The 2007 National Lakes Assessment

Water Quality, Recreational Suitability, and Ecological Integrity of Lakes and Reservoirs

Approach, Key Findings, and Opportunities for USFS

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Briefing for USFS Workshop

3-2-10

Purpose of this Presentation

- Introduce National Aquatic Resource Surveys
- Provide findings of the first NARS survey of lake water quality.
- Highlight approach and opportunities for USFS.

National Aquatic Resource Survey Initiative

- **Program of recurring national-scale aquatic resource surveys**
- **Report on the condition of the Nation's waters using resource-specific surveys that occur once every five years**
  - Probability Design to ensure unbiased representativeness
  - Meets CWA goal to report attainment status of all waters
  - Partnership with States, Tribes and Federal Agencies
- **Five water resource types**
  - Flowing waters (streams & rivers), lakes, wetlands, coastal estuaries
- **Promote State and Tribal capacity for monitoring and assessment**
  - **Opportunity for state-scale surveys**
  - **Opportunity for Federal Land Management Agencies**
  - **Opportunity for Specific Subpopulations of Interest**
  - **New monitoring approaches and assessment tools**
- **Promote consistency in cross-jurisdictional assessment of water quality**

NARS Survey Field Campaigns

- 2004 – Wadeable Streams Assessment
- 2007 – National Lakes Survey
- 2008 – Nat. Rivers Streams Survey 1/2
- 2009 – Nat. Rivers Streams Survey 2/2
- 2010 – Nat. Coastal Assessment (3rd)
- 2011 – Nat. Wetlands Assessment
- 2012 – National Lakes Survey

National Lakes Assessment

- **Report on the condition of the Nation's Lakes**
  - Statistically valid design that represents the condition of all lakes (similar to stratified random sample)
  - Regional and national estimates of the condition of lakes, option for State-scale estimates or other subpopulations (e.g. National Forests)
  - Use consistent sampling and analysis procedures to ensure the results can be compared across the country

- **Numerous regional and state-scale assessments added to NLA**
  - **(R 10 states, R 1 States, Prairie Pothole Region, VT, NH, OK, MI, MN, WI**

Partnerships within the NLA

- States carried out sampling and/or interacted with Regions and contractors
- Steering Committee of state lakes program staff
- Coordinated outreach of survey design, data analysis approaches, and results via North American Lake Management Society
- Design, Analysis, coordinated by ORD Western Ecology Division (Corvallis, OR)

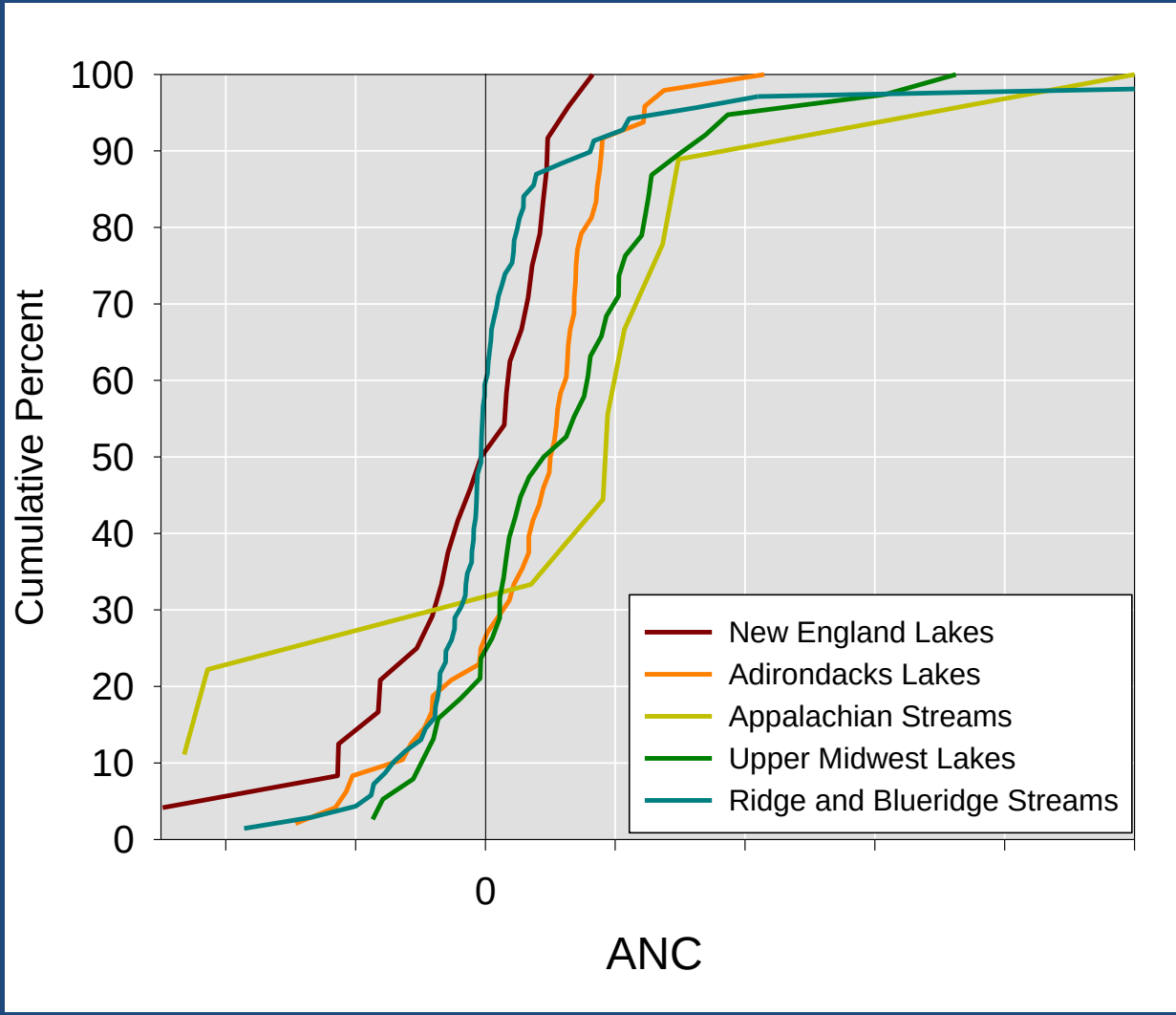
National Lakes Assessment - Effort

- 1,152 unique lakes sampled (lower 48)
- Over 16,000 sites “evaluated”
- Over 3,600 crew person-days
- Over 640,000 survey measurements
- Data analysis team comprised of OWOW, ORD, OST, and Regional scientists.

