

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



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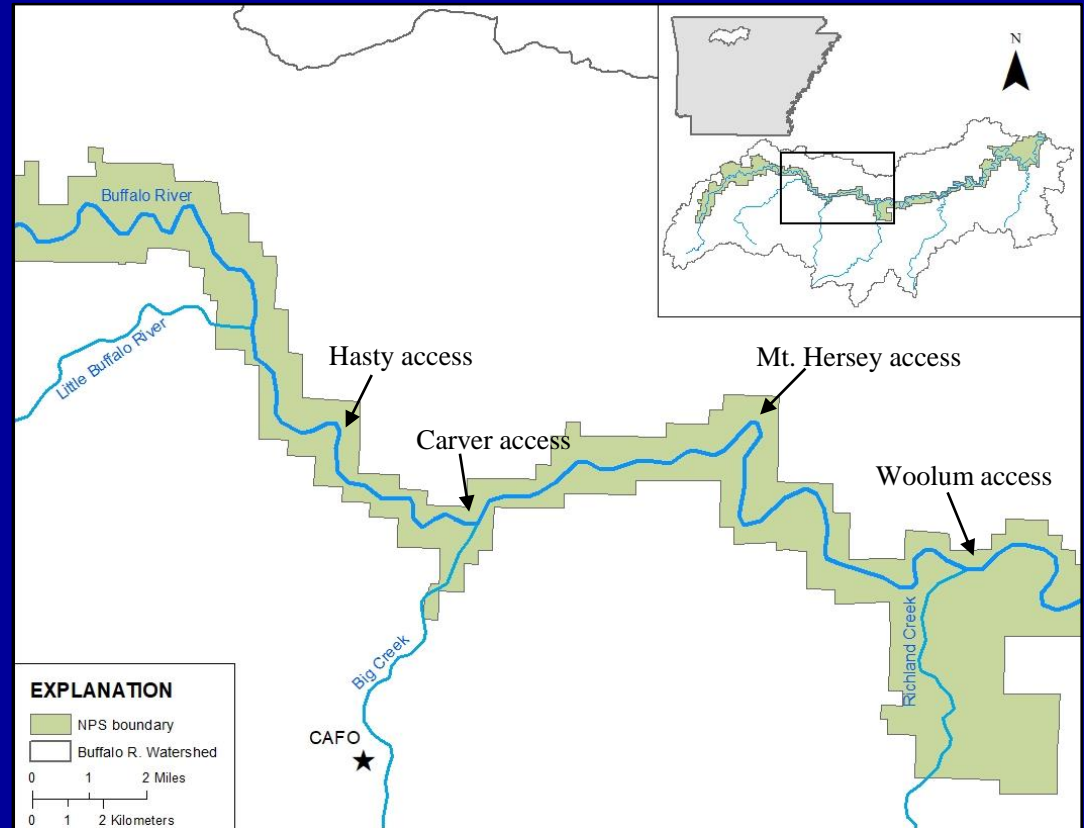
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Cause for concern

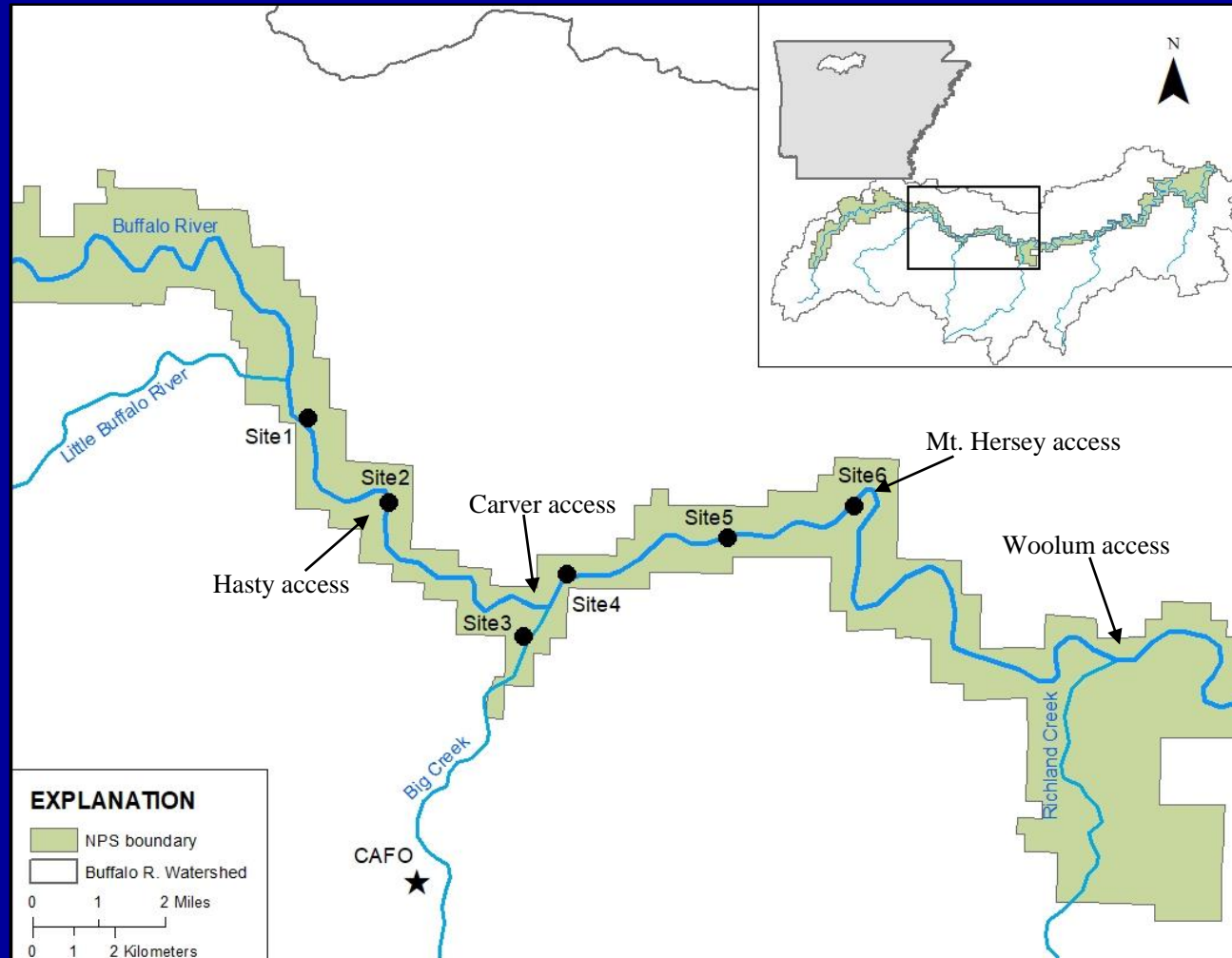
- In 2013, a large Confined Animal Feeding Operation (CAFO) was constructed on Big Creek
 - Capacity for 2,500 sows and 4,000 pigs
 - 1.9 mil gal settling ponds (no discharge)
 - waste (slurry) applied to a number of fields/pastures in the Big Creek watershed



