MNI, MAU, ABC: Examining Methodological Bias in Faunal Analysis

Anna Watson

Indiana University of Pennsylvania

Follow this and additional works at: https://knowledge.library.iup.edu/honors_theses

Recommended Citation
https://knowledge.library.iup.edu/honors_theses/69

This Thesis is brought to you for free and open access by Knowledge Repository @ IUP. It has been accepted for inclusion in Cook Honors College Theses by an authorized administrator of Knowledge Repository @ IUP. For more information, please contact sara.parme@iup.edu.
MNi MAU: ABC:
EXAMINING METHODOLOGICAL BIAS IN FAUNAL ANALYSIS

2007

ANNA WATSON
MNI, MAU, ABC:
Examining Methodological Bias in Faunal Analysis

A Thesis
Submitted to the Department of Anthropology
In Partial Fulfillment of the
Requirements for the Honors Degree
Bachelor of Arts

Anna Watson
Indiana University of Pennsylvania
May 2007
Indiana University of Pennsylvania
The School of Graduate Studies and Research
Department of Anthropology

We hereby approve the thesis of

Anna Watson

Candidate for the degree of Bachelor of Arts

Dr. Sarah Neusius
Thesis advisor

Dr. Philip Neusius
Reader

Dr. Beverly Chiarulli
Reader
Introduction

A major concern of the faunal analyst is the degree to which bias affects the conclusions drawn from a particular sample. Bias can enter the archaeological record in many ways, ensuring that the assemblage with which the analyst works is not the same as the living population or even the assemblage at the time of deposition. Taphonomic factors transport bones from their deposition site, or render them unable to be identified. Additionally, despite the fact that “the only real direct control the analyst has over the nature of [faunal] samples lies in the means used to retrieve them from the ground” (Grayson 1984: 114), choices made during the excavation, transport, processing and analysis of remains may compound bias. Any errors made during this process (by an excavator or by the analyst) will further change the nature of the sample.

This project uses the faunal assemblages of two separate sites in order to examine the intersection of bias and archaeological reality. Despite the extremely biased nature of both sites, conclusions may be drawn that illuminate our understanding of each site and of the cultural group to which both belong. Bias is a serious problem in faunal analysis, but it is not insurmountable.

The Sites

The Brant I site (26In326) and Johnston site (26In2) are similar in many ways. Both sites are within the Conemaugh-Blacklick watershed in the unglaciated Allegheny Plateau (Figure 1). The sites are on the first terrace above a waterway within the floodplain. They are both village sites associated with the Monongahela culture complex and both have been deemed eligible
Watson 2

for inclusion in the National Register of Historic Places. The excavation and analysis of these sites is part of a larger investigation of the Late Prehistoric in west central Pennsylvania being undertaken at IUP by Drs. Sarah Neusius and Beverly Chiarulli.

Another important similarity between these sites is their place in a vast trading network. Brant I is adjacent to the historically known Catawba Indian Trail and lies on the northern borders of the traditionally defined Monongahela cultural area. Both of these factors indicate the possible presence of cultural assemblages that differ from the expected Monongahela pattern (Neusius 2005). The Catawba Path was a major pathway with extensions running from Canada in the north, to Florida in the south, and westward into the Mississippi Valley. The Catawba itself ran from Ichsua New York, through Indiana and Uniontown, Pennsylvania, to West Virginia and the Carolinas (Chiarulli et al. 2001). It is not known how far into the past this trail was active, but a proximity to this or a similar trail would have exposed Brant I to trade goods and cultural influence from outside the region. Johnston’s participation in this trade network is represented by the presence of shell beads made from the small Marginella apicina gastropod native to the Gulf of Mexico.

Brant I sits on a small rise or terrace near the confluence of Blacklick and Two Lick Creeks, major tributaries of the Conemaugh River. It has been identified as a Late Prehistoric village from the Middle Monongahela. Brant I is located in Burrell
Township, Indiana County, near the town of Black Lick, Pennsylvania. The land on which the site lies is owned by the Army Corps of Engineers and administered as part of Conemaugh River Lake. The site was first identified by GAI consultants during an archaeological survey in preparation for a gas well and pipeline running through the area. It was excavated by the IUP Archeological Field School between May 28 and July 3, 2002. Due to the excellent preservation of the artifacts and the presence of undisturbed features including a burial pit, the site was deemed eligible for inclusion on the National Register.

During excavations, two oval storage basins bordered by posts were discovered. Although further excavation is needed to confirm this, the basins may be similar to storage structures found on other Monongahela sites. A great deal of faunal material was recovered from these basins, but none from the postmolds, indicating that the basins may have been used for refuse. The faunal material from the basins is further discussed below.

Four radiocarbon dates have been obtained from Brant I, two standard and two AMS. The standard dates are based on charcoal recovered from one of the storage basins, and are 710+/-60 BP and 560+/-60 BP (Neusius 2005). The first AMS date was taken from residue found inside a pipe fragment recovered in the upper plowzone (the stratigraphic layer that contained most of the Brant I cultural material). The date is 880+/-40 BP, with a calibrated date range of AD 1030-1250 and an intercept of AD 1180 (Neusius 2005).

The second AMS date was taken from a Phaseolus vulgaris (common bean) cotyledon found in a flotation sample from the second storage basin. The final date is
610+/-40 BP with a calibrated date range between AD 1290-1420. This date also establishes the contemporaneity of the two storage basins to the late 13th or early 14th century, while the first AMS date is somewhat earlier, from the end of the 12th century (Neusius 2005). The pooled calibrated date range is 1260-1300.

Over 5000 ceramics, 1400 pieces of chipped stone, and 40 groundstone artifacts were recovered from Brant I. Ms. Amanda Shafer, then an Anthropology undergraduate at IUP, examined the ceramics from one of the storage basins. Shell tempering is the most common at 58.5%, with limestone and grit tempers also present. Half of the ceramics were cordmarked. Cordage twist assessment was possible on only 34 sherds, and this analysis yielded 38.2% Z twist and 47% S twist (Neusius 2005).

Ms. Jessica Ashbrook, also an IUP Anthropology undergraduate at the time, undertook a preliminary study of the lithics. Fifteen of the chipped stone class artifacts are complete or partial stone tools, including triangular projectile points, drills, and bifaces. The majority of the chipped stone is small debitage lacking cortex, and the material is most often local chert although non-local types are also represented. A higher percentage of stone tools are of non-local material than the debitage. A small piece of shaped cannel coal was also recovered from the site (Neusius 2005).

Ethnobotanical analysis of flotation samples from Brant I was undertaken by Dr. DeeAnne Wymer of Bloomsburg University. As expected, Brant I contains evidence of agriculture with particularly large quantities of Phaseolus vulgaris. Tobacco remains were also identified, a far rarer find (Neusius 2005, Ramsey and Wymer 2005). Both wild and cultivated seeds were discovered at the site. The region surrounding the Brant I
site is moist, with an average precipitation of 140-152 cm per year and a mean annual
temperature of 4-12°C. The growing season lasts for roughly 150 days (McNab 1994).

Primary cultigens included *Phaseolus vulgaris* and maize, while wild seeds from
food resources were recovered from *Sambucus* sp. (elderberry), *Rhus* (sumac) and *Rubus*
(raspberry). *Phaseolus vulgaris* is rare for a Monongahela site, particularly in the
quantities recovered. Overall, the inhabitants of Brant I seem to have followed a focal-
diffuse plant strategy, focusing on a few cultigens such as beans and maize while
supplementing their diets with nuts and wild fruits, a conclusion which is consistent with
the findings of other sites in the area (Neusius and Gross 2007; Ramsey and Wymer
2005).

Wood charcoal and other plant remains indicate that the Brant I environment was
an oak-hickory temperate deciduous forest, still the most common in Pennsylvania
(Alerich 1993, New York National Heritage Program 2006). This forest type is
extremely rich in biodiversity with a wide range of microhabitats, and is home to more
than 225 species of terrestrial vertebrate (Ricketts et al. 1999). Prior to European contact,
large carnivores in the region of the Brant I site included the black bear, wolf, mountain
lion, and fisher. Large prey species were the whitetail deer and elk (woodland bison may
also have been present). Other prey species included rabbit, squirrel, ruffed grouse,
turkey, and Canadian goose. Aquatic species such as trout, bass, mussel shells, and
turtles were prevalent. Also present in the region were the fox, raccoon, and numerous
species of amphibians, reptiles, and small rodents (McNabb 1994).

Prior to this analysis, the Brant I faunal assemblage was sorted and described by
Mr. Isaac McKeever, then an IUP Anthropology undergraduate. He found a primarily
mammalian assemblage dominated by white-tailed deer. Avian, turtle bone, and freshwater shell were also present. Some fragments of turtle shell have been drilled (Neusius 2005). The results of the analysis completed for this study expanded on Mr. McKeever’s identification.

