The Million-Dollar Question:
How are New Hampshire’s Lakes and River doing?

2019 Water and Watershed Conference
Plymouth State University

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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

<table>
<thead>
<tr>
<th>Assessment Units (distinct ‘waterbodies’)</th>
<th>8,833</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling Stations</td>
<td>9,802</td>
</tr>
<tr>
<td>Parameters evaluated</td>
<td>196</td>
</tr>
<tr>
<td>Waterbody/ Use/Parameter combinations</td>
<td>91,342</td>
</tr>
<tr>
<td>Grab samples</td>
<td>4,347,047</td>
</tr>
<tr>
<td>Water Quality Standard Comparisons</td>
<td>3,840,045</td>
</tr>
</tbody>
</table>
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)
• 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?

Dang, I always get this question. How am I going to answer it tonight?

Hey, Dave you work for DES, right? How are healthy is the water?
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

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
**Design** is the backbone of the strategy

Probability-based monitoring – randomly selected sites

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

Trend monitoring – repetitively sampled sites

**QUESTION ANSWERED:** Are conditions getting better or worse over time?

Synoptic monitoring – 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

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)
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?

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

- Lower Falls, Peabody River: 7% Poor (~600 miles)
- Lower Falls, Swift River: Not assessed, 22.76%
- Merrimack River, Concord: Poor (Non Support), 6.97%
- Emerald Pool, Peabody River: 70% Good (~6,200 miles)
How healthy are the biological communities?

Indicators:

- Fish and Macroinvertebrates
- 52% Good (~4,500 miles)
- 8% Fair (~680 miles)
- 18% Poor (~1,600 miles)

- 52% Good (Full Support), 51.53%
- Poor (Non Support), 18.06%
- Fair (Full Support), 7.66%
- Not Assessed, 22.76%

• 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?
14 RMN sites had 10 or more years of data
- 8 sites no trend
- 6 sites decreasing (improving) trend
- 0 sites increasing (worsening) trend

**Example:** Ashuelot River, Swanzey
- **Pre-2004** ~40-50ug/L
- **Since 2010** ~20ug/L

**Reason:** 2004 treatment plant upgrades; 2007 new permit

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

Total Phosphorus

Increasing (Worsening): 0
Decreasing (Improving): 2
No trend (Stable): 33
Insufficient Data: 45
Biological Response to High Nutrients

Cyanobacteria Bloom, BOOM!

News from the New Hampshire Department of Environmental Services

FOR IMMEDIATE RELEASE
DATE: 07/05/2018
CONTACT: Amanda McQuaid (603) 271-0698 (O), 848-8094 (C)

des.nh.gov
twitter.com/NHDES
twitter.com/NHDES_Beaches

State Issues Cyanobacteria Beach Advisory and Lake Warning for Greenwood Pond in Kingston, New Hampshire
Lost Recreational Opportunities

34 advisories issued in 2018
Excessive nutrients can be “gift” from the past

- 6 consecutive years of blooms

### TP Inputs

<table>
<thead>
<tr>
<th>Source</th>
<th>%</th>
<th>TP (lbs/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric</td>
<td>10</td>
<td>8.4</td>
</tr>
<tr>
<td>Internal Loading</td>
<td>34</td>
<td>28.4</td>
</tr>
<tr>
<td>Waterfowl</td>
<td>5</td>
<td>3.7</td>
</tr>
<tr>
<td>Septic System</td>
<td>7</td>
<td>6.2</td>
</tr>
<tr>
<td>Watershed – Northern</td>
<td>13</td>
<td>10.6</td>
</tr>
<tr>
<td>Watershed - Southern</td>
<td>31</td>
<td>25.6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>100</td>
<td><strong>82.9</strong></td>
</tr>
</tbody>
</table>