Project Scope

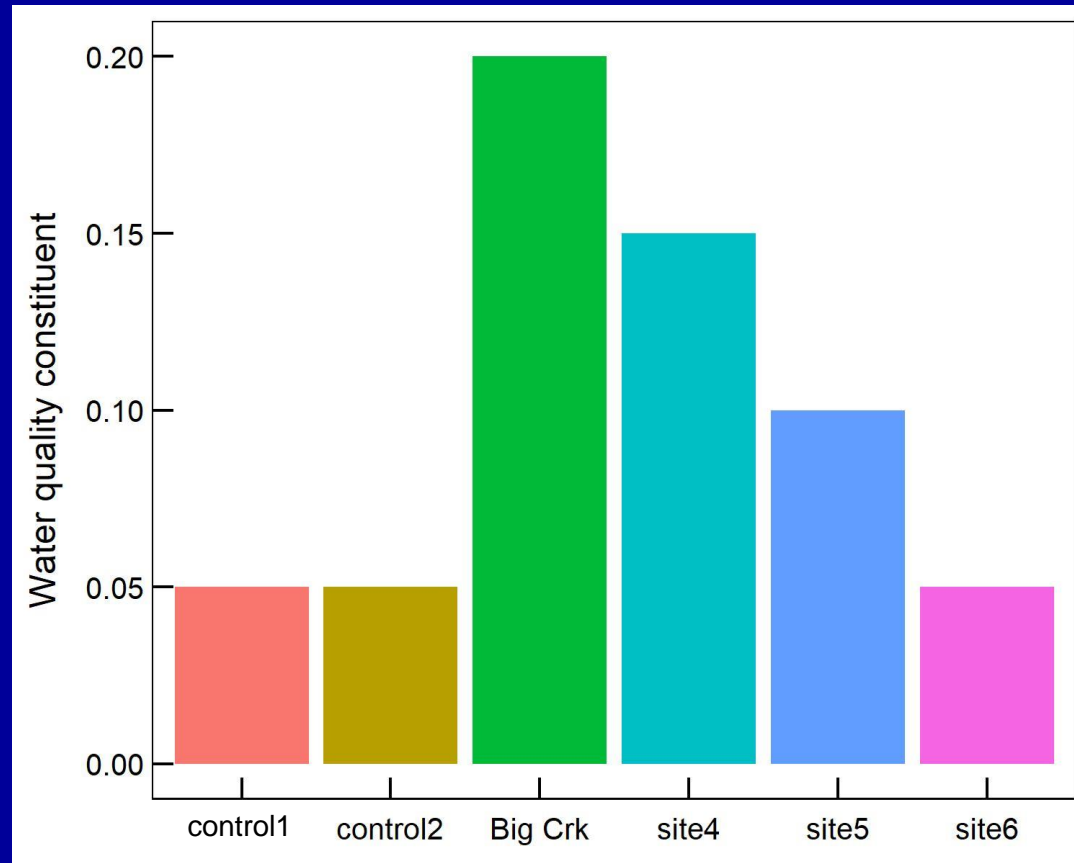
- Investigate water quality along a presumed gradient relative to the CAFO location
 - Nutrients (nitrogen and phosphorus species)
 - Periphyton (chlorophyll *a* and assemblage metrics)
 - Bacteria (culturable bacteria and bacteria metabolic activity)
 - See presentations by Dr. Jill Jenkin's lab group (USGS Wetlands and Aquatic Research Center)

Sample sites



USGS Station ID	
Site1	07055760
Site2	07055770
Site3	07055814
Site4	07055824
Site5	07055828
Site6	07055832

Hypothetical Generalized Hypotheses



Collection methods

- Samples collected May 2017 – Feb. 2019
 - Nutrient water samples (monthly)
 - USGS protocol for multi-point grab or flow integrated (EWI) sample
 - USGS National Water Quality Lab (NWQL)
 - Bacteria (monthly)
 - Single point grab
 - USGS Wetlands and Aquatic Research Center
 - Periphyton (quarterly)
 - Standardized area rock scrape (n = 25 per site)
 - USGS National Water Quality Lab (NWQL)
 - QA/QC collected at 10-20% of sample sites

