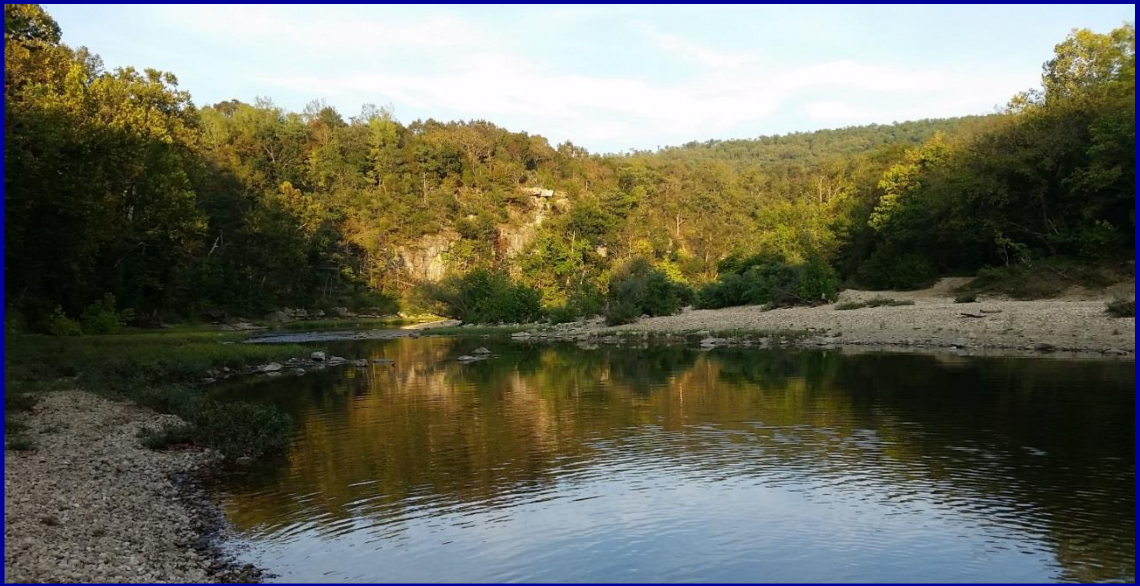
A preliminary update on USGS studies being conducted in the Buffalo River Basin



BEAUTIFUL BUFFALO RIVER ACTION COMMITTEE
13 Nov 2018

Billy Justus, Aquatic Research Biologist
USGS Lower Mississippi-Gulf Water Science Center

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

Some basic "USGS history"

- Established in 1879,
- Impartiality has been the key to longevity,
- Conducts science investigations for many Federal, state, local government agencies, and non-government cooperators

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 (12 mussels, 4 fishes, 3 insects, and 1 crayfish)
- Two reaches (including the Big Creek confluence) are critical habitat for the Federally-threatened rabbitsfoot mussel

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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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Mill Creek Microbial Source Tracking (MST) Recap

- Billy Justus[1], and Nathan Wentz[2]
- [1]USGS Lower Mississippi-Gulf Water Science Center
- [2]Arkansas Department of Environmental Quality

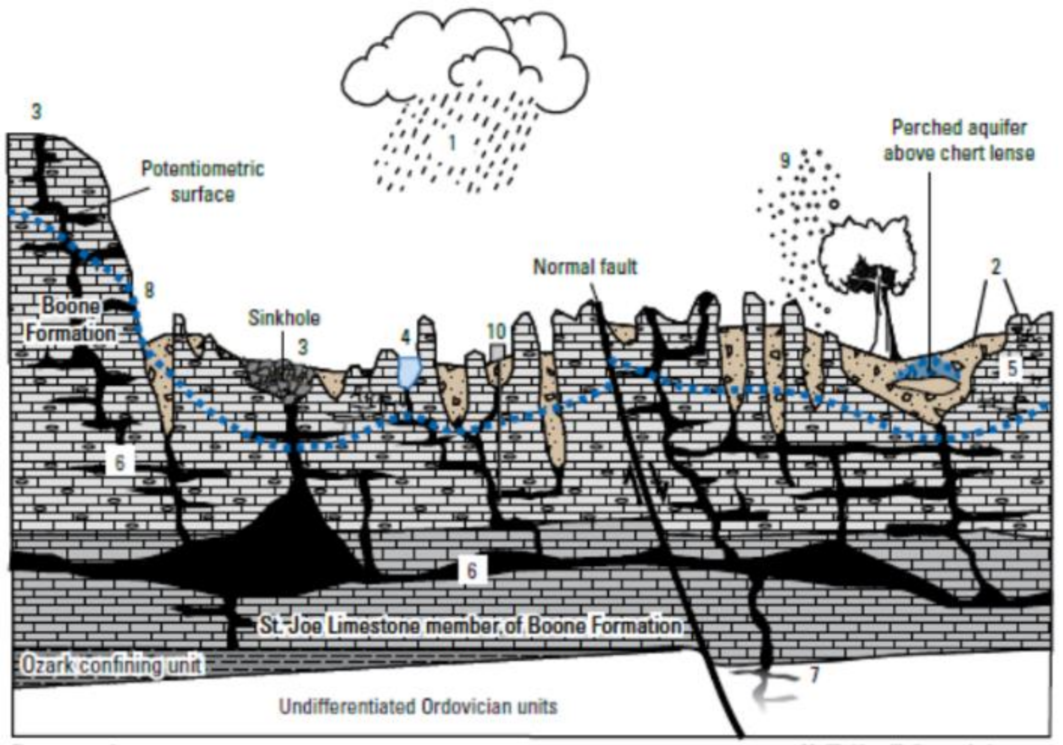
- **Fecal material entering Mill Creek has resulted in high concentrations of bacteria and probably nutrients**
- **Likely sources are humans, cattle, and poultry**
- **Sources need to be determined before corrective measures can be implemented.**

Buffalo River at Pruitt, AR

The role of Karst/GW pathways for nutrients; Mill Creek example

- 70-80% of the recharge area of the Dogpatch springs originates from the Crooked Creek basin to the north (Aley and Aley 2000)

- Nutrient concentrations in the Mill Creek basin are much higher in groundwater than in surface water



Aley, T., and Aley, C., 2000, Inventory and delineation of karst features, Buffalo National River, Arkansas. Report on Phase 2 investigations and final project report. Ozark Underground Laboratory, Protem, Missouri

