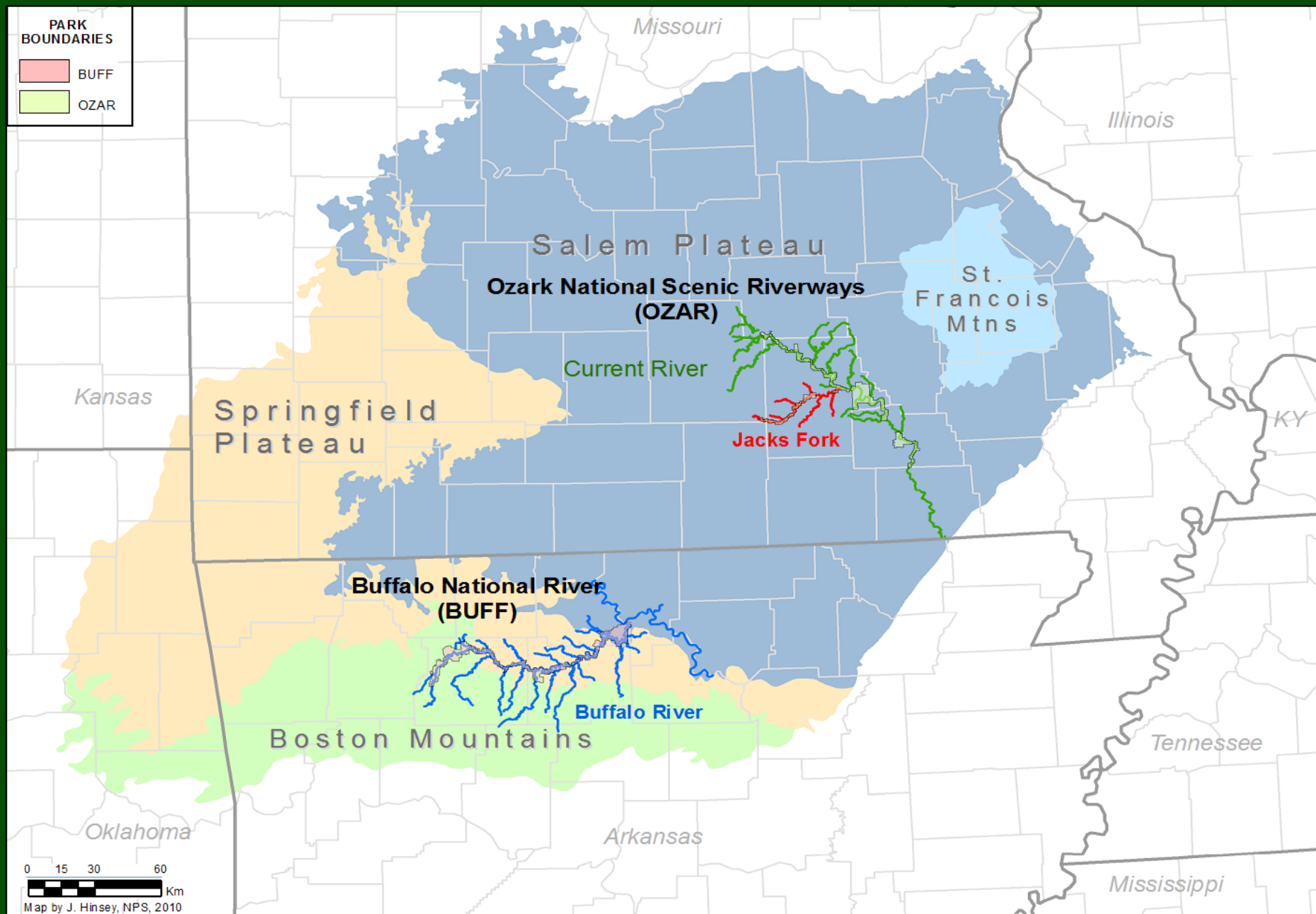




Long-term aquatic invertebrate monitoring at Buffalo National River, Arkansas

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Buffalo National River

- BUFF established in 1972
- Goal: to protect the riverine corridor(s) & tributaries
- Problem: Narrow jurisdictional boundaries
 - BUFF 11% of the watershed
- **Most of the watersheds not fully protected from human activities**





Ongoing Threats in Watersheds

- Gravel mining, deforestation, non-point source pollution, CAFOs, certain agricultural operations, exotic species, etc.
- Projected threats: human population, climate change
- Karst topography
 - Risks for contamination elevated





Monitoring Water Quality with Aquatic Invertebrates

- Important biomonitoring tool for understanding & detecting changes in ecosystem integrity over time.
 - Broad range of responses and sensitivities to different environmental stressors.





