U.S. National Lakes Assessment
2012 Algal Toxin Results

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National Lakes Assessment (NLA) Objectives

Assess the biological, chemical, physical, and recreational condition of lakes, reservoirs and ponds using indicators of condition and stress

- Assess at national and regional scales

- NLA 2007 – baseline status

- NLA 2012 – 2nd round, status and change

- NLA 2017 – 3rd round, in the field now

Rank stressors based on the relative associations between indicators of condition and indicators of stress

Build/ enhance state and tribal monitoring capacity

Sample Design

Targeted design

Focus is usually on specific questions

Allow for detailed analysis of local trends, cause and effect, fate and transport, etc.

Particularly informative about local characteristics

Statistically representative design

Focus is usually on broad questions

Site-selection and data analysis are based on statistical methods

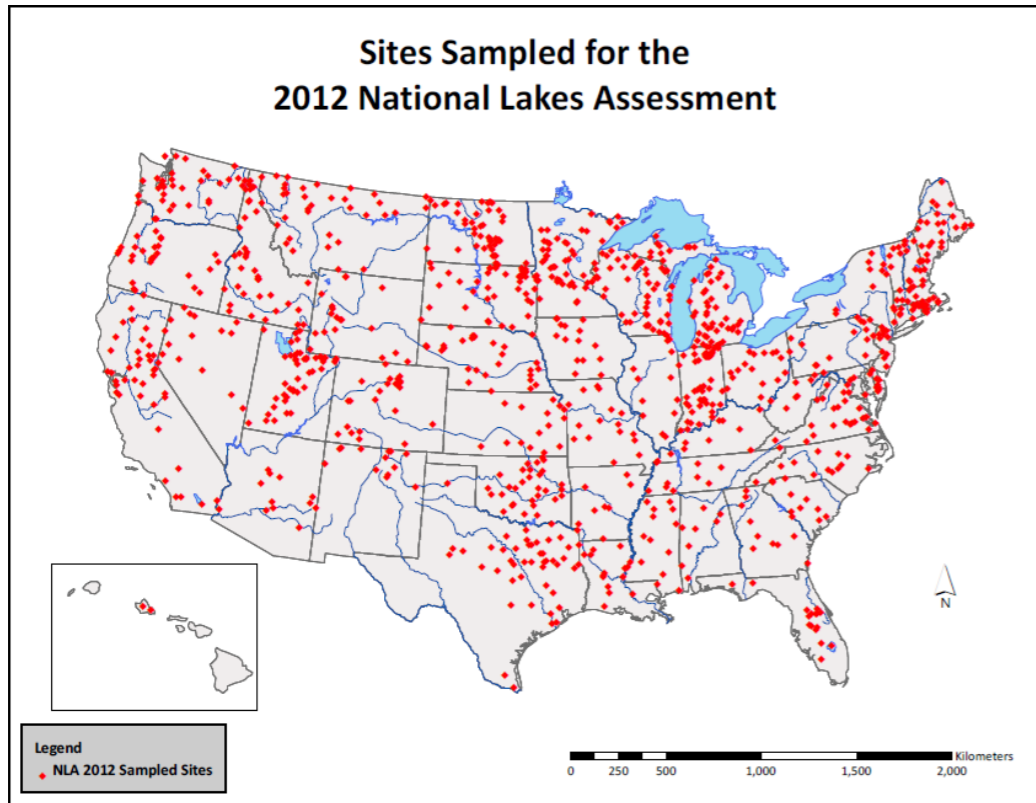Particularly helpful for generalizing to a target population