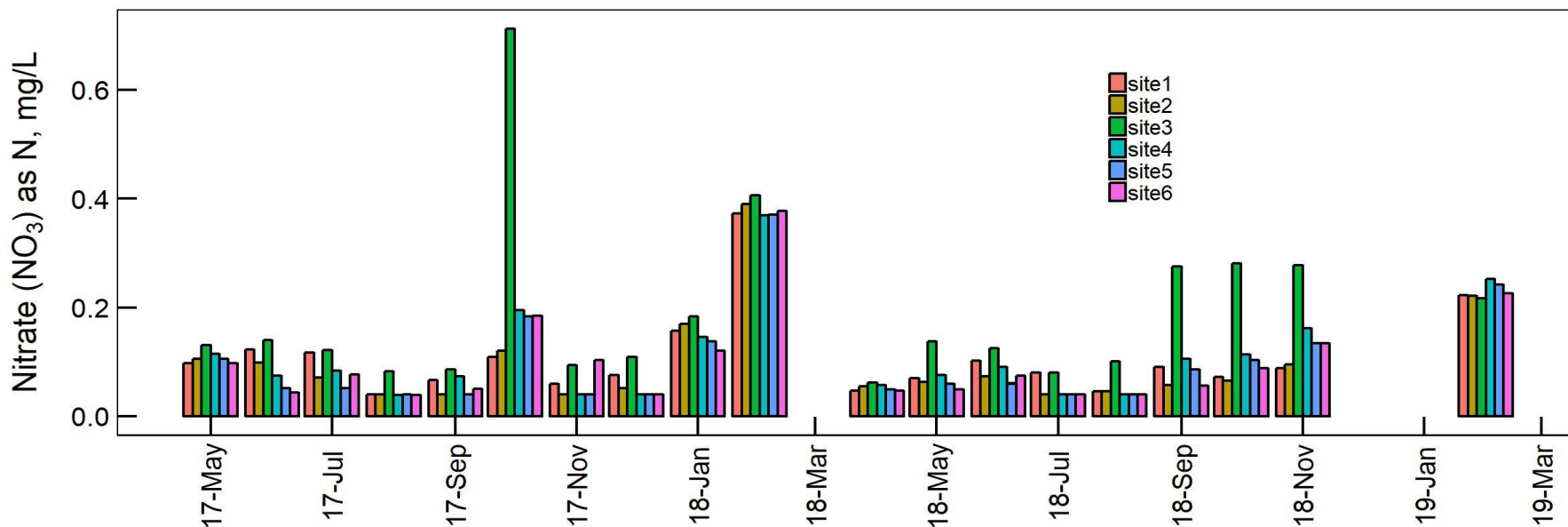


Statistical methods

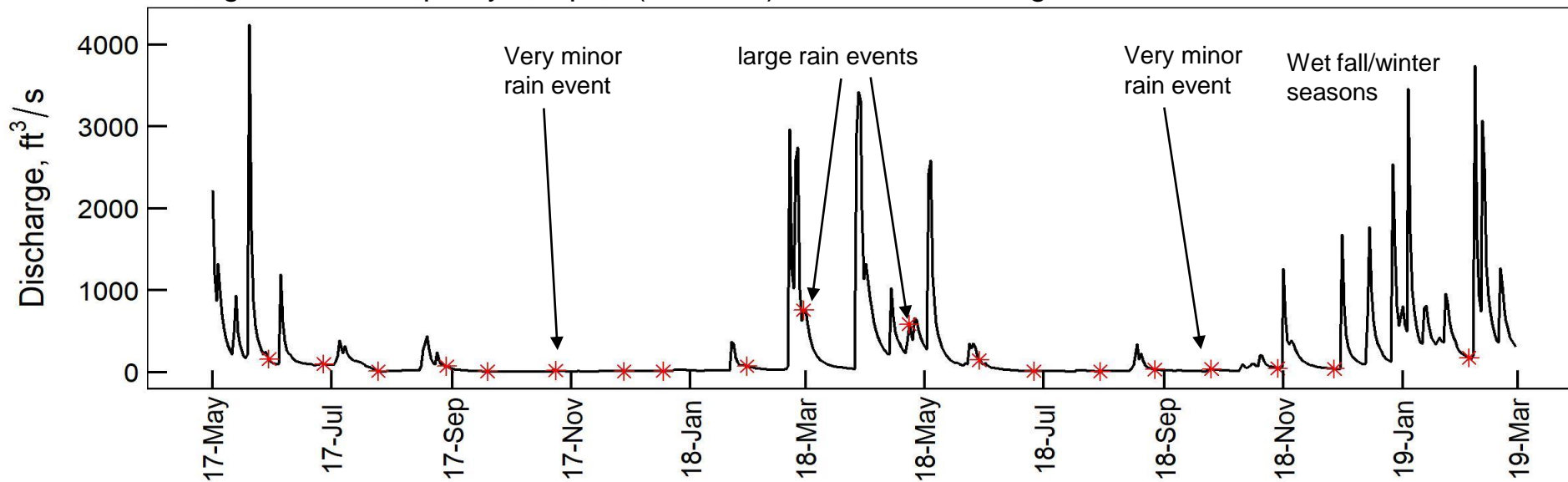
- **Censored data = concentrations outside laboratory detection limits**
 - Parametric Robust ROS (regression order statistic) and Non-parametric “survival analysis”
- **Summary statistics and boxplots**
- **Non-parametric analysis of variance among sample sites**
 - Kruskal-Wallis
 - Pairwise Wilcoxon signed-rank test (adjusted for multiple comparisons)

