Linking Nutrient Pollution and HABs: State of the Science and EPA Actions

Part 4: Summer Webinar Series to Build Awareness About Harmful Algal Blooms and Nutrient Pollution

Wednesday, Sept. 25, 2013
1:00pm – 3:00pm ET

The Watershed Academy

Speakers:

Hans Paerl, PhD Professor, Institute of Marine Sciences, University of North Carolina at Chapel Hill
Ellen Gilinsky, PhD Senior Policy Advisor to Acting Assistant Administrator, Office of Water, US EPA
Mario Sengco, PhD Physical Scientist, Office of Science and Technology, US EPA

Moderated by: **Christina Badaracco**, ORISE Intern, US EPA

Today's Schedule

- Introduction and GoToWebinar Logistics
- Hans Paerl
  - Causes of HABs
  - Reducing nutrient pollution
- Ellen Gilinsky
  - EPA's tools
  - State nutrient frameworks
- Mario Sengco
  - Implementing numeric nutrient criteria
  - Nutrient toolkit
- Polling Questions
- Q&As
- Final Announcements

Webinar Logistics

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Today’s Topic and Speakers

Nutrient Pollution and HABs

Hans Paerl, PhD

- Professor of Marine and Environmental Sciences
    - University of North Carolina at Chapel Hill

EPA Tools and State Nutrient Framework

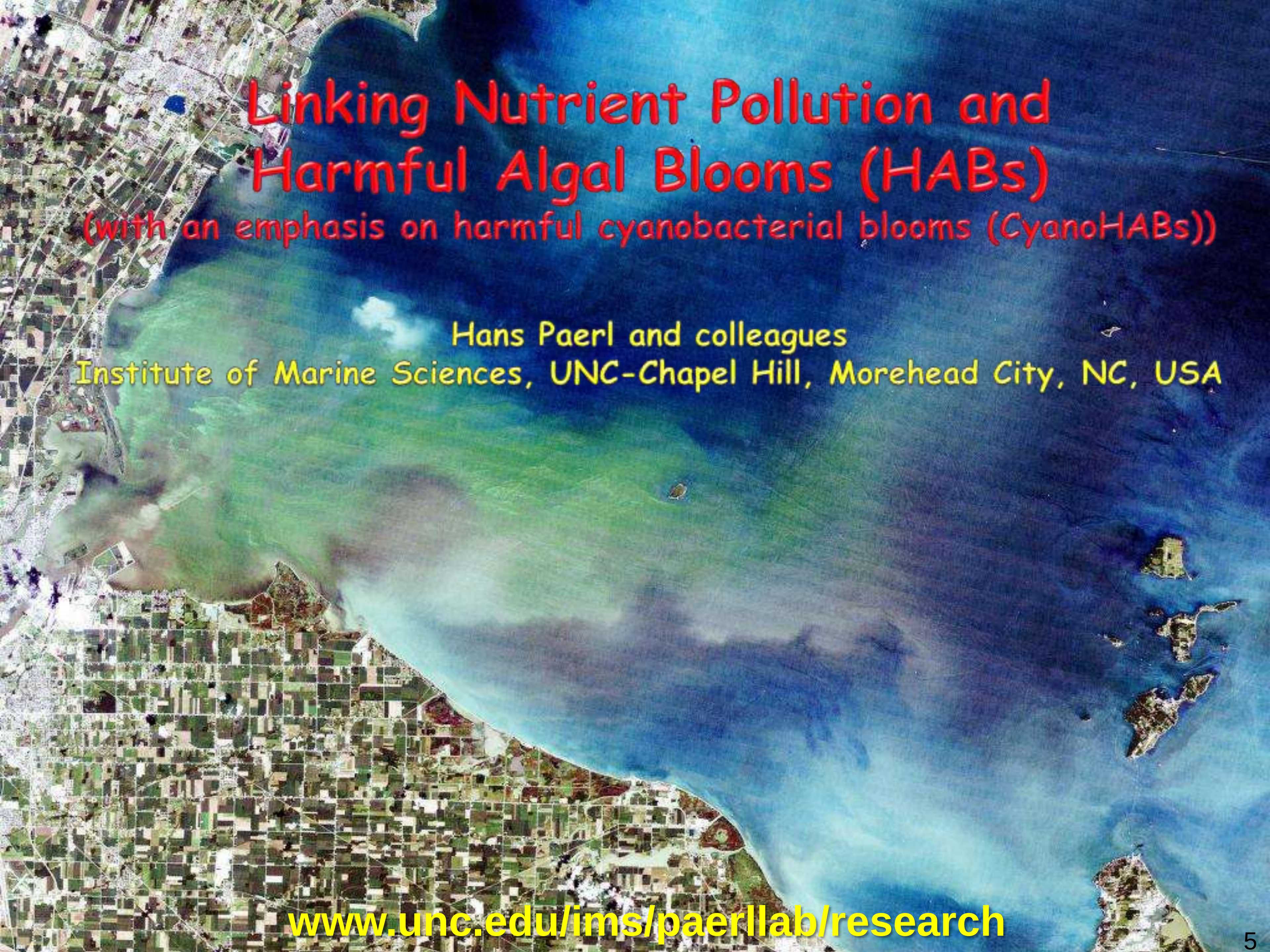
Ellen Gilinsky, PhD

- Senior Policy Advisor
    - Office of Water, US EPA

Numeric Nutrient Criteria and Citizen Actions

Mario Sengco, EPA

- Senior Policy Advisor
    - Office of Water, US EPA



Linking Nutrient Pollution and Harmful Algal Blooms (HABs)

(with an emphasis on harmful cyanobacterial blooms (CyanoHABs))

Hans Paerl and colleagues

Institute of Marine Sciences, UNC-Chapel Hill, Morehead City, NC, USA

www.unc.edu/ims/paerllab/research

Cyanobacterial Harmful Blooms (CyanoHABs): Symptomatic of human and climatic alteration of aquatic environments

Urban, agricultural and industrial expansion

↓

Increasing nutrient (Nitrogen & Phosphorus) inputs

↓

Water use and hydrologic modification play key roles

↓

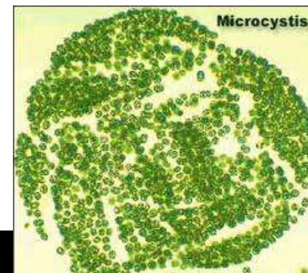
Climate (change) plays a key interactive role

Blooms are intensifying and spreading

↙ ↓ ↘

Why the concern about CyanoHABs?

- Toxic to zooplankton, fish, shellfish, domestic animals and humans
- Cause of hypoxia and anoxia, leading to fish kills
- Odor and taste problems
- Loss of drinking water, recreational, fishing use/sustainability



It’s a global problem

- **Freshwater Ecosystems**

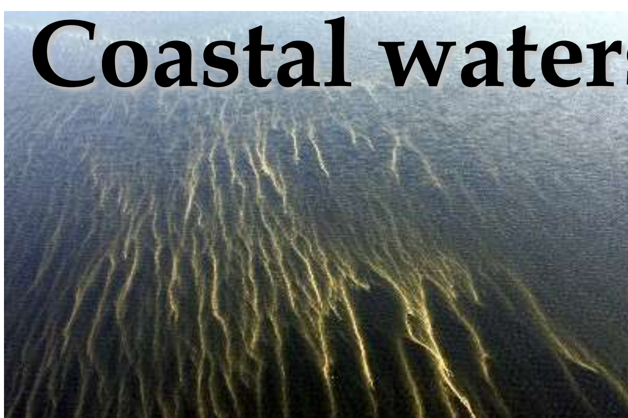
(lakes, reservoirs, streams, rivers)



- **Estuaries**



- **Coastal waters & seas**



Nutrient-eutrophication & HAB issues

- Dogma: Primary production controlled by P availability in freshwater, N in marine ecosystems.

- However: Accelerating anthropogenic N & P loading has altered nutrient limitation and eutrophication dynamics

Results: Human-impacted systems reveal a complex picture and a challenge to nutrient management

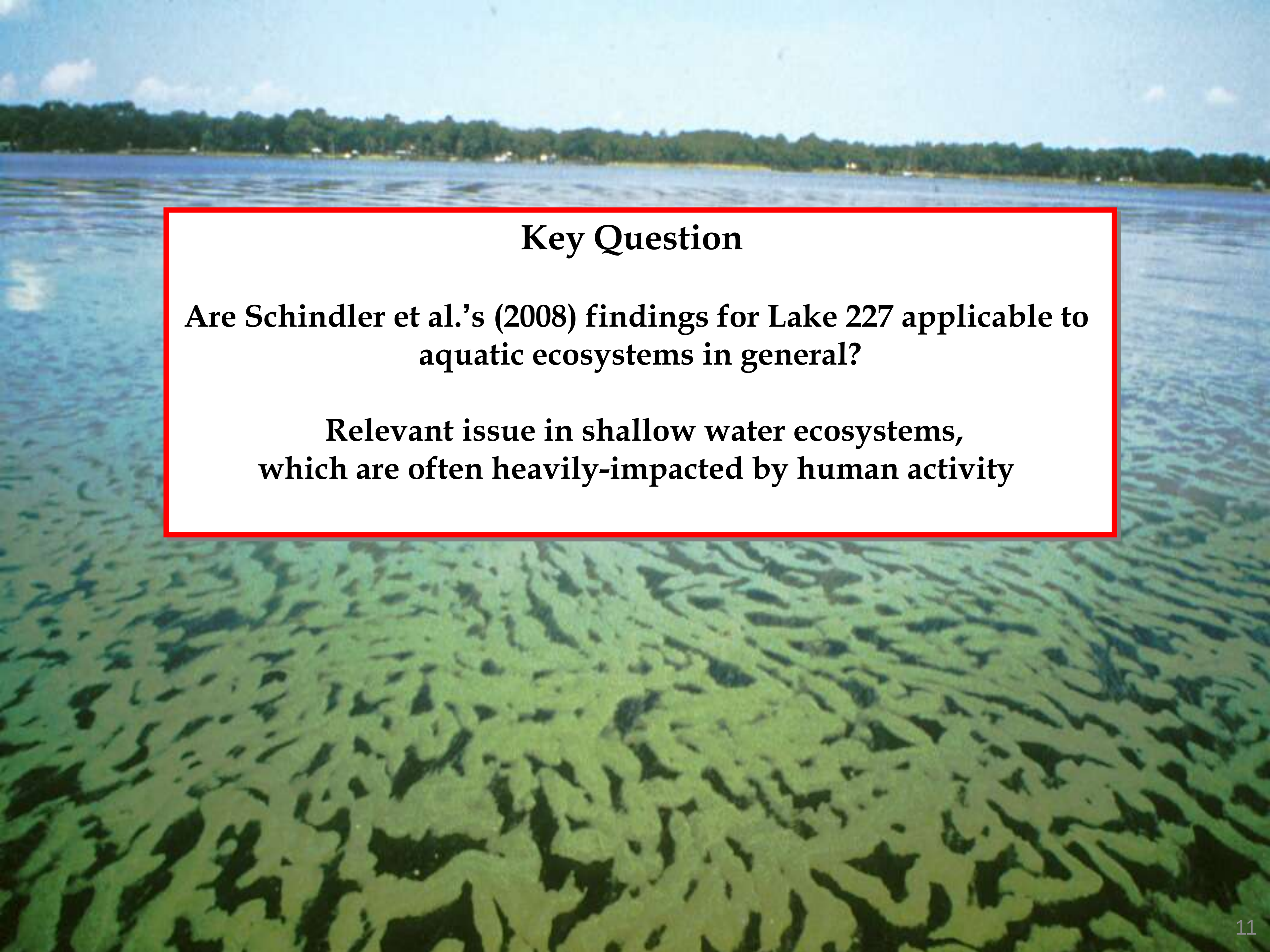
Recent controversy regarding nutrient limitation/controls in CyanoHAB-dominated aquatic ecosystems

"Eutrophication of lakes cannot be controlled by reducing nitrogen input: Results of a 37-year whole-ecosystem experiment"

Schindler et al. Proceedings of the National Academy of Science USA 105:11254-11258 (2008).

Conclusion by Schindler et al. (2008) (based on one lake: Lake 227) assumes that N_2 fixation will supply ecosystem N needs Therefore, why worry about N? Argument extended to estuarine and coastal systems

This assumption has been challenged
(Lewis and Wurtsbaugh 2008; Conley et al., 2009; Paerl 2009; Scott & McCarthy 2010: Lewis et al. 2011)

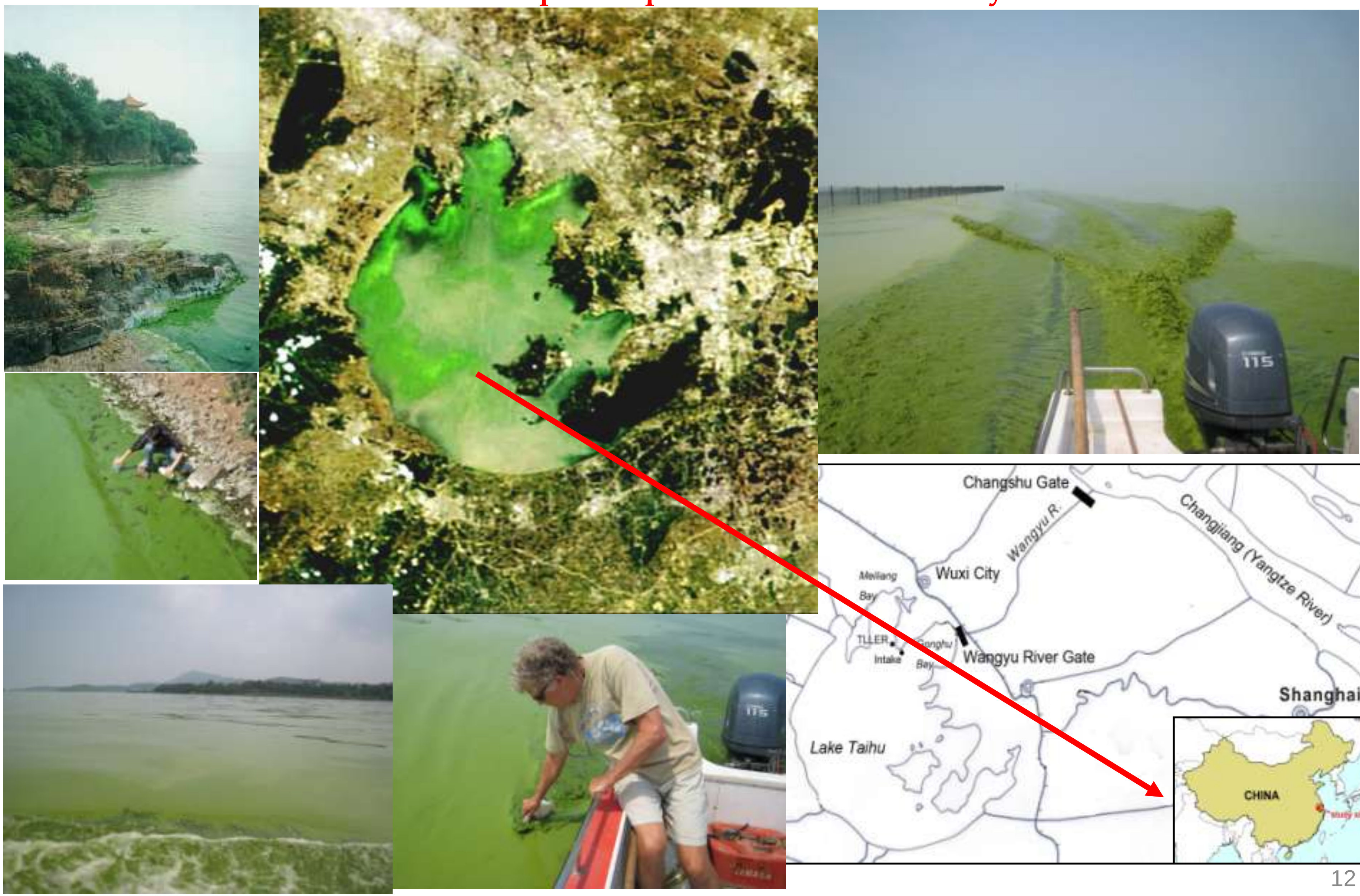


Key Question

Are Schindler et al.'s (2008) findings for Lake 227 applicable to aquatic ecosystems in general?

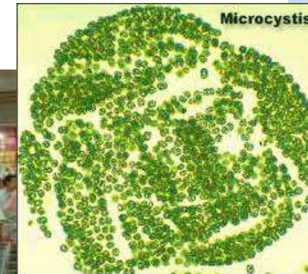
Relevant issue in shallow water ecosystems, which are often heavily-impacted by human activity

Lake Taihu 3rd largest lake in China. Nutrients (lots!) associated with unprecedented human development in the Taihu Basin (Jiangsu Province). Results: Blooms have increased to "pea soup" conditions within only a few decades.



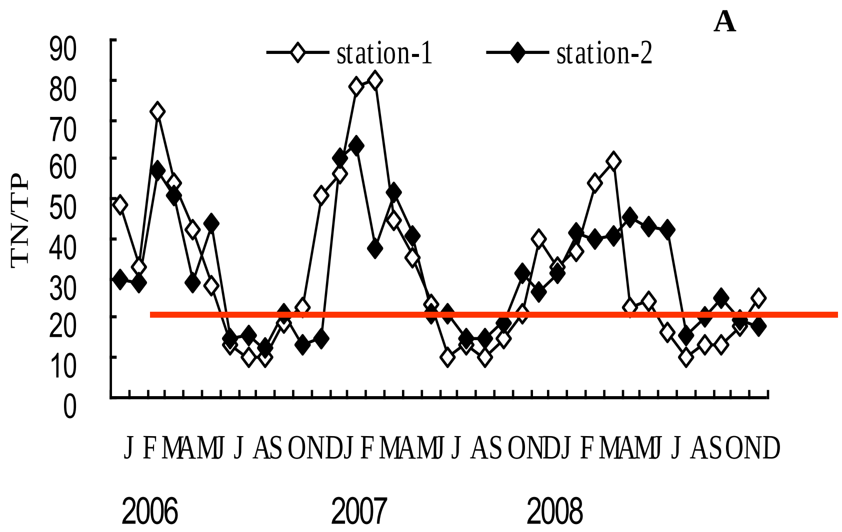
The water crises (2007- ?) in the Taihu Basin:

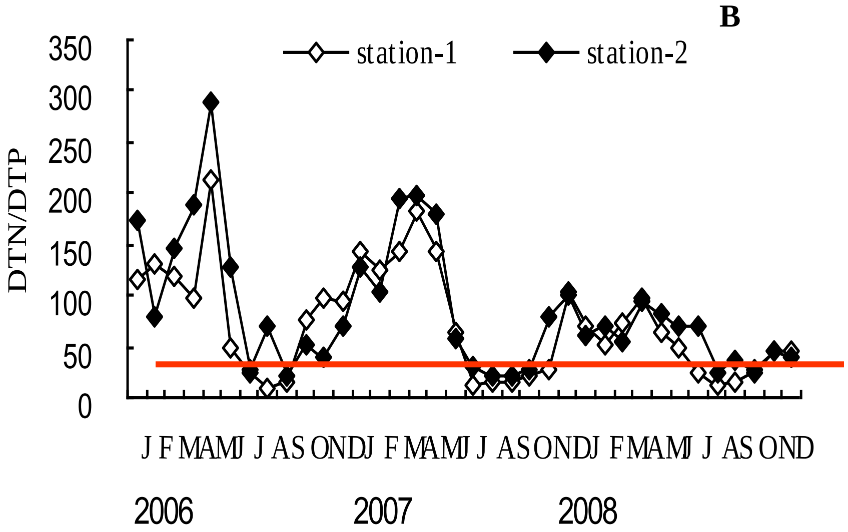
- Cessation drinking water use for >20 million (hepato- and neuro-toxins)
- Curtailed recreational use (contact dermatitis)
- Fisheries (commercial and recreational)
- Tourism???