Example: Estimated population size of Coho Salmon in coastal Oregon

Historic long term monitoring suggested minimal problem

In this case, the historic survey was biased

Probability results more accurately reflect the broader population

Sites Sampled for the
2012 National Lakes Assessment
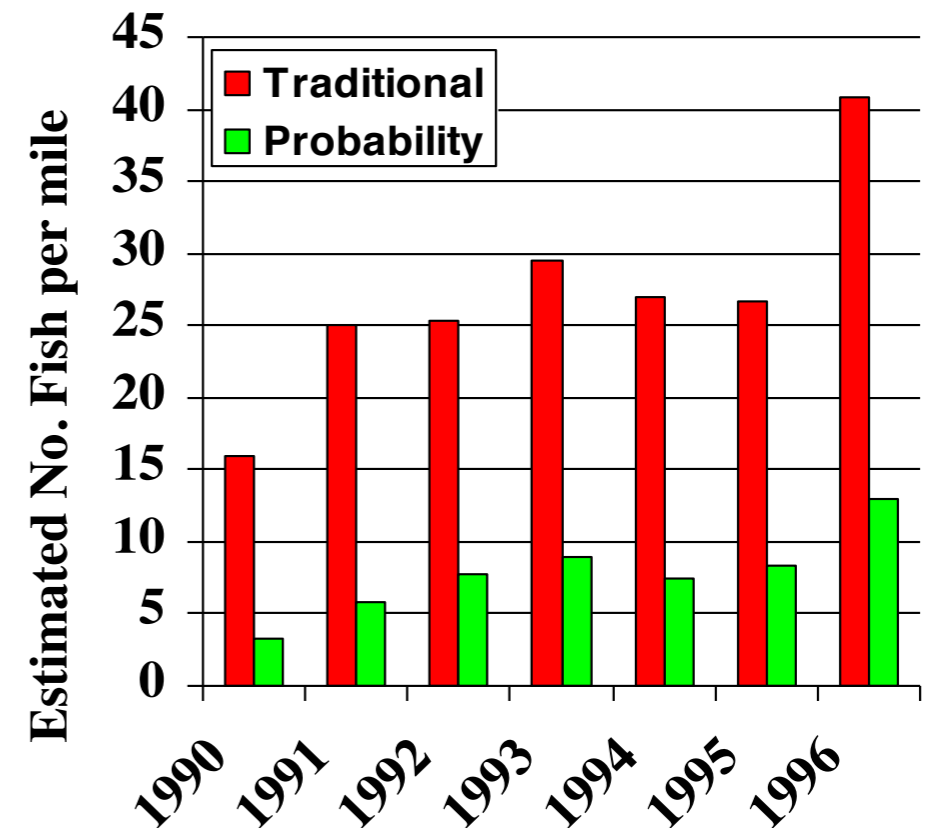
NARS uses a stratified, randomized design, which allows each survey to develop inferences from the sample (e.g., 1,038 lakes) to the population (e.g., 112,900 lakes)

Assessments are not designed to capture short-term temporal dynamics within a lake or peak events

Nationally consistent, co-located data are rare

Unbiased sampling design allows us to objectively identify occurrence patterns

Algal Toxin Risk Questions

1. How widespread is the risk of algal toxin exposure in lakes in the US?
   - Microcystin concentration
   - Cyanobacteria cell density
   - Chlorophyll-a

2. Is there a significant change in the risk of exposure to algal toxins from 2007 to 2012?

3. Does the assessment results change if we collect samples near the edge of a lake?

Algal toxin sample collection and processing

Exposure to algal toxins is one of the factors that affects recreational use of lakes in the US

World Health Organization (WHO) considers 3 metrics in recreation use assessment

Collection

1229 samples on 1129 individual lakes (includes 2 lakes in HI)

Middle, open water location on the lake (index site)

Near shore location on the lake ("J" littoral site)

Integrated water column sample in photic zone (up to 2m deep)

Processing

Microcystin: ELISA analysis run by a national lab (within budget, fast turn-around, congruent with scope of NLA)

