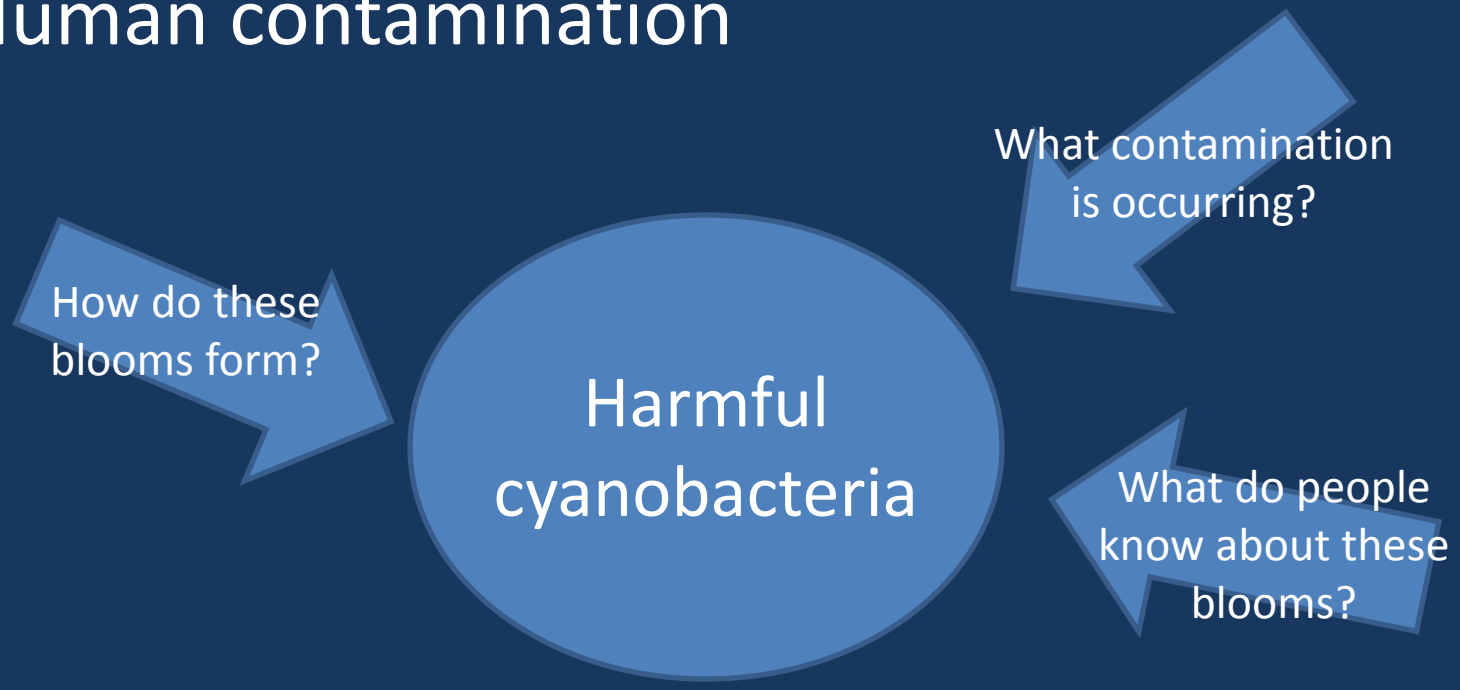
Knauss Brown Bag Lunch:

The bloom that wasn't: Perfect demonstration of how nature does not follow a graduate student's timeline

By: Emily A. Smith

Why do I study cyanobacteria?

- Phytoplankton is essential part of the global ecosystem.
- Cyanobacteria is oldest organism on planet
- Human contamination



Humans and coastlines

- Origins of coastal living dates back to ~125K years
- Food supply and future transport
- Increased Human habitation
- Increasing population
- Rise in agriculture

Estuaries

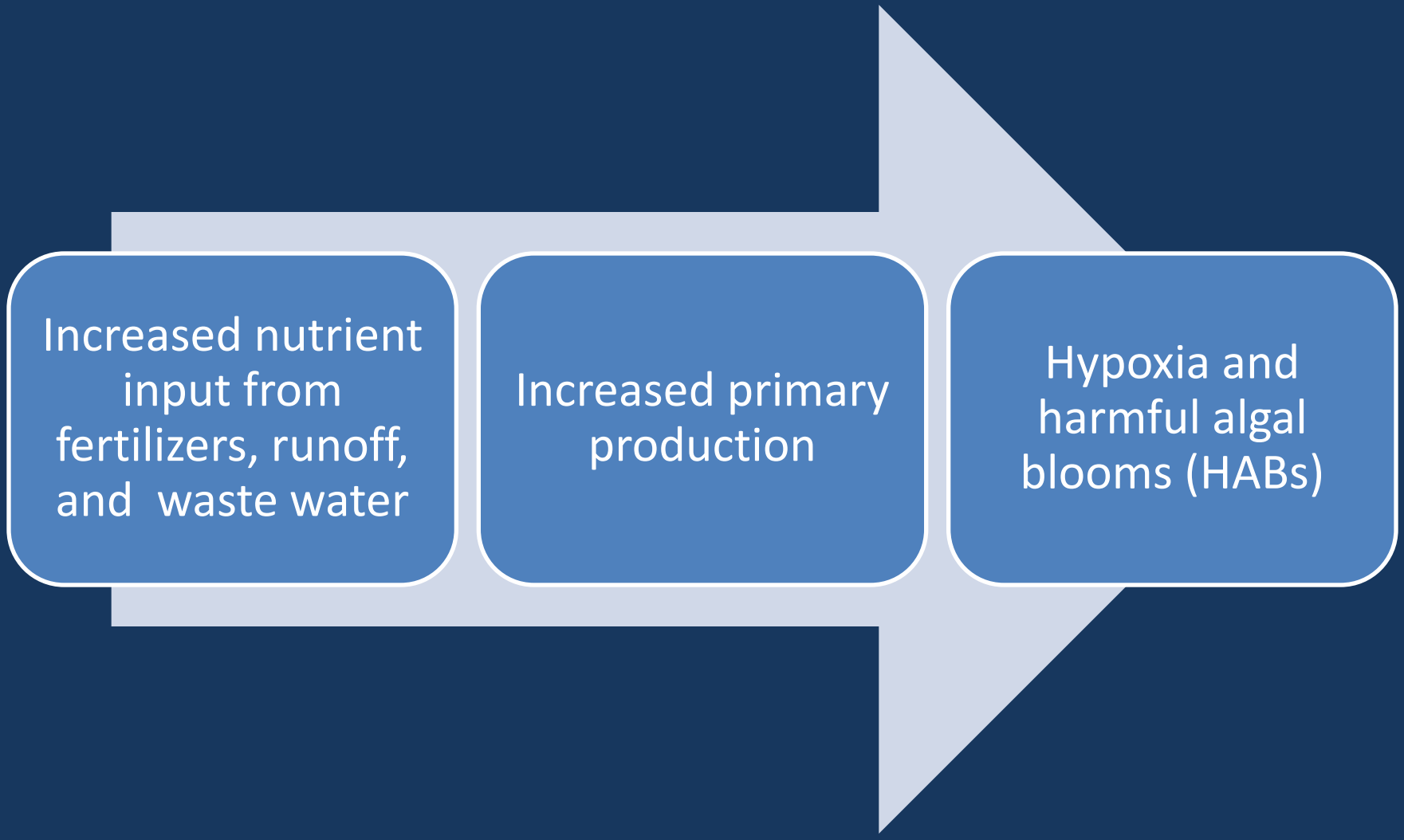
- Intermediate areas between land and ocean
- Biologically diverse
- Subject to multiple variations in tidal interactions, salinity, sedimentation etc.
- Cut-off and reconnection to fresh water

