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Multiple Approaches to Prehistoric Pit Features at the Puncheon Run Site

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I. INTRODUCTION

SLIDE--VIEW OF PIT

My focus today will be on one small part of the Puncheon Run Site, a group of pit features in an area with few plowzone artifacts. The cluster includes a dozen rather large pits, in area measuring about 5 by 12 meters, about 100 meters from the nearest artifact concentration.

Pits like these are important to our understanding of the prehistoric past, because the storage of surplus food is a key theme in many anthropological theories. To some anthropologists, the ability to store surplus food is the necessary basis for population growth, the development of semi-sedentary lifestyles, and the evolution of ranked societies, changes that seem to be taking place in eastern North America in the Late Archaic and Early Woodland Periods.

We will be looking today at what this one particular pit cluster can tell us about those themes.

MAP--OVERALL

The location is a gently sloping terrace, 50 meters from Puncheon Run, 500 meters from the St. Jones River.

MAP--LOCUS 1

SLIDE--VIEW OF AREA FACING EAST

SLIDE--VIEW OF AREA FACING CREEK

The area had been plowed and had suffered substantial erosion; no E horizon was remaining. There were several large groundhog dens in this field, and some of the features showed evidence of having been thoroughly tunneled.

An old ditch about 50 meters from this area had been filled with trucked-in soil sometime in the past 50 years, and we wonder if part of the Pit Cluster area may have been leveled with a bulldozer at that time. The area around the ditch was plowed after the ditch was filled. We saw no obvious signs of machine disturbance, but the complete lack of plowzone artifacts in some parts of the site made us wonder.

II. DESCRIPTION OF LOCUS 1 PIT CLUSTER

SLIDE-MAP

The Pit Cluster was discovered by luck, when a Phase I shovel test pit happened to enter a pit feature. A test unit dug on the same spot confirmed the presence of the pit. Because of the low artifact density, without this chance find we would not have returned to this area during the Phase II.

In what I call the main pit cluster there were 10 silo-shaped and 2 deep basin-shaped pits.

Plowzone artifact density in this part of the site was about 2 artifacts per 1x1-meter unit. Immediately over the pit cluster were two units with 5 and 7 artifacts, so there was a very small artifact concentration associated with these pits.

During the Phase III excavations the plowzone was stripped from an area measuring about 40 by 40 meters. Within this larger area were more than 100 features, most of them probably natural but several whose origin is not understood.

III. EXCAVATION

TECHNIQUES AND STRATIGRAPHIC ANALYSIS

SLIDE--PIT ½ EXCAVATED

Our procedure in digging these pits was consistent. First, we dug half of the pit by arbitrary 10-centimeter levels. Then we excavated a block of subsoil around the feature to fully expose the profile of the pit.

SLIDE--PIT ½ EXCAVATED WITH WINDOW

This was very useful, because in three cases we had completely misjudged the pit boundaries. In some of the pits there were two different fills, an inner and an outer, and we had mistaken the boundary of the inner fill for the feature boundary.

SLIDE--PIT PROFILE WITH SAMPLE BLOCKS

SLIDE--PIT 3/4 EXCAVATED

We then excavated the second half of the feature by strata, separating deeper strata into 10-centimeter levels.

THE SILO PITS

The ten silo pits were all similar to each other in shape, size, and the character of the fill. All were nearly round, with slightly sloping sides and flat bottoms. The fill was for the most part sandy loam with charcoal flecking.

SLIDE--FEATURE 3

One of the silo pits was significantly larger than the others. This one had a surface diameter of more than 2 meters and it was 1.35 meters deep.

We have three radiocarbon dates from this feature, 1820±80, 1820±80, and 1870±100.

SLIDE--PIT

The other nine pits had an average diameter of 1.6 meters, and they were all quite close to this value. The depths varied more, from 1.2 meters to 55 centimeters; this was measured from the stripped surface, so they were once at least 25 centimeters deeper. The average volume was 1300 liters; the one large pit was twice this value, or 2600 liters, and the smallest was 860 liters.

Three of the pits intersected with each other, so they were probably not in use at the same time. On the other hand, the clustering of the pits was so tight that they probably were used within a few years of each other.

