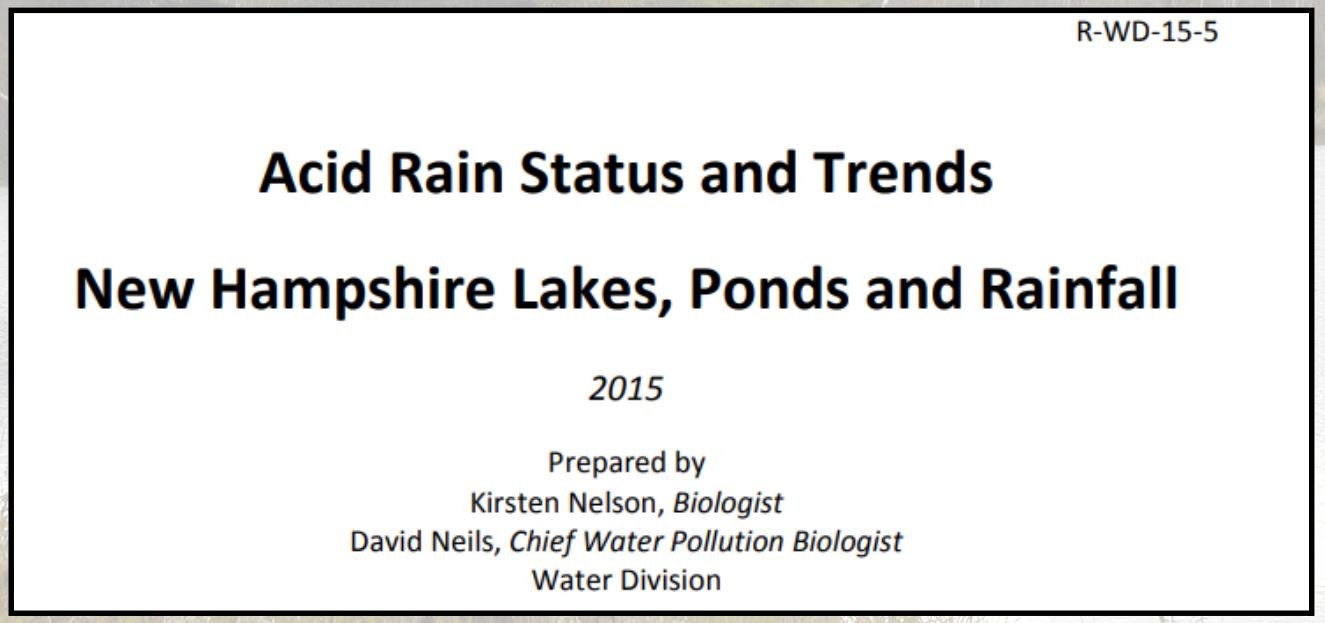
It’s Not All Gloom and Doom

NHDES Acid Rain Monitoring Programs

Rooftop Rain: Initiated 1972, ~40 “events” per year