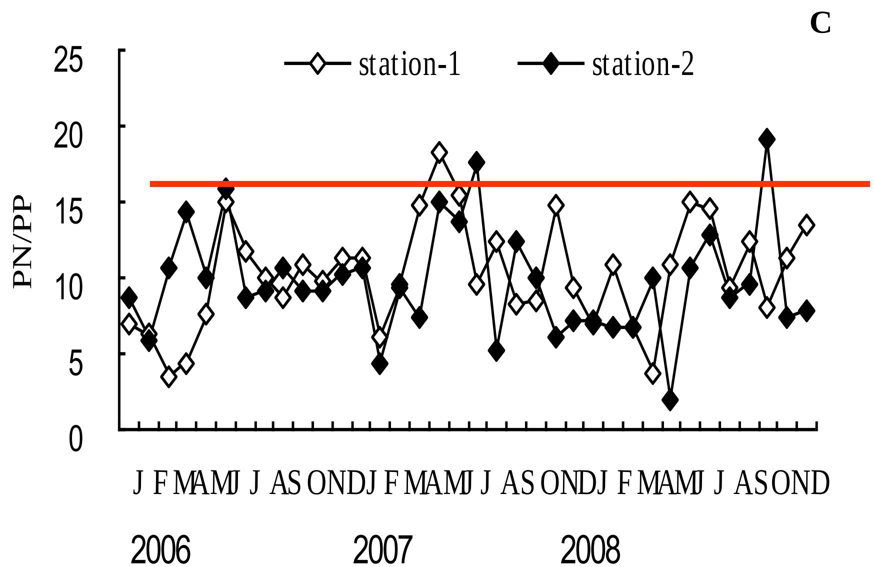


Nutrient dynamics in Taihu

N & P inputs exceed what's needed for balanced algal growth. Result: "Runaway" eutrophication & toxic CyanoHABs







Nutrient (N&P) ratios in Taihu

Redfield (balanced growth) ~15:1 (N:P)

HYPOTHESIS

Dual (N & P) reductions will be needed to stem eutrophication and CyanoHABs

Xu et al., 2010

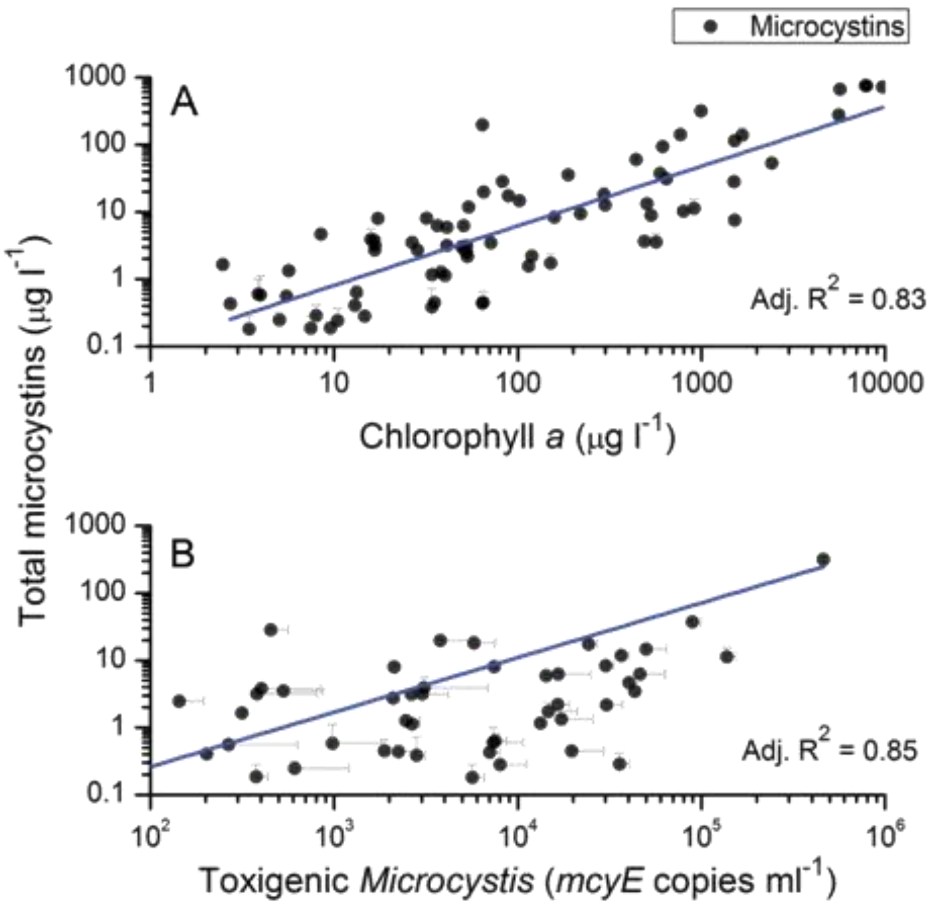
Effects of nutrient (N & P) additions on phytoplankton production (Chl *a*) in Lake Taihu, China: **Both N & P inputs matter!!**

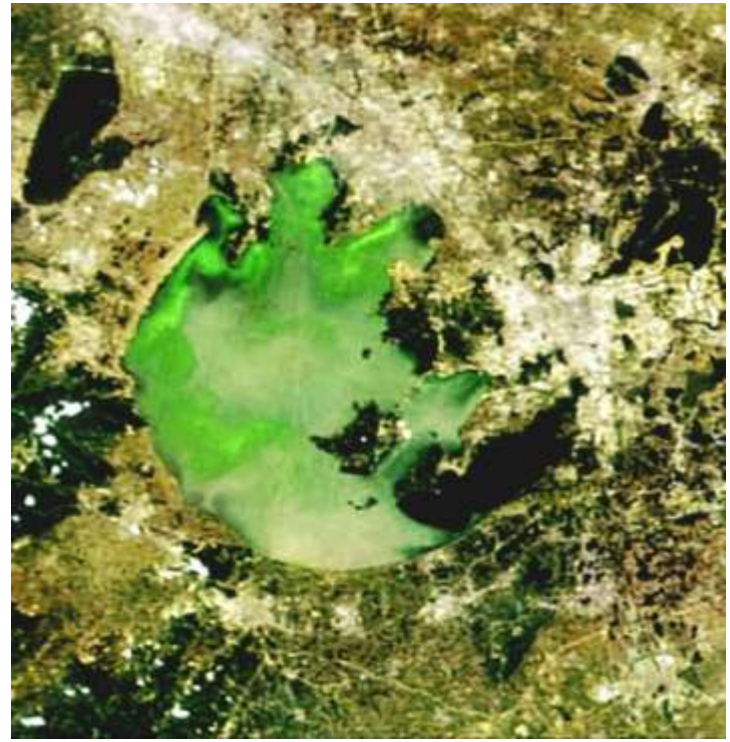
Xu et al. 2010; Paerl et al. 2011

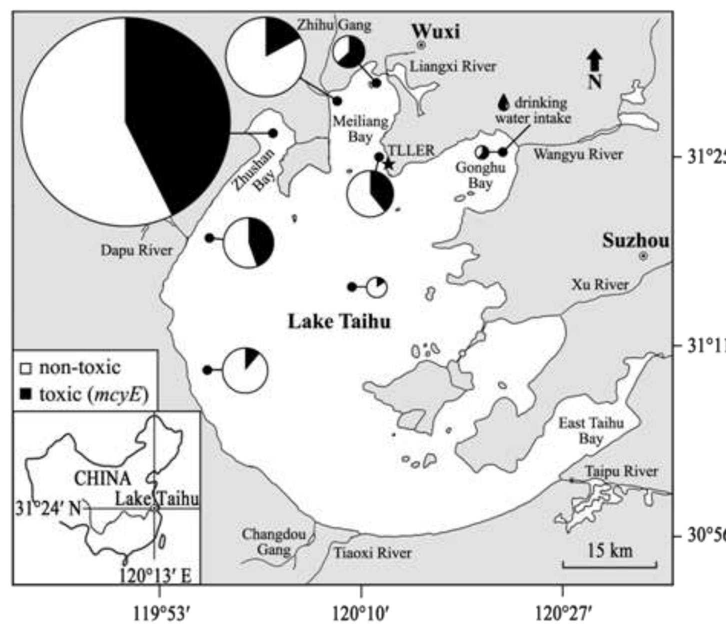
<u>CyanoHAB Toxicity</u>

•Related to nutrient inputs and biomass

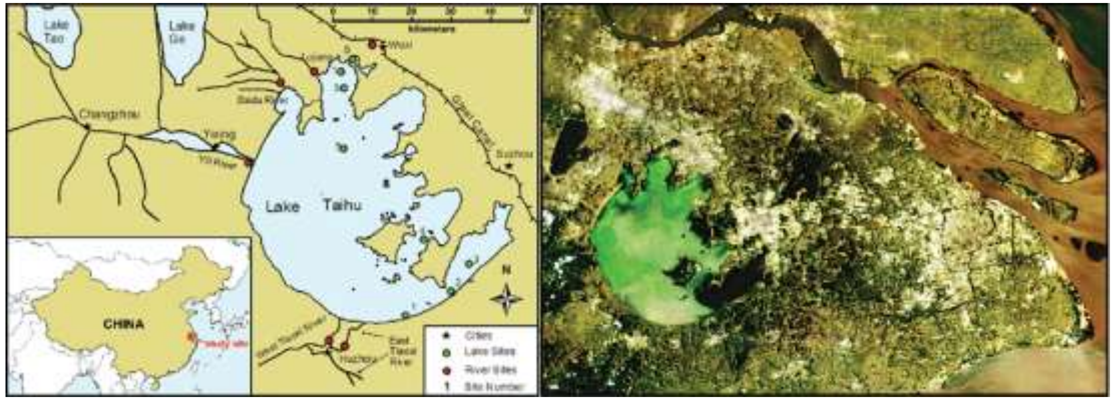
•Chlorophyll a is a sensitive, relevant and easy to use indicator







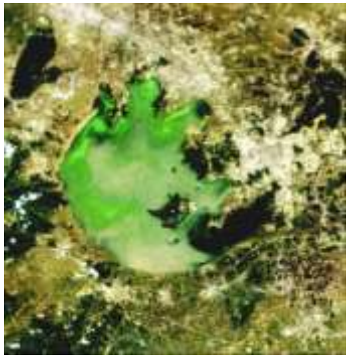
Otten et al., 2011, 2012; Wilhelm et al., 2011



To address Taihu's WQ problems, mitigate CyanoHABs, & ensure sustainability, we are:

- **Determining nutrient inputs, availability, and controls on CyanoHABs**
- **Developing nutrient-bloom thresholds**
- **Linking eutrophication to algal toxicity and water use**
- **Formulating nutrient management recommendations**
- **Identifying options for meeting them**
- **Engaging managers to develop long-term strategies for ensuring sustainability of Taihu & other large lakes threatened by CyanoHABs**

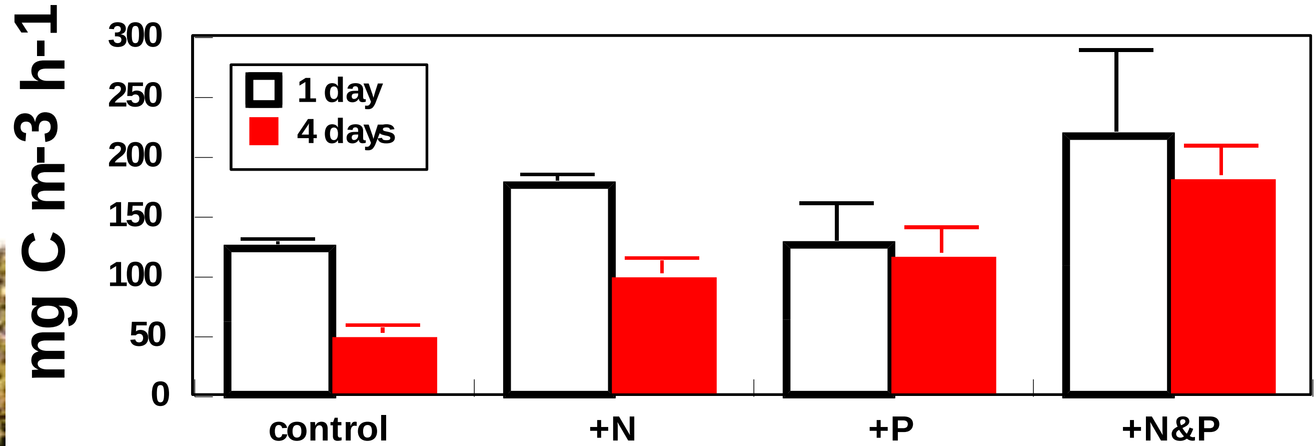
Is Taihu a “looking glass” for hypereutrophic shallow ecosystems worldwide?

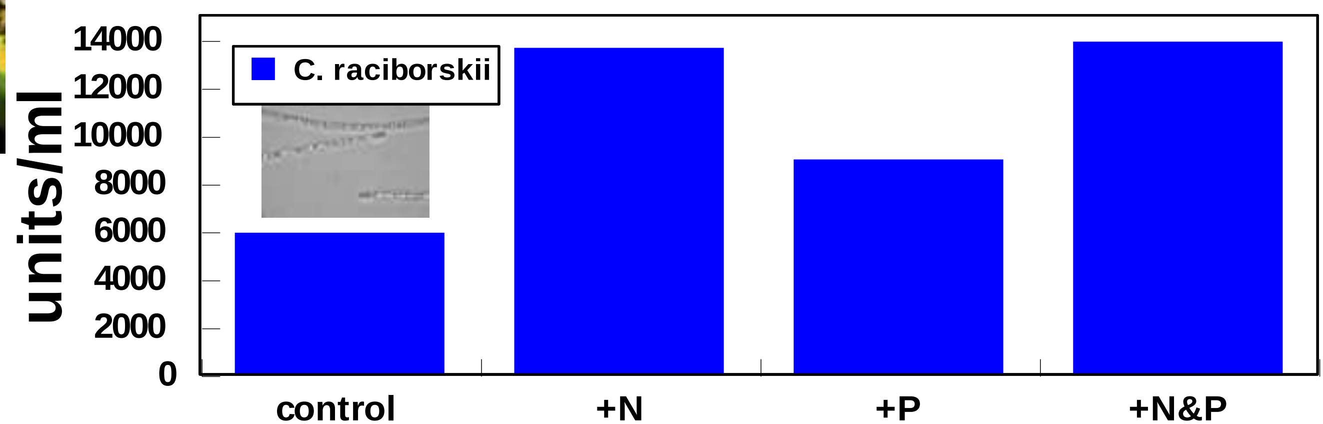


Florida lakes : *Cylindrospermopsis raciborskii,* rapidly-proliferating, toxic N_2-fixing cyanoHAB

- High P uptake and storage capacity
- High NH_4^+ uptake affinity (competes well for N)
  - N additions (NO_3^- + NH_4^+) often significantly increase growth (chl *a* and cell counts) and productivity
- N_2 fixer (can supply its own N needs)
- Tolerates low light intensities
  - Eutrophication/decreased transparency favors *Cylindro*
  - Often in water column with other cyanoHABs

St. Johns R. System, FLorida: Nitrogen and Phosphorus Effects on CyanoHAB Growth and Bloom Potential (*Cylindrospermopsis raciborskii*)

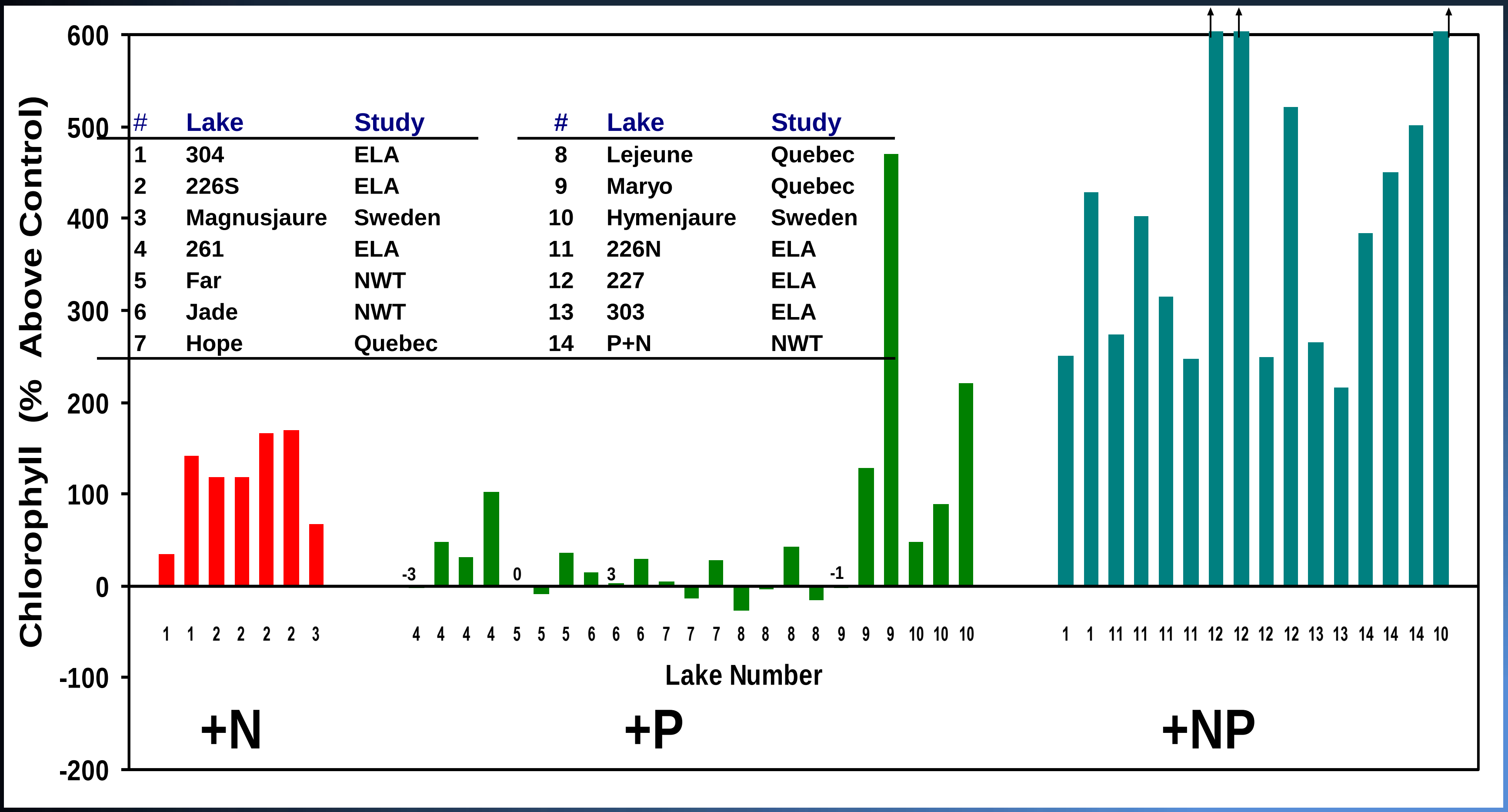




Take home message: *Cylindrospermopsis raciborskii* is opportunistic
Dual N & P input constraints will likely be needed to control it

Piehler et al, 2009

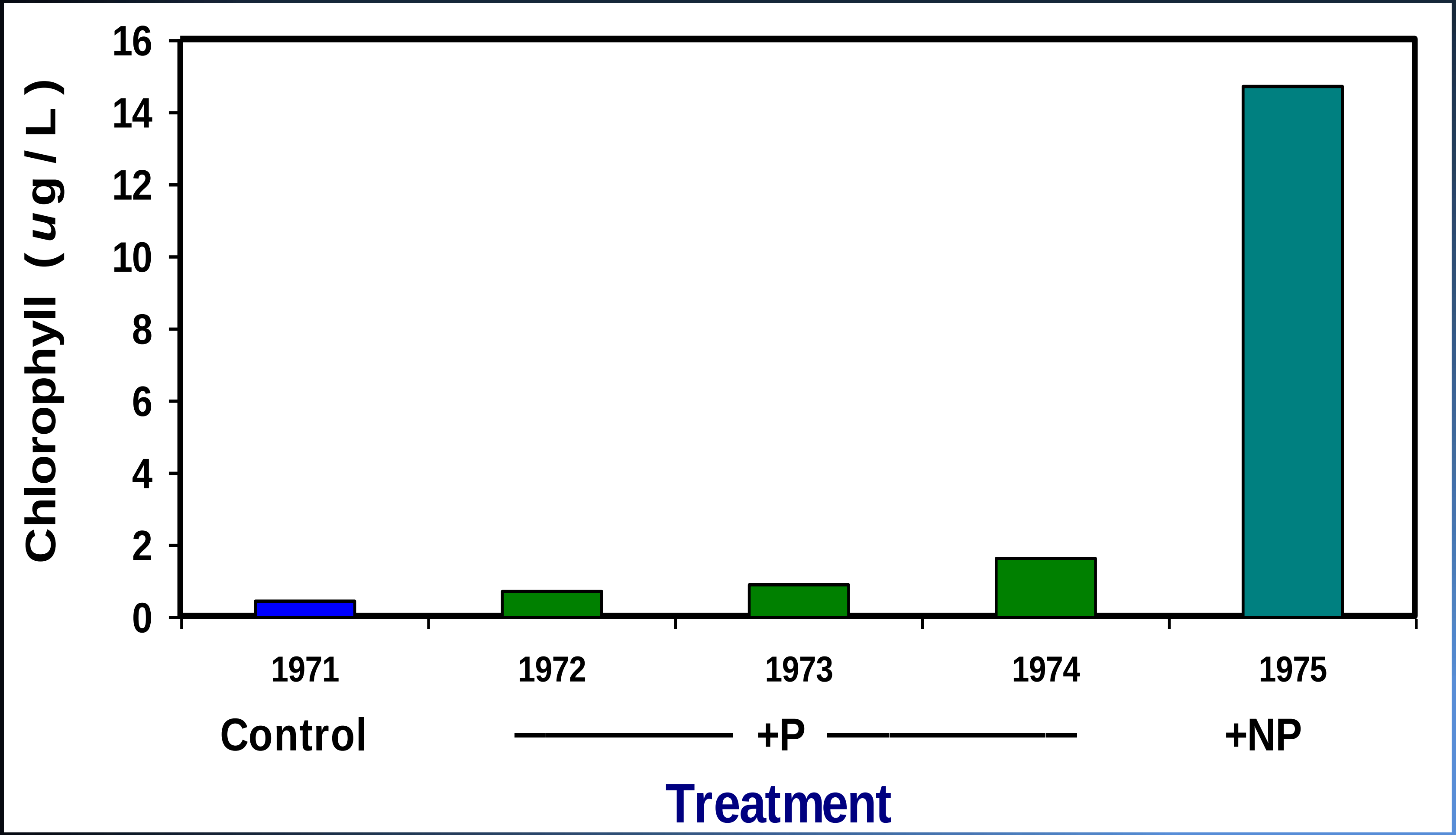
Whole-Lake Fertilization Experiments (ELA, Quebec, NWT, Sweden)



Co-Limitation Dominant

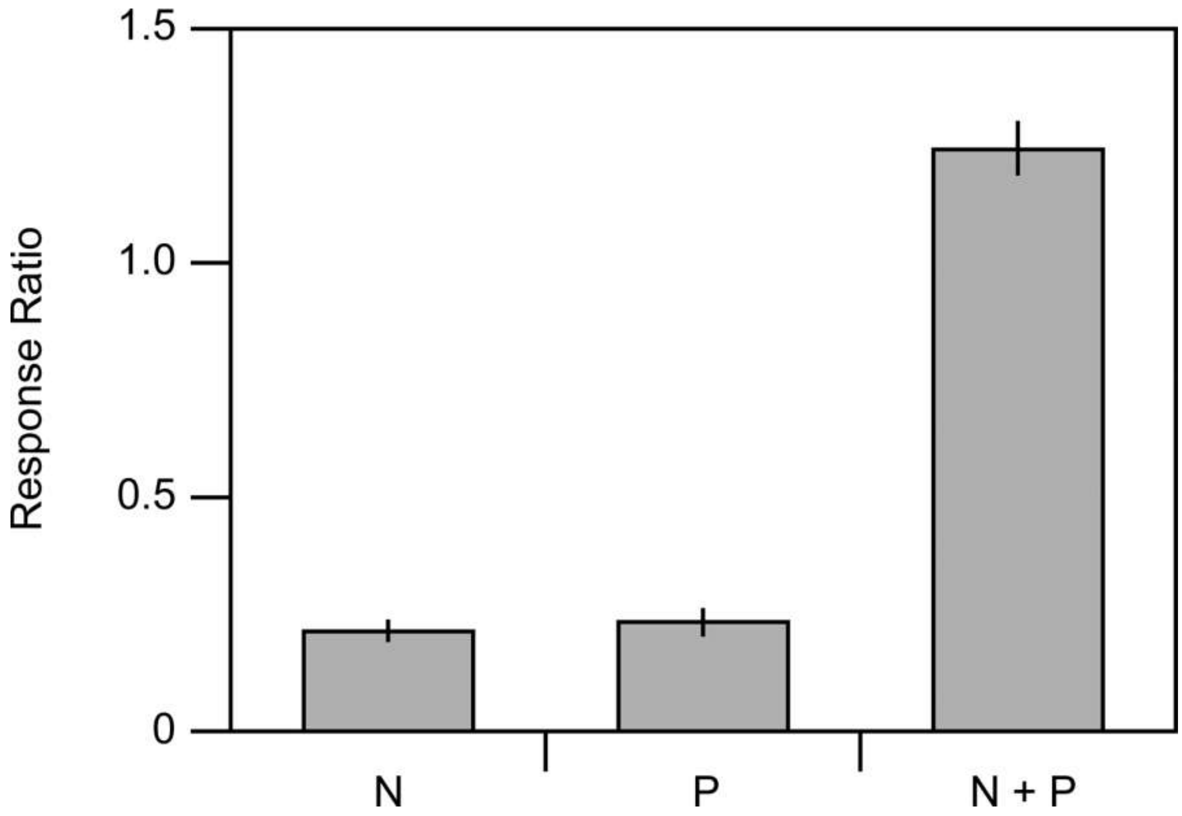
Wurtsbaugh et al., 2012

The results from Lake Hymenjaure in Sweden are particularly revealing



Holmgren, S. K. (1984) Int. Rev. Gesamten Hydrobiol. 479 Hydrogr.: 781–817.

