# *MIDDLE WOODLAND FISHING METHODS AT THE BLUE WATER BRIDGE SOUTH SITE (AfHo-7)*

**By**

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**Abstract**

This thesis examines the fishing methods used by the pre-contact Native inhabitants of the Blue Water Bridge South site (AfHo-7) through ethnographic and archaeological research, the fish fauna remains and the fishing related artifacts excavated from the site. From these lines of evidence it was determined that spring spawning fish species such as lake sturgeon and walleye were being harvested with the use of harpoons and spears for the former, and fish nets and leisters for the latter. Evidence also strongly suggests the existence of an intensive summer fishery that used nets for the capture of spawning freshwater drum as well as a spring and summer opportunistic fishery that employed fish-hooks and nets. This site was inferred to have followed a spring early-summer macroband settlement pattern with perhaps a minor fall occupation that may have involved fishing for spawning lake whitefish. Based on the overall pattern of settlement and subsistence inferred for the Blue Water Bridge South site and comparisons with other Middle Woodland sites within the central Great Lakes region, it was concluded that the Middle Woodland pattern of settlement and subsistence was highly variable and influenced by both environmental variables and human choice.

# Chapter 1
# Introduction

## Statement of Goal of Study

The purpose of this thesis is to investigate the fishing methods employed by the Native peoples at the Blue Water Bridge South (AfHo-7) site, and by extension, other Middle Woodland peoples. Data will be derived from the fish remains and fishing related artifacts excavated from the Blue Water Bridge South site and will be interpreted in light of information obtained from ethnographic and ethnohistoric sources, archaeological fish research, and fish biology and behaviour. A broader understanding of Middle Woodland fishing strategies will be gained by comparing the conclusions derived from the analysis of the Blue Water Bridge South site with other Middle Woodland sites located within the central Great Lakes region.

## Middle Woodland Fishing Strategies

Most of what we know about the general trends concerning fishing methods employed by prehistoric cultures has come from Cleland's (1982) synthesis on the development and importance of this fishery which focussed on the upper Great Lakes Region. Here he presents an evolutionary model outlining the cumulative adoption of various fishing technologies through time where new innovations were added to those already utilized. Paramount to this model is the suggestion that by the Late Woodland period (ca A.D. 1000) no new fishing technologies were adopted but rather there was a change in the application of existing technologies resulting in an increase in the complexity and efficiency of taking fish (ibid. 1982:773).

This model presents the Middle Woodland period as a time when true harpoons and seine nets were added to the earlier Archaic tool kit of simple spears and hooks. Although other fishing equipment was employed, they are noted as playing a minor role in the Middle Woodland fishery in comparison to netting technology. Cleland (1982:774) proposed that it was the larger temporary working groups required for, as well as maintained by, the seine net fishery that can be credited for leading to significant changes in the Middle Woodland settlement system involving larger and more numerous lakeshore habitation sites.

Cleland’s (1982) model has been criticised for being applied too broadly, not taking into consideration fish availability (Molnar 1997:41-44) and lacking clear cut archaeological evidence (Colley 1990:231-233). Overall, this model has not been widely evaluated. Less than a handful of studies have examined Cleland’s model using archaeological fish assemblages and of those carried out, they pertain solely to the Late Woodland period (see Martin 1985; Molnar 1997; Smith 2002). Because of the large number of fish remains and fishing artifacts excavated from the Blue Water Bridge South site, this site has the potential to contribute to our knowledge and understanding of fishing strategies within the Middle Woodland period.

**The Blue Water Bridge South Site (AfHo-7)**

Located near the present bank of the St. Clair River within Point Edward, Ontario, the Blue Water Bridge South (BWBS) site was excavated in 1994 as part of a salvage excavation carried out in advance of construction activities related to the twinning of the Blue Water Bridge (Mayer Heritage Consultants 1996). The excavations resulted in the recovery of one of the largest faunal assemblages of any Middle Woodland site within the Great Lakes region. Of the over 410,000 items recovered, over 200,000 are fish remains which suggests, along with the roughly 320 fishing related artifacts, that fish were an important component of subsistence (Mayer Heritage Consultants 1996:50-51). Excavations of the BWBS site were carried-out at the location of two bridge foundation piers, referred to as K2 and K3. The prehistoric deposits found within K2 were over 50% disturbed by historic activities and, given such, will not be the focus of this current study except as they can round out our knowledge of the fishing related artifacts found at the site. However, with the exception of an uppermost historic fill layer, K3's prehistoric deposits were intact with up to 12 stratigraphic levels being visible (Mayer Heritage

Consultants 1996; O'Neal 2002:29). Due to variability in excavation strategies and data recording and the small sample sizes in some stratigraphic layers, for analytical purposes the stratigraphic levels were subdivided into relatively discrete "occupational levels" defined from top (latest dating) to bottom (earliest) as Component 1, Fish Layer, and Component 2. The calibrated radiocarbon dates of charcoal from hearths and pit features from K3 indicate that the occupations date between A.D. 140 and A.D. 660, an age estimate reinforced by the styles of artifacts recovered, such as the projectile points and harpoons. Given the short time range of the K3 occupation as a whole and the limitations in the precision of radiocarbon dating, individual date ranges could not be assigned to the above noted cultural levels (O'Neal 2002:29-30) and, as such, relative dating will be employed when discussing temporal differences between levels. In order to maintain stratigraphic control, artifacts and fish remains for analysis were taken only from those squares, 13 in total, where all three occupational levels were represented. The fish sample size totalled 38,582 individual specimens which is sufficient for the purposes of this study.

**The Middle Woodland Period and the Blue Water Bridge South Site**

The Middle Woodland period in southern Ontario spans from approximately 400 B.C. to A.D. 700. Previous syntheses have distinguished three cultural complexes within southern Ontario during this period that include the Point Peninsula in southcentral and eastern Ontario; Couture, in southwestern Ontario; and the Saugeen within central Ontario to the Niagara Peninsula and along the eastern shore of Lake Huron (Finlayson 1977; Spence et al. 1990; Spence and Fox 1986; Wright 1967). Based on a preliminary examination of artifacts recovered from the BWBS site as well as spatial location, it was thought to be representative of the Couture Complex (Chris J. Ellis, personal communication 1997). However, O'Neal's (2002) subsequent MA research on the BWBS site ceramic assemblage indicated that this site had both Saugeen and Couture Complex characteristics, as well as previously unreported ceramic trends that could not be strictly assigned to either. As with most new large Middle Woodland sites reported from previously little known areas, the site has its own unique characteristics.

**Thesis Organization**

This thesis will concentrate on inferring the fishing methods employed by the Native Peoples at the BWBS site and will provide a discussion on how the patterns observed here compare to those described for other Middle Woodland sites within the central Great Lake region. Chapter 2 will discuss the BWBS site and the sample of fish remains and artifacts excavated from this site. In order to provide a context within which inferences about fishing methods used at this site can be made Chapter 3 will provide a discussion of what is known about aboriginal fishing methods historically. Chapter 4 will provide a discussion concerning the fishing artifacts recovered from the site and what they suggest about the fishing methods used. Chapter 5 presents the methodology that will be used for the analysis of the fish remains as well as a discussion on the taphonomic factors that can bias fish assemblages. Chapter 6 will present the results of this analysis as well as the inferences that can be drawn about fishing methods employed at the site from the fish faunal remains in combination with those inferences derived from the fishing related artifacts within Chapter 6. Chapter 7 will compare the inferences drawn about the fishing methods used by the inhabitants of the BWBS site with other Middle Woodland sites within this region. Finally, Chapter 8 will summarize the conclusions made within this thesis.

# Chapter 2

# The Blue Water Bridge South Site (AfHo-7)

## The Blue Water Bridge South Site (AfHo-7) Location

The Blue Water Bridge South (BWBS) site is located within Point Edward, Ontario along the St. Clair River just south of the river's narrowest point where Lake Huron flows into it (Figure 1). The BWBS site was discovered during an archaeological assessment of an area proposed to be impacted by the construction of a bridge that was to be built alongside the already existing Blue Water Bridge that spans the St. Clair River from Point Edward, Ontario to Port Huron, Michigan (Mayer Heritage Consultants 1996).

## Local Environment

The site is located in the Huron Fringe physiographic region which is characterised as a 320 kilometre strip of wave-cut terraces along the glacial and post-glacial Lakes Nipissing and Algonquin (Chapman and Putnam 1984:161-162). The southern portion of this region, and the area in which the site is located, has sandy beach shores that protect a marshy lagoon. Surface soils within the extreme northwest corner of Point Edward predominantly consist of sand. Plainfield sand and Granby sandy loam define the soils of the site, the former being essentially a stone free, sorted outwash with excessive drainage and the latter, a sandy loam which is poorly drained but also essentially stone free. According to a Burwell's survey plan of 1828, much of Point Edward at this time was characterised as swamp and marshlands. Although later in time, the prominence of swamp lands within Point Edward and their proximity to the BWBS site is shown on the 1871 map of Point Edward (Figure 2). During the spring, a sudden input of water due to rain or spring melt, or plugging of the outlet of Lake Huron at the mouth of the St. Clair River due to ice, would cause the marshlands to become inundated temporarily becoming shallow channels and causing part of the village to become a "vertitable island" (Miller 1978:12). Various marsh reclamation projects have occurred since European settlement of Port Edward began in 1845 and by 1903 the marshlands

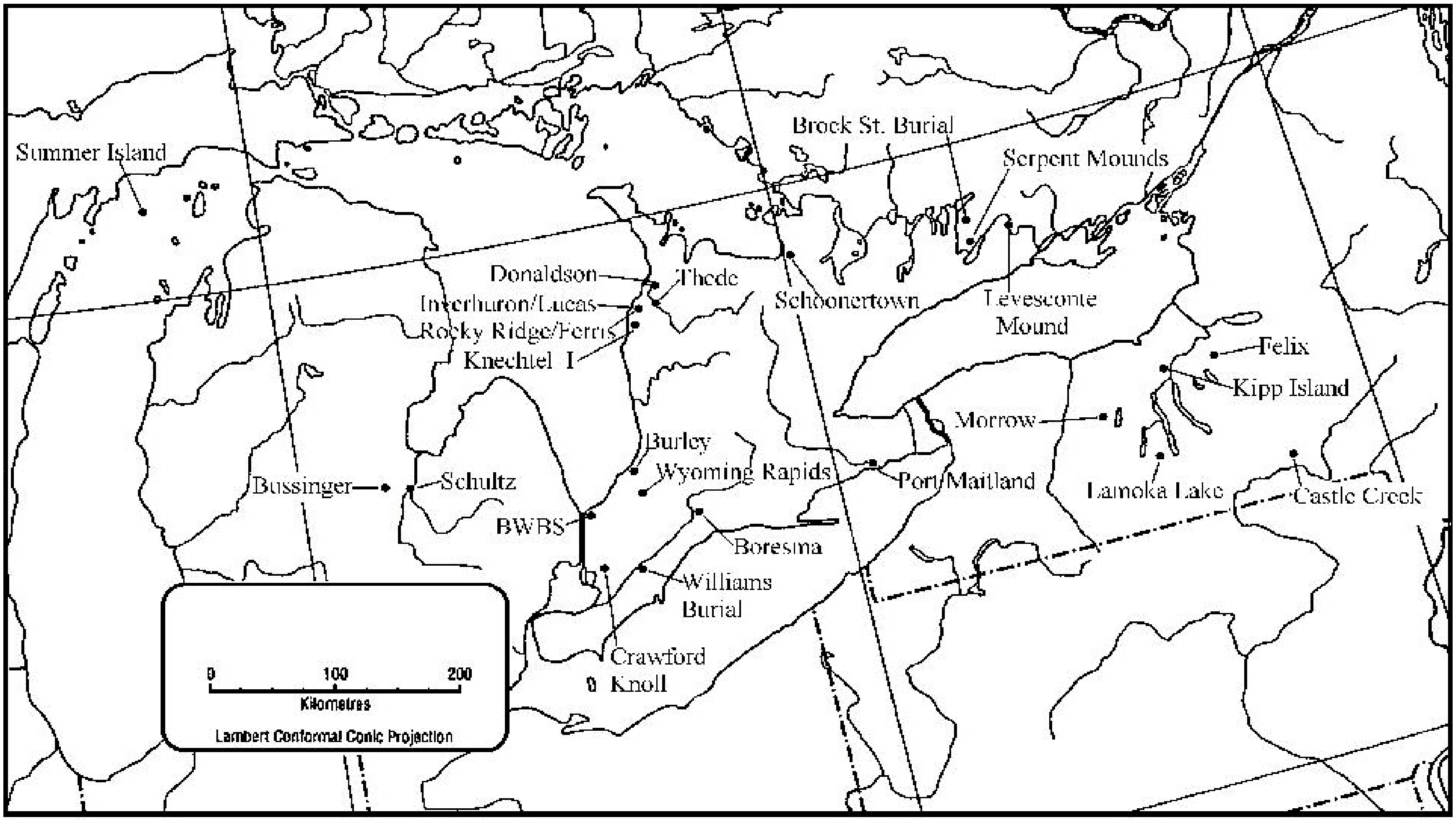


**Figure 1: Archaeological Sites Discussed within this Thesis**

were present only within the south and southeast of the village (Figure 3). An early expedition along the St. Clair River, north of Lake St. Clair, provides the following description of the local environment:

> The country on both sides of the beautiful strait is adorned with fine open plains, and you can see numbers of stags, deer, bears, by no means fierce and very good to eat and all kinds of game, swans in abundance... The rest of the strait is covered with forests, fruit trees like walnuts, chestnuts, plum and apple trees, wild vines loaded with grapes, of which we made some little wine. There is timber fit for building (Miller 1978:12).

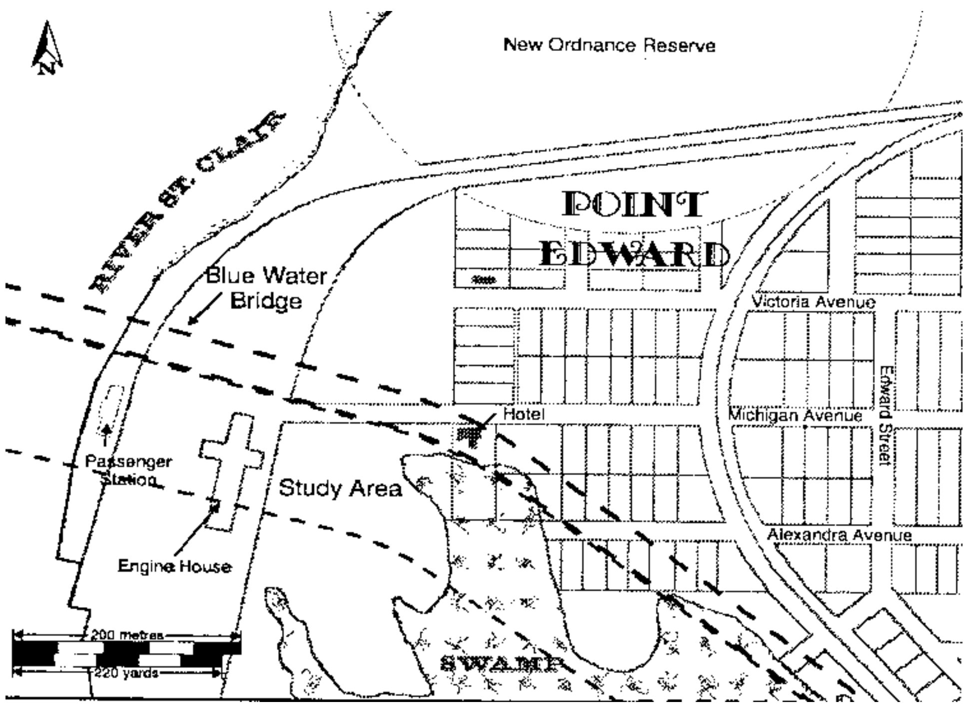


**Figure 2: 1871 Map of Point Edward**

Also at this time, the St. Clair River was reported to consist of a number of channels emptying Lake Huron. The rough nature of the river was noted in 1697 by Father Hennepin:

> We found the current at the entrance of the strait as strong as the tide is before Rouen. We ascended it nevertheless, steering north and northeast, as far as Lake Orleans [Huron]. There is little depth as you enter and leave Lake St. Clare, especially if you leave it. The discharge from Lake Orleans divides at this place into several small channels, almost all barred by sandbanks. We were obliged to sound them all, and at last discovered a very fine one, with a depth of least two to three fathoms of water, and beyond the sandbars almost a league wide at all points (Miller 1978:12).

As late as 1835, Sarnia was referred to as "The Rapids" due to the turbulent waters at the joining of Lake Huron with the St. Clair River at Point Edward (Mayer Heritage Consultants 1996:4) and up to the late 18th and early 19th century it was reported that the St. Clair River consisted of at least three separate channels (Smith 1852:4). Two of these were reported to have gradually filled up becoming covered with vegetation, forming a

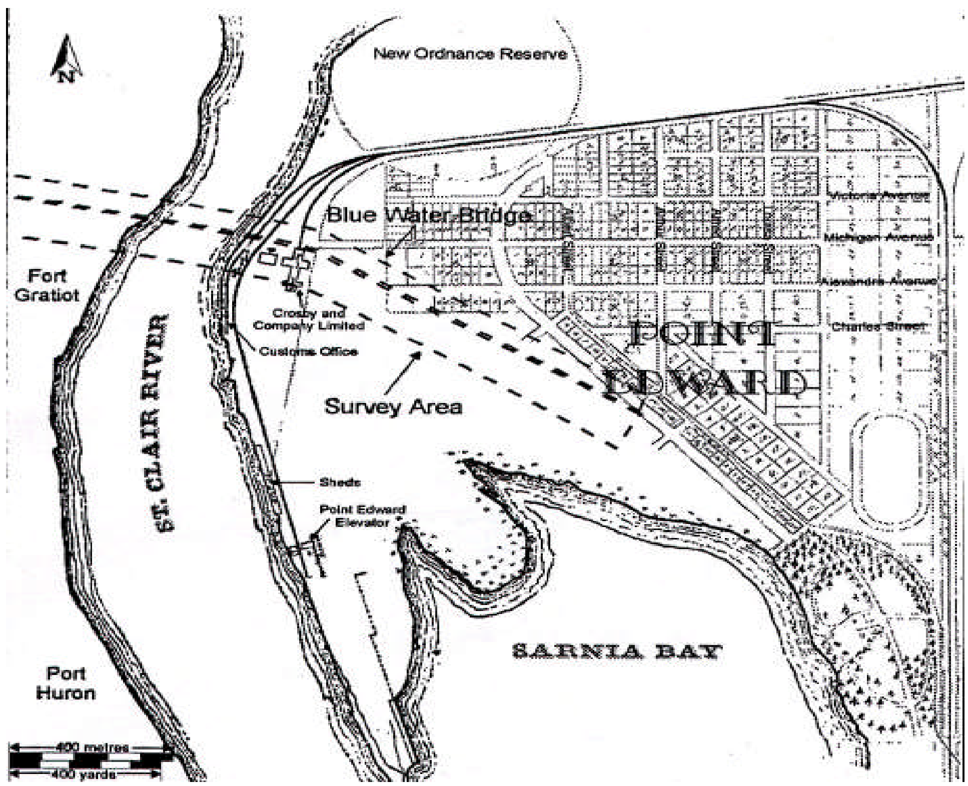


**Figure 3: 1903 Map of Point Edward**

protruding cape and islands, and eventually enclosing the present day Sarnia Bay. The remaining channel formed the present day St. Clair River.

Given the above, it is clear that the present day local environment of Point Edward is different from that which may have been present in the past. What is known is that there may have been a number of different aquatic environments within close proximity of the BWBS site which include river channels, rapids, a marshland and a bay (Sarnia Bay) and this environment may have changed according to sudden seasonal water inputs or plugging of the river channels.

**Excavations**

Based on the Stage 1-3 investigations, the site was estimated to be two hectares in size. However, only those areas of the site to be impacted by the construction were subject to excavation (Mayer Heritage Consultants 1996). Given such, excavations focussed on two areas of the site where two bridge supporting piers, the third and fourth piers, designated K2 and K3 respectively, were proposed to be constructed (Figure 4).

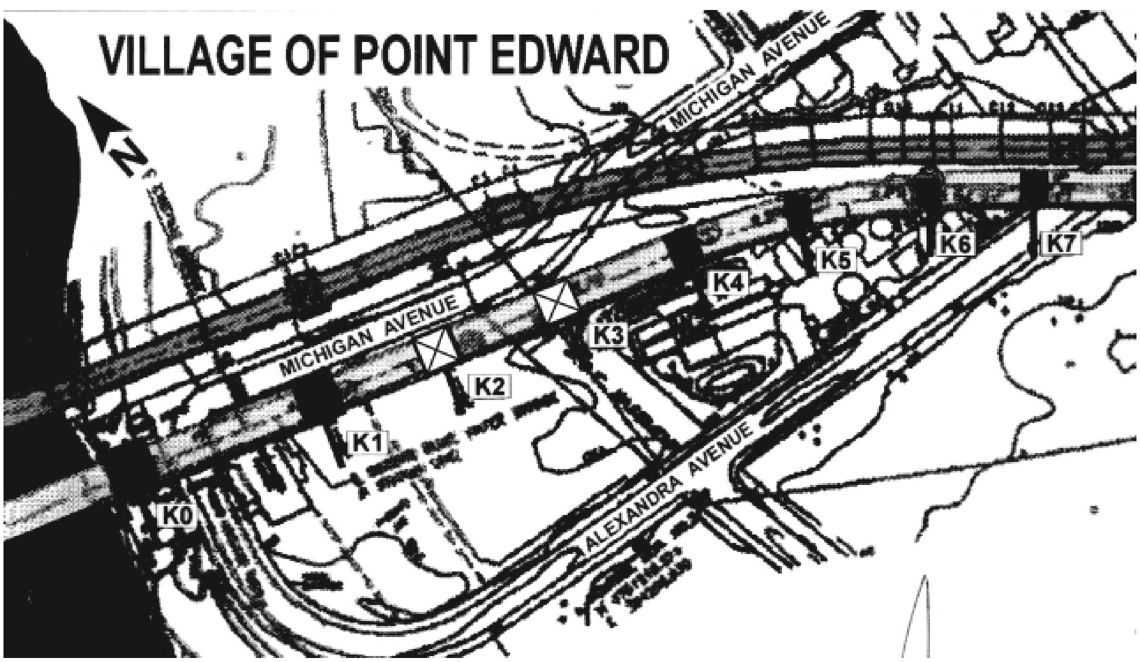


**Figure 4: Location of K2 and K3**

(Michigan Department of Transportation 1994)

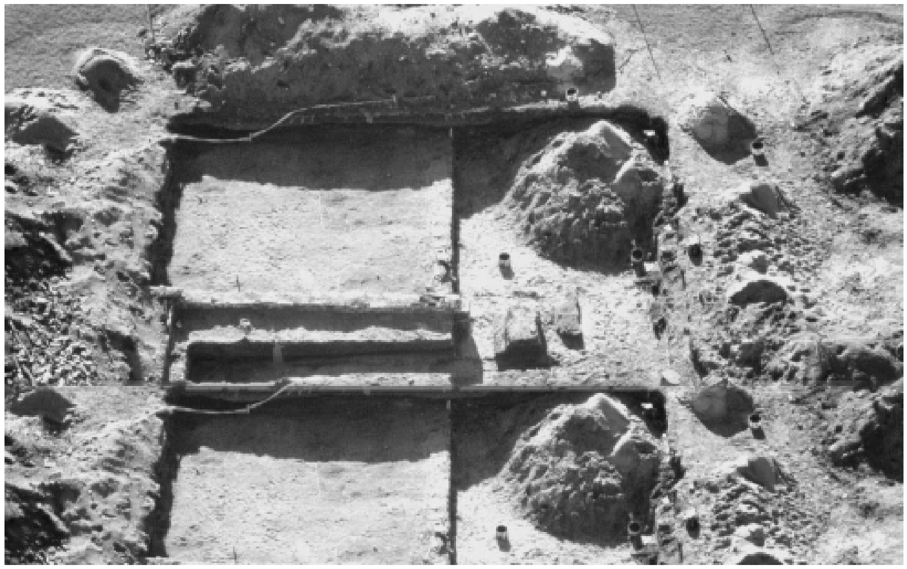

**Figure 5: Overhead View of K2 During Excavations**

The field notes, photographs, and archaeological remains are currently housed at the University of Western Ontario where they are available for graduate research.

**Figure 6: Overhead View of K3 During Excavations**

As previously noted, K2 was found to be heavily disturbed by historic activities (Figure 5) through roughly 50 % of its deposits and, as such, this present study will focus on K3 (Figure 6). However, the K2 fishing related tools serve to round out our knowledge of the fishing methods employed so they will be used here. At K2 an area of 12 by 13 m, or 156 one metre squares, was excavated. In some places K2 actually yielded precontact Native materials in layers both above and below evidence of historic European industrial activity, including building foundations, indicating the high degree of disturbance and suggesting redeposition of Native materials from elsewhere on the site. Nonetheless, and although not directly dated by radiocarbon, the K2 precontact materials as a whole are dominated by artifact forms such as Jack's Reef style corner-notched stone points, cord-wrapped stick pottery and, as will be described in detail later, certain styles of harpoons. This evidence suggests a date later than that for K3 or from ca. A.D. 500-700 (O'Neal 2002:35, 49).

In order to mitigate the impacts proposed for the construction of K3, an area also measuring 12 metres by 13 metres and consisting of 156 one metre squares was excavated. As mentioned earlier, over 410,000 artifacts were recovered that included over 200,000 fish remains which suggests, along with 320 fishing related artifacts, that fish were an important component to the subsistence of the site's inhabitants (Table 1). Although excavations involved a relatively small portion of the estimated total site area, this assemblage is one of the largest recovered from a Middle Woodland site within southern Ontario.

**Stratigraphy**

With the exception of the uppermost layers, the archaeological deposits were relatively undisturbed which is rare for southern Ontario because most sites have been impacted extensively by agricultural or urban activities. Twelve stratigraphic layers were recorded during the excavations and where labelled, from youngest to oldest, 1 through 12 (Figure 7 & 8). The uppermost layers, which may have included a Late Woodland occupation, were previously removed by historic grading activities and had been replaced during the 1960's as part of the Sarnia Bay land reclamation project with five layers of fill

**Table 1: Artifacts Recovered from the Blue Water Bridge South Site**

| Material Category | Frequency | Material Category | Frequency |
|---|---|---|---|
| Abrader | 3 | Drill | 19 |
| Adze | 6 | Fire-Cracked Rock | 5,493 |
| Modified Bone | 109 | Miscellaneous | 5 |
| Antler/Bone Harpoon | 3 | Gorget | 3 |
| Anvil and Hammerstone | 19 | Misc. Ground Stone | 6 |
| Bone (mammal, fish, bird) | 294,280 | Knife | 10 |
| Bone (human) | 2,262 | Historic Misc. | 4 |
| Biface | 279 | Netsinkers | 276 |
| Pottery (body sherd) | 2,905 | Nodule | 8 |
| Pottery (fragmentary) | 11,935 | Organic Concretions | 184 |
| Pottery (rim sherd) | 20 | Projectile Point | 145 |
| Pottery (rim sherd frag.) | 233 | Ochre | 10 |
| Pottery (neck or shoulder sherd) | 8 | Rubbing Stone | 10 |
| Celt | 2 | Scraper | 146 |
| Chipped Stone (misc.) | 8 | Shell Bead | 1 |
| Chipping Detritus | 85,758 | Stone Pipe | 1 |
| Charcoal | 778 | Utilized Flakes | 4,224 |
| Copper Artifact | 4 | Uniface | 16 |
| Core | 872 | Wedge | 4 |
| Carbonized Plant | 778 | **Total** | **410,237** |

identified as, from top to bottom, two layers of topsoil, a brick layer, a slag layer and a gravel layer (O'Neal 2002:23). These fill layers were removed with a backhoe in preparation for excavation of the site. Below this fill layer were seven additional layers, six of which contained artifacts, faunal remains and various features that resulted from the occupation of the site. These had been designated from top to bottom, A, B, Transitional, Fish Layer, C and Subsoil (Mayer Heritage Consultants 1996). The

Transitional and the Subsoil layers are not considered cultural or occupational layers, as artifacts and features had been intruded into them from the layers above (O'Neal 2002: 25-28). The Fish Layer was reported to have consisted of only faunal remains, mostly of fish, and averaging about 4 cm in thickness across the whole of K3 (O'Neal 2002: 26-27 and personal communication 1997). Similar stratigraphy, including the fish layer, was reported to have been observed in an area undergoing road work roughly 35 metres to the south of the excavated area (O'Neal 2002:27).

