Utah's Harmful Algal Bloom Response Program & Utah Lake Water Quality Study

UTAH DEPARTMENT of ENVIRONMENTAL QUALITY
WATER QUALITY

2019 Spring Runoff Conference
March 26, 2019

Scott Daly

Utah's Harmful Algal Bloom Response Program

What is this stuff?

Algae

- Eukaryotic
- Green or Brown

- Photosynthetic
- Live in water
- Can form blooms

Cyanobacteria

- Prokaryotic
- Blue green
- Can produce toxins

Bloom Forming: Cyanobacteria and toxins (cyanotoxins)

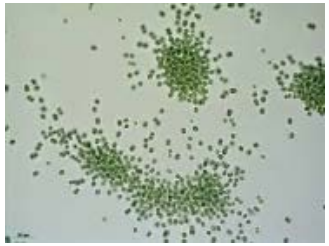
Liver, nerve, or skin toxins

Selectively produced by many genera but not very predictable

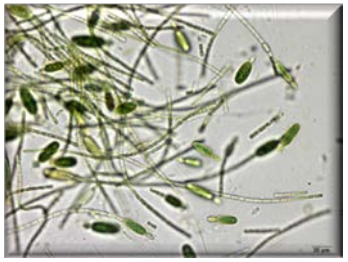
Widely distributed but not often at acutely toxic levels

Analyses are available for some *but not all* of these toxins

Dolichospermum (Anabaena)
-Microcystins (liver)
-Anatoxin-a/a(s) (nerve)
-Saxitoxins (nerve)

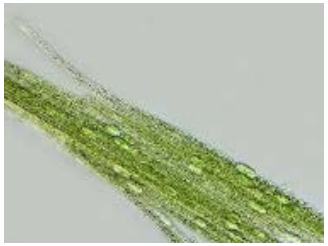


Microcystis
-Microcystins (liver)
-Toxin is most common and easily measured
-100 congeners



Cylindrospermopsis
-Cylindrospermopsins (liver)
-Saxitoxins (nerve)
-Benthic/epiphytic rather than planktonic

Nodularia
- Nodularins (liver)
- Found in brackish water including bays of Great Salt Lake



Aphanizomenon
-Anatoxins (nerve)
-Cylindrospermopsins (liver)
-Saxitoxins (nerve)