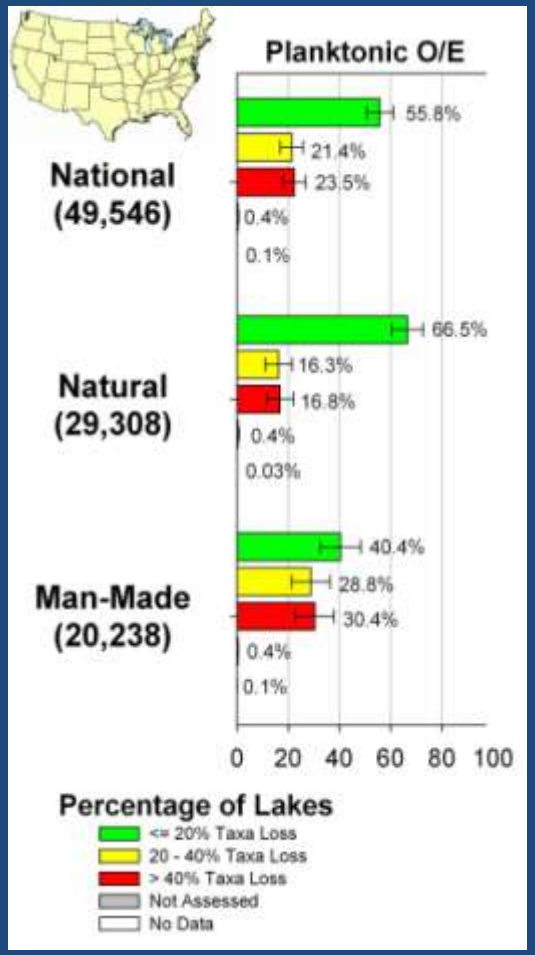
National Lakes Assessment Indicators

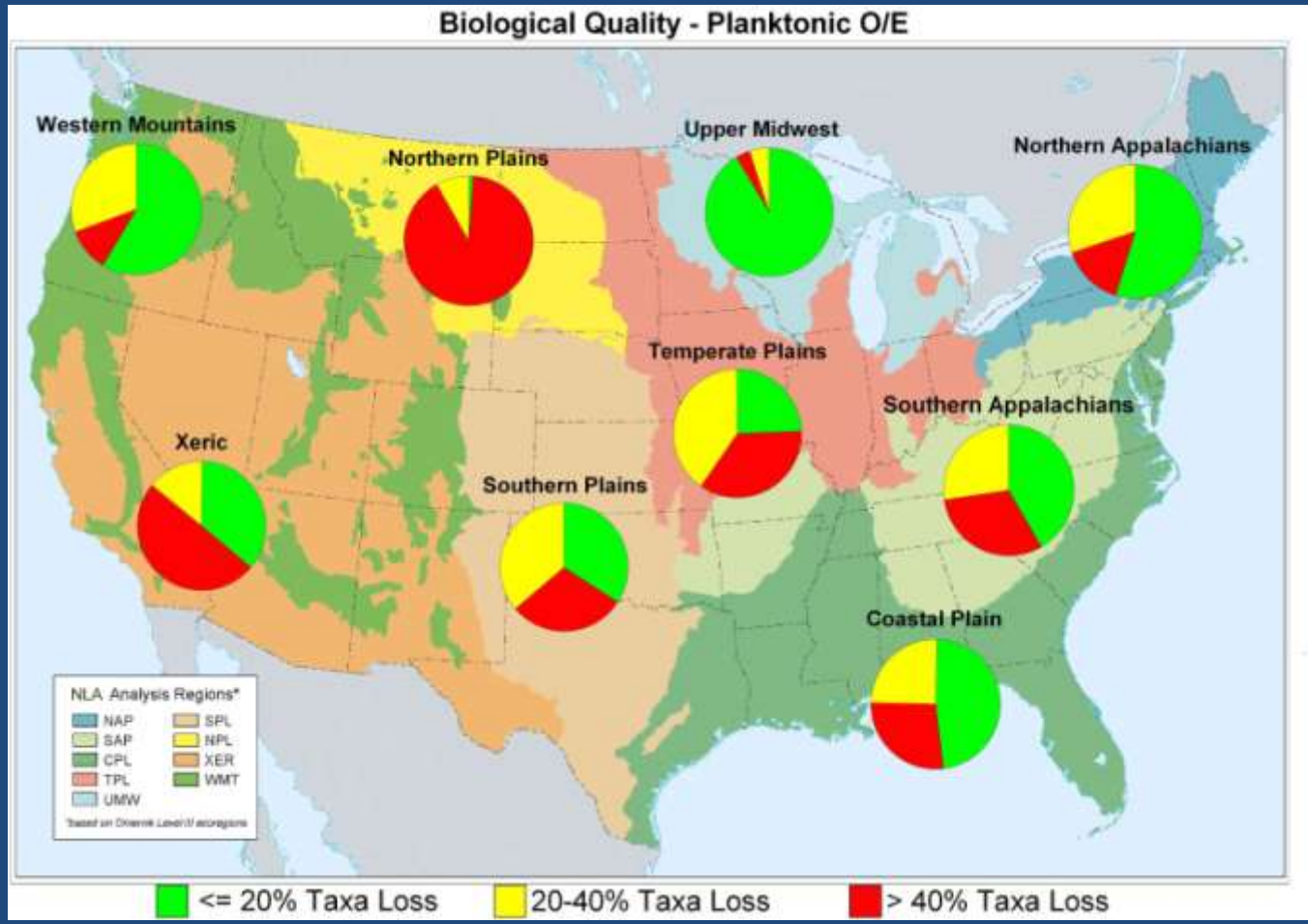
- Biological Integrity
  - Index of Taxa Loss
  - Index of Biotic Integrity
- Chemical Integrity
  - Chlorophyll-a
  - Phosphorus
  - Nitrogen
  - Transparency
  - Anions, Cations
  - ANC
- Stressor Identification
- Recreational Condition
  - Risk of cyanotoxin exposure
  - Occurrence of microcystin
  - Enterococci
- Habitat Integrity
  - Littoral/Riparian Complexity
  - Littoral habitat quality
  - Riparian zone integrity
  - Shoreline disturbance

All Data Backed by Cumulative Distribution Functions

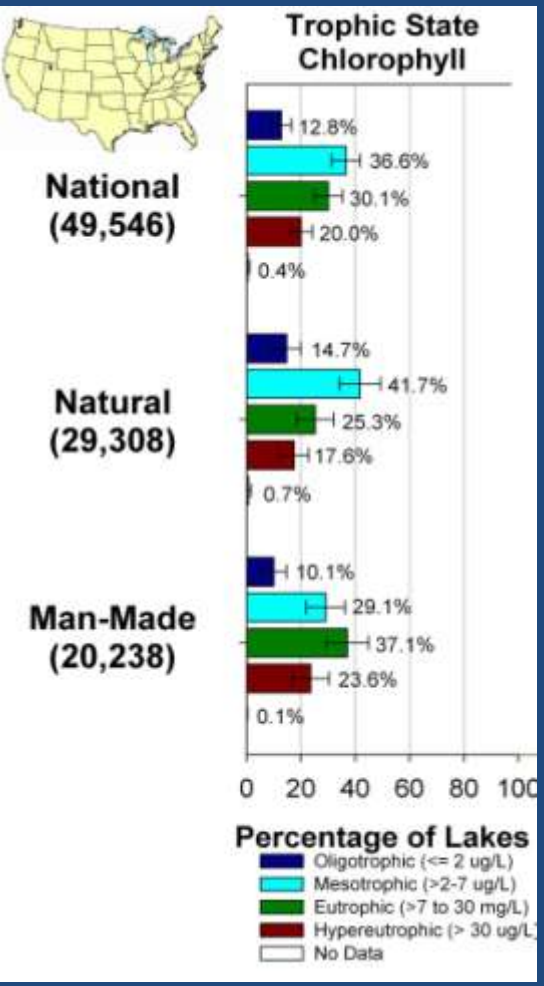


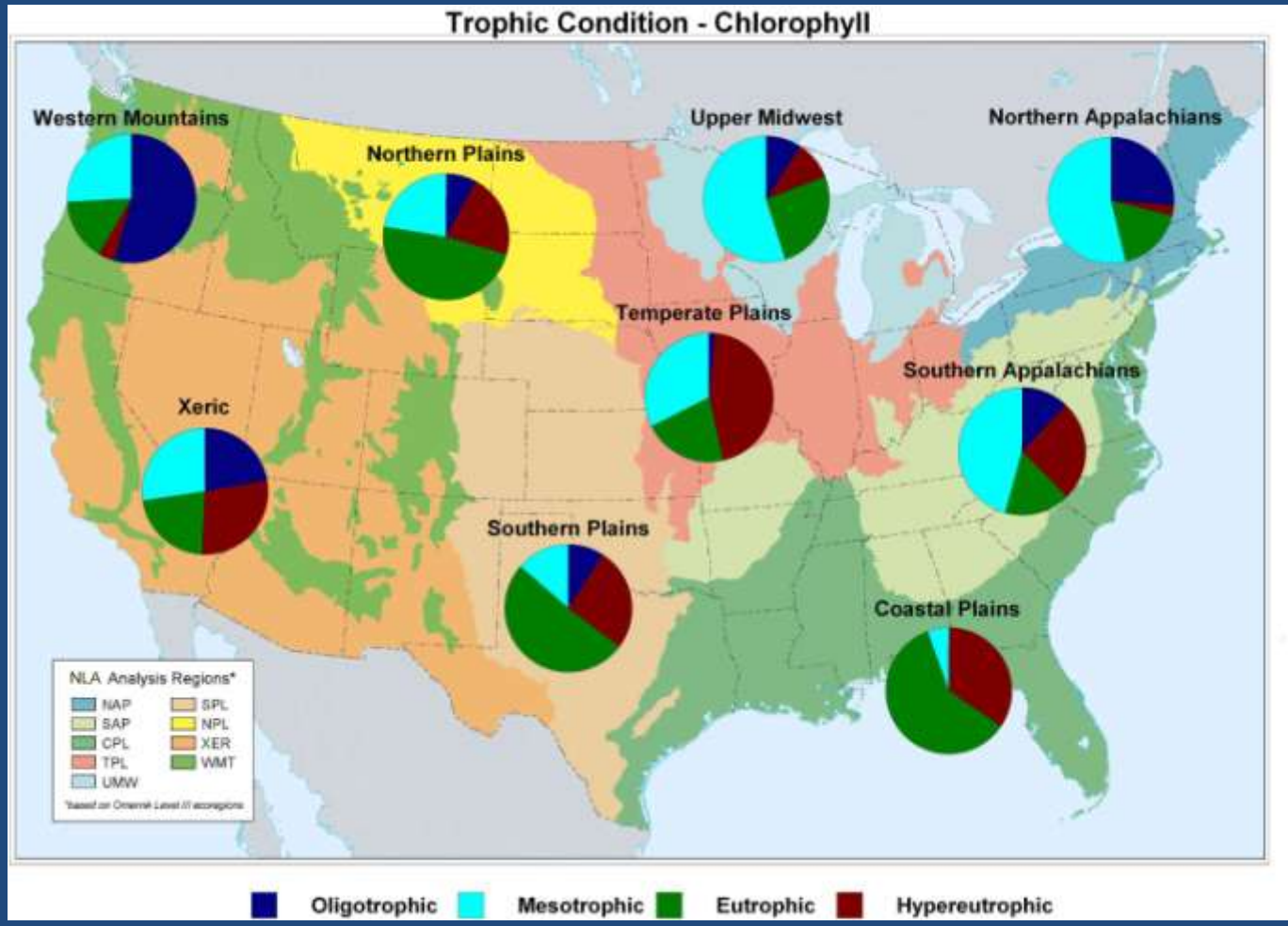
Biological condition of the nation's lakes