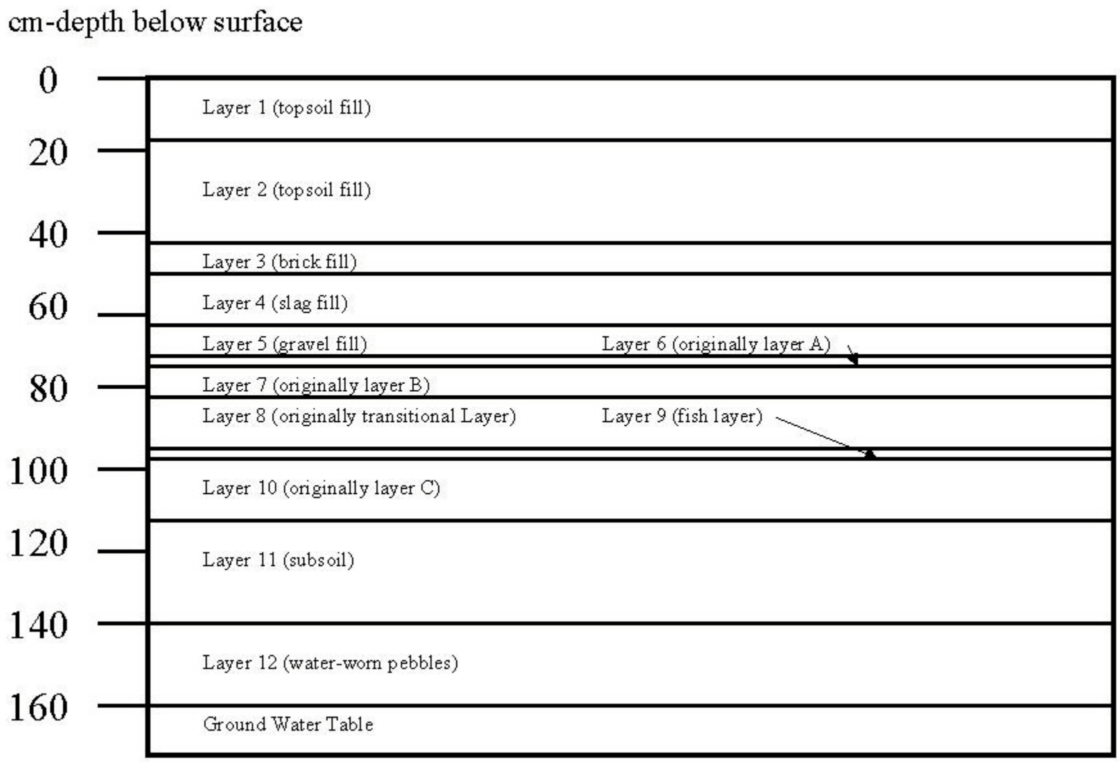


**Figure 7: Stratigraphy of K3**

Given that this site was relatively undisturbed and was assumed to have a number of discrete and datable occupational levels, it was originally felt that it offered the opportunity to examine Middle Woodland lifeways at an extremely rare fine-grained level in terms of individual periods of occupation (Chris Ellis, personal communication 1997). The site was reported to have been excavated at 10 cm arbitrary levels with changes in stratigraphy triggering the end to a level (Bob Mayer, personal communication 1997). However, in reality, the excavations did not always follow this methodology with many squares being excavated without regard to natural stratigraphy and, as a consequence, artifacts from multiple stratigraphic layers were bagged together. Additionally, vertical measurements for the arbitrary levels were taken in reference to the surface created by the removal of the historic fill layer rather than being recorded from a horizontal and level baseline. Given that there is no way of knowing how this surface varied across K3, it is difficult to match up levels identified from one square to those of adjacent squares. The uncertainty of whether discrete occupation layers could be identified was further compounded by the fact that artifacts can move to upper and lower levels depending on soil type and other environmental variables (Villa 1982; Hofman 1986).

**Figure 8: Stratigraphy of East Wall of K3**

The possibility that mixing between layers occurred at this site is supported by the soil report prepared for the site (Guillemette and King 1996). Here, among other things, Guillemette and King examined the particle size of the stratified layers of K3 in order to gain an understanding of the depositional environment of the site. They concluded that the sedimentary structure was consistent with that typically created in a centre river channel depositional environment and noted that the particle sizes of the cultural levels were poorly sorted in comparison to the subsoil level. This difference in sorting was attributed to the mixing of particles between layers. The particles consist mostly of sand and, given such, are highly susceptible to mixing due to trampling and other human activities at the site.

Given the above, for most of K3 the identification of discrete occupation layers was extremely difficult. However, through an examination of field notes and square by square recorded observations, three 'occupational levels' were identified that provided some measure of stratigraphic control in terms of defining occupational periods for the site (Figure 9). This approach was also used by O'Neal (2002) as part of his MA research for the site who, it should be emphasised, independently achieved similar results in terms of identifying levels suitable for analysis which will be described below. In order to maintain consistency and comparativeness between O'Neal's investigation of the site, this analysis will use the same labels for the occupational levels as proposed by O'Neal (2002:26:28).

Component 1

Although the overall extent of the mixing between the various layers was difficult to determine, given the relative thinness of levels A and B, the movement of artifacts between them was quite probable. Consequently, there was uncertainty as to whether layers A and B were separate. Since the artifacts within the Transitional layer were assumed to have resulted from the upper layers, A, B and the Transitional layers were combined as a single occupational level designated Component 1 (O'Neal 2002: 26).

Fish Layer

Based on field descriptions, photographs and O'Neal's observations (2002:26-27), the Fish Layer appeared to be relatively homogeneous. Beyond a number of identifiable pit features that extended into Layer C, the extent to which the Fish Layer mixed with and intruded into the lower Layer C is difficult to assess. However, given the Fish Layer's thickness and extent, it's hard to imagine that there would be much human activity occurring directly on top of it. As such, the Fish Layer will be identified as a separate occupational level, although earlier studies did not refer to it as a "cultural stratigraphic level" (Mayer Heritage Consultants 1996; O'Neal 2002). Unless evidence is found to the contrary, this study is assuming that the artifacts found within this level were the result of a relatively discrete period of human activity at this site.

Component 2

Layer C appeared to be sufficiently distinct from the Fish Layer above it to be defined as a separate occupational layer. However, the Subsoil layer below it contained artifacts that originated from C (O'Neal 2002:28) as the result of the intrusion of

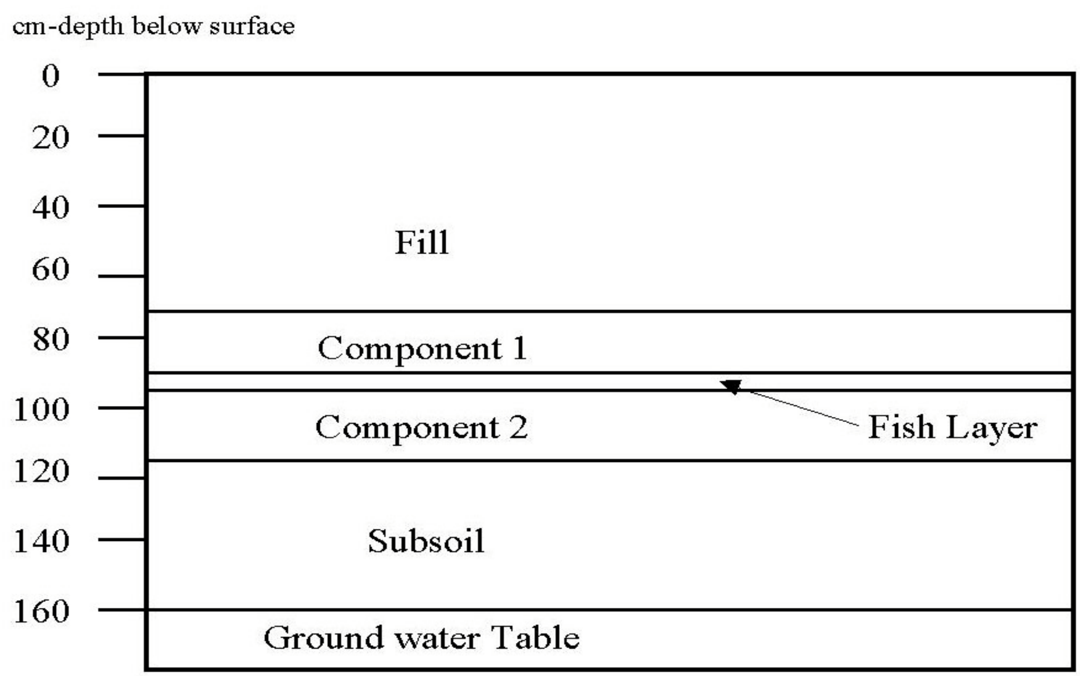


**Figure 9: Occupation Levels Used in this Thesis**

settlement features and the gradual downward movement of objects through the sand through natural processes and human trampling. As a result, layers C and Subsoil have been combined as a single, earlier, occupation level identified as Component 2 (O'Neal 2002:27-28).

**Horizontal Units of Analysis**

The identification of vertical units for analysis in terms of occupational levels provided the opportunity to look at cultural patterns through time. However, due to the

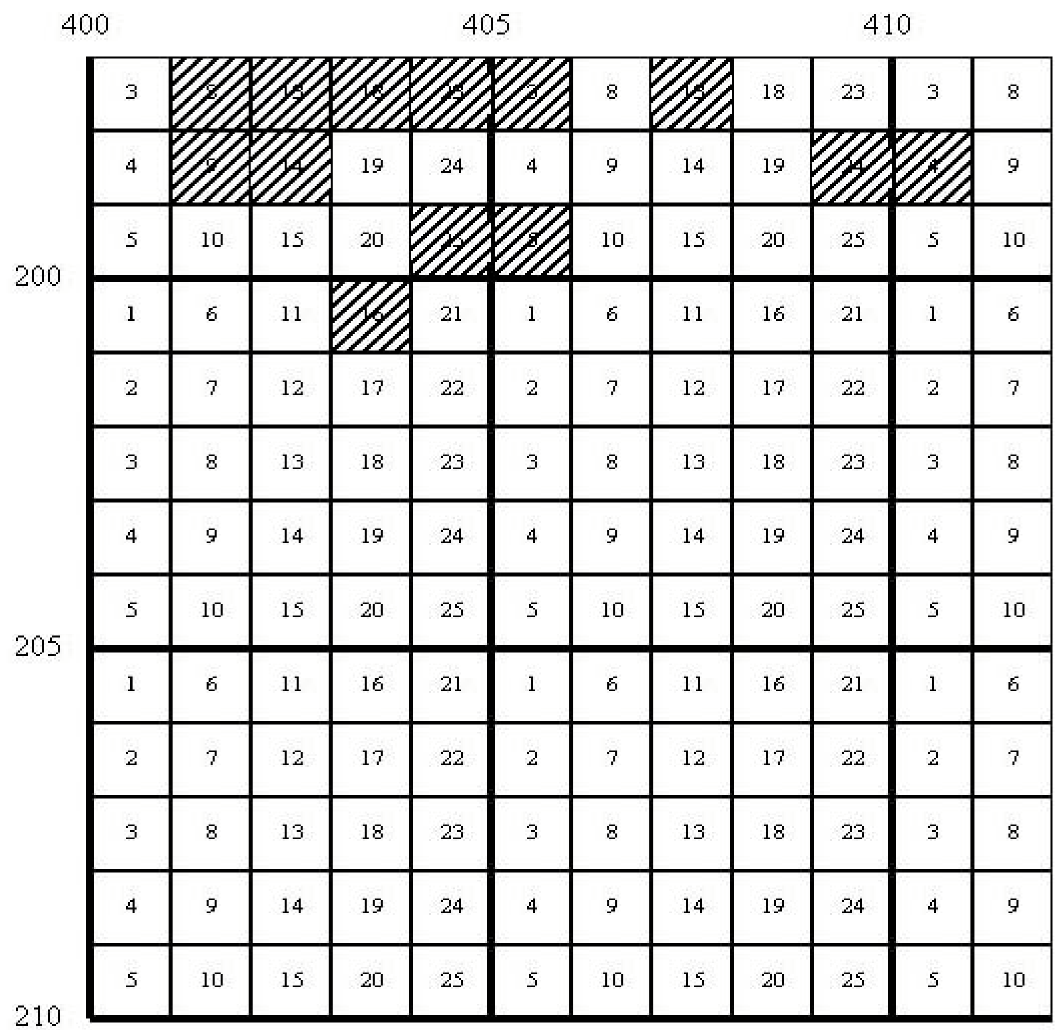


**Figure 10: Location of the 13 Squares Used for the Analysis of the Fish Remains**

above-noted inconsistencies in excavation methodology and recording, these levels would not be identified equally across the site. Through a square by square examination, discrete Component 1, Fish Layer and Component 2 assemblages were identified within 13 one-metre excavation units and it is the information derived from the excavation of these squares that will be the focus of this current study (Figure 10). The fish sample size derived from these 13 units totalled 38,582 individual specimens. In comparison to the overall estimated size of this site, as well as the total assemblage excavated from K3, this is an extremely small sample. However, under the circumstances, it is the largest sample that can be obtained from K3 that will allow for the examination of patterns through time.

**Carbon 14 Dating**

Chronometric dates for the site were arrived at through radiocarbon dating. Charcoal used for the dating was excavated from hearths and pit features located in layers 6, 7, 8, 10 and 11 (Figure 7). Only layer 10, located within Component 2, provided a large enough sample to allow for conventional carbon-14 dating which was carried out at the Environmental Isotope Lab at the University of Waterloo. The charcoal samples from layers 6, 7, 8 and 11 were processed using accelerator technology, which works well with smaller samples, through the services of Isotrace located at the University of Toronto.

**Table 2: Radiocarbon Dates for the Blue Water Bridge South Site**

| **Original Layer** | **Revised** | **Uncalibrated** | **Calibrated** | **% Confidence** |
|---|---|---|---|---|
| 6(A) | Component 1 | 1560+/- 90 BP | AD320 to AD660 | 92.7% |
| 8(Transitional) | Component 1 | 1680+/- 50 BP | AD220 to AD460 | 94.3% |
| 10(C) | Component 2 | 1720+/- 60 BP | AD140 to AD430 | 95.4% |
| 11(Subsoil) | Component 2 | 1510+/- 50 BP | AD430 to AD640 | 95.4% |

The results of this dating are presented in Table 2. Layer 7 provided an uncalibrated date of 19,640 BP +/-150 years which suggests that the charcoal sample was likely contaminated possibly due to the slag and coal layer of fill overburden or its exposure to older material (O'Neal 2002:29). Given such, this date will not be considered further. Calibration of these dates was done by O'Neal (2002) through the use of the OxCal shareware software v. 3.5 which resulted in calibrated date ranges of A.D. 320 to 660 for layer 6, A.D. 220 to 460 for layer 8, A.D. 140 to 430 for layer 10, and A.D. 430 to 640 for layer 11. The relative late date for layer 11 is due to the charcoal dates are statistically identical and it can therefore be concluded that the site represented by K3 dates to between A.D. 140 and A.D. 660 (2002:29). As noted earlier, given the short time range of the occupations and the limitations in the precision of radiocarbon dating, individual date ranges could not be assigned to the cultural levels.

# Chapter 3

## Native Fishing Methods During the Early Contact Period within the Great Lakes Region

### Goal of Chapter

The goal of this chapter is to present what is generally known about early contact Native fishing methods used within the Great Lakes region. Although it would be preferable to provide accounts concerning aboriginal fishing methods from the immediate locale of the BWBS site because of microenvironmental variation, there are three practical reasons for taking this more general approach. First, information concerning contact aboriginal fishing methods specific to the local environment of the BWBS site is non-existent. In fact, in those rare cases where native fishing methods were recorded, for much of the Great Lakes region only the most general observations were made and it is often unclear which specific groups were being discussed (Kinietz 1965:330-338; Rostlund 1952). Second, although there are some excellent historic descriptions, few references are made to the patterns of subsistence or the role of animals and even fewer references are made to Native fishing practices. Finally, since the intent of this presentation is to provide a general context within which archaeological data generated from the BWBS site can be discussed, the use of information derived from the larger Great Lakes region is not overly problematic. Chapter 7 will examine this information in light of what is inferred about the fishing methods employed by the BWBS site inhabitants through the analysis of the fish remains and fishing related artifacts discussed in Chapters 5 and 6 and what is known archaeologically about Middle Woodland fishing methods in general.

### Aboriginal Fishing Methods within the Great Lakes Region

In his discussion on the writings of early European explorers of the upper Great Lakes region Cleland remarked " . . . it is the rare account that does not mention the importance of the fishery" (1982:762). In fact, it is through these accounts that we have become aware of the fishery's significant role in early-contact aboriginal subsistence within this region. For example, in his writings of 1703, French Baron Lahontan reported that the Huron and Odawa within the Mackinac region:

> ...could never subsist here without that fishery; for they are obliged to travel about twenty leagues in the woods, before they can kill any hares or elks... (Thwaites 1905:147).

Although ethnohistoric accounts from the early contact period may provide insight into aboriginal fishing methods used just prior to European influences, these do not necessarily represent precontact patterns of behaviour (Rau 1884:113). Even in situations where direct ancestral linkages can be demonstrated, it is incorrect to view Native cultures as static entities, unchanging from one generation to the next. Additionally, it is important to keep in mind that most of these historic accounts were not generated by trained ethnographers but by explorers, fur traders, missionaries and/or pioneer settlers. Although they may have been keen observers, their accounts should not be accepted without question, especially reports on personal matters. On the other hand, on the topic of fish or fishing practices, Rostlund maintains that the biases of recorders are not a serious concern here:

> ...there were no ichthyological or ethnographical reputations at stake in the sixteenth and seventeenth centuries and no glory was gained nor was any career advanced by saying that a catfish had been seen or that an Indian possessed fish nets (1952:79-80).

Although it has been proposed that most Native populations at contact used essentially the same techniques for fishing (Molnar 1997:19), Cadillac reported that "each country has its own method of fishing" (Kinietz 1965:23). Here "country" could be interpreted to define locations that differ in terms of their hydrological conditions, for example, lakes, rivers, and shallow bays, and in fish species availability. What will be noted below is how these variations have influenced what fishing methods were used within the Great Lakes region.

Background research for this chapter will come from published primary and secondary sources as well as unpublished material. There are only a small number of primary sources that document early contact aboriginal fishing practises within the Great Lakes Region. These include the accounts of Jesuit missionaries recorded within the multi-volume Jesuit Relations translations (Thwaites 1896-1905) which will be cited with reference to the volume and page number (JR volume: page), the writings of the Recollet missionary Father Gabriel Sagard presented within Wrong (1939), the French explorer Samuel de Champlain provided within Biggar (1922-1936) and, finally, accounts from a range of sources provided within Kinietz (1965). Excellent secondary sources for historic native fishing methods include, for example, Cleland (1982), Rau (1884) and Rostlund (1952).

**Fish Nets**

Rostlund (1952:82) reports that the earliest ethnohistoric accounts by Columbus, Cartier and De Soto describe the use of nets by aboriginal populations. However, he states that in many cases it is not clear what type of net is being used. Fish nets are typically categorized based on their function moreso than their form (see Rostlund 1952:91-93) which is not surprising considering different forms of a net can function in essentially the same way. Fortunately, some ethnohistoric accounts from the Great Lakes region reveal much about how these nets functioned, allowing the critical reader to infer the type of net being used.

The net fishery within the Great Lakes region was very important to the subsistence of early contact Native populations. In his discussion of a broad geographical area that encompasses this region, Rostlund states ". . . if the aboriginal fishery of any region deserves to be symbolized by a fish net it was this interior large-lake fishing area"

(1952:85). Based on his estimates, within the region along the Great Lakes to the Mackenzie valley "dip nets, but particularly large seines and set gill nets, the latter used both summer and winter, must have accounted for more captured fish than other [fishing] methods" (Rostlund 1952:85). Within the Great Lakes region, all three of these types of nets have been reported to have been used by aboriginal groups. These will be described below along with the ethnohistoric documentation of their use.

<u>Gill Nets</u>

Gill nets function to ensnare fish by their gills as they attempt to swim through the mesh of the net. Gill nets are kept vertical with sinkers on the bottom and floats on the top and are often anchored to a specific location with the use of larger weights (Cleland 1982:774-776). Gill nets are typically left for a period of time, set in the path of migrating fish, with the location of the net being marked for later retrieval with some type of buoy. As a general rule, the size of fish caught by this method is predictable. It is the shape and size of the mesh that regulates the size of fish that will be captured (von Brandt 1984:207). In fact, fish are most efficiently taken when their girth is roughly 25 percent larger than the size of the mesh (McCombie and Berst 1969). Given such, the larger the mesh the larger the fish that will become entangled in it, at the same time allowing smaller fish to swim freely through it. Von Brandt describes the process of a fish being captured in a gill net:

> In trying to swim through the mesh of netting which is a little smaller than the largest circumference of their body, they get stuck or, in other words, 'meshed'. This can happen at the beginning of the dorsal fin of the fish, but mostly it will be behind the opercula and the fins - i.e. they are 'gilled'. The pressure of the mesh or twine then hooks them so that the fish can go neither forward nor backward. By struggling to become free from the mesh the fish can further entangle itself. It may be gilled, or gilled and entangled, and others, especially the larger ones, can be caught by entangling only, all in the same mesh (von Brandt 1984:355).

The use of gill nets is most effective in calm and clear water that lacks the vegetation that can clog the mesh. With the right kind of floats, gill nets can be used at depths of up to 150 metres (von Brandt 1984:365) making them appropriate for catching deep water fish such as whitefish and lake trout, species of fish often found at depths of up to 30 fathoms, 180 feet or roughly 55 metres. To get to the deeper offshore water, gill nets were used from boats. In 1867, the French missionary Joutel describes the use of gill nets among the Huron for offshore fishing at Mackinac:

> There were fish of various kinds which they catch with nets, made with a very good mesh; and, although they only make them of ordinary sewing thread, they will nevertheless stop fish weighing over ten pounds. They go as far as a league out into the lake to spread their nets, and to enable them to find them again, they leave marks, namely, certain pieces of cedar wood which they call *aquantiquants*, which serve the same purpose as buoys or anchors. They have nets as long as two hundred fathoms, and about two feet deep. At the lower part of these nets they fasten stones, to make them go to the bottom; and on the upper part they put pieces of cedar wood which the French people who were then at this place called floats. Such nets are spread in the water, like snares among crops, the fish being caught as they pass, like partridges and quails in snares. The nets are sometimes spread in a depth of more than thirty fathoms, and when bad weather comes, they are in danger of being lost (Kinietz 1965:29).

Sagard describes a Huron fishing trip to one of the Islands in Georgian Bay that took place in 1623. Canoes were used to place the nets in the water. The use of a gill net is suggested by the observation that the nets were left in place and retrieved the following day. He writes:

> Every evening, they carried the nets about half a league or a league out into the lake, and in the morning at daybreak they went to draw them in, and always brought back many fine big fish such as *Assihendo* [whitefish], trout, sturgeon, and others (Wrong 1939:185-186).

A league represents a variable length of distance over time with an upper limit of 8 km being proposed for "regular Native travel on the lake [Huron]" (Molnar 1997:35).

Seine Nets

Seine nets can take many forms and configurations (von Brandt 1984); however, they all share basic functional characteristics. A seine net functions like a wall (Cleland 1982:774), corralling and holding fish (rather than ensnaring as with a gill net) and then moving them *en masse* to the shore (von Brandt 1984:283) or some other location where they can be retrieved from the net. To function properly the net has to be kept snug and tight to the bottom of the water source as it is moved through the water. This is accomplished by securely attaching many closely spaced sinkers to the bottom of the net. The net is kept upright with carefully spaced floats attached to its top (Cleland 1982: 774-775). However some seine nets have been observed to be staked in place with sticks (Weston 1978). Once set the net is hauled up immediately to corral the fish and draw them to the shore (Cleland 1982:774; von Brandt 1984). Because of how they function, seine nets are most effective in taking fish in shallow water. Since seine nets use a finer mesh than gill nets, seine nets tend to take a wider distribution of sizes of fish and the finer the mesh the more small-sized fish caught. One of the earliest accounts of Native fishing within the upper Great Lakes region was provided by the explorer Samuel de Champlain in 1615 in which he describes Huron ice-fishing within Georgian Bay.

> They make several round holes in the ice and that through which they are to draw the seine is some five feet long and three feet wide. Then they begin to set their net by this opening: they fasten it to a wooden pole six or seven feet long, and place it under the ice, and pass this pole from hole to hole, where one or two men put their hands through and take hold of the pole to which one end of the net is tied, until they came back to the opening five or six feet wide. Then they let the net drop to the bottom by means of certain small stones fastened to the end of it. After it has been to the bottom they draw it up again by main force by its two ends, and thus they bring up the fish that are caught in it. That in brief is the method they use for fishing in the winter (Kinietz 1965:24).

Cleland suggests that this account describes the use of the gill net (1982:762), however, it has been argued that since the net was hauled up immediately, it should be typed as a seine net (Molnar 1997: 24), which is further supported by Sagard's report that the Huron fished under the ice using seine nets attached to lines (Wrong 1939: 98).

The use of both seine nets and gill nets requires a large labour input not only for making, setting, tending and retrieving nets but also for processing and/or preserving the resulting catch (Cleland 1982). The number of persons required to set the nets will depend on its size and configuration (Martin 1985: 80). A net staked in a fixed position may only require one person whereas a large net may require six or more people. Men were described as the makers of nets (Rau 1884:268-269). Reverend Pitezel noted that ". . . the chief was employed in making a gill-net, which labour he performed with great ease and dexterity" (1857:50). Women and girls were noted for making the cordage for the nets:

> ...they make these nets of nettles or wild hemp, of which there is much in most places, and the women and girls spin and twist on their bare thighs (Kinietz 1965:369).

Dip Nets

The use of dip nets is restricted to environments with the appropriate hydrology such as the falls of Willamette (Rostlund 1952:89) or the rapids of Sault Ste. Marie (Kinietz 1965:324). The Jesuit Dablon offers an account from 1669 of the use of dip nets by the Chippewa at the St. Marys River rapids in Sault Ste. Marie which describes the form and function of the dip net:

> It is at the foot of these rapids, and even amid these boiling waters that extensive fishing is carried on, from Spring until Winter, of a kind of fish found usually only in Lake Superior and Lake Huron. It is called in the native language *Atticameg*, and in ours "whitefish," because in truth it is very white; and it is most excellent, so that it furnishes food, almost by itself, to the greatest part of all these peoples. Dexterity and strength are needed for this kind of fishing; for one must stand upright in a bark Canoe,

> and there among the whirlpools, with muscles tense, thrust deep into the water a rod, at the end of which is fastened a net made in the form of a pocket, into which the fish are made to enter. One must look for them as they glide between the Rocks, pursue them when they are seen; and, when they have been made to enter the net, raise them with a sudden strong pull into the Canoe. This is repeated over and over again, six or seven large fish being taken each time, until a load of them is obtained. Not all persons are fitted for this kind of fishing; and sometimes those are found who, by the exertion they are forced to make, overturn the Canoe, for want of possessing sufficient skill and experience (Kinietz 1965: 323-324).

La Potherie also provides an account of its use among the Chippewa in 1716 again at the St. Marys River Rapids in Sault Ste. Marie:

> The Sauteurs, who lived beyond the Missisakis, take their name from a fall of water which forms the discharge of Lake Superior into Lake Huron, through extensive rapids of which the ebullitions are extremely violent. Those people are very skilful in a fishery which they carry on there, of fish which are white, and as large as salmon. The savages surmount all those terrible cascades, into which they cast a net which resembles a bag, a little more than half an ell in width and an ell deep, attached to a wooden fork about fifteen feet long. They cast their nets headlong into the boiling waters, in which they maintain their position, letting their canoes drift while sliding backward. The tumult of the waters in which they are floating seems to them only a diversion; they see in it the fish, heaped up on one another, that are endeavouring to force their way through the rapids; and when they feel their nets heavy they draw them in. It is only they, the Missisakis, and the Nepicirininens who can practise this fishery, although some Frenchmen imitate them. This kind of fish is large, has firm flesh, and is very nourishing (Kinietz 1965:324).

Dip nets were often used in conjunction with a waterfall or an artificial barrier such as a seine net or a weir that acted as a barrier to fish movement (Rostlund 1952:85-89). This practice substantially increased the labour requirements of this method. Although a single person from a perch such as a rock could operate a long-handled dip net, large-scale catches would require the efforts of a number of individuals in both the capture of fish and in the construction and maintenance of gear.

**Spears, Leisters and Harpoons**

Spears enable the fisherman to extend the range and reach of their arms and long spears are especially useful when spearing randomly under ice or in rough or deep water (von Brandt 1984:43-46). The chance of spearing fish is best in waters teaming with fish such as below waterfalls and narrow passages (Rostlund 1952:105-108). Rostlund (1952:105) groups all types of spears reported in Native North America within one of three classes: simple fish spears, harpoons and leisters.

Simple fish spears consist of a long shaft with a sharp pointed end of metal, stone, or wood that is thrown or thrust. Simple spears whose tips have been fire hardened or armed with a fixed point can kill as easily as the other classes of spears, however, it's disadvantage in not being able to hold on to prey. Leisters and harpoons are designed to overcome this disadvantage.

Leisters are spears which also have a fixed head but there are three or more prongs that are located on the side of the shaft and have infacing barbs which function to grasp fish on their sides like ice tongs (Rostlund 1952:105) providing a reasonably secure hold until the fish can be lifted out of the water and removed from the pronged tip.