July 2016

Scofield Reservoir near Dam 9-25-2018

Phycocyanin Value: 5,000

Microcystin: 950 ug/L

Anatoxin-a: 0.19 ug/L

Cell count: 734,081 cells/mL

Scofield Reservoir

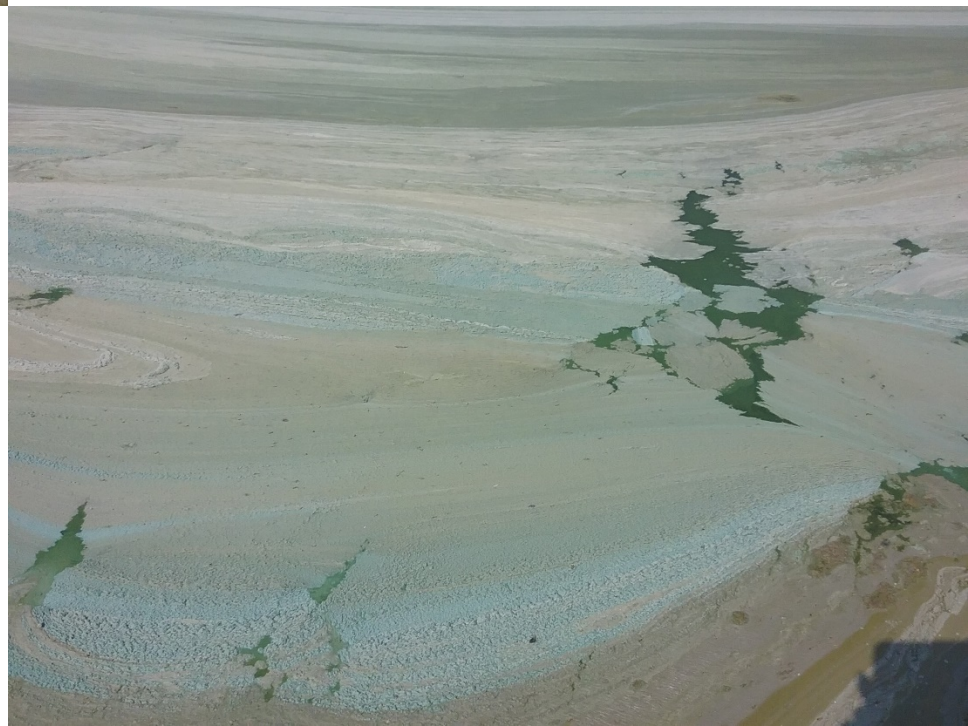
Utah Lake Lincoln Marina 8-6-2018

Phycocyanin Value: 14,800

Microcystin: 233 ug/L

Anatoxin-a: <0.10 ug/L

Cell count: 42,109,864 cells/mL



Panguitch Lake North Shore 9-12-2018

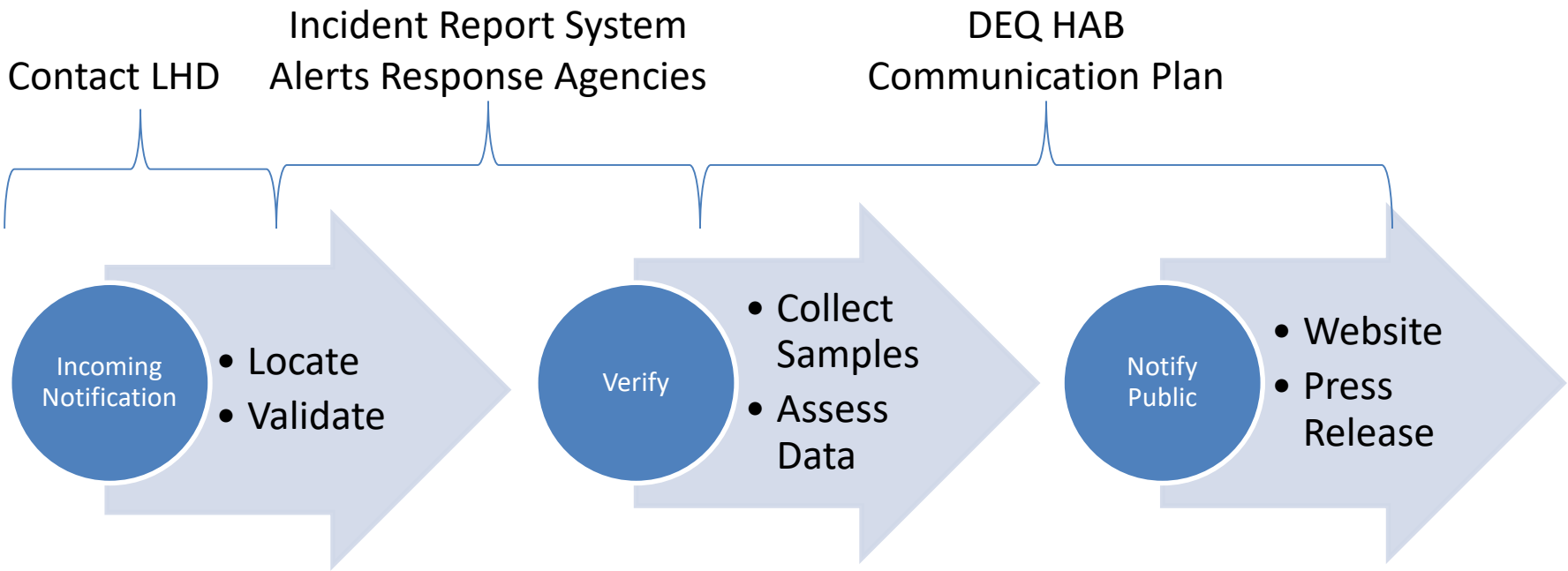
Phycocyanin Value: 5,000

Microcystin: 37,000 ug/L

Anatoxin-a: 0.78 ug/L

Cell count: 2,708,853 cells/mL

Cyanobacteria Exposure Risk Response Process



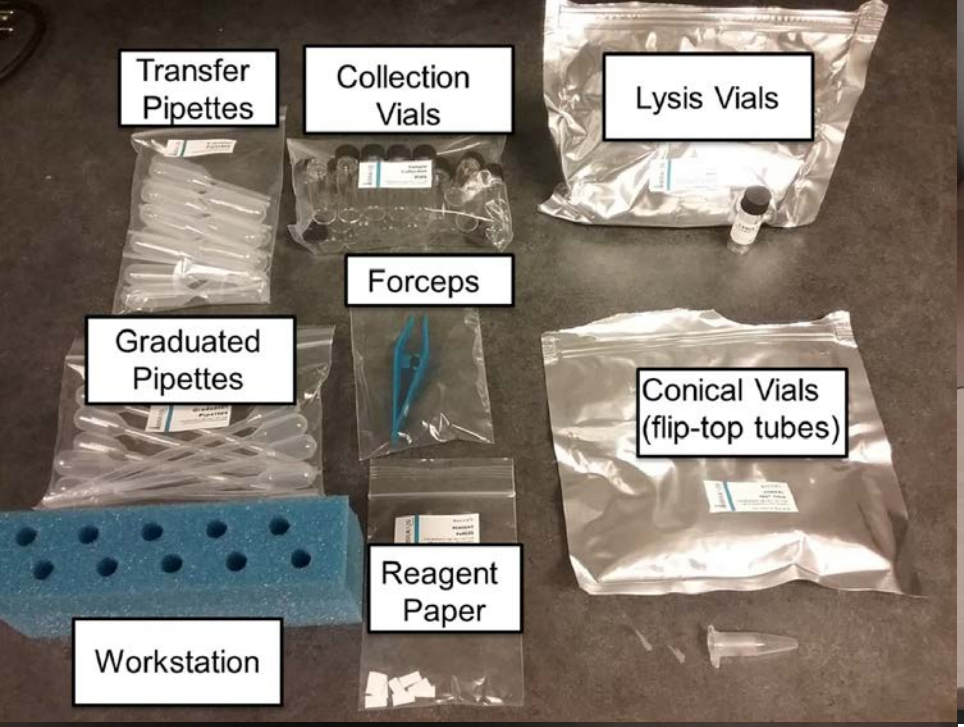
Measurement Equipment

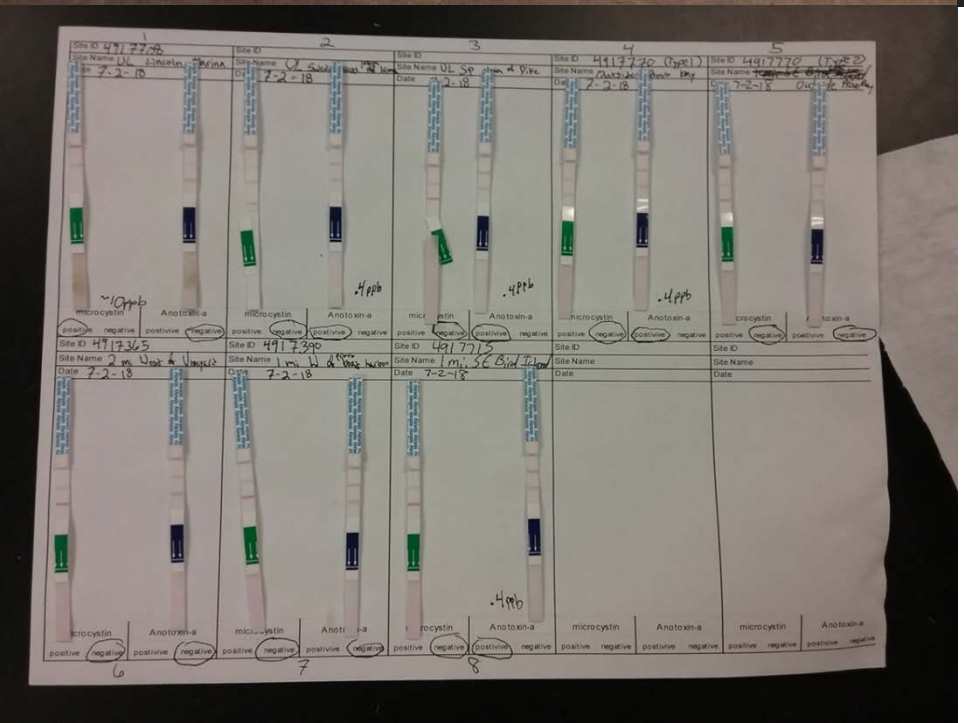
Phycocyanin Probe: Turner Designs Cyclops-7