Remote Pond: Initiated 1981, 10-35 waterbodies

Acid Outlet Ponds: Initiated 1983, 20 waterbodies



R-WD-15-5

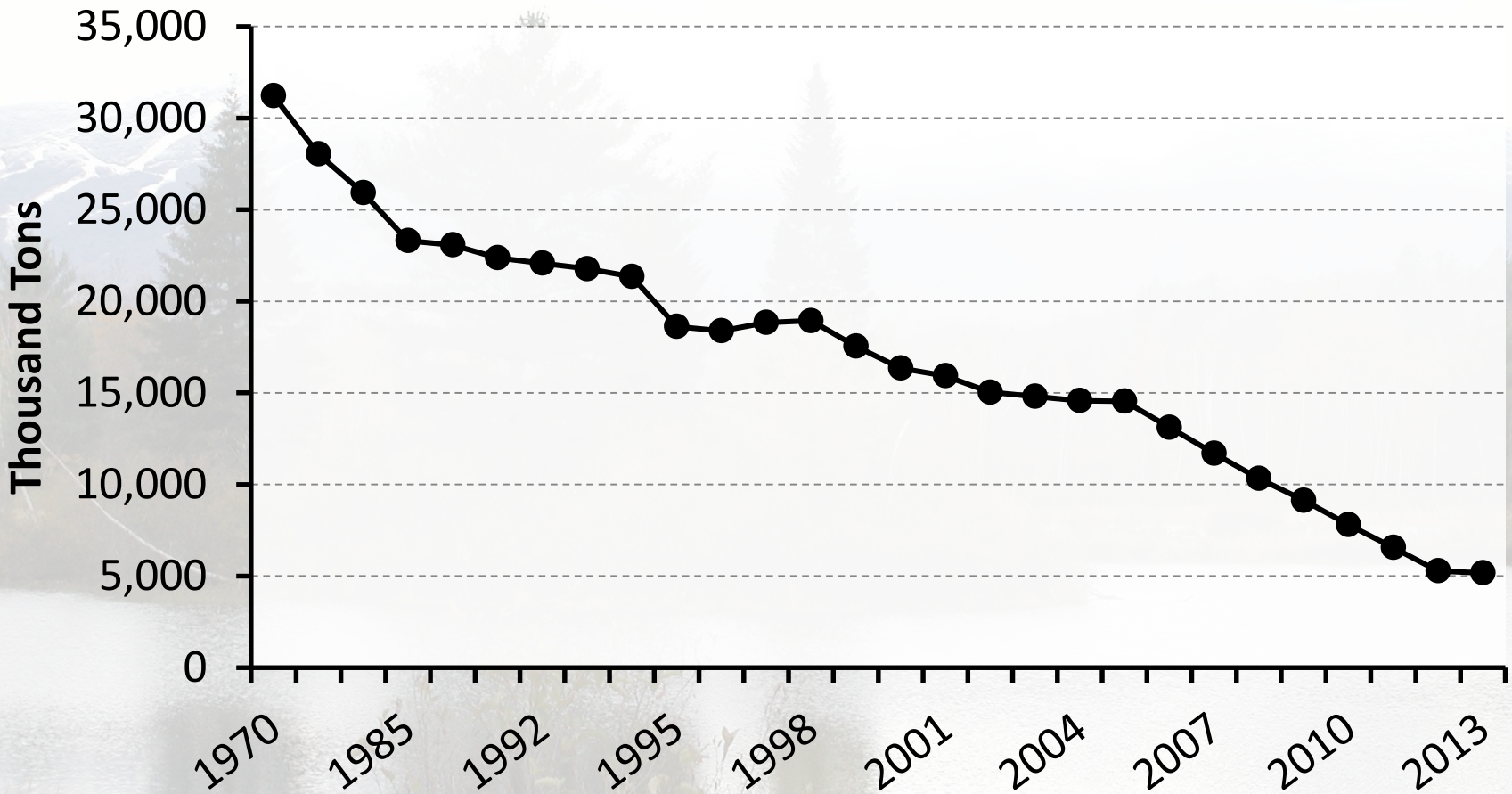
Acid Rain Status and Trends