In contrast to simple fish spears and leisters, harpoons are spears with a detachable and retrievable head or point. The point of a harpoon detaches from the shaft upon penetration and the shaft remains attached to the harpoon point through a line. The shaft then floats to the surface and works as a break or retarder to slow down the fleeing fish (Rostlund 1952:105-108). To haul in the catch, the fisherman picks up the floating shaft and pulls on the attached harpoon line which is connected to the separated harpoon head lodged within the fish (von Brandt 1984: 51).

Although the use of spears has been reported for the upper Great Lakes region by early historic sources (Cleland 1982:763), it is not always clear what classes of spears were being employed. For example, although La Potherie refers to the Saulteaux Ojibwa use of spears while fishing among the islands of northern Lake Huron (Kinietz 1965:323), not enough information was provided to determine the class of spear being used. By contrast, in a report from 1709 by Antoine Denis Randot, an early administrator for New France, it is clear that the use of a harpoon was being described:

> They use a pole eighteen to twenty feet long, at the end of which there is a dart made of a flat and sharply pointed bone with teeth to the top. This dart is pierced and attached with a small cord to the pole in which it fits. When a savage spears a fish in eight to ten fathoms of water this dart leaves the pole and remains attached by the teeth to the body of the fish, which he then draws to him (Kinietz 1965:370).

Spears, in particular harpoons, were used in open water and through the ice to take larger fish. Father Charlevoix writes in 1721 and 1728 that:

> They take three Sorts of the last [trout] among which some are monstrous Size, and in such Numbers, that a Savage with his Spear will sometimes strike fifty in three Hours Time (Rau 1884:272).

The spearing of sturgeon is mentioned so frequently that it can be considered a specialized fishery (Rostlund 1952:106). A description of the use of a harpoon to catch sturgeon was provided by Smith and Snell (1891:203):

> The Indians have for some years been engaged in the capture of sturgeon with spears 25 or 30 feet long having detachable points. They paddle about in the smooth water in the vicinity of the islands watching for sturgeon, which usually lie motionless on the bottom. When one is seen the spear is lowered in the water, its position being clearly marked by a white quill which shows plainly at a depth of 30 feet. When near the sturgeon the spear is quickly plunged into its flesh, the handle becomes detached, and the fisherman seizes the line fastened to the iron and plays the fish until it becomes exhausted, when he draws it to the surface, kills it, and pulls it into the canoe . . . seven fish, averaging 65 pounds, dressed, were brought in by an Indian as the result of one day’s labor.

**Angling**

Angling, also referred to as line fishing or fishing with the use of a handline, is a method of fishing whereby a fisherman holds onto a line which offers to a fish a partially fixed bait on a hook. The fisherman feels with his finger for the bite of the accepting fish and at the right moment attempts to set the hook to prevent the fish from getting away. The fish is then lifted from the water together with the bait (von Brandt 1984:67,81). Rostlund (1952:113, 119) categorizes most of the fish hooks used within historic Native North America into one of three types: gorges, composite hooks, and single-piece carved and often curved hooks. First, the gorge hook, which acts like a small toggle, is a straight item, pointed at both ends, which is made of slivers of bone, wood, copper or stone and is suspended by a line wrapped around its centre. The composite hook, as the name suggests, is made up of individual parts that are lashed together, and can vary in shape, material and other details. The third type of fishhook is the curved fishhook which consists of a single piece of material, most commonly cut from bone but they can also been made from shell and, although rare, of stone.

Angling can be used to catch fish under as many different water conditions as seine and gill nets; however, they are limited by the species that will accept them (Cleland 1982:764; Rostlund 1952:81). For example, salmon have been known not take a hook during their spawning run, and it is reported that herring and lake whitefish will not take a hook at any time (Rostlund 1952:113). Additionally, unlike gill or seine nets, this method of fishing will often result in catching only one fish at a time, making it labour intensive when larger catches are desired (von Brandt 1984:80). One way to get around this is to use a drift line or trot line which would allow for the angling of many hooks on a single line increasing the numbers of fish caught on each line (von Brandt 1984:92, 94-95).

Sagard reports the presence of composite hooks made of wood and a bone bar tied with hemp cord within the stomachs of fish thought to be too big to be landed with the line (Wrong 1939:189). He also reported the Huron using a trotline behind their canoe baited with frog skin (1939:60).

**Weirs**

Weirs function to constrict the migration of fish enabling them to be captured (Rostlund 1952:102) whether, for example, through spearing or with the use of dip nets. Like the dip net, the use of weirs is restricted by the water conditions of the local environment. They cannot be built in deep or swiftly moving water and they are most successful when placed in environments were the movement of fish in quantity takes place naturally as during spawning runs, or where it is induced through fish drives. They can vary in construction but they all still function in much the same way. They have been made of stone, wood or even stretched net (Rostlund 1952:102). The popularity of the use of weirs for fishing in some areas is suggested by its continued use over long periods of time. For example, Johnston and Cassavoy (1978:697) have documented the use of fish weirs going as far back as 4500 B.P. at the Atherley Narrows located between Lakes Simcoe and Couchiching. Champlain describes the use of the weirs by the Huron at this same location in 1615:

> There is another lake immediately adjoining [Lake Simcoe] draining into the small ones [Lake Couchiching] by a straight [Atherley Narrows], where the great catch of fish takes place by means of a number of weirs which almost close the straight, leaving only small openings where they set their nets in which the fish are caught; and these two lakes empty into the Freshwater Sea [Georgian Bay of Lake Huron by way of the Severn River]. (Biggar 1929: 56-57)

Johnston and Cassavoy (1978:707) propose that spring spawning fish such as walleye, suckers, catfishes, bullheads, perch and pike, and fall and early winter spawning fish such as lake trout, cisco, herring, and whitefish where captured at this location.

Although it is unclear which northern population he is reporting on, in 1709 Antoine Denis Randot also describes the use of weirs to catch fish: “they make barriers, leaving only one exit where they place some nets which they draw up full of fish when they have need of them” (Kinietz 1965:369).

According to Rostlund (1952), although seine and gill nets are “the most advanced and efficient fishing methods known to the American Indians", weirs and traps accounted for more fish than any other method and "were not only the most widely but, so far as can be judged from the record the most commonly employed fishing gear". He views weirs and traps as being "economically by far the most important" (1952:102). However, within the upper Great Lakes, weirs have only been reported to have been used at the Atherley Narrows and, therefore, may have played a minor role within this region. The labour requirements to build and maintain these artificial structures was no doubt very great and required the cooperation of many individuals for this as well as the butchering and processing of the catch. However, catches were no doubt large making this method of fishing an efficient use of resources.

**Minor Fishing Methods**

The proceeding discussion focussed on the major methods of fishing reported for the Great Lakes region within the ethnographic literature. However, other methods of fishing may have been utilized but for some unknown reason may not have attracted enough interest to be worthy of mention. Fish could be caught by hand, after being stunned with a stick (Wheeler and Jones 1989:167) or a rock, or with a bow and arrow, for example. Also, there are other methods of fishing such as poisoning and the use of torchlight that were present during the early contact period within Native North America (Rostlund 1952). However, their presence within the Great Lakes region was not extensively documented within the ethnographic literature. Although one must not immediately discount these methods, they leave little in the way of diagnostic traces within the archaeological record from which they could be inferred.

**Summary of Aboriginal Fishing Methods**

In comparison to all the fishing methods described above, the use of the seine and gill nets were reported more often and therefore most likely provided the largest proportion of the total catch for most groups within the Great Lakes region. Gill nets were reported to be particularly effective for catching deep-water fish species such as whitefish and lake trout whereas seine nets were observed being used in both open and ice-covered water for catching shallow water species such as suckers, freshwater drum and walleye. Labour requirements for constructing, maintaining, and using these nets were high and involved the co-operative efforts of both sexes. Canoes would have been needed to set and retrieve the deep-water gill nets although they would not be essential to the use of the seine net.

Dip nets were used in very specific but natural hydrological conditions such as waterfalls and rapids to capture fish moving up river to spawn. As noted earlier, their use required the combination of strength, agility, and skill and consequently could be used only by select individuals to capture fish although the making of gear and the processing of fish could be done by others.

A method of fishing that would have the same seasonal and locational versatility as nets would be angling. Although the labour requirements would be much lower than that required for nets, the overall return would be relatively small in comparison and would only be effective in capturing species that would take the bait. Nevertheless, a single individual at a particularly good fishing spot could catch enough fish during a few hours of work to feed an extended family for a number of days. Overall, angling was not widely reported within the upper Great Lakes region in the historic period but as a more individualistic and familiar activity it may have elicited fewer comments from European observers.

Spears, leisters and harpoons were often reported to be employed in the capture of larger species of fish such as the sturgeon and lake trout. These were used under many different hydrological conditions including under ice, below waterfalls, or in deep water.

Weirs may have contributed significantly to fish catches in those areas that would support this technology but in comparison to other methods employed within the Great Lakes region they may have only played a minor role.

## Chapter 4

## Fishing Artifacts Recovered from the Blue Water Bridge South Site

This chapter will focus on the fishing related artifacts found during the excavations of the BWBS site. These kinds of artifacts are considered the most clear-cut evidence for inferring fishing methods (Wheeler and Jones 1989:169). The information provided in Chapter 6 concerning the identification of fish species present at this site, their behaviour and what method of fishing works best to catch them, along with the ethnographic literature on fishing methods presented in Chapter 3, will be used within this chapter to infer fishing techniques employed by the occupants of the BWBS site. Although similarities and differences between the BWBS site and other sites within the upper and lower Great Lakes will be provided within this chapter, detailed comparisons between these sites, as well as what this suggests about Middle Woodland fishing methods will be presented in Chapter 7.

As mentioned previously, a total of 320 fishing related artifacts were reported to have been recovered from the BWBS site. This material included 276 netsinkers, three antler/bone harpoons, one barbed bone point and 50 gorges. The identification of these items is based on their resemblance to pre-existing artifact types and those described in the ethnographic literature. The antler harpoons and points as well as some of the gorges were detailed previously by O'Neal (2002). However, the entire modified bone assemblage was reanalysed by this author because no photos or catalogue numbers were presented that would indicate which of the modified bone artifacts were identified by O'Neal.

### Bone and Antler Fishing Artifacts

Before beginning the discussion on bone and antler fishing artifacts recovered from the BWBS site it is important to note that because bone and antler are very strong and flexible materials, they lend themselves to be shaped into a number of artifact types which, besides fishing equipment, include items such as awls, punches, gravers, matting/netting needles, and so on. As with lithic tools, when a bone or antler artifact no longer performs optimally either because it is damaged or worn, rather than being discarded, it is sometimes reshaped and reworked into a different tool to perform another or similar function. In fact, one piece of bone or antler may be employed to carryout a number of different tasks over its life span with minor modification. This adds support to the old adage that form does not always reveal function. For example, a long bipointed artifact made of bone or antler could function just as well as a leister tang as it would as a bone awl or punch. If it breaks, its pieces can be modified into smaller bipointed artifacts such as leister points, which would function just as well as gorges, parts for composite fish-hooks, awls, etc. It is often an artifact's last use that is reflected most visibly through the form or observable patterns of wear. Because of this fact, for bone and antler artifacts that show evidence of performing a number of functions, the research focus of the analyst will influence how the artifact will be typed. In this particular case, since the identification of bone and antler fishing related artifacts is desired, those artifacts that resemble these in terms of form, despite more recent modification that suggests alternative usage, will be identified as fishing artifacts.

<u>Harpoons and Bone Point</u>

Only one harpoon was recovered from K3 (Figure 11b). It was recovered from 200-405, subsquare 2 at 27 cm below the historic fill layer. Although not from one of the 13 squares which were the focus of the fish analysis, according to O'Neal (2002: 48) its provenience indicates it is associated with Component 2. It is poorly preserved with its base partially missing. Constructed from bone**,** this specimen is a barbless, conical, toggle-headed form with a line hole near the end of the socket. It measures 67 mm in length and 18 mm in width (diameter), and has a hole diameter of 5 mm (Table 3). Similar specimens have been recovered from other Middle Woodland sites (see Figure 1) including: Donaldson (BdHi-1)**,** located on the north Bank of the Saugeen River, Bruce County, Ontario (Finlayson 1977:434, Figure 26; Wright and Anderson 1963:49, 88); Schultz (20SA2) located on Green Point within the Saginaw River Valley, Michigan

(Murray 1972: Figure 72); Summer Island (20ED4) in the northern Lake Michigan basin (Brose 1970:141, 152, Plate XXVl-s); and several other sites in adjacent areas of northern and southeastern Ontario (Mason 1981:275) and Minnesota (Wilford 1955). This type of harpoon also has been found on sites going back as far as the Late Archaic period, for example, from the Portes de Morts site, Wisconsin (Mason 1965).

The remaining two antler harpoons and antler bone point were recovered from K2. As mentioned previously, K2 seems to date mainly to just after the uppermost/later preserved Component 1 at K3. Although its fauna was not the focus of this current study, it can provide useful information concerning cultural affiliations and dating of the BWBS site as a whole and will therefore be described below.

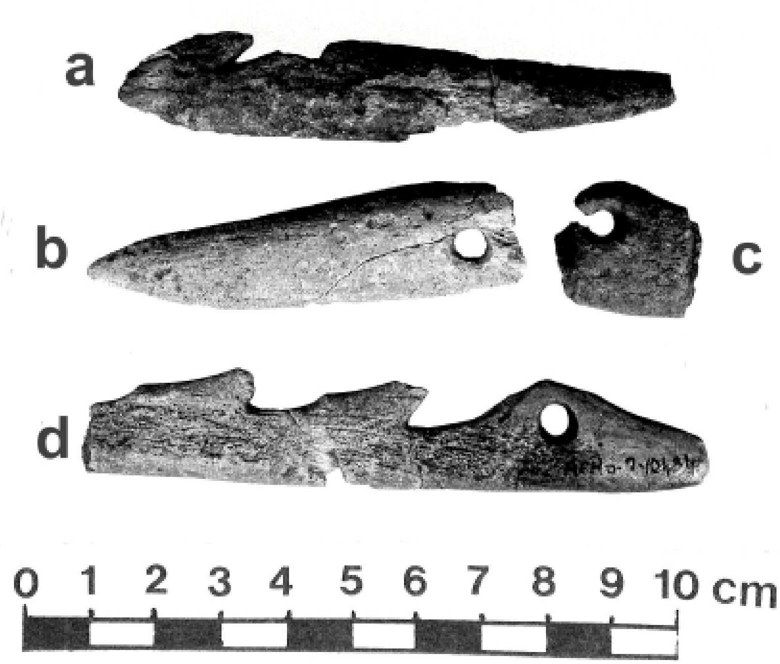


**Figure 11: Bone and Antler Harpoons and Point**

The first harpoon to be discussed from K2 is reasonably well preserved although it is missing its tip (Figure 11d). It is constructed from antler and has at least two barbs on its one side (unilateral) with a line hole located within a widened portion above the contracting proximal end. Minimally, it measures 94.3 mm long by 17.5 mm wide by 7.1

mm thick. The line hole diameter is 5 mm (Table 3). This specimen is typed as a unilaterally barbed harpoon.

**Table 3: The Harpoons' and Bone Point's Metrics**

| Artifact | Max. Length | Max. Width | Thickness | Hole Diameter |
|---|---|---|---|---|
| a | 86 mm + | 16 mm | 6.5 mm | n/a |
| b | 67 mm + | 18 mm | n/a | 5 mm |
| c | n/a | 20 mm | 10 mm | 4 mm |
| d | 66 mm + | 17.5 mm | 7.5 mm | 5 mm |

The second harpoon from K2 is represented only by the segment of the widening stem above the broken line hole (Figure 11c). Constructed from antler, it appears to have been deliberately cut from its fore-section, probably during an attempt to fix the broken hole (O'Neal 2002:48). The existing fragment measures 22.1 mm long, by 19.7 mm wide by 9.85 mm thick, has a hole diameter of 4.5 mm (Table 3). Although it is fragmentary, the presence of the line hole and the overall form of the recovered piece suggests that it comes from a unilaterally barbed harpoon like that just described.

The final artifact recovered from K2 resembles others that have been typed as unilaterally barbed points (Ritchie 1973*)*. Constructed from antler it has a single complex barb along one side of the distal end and has a tapered stem (Figure 11a). Minimally it measures 85 mm in length, 5.4 mm in width, 6.8 mm in thickness (Table 3).

Very similar examples of the harpoons and barbed point recovered from K2 have been found at a number of sites in central to western New York and southern Ontario that Ritchie (1980: 234-266) assigns to a late Middle Woodland Kipp Island Phase. The Kipp

Island site in central New York, from which the phase gets its name, has both burial and habitation components that date from the early to the late Middle Woodland period indicating a continuous 600 year occupation by Point Peninsula groups (Ritchie 1973:155) but Ritchie (1980:228-253) dates the Kipp Island Phase to ca. A.D. 500-750. The single unilateral antler point recovered from K2 is almost identical to the one found at the Kipp Island No. 3 site located within Seneca County, central New York (Ritchie 1973:79.21), with a radio-carbon date of A.D. 630+/-100 years (1973:155). Also found here was a unilateral antler point with an impressive 12 barbs (Ritchie 1980: Plate 80). Other sites that have unilateral antler points but with two or more barbs include the Brock Street Burial site, located north of Lake Ontario within Peterborough County, Ontario, and a child's burial site at Port Maitland, Welland County, Ontario, just north of Lake Erie (1980: Plate 81). According to Ritchie (1980), Kipp Island Phase sites with unilaterally barbed antler harpoons similar to those found in K2 with two or more barbs include the Williams site burial near Chatham, Kent County, Ontario, as well as the previously mentioned Kipp Island No. 3 site (1980: Plates 79-2 &3). In addition to the antler harpoons and points, other notable similarities between K2 and this phase include the dominance of Jack's Reef projectile points and a high percentage of corded pottery (O'Neal 2002:32-35, 76) as well as the absence of conical toggle-head harpoons (Ritchie 1980:245). Given the co-occurrence of artifact types just noted, a late Middle Woodland date for most of the K2 Native materials is quite probable (O'Neal 2002:49) indicating an age of about A.D. 600-700 or slightly younger than the K3 deposits which, as noted earlier, have been assigned an age of A.D. 140 to 660.

Harpoons similar to those from K2 have been found at non-Kipp Island Phase sites as well but these also appear to fall within the same later time range. For example, the Bussinger site located within the Saginaw Valley, Michigan, according to the investigator of this site, is related to materials recovered from the Kipp Island Phase, although it has dates ranging from A.D. 600 to as late as A.D. 1000 (Fitting 1970:169).

Given the extent and nature of historic modifications to the site and the differences in dating between K2 and K3, two possible site alteration scenarios come to mind. It is possible that the younger deposits, as seen at K2, may have been present at K3 but have been removed during the historic period truncation of that area. Alternatively, not only may K2 represent much disturbed in situ occupations in the ca. A.D. 600-700 time span, but given that some of the aboriginal materials were found in secondary deposits actually overlying historic European occupation debris, some of the deposits at K2 might represent these later occupations scoured from other areas of the site including even K3 and pushed to their new location at K2 (Chris Ellis, personal communication 2003). In any event, the harpoons and bone points, as well as the projectile points, appear to function better as temporal indicators than the pottery recovered from the Blue Water Bridge South site (O'Neal 2002).

Spear Prong or Valve

An unusually shaped modified bone recovered from the Fish Layer within K3 200/400, subsquare 16 at a depth of 8-32 cm below the historic fill, Cat. No. 5204, might be a spear valve or prong (Figure 12a). Its provenience places it within the Fish Layer. With a slightly lens-shaped traverse section with one pointed end and the other blunted, its length is 48.9 mm and width is 9.25 mm. It is slightly convex in longitudinal profile so that the pointed end sticks up slightly when the convex face is lain on a flat surface. It has a depression for roughly two-thirds down its length from the blunted end possibly where the binding would attach it to a prong. Examples of this type of artifact have not been found within the literature for the upper or lower Great Lakes region. Therefore, confirming its identification is difficult. However, it very closely resembles the historic period antler valves from the Northwest Coast as illustrated in Stewart (1982:71-72).

Compound/Composite Fish-hook and Bone Point

One single pointed artifact recovered from the BWBS site, Cat. No. 8658, may be an example of the small bone points used to make a compound or composite fish-hook (Figure 12b). It resembles the bone points recovered from other sites in being bevelled on one side (Ramsden 1971:22-23). The bevelled end of this point would rest against a wood or bone shank to which it would be bound (Ritchie 1980:48) much like that described for those made of hawthorns found at the Late Woodland Castle Creek site in New York. At Castle Creek the items still had preserved cordage and a trot line with almost a dozen dropper lines attached (Ritchie 1969:278-279). Unfortunately, this artifact from the BWBS site assemblage was recovered from the disturbed overburden in K3 so its exact provenience and age is not known.

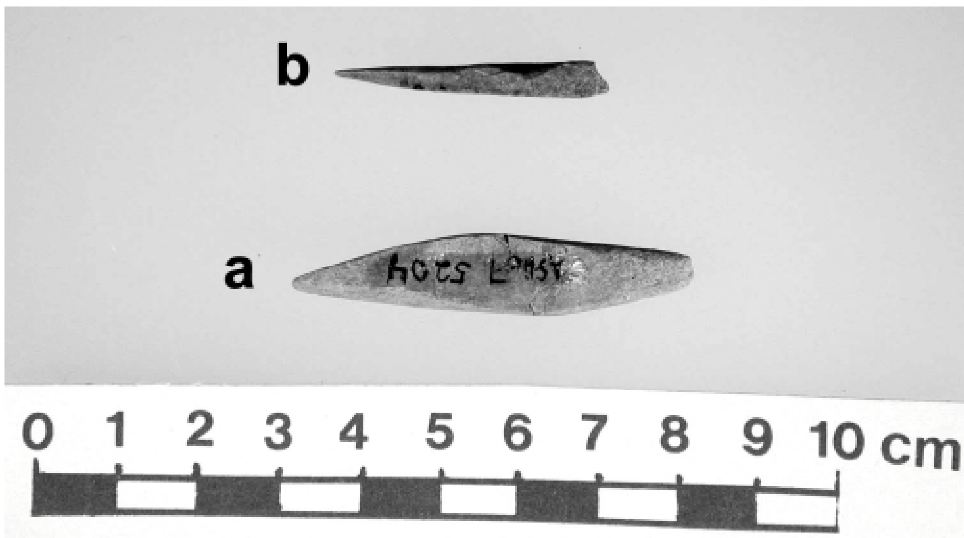


**Figure 12: Spear Valve or Prong and Bone Point for Composite Fish-hook**

Similar artifacts have been recovered from Archaic Lamoka Phase sites (Ritchie 1980:48), the Rocky Ridge site (Ramsden 1971) and the Crawford Knoll site (Ellis et al. 1990: Figure 4.26). Also, given their small size and form, some of the bone barbs recovered from the Knechtel 1 Late Archaic site resemble those bone points recovered from the BWBS site (see Wright 1972: Plate 3 Figure 14, Plate V Figure 8 and 22, Plate VI, Figure 23 & 24). However, since metrics are not available, this is only a guess based on similarities in appearance.

None of the Middle Woodland sites described above reported the recovery of bone points similar to those from the BWBS site. It is not known whether this reflects an absence of use of composite fish-hooks with a bone point, or that they have been missed during analysis, or something else. It is quite possible that they were not recognised as such. With the exception of one specimen, those within the BWBS site collection were originally catalogued as possible bone awl tips. However, given their small size and the sharpness of the point this interpretation is unlikely.

Gorges

As mentioned in Chapter 3, gorges are bi-pointed implements made of slivers of bone, wood, copper or stone and are suspended by a line or leader (Rostlund 1952:113, 119). They are typically lens-shaped in transverse section and some have visible constrictions or slight grooves across the centre of the shaft (Brose 1970:142) to facilitate the tying of the line. It is believed that the line was tied around the middle of the gorge which was then wrapped in bait. When it was swallowed by the unsuspecting fish the gorge turns in the fish gullet or stomach snagging the fish from the inside (Mason 1981).

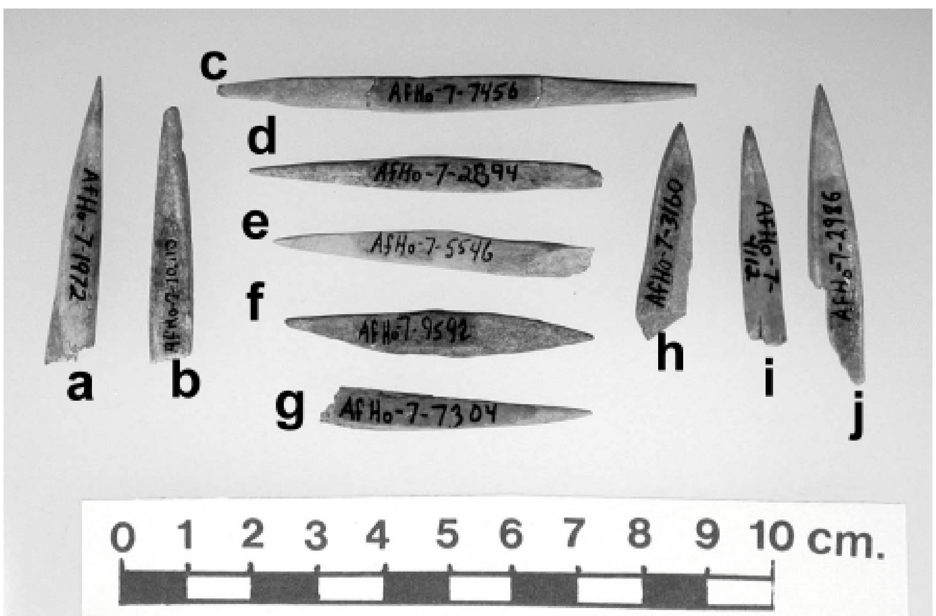


**Figure 13: Bone Gorges**

Gorges could be used on a line either singly, or in bunches with several of them and their respective leaders as with, for example, a trot line.

Ten bone gorges were identified by the author within the BWBS site's modified bone artifact assemblage (Figure 13a-j) which includes seven from K3 (two from Component 1 and six from Component 2), and two from K2 of unknown depth. An additional five modified bone artifacts may be broken pieces of gorges but it is difficult to tell based on the current condition of these artifacts. All of these fragmentary artifacts were derived from K3 Component 2. All of the gorges, including the possible examples, were constructed from mammalian long bone, most likely ulnas, are relatively straight and have sharpened points when at both ends when complete. None of these pointed ends show evidence of end wear that would suggest use as awls or some other tool form. Their provenience, condition and metric data are detailed in Table 4.

The gorge is considered a common prehistoric fishing tool (Ferris and Spence 1995) found on sites from as early as the Middle to Late Archaic period around 3500 B.C. (Ellis et al. 1990; Ritchie 1980). In particular, they have great antiquity within the general Great Lakes area. For example, in New York State they have been documented on the Archaic Lamoka Phase sites such as the Lamoka Lake site itself dated at ca. 2500-2000 B.C. (Ritchie 1936:4, Plate IX; 1980:31, 47, Plate 12) and at the Brewerton Phase Frontenac Island site, dating to ca. 3000 B.C., where several were recovered in a heap suggesting use on a trot line (Ritchie 1969; 1980:48). In southern Ontario they have been reported from several Terminal Archaic sites dating to ca. 1500-800 B.C. including the Rocky Ridge site and the Knechtel 1 site, both along the east shore of Lake Huron (Ramsden 1971:23; Wright 1972:37, Plate V. fig. 24, Plate VI fig 20), and possibly on the Crawford Knoll site in the Lake St. Clair delta area (Ellis et al. 1990:112-113, Figure 4.26).

In terms of the Middle Woodland period, gorges have been reported on sites assigned to the Kipp Island Phase, which include the Port Maitland site noted above, and the Felix site located on the Seneca River in Onondaga County, New York (Ritchie 1980:246). Gorges also have been reported for some earlier Point Peninsula sites, for

**Table 4: The Bone Gorges' Metrics**

| Cat. No. | Location | OL | Condition | Length (mm) | Width (mm) | Photo |
|---|---|---|---|---|---|---|
| 1972 | 205/400 ss7, 40-60 cm | 2 | 2/3 | 44.75 | 7.38 | a |
| 10110 | (K2)190/405 ss6 to 10 depth unknown | ? | 2/3 | 39.42 | 6.75 | b |
| 7456 | 195/405 ss15, 43-80 cm | 2 | complete | 73.51 | 5.565 | c |
| 2894 | 205/405 ss5, 22-60 cm | 2 | 4/5 | 54.99 | 4.50 | d |
| 5546 | 200/400 ss21, 010-28 cm | 1 | 3/4 | 48.90 | 5.81 | e |
| 9592 | K2 185/405 ss14&15 00-15 cm | ? | complete | 47.45 | 6.99 | f |
| 7304 | 195/405 ss12 feat 302 60dbs | 1 | 2/3 | 41.81 | 6.51 | g |
| 3160 | 205/405 ss11, 30-55 cm | 2 | 1/2 | 33.80 | 7.82 | h |
| 4112 | 200/410 ss6, 28-60 cm | 2 | 1/2 | 34.22 | 6.60 | i |
| 2986 | 205/405 ss7, 40-60 cm | 2 | 4/5 | 46.31 | 7.85 | j |
| 2114* | 205/410 ss16, 33-54 cm | 2 | 1/3 | 22.75 | 6.55 | na |
| 3901* | 205/410 ss9, 42-63 cm | 2 | 1/3 | 23.15 | 6.65 | na |
| 8758* | 200/405 ss11, 44 cm, feat 191 | 2 | 1/3 (calcined) | 20.21 | 6.39 | na |
| 2355* | 205/410 ss22, feat 160, 50 depth below surface | 2 | 1/4 | 19.51 | 7.02 | na |
| 2722* | 205/405 ss2 40-51cm | 2 | 1 /4 | 22.73 | 5.11 | na |

OL= Occupational Level

* Possible bone gorge

example, the Levesconte Point Peninsula Mound in southcentral Ontario (Kenyon 1986: Plate 16) and from the Serpent Mounds area (Johnston 1968). The Summer Island site in Wisconsin has yielded both Native copper and possible bone gorges (Brose 1970:130,142). At the Donaldson site in the Bruce peninsula area of Ontario the only recovered example was also of copper (Finlayson 1977:458).

