Variation in the Relative Abundance of Common Fishes Across Archeological and Modern Time Periods

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Introduction

For millennia, fish populations in the Lower Illinois River Valley have been an important resource for both people and animals (Sparks 2010). Today, people use the river in many ways, to procure food for commercial consumption, transport goods, irrigate agricultural fields, and obtain fresh water. Many people use the river to fish, targeting a small group of fishes relative to the large number of species available. In the deep past, people living in the Illinois River Valley also used these rivers. Similar to today, they only used a specific suite of fish species, though these species may differ from those currently targeted (see Table 1). With the longevity that people used these river systems, we may be able to see changes in the ways people have used selected fish taxa through time. Here, we test for differences in the relative abundance of commonly represented fish taxa through a 2,000 year time-span. This test helps us understand the ways people have used and affected these fish populations.

Methods

Zooarcheological data were compiled from previously reported collections, as well as zooarcheological analysis conducted by Ottenfeld and other students from this Research Experience for Undergraduates site (Table 1). Ecological data were compiled from the Illinois Natural History Survey using the Long Term Resource Monitoring element of the U.S. Army Corps of Engineers' Upper Mississippi River Restoration Program (Ratcliff et al. 2014), and the Long-term Survey and Assessment of Large-river Fishes in Illinois (LTEF 2015)

Level of taxonomic specificity in archeology is not always compatible with living fishes. Fish family data were grouped or divided into categories to make the two datasets comparable and to reflect the most common taxa found in archeological collections. Archeological specimens classified as freshwater catfishes (Ictaluridae) were divided into two genera, catfishes (*Ictalurus* spp.) and bullheads (*Ameiurus* spp.). Species within these genera were summed across archeological collections to determine the ratio in which these two genera were represented. This ratio was then applied to individuals identified as freshwater catfish. We grouped specimens identified below the taxonomic level of family to their respective family of suckers (Catostomidae) and sunfishes (Centrarchidae). With the exception of those already listed, all other archeological specimens identified to genus or species were left in their original classification. Only species found in archeological samples were analyzed in the ecological samples, and we grouped ecological data at the same taxonomic levels applied to archeological data.

Archeological and ecological data were analyzed in Primer 7 and standardized by calculating the relative abundance within samples. Bray-Curtis Similarity was used to establish a similarity matrix. We used ANOSIM to test for variation in the relative abundance of fishes among Middle Woodland, Late Woodland, Mississippian, and modern time periods. We used non-metric multidimensional scaling (MDS) to illustrate the ANOSIM results (Figure 3; Table 1).

Results

We did find significant differences in the relative abundance of fishes among time periods (ANOSIM R= 0.748, p= <.001). The relative abundance of fishes in the modern data differed significantly from all archeological periods (Figure 1). There was no significant difference in the relative abundance of fishes among the archeological periods with the exception of the Late Woodland and Mississippian (Table 2). Bowfins and bullheads had greater relative abundance in the archeological collections (Figure 2A), whereas freshwater drums and centrarchids were more common in modern time (Figure 2B). Some fish taxa consistently were seen among both modern and archeological periods (Figure 2C). The high relative abundance of gar (*Lepisosteus* spp.) in one Mississippian collection leads to low similarity between the Mississippian samples (Figure 2D).

Groups	R-Value	p-Value
Middle Woodland, Late Woodland	0.185	0.190
Middle Woodland, Mississippian	0.000	0.500
Middle Woodland, Modern	1.000	0.012
Late Woodland, Mississippian	0.688	0.036
Late Woodland, Modern	0.906	0.002
Mississippian, Modern	0.875	0.036

Table 2. ANOSIM results for pair-wise comparisons of time periods.

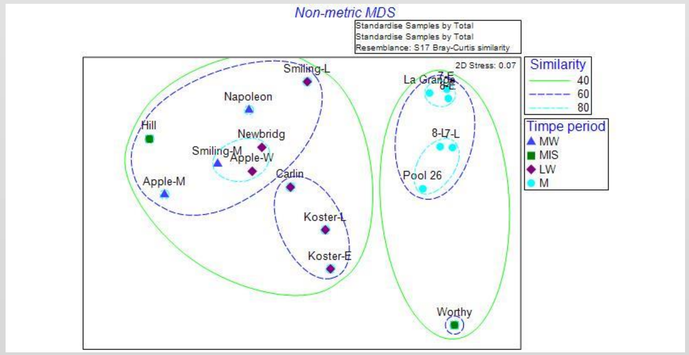


Figure 1. Non-metric MDS groupings of samples from Lower Illinois River Valley. MW= Middle Woodland LW= Late Woodland Mis= Mississippian, and M= Modern.