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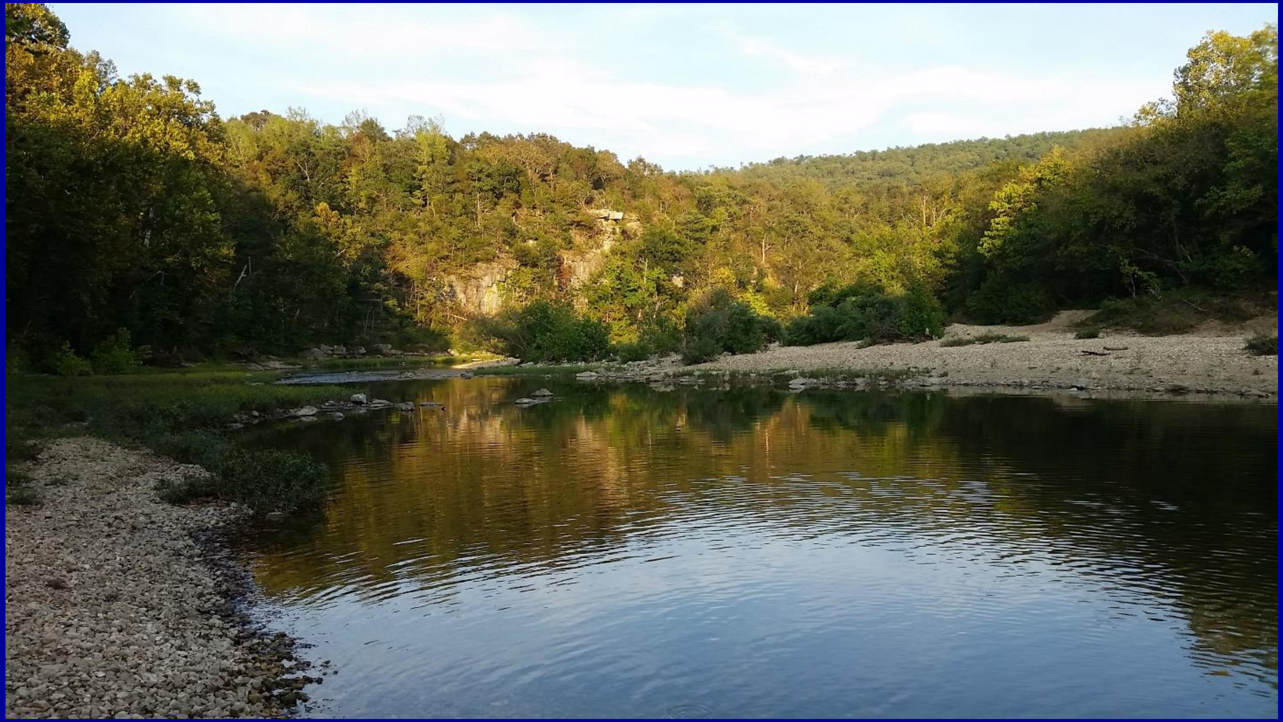
"Microbial Source Tracking" Background

- **Microbes associated with different animal groups have unique host-associated genetic sequences (markers)**

- **Known "source samples" are collected for all test organisms prior to water sampling**




Preliminary Study Update: A Comparison of Nutrient Water Quality in the Buffalo River Upstream and Downstream of Big Creek



B.G. Justus[1], Lucas Driver[1], Jill Jenkins[2], Shawn Hodges[3], and Ashley Rodman[3]

[1]U.S. Geological Survey, Lower Mississippi-Gulf Water Science Center, Little Rock, AR. bjustus@usgs.gov, ldriver@usgs.gov;
[2]U.S. Geological Survey, Wetland and Aquatic Research Center, Lafayette, LA, jenkinsj@usgs.gov ;
[4]Buffalo National River, National Park Service, Harrison, AR. shawn_hodges@nps.gov

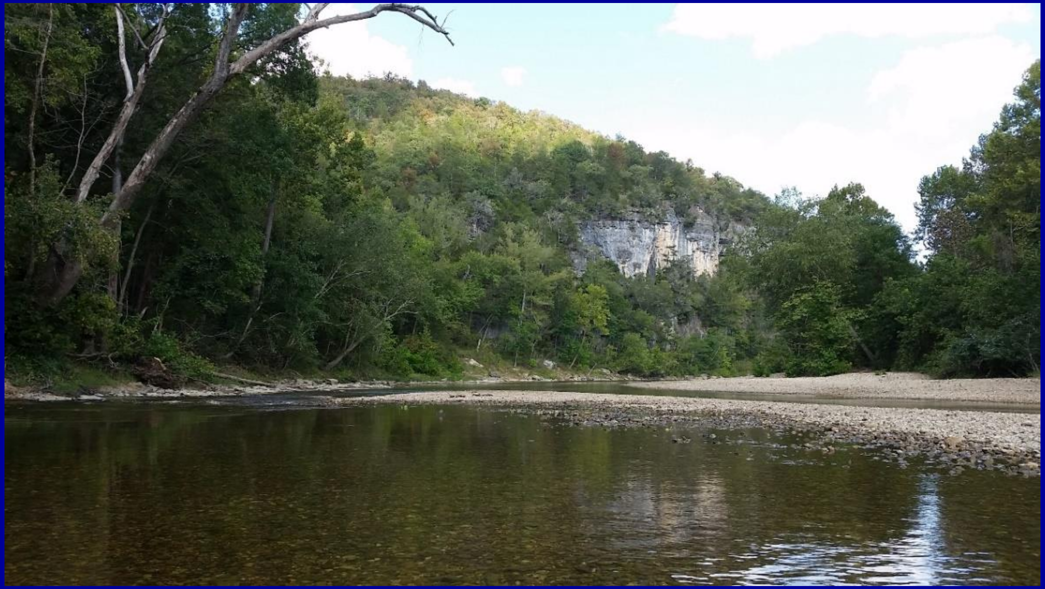
U.S. Department of the Interior
U.S. Geological Survey

In 2013, a Swine CAFO began operation on Big Creek (a Buffalo River tributary)…….

– Capacity for 2,500 sows and 4,000 pigs

– Uses settling ponds (1.9 million gallons/no discharge)

– Swine waste (slurry) is applied to a number of hay fields and pastures along Big Creek and Left Fork Big Creeks (~630 ac)



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Project Scope

- **Conduct biological and chemical analyses and document water quality along a gradient downstream of the CAFO and at control sites unaffected by swine (May 2017 – Dec 2018)**