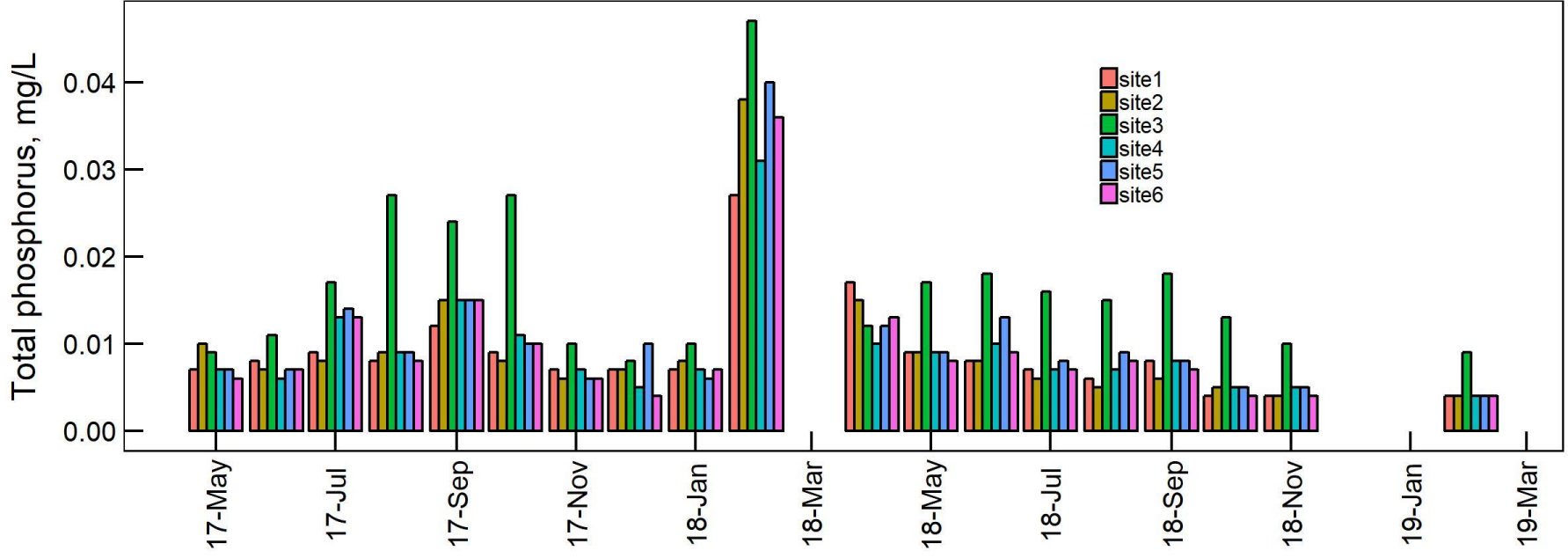
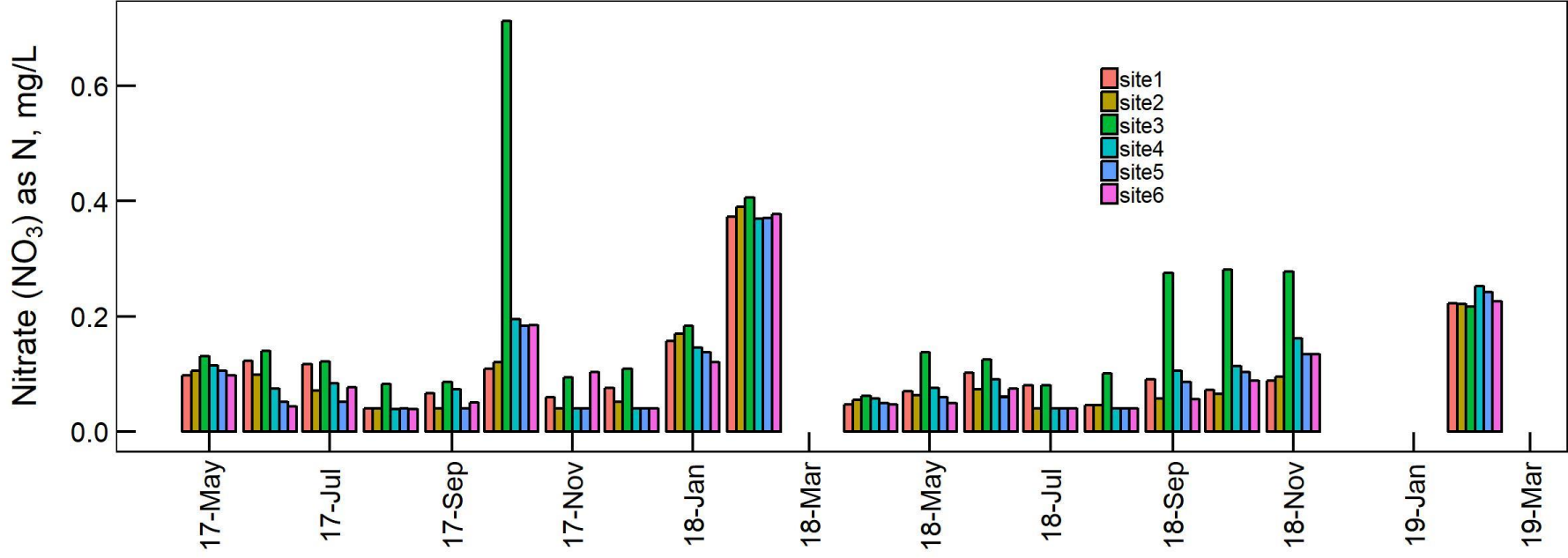
Month	Nitrate conc.
January	0.06
February	0.08
March	0.12
April	0.07
May	<0.04
June	<0.04
July	0.04
August	0.05
September	0.09
October	0.15
November	<0.04
December	0.06