O'Neal (2002:51) notes that gorges are not reported from sites such as the Michigan Schultz site and the Boresma site located within southwestern Ontario (Wilson 1991) where fishing was, based on faunal remains and location, an important activity. O'Neal suggests that they were not reported because they were not separated from the other modified bone artifacts found within these assemblages. Given the difficulty of separating out gorges from the other modified objects such as awls, this explanation is a viable one. Support for the above interpretation is provided by Rostlund who notes that there is no sure way of deciding whether the small pointed artifacts found in archaeological sites were actually used for catching fish or for some other purpose (1952:117). In fact, 50 bone gorges were originally identified in the BWBS site assemblage (Mayer Heritage Consultants 1996) and O'Neal (2002) identified only 17 within the assemblage. In contrast, this author only identified nine bone gorges within the assemblage with an additional five being possible candidates. Since the catalogue numbers for the 50 originally identified bone gorges (Mayer Heritage 1996) and for O'Neal's (2002) gorges were not reported, it is difficult to know how our classifications of these items compare. Nonetheless, the absence of noticeable wear at pointed ends on the items classed as gorges here does suggest they are certainly not awls or some similar kind of tool. The central wear/depression strongly suggests suspension from their centre as is to be expected if they were dangled on a line.

**Leister Points and Central Tangs**

Seven bone leister points were identified by the author within the BWBS site assemblage, some of which may have been originally identified as bone gorges but without catalogue numbers this is difficult to confirm. As mentioned in Chapter 2, leisters are spears with infacing barbs (or points) located on the side of the shaft to grasp the fish. Their provenience, condition and metric attributes are detailed in Table 5. Of these only three are relatively complete, two with slight damage to their tips. They average 97.7 mm in length and 7.11 mm in width. The identification of some of the more fragmentary specimens was based on their similarity in size and shape to the complete specimens from the assemblage, although one specimen, Cat. No. 5469, has wear patterns that suggest it functioned as an awl prior to becoming discarded or lost. Of the total recovered from the site only one was from K2. The remainder came from K3 and included two from Component 1, and five from Component 2 (Figure 14a-g).

As with the gorges, leister points have been found at a number of Archaic sites such as the 2500 B.C. Lamoka Lake site (Ritchie 1936:4, Plate IX, 1980:31, 47, Plate 12) and at even earlier (ca. 3500-2500 B.C.) Brewerton and Frontenac Phase sites in New York (Ritchie 1980:95, Plate 2, Figure 26 & Plate 35, Figure 4 & 5). However, they appear to be absent from the later Archaic sites along the eastern shore of Lake Huron such as Rocky Ridge (Ramsden 1971) and Knechtel I (Wright 1972).

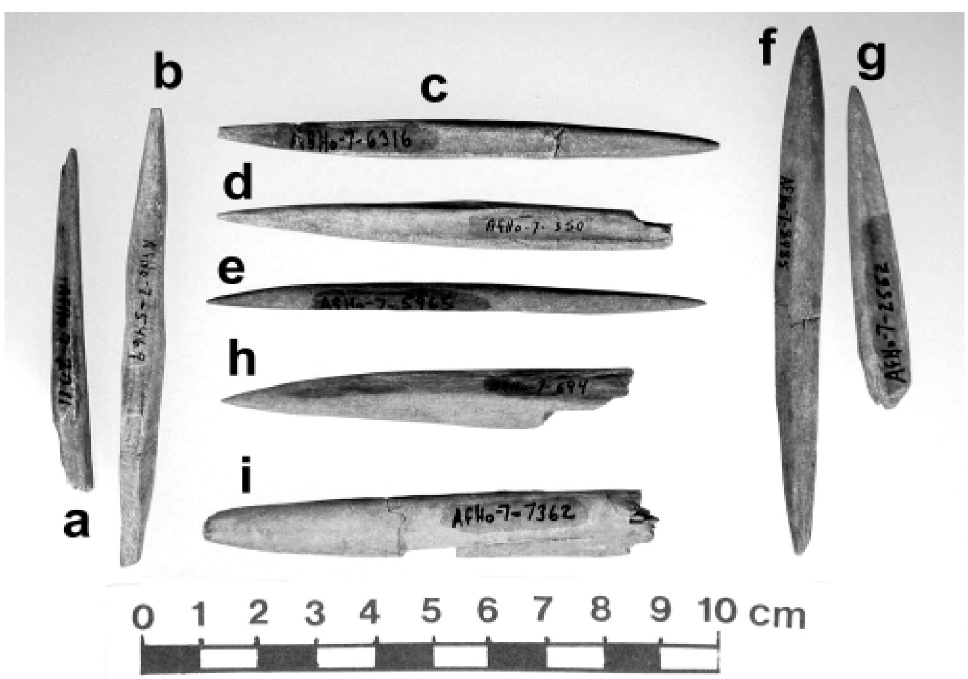


**Figure 14: Leister Points and Central Tangs**

During the Middle Woodland, leister points appear on Kipp Island Phase related sites such as the child□s burial at Port Maitland, Ontario (Ritchie 1980:233). At the Summer Island site, Wisconsin, leister points are not reported but a bipointed bone implement recovered from the site (Brose 1970: Figure 74f) resembles the leister points recovered from the BWBS site and from those sites noted above. Leister points also are not reported for the Middle Woodland Schultz, Michigan or the Donaldson, Ontario sites (Finlayson 1977; Fitting 1972; Wright and Anderson 1963).

**Table 5: The Leister Points' Metrics**

| **Cat. No.** | **Location** | **OL** | **Condition** | **Length (mm)** | **Width (mm)** | **Wear** | **Photo** |
|---|---|---|---|---|---|---|---|
| 2071 | 205/410 ss15, 27-50 cm | 2 | 2/3 complete (missing tip) | 62.65 | 53.9 | Damaged tip | a |
| 5469 | 200/400 ss20, 35-55 cm | 2 | 4/5 complete (missing tip) | 82.98 | 6.19 | Used as awl? | b |
| 6316 | 195/400 ss13, 38-48 cm | 2 | almost complete | 87.29 | 7.40 | Damaged tip | c |
| 350 | (K2) 205/405, ss20, 350 dbs | 0 | 4/5 complete (missing tip) | 9.41 | 8.18 | | d |
| 5965 | 195/400 ss4, 21-43 cm | 1 | complete | 86.31 | 4.55 | | e |
| 8985 | 205/405 ss24, 40-55 cm | 2 | almost complete | 98.61 | 8.39 | Damaged tip | f |
| 2552 | 205/400 ss9, 30-60 cm | 1 | 1/2 complete | 59.09 | 9.51 | | g |

OL= Occupational Level

Two modified bone artifacts may have also functioned as the central tangs for leisters. Their metric data are presented within Table 6 (Figure 14h and i). These items are made of bone, and one of them, Cat. No. 7362, may have functioned as an awl as suggested by the wear pattern on its tip. Both were recovered from K3 with the former coming from Component 1 and the latter from Component 2. Neither of these artifacts is complete but because they are similar in form to the leister points, but are more robust in terms of overall form, it is suggested that they functioned as central tangs for leisters.

**Table 6: The Leister Central Tangs' Metrics**

| Cat. No. | Location | OL | Condition | Length (mm) | Width (mm) | Wear | Photo |
|---|---|---|---|---|---|---|---|
| 694 | 195/400 ss20, 06-30 cm | 1 | 1/2 complete | 71.97 | 10.10 | | h |
| 7362 | 195/405 ss13, feat 60, 60 cm | 2 | 1/2 complete | 78.58 | 12.51 | awl wear | i |

OL= Occupational Level

**Netsinkers**

It has been debated whether the artifacts described by archaeological researchers as "netsinkers" (Jury 1952; Fitting 1970; Mason 1981; Ramsden 1971; Ritchie 1980; Wright and Anderson 1963) are such, or functioned as weights for some other purpose (see Brose 1970:124; Rostlund 1952:87-88). However, definitive archaeological support for their use as netsinkers has come from the Early Woodland (ca. 800-300 B.C.) Morrow site in New York. Ritchie (1969: 188) reports that:

> A thick, ovate-shaped, natural pebbles with notched or grooved ends came from the Morrow site, and in one burial a group of such objects, obviously sinkers, was actually still attached by a double cord to a carbonized fish net. Tragically, this unique specimen, rolled into a compact mass along one side of the grave, and reduced to a carbonized state by the crematory fire, was dug out by a collector and only small fragments were salvaged. The material was apparently Indian-hemp fiber, twisted into a cord of small diameter, which was woven into a net with about two-inch mesh.

Additionally, Rostlund (1952:88) indicates that: "if these [notched] stones are accepted as proof of fish nets, they *must* imply large seine or gill nets, for sinkers are not required on small hand nets, dip nets, scoop nets, or the like" [emphasis in the original].

The earliest evidence of fishing with nets within the Great Lakes region comes from the Archaic period. At the Lamoka site, for example, over 8,000 notched pebble netsinkers were found (Ritchie 1944). Although Cleland (1982) argues that nets did not appear until the Middle Woodland period within the upper Great Lakes region the presence of these notched cobbles at a number of Archaic and Early Woodland sites located along the eastern shore of Lake Huron demonstrates that this argument is incorrect. For example, netsinkers have been recovered from the Late Archaic Rocky Ridge and Knechtel I sites (Ramsden 1971:19, 21; Wright 1972:7), and the Early Woodland components at the Inverhuron and Ferris sites (Fox 1986:14; Kenyon 1959:16).

During the Middle Woodland period netsinkers are commonly reported on sites located within the upper Great Lakes that also report the presence of fish remains and, of course, are in good locations to intercept fish species. For example, they have been reported on Ontario Lake Huron area sites such as Donaldson (Finlayson 1977: 416; Wright and Anderson 1963: 41, 83), Inverhuron-Lucas (Finlayson 1977: 554, Plate 50; Lee 1960) and Burley (Jury 1952: 6, Plate VI), and at the Summer Island site, Wisconsin (Brose 1970:122-125, Plate XXIII). However, they have not been reported on the Schultz site in Michigan although the site investigator has argued that Middle Woodland inhabitants of this site used nets (Fitting 1972:108).

Within the lower Great Lakes drainage netsinkers have been reported from Middle Woodland sites such as Boresma on the Thames River (Wilson 1990:74, Plate 16) and Scott O'Brien on the Credit River where over 60 were found together in a single pit, possibly representing a cached net remnant (Williamson and Pihl 2002:82-83). They are also reported on Kipp Island Phase sites in New York, such the Felix site (Ritchie 1980: Plate 82, Figure 22) and the Kipp Island site itself (Ritchie 1973:161).

<u>The Blue Water Bridge South (BWBS) Site Netsinkers</u>

Although 276 netsinkers were reported to have been recovered during the BWBS site excavations (Mayer Heritage Consultants 1996) this author identified only 237. Twelve were not located, 22 were blanks, which were similar in shape and size to the finished netsinkers but lacked the notching, and five were just rocks. The presence of two notch flakes from K2 and netsinkers that appear to be broken across the middle during manufacture (one from K2 and six from K3) suggest that netsinkers were being manufactured at this site. This observation is supported by an experiment in netsinker manufacture in which limestone cobbles were struck with a hammer stone to replicate the notching pattern observed on archaeological specimens. During this experiment some specimens broke across the point of impact to the first notch displaying a similar breakage pattern as that noted above (James R. Keron, personal communication 2003). The presence of a large number of blanks suggests either that abundant raw material was available already in the habitation area for netsinker manufacture or that they may have been collected and stored for later manufacture. Most likely, the actual netting was manufactured during the winter months and transported without netsinkers to the fishing locale, the plan being to make netsinkers from local raw material at this site. Of the 237 netsinkers recovered, 65 were fragmentary, 42 lacked provenience information, and two were recovered from the overburden in K3, leaving 128 complete netsinkers for metric analysis (17 from K2 and the remaining 111 from K3). The total number of netsinkers that came from the 13 squares which were the focus of the fish analysis totalled only 13. These included three from Component 1, five from the Fish Layer and five from

Component 2. Of these only seven were complete enough to provide all the metric measurements. Therefore, in order to have a more meaningful sample size, it was decided to use all of the complete netsinkers recovered from K2 and K3.

A number of netsinker types were identified during the analysis (Table 7). The first type is defined as a side-notched netsinker, which resembles the round or slightly oval netsinkers with notches along the lateral (width) axis or sides. This form is the one most often illustrated within archaeological site reports (see Brose 1970; Finlayson 1977; Jury 1952; Fitting 1970; Mason 1981; Ritchie 1980; Wright and Anderson 1963) (Figure 15). Their metric data are presented in Appendix A. Of the 103 specimens of the side-

**Table 7: Netsinker Types**

| | Weight (gm) | Length (mm) | Width (mm) | Thickness (mm) | Internotch Width (mm) | Notch Depth (mm) | Notch Width (mm) |
|---|---|---|---|---|---|---|---|
| **Side-notched K3(103)** | 265.10 | 100.83 | 75.25 | 23.58 | 64.37 | 5.22 | 22.68 |
| **Side-notched K2(13)** | 144.05 | 87.62 | 60.38 | 19.46 | 51.62 | 4.38 | 18.97 |
| **End-notched K3(8)** | 187.3 | 86.38 | 64.88 | 23 | 78.12 | 4.12 | 17.65 |
| **Atypical K2(4)** | 100.23 | 82 | 51.5 | 17.5 | 40.75 | 5.38 | 12.5 |

notched type recovered, some were very large, two weighing in at 1100 and 1200 grams respectively and, as a result, averages for this type for K3 may be a bit skewed. Also, these larger sinkers were recovered from Component 2 and are therefore not necessarily representative of what was found in Component 1 or the Fish Layer. These larger specimens may have been used as end weights for the net or for some other purpose such as anchoring a canoe. The majority of the side-notched type of netsinkers from K3 (n=101) were made from waterworn limestone cobbles with the remainder being a granitic or an unidentified metamorphic rock.

Notching was accomplished through chipping, although three specimens showed evidence of grinding as well. Some specimens (n=21) were split laterally on one side, perhaps to thin them out to reduce their weight. This pattern of breakage was also identified during the netsinker manufacture experiment noted above. The split appears to occur along a plane of weakness in the limestone material and happens unintentionally; therefore, the split on the BWBS site may have been just a by-product of the manufacturing process (James R. Keron, personal communication 2003). Side-

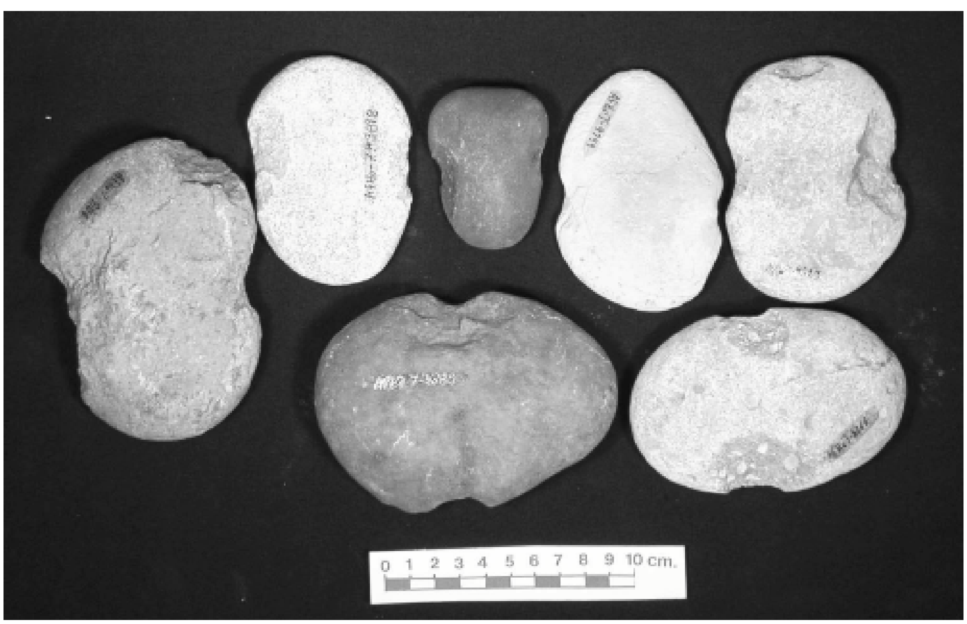


**Figure 15: Side-Notched Netsinkers Recovered from the BWBS Site**

notched netsinkers were also recovered from K2 (n=13). They resemble those recovered from K3 but the collection lacks some of the larger specimens reported for K3.

The second type of netsinker identified within the BWBS site assemblage is referred to as an end-notched netsinker. These are long and thin and have notches at the narrow ends rather than along the longitudinal axis (Figure 16). Metric data for these is provided in Appendix A and Table 7. In comparison to the side–notched type netsinkers found in both K2 and K3, the end-notched forms are longer with a smaller notch depth and width, although they have a larger internotch width (i.e. the distance between the two opposing notches). In terms of shape, they fall closer to the range of those found within K2. With the exception of one granite specimen, all are made from waterworn limestone cobbles and, with the exception of one specimen that shows evidence of chipping and grinding, the notches on the end-notched netsinkers are produced through chipping. This type of netsinker on the BWBS site is exclusive to K3, almost all of them being recovered from Component 1 within a few metres of each other in the southwestern

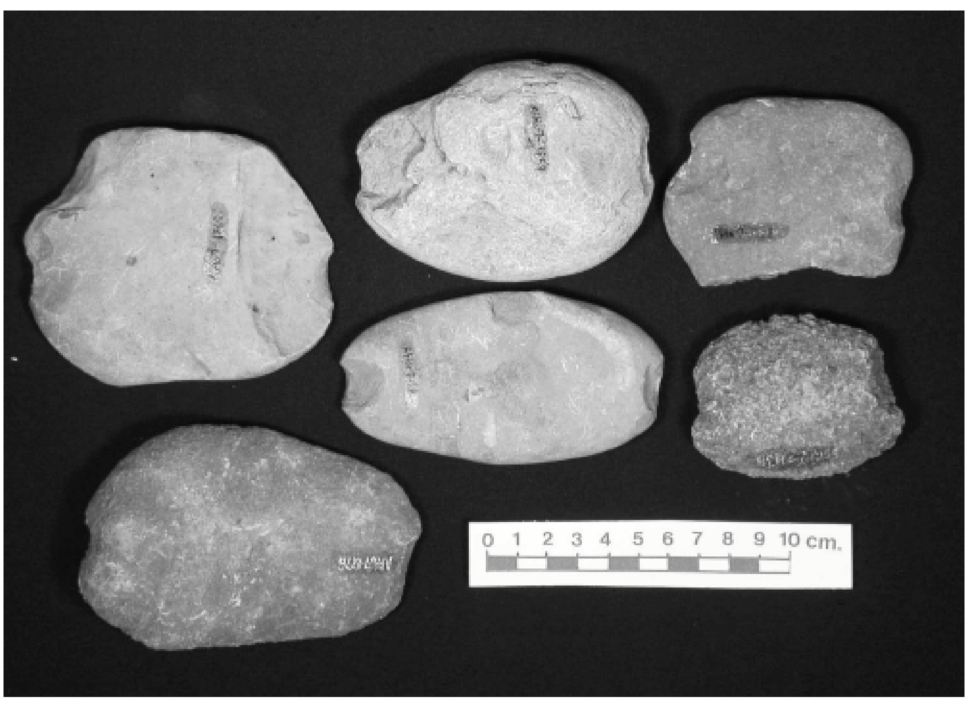


**Figure 16: End-Notched Netsinkers Recovered from the BWBS Site**

portion of the area. It is quite probable given their association in terms of both space and form that they were attached to the same net. This type of netsinker would be ideal for waters with swifter currents where they would be less prone to become entangled in weeds and where their flat elongated shape would stick in the substrate, probably slowing the movement of nets under such conditions.

The third type of netsinker recovered from the BWBS site is referred to as ”atypical”. This type is irregularly shaped and would be best suited for three-way tying where the net cordage would pass over three corners as opposed to two in the side-notched (Figure 17). Metric data for these are presented in Appendix A and Table 7. These were exclusively recovered from K2 (n=4). It is possible, as with the end-notched netsinkers recovered from K3, that these atypical netsinkers performed a specialized function. Like the end-notched forms, their irregular shapes would have made them less prone to movement by swift currents; however, given the lack of provenience data, any sort of clustering of these cannot be demonstrated. At the very least, since they were all recovered from K2, this distribution may indicate they are a type used slightly later in time. As with most of the other netsinkers recovered from this site, the atypical type netsinkers were made from water-worn limestone cobbles (n=3), although one was made

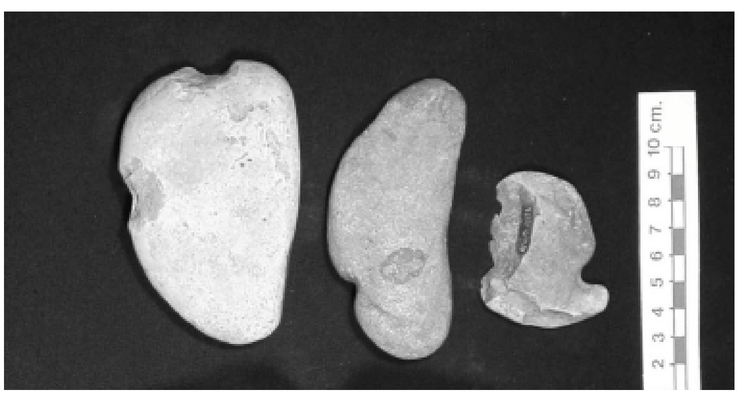


**Figure 17: Atypical Netsinkers Recovered from the BWBS Site**

from an unidentified metamorphic rock in which notching was carried out by both chipping and grinding. In comparison to the other netsinkers recovered for this site, these netsinkers have the smallest average notch width, which may suggest the cordage may not have had as much contact with it resulting in a weaker binding. However, a more secure bond would be maintained through the three way tying to the netting.

There have been few comprehensive studies on netsinkers with most reports just providing general descriptions and very basic metric data. However, Brose (1970:123-126) did some metric comparisons with the netsinkers recovered from the Summer Island site with interesting results. He graphed the internotch width, the notch depth, the notch width versus notch depth and the internotch width versus weight and discovered the following:

> 1) Weight was more important than length when selecting cobbles to be made into netsinkers.
>
> 2) Regardless of the original length, the netsinkers all had roughly the same internotch width.
>
> 3) The size of the notch width and notch depth are highly dependant on the size of the cordage used to bind the sinkers to the nets.

Most importantly he concluded that**:**

> ...these notched stones are not carelessly manufactured or randomly selected cobbles but represent an artifact whose final shape was conditioned by the cultural concepts of its makers as fully as are the shapes of the ceramics or the projectile points they employed (Brose1970: 126).

In order to see how the BWBS site netsinkers compared to those from the Summer Island site, the same variables were graphed. However, only the side-notched type netsinkers were compared to the Summer Island data. As mentioned above, the sample size of complete netsinkers recovered from the 13 squares used in the fish analysis was small. Therefore, all the sinkers from K2 and K3 were used. Given its later date, K2 was treated as a separate Late Middle Woodland component of the site and was graphed separately from K3, but to allow for comparisons they were illustrated on the same graphs.

It is important to note that Brose worked with a small sample of 14 netsinkers all of which on average in comparison to BWBS have smaller values for length, width, thickness, weight and mean depth of notches but had comparable mean internotch width. However, comparing this sample to the larger sample recovered from the BWBS site may not be problematic given that this site was occupied for a shorter period of time during the Middle Woodland period (Brose 1970:152) and therefore the number of netsinkers recovered may be representative for this site.

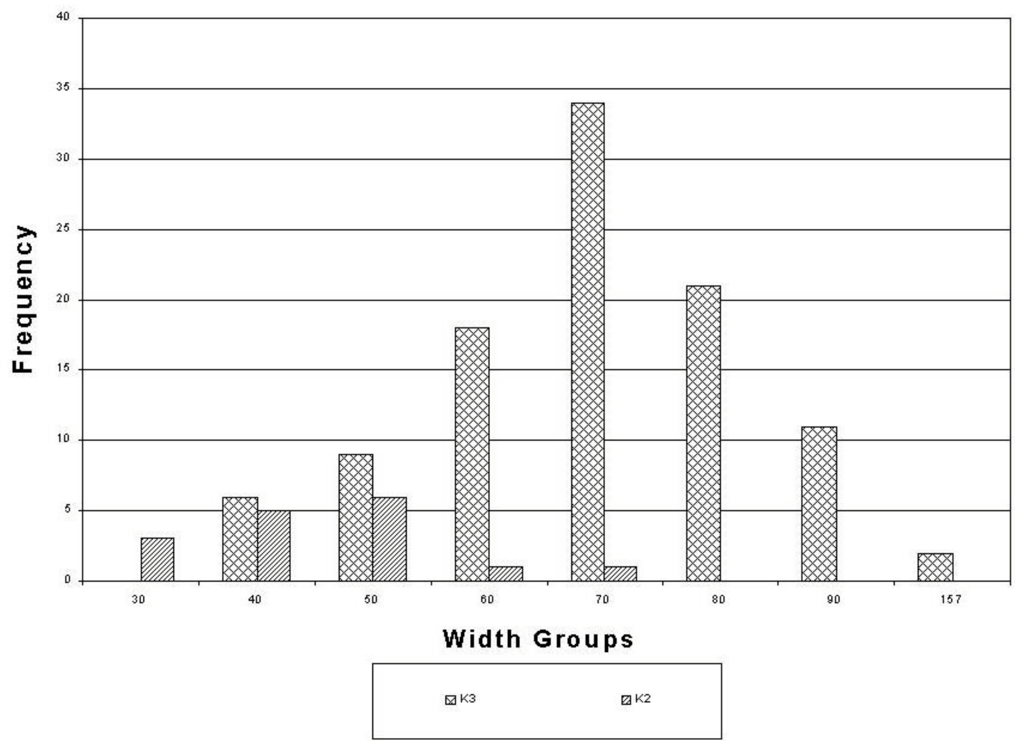


**Figure 18: Internotch Width (mm)**

The internotch width for both K2 and K3 for the side-notched type netsinkers is normally distributed (Figure 18). These results are similar to Brose's who concluded from this pattern that there is a selection towards similar internotch widths. He went further and graphed internotch width versus weight and concluded from the result that, regardless of the length of the original cobble, weight was the "principal desideratum" in choosing which cobbles will be manufactured into netsinkers (Brose 1970:125). However, I would argue that, with a few notable extreme outliers, the internotch width also stays roughly the same regardless of the weight of the original cobble. This trend is illustrated within Figures 19 and 20 which show internotch width versus weight and

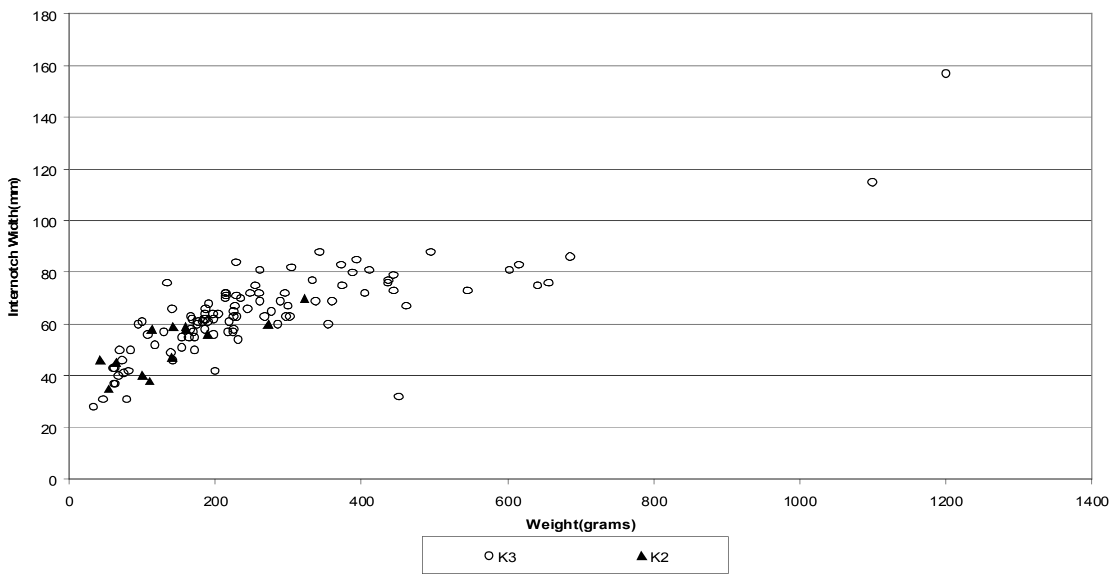


**Figure 19: Internotch Width Versus Weight**

relationship between weight, length and internotch width. For example, as the weight increases so does the internotch width. However, there is a selection, although weak, for internotch width versus length. These graphs illustrate that there is a very close internotch widths that measure around 60 mm for those sinkers that weight between 150 and 300 grams (Figure 19). Additionally, Figure 20 illustrates that as the length increases so does the internotch width, again clustering around 60 mm with a strong tendency to select for cobbles that measure between 50 to 150 mm in length with most of them clustering around 100 mm. Therefore, my analysis suggests that both weight and length are equally important in determining what cobbles are selected for netsinkers and that there was a strong selection towards choosing cobbles that fall within a certain weight and length range.