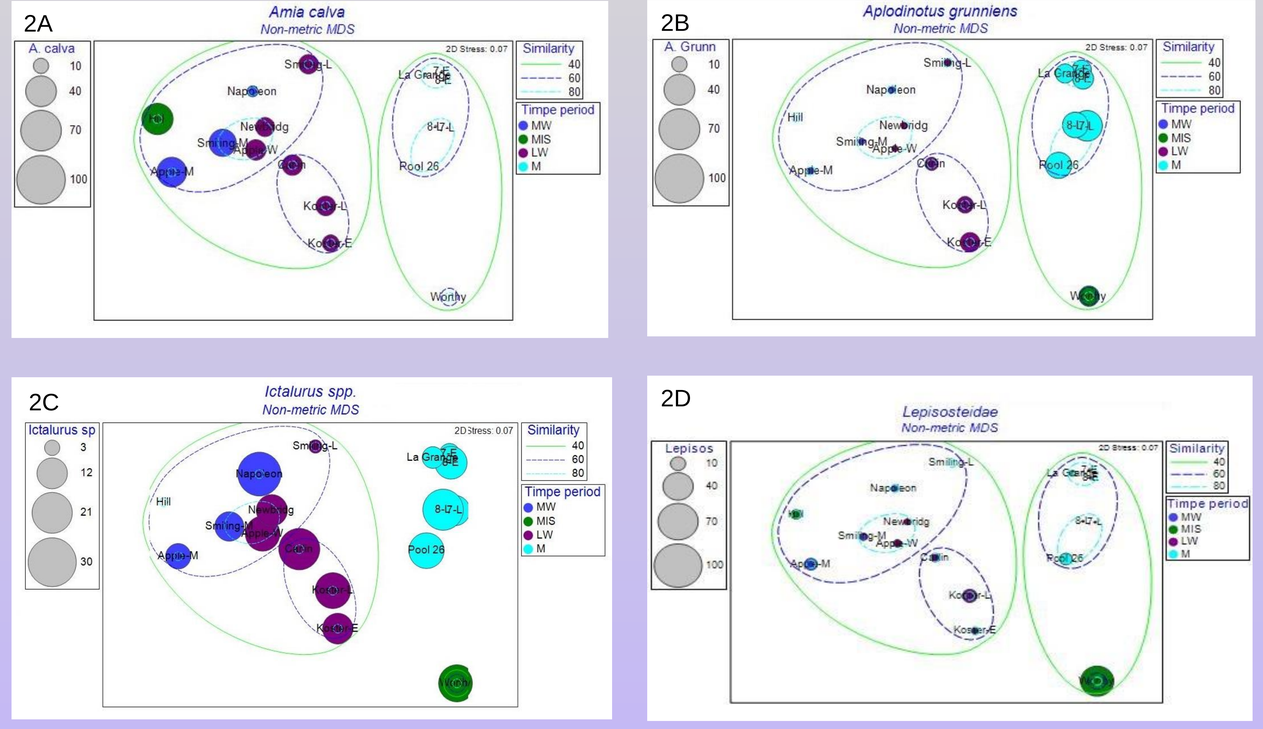
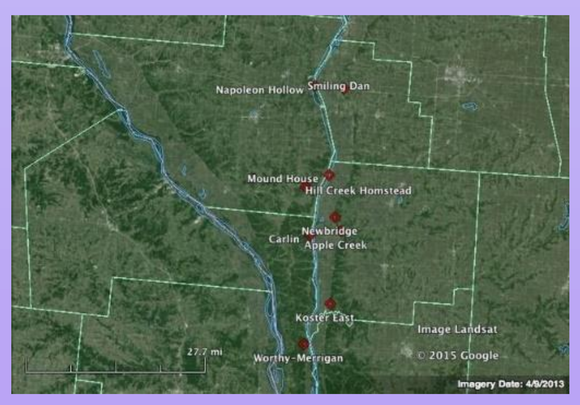


Figure 2. MDS showing grouping of archeological and modern samples from Lower Illinois River Valley. Bubbels show relative abundance of A) *Amia calva,* B) *Aplodinotus grunniens,* C) Lepisosteidae, and D) *Ictalurus* spp. MW= Middle Woodland, LW= Late Woodland, Mis= Mississippian, and M= Modern.



