A Snapshot of Lake Health Across Wisconsin

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National Aquatic Resource Surveys

• Goal: Assess the quality of the nation’s waters
• Water:
  – Coastal
  – Lakes and Reservoirs
  – Rivers and Streams
  – Wetlands
• Who:
  – EPA
  – States
  – Tribes
National Lakes Assessment

• What is the current biological, chemical, physical, and recreational condition of lakes?
• What are the most common water quality problems?
• Is lake condition improving or getting worse?
Extrapolate Results to ALL Lakes with a Probabilistic Survey
2012 National Lakes Assessment

- **Nutrient pollution**
  - excess nitrogen in 35% of lakes
  - excess phosphorus in 40% of lakes
- **Lakeshore Habitat**
  - Degraded riparian and shallow habitat in 29% of lakes
- **Biological condition**
  - degraded macroinvertebrates in 31% of lakes
- **Algal Toxins & Herbicide**
  - high microcystin & atrazine in <1% of lakes
2017 NLA
46 - 52 lakes

Chemistry
Habitat
Biology
Aquatic Plants
AIS
<table>
<thead>
<tr>
<th>National Lakes Assessment</th>
<th>Integrated Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Random sample</td>
<td>• All lakes sampled for any reason</td>
</tr>
<tr>
<td>• 1 time sample</td>
<td>• 6 samples over 2 years</td>
</tr>
<tr>
<td>• Reference lakes in Upper Midwest</td>
<td>• Wisconsin water quality criteria</td>
</tr>
</tbody>
</table>
Chemistry & Biology at Deepest Spot

- Chemistry
- Nutrients
- Chlorophyll $a$
- Algal toxins
- $E. \ coli$
- Fish eDNA
- Phytoplankton
- Zooplankton
Habitat & Biology Nearshore

- Macroinvertebrates
- Riparian Habitat
- Shallow Water Habitat
- Human Influences
Aquatic Plant Surveys
Aquatic Invasive Species

- Zebra/Quagga Mussels
- Spiny Waterflea
- Snails
- Riparian Plants
- Aquatic Plants
What we learned about Wisconsin lakes
Trophic Status

- Hypereutrophic: 14%
- Eutrophic: 42%
- Mesotrophic: 34%
- Oligotrophic: 10%

Chl-a (ug/L)
- Oligotrophic ≤ 2
- Mesotrophic >2 - 7
- Eutrophic >7 - 30
- Hypereutrophic >30
ALKALINITY

- Low <15
- Moderate 15-30
- High >30

Low: 56%
Moderate: 12%
High: 32%
CALCIUM

Suitable for crustaceans 27%

Not suitable for zebra mussels 8%

Not suitable for snails or zebra mussels 65%

Not suitable for snails or zebra mussels <5 mg/L
Not suitable for zebra mussels <10 mg/L
Suitable for crustaceans >10 mg/L
COLOR

Clear  16%

Brown  36%

Moderate  48%

SU

Clear   <10
Moderate 10-39.9
Brown   >40
Healthy macrophytes, healthy lakes

**Chemical**
- Nutrient cycling
- Oxygen/CO$_2$

**Physical**
- Hydrodynamics
- Stability

**Biological**
- Habitat
- Food web
Over half of WI lakes are “very” littoral.

- Limited: 0-33%
- Moderate: 34-69%
- Extensive: 70-100%

Areal extent of littoral zone:

- Limited: 16%
- Moderate: 29%
- Extensive: 55%
Most lakes have extensive vegetation throughout the littoral zone.

### Percent of littoral zone vegetated

- **Very patchy**: < 20%, 13%
- **Patchy**: 20-41%, 10%
- **About half**: 42-59%, 25%
- **Mostly**: 60-89%, 33%
- ** Entirely**: 90-100%, 19%

Gretchen Hansen
Nearly 1/3 of lakes are species-poor, 1/3 are species-rich.

- Species-poor: 29% (Low richness: 24%)
- Species-rich: 34%
- Very rich: 13%

Number of species (richness):
- Poor: \( \leq 5 \)
- Low: 6-10
- Rich: 11-20
- Very rich: >20
Wet meadow

Sedge fen

Sphagnum bog
What are our plant communities like?

- Not Sampled: 14%
- Chara: 14%
- Echinatum: 13%
- Moss: 18%
- Submersed Cosmopolitan: 15%
- Mixed Characid: 5%
- Floating-leaf: 15%
- Isoetid: 6%
Chemical & Biological Condition of Wisconsin Lakes
Nutrients

**TOTAL PHOSPHORUS**
- Most Disturbed: 21%
- Least Disturbed: 54%
- Moderately Disturbed: 25%

**TOTAL NITROGEN**
- Most Disturbed: 9%
- Least Disturbed: 78%
- Moderately Disturbed: 13%
Algae & Algal Toxins

**CHLOROPHYLL A**
- Most Disturbed: 48%
- Least Disturbed: <6.7 ug/L
- Moderately Disturbed: 9%
- Least Disturbed: <6.7 ug/L
- Most Disturbed: >9.6 ug/L

**MICROCYSTIN**
- Not detected: <0.1 ug/L
- Detected: <0.3 ug/L
- Above infant & preschool children limit: 6%
- Above infant & adults limit: 6%
- Below infant & preschool children limit: 21%
- Not detected: 67%

**CYLINDROSPERMOPSIN**
- Not detected: <0.04 ug/L
- Detected: <0.7 ug/L
- Below infant & preschool children limit: 7%
- Not detected: 93%
ATRAZINE

Below health criteria 21%

Not detected 79%

Not detected <0.046
Below health criteria <0.62
Macrophytes respond to anthropogenic disturbance
Most macrophyte communities are in excellent or good condition

General condition assessment
- Excellent: 39%
- Good: 31%
- Poor: 21%
- Not assessed: 9%
Many communities may be experiencing nutrient-related stress.
## Summary of Lake Health Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Moderate/Healthy Lakes</th>
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<tbody>
<tr>
<td>Phosphorus</td>
<td>79%</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>91%</td>
</tr>
<tr>
<td>Chlorophyll $a$</td>
<td>52%</td>
</tr>
<tr>
<td>Algal Toxins</td>
<td>88 - 100%</td>
</tr>
<tr>
<td>Plants: Phosphorus</td>
<td>66%</td>
</tr>
<tr>
<td>Plants: Disturbance</td>
<td>79%</td>
</tr>
<tr>
<td>Atrazine</td>
<td>100%</td>
</tr>
</tbody>
</table>
Results yet to come...

- Fish eDNA
- Dissolved gases – $\text{CO}_2$ & $\text{CH}_4$
- Phytoplankton
- Zooplankton
- Sediment contaminants
- Macroinvertebrates
- Lakeshore habitat
- Aquatic Invasive Species
Conclusions

• Wisconsin lakes are varied and diverse
• Most lakes are in good health
• Nutrient pollution is a common stressor
• Other pollutants rarely exceed advisories
• Randomized studies reveal the rich nature and current condition of Wisconsin Lakes
THANKS!

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EPA
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