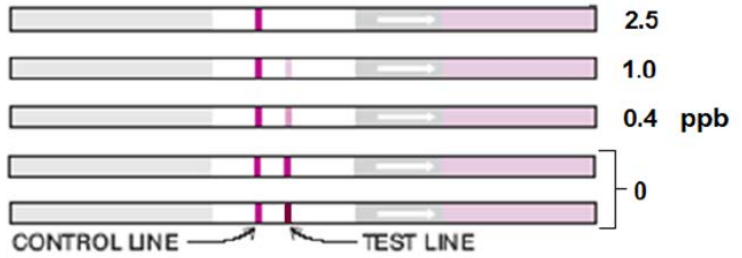
Sonde: In-Situ SmarTROLL MP

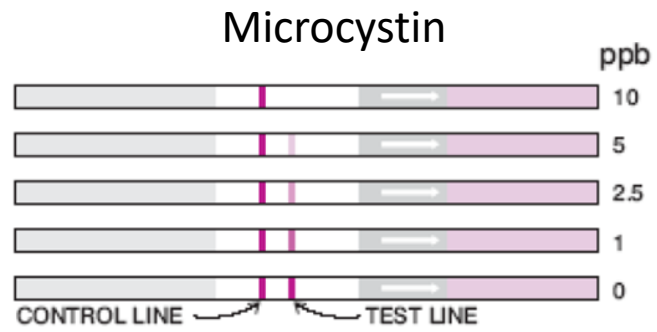
What samples do we collect?

- Anatoxin-a
- Microcystin
- Phytoplankton


Transfer Pipettes
Collection Vials
Lysis Vials
Forceps
Graduated Pipettes
Conical Vials (flip-top tubes)
Reagent Paper
Workstation

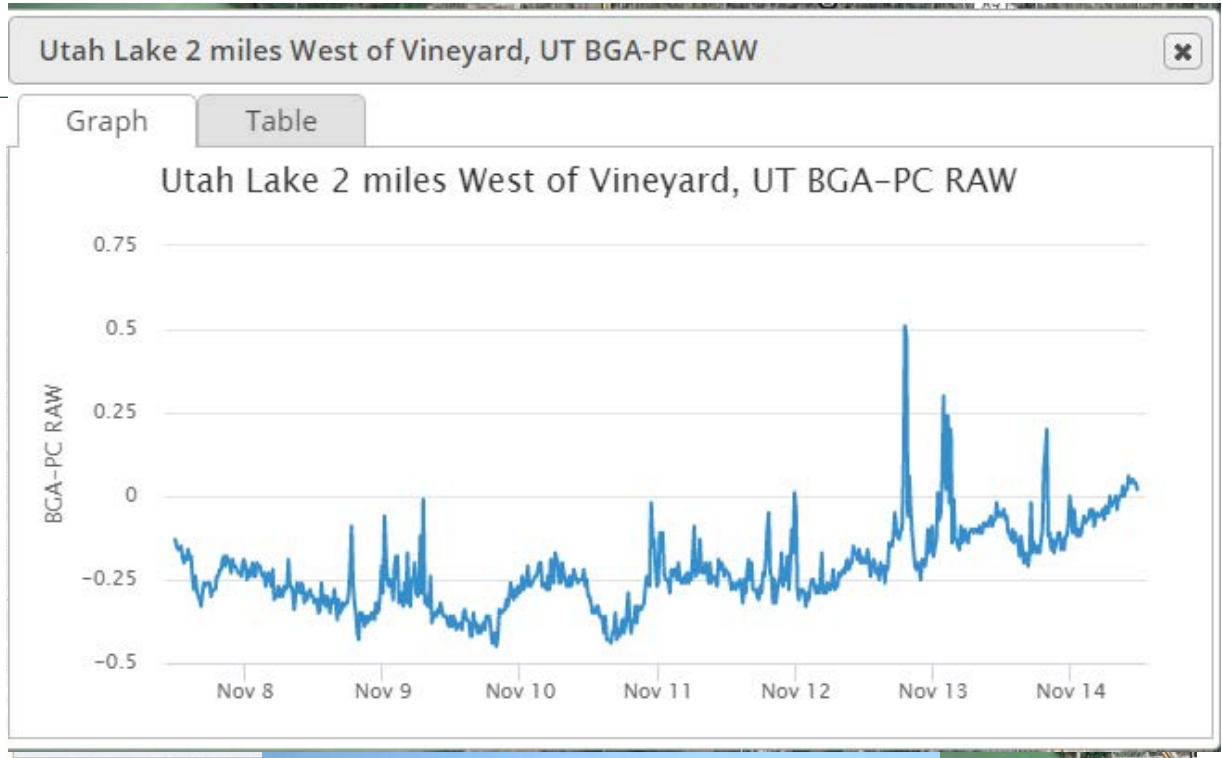


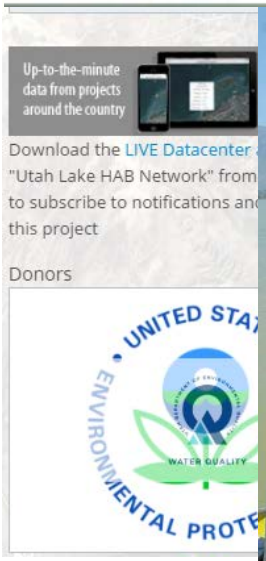

Anatoxin-a
2.5
1.0
0.4
ppb
0
CONTROL LINE
TEST LINE

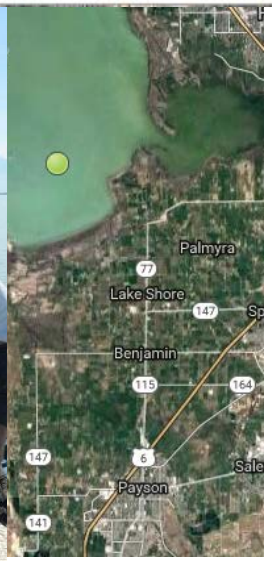

Microcystin
ppb
10
5
2.5
1
0
CONTROL LINE
TEST LINE

Utah Lake Buoy Network

- 3 high frequency sondes
- Telemetered every 60 min.
- Parameters:
  - Temperature
  - Conductance
  - pH
  - Dissolved oxygen
  - DO saturation
  - Chlorophyll
  - Turbidity
  - Blue-green algae
  - fDOM

