Filamentous Algae Relations To Surface And Groundwater Nutrient Pathways In The Karst Watershed Of The First National River (Buffalo River, Arkansas)

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Buffalo River Symposium

April 23, 2019

Margaret White Spring (Photo courtesy of Jeffery Quinn, Arkansas Game and Fish Commission)

U.S. Department of the Interior
U.S. Geological Survey

Buffalo National River (BUFF) Facts

– In 1972, became the first National River in the US,
– In 2015, over 1.7 million people visited the BUFF (Thomas and Koontz, 2016),
  – > $77.5 million spent
  – ~1,200 jobs supported
  – over $90.2 million contributed to the local economy
– 20 State Species of Concern for Arkansas, including two mussels that are Federally-endangered (snuffbox mussel) or threatened (rabbitsfoot mussel)

Thomas, C. C., & Koontz, L. 2016. 2015 National Park visitor spending effects: economic contributions to local communities, states, and the nation. Natural Resource Stewardship and Science, US Department of the Interior. Fort Collins, Colorado: National Park Service.

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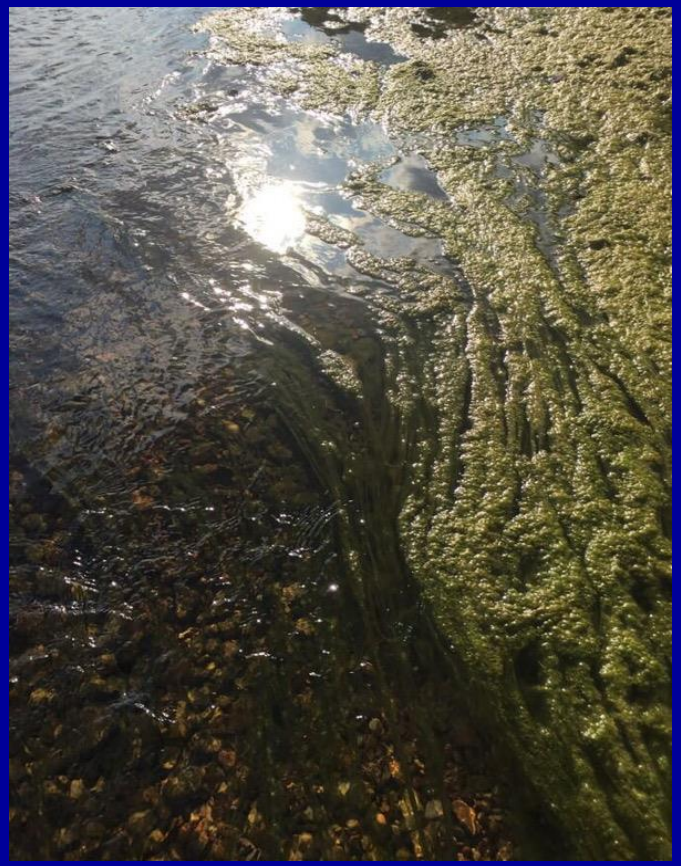
Buffalo River Filamentous Algae Study

- Cooperative project with [2]Arkansas Game and Fish Commission (AGFC)
- $95K total - $50K AGFC and $45K USGS

Most often asked question by public, “Has growth of filamentous algae really increased in the Buffalo?

- Based on internal algal surveys and 36 complaints filed through their website …, ADEQ estimates that FA blooms covered approximately 95 river miles in 2018—**an estimated increase of 70 and 25 river miles over the two preceding years**, respectively.

Second most often asked question, “What are the changes over time that have resulted in increasing amounts of filamentous algae in the Buffalo?



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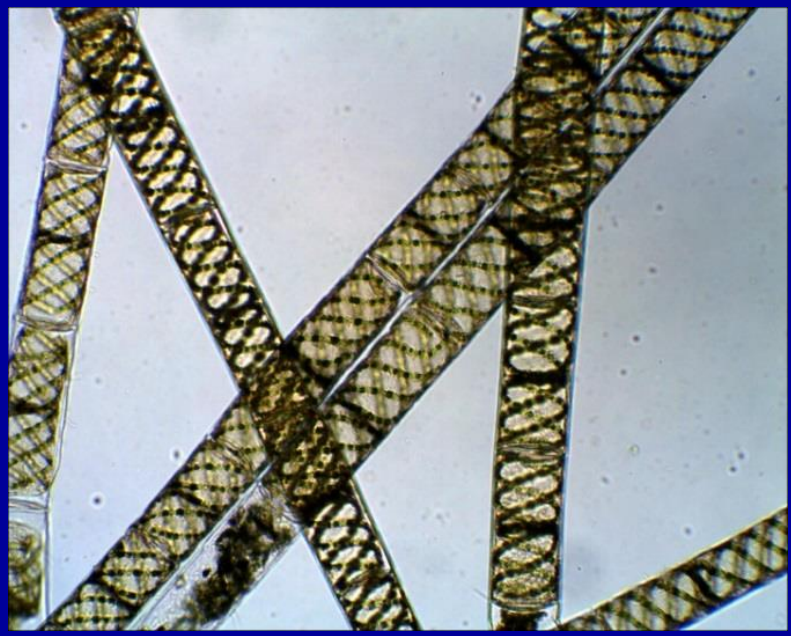
June 2018 Reconnaissance Findings……

1. What is the most common filamentous algae?
   - *Spirogyra* (photo below by Reed Green, USGS) and *Rhizoclonium*

2. Is filamentous algae more prominent in some parts of the river than others?
   - Filamentous algae coverage is much greater in the lower Buffalo River, downstream of Hwy 65.

3. Does the location of the filamentous algae in the river indicate habitat preference or nutrient sources? Yes, location seems to indicate habitat preference and potential nutrient sources