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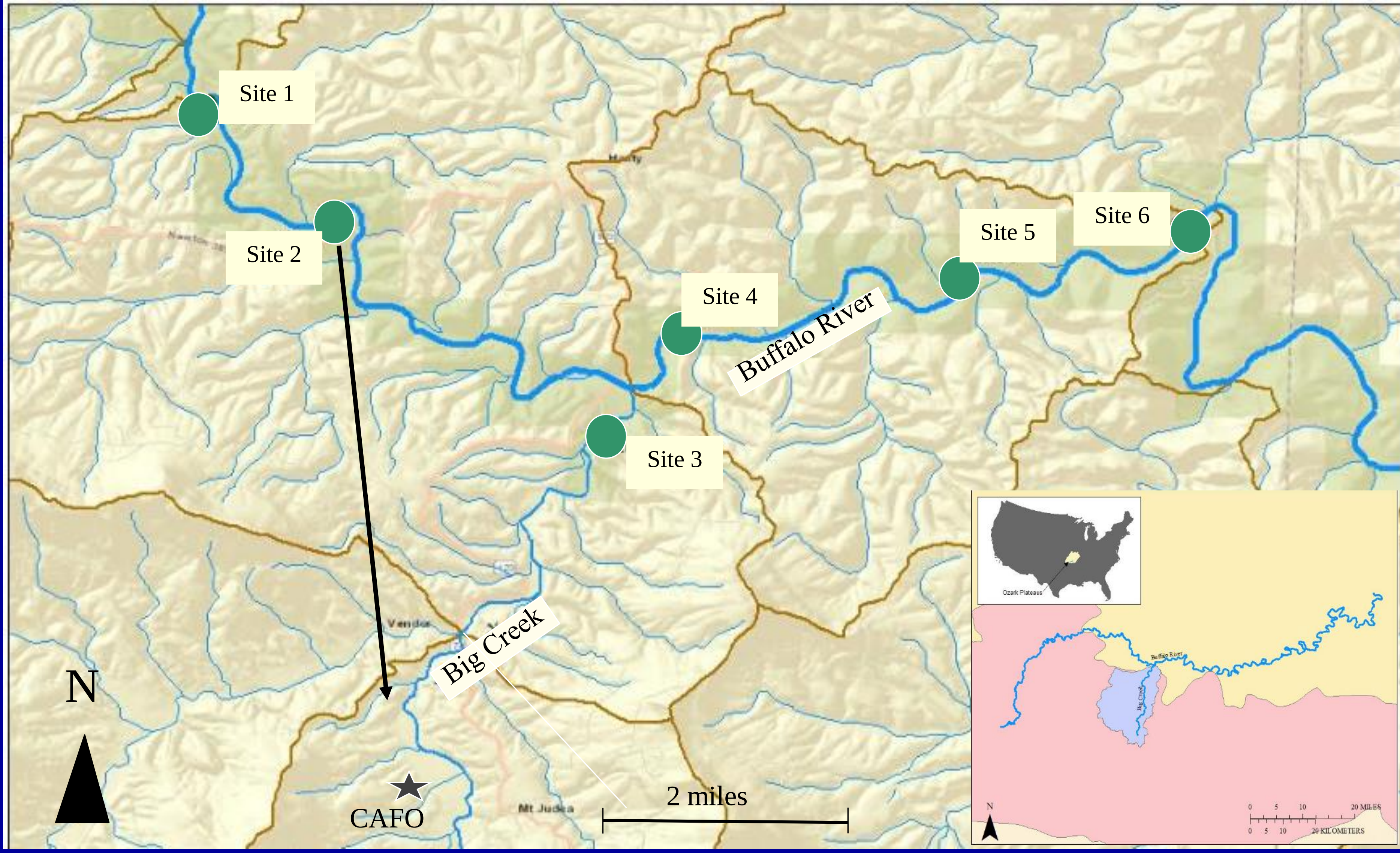