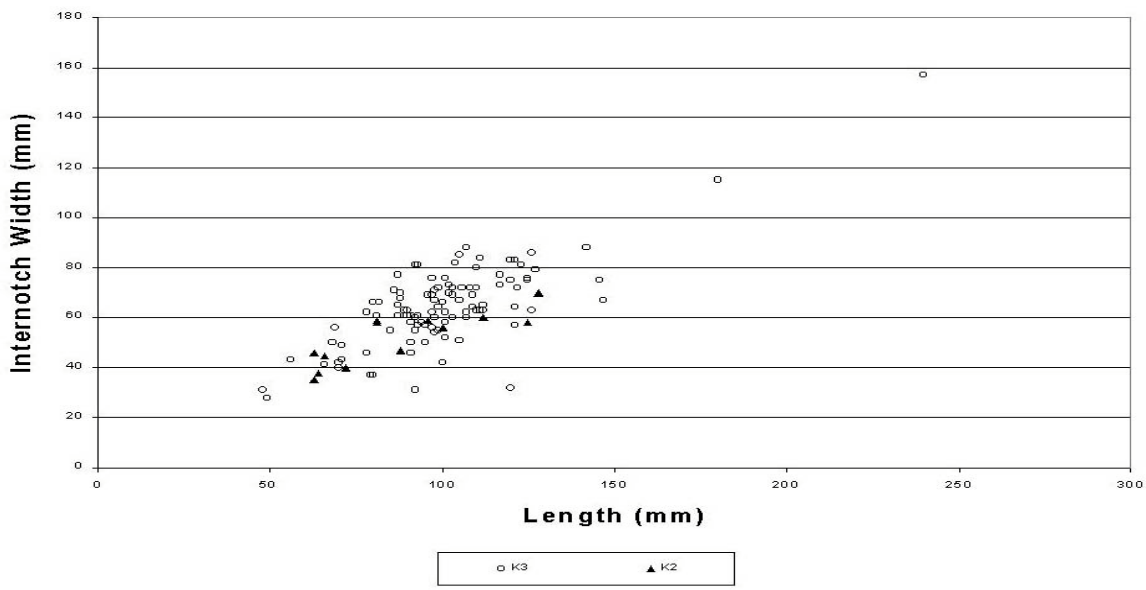


**Figure 20: Internotch Width Versus Length**

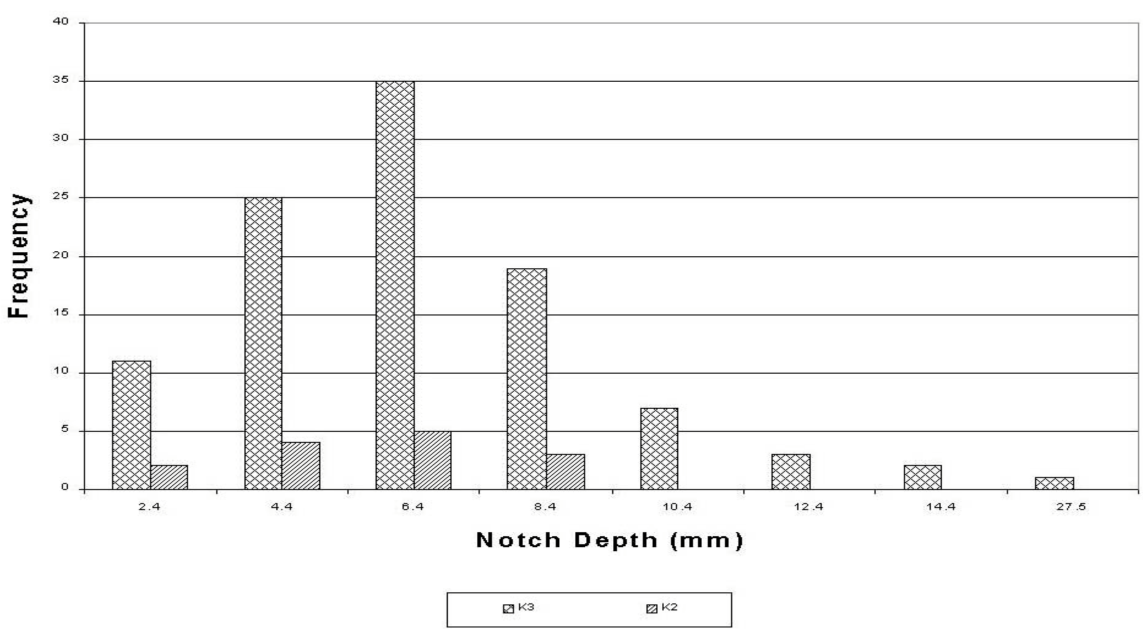


**Figure 21: Notch Depth (mm)**

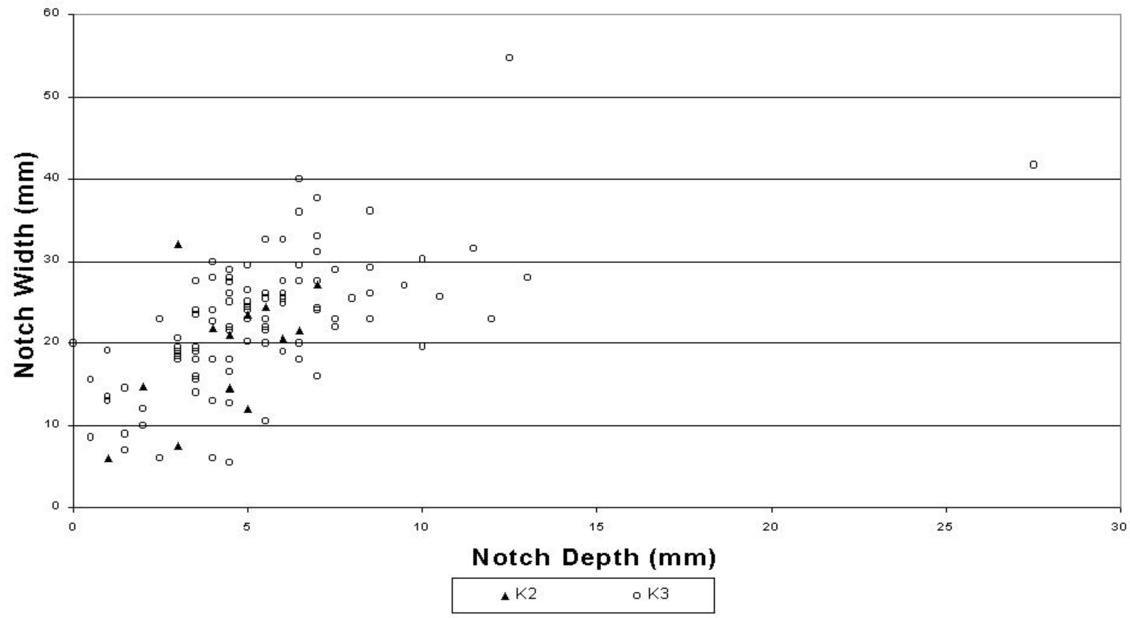


**Figure 22: Notch Depth Versus Notch Width**

Figure 21 illustrates the notch depth (mm) for both K2 and K3 which shows that this variable is unimodal. This contrasts sharply with Brose□s analysis in which notch depth had a bimodal distribution. Since his pattern illustrated that the goal was not to make notch depths of equal widths as was the case with internotch width, he concluded that some other factor must be influencing notch depth. He graphed notch depth against notch width and found that the netsinkers with the deeper notches had the narrower widths and the ones that had the smaller notch depths had the widest notches. He inferred that this pattern indicated that two different cordage sizes were being used at the Summer Island site, 16 mm and 9.2 mm, to bind the netsinkers to the nets (Brose 1970:125). Furthermore, the pattern observed indicated that the netsinkers with the deepest notches used the smaller cords and that the deeper notches provided a more secure fastening. For example, the longer cobbles with the narrow deep notches may have been used in shallower water where a more secure fastening was needed because it would have received more disturbances resting on the bottom. This was perhaps provided by the deeper notches (Brose 1970:125-126).

The distribution of notch width for the BWBS site is not as discrete as that for the Summer Island site, therefore, it is difficult to determine if one or more different cordage sizes were used (Figure 22). If as previously suggested, nets were transported to the fishing locations ready made, no doubt the net would have the cordage used to tie the netsinkers already attached thereby dictating the cordage width of any newly constructed netsinkers. Having a single cord width would make netsinker manufacture much easier than deciding which netsinkers will go with what nets. However, as indicated by Brose, cordage and netsinkers where used under different hydrological conditions. The BWBS site was located on the bank of a river channel, was in close proximity to a lake, a bay, and possibly a marshland pond associated with the nearby swamp lands, all of which would have their own unique hydrological conditions. Depending on where the nets were used and under what conditions, a number of different cordage sizes may have been required.

The side-notched type netsinkers would work best in shallow calm waters with heavier weed growth. Although the weight of the netsinkers would help stabilise them within the water, their round shape would not be able to resist currents. Therefore they would be better suited for calmer waters. Their round shapes would also prevent them from becoming entangled in weeds, which are more common in calmer waters. Given such, they may have only been used in calmer portions of the river and ponds. As noted above, the end-notched netsinkers would be ideal for areas with waters having swifter currents because their long thin shape would stick in the mud better than oval netsinkers thereby stabilising the net in the water. Given their shape, they would be more suitable for swifter waters that lacked vegetation, otherwise they would become entangled in the weeds making their retrieval difficult. Since the end-notched forms were only found within Component 1 and may have an association with one net, perhaps the water speed of the river channel had been swifter during more recent occupations of the site. Finally, the atypical netsinkers found in K2 are difficult to explain. The three way tie offers a very secure hold and with its irregular shape would likely stick in the mud more effectively than the roundish netsinkers which are thought to be characteristic of a netsinker that would be required under shallow water conditions where more disturbances would be encountered. Perhaps the river channel was shallower during the later Middle Woodland or alternatively, the nets were used in the pond or other location.

### Summary

From the discussion above, it can be concluded that the Native people who occupied the BWBS site used a number of methods for procuring fish. Although the form of harpoon changed through time, it appears to have been employed throughout the site's occupation for spearing fish in shallower waters. Angling was carried out with gorges and composite fish-hooks to catch fish perhaps in the nearby ponds or while trolling during excursions onto the lake. Leisters were likely used to catch fish in the shallows with the use of a canoe or at the rapids at the mouth of Lake Huron, as well as to retrieve fish from seine nets set in the river channel. The netsinkers recovered from this site not only suggest that they are deliberately manufactured to meet the requirements of the nets brought to the site but also to meet hydrological conditions which may have varied through time and location.

# Chapter 5
## Methodology of the Analysis and Taphonomy

As outlined in Chapter 3, a variety of fishing methods were used by prehistoric and early contact aboriginal populations within the upper Great Lakes region. According to Wheeler and Jones, diversity in fishing methods is the result of various techniques evolving to specialize in the capture of a target "species or range of species of a limited size" (1989:168). It could be argued that the targeting of fish was a response to factors such as palatability, meat contribution, accessibility, availability, ease of capture, or some culturally prescribed preference. Whatever the reason, the ability to target fish is made possible by the fact that many species of fish are predictable in terms of their feeding and breeding behaviour and the habitats they prefer to live in and exploit. Once these behavioural patterns of a target fish are known, fishing methods may then be devised to catch them (Brinkhuizen 1983:11). For example, fish species such as whitefish and lake trout, which congregate in large numbers in deeper water, can be caught effectively with gill nets, which is a method that will capture fish of these species over and above a particular size range. Bottom-feeding, shallow-water, solitary fish species such as catfish or suckers can be caught individually either through spearing with a harpoon or angling with bait on a hook. Therefore, the fishing methods used in the past can be inferred through an examination of the fish species present and their size within an archaeological assemblage (Wheeler and Jones 1989:168).

This chapter will present a methodology for determining the species composition of fish found within the BWBS site archaeological assemblage from which the fishing methods used in the past can be inferred. Also, determining the size of the fish represented within the assemblage could help to infer the use of methods that target fish on the basis of size. For example, netting might only capture fish over and above a particular size. Therefore, techniques used to determine fish size will be discussed. Because time, labour, and funding are limited, this present analysis will employ methods that provide the greatest amount of information possible given these constraints. In order to understand those factors that may bias the data and lead to false inferences, a discussion of the cultural and natural taphonomic forces affecting the BWBS site fish assemblage will be provided. The data generated from this analysis and associated inferences will be presented in the following chapter.

**Species Identification**

Identifications were made with reference to the comparative faunal collections housed at the London Field Office of the Heritage Operations Unit, Ontario Ministry of Culture as well as specimens from the author's own collection. Because significant differences in fish behaviour are found at the level of species, a primary goal of this analysis was to make identifications at least to this level. Given such, the elements chosen from the assemblage for identification were done so on the basis of the degree of reliability and ease of identification to species level. A discussion of these elements is provided below.

<u>Elements Chosen for Species Identification</u>

Most of the elements of a fish skeleton are not distinctive enough to be considered diagnostic of any particular species (Colley 1990: 211-212; Wheeler and Jones 1989). For example, most pterygiophores, ribs, and fin rays are easily identifiable to element but as taxa are only identifiable to the level of class. Through the examination of a number of North American fish species, Needs-Howarth (1999, 2001) found eight elements of the pectoral girdle and cranium that are demonstrated to be "reliably and consistently identified to species" (*ibid* 2001:405). These include the dentary, quadrate, articular, cleithrum, ceratohyal, hyomandibular, operculum and the preoperculum. These elements were used for species identification. However, in situations where they could not be identified to species, they were identified to at least the level of family wherever possible. Since some fish may be butchered off site, it is recommended that fish vertebrae be identified and quantified to take into consideration the representation of "headless fish" (*ibid* 2001:405). Although fish vertebrae from archaeological assemblages are difficult to identify to species because they often lack their diagnostic protuberances (which are fragile and break off quite easily (e.g. Wheeler and

Jones 1989; 108), an attempt will be made to identify these to at least the level of family. Fish scales and otoliths, which were recorded to have been present in large numbers during the preliminary analysis of the assemblage, can often be identified to species level (Casteel 1976:17-37, 65-69) and identifications of these will be done to at least family level.

**Fish Size**

Live fish size is typically recorded as a measurement of live length and/or live weight. Lengths have been measured in terms of total length (snout tip to tail extremity), standard length (tip of the snout to the end of the hypural plate) and fork length (snout tip to the fork of the tail). Weights have been recorded as total weight or gutted weight (Wheeler and Jones 1989:139). Fish bone has been used to estimate live fish size as a measure of live length and/or weight. However, because live fish weight will vary in response to factors such as general health, food availability and spawning behaviour (Needs-Howarth 1999:29) there is a stronger relationship between fish bone size and live length.

Some of the more popular methods used for estimating live fish size from archaeological bone include the single regression, the double regression and the proportional methods (Casteel 1976:93-126; Martin and Colburn 1989; Needs-Howarth 1999; Wheeler and Jones 1989:139-149). These involve taking direct measurements from the archaeological fish bone and comparing them mathematically to specimens of known size to calculate the total length of the archaeological specimen (Casteel 1976:93-123). Although more accurate than some methods employed, they require access to multiple comparative specimens of known size, and in the case of the single regression method, at least 30 specimens for each species (Wheeler and Jones 1989:142), something not available for most of the species examined here.

It has been noted that "the quickest and simplest way to estimate the size of fishes is to compare the archaeological specimens with bones from a fish of known size" (Wheeler and Jones 1989:141). Although not as precise as the methods discussed above, this method will provide a general indication of the size ranges in terms of total length of fish found within the assemblage quickly and requires access to only one comparative specimen of known size for each species. Given its advantages, this method will be used to estimate the size of some of the fish species represented within the BWBS site assemblage. The archaeological bone will be recorded as being smaller than, equal to, or larger than those bones from a reference specimen of known live total length. Only those elements used for species identification noted above will be used for size estimations.

Otoliths as an Indicator of Fish Size

As mentioned above, preliminary analysis of the BWBS site fish assemblage indicated that there were a large number of freshwater drum otoliths present. Otoliths are concretions composed of calcium salts located within the inner ear of the fish skull which appear to control hearing and equilibrium in bony fishes (Casteel 1976:17-19). Calcium carbonate is deposited on the surface of the otoliths at different rates depending on the temperature of the water and the environment. Generally speaking, in the summer and autumn, when the water is warmer, the calcium carbonate is deposited in large amounts resulting in rapid otolith growth and during the colder periods, as in winter and spring, growth is slowed substantially (Casteel 1976:32). Although the use of otoliths in numerous fields of study has been ongoing since the late 19th century, it has only been since the 1960's that archaeological studies have explored the utility of otoliths (see Casteel 1976; Fitch 1967, 1969; Priegel 1963; Witt 1960).

Of interest here, various studies have examined the relationship between otolith length and weight, and live fish length and weight (see Brown and Casselman N.D.; Casteel 1974; Templeton and Squires 1956; Trout 1954; Witt 1960). For the freshwater drum, Witt (1960:181-185) determined the mathematical relationship between otolith size (weight or length) and live fish weight and total length. The length of the otolith is measured in millimetres from the anterior to the posterior end; otolith weight is measured in grams (Witt 1960). Length measurements of the otoliths are considered more reliable because the otoliths may undergo weight gain or loss as a result of gaining or losing solids and/or liquids before or after burial (Casteel 1976:27). It has also been noted that slower growing fish species tend to have heavier and longer otoliths. Among species whose males mature faster than females and, therefore, their growth rate slows down sooner, the otoliths from males will be heavier than the otoliths from females of the same age (Wheeler and Jones 1989:145). Although the estimates of live body length from otolith length measurements would likely be more accurate, the appropriate landmarks used by other researchers to measure the length of the freshwater drum otoliths could not be determined. Although less accurate than estimates derived from otolith length, given that only a general idea about fish size is required for this current study and that taking weight measurements resulted in the least amount of damage to the otoliths, live fish total length estimates will be derived from otolith weight. As a cautionary note, Witt's derived mathematical relationship for otolith size and live fish size may be inherently inaccurate given that otolith growth will vary according to local conditions (Brown and Casselman N.D.) and that the otoliths used to determine this relationship came from widely different environments including the Midwest, the southern United States and the lower Great Lakes, just to name a few (Witt 1960:181). However, since only relative size estimates are sought, the use of these equations for the BWBS otolith sample is not considered problematic. Additionally, the live fish size estimates derived from the otoliths will be compared with those derived from direct visual comparisons between the archaeological bone and the bone from fish of known size thereby providing a check for spurious size estimates.

**Quantification**

In order to identify mass capture fishing events and to evaluate the relative contribution of the various fish species to the diet, the number of fish represented in the assemblage will be calculated. The minimum number of individuals per taxon (MNI) and the number of identified specimens per taxon (NISP) are the most commonly used methods for quantifying animal remains. The advantages and disadvantages of these methods will be outlined briefly below (for a thorough discussion see Grayson 1979, 1984). For a discussion of other methods used for quantifying faunal remains the reader is referred to Lyman (1994).

NISP

NISP (Grayson 1979) is the most basic measure of faunal frequency and the most commonly used form of faunal data in archaeology. This measure represents the total number of individual *specimens* identified to a particular taxon and is used to determine relative abundances of taxa. A specimen has been defined by Grayson (1984:16) as a "bone or tooth, or fragment thereof, from an archaeological or paleontological site". Although NISP is often presented within faunal reports, its exclusive use is considered problematic because these counts have the potential to produce misleading assemblage data which are not amenable to some standard statistical techniques (Grayson 1984:24). This limitation is primarily due to the fact that NISP counts can over-represent certain taxa with: a) greater degrees of fragmentation (Grayson 1973,1979; Thomas 1969; Watson 1972); b) higher rates of recovery due to factors such as bone size (Thomas 1969; Watson 1972); and c) fish species that have more bones in their skeletons (Klein and Cruz-Uribe 1984; Payne 1972). Second, because NISP assumes independence of all bone fragments within an assemblage (e.g. that each bone is from a different individual fish), NISP counts can produce artificially inflated sample sizes (Watson 1979).

MNI

MNI, or minimum number of individuals, quantifies the minimum number of *individuals* of each taxa (species, genus, or family) that could account for the bones within the assemblage. These counts have been argued to be superior to NISP primarily because they eliminate the problem associated with an assumption of independence (Grayson 1984:27). MNI counts also solve the problem associated with differential fragmentation as well as inflated element frequencies caused by skeletons with more bones (Casteel 1976; Grayson 1973; Klein and Cruz-Uribe 1984). And, unlike NISP, standard statistical techniques such as meat weight estimates can be calculated directly from MNI, thus taking into account the idea that variation in species size has a definite effect when making dietary inferences (Chaplin 1971; White 1953). However, there are problems associated with the calculation of MNI.

First and foremost is the reality that few analysts can agree on the best way to calculate MNI. Methods used range from simply counting only the complete bones and recording the highest frequency of a single skeletal element (White 1953), to estimates which consider all complete and fragmented bones and which pair these bones to particular animals based on size, sex and/or age distinctions (Chaplin 1971; Bokonyi 1970; Flannery 1969). The latter method results in a higher MNI count since it recognizes that there may be individual animals of a certain taxon represented by only one skeletal element within the assemblage. Consequently, the MNI values reported by different analysts are often not comparable. Second, when comparisons of the relative frequencies of species are made, MNI estimates tend to exaggerate the relative importance of 'rare' species at the expense of common species (Klein and Cruz-Uribe 1984; Casteel 1976). Third, MNI counts will vary according to how an assemblage is subdivided for analysis, whether it be by excavation unit or level, or some other division. For example, Grayson (1973, 1979, 1984) demonstrated that, depending on how this subdividing is done, MNI values can range anywhere between the 'true' MNI (when all specimens are grouped together) to NISP (when each specimen is considered as a distinct assemblage). In other words, the same assemblage can produce very different MNIs. Fourth and lastly, Grayson (1984) has argued that there is a statistically significant log-log linear relationship between MNI and NISP which suggests that MNI estimates are highly dependant on NISP counts and therefore has the disadvantages inherent in NISP as well as those of the aggregation effects mentioned above.

It is apparent that both methods of calculating taxonomic abundance have drawbacks, and at best they are able to indicate relative abundances (Grayson 1984:93-97). By convention, faunal studies utilize MNI as the basic counting unit and present NISP counts for comparative purposes only (Grayson 1984:24). As noted in Chapter 3, the BWBS site stratigraphy was subdivided into three occupational levels: Component 1, Fish Layer, and

Component 2. Each of these levels are inferred to represent separate periods of occupation and therefore will be treated as separate units for MNI and NISP calculations. Although determining the MNI counts for each of these cultural levels can provide information relating to the overall contribution of various fish species to the diet, these counts cannot reveal information about individual fishing events and the methods used because the fish bone excavated from each occupational level most likely represent multiple fishing events, possibly using different methods of fishing. Therefore, it is desirable to subdivide the site not only vertically in terms of occupational levels, but also horizontally in terms of fishing events. These fishing events may be represented by discrete concentrations of fish bone found within pit features. Numerous pit features were identified during the excavation of the BWBS site some of which were tentatively assigned a function based on interpretations in the field. Although little is known about pit features of the Middle Woodland period, studies of Iroquoian sites suggest that although pit features may have been originally constructed to serve a number of different uses, whether it be for storage of food or personal effects, they are usually filled in quickly with waste once their intended use had ended (Chapdelaine 1993; Green and Sullivan 1997:2) and, as such, may represent the activities that occurred over a relatively short period of time. Pit function can be inferred based on the shape and the contents of the pit with each having a different refuse depositional history (Green and Sullivan 1997:1-3) and given their short life, they allow the opportunity for fine-grained study (Needs-Howarth 1999:6). Therefore, MNI and NISP will be calculated separately for each pit feature as well as for the occupational levels. Finally, due to large size of the assemblage, the matching of left and right elements of individual fish is not practical. Instead, pairing of left and right elements will be based on relative bone size estimates. Although this has the potential to distort the counts, it would be closer to the actual amount than to add up all of the bones of a paired element without regard for size and divide by two.

**Site Formation Processes**

It is important to remember that the archaeological record is not a 'snap shot' of past human behaviour coming down to us unaltered through time. Taphonomic forces and other site transformation processes may impact the remains of the fish originally captured and what was recovered by the archaeologist. Therefore, before inferences can be drawn about the fishing methods employed by the inhabitants of the BWBS site, it is important to consider those natural and cultural processes that may have affected the physical condition and/or the representation of the fish remains, thereby biasing the assemblage and possibly leading to false inferences. This section will begin by providing a brief discussion on the study of taphonomy and will outline the environmental and cultural forces that may have affected the BWBS site fish assemblage. For a more detailed discussion of the taphonomic processes that affect archaeological assemblages see Behrensmeyer and Hill (1980) and Voorhies (1969).

**Taphonomy**

According to Payne (1972) and Uerpmann (1973) it is not possible, regardless of how extensive or how careful the excavation, to recover all of the faunal material associated with an archaeological site. They have proposed that there is always some unknown quantity of material unaccounted for. Borrowed from paleontological studies, taphonomy has come to be defined in archaeology as the "study of the transformation of the material into the archaeological record" (Bahn 1992:489). As a subfield of archaeology, contemporary zooarchaeology has expanded taphonomy's scope to include the actions of humans on the modification and burial of animal remains. Actualistic studies have become common place since the popularization of New Archaeology in the 1970's and have provided much information on the natural and cultural processes that affect animal remains (see Binford 1978). Although most of the taphonomic studies have dealt with the remains of large land mammals, fish are subject to the same taphonomic processes (Binford 1981; Gifford 1981). In the case of fish, taphonomic factors start working as soon as they are caught and include the effects of butchering, cooking and digestion, scavenging by animals, weathering, water, soil, trampling and finally burial (Wheeler and Jones 1989:61).

## Cultural Taphonomic Processes

### Procurement and Butchering Practices

As noted above, the process of catching a fish can result in damage to their skeletons. This damage can be accidental as in the loss of scales or deliberate as in the case of splitting the jaws to retrieve swallowed fish hooks (Wheeler and Jones 1989:65). To make them easier to handle some fish are subjected to superficial treatment after capture. For example, the sharp spines of catfish may be removed (*ibid* 1989:64) at the place of procurement. When fish are butchered to reduce weight for transport, retard spoilage, or eliminate inedible portions, entrails may be removed and/or the fish may be decapitated, and the bones may be fragmented or cut (*ibid* 1989:65). When a fish is decapitated, it is usually the first five vertebrae of the fish that are removed along with the head and cut marks may be present on the terminal vertebrae. Off-site butchering may result in some fish remains never arriving at the main habitation site (Payne 1972; Uerpmann 1973). The resulting assemblages will consist of a large accumulation of head bones with a few vertebrae at the butchering and processing site (Wheeler and Jones 1989:65) and an over representation of caudal and posterior pre-caudal vertebrae at the site of consumption. Very little has been reported in the ethnohistoric record about butchering methods employed by early aboriginal groups within the Great Lakes region. For the most part, recorded observations have been restricted to processing and food preparation methods described below.

### Processing and Food Preparation Methods

Some fish may be cooked and eaten whole which may result in their loss from the assemblage. However, studies have shown that depending on their initial size, from 10-25% of fish bone can survive the digestive process (Butler and Schroder 1998). Among some aboriginal populations, fish bones were valued as a food source especially during lean periods. It was reported that fish were ground and pulverized into fish meal, thereby greatly reducing the fish bone assemblage. This process varied with fishmeal sometimes being stored dry, or sometimes mixed with corn gruel, fish oil, grease, or berries (Rostlund 1952:138-141). Within the Great Lakes region, fish meal was not considered a staple food but was usually added as a seasoning to corn gruel. The portion of fish that made up the meal, however, varied among aboriginal groups; powdered dried whole fish was observed among the Huron (JR 17:17) and the Iroquois (JR 33:77), pounded smoked or dried fish among the Mohawk and ground fish bones among the Ottawa (JR 51:71, Thwaites 51).