A summary of N & P limitation in lakes worldwide

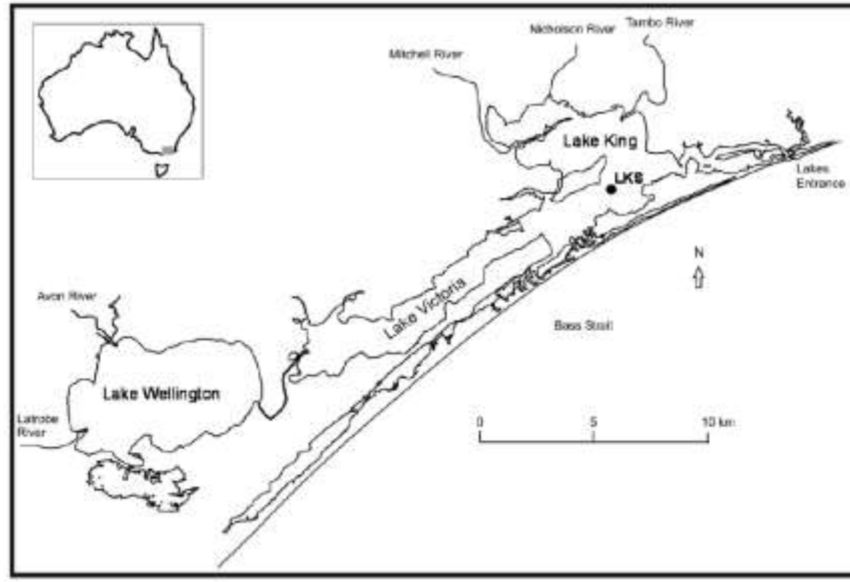


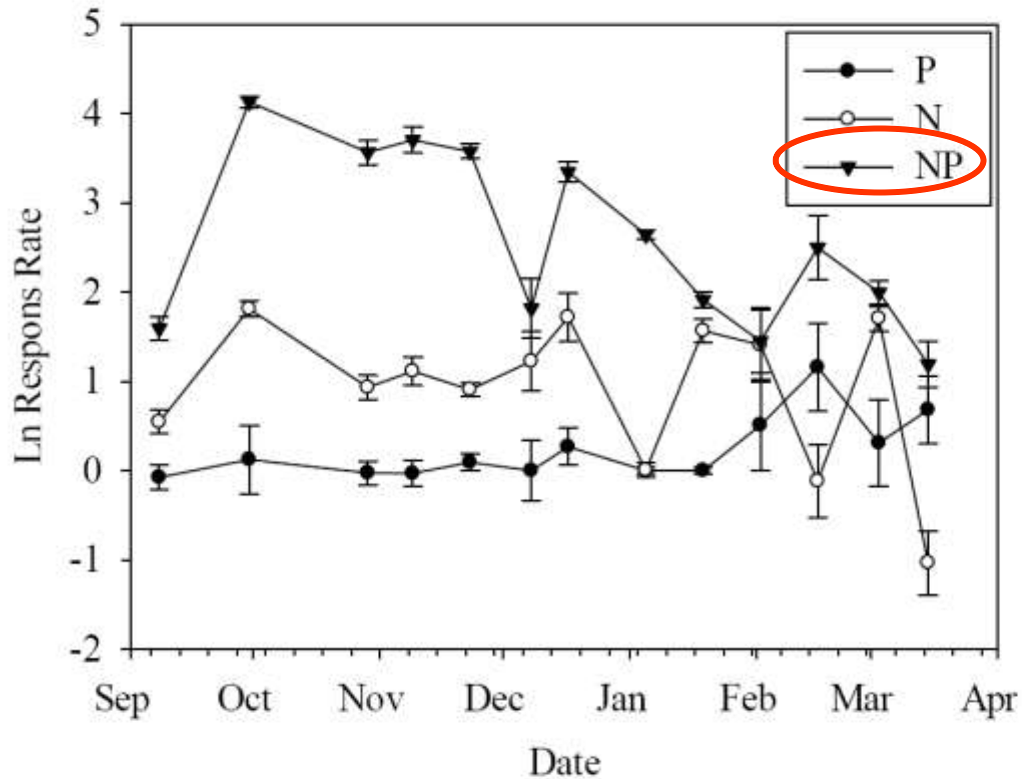
Lakes: N= 55

Lewis et al., ES&T 45:10300-10305 (2011)

What about the freshwater to marine "Continuum"?

Nutrient limitation "down under": the Gippsland Lakes Catchment Victoria, Australia

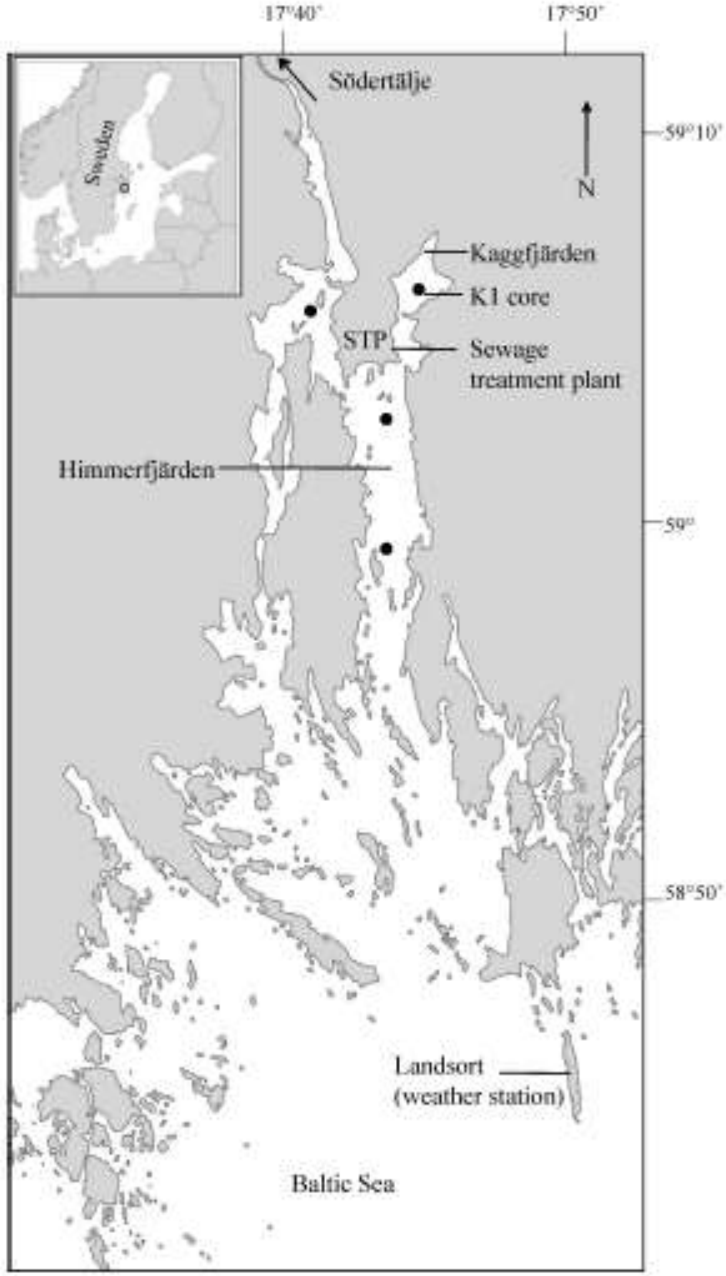




Holland et al. 2012

Nutrient load and phytoplankton growth response in Himmerfjärden, Sweden

Courtesy: Ulf Larsson & Ragnar Elmgren
Stockholm University



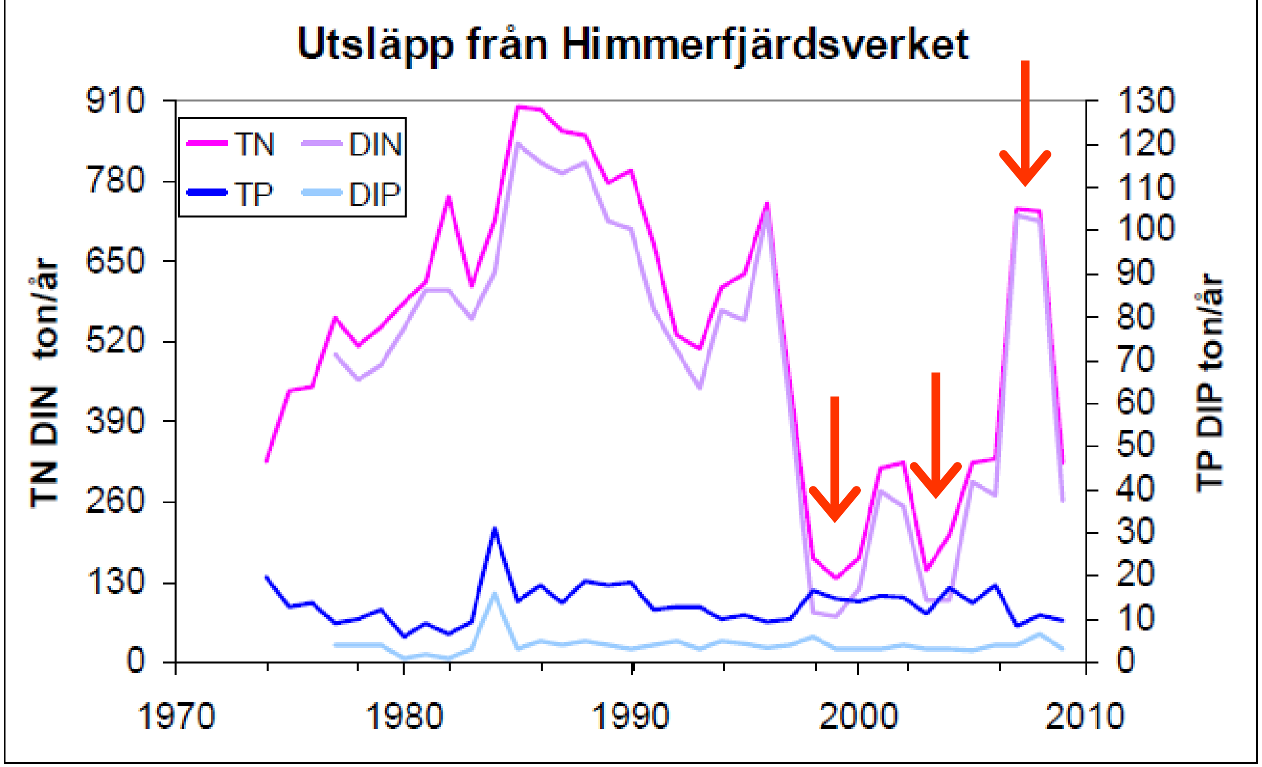
The Himmerfjärden case:

Coastal area with large sewage treatment plant

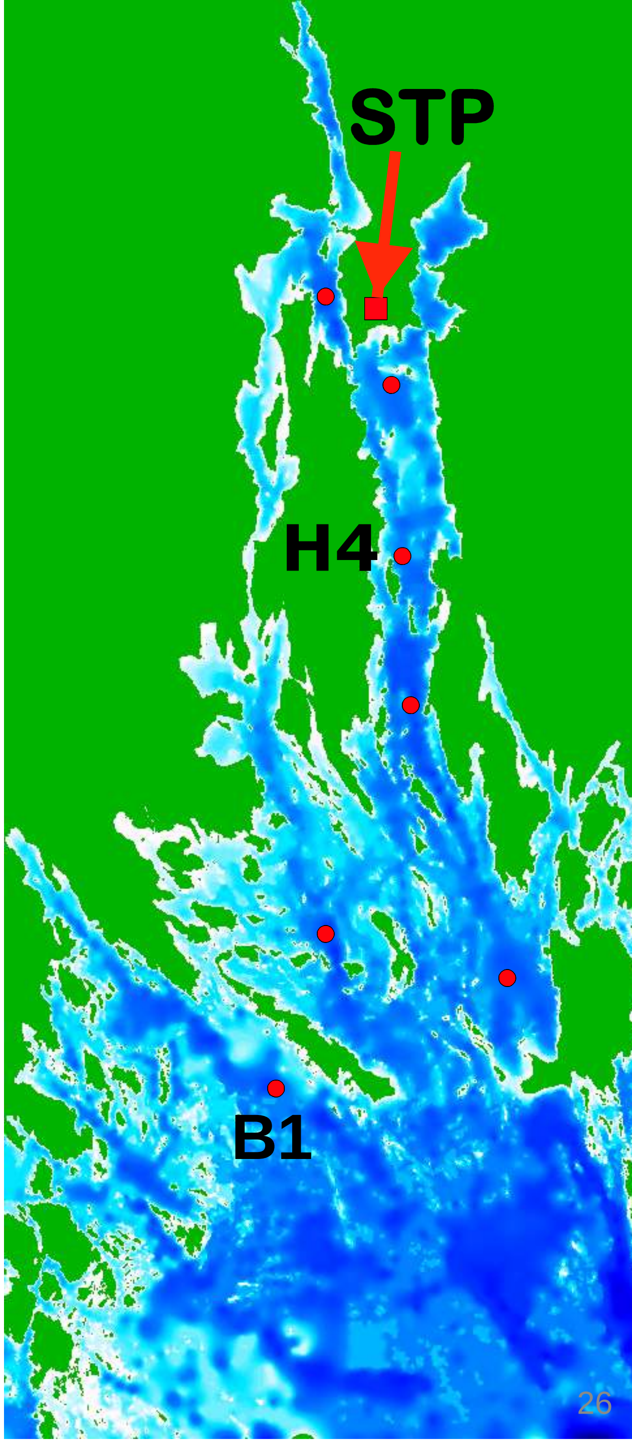
P removal since 1976, N removal started in 1993 (50%) & 2000 (80%), no N removal 2004-2008

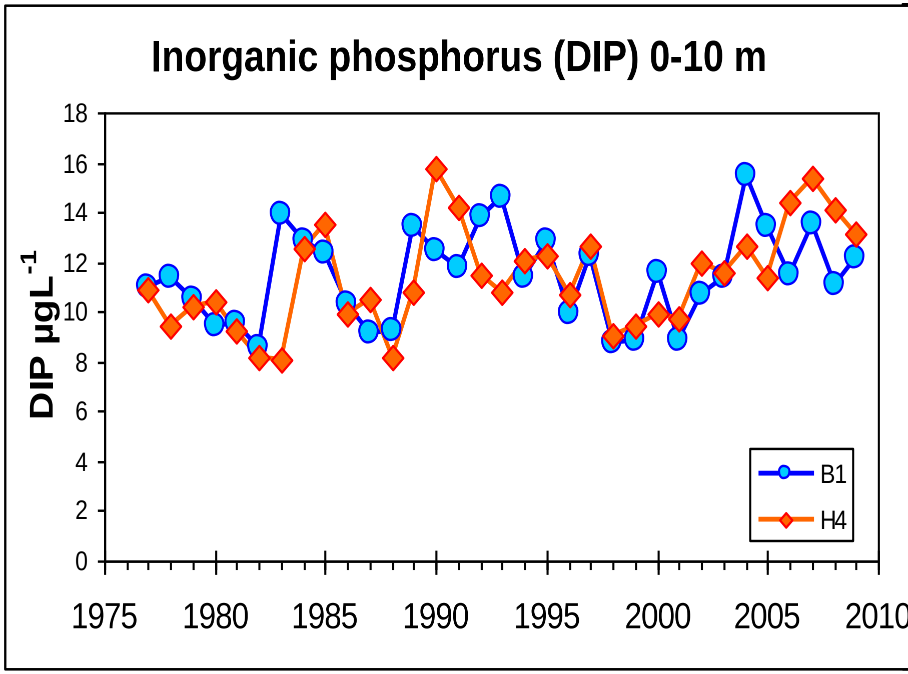
RESULTS ON PHYTOPLANKTON (Chl a)?

