Characteristics of Debitage Associated with Bone Tool Production: A Preliminary Assessment of the Late Archaic Pockoy Shell Ring 1 (38CH2533)

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Statement of Problem:

The study of bone artifacts generally focuses on final products and generalized reduction sequences with far less consideration given to the characteristics of bone debitage. Bone debitage often is regarded immaterial because production is considered more efficient and less wasteful than lithic or shell tool production.

Goals:

1) Describe two methods of bone tool production commonly employed in experimental reproduction;
2) Identify characteristics of bone debitage to facilitate identification of archaeological tool manufacture;
3) Assess faunal remains and worked bone from Pockoy to interpret evidence of bone tool production

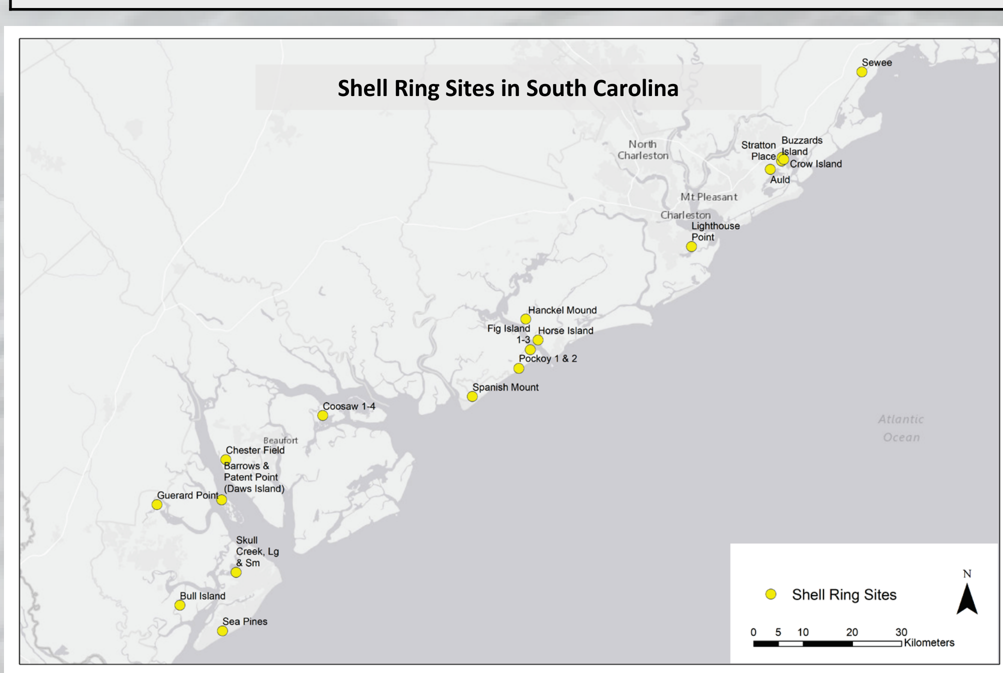
1. Introduction

- Archaeological identification of bone production sites is impeded by current practices.
- Bone tool production is represented by clear stages and diagnostic debris.
- Most archaeological research emphasizes the final product rather than the associated debitage or a clear *chaine operatoire* (Leroi-Gourhan 1964).
- Production sequences are often oversimplified or unspecified.
- But see Bergsvik and David 2015; Betts 2007; Gates-St. Pierre et al. 2015.

2. Background

- Pockoy Shell Ring 1 is part of the Late Archaic Shell complex in Edisto, SC.
- Numerous worked bone fragments were recovered.
- This led researchers to consider the role of Pockoy as a production area within the broader Late Archaic landscape.
- Existing literature reviewed to compare worked bone identified in nearby, contemporaneous sites.

Site Name	Excavation size (m²)	Worked bone (NISP)	Citation
Pockoy Ring 1 (38CH2533)	24	109	-
Fig Island (38CH42)	12	73	Saunders 2002
Spanish Mount (38CH62)	8.5	10	Reitz and Jung 2018; SCDNR n.d.
Bass Pond Dam (38CH124)	25	7	Michie 1979
38CH1693	25.5	4	Trinkley and Hacker 2007
Spring Island (38BU2)	16	15	Espenshade et al. 1994



3. Methods

Experimental Replication

- Assess Stone-Tool Grooved-and-Split technique and two variations of the Anvil/Wedge technique.
- Analyze debitage associated with each method in terms of age of bone, morphology, and break characteristics.