The Johnston Site (36In2) was first identified in the 1950s by Ralph Solecki who surveyed the Conemaugh drainage in anticipation of the destruction caused by the Conemaugh Lake Dam (Chiarulli and Neusius 2004a, 2004b, Dragoo 1955). Like Brant I, it is also on a terrace within the flood plain of the Conemaugh River Reservoir (Chiarulli et al 2001, Dragoo 1955). Don Dragoo of the Carnegie Museum of Natural History supervised the first excavations at the site which discovered a Late Prehistoric Monongahela village (Chiarulli and Neusius 2004a, 2004b, Dragoo 1955). Johnston is located in Burrell Township, Indiana County, Pennsylvania, within the Conemaugh river reservoir opposite the juncture of the Conemaugh River and McGee Run. It is listed on the National Register.

Dragoo’s report was the first to identify the inhabitants of Johnston as Monongahela. His 1952 excavation revealed two parallel circular stockades surrounding the village area with connected structures that Dragoo referred to as “bastions”. Ditches on the interior side of the stockades seemed to have been used as refuse dumps. Inside the village, a central plaza area was surrounded by post enclosed structures that Dragoo interpreted as houses. The structures were about 20-22 feet (6-7m) in diameter with a small doorway less than 2 feet (.6m) wide (Dragoo 1955).

Smaller post-enclosed structures have been interpreted by Dragoo as storage structures. Some of these were free standing and others attached to the sides of the house.
structures. Within each storage structure were pits measuring roughly 10 feet long by 4 feet wide (3m by 1m) and 8 to 18 inches (20-45cm) below the 1952 ground surface. Unlike the ditches associated with the stockades, little cultural material and no faunal remains were found within these storage structures. Other small non-standardized refuse pits were found in the village area and these did contain broken animal bones, shells, and ceramics (Dragoo 1955). This differs significantly from the findings at the Brant I site.

Seventeen burials were found during Dragoo’s excavation, four adult males, two adult females, and eleven subadults. Similarities in bone morphology in addition to the presence of some intentional skull deformation of the Johnston individuals showed similarities to remains from other Monongahela sites, particularly to the south and west (Dragoo 1955). No burials were discovered during the 2006 excavation.

Ceramics recovered from the 1952 excavation were overwhelmingly (96.5%) shell tempered, with small amounts of limestone, grit, and untempered ceramics. 99% of the shell tempered ceramics were cordmarked, with the majority of decoration variability occurring in the vessel rims. One unique vessel found inside a burial may indicate trade or migration from outside of the Johnston area. Dragoo determined that the majority of the ceramics belonged to the pre-existing Monongahela Cordmarked type designation, although other types were also present. In addition to ceramic vessels, clay pipes and small clay balls were recovered, the latter possibly some type of game piece (Dragoo 1955). Preliminary analysis for the 2006 excavation show 80% shell tempered ceramics, 19% grit tempered, and small amounts of limestone.

Stone tools from the Johnston site were described by Dragoo as mainly utilitarian items. Hammer stones, pitted stones, celts, adzes, and grinding implements were
recovered. Polished stone balls were common and made of a variety of materials including quartzite, hematite, and sandstone. Discoidals have been found at the site but none were found during the 1952 excavation. The bowls of two stone pipes were recovered during excavation, the stems presumably made of bone or wood. Three worked pieces of cannel coal were also found. The major type of projectile point was triangular and about .5-1 inch in length (1.25-2.5cm). Other points were found, including some crude specimens that along with a few pieces of thick pottery may represent an earlier occupation. Larger blades and drills were also recovered (Dragoo 1955).

The faunal analysis from the 1952 excavation focused on the standard "laundry list" of species recovered. Approximately 2000 fragments were found and of these about half were identifiable, with deer predominating. (Table 1). The bones were characterized as well preserved, but fragmented.
Guilday, who analyzed the remains, noted that it was unlikely that the refuse yielded a complete picture of all animals in the region, rendering the sample biased. Notably absent from the assemblage were the red fox, porcupine, and opossum, which may not have inhabited the area in prehistoric times. With this exception, Guilday uses the assemblage to support the claim that the prehistoric environment was very similar to the current one (Guilday 1955), which is the same type of forest environment described above for the Brant I site.

Dragoo notes the presence of several bone artifacts at the Johnston site. Bone beads made from bird and mammal bones were very common, with fourteen hundred found in a single burial and many others throughout the village. The beads found were between .25-1 inch long (.5-2.5cm) and .25-.74 inches (.5-2cm) in diameter. Note that Dragoo did not screen all of the soil, nor did he take flotation samples. Worked bone in the process of becoming beads was also recovered. Other decorative bone artifacts were pendants fashioned from teeth and digit bones and mussel shell beads and pendants (Dragoo 1955). Utilitarian bone artifacts were represented by awls, arrow points, fishhooks, and worked turtle shell that may have been a small vessel (Dragoo 1955). Beads in particular are a common trait of the Monongahela cultural group.

**The Monongahela**

The Monongahela lived throughout the lower portion of the upper Ohio River Valley, a region which includes southwestern Pennsylvania and sections of Ohio, Maryland, and West Virginia. The span of the culture is divided into three subphases: Early (AD 1050/1100-1250), Middle (AD 1250-1580), and Late (1580-1635). These divisions are largely based on differences in ceramic decoration and technology (Johnson
2001). Johnston and Brant I, the sites under consideration here, fall into the Middle subphase and it is on that subphase that this summary will focus.

The first archaeologist to describe the Monongahela was Mary Butler in her 1959 work "Three Archaeological Sites in Somerset County, Pennsylvania", based on a series of WPA work relief excavations. Due to the cultural consistency of the three sites, Montague, Hanna, and Clouse, and their similarity to other sites in the region, Butler named the culture after their location in the drainage of the Monongahela River (Butler 1959). Since that time the criteria for a site's inclusion in the Monongahela culture has grown, spawning concerns that the definition of what constitutes a Monongahela site is somewhat vague (McHugh 1984).

Butler's original suite of related traits included vase and claw shaped pipes, cannell coal pendants, beads (both bone and shell), stockades surrounding villages, and circular houses indicated by the presence of postmolds (Butler 1959). Since then, the list has grown. Triangular projectile points (Johnson 2001), limestone and shell tempered ceramics, often cordmarked, a subsistence strategy with heavy reliance on maize horticulture, semi-subterranean enclosed storage structures, and the placement of villages in the uplands are also now considered Monongahela attributes (Nass and Hart 2000).

Means (2002) and McDermott (2007) in particular have urged caution in the assumption that these traits define a historically meaningful cultural complex. The definition of the Monongahela culture relies heavily on the grouping of similar agricultural and residential patterns. There is no evidence to suggest that the Monongahela people would have considered themselves to be one coherent group. The
amount of regional and temporal variation built into the definition allows for the over-emphasis of similarities and suppression of differences (Means 2002).

Monongahela sites are distributed in an east to west band across the unglaciated Allegheny Plateau and the adjacent Allegheny Mountain section of the Appalachian Plateau. The area which stretches from modern Morgantown, West Virginia to Pittsburgh, Pennsylvania has been referred to as the “core” of this culture (Johnson 2001). The Johnston and Brant I sites are to the north of this area, in the Kiskiminetas Basin. The region in which the Monongahela lived contains a wide variety of environmental zones each of which would provide different resources. Overall, the area is characterized by deep, narrow river valleys and narrow floodplains with some ridge development (Nass and Hart 2000).

By the Middle phase the Monongahela people relied heavily on horticulture, particularly maize and beans. Caries are more frequent in human remains from this phase than from the Early Monongahela, and are different from other groups in the area who were less dependant on horticulture. The rate of caries among the Middle Monongahela is similar to other focal horticulturalists (Sciulli 1995). Hunting and gathering supplemented these crops, with a particular reliance on white-tailed deer. Marine resources such as turtles, fish, and freshwater shell were also exploited (cf Church 1994).

Monongahela mortuary practices suggest a degree of ranking within the society, with some burials containing more grave goods and evidence of burial ceremonialism than others (Davis 1984). The Monongahela had access to a trading network that extended from the Gulf of Mexico and out into the Midwest. A common find at many sites are beads made from Marginella apicina, a small gastropod native to the Gulf of
Mexico. *Marginella* beads are another indication of a rich burial, with some individuals possessing strands with thousands of shell beads (Dragoo 1955). Related cultural complexes such as Fort Ancient have similar types of burials (Davis 1984).

Most Middle phase burials followed the pattern set by the Early subphase. Infants and juveniles are often interred in shallow pits within the house, under the central hearth or just inside the interior wall. Adult and adolescent burials are more typically found in the space between the house ring and the palisade. With the exception of infants, all burials are flexed, and except for personal jewelry, grave goods are generally rare. Some sites also show evidence of charnel houses (Johnson 2001). Means (1999) suggests that burial practices were individual to each village or region, with group cemeteries performing the dual purposes of reinforcing the territoriality and cementing the cohesion of each community.

A major attribute of the Monongahela culture is the form and placement of its villages. 74% of Monongahela components are villages, and of these 57% are in the uplands (Johnson 2001). This large percentage of upland villages is particularly unique (Nass and Hart 2000). It has been theorized that as the exploitation of maize increased in importance, the smaller sites characteristic of the Late Woodland (AD 500-900) were abandoned in favor of larger village sites. The earliest confirmed date for maize (excluding the controversial Meadowcroft date) in this area is 1080 +/- 70BP (Neusius and Gross 2007). This coincides with the earliest village site (Means 2002).