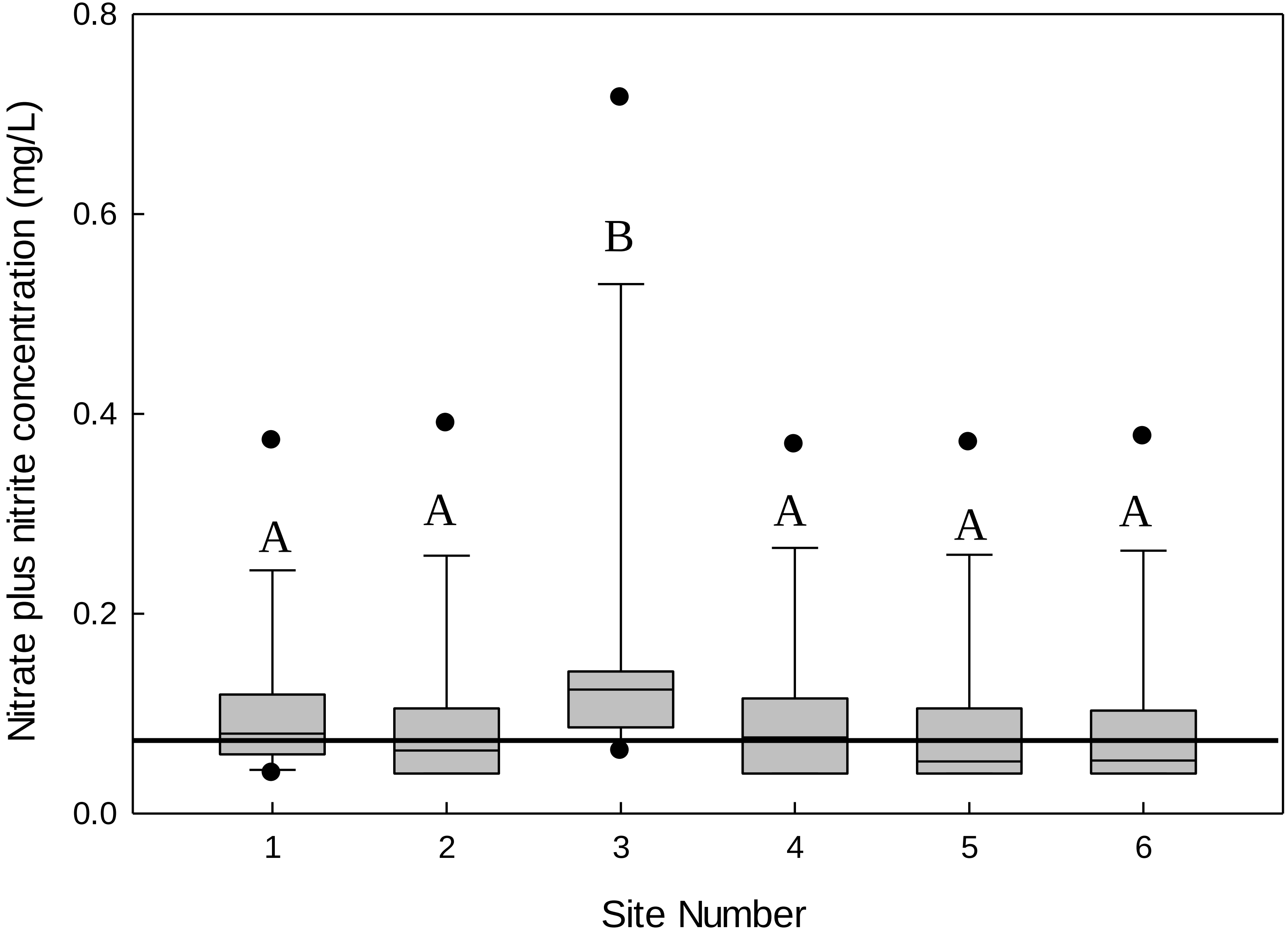
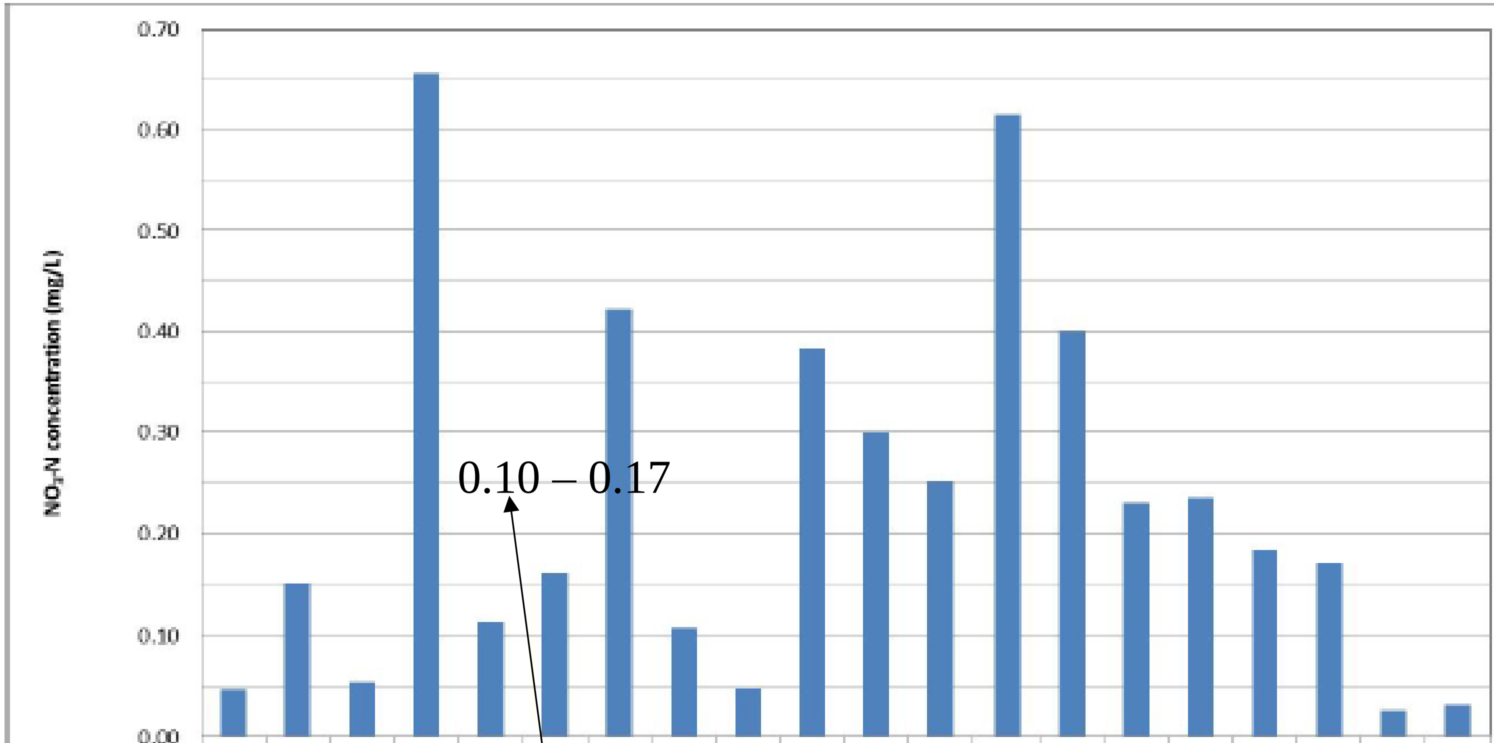
Site Locations