Diversions

- Divert flood waters away from major cities

- Management tool to re-connect freshwater, nutrients and sediment to natural floodplains

Damage caused to coasts and estuaries



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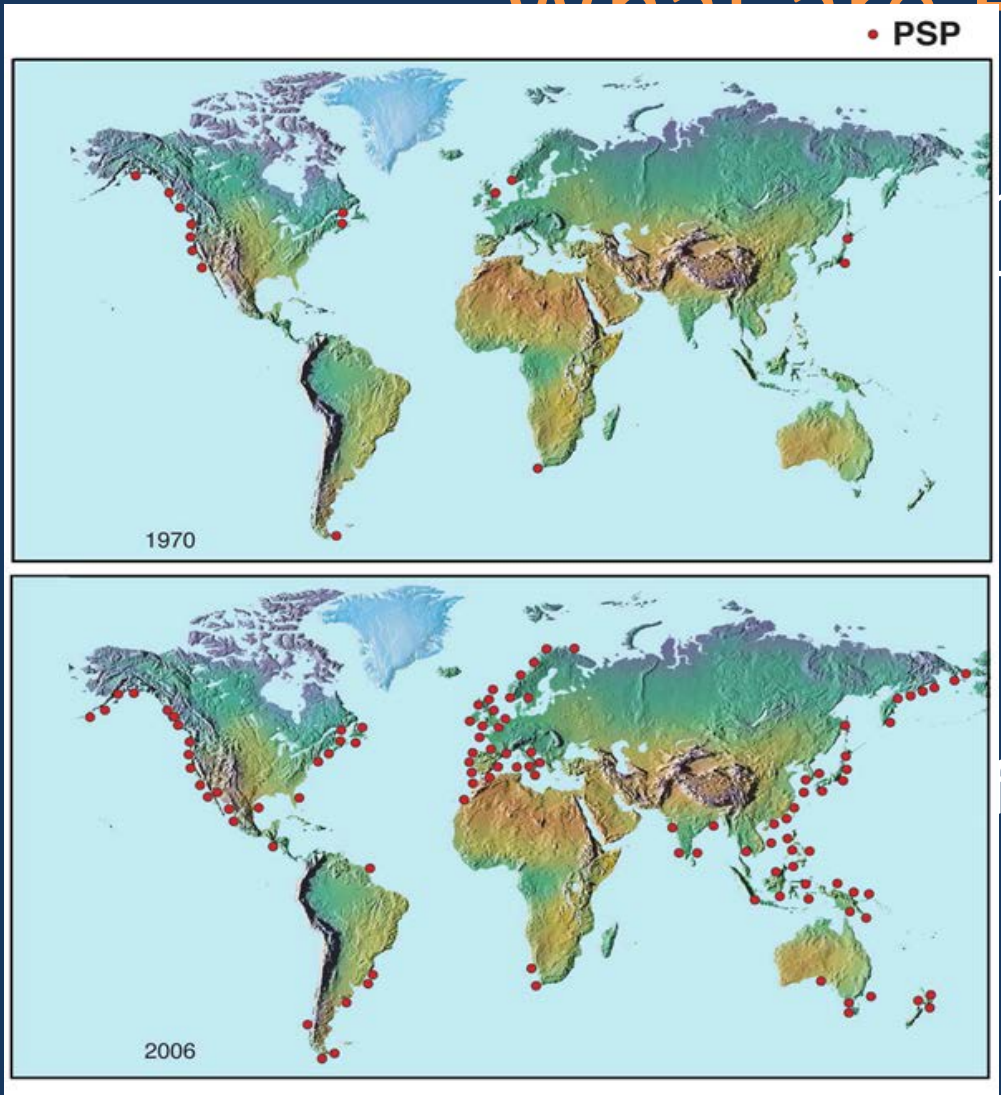
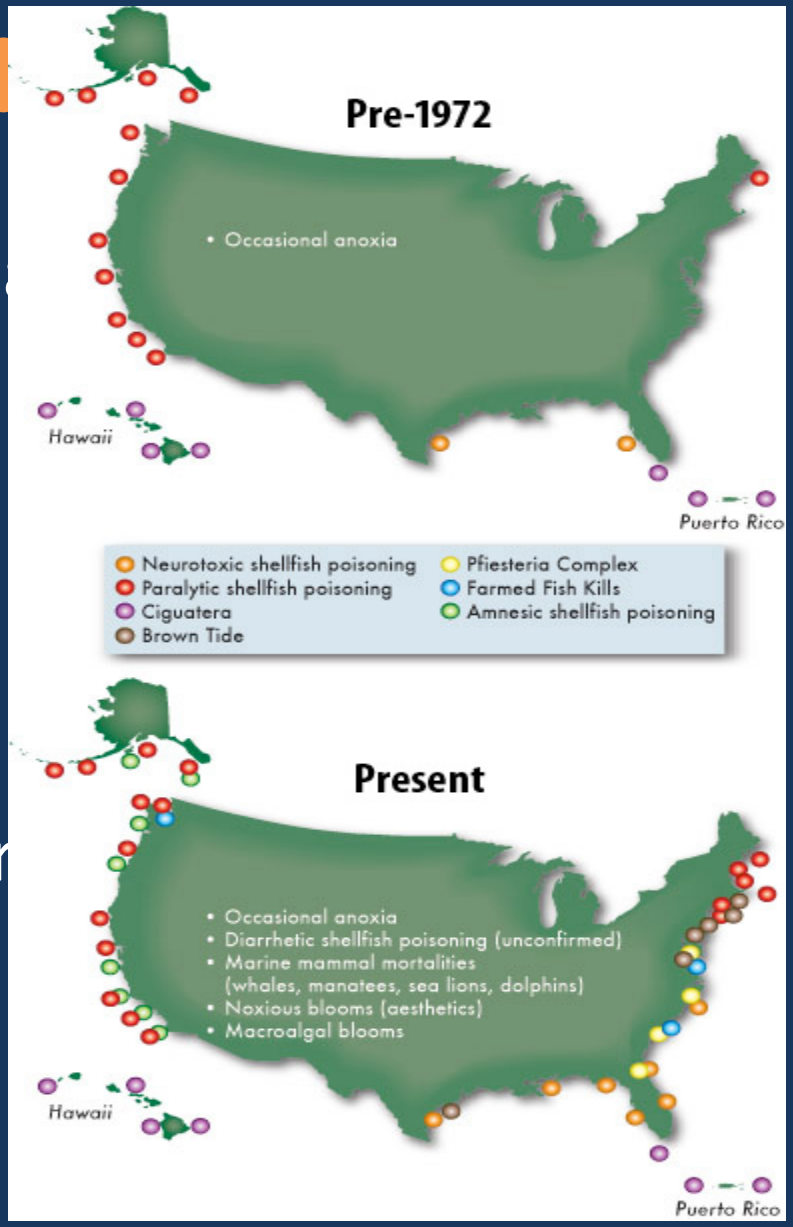


Figure source, Woods Hole Oceanographic Institute



Cyanobacteria HABs (CyanoHABs)

- Fresh and estuarine waters
- Different functional types
  - Nitrogen fixing
  - Chain and colony species
  - Toxin producers
    - Anatoxins, saxitoxins and microcystins
- Harmful consequences
  - Can form a scum to block sunlight
  - Contaminate drinking water
  - Gastrointestinal problems