Ethnographic cases suggest that to a community of people like those who inhabited the Monongahela sites, a village would represent the largest ideal congregation of the community’s members, although the entire number might not all reside in the
village concurrently. The layout of a village is intricately connected to the layout of the society. Members of the community take an active interest in the form and structure of the village, and in turn the village plays an active role in reinforcing cultural norms and values, often including in its form a representation of the structure of the cosmos (Means 2002).

The basic structure of a Monongahela village is similar to many other villages around the world (Means 2002). A ring of round houses encircled an open plaza area. In larger villages, a second ring of houses may lie behind the first (Johnson 2001). The exact structure of the houses has been debated (cf George 2002), but it seems that they were similar in structure to other houses in the region. In many villages a series of ditches and palisade wall protected the houses and plaza. Herbstritt (2003) divides the Monongahela village into three parts: a community zone (the plaza), a domestic zone (the houses), and a fortification zone (the palisade). There is clear evidence of the involvement of the villagers as Means (2002) suggests, with changes in village structure which reflect site planning such as the clearing of structures by burning (Herbstritt 2003).

Post-enclosed semi-subterranean storage facilities are represented at all Middle Monongahela subphase village sites. Often these were attached to the houses, creating a sort of flower shape, with the round living structure in the center surrounded by the elongated, petal shaped storage structures (Johnson 2001, Nass and Hart 2000). These storage structures indicate a control over surplus resources and perhaps even a decrease in seasonal mobility from earlier times. In some sites a large central structure has several petal appendages, which may indicate the presence of an individual or group who would gather surplus and distribute it to the community in times of need (Nass and Hart 2000).
The unusual placement of upland village sites has caused a great deal of discussion and debate, with two theories predominating: warfare and climatic. While both models have weaknesses, a warfare scenario pits the upland dwellers against the lowlanders, or suggests that the Monongahela moved to the upland villages because they were more easily defended. George (1983) has also theorized that the Monongahela might have at some time been subjugated by members of the nearby Fort Ancient culture. McDermott (2007) warns that the Monongahela and Fort Ancient cultural groupings have been outlined by archaeologists and most likely do not represent coherent, nationalistic entities. Evidence for a seasonal round indicates that the same groups used many sites, which contradicts the upland vs. lowland scenario. Additionally, carbon isotope analysis from human remains reveals no difference in diet between the two areas (Sciulli 1995).

However, McDermott (2007) claims that there is evidence of violence at several Monongahela sites, although evidence for this is scanty. Monongahela warfare must be considered in the same light as other tribal groups. A series of exchanges (including marriage partners and other gifts) built affinity between individuals or groups. Shifting alliances and feuds naturally developed, creating both intra- and inter-tribal conflict. Just as in modern societies the root causes of such conflicts were complex and not always reducible to a simplistic explanation such as material or environmental factors. McDermott (2007) suggests a sort of feuding complex for this region which may have included ritual torture of captives and a related increase in burial ceremonialism. He states that “there was a fundamental crisis in how social relations were organized in the practices of people living around the Monongahela and Youghiogheny River valleys
between ca. A.D. 1400-1580" (McDermott 2007: 13). This slightly post-dates Brant I and Johnston.

The evidence more readily supports a climatic explanation for the upland and lowland village sites. The beginning of the Middle Monongahela phase coincides with a climatic decline AD 1200-1250, and a corresponding abandonment of Monongahela sites on the outlying northern and eastern margins of the territory. This retreat to the core area is particularly interesting because the core represents a microniche with a significantly longer frost-free growing period than the outlying areas - 170 days compared to 140 (Johnson 2001, Nass and Hart 2000). Brant I and Johnston lie outside the core area, indicating that site abandonment was not universal. The continued occupation of these two sites may represent evidence to oppose this entrenched theory of retreat to the core area.

Evidence of increased dental caries (Sciulli 1995) at these sites indicates a heavier reliance on maize than in the Early Monongahela. In a time of environmental flux, the presence of sites in a variety of environments would provide a safety net if crops failed in one region but not another (Nass and Hart 2000). Soils in upland sites may also have been more fertile than in the lowland (Johnson 2001), and in colder seasons higher areas may have stayed warmer, extending the growing season.

The Monongahela cultural complex is only beginning to be understood by archaeologists, and each newly excavated site adds a great deal to research in the area. It is essential to consider the effects of a biased sample on the scholarship of the Monongahela. Unfortunately, faunal assemblages from both the Brant I and Johnston sites are highly affected by bias.
Bias

Each site has its own set of circumstances that have affected the resulting assemblage, and influence the ability to compare sites. These include not only the culturally mediated differences that one might expect in a comparison between sites, but also differences in taphonomic conditions, excavation method, and analyst expertise. Disparities even in element identification between experts can be extreme, and will of course affect statistical calculations. In a study done by Gobalet (2000), four expert faunal analysts produced drastically different results when asked to identify the same collection of fish remains. The results were so incredible that they led Gobalet to state: “this leads to the conclusion that these investigators do not know what is going on despite doctoral degrees and approximately 50 years of collective professional experience” (2000: 380).

Of further concern is the comparison of statistically derived calculations such as relative abundance (Kline and Cruz-Uribe 1984). Even if the sources of difference listed above are a non-issue, differences in how different analysts calculate these measurements may lead to a falsely similar or dissimilar comparison between sites. For example, MNI may be calculated in many different ways, and if the method of calculation differs between sites, a comparison is not possible (Grayson 1973).

However, similar assemblages may be compared with caution (Grayson 1984). Brant I and Johnston are excellent candidates for comparison as they are similar in cultural origin, taphonomy, excavation technique, and analyst expertise. The inhabitants of Brant I and Johnston belonged to the same cultural designation, the Middle
Monongahela, and are in the same general area outside of the cultural core. Both sites are agricultural village sites situated on the first terrace of a river which occasionally floods.

Brant I was excavated by the IUP Archaeological Field School in 2002, directed by Drs. Philip Neusius and Sarah Neusius. Johnston was excavated by the IUP Archaeological Field School in 2006, directed by Drs. Sarah Neusius and Beverly Chiarulli. Finally, both assemblages were analyzed by the same person, myself, with the assistance of faunal expert Dr. Sarah Neusius, who also directed both excavations. This was the first analysis of faunal remains that I have undertaken. Although I was advised by Dr. Sarah Neusius, the ultimate decisions regarding identification are mine. Any errors of identification are therefore my own, and will at least affect both sites.

A preliminary assessment upholds the conclusion that the assemblages of Brant I and Johnston are similar enough to yield a coherent comparison. Both assemblages are small (although Brant I is significantly smaller, a fact that will be considered), and contain similar species with white-tailed deer as a dominant taxa. Both are highly fragmented, and contain a high percentage of burned material. Modified bone is present at both sites, in decorative elements (drilled turtle shell at Brant I, beads from Johnston), and in tools (polished bone and other signs of functional use are present in both sites). If any two sites may be safely compared, it is Brant I and Johnston.

A primary focus of this study must also be the effects of sample size on analytical results. Both Brant I and Johnston have small, fragmented assemblages with correspondingly small MNI and NISP numbers. This is particularly true for Brant I. The degree to which sample size affects analysis has been debated. Attempts have been made to calculate a cut-off size over which the sample is sufficient for analysis (Cruz-Uribe
1988; Grayson 1978), although this material was later judged to be overly simplistic (Meltzer et al. 1991). Regardless, all experts would agree that the size of the assemblages from both Brant I and Johnston are small enough to make sample size bias a significant concern.

Sample size has been found to affect several key faunal analysis calculations, particularly MNI, diversity, and relative abundance (Cruz-Uribe 1988; Grayson 1978, 1981, 1984; Meltzer et al. 1992). For these measurements, sample size is strongly and positively correlated with increasing estimates. This follows logically; a larger sample will contain more specimens overall from which follows the statistical bias. Adding to this is that in most assemblages, a few species dominate with large numbers of identifiable elements. In Brant I and Johnston, like most Eastern Woodland sites, the dominant species in the assemblage is white-tailed deer. Species that are rarer may be represented by only a few bones, so that “as sample size increases, the abundance of rarer taxa will increase strictly as a function of the probability that such rarer taxa will be detected” (Grayson 1981). Although this is not absolutely true for every assemblage, the effect is large enough to merit consideration.

Overlooking this subtle issue has caused bias-related error in several studies (Grayson 1981), rendering the conclusions faulty. Solutions to the problem vary according to which measurement is being considered, but some general suggestions include removing from the sample strata with very small NISP (Grayson 1984), grouping species together to create sub-categories (Grayson 1973, 1978; Lupo and Schmitt 1995), grouping entire assemblages together (Kelly and Cross 1984) and only analyzing assemblages with an MNI higher than 25 (Cruz-Uribe 1988), among others. Some
studies (cf Lupo and Schmitt 1995) have found that sample size plays a smaller role than expected, or does not seem to affect results. Despite increased research in the field, it is clear that sample-size related bias remains problematic for faunal analysts in most assemblages.

While it is foolish to ignore the effects of sample size, it also does not seem wise to avoid analyzing small assemblages for fear of yielding erroneous conclusions. Surely small assemblages can add to our knowledge of the culture that produced them, even if it is not possible to analyze them in the same way as larger collections. With certain reservations, it is therefore still appropriate to analyze small assemblages beyond merely listing the identified species. Some small samples also may not have as many problems with sample size bias.