New Hampshire Lakes, Ponds and Rainfall

2015

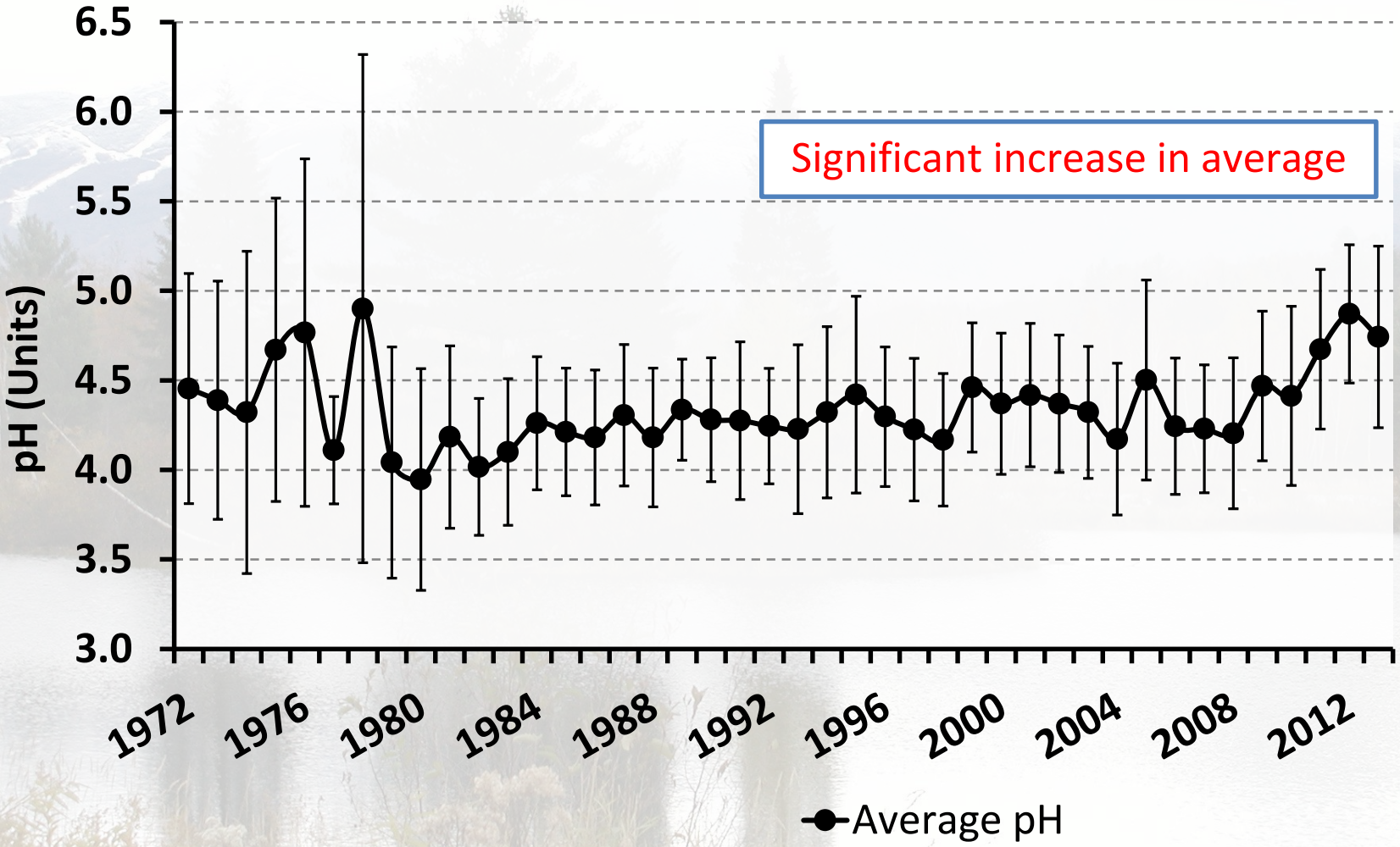
Prepared by
Kirsten Nelson, *Biologist*
David Neils, *Chief Water Pollution Biologist*
Water Division