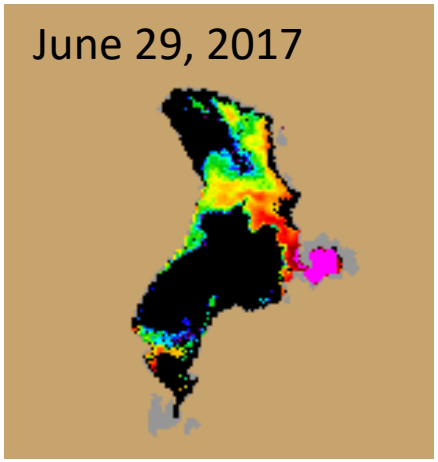


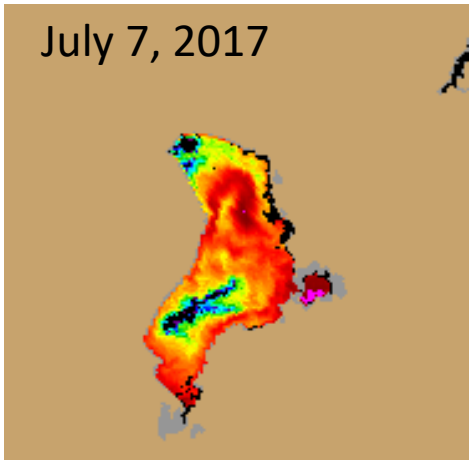


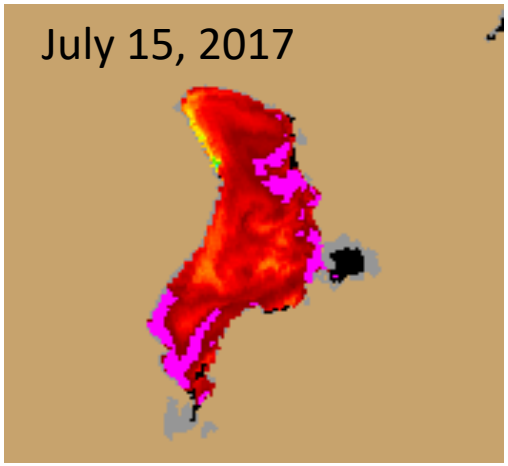


https://wqdatalive.com/public/669

Use of satellite images for HAB detection and movement on Utah Lake

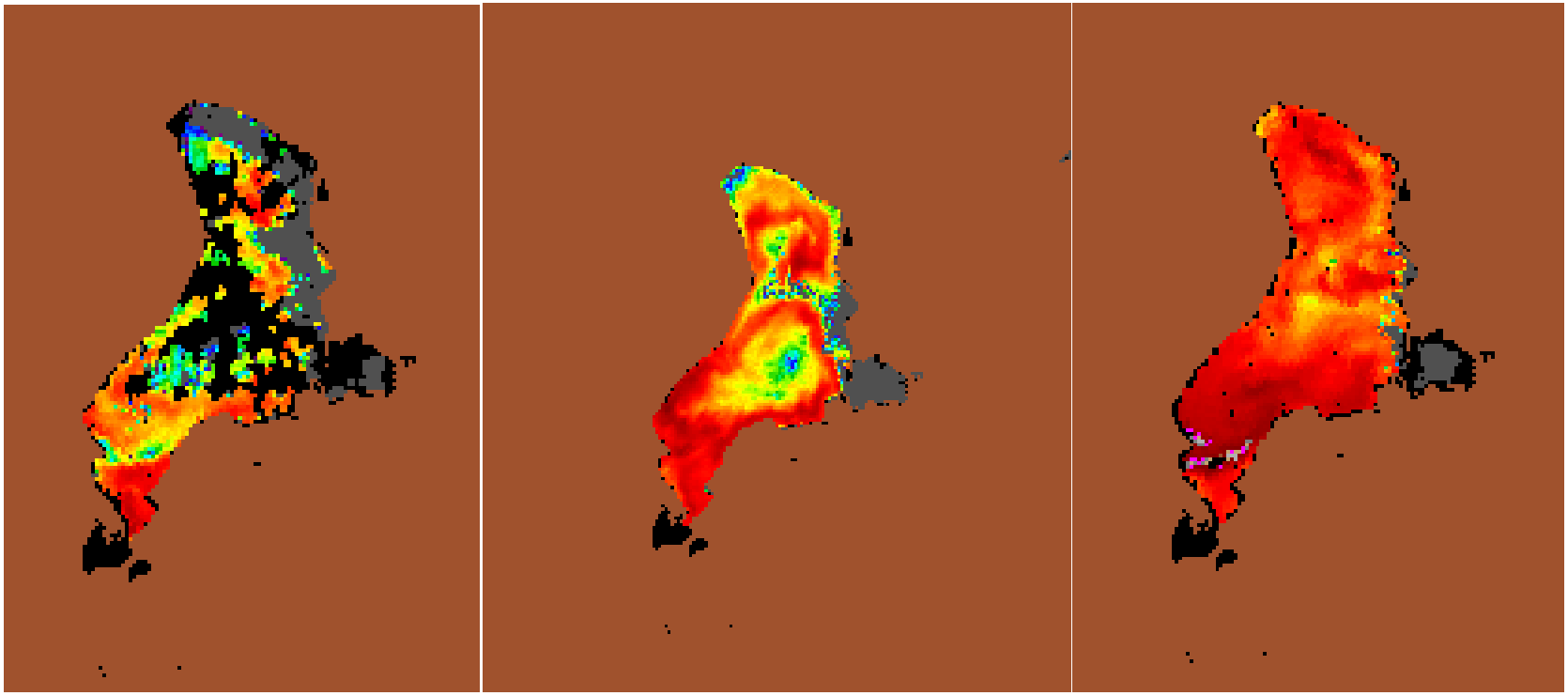






ESA Sentinel-3
Interpolation via
CyAN Project

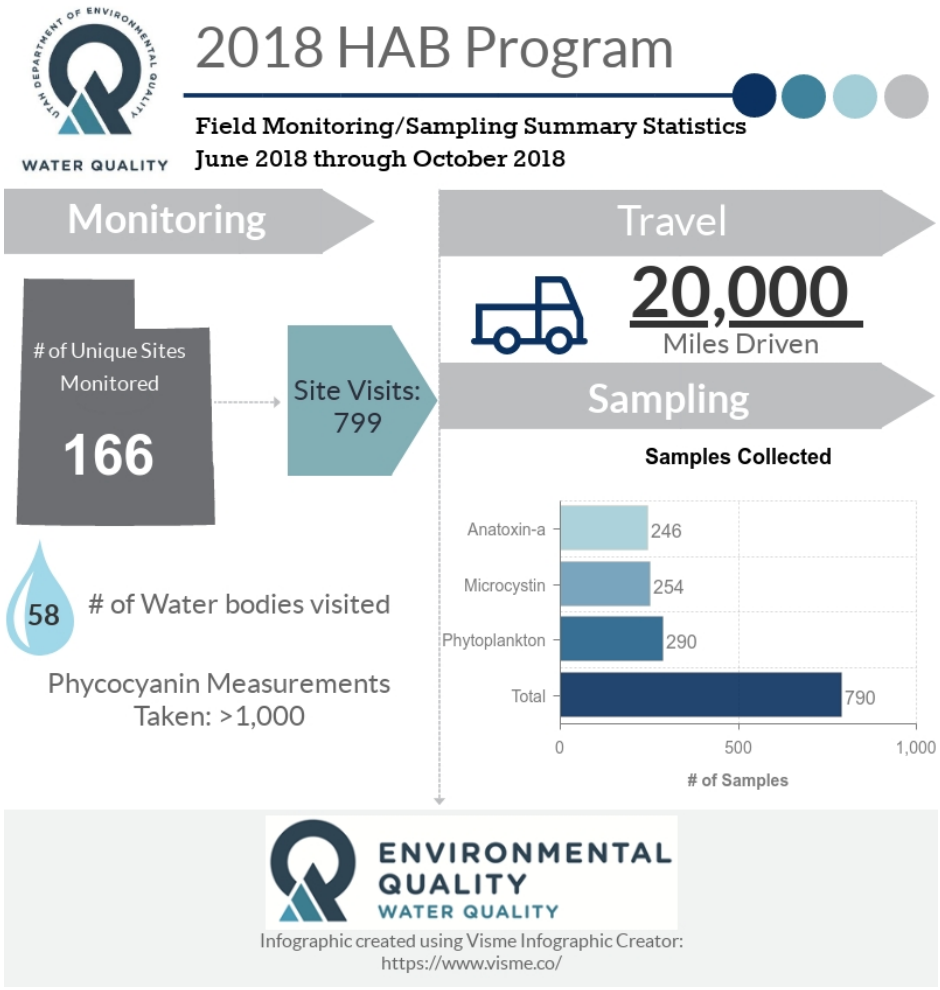
2018 Activity