The consumption of partially decayed or fermented fish was reported within Native groups of the Great Lakes region. Among the Huron, whole fish were hung up in bunches on the poles of their houses (Tooker 1964:63) and allowed to rot for months "in order to make their soup smell better" (Wrong 1939:230). The use of rotten fish flesh as seasoning for corn soup was reported among the Iroquois and the Mohawk (Thwaites 51:137). With the exception of the Huron, it is not known if fish were butchered in any way prior to being allowed to ferment or if there was a preferred location for carrying out the fermenting. Outside of the Great Lakes region aboriginal groups were noted to ferment only selected parts of the fish (Rostlund 1952:199-200). For example, the fermenting of fish heads buried in mud for several months was practised by the Carrier Indians (Wilkes 1850:452). Overall, this method of food preparation may be difficult to recognize in the archaeological record due to its variable nature and lack of information about it. As a cautionary note, the pattern of remains created by fish heads left to ferment but not retrieved could mirror that created by butchering practises involving decapitation.

Heating through boiling or roasting causes bone to loose much of its mechanical strength (Jones 1990; Ritcher 1986) causing it to become friable and susceptible to disintegration (Chaplin 1971:14). However, denser bone such as fish vertebrae seem to resist this type of damage (Spennemann and Colley 1989). Consequently, assemblages with an overabundance of dense fish bones may indicate the heating of fish for consumption. The roasting of fish may result in bones being burnt. Burning shrinks bone and, when exposed for extended periods or at particularly high temperatures, will cause it to become calcined as indicated by its blue-white colour (Davis 1987:26). Transverse breaks are characteristic of mammal bone exposed to intense heat through cooking, burning, and/or mineralization (Johnson 1983:60). These consist of sharply defined linear fragments running perpendicular to the long bone's axis.

The boiling of fish heads, especially suckers, and the boiling of salted meat was recorded among the Chippewa of the Upper Great Lakes region. Frances Densmore (1929:42) described two methods of the roasting of fish among these groups:
1) The fish was cleaned and placed between sections of a split stick, which was thrust into the ground before the fire. In this way the fish could be turned so that all sides would be equally cooked.
2) The fish, without being opened, was impaled head upwards on a stick, which was placed upright in the ground before the fire. As the fish cooked, the stick was turned so as to expose all sides to the fire. When thoroughly cooked the fish was split open and seasoned with maple sugar.

The drying and smoking of fish was reported among the Huron (Thwaites 10: 101, 34: 215) where such fish would be set aside for feasts and added to corn (Thwaites 10:179-181, 14:95). Fish caught during the late fall to early winter spawning runs, which include species such as whitefish, lake trout and cisco, would be dried and stored for the winter (Heidenreich 1971: 217). Dried and smoked fish were stored for winter use among the Potawatomi (Clifton 1978: 735). The Chippewa were reported to have dried small fish such as perch without cleaning:

> Sunfish were split lengthwise and laid on the horizontal poles of the rack, while large fish, such as pickeral or bullpoints (catfish), were cleaned and cut along each side of the backbone, leaving the head attached to the body of the fish and also to the backbone. The fish was then hung over one of the top rails of the frame, the body being on one side and the backbone and tail on the other. When the fish was partially dried the flesh was split lengthwise, making a thinner strip, the inside of which was exposed to the fire (Densmore 1929:42).

In the late fall the Chippewa strung whole uncleaned fish in bunches of ten and allowed them to freeze for winter use. Before consumption the skin would be peeled off and the fish cooked (Densmore 1929:42-43). In the instance of unclaimed caches of dried, smoked or previously frozen fish, this pattern of food preparation may be recognized as a discrete assemblage or subassemblage of complete fish skeletons, as long as the natural processes that could have created a comparable pattern have been ruled out.

<u>Exchange</u>

The exchange of fish with other groups for various goods could affect the representation of fish remains within archaeological assemblages resulting in either an addition or deletion of fish remains depending on whether a group is giving or receiving the fish. However, this pattern of behaviour would be difficult to recognize among the givers of fish and only among the receivers if the fish were exotic to their locale. Although La Potherie reported that the Saulteaux sold excess whitefish in Mackinac to other aboriginal groups and to the French (Kinietz 1965:324), fish are not reported as being a common item exchanged amongst the aboriginal populations in the Great Lakes region.

<u>Patterns of Discard</u>

Very little has been reported about patterns of fish bone discard although ethnographic and ethnohistoric sources suggest that people usually discard (and process) away from habitation areas (Brumbach 1986:37, 44, 46), or burn fish remains to reduce the volume of waste or the rotting portions that would attract pests or to satisfy other cultural proscriptions (Molnar 1997:66). Burning does not always result in the complete destruction of the bone and depending on the degree of exposure to flame or high temperatures, it may result in charring or calcination of some of the remains. However, Gabriel Sagard recorded that the Huron had a prohibition against burning fish bones. It was believed by the Huron that this would cause the spirits of the dead fish to tell the living fish in the lake of their fate and the living fish would avoid being caught, reducing the catch (Wrong 1939:186-187).

Sagard also reported that the fish nets would tell the living fish if they observed fish bones being burned (*ibid* 1939:187).

Site Occupation Intensity

As noted earlier, the BWBS site was occupied at K3 over a long time between A.D. 140 and A.D. 660 (O'Neal 2002:29) and site activity was extensive as indicated by the depth of the deposits and the density of cultural features identified (Mayer Heritage Consultants 1996). Site reoccupation is evident by the presence of multiple stratigraphic levels containing cultural material which, as outlined in Chapter 3, were subdivided into three "occupational levels" designated Component 1, Fish Layer, and Component 2. Disturbance and damage to the faunal material in each level due to the reoccupation of the site is highly probable. Actualistic studies with obsidian flakes have demonstrated that the effects of site reoccupation can include vertical and horizontal displacement and possible damage to the artifacts (Gifford-Gonzalez et al. 1985:813-815). Trampling of the site surface, for example, may result in breakage to the faunal material. Trampling breaks on bone may resemble 'splintered breaks' which are irregular, jagged edges caused by the longitudinal and perpendicular fractures (Driver 1985:10). This pattern reflects bone breakage well after the bone has dried. Preliminary examination of the faunal material indicated that the bone was highly fragmented although it has yet to be determined if the breakage pattern is the result of trampling. However, given the small size and nature of the morphology of fish bones, these types of breaks may not be visible.

Chapter 2 noted that mixing or movement of artifacts between layers of the site might be probable given the sandy soils of the site which are highly susceptible to mixing due to trampling and other human activities (Guillemette and King 1996). However, the mixing of artifacts between the occupational levels is not considered likely; movement between Component 1 and Component 2 is remote because they are separated by the relatively homogeneous Fish Layer, and movement between and the Fish Layer and Component 1 is unlikely because they are separated by a substantial non-cultural "transitional layer." While movement between the Fish Layer and the underlying Component 2 was possible, the homogeneity of the Fish Layer and difference from Component 2 indicates it was probably minimal.

Recovery Biases

The recovery method chosen by the excavator will greatly influence the size of the faunal remains recovered from an archaeological site. Studies of mammal bone collection strategies have demonstrated that hand collected assemblages are biased in favour of a few species which produce large and easily recognizable bones (see Payne 1972; Wheeler and Jones 1989). Sieving has proven to be a method capable of recovering remains that are often missed through hand collection alone. However, experiments have shown that smaller fish bone elements tend to be easily missed when sieving in screen mesh size greater than 2 mm (Clason and Prummel 1977). Flotation is a method that has been shown to recover greater numbers of fish bone, especially bones from the smaller fish, than dry screening (Garson 1980; Lennox et al. 1986; Stewart 1991). However, water sieving is preferred by some because it not only washes the bones making them more visible, it also separates the bone fragments from lumps of soil (Payne 1972). And larger volumes of soil can be processed more quickly than by dry sieving or flotation.

The soil excavated from the BWBS site was reported to have been screened through 6 mm mesh wire cloth (Mayer Heritage Consultants 1996) which would have resulted in a substantial loss of the smaller bones. However, preliminary examination of the faunal assemblage indicates that bone fragments of less than 6 mm were being recovered thereby suggesting that an unreported method of fish bone recovery was being employed. Float samples were taken from cultural features and were processed by the author. The fish remains were sorted from the processed floats by the author. It is hoped that the fish remains recovered from the floats will provide information relating to small fish species not recovered during the dry sieving of the site and will provide some control over recovery biases.

Finally, the experience of the analyst and the condition of the comparative specimens will have a direct impact on the number and reliability of identifications. All fish bones were examined. However, as noted above, the analysis will use only selected elements for identification to at least the family level. Although this may result in some missed identifications, given the size of the assemblage and the constraints of the analysis, this procedure is unavoidable.

**Natural Taphonomic Processes**

Soil pH and Abrasion

Soil pH is a major factor influencing whether particular bones of the skeleton will survive. The mineralized cartilaginous bones of the lake sturgeon, for example, rarely survive, breaking down into small grains once the organic material within it is destroyed leaving behind only their external bony plates. Acidic soils result in the destruction of most of the fish skeleton and otoliths rarely survive except in base-rich (neutral) environments (Wheeler and Jones 1989:63). The particles making up soils will also influence the survival potential of fish bones. Post-burial abrasion, for example, is exacerbated in soils rich in hard mineral particles.

The BWBS site is situated on a sandy loam soil with exceptional drainage. Based on the presence of a large number of otoliths and the lack of acid etching, the site soils are likely on the neutral side and overall are well-preserved. Although relatively well-drained, the soils of the site area have been inundated by periodic flooding as indicated by the build up of stratigraphic layers characteristic of what occurs within river channel environments. Although this flooding may have contributed to the poor preservation of some of the pottery as noted by O'Neal (2002:61), it can enhance the survival of bone and therefore may partially account for the exceptionally large faunal assemblage recovered from the site.

Weathering

Breaks caused by weathering display longitudinal fissures and cracks and may also show flaking of the bone surface. These breaks typically result from exposure to sun, air and moisture and are indicative of slow burial or repeated reburial episodes (Behrensmeyer 1978). Preliminary examination of the BWBS site faunal assemblage did not identify this breakage pattern which suggests that the faunal remains were quickly and permanently buried, perhaps as a result of seasonal floodings which geological analyses indicate were rapid and substantial (Guillemette and King 1996). Buried bones can be thoroughly fragmented from frost action, sometimes recognized by the polish this process causes on surviving pieces (Bonnichsen 1979; Brain 1969; Hill 1976). Although difficult to recognize on fish remains, some mammal bone within the assemblage appeared to have naturally polished surfaces that would suggest that the fragmentary nature of the assemblage was likely the result of this process as well as trampling.

Scavengers and Burrowing Rodents

The effects of scavengers such as carnivores or rodents can damage or eliminate culturally deposited bones at an archaeological site. Dogs, for example, have been reported to completely “devour” the bones of small animals such as fish on site (Lyon 1970:214). Lyon (1970) asserts that in such cases “ there would be no way in which the [archaeologist] could suspect any use of fish...”. Casteel (1971:466-467) argues that this is an overstatement. There would be some record of the fish brought to the site whether directly through some bones being left behind or indirectly, such as through the presence of artifacts used in fishing. Bones displaying chew marks or the distinctive crushing characteristic of dogs as agents (Jones 1983) are a good indicator that this pattern of bone destruction has taken place. Scavenging birds can displace faunal material with owls contributing to the assemblage with their pellets. Finally, burrowing animals can displace or remove artifacts from their original archaeological context as well as add to the assemblage through their own meals or through their death. Careful observations concerning the depositional context of the artifactual material can often recognize when this type of process has taken place.

## Chapter 6

### Fish Remains from the Blue Water Bridge South Site, Pier K3

As mentioned previously, the fauna sample used for the analysis totalled 38,582 individual specimens and was derived from 13 one meter excavation units from which three occupational levels were identified. From top to bottom these levels are: Component 1, Fish Layer, and Component 2. Within this sample, 4,619 individual specimens or 11.90 % of the total sample were identified to species. Nine species were identified representing eight different fish families. Table 8 details these identifications according to relative size estimates, species, NISP and MNI per occupational level. Fish species identifications from the features, including the MNI and NISP values, are included in these totals, as well as being presented by individual features in Appendix C.

Although float samples were taken from most of the features, many floats, such as those from post molds, did not contain fish remains. Of those features that contained fish remains, the species most identified included freshwater drum, walleye and sturgeon. These three species were also found, and were the most common by far, within the larger assemblage. Therefore, it can be assumed that non-feature contents of fish remains used for this analysis are representative of the remains of fish species that were available for recovery at this site.

As shown in Table 8, walleye (*Stizostedion vitreum*), freshwater drum (*Aplodinotus grunniens* Rafinesque) and lake sturgeon (*Acipenser fulvescens* Rafinesque) each contributed by themselves more to the NISP totals for each occupational level than all other species combined. In terms of MNI, walleye and freshwater drum had the highest totals for each occupational level with largemouth bass (*Micropterus salmoides* Lacepede), instead of sturgeon, being a distant third. However, as will be discussed below, this difference is a partial artifact of difficulties in estimating lake sturgeon MNI. Other fish species identified within the sample include white sucker (*Catostomus commersoni*), channel catfish (*Ictalurus punctatus*), brown bullhead (*Ictalurus natalis*), white crappie (*Pomoxis annularis* Rafinesque), lake whitefish (*Coregonus clupeaformis* Mitchill and bowfin (*Amia calva* Linnaeus). Although the overall contribution of this

**Table 8: Summary of Species Identifications by Occupational Level**

| **Component 1** | **NISP** | **% NISP** | **MNI >** | **MNI =** | **MNI<** | **MNI Size Unknown** | **Total MNI** |
|---|---|---|---|---|---|---|---|
| Walleye | 1052 | 50.12 | 118 | 5 | 23 | - | 146 |
| Freshwater Drum | 830 | 39.54 | 66 | 3 | 9 | 1 | 79 |
| Sturgeon | 192 | 9.15 | - | - | - | 1 | 1 |
| Largemouth Bass | 17 | 0.81 | 11 | - | - | - | 11 |
| Bowfin | 1 | 0.05 | 1 | - | - | - | 1 |
| Channel Catfish | 6 | 0.29 | 1 | - | - | - | 1 |
| White Crappie | 1 | 0.05 | - | - | 1 | - | 1 |
| *NISP Total for Component 1* | *2099* | | | | | | |
| **Fish Layer** | **NISP** | **% NISP** | **MNI >** | **MNI =** | **MNI<** | **MNI Size Unknown** | **Total MNI** |
| Walleye | 961 | 50.66 | 129 | 27 | 14 | - | 170 |
| Freshwater Drum | 781 | 41.17 | 62 | - | 3 | - | 65 |
| Sturgeon | 134 | 7.06 | - | - | - | 1 | 1 |
| Largemouth Bass | 13 | 0.69 | 6 | - | - | - | 6 |
| Channel Catfish | 4 | 0.21 | 1 | - | 1 | - | 2 |
| Brown Bullhead | 1 | 0.05 | 1 | - | - | - | 1 |
| Bass (sp. indeterminant) | 3 | 0.16 | - | - | - | 3 | 3 |
| *NISP Total for Fish Layer* | *1897* | | | | | | |
| **Component 2** | **NISP** | **% NISP** | **MNI >** | **MNI =** | **MNI<** | **MNI Size Unknown** | **Total MNI** |
| Walleye | 202 | 32.42 | 36 | 1 | 6 | - | 43 |
| Freshwater Drum | 364 | 58.43 | 73 | 2 | 9 | - | 84 |
| Sturgeon | 32 | 5.14 | - | - | - | 1 | 1 |
| Largemouth Bass | 16 | 2.57 | 9 | - | - | - | 9 |
| White Crappie | 1 | 0.16 | - | - | 1 | - | 1 |
| Bass (sp. indeterminant) | 5 | 0.80 | 3 | - | - | - | 3 |
| Sucker | 3 | 0.48 | 1 | - | - | - | 1 |
| *NISP Total for Component 2* | *623* | | | | | | |

group of fish species is considered minor, their presence provides useful information concerning the fishing methods that may have been employed at the BWBS site.

As noted in Chapter 4, the pairing of left and right elements for MNI calculations was based on relative bone size estimates in reference to a comparative specimen of known live length or maturity. The MNI size classes were defined as smaller than (MNI<), equal to (MNI=), or larger than (MNI>), the comparative specimen. An exception is the freshwater drum where the pairing of otoliths for MNI estimation was based on similarities in otolith weight, as will be discussed below.

What follows is a detailed discussion of the different fish species identified within the assemblage focusing on a description of their representation within each occupational level, their habitat and behaviour, and how this information assists in determining the fishing methods that may have been used at the BWBS site. In those cases where available, ethnographic and/or historic, as well as contemporary descriptions of the methods used to catch these species of fish, will also be provided.

**Family Percidae**

Only one species of fish belonging to the Percidae family was identified within the BWBS site fish assemblage: *Stizostedion vitreum,* more commonly known as walleye or sometimes pickerel or pikeperch (Rostlund 1952:38). In terms of MNI, walleye ranks highest in Component 1 (N=146), and the Fish Layer (N=170), but ranks second to freshwater drum in Component 2 (N=43; Table 8). A chi-square test comparing the distribution of the three major and easily quantifiable species (walleye, freshwater drum and largemouth bass) by the three components confirms that there is a significant difference in the distribution by component when considered either by NISP (Chi Square=94.140, df=4, $p<0.001$) or MNI (Chi Square=56.579, df=4, $p=0.001$). In sum, walleye seem over represented in the later component and the fish layer versus the earlier Component 2 or phrased another way, drum and to some extent largemouth bass are over-represented in Component 2. Although sampling bias cannot be discounted, natural fluctuations in walleye populations in the area or a change in seasonal resource emphasis of fish species could account for this pattern.

Walleye become mature and spawn when they reach 30-37 cm in length at about three to five years of age (McLane 1974:157). The comparative specimen used to estimate relative size of the identified walleye elements measured 41 cm in live body length which suggests that this specimen represents a mature fish and that any elements identified as being greater than, and possibly equal to, this specimen are very likely to have been from a mature fish as well. Most of the walleye elements identified within the assemblage were in the "greater than" size class with a relative few falling within the MNI= and MNI< size classes. Only a relatively small number of walleye elements were identified as being smaller than the comparative specimen and their MNI totals include 23 (NISP = 65) for Component 1, 14 (NISP=17) for the Fish Layer, and six (NISP=51) for Component 2. It is not known if these specimens are just smaller than the comparative but still fit within the size range for mature fish or represent immature fish. Whatever the case may be, their presence within the assemblage would not have been acknowledged if the comparative size ranges of the fish within the assemblage were not considered when calculating MNI.

During early to mid-summer walleye can be found in large lakes and rivers in shallow to moderate depth waters or on bars or reefs and appear to reach their greatest abundance in large shallow turbid lakes. The walleye is a sight predator and the adult fish feed on other fish and can be cannibalistic if foraging fish are unavailable. They travel with other fish species such as perch, suckers, pike, smallmouth bass and muskellunge. Extremely sensitive to bright light, they seek shelter in deep and turbid waters and feed most intensively during twilight or dark (Scott and Crossman 1998:772). They migrate to spawn in the shallow shoals or tributary rivers during the spring shortly after ice break up in response to changing water temperatures, which may begin as early as April in southwestern Ontario (Scott and Crossman 1998:771). In fact, the walleye, as well as other species of this family, require steady but rapid water temperature changes to spawn successfully. They will use a variety of bottom conditions within moving water for spawning activities at depths of up to 3-5 fathoms with peak spawning occurring at water temperatures near 10 $^{o}$C (Goodyear et al. 1982:131-137). Spawning grounds are characteristically white water below impassible falls, at dams in rivers, or in boulder to coarse-gravel shoals. Spawning begins after ice break up on the tributaries although ice may still exist on the lakes (Scott and Crossman 1998:771). After spawning, around the late spring-early summer or the at the end of June, and later in northern waters (Scott and Crossman 1998:771), there is a mass return to the open waters and then dispersal, although some fish may linger in the rivers (McCrimmon and Skobe 1970:107-111). The average size of walleye caught by contemporary fishermen is 0.45 to 13.5 kg., although larger ones have been captured by anglers.

Commercial fisheries use gill nets to catch walleye. This species of fish are active during the winter time and are taken by ice fishermen by angling through a hole in the ice (Scott and Crossman 1998:772). McKenney (1827:152) observed walleye being captured with torchlight and a leister by Chippewa fishermen in the St. Clair River area. Walleye are not easy to catch (Luxenburg 1972:99) but during spawning they are often crowded within a small part of a river where they can be easily speared or netted (McCrimmon and Skobe 1970:107-111).

Since most of the individuals represented within all three occupational levels are from mature fish it can be argued that they were procured during their spring spawning run which begins in April and may run into June. If the smaller fish represent small adults, they were likely caught at the same time of year as the other adult fish, however, if immature, they could have been caught at this time of the year in Lake Huron at moderate depths. Given the large numbers of walleye found within each occupational level at the BWBS site Pier K3, they were most likely captured en masse with fish nets during their spring spawning run within the river channel, or with leisters or spears while spawning at the rapids at the mouth of Lake Huron. The presence of the components for leisters and netsinkers at this site support this suggestion. It is also suggested that if these fish were caught in the river channel, a seine net would have been used because gill nets work better for deeper calmer waters. The varying distribution of fish sizes also support the use of seine type nets as these nets catch a broader distribution of fish sizes than the gill net. Fish gorges and fish points for composite fish-hooks were recovered from the BWBS site, therefore, angling for walleye could have occurred either within the river channel for spawning fish or within Lake Huron for immature fish. It is also quite possible that all of the walleye could have been caught during the winter months by angling or by the setting of seine nets through the ice on Lake Huron. However, if it is accepted that immature fish are represented within this assemblage, more of these would be expected with this method.

**Family Sciaenidae**

The freshwater drum, *Aplodinotus grunniens* Rafinesque, a member of the croaker family referred to as Sciaenidae, and also known as sheepshead, was identified within all three cultural levels in relatively large numbers (Table 8). Its largest representation in terms of MNI was within Component 1 (78**;** NISP=830), followed by Component 2 (75**;** NISP=364) and the Fish Layer (65**;** NISP=781). Although its MNI totals are only half of that for walleye in both Component 1 and the Fish Layer, as noted above, its MNI totals remain relatively constant through time. Relative size comparisons for the freshwater drum were done in comparison to the comparative specimen as well as through the body length measurements derived from the weights of the otoliths recovered from the squares used in this analysis.

Mature males of this species are around three to four years old and measure 25-30 cm whereas mature females are often four to five years of age and measure 27-30 cm (Priegel 1967:7). The comparative specimen used to estimate relative size of the identified freshwater drum elements measured 42 cm in length and, given the above noted size range for mature specimens, it suggests that this specimen is from a mature fish. Additional support for this interpretation comes from the growth measurements of one-to-six year old specimens within different water environments (Table 9). It is clear from Table 9 that based on its length the comparative specimen must be at least six years old and therefore it represents a mature fish.

Relative size comparisons with the comparative specimen determined that most of the elements identified were equal to or greater in size than the comparative, and therefore likely from mature fish. However, there were some elements that were smaller in size which may represent immature fish (Table 8). These include an MNI of nine for

Component 1, an MNI of three for the Fish layer and an MNI of ten for Component 2.

**Table 9: Average Growth of Freshwater Drum in Various Waters**

| **Time (Years)** | **I*** | **II*** | **III*** | **IV*** | **V*** | **VI*** |
|---|---|---|---|---|---|---|
| Lake Winnebago | 12 | 21 | 25 | 30 | 33 | 35 |
| Lake Erie | 12 | 20 | 25 | 30 | 33 | 36 |
| Mississippi River | 12 | 22 | 29 | 33 | 36 | 40 |
| Minnesota Lakes | 11 | 20 | 26 | 30) | 33 | 35 |

*Total length in centimeters at end of each growth year (adapted from Priegel 1967:7).

As mentioned previously, Witt (1960:181-185) had determined the mathematical relationship between otolith weight and length to live body length and weight of freshwater drum. He also stated that only weight measurements were taken for the otoliths for fear of damaging them while measuring their lengths due to their fragile state and because the measurement landmarks could not be determined. Witt's equation is as follows, where OW = otolith weight (gms) and BL = body length (mm):

$$\text{Log OW} = -3.1286 + 2.3534 \text{ Log BL}$$

Appendix B provides the results of these calculations based on the individual otoliths. A summary of this data is provided within Table 10 in terms of live body length size ranges and averages for the three occupational levels.

**Table 10: Live Body Length from Otolith Weight**

| | **Component 1 (n=89)** | **Fish Layer (n=21)** | **Component 2 (n=100)** |
|---|---|---|---|
| **Length Range (mm)** | 328-680 | 375-697 | 341-682 |
| **Average LBL (mm)** | 504 | 516 | 515 |

Based on these calculations, it is apparent that 21 fish represented within the sample are smaller than that of the comparative specimen which had a live body length of 42.5 cm, an estimate which is also supported by observations made through relative size comparisons. These include ten specimens from Component 1, nine from the Fish Layer and two from Component 2. The minimum live body length size of 33 cm was obtained for a specimen identified within Component 2 with all others measuring above this length. However, according to Table 9 this specimen is greater than the smallest live body length of 30 cm recorded for a mature fish. Therefore, it is suggested that all the freshwater drum otoliths, including those smaller than the comparative specimen, are from mature fish.

Otolith MNI

As indicated previously, MNI values for freshwater drum were calculated from both the relative size comparisons and the pairing of the left and right freshwater drum otoliths of similar weight. Left and right otoliths were paired for those that weighed within 0.01 of a gms of each other, a procedure which was thought to account for measurement error or the loss of calcium carbonate due to handling. Those individual otoliths that did not have a similarly weighing otolith, or were similar in weight to another otolith pair but could not be paired themselves (e.g. there were three of about the same size), were considered to represent one individual fish. Higher MNI values were obtained with this method for all occupational levels than those which would have been estimated by simply using the more conventional method of adding them all up and dividing by two (Table 11).

**Table 11: Otolith MNI Calculations**

| | **Number of Complete Otoliths** | **MNI Based on Otolith # Divided by 2** | **MNI Base on Otolith Weight** |
|---|---|---|---|
| **Component 1** | 95 | 47.5 | 75 |
| **Fish Layer** | 24 | 12 | 23 |
| **Component 2** | 103 | 51.5 | 82 |

The higher values for MNIs based on otolith weight is primarily due to the fact that unlike the weight method, the conventional method assumes that both members of the pair of elements of a particular fish are represented within the assemblage. Due to the fragile nature of the otoliths, some of the weights are undoubtedly biased resulting in some otoliths not being paired with their mate, thereby artificially increasing the MNI totals.

As mentioned previously, one of the primary reasons for estimating live body length from otolith weight was to provide a check on the relative size estimates based on visual comparisons between the comparative specimen and the archaeological fish bone. Table 12 compares the relative size estimates derived from both of these methods for each size class and occupational level. The MNI estimates based on otolith weight were lower for Component 1 and the Fish Layer but higher for Component 2 than those based on relative size comparisons. A chi-square test of the data on Table 12 by component confirms that this difference is significant (Chi-Square=34.618, df=2, p=0.001).

**Table 12: MNI Estimates for Freshwater Drum Based on Relative Size Comparisons and Otolith Weight Pairing**

| **Component 1** | **MNI >** | **MNI =** | **MNI<** | **MNI Size Unknown** | **Total MNI** |
|---|---|---|---|---|---|
| Relative Size Comparisons | 66 | 3 | 3 | 1 | 73 |
| Otolith Weight Pairing | 65 | 1 | 9 | | 68 |
| Total MNI | 66 | 3 | 9 | 1 | 79 |
| **Fish Layer** | **MNI >** | **MNI =** | **MNI<** | **MNI Size Unknown** | **Total MNI** |
| Relative Size Comparisons | 62 | 0 | 3 | | 65 |
| Otolith Weight Pairing | 21 | 0 | 2 | | 23 |
| Total MNI | 62 | 0 | 3 | | 65 |
| **Component 2** | **MNI >** | **MNI =** | **MNI<** | **MNI Size Unknown** | **Total MNI** |
| Relative Size Comparisons | 37 | 2 | 1 | | 40 |
| Otolith Weight Pairing | 73 | 0 | 9 | | 82 |
| Total MNI | 73 | 2 | 9 | | 84 |

> 425 mm, =425 mm, <425 mm (within 0.01 gms)

This variation may reflect nothing more than differing discard patterns at the site through time in which the heads were discarded at different locations than the rest of the fish. As a result, in comparing the two methods it is suggested that the MNI derived from relative size comparisons is the better method. It draws on all the fish remains from the site, whereas the estimates derived from otolith weight are not as reliable because they are strongly influenced by discard patterns of fish heads employed at a site. Such factors mean these methods cannot be expected to yield similar MNI values and invalidate the idea the MNIs derived from otolith weight are a suitable check for those derived from relative size comparisons.

In comparison to any other North American freshwater fish species, the freshwater drum has the greatest latitudinal range, but their breeding behaviour is not well documented. Lake Erie studies suggest that spawning occurs in July in the open lake, in bays or the lower portions of rivers at depths of about 2 metres, possibly over mud and/or sand bottoms. Described as a bottom feeder**,** adults typically eat insects, crayfish, molluscs and other small fish (Scott and Crossman 1998:814-816). They live in shallower waters up to 12 – 18 metres in depth and seem to prefer turbid and silty habitats (Hubbs and Lagler 1964:116). In fact, they are commonly found in big, sluggish and silty lakes or rivers (Rostlund 1952:41). Although not a sought after food fish among contemporary anglers, they are often caught while angling with a hook and line (Scott and Crossman 1998:814-816). Average size ranges between one to two lbs, although 10 lb. specimens have been reported for the Great Lakes (Scott 1967:115). Very little is known ethnohistorically about this fish (Rostlund 1952:41). The only ethnographic reference for the catching of drum was provided by McKeeney who reports a group of Chippewa Indians fishing by torchlight within the St. Clair River using what was described as a trident to spear freshwater drum as well as other fish attracted to the light (1827:152).

