Examining *Ictalurus* spp. and *Ameiurus* spp. Size Distribution in the Lower Illinois River Over 2,000 Years

Paula M. Long[1] and Abigail T. Uehling[2]

[1] University of Central Arkansas, Department of Anthropology, Conway, AR, plong3@cub.uca.edu

[2]Hamilton College, Department of Biology, Clinton, NY, auehling@hamilton.edu

The National Great Rivers Research & Education Center

ILLINOIS NATURAL HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

Center for American Archeology, Kampsville, Illinois

Illinois State Museum

Introduction

For millennia, the Mississippi and Illinois rivers have provided resources for people (Sparks 2010). Archeological sites along the Illinois River demonstrate that past peoples relied heavily on both bullheads (*Ameiurus* spp.) and catfishes (*Ictalurus* spp.) and the river remains an important habitat for these two genera (Table 1). Anthropogenic influences, such as water management, have drastically altered the ecology of the Illinois River (Thompson 2002) and subsequently affected fishes by limiting habitat availability. Fish can survive in various habitat types, although many prefer specific environmental conditions. Catfish, for example, are rheophilic fishes characteristically found in fast-moving water, whereas bullheads, are limnophilic, preferring slow-moving backwaters (Robinson and Buchanan 1988).

We compare the variation in size distribution of catfishes and bullheads among archeological and present-day collections. Changes in the size distribution of bullheads and catfishes might be expected because there have been substantial changes in the preferred habitats for these species in the Lower Illinois River Valley across millennia (Sparks 2010; Wootton 1998).

Table 1. Site Data of Archaeological and Ecological Data from the Lower Illinois River Valley

Site Names and #'s	Time Period	Dates	Analysts
Napoleon Hollow: 11PK500	Middle Woodland	164 cal B.C.- cal A.D. 388*	Styles et al. (1986)
Apple Creek: 11GE2	Middle and Late Woodland	cal A.D. 134-805*	Parmalee et al. (1972)
Smiling Dan: 11ST123	Late Woodland	A.D. 250-1000	Styles et al. (1985)
Carlin:	Late Woodland	cal A.D. 610-1210*	Styles (1981)
Newbridge: 11GE456	Late Woodland	cal A.D. 605-885*	Styles (1981)
Koster East Early: 11GE4	Late Woodland	A.D. 700-800	Enzerink (2015)
Koster East Late: 11GE4	Late Woodland	A.D. 800-900	Ottenfeld (2015)
Worthy-Merrigan: 11C382	Mississippian	A.D. 1000-1300	Dopson (2015)
Hill Creek: 11PK525	Mississippian	cal A.D. 1190-1260*	Colburn (1985)
Reach 7 (7-E)	Modern	A.D. 1957-1993	LTEF
Reach 8 (8-E)	Modern	A.D. 1957-1993	LTEF
Reach 7 (7-L)	Modern	A.D. 1994-2014	LTEF
Reach 8 (8-L)	Modern	A.D. 1994-2014	LTEF
Pool 26	Modern	A.D. 1994-2014	LTRM
La Grange	Modern	A.D. 1994-2014	LTRM

*Calibrated dates 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).

Methods

We worked with archeofaunal collections that had size class estimates for 10 or more specimens (Table 1). Ecology data consisted of electrofish sampling from two long-term monitoring programs; The Long Term Resource Monitoring (LTRM) 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). Relative abundance of specimens among 16-cm size classes for the two genera were analyzed using Primer 7 and the Bray-Curtis similarity test, indicating temporal correlations in archeofaunal and ecological data.

Results

Relative Size Abundance of *Ictalurus* spp.