Map showing archeological sites in the Lower Illinois River Valley.

Site Names and #'s	Time Period	Dates	Analyst
Napoleon Hollow: 11PK500	Middle Woodland	164 cal BC- cal AD 388*	Styles and Purdue (1986)
Apple Creek: 11GE2	Middle and Late Woodland	cal AD 134-805*	Parmalee (1972)
Smiling Dan: 11ST123	Late Woodland	AD 250-1000	Styles, Purdue, and Colburn (1985)
Carlin	White Hall 1350 BP	cal AD 610-1210*	Styles (1981)
Newbridge: 11GE456	White Hall	cal AD 605-885*	Styles (1981)
Koster East Early: 11GE4	Late Woodland	AD 700-800	Enzerink (2015)
Koster East Late: 11GE4	Late Woodland	AD 800-900	Ottenfeld (2015)
Worthy-Merrigan: 11C382	Early Mississippian	AD 1000-1300	Dopson (2015)
Hill Creek: 11PK525	Mississippian	cal AD 1190-1260*	Colburn (1985)

Table 1. Site names and calabrated dates for archeological sites on the Lower Illinois River Valley.
*Calibrated dates are reported for Napoleon Hollow, Apple Creek, Smiling Dan, (King et al. 2011), Carlin, Newbridge (Studenmund 2000), and Hill Creek (Conner 1985). Other dates were confirmed by relative dating in Smiling Dan (Stafford 1985), Koster East Early, Koster East Late (Farnsworth 1991), and Worthy-Merrigan (Wettersten 1983).

Discussion

Changes shown between archeological and modern time periods give credibility to the assumption that the use of river resources have changed significantly through time. These changes mostly center on a shift away from bowfins and bullheads (Figure 2A). These are two groups with an affinity for backwater habitats. There is a shift towards an increased relative abundance of freshwater drums and centrarchids (Figure 2B). These changes may reflect a greater amount of human impact on river populations (Sparks 2010).

There are previously documented changes through archeological periods, such as shifts in plant-based foodways strategies (Smith 1992), socio-political organizations, and material culture (Wiant and McGimsey 1986). We expected differences in the relative fish abundance among time periods, but found no significant variation in relative fish abundance throughout the archeological periods. Because of the high variability among archeological collections, we need a greater number of samples to statistically differentiate archeological periods and understand the variability observed among archeological collections.

Although we observed significant differences between the archeological and modern datasets, there are a number of factors we cannot account for that may impact our results. Archeological sites here are limited to the Lower Illinois River Valley. Furthermore, archeological datasets are derived from excavations dating back to the 1960s (Parmalee et al. 1972), before modern standards were established. Archeofaunal collections analyzed here were subjected to various processing methods, biasing the recovery of fish specimens and possibly the genera and families recovered (Reitz and Wing 2008).

Conclusion

The differences between the archeological and ecological data show a significant change in the relative abundance of different fish taxa over time. These differences, compared to the similarities between the archeological collections, suggest that a change has occurred in the Illinois River between modern and ancient times. Socio-political institutions, material culture, and plant-based subsistence strategies varied between archeological time periods, but we do not detect shift in the groupings of fishes used by people. Our study highlights the need to further examine factors that might be influencing the relative abundance of fishes in archeological collections.

Acknowledgements

The National Science Foundation Research Experiences for Undergraduates (Award No. 1460787, PI Colaninno, Co-PI Chick) supported this research. We would like to thank Dr. Carol Colaninno, Dr. John Chick, Dr. Terrance Martin, Kelly Brown, and Autumn Beyer for their time and assistance throughout this project. We would also like to thank the staff at The National Great Rivers Research and Education Center, Illinois Natural History Survey, Center for American Archeology, and the Illinois State Museum. Our fellow REU students provide data, research, and support while writing this poster, which made this research possible. The authors are responsible for all contents, including any errors, herein.