Since all of the freshwater drum identified within the assemblage are inferred as being adult fish, it is likely that they were caught during their spawning run in July. The river channel would have provided the environment that this species of fish sought for spawning. Given the large numbers represented within each occupational level, it is likely that they were caught with nets although, like the walleye, they also could have been caught by angling with gorges or composite fish-hooks, or at night with leisters or spears with the use of torchlight. They are not likely to have been captured at the rapids where the walleye would have been caught because these waters, with their fast and swift currents, are not preferred locations for freshwater drum spawning. Also, although both walleye and freshwater drum could have been captured with nets in the river channel, there is little or no overlap in their spawning periods; the freshwater drum fishery should be considered distinct from that of the walleye.

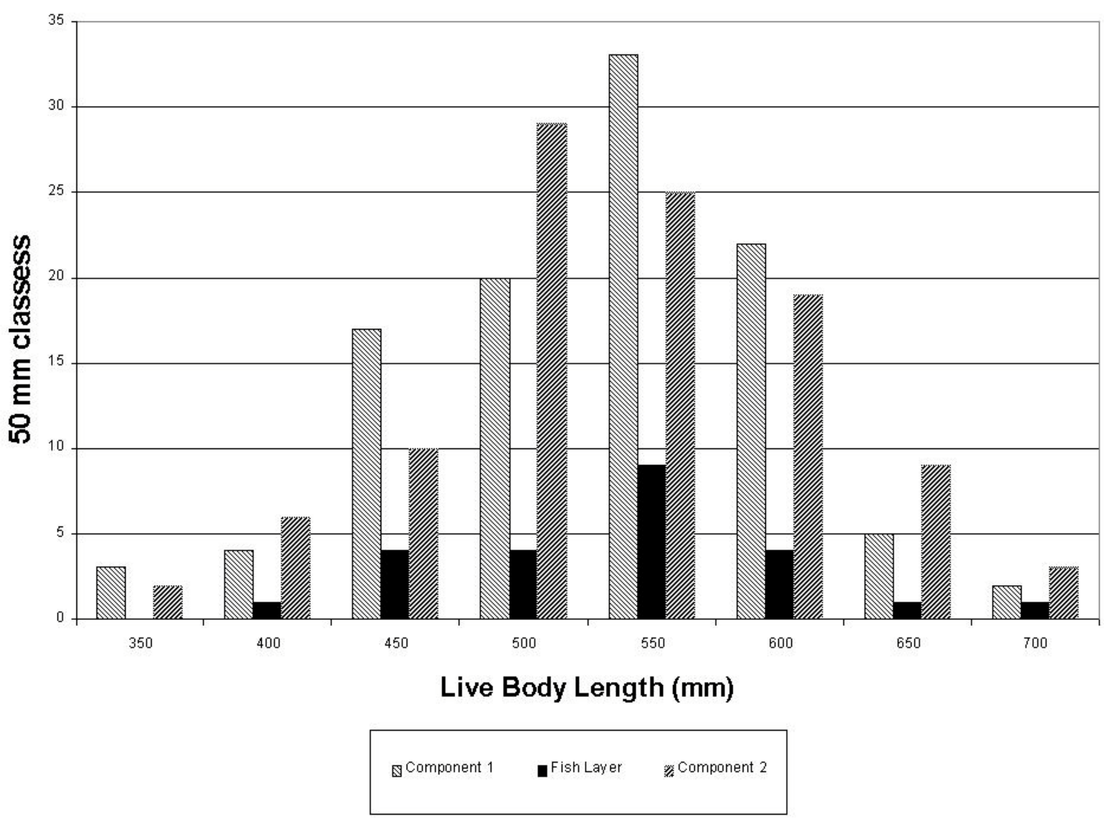


**Figure 23: Freshwater Drum Live Body Length (mm)**

As mentioned above, the MNI totals suggest that the procurement of freshwater drum remained relatively stable through time. Additionally, the MNI totals for the occupational levels presented within Table 8 suggest that there was a preference for catching freshwater drum that were larger than the comparative specimen, or 425 mm in length, which is a similar procurement pattern inferred for the walleye. However, since there is a wide range of fish sizes represented within each MNI relative size category, as demonstrated by the live body length calculations based on otolith weight (Appendix B), this inference could be investigated further. Figure 23 illustrates the distribution of live body length size estimates based on otolith weight as grouped within 50 mm size classes.

This figure clearly illustrates that the live body length of the freshwater drum as calculated from the otolith weight follows a normal distribution for each of the occupational levels. Although the population's size distribution among adult freshwater drum is not known, it can be assumed to mirror a normal distribution where there are many more individuals around the mean and fewer at the extremes. This suggests that selection in terms of fish size for the freshwater drum was not being practiced by the site's inhabitants. It also suggests that the type of nets used for their capture were of the seine type which catches a larger distribution of sizes than the gill net. Moreover, seine nets would work better than gill nets within a river channel environment.

**Family Acipenseridae**

Only one species of fish belonging to the Acipenseridae family was identified within the BWBS site fish assemblage, *Acipenser fulvescens* Rafinesque, more commonly known as the lake sturgeon. As mentioned previously, although NISP totals were relatively high for lake sturgeon, MNI values were low. This contrast is a result of the fact that only fragmentary scutes were identified that could not be assigned to separate individuals. Therefore, the sturgeon MNI may be larger than reported. Lake sturgeon are a large and heavy primitive fish with a prominent body covering of boney scutes. Today, sizes usually range from 1 to 1.5 m in length and 4.5 to 36 kg in weight but larger specimens weighing over 90 kg have been captured and the largest on record is a 310 lb. catch from near Lake Superior (Scott and Crossman 1998:82-89). Although it is difficult based on MNI totals to estimate the relative size of the contribution sturgeon made to the diet of the site's inhabitants, because they are so large, one or two mature fish would probably contribute as much in terms of meat as all of the walleye captured during any one occupational level. Hence, the contribution of this fish to the diet of the site's inhabitants was probably significant.

Lake sturgeon are relatively dispersed for most of the year inhabiting the mud or mud and gravel bottoms of large lakes and rivers at around 4.5 to 9 m. They then move to spawning grounds, congregating into small male-female groups in early May to late June dependant on the water temperatures with optimum spawning temperatures being between 13 and 18 $^{o}$C. Spawning takes place in water depths of 1 to 5 metres in swift waters or rapids such as at the foot of a low falls, which would contain further movement (Scott and Crossman 1998:82-89).

Sturgeon are filter feeders that use their tube-like mouths to suck small plants, animals and fish such as smelt or eulachon (Scott and Crossman 1998:86). Although they are not biting fish, this feeding behaviour cause them to suck in a baited hook occasionally allowing them to be caught with lines (Harkness and Dymond 1961:61; Rostlund 1952:11). Sagard's report of finding large fish with hooks in their bellies suggest that sometimes the line may not have been strong enough to hold them (Wrong 1939:189). Hennepin (1972:522-523) and Sagard (1968:60) report the aboriginal use of nets to catch sturgeon. As noted previously, sturgeon fishing with a spear or harpoon was a specialized fishery during early historic times and was reported by Lahontan (1905:361:362) and LaPotherie (Blair 1911:280). The French explorer Charlevoix (1923:236) provides a particularly descriptive account of Great Lakes sturgeon fishing in 1720**:**

> Two men place themselves in the two extremities of a canoe; the [one] next [to] the stern steers, the other standing up holding a dart to which is tied a long cord, the other extremity whereof is fastened to one of the cross timbers of the canoe. The moment he sees the sturgeon within reach of him, he lances his dart at him and endeavors, as much as possible, to hit in the place that is without scales. If the fish happens to be wounded, he flies and draws the canoe after him with extreme velocity; but after he has swam the distance of an hundred and fifty paces or thereabouts, he dies,

and then, they draw the line and take him.

The presence of toggle-headed harpoons within the BWBS assemblage suggests that spearing most likely was the method of procurement. It may have taken place at the rapids located near the mouth of Lake Huron during their spring spawning run from early May to late June. However, given that their spawning season overlaps with that of the walleye, it is possible that the lake sturgeon were incidental catches while fishing for walleye with seine nets in the river channel, an area which would also provide suitable spawning habitat. As noted above, they could also have been caught through angling with gorges. However, since they are strong heavy fish**,** they would not likely have been caught incidentally on a line set up for a walleye but rather intentionally with a line specifically designed to catch and hold lake sturgeon.

**Family Centrarchidae**

Two species of this family were identified within the fish assemblage of the BWBS site and include the largemouth bass (*Micropterus salmoides* Lacepede) and the white crappie (*Pomoxis annularis* Rafinesque). A number of elements (NISP=8) were identified to this family although the species was not identified, therefore they were assigned to *Micropterus* spp.

<u>Largemouth Bass</u>

Evidence of largemouth bass was found within all three occupational levels which include an MNI of 11 (NISP=17) for Component 1, an MNI of six (NISP=13) for the Fish Layer and an MNI of nine (NISP=16) for Component 2. The size of the elements identified for the largemouth bass was greater than or equal to that of the comparative specimen. Although size measurements were not available for the comparative specimen it was indicated that it was a mature fish. Given the above, it can be assumed that the largemouth bass represented within the assemblage are mature fish. Given the relatively low MNI numbers, the relative contribution of this fish to the diet of the Native inhabitants of this site is not considered to be significant in comparison to the walleye, sturgeon and freshwater drum; however, it is more significant than the other fish identified.

Almost twice as many largemouth bass were identified within Component 1 (MNI=11) than the Fish Layer (MNI=6) but only two more than from Component 2 (MNI=9). Whether this difference indicates anything in relation to procurement practices is hard to determine. The samples are too small to warrant meaningful statements about changes in resource reliance from one occupational level to the next. Perhaps given this and their low numbers they may be just incidental catches.

Spawning for the largemouth bass occurs from late spring to early summer and usually takes place when water temperatures reach 16.7 to 18.3 $^{o}$C, although nest building by males will begin earlier when temperatures reach 15.6 $^{o}$C. Bottoms for spawning will vary from gravelly sand to marl and soft mud bottoms, with plenty of cover from water lilies or bulrushes. They commonly seek the shallower and protected sites in weedy bays for spawning (Scott and Crossman 1998:734-737). At other times of the year this species is found: in sluggish waters with soft bottoms having stumps and extensive weed growth such as pond weed cattails and lilies; at depths generally <20 m in the warm water of small, shallow lakes or shallow bays of larger lakes; and rarely, in larger slow rivers. Largemouth bass have a high tolerance for warm waters and slight turbidity and are sight feeders, usually feeding in schools close to vegetation. As adults they feed on other fish, insects and frogs. Their feeding is restricted in colder water during spawning (Scott and Crossman 1998:738).

The largemouth bass grows much larger than other members of this family (such as the smallmouth bass, *Micropterus dolomieu*, the pumpkinseed, *Lepomis gibbosus* (Linneaus) and the white crappie to be described below), reaching a record weight in Ontario waters of 6.4 kg. On average, anglers do not often catch specimens that weigh more than 2.5 kg. This fish can be caught easily with worms, minnow or frogs on a hook and can be attracted easily with surface lures (Scott and Crossman 1998:739). Little is said about the basses in the early historic literature or the later ethnohistoric accounts (Rostlund 1952:40). Smith (Martin 1985:60) described the spearing of largemouth bass at a small weir but it is not clear which group he was discussing. The catching of bass with torchlight and spear was reported for the St. Clair River but it is not certain if it was the largemouth species (McKenney 1827:152).

The fish identified as bass within the assemblage are all from mature individuals and therefore they were most likely caught during their spawning runs. Although their spawning period overlaps with that of walleye they may not have been caught incidentally while fishing for walleye with nets because these species prefer different habitats for spawning. It is likely that the largemouth bass was caught away from the site, perhaps in a large marshland pond located within the nearby wetlands where it would have lived year round or in Sarnia Bay. Since nets of any type do not work well within these environments, the largemouth bass were most likely caught through angling with a gorge or composite fish-hook.

White Crappie

Evidence for white crappie was found within Component 1 (NISP=1) and Component 2 (NISP =1) but based on its very low representation, it is considered a very minor contributor to the diet of the site inhabitants. The sizes of the elements recovered were identified as being smaller than the comparative specimen which was mature, but no measurement data are available for the comparative so it cannot be determined if they are a smaller mature or simply an immature fish.

Biological information for this species in Canada is virtually nonexistent but information concerning US populations is available (Scott and Crossman 1998). Spawning begins in late spring and runs to early summer at temperatures between 14-23 $^{o}$C. Nests are cleaned and prepared by males at depths of 2-100 cm of water near rooted plants or algae, sometimes in the protection of undercut banks. Adults feed on insects, crustaceans and small fish. In Ontario, white crappie have been found in muddy, slow moving portions of larger rivers and in silty streams, ponds and lakes. They can be easily caught through angling with a worm or minnows in shallow water but they are highly attracted to shiny lures that are jigged or trolled. They are often caught in the warm, weedy sheltered bays and in the mouths of tributary streams that lead into the Great

Lakes (*ibid* 1998:741-744). No historical or ethnographic information about methods of capture are available although the reference to hunting with torchlight for bass provided by McKenney (1827:152) could apply to this species. Given the low numbers of this fish within the assemblage, it is likely that they were caught through angling within a marshland pond, or if mature, with spears or leisters when they were spawning in the shallower waters. They could have lived there year-round with individuals of all ages being available for capture. As argued for the largemouth bass, the white crappie was not likely captured in a net because the marshland pond habitat in which it lived would inhibit the use of such techniques.

**Family Ictaluridae**

Two members of the Ictaluridae where identified within the BWBS site assemblage. These include the channel catfish (*Ictalurus punctatus* Rafinesque) and the brown bullhead (*Ictalurus natalis*).

The Channel Catfish

The channel catfish were identified within Component 1 (NISP=6, MNI=1) and the Fish Layer (NISP=4, MNI=1) and are considered representative of mature fish because the elements identified are larger than those of the comparative specimen. The channel catfish typically inhabits the sand or gravel bottoms of cool, clear and fairly deep waters of lakes and large rivers. Although spawning usually takes place in the late spring or early summer when water temperatures reach 23.9 to 29.5 $^{o}$C, the species may or may not migrate to spawn depending on habitat. Channel catfish prefer to spawn in secluded areas where nests can be concealed within log jams, rocks, holes, etc. The channel catfish is an omnivorous bottom feeder, feeding on plants, insects and small birds. Its average weight is 1-2 kg but it can reach sizes of up to 14 kg or more (Scott and Crossman 1998: 604-610).

No historical or ethnographic information about methods of capture for this species of fish are available. It is possible that the channel catfish was caught while spawning within a log jam in the river channel and that it was captured through angling with gorges or hooks. Yet, given that its spawning season overlaps with that of the walleye, the species may have been incidentally captured while net fishing for walleye within the river channel.

The Brown Bullhead

The brown bullhead is represented by one identified specimen recovered from the Fish Layer and comparative size estimates suggest it is from an adult fish. The brown bullhead differs from the channel catfish in that it inhabits warmer and shallower rivers, streams and wetland habitats, with sand or mud bottoms with aquatic vegetation. However, it is very tolerant of a wide variety of conditions and has adapted to life in heavily polluted water. Spawning occurs from May-June when water temperatures reach 21.1 $^{o}$C. and this may not involve migration. It is an omnivorous bottom feeder like the channel catfish but it is smaller, averaging only 0.3 to 0.6 kg in weight and 20.0 to 35.5 cm in length. It is a solitary, nocturnal fish and could be caught quite easily with traps, and gill nets (McMurty 1991) or a baited line (Cossette 1995:549-55).

No historical or ethnographic information about methods of capture for this species of fish are available. It is likely that the brown bullhead was caught in the marshland pond through angling with gorges or composite hooks.

**Family Amiidae**

The bowfin, *Amia calva* Linnaeus, is represented within Component 1 (NISP =1). It is a spring spawner which can occur from late April in the south to late May to June in the Georgian Bay region. The nests are prepared by males in vegetative waters in shallow lakes and rivers. Adults live in swampy, vegetative bays of warm lakes and rivers. Bowfins are predators that use sight and smell to catch fish, crayfish and frogs. Most available size information is indirect and based on scale studies with the maximum size reaching 15 pounds in Quebec. Those caught in Canada are usually between 2-3 lb. in weight and measure 45-60 cm Considered a pest by commercial and contemporary anglers, it readily takes live bait and lures that are fished from the bottom (Scott and Crossman 1998:112-116).

No historical or ethnographic information about methods of capture for this species of fish are available. The size of the recovered specimen, versus the modern comparative specimen suggests that it is a mature fish and given its preferred spawning habitat it is suggested that the river channel or Lake Huron contained shallower vegetative areas. It is likely that the bowfin was caught in the shallows of the river channel or lake by angling with a gorge or composite hook, or incidentally while migrating to this location, in a net set for walleye.

**Family Catostomidae**

The white sucker, *Catostomus commersoni* of the Catostomidae family, was identified within Component 2 of the assemblage. The three elements recovered were likely from a single individual (MNI=1) and were larger than the mature comparative specimen, so it is suggested that the archeological specimens are from a mature fish. This species of fish behave similarly to sturgeon in that they prefer shallow lakeshore areas or shallow moving tributaries for spawning. Migration of large schools of fish to the spawning grounds occurs during mid-April to mid- May and is temperature dependant. The species usually enters spawning streams as soon as stream temperatures exceed 5 $^{o}$C. Spawning occurs in very shallow waters 15 to 28 cm deep on a gravel bottom. They congregate into groups consisting of one female and several males for short periods. These are not very large fish and a record weight was 7.3 pounds from Great Slave Lake. They are bottom feeders that feed exclusively on invertebrates and sometimes become a meal for larger fish such as the northern pike (Scott and Crossman 1998:531-535).

No historical or ethnographic information about methods of capture for this species of fish are available. Based on their preferred spawning habitat the presence of this species suggests, like the bowfin, that a shallow stream or shallow portion of the river must have been nearby. It is possible, like the bowfin, that this individual fish was caught in a net while migrating to its spawning grounds. However, since they move in large numbers at this time, a larger catch and, therefore, a larger representation within the sample would have been expected. It is more likely that this fish was caught through angling with a composite hook or gorge.

**Family Salmonidae**

Lake whitefish, *Coregonus clupeaformis* (Mitchill), of the family Salmonidae, was identified at the site. However, it was recovered from a location outside of the 13 provenienced squares used in this analysis. Its identification was done during an earlier analysis of areas of the site not then known to lack representation of the three occupational levels. A single vertebrae was located within square 205 N 405 E, subsquare 24 at a depth of 15-40 cm (Figure 10). Its depth suggests that it was located within Component 1 as identified by O'Neal (2002).

Lake whitefish are considered a cool water species highly sensitive to water temperatures and will move throughout the year to seek cooler habitats. During the summer in lakes with thermal stratification, they move to stay within cool waters as the water temperature increases. In the spring they move to deep shoal waters and then back to deeper waters as warming occurs in the shoals. Lake whitefish have an all-season depth distribution of 18-53 metres but it may be found at depths of 128 metres. They congregate in large numbers at these locations (McCrimmon 1958). This species differs from the others discussed above in that it is the only one that breeds in the fall, usually November and December when waters drop to near freezing in the Great Lakes region (Scott and Crossman 1998:271). At this time, adult lake whitefish will move in large numbers to shoal or reef areas and inshore shallows over rocks or hard bottom conditions to spawn. Adults are bottom feeders, consuming invertebrates, fish and phytoplankton in some regions.

Today, whitefish are caught commercially in gill nets or trap nets with the most common size being between 0.7 to 1.4 kg (Scott and Crossman 1998:269-277). Although Schoolcraft (1852:53) notes that "the whitefish, so common to the whole line of lakes, never bites at a hook, and is captured solely by nets", contemporary anglers habitually catch whitefish at all times of the year, especially in the fall and winter. They use a small hook usually with salted or fresh emerald shiner, while winter fishing sometimes involves prebaiting the water with salted minnow or boiled grain (Scott and Crossman 1998:276). In fact, McCrimmon and Skobe (1970) note local fishermen catching as many as 50-150 fish per day during the winter fishery. Hennepin reports the Iroquois using nets to catch lake whitefish (1972:522-523) and as mentioned previously, Sagard describes the Huron fishing for whitefish with gill nets in deep water about half a league to a league out into the lake (Wrong 1939:185-186).

The presence of lake whitefish within the assemblage may suggest that the site's inhabitants are practising some offshore lake fishing given that these fish do not prefer river channel or marshland pond habitats. This specimen could have been caught while angling on the lake, like the bowfin, or through trolling during an excursion onto the lake. As an alternative explanation, the presence of lake whitefish may be the result of a short term fall occupation of this site where an excursion onto the lake resulted in the capture of this fish which was then brought back to the site for consumption.

**Fish By Feature**

The fish found within features were examined in order to look for evidence for mass capture methods of fishing such as weirs or nets. As noted previously, given the nature and use-life of a feature, the artifactual material found within these may represent a single event or a more restricted time period than that recovered from the site as a whole. In particular, the co-occurrence of particular fish species as well as their relative size estimates can be used to determine season of capture as well as methods of capture. This reasoning is based on the assumption that fish co-occur within the same feature deposits were caught around the same time of year, or at least while the feature or pit was still open or in use, and likely using the same fishing technique.

Twenty cultural features located within the sample area contained fish remains. This included three hearths, one wall trench, and one pit feature with the remaining 15 possibly functioning as refuse pits. The representation of fish found within these features is similar to that found within the general site area with the exception of an absence of the minor fish species found within the assemblage noted above. Given such, it was thought that nothing new would be gained by providing a detailed feature by feature description.

Instead, a general summary of what was found is provided below. However, the fact that all of the fish recovered from the features were from mature specimens based on comparative size estimates and freshwater drum otolith data, suggests that the assemblage has not been affected by recovery bias.

The relative representation of the various species of fish found within the features varies from that found within the general site area: walleye, freshwater drum and sturgeon, appear in the higher frequencies and largemouth bass is represented in much lower numbers. As with the larger sample, the representation in terms of MNI numbers suggests that methods of mass capture such as nets may have been used, however, given the variation in habitat and spawning season between freshwater drum and walleye, it is likely that they were captured at different times of the year. Although net fishing for walleye would have accounted for their relatively large numbers within the features, large numbers also could have been procured at the rapids. As mentioned previously, the sturgeon may have been an incidental catch in a net set up for walleye**;** however, angling or spearing also may have been possible. The largemouth bass were more likely caught by angling in the marshland pond and brought back to the site for consumption.

In terms of the occupational levels there appears to be a greater number of features located within Component 2 (n=12) with only five found within Component 1 and three within the Fish Layer. However, the overall representation of fish found within Component 2 is smaller than that found within the Fish Layer and Component 1. Given the above, the features do not provide any new information about fish utilization or fishing methods used at the site but rather confirm those patterns observed within the larger sample.

**Summary**

The analysis of the BWBS site fish faunal assemblage indicates that the site's inhabitants exploited spawning fish from spring to early summer using seine nets, spears, harpoons and leisters, as well as angling with gorges and composite fish-hooks. They exploited at least three different water environments to catch a wide range of species which include the river channel with its associated rapids and shallows, the vegetative shoals and deeper waters of Lake Huron, and a large marshland pond as in Sarnia Bay. The evidence suggests that there was a highly specialized seine net fishery for both walleye and freshwater drum that began in the early spring with the spawning runs of the walleye and ended in July with the end of the spawning runs of the freshwater drum, likely without much overlap. The seine nets may have been set across the river channel and drawn close to shore where the fish could be speared with leisters or plucked by hand as they splash around in the shallows. Unintentional catches of sturgeon, channel catfish and bowfin may have occurred while fishing with nets for walleye. A specialized fishery for both spawning sturgeon and the walleye may also have taken place at the rapids near the mouth of Lake Huron where many walleye would be taken with leisters and spears, and sturgeon with spears and harpoons. These above-noted fisheries were considered primary and most important to the site's inhabitants because they no doubt provided them with the dietary mainstay in terms of fish resources.

Some species identified within the assemblage had only a minor representation suggesting that they were probably caught as part of a more generalized fishery that the site's inhabitants enjoyed but may not have depended on for survival. These species include those that were likely caught in a marshland pond environment through opportunistic angling with gorges or composite hooks which were intended to catch anything that would bite the bait. The species caught with this approach include the largemouth bass, the white crappie and the brown bullhead. Angling also could have been done in the river channel which would have caught fish species such as sturgeon, channel catfish, bowfin, freshwater drum and walleye. Also included in this category is a single lake whitefish, which was probably caught on a troll or trot line during a canoe trip onto Lake Huron but brought back to the site for consumption.

# Chapter 7

## Middle Woodland Fishing Methods

As outlined in Chapter 4, the fishing related artifacts recovered from the BWBS site included toggle-head and unilaterally barbed harpoons, unilaterally barbed points, leister components, gorges, composite bone hooks, and netsinkers, suggesting that fish were caught through spearing, angling and with the use of nets. As noted in Chapter 6, the fish species identified within the three occupational levels of this site indicate that walleye, freshwater drum and sturgeon contributed significantly to the diet of the site's inhabitants throughout the occupation of the site with other fish species such as bowfin, channel catfish, largemouth bass, white crappie, brown bullhead, lake whitefish and sucker contributing only in a minor way to subsistence. The emerging fishing strategy for fish procurement at this site includes the following:

1) a highly specialized seine net fishery for the harvesting of spring spawning walleye and early summer spawning freshwater drum within the river channel;

2) a specialized fishery of spawning lake sturgeon and walleye at the rapids located near the mouth of Lake Huron employing harpoons, spears, or leisters;

3) incidental catches of spring spawning species such as sturgeon, channel catfish, and bowfin while fishing with nets for walleye within the river channel;

4) the procurement of a small number of spawning marsh pond or shallow bay species as a result of a more generalised fishery at the site involving opportunistic angling. Species probably caught this way include largemouth bass, white crappie, and brown bullhead and, out on Lake Huron, non-spawning lake whitefish and possibly bowfin; and

5) perhaps a short term fall occupation during which time fall spawning whitefish were caught opportunistically through angling as well as brown bullhead, white crappie, largemouth bass and freshwater drum which live year round within the river and pond or bay aquatic environments.

This pattern of fish exploitation, although very important, likely represents only a small part of the overall yearly settlement and subsistence pattern followed by the site's inhabitants. However, without an analysis of the remainder of the faunal assemblage, it is difficult to be certain about the relative importance of fish to subsistence at this site. The current traditional view of Middle Woodland settlement and subsistence in the central Great Lakes, perhaps best known from the "Saugeen culture" (Finlayson 1977), involves a seasonal round where populations amalgamate and split depending on the resources available at specific locales. Although other resources such as deer were used, during the spring to early summer, fish were a major component of the diet. They were exploited by larger "macrobands" of people who gathered at major riverine locations ranging from near river mouths to major rapids inland. At some time in the summer and continuing through to the fall, these aggregates divided into microbands and moved to lakeshore areas where they exploited a range of fish species as well as aquatic mammals, turtles, birds and deer (Deller et al. 1986; Spence et al. 1990:153-155). It has also been suggested that a third component of this seasonal round involved the establishment of small inland camps of dispersed families in the winter but this part of the cycle has not been well demonstrated archaeologically (Ferris and Spence 1995:100). The fishing activities that occurred at the BWBS site, as well as its large scale (see O'Neal 2002), fit well within the pattern involving the spring to early summer macroband settlement. In order to understand how the BWBS site relates to other Middle Woodland fishing sites, the remainder of the chapter will compare the fishing methods employed at the BWBS site to those of a selected range of other Middle Woodland sites within the central Great Lakes region. A summary of the fauna and fishing related artifact data from these sites is presented in Tables 13 and 14.

**The Schultz Site**

The Schultz site (20SA2) is a stratified Early Woodland to Late Woodland site located on Green Point within the Saginaw Valley of Michigan (Fitting 1972; Figure 1). It is situated along the northeast margin of the Shiawassee flats where the Cass, Flint, Shiawassee, and Bad Tittabawassee Rivers converge to form the Saginaw River. Formal excavations of this site occurred from 1959 to 1964 by the University of Michigan Museum of Anthropolgy (UMMA) and by Michigan State University (MSU) in 1991 (Lovis et al. 2001). Radiocarbon dates are not available for the lowest of the Middle Woodland levels at the Schultz site although these have been assigned a tentative date of

**Table 13: Summary of Fishing Related Artifact Data for Selected Sites**

| | BWBS | Schultz | Donaldson | Summer Island | Wyoming Rapids | Boresma | Schoonertown | Inverhuron / Lucas | Thede |
|---|---|---|---|---|---|---|---|---|---|
| Toggle Headed Harpoons | x | x | x | x | | | | | |
| Unilaterally Barbed Harpoons | x | | | | | | | | |
| Unilaterally Barbed Points | x | | | | | | | | |
| Gorges - Bone | x | | | | | | | | |
| Gorges - Copper | | | x | x | | | | | |
| Composite Fish Hook | x | | | | | | | | |
| Fish Hooks - Bone | | | | | | | | | |
| Fish Hooks - Copper | | | | | | | | x | |
| Leister Points | x | | | | | | | | |
| Netsinkers | x | | x | x | | x | | x | |
| Net Making Shuttles | | x | | | x | | | | |

approximately 10 B.C. to A.D. 160 (Fitting 1972:66). However, overlying levels have radiocarbon dates that calibrate to ca. A.D. 300-600 (Fitting 1972:66-67; Lovis et al. 2001:620).