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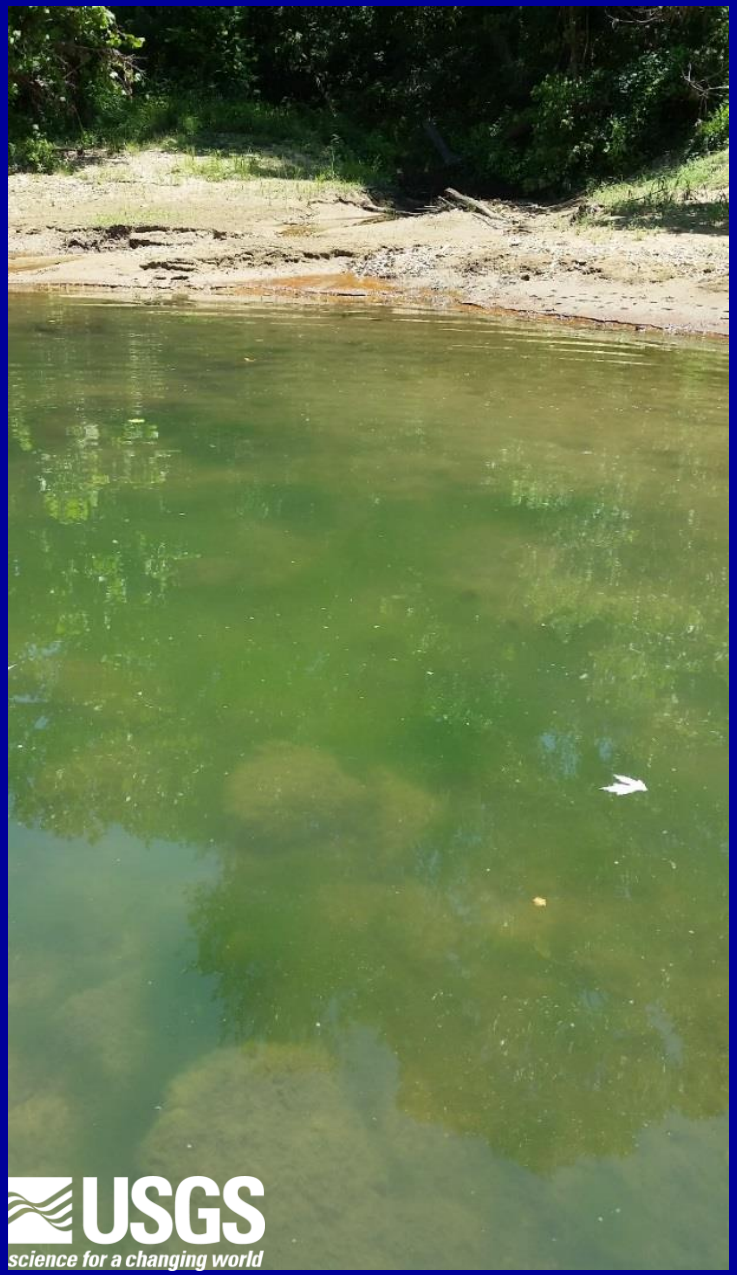
Algae was also often associated with springs and cold tributaries.



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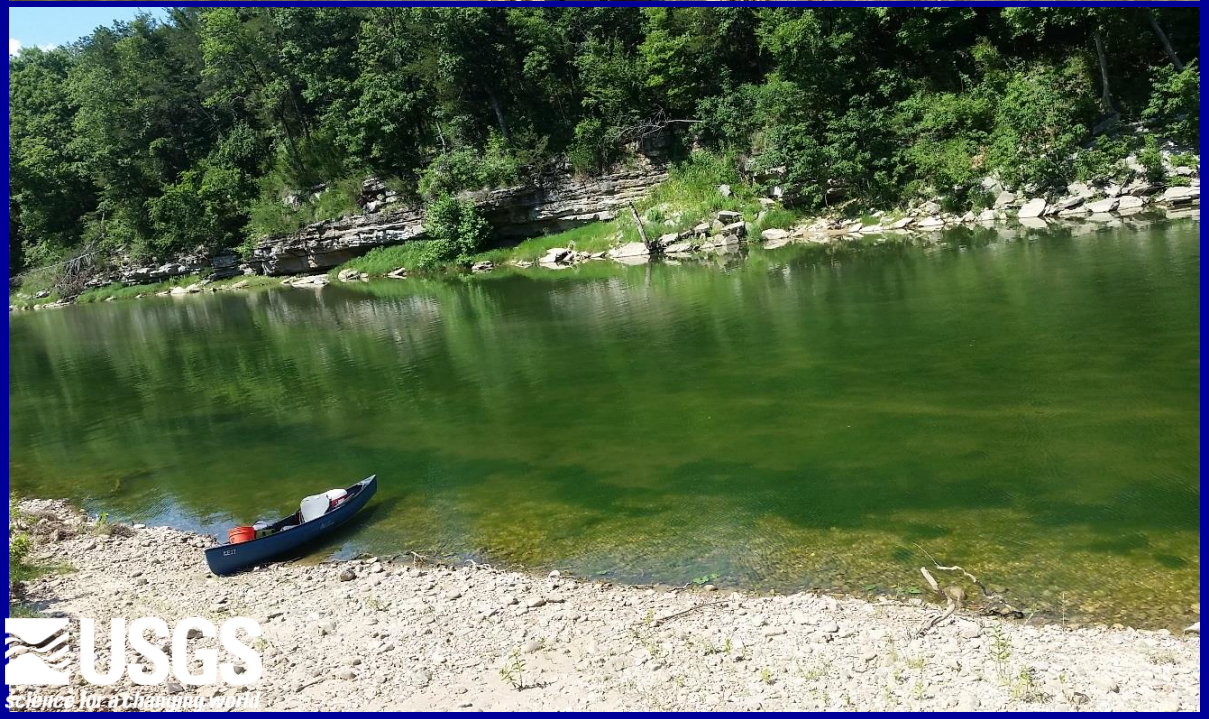
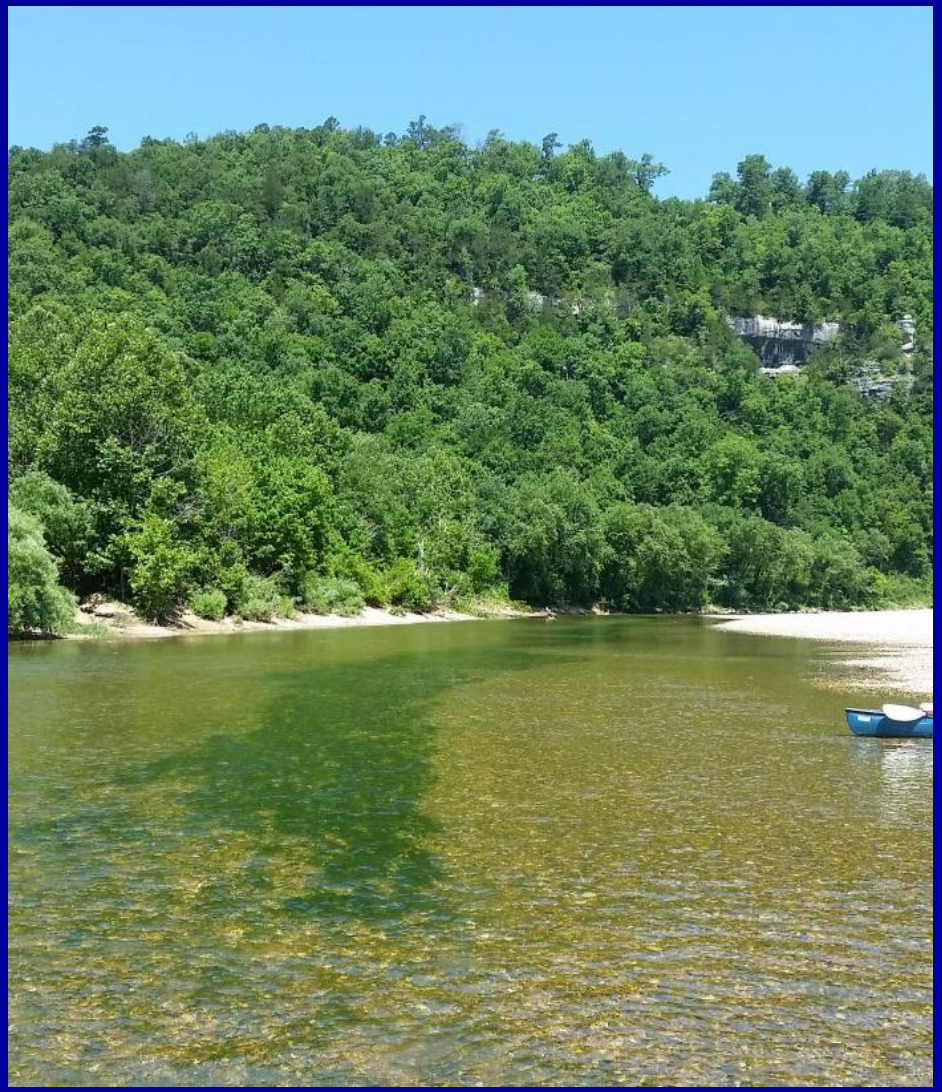
Also often associated with gravel bars…..