Cyanobacteria density: cell enumeration conducted by a national lab

Chlorophyll-a: analysis run by national and state labs
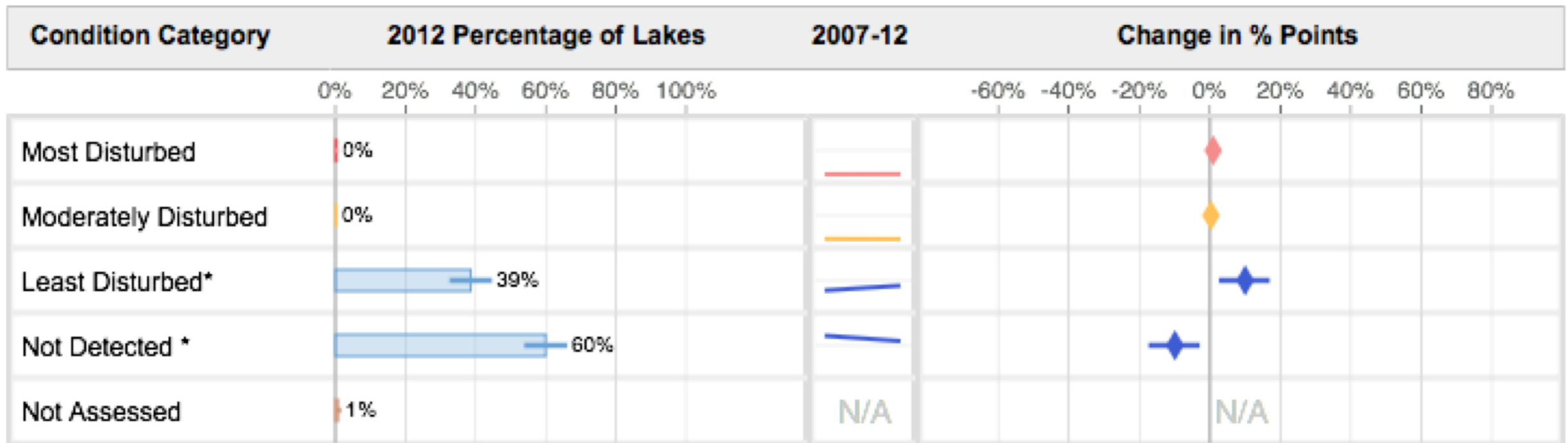
Microcystin (ug/L)

least disturbed <10; moderately disturbed 10- < 20;   most disturbed > 20

Cyanobacteria cell density (cells/mL)

least disturbed <20,000; moderately disturbed 20,000- <100,000;   most disturbed >100,000

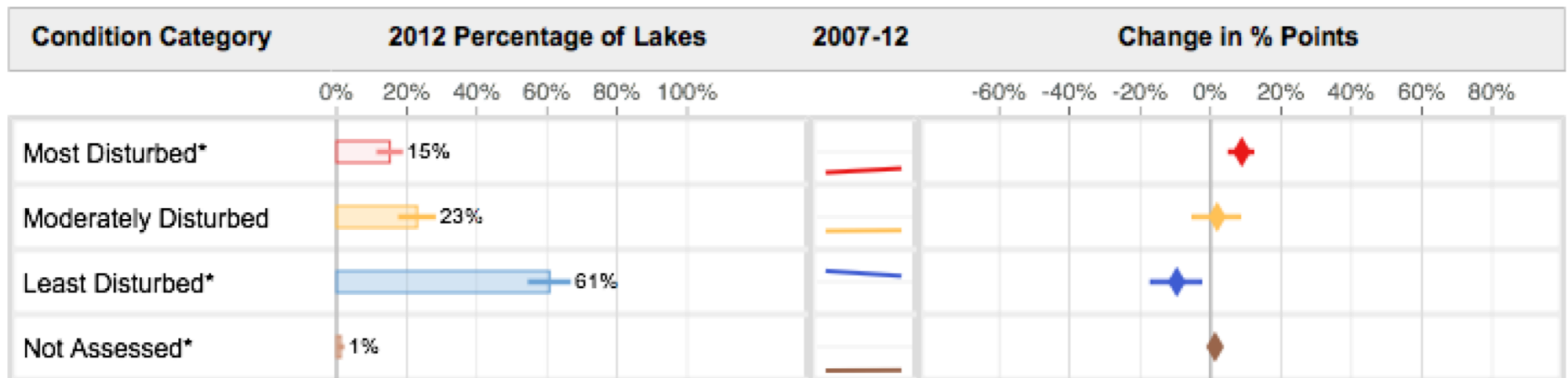# Cyanobacteria cell density (cells/mL)
most disturbed >100,000