Nitrate concentrations for 19 samples collected from May 2017 to February 2019

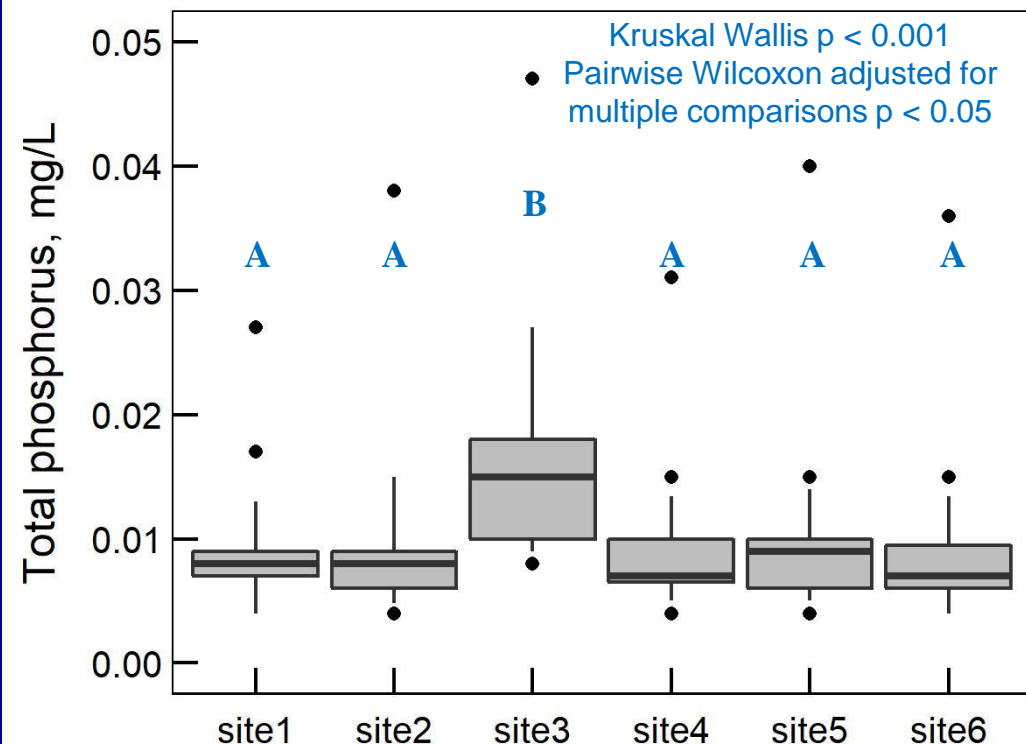
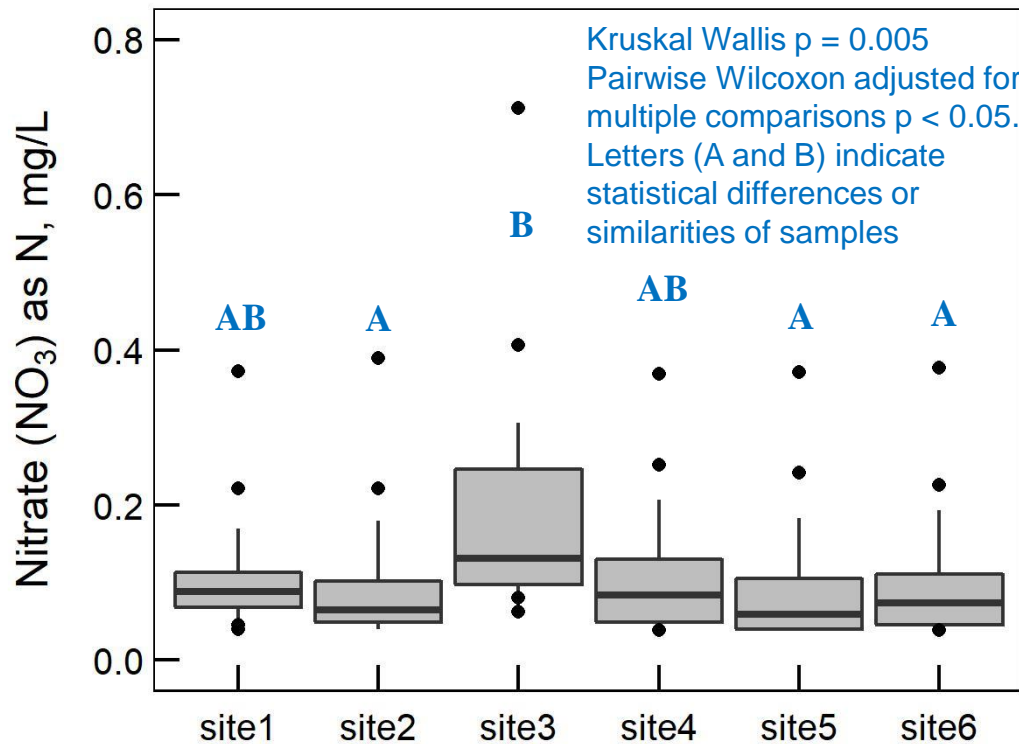


Timing of 19 water-quality samples (red stars) relative to discharge for the Buffalo River at Pruitt





Boxplots and ANOVA



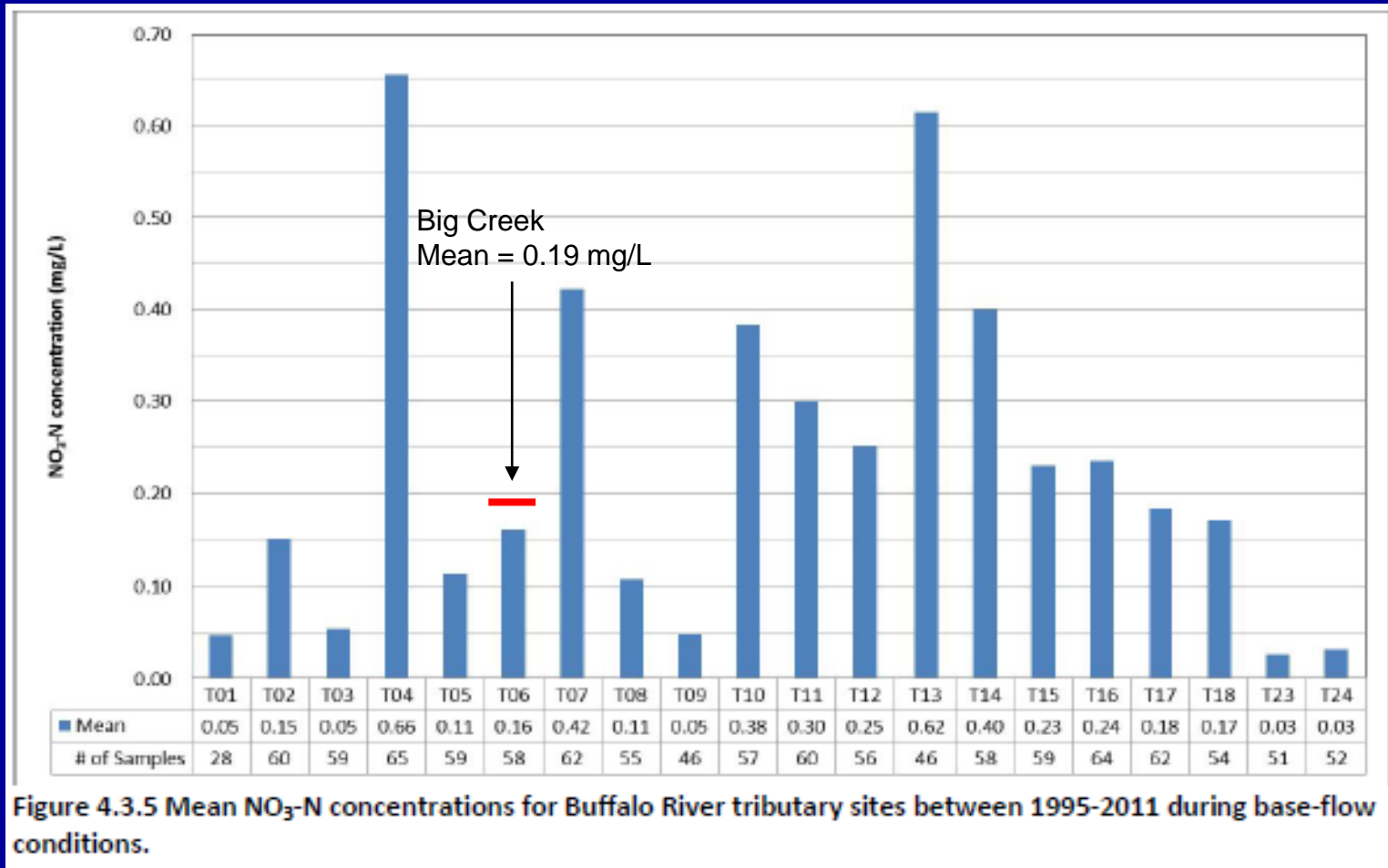
- No statistical differences between upstream and downstream sites
- Big Creek has higher nutrient concentrations than mainstem sites
- But keep magnitude of nutrient concentrations in perspective