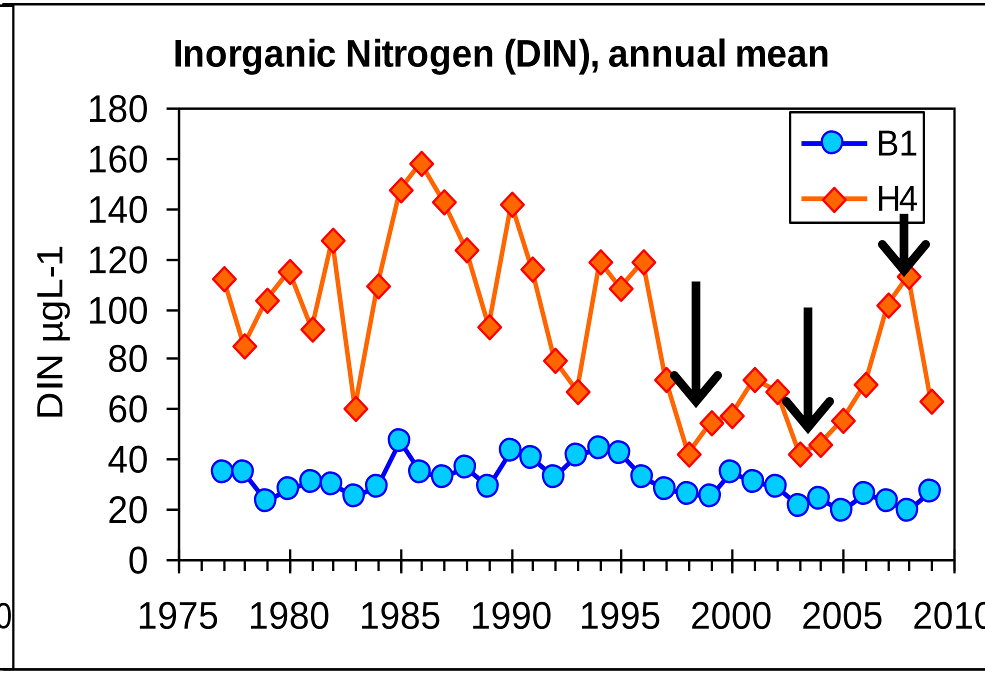
Plant loads , tonnes/ year

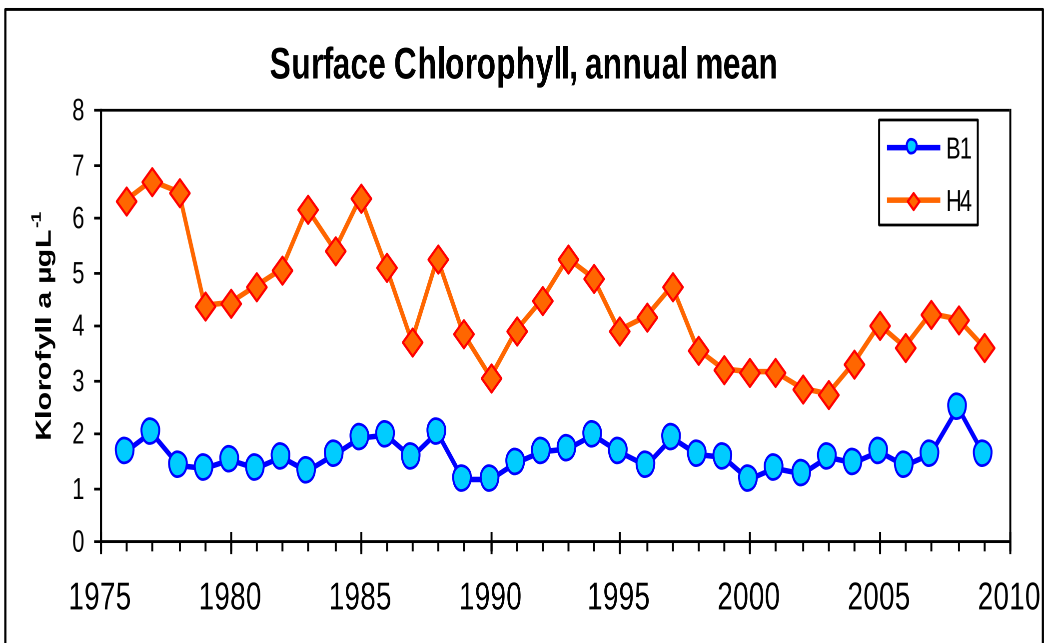


H4 =Eutrophicated station
B1= Reference station

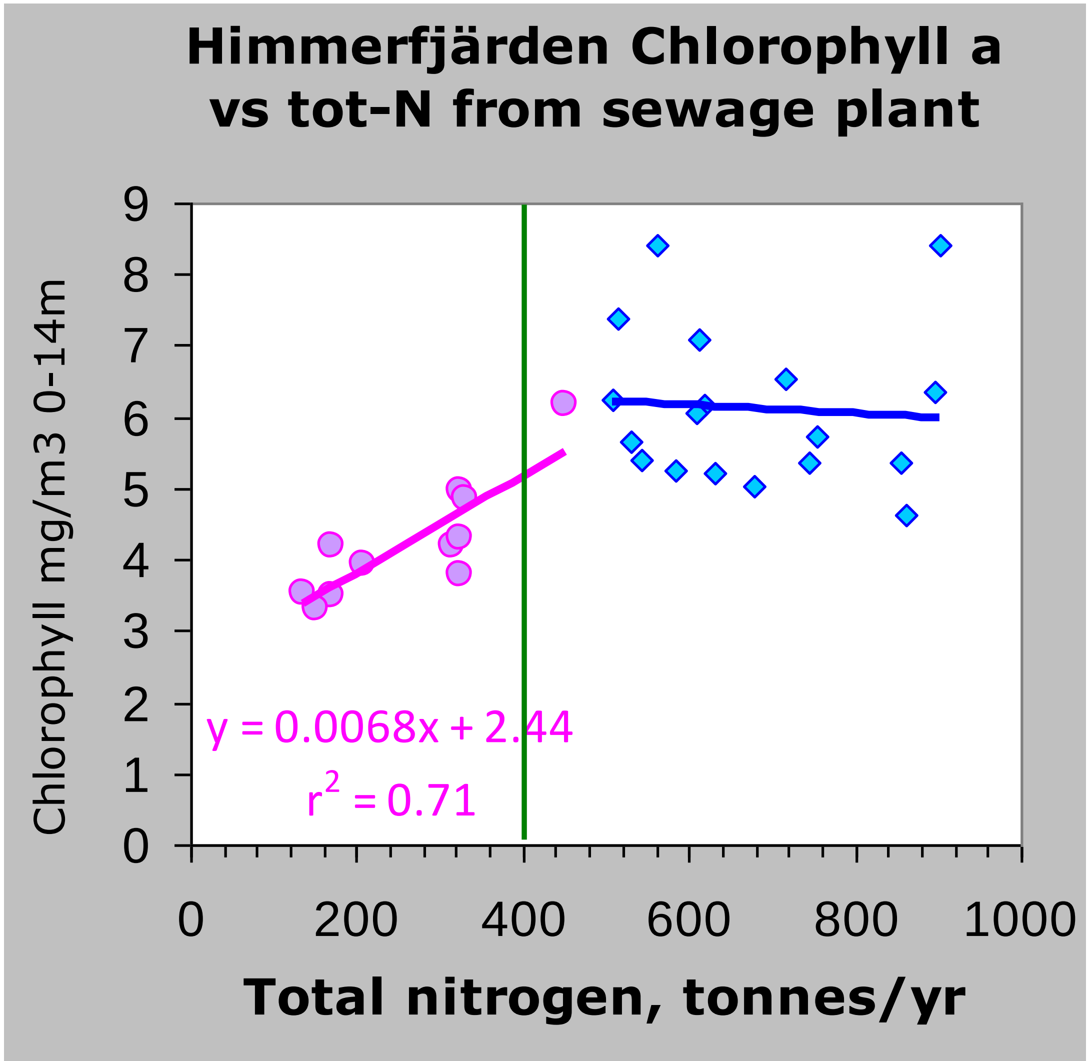



Inorganic phosphorus (DIP) 0-10 m
DIP µgL-1
B1
H4
0
2
4
6
8
10
12
14
16
18
1975
1980
1985
1990
1995
2000
2005
2010


Inorganic Nitrogen (DIN), annual mean
DIN µgL-1
B1
H4
0
20
40
60
80
100
120
140
160
180
1975
1980
1985
1990
1995
2000
2005
2010


Surface Chlorophyll, annual mean
Klorofyll a µgL-1
B1
H4
0
1
2
3
4
5
6
7
8
1975
1980
1985
1990
1995
2000
2005
2010

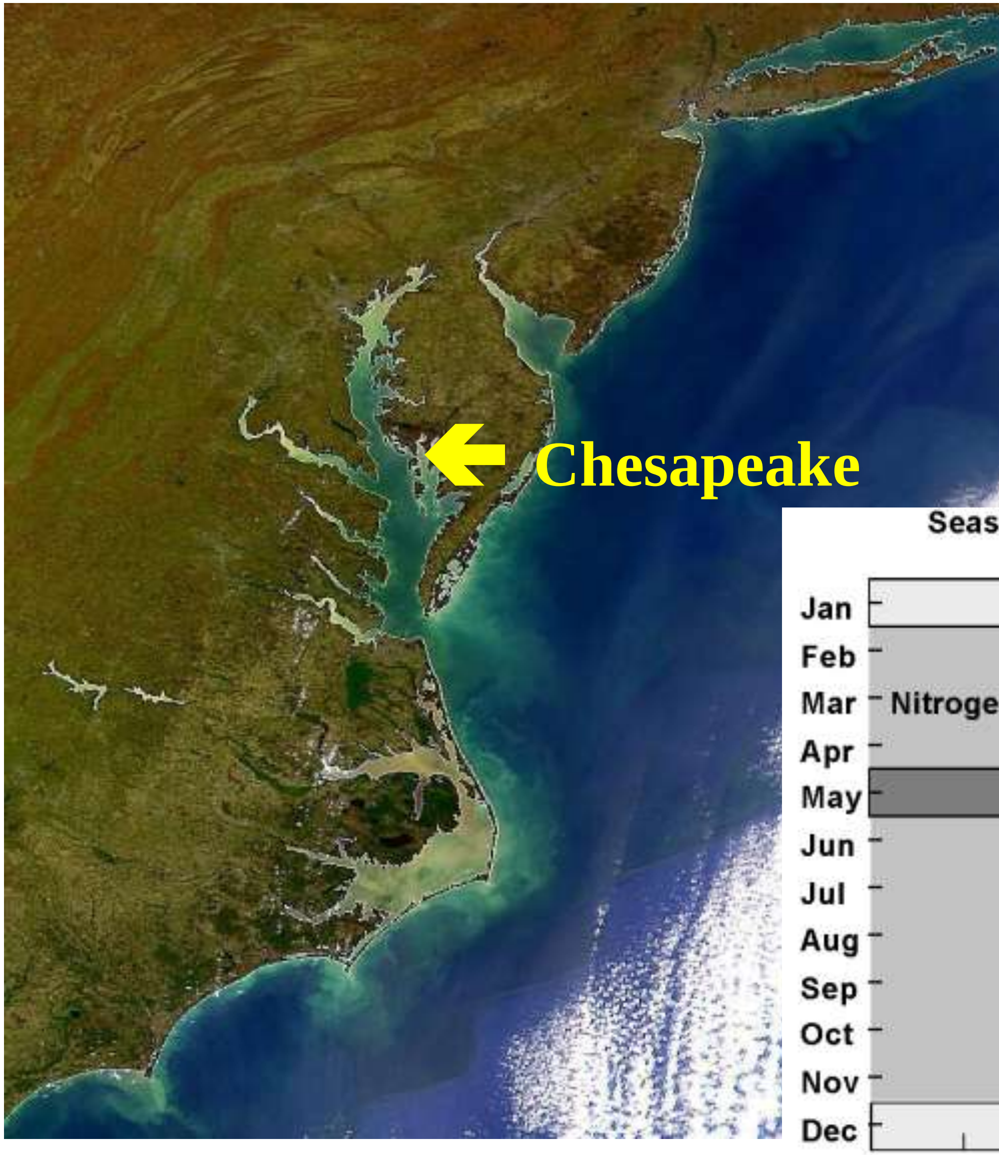
Developing a N loading-bloom threshold



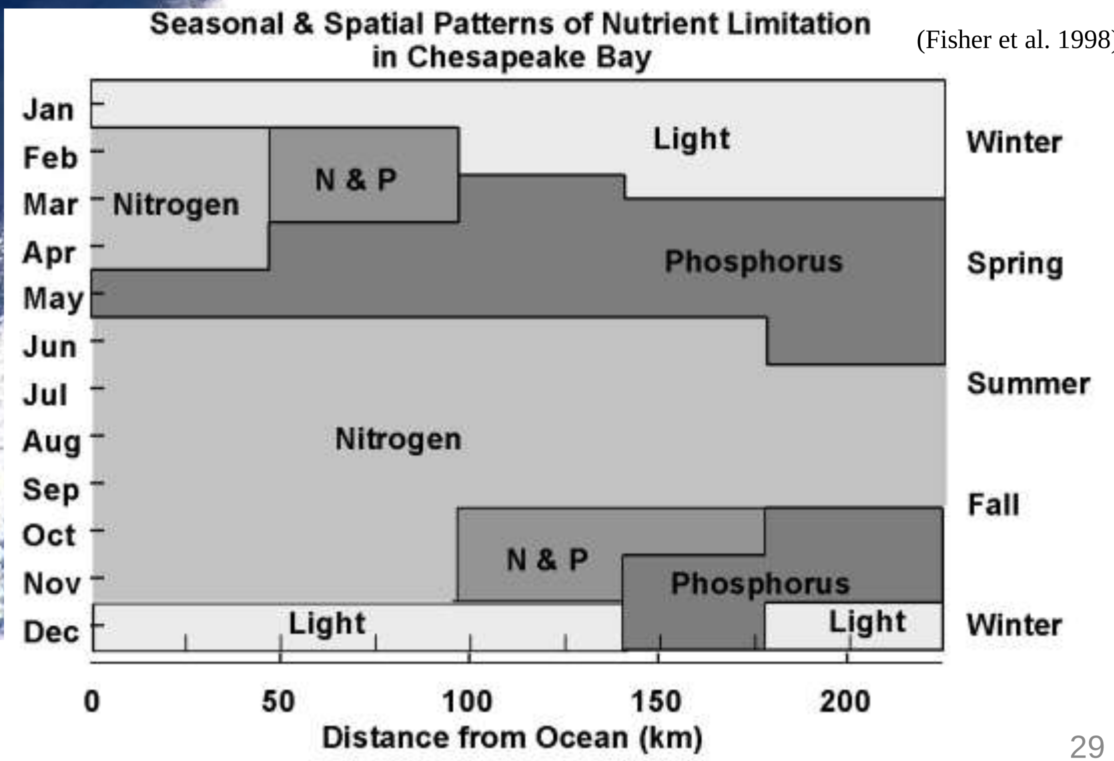
Lowering nitrogen discharge below 400 tonnes/yr clearly reduced local phytoplankton biomass.

Source:
Ulf Larsson, pers.comm.

Nutrient limitation Dynamics in Estuaries: the Chesapeake Bay

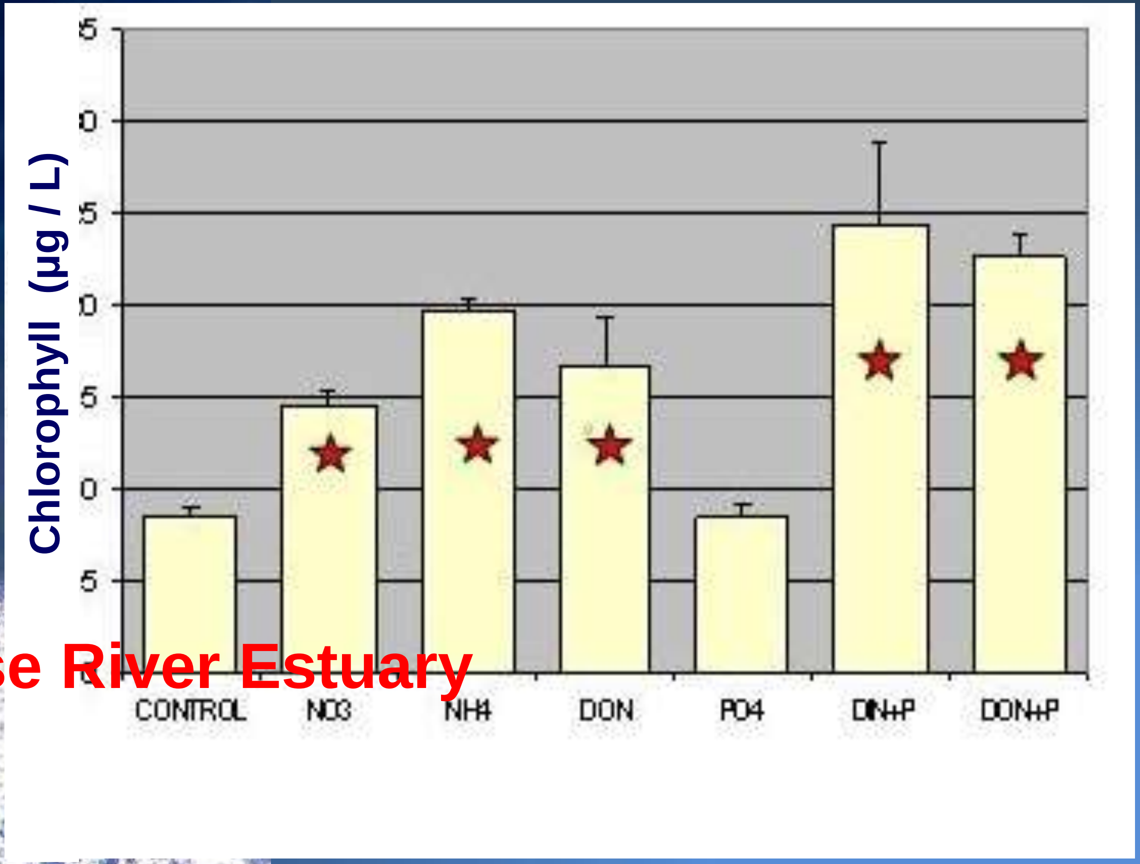


Fisher et al. 1998



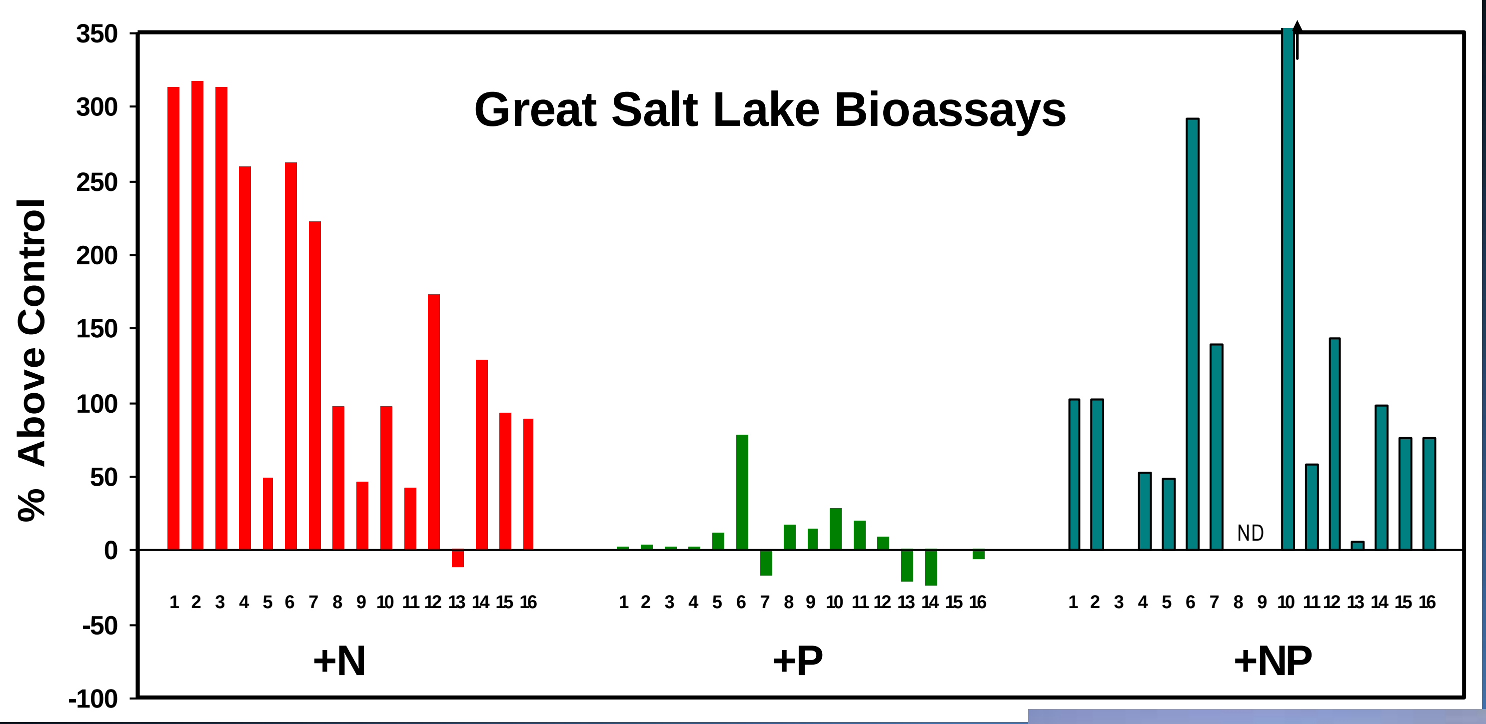
(Fisher et al. 1998)

Nutrient limitation in the Neuse River Estuary, NC



Paerl et al., 1995; Gallo 2006

Nutrient limitation in saline lakes affected by CyanoHABs



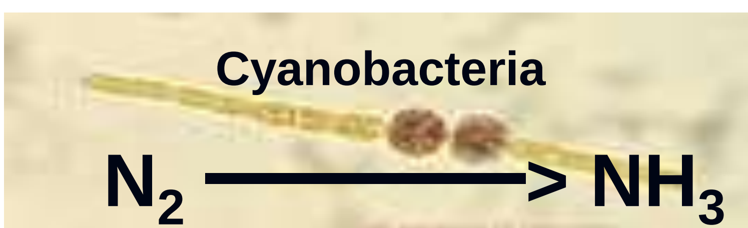
- Salinities too high for nitrogen-fixing cyanobacteria
- High sulfate facilitates P release from sediments
  (Caraco et al. 1988; Blomqvist et al. 2004)

Stephens & Gillespie (1990) L&O 21; Porcell a & Holman (1972) Utah Water Research Laboratory
Wurtsbaugh (1988) Verh. Int. Ver. Limnol. 23 ; Marcarelli et al. (2006) Can. J. Fish. Aquat. Sci 63

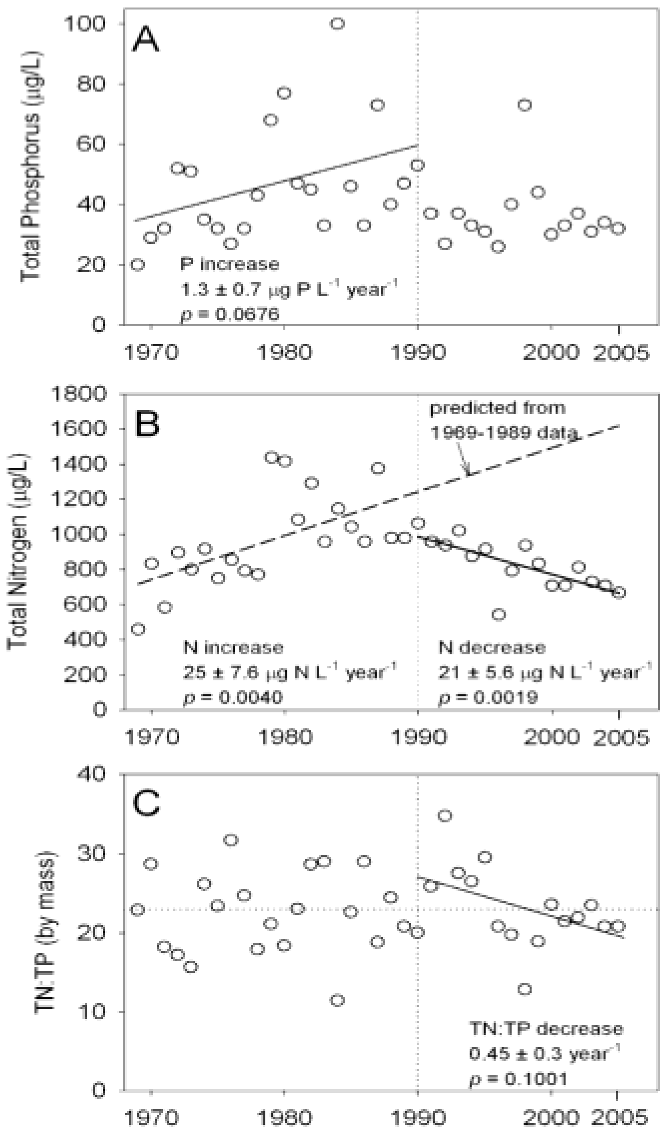
Let’s go back to the ‘P only” paradigm from whole-lake experiments, suggesting that P alone controls algal biomass (Schindler et al., 2008).