Trend in US Sulfur Dioxide Emissions



Source: USEPA

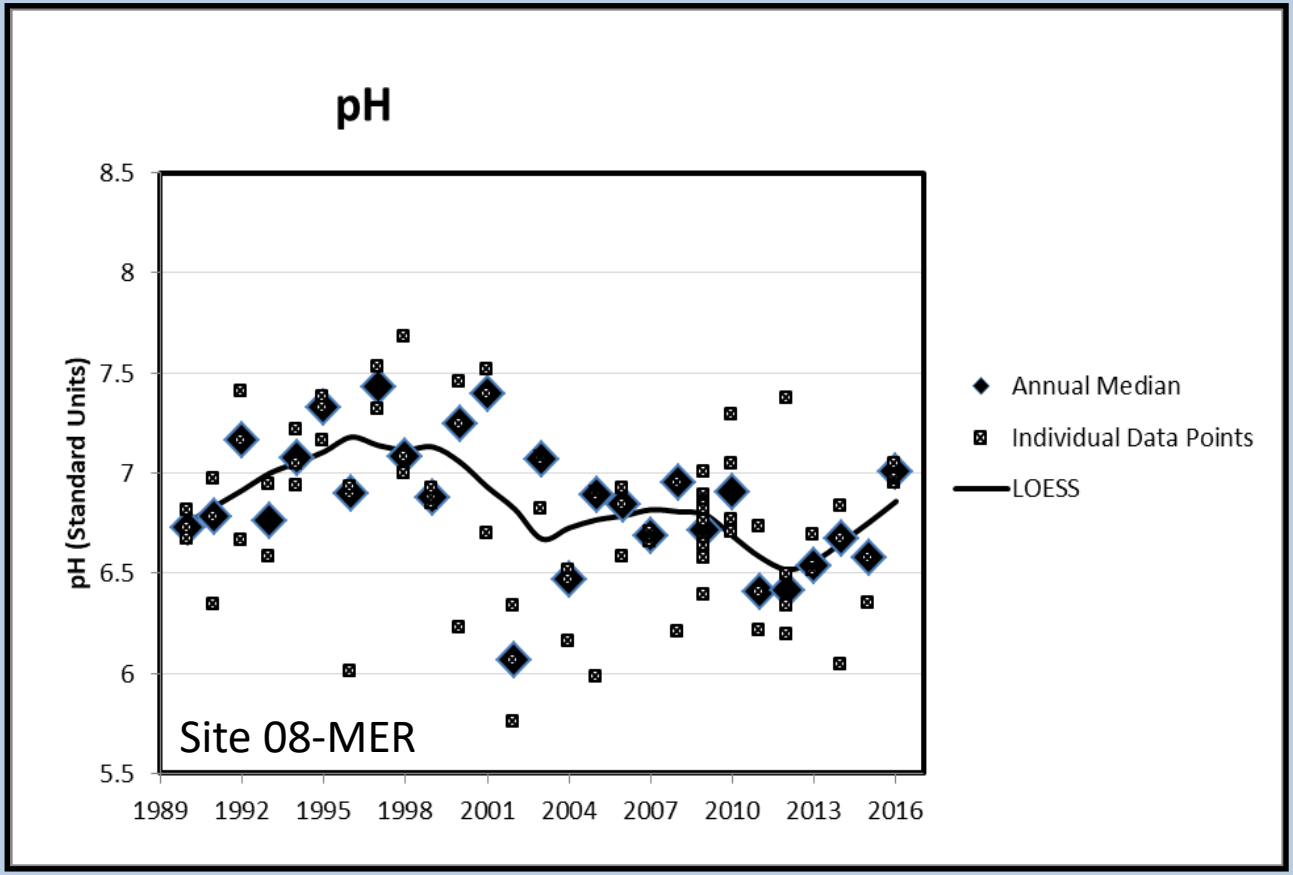
pH Trends in Rooftop Rain at NHDES



Plot and analysis: K. Nelson, NHDES

The Lingering Impacts of Acid Deposition in NH Surface Waters

RMN pH Trends:



Example: Merrimack River, Manchester

RMN Sites

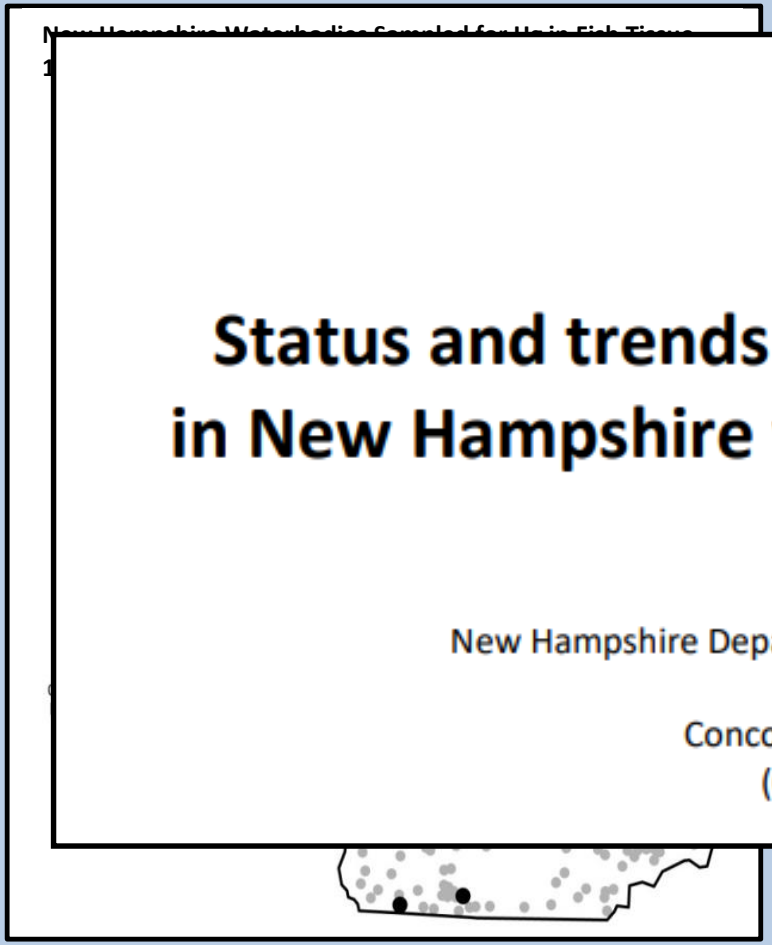
- 11 sites no trend
- 6 sites decreasing (worsening)
- 1 site increasing (improving)

Statewide

- Median = 6.53
- 75% of data less than 6.78

Mercury in Fish Tissue