July 28, 2018

July 31, 2018

August 5, 2018



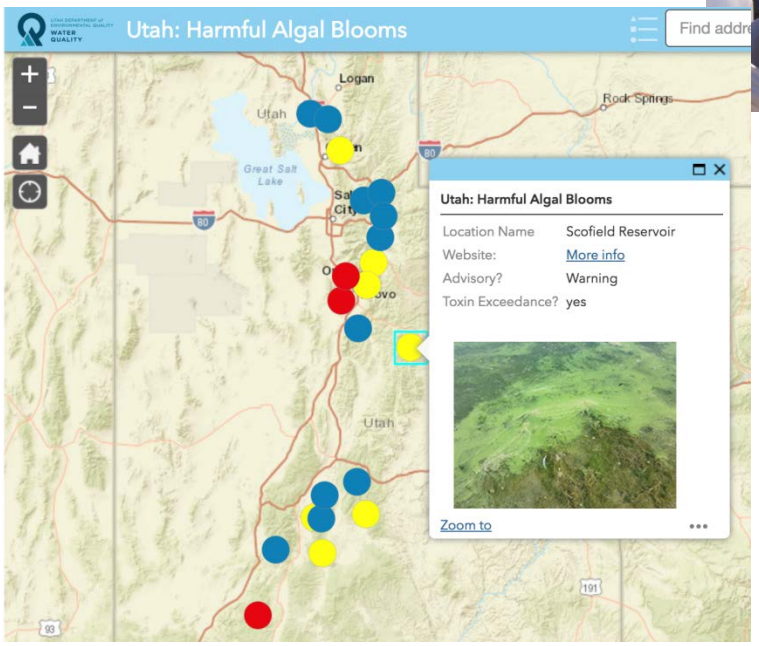
Results:

- Recreational advisories issued across 25 waterbodies issued by 10 of 13 Local Health Departments
- 2 UDAF-issued livestock/irrigation advisories
- First advisory issued June 12, 2018 for Provo Bay, Utah Lake and advisories remained late on Deer Creek Reservoir shoreline and 3 Utah Lake marinas.