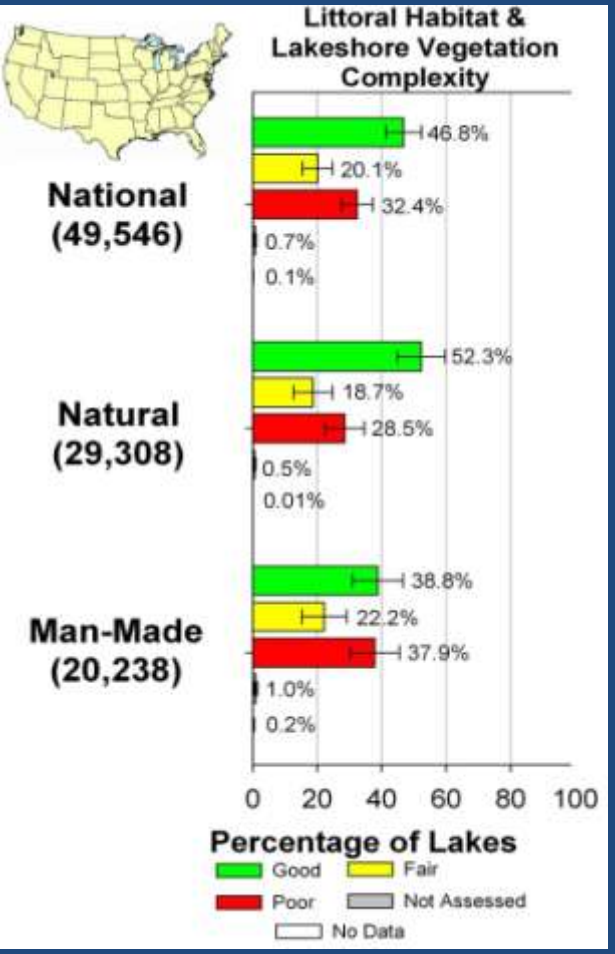


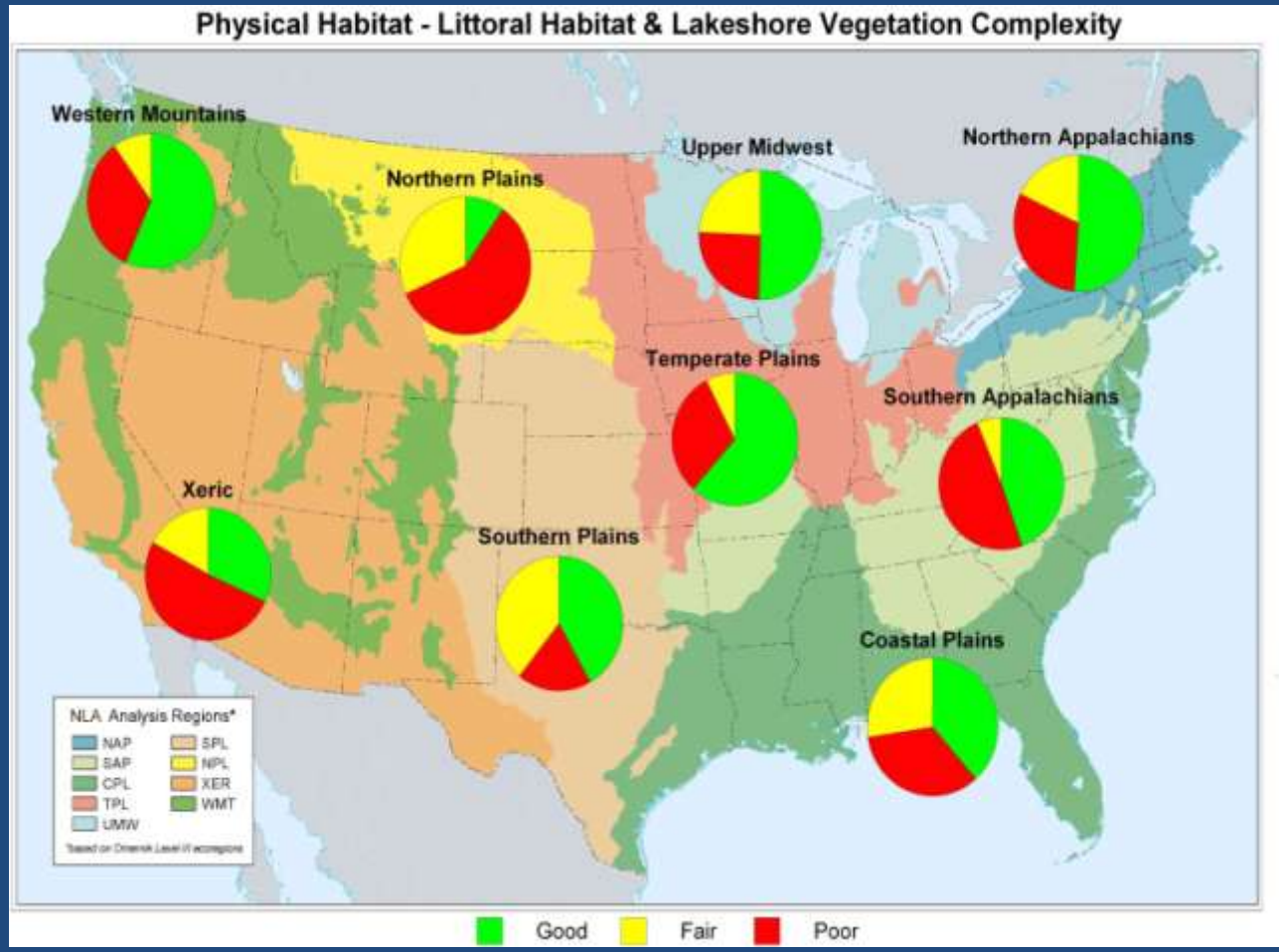
Trophic condition of the nation's lakes





Habitat integrity of the nation's lakeshores

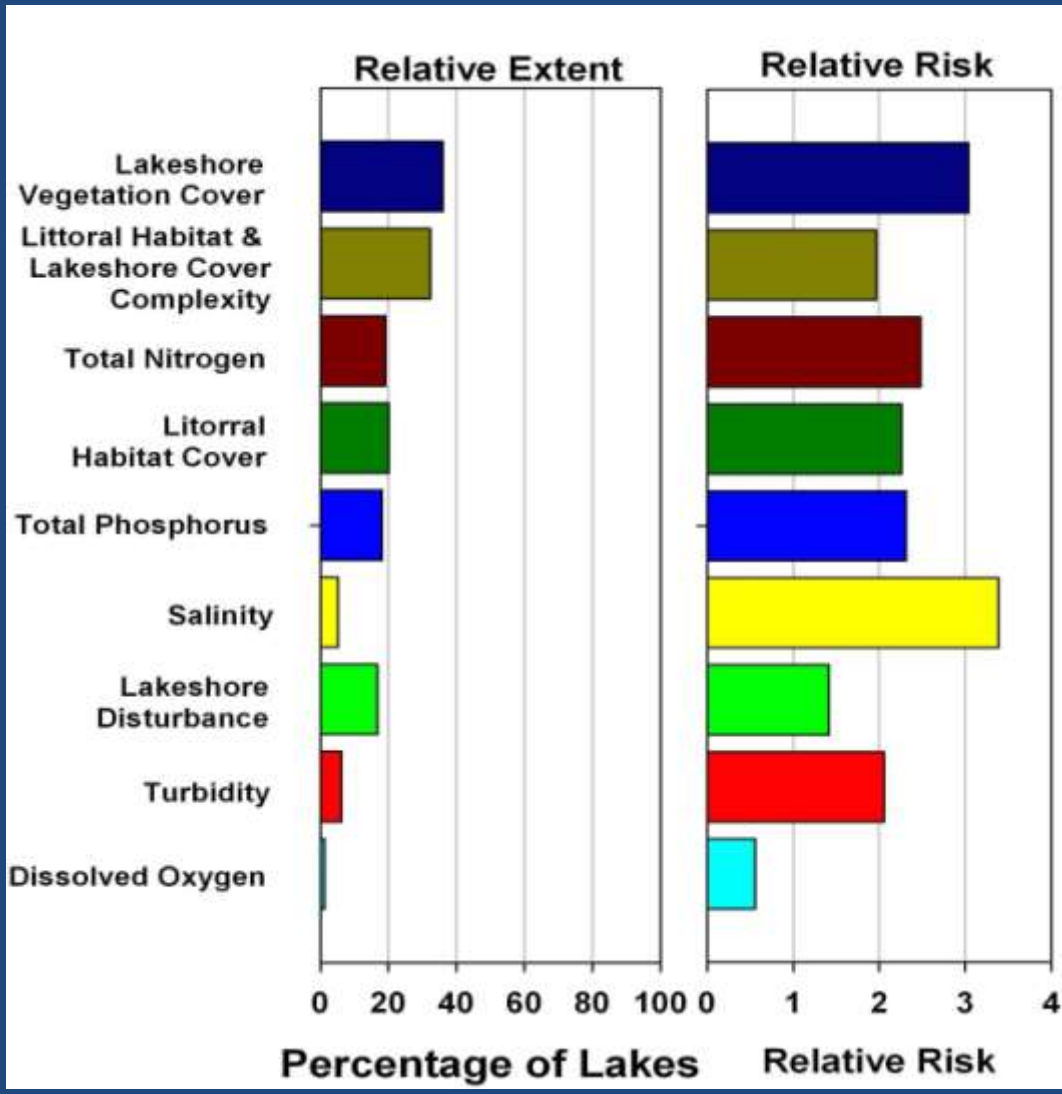




Stressors to biological integrity of the nation's lakes

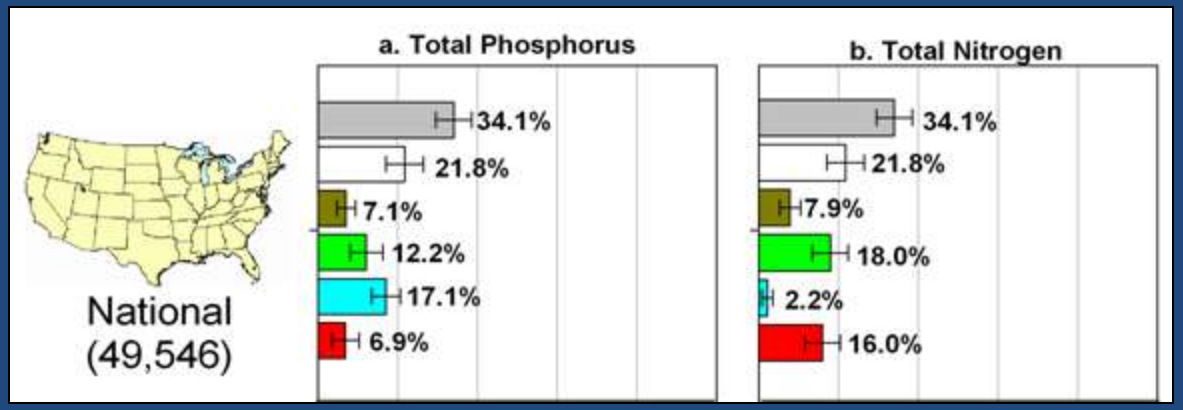
Rel. Extent: Percent of lakes in poor condition

Rel. Risk: Likelihood that biological integrity is poor when stressor is poor

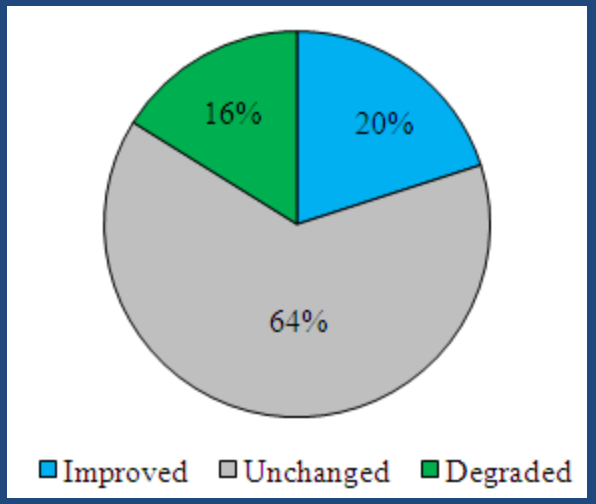


Trends: Sediment diatoms and Nat. Eutro. Survey

Based on sediment diatom inferences, 12% of lakes are improving, and 7% are degrading.



