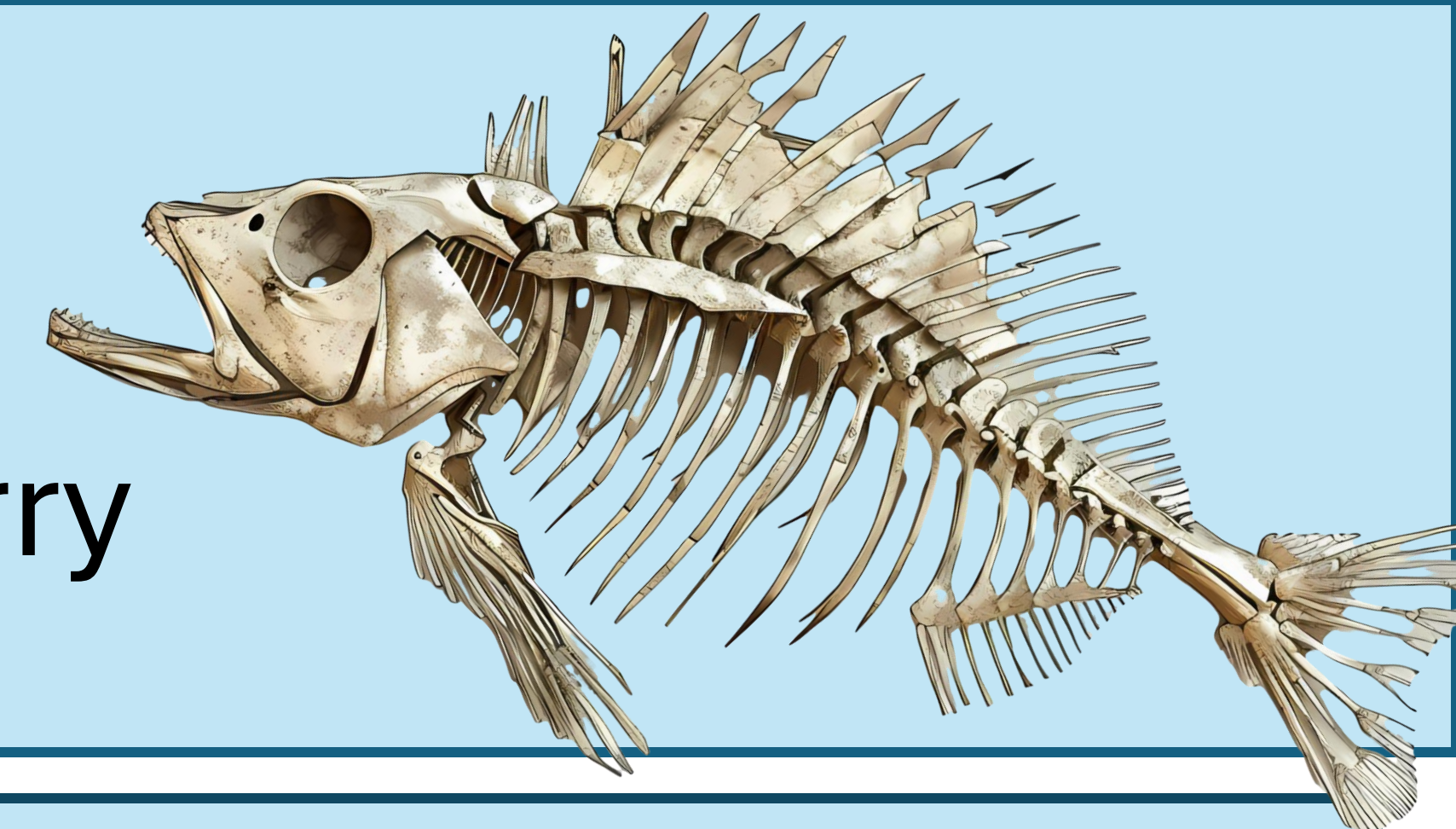


Georgia's Past Biodiversity and Climate: Applying Modern Biodiversity Indices to a Pleistocene Fossil Assemblage from Clark Quarry

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Introduction

Clark Quarry: Late Pleistocene (~60-20 kya) fluvial environment in Glynn County, GA ~15 km inland from today's coastline¹.