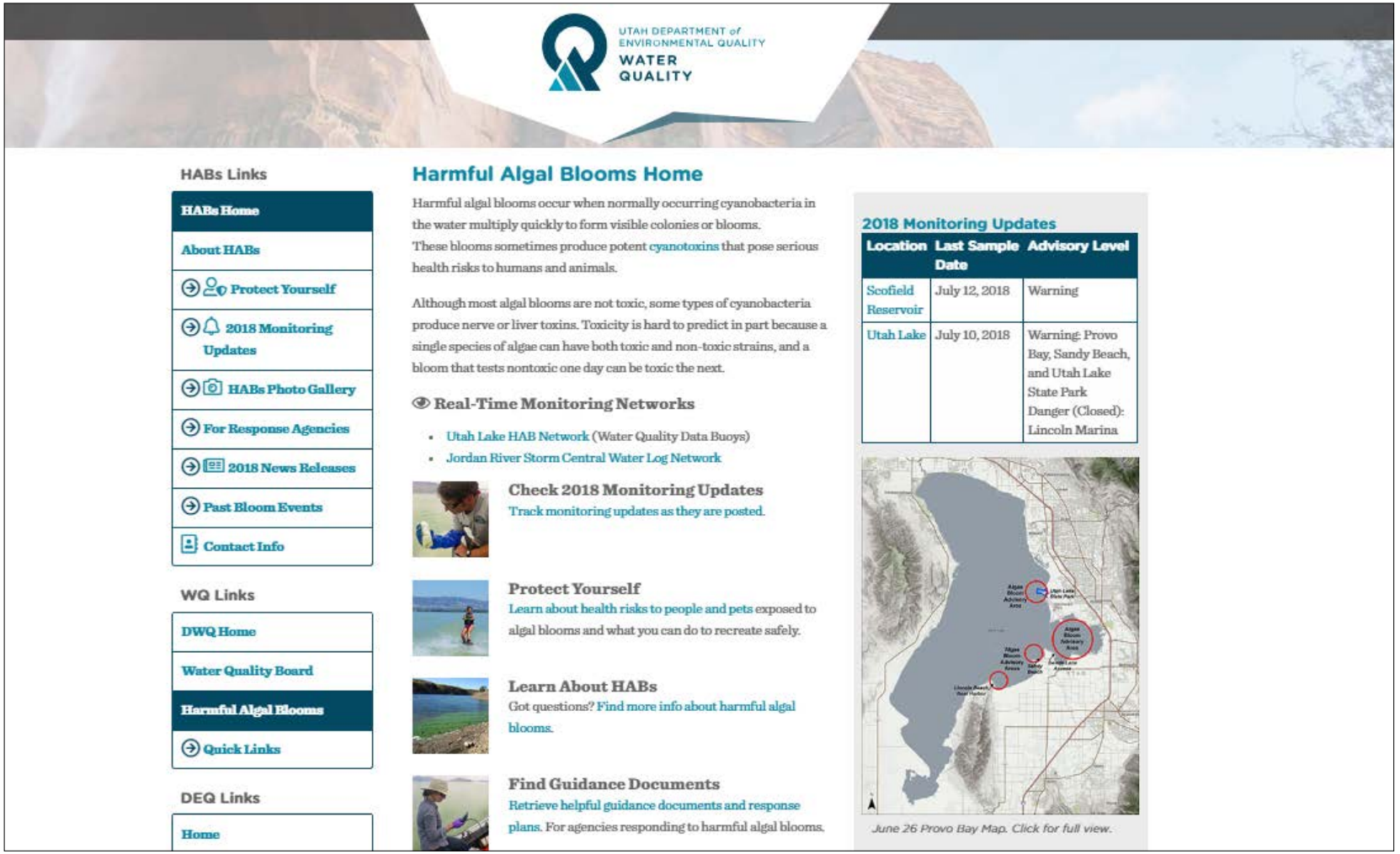
HAB Response Program

Funding Request: $200,000 (ongoing)

- Proactive monitoring of high-risk waters
- Trained personnel available for bloom response
- Provide Local Health Departments with timely data
- One-stop location for bloom related information



habs.utah.gov



Utah Lake Water Quality Study

Steering Committee Composition

Stakeholder Interest	Affiliation
Utah Lake Commission (Co-chair)	Utah Lake Commission Executive Director
Water quality (Co-chair)	Utah Div. of Water Quality
Recreation, fishing, and sovereign lands	Utah Department of Natural Resources
Agriculture/ water rights/ water users	Utah Lake Water Users Association
Fish and wildlife	U.S. Fish and Wildlife Service
Agriculture	Utah Conservation Commission Zone,3, Utah Department of Agriculture and Food, or local agricultural interest
Public health	Utah County Health Department
Recreation	Recreational club, anglers, hunters, or business
Conservation and environment	Environment or conservation organization
Water management of Utah Lake	Central Utah Water Conservancy District or appropriate water manager
Stormwater	Utah County
Publically Owned Treatment Works	Municipal or district
Municipal	City Mayor or designee
Municipal	City Mayor or designee
Municipal	City Mayor or designee
Academia	University researcher

Science Panel Membership

				Related Expertise											
	Representative	Affiliation	Primary Discipline	Aquatic ecology	Biogeochemistry	Fisheries management	Hydrodynamic modeling/hydrology	Nutrient cycling	Limnology	Phycology	Toxicology	Water quality criteria	Water quality modeling	Wetland science
Independent (Voting)	Michael Brett	University of Washington	Limnology						X					
	Mitch Hogsett	Forsgren Associates	Biogeochemistry		X									
	Ryan King	Baylor University	Aquatic ecology	X	X			X	X				X	X
	James Martin	Mississippi State University	Water quality modeling	X	X		X	X				X	X	
	Hans Paerl	University of North Carolina	Limnology	X	X			X	X	X				
Ex Officio (Non Voting)	Janice Brahney	Utah State University	Biogeochemistry		X									
	Soren Brothers	Utah State University	Limnology						X					
	Greg Carling	Brigham Young University	Biogeochemistry		X			X						
	Jereme Gaeta	Utah State University	Aquatic ecology	X		X								
	Theron Miller	Wasatch Front Water Quality Council	Biogeochemistry	X	X	X	X	X	X		X	X	X	X

Initial Science Panel Charge

Initial high-level charge

1. What was the historical condition of Utah Lake with respect to nutrients and ecology pre-settlement and along the historical timeline with consideration of trophic state shifts and significant transitions since settlement?

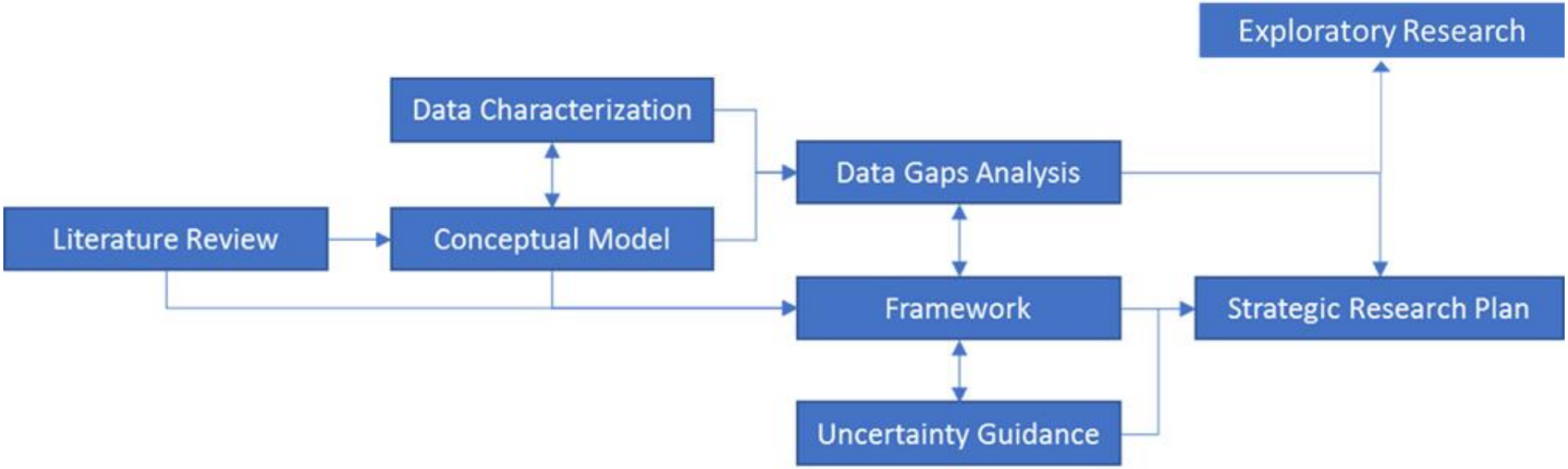
2. What is the current state of the lake with respect to nutrients and ecology?