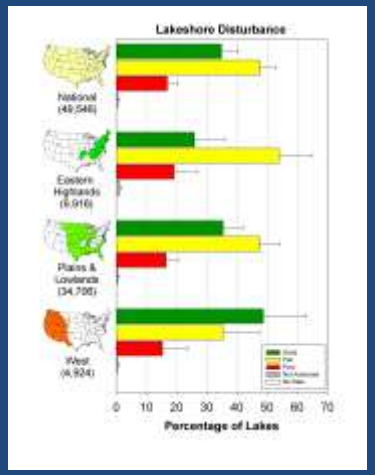
Using the NES→NLA comparison, 20% of NES lakes have improved, while 16% have degraded.



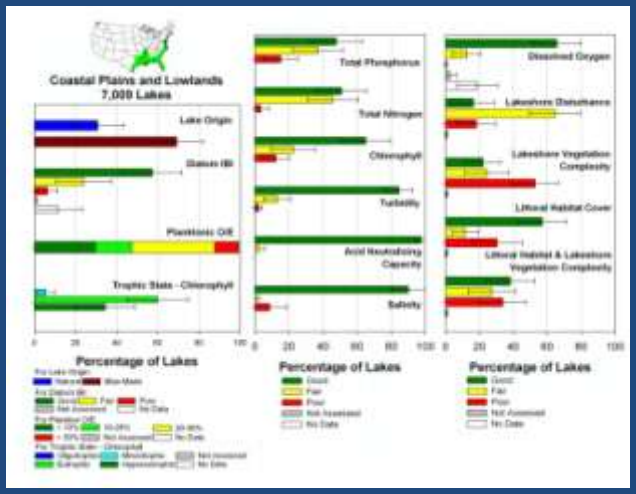
National Lakes Assessment: Report

Intro and design

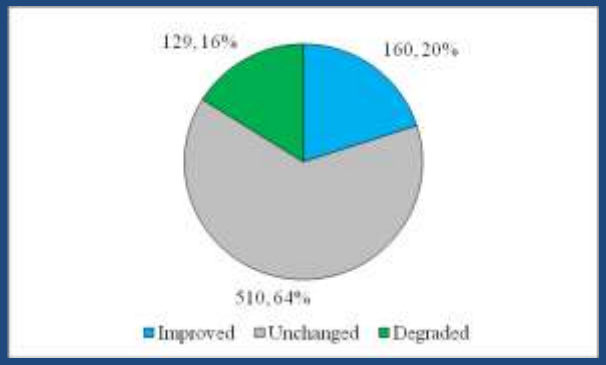
National Findings



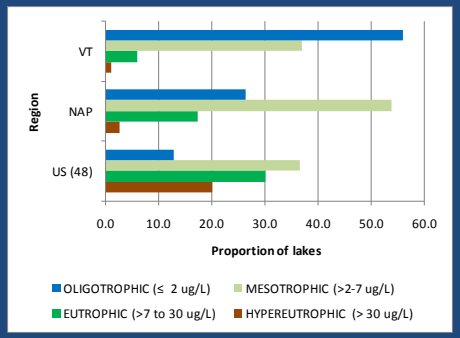
Ecoregional Findings



Change over time



Uses of the NLA Results

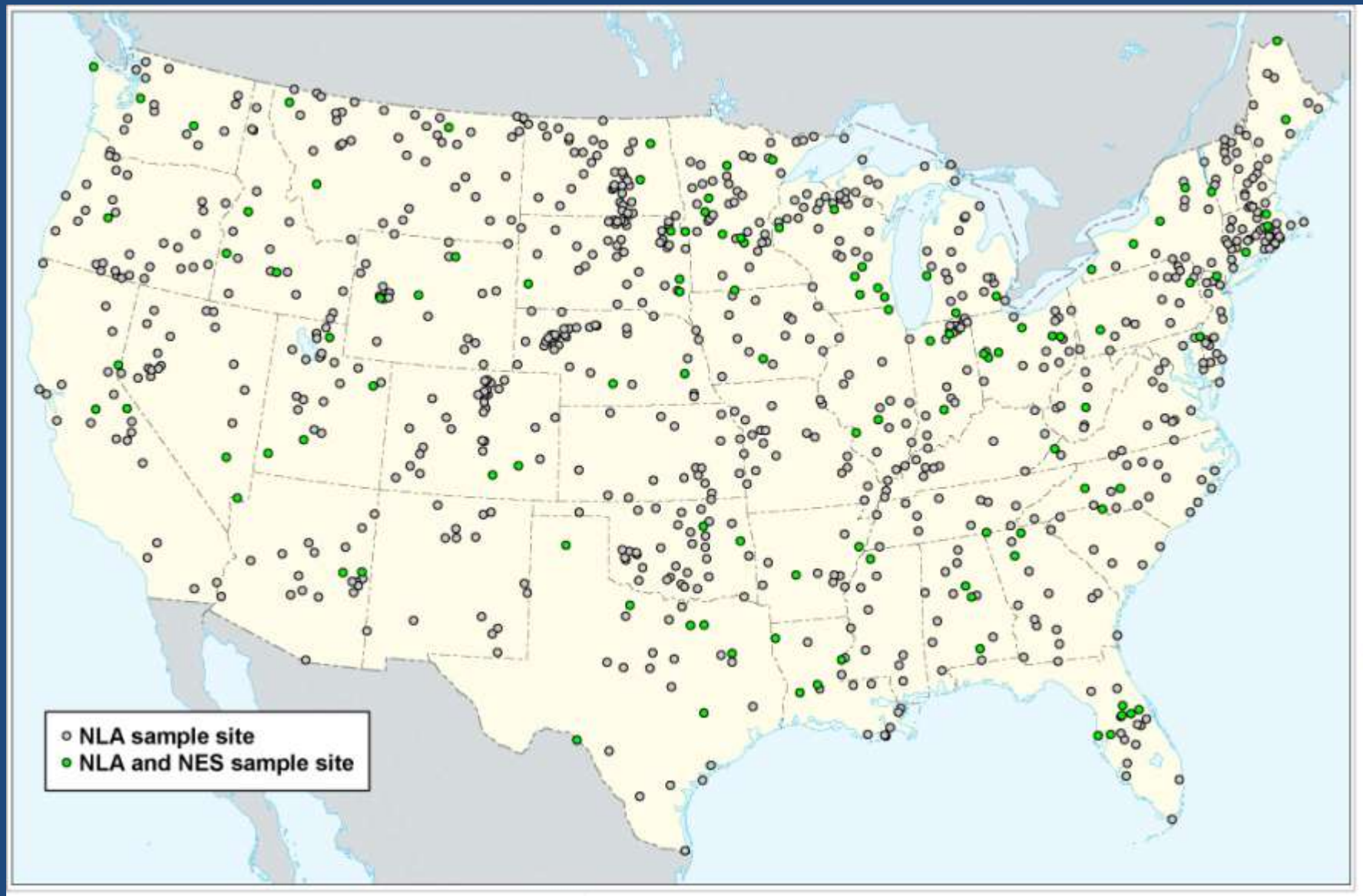


Future challenges –2012

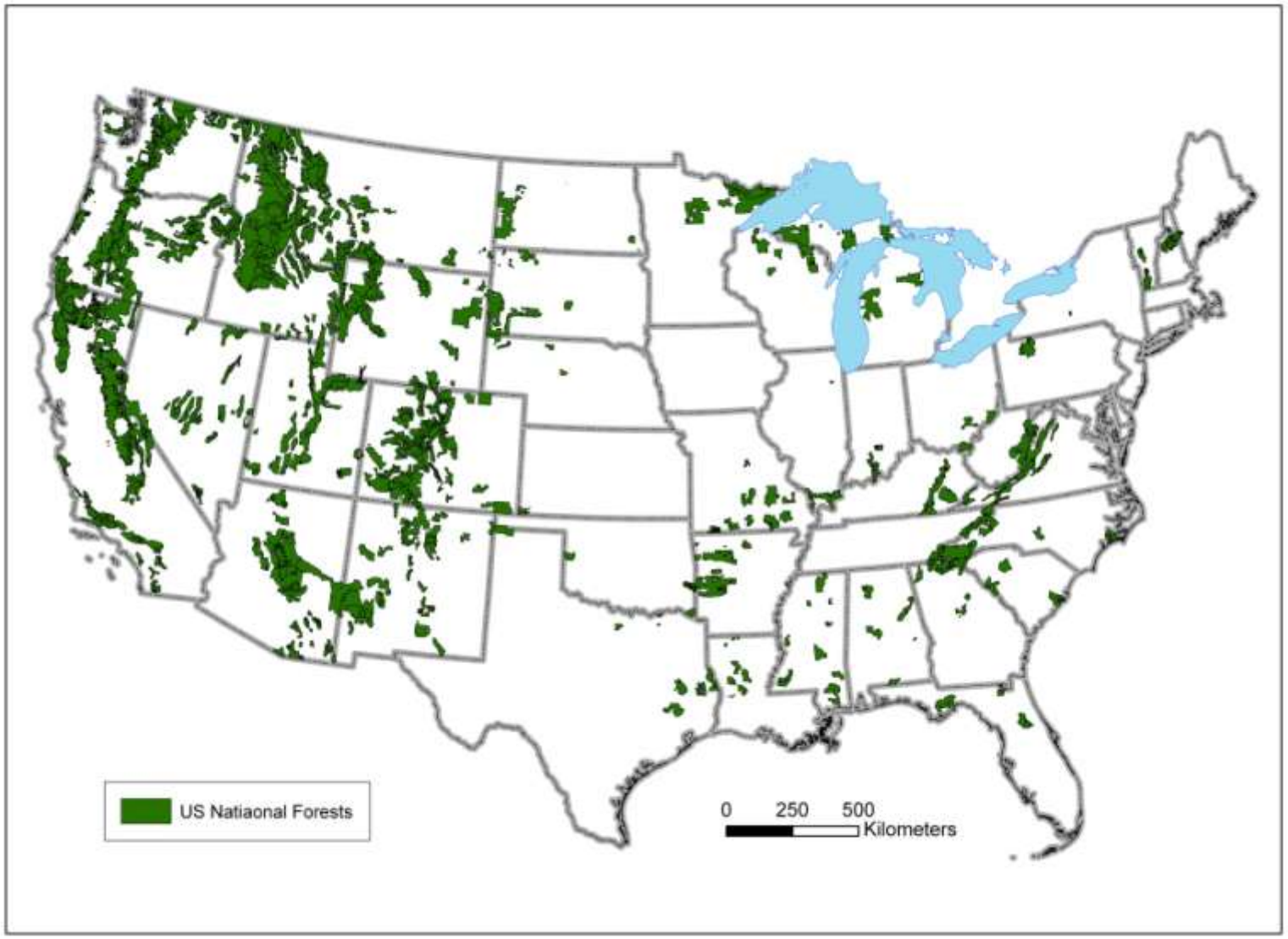
Opportunities for USFS

- Simply use NLA findings for comparison to FS data
- Enhance sample size in NLA for subpopulations of interest to FS:
  - Geographic subpopulations – e.g. lakes on FS land; high elevation western lakes
  - Specific types of problems – e.g. lakes sensitive to acidification