How detrimental are the effects of bias on reconstructions of past habitat and subsistence utilization? According to Gilbert and Singer (1982), bias warps species ratios so that they cannot be accepted as representative of the original sample. They claim that there are two methods to combat this problem; reconstructing the means by which the sample became unrepresentative, or adjusting for the bias. Of these, they suggest that the former is more feasible. In taking this advice, the faunal analyst must reconstruct the taphonomic pathway of the site.

Of course, animal remains undergo a great deal of change between the time of death and archaeological analysis. Each agent which acts upon the faunal material — scavenging animals, water, fire, trampling, cultural practices, etc — alters the appearance and composition of the assemblage. It is important to remember that many taphonomic
effects act on bones in concert, creating a very complicated scenario that may be difficult to understand (Gilbert and Singer 1982).

Taphonomic factors can be crudely divided into two categories: non-cultural and cultural agents. Although archaeology is generally more concerned with the latter, an understanding of the former is essential in reconstructing a site. One undeniably non-cultural taphonomic factor in both the Brant I and Johnston sites is water transport. Both sites are on floodplains that would have experienced flooding. Water tends to transport lighter elements with a broad, flat shape (Lyman 1994), and polishes bone smooth (Kline and Cruz-Uribe 1984). With the exception of a high percentage of dense bone (which may be related to many factors, discussed below), the Brant I faunal assemblage shows little evidence of water disturbance despite evidence from the soil stratigraphy indicating that flooding did occur. The characteristic polishing effect of water was not noted on any element. In the Johnston site, the faunal remains in some areas did display water polishing. Interestingly, these often occurred throughout the levels of a unit, rather than in only one level across many units. N1000 W1021 contained water polished material in levels 2-7, and N1000 W1000 contained water polished material in levels 3-6. The significance of this distribution is still unclear.

Concerns about fragmentation and bone density are a common topic for taphonomic analysis. Assemblages with higher percentages of harder, smaller, and denser bones have been more heavily impacted by non-cultural taphonomic disturbance (Brain 1981; Kline and Cruz-Uribe 1984; Lupo and Schmitt 1995). These high density fragments are more likely to survive mineral leaching, compaction (Kline and Cruz-Uribe 1984), digestion by carnivores (Schmitt and Juell 1994), and water transport (Lyman
1994). As taphonomic processes act on an assemblage, they gradually destroy the lower
density remains, and as the lower density remains become more fragmentary, they are
more difficult to identify, as figure 2 shows (Kline and Cruz-Uribe 1984).

![Figure 2: Whitetail deer phalanges from the Johnston site with differing degrees of fragmentation. The elements on the far right are modern examples from the IUP comparative collection.](image)

The assemblages of both the Brant I and Johnston sites were extremely
fragmented (Figure 2). The Brant I site contained 1216 fragments of bone, with an
average weight of 0.23g. Johnston contained 4028 bone fragments, averaging
0.32g. Of course, not all of the remains were so small and average weight varied
by location within the site.

Nevertheless, the extremely fragmented condition of both sites made
identification difficult. Only 42 bones from Brant I were positively identifiable to
species (3% of the total), and a majority of these were from whitetail deer. An
additional 9 fragments were tentatively identifiable to species.

75 bones from Johnston were positively identifiable to species (2% of
the total), with an additional 5 tentatively identifiable to species. Figure 3 shows the
small number of fragments for both sites identifiable to element. Again in Johnston

![Figure 3: Identifiability of bone fragments](image)
The benefits of a larger sample size are clear in this instance, as the 9 tentatively identified fragments from Brant I added three species that were not otherwise conclusively identified in the assemblage. This was not the case for the Johnston material, where the tentative identifications added no otherwise unidentified species. These elements compared favorably to elements from the comparative collection, but identification was not absolutely certain. Including elements identifiable to the family level does not significantly change the analysis.

The degree of fragmentation in a sample can be demonstrated by a comparison of the presence of high density, medium density, and low density elements. For Johnston, high density elements represent 47% of the assemblage, with low density elements forming only 3%. High density elements have come to dominate the assemblage, indicating that a vast majority of the original depositional material has been lost. Particularly high density elements, teeth, are characteristic of a site which has suffered post-depositional destruction (Kline and Cruz-Uribe, 1984). Teeth become isolated when the lower density mandibles and maxillas in which they are rooted become fragmented. A startling 33% (1/3) of the Johnston assemblage is composed of isolated teeth and teeth fragments. Other high density elements, carpals and tarsals, represent 9% of the overall assemblage.

The amount of information lost in this manner is astonishing: in one study, hard skeletal parts did not begin to dominate an assemblage until 97% of the initially deposited bones had been lost (Rogers 2000). Measurements such as %survivorship can be used to determine the amount of density-related attrition. Because different animals have different numbers of particular elements, this must be measured independently for each
species and is based on MNI (Lyman 1994). For the Johnston assemblage, density-related attrition can be demonstrated in a comparison between the numbers of a very dense element, such as the petrous portion from the skull, and an element with low density, such as cervical vertebrae. A deer has two petrous portions and 7 cervical vertebrae in each skeleton. With an MNI of 3, a complete assemblage would contain 6 petrous portions and 7 cervical vertebrae. The Johnston assemblage contains 3 petrous portions (50% survivorship) and 1 cervical vertebra fragment (14% survivorship).

Human usage of bone also contributes to its fragmentation, so that it can be difficult to determine whether humans or natural processes are responsible for the degree of fragmentation within a site (Figure 4). Human processing techniques (for example, the extraction of marrow) are designed to exhaust the potential caloric energy of the bone. Because of this, human faunal refuse may be unattractive to scavengers (Lupo and Schmitt 1995). Humans also utilize different animals in different ways. A study done on an early (2000BC) pastoral site in Kenya showed that caprine bones were more complete and cattle bones more fragmented, due to cultural differences in utilization (Marshall and Pilgrim 1993).

It has also been suggested that a site containing a great deal of high density elements such as foot bones represents a kill site, while a site with a mixture or a majority
of lower density elements represents a home base (Rogers 2000). The theory is based on the assumption that rather than carry an entire slaughtered animal back to a home base, less meaty parts (which also have generally denser bones) would be left at the kill site. This is closely related to Binford’s (1978) MGUI index, which attempts to account for differential transport and use of elements based on their utility. The difficulty for an analyst is measuring the intersection between human effects on bone density and natural effects. Lyman (1994) and Grayson (1988, 1989) have argued that analysis of the correlation between skeletal part abundance, element utility, and element density can verify the distinction between a kill site and a home base. If the correlation is significant, no interpretation is possible, because taphonomic processes have biased the sample in favor of denser elements. Due to time constraints this analysis does not include density correlations, but this would be an excellent topic for future study.

No doubt humans played a significant role in the fragmentation of bone in both the Brant I and Johnston assemblages. In addition to fragmentation related to subsistence practices, both sites also show modification of bone both for tool production and decoration (see below). The degree to which humans have affected the assemblage in comparison to the clearly powerful natural taphonomic processes is probably unknowable, and the analyst must be content to conclude that cultural and natural effects worked together to fragment the faunal material.

As to the distinctions between a kill site and home base, analysis from other data types might be more reliable than faunal data. Both Brant I and Johnston have been classified as village sites due to the presence of dwellings and storage structures, and in the case of Johnston the palisade. In all likelihood these sites were not kill sites, but
locations where game processing occurred. Further analysis of cutmarks on the bones would be suggested to verify this conclusion. Additionally, the most common species in the assemblage, whitetail deer, is small enough to be transported entirely by one person (Madrigal and Holt 2002), although the prehistoric deer in this region were larger than modern deer. The only species in the assemblage that could have represented a transport issue is elk.

The presence of burned bone in a site also raises questions about the division between cultural and natural factors. Humans affect bones with fire in a variety of ways, including cooking, tool making, and waste disposal. These each have their own archaeological signature. Although it is difficult or impossible to determine the exact temperature to which a bone has been heated based on discoloration alone (Marshall 1989), bones display different coloration depending on how hot the fire was, and a variation in discoloration across the site indicates that cultural processes are responsible for burnt material (Lupo and Schmitt 1995). This is shown for Brant I in Figure 5. This is because a natural burning event, such as a forest fire, would create a more uniform distribution of discolored bone, particularly in a small area.

Studies have shown that in faunal assemblages created by humans, the size class of the bones has a correlation with degree of burning. For larger species, a higher percentage of material has been burned. (Lupo and Schmitt 1995).
Of course, fire also acts to fragment an assemblage, and Brant I and Johnston have a high percentage of burned material. 66% of the Brant I assemblage and 47% of the Johnston assemblage is burned. There is a range of color in the burned material at both sites; however, the majority of bone is either charred black or calcined, conditions which occur when the bone has been exposed to fire for longer periods of time than mere cooking of the meat. It may be assumed that bones were exposed to roasting before the meat was consumed, and further burning has obliterated that slight discoloration. It seems that for both sites, fire was used as a method of waste disposal. Variation in burning throughout the site is also indicative of human agency (Figure 5).