On average, about 20 artifacts were recovered in each pit, so the artifact density was similar to that in the plowzone. Most of these artifacts were flakes or small pieces of fire-cracked rock. About a dozen small potsherds were found, non-diagnostic but apparently some grit- or sand-tempered Early Woodland variety. No obvious stone tools were found. There were 7 battered stones that might have been hammer or anvil stones; none of these was entirely convincing, but they could certainly have been used to break a few nuts, and there were not many natural cobbles in the topsoil in this area.

THE BASINS

SLIDE--FEATURE 50

Within the group of ten silo pits were two smaller, basin-shaped pits. One was about a meter in diameter and 40 centimeters deep, the other was 1.5 meters in diameter and 55 centimeters deep, or nearly as big as the smallest silo pit.

Besides the difference in shape, these features had different fills, containing areas of scorched soil and substantial pockets of charcoal. The bottoms of the pits were not burned, so they were probably not fire pits.

THE RED-RINGED PITS

SLIDE--THE RED-RINGED PITS

SLIDE--THE RED-RINGED PITS

I want to talk mainly today about the features we do understand, but I don't want to mislead you into thinking we understood everything we found.

About 10 meters away from the main pit cluster was a group of puzzling features we call the Red-Ringed pits, because they all had a zone of pronounced reddish oxidation around their boundaries. The sub-plowzone soil in this part of the site was pure sand, and the fill in the pits was sandy loam, which made them much harder than the surrounding soil; after stripping and trowelling they stood up as low mounds.

SLIDE--RED-RINGED PIT

These pits proved to be basin-shaped and not particularly regular, with very few artifacts. We believe they are natural.

ANOMALOUS PITS

SLIDE--FEATURE 69

Two pits were found near the main pit cluster that present major interpretive difficulties. One of these was an oval feature about 3 meters long, 1.5 meter wide and 1 meter deep, so dug through with rodent tunnels that there was as much tunnel as feature. This feature contained about as many artifacts as the ten silo features put together (212), including 105 sherds of ceramic. The sherds were all Selden Island (a steatite-tempered variety dating to roughly 900 to 500 BC), and they may have come from one vessel.

These artifacts were not just part of an overall concentration that washed into the pit, because a plowzone unit dug almost over the feature yielded no artifacts at all.

So there must have been some kind of prehistoric pit in this area before the rodents went to work; but, so far as we could tell, all of the pottery came from the rodent burrow, not the other part of the feature.

Because of the degree of disturbance, we doubt that we will ever get a good radiocarbon date from the feature, but the Selden Island ceramic suggests that this pit was at least 500 years earlier than the main pit cluster.

The second anomalous feature was next to the Red-Ringed Pits. This was a crescent-shaped feature that everyone agreed looked like a tree throw. But, although the nearby pits contained

very few artifacts, and the closest plowzone sample unit none, this apparent tree throw yielded more than 50. Among this total were a pitted anvil or nutting stone, a bifurcate point, a small stemmed point, and a couple of very small potsherds. This is an unusual collection of objects to find in any feature, cultural or natural, and it suggests that there were once a substantial number of artifacts laying around this part of the site. Why, then, were there none in the nearby Red-Ringed pits?

These pits represent one of the conundrums of Delaware archaeology, features that are not obviously cultural in origin but containing cultural materials. They seem to have been formed by a combination of natural and cultural processes. Rather than spend too much time wondering how they were formed, we prefer to concentrate on what can be learned from them about the past. In the case of our second pit, very little, because of the jumbled nature of the artifact collection. In the first, though, perhaps something could be learned, since the artifacts may represent a single episode.

IV. IMPORTANCE OF ETHNOGRAPHIC DATA TO THE INTERPRETATION

Setting aside the red-ringed and anomalous pits, we will concentrate for the rest of the paper on the interpretation of the main pit cluster, the 10 silo pits and 2 basins.

SLIDE--SILO PIT

Ethnographic Accounts of Storage

The ethnographic research done as part of the Puncheon Run project has influenced our understanding of what we found in a couple of important ways.

First, we were interested to find out what was actually known about the use of storage pits in eastern North America.

Samuel Champlain (1929 III:410), writing in 1605 about an area that was probably in Massachusetts, said the Indians

> dig holes some five to six feet deep more or less, and place their corn and other grains in large grass sacks, which they throw into the said holes, and cover them with sand to a depth of three or four feet above the surface of the ground.