Lakes Sampled in NLA



USFS Land



Lakes on USFS Lands

Source: NHD+

Lower 48	**23,051**
> 1 – 4	12,584
>4 - 10	5,668
>10 - 50	3,709
>50 – 100	521
>100 – 500	480
>500 – 5,000	87
>5,000	2
Eastern US	**10,541**
Western US	**12,510**
Western US < 5,000ft	2,765
Western US > 5,000ft	9,745

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Condition of USFS Lakes

Estimates from NLA

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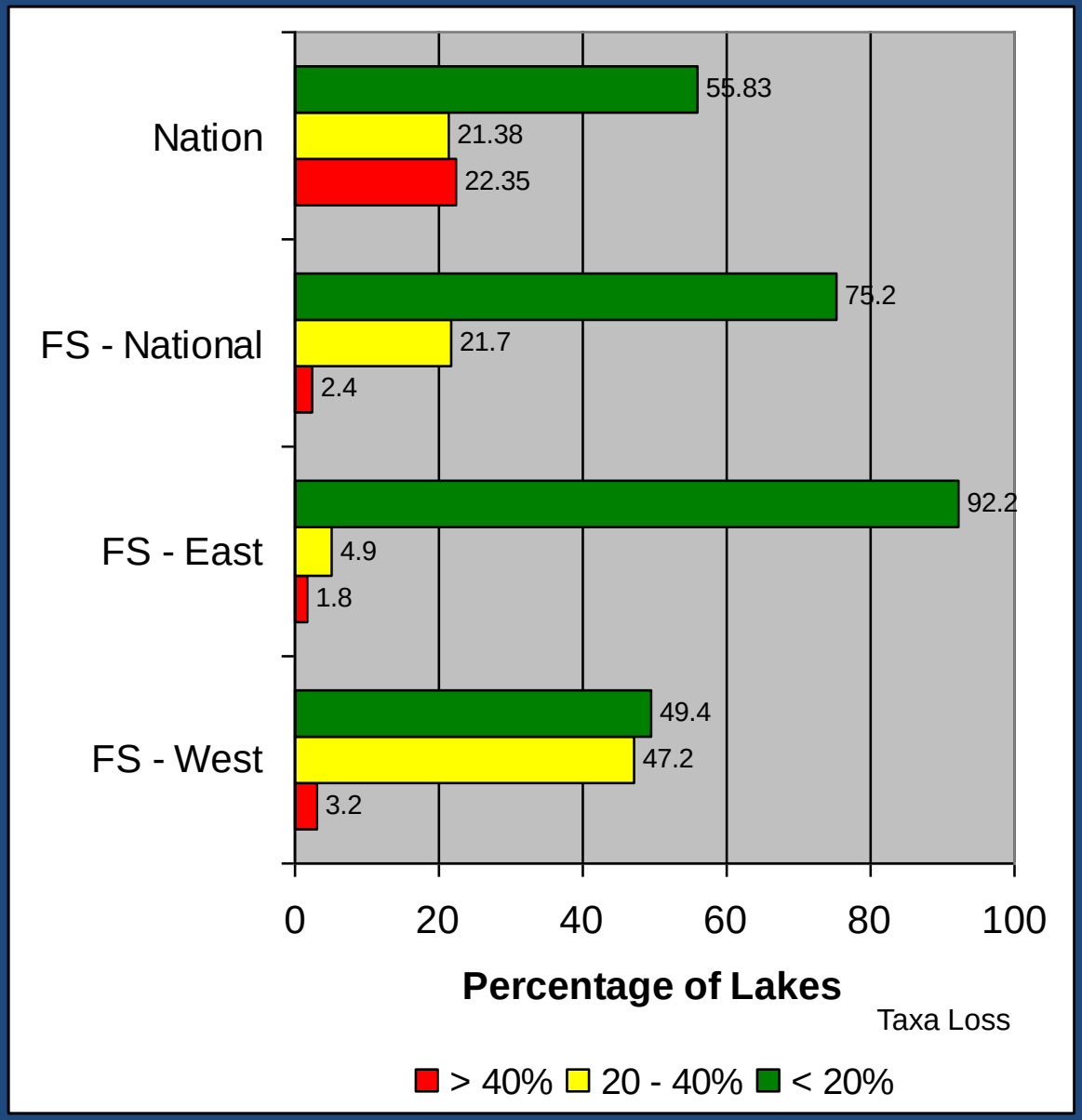
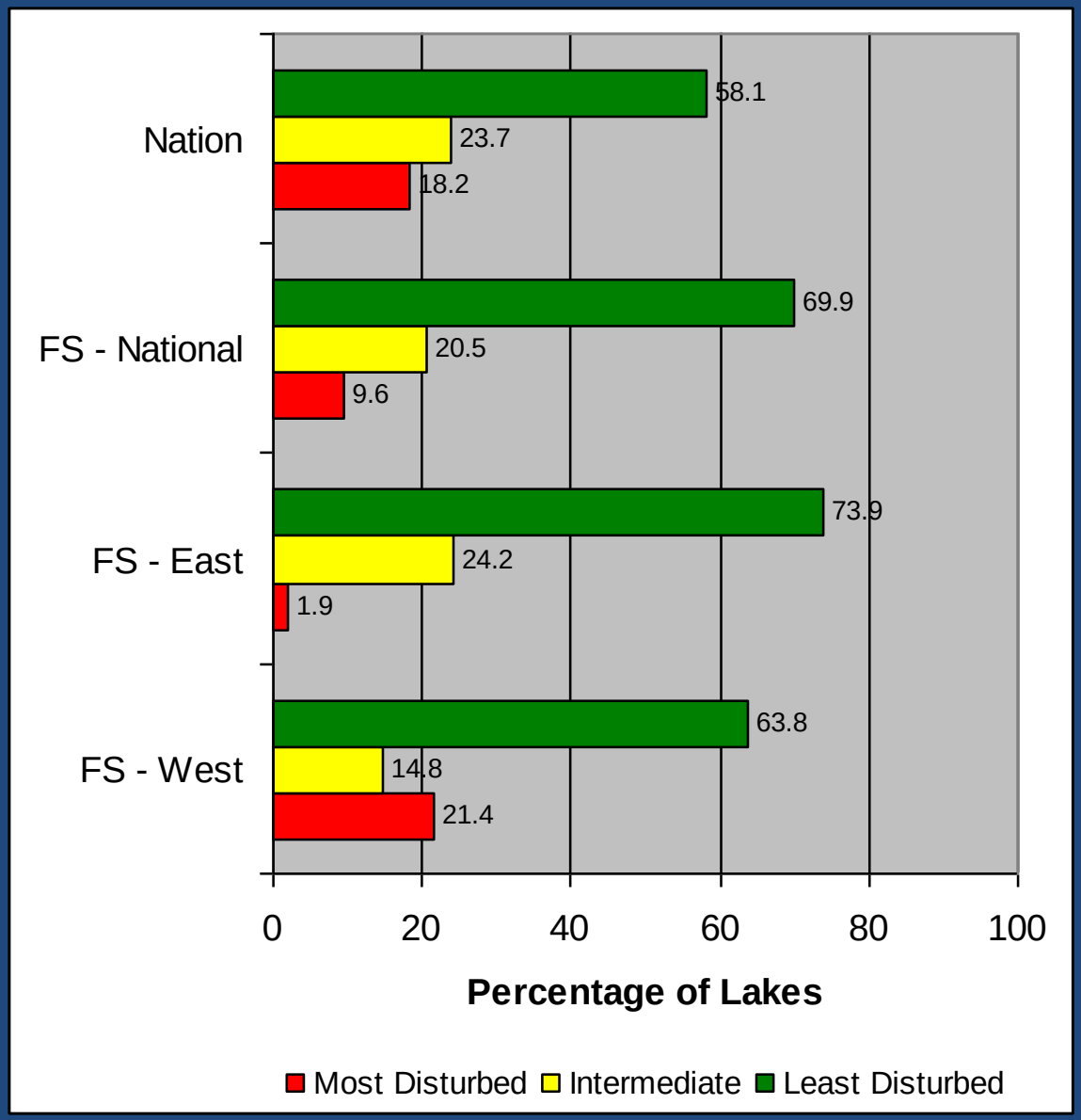
Biological Quality