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Research objectives and goals

- Determine if the filamentous algae are responding to nutrients and, if so, what is the pathway (groundwater/springs, surface water/tributaries, or both)?
- Eventual goal, determine what the nutrient sources are? Potential sources most likely include a combination of human (i.e. recreational use, septic tanks) and livestock.

Photo courtesy of
Shawn Hodges (NPS)

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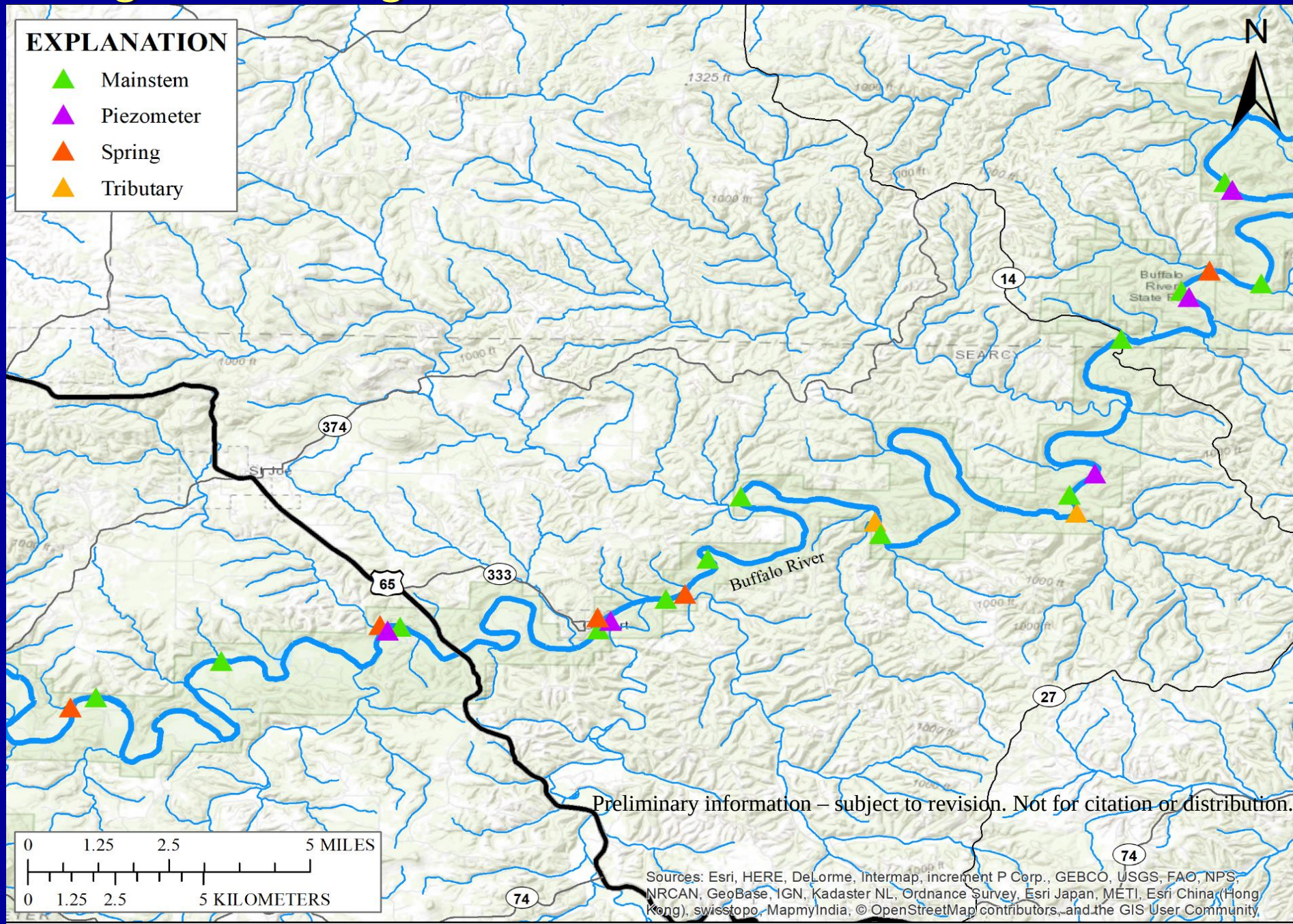
Sampling Targets

- 5 shallow wells (established on gravel bars)

- 6 springs or spring tributaries (adjacent to the mainstem)