U.S. EPA National Lakes Assessment 2012
Percentage of Lakes in Most Disturbed Condition
2012 Estimates and Change from 2007 | WSA9 Ecoregions | Cyanobacteria (Risk)

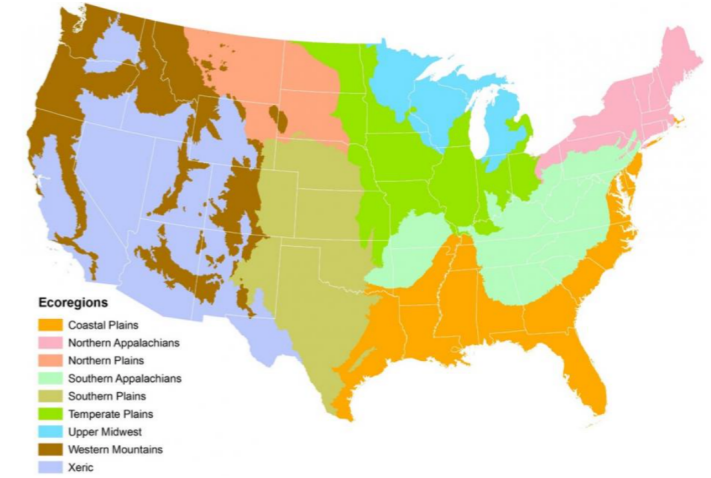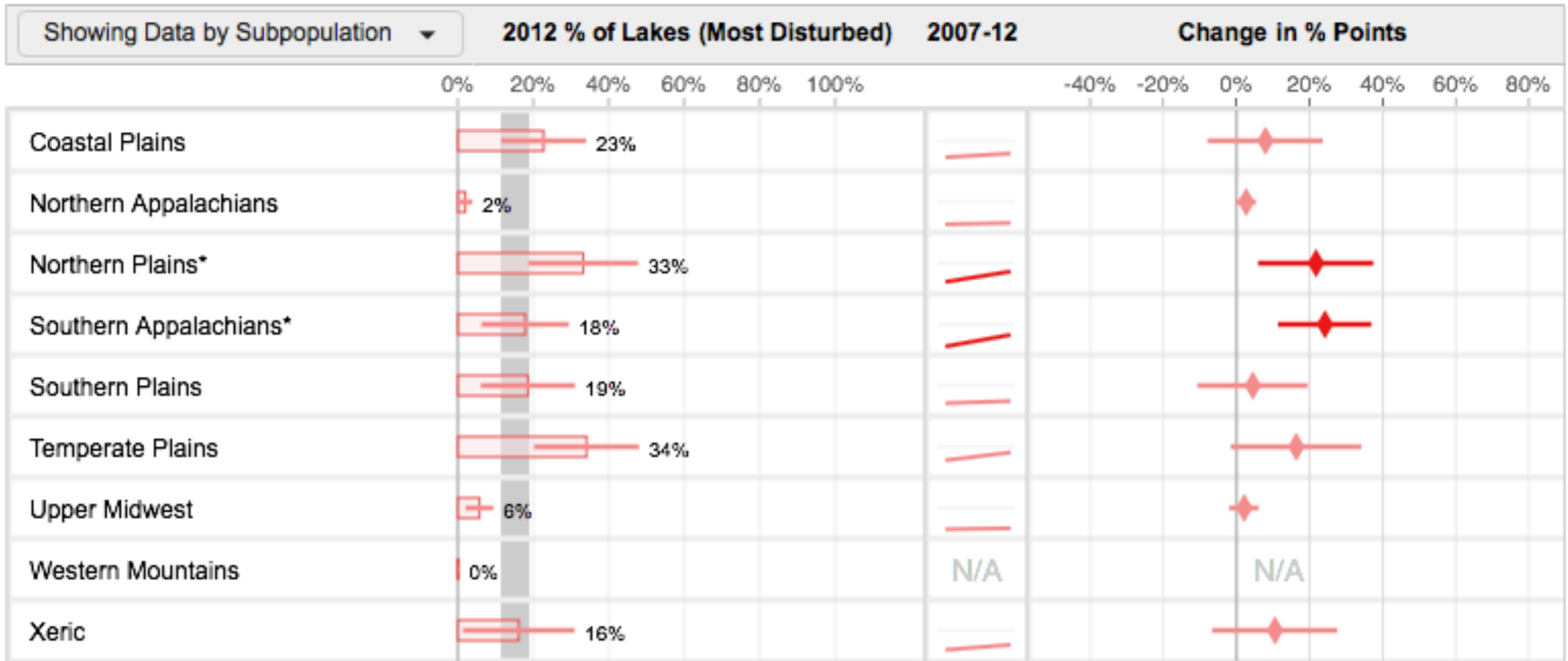| Showing Data by Subpopulation ▼	2012 % of Lakes (Most Disturbed)	2007-12	Change in % Points
Coastal Plains	23%		
Northern Appalachians	2%		
Northern Plains*	33%		
Southern Appalachians*	18%		
Southern Plains	19%		
Temperate Plains	34%		
Upper Midwest	6%		
Western Mountains	0%	N/A	N/A
Xeric	16%		