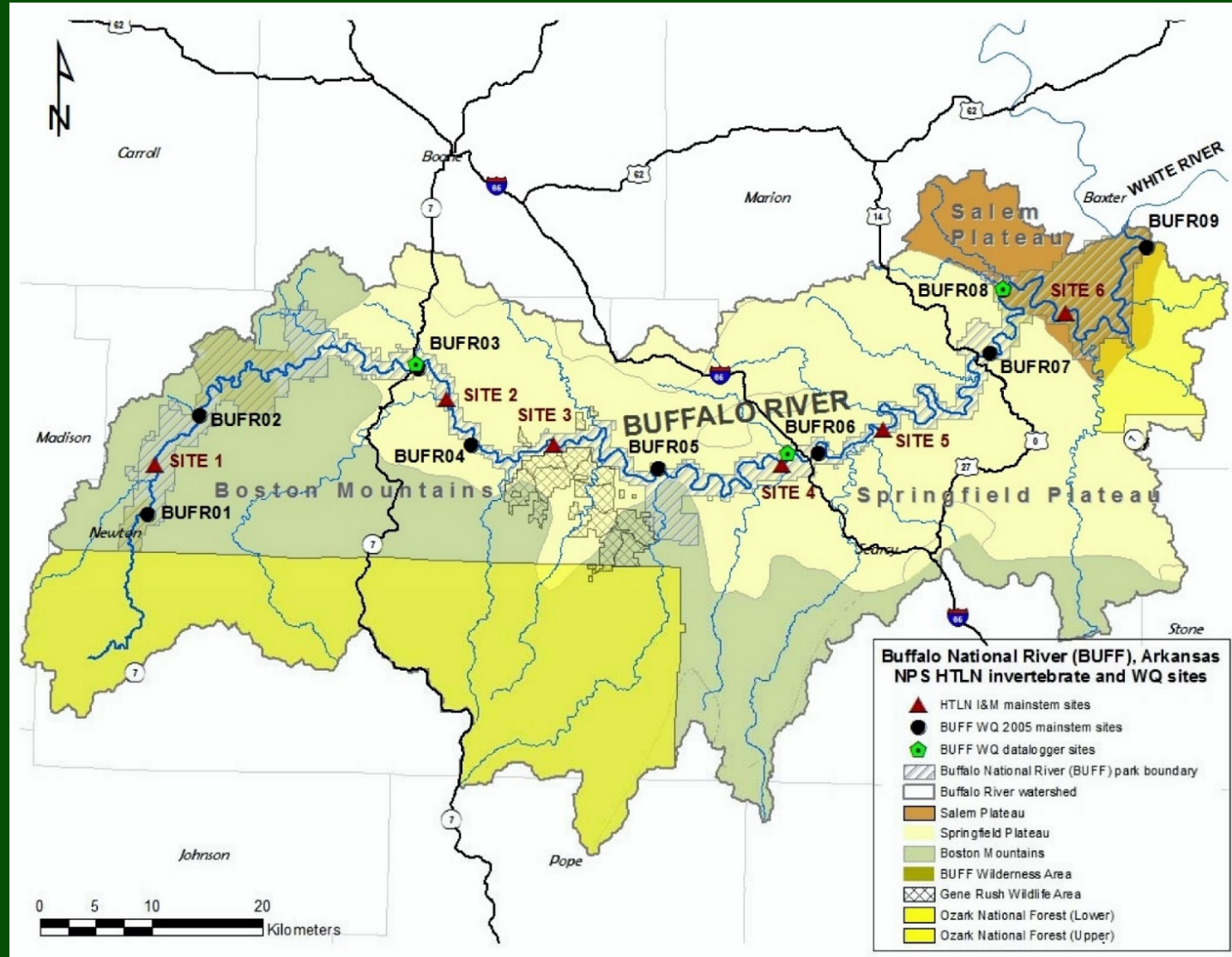
Invertebrate Monitoring

- Six permanent mainstem river sites
- 10 Tribs:
 - Targeted: Mill Creek (Pruitt), Davis Creek, Calf Creek, Bear Creek
 - Panel 1: Clabber Creek, Middle Creek, Leatherwood Creek
 - Panel 2: Cecil Creek, Little Buffalo River, Water Creek
- Randomly selected & spatially balanced sites-
Generalized Random-Tessellation Stratified method (GRTS)
 - 3 consecutive riffles, 3 samples each (n=54 mainstem samples)
 - Slack-surber sampler
 - November-February index period
 - Genus level IDs
 - 2005-2010 annually
 - Now every two years