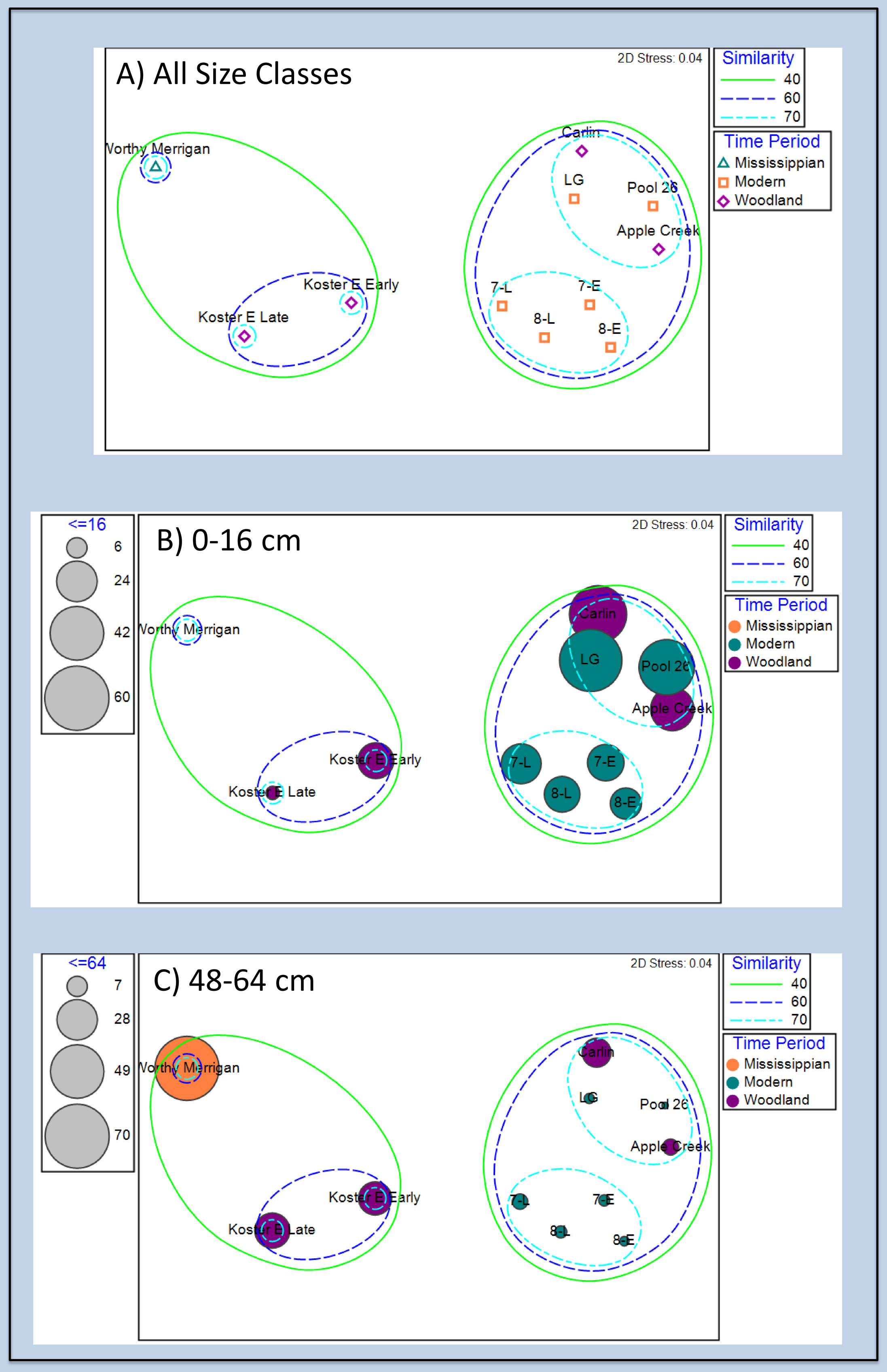

Figure 1 a) shows groups of archeological and ecological samples based on the relative abundance of *Ictalurus* spp. among size classes in the Lower Illinois River. b-c) Bubbles represent the relative abundance of selected size classes in each sample. Modern = Ecological samples, Woodland and Mississippian = Archeological samples

Relative Size Abundance of *Ameiurus* spp.