- 13 mainstem sites

Filamentous Algae Monitoring Locations



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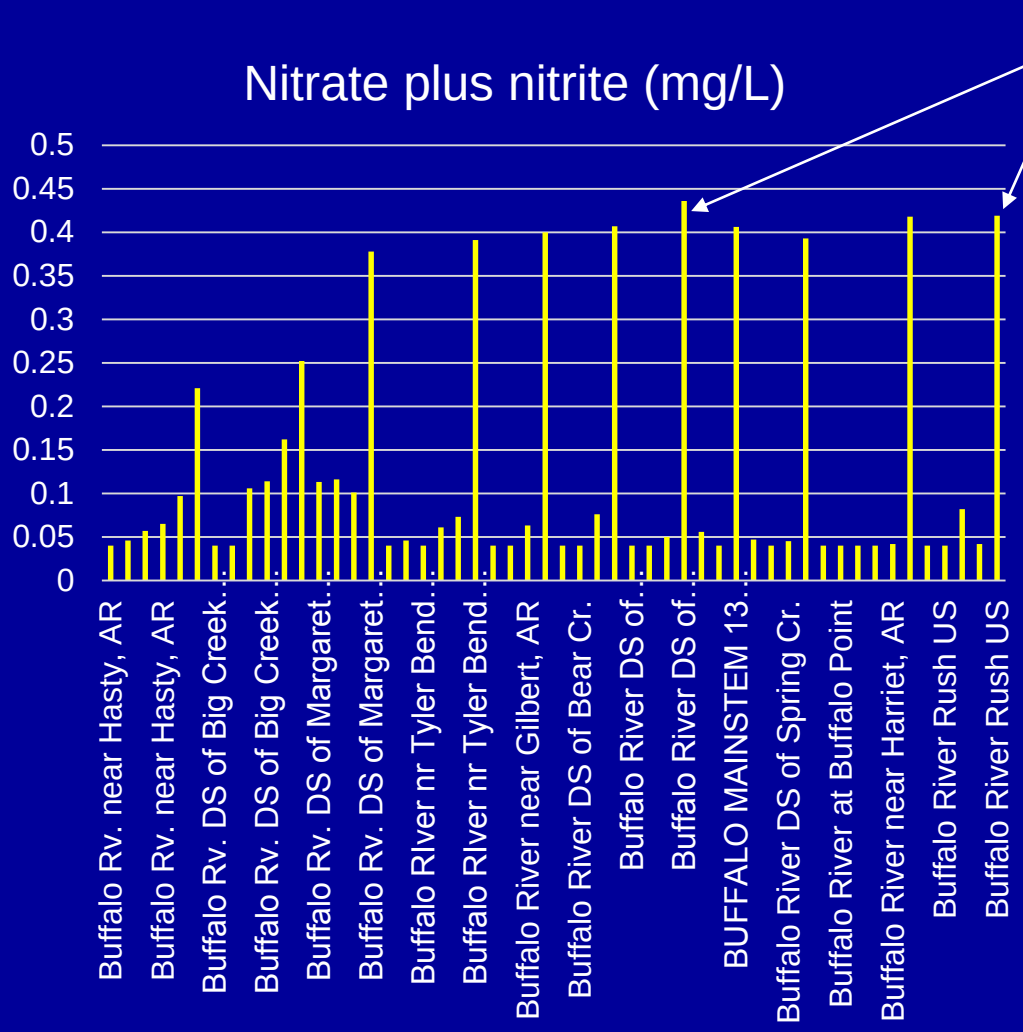
Nutrient concentrations in the Buffalo vary greatly by season



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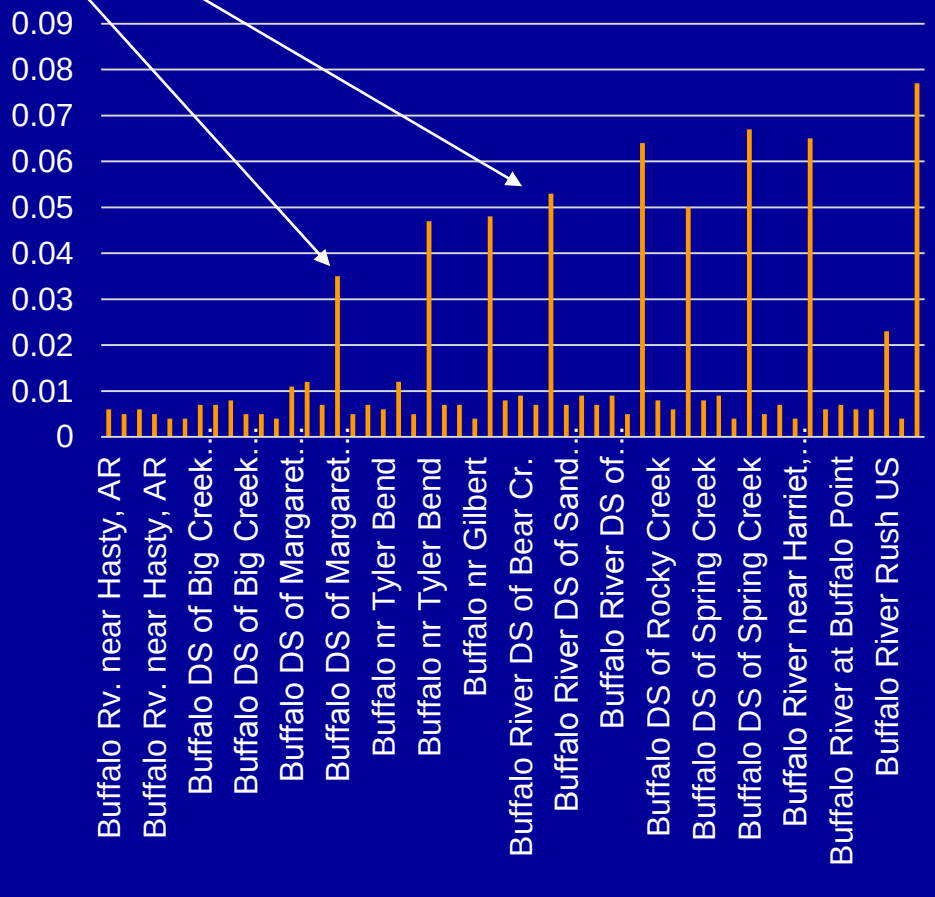

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Mean nutrient concentrations in gravel bars and springs in the growing season (July, Sept, and Oct)

Gravel bars

Access point	NO3 + NO2	Total P
	mg/L as N	mg/L as P
Tyler Bend	0.098	**0.066**
Gilbert	0.094	**0.436**
Spring Creek	0.101	**0.028**
Buffalo Point	**0.57**	**0.875**
Rush	0.108	**0.031**

Total Phosphorus (threshold of 0.020 mg/L)

Nitrite plus Nitrate (threshold of 0.5 mg/L)

Springs

Access point	NO3 + NO2	Total P
	mg/L as N	mg/L as P
Margaret White Spring	0.212	0.014
Mill Ck above Buff R near Tyler Bend	0.343	0.010
Gilbert Spring	**0.813**	**0.03**
Spring Pond nr Panther Creek	**0.550**	0.007
Panther Creek	**0.943**	**0.026**
Spring on RR	0.092	0.017