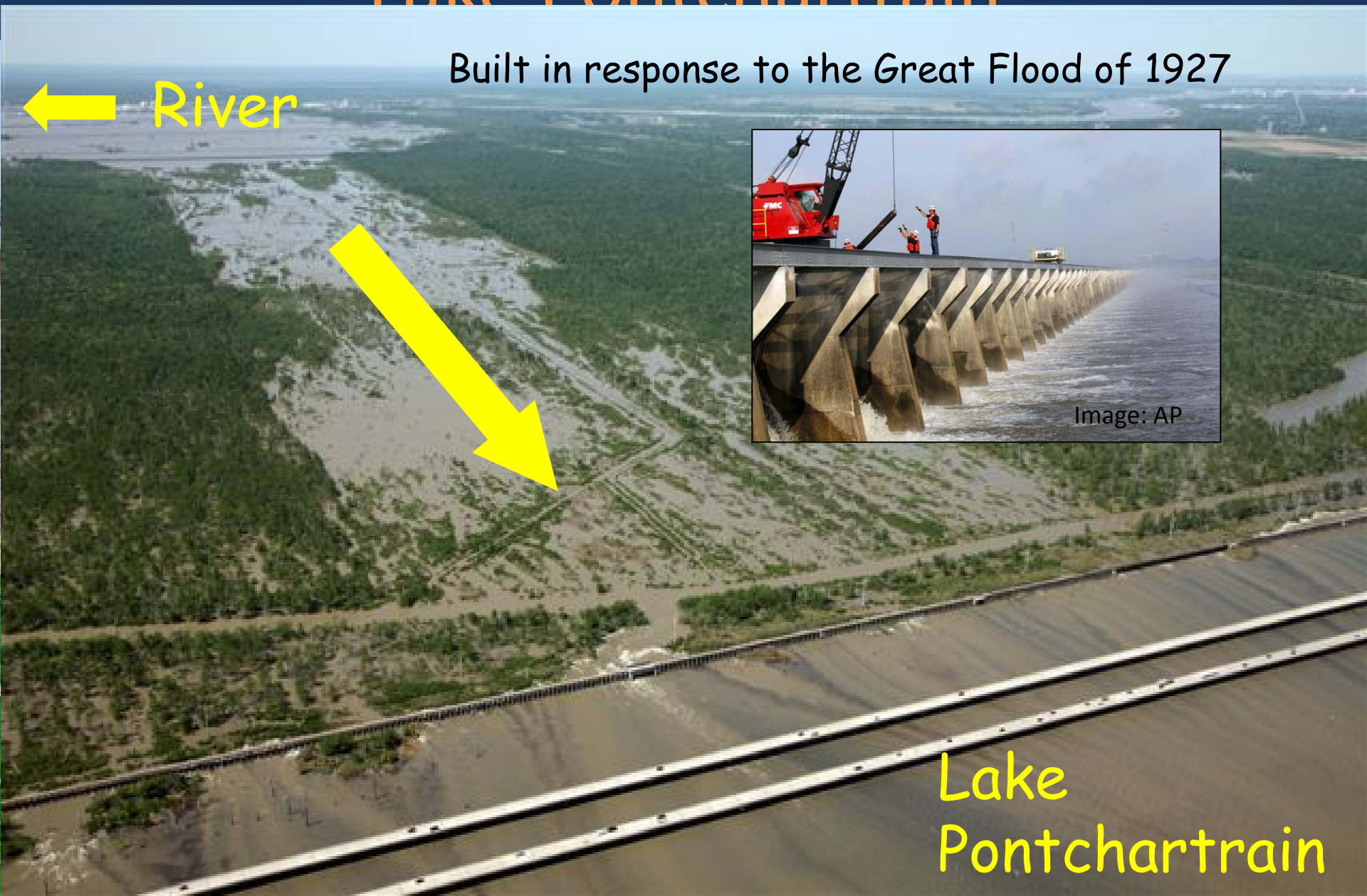
Louisiana and toxic cyanobacteria

- Freshwater cyanobacteria (*Anabaena* spp. and *Microcystis* spp.) have been found in estuarine waters (Garcia et al, 2010; Czubakowski, 2010; Bargu et al. 2011)
- Many cyanobacteria species are capable of producing multiple toxins
- Blue crab (Garcia et al, 2010) and catfish have been found to have toxins present

Bonnet Carré Spillway

Lake Pontchartrain

Built in response to the Great Flood of 1927



Objectives of the study

- 1) To study phytoplankton dynamics and shifts due to changes in hydrology in 2011 and 2012
    - Community responses to changing nutrient levels and other environmental parameters
- 2)To study bloom dynamics of toxic species and associated toxin production

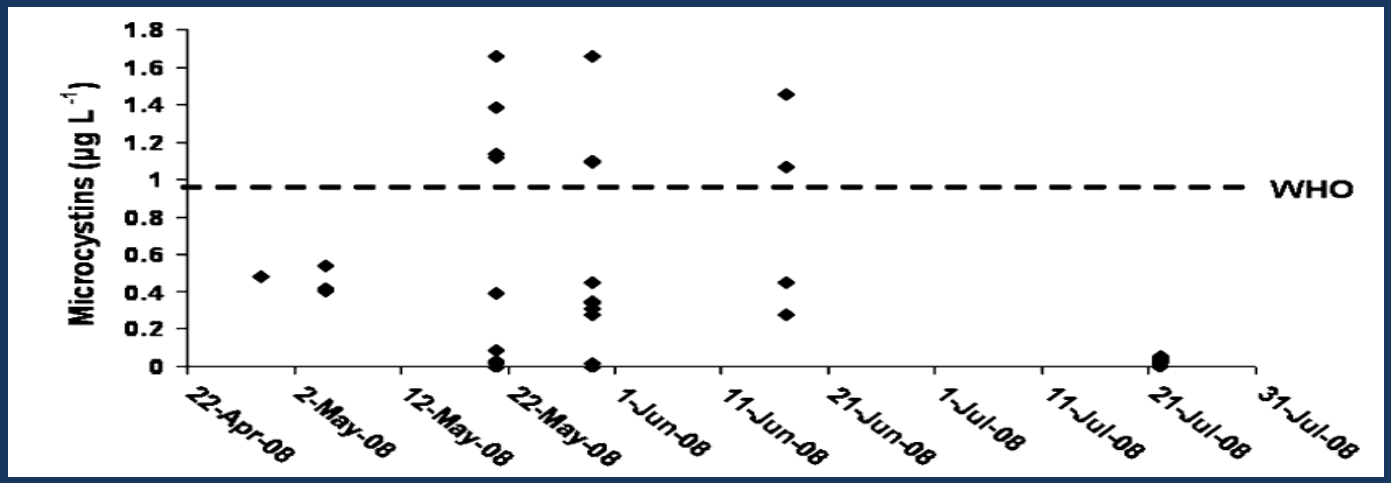
Phytoplankton Community of the Lake

- Spring:
  - A lot of nutrients available either from the runoff of the land and episodic diversion openings, or tributaries
  - Large diatoms bloom

- Summer:
  - Nutrients become more limited
  - Warmer water temperatures
  - Stratified water
  - Cyanobacteria blooms (smaller in size than diatoms)