Human behavior biases bone assemblages in a variety of ways. A human-collected assemblage is itself a biased assortment of the species in an area, as particular species may be preferred at certain times of the year, or overall (Bettinger 1991, Gilbert and Singer 1982). In addition to marrow extraction and burning, humans use bone for tools and toys, carefully selecting the elements they use for these processes (Gilbert and
Singer 1982). This modification alters the characteristics of the bone and may make it difficult or impossible to identify.

The inhabitants of Brant I and Johnston, like most other prehistoric peoples, used bone for tools and as decoration. The presence of polished bone at both sites may be evidence of tool use, such as a digging stick, or of preparation to produce a decorative item such as a bead. Bone beads are a characteristic of the Monongahela cultural complex, and so it is not surprising that Johnston contains several examples of beads either in a stage of manufacture or in finished form (Figure 7). One specimen is a bead made from Marginella apicina (Figure 8), a small gastropod native to the Gulf of Mexico. Dragoo’s 1952 excavations at Johnston found several of these beads. Also found at Brant I was a drilled turtle carapace (Figure 9).

MNI and NISP

NISP (Number of Individual Specimens) is a standard tool for faunal analysts. It is calculated simply by adding the elements from a particular species together. This number can then be compared to the NISP of other species, with the goal of obtaining an idea of the importance for each species to the population. However, the bias associated with NISP can be extreme. Bone attrition can lead to an assemblage dominated by dense elements, as discussed above, and some species have more dense bones than others. Some bones are simply more recognizable than others, or less likely to be broken. NISP
is also affected by butchering patterns, degree of completeness of the recovered specimen, and sample size effects. These problems all lead to an inflated (or deflated) count for particular species, biasing the sample (Grayson 1984, Marshall and Pilgrim 1993).

Potentially more serious are the difficulties related to the use of NISP in statistical formulas. Because of the problems cited above, NISP does not support the use of as many types of statistical analysis as other methods of counting remains. It can be used in calculations but the results may be biased. This means that NISP is extremely difficult to compare between sites. Even if NISP is counted without bias, the inability to accurately compare two assemblages severely limits the uses to which NISP can be put (Grayson 1984).

Despite these problems, many experts believe that NISP is still a functional tool for the faunal analyst (Grayson 1984, Marshall and Pilgrim 1993). For example, Marshall and Pilgrim (1993) found that although fragmentation in a sample does act to increase NISP, over time even very dense elements will be difficult to identify. This leads to a diminishment in the degree of bias in an NISP calculation with increased fragmentation. Additionally, Lupo and Schmitt (1995) discovered in one study that assemblages with larger NISPs had a tendency to be less diverse than assemblages with smaller NISPs, contrary to expectation. Although this may be true only for these particular assemblages, this finding still indicates that NISP may not be too biased to use in analysis.

In response to the concerns surrounding the use of NISP, MNI (Minimum Number of Individuals) has become a more popular tool for the analyst (Grayson 1973,
Marshall and Pilgrim 1993). MNI is deceptively simple in concept. An assemblage is evaluated based on the smallest possible number of individuals that could have produced the remains. An assemblage with three left femurs must be comprised of at least three individuals. MNI is generally determined using a combination of types of elements represented at the site, and evidence for aging on those elements. Because it creates independent units, MNI is more amenable to statistical manipulation than NISP (Grayson 1973).

Absolutely crucial to the calculation of MNI, and a primary source of bias, is the effect of aggregation. It is highly unlikely that the inhabitants of an area distributed the remains of each animal evenly throughout the site, taking particular care to place them where the archaeological test units will be excavated. Another consideration is stratigraphy, particularly if a site has multiple components. It is even less likely that one animal would have been shared over generations. In attempting to cope with this reality, analysts have aggregated particular areas of a site (for example, by unit, level, or feature), and calculated MNI from the aggregation that seemed the most appropriate.

Chaplin suggests that analysis should begin by determining the “smallest significant working unit” (1971; 61). How to determine that unit is not described. A different type of aggregation within a site will yield a different MNI, at times drastically different (Grayson 1973, 1984). Aggregation may even be subconsciously used to further an argument: “a highly motivated investigator can at times apply different approaches to aggregation to the same set of faunal materials in such a way as to obtain a wide range of outcomes, and then select the set of aggregates that provides the most aggressive support for any given hypothesis” (Grayson 1984, 29). The effects of aggregation are also
compounded by taphonomical factors. A larger site will be more affected by aggregation than a smaller site. Problematically, the MNI from sites that have been aggregated in different ways is probably not comparable (Grayson 1984).

Solutions to the aggregation dilemma have been posed. In his 1973 paper, Grayson compares the MNI from a site that has been calculated for three different levels of aggregation: the entire site as a whole (smallest MNI), clusters of material separated by stratum (middle MNI), and counting each cluster of material both vertically and horizontally as one individual unit (maximum MNI). He suggests using stratigraphic distinctions, although of course this becomes more difficult when the site has only one occupation. Lyman states that “we need to count our bones several different ways, or at several different levels of inclusiveness, in order to generate the frequency data appropriate to the frame of reference to which we wish to relate that data” (1985, 265). The suggestions that an analyst should calculate MNI to several different levels of aggregation is a good one, because an awareness of how and why this number changes may reveal something about the site.

Inherent bias in MNI calculations is not limited to aggregation effects. The process by which an animal is killed, utilized, preserved, and excavated changes the numbers of elements in an assemblage, due to the changes that occur during these transformations (Kline and Cruz-Uribe, 1984). Cultural effects such as meat sharing also skew MNI data by spreading one animal across a larger area, or even between multiple sites (Gilbert and Singer 1982). Fragmentation and sample size effects may strongly warp MNI, with smaller sites exaggerating MNI because of low numbers of identifiable elements (thereby also exaggerating the abundance of rare animals), and larger sites
minimizing MNI (Grayson 1978).

There is disagreement about how similar the results of an analysis done with NISP are to an analysis done with MNI. Grayson (1984) claims that the results of particular analyses such as rank order are quite different when NISP is compared to MNI. Marshall and Pilgrim (1993) disagree, stating that produced results are similar, but vary in their details. Many taphonomic factors act differently on MNI and NISP, for example, postdepositional fragmentation will raise NISP but lower MNI (Kline and Cruz-Uribe 1984). Using the ratio MNI/NISP has been suggested as a solution to the biases of both calculations (c.f. Kline and Cruz-Uribe 1984), but this may not be a reliable method. The relationship between MNI and NISP is not linear, as is usually assumed, but curvilinear (except in certain assemblages where, for instance, only a few elements are used to define a species). This is important because a linear relationship indicates a direct one-to-one correlation, whereas a curvilinear relationship does not. MNI/NISP is also influenced by biasing agents like sample size and aggregation techniques (Grayson 1984).

<table>
<thead>
<tr>
<th>Species</th>
<th>Brant I</th>
<th>Johnston</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NISP</td>
<td>Rank</td>
</tr>
<tr>
<td>Chipmunk (Tamias striatus)</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>Squirrel (Sciurus)</td>
<td>1</td>
<td>4 (tie)</td>
</tr>
<tr>
<td>Black Bear (Ursus americanus)</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Raccoon (Procyon lotor)</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>Fox (Urocyon and Vulpes)</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>Cervidae (Odocoileus and Cervus)</td>
<td>41</td>
<td>1</td>
</tr>
<tr>
<td>Ruffed Grouse (Bonasa umbellus)</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>Wild Turkey (Meleagris gallopavo)</td>
<td>1</td>
<td>4 (tie)</td>
</tr>
<tr>
<td>Canada Goose (Branta Canadensis)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Turtle</td>
<td>48</td>
<td>---</td>
</tr>
<tr>
<td>Fish</td>
<td>1</td>
<td>---</td>
</tr>
<tr>
<td>Freshwater Mussel</td>
<td>12</td>
<td>---</td>
</tr>
</tbody>
</table>

Table 2: Species NISP and rank for Brant I and Johnston
What is important to remember is that NISP and MNI are at two extremes, with NISP producing the highest possible estimates of species presence, and MNI the absolute lowest. The reality is most likely somewhere in between, but we have no way of determining the middle of the distribution with any veracity (Grayson 1984). NISP and MNI should at least be compared to each other before either is used (Marshall and Pilgrim 1993). In some cases, qualitative measurements may be more plausible than either measurement.

This may be the case for the Brant I and Johnston sites. Table 2 shows the top five most common mammalian species for both sites, ranked according to NISP. Note that while whitetail deer are the most common species at both sites, the rank orders do not coincide for other species. Many species from both sites are represented by a single element. Comparatively, a species like the black bear seems quite common. However, that NISP is based on six fragments of the same tooth. Excavation and sample size bias are demonstrated excellently by a comparison of the 2006 IUP Johnston excavation results with the 1952 Dragoo excavation (Table 1). Whitetail deer still predominate the 1952 assemblage, but other important species such as the woodchuck were not found (or are unidentifiable) in the 2006 assemblage. MNE (Minimum Number of Elements) might be used to address this problem, but was not calculated in this analysis.