Zooarchaeological materials from Pockoy Shell Ring 1

- Deer and mammal fragments for possible CLF
- Ratio of deer metapodials relative to other body regions
- Portions of metapodials present
- Quantify worked bone fragments
- Ratio of decorated and undecorated fragments

4a. Experimental Data

Stone-Tool Grooved-and-Split Technique

- Deep, longitudinal incision along the entire length of both bone surfaces are sawed with sharp flake or biface.
- Fresh or freshly cooked bone provide the best results.
- Two halves of bone are separated with a wedge, often results in a slightly irregular chipping on the external end of the grooved surface.
- Epiphyses are removed from fragments by sawing and can be identified by cut marks.
- Removal of the distal end first is recommended for pin making.

Groove and split technique: Left, using lithic flake to make initial groove longitudinally along anterior deer metapodial; Center, groove cut longitudinally along anterior bone surface, nearly through to the medullary cavity; Right, with both anterior and posterior surfaces completely grooved with a stone wedge inserted in one end to fully split the bone.

4b. Experimental Data

Anvil and Wedge Technique

- Two variations of percussive reduction with similar schematic approaches and debitage.
- Best applied to dry or seasoned bone.

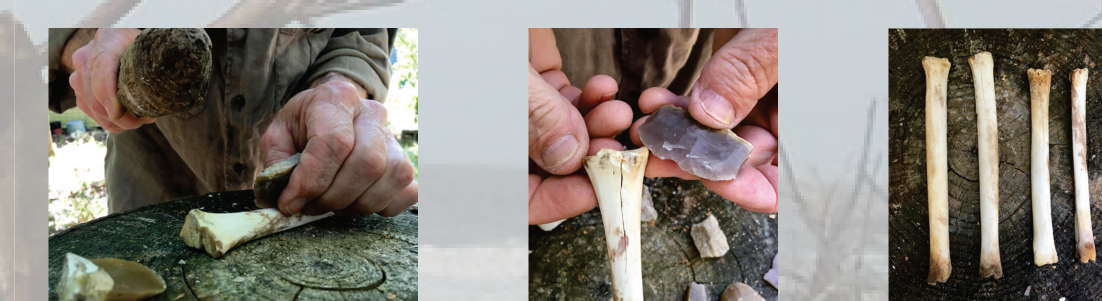
The Anvil Method

- Sharp-edged anvil is situated beneath bone and bone is aligned with anticipated location of the lengthwise fracture.
- Strike top surface of bone along length with mallet until the underside begins to fracture, then repeat the process for the other side.
- A wedge is used to complete the splitting process.
- Internal chipping or beveling at the wedged area often results from this method.

The Wedge Method

- Uses a smaller flake wedge or biface fragment instead of anvil.
- Bone is placed on a work surface; the wedge is placed along the anticipated fracture line on the upper surface of the bone and struck with a mallet. Once a fracture begins to form on the upper surface, the bone is turned over and the process repeated.

Anvil method: Left, initiating the first of a series of cracks on the underside of the bone using a sharp anvil and a mallet; Center, longitudinal fracture starting to form; Right, having employed the process to both sides of the bone, it is now almost fully split. Note that the crack is created through a slow and repetitive series of blows while moving the bone along the anvil edge. Particular attention is paid to the ends of the bone to ensure clean splitting.



Wedge method: Left, lithic flake being tapped along the anterior length of the bone; Center, same wedge used to split the epiphysis; Right, deer metapodials split into halves: The left two fragments represent the anvil method, and the right two fragments represent the wedge method. Both bones were dry or seasoned, and both yielded exceptionally good pieces.

5. Insight from Experimental Research

- Metapodials are common in tool production due to their robust and relatively straight shafts, but other long bones can be used.
- Controlled bone reduction processes yield long, splintered debitage (**controlled longitudinal fragments**, or **CLFs**), as compared to bone fragments that result from smashing for marrow or other non-tool uses.
- While awls and other utility items can be made from a variety of bone fragments, bone pin manufacture requires reliable CLF.
- Although dried bone is preferable for the anvil/wedge methods, bone can be briefly boiled or soaked in water to improve workability.
- The proximal and midshaft regions of deer metapodials are thicker than the distal ends, making them suitable for pin production.
- Early removal of distal metapodial ends improves the predictability in splitting and produces higher quality CLF for both methods.