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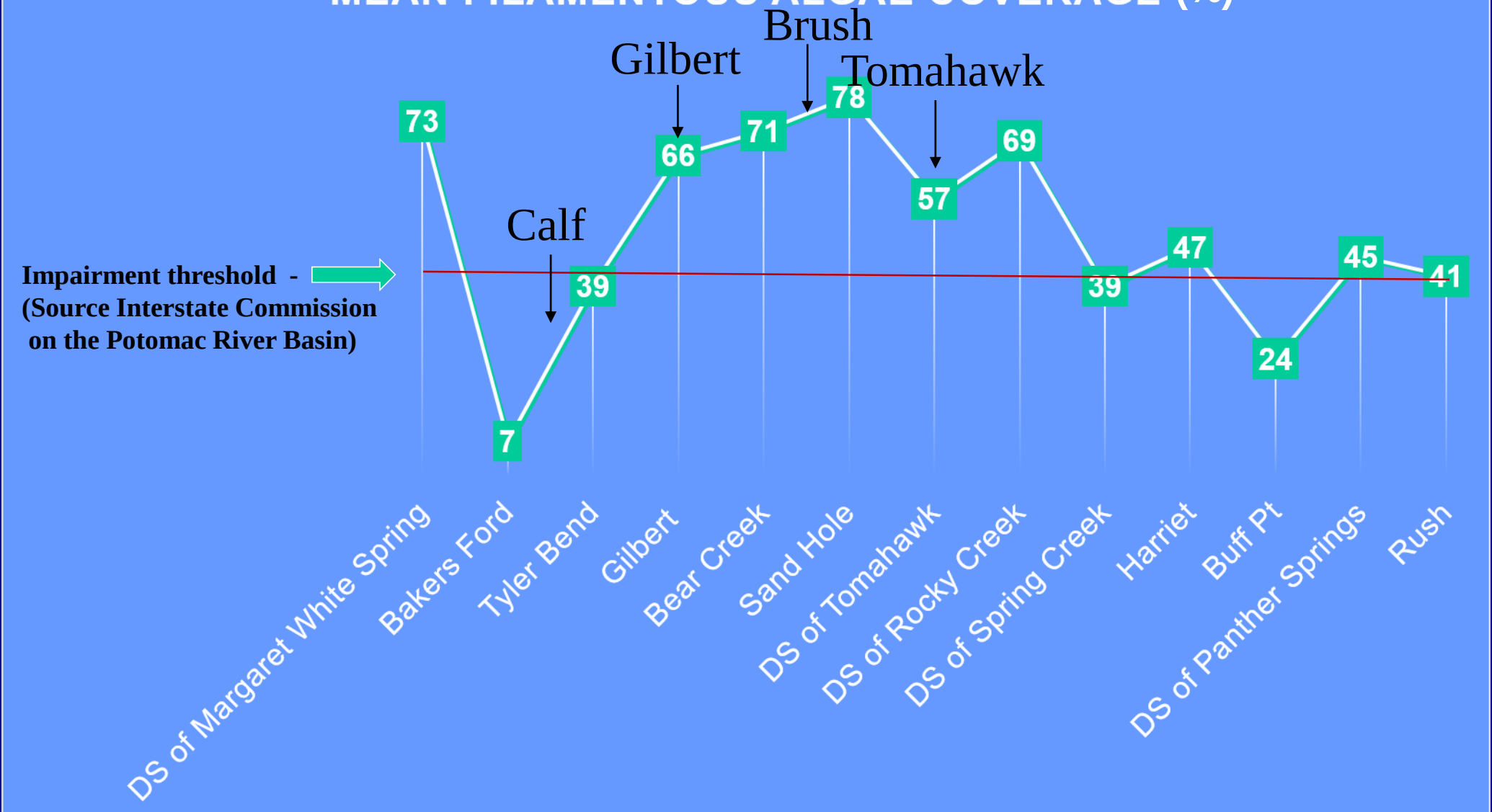
MEAN FILAMENTOUS ALGAE COVERAGE (%)