MNI was also calculated for both sites, but the low numbers of identifiable elements had a large effect on the results. Aggregation effects are a strong source of bias in
both assemblages. Figure 11 compares the results of the whitetail deer MNI calculated in three different ways (Figure 10). As the aggregation becomes less inclusive, the MNI increases dramatically. Again, sample size effects on aggregation are evident in the greater increase of the larger Johnston site. Although both NISP and MNI estimates rank whitetail deer as the most common species at Brant I and Johnston, they are unable to rank other species with any reliability. Many species were represented by a single element, and so their actual importance in the subsistence lives of the inhabitants is unknown.

Species Ratios

Instead of relying on NISP or MNI alone, alternative methods may be employed in order to consider the subsistence strategies of the inhabitants of Brant I and Johnston. I have chosen to rely somewhat on NISP in order to provide a basic number structure to manipulate. In separating animals by species, an analyst allows cultural bias to enter the analysis. Prehistoric (and modern) hunters would have been concerned with the size of the animal, or the method in which it was captured, or both, rather than selecting animals based on their taxonomy (Lupo and Schmitt 1995). The analyst may attempt to group specimens based on size or other criteria. Of course, there is no guarantee that these groups will accurately represent the prehistoric mind. Separating specimens by species, however, is almost certainly also not an accurate representation of how the inhabitants of Brant I and Johnston thought about the animals that they relied upon for subsistence. At the very least a different type of grouping method may present the analyst with a different, non-quantitative way to consider the assemblage.
Before examining other factors of the species represented at Brant I and Johnston, some animals must be removed from consideration. Interestingly, no obviously non-food species were identified at Brant I. At Johnston, chipmunks (NISP=7) may represent later intrusions due to burrowing. It is possible that chipmunks were consumed as food resources, but this is unclear. Small gastropods (NISP=50) are representative of flooding episodes or bead making. In both cases, these species were not used for subsistence and may be removed from the current discussion.

Immediately, the concern becomes the manner and level of aggregation of the assemblage. Every fragment was identified as specifically as possible, but most were not able to be assigned to a species. In this case, the bone would be placed in a broader category. For example, a bone might be identified as “large mammal”, “medium bird”,

<table>
<thead>
<tr>
<th>Johnston Site</th>
<th>Aggregate</th>
<th>NISP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Mammal</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Small or Medium Mammal</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>Medium Mammal</td>
<td>298</td>
<td></td>
</tr>
<tr>
<td>Medium or Large Mammal</td>
<td>2624</td>
<td></td>
</tr>
<tr>
<td>Large Mammal</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>Rodentia</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Mustelid</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Carnivore</td>
<td>4 (includes one medium animal and one large, others indeterminable)</td>
<td></td>
</tr>
<tr>
<td>Cervidae</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>Squirrel</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Fox</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Raccoon</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Small Bird</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Medium Bird</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Large Bird</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Wild Turkey</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ruffed Grouse</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Turtle</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Mussel Shell</td>
<td>202</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brant I Site</th>
<th>Aggregate</th>
<th>NISP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small or Medium Mammal</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Medium Mammal</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Medium or Large Mammal</td>
<td>304</td>
<td></td>
</tr>
<tr>
<td>Large Mammal</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Cervidae</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Squirrel</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Black Bear</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Small Bird</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Medium Bird</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Wild Turkey</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Canada Goose</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Turtle</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Mussel Shell</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Johnston and Brant I subcategories. Note that each bone is only counted in one subcategory. Although a fox is also a carnivore and a medium mammal, an element identifiable as “fox” would be counted only in that subcategory.
or even "medium or large mammal". With this in mind, the following tables include a list of every taxonomic category placed within the larger group. Small mammals were excluded due to the difficulties in determining whether they represent human subsistence

<table>
<thead>
<tr>
<th>Figure No.</th>
<th>Category</th>
<th>Aggregate Subgroups (see Table 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 &amp; 12</td>
<td>Carnivore</td>
<td>Bear</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carnivora</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mustelid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fox</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Raccoon</td>
</tr>
<tr>
<td>11 &amp; 12</td>
<td>Rodent</td>
<td>Squirrel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rodentia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Squirrel</td>
</tr>
<tr>
<td>11 &amp; 12</td>
<td>Artiodactyl</td>
<td>Cervidae</td>
</tr>
<tr>
<td>13 &amp; 14</td>
<td>Large Mammal</td>
<td>Large Mammal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bear</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cervidae</td>
</tr>
<tr>
<td>13 &amp; 14</td>
<td>Medium Mammal</td>
<td>Medium Mammal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Squirrel (included as a prey species)</td>
</tr>
<tr>
<td>13 &amp; 14</td>
<td>Large Mammal</td>
<td>Identical to “Large Mammal” under Figure 14</td>
</tr>
<tr>
<td>15 &amp; 16</td>
<td>Medium Mammals</td>
<td>Identical to “Medium Mammal” under Figure 14</td>
</tr>
<tr>
<td>15 &amp; 16</td>
<td>Large or Medium Mammals</td>
<td>Large or Medium Mammals</td>
</tr>
<tr>
<td>17 &amp; 18</td>
<td>Large Bird</td>
<td>Wild Turkey</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Canadian Goose</td>
</tr>
<tr>
<td>17 &amp; 18</td>
<td>Medium Bird</td>
<td>Medium Bird</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium Bird</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ruffed Grouse</td>
</tr>
<tr>
<td>17 &amp; 18</td>
<td>Small Bird</td>
<td>Small Bird</td>
</tr>
<tr>
<td>19 &amp; 20</td>
<td>Fish</td>
<td>These categories contain no aggregation</td>
</tr>
<tr>
<td>19 &amp; 20</td>
<td>Mussel</td>
<td>These categories contain no aggregation</td>
</tr>
<tr>
<td>19 &amp; 20</td>
<td>Turtle</td>
<td></td>
</tr>
<tr>
<td>21 &amp; 22</td>
<td>Mammal</td>
<td>Large Mammal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium Mammal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium or Large Mammal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cervidae</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Squirrel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bear</td>
</tr>
<tr>
<td>21 &amp; 22</td>
<td>Aves</td>
<td>Medium Bird</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small Bird</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wild Turkey</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Canada Goose</td>
</tr>
<tr>
<td>21 &amp; 22</td>
<td>Aves</td>
<td>Large Bird</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium Bird</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small Bird</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wild Turkey</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ruffed Grouse</td>
</tr>
</tbody>
</table>
activities or burrowing intrusions into the site. The only exception to this exclusion is squirrel, which as a common prey animal was grouped with mammals of medium size.

Some categories, including “unidentifiable bone”, “unidentifiable mammal” and “unidentifiable bird” were also not included in any chart. It seems necessary to note that 653 fragments (54%) of the Brant I assemblage were categorized as “unidentifiable mammal”, as well as 184 fragments (5%) of the Johnston assemblage. The inclusion of

<table>
<thead>
<tr>
<th>23 &amp; 24</th>
<th>Riverine</th>
<th>Fish</th>
<th>Mussel Shell</th>
<th>Turtle</th>
<th>Fish</th>
<th>Mussel Shell</th>
<th>Turtle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Game</td>
<td>Large Mammal</td>
<td>Cervidae</td>
<td>Bear</td>
<td>Large Mammal</td>
<td>Carnivora (1 element)</td>
<td>Cervidae</td>
<td></td>
</tr>
<tr>
<td>Medium and Small Game</td>
<td>Medium Mammal</td>
<td>Medium Bird</td>
<td>Squirrel</td>
<td>Wild Turkey</td>
<td>Goose</td>
<td>Medium Mammal</td>
<td>Large Bird</td>
</tr>
<tr>
<td>Riverine</td>
<td>Turtle</td>
<td>Fish</td>
<td>Mussel Shell</td>
<td>Turtle</td>
<td>Fish</td>
<td>Mussel Shell</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>25 &amp; 26</th>
<th>Large Mammal</th>
<th>Large Mammal</th>
<th>Cervidae</th>
<th>Large Mammal</th>
<th>Carnivora (1 element)</th>
<th>Cervidae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Mammal</td>
<td>Medium Mammal</td>
<td>Squirrel</td>
<td>Medium Mammal</td>
<td>Mustelid</td>
<td>Carnivora (1 element)</td>
<td>Squirrel</td>
</tr>
<tr>
<td>Large Bird</td>
<td>Wild Turkey</td>
<td>Canada Goose</td>
<td>Large Bird</td>
<td>Wild Turkey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small and Medium Bird</td>
<td>Small Bird</td>
<td>Medium Bird</td>
<td>Small Bird</td>
<td>Medium Bird</td>
<td>Ruffed Grouse</td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>Fish</td>
<td>Fish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turtle and Mussel Shell</td>
<td>Turtle</td>
<td>Mussel Shell</td>
<td>Turtle</td>
<td>Mussel Shell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialized</td>
<td>Black Bear</td>
<td>(none)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Aggregated categories of figures
this category would change the analysis results far more significantly for the Brant I assemblage than for the Johnston assemblage, and is another reminder of the greater fragmentation of Brant I bone. All charts are based on NISP, which introduces a regrettable but necessary amount of bias.

The assemblage seems naturally to fall into three categories of animals: mammals, birds, and riverine species. Before comparing these to each other, each will be discussed individually. A breakdown of the mammal types in each assemblage is shown in Figures 11-18.