Mean NO₃:
Big Creek = 0.19 mg/L
Mainstem sites = 0.098 mg/L

Mean TP:
Big Creek = 0.017 mg/L
Mainstem sites = 0.009 mg/L

Comparison of mean nitrate concentration for 19 samples collected at Big Creek (under various hydrologic conditions) to means calculated at Big Creek and other selected tributaries using baseflow data collected by the National Park Service from 1985 to 2011.

Trib_ID	Trib
T01	Beech Creek
T02	Ponca Creek
T03	Cecil Creek
T04	Mill Creek
T05	Little Buffalo River
T06	Big Creek
T07	Davis Creek
T08	Cave Creek
T09	Richland Creek
T10	Calf Creek
T11	Mill Creek -mid
T12	Bear Creek
T13	Brush Creek
T14	Tomahawk Creek
T15	Water Creek
T16	Rush Creek
T17	Clabber Creek
T18	Big Creek - low
T23	Middle Creek
T24	Leatherwood Creek



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

Comparison of mean total phosphorus concentration for 19 samples collected at Big Creek (under various hydrologic conditions) to means of ortho-phosphorus concentrations at Big Creek and other selected tributaries using baseflow data collected by the National Park Service from 1985 to 2011.

Trib_ID	Trib
T01	Beech Creek
T02	Ponca Creek
T03	Cecil Creek
T04	Mill Creek
T05	Little Buffalo River
T06	Big Creek
T07	Davis Creek
T08	Cave Creek
T09	Richland Creek
T10	Calf Creek
T11	Mill Creek -mid
T12	Bear Creek
T13	Brush Creek
T14	Tomahawk Creek
T15	Water Creek
T16	Rush Creek
T17	Clabber Creek
T18	Big Creek - low
T23	Middle Creek
T24	Leatherwood Creek