Left: Sample of replicated anvil-split CLFs from the author's (SJ) teaching area.

Right: Top, archaeological mid-stage anvil/wedge split bone pin blank from Lake Spring (9CB22); bottom, replicated anvil-split CLF.

6. Assumptions based on Experimental Research

a. Bone tool production is generalized as an efficient method with less wasted bone fragments. However, controlled bone reduction areas should display an abundance of CLFs.

b. Blanks, rejects, and intermediate stages of pin/tool manufacture will be present.

c. Metapodials will be over-represented in areas of mass tool production. However, proximal fragments may be underrepresented due to their suitability for pins.

d. Decoration represents a bottleneck in tool production. Therefore, it is expected that both undecorated fragments and fragments depicting a range of decorating stages will be present at a production site.

Bone pins reproduction by author (SJ)

7. Zooarchaeological Analysis

- Unidentified mammal and deer (n=418) from Pockoy analyzed for potential CLF.
- Refitting fragments counted as one piece.

Fragment Characteristics	NISP
CLF with modification evidence	5
Potential CLF, unmodified	2
Unmodified or shattered fragments	411
Total	418

- Worked fragments (n=119) assessed for decoration.
- Differences in thickness observed but not quantified due to fragmentation.

Worked bone fragments	NISP
Undecorated fragments	89
Decorated fragments	20
Total	109

- Deer element ratios assessed to determine important body regions.
- MNE determined by side, bone portion, and recovery context.
- Adjusted ratio was calculated based on the number of times each element occurs in the body.

Deer element	NISP	MNE	Adjusted MNE
Humerus	2	1	0.50
Radius	1	1	0.50
Femur	5	4	2.00
Tibia	4	3	1.50
Metapodial	19	5	1.25
Total	30	14	

- Ratio of proximal and distal metapodials assessed.

Metapodial portions	NISP
Proximal	4
Shaft	10
Distal	5
Total	19

Modified bone and CLF debitage from Pockoy

Metapodial proximal fragment recovered from eroding beachfront midden, oblique and superior views displaying stone tool grooving. A small exterior chip (red arrow) approximately halfway up groove suggests this was fresh when worked.

CLFs and pins. From left to right, proximal metapodial fragment with grooving; refitting CLF; broad, flat CLF; late-stage bone pin blank or undecorated pin from a proximal metapodial; and polished upper portion of undecorated pin.

Refitting artifact metapodial fragments, from four pieces. Overall morphology and modifications suggest this bone was split using anvil/wedge method.

8. Discussion

Expected Production Area Traits	Pockoy
Abundance of CLF	N/A
Presence of blanks, rejects, and intermediate tool stages	N/A
Abundance of metapodials	N/A
Underabundance of proximal metapodials	N/A
Tools representing undecorated and stages of decoration	Yes

Assessment of Experimental Assumptions

a. Less than 2% of the of the 418 faunal fragments displayed clear evidence of CLF. The majority of faunal remains display morphology consisting with smashing, such as may be associated with food processing.

b. Few clear examples of blanks, rejects, or intermediate stages of production are observed.

c. Metapodials are not especially abundant at the site, and proximal and distal metapodial fragments are evenly represented.

d. 82% of worked bone is undecorated. This may result from a decoration bottleneck, condition of fragments, or utilitarian nature of objects. Further assessment is precluded due to fragmentation.

9. Conclusions

Two methods of bone tool production are presented with descriptions of associated bone debitage. These debitage characteristics provide a means to identify and interpret archaeological production areas. Although Pockoy has a high number of worked bone fragments compared to contemporaneous sites, the corresponding zooarchaeological materials **do not display traits indicative of tool production**. Few CLF are identified, metapodials are not overrepresented, and both ends of the metapodial are evenly represented.

These results suggest that while some manufacture took place, the site was not a locus for intensive bone tool production. Additional research is required to validate these interpretations.

References, Acknowledgements, Poster PDF, and Extras:
http://mediaprehistoria.com/SEACrefs2019/