Mammals are dominated by artiodactyl species, in this case whitetail deer and elk, both cervids. Carnivores and rodents are both present, carnivores in greater numbers. If chipmunks were included in the Johnston material, this balance might change.
considering hunting methods, it makes sense to compare large mammals to medium mammals, as each would be hunted in a different way.

Interestingly, there is an opposite relationship for each site. In the Johnston site, large mammals represent 60% of the sample. In the Brant I site, about 60% of mammals that represent hunted species are medium sized, although deer predominate the assemblage. This may be due to sample bias. As bones of larger species become more fragmentary, they would no longer be large

![Figure 15: Mammal types, Johnston](image)

Figure 15: Mammal types, Johnston

“large mammal” category, and would be placed in the “medium to large” category, excluded from this chart. Figures 15 and 16 show the relationship between the categories of medium, large, and medium or large bones for each site.

The number of bird bones in each assemblage is much lower. Because it was decided to remove “indeterminate mammal” from the data pool, “indeterminate bird” was also removed.
5 elements from Brant I (.4% of the entire assemblage, 25% of the bird remains) and 62 elements from Johnston (2% of the entire assemblage, 70% of the bird assemblage) fall into the “indeterminate bird” category. When comparing different sizes of bird (which would require different hunting methods), the percentage of large birds is similar in both assemblages (Figures 17 and 18). Medium birds had a far greater presence at Johnston than at Brant I, perhaps because of the common use of bird longbones for bead production.

The third category of animal from each site includes those species from a riverine environment, to which the inhabitants of Brant I and Johnston had easy access. Although these species are a part of the same environmental niche, the methods in which they would have been collected by humans are different. This is further considered below. Figures 19 and 20 show the distribution of riverine species for each site.

Only one fish element was recovered from Brant I. A cursory examination of the flotation material (which is not included in this analysis) revealed no more fish remains. These results are very surprising considering the proximity of Brant I to more than one waterway. Perhaps the fish remains are too fragmentary to identify, or were deposited in
another area of the site. It seems unlikely that the single element is an accurate representation of the actual fish utilization at Brant I. A higher number of fish remains were recovered from Johnston, and there is a significant amount of fish bones and scales in the flotation material. Due to multiple factors, the fish elements from Brant I and Johnston were not able to be identified to species during this analysis, although this identification would be possible.

Also present in high percentages at the Johnston site is mussel shell. Mussel shell was only recovered in small amounts from the Brant I site, and the remains are quite fragmentary. Mussel shell dominates the Johnston riverine species assemblage. This is probably due not only to the reliance on mussel shell as a food source, but also because shell tends to fragment easily and thereby increase the NISP. The amount of turtle remains from Brant I and Johnston are more comparable than the chart might suggest, because the Johnston chart is skewed by the high number of mussel shell. All elements are pieces of shell, which is very distinctive regardless of fragmentation degree. This makes turtle more readily identifiable than other animals, but fragmentary pieces of shell are unable to be identified to species. There were no riverine mammal species, such as beaver, represented in the assemblage.
Comparing the percentages of mammal, bird, and riverine species seems logical. The three groups – land, air, and water – would all require different hunting methods. It is even possible that this seemingly basic distinction would exist in the minds of the prehistoric inhabitants of the site, although this is impossible to determine. The charts for each site appear similar, with mammals representing 85-90% of the assemblage. Mammal bone is easy to identify, which may account for some of this dominance. Bias in cultural use of bone (for example, the preferential creation of beads from bird bone) that leads to differential destruction could also be a factor. An examination of the flotation material from Johnston might provide a more balanced picture of the subsistence methods, and should be explored in future research. Nevertheless, this chart demonstrates the heavy reliance of the Brant I and Johnston people on mammals.

The extreme emphasis of mammals compared to other species yielded in Figures 19 and 20 does not reflect a true grouping based on hunting method. Strategies and tools used for hunting a squirrel are not the same as those used for hunting an elk and a more appropriate grouping method would take this into consideration. In this light, the assemblages have been sorted below in Figures 21 and 22 into categories based on size.
and location. Riverine species remain in one group, but large mammals have been separated out, and all sizes of birds grouped with medium mammals. Aggregating the collections with this method yields a far more balanced and remarkably similar picture of both the Brant I and Johnston assemblages. This is in part due to the removal of the large “medium or large mammal” category from the analysis. Mammals obviously represent an important resource for the inhabitants of Brant I and Johnston, but those people may have viewed the species according to size, instead of grouping them into a category similar to our modern “mammal” designation.

Even this level of aggregation may not accurately record hunting categories represented by the Brant I and Johnston assemblages. For Brant I, “Large Game” includes both bear and cervids, animals which would require a different hunting strategy. Bear does not represent a high percentage of the assemblage (the 6 NISP is due to one fragmented tooth) and although of course the meat can be eaten, the animal was not hunted frequently and might even have had symbolic associations. In the “Medium and Small Game” category for both sites, birds would be hunted differently than terrestrial animals, and large birds such as turkey would not be exploited in the same way as medium...
or small birds. As was briefly stated above, fish in the “Riverine” grouping would be
gathered differently from mussel shell and turtles. Figures 23 and 24 show the
distributions of this final aggregation.

![Hunting Categories in Brant I Assemblage](image)

![Hunting Categories in Johnston Assemblage](image)

**Figure 25: Hunting categories, Brant I**

With this change, about 10% of the material from Brant I and Johnston is
removed from the three larger categories described above. 90% of both assemblages is
dominated by large mammal (cervid species), medium mammal, and turtle or mussel
shell. This final aggregation is the most likely to reflect a realistic distribution of the
Brant I and Johnston species based on subsistence utilization. Instead of using the exact
percentages, it might be stated that very little subsistence energy was gained from the
exploitation of birds and fish.

Although additional research needs to be done in this area, the recategorization of
the faunal remains in this way may be less affected by bias than estimates based on MNI
or NISP alone. This method of analysis has drawbacks, particularly that there is no
mathematical way to compare non-quantitative results with assemblages from other sites.
However, with a heavily biased assemblage such as that of Brant I and Johnston, a
qualitative analysis may be more appropriate. With a more complete understanding of
the effects of bias on the Brant I and Johnston sites, the analyst can now draw
conclusions from the assemblages and compare the sites.
Results of Analysis

After a thorough consideration of bias and how it will affect the sample, the analyst can begin to draw conclusions from the remains. An important facet of faunal analysis that has not yet been considered is patterns of use that vary in different areas of the site. The below section addresses these activity areas and attempts to make sense of the effects of bias on the samples in order to create a coherent and useful discussion of how the Late Prehistoric people represented at Brant I and Johnston interacted with the animals in their environment.

Brant I

The majority of the animal bone recovered from the site (71% of the total) was found in features. The average weight of these fragments is less than a gram. Of the six features containing faunal remains, Feature 8, 9, and 29 merit further discussion.

Features 8 and 9 were both identified as possible storage structures. Feature 8 is in unit 419N 130W, and contains 266 fragments of bone. As Figure 28 demonstrates,
half of that bone (51%) is burned. The average weight of recovered bone is .14g, smaller than the already small site average of .23g. Unburned bone from Feature 8 tends to be heavier, with an average weight of .21g. As is expected, burned bone from the feature is lighter on average, only .07g. Five of the bones from the unit display possible cutmarks.

Feature 9 is in unit 398.5N 130.5W, and contains faunal remains that are very similar to those recovered from Feature 8. 190 total fragments were recovered, with an average weight of .26g. 58% of the material is burned. The average weight of burned material is .12g, and unburned material is .46g. Overall, the material from Feature 9 is slightly larger, but the difference is not very large. Additionally, 68 bones (36% of the total from the feature) are classified as “very fragile”, meaning that they were not burned but had deteriorated to an extremely delicate state. 2 bones show possible cutmarks.

The material from Features 8 and 9 does not contradict the assessment of these features as storage structures typical of sites in the Monongahela cultural complex. The burned material may very well represent a waste disposal method, and the cutmarks seem indicative of subsistence utilization. No bones were recovered from the postmarks associated with the features.

Feature 29 was the site of an infant burial (excavated only until the contents of the feature became apparent, and then reburied). It contains 290 pieces of bone, more than any other feature and 24% of the site total. As is expected, the bone in this unit differs significantly from the bone found in the storage pit features. The feature was excavated in two sections which were identified by soil staining (Figure 29), and referred to as the inner and outer portions of the feature. The inner portion of Feature 29 was closer to the
location of the burial. The average weight of bone in both areas of the feature is quite small, only .13g. Burned bone averages .11g, and unburned bone .37g. 92% of the bone
is burned from the feature as a whole, and this burned material is concentrated in the inner portion of the feature. The inner area also contains 89% of the total bone from the feature.

The burned material may represent some sort of grave offering, as it seems unlikely that waste would be disposed of so close to a human interment. No cutmarks or particularly fragile (unburned) bone was found in this feature. What was recovered were bones that showed signs of decorative modification, including two polished bones and a drilled turtle carapace (pictured above). The drilled carapace was not, of course, in direct contact with the remains as these were not excavated.
Johnston

In contrast to Brant I, only 310 bones (8%) were recovered from features. Of these bones, Feature 28 contains 253 (82% of the bones recovered from features, 6% of the bones from the entire site). Feature 28 is in unit 978N 981W and represents a possible midden deposit. Like the other units, the majority of bone was recovered from levels 5 and 6 (40-50cmbd and 50-60cmbd, respectively). Level 6 contained Feature 28 and was divided into four areas based on soil staining: Area A, Area B, Feature 28 (called Area C in level 5), and a window. Areas A and B contained far less faunal material than the window or Feature 28 and is probably the remains of one of Dragoo’s excavation trenches. The faunal material from Feature 28 shows slight but possibly significant differences from the other areas of the unit.