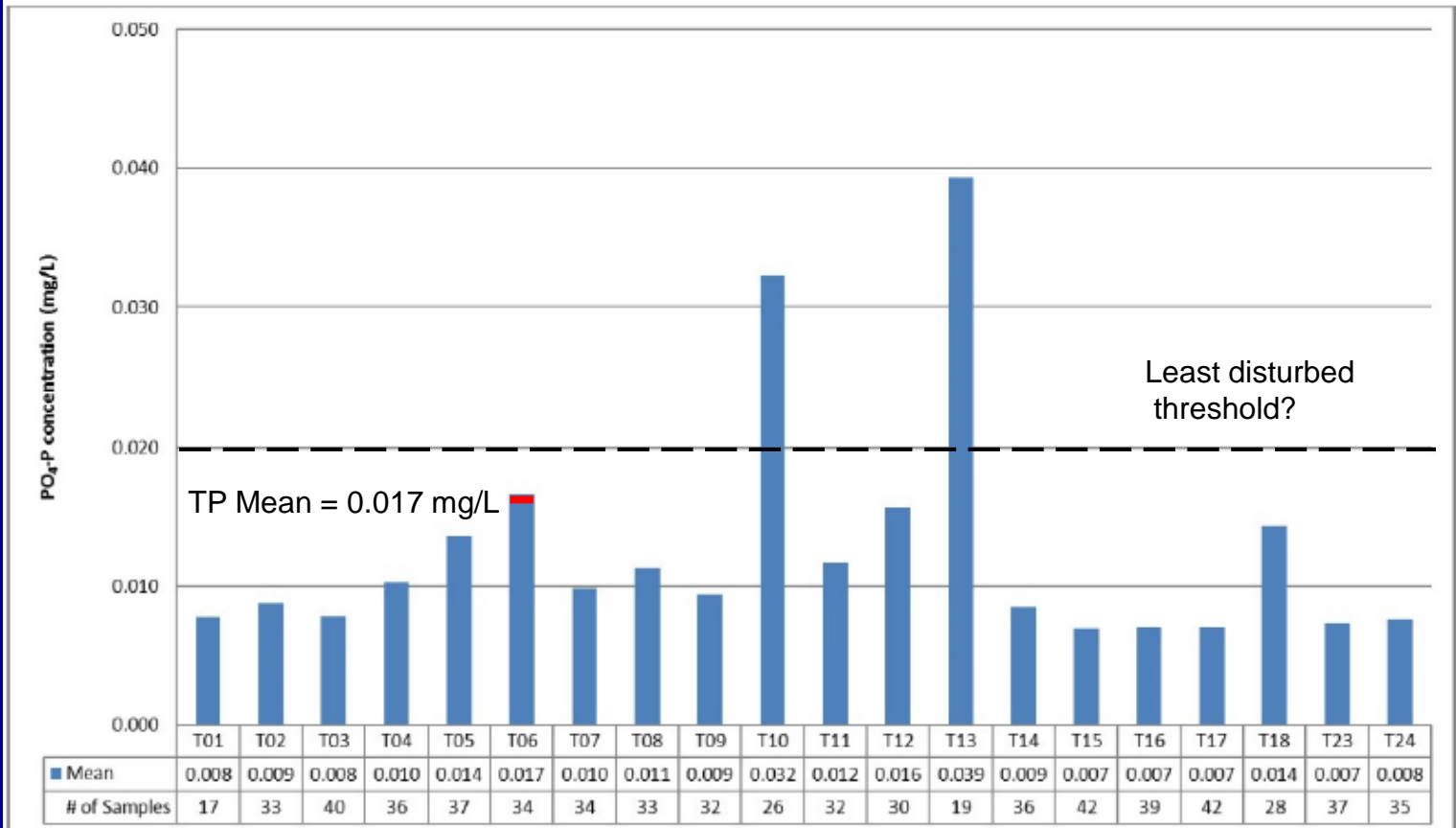
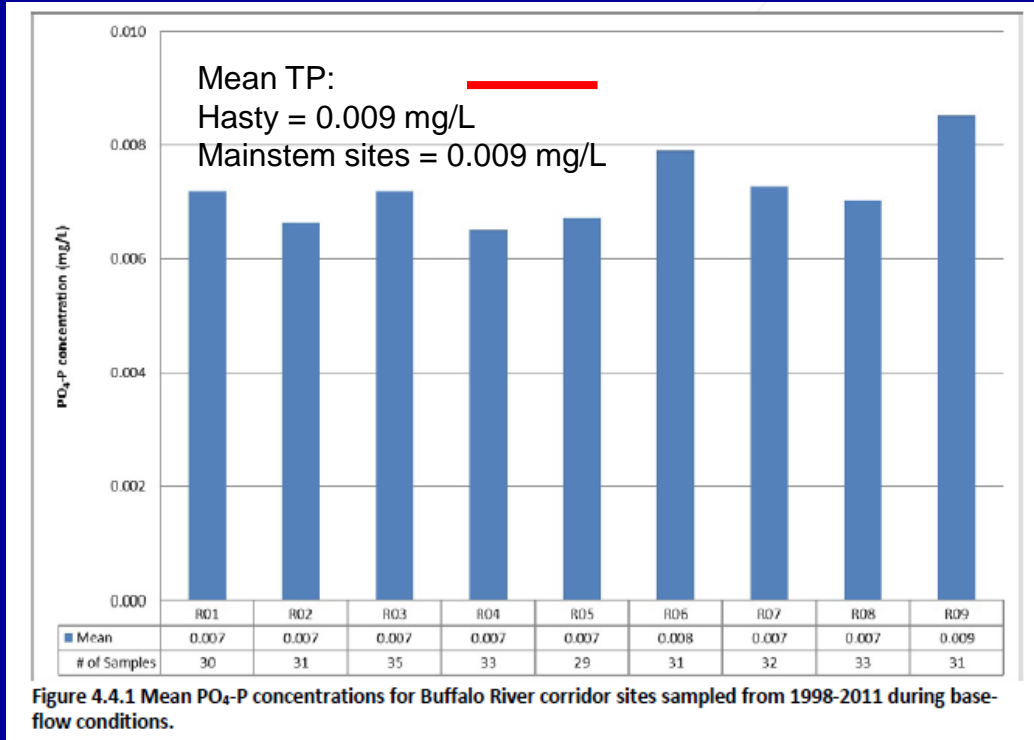
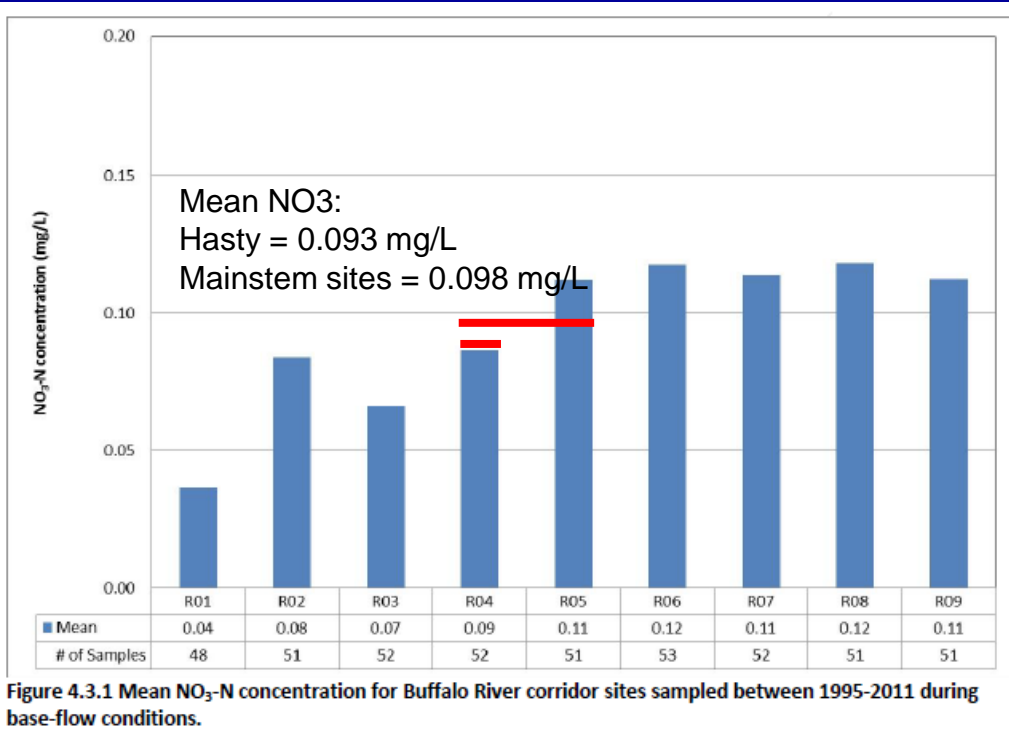


Figure 4.4.3 Mean PO₄-P concentrations for Buffalo River tributary sites sampled from 1998-2011 during baseflow conditions.