Previous Spillway Openings

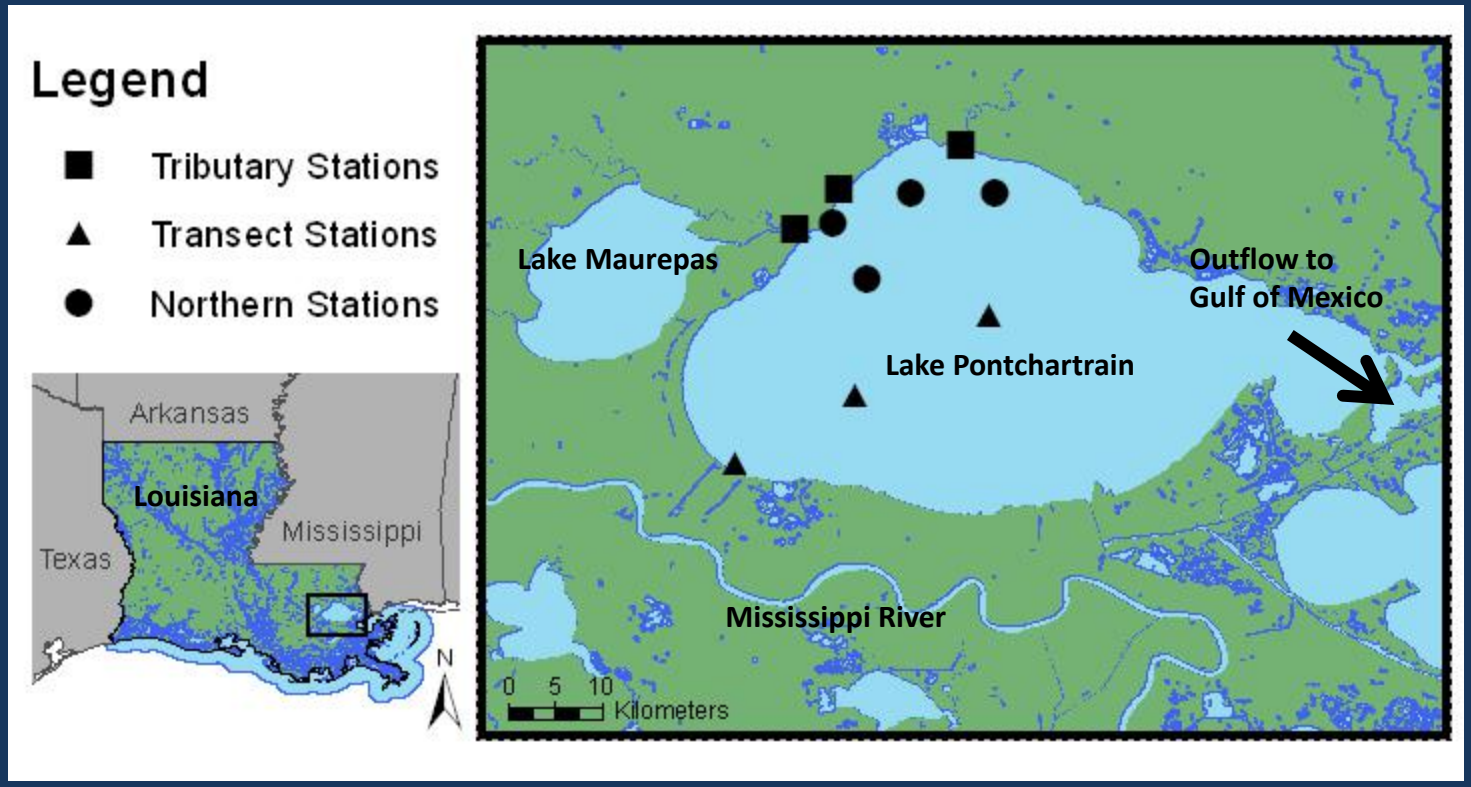
- Cyanobacteria bloom following the 1997 opening (Turner et al., 2002, Dortch et al, 2001)
- Following the 2008 opening, there was a diatom bloom followed by a cyanobacteria bloom in the summer after spillway was closed with microcystin levels above WHO limits (White et al. 2009, Bargu et al., 2011)



Sample Stations

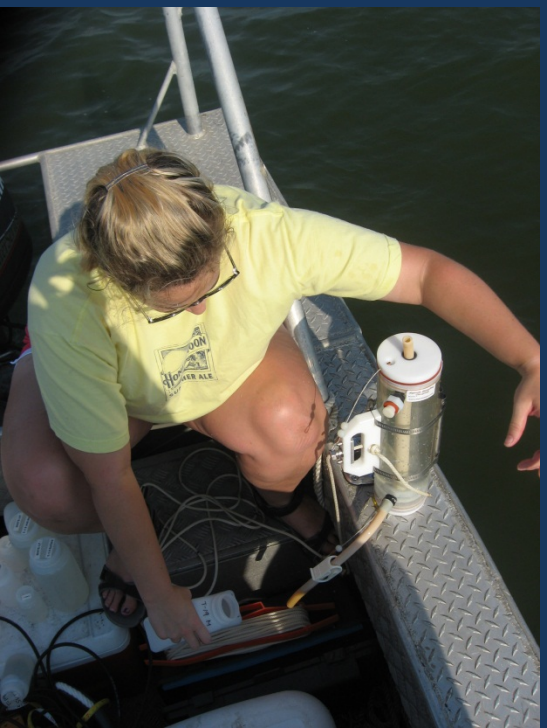
2011: Transect and northern

2012: All stations



Materials and methods

- Whole water surface samples collected and analyzed

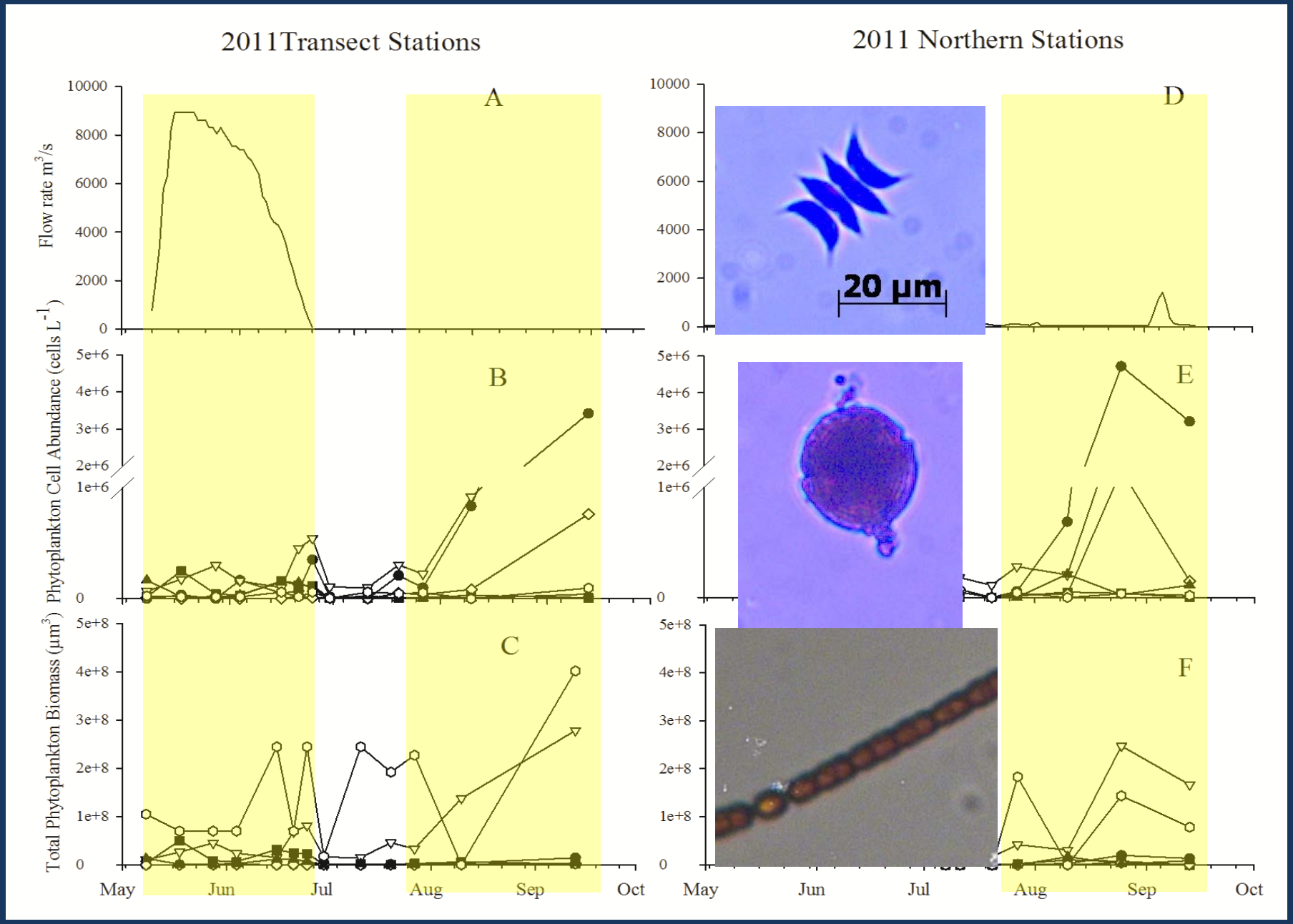


Measured in field:

- pH
- Turbidity
- Temperature, DO, salinity
- Light intensity

Measured in lab:

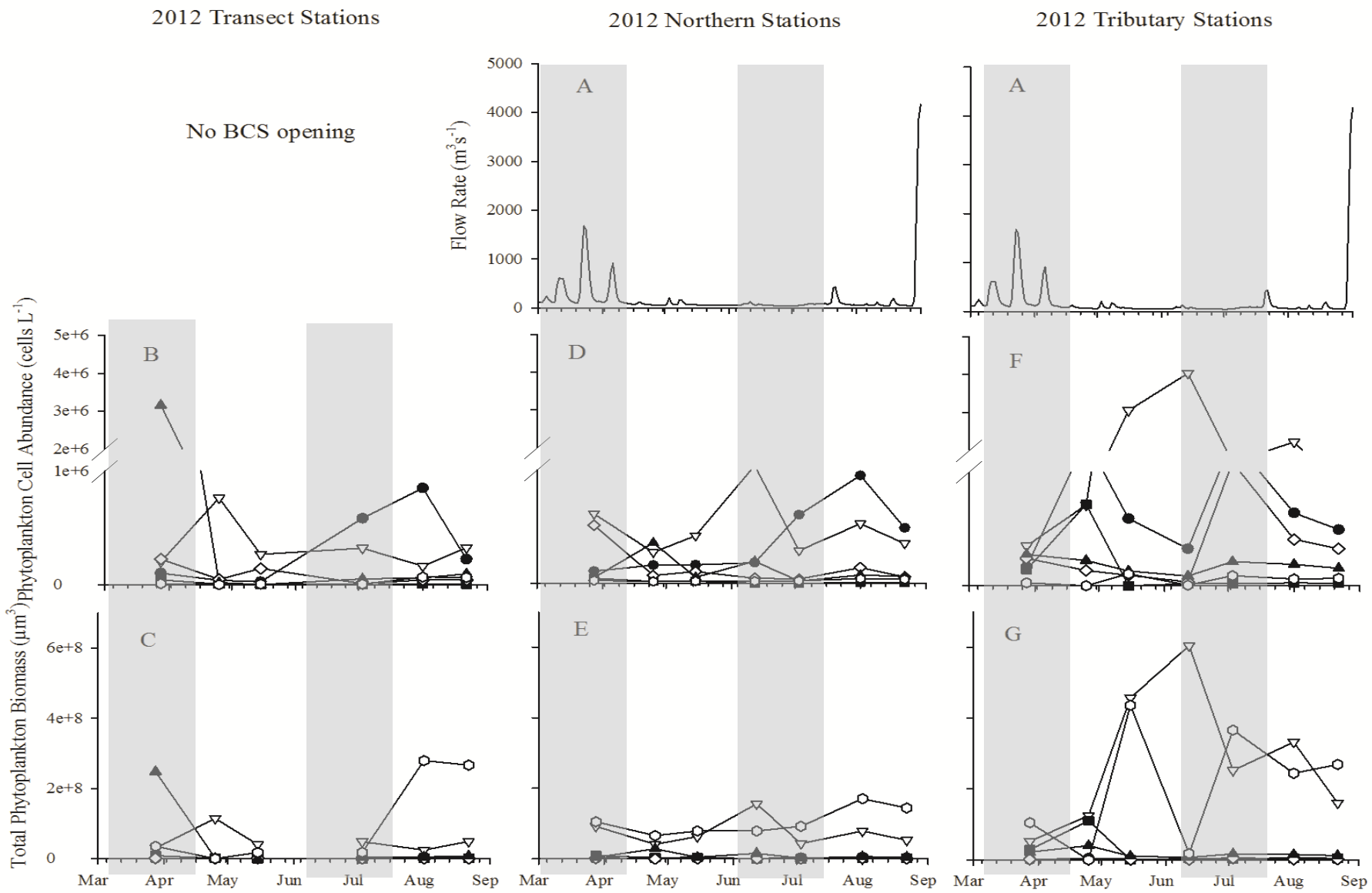
- Chl *a*
- Microcystins
- Fixed samples for community composition
- Nutrients



Legend: cyanobacteria (●), chlorophytes (▽), centric diatoms (■), cryptophytes (◊), pennate diatoms (▲), and dinoflagellates (○).

2011 Comparison Summary

- High flow rate from BCS and subsequent turbidity and associated light limitation significantly affected the phytoplankton community
- Biomass mainly attributable to dinoflagellates
- Highest abundances started with chlorophytes and centric diatoms, then in late summer shifted to mainly cyanobacteria (BUT only 3% of total biomass)



Legend: cyanobacteria (●), chlorophytes (▽), centric diatoms (■), cryptophytes (◊), pennate diatoms (▲), and dinoflagellates (○).

2012 Comparison Summary

- Nutrient availability played a more significant role in phytoplankton community composition.

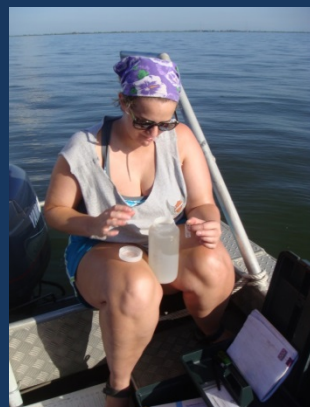
- There was a shift from chlorophytes in the spring to cyanobacteria in the summer but again overall biomass contribution was low (0.7%).

		2011	2012
Time period	Stations	Dissolved toxin (µg MC equivalent L^{-1})	Dissolved toxin (µg MC equivalent L^{-1})
		Average ± SD (range)	Average ± SD (range)
Early Spring	Transect	Not collected	
Late Spring	"	0.9 ± 0.2 (0.6-1.2)	
E. Summer	"	0.5 ± 0.3 (0.2-0.9)	
L. Summer	"	1.3 ± 0.3 (1.0-1.7)	
Early Spring	Northern	Not collected	
Late Spring	"	Not collected	
E. Summer	"	0.4 ± 0.5 (0.8-1.1)	
L. Summer	"	3.4 ± 1.5 (1.3-5.5)	
Early Spring	Tributaries	Not collected	
Late Spring	"	"	
E. Summer	"	"	
L. Summer	"	"	

BDL = Below Detection Limit (0.15 µg MC equivalent L^{-1})

What happened?

- Possible reasons why a cyanobacteria bloom did not occur in 2011
  - High volume of water pushed out seed population
  - Constant turbidity
  - Drought year did not allow contributing tributaries to re-seed the lake
- No cyanobacteria bloom in 2012
  - Lower overall biomass compared to 2011
  - Low nutrient availability
  - Drought year meant low flow from the tributaries
    - No reseeding from tributaries



Management Implications

- All years were different in timing, amount of water, nutrient input and phytoplankton community response.
- Year-round monitoring needs to occur

Scientific Literacy

Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. It also includes specific types of abilities (NSF, 1996).