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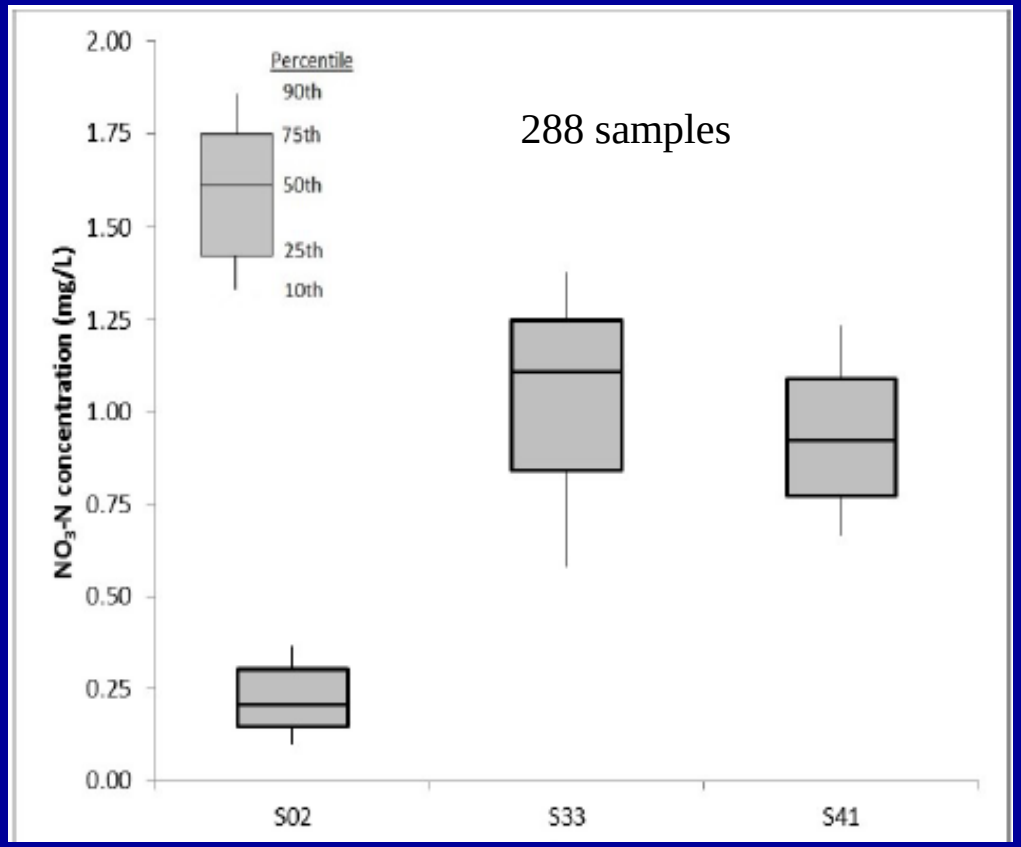
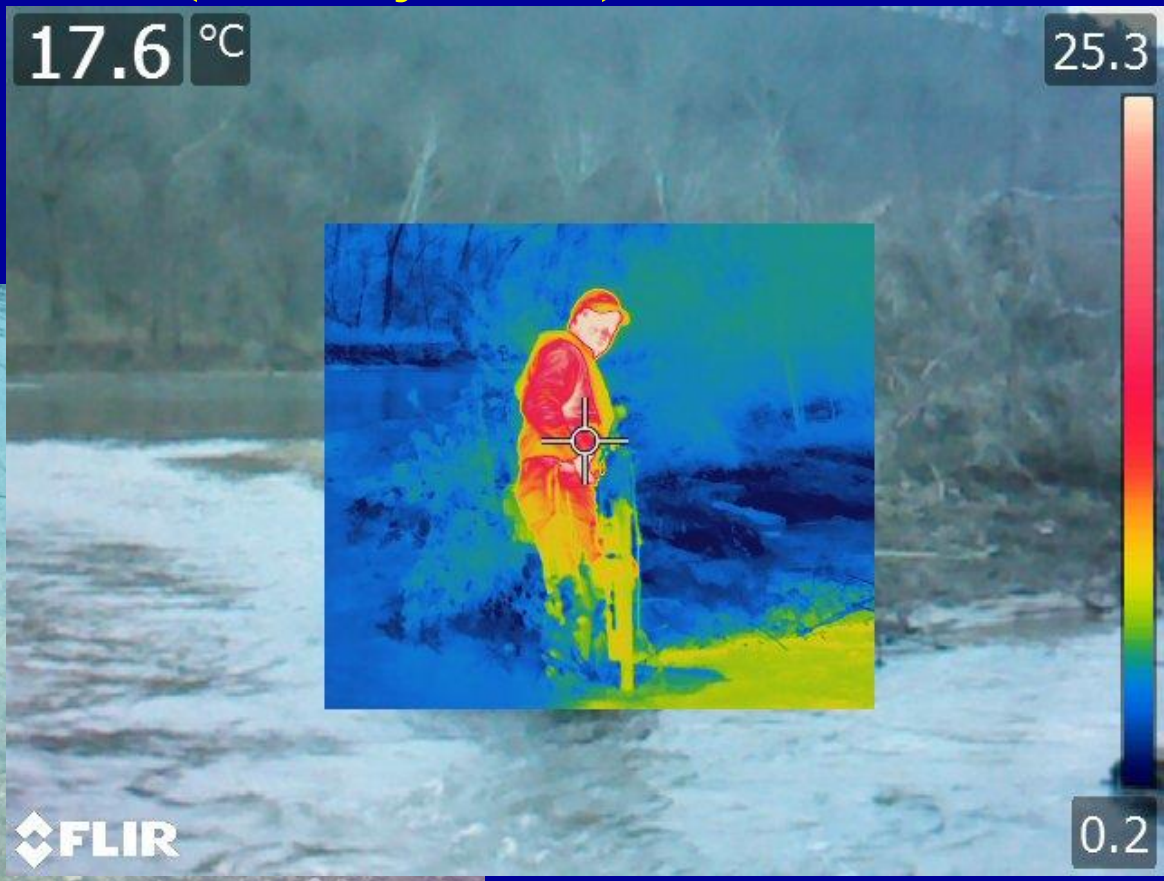
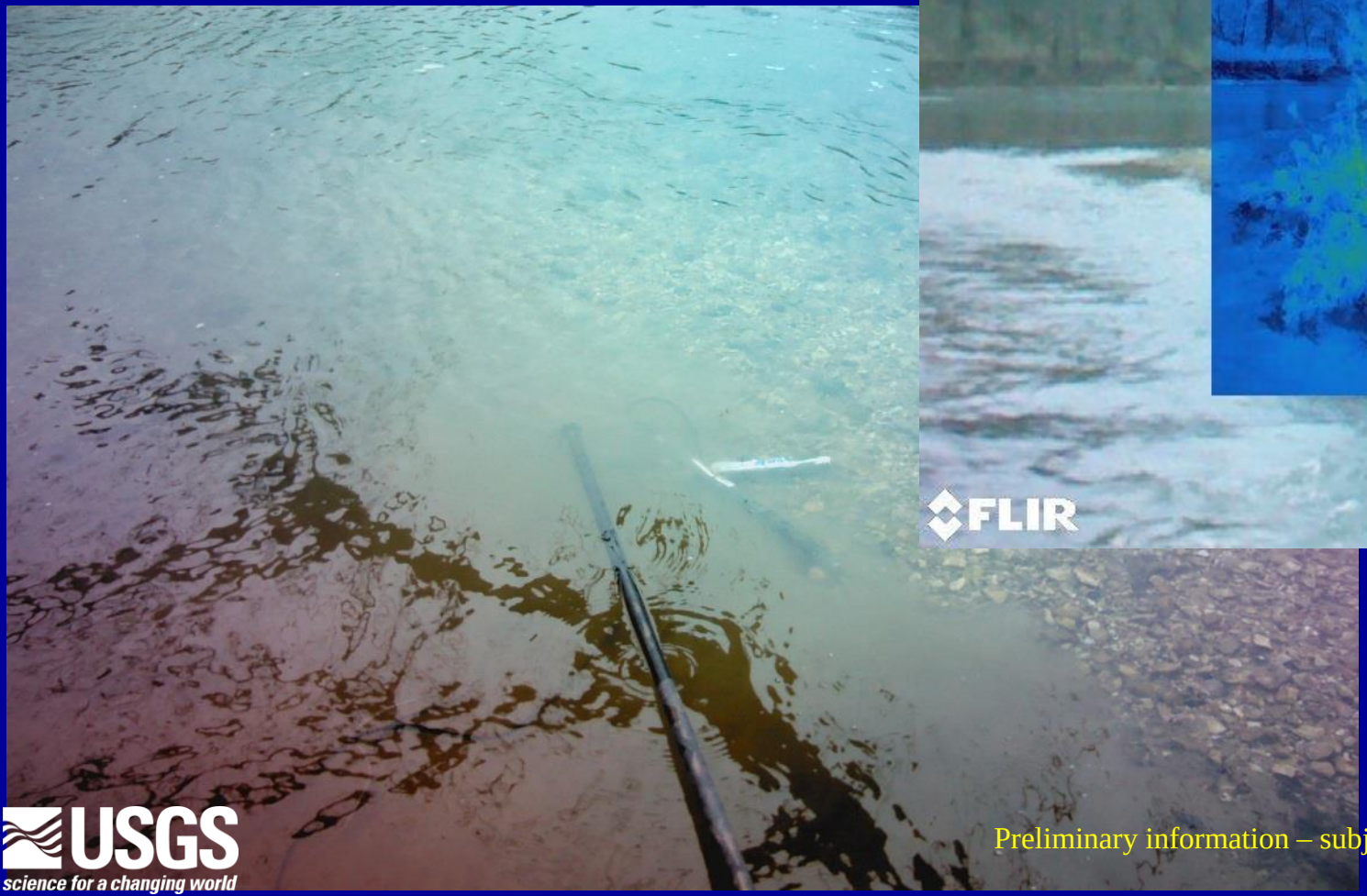
Nitrate concentrations in springs are generally much higher than in tributaries (collected from 1999-2011 during base-flow conditions).