Best accounts of pit storage actually come from the Pilgrims, who looted several pits just after arriving in the new world.

The journal known as *Mourt's Relation* tells us,

> There was also an heape of sand, made like the former, but it was newly done, (we might see how they had padled it with their hands,) which we digged up, and in it we found a little old Basket full of faire Indian Corne, and digged further & found a fine great new Basket full of very faire corne of this yeare, with some 36. goodly eares of corne, some yellow, and some red, and others mixt with blew, which was a very goodly sight; the Basket was round, and narrow at the top, it held about three of foure bushels, which was as much as two of us could lift up from the ground, and was very handsomely and cunningly made." They took "as much of the Corne as we could carry away with us."

Later the *Relation* tells of finding baskets of acorns in other pits, and also a container of oil.

These descriptions are actually rather important for considering how pits get filled in, and where the soil in them comes from. When removing a basket full of corn or acorns from the ground, one would be unlikely to dig all of the dirt out of the hole. Just enough would be cleared away to reach the baskets and pull them out. The rest of the dirt would fall into the bottom of the hole. The lower part of the pit would never be exposed to the elements, and would not erode, and this may be why the lower parts of our pits are so well preserved, as shown in this drawing of one of our pits.

SLIDE--PROFILE DRAWING OF FEATURE 3

On the other hand this profile may show re-use of a pit,

SLIDE--PROFILE DRAWING OF FEATURE 4

As subsequent episodes result in partial removal of the soil that has fallen or washed into the pit.

Sedentism--De Boer's Thesis

It is common to associate the digging of large storage pits with increasing sedentism. When people were able to store the surplus from some seasons for use in others, so the argument goes, they did not have to move around so much, and could spend much of the year at sites we call "Base Camps." They could then develop complex societies, hierarchies, and all those other things.

But the ethnographic evidence does not actually support this thesis. As Warren De Boer pointed out in a 1988 article, our accounts associate pit storage not with permanent settlement but with site abandonment. For example, one account from the New York area written in 1622 says,

> The grain being dried, they put it into baskets woven of rushes or wild hemp, and bury it in the earth, where they let it lie, and go with their husbands and children in October to hunt deer, leaving at home with their maize the old people who cannot follow. (Issac de Rasieres, 1622)

A number of accounts mention that burial of goods was a way of hiding them. William Strachey, writing about the Virginia Algonquins in 1612, said:

> Their Corne and (indeed) their Copper, hatchetts, Howes, beads, perle and most things with them of value according to their owne estymation, they hide one from the knowledge of another in the grownd within the woods, and so keepe them all the yeare, or untill they have fitt use for them.

Pit storage does imply that the people who buried the food plan to return to the site, but it does not mean that they lived there for extended periods.

Historic Native Americans knew other ways of storing food as well. Thomas Hariot mentioned above-ground granaries in North Carolina, and the Pilgrims also found food hanging from the roofs of Indian houses.

The storage pits at Puncheon Run support De Boer's hypothesis, because they are clearly not in an area of long-term occupation.

One possible scenario for the storage pits at Puncheon Run is that people came to the spot for a few days, gathered some resource, stored it in the pits, and went away. The stored food may have been nuts, seeds, or roots. If they needed the stored food later, they may simply have come back to get it.

Use of Wooden Tools for Nut Processing

SLIDE--HURON SCENE

Ethnography has also our influenced our understanding of what might have gone on around these pits. One of the puzzles of this pit cluster is the very low number of artifacts found in the immediate area.

But descriptions of Native American technology from our ethnographic accounts do not emphasize stone or pottery. Of course, all archaeologists know that they are recovering only a small part of ancient culture, but it never hurts to remind ourselves of it.

John Smith, perhaps the most careful observer among the seventeenth-century ethnographers, devoted about two pages to the material culture of the Virginia Algonquins and mentioned only two items made of stone (arrowheads and axes). Digging was done with "a crooked piece of wood," bows were shaped by scraping with clamshells, knives were "splinters of reed" sharp and

sturdy enough to joint a deer. Baskets and nets get many more mentions than pottery.