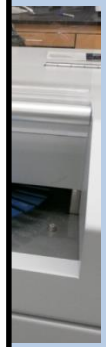
- NHDES sampling program in place since 1992
- Data on 26 species, 227 waterbodies, 4,100 fish



R-WD-17-22

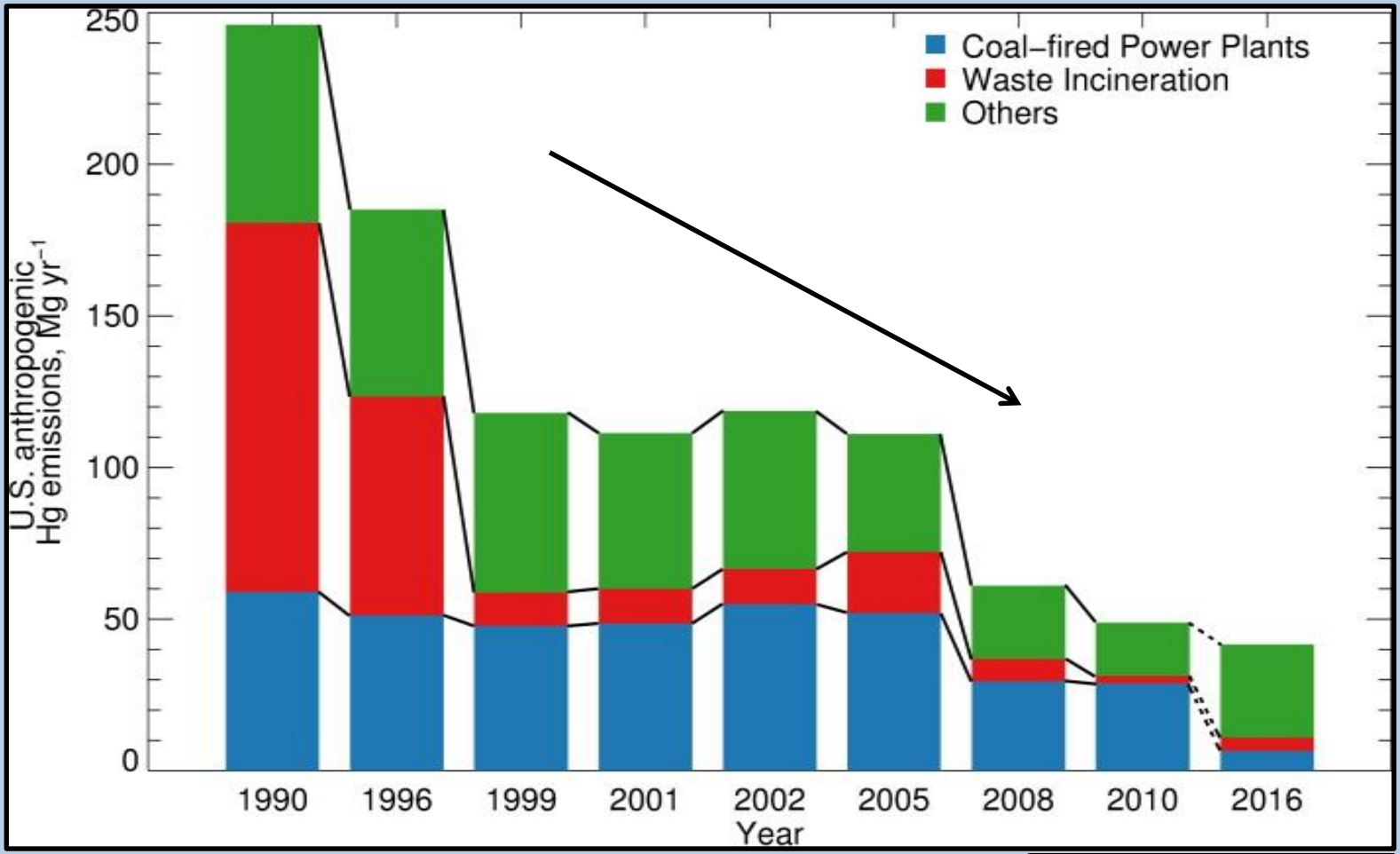
Status and trends of mercury in fish tissue in New Hampshire waterbodies, 1992 – 2016