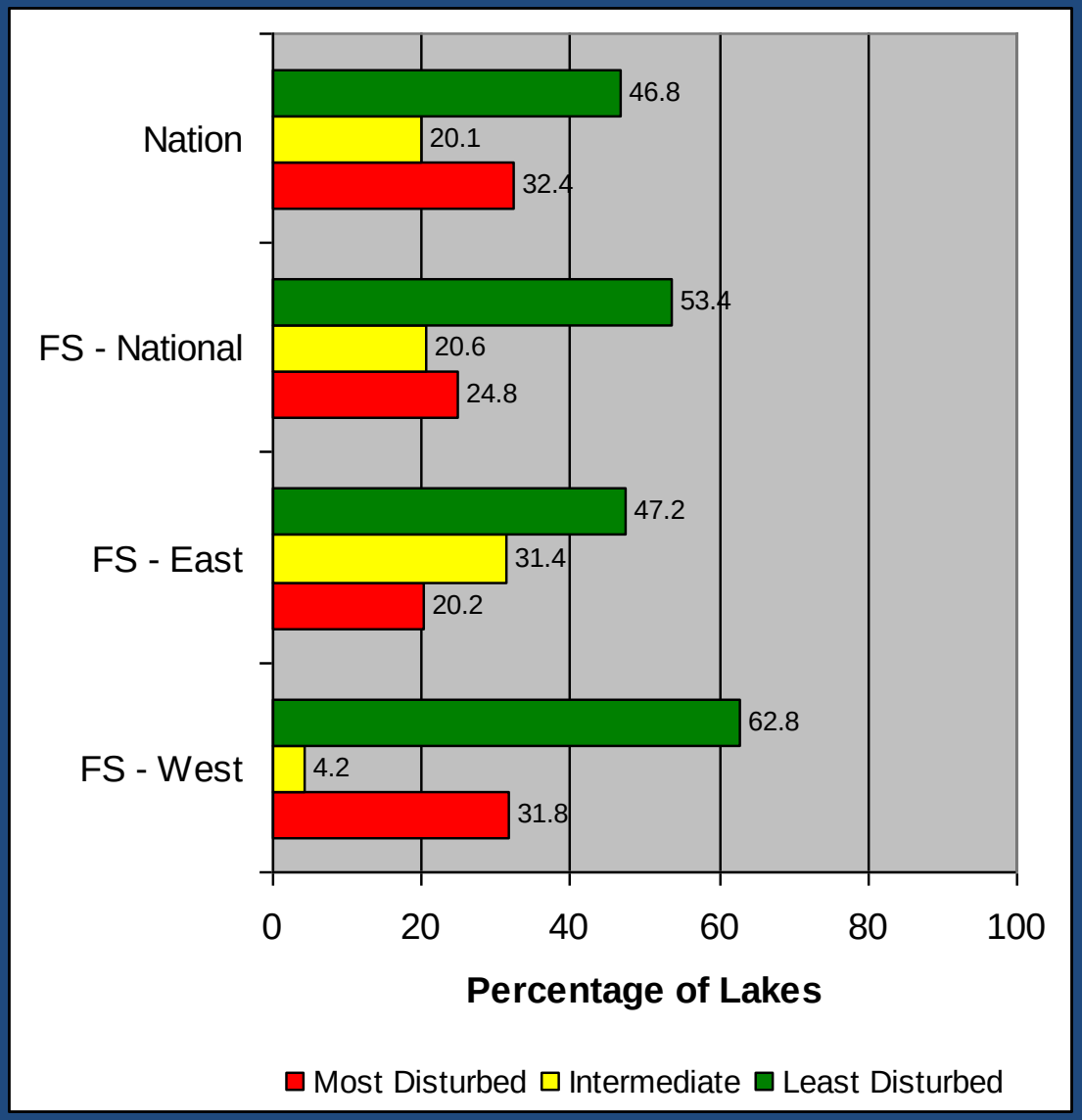
Nutrients

Total Phosphorus



Physical Habitat

Littoral Habitat and Riparian Veg Complexity



Special Interest Subpopulation Acidification

The TIME and LTM Projects: Monitoring to Assess Regulatory Effectiveness for Acidification

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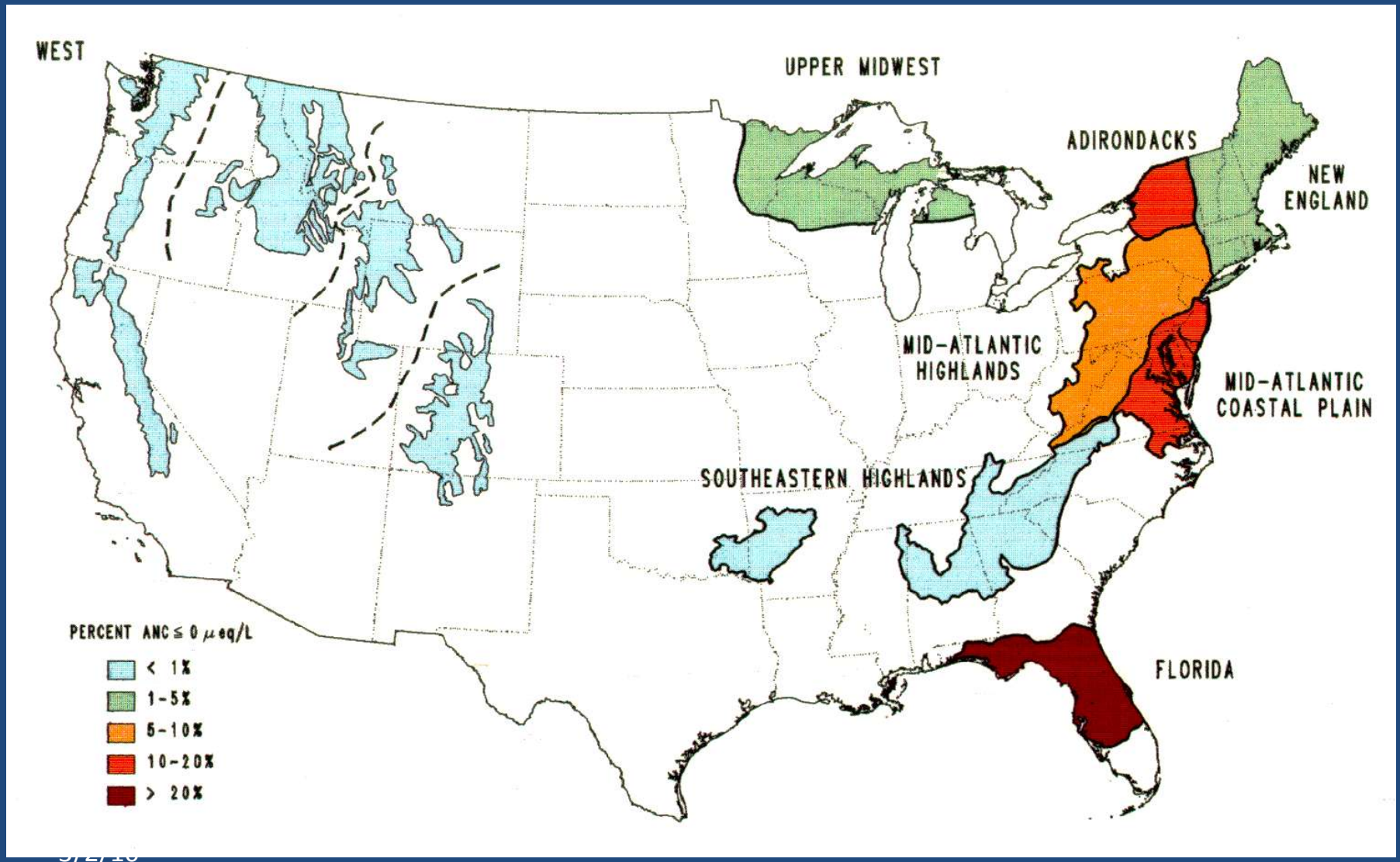
Clean Air Act Amendments of 1990

Goal of Title IV:

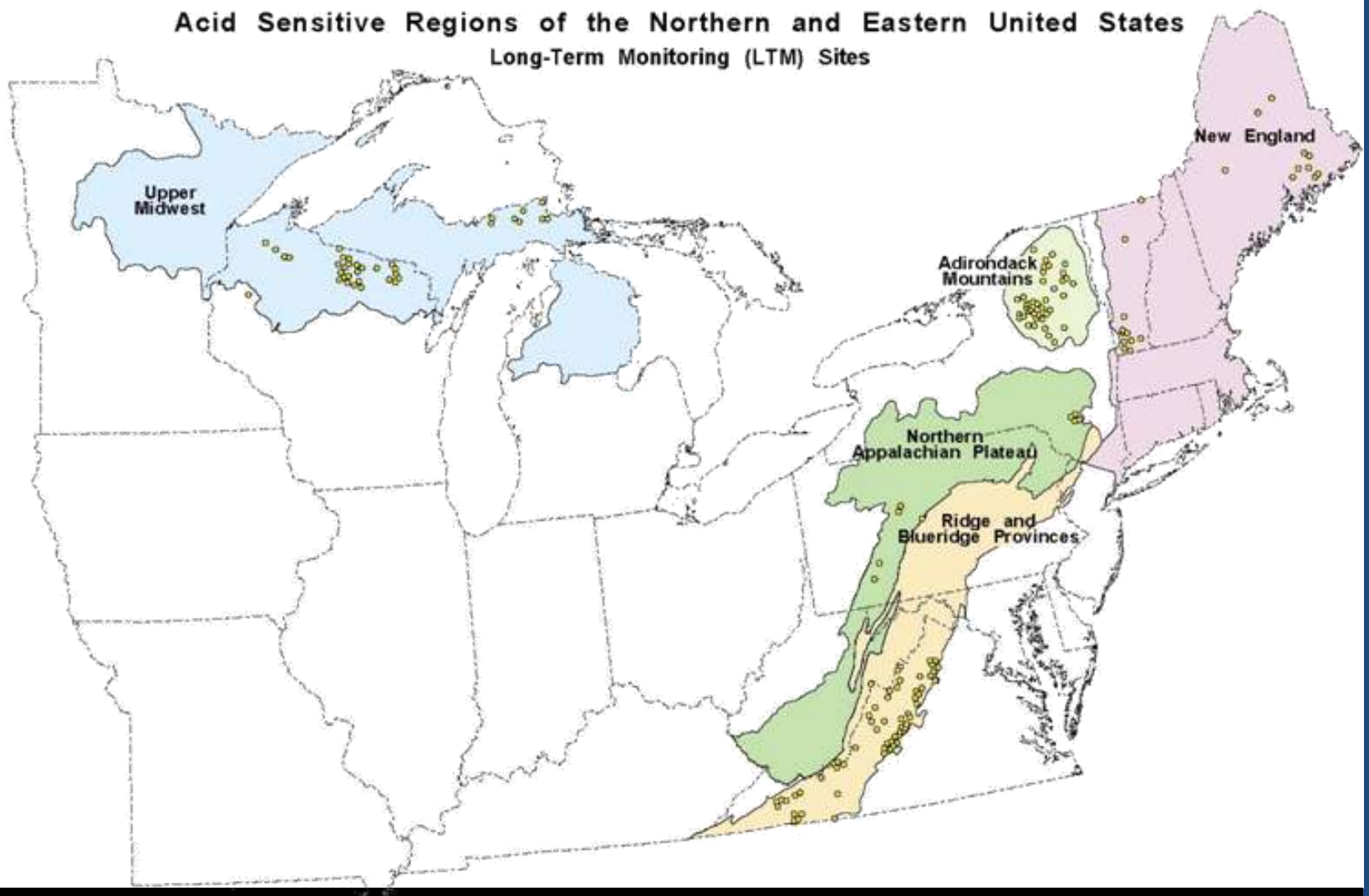
"reduce the adverse effects of acid deposition through *reductions in annual emissions of sulfur dioxide of ten million tons from 1980* emission levels, and of nitrogen oxides emissions of approximately two million tons from 1980 emission levels"