Sampling Sites





Stream Condition Index (SCI)

- Multi-metric index founded on data collected from 26 reference streams in the Ozarks region
- Four metrics (more is better except HBI)
 - Taxa Richness
 - EPT (Ephemeroptera, Plecoptera, Trichoptera) Richness
 - Shannon's Diversity Index
 - Hilsenhoff Biotic Index

Rabeni, C. F., R. J. Sarver, N. Wang, G. S. Wallace, M. Weiland, and J. T. Peterson. 1997. Development of regionally based biological criteria for streams of Missouri. A report to the Missouri Department of Natural Resources. Cooperative Fish and Wildlife Research Unit, University of Missouri, Columbia, MO.



Stream Condition Index (SCI)

- Metric values are normalized, unitless, comparable & have equal influence on the SCI results.
 - The lower or upper (HBI) quartile of the distribution for each metric is used as the minimum value representative of reference conditions (maximum for HBI).
- Normalized metrics are assigned scores (1, 3, 5)
- Scores summed for all four metrics

SCI Scoring: ≥ 16 not impaired, 10-14 impaired, 4-8 very impaired.

Ozark Rivers Stream Invertebrate Multimetric Index (ORSIMI)

- ORSIMI is similar to the SCI--based on four metrics: taxa richness, EPT richness, Shannon's Diversity Index, and the HBI
- Arbitrarily scaled to 100 for the baseline period (in this case, 5 years).
- Each of the four metrics of the ORSIMI contributes the same weight to the overall index, but this index has more sensitivity to change.
 - Any change of any magnitude in any metric will result in a change in the overall OSIMI.
 - That change potentially could be negative or positive (i.e., total scores may be >100 if conditions improve).
- Unlike the SCI, there are no subjective judgments on what values indicate "impairment"; any comparisons will simply be to a baseline condition.

ORSIMI-2016

- Original ORSIMI values set at 100

	Avg Taxa Rich	Avg EPT Rich	Avg Shannon	Avg HBI	10-HBI	ORSIMI
BUFFM01	25.611	15.074	2.0049	4.7737	5.2263	100
BUFFM02	24.651	12.333	2.2123	4.7376	5.2624	100
BUFFM03	21.999	12.444	2.0555	4.4671	5.5329	100
BUFFM04	21.047	11.239	1.9144	4.7828	5.2172	102
BUFFM05	22.445	12.461	2.085	4.4213	5.5787	105
BUFFM06	23.464	11.796	2.1826	4.6711	5.3289	101