New Hampshire Department of Environmental Services
PO Box 95
Concord, NH 03302-3503
(603) 271-8865



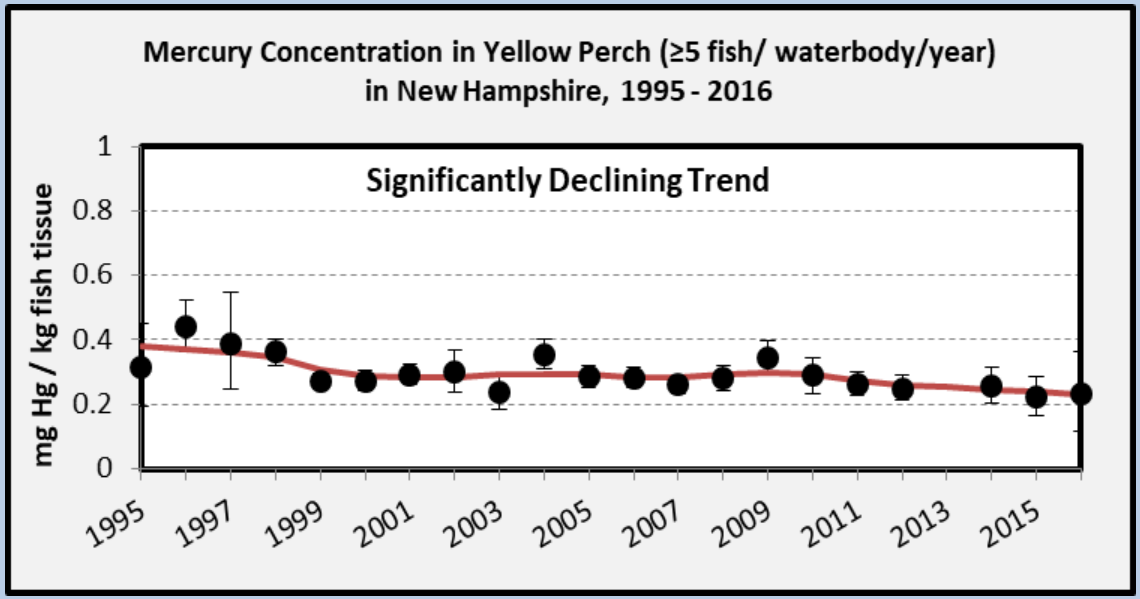
Data

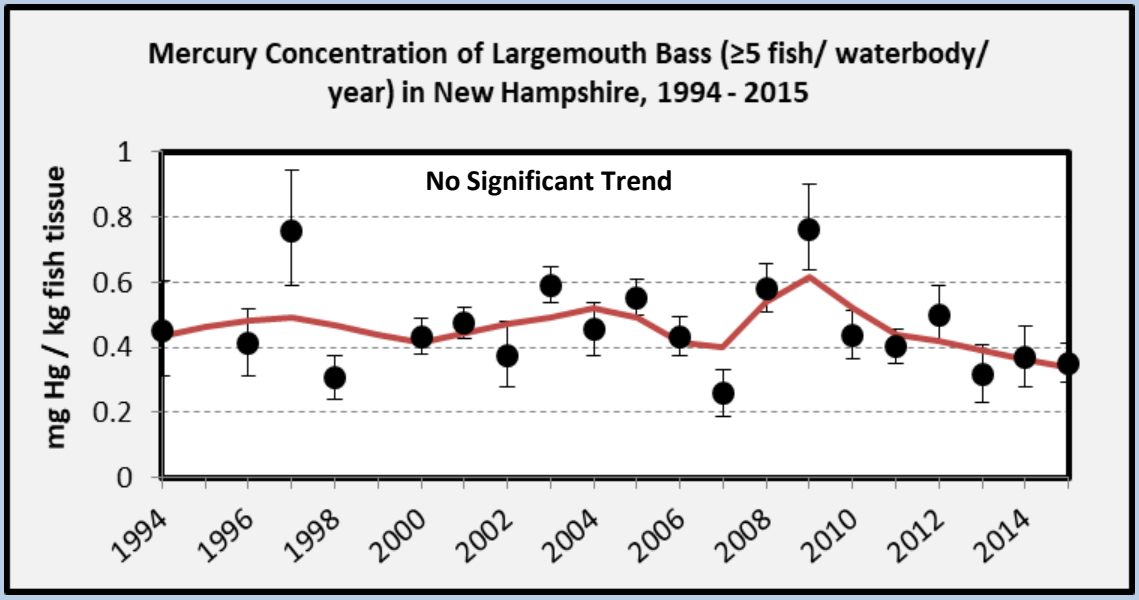
US trends in atmospheric mercury emissions



Zheng and Jaegle (2013)