SLIDE--NANTICOKES AND WOODEN MORTARS

Particularly important for us is the rarity of grinding stones in the ethnographic evidence. Generally, corn was pounded in a wooden mortar. According to Peter Lindstrom,

> They use no querns, but the meal for baking they pound asunder with a pestle and mortar, which they make in this manner, that for the purpose they cut a thick and large tree, 1 ½ ells from the root, in the stump of which they dig out a round hole and thus make a mortar which is suited for the purpose and in which they pound all their grain into meal.

SLIDE--WOODEN MORTAR

Acorns could also be pounded in wooden mortars. Smith's account of the making of walnut milk, a local delicacy, says that the walnuts were first broken with stones and then pounded in wooden mortars; perhaps in rock-poor coastal Delaware the whole operation could have been done with wooden tools.

There seems to be a sort of tacit assumption among archaeologists that on any important site something will have been done with stone tools, leaving something for us to find. But consider a site where some root such as tuckahoe was gathered (in baskets), sliced (with a reed knife), laid out to dry (on mats or wooden racks), and stored in pits (dug with a stick). There might not be anything at all for us to find except the pits themselves.

Our pit cluster at the Puncheon Run Site is not the only place where large, cylindrical pits were found in an area with few artifacts; a very similar pit was found during Phase II testing at the Dragon Run North Site in New Castle County, but because there were so few artifacts, no further work was done.

For all we know, these sites may, in fact, be very common.

V. CONCLUSION

SLIDE--EXCAVATING PIT

The results of the excavation of the pit cluster at Puncheon Run undermine any notion that the digging of storage pits was a sign of increasingly increasingly sedentary behavior in the Late Archaic and Early Woodland Periods.

Storage pits do not necessarily indicate long-term occupation. "Base camp" sites may just be various sorts of procurement sites superimposed on each other.

Site Catchment, Prehistoric Subsistence, and the Reliability of Protein Residue Analysis

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Introduction

The detection and identification of ancient protein residues on lithic tools has been a holy grail of archaeology since its first announcement by Thomas Loy in the early 1980s. The ability to classify relict proteins in the laboratory presented archaeologists with a potentially robust method to study prehistoric subsistence strategies, biotic community patterns, and lithic tool use. From the onset, however, serious doubts about the underlying assumptions and methodologies of this analytical approach have been raised. Some critics have questioned whether organic proteins can survive for more than even a few years let alone the thousands claimed by proponents (Eisele et al. 1995, Leach and Mauldin 1995, Smith and Wilson 1992), while others have rejected the accuracy and validity of the laboratory procedures (Downs and Lowenstein 1995, Fiedel 1996, Leach 1998, Petraglia et al 1998). Questionable or unlikely interpretations of results have also been noted as a problem, particularly in terms of the contextual relationships of archaeological artifacts with putative prey species (Fiedel 1996). These three concerns are dealt with in relation to the protein residue testing program of the Puncheon Run Site.

Hypothesis

The tidal lowlands of the Mid-Atlantic coastal plain contain biotic communities characterized by wide specie breadth and high productivity. Locally abundant animals include numerous types of fish, shellfish, and water-fowl, rodents, turtles, and deer. The expansion of human populations in the coastal region has been credited in part to the diversity and richness of available prey species. It is likely that increased population densities fostered the exploitation of greater numbers of species in an increasing variety of habitats. Changing patterns of faunal diversity and richness within human diet should therefore be apparent in the archaeological record (Byrd 1997, Reitz 1982). Unfortunately, much of the Mid-Atlantic region, and Delaware in particular, labors under a burden of poor faunal preservation due to a combination of weak soil development and strongly acidic soils. The record of prehistoric subsistence in the region thus can be read, in general, only indirectly, through functional analyses of artifacts and features, and by inferences gained from soil chemistry, pollen cores, or phytolith samples.

The protein residue data lifted off stone tools is, in contrast, a more direct approach to the identification of prehistoric faunal exploitation and explains its eager use by many researchers. The possibility of long-term survivability of organic proteins in archaeological contexts and the ability to index these proteins by taxa seemed to provide an avenue toward understanding ancient subsistence exploitation where skeletal elements are absent. Beyond the mere identification of prey species however is the opportunity to map out the behavioral landscape of these resources and in turn, to clarify the scheduling and logistical planning used in the organization of subsistence strategies.