Kruskal-Wallis One Way Analysis of Variance on Ranks – Site 3 is statistically different (P =0.005)



How do current nitrate concentrations in Big Creek (T06 below) compare to past data?



	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	T13	T14	T15	T16	T17	T18	T23	T24
Mean	0.05	0.15	0.05	0.66	0.11	0.16	0.42	0.11	0.05	0.38	0.30	0.25	0.62	0.40	0.23	0.24	0.18	0.17	0.03	0.03
# of Samples	28	60	59	65	59	58	62	55	46	57	60	56	46	58	59	64	62	54	51	52

Figure 4.3.5 Mean NO_3-N concentrations for Buffalo River tributary sites between 1995-2011 during base-flow conditions.

Watershed Conservation Resource Center. 2017. Surface-Water quality in the Buffalo National River (1985-2011). Prepared for the Buffalo National River. 71p.

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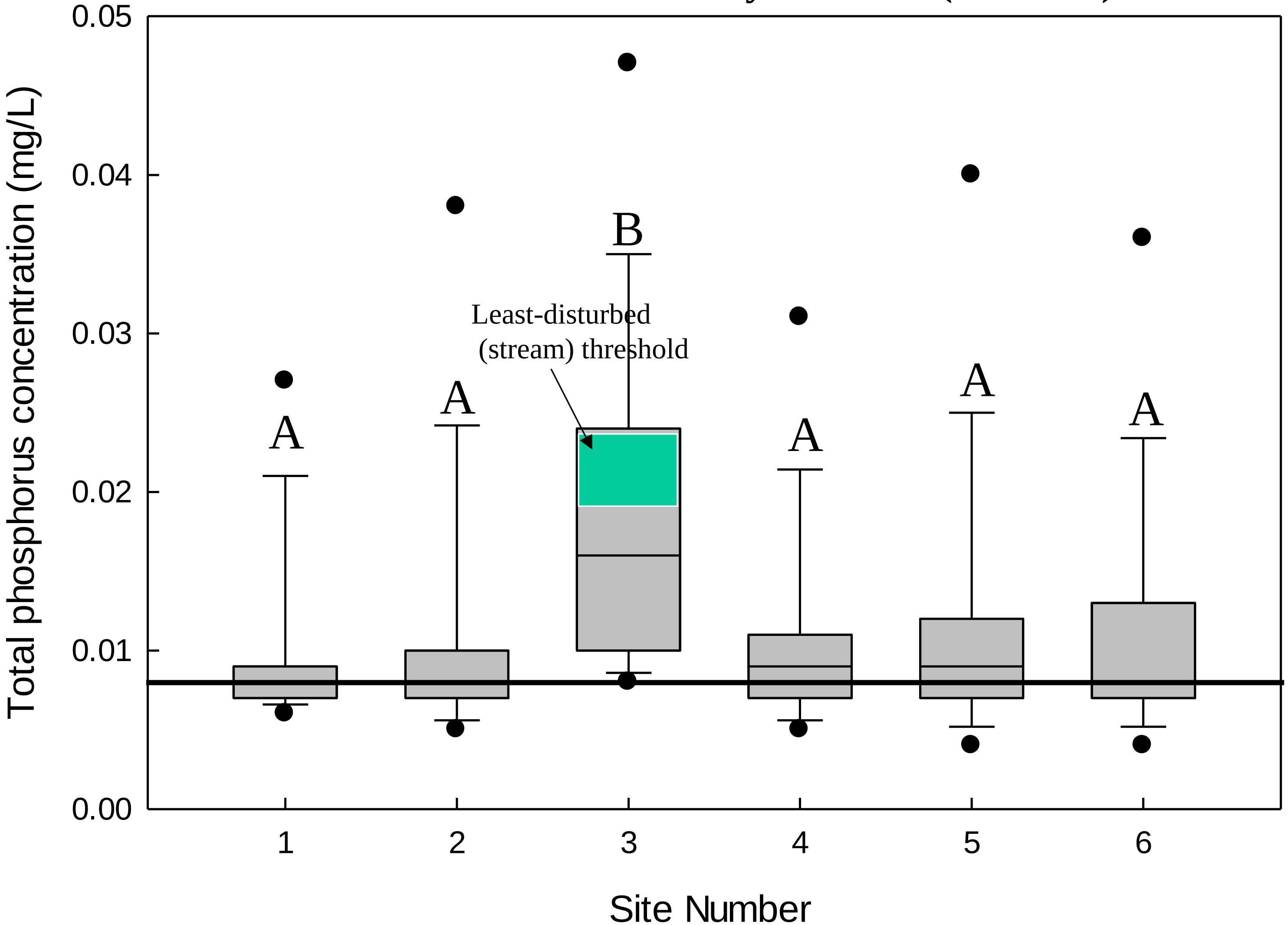
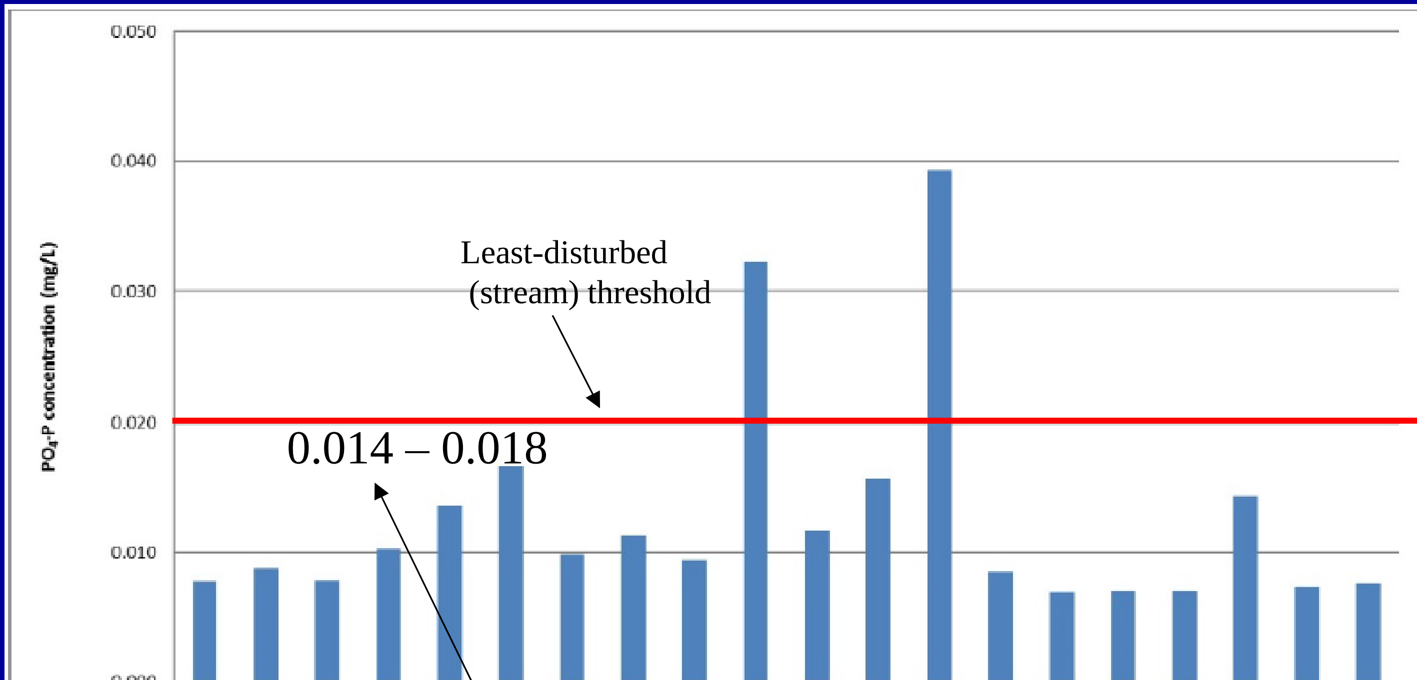
Kruskal-Wallis One Way Analysis of Variance on Ranks – Site 3 is statistically different (P =0.007).



How do current phosphorus concentrations in Big Creek (T06 below) compare to past data?