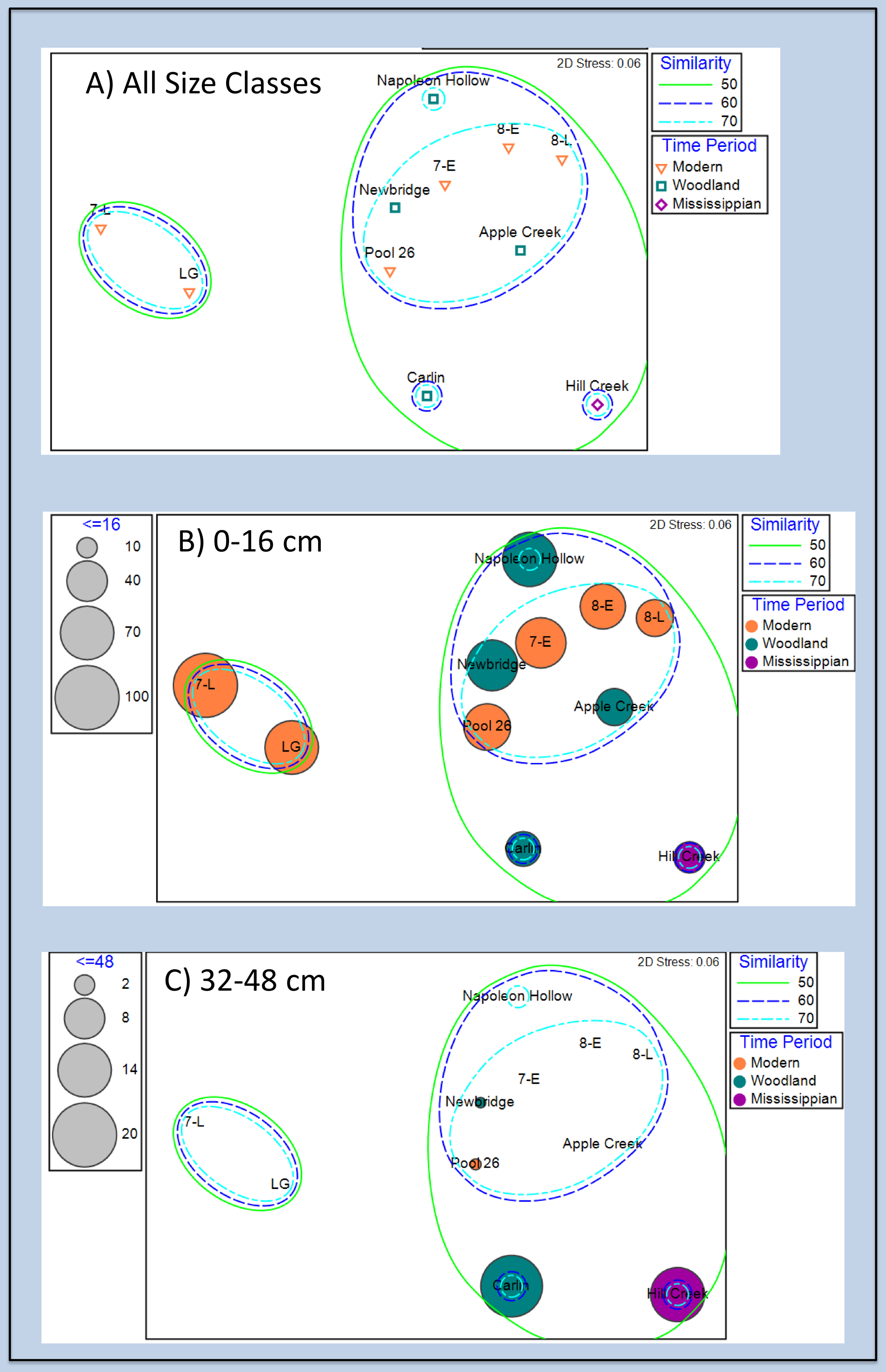

Figure 2 a) shows groups of archeological and ecological samples based on the relative abundance of *Ameiurus* spp. among size classes in the Lower Illinois River. b-c) Bubbles represent the relative abundance of selected size classes in each sample. Modern = Ecological samples, Woodland and Mississippian = Archeological samples

Table 2. Sample Statistic (R-value) and Statistical Significance (p-value)

Genus	R-value	p-value
Catfishes (all sites)	0.543	0.002
Woodland, Mississippian	0.250	0.400
Woodland, Modern	0.397	0.033
Mississippian, Modern	1.000	0.143
Bullheads (all sites)	0.083	0.301
Woodland, Mississippian	0.500	0.200
Woodland, Modern	-0.050	0.533
Mississippian, Modern	0.400	0.286

The size distribution of catfishes differed significantly between archeological and modern data (R = 0.543, p = 0.002, Figure 1; Table 2). Small size classes had greater relative abundance in the modern time period, whereas large size classes had greater relative abundance the archeological periods (Figure 1). There was no significant difference in the size distribution of catfishes among archeofaunal collections (p > 0.05, Table 2).

For bullheads, there were no significant differences among any archeological time periods (p > 0.05, Table 2), however we observed general groupings (Figure 2).

Ictalurus spp.

Ameiurus spp.

Discussion

Archeofaunal collections have a significantly higher abundance of larger catfishes than modern ones. There is not significant size change among archeological samples. Many factors influence the size of fishes. Habitat change induced by water management could play a role in these trends (Sparks 2010) by limiting habitat availability for fish species. Increased rates in predation, fish-induced genetic selection, and environmental parameters also impact size structures of fish populations (Conover 2000; Wootton 1998).

Analysis of bullheads also indicates no statistical significance among time periods, although we did see patterns that were not related to time. The greatest abundance of bullheads are in smaller size classes for both datasets. The lack of variation of the size distribution of bullheads among periods, with the exception of two sites which are outliers, suggests that the decrease in frequency of backwater lakes and other anthropogenic changes may not impact the size distribution of this genus.

Numerous factors could account for a lack of significance differences in the relative distribution of catfish and bullhead sizes among the archeological collections. Methodological and preservation biases favoring less fragile fish bones (Colaninno et al. 2015; Styles 1981), along with limitations of the archeological record also are potential biases.

Conclusions

We found significant differences in the relative abundance of catfish size classes between ancient and modern collections, with large catfish size classes most abundant in archeofaunal collections rather than modern ones. Many ecological factors such as predation, genetic selection, and habitat fragmentation could be represented in these data and cannot be refuted as possible dissimilarities in sizes. In contrast, there was no statistical significance among archeofaunal collections for catfishes.

Unlike the catfishes, bullhead demonstrated no significant differences between archeological and ecological samples. There were distinct groupings among archeological and ecological samples, but these groups did not correspond to time period. This surprising result suggests that further analysis of bullheads might yield insight to the potential role of humans altering populations of this genus.

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