Given the diversity of native fauna in the Delaware coastal plain, a contextual approach was used to refine the selection process of possible food sources for protein residue testing. Extensive wetlands intermixed with riverine and estuarine environments suggest that site occupants had

access to the abundant aquatic resources surrounding them. Site catchment analysis based on distance, abundance, ease of capture, nutritional value, and the processing time of resources, clearly orders fish and shellfish as high ranking food sources. Given their high rank in any likely human diet within this ecozone, it seemed appropriate to search for fish residues on stone implements. This would accomplish two main goals. First, targeting locally available animals would satisfy Feidel's requirement that residue analysis be undertaken within a context of possible prey species rather than from the commercial availability of antiserum, and would have the effect of eliminating interpretations that were "...without obvious and demonstrable faunal associations" (1996:145). Secondly, by selecting fish with known behaviors and ranges, it is hoped to be able to gain insights into issues relating to settlement seasonality, technology, and subsistence organization. A similar research strategy based on the ethology of deer was undertaken by Cavallo (1991, 1993) and has proven useful in delineating patterns of prehistoric sites by moving beyond a simplistic view of cultural geography.

Little is known of the exact nature of fish populations in the Delaware Bay and its drainages during prehistory. Population dynamics and the diversity of species have been greatly influenced by the high level of industrial fishing during the last century, by the extent of industrial and residential pollutants, and by the intentional and unintentional introduction of non-indigenous species to the region. Although modern trawl data are not viewed as a particularly good fit to the characteristics of the early bay, the identities of native versus introduced fish species are fairly well established in the literature (Cooper 1982, Lee et al. 1976, Raasch and Altemus 1990, USGS 1999).

Specific fish species were selected for capture and antisera development based on several criteria. Abundance was viewed as an essential property of any sampled fauna because of the increased likelihood that a clustered and abundant food source would have been included in prehistoric diets. Fish that school or spawn in great number are more efficiently exploited than non-aggregated species (Butzer 1984:226, Reitz and Quitmyer 1988:105). Bay anchovy (*Anchoa mitchilli*), Atlantic croaker (*Micropogonias undulatus*), weakfish (*Cynoscion regalis*), and striped bass (*Morone saxatilus*) are among the most abundant aquatic resources in Delaware Bay, a factor used in the selection of these species.

Fish exhibiting diverse behaviors and habitats were chosen to gauge the variability of hunter/gatherer adaptations to spatial and seasonal factors. For example, American eel (*Anguilla rostrata*) leave the tidal creeks in large number during the fall to spawn seaward, a behavior known as catadromy. In contrast are anadromous, or upstream spawners, which move into the Delaware River and tidal streams during the spring and early summer. Sturgeon, alewife, and striped bass are anadromous species included in this study.

Technological considerations play a role in human adaptational responses to animal behaviors, particularly as they relate to the size of potential prey species. The susceptibility to fishing gear is in large measure a factor of the size of the fish. Gill nets, for instance, are highly selective for size as a function of the width of the mesh. Fish smaller than the mesh-size escape through the

net untouched while species sufficiently larger than the mesh are not ensnared. The abundant but small Bay anchovy, if selected for collection, would have necessitated the manufacture of fine-mesh netting, or baskets. Thus the choice of gear will be determined by the kind of fish being targeted (Greenspan 1998:973). With this in mind, test specimens of variable sizes were selected to assess the range of possible fishing technologies practiced by the inhabitants of the Puncheon Run Site. Habitat also plays a role in selection of technology. Species that make their way up tidal creeks may have been most efficiently exploited by constructing weirs or tidal traps. Some large, open-water species such as sturgeon and mature striped bass are strong and capable of damaging nets. Gaffing, or spearing is the most efficient means of catching large fish.

In all, 11 fish species were represented in the study. In addition to searching for aquatic resources, 5 terrestrial species were tested. These included deer, bear, rabbit, guinea pig, and turkey.

Protein Detection and Identification

At a basic level the science involved in the immunological identification of relict proteins relates to the ability of organisms to resist infectious disease by the production of antibodies to neutralize invading pathogens, such as bacteria or viruses. Antibody molecules are proteins able to chemically recognize the surface structures of specific foreign proteins, or antigens, and bind with them creating an immunity to the disease causing agents (Loy and Dixon 1998, Malar et al. 1995). It is this binding of antibody to antigen and the specificity of the reaction that is taken advantage of by an immunological approach to identifying protein residues.