- **A scientifically literate person is defined as one who has the capacity to**:

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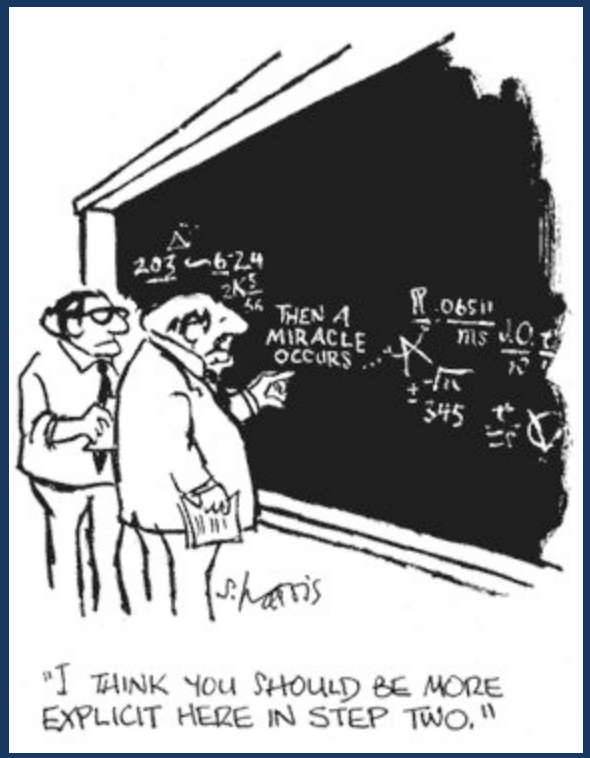
(National Center for Education Statistics)

http://mad4science.wordpress.com/2009/05/19/what-does-a-scientist-look-like/

Scientific Literacy

- Bad news: Only 28% of Americans are scientific literate (Michigan State University, 2007)

- Good news: 4 in 5 adults do think science education is “absolutely essential” or “very important” (California Academy of Sciences survey, 2009)



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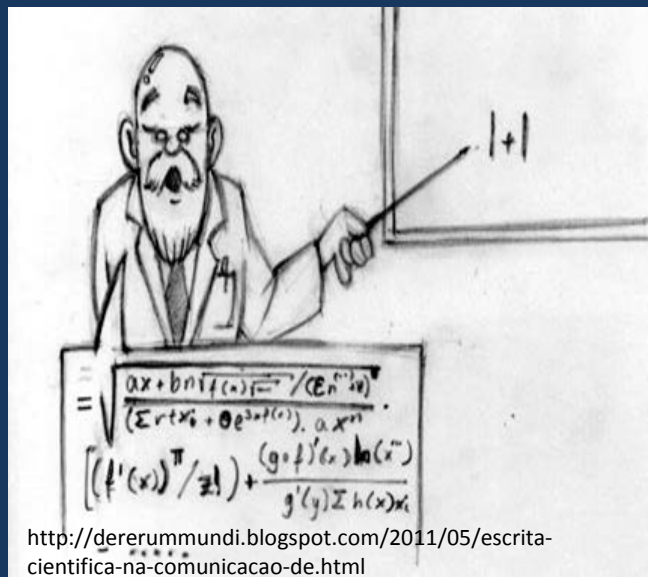
Problems with Communicating about Science

- Understanding what average person knows
  - Time intense
    - Creation of non-biased questions
    - Conducting surveys and follow-ups
    - Qualitative data

Scientists don't always know *how* to communicate with the public



http://dererummundi.blogspot.com/2011/05/escrita-cientifica-na-comunicacao-de.html

Goals

Gauge scientific literacy in regards to algae and harmful algal blooms in South LA

Gauge visual accuracy of different water conditions

Create educational material based on initial interviews

Methods

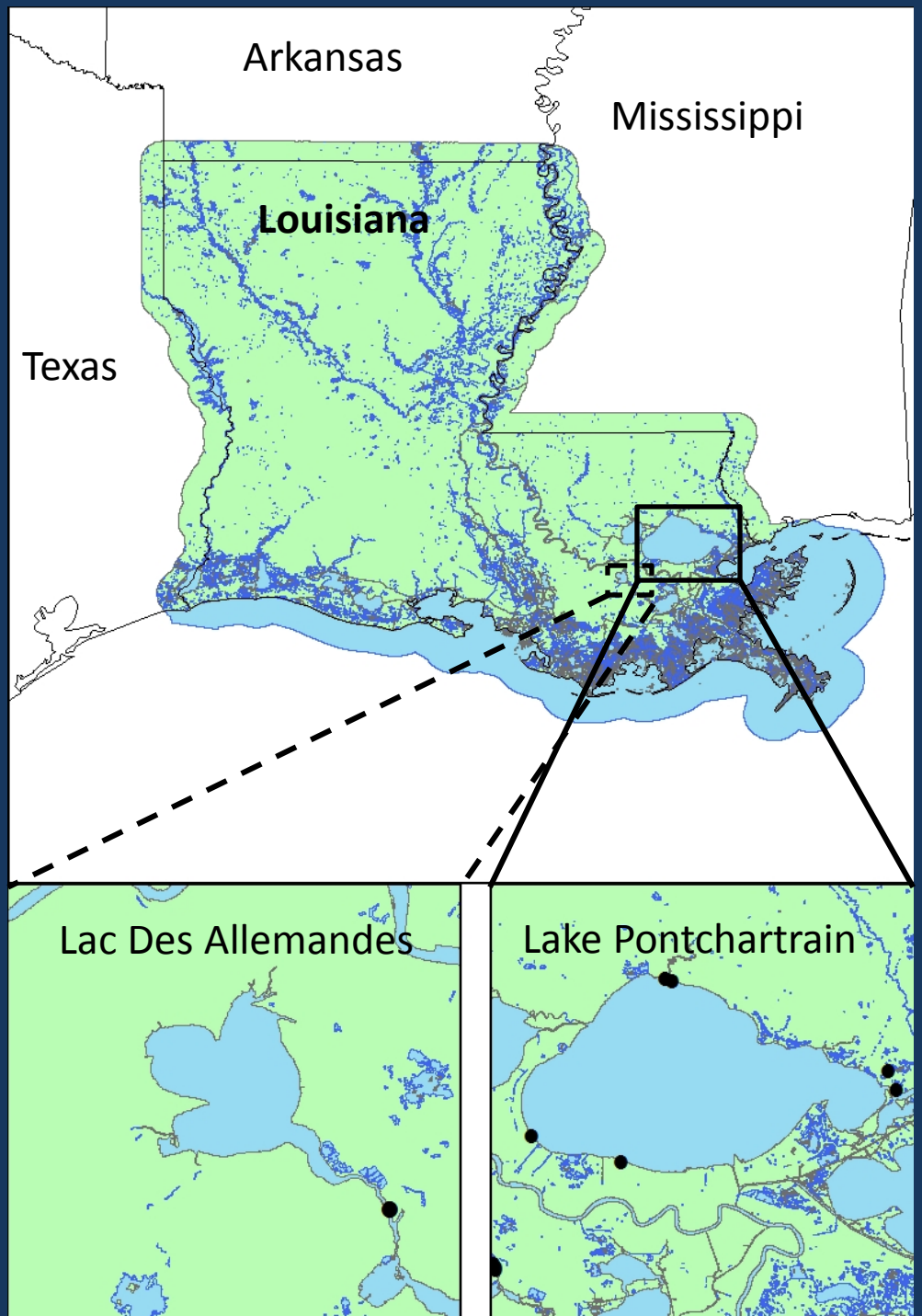
Initial interviews with sport and commercial fishermen

Purpose:
- Collect basic demographics
- Visual accuracy test
- Scientific literacy of terms (algae, harmful algal blooms)

Use results to produce educational material

Distribute brochures and conduct follow-up interviews

Purpose:
- Determine if the correct media was being utlized


Arkansas
Mississippi
Louisiana
Texas
Lac Des Allemandes
Lake Pontchartrain

Fisherman Interview (initial)

Demographics

Date	Time	Location	Interview #
Gender: ☐ M or ☐ F	Age	☐ Commercial ☐ Sports Fisherman	
Experience of fishing (years)		How often do you go fishing? ☐ once a year ☐ once a month ☐ once a week ☐ more than once a week	
Type of fish:		Do you: ☐ eat what you catch? ☐ Sell? ☐ Share?	