3. What additional information is needed to define nutrient criteria that support existing beneficial uses?

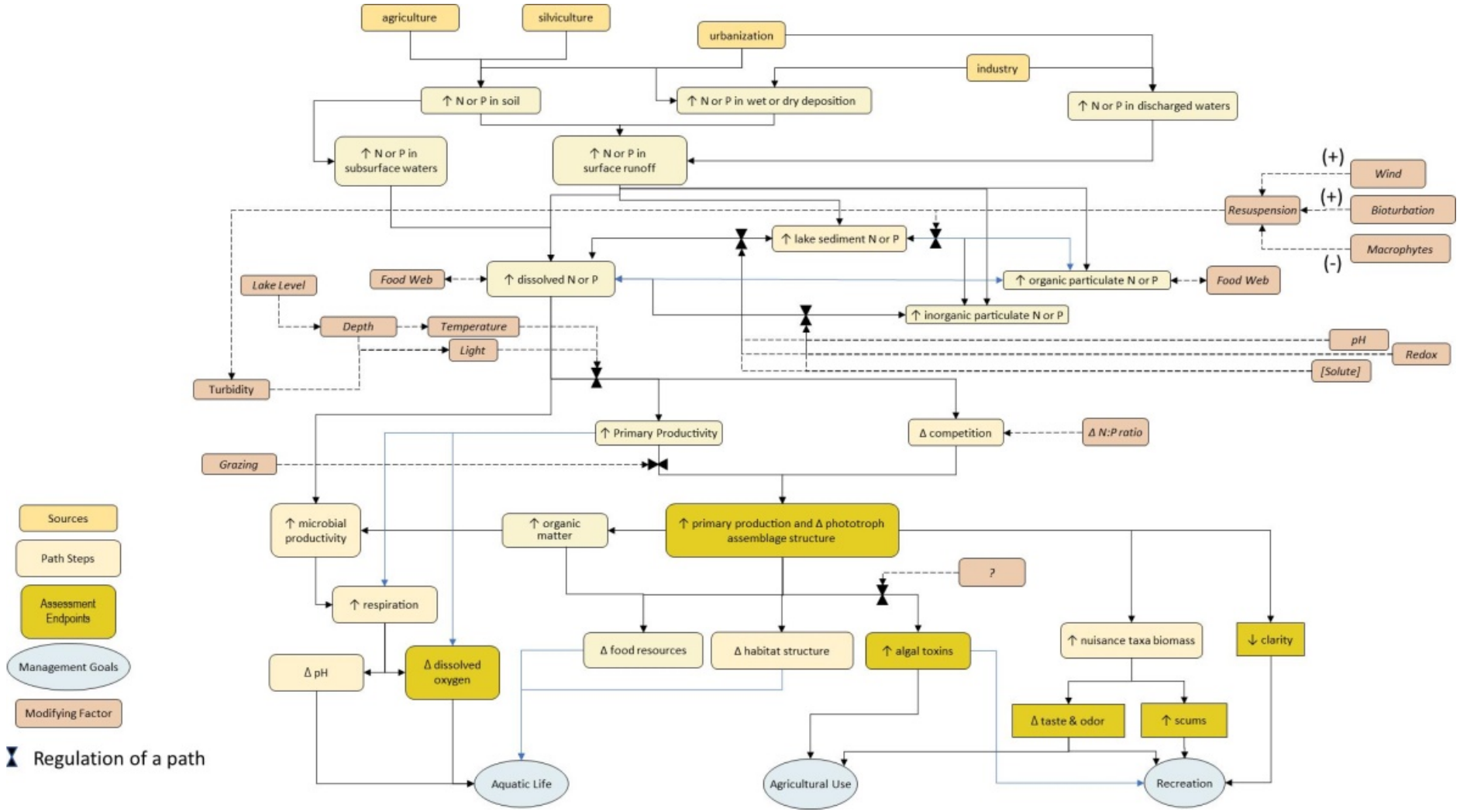
Future high-level charge

4. Is there an improved stable state that can be reached under the constraints of current water and fishery management?

Science Panel Support

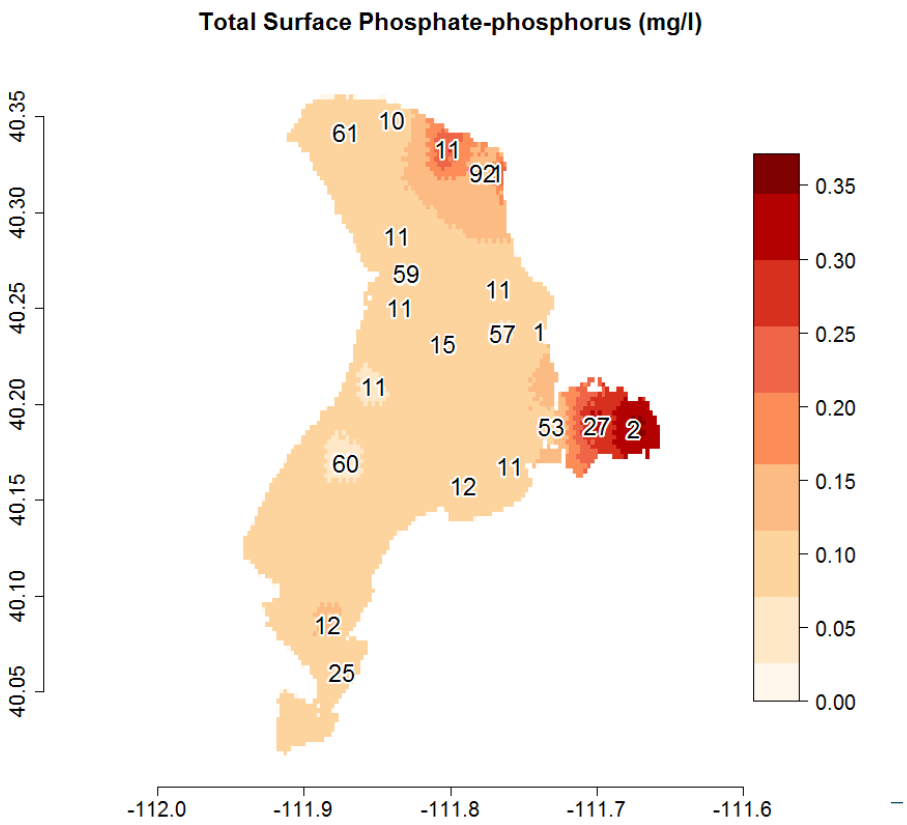


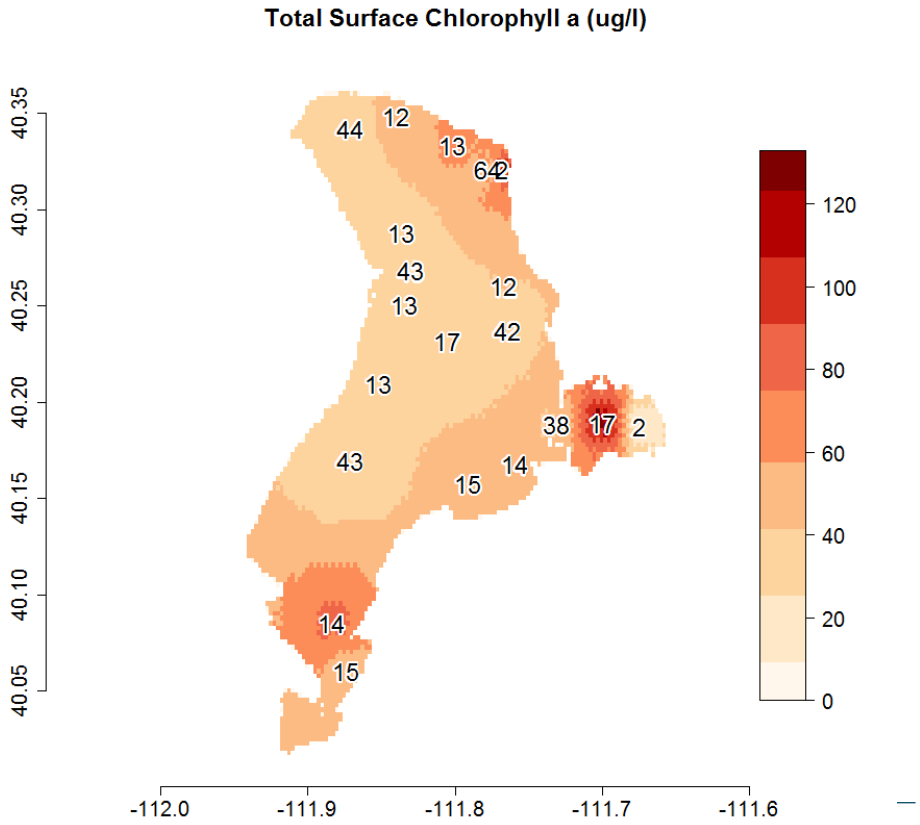
Conceptual Models



Data Characterization

https://udwq.shinyapps.io/UtahLakeDataExplorer





Nutrient Criteria Framework

Approaches

- Reference condition
- Empirical stressor-response models
- Mechanistic stressor-response models
- Scientific literature

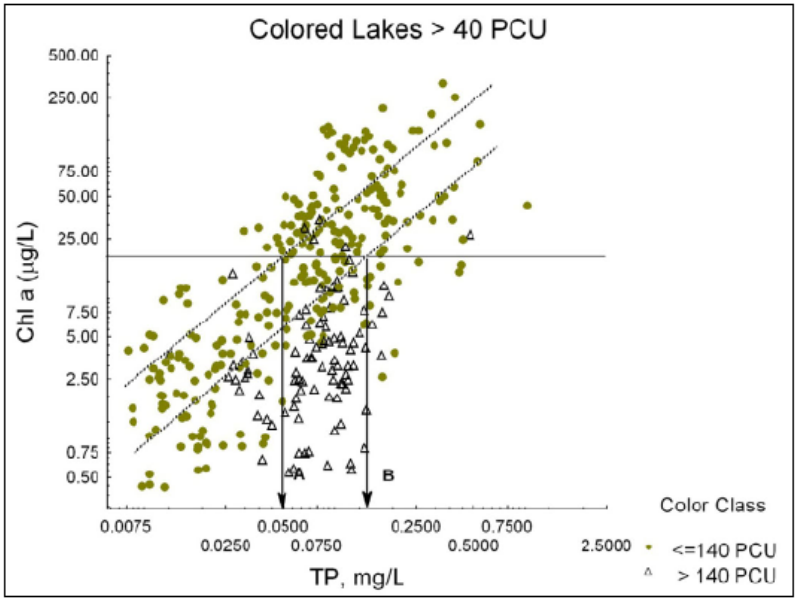
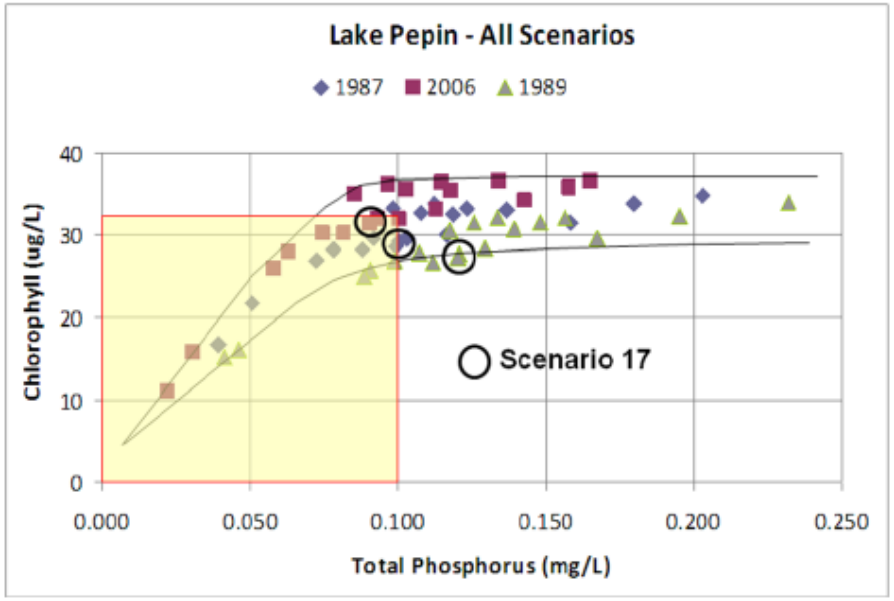


Figure 2-29. Chl-*a* and TP in colored lakes, showing 50% prediction interval (dotted lines). Note that symbols and data as in Figure 2-23. Horizontal line: chl-*a* criterion (20 µg/L). A indicates TN concentration corresponding to 25% probability of chl *a* exceeding 20 µg/L; B indicates concentration corresponding to 75% probability of exceedance.



Near-term research priorities

Historical conditions

- Historical P, N, and Si concentrations in sediment cores
- Photopigments and DNA in the paleo record
- Diatom community and macrophyte community in the paleo record

Current lake conditions

- Sediment equilibrium P concentrations throughout the lake
- Calcite “scavenging” in the P cycle
- Sediment oxygen demand of, and nutrient release from sediments

Schedule

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Phase 1 – Data gathering and characteristics																
Phase 2 – Criteria development																
Phase 3 – Implementation Planning																
Criteria and Implementation Plan Submittal to WQB and EPA																
Nonpoint Source and MS4 Implementation																
POTW Permit Implementation																

Discussion

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