Biodiversity Indices Used:

Shannon-Weaver Index

- Assumes all species are represented and randomly sampled

$$-\sum p_i \cdot \ln(p_i)$$

Inverse Simpson Index

- Assumes rare species have little effect on diversity

$$1 - \sum p_i^2$$

Chao Estimator²

- Estimates species richness including unrepresented species.

$$chao1 = \begin{cases} s + \frac{N-1}{N} \frac{F_1^2}{2F_2} & F_2 > 0 \\ s + \frac{N-1}{N} \frac{F_1 \cdot (F_1 - 1)}{2} & F_2 = 0 \end{cases}$$

Objectives

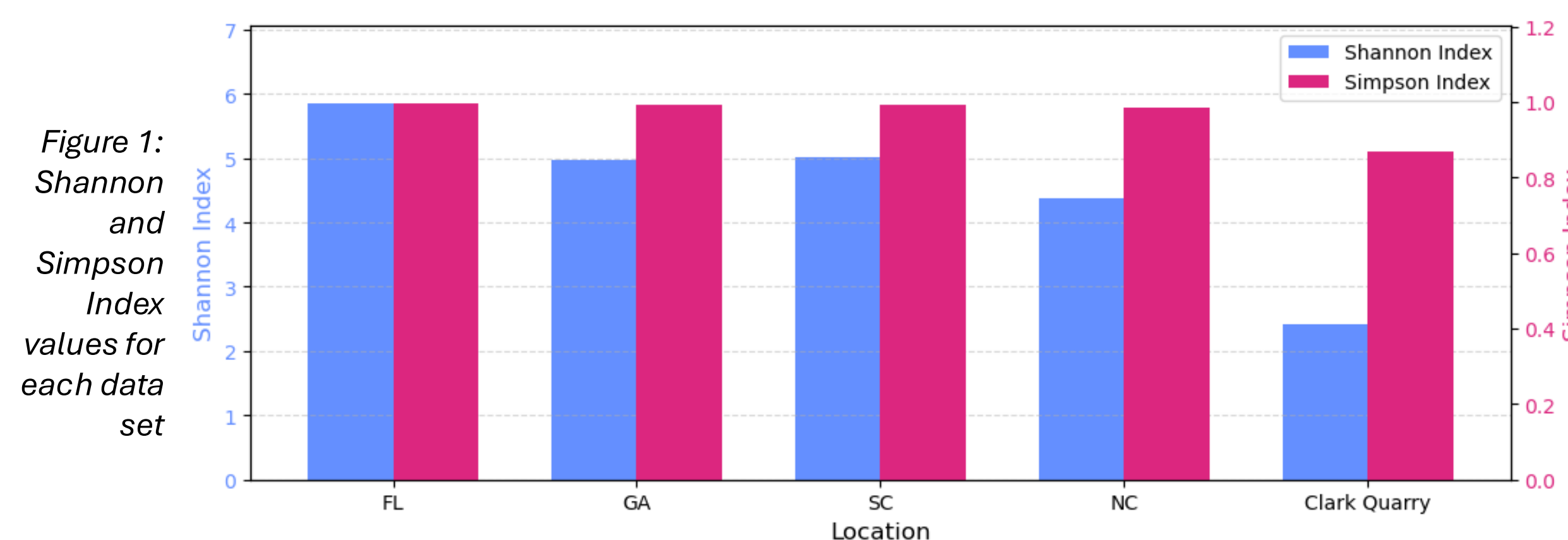
- 1) Apply various biodiversity indices to our focal site Clark Quarry and additional datasets in GA, FL, NC, and SC.
- 2) Critically reflect appropriateness and accuracy for paleo-ecological interpretation
- 3) Evaluate assumptions about paleo-biological community composition using established radiological isotope data.

Methods

- Fossil data downloaded from Paleobiology Database: NC, SC, GA, and FL.
- Microfossil database includes specimens collected from Clark Quarry and identified in the College of Coastal Georgia Micro-Fossil Lab
- Indices calculated (Figure 1) and tables (Table 1) made with Python³. Pandas⁴ used to sort the data, Matplotlib⁵ to make the plot, and NumPy⁶ for the formulas.
- Literature search conducted to investigate past paleo-ecology methods and diversity indices
- Late Pleistocene climate and Marine Isotope Stages (MIS) were also considered to determine any possible ecological response to climate.



Results



Location	Shannon Index	Simpson Index	Species Richness	Estimated Richness
FL	5.85	0.996	542	742
GA	4.96	0.992	163	306
SC	5.01	0.991	209	299
NC	4.36	0.984	109	167
Clark Quarry	2.42	0.869	20	55

Table 1: Diversity measures including richness and estimated richness

Conclusions and Implications

- Index results: (Figure 1)
 - The Shannon-Weaver and Inverse Simpson Indices show a highly diverse community in each of the states.
 - Clark Quarry's values indicate low diversity likely due to inadequate sample size.
- Considering the assumptions of both Shannon-Weaver and Inverse Simpson, these indices are not appropriate for estimating paleo-diversity
- Many paleo-ecological methods produce results that are not easily comparable to modern ecological results.
- Chao Estimator: (Table 1)
 - The estimator results suggest a large portion of community is not represented in the fossil assemblages
 - Clark Quarry estimated richness is more than twice what has been recorded.
- Literature suggests that the Clark Quarry sediments were deposited between MIS 2 and MIS 4 during which there was a global 0.5 decrease in $\delta^{18}\text{O}$ ⁷. Results are inconclusive given current ecological information.

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