Less burned material was recovered from Feature 28 (18%) than from any other area. The window, which abuts Feature 28, has the highest percentage at 38%. The material from Feature 28 is also slightly larger on average, .88g compared to a range of .24-.38g in the other areas. This difference is due to the greater amount of material that weighs more than a gram. 3 bone beads were found in Feature 28, which is a large number in comparison to the rest of the site. 4 beads were recovered from the window in
978N 981W, however. If the area of the window is associated with Feature 28, the analysis results would change, perhaps reducing the differences in faunal assemblage between Feature 28 and the other areas of the units.

If Feature 28 is a storage or refuse area similar to Features 8 and 9 from the Brant I site, this would reveal some slight differences in the behavior of the inhabitants of the sites. Fewer burned material from Feature 28 might indicate a difference in disposal methods.

The presence of modified bone in Feature 28 is also different from the composition of the faunal remains from Features 8 and 9. The significance of these differences is unclear, and further excavation and analysis of the area surrounding Feature 28 must be accomplished before these claims can have any certainty.

Comparisons and Similarities

The assemblages of Brant I and Johnston are similar in many respects, as was predicted from the overall similarities between the two sites. The faunal remains indicate a culture with a continued reliance on hunting and gathering, despite the growing importance of maize and bean based horticulture. Several species were exploited at both sites, but whitetail deer represent a vast majority of the assemblage. Despite the fragmented assemblage, the presence of foot bones from both deer and elk suggest that even these larger species were brought to the site before butchering. Smaller mammals
such as squirrels were also hunted. Occasionally the black bear was exploited at both sites (bear was not present in the 2006 Johnston assemblage, but was found earlier, see Dragoo 1955), although the less hazardous nature of a deer hunt would have made the bear less common as a standard food species. The possibly ritual aspects of a bear hunt are highlighted by the presence of drilled bear canines found at Johnston in the 1952 excavation.

Birds were present in both assemblages, but in reduced numbers. Large birds such as wild turkey were found in both assemblages. Bead work at Johnston may have fragmented or altered bird bone beyond identification, and the greater number of bird remains from Johnston may be an effect of this cultural practice, or of sample size effects.

Riverine species such as turtle, mussel shells, and fish formed another cornerstone of the diet at Brant I and Johnston. The proximity of these sites to waterways is such that it would be strange if riverine species were not found. Johnston inhabitants seem to have relied more heavily on riverine species than at Brant I, although further excavation at both sites might change this interpretation. Mussel shells represent the only identified faunal species that can be described as a gathered, rather than a hunted food source (turtles might also be categorized in this fashion). Regardless of the division of labor at the site, it may be assumed based on ethnographic analogy that both genders could therefore contribute to the protein needs of the community.

If the sites were occupied seasonally, this might be reflected in the faunal assemblage. Age analysis of the teeth was crucial in the MNI calculations of whitetail deer for both sites. A juvenile whitetail deer tooth was recovered from Brant I, which
may indicate that the site was occupied in the spring or summer months. Horticultural remains verify that the site was used during the growing season. No juvenile whitetail deer teeth or remains were recovered from Johnston, and the botanical analysis has not yet been completed. The absence of juvenile whitetail deer remains does not mean that they were not present at the site, and so the seasonality of the Johnston site is as yet undetermined.

Cultural bone modification was observed at both sites. The intermixture of burned and unburned bone indicates human agency rather than a natural occurrence such as a forest fire. At Brant I, fire seems to have been used for waste disposal and for ritual activities. The more complete burning at the burial site (Feature 29) shows that the ritual destruction of the animal was important, perhaps as a sort of burnt offering. In the storage pits (Features 8 and 9), burning was used more carelessly as a waste disposal tool. Presumably, activities surrounding waste disposal were not as vital as those surrounding human burial. There were no areas of Johnston specifically identified as ritually important, so no comparison can be made in this instance. However, the lesser degree of burning at Johnston, particularly in the possible midden area (Feature 28) may show a slight difference in the preferred waste disposal methods.

Bone tools and decorative elements were also common at both sites. An unidentifiable bone from Brant I is clearly a tool, although of unknown use. The presence of polished bone at both sites may be indicative of a tool such as a digging implement or shaft straightener, or an improvement of the visual or tactile quality of the bone. Drilled turtle carapace from Brant I and beads from Johnston are more definite examples of bone intended to show beauty, wealth, or status.
Conclusion

As was predicted from the large number of similarities between the sites, the faunal remains from Brant I and Johnston are very similar. Much of this similarity is due to the identical environment in which both sites are located, but it may also be due to cultural affiliations. It is difficult to tell what the differences between the assemblages mean, as neither site has been completely excavated. These differences, such as the increased usage of fish or the presence of beads in Johnston, may be significant indications of cultural difference. The differences may also be related to the slightly different dates recovered from the sites, or to the as-yet controversial evidence for violence and societal upheaval among the Monongahela at this time. In my opinion, analysis of the faunal remains cannot be conclusively shown to demonstrate cultural affinity, but neither can it show dissimilarity.

Even in these fragmentary assemblages, information could be obtained about the lifeways of the people from the Brant I and Johnston sites. There is a tremendous potential for more research using this data, demonstrating that there is still more to be learned. Different statistical tests and techniques such as MNE and ubiquity calculations may further determine the extent of bias in the sites. In the case of Johnston, a thorough analysis of the flotation results may give a very different picture of the site, one with a heavier reliance on riverine species such as fish and mussel. A study of taphonomy would show the probable cultural and non-cultural factors that have contributed to the appearance of the assemblages today.

The degree of bias in Brant I and Johnston was quite large, but bias affects every assemblage. The analyst must be prepared to examine effects such as sample size,
fragmentation, and taphonomic factors in order to prepare the most feasible analysis possible. New statistical methods will make it possible to perform quantitative analysis on ever more biased sites, but as always these must be used with caution. No assemblage is too biased to yield some degree of information about a site, even if alternative, nonquantitative methods are needed in order to counter the effects of that bias. Despite the difficulties in analyzing this type of assemblage, insights can be gained about the inhabitants who created the faunal debris. Although the amount of bias that affect faunal assemblages can seem overwhelming, many things can be done to ensure that any results obtained are genuine.
Works Cited

Alerich, C. L.

Bettinger, Robert L.

Binford, L.R.

Butler, Mary

Brain, C.K.
1981 The Hunters or the Hunted. Chicago: University of Chicago Press

Chaplin, R.E.

Chiarulli, B.

Chiarulli, B. A., and Neusius, S.W.

2004b Late Woodland/Late Prehistoric Settlement in the Central Allegheny Valley. Indiana University of Pennsylvania. Paper given at the 75th Annual Meeting of the Society for Pennsylvania Archaeology.

Church, F.
1994 An Analysis of the Faunal Assemblage from the Mon City Site (36Wh737). Pennsylvania Archaeologist 64(2):8-39

Cruz-Uribe, K.
Davis, C.E.
1984 A Mortuary Pattern for Monongahela. Pennsylvania Archaeologist 54(1-2)

Dragoo, D.

George, R.L.

Gilbert, A S, Singer, B H

Gobalet, K. W.

Grayson, D. K.

Guilday, J.E.
1955 Animal Remains from an Indian Village Site, Indiana County, Pennsylvania. Pennsylvania Archaeologist 25(2):142-147

Herbstritt, James T

Johnson, William C.
Kelly, L.S. and Cross, P.G.

Kline, R.G. and Cruz-Uribe, K.

Lupo, K.D. and Schmitt, D.N.

Lyman, R.L.

Madrigal, T.C. and Holt, J.Z.

Marshall, F. and Pilgrim, T.

Marshall, L. G.

Means, B.K.
McDermott, J.
2007 Social Change, Social Conflict: A Question of the Emergence of Tribal Warfare in the Middle Monongahela Period, A.D. 1250-1580. University of Pittsburgh

McHugh, William
1984 Archaeological Goals and Methods and Monongahela Systematics. Pennsylvania Archaeologist 54(1-2):26-31

McNab, W. H.

Meltzer, D.J., Leonard, R.D. and Stratton, S.K.

Nass, J.P. Jr. and Hart, J.P.

Neusius, S. W.
2005 Project Report, Laboratory Analysis of Archaeological Materials from the Brant I Site, A Late Prehistoric in Indiana County, Pennsylvania. For Faculty Professional Development Council. Indiana University of Pennsylvania.

Neusius, S. W. and Gross, T.G.

New York Natural Heritage Program

Ramsey, J. and Wymer, D.
2005 A Paleoethnobotanical Assessment of The Brant I Site, (36IN26), Indiana County, Pennsylvania. Bloomsburg University.

Ricketts, T. H.
Rogers, A.R.

Schmitt and Juell

Sciulli, P.W.