Have you heard of ***algae***? Can you please describe and tell me what you know about this organism?

Scientific literacy

Visual Accuracy

Below (or on a separate page) are pictures of water that are different in color.
Which of the picture(s) most closely resembles "colored water" have you seen before?

Can you remember where you were when you saw this color of water? What time of year?

From these pictures, in which type(s) of "colored water" would you <u>not</u> go fishing? (pictures attached)

Have you ever caught "bad fish" or a fish that you would not eat? ☐ yes ☐ no

If so, why did you think it was "bad"? ☐ taste ☐ visual cues ☐ other _____

Have you ever gone to a doctor/hospital from eating bad fish/shellfish? ☐ yes ☐ no

Did you ☐ catch or ☐ buy this fish? Where?

Where do you get information (on fishing conditions) about the lake?

Results: Demographics

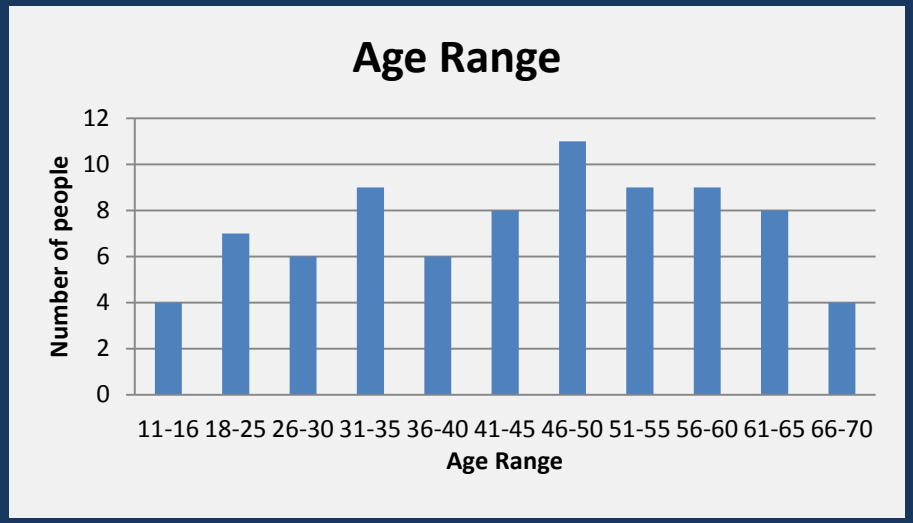
n=82

89% Male

85% sports fishermen

50.3% eat their own catch

27% fish more than once a week



Results: Scientific Literacy

100% have heard of algae

Have you heard of ***algae***? Can you please describe and tell me what you know about this organism?

24% Green stuff/ gunk/ grassy/ slime

21% associated it with water

17% knew that it grew

Are you familiar with the term "harmful algal blooms"? What does this mean?

60% did not know

16% thought it removed oxygen from the water

10% used the term "red tide" or "too much algae"

"I got that one time from a girl on Bourbon St."

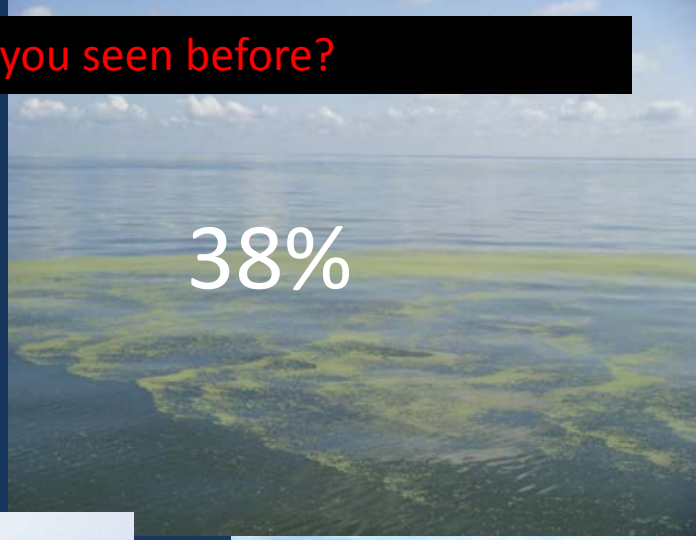
"Green and slimy and gross"

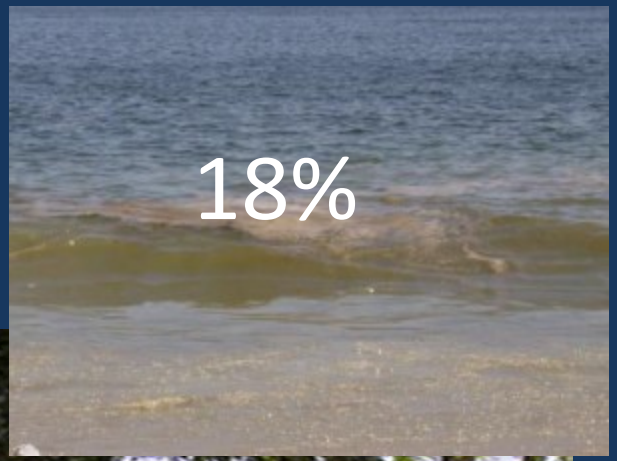
"Stuff in my pool"

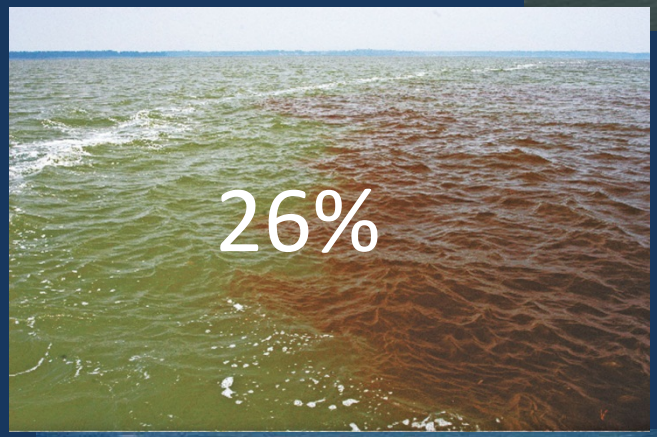
Sample Answers

Which of the following water conditions have you seen before?