Antisera production proceeds from the capture of the faunal samples to the introduction of homogenized blood and tissue from each study specie into laboratory rabbits. Antibodies specific to the introduced samples are produced by the rabbits' immune system and are collected by bleeding the animal after a 3-4 month incubation period. The resulting antisera are tested for appropriate strength and specificity of reaction before use against the lithic specimens. Each stone artifact is washed in a mild detergent and ultrasonically bathed to extract suspected residual proteins in solution.

In the technique called cross-over immuno-electrophoresis, or CIEP, samples of suspect proteins are individually tested with each of the prepared antisera in closely paired holes or wells within a gel medium through which an electric current (130 volts) is applied. The two wells act as anode and cathode as the antigen and antibodies are driven toward one another by the charge of the current. If binding occurs, indicating the presence of an antigen, a visible precipitate will link the two wells. Each sample resulting in a positive reaction is then diluted to 1:10 or 1:20 strength to increase the specificity of the reaction and confirm the relationship between antigen and antiserum. Only positive results from this final test are reported.

Forty one stone tools were selected for protein residue analysis from an area of the site called Locus 3. Situated near the confluence of the St. Jones River and the Puncheon Run, Locus 3

contains two large activity zones . One zone was centered around a very large grinding slab, or metate, in close association with three FCR clusters and a lithic assemblage of some 8000 artifacts. Thirty bifaces, a scraper, and a mano, were submitted for analysis from this zone. The second activity zone comprises a cluster of three very large pit features. Seven bifaces and two scrapers were submitted for analysis from this zone.

All submitted artifacts were recovered from subsoil or feature contexts. Artifacts from plowzone contexts were rejected for analysis due to possible contaminants from agricultural fertilizers. Contaminants introduced into the soil matrix surrounding artifacts have been noted as a likely source of false positive results presented in previous studies (Custer et al 1988, Hyland et al 1990, Marlar et al 1995). With regard to this concern, soil samples from several locations within each activity zone were collected and forwarded along with the artifacts for testing of possible contamination.

Criticism of CIEP

The focus of criticism toward protein residue testing turns on one theoretical and one methodological issue. It is known that proteins degrade with time and exposure, but it remains unclear how far proteins can degrade and still be detected and identified by taxa (Cattaneo et al. 1993, Eisele et al. 1995, Fullagar et al. 1996, Loy 1994, Loy and Dixon 1998, Newman et al. 1996). Loy and Hardy (1992), at one end of the spectrum, claimed to be able to detect biologically viable immunoglobulin proteins on tools from a 90,000 year old Neanderthal cave site in Israel. It is conceivable that the protection offered by the rock overhang of the cave slowed the normal progression of microbial decay of the proteins. The semi-arid conditions of the eastern Mediterranean may also be a contributing factor to the continued biological activity of some proteins. Other researchers, however, reject this time span as impossibly long. In separate experimental studies, Cattaneo et al (1993) and Eisele et al (1995) both noted the near total degradation of immunoglobulin proteins within months after burial of test bifaces in outdoor soils. It appears unlikely given these results that immunoglobulin proteins could survive for the lengths of time claimed by Loy and Hardy. The Cattaneo and Eisele experiments do indicate however that different proteins exhibit differential survivability. Albumin appears to have greater resistance to microbial decay than the immunoglobulins (α, β, γ). This is significant for the current study because albumin is the target protein for this immunological testing program.

Of methodological concern is the relative cross-reactivity of the different immunological testing procedures. This relates directly to the specificity of the supposed taxonomic identifications, and can vary from species level to family or even order. Obviously, as the identifiable taxonomic units become more inclusive, or phylogenically broad, the data lose value as specific behaviors and habitats of individual species get lumped with increasingly divergent groups of animals. For example, a positive reaction to protein residue identifiable only to the mammalian order Carnivora, could include such disparate animals as the red fox, striped hyaena, harbor seal, and giant panda, among many others. Striking off non-indigenous species from the list of possible prey would eliminate having to explain how striped hyaena, harbor seal, or giant panda residues had made

their way onto Eastern woodland bifaces, but we are still left with a dizzying variety of native species with vastly different habitats and behaviors that could be eligible suspects for the detected proteins. This problem of cross-reactivity has been linked with the performance of immunological testing techniques, in particular CIEP (Cattaneo et al 1993, Eisele et al. 1995, Fullagar et al. 1996).