U.S. Environmental Protection Agency (USEPA). 2016. *National Lakes Assessment 2012: A Collaborative Survey of Lakes in the United States.* Interactive NLA Dashboard. https://nationallakesassessment.epa.gov/

* Reflects a statistically significant change at 95% between 2007 and 2012. Such changes are also indicated using darker colors.
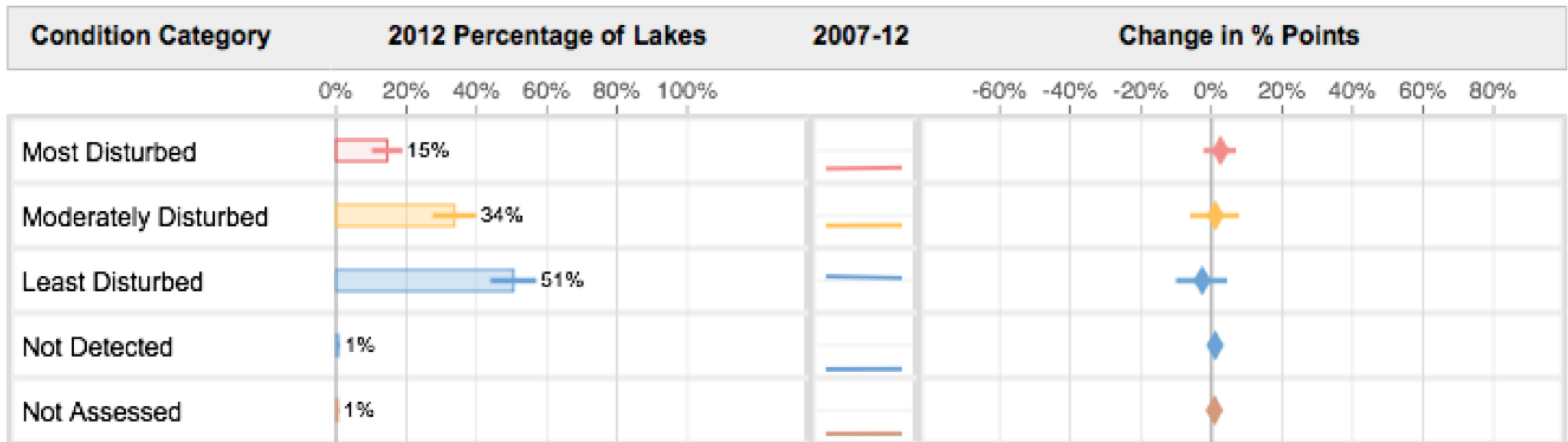
Chlorophyll-a (ug/L)

least disturbed <10; moderately disturbed 10- 50;   most disturbed > 50

U.S. EPA National Lakes Assessment 2012
Percentage of Lakes in Each Condition Category
2012 Estimates and Change from 2007

Chlorophyll A (Risk) | National

Condition Category	2012 Percentage of Lakes	2007-12	Change in % Points
Most Disturbed	15%		
Moderately Disturbed	34%		
Least Disturbed	51%		
Not Detected	1%		
Not Assessed	1%		