Photo courtesy of UNH LLMP
Chloride
Salt use in the US

Source: Salt Institute
Lake Specific Conductance - Trend

VLAP Lake Median Conductivity 1990-2018

- Sig. increase from \( \sim 50 \) to \( >70 \) us/cm
- Statewide Median = 60us/cm; \( \sim 75\% \) data <100us/cm
River Statewide Sp. Conductance - Trends

Sig. increase from ~50 to >70 us/cm

Statewide Median = 71us/cm; ~75% data <128us/cm
Aquatic Invasive Plants: Infestations & Management

Hydrilla
Curly-leaf pondweed
Eurasian milfoil
Variable milfoil
Fanwort
Water chestnut
Currently over 100 infestations in 88 waterbodies

~1,500 – 1,700 acres infested statewide
### 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

Comparison of Herbicide and Non-Herbicide Projects for Invasive Aquatic Plant Control in NH

~80 projects / year
Evidence of Climate change in NH surface waters

Donald J. Trump
@realDonaldTrump

In the beautiful Midwest, windchill temperatures are reaching minus 60 degrees, the coldest ever recorded. In coming days, expected to get even colder. People can't last outside even for minutes. What the hell is going on with Global Waming? Please come back fast, we need you!

202K 9:28 PM - Jan 28, 2019

What the hell is going on with Global Waming?
Evidence From NH Lakes That Our Climate is Changing

~1900, 4/25
~1950, 4/18
Now, 4/5

What are the implications of two additional ice-free weeks?

Ice Out Dates by Year

Plot & analysis by K. Nelson, NHDES
It’s Not All Gloom and Doom

Come on guys, IT’S NOT THAT BAD!!!
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
Trend in US Sulfur Dioxide Emissions

Source: USEPA
pH Trends in Rooftop Rain at NHDES

Significant increase in average

Plot and analysis: K. Nelson, NHDES
The Lingering Impacts of Acid Deposition in NH Surface Waters

RMN pH Trends:

- **Example:** Merrimack River, Manchester

- **Site 08-MER**

  - Annual Median
  - Individual Data Points
  - LOESS

### 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

- Statewide median = 6.53
- 75% of data < 6.78
- 40% of RMN sites do not meet WQS; 3 sites < 6.0
Mercury in Fish Tissue

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


New Hampshire Department of Environmental Services
PO Box 95
Concord, NH 03302-3503
(603) 271-8865
US trends in atmospheric mercury emissions

Zheng and Jaegle (2013)
Mercury in Fish Tissue - Trends

Mercury Concentration in Yellow Perch (≥5 fish/ waterbody/year) in New Hampshire, 1995 - 2016

Significantly Declining Trend


No Significant Trend
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

**Province Lake**  
**Watershed Management Plan**

**WB Condition:**
Oligo → Mesotrophic  
Mean TP = 14ug/L

**GOAL:** 25% reduction in TP load & TP conc. of 10.8ug/L

Photo: Linda Schier
“Things” we can do

1) Watershed Planning (con’t)

**Grant Funds**

<table>
<thead>
<tr>
<th>Grant year</th>
<th>319 grant $</th>
<th>Local match</th>
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<tbody>
<tr>
<td>2012</td>
<td>$75K</td>
<td>$85K</td>
</tr>
<tr>
<td>2015</td>
<td>$98K</td>
<td>$105K</td>
</tr>
<tr>
<td>2016</td>
<td>$77K</td>
<td>$100K</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>$250K</strong></td>
<td><strong>$290K</strong></td>
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</table>

**Nutrient Reduction Efforts:**

- Septic system replacement cost
  - $4,600 towards replacement of septic system
  - 8 land owners participated
  - ~10% of annual expected load reduction

- Youth Conservation Corps
  - Free labor for BMP installation
  - 137 projects on 34 properties
  - 77 lbs. of phosphorus / yr. removed
“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...

[Image of a person pushing a large rock with the text: "PLASTIC STRAWS SUCK!"]
So Maybe the Million Dollar Question is....
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