Acidification Status, 1990

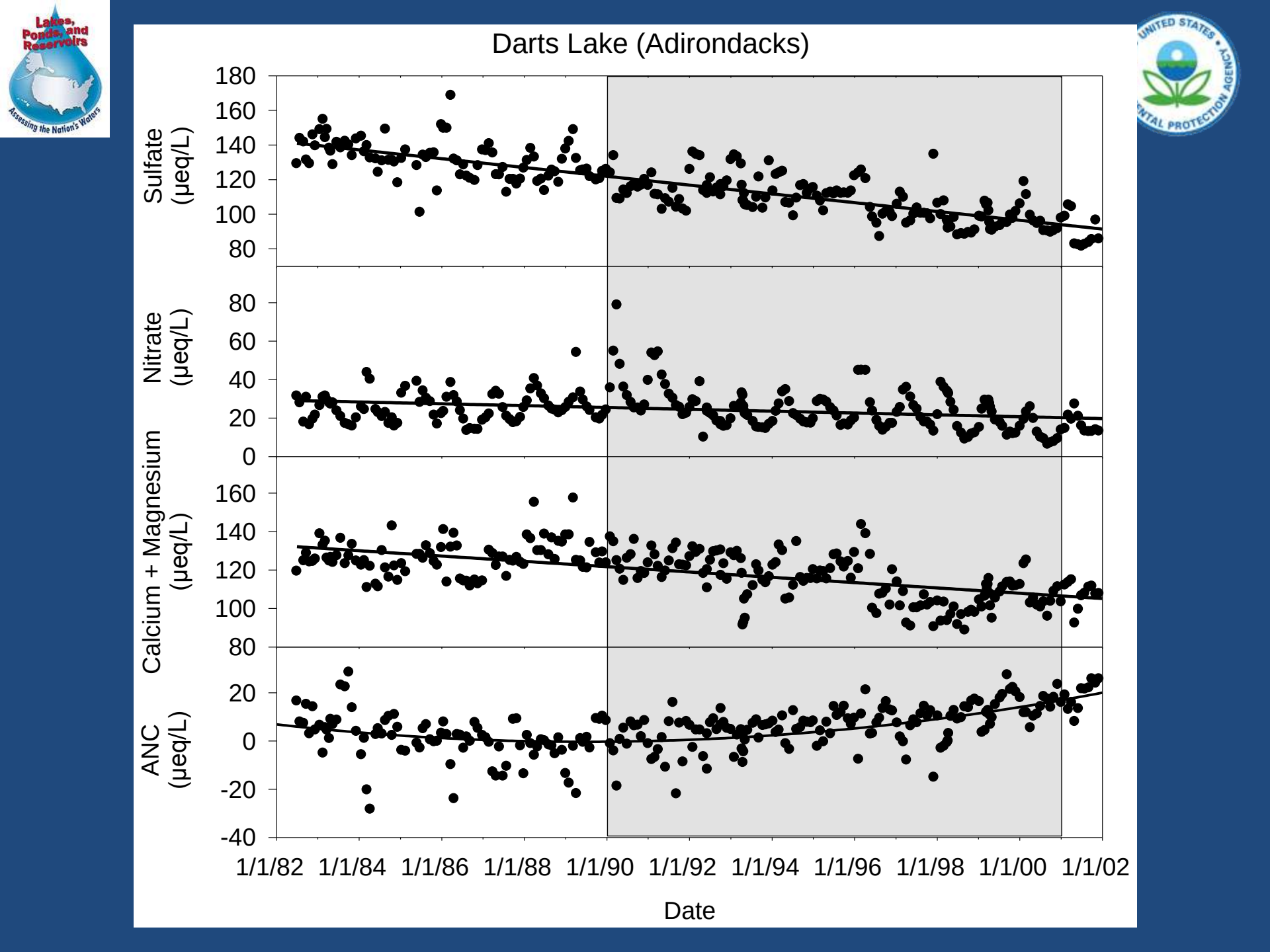
(results from National Surface Water Survey, 1985-88)