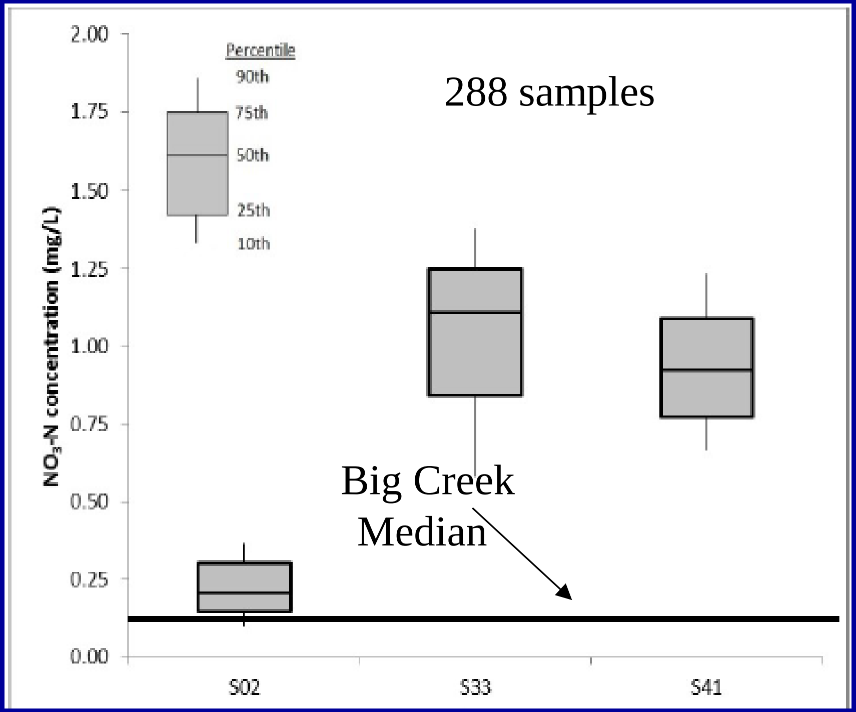


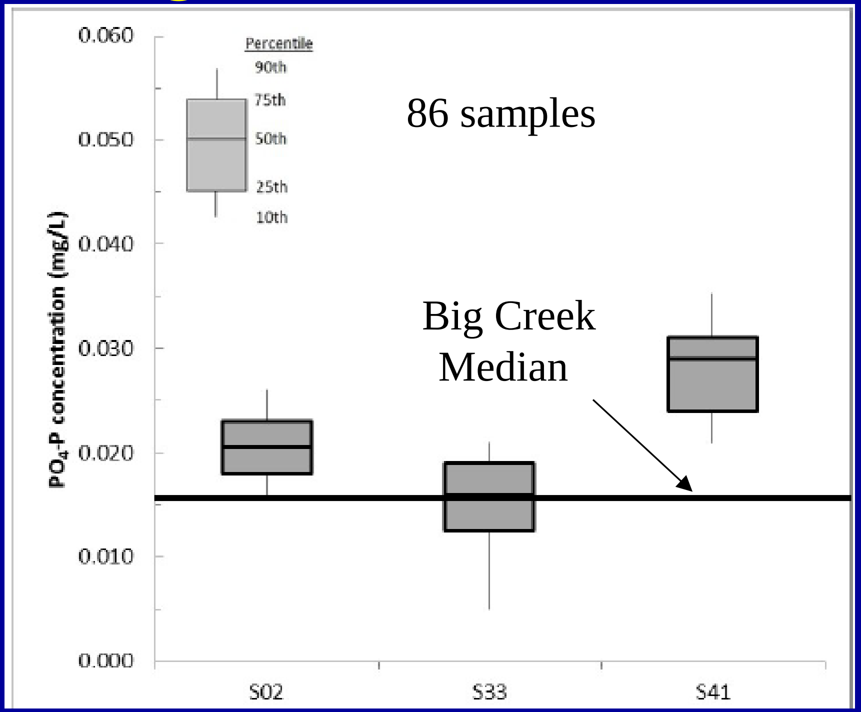
	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	T13	T14	T15	T16	T17	T18	T23	T24
Mean	0.008	0.009	0.008	0.010	0.014	0.017	0.010	0.011	0.009	0.032	0.012	0.016	0.039	0.009	0.007	0.007	0.007	0.014	0.007	0.008
# of Samples	17	33	40	36	37	34	34	33	32	26	32	30	19	36	42	39	42	28	37	35

Figure 4.4.3 Mean PO_4-P concentrations for Buffalo River tributary sites sampled from 1998-2011 during base-flow conditions.

(borrowed from Watershed Conservation Resource Center, 2017)

How did concentrations in Big Creek compare to Spring data collected from 1999-2011 during base-flow conditions?





(borrowed from Watershed Conservation Resource Center, 2017)

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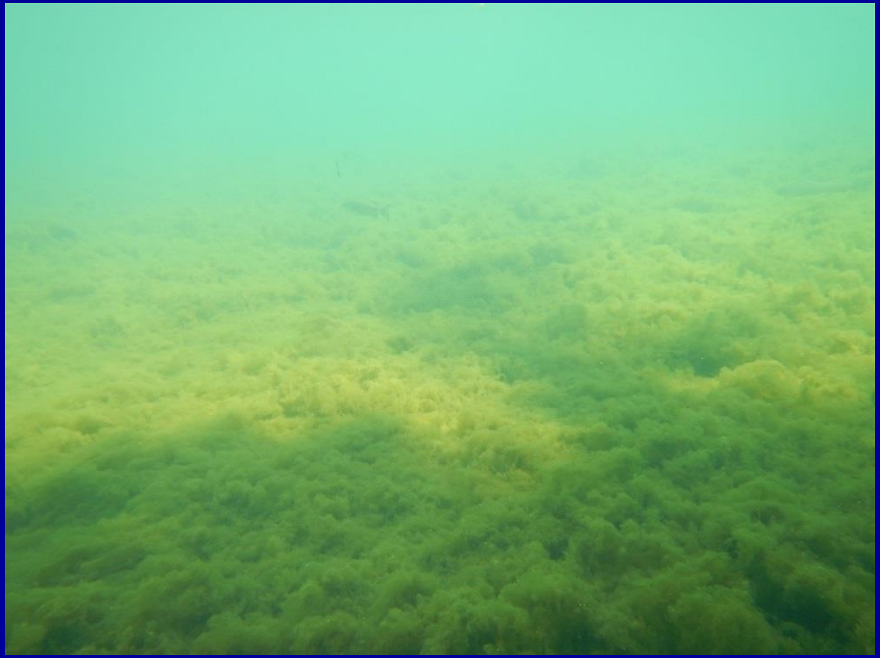
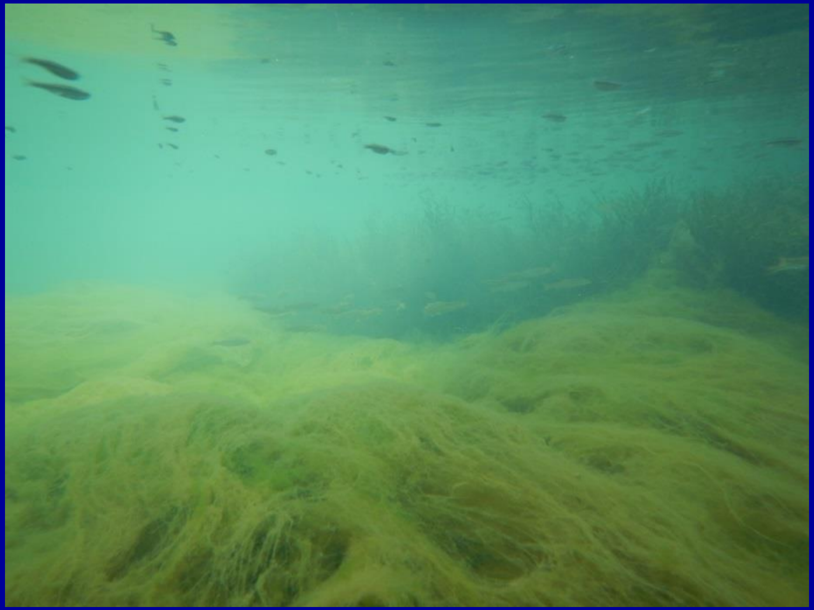
Filamentous Study Overview

- **Billy Justus, Aquatic Research Biologist,** U.S. Geological Survey, Lower Mississippi-Gulf Water Science Center, Little Rock, AR. bjustus@usgs.gov;

-

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





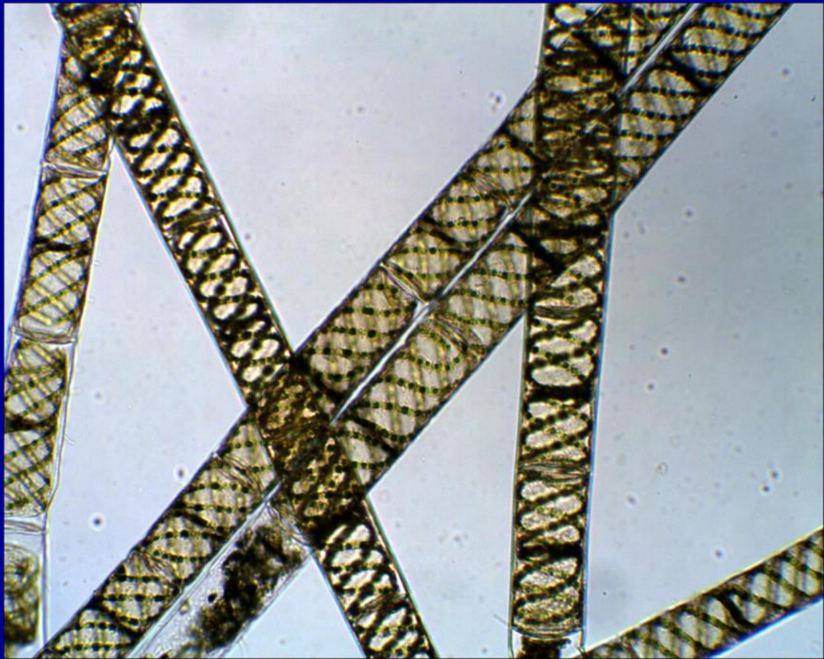
Photos courtesy of Jeffery Quinn, Arkansas Game and Fish Commission