(borrowed from Watershed Conservation Resource Center, 2017)

Demonstration for how water temperature, nitrate, and conductance compare at spring and mainstem sites (January 2019)





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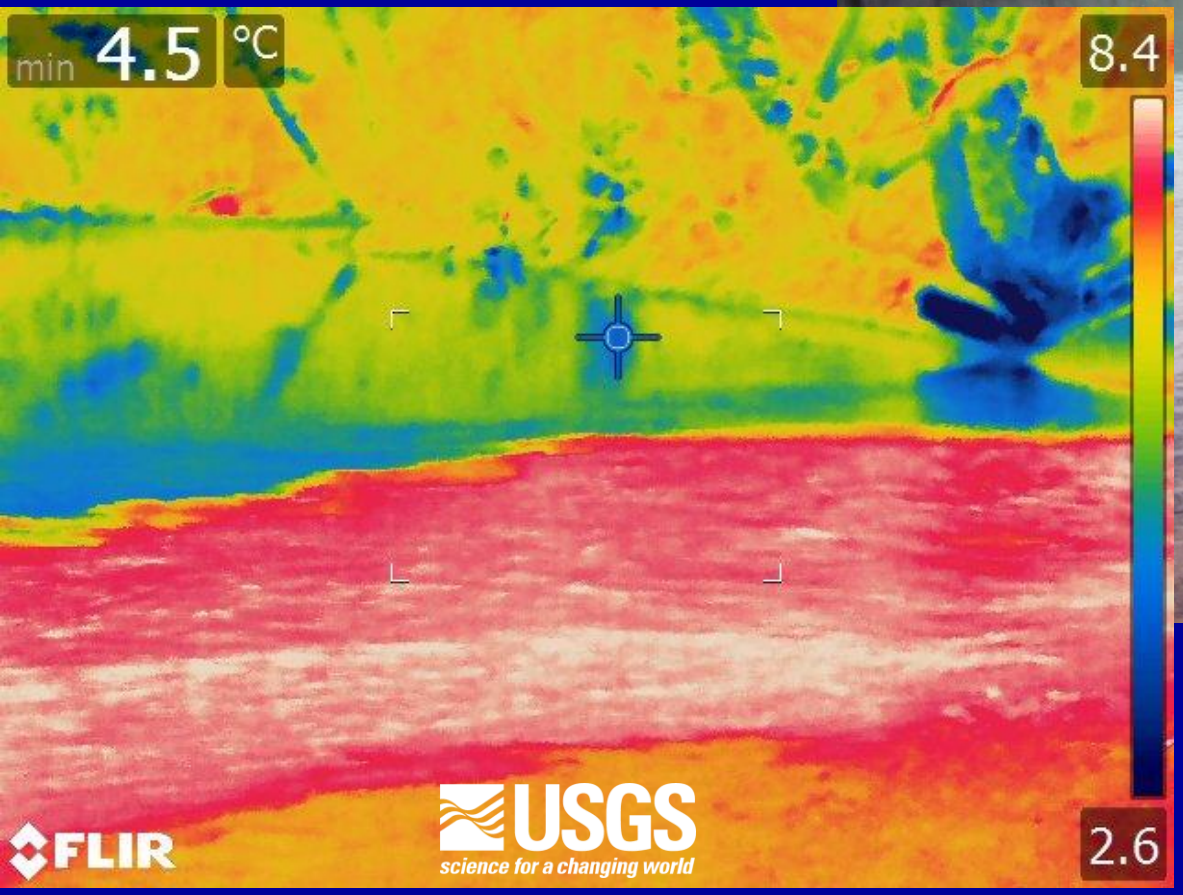
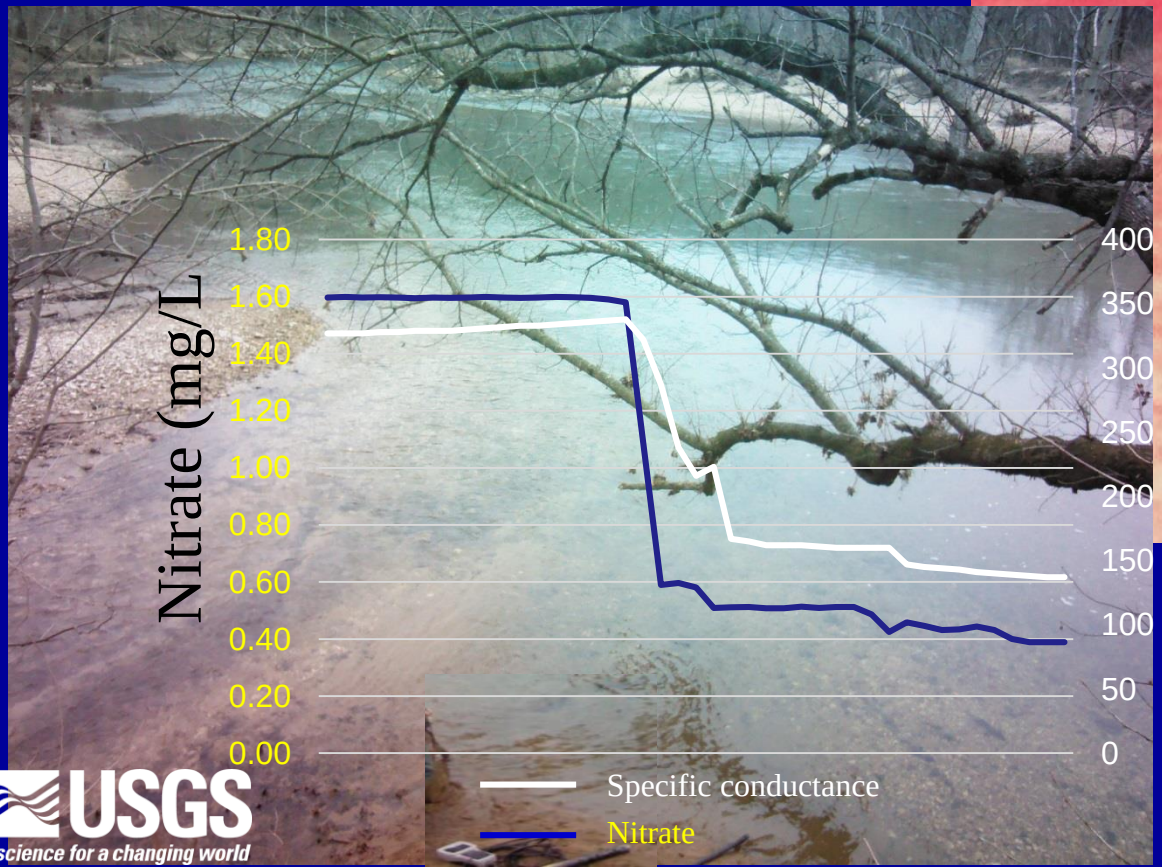
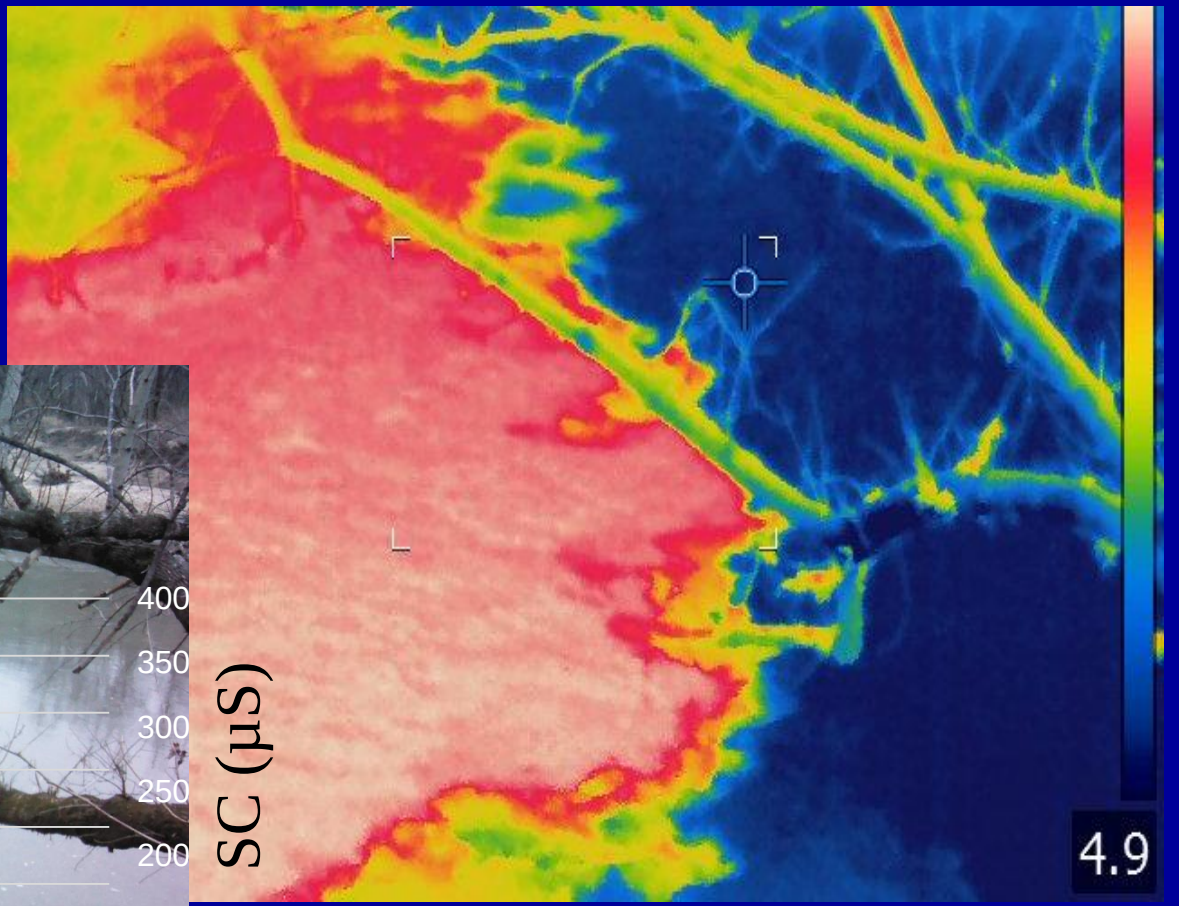
Demonstration for how water temperature, nitrate, and conductance compare at spring and mainstem sites (January 2019)….continued