Results

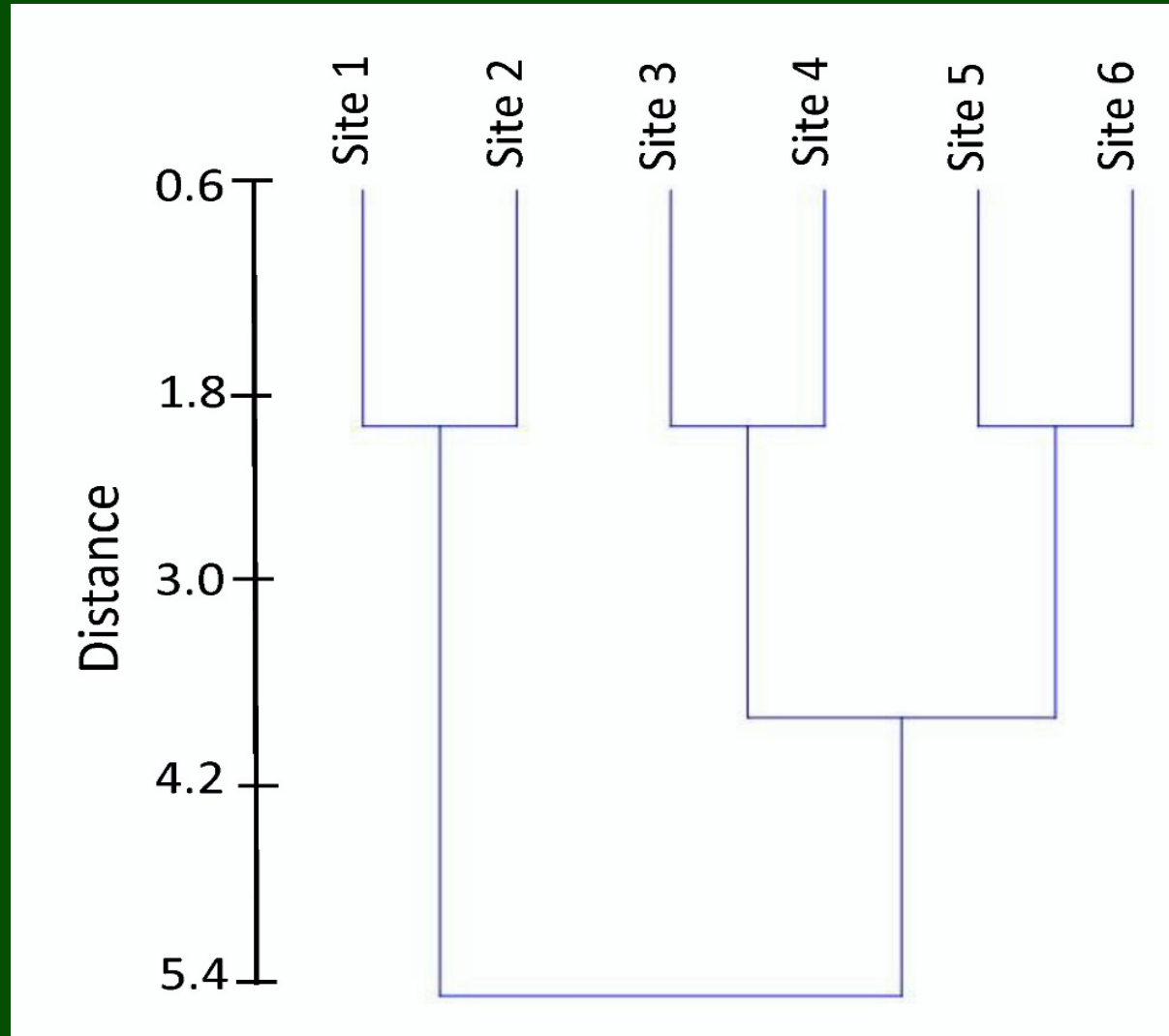
- 7 sampling events analyzed for both parks
- Invertebrate fauna is diverse (~170) taxa
- Chironomidae were not identified beyond family level
 - Number of distinct taxa much higher.
- Many taxa are shared across sampling sites along river continuum.
 - EPT taxa are dominant