June 2018 Reconnaissance Questions/Answers……

1. What is the most common filamentous algae?
   - *Spirogyra* (photo 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



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Often associated with gravel bars

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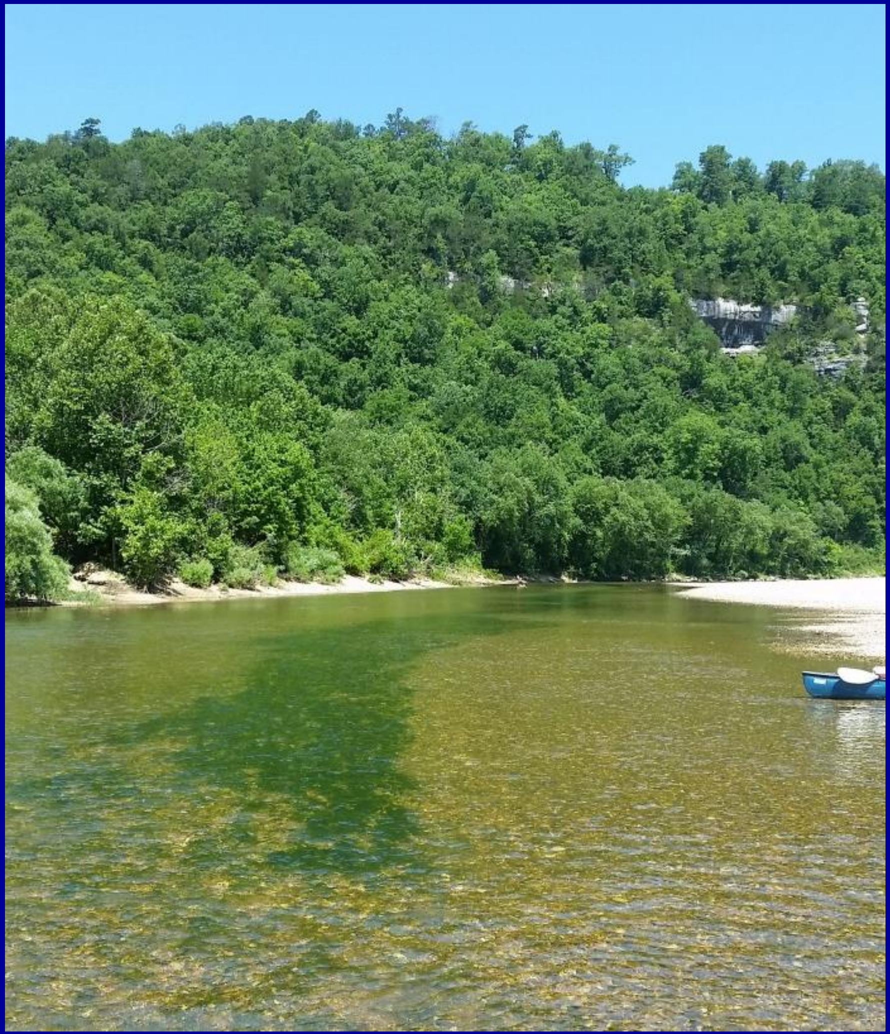
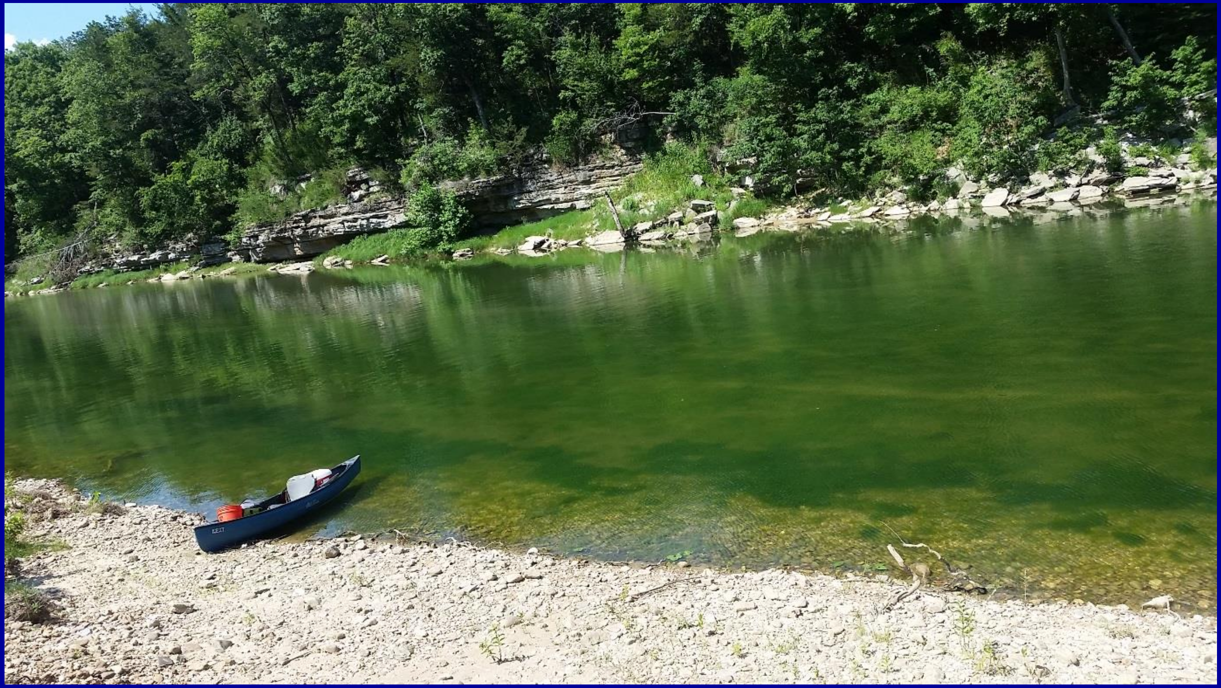
Gravel bars continued…..



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



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Also, often associated with springs and cold tribs.

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

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.