U.S. Environmental Protection Agency (USEPA). 2016. *National Lakes Assessment 2012: A Collaborative Survey of Lakes in the United States.* Interactive NLA Dashboard. https://nationallakesassessment.epa.gov/

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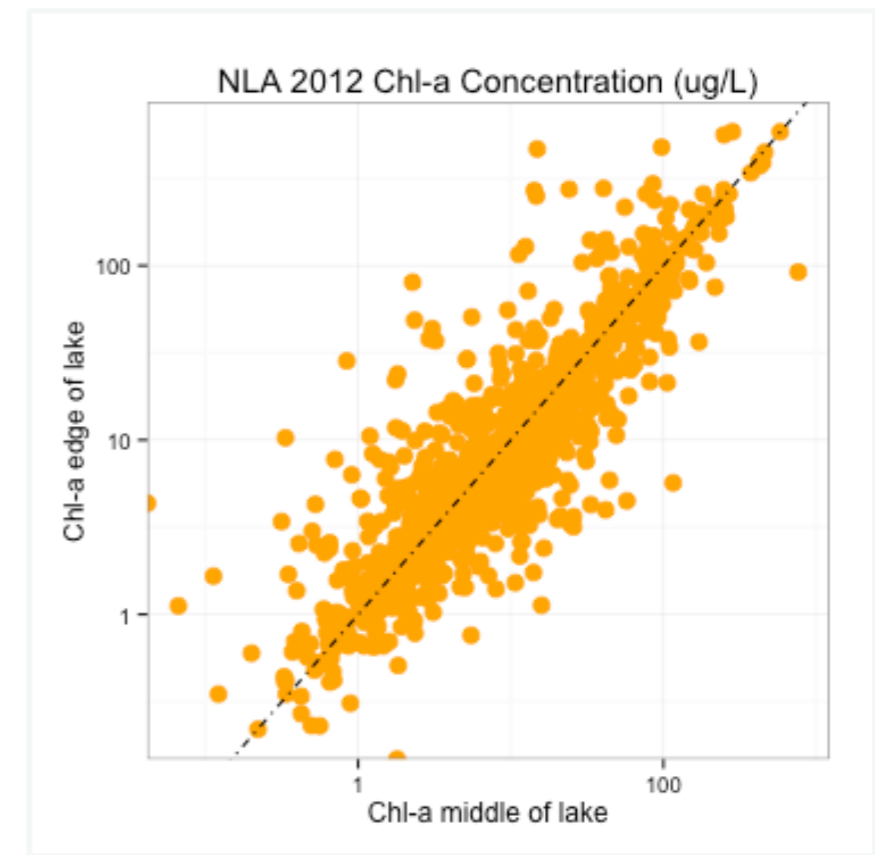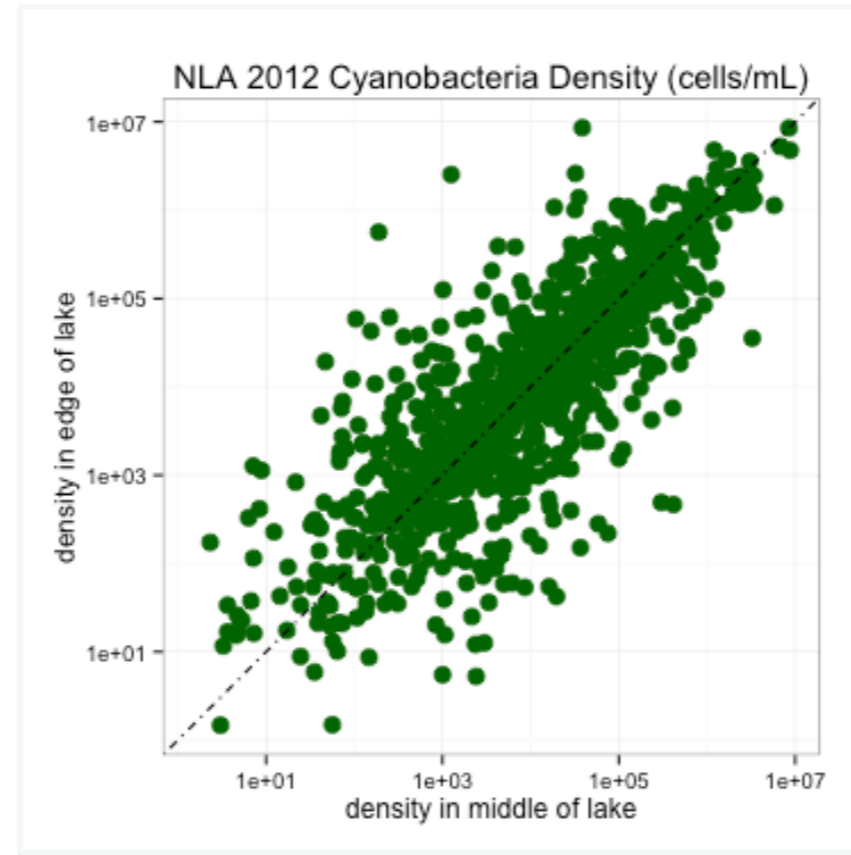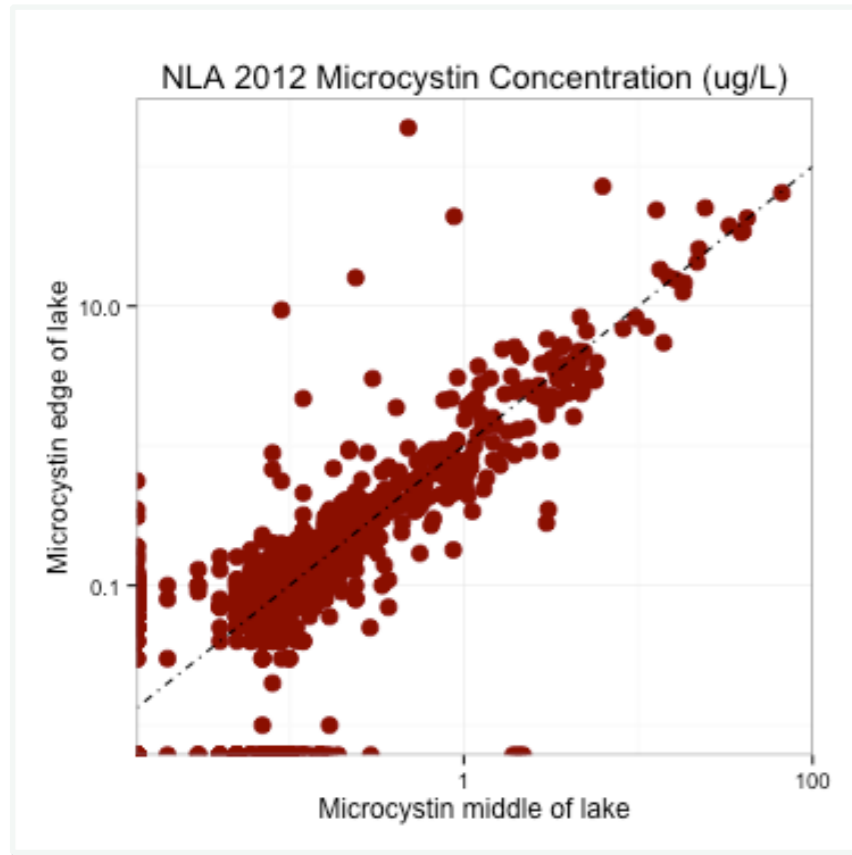# Three indicators of algal toxin risk

Exposure risk	Microcystin (μg/L)	Cyanobacteria density (cells/mL)	Chlorophyll-a (μg/L)
low	99%	61%	51%
medium	0.3%	23%	34%
high	0.4%	15%	15%

Risk estimates vary by indicator

Algal toxin indicators at the index and littoral site

plotted against a 1:1 line

Sample location within a lake did not significantly alter assessment results

U.S. National Lakes Assessment

(https://nationallakesassessment.epa.gov)

Photo: Hilary Snook, 2012