Argument:

If nitrogen is in short supply, nitrogen fixation by cyanobacteria will make up the nitrogen deficit:



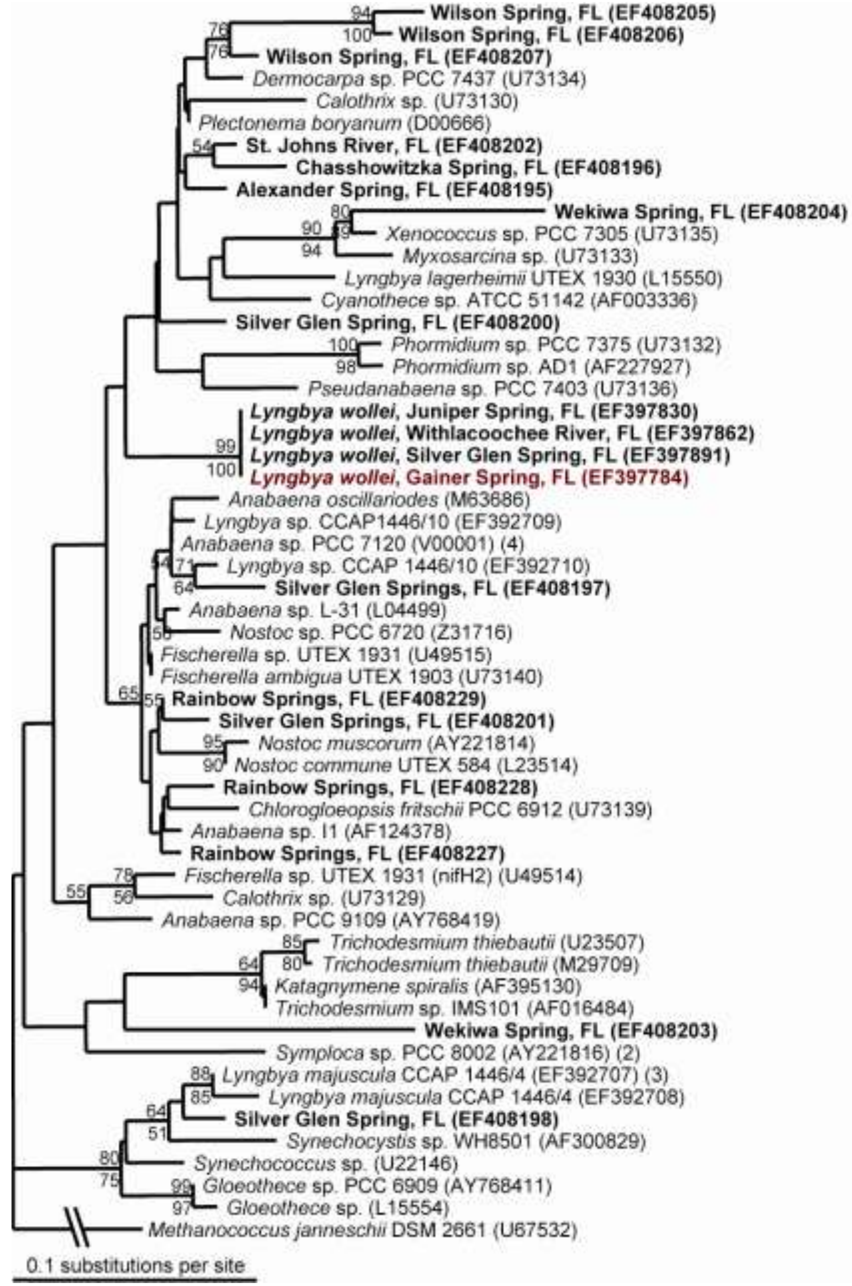
Let's look at the data for lake 227: What happened following N&P fertilization (1968-1989), then only P fertilization (1989 ➔)?



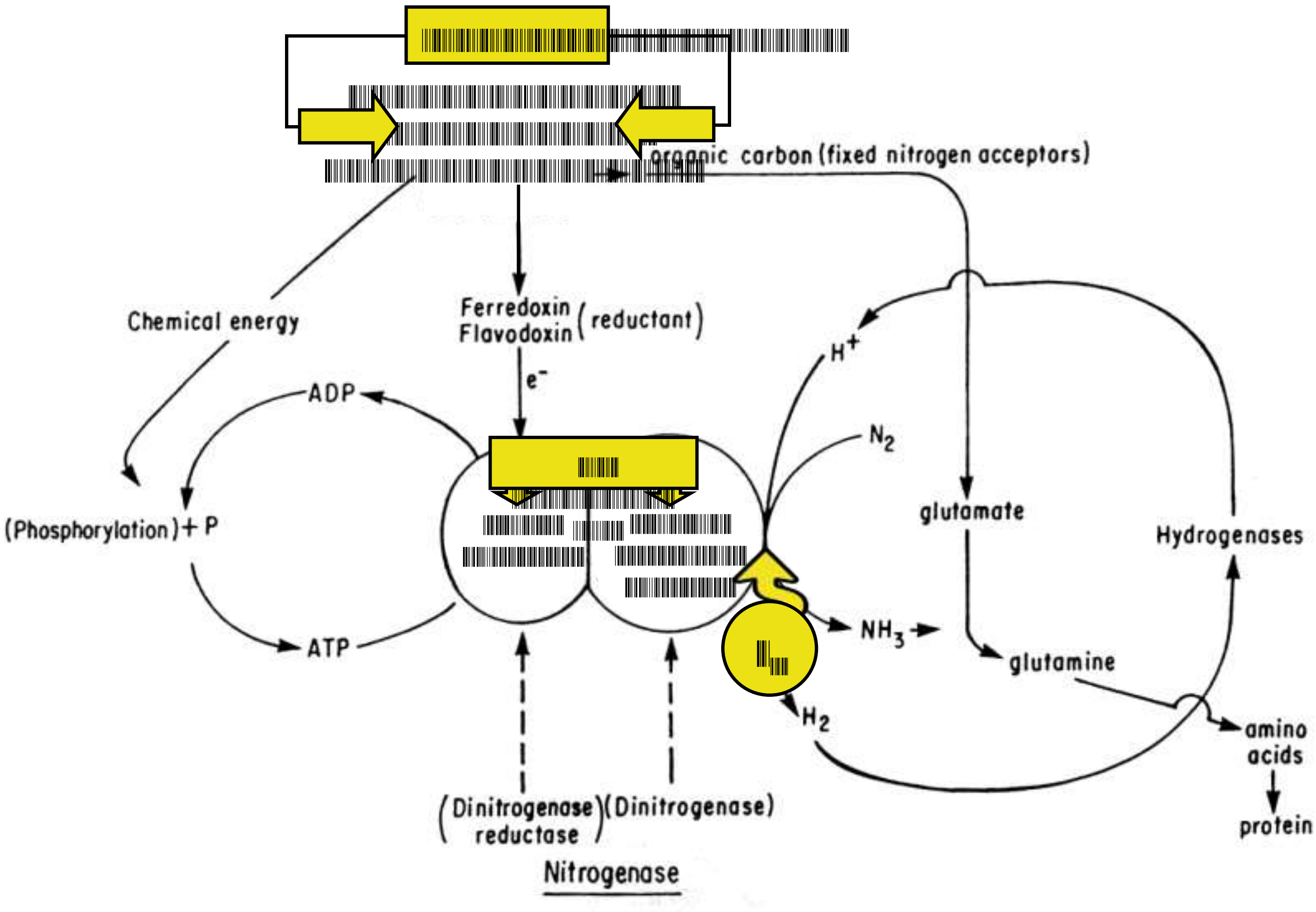
Following cessation of N fertilization, total N, TN:TP, and phytoplankton biomass decreased. N_2 fixation could not keep up with ecosystem N demands.
(Scott & McCarthy L&O 55:1265-1270 (2010))

WHY?????

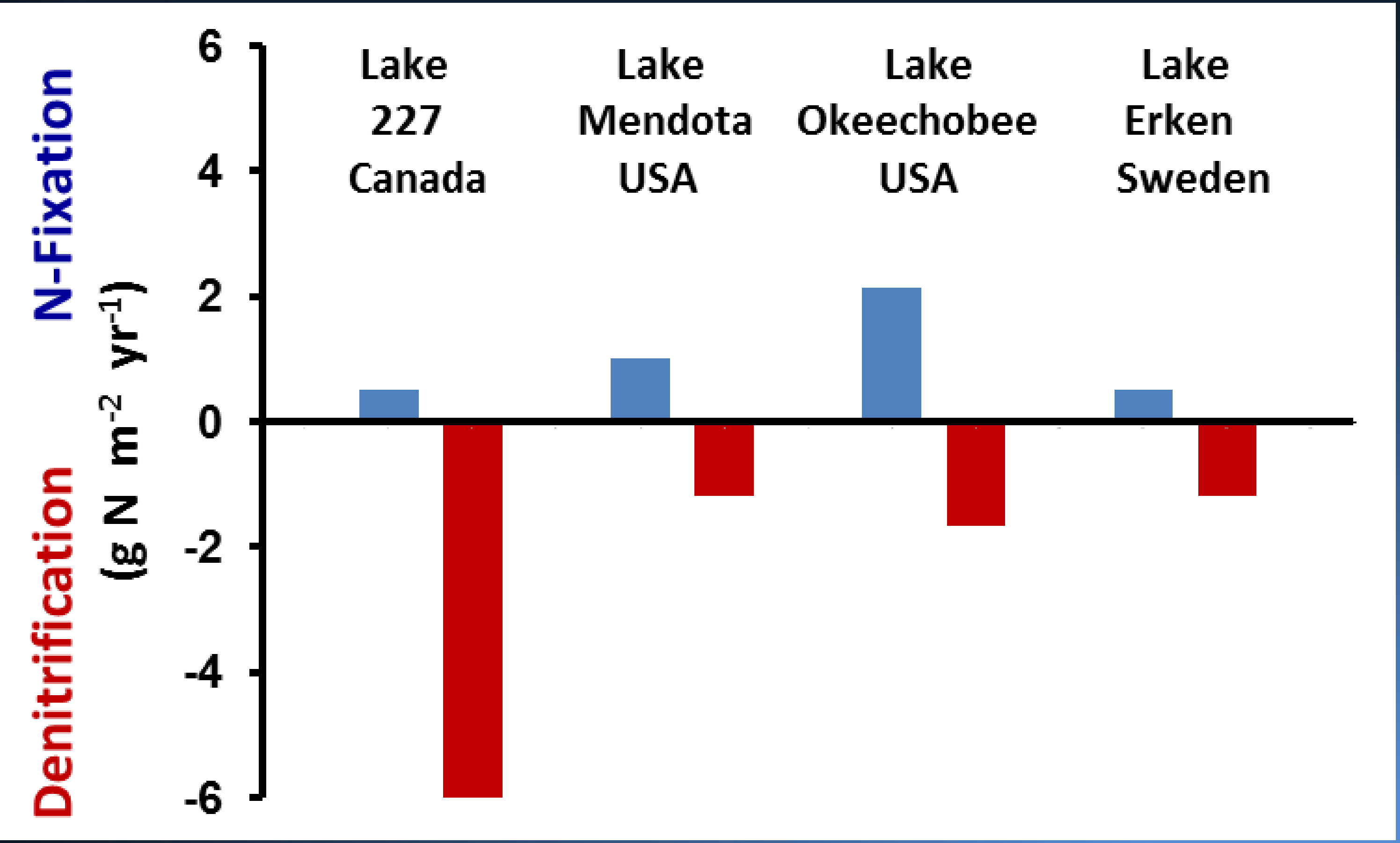
It's not because there's a shortage of N2 fixing taxa



Controls on N_2 fixation: It's not just P or N:P…Other controls



Also, on the ecosystem scale, N_2-fixation may be offset by denitrification

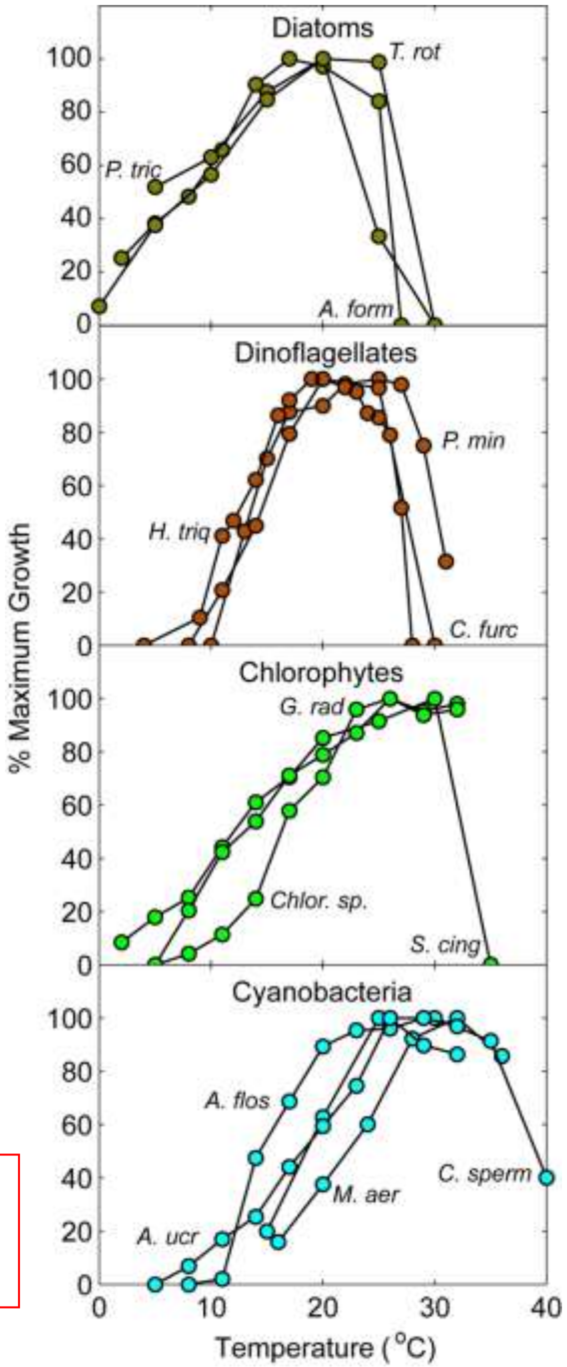


Take home message: Additional external N inputs can accelerate eutrophication

Paerl and Scott (2010) Env. Sci Tech. 44

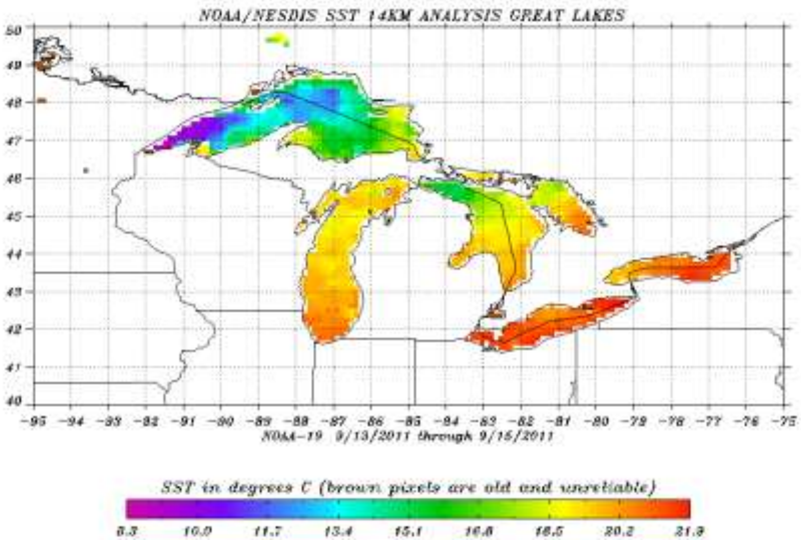
Confounding Impacts of Climate Change: It's Getting Warmer

The link to CyanoHABs……..
Temperature affects growth rates



References: Kraweik 1982, Grzebyk & Berland 1996; Kudo et al., 2000, Litaker et al., 2002, Briand et al., 2004, Butterwick et al., 2005, Yamamoto & Nakahara 2005, Reynolds 2006

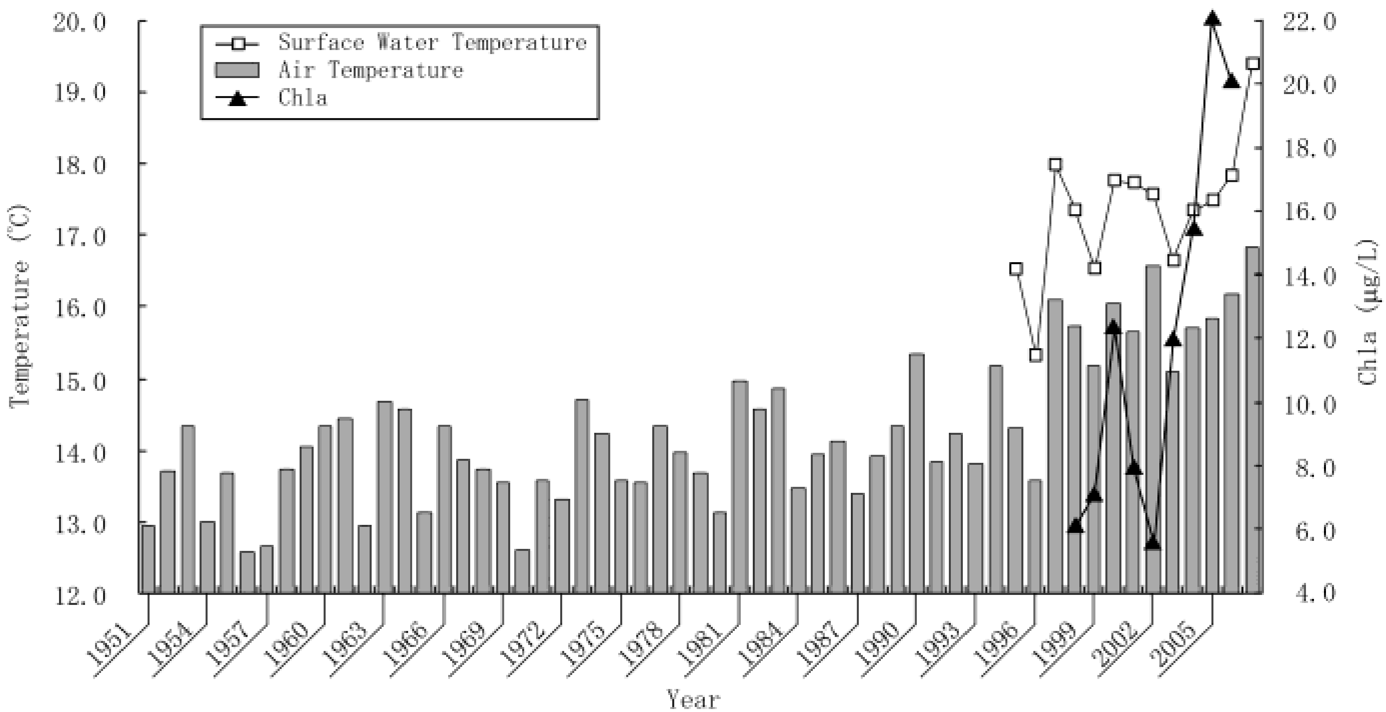
Cyanobacterial resurgence in
Lake Erie (Great Lakes):
Combined effect of eutrophication and
warming?



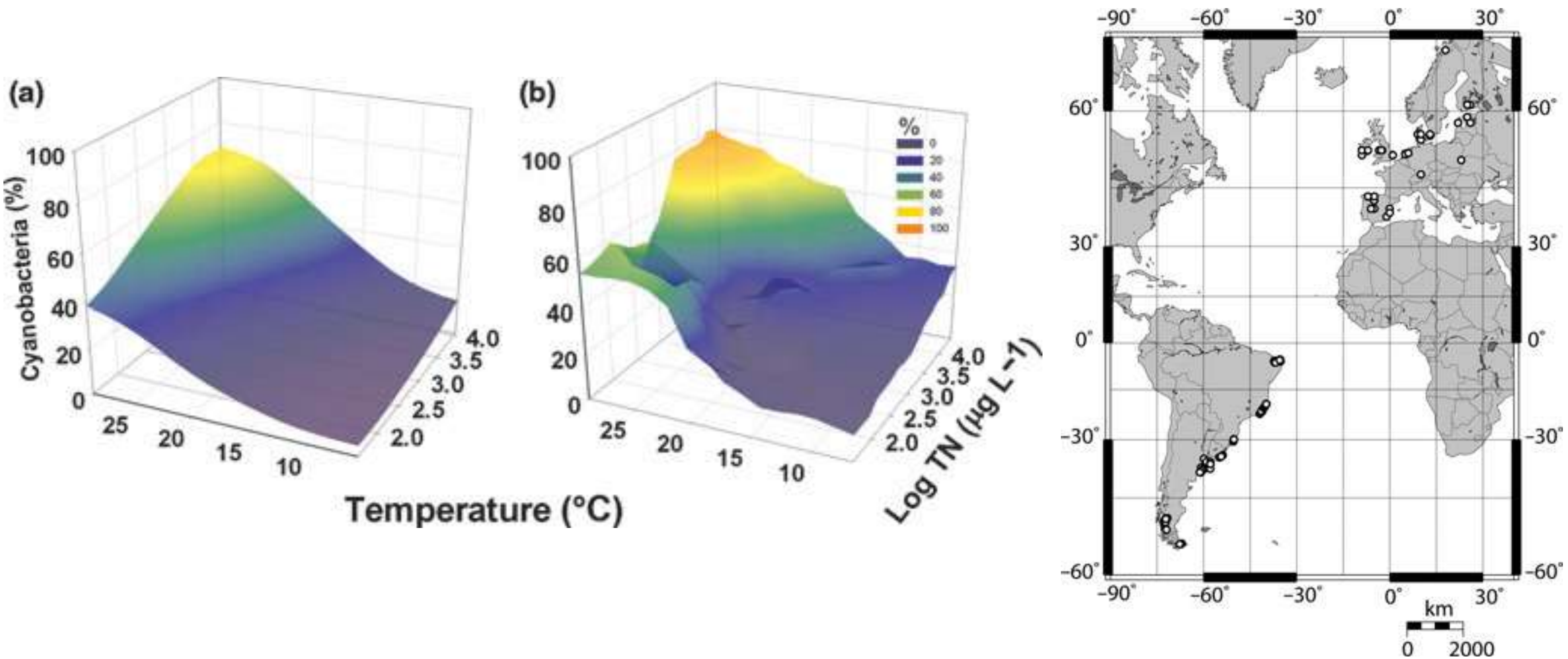
***Microcystis* spp ↗**

Courtesy NOAA/NESDIS & NASA/SeaWiFS

Temperature increases and longer-lasting, more intense cyanobacterial blooms in Taihu. Is warming changing CyanoHAB thresholds?