15% Never have seen any of them

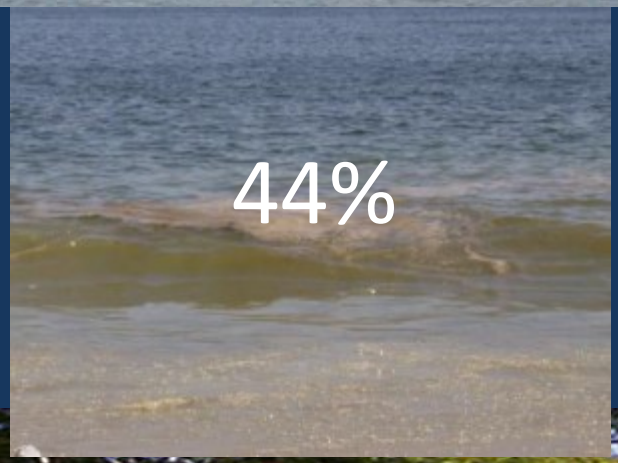


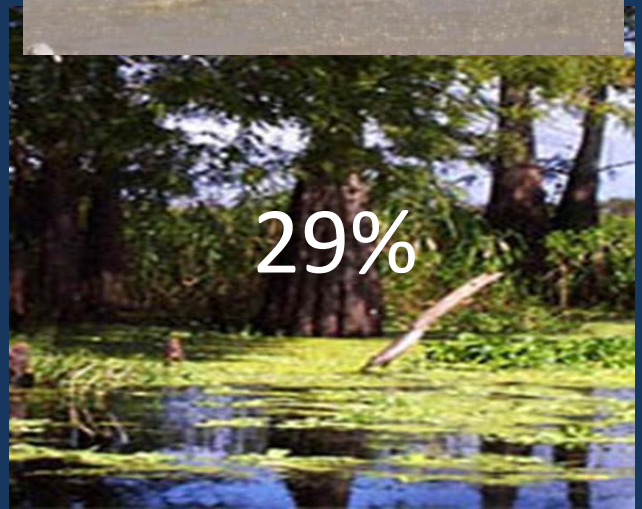




Which of the following water conditions would you NOT go fishing?

5% Would fish in any of them





ALGAE

THE GOOD

1. Sunlight shines on waterbodies.

2. Algae uses sunlight and nutrients to produce oxygen and grow.

3. Algae is a food source for small fish, crabs and shrimp. Therefore, algae is important and needed in the food web of lakes.

However, sometimes there can be harmful consequences.

4. As a normal process, algae dies and sinks to the bottom where bacteria eat it.

THE BAD

5. Bacteria use oxygen by taking it out of the water. If a lot of algae grows at once, it causes an algal bloom. If too much dies at once, too much oxygen can be taken out of the water.

IS IT OK TO GO FISHING, CRABBING OR SWIMMING DURING AN ALGAL BLOOM?

Most of the time it is fine to go fishing, crabbing and swimming, but be careful in the summer when you see a lot of coloration in the water or notice a strange smell.

DUCKWEED A PROBLEM

HARMFUL ALGAE IS A PROBLEM

Thanks to Robert Ray at Sea Grant for helping make this possible!!

ATER SAFETY

e a question about the safety of the

ntact:

and Fisheries:

1-800-256-2749

Lake Pontchartrain Basin Foundation:

1-504-836-2239

Or a scientist:

Dr. Sibel Bargu - *sbargu@lsu.edu*

Emily Smith (graduate student) - *esmi122@lsu.edu*

Sea Grant Louisiana

Follow-up surveys

- Several brochures were taken (not thrown away)
- Brochure is published on Louisiana Sea Grant's Website and Facebook page
- Most people had not seen the brochure previously
  - Learned something once they did look at it
    - i.e. algae also produces oxygen and not all algae is bad

Conclusions

- Scientific literacy in South Louisiana for the term algae is average (~27%) with the nation, but below average for harmful algal blooms.
- 30-50% of people are able to visually recognize two common water conditions.
- Only 40% were able to recognize a cyanobacteria bloom.
- Knowledge about cyanobacteria is essential because of how much this estuary is used.
- Paper media may not be the best form of communication

Acknowledgements

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WHERE DISCOVERIES BEGIN

Sea Grant

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Questions?

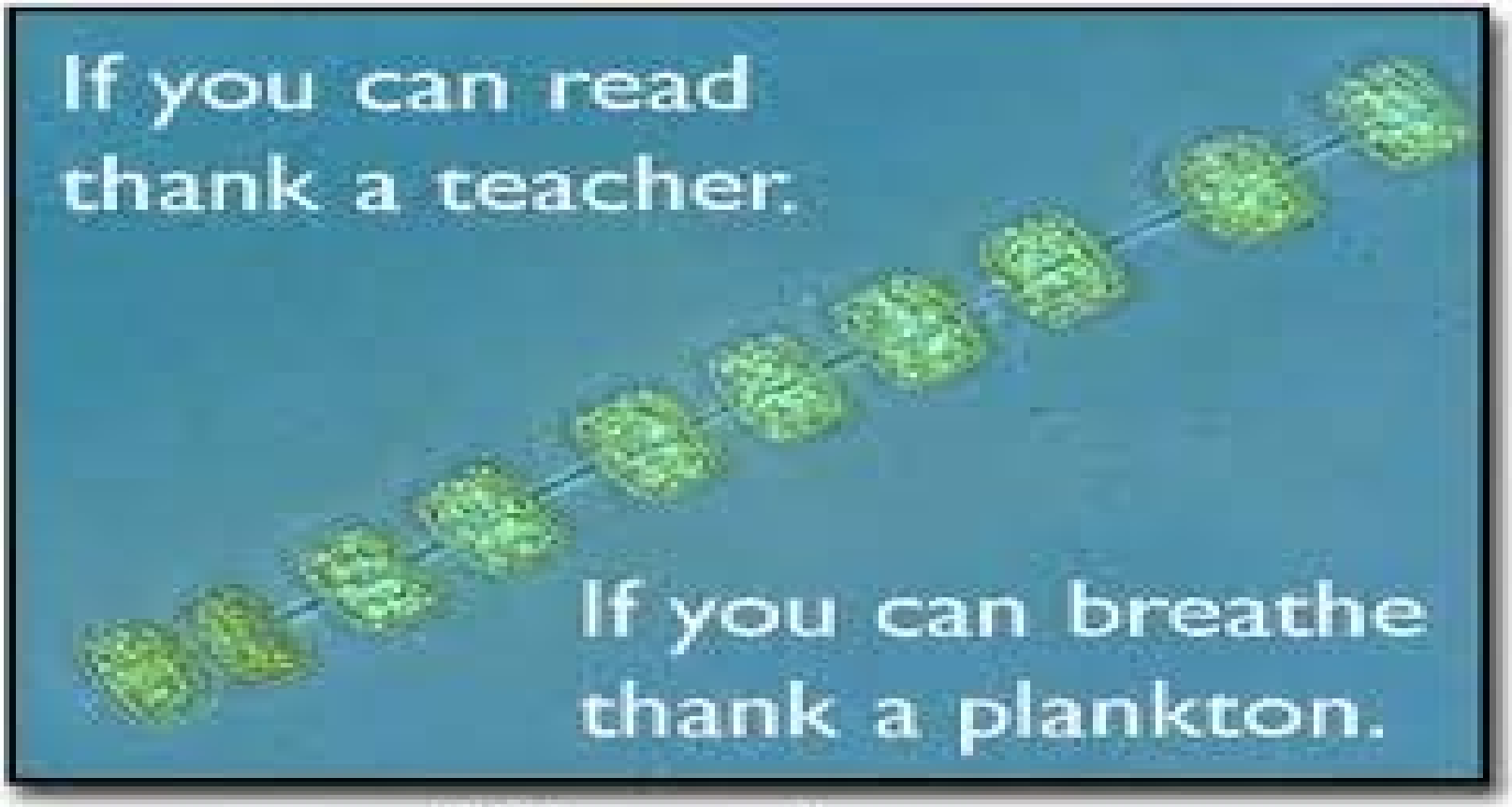

Image courtesy D. Townsend