Preliminary information – subject to revision.
Not for citation or distribution.

Demonstration for how water temperature, nitrate, and conductance compare at spring and mainstem sites (January 2019)….continued





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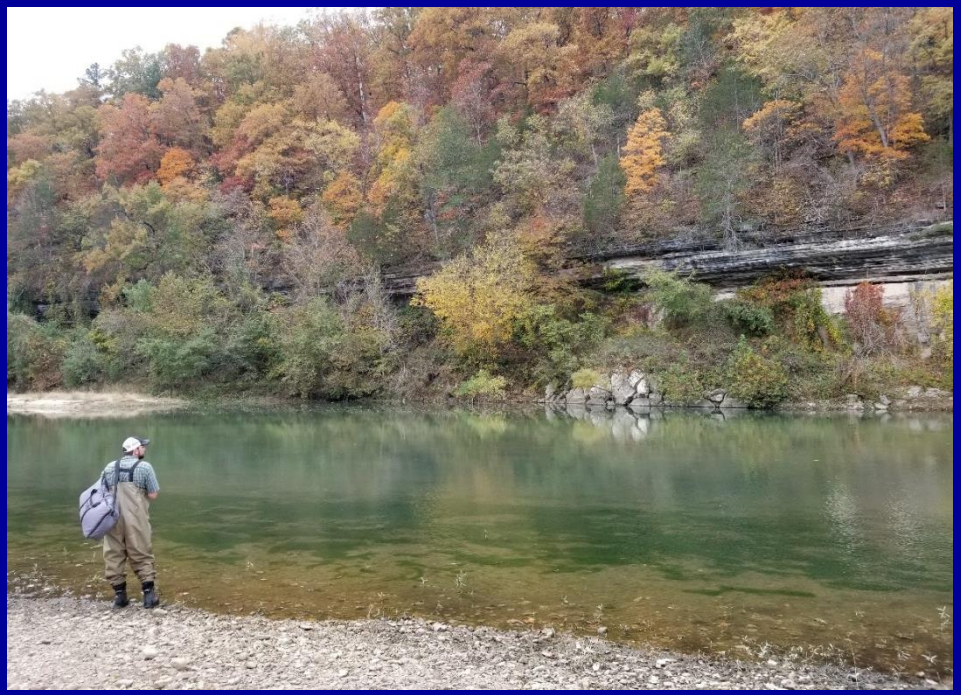
Filamentous Data Summary…..

1. **Springs seem to be sources of N and also low concentrations of P.**

2. **High P concentrations were detected in gravel bars**

3. **Mainstem N and P concentrations are low in the growing season compared to other times**



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More data are needed to assess nutrient variability associated with attenuation (seasonality) and flow conditions…..

- **Determine how nutrients in the river and gravel bars change between periods of low- and high-human use.**

- **Determine how nutrient concentrations in the river and gravel bars change following storm events.**

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Acknowledgements

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