Cyanobacterial dominance along temperature & nutrient gradients in 143 lakes

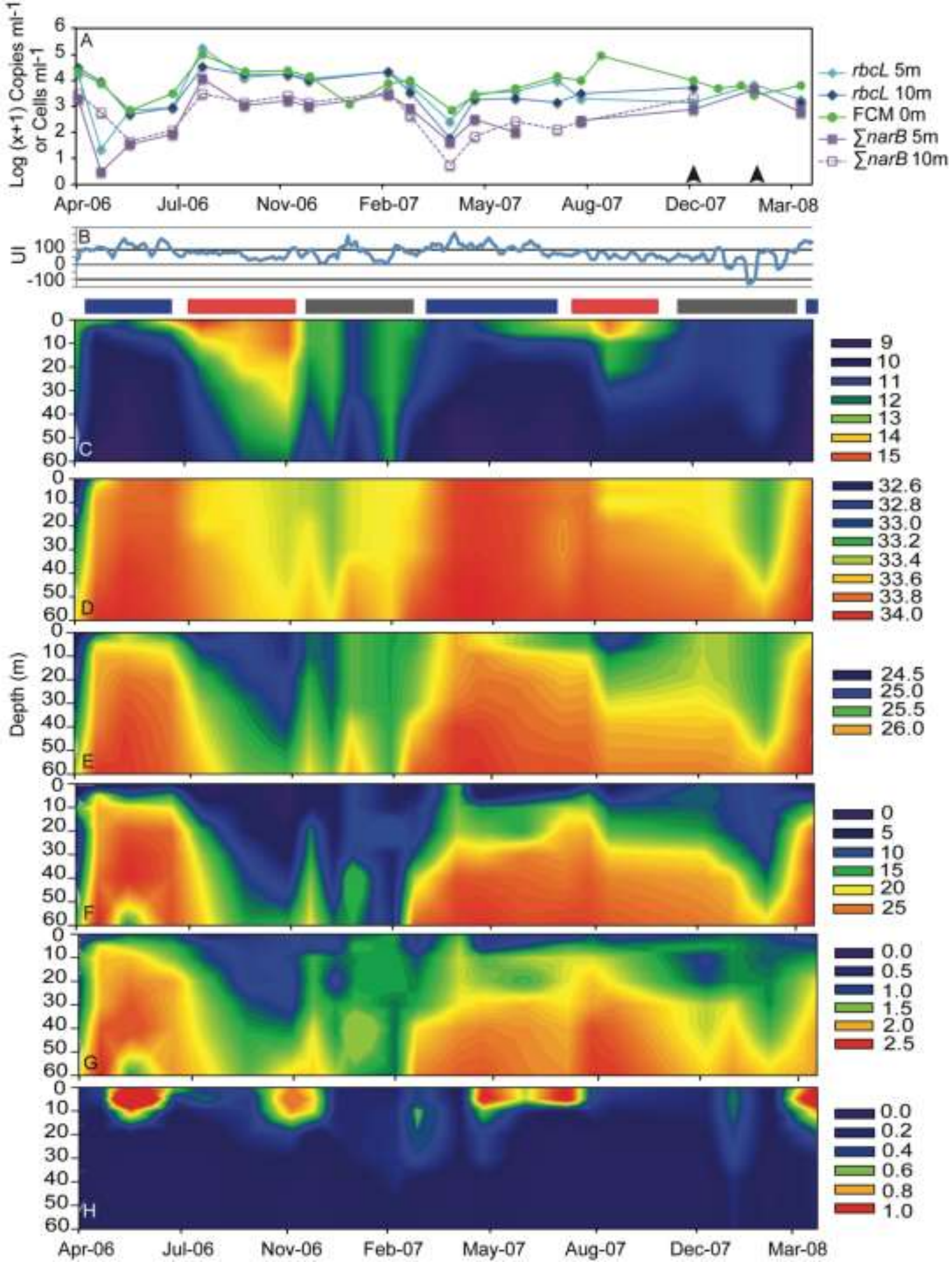


Percentage of cyanobacterial biovolume in phytoplankton communities as a function of water temperature and nutrients in 143 lakes along a climatic gradient in Europe and South America.

(a) Combined effects of temperature and nutrients as captured by a logistic regression model

(b) Response surface obtained from interpolation of the raw data using inverse distance weighting

From Kosten et al. (2011). Global Change Biology DOI: 10.1111/j.1365-2486.2011.02488.x



Temperature and Coastal Cyanos

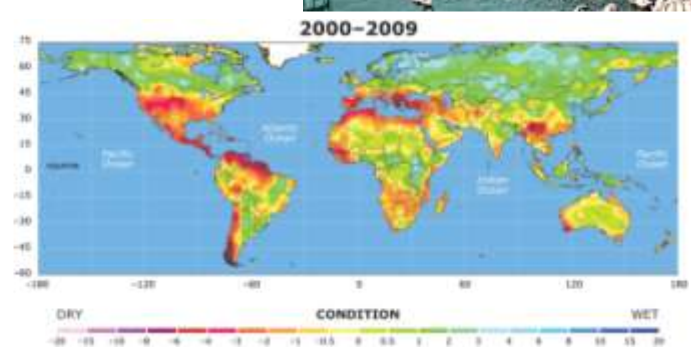
Synechococcus abundance and oceanographic conditions at Station M0 (0 – 60 m), Monterey Bay, CA during 2006 – 2008.

(A) *Synechococcus* abundances determined by *rbcL* qPCR, flow cytometry (FCM) and the sum of abundances from all 5 *narB* assays. (B) A 7-day running average of the upwelling index (UI). (C) Temperature (C), (D) Salinity, (E) Sigma T, (F) Nitrate (μM), (G) Phosphate (μM) and (H) Fluorescence (fsu) data from M0 profiles.

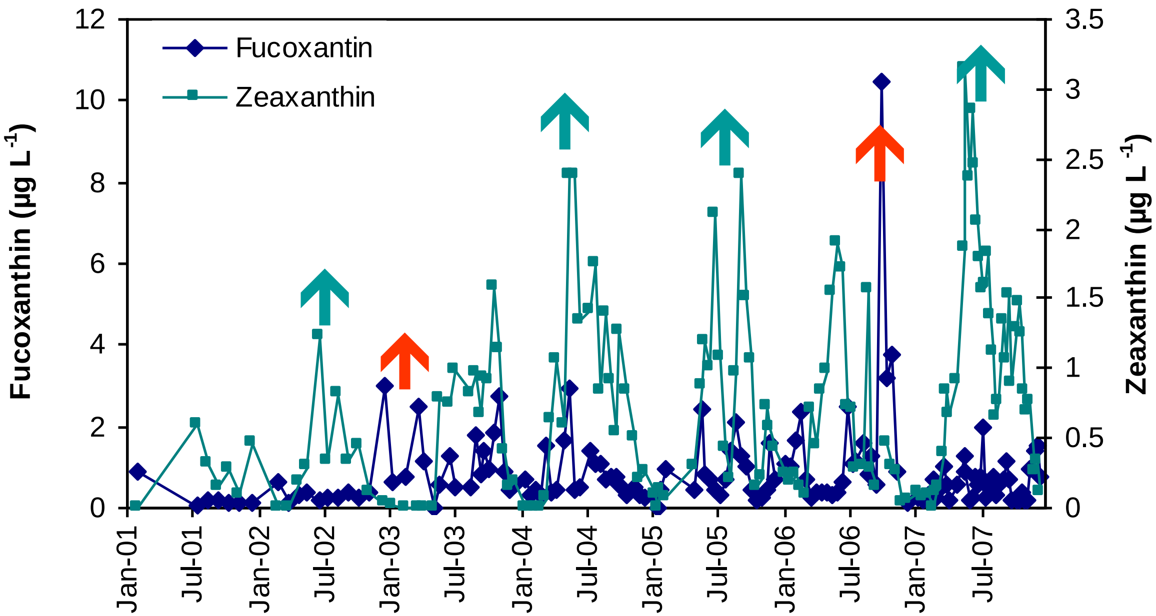
R.W. Paerl et al., 2011
Environ. Microbiol.

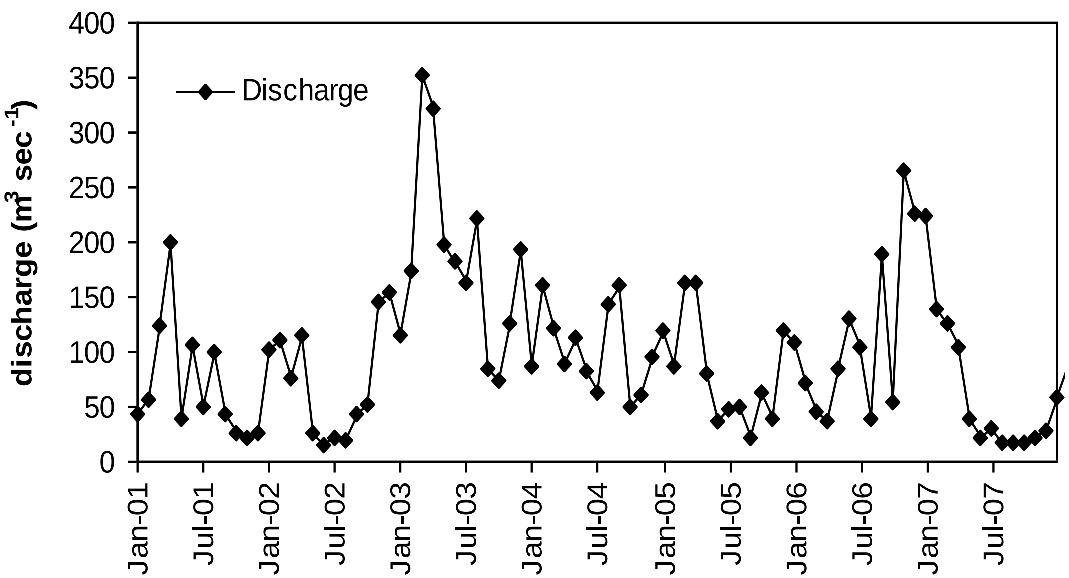
Hydrologically: Things are getting more extreme

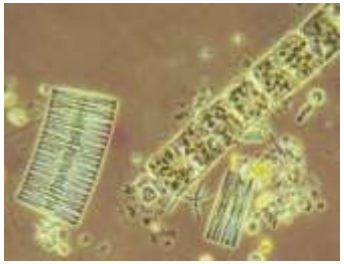
- **Storms, droughts more intense, extensive & frequent**



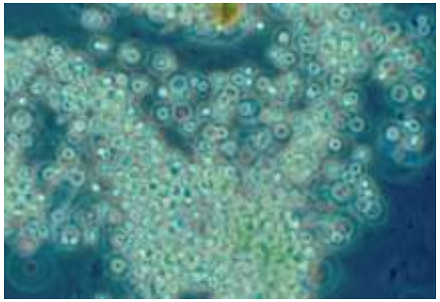
Hydrology (flushing) interacts with temperature to determine diatom (fucoxanthin) and cyanobacterial (zeaxanthin) dominance in Neuse River Estuary







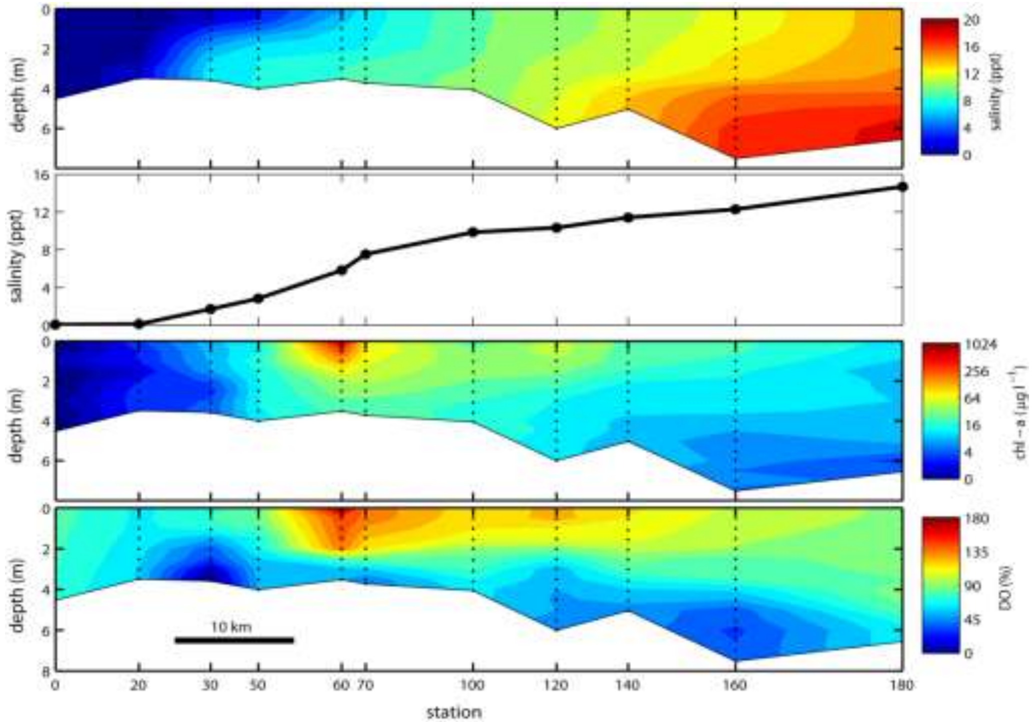
Diatoms like it cool & fast

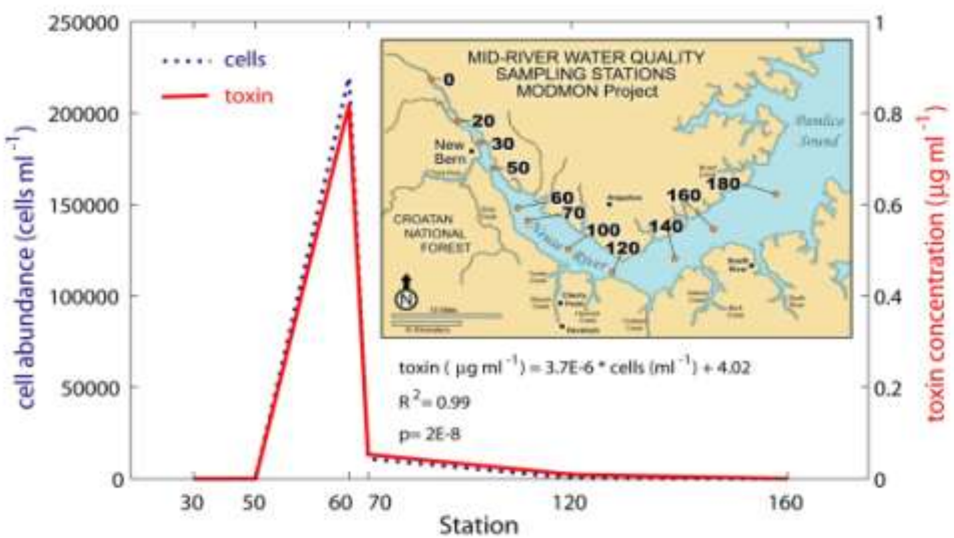


Cyanos like it hot & slow

Paerl et al. 2009

A toxic dinoflagellate (*Karlodinium*) bloom following nutrient-enriched runoff from Tropical Storm Ernesto, Oct. 2006





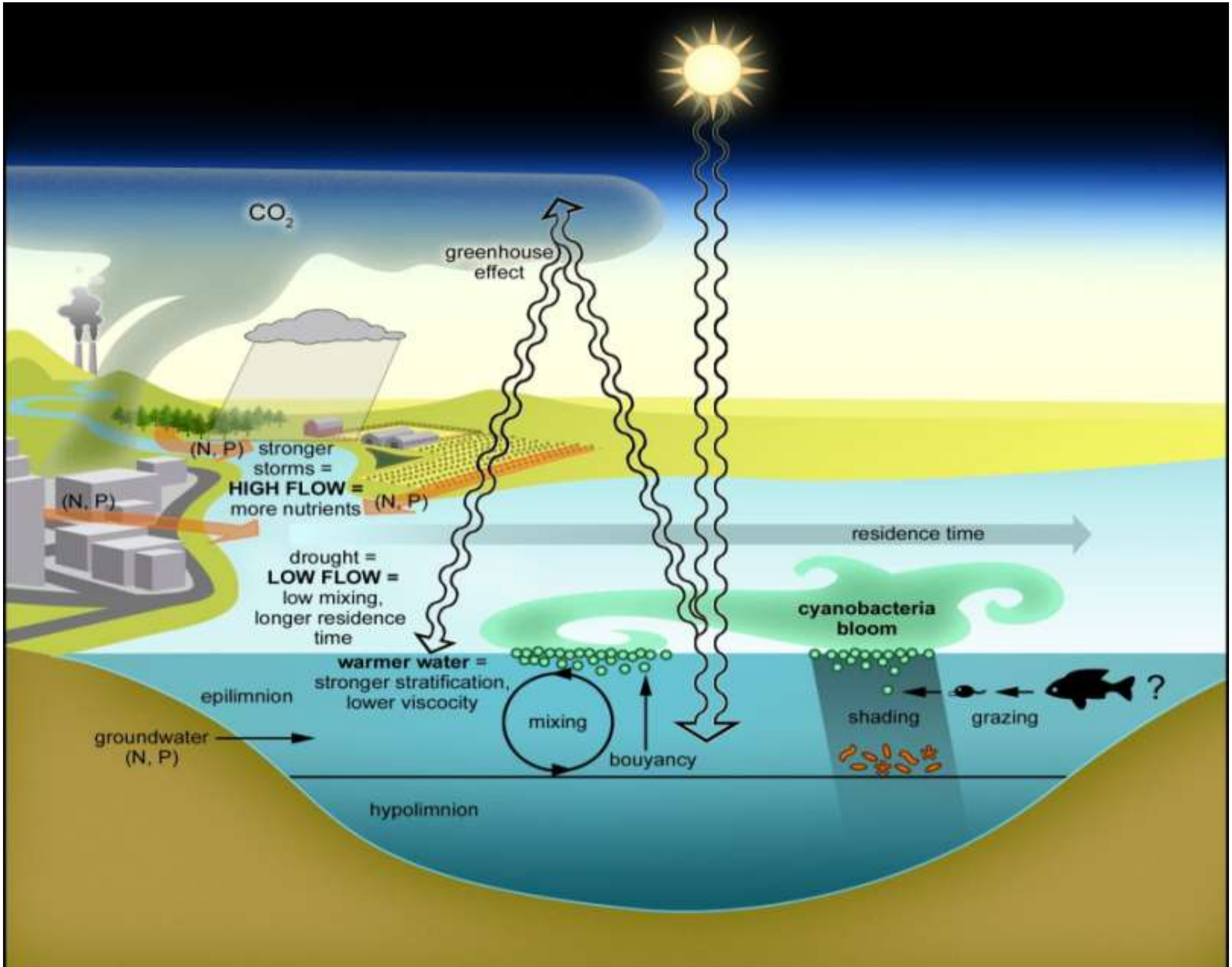
- Runoff associated with Ernesto contained nutrient load and set up strong salinity stratification.

- Favorable light and temperature conditions created ideal conditions for an algal bloom.

- Near-surface stratification was favorable for motile dinoflagellates; *Karlodinium* prefers these conditions in fall.

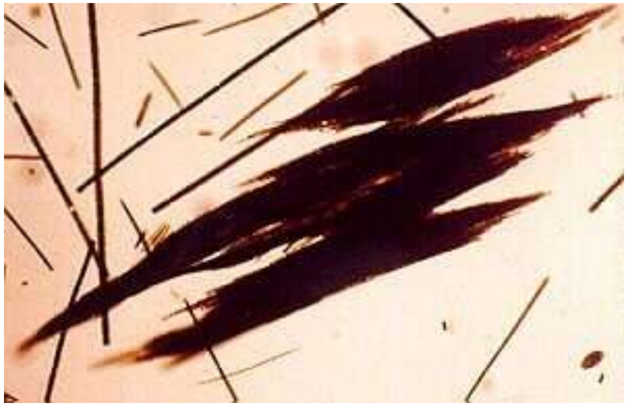
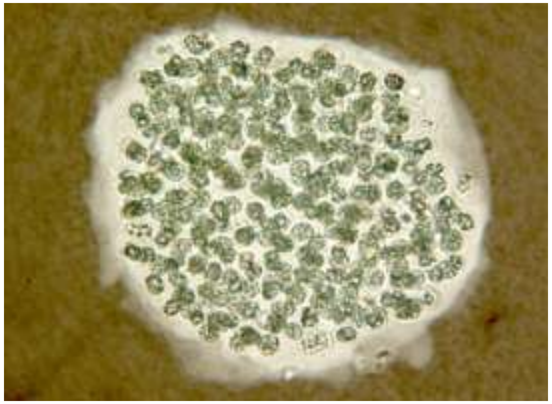
Hall et al. 2008

Global warming, associated climate change and Cyanobloom potential



Management Ramifications

- In most cases, both N & P reductions are needed
- Nutient-bloom threshold are system-specific
- Nutrient-bloom thresholds may be changing
  - May need to reduce N and P inputs even more in a warmer world
- Nutrient input restrictions over longer seasons
- Nutrient N/P input ratios may need to be reformulated
  - If cyanos are favored by higher temperatures, longer warm seasons

Relevant references

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Thanks!!

www.unc.edu/ims/paerllab/research/cyanohabs/

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H. Xu
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TLLER "crew"

NSF

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Questions?