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



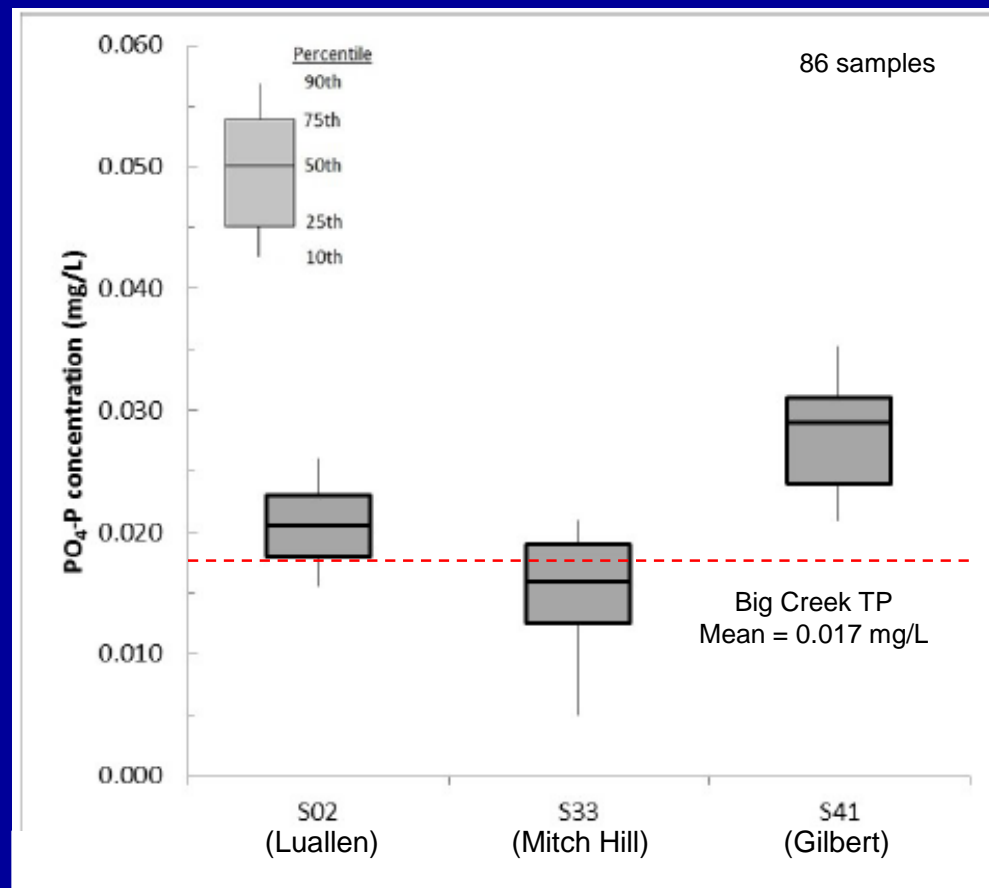
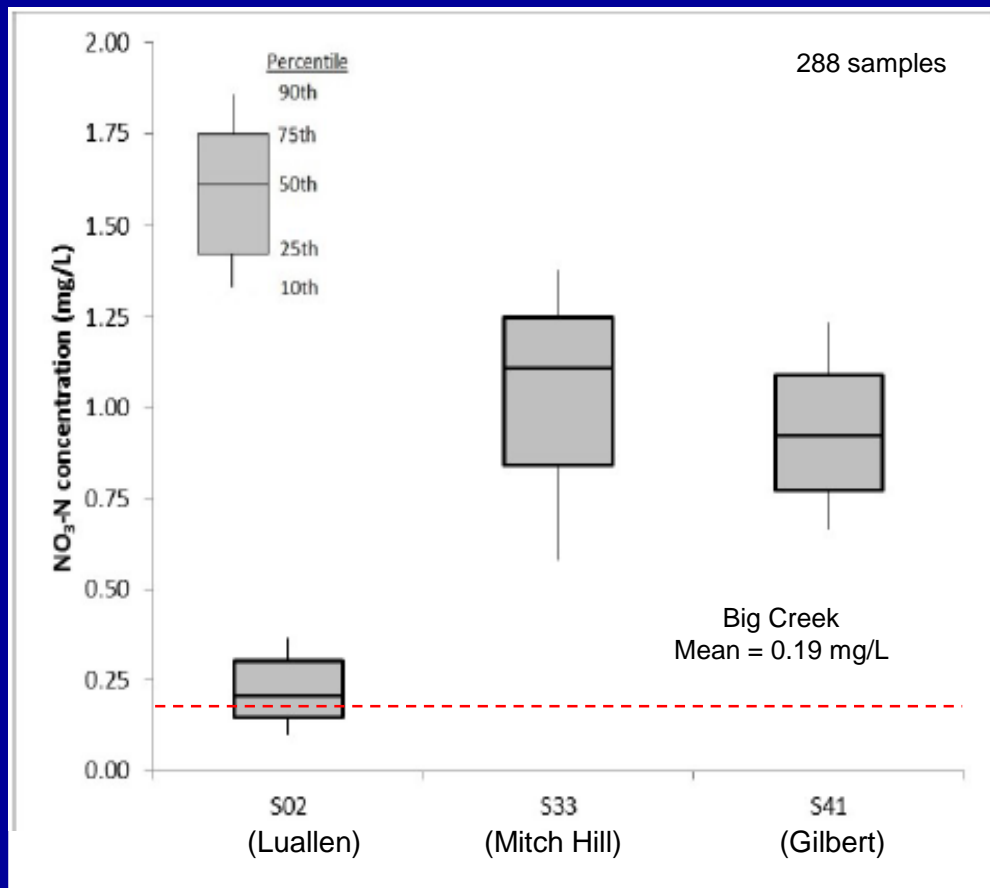
Historic nutrient data: Buffalo R. mainstem sites



River_ID	River Corridor
R01	Wilderness boundary
R02	Ponca
R03	Pruitt
R04	Hasty
R05	Woolum
R06	Gilbert
R07	Highway 14
R08	Rush
R09	Mouth

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

Big Creek has lower nitrate concentrations and roughly the same phosphorus concentrations as some spring sites that have been monitored by the National Park Service



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

Conclusions

- **Our results indicate that nutrient concentrations upstream and downstream of Big Creek (and CAFO) are not statistically different**
- **Although nutrient concentrations are consistently higher in Big Creek than in the mainstem Buffalo River...**
 - **Mean NO₃ and TP concentrations were often lower or consistent with historic concentrations from mainstem, tributary, and spring sites within Buffalo R. watershed**
- **Forthcoming analysis of seasonal periphyton data collected as part of this study will assist in determinations for the degree of nutrient attenuation by algae across the six sites and over the seasonal sampling intervals**
- **Based on anecdotal observations, filamentous algae growth in 5-mi stretch downstream of Big Creek (Carver to Mt. Hersey) is less than in sections downstream of Hwy 65.**

Questions?