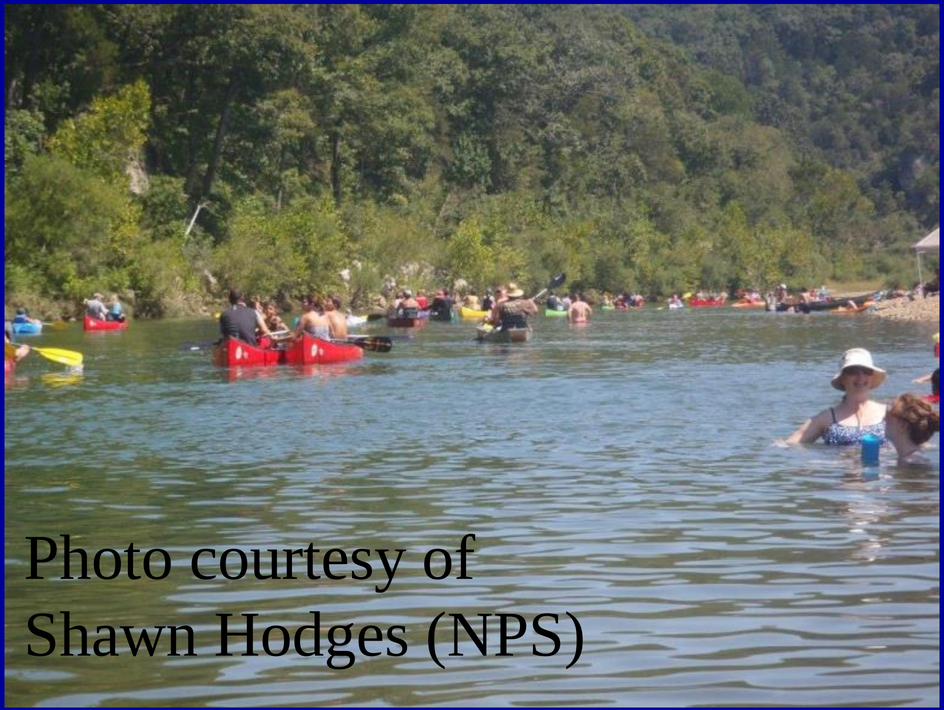
Photo courtesy of Shawn Hodges (NPS)

Approach

- Sample shallow wells located on gravel bars
- Identify spring sampling sites
- Establish a large number of sampling sites on the mainstem

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

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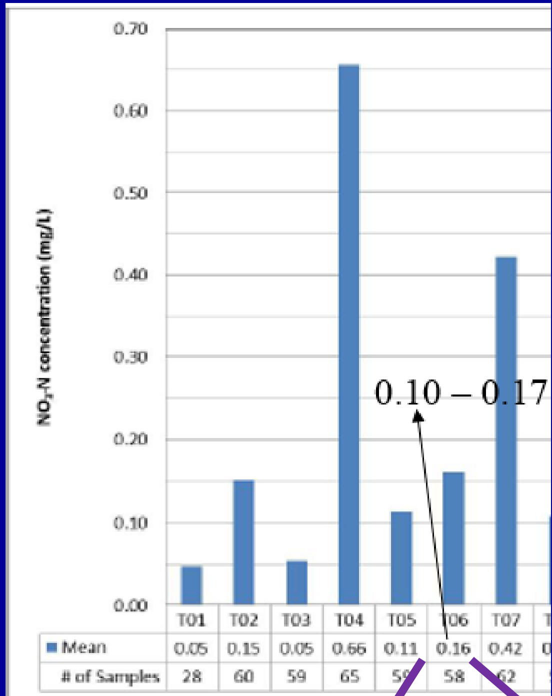

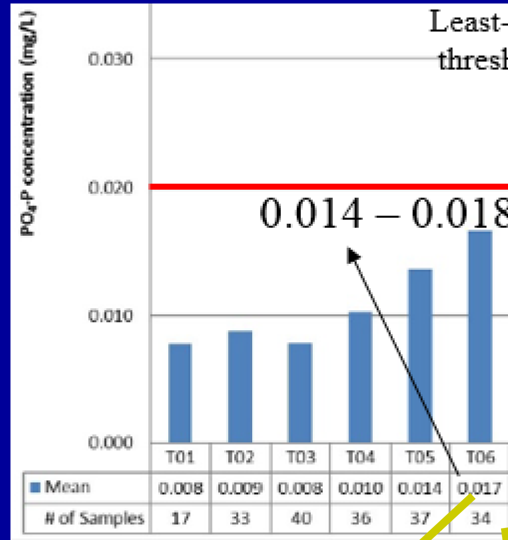

Mainstem

Access point	NO3 + NO2	Dissolved P	Total P
Buff DS of MWS	**0.113**	**0.007**	**0.011**
Buff at Baker Ford	< 0.040	< 0.003	0.005
Tyler Bend	< 0.04	< 0.004	0.006
Buffalo nr Gilbert	< 0.040	< 0.003	0.007
Buff DS of Bear	< 0.040	0.004	0.008
Buff DS of SandHole	< 0.040	0.004	0.007
Buff DS of Tomahawk	< 0.040	0.004	0.007
Buff DS of Rocky	**0.056**	**0.003**	**0.008**
Buff DS of Spring Crk	**0.047**	**0.004**	**0.008**
Buff @ Harriet	< 0.040	< 0.003	0.005
Buff @ Buff Pt	< 0.040	< 0.003	0.006
Buff DS of Springs	< 0.040	< 0.003	0.006
Buff @ Rush	< 0.040	< 0.003	0.006

Springs

Access point	NO3 + NO2	Dissolved P	Total P
	mg/L as N	mg/L as P	mg/L as P
Margaret White Spring	0.212	0.014	0.014
Mill Ck above Buff R near Tyler Bend	0.348	0.009	0.010
Gilbert Spring	**0.843**	**0.028**	**0.027**
Spring Pond nr Panther Crk	**0.550**	0.004	0.007
Panther Creek	**0.943**	**0.034**	**0.032**
Spring on RR	0.094	0.007	0.017

Gravel bars

Access point	NO3 + NO2	Dissolved P	Total P
	mg/L as N	mg/L as P	mg/L as P
Tyler Bend	0.083	0.014	**0.085**
Gilbert	0.071	0.025	**0.836**
Spring Crk	0.107	0.024	**0.031**
Rush	0.108	0.019	**0.031**

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Filamentous Data Summary…..

1. Springs may be sources of N and also lower amounts of P.

- **Action needed – Conduct** dye tracing at some springs (Margaret White, Gilbert, Panther Creek, and Spring Creek) to determine more about each watershed and what activities are occurring there.

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Filamentous Data Summary continued…..

2. Gravel bars seem to be sources of high P

- **Action needed –**
- Determine how nutrients in the river and gravel bars change between fall and winter (low river use) and spring and summer (high river use).

- Determine how nutrient concentrations in the river and shallow wells (on gravel bars) change following storm events

- (Eventually) Use microbial source tracking to tease out the animal and human nutrient contributions.

Other science needs/Plans forward…..

Evaluate the human impact

- The one most obvious change in use since the Buffalo became a national park is the number of visitors (swimming, camping, and staying in cabins)

- Phosphorus concentration in human urine can range from 280–400 mg/L (consider how this compares to an approximate stream biological threshold of 0.023 mg/L)

Evidence for why filamentous algae is related to sources other than the hog farm…..

- Nitrate and TP concentrations downstream of Big Creek are similar to upstream concentrations

The 5-mile stretch between Carver and Mt. Hersey, has much less algae than river sections downstream of 65.

Nutrient concentrations and FA coverage seem to be much higher at Gilbert (~35 miles down), Spring Creek (~50 miles down), and Panther Creek (~58 miles down) than what is measured at Big Creek

Acknowledgements (for sampling participation)

USGS staff: Lucas Driver, Ted Wallace, and Joey Fleming

BUFF staff: Shawn Hodges, Ashley Rodman, and Hannah Sutcliffe

ADEQ staff: Tate Wentz and Chelsey Sherwood

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