Nutrient Pollution Solutions: EPA's Approach

Ellen Gilinsky, Senior Policy Advisor

U.S. EPA Office of Water

Linking Nutrient Pollution and HABs Webinar:

State of the Science and EPA Actions

September 25, 2013

Outline

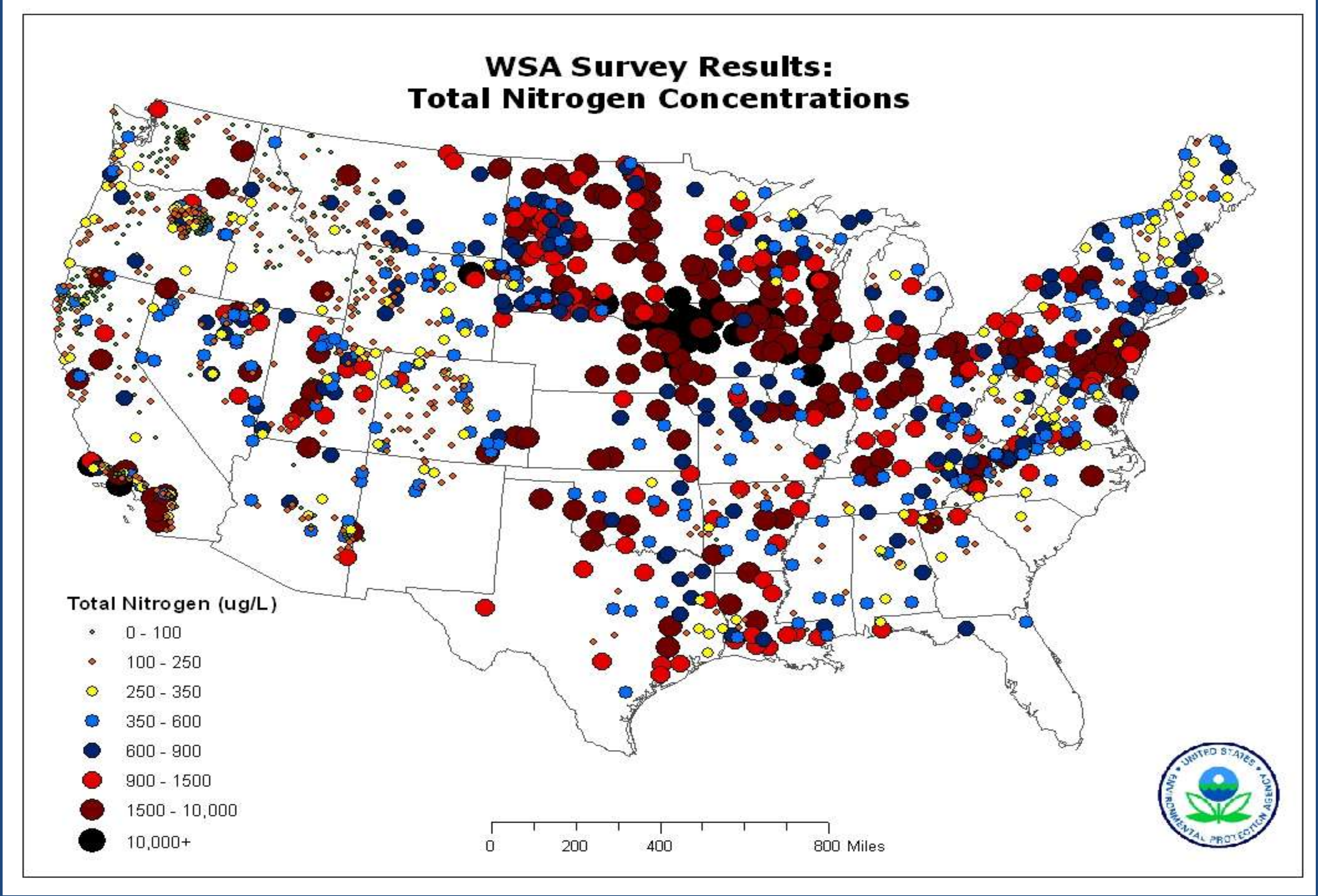
- National Scope of Nutrient Pollution
- Public Health and Aquatic Impacts
- Our Goals and How We Will Get There
- Nitrogen & Phosphorus Sources
- Call to Action: Helping State Progress via Nutrient Frameworks
- Looking Ahead

The Problem……

National Scope of Nutrient Problem

- **Well Documented Problem and Impacts, e.g.:**
  - EPA: Science Advisory Board (2007), Wadeable Streams and Lakes Assessments (2006, 2008), National Coastal Condition Report III (2008)
  - National Research Council: Mississippi River Water Quality (2008), Urban SW (2008)
  - USGS: Impact of Nutrients on Groundwater (2010), SPARROW Loadings (multiple)
  - Many published articles, State and university reports
  - State EPA Nutrient Innovations Task Group (NITG) *Call to Action* Report
- **15,000 Nutrient-related Impairment Listings in 49 States**
  - 2.5 Million Acres of Lakes and Reservoirs & 80,000 Miles of Rivers and Streams
  - >47% of Streams have Med to High P; >53% have Med to High N
- **78% of Assessed Continental U.S. Coastal Area Exhibits Eutrophication Symptoms**
- **168 Hypoxic Zones in U.S. Waters**
- **Public Health Risks – Contaminated Drinking Water is Significant & Costly**
  - Rate of nitrate violations in community water systems doubled over past 7 years

Concentrations of Nitrogen Nationally Wadeable Streams Assessment (surface water)

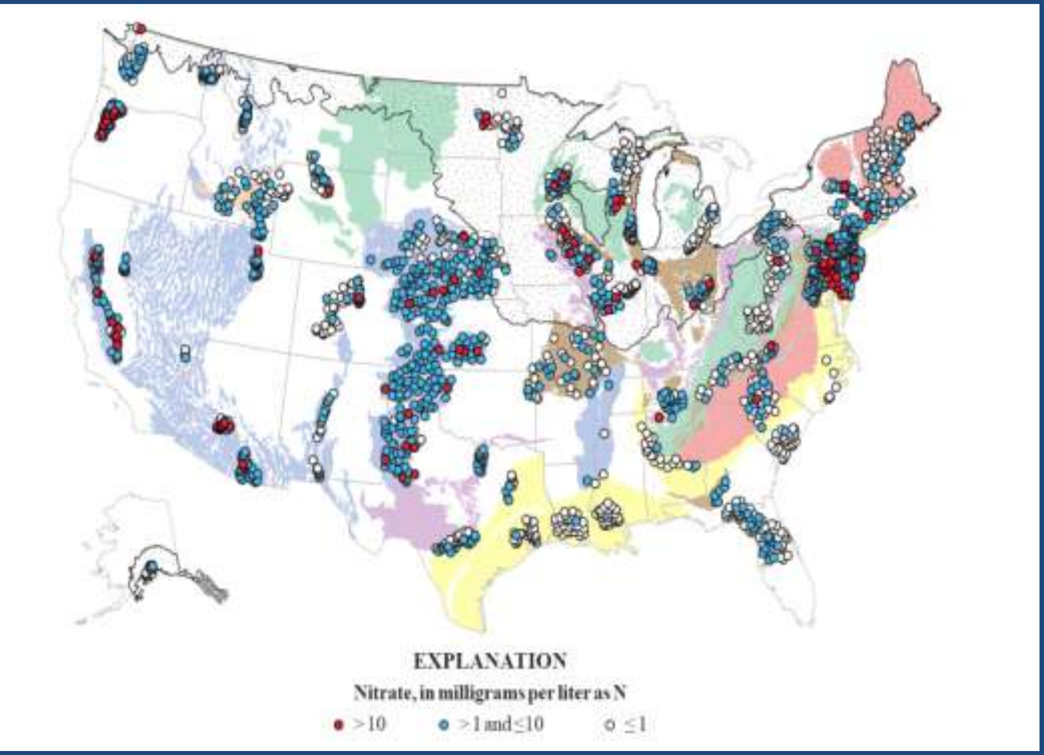


2010 USGS Report Nutrients in Streams & Groundwater

- Analysis of occurrence data from 1992 to 2004
- Nitrate MCLG exceeded in 7% of 2,400 DW wells sampled
- Nitrogen concentrations generally highest in Ag streams in Northeast, Midwest, & Northwest
- Despite substantial Federal, State and local efforts, limited national progress during this period
- Nitrate concentrations likely to increase in drinking water aquifers over next decade as nitrogen moves into groundwater system

National Drinking Water Impacts

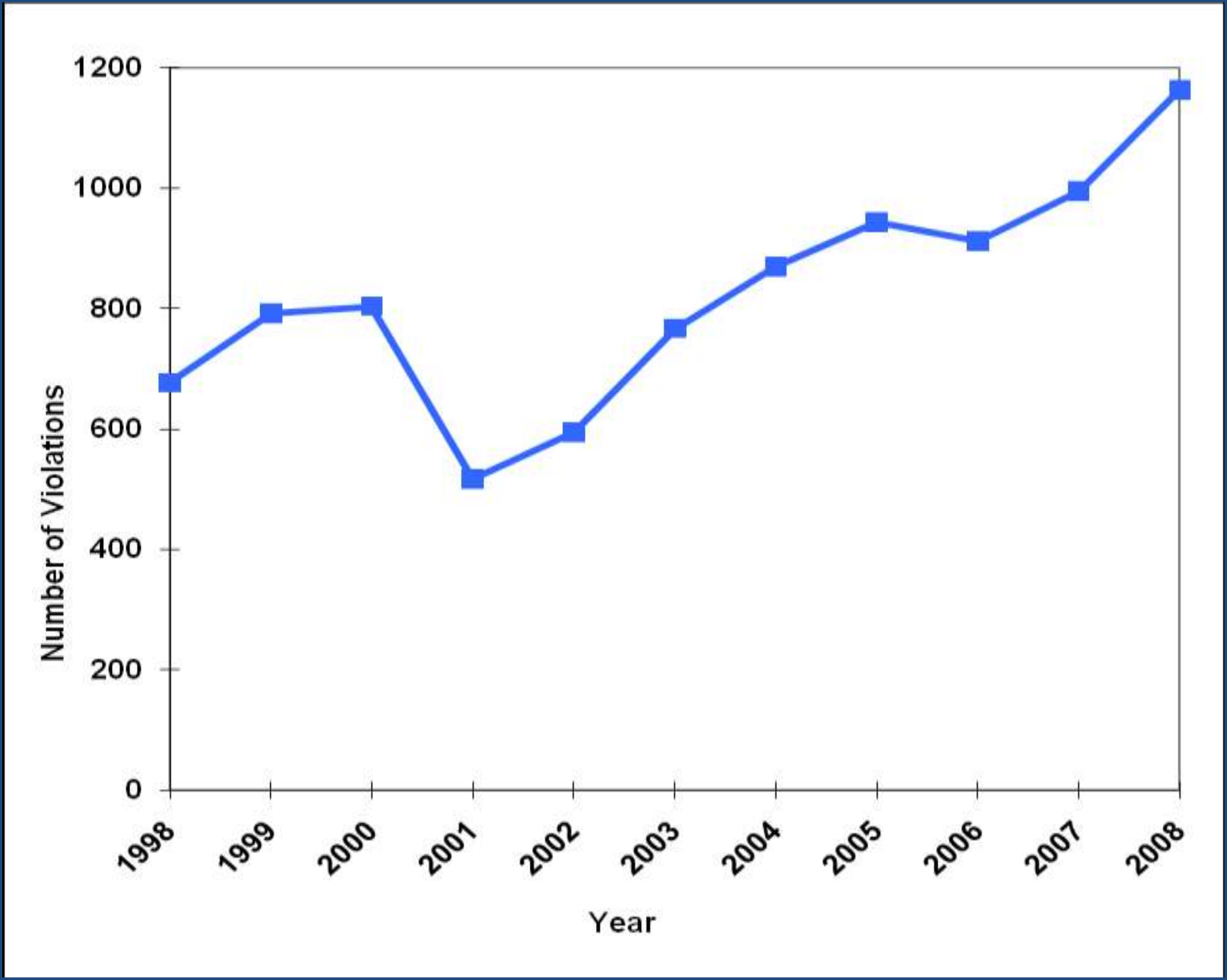
- Public Health Risks:



(MCL of 10 mg/l exceeded as N in 4.4 percent of the wells)

– Disinfectant by-products; significant & costly
– Contaminated drinking water supplies
– Rate of nitrate violations in community water systems doubled over past 7 years
– Harmful algal blooms
– Increased treatment costs
    - Large Systems
    - Small Systems
    - Private Wells

Community Water System (CWS) Drinking Water Nitrate Violations



Examples of Impaired Reservoirs

Microcystis bloom - August 2003

Grand Lake St. Mary’s Ohio 2010

Examples of Impaired Streams

Impacts on Downstream Waters

Microcystis Bloom – Goodby's Creek at the St. Johns River, Jacksonville, FL – September 14, 2005

[Health Advisory listed by the FL Department of Health as a result of algal blooms and fish kill in the St. Johns River, Jacksonville, FL - June 15, 2010]()

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Our Goals

- **Reduce** sources of nitrogen and phosphorus pollution
- **Restore** surface and ground waters already degraded by nutrient pollution
- **Build** federal/state/local capacity to plan for and reduce such pollution through both voluntary and regulatory means
- **Communicate** the effects of nutrient pollution

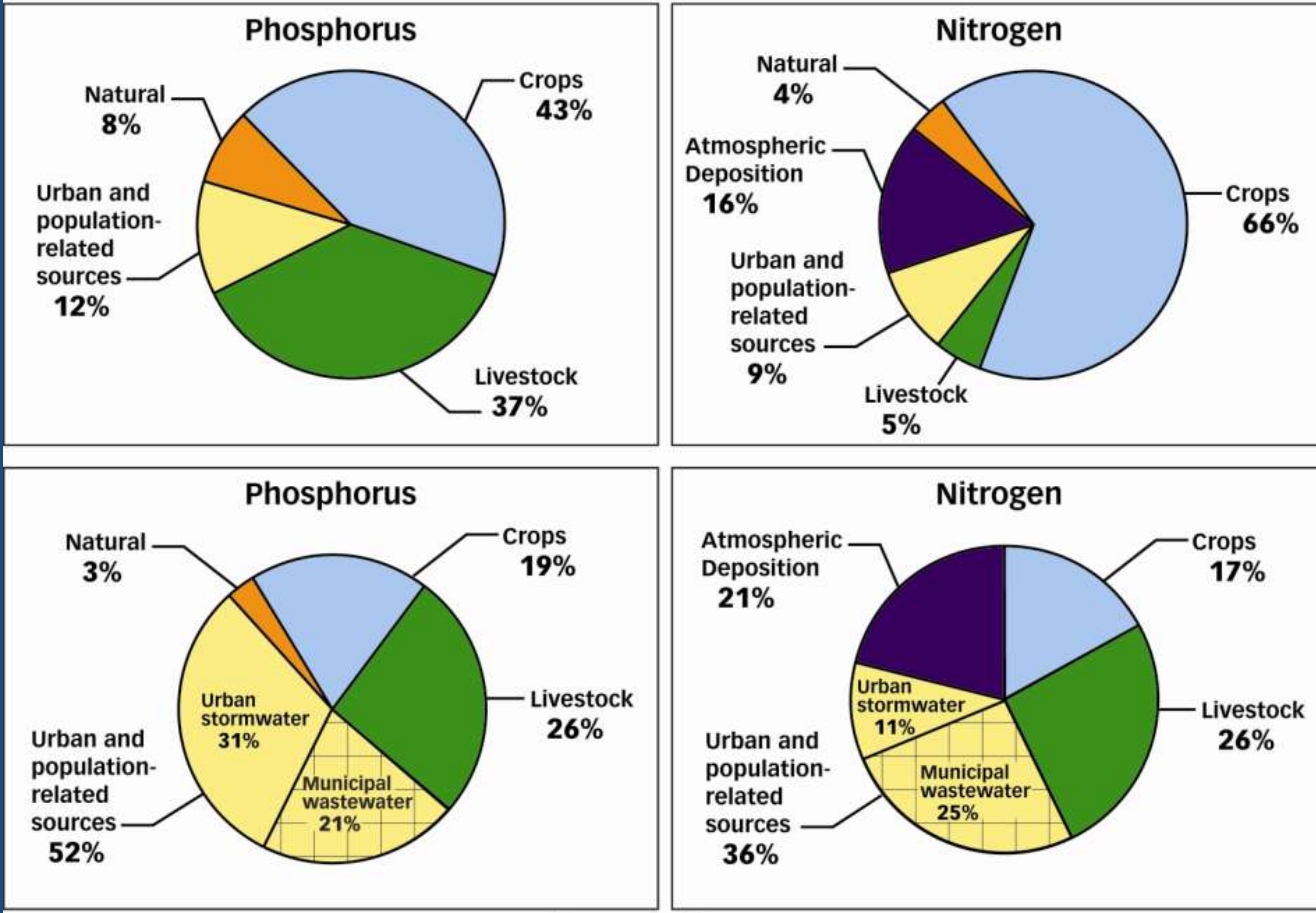
How Will We Get There?

- Set the stage – work with states' nutrient frameworks
- Pollution prevention, protecting source water and healthy waters, plus restoring waters
- Innovation – promote cost effective and practical solutions
- Assess how we're doing
- Reach the public

What are the N & P Sources?

- **Municipal Wastewater Treatment**
  - Among most heavily regulated sectors, treat >18 mil tons of human waste annually
  - >16,500 municipal treatment system permits, ~7% have numeric limits, 18% monitor
- **Atmospheric Nitrogen Deposition**
  - Regulations in place, more underway
  - These sources can be significant, e.g., in the Chesapeake Bay and Mississippi River watersheds, atmospheric N accounts for 21%
- **Urban Stormwater**
  - 80% of U.S. lives on 10% of land, urban pop impacting coastal areas
  - 50% of existing urban landscape redeveloped by 2030, and additional 30% of undeveloped land likely to be developed
- **Agricultural Livestock**
  - $130 Billion Industry , >1 bil tons of manure annually
  - Largely Unregulated by CAFO Rule
- **Agricultural Row Crops**
  - $120 Billion Industry, in many areas a significant source of N&P
  - Exempt from CWA, variable controls at State level

Gulf of Mexico



Chesapeake Bay

National Population Growth

- Nutrient Impacts Reflect Doubling of U.S. Population Over Past 50 Years
- Additional 135 Million People by 2050
- Nutrient Pollution Expected to Accelerate

Year	U.S. Population
1950	152 million
2008	304 million
2050	439 million

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What are the Tools?

- **TMDLs (Clean-up Plans)– Essential, but really enough?**
  - Wait Until There's a Problem?
  - Restoration over Prevention - Expensive
  - No Protection for High Quality or Attained Waters
  - We're Losing Ground
- **Permit Limits**
  - Hard to Manage Without Clear Numeric Targets
- **Priority Best Management Practices in Priority Watersheds**
- **Nutrient Criteria**
  - Narrative - Qualitative Goals (traditional approach)
  - Numeric - Quantitative & Measureable Goals
    - Causal and/or response variables?

Why a Nitrogen and Phosphorus Pollution Framework Now?

- Current efforts to address hard fought but collectively inadequate
- Potential to become one of the costliest and most challenging environmental problems
- Growing population = more N and P pollution from urban stormwater, municipal and industrial wastewater discharges, air deposition, agriculture
- To protect public health and the environment, need to act *now* to reduce N and P loadings -- while states continue to develop numeric nutrient criteria and standards
  - Since 1998, EPA has encouraged states to develop numeric nutrient criteria to gauge N and P pollution and develop and implement appropriate solutions

Framework: Guiding Principles

- **Results, results, results**: build from existing state work but accelerate progress and demonstrate clear results

- Encourage a collaborative approach between federal partners, states, and stakeholders

- States need flexibility to achieve near-term reductions in N and P pollution while they make progress on their long term strategies

Framework Elements: Assessment and Prioritization

- Prioritize watersheds by state for nutrient loading reductions
  - Estimate N & P loadings delivered to waters in all major watersheds across the state at HUC8 scale or smaller
  - ID watersheds that account for substantial portion of urban and/or ag
  - ID targeted/priority HUC12 or similar watersheds for targeted N & P load reduction activities, considering receiving water problems, drinking water supply impacts, nutrient loadings, opportunity to address high risk nutrient problems, etc.

- Base watershed load reduction goals on best available information
  - Set numeric goals for loading reductions for each targeted/priority HUC12 that will collectively reduce the majority of N & P loads from identified HUC8

Framework Elements: ID and Implement Metrics, Measures, and Practices to Reduce Loads

- Ensure Effectiveness of Point Source Permits in Targeted/ Priority Sub-watersheds
  - Municipal and Industrial Wastewater Treatment Facilities
  - Concentrated Animal Feeding Operations (CAFOs)
  - Urban Stormwater
- Agricultural Areas
  - Partner with federal & state agricultural partners, NGOs, landowners
  - Consider innovative approaches (e.g., stewardship initiatives, markets)
  - Accelerate adoption of most effective conservation practices where most needed
- Reduce Stormwater Runoff and Septic System Impacts
  - Use state, county and local government tools in communities not covered by MS4 program to address runoff (including LID/GI approaches) and septic systems, consider limits on P use

Framework Elements: Accountability and Transparency

- Accountability and Verification Measures
  - Identify which tools will be used within targeted/priority sub-watersheds to ensure reductions
  - Verify that load reduction practices are in place
  - Assess/demonstrate progress in implementing and maintaining management activities and achieving load reductions goals

- Annual public reporting of implementation activities and biannual reporting of load reductions and environmental impacts associated with each management activity in targeted watersheds
  - Establish process to annually report for each watershed
  - Share annual report publically on the state’s website with request for comments and feedback for an adaptive management approach

Framework Elements: Numeric Criteria

- Develop work plan and phased schedule for developing numeric criteria for classes of waters (lakes/reservoirs, rivers/streams, and estuaries)
  - Should contain interim milestones, e.g., data collection, data analysis, criteria proposal, and criteria adoption consistent with the CWA
  - Reasonable timetable: complete numeric N & P criteria for at least one class in accordance with a robust, state-specific and phased workplan

- Fundamental goal: states will develop numeric WQS on a longer schedule while continuing to reduce loads

Potential Federal Resources

- US EPA –through the State Water Quality Agencies
  - Water Quality Management Planning – Section 604(b)
  - Water Pollution Control Program Grants – Section 106
  - Nonpoint Source Implementation Grants – Section 319
  - State Revolving Fund Program
- USDA Farm Bill Conservation Programs
  - CIG, EQIP, CRP, CCPI, WREP…
- USGS (Cooperative Monitoring Program – state contracts with USGS for water quality monitoring)
- Department of the Army (USACE: 1135, 204, 206)

EPA Technical Assistance: N and P Pollution Data Access Tools

- NPDAT - Consists of a geospatial viewer, introductory website, and data download tables: www.epa.gov/nutrientpollution/npdat
  - Provides streamlined access to data, in commonly-used formats
- Nutrient Indicators Data Set - http://www2.epa.gov/nutrient-policy-data/nutrient-indicators-dataset
- Supports states as they consider
  - Extent and magnitude of N and P pollution
  - Water quality problems and vulnerabilities related to this pollution
  - Potential pollution sources

Looking Ahead – Key Priorities

- Drinking Water & Ecological Risks and Economic Impacts Documentation
- Broader EPA–USDA Coordination
- Continued Commitment to Science
- Nutrient Management Frameworks
- State Numeric Nutrient Standards
- Broader and More Effective Outreach to Stakeholders
- Stormwater

Questions?