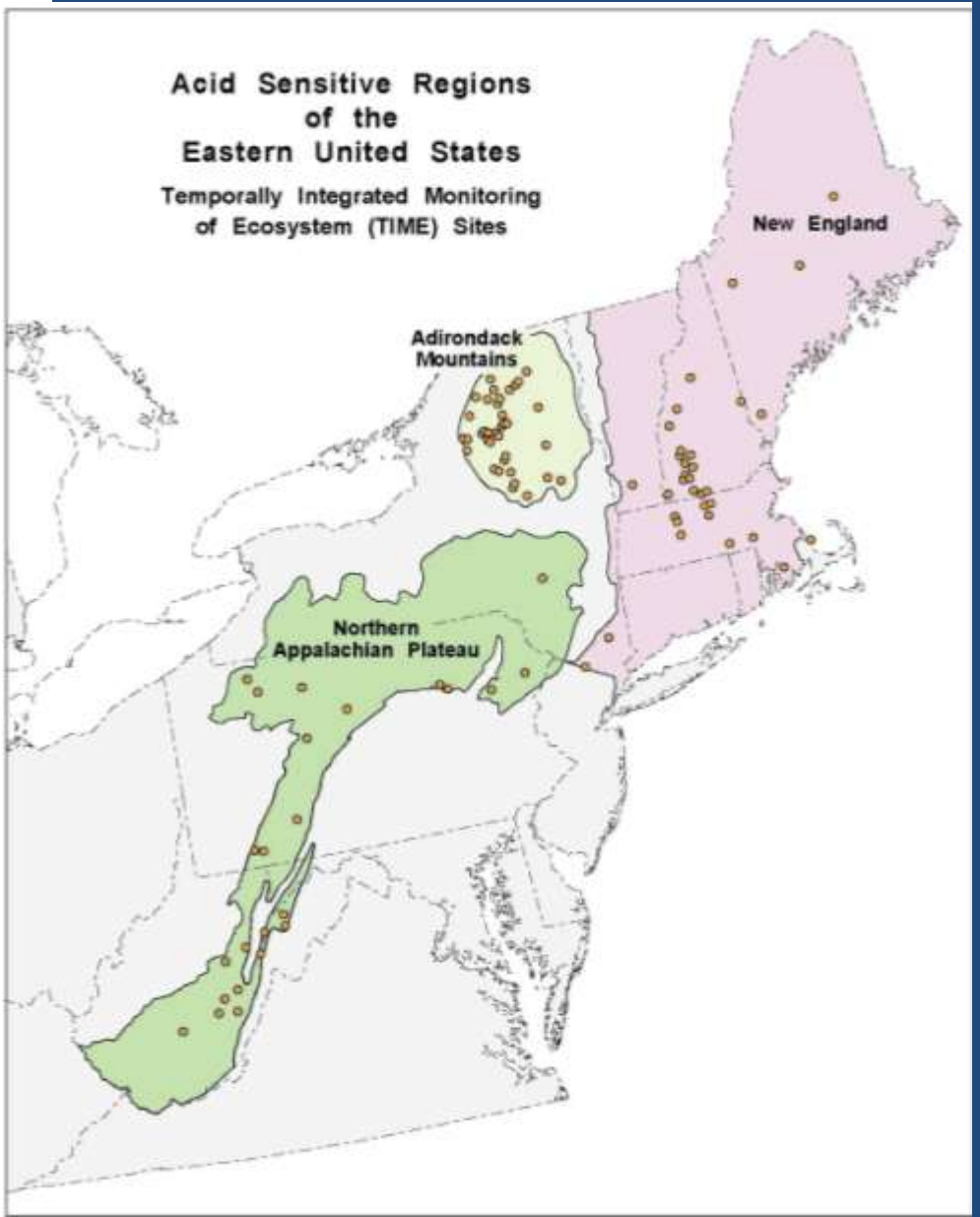
Acid Sensitive Regions - LTM



All sites deliberately chosen – most have data since 1983

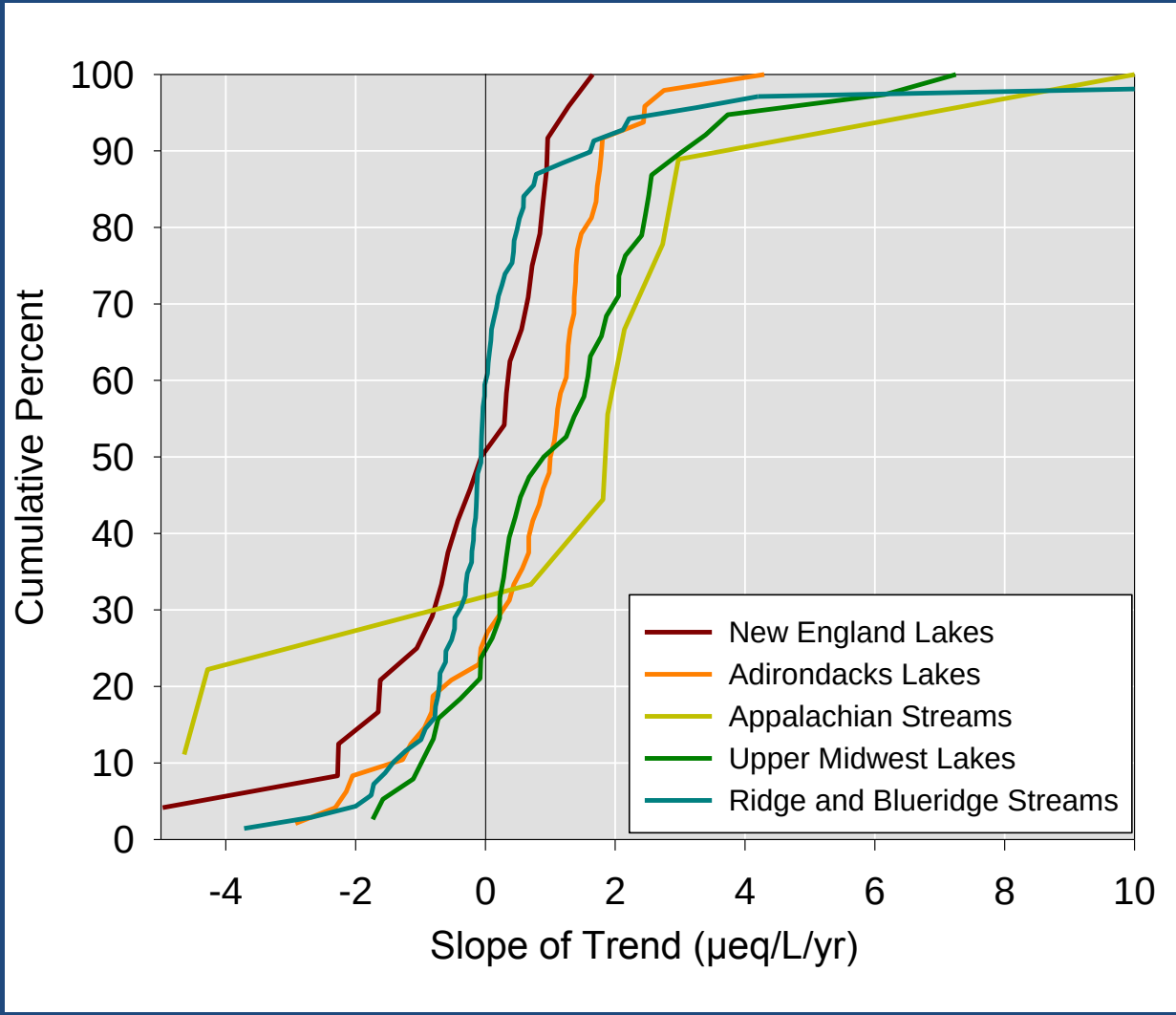

Darts Lake (Adirondacks)
Sulfate (µeq/L)
180
160
140
120
100
80
Nitrate (µeq/L)
80
60
40
20
0
Calcium + Magnesium (µeq/L)
160
140
120
100
80
ANC (µeq/L)
20
0
-20
-40
1/1/82
1/1/84
1/1/86
1/1/88
1/1/90
1/1/92
1/1/94
1/1/96
1/1/98
1/1/00
1/1/02
Date

Acid Sensitive Regions - TIME



- All sites chosen with probability design
- Northeast lake data since 1991
- Mid-Atlantic stream data since 1993

Alkalinity Trends in TIME/LTM Regions



Changes in Populations since CAAA

Region	Population Size	Number Acidic[1]	% Acidic[2]	Time Period of Estimate	Current Rate of ANC change[3]	Estimated Number Currently Acidic	Current % acidic	% Change in Number of Acidic Systems
New England	6,834 lakes	386 lakes	5.6%	1991-94	+0.3	374 lakes	5.5%	-2%
Adirondacks	1830 lakes	238 lakes	13.0%	1991-94	+0.8	149 lakes	8.1%	-38%
No. Appalachians	42,426 km	5,014 km	11.8%	1993-94	+1.0	3,393 km	7.9%	-32%
Ridge/Blue Ridge	32,687 km	1,634 km	5.0%	1987	-0.0	1,634 km	5.0%	0%
Upper Midwest	8,574 lakes	251 lakes	2.9%	1984	+1.0	80 lakes	0.9%	-68%

[1] Number of lakes/streams with Gran ANC<0 in past probability survey (data collected at “Time Period of Estimate”, in column 5)
[2] Percent of population (from Column 2) with Gran ANC<0 in past probability survey (data collected at “Time Period of Estimate”, in column 5)
[3] Based on regional trends presented in this report, in µeq/L/year

Regional Trends in TIME/LTM Regions

Broadly, in surface waters of glaciated terrain :

- SO_4^{2-} decreased at a rate of –2.5 µeq/L/yr
- NO_3^- decreased at a rate of –0.5 µeq/L/yr
- Sum of these changes sets an upper limit to our expectation of ANC recovery of +3 µeq/L/yr
- Gran ANC increase is actually about 1/3 of this, +1 µeq/L/yr
- Difference almost entirely explained by regional declines in base cations; average regional median decline in $[Ca^{2+} + Mg^{2+}]$ = -1.8 µeq/L/yr

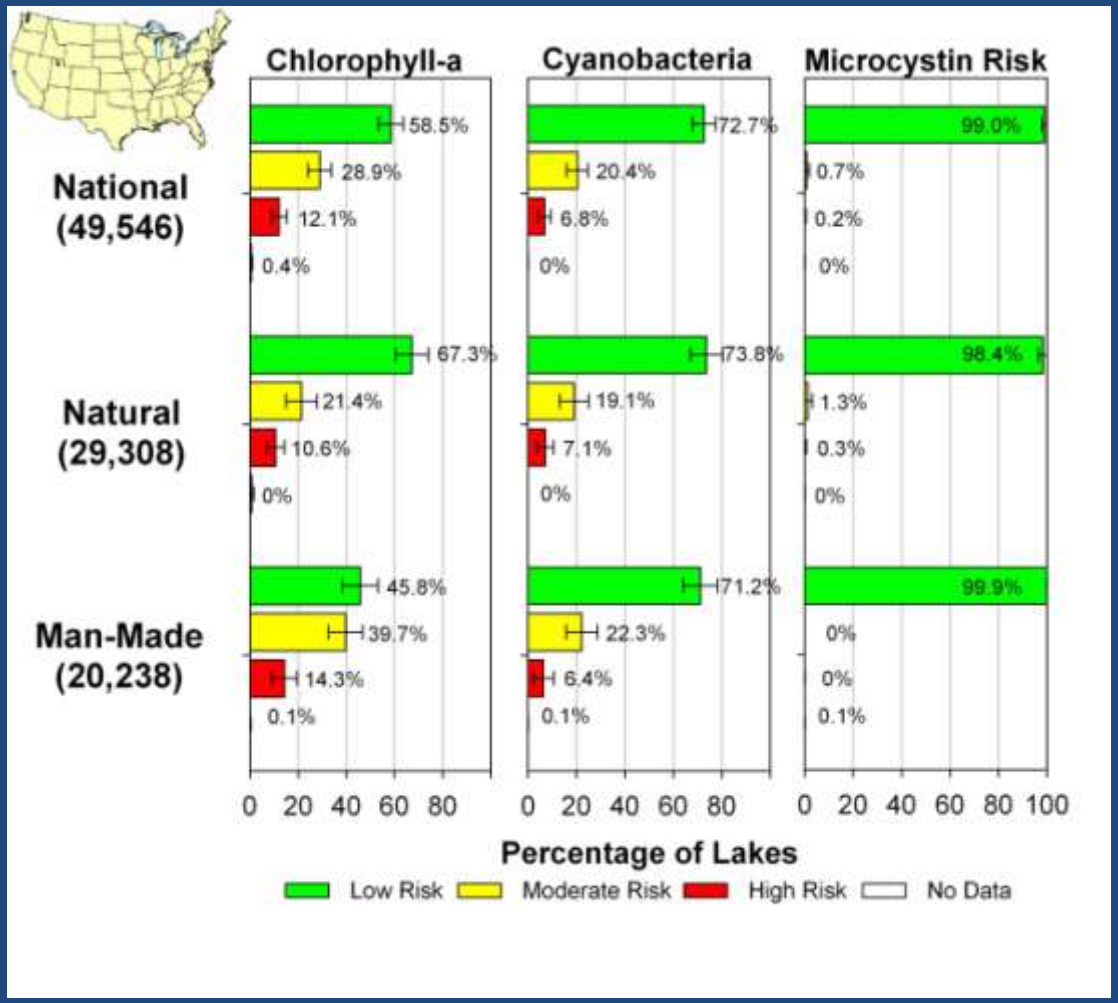
Major Conclusions

1. Large regional declines in surface water sulfate – unquestionably due to CAAA
2. Regional “recovery” (increase in ANC) in two regions with largest proportions of acidic surface waters (Adirondacks, Appalachian Plateau)
3. Ridge and Blue Ridge provinces continue to show lagged response – and no recovery
4. Key uncertainties make prediction of future difficult – base cations, nitrate, organic acids

Conclusions from Presentation

- NLA provides opportunity for cross agency collaboration
- ~ $10M of data available for comparison to FS systems
- Opportunities are there – just requires discussion
- Timing is right – just starting 2012 lake survey planning

Recreational condition of the nation's lakes



National Lakes Assessment: Significant Advances

- First-ever national-scale assessment of lakes of this scale.
- National IBI based on sediment diatoms
- National Taxa Loss model based on plankton
- National perspective on extent of microcystin occurrence
- Consistent assessment of habitat condition
- Support evaluation of nutrient criteria recommendations for lakes

Significant finding – littoral and habitat degradation

- The finding that ***littoral and riparian habitat alterations are the most important stressors*** to biological integrity is consequential.
- Opportunity exists to leverage NLA findings to promote mitigation of cumulative lakeshore impacts at the national, state, and even local level.
- Professional lake community is eager for national-scale findings to support state-scale initiatives to protect lakeshores.