Mercury in Fish Tissue - Trends



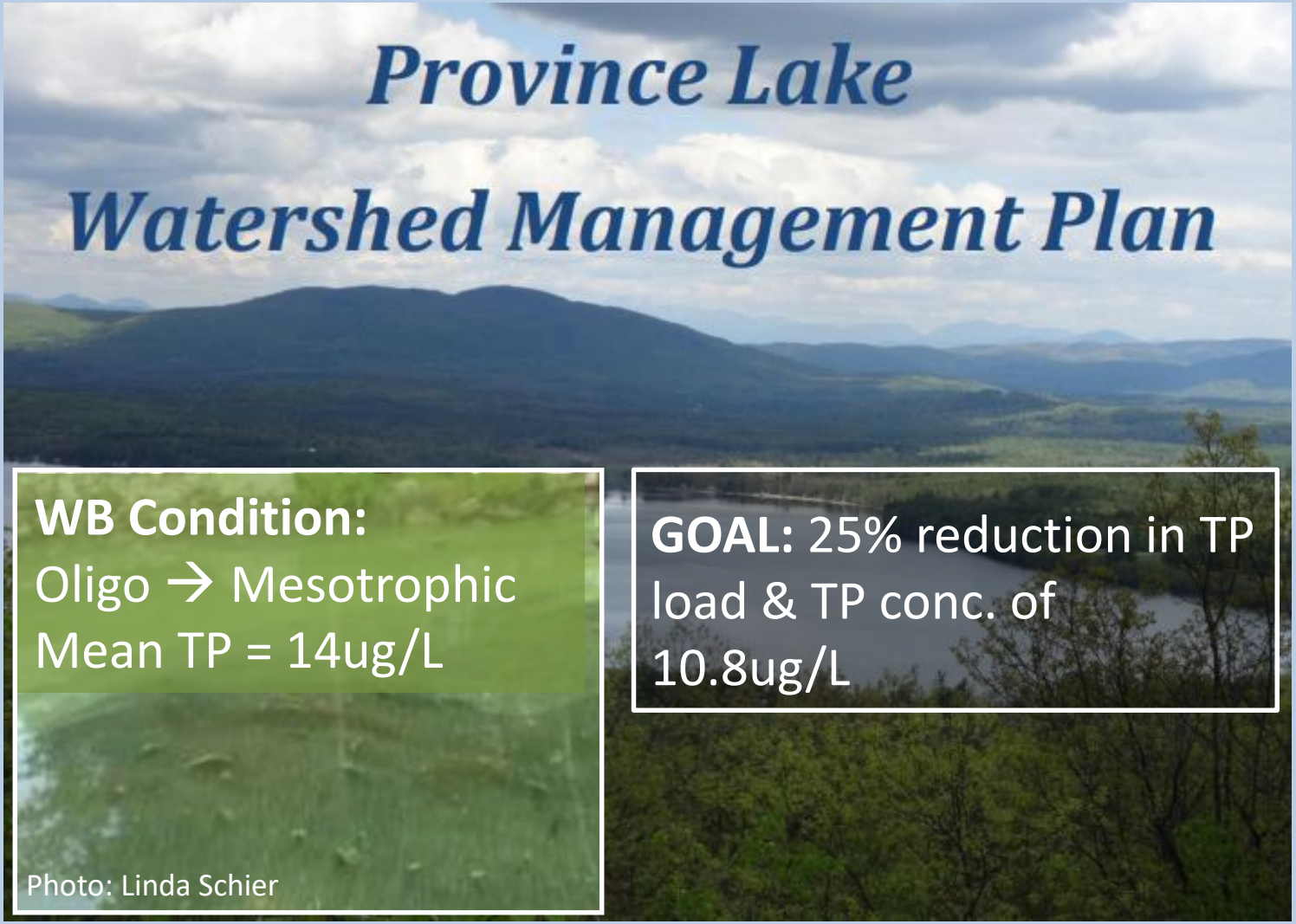


WQ Status and Trends Take Aways…

- NH surface waters are generally in “good” condition
- Statewide trends are towards higher specific conductance
- Excessive nutrients are restricted to certain waterbodies but cause big problems
- Management of exotic plants requires lots of time and money
- Climate change effects are real and documented
- Legacy problems associated with acid and Hg deposition are slowly improving

“Things” we can do

1) Watershed Planning



“Things” we can do

1) Watershed Planning (con’t)

Grant Funds

Grant year	319 grant $	Local match
2012	$75K	$85K
2015	$98K	$105K
2016	$77K	$100k
Totals	**$250K**	**$290K**

Nutrient Reduction Efforts:

“Things” we can do

2) Volunteer Water Quality Monitoring

You can’t fix what you don’t know….

VLAP:

- **180 lakes and ponds**
- **500 volunteers**
- **15,000 samples**
- **>120 lakes w/ 10+ yrs data**

“Things” we can do

3) Homeowner Stormwater Management

https://www4.des.state.nh.us/SoakNH/

- Voluntary program coordinated by NHDES
- Goal is to assist communities and homeowners manage stormwater
- Includes DIY projects and instructional videos

Homeowner Stormwater Management Practices

Hope in restoring and preserving NH surface waters lies with US

The "All at Once" method

The little things matter and are less daunting…

So Maybe the Million Dollar Question is….

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NEW HAMPSHIRE DEPARTMENT OF Environmental Services