Results

The results of the study can be separated into two categories. First, the status of antisera development, and second, the tally of results for artifacts tested against the antisera.

Atlantic sturgeon and alewife antisera exhibited non-specific reactions, in other words, they cross-reacted with all other blood samples, and were thus eliminated from artifact testing. The antisera of white perch, striped bass, and Atlantic croaker were able to discriminate reactions only to the level of their common order, the Perciformes. The Perciformes comprise several major families of fish native to Delaware waters, including the perch, bass, darter, drum, and sunfish (Jackson 1998, Raasch and Altemus 1991). A fourth subject specimen, American eel, likewise was cross-reactive to its order, the Anguilliformes, but this order is phylogenically very narrow. The only consequential member of the order native to the Delaware Bay is the American eel, so we can regard this antiserum with high confidence as specie-specific within the geographic parameters of this study. The antisera of bay anchovy, gizzard shad, and weakfish (sea trout) are specie-specific, reflecting no cross-reactivity to other species.

Of 41 artifacts submitted for testing, 7 produced positive reactions to subject antisera. Four bifaces from the metate block were positive to striped bass, Atlantic croaker, American eel, and deer or elk, respectively. Seven soil controls were submitted to test for contamination. One reacted positively to guinea pig, possibly reflecting rodent activity, and a second reacted to gizzard shad. At the second activity zone approximately 60 meters to the southeast, 3 tools recovered from the periphery of Feature 37 were positive; 2 bifaces reacted to gizzard shad, and a scraper to American eel. Soil controls from Feature 37 fill were negative.

In addition to the archaeological assemblage, 2 replicative projectile points fashioned from local cobbles were submitted for residue testing. The cobbles were obtained on-site from a point-bar in the lower reach of the Puncheon Run. These unutilized specimens were included to test the claim that the CIEP technique often returned false positive results. To our initial surprise, both replicated bifaces reacted positively to deer/elk antiserum, which seemed to confirm the criticisms leveled at the procedure. On second thought, however, there may be a simpler, more elegant explanation. Each cobble was split freehand by hammerstone, followed by bifacial reduction and thinning by elk billet, and pressure flaked with deer antler. Antler contains an abundance of proteinaceous material, which could easily have been transferred to crevices and joints in the bifaces in the form of fragments or dust during percussion and pressure flaking. By attempting to accurately replicate the process of prehistoric flintknapping we may have outsmarted ourselves into

believing that these bifaces were "pristine" because they were not used in subsistence activities. Through an unanticipated means, CIEP may actually have confirmed its ability to correctly detect and identify some protein residues.

Conclusions

Analysis of protein residue data from the Puncheon Run Site revealed evidence of positive reactions to 4 faunal antisera. Detected proteins were identified as American eel (*Anguilla rostrata*), gizzard shad (*Dorosoma cepedianum*), unspecified members of the fish order Perciformes, and deer or elk. Of seven tools testing positive, six reacted to fish antisera. If this is an accurate reflection of aboriginal subsistence patterns it would tend to support the hypothesis that resident hunter-gatherers were more reliant on aquatic prey species than on terrestrial species. An emphasis on subsistence fishing, with its relatively high manufacturing and maintenance costs carries with it implications regarding complex social organization and sedentism. A multi-seasonal, or semi-sedentary occupation of the site may be inferred by the bi-modal scheduling of eel spawns in fall and shad in spring, which represent the optimal times for the procurement of these species.

The fish antisera developed for this project exhibited variable degrees of cross-reactivity, which may reflect unanticipated problems with laboratory procedures, phylogeny, or the post-capture degradation of specimens. Investigations that are predicated on the ability to identify specie-specific indicators of subsistence activities may suffer from overly-broad cross-reactivity. On the other hand, there is room for research that utilizes immunological reactions with a limited range of taxonomic specificity. For instance, it may be sufficient to demonstrate that particular use-wear patterns on tools are associated with butchering activities, without necessarily identifying the specie being butchered.

The reliability of these results ultimately rests on their reproducibility. In a second stage of this program, test bifaces will be submitted for analysis after butchering selected target fish. If results between the two stages are comparable, it may afford greater confidence in the overall analytical procedure.

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