Sørensen similarity index

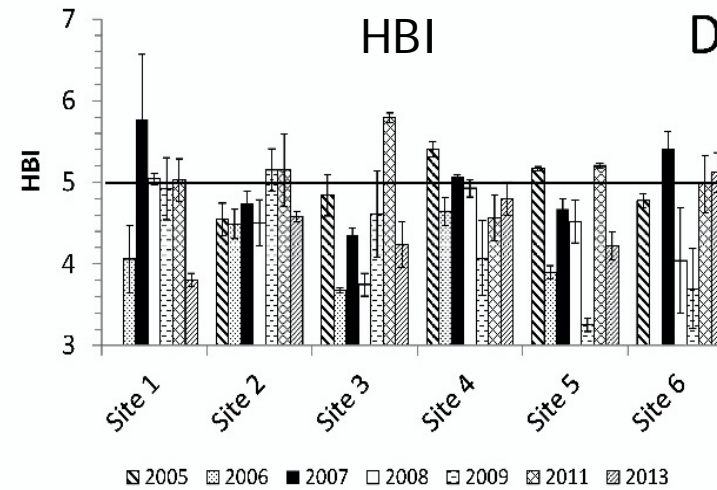
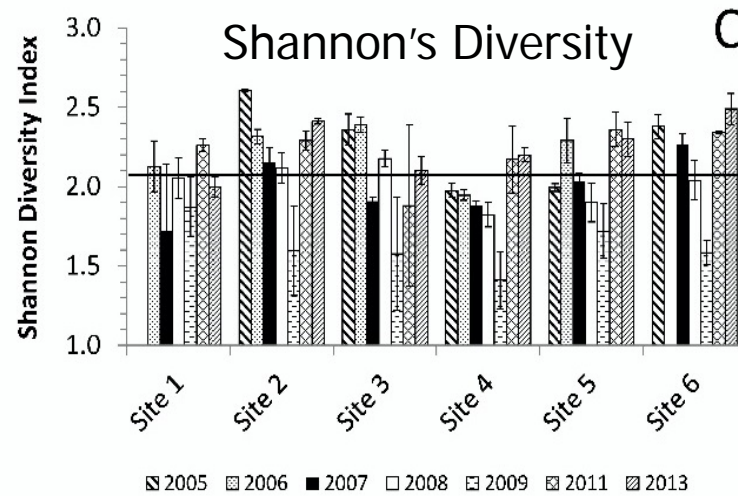
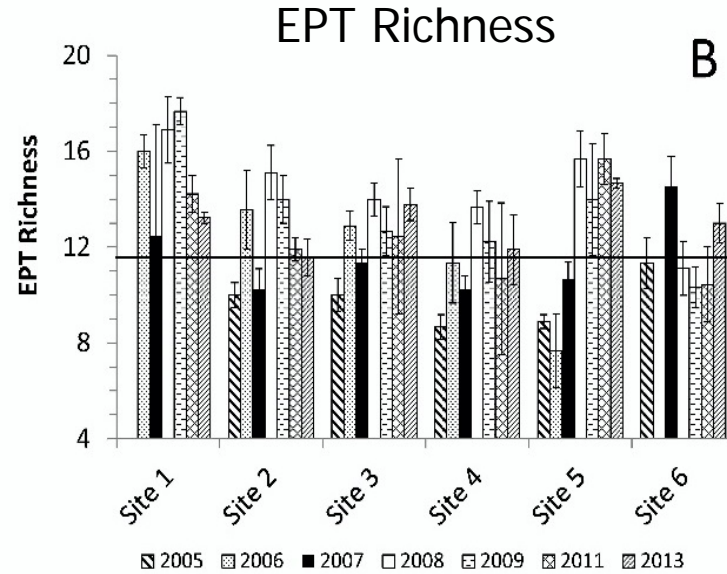
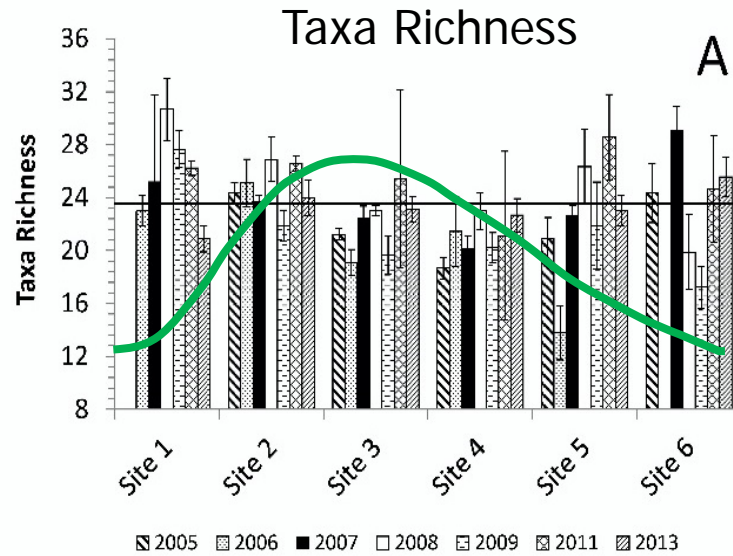
	Site 2	Site 3	Site 4	Site 5	Site 6
Site 1	0.70	0.79	0.76	0.76	0.72
Site 2		0.77	0.75	0.73	0.73
Site 3			0.83	0.82	0.80
Site 4				0.81	0.74
Site 5					0.81