U.S. Environmental Protection Agency
Office of Water
Office of Science and Technology

Numeric Nutrient Criteria: A Vital Tool To Address Nutrient Pollution

Mario Sengco
Standards and Health Protection Division

HAB Awareness Campaign, 25 September 2013

Framework Elements: Numeric Nutrient Criteria

Goal

For states to develop numeric nitrogen and phosphorus water quality standards on a reasonable schedule while making progress on reducing loads in the near-term

Develop work plan and phased schedule for developing numeric criteria for classes of waters (lakes/reservoirs, rivers/streams, and estuaries)

- Should contain interim milestones, e.g., data collection, data analysis, criteria proposal, and criteria adoption consistent with the Clean Water Act
- Reasonable timetable: complete numeric N & P criteria for at least one class of waters in accordance with a robust, state-specific workplan and phased schedule

What Are Nutrient Criteria?

40 CFR 131.3(b) – "Criteria are elements of State water quality standards expressed as constituent concentrations, levels or narrative statements, representing a quality of water that supports a particular use."

http://earthobservatory.nasa.gov/Features/WaterQuality/Images/secchi_comparison.jpg

Nutrient criteria:

Causal parameters – nitrogen (N), phosphorus (P)

Response parameters – chlorophyll *a*, turbidity

http://www.waterencyclopedia.com/images/wsci_01_img0017.jpg

Forms of nutrient criteria:

Numeric

Causal: TN = 0.56 mg/L; TP = 33 µg/L

Response: chl *a* = 2.4 µg/L; Secchi depth = 1 m

Narrative

Causal: Concentration to support balanced flora and fauna

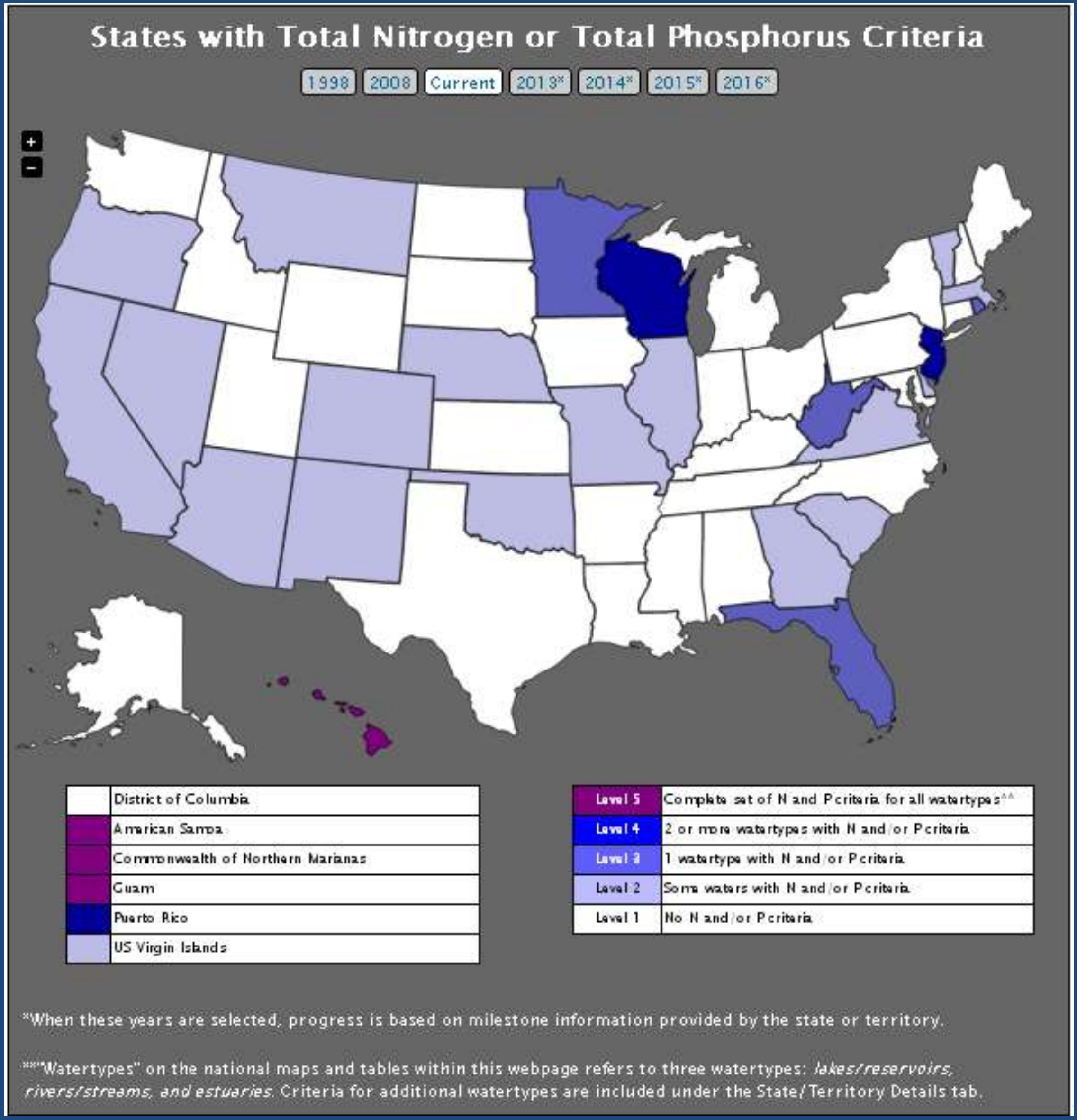
Response: Free from floating or nuisance algae

Why Adopt Numeric Nutrient Criteria?

Numeric N and P criteria will allow for more efficient and effective implementation of state WQS programs by:

- Facilitating state water quality assessments;
- Ensure protection of state waters by identifying nutrient problems *before* ecosystem responses are observed;
- Facilitating and expediting NPDES permit writing and development of TMDL loads for N and P.

Progress – Where Are We?



http://cfpub.epa.gov/wqsits/nnc-development/

A New Nutrient "Toolkit"

- Product of collaboration between EPA and the Association of Clean Water Administrators (ACWA)

- Provide information to facilitate state adoption of nutrient criteria.
    - EPA – Federal government resources
    - ACWA – non-EPA resources and state examples

- Audience: Agency, state, & NGO resources to facilitate adoption of NNC

- Contents:
    - Criteria development resources
    - Monitoring, assessment, reporting, planning
    - Permitting, WQBELs, trading
    - Economics/financing
    - Communications

Nutrient Toolkit

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Toolkit of Resources to Provide States with Flexibility in Adopting and Implementing Numeric Nutrient Criteria

EPA has developed a toolkit that provides all available Agency resources to facilitate state adoption of numeric nutrient criteria. Toolkit of Resources to Provide States with Flexibility in Adopting and Implementing Numeric Nutrient Criteria presents states, territories, and tribes with the resources to address: criteria and standards development; water quality monitoring, assessment, reporting, and planning; permitting, WQBELs, and trading; economics and financing; and communications materials. This dynamic toolkit will be updated as new Agency materials are developed.

The Association of Clean Water Administrators (ACWA) has developed a companion Nutrient Toolkit page, where a similar set of state materials will be housed. ACWA is announcing the release of the preliminary state toolkit today, as well. The preliminary state toolkit is now available at: http://www.acwa-us.org/#!__NNC%20Toolkit.

For further information on states' and territories' progress in adopting numeric nutrient criteria see our State Development of Numeric Criteria for Nitrogen and Phosphorus Pollution website.

Criteria Documents

- Actions to Help States Address Barriers to Numeric Nutrient Criteria Implementation

EPA Nutrient Coordinators

Region	Name	Phone Number
Region 1	Toby Stover Ellen Weitzler	(617) 918-1604 (617) 918-1582
Region 2	Izabela Wojtenko	(212) 637-3814
Region 3	Mark Barath	(215) 814-2759
Region 4	Lauren Petter Ed Decker	(404) 562-9272 (404) 562-9383
Region 5	Brian Thompson Barb Mazur	(312) 353-6066 (312) 886-1491
Region 6	Mike Bira Melinda McCoy	(214) 665-6668 (214) 665-8055
Region 7	Gary Welker	(913) 551-7177
Region		(406) 457-

http://www2.epa.gov/nutrient-policy-data/toolkit-resources-provide-states-flexibility-adopting-and-implementing-numeric

ASSOCIATION OF CLEAN WATER ADMINISTRATORS EST. 1961

Return to Home

Last updated September 2013

Toolkit for Adopting and Implementing Numeric Nutrient Criteria (NNC)

ACWA is pleased to offer this collection of links to State and NGO resources intended to help State Water Quality Regulators assess their ability to adopt and, where applicable, implement NNC. The resources are organized by category. It is ACWA's intent to continue adding relevant resources to this webpage. Please send suggestions to ktracy@acwa-us.org. Additional resources are available on ***EPA's Federal NNC Toolkit Page*** *here.*

Criteria Development

- *Florida's Development of Numeric Nutrient Criteria - see Technical Support Documents, Legislative Reports, and more*
- *Montana's Development of Numeric Nutrient Criteria - see Technical & Economic Reports*
- *Mississippi's Development of Numeric Nutrient Criteria*
- *New Jersey's Nutrient Related Research*

Water quality monitoring, assessment, reporting, and planning for nutrients

- *Maryland's Assessment and Scenario Tool (MAST)*
- *West Virginia Recreational Activity and Filamentous Algae - report on resident tolerance levels to filamentous algae*

Permitting, WQBELs, and trading guidance

- *Long Island Sound nutrient trading (Connecticut)*
- *Wisconsin phosphorus adaptive management and trading initiatives*

Economics/Financing

- *Maryland Water Quality Financing Administration - WQFA administers various loan and grant programs to provide low interest rate loans and/or grant funding for clean water and drinking water capital projects statewide*
- *National Academy of Sciences--Economic Analysis of Final Water Quality Standards for Nutrients for Lakes and Flowing Waters in Florida*
- *Montana's Development of Numeric Nutrient Criteria - see MT's Economic Consideration Reports*
- *Utah's Economic Evaluation of Statewide Nutrient Criteria Development*

Communications Materials

- *Agricultural collaboration: Midwest Cover Crops Council*
- *Illinois Sierra Club - see the Sierra Club's two-page overview of nutrients issues in Illinois*
- *Mississippi River Collaborative - a partnership of environmental organizations and legal centers in Mississippi River states, which works to address nutrient pollution issues*
- *American Farmland Trust - a three-state collaboration to benefit farmers and improve water quality in the Ohio River Basin*

State NNC Development Plans

Many states have such plans. Here are several to peruse:

- Florida's NNC Development Plan (March 2009)
- Wisconsin's Eutrophication Management Strategy (2007)
- New Jersey's Nutrient Criteria Enhancement Plan (2009)
- Colorado's 2002 Nutrient Criteria Development Plan and 2013 Updates

http://www.acwa-us.org/#!__NNC%20Toolkit

Criteria Documents

Technical Guidance, Information and Support

- Manuals
  - Lakes/Reservoirs
  - Rivers/Streams
  - Estuaries/Coastal waters
  - Wetlands
- Stressor–response guidance for nutrient-based criteria
- Factsheet on a dual nutrient management approach
- EPA's CWA 304(a) Recommended Criteria Values by Ecoregions for Rivers/Streams and Lakes/Reservoirs
- N-STEPS (Nutrient Scientific Technical Exchange Partnership and Support)

NOTE: EPA will be providing training to all states and EPA regional offices on the scientific advances in nutrient criteria development in 2014.

http://www2.epa.gov/nutrient-policy-data/toolkit-resources-provide-states-flexibility-adopting-and-implementing-numeric

Policy-Related Documents

- Revised water quality standards handbook
- Revised water quality standards regulations
- "What is a new or revised water quality standard under CWA 303(c)(3)?"
  - FAQs
- Multiple discharger variance FAQs

<u>NEW</u>

- *Actions to Help States Address Barriers to Numeric Nutrient Criteria Implementation (2012-2014)*
- *Guiding Principles on an Optional Approach for Developing and Implementing a Numeric Nutrient Criterion that Integrates Causal and Response Parameters* (2013)

http://www2.epa.gov/nutrient-policy-data/toolkit-resources-provide-states-flexibility-adopting-and-implementing-numeric

Monitoring, Assessment, Reporting and Planning

- AQUATOX – a simulation model for aquatic systems
- Impaired waters and TMDLs
- Nitrogen and phosphorus pollution data access tool (NPDAT)
- Nonpoint source pollution management
- Water quality monitoring and assessment

For additional information:
http://www.acwa-us.org/#!__NNC%20Toolkit

Permitting, WQBELs and Trading

- Compendium of nutrient removal efficiencies for wastewater treatment plant technologies—2013
- Compliance Schedules for Water Quality-Based Effluent Limitations
- Discharge Monitoring Report (DMR) pollutant loading tool
- Emerging technologies report on wastewater treatment
- Municipal nutrient removal technologies reference document
- Nutrient control design manual, state of technology review report
- Water quality trading tools

http://www2.epa.gov/nutrient-policy-data/toolkit-resources-provide-states-flexibility-adopting-and-implementing-numeric

Economics and Financing

- Clean Water State Revolving Fund (CWSRF)

- Compendium of Clean Water Act financing

- EPA spreadsheet tools to evaluate economic impacts for variances, use attainability analyses, and antidegradation

- USDA Farm Service Agency Grants

- Water pollution control program grants (section 106)

- Economic study on the costs associated with nutrient pollution relative to the cost of managing and controlling nutrient pollution (ongoing)

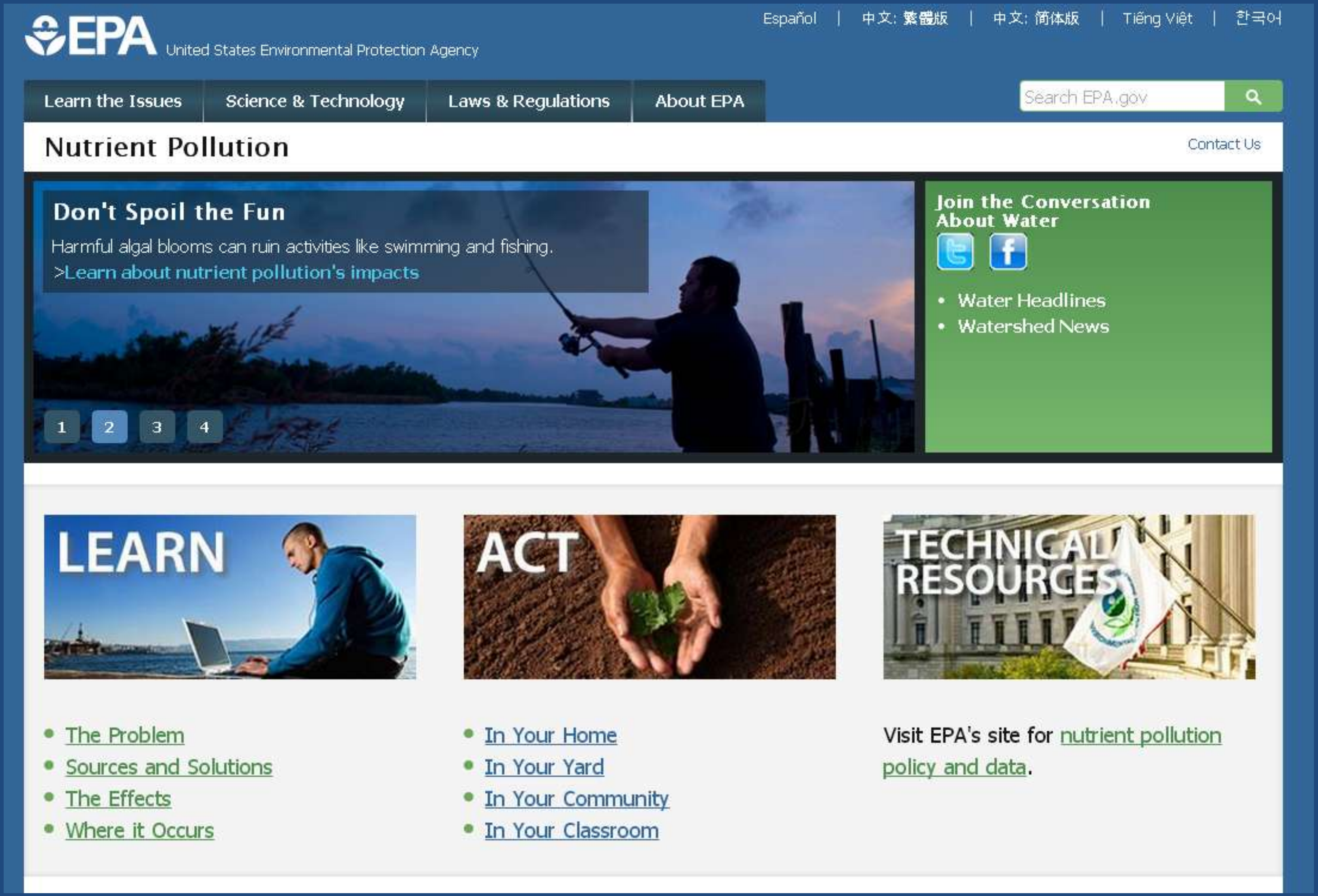
http://www2.epa.gov/nutrient-policy-data/toolkit-resources-provide-states-flexibility-adopting-and-implementing-numeric

Communications

- Community nutrient outreach website
- EPA National Estuary Program (NEP)
- Facts and figures: EPA nutrient pollution policy and data
- Slides: Previous EPA nutrient management presentations

http://www2.epa.gov/nutrient-policy-data/toolkit-resources-provide-states-flexibility-adopting-and-implementing-numeric

Learn More About Nutrient Pollution



http://www.epa.gov/nutrientpollution

Learn More About Harmful Algal Blooms

EPA United States Environmental Protection Agency

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Cyanobacterial Harmful Algal Blooms (CyanoHABs)

Algae are natural components of marine and fresh water flora performing many roles that are vital for the health of ecosystems. However, excessive growth of algae becomes a nuisance to users of water bodies for recreation activities and to drinking water providers. Excessively dense algal growth could alter the quantity and quality of light in the water column. Some types of algae may also cause harm through the release of toxins. When conditions like light availability, warm weather, low turbulence and high nutrient levels are favorable, algae can rapidly multiply causing "blooms." When blooms (or dense surface scums) are formed, the risk of toxin contamination of surface waters increases especially for some species of algae with the ability to produce toxins and other noxious chemicals. These are known as harmful algal blooms (HABs).

Algal bloom at Grand Lake St. Mary's, Ohio, 2010. Photo by Russ Gibson, Ohio EPA

The Harmful Algal Bloom and Hypoxia Amendments Act of 2004 mandates that the National Oceanic and Atmospheric Administration (NOAA) advance the scientific understanding and ability to detect, monitor, assess, and predict HABs and hypoxia events in coastal waters and the Great Lakes. Research and advances in knowledge have occurred regarding marine HABs. However, research on U.S. inland and fresh waters HABs has not been as extensive with the greatest federal efforts focused on the Great Lakes.

http://www2.epa.gov/nutrient-policy-data/cyanobacterial-harmful-algal-blooms-cyanohabs

Reducing Your "Nutrient Footprint"

EPA United States Environmental Protection Agency

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Nutrient Pollution

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What You Can Do

We can all take action to reduce nutrient pollution through the choices we make around the house, with our pets, in lawn maintenance, and in transportation. Families, individuals, students and teachers can access resources online to find out more about the health of their local waterways and participate in community efforts to make their environments healthier and safer.

Learn how you can help prevent nutrient pollution:

- In your home
- In your yard
- In your community
- In your classroom

Contact Us to ask a question, provide feedback, or report a problem.

http://www2.epa.gov/nutrientpollution/what-you-can-do

Reducing Your "Nutrient Footprint"

Cleaning Supplies-Detergents and Soaps

- Choose phosphate-free detergents, soaps, and household cleaners.
- Select the proper load size for your washing machine.
- Only run your clothes or dish washer when you have a full load.
- Use the appropriate amount of detergent; more is not better.

Pet Waste

- Always pick up after your pet.
- Avoid walking your pet near streams and other waterways. Instead, walk them in grassy areas, parks or undeveloped areas.
- Inform other pet owners of why picking up pet waste is important and encourage them to do so.

Lawn Care

- Apply fertilizers only when necessary and at the recommended amount.
- Don't apply fertilizer before windy or rainy days.
- Avoid applying fertilizer close to waterways.

Questions?


The Choice is Yours.
Clean Water or Green Water?
Lake Erie
Lake Erie during an algal bloom

Contact Information

Hans Paerl

Institute of Marine Sciences
University of North Carolina at Chapel Hill
Phone: 252-726-6841, ext. 133
Email: hpaerl@email.unc.edu
Lab homepage: http://www.unc.edu/ims/paerllab/

Ellen Gilinsky

Office of Water

US Environmental Protection Agency

Phone: 202-564-2549

Email: gilinsky.ellen@epa.gov

Mario Sengco

Office of Water
US Environmental Protection Agency
Phone: 202-566-2676
Email: sengco.mario@epa.gov

Watershed Academy Certificate

- **If you would like to obtain a participation certificate, type the link below into your web browser:**

http://water.epa.gov/learn/training/wacademy/upload/2013-09-25-certificate.pdf

Additional Resources

EPA HABs website:
http://www2.epa.gov/nutrientpollution/harmful-algal-blooms

Facebook: https://www.facebook.com/EPAWaterIsWorthIt

Twitter: @EPAWater

Flickr: http://www.flickr.com/photos/usepagov/sets/72157634706332559/

State of the Environment blog: http://blog.epa.gov/epplocations/

Watershed Academy Webcasts: www.epa.gov/watershedwebcasts