Ascendant hierarchical cluster analysis





BUFF Community Metrics

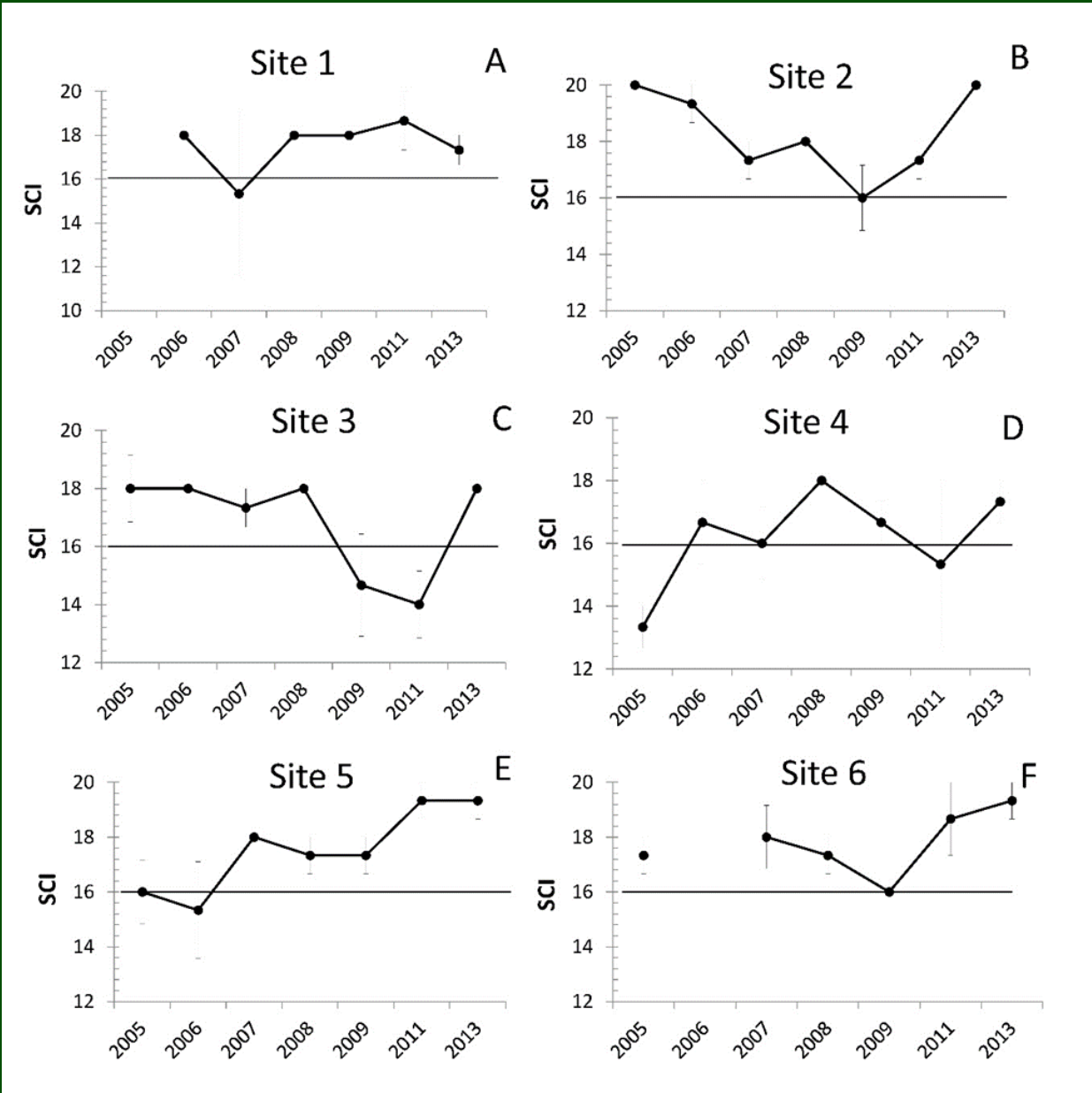


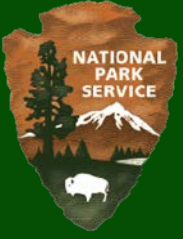


SCI-BUFF

- Values generally showed no impairment.
- The observed variability shows multi-year sampling needed so not too much emphasis placed on a single season.

SCI Scoring: ≥ 16 not impaired, 10-14 impaired, 4-8 very impaired.





Conclusions

- Invertebrate communities & water quality are largely sound and have high integrity, BUT
 - Numerous ongoing and projected threats are present in the respective basins
 - Those threats largely originate outside of the jurisdictional boundaries of the parks.
- Inherent variability of invertebrate communities across sites & years shows importance of multiyear assessments and monitoring to support management decisions.
- Must be weighed in relation to fish community monitoring & WQ
- Aquatic invertebrate monitoring provides a sound tool to recognize both deterioration and chronic decline of water quality.



Questions?