Fishing related artifacts recovered from the Middle Woodland component of this site during the UMMA excavations included two antler toggle-head harpoons and eight possible net-making shuttles (Table 13). Although MNI data were not provided, for the UMMA investigations, in terms of NISP the major fish species, in order of abundance, included walleye, sturgeon and freshwater drum. Minor fish species in terms of NISP (again in order of abundance) included longnose gar, bullhead, channel catfish, bowfin,

**Table 14: Summary of Fish Species Data for Selected Sites**

| | BWBS | Schultz | Donaldson | Summer Island | Wyoming Rapids | Boresma | Schoonertown | Inverhuron-Lucas | Thede |
|---|---|---|---|---|---|---|---|---|---|
| *Acipenser fulvescens* - lake sturgeon | x | x | x | x | | x | x | | x |
| *Stizostedion vitreum* - walleye | x | x | | x | x | | x | | x |
| *Stizostedion* sp. - sauger/walleye | | | x | | | x | | | |
| *Perca flavesens* - yellow perch | | x | x | | | | | | |
| *Aplodinotus grunniens* - freshwater drum | x | x | x | x | | x | x | | |
| *Micropterus salmoides* - largemouth bass | x | x | | | | | | | |
| *Micropterus dolomieu* - small mouth bass | | x | | | | | | | |
| *Micropterus* sp. - largemouth/smallmouth bass | | | x | x | | x | x | | |
| *Pomoxis annularis* - white crappie | x | | | | | | | | |
| *Catostomus commersoni* - white sucker | x | | | | | | | | |
| *Castomus catostomus* - longnose sucker | | | | | | | | | |
| Catostomidae sp. | | x | x | x | x | x | x | | x |
| *Ictalurus punctatus* - channel catfish | x | x | x | | x | x | x | x | x |
| *Ictalurus natalis* - brown bullhead | x | x | x | | | x | x | | |
| *Noturus flavus* - stone cat | | | x | | | | | | |
| *Lepisosteus osseus* - longnose gar | | x | | x | | | | | |
| *Salvelinus namaycush* - lake trout | | x | x | | | | | | |
| *Coregonus clupeaformis* - lake whitefish | x | | x | | | | x | | |
| *Amia calva* - bowfin | x | x | | | | | | | |
| *Esox lucius* - northern pike | | x | x | x | | x | x | | |
| *Semotilus atromaculatus* -creek chub | | | x | | | | | | |
| *Lota lota* - burbot | | | | | | x | | | |

northern pike, yellow perch, sucker and lake trout (Fitting 1972:97). The pattern of seasonal exploitation was defined primary on the basis of the spawning periods of the lake species found within the assemblage (Luxenburg 1972:91-115). This information suggested the spring to early summer harvest of walleye, sturgeon, channel catfish, suckers, yellow perch and smallmouth bass and the fall harvest of lake trout as they move inland to spawn. Fishing with nets was proposed due to the variable size range in fish identified within the assemblage although the possibility that weirs may have been used was also noted (Luxenburg 1972:108, 260).

MSU excavations in 2001, using fine-scale excavation techniques involving flotation, revealed a similar pattern of fish exploitation (Lovis et al. 2001:622). To date only an excavated area referred to as Column 11 has been analyzed. Walleye and freshwater drum ranked higher in these samples in terms of NISP but there was an absence of channel catfish and sturgeon, a larger representation of bullhead and largemouth bass, as well as additional fish species such as bluegill and crappie, which were not identified within the UMMA assemblage. Spatial variation across the site was proposed to account for the larger numbers of channel catfish remains recovered from the UMMA excavations (Lovis et al. 2001:625). Methods of fishing were not discussed as part of the MSU report (Lovis et al. 2001). Based on the fish as well as other fauna at the site it was determined that resource extraction was strongly oriented towards the exploitation of the local aquatic environment of warm clear waters with abundant vegetation and a mud bottom. It was proposed that fish species such as gar, walleye, perch, bluegill, crappie, pike, bullhead, bowfin, and largemouth bass would be caught here. The remaining fish species would have been found away from shore in clearer cooler waters of greater depth (Lovis et al. 2001:622).

**The Blue Water Bridge South Site and the Schultz Site**

The Schultz site (Figure 1) is very similar to the BWBS site in terms of its dating, location with respect to a number of different hydrological conditions and fish species representation. There is also the notable similarity in the presence of toggle-head harpoons and the large number of sturgeon remains suggesting a specialized sturgeon fishery occurred at both sites. However, given the absence of rapids at the Schultz site, which may also explain the absence of leisters which work well there, it is probable that the spawning sturgeon were speared while stranded in the shallows or while being observed from a canoe during their spawning run. Other large fish species such as the channel catfish could have been caught this way as well. Of course, the occasional sturgeon could have also have been caught incidentally in the nets set for spring spawning walleye as with the BWBS site. Although the Schultz site lacks the evidence in the form of netsinkers for the use of seine nets, the presence of net-making shuttles suggests nets were being made at this site and, as noted previously, instead of netsinkers poles can be used to anchor seine type nets. The seine net could have been stretched across the river channel with poles catching spring spawning walleye, the occasional sturgeon and summer spawning freshwater drum, a pattern also observed at the BWBS site.

The presence of a pond or marshland environment similar to that of Sarnia Bay near the BWBS site or a shallow vegetative portion of the river is indicated by the presence of fish species such as perch, bluegill, crappie, pike, bullhead and largemouth bass, and reptilian species at this site that prefer this environment. The creation of ponds through the occasional flooding of the flats was noted (Wright 1972:44) and it was suggested that it was shallower and weedier near shore along the Tittabawassee River (Wright 1972:108). However, in contrast to the BWBS site, there is a lack of evidence for angling at the Schultz site, which would have been an effective way of catching these species within the warm, shallow and vegetative environment. It could be suggested then, that these species may have been caught incidentally in nets while travelling in the river to their spawning grounds.

Unlike the BWBS site, it is possible that all the fish species were caught at the Schultz site with the use of a weir. This use would explain the diversity of the assemblage despite the lack of tangible evidence for various fishing methods. A bag net, for example, which does not require netsinkers, could have been used to retrieve the smaller fish from the weir.

Although not strongly supported by other evidence from the Schultz site, the presence of fall and early winter spawning fish species such as whitefish and lake trout suggest a short late-fall early-winter occupation for the site. Although whitefish remains were recovered from the BWBS site, it was suggested given their low numbers that they were probably caught by angling during an excursion onto Lake Huron although a short fall occupation may have occurred. While evidence for angling in the form of gorges and composite hooks is present at the BWBS site, such gear is absent at the Schultz site. Given such, it is therefore probable these fish were caught within the river system close to the Schultz site while spawning during a short fall to early-winter occupation of the site.

**The Summer Island Site**

The Summer Island site is located on Summer Island which is part of an island chain lying across the entrance to Green Bay, Wisconsin within the northern Lake Michigan basin (Brose 1970:7; Figure 1). The island measures roughly three wide (northeast to southwest) and five km long (northwest to southeast) with a coastline of approximately 16.5 km. Limited investigations of this site began in 1959 and were continued by the UMMA in 1963, 1965 and 1967. The main concentration of the site was located roughly 150 ft from Summer Harbour. Based on a number of radiocarbon dates, the site has been dated to around A.D. 200 (Brose 1970:152). Excavations were carried out using eighth-inch hardware cloth and the contents of all features were subject to flotation (Brose 1970:17-24). The site has a Middle Woodland component followed by Upper Mississippian and Proto-historic components (Brose 1970). The following discussion focuses on the Middle Woodland component.

Fishing-related artifacts recovered from the site included fourteen netsinkers, three copper gorges, two fishhooks, eight possible net-making shuttles and four antler toggle-head harpoons. The fish identified at the site prefer habitats with clean rocky bottoms, cool water and little rooted vegetation. In terms of NISP, ranked according to decreasing abundance, sturgeon ranked the highest with an NISP of 698, followed by walleye (NISP=18), bass (NISP=5), northern pike (NISP=2), sucker (NISP=2), gar (NISP=1) and freshwater drum (NISP=1) (Brose 1970:145).

The pattern of fish procurement involves the intense exploitation of spring spawning sturgeon and walleye with the use of spears for the former and nets for the latter. Based on the relative representation, the harvesting of sturgeon was inferred as a major subsistence activity at the site and may even have been the principal reason for it (Brose 1970:145-149). Sturgeon was suggested to have been captured using nets or spears as they spawned in the shallow water along the rocky shoals surrounding the island. Also, miscellaneous hook-and-line and spearing of other species of fish was suggested *(ibid* 1970: 165).

**The Blue Water Bridge South Site and the Summer Island Site**

The Summer Island site was occupied around the same time as the BWBS site; however, unlike the BWBS site, it has a well-preserved Late Woodland component. Based on the presence of both toggle-head harpoons and a large number of sturgeon remains at this site, spearing of spring spawning sturgeon in the shallows was a major activity here. Also, the presence of netsinkers and relatively abundant walleye remains also suggests that a walleye fishery was a major activity at this site. The remaining fish species were likely caught incidentally in nets set for walleye or through opportunistic angling or trot line fishing within the island shoal waters. All of these methods noted above for the Summer Island site were also inferred for the BWBS site although what is absent at the Summer Island site is the summer freshwater drum fishery and the opportunistic pond/marshland fishing. Given such, it appears that the BWBS site had a much longer and more intensive fishery with a greater focus on walleye and freshwater drum than that observed at the Summer Island site. Perhaps local microenviromental conditions could explain the lack of evidence for opportunistic pond/marshland fishing at the Summer Island site

As mentioned previously, the netsinkers recovered for the Summer Island site differ from those recovered from the BWBS site in terms of weight, which may be the result of varied hydrological conditions between the two sites. For example, the Summer Island site is located on an island surrounded by shoals with little current. If any nets are set within these waters, the netsinkers would not have to weigh very much to stabilize them. This situation contrasts with what is observed at the BWBS site where netsinkers would have to be heavier to hold a net steady within the river channel environment. Also, netsinkers within shallow waters may receive more disturbances and would, therefore, require a type of notch that would provide a more secure hold. Brose (1970:125-126) has suggested that the long cobbles with deep notches were used for these conditions. At the BWBS site, the atypical netsinker may have provided for this eventuality and a small number of the netsinkers recovered from Summer Island, which resemble the atypical netsinkers recovered from the BWBS site (Brose 1970: Plate XXIII), may also have been used when water conditions warranted a more secure hold on the net.

**The Donaldson Site**

The Donaldson site (BdHi-1) is located within the Bruce Peninsula of Ontario, on the north bank of the Saugeen River roughly three km from where it flows into Lake Huron (Figure 1). Considered the type site for the Saugeen culture, it was first documented in 1947 by a collector, and then subjected to formal excavations by: Thomas Lee in the late 1940's and early 1950's, James V. Wright in 1960 (Wright and Anderson 1963) and William Finlayson in 1971 (Finlayson 1977:242).

Calibration of the radiocarbon dates from the site suggest an occupation from ca. 200 B.C. to A.D. 700 (O'Neal 2002:91; Spence et al. 1990:126) with the major occupation during the earliest part of this range (Finlayson 1977:511-512). Fishing artifacts recovered from these investigations include six toggle-head harpoons, two bone harpoons, one copper gorge and three netsinkers (Wright and Anderson 1963, Finlayson 1977:416, 432-440, 458). Unfortunately, the two fish faunal assemblages recovered during separate investigations are not comparable because one quantified the fish remains in terms of the total weight of the bones identified to each species (Wright and Anderson

1963), whereas the other presented the fish species identifications in terms of NISP and MNI (Finlayson 1977).

Wright and Anderson's (1963) investigations documented seven fish species that include, in terms of bone weight from largest to smallest, lake sturgeon, freshwater drum, walleye, white sucker, channel catfish, yellow perch and bass. Based on the spawning period of these fish species, the site was interpreted as a spring and early summer fishing station during which spawning fish were captured at the rapids (Wright and Anderson 1963:49, 57; Wright 1972:52).

Only a small proportion of the fish assemblage recovered by Finlayson had been examined, therefore it is suggested that these data should only be used to infer the range of species captured as opposed to relative abundance that could be used to interpret dietary emphasis (Finlayson 1977:469). However, Finlayson's investigations were comprehensive and involved an extensive excavation of a hillside midden previously identified and tested by Wright and Anderson (1963) as well as excavations within the general habitation area (1977:239-257). Also, the percentage of the fish remains analyzed, as well as the total NISP of the fish species at the site, are much higher than that obtained for the BWBS site. Thus, it is thought that any conclusions inferred concerning methods of capture and patterns of fish resource exploitation from Finlayson's (1977) data would have at least the same amount of validity as those of the BWBS site.

Finlayson's (1977) investigations identified 12 different fish species that include, from largest to smallest in terms of MNI, sucker (MNI=34), channel catfish or bullhead (MNI=11), pickerel or sauger (MNI=7), with freshwater drum and largemouth/smallmouth bass represented by an MNI of two, and lake sturgeon, whitefish, northern pike, creek chub, and lake trout represented by an MNI of one (Finlayson 1977:465). In terms of NISP, sucker has the largest NISP of 912 followed by lake sturgeon (NISP=510), then by pickerel or sauger (NISP=465), channel catfish/bullhead (NISP=249), freshwater drum (NISP=98) and smallmouth and largemouth bass (NISP=37). The remaining fish species could be considered minor with an NISP equal to or less than eight: whitefish, lake trout, northern pike, creek chub and stone cat (Finlayson 1977:465).

Both investigations suggest that lake sturgeon was by far the most important species being exploited at this site, while other species such as drum and walleye are present in significantly smaller amounts (Finlayson 1977:468). The pattern of seasonal exploitation for this site was interpreted as a spring harvest of species such as sucker, northern pike and pickerel that spawn soon after ice break-up, a late spring into early summer harvest for stone cat and smallmouth bass, and a July harvest of summer spawning freshwater drum. A perhaps more ephemeral use of the site by smaller groups in the late-fall to early-winter was suggested by the presence of lake whitefish and lake trout which have a spawning time of October for the former and November for the latter (Finlayson 1977:483, 512).

In terms of fishing methods utilized at this site Finlayson (1977) has suggested that larger fish such as sturgeon may have been speared with a toggling harpoon. Nets were utilized in taking at least some fish and the absence of copper fish-hooks suggests that angling was probably not an important fishing technique at this site. Finally, the location of the site with respect to the rapids suggests that some form of weir may have been constructed to aid in the acquisition of a large number of fish, although Finlayson (1977:613) states that there is no evidence to support this proposition.

**The Blue Water Bridge South Site and the Donaldson Site**

The Donaldson site is located roughly 195 km to the north of the BWBS site (Figure 1). The accepted radiocarbon dates for the Middle Woodland component of the site using one standard deviation are 470 B.C. to A.D. 480 which place it in the early phase of the Saugeen Culture (Finlayson 1977:511-512). The BWBS site dates of A.D. 140 to A.D. 660 indicates the two sites are contemporary mainly in the later parts of the Middle Woodland and with perhaps a slightly later continuing use of the BWBS.

The two sites differ in terms of their location with respect to various hydrological environments. Both the Donaldson and the BWBS sites are located on river channels with associated rapids and within close proximity to Lake Huron. Based on the presence of bass, bullhead and suckers, the river channel must have been warm, shallow and vegetative in some areas. Both sites have a fishery that focused on the harvesting of early spring spawning fish species but the focus fish are slightly different. At the Donaldson site sucker, sturgeon and channel catfish/bullhead were represented in relatively large numbers and would be considered to have contributed in a significant way to subsistence. At the BWBS site the spring spawning fish of major significance include the walleye and sturgeon. The differences in the focus species may reflect variability in availability due to different hydrological regimes associated with these sites but may have also reflected differences in availability due to natural fluctuations in the populations of these species. However, it is not clear which species of sucker was identified within the assemblage as well as what proportion of bullhead and channel catfish were recovered. Since these species do vary in terms of their preferred spawning habitat, it is difficult to determine what types of environments were being exploited and what fishing methods were being used to catch these fish.

As with the BWBS site, the presence of toggle-head harpoons at the Donaldson site suggests sturgeon were speared at the rapids. The capture of walleye at the BWBS site is suggested to have occurred with the use of leisters at the rapids and with nets in the river channel. The small numbers of walleye at the Donaldson site, along with an absence of leister components and a small number of netsinkers (N=3), suggest that this walleye fishery was not an important component of the Donaldson site fishery. Evidence for a summer fishery comes from the presence of freshwater drum at both sites. At the BWBS site, large numbers of freshwater drum were likely caught with the use of seine nets stretched across the river channel. Given the low number of freshwater drum at the Donaldson site (MNI=2), it is likely that this fishery was not practiced which further supports the idea that the netsinkers recovered here were used for a net other than a seine type.

The opportunistic angling inferred for the BWBS site, based on the presence of fish species such as largemouth bass, bullhead and white crappie, along with the proximity of Sarnia Bay as well as a local marshland, which would support the spawning habits of these fish, as well as the abundance of gorges and evidence for hooks, seem to be almost absent at the Donaldson site. Only one copper gorge was recovered during the excavations of the Donaldson site, and along with the presence of fish species such as stone cat, smallmouth and large mouth bass and creek chub, angling for these warm-water fish in the shallower areas of the river may have been practiced.

Finally, a fall fishery was proposed for the Donaldson site based on the presence of white fish and lake trout remains. However, this interpretation is questionable given the low number of these (MNI=1) and the absence of other faunal or floral indicators for a fall occupation at the site. Another possibility is that the fish were caught during an excursion onto the lake. Until more evidence for a fall and early winter occupation for the site is provided, this inference should be considered tentative.

Two end-notched and one side-notched netsinkers were recovered from the Donaldson site. Metric data are only available for one side-notched item and one end-notched item. The end-notched netsinker is much lighter (103.1 g) than any of those recovered from the BWBS site. The side-notched netsinker recovered from the Donaldson site is irregularly shaped and with the exception of a large bump at one end, which extends it length substantially, it would resemble an end-notched netsinker. Its metrics fall within the range of the side-notched netsinkers recovered from the BWBS site but given its irregular shape it would be better suited for weed-free waters with swifter currents. Its weight, however, falls within the range of those of the end-notched netsinkers recovered for the BWBS site that were inferred to anchor seine nets, which were proposed to have not been in use at the Donaldson site. However, based on the small sample size comparisons with the netsinkers recovered form the BWBS site would not be meaningful.

**The Boresma Site**

The Boresma site (Figure 1) is located on a slight rise in the Thames River flood plain, two metres above an abandoned channel 175 metres east of the present day Thames

River, Township of Delaware, Middlesex County (Wilson 1991:9). The site was partially excavated by Jim Wilson in 1989. The radiocarbon dates for the site all fall within the range noted for other Middle Woodland occupations, with calibrated dates falling between 200 B.C to A.D. 700 (O'Neal 2002:91; Wilson 1991:79-80). The only fishing artifacts recovered from the site include four netsinkers (Wilson 1991:74). The fish remains recovered from largest to smallest in terms of NISP are walleye and/or sauger (NISP=7,102), white and/or longnose sucker (NISP=2,688), lake sturgeon (NISP=177), large and/or smallmouth bass (NISP=96), northern pike (NISP=32), freshwater drum (NISP=16), and the remainder, all with an NISP of less than six, include burbot, channel catfish and brown bullhead (1991:33-34). Only MNI for walleye (MNI=573) and sucker (MNI=83) were provided.

The Boresma site is interpreted as a riverine base camp, possibly occupied year round, based on consideration of the whole faunal assemblage including deer remains. However, fish exploitation was restricted to the spring harvest of spawning fish such as walleye and/or sauger, white and/or longnose sucker, lake sturgeon, large and/or smallmouth bass and northern pike. The summer spawning fish were proposed to have been caught only incidentally and include fish species such as bullhead, freshwater drum and bass that were not necessarily important to the diet of the site's inhabitants. A large number of heads were noted in the assemblage which suggests the fish were being smoked or dried for later use (Wilson 1991:121-126, 40). The use of nets has been inferred as the primary means of fish harvesting, although it is possible that the spring spawning runs may have employed a weir. The presence of a small number of netsinkers at the site suggest that nets may not have been transported to the habitation area but left at the fishing spot (1991:39), which would make sense given that the site is located on a slight rise, therefore, carrying these netsinkers to camp would involve unnecessary labour.

**The Blue Water Bridge South Site and the Boresma Site**

The Boresma site is located inland along the Thames River which eventually flows westerly to Lake St. Clair. The Boresma site was thought to be a good comparative site for the BWBS site given that its range of radiocarbon dates completely encompass those dates obtained for the BWBS site (O'Neal 2002:94).

Unlike the BWBS site, the Boresma site has only access to fish species located within a riverine environment. In contrast to the BWBS site, only a spring fishery involving the capture of walleye, sucker and lake sturgeon is proposed for the Boresma site with summer fish species being caught incidentally. It is proposed that these fish were caught with nets, as indicated by the presence of netsinkers, or possibly with a weir. The large number of sucker at this site (MNI =83) could have been caught with nets and the absence of other fishing technologies such as gorges or fish-hooks, suggests that the other species of fish at this site may have been caught this way as well. Weirs were also suggested to have been used at this site although there is no evidence of any weir- like structure in proximity to the site. Like seine nets, weirs would catch fish indiscriminately based on species or size, especially bottom-feeding fish such as the bullhead and sucker which could easily swim under a seine net. The use of seine nets, as indicated by the presence of four netsinkers, could have been used in combination with the weir to corral fish species such as walleye and sturgeon. After the spring fishery, the weirs could be examined occasionally to retrieve incidental catches of freshwater drum, bass, etc. It is likely, given the lack of evidence for spears, leisters and harpoons, that the fish were killed with rocks or clubs in the shallows after being corralled to shore with the nets. Although the use of nets at the BWBS site was proposed, the nets were inferred to have been used without a weir, the rapids acting as a barrier aiding in the corralling of spawning walleye and freshwater drum. The overall lack of spearing technologies at the Boresma site also contrasts sharply with that found at the BWBS site.

The pattern of fishing at the Boresma site also differs from that observed at the BWBS site in that the Boresma site lacked the summer freshwater drum fishery. As noted above, freshwater drum were thought to have been caught incidentally at the Boresma site and were thus not important to subsistence at the site, a conclusion which is supported by their low numbers.

All four netsinkers recovered were manufactured from water-worn river cobbles. Three are notched on their short axis while one is notched on its long access. The respective measurements are: length 90 mm, 71 mm, 71 mm, and 105 mm; width 62 mm, 70 mm, 66 mm, and 68 mm; and thickness 29 mm, 20 mm, 20 mm, and 22 mm (Wilson 1991:74). Given the lack of measurements concerning internotch width and weight it is difficult to evaluate how these compare with those recovered from the BWBS site. Two of these netsinkers, however, resemble the atypical type of netsinkers recovered from the BWBS site (Wilson 1991: Plate 16).

**The Wyoming Rapids Site**

The Wyoming Rapids site (AgHk-4), test excavated by Ian Kenyon in 1978 (1979:1), is located on the Ausable River at a major rapids located some 10-12 km inland from the Lake Huron shore (Figure 1). It is a stratified Early, Middle and Late Woodland site with the Middle Woodland component being assigned to the Saugeen Culture by Kenyon (1980) although Couture Complex vessels were found with the Saugeen material (Spence et al. 1990:151). In 1983 limited investigations of this site were again initiated, in order to collect more data on the age of the site and subsistence practices. Soil samples were taken for flotation processing. Like the BWBS site, the Wyoming rapids site had an extensive faunal layer consisting of mostly fish remains, that could be traced for about 100 metres along the exposed bank (Kenyon and Fox 1983:5). Material for a single radiocarbon date that calibrates to about A.D. 0 was also recovered from this layer. Fishing related artifacts were not recovered. In terms of fish remains, they are reported to be mostly sucker (NISP= 1309). These fish are most easily caught in the early spring when they move up river to spawn. A small number of yellow walleye remains were also identified which are also early spring spawners (Prevec 1983).

The emphasis on the site is the procurement of spring spawning fish, especially sucker. Based on the whole faunal assemblage, it is proposed that the Wyoming Rapids site is a spring to early summer macroband settlement in Finlayson's (1977) terminology and that the Wyoming Rapids site may be the Ausable counterpart of the Donaldson site. This component contrasts sharply with the Early Woodland component of the site which appears to have been a small fall hunting/nut gathering camp (Kenyon and Fox 1983:9).

**The Blue Water Bridge South Site and the Wyoming Rapids Site**

With the exception of the presence of the spring fishery for spawning fish, this site does not resemble the BWBS site in terms of fishing methods and fish species emphasis. The absence of fishing relating artifacts, the large number of sucker remains (NISP=1309) and negligible number of walleye remains (NISP=6) suggest that a very limited but intense fishery is occurring at this site. The absence of fishing related artifacts is most likely a product of the limited investigations at the site and perhaps, to some extent, so too is the range of fish species represented. Also, it is not clear whether the species of sucker represented within the assemblage is white sucker or longnose sucker (Prevec 1983). Yet, given the prominence of the rapids and the fact that white sucker will spawn in white water (Scott and Crossman 1998: 540) it is likely that this species is the one represented.

The limited excavations at the Wyoming Rapids site mean that any discussion of what was found or not found is largely academic. Assuming what was found is representative, there are few fishing methods that are selective enough to catch only one species of fish and although a small amount of walleye remains were recovered (NISP= 6) representation of even a small number of other species would be predicted. Rostlund (1952) notes that no specialized sucker fisheries were documented among early historic native populations within North America. However, since white suckers sometimes travel in very large groups to their spawning grounds, sometimes in the 100's, to either gravel bottoms of shallower waters or to the white water at rapids (Scott and Crossman 1998:540), it is possible to imagine such a catch occurring if the timing of the fishery was at the height of the sucker spawning period and either the tail end or very beginning of the walleye spawning period. Of course, fish species at this site may be the result of natural fluctuations in these populations that may occur due to variation in hydrological conditions or fish population numbers. In the absence of evidence for spearing and netting or other methods of fishing it is not known how these fish were captured. What is also missing from the Wyoming Rapids assemblage is evidence for a generalized and opportunistic angling fishery that was practised at the BWBS site. The limited excavations mean the above discussion is very speculative. However, given the focus on suckers that normally spawn between May and June, the small number of walleye remains (NISP=6) that spawn during the same period, and the absence of July spawning freshwater drum it is suggested that the fishery here was shorter in duration than what was observed at the BWBS site, perhaps only occurring for a week or two during the height of the white sucker spawning period

**The Inverhuron-Lucas Site**

The Inverhuron-Lucas site (Figure 1) is a multicomponent Middle Woodland Saugeen Culture, Iroquoian and Euro-pioneer site. It is located on a raised beach on the east shore of Lake Huron at the point where a small creek, the Little Sauble, bends sharply to flow southward 100 yards to the shoreline and parallel to it (Lee 1960:31), roughly 48 km south of the Donaldson site (Finlayson 1977:557-558). The site was discovered by Mr. Fritz Knectel; he surfaced collected it in the 1930's and 1940's (Kenyon 1959:2). More formal investigations of the site were carried out by Thomas Lee, with the National Museum of Man, in the early 1950's while surveying for sites in the Inverhuron Park (Lee 1951, 1952, 1960). Although numerous netsinkers were recovered during Lee's investigations it was believed that they are related to the Iroquoian component of the site (Lee 1960:37, 43-45). No fish remains were reported to have been recovered. In 1957 Walter Kenyon, with the Royal Ontario Museum, conducted excavations at the site involving a larger area than excavated by Lee (Kenyon 1959, Plate 50). Four end-notched netsinkers and one unbarbed copper fish-hook were recovered from the Middle Woodland component. Fish remains, consisting of "a number of fish-scales and bones" were reported but only channel catfish spines, used as tools, are identified (Kenyon 1959:20, 33). No metric data for the netsinkers is available to allow for comparisons with those recovered from the BWBS site (1959: 16, Plate VI, Nos. 10-12).

In 1972 Finlayson (1977) conducted extensive investigations of the Middle Woodland component of the site involving flotation in order to collect data related to the subsistence practices. The only fishing related artifact recovered was a single end-notched netsinker that is 73 mm long, 57 mm wide by 21 mm thick. It weighed 91.4 gm, with a 70 mm distance between notches (Finlayson 1977:554). With the exception of being lighter, the metric data fall within the range of the end-notched netsinkers recovered from the BWBS site. A small number of faunal remains were recovered. Fish remains were almost nonexistent with a total of six vertebrae and a fish scale being recovered (Finlayson 1977:555). Floral remains suggest that the site was occupied from July or August to September or October and was not likely occupied during the winter because it would have been too windy and cold at this location (1977:556). The site has been interpreted as a late summer-fall microband settlement within Finlayson's (1977:576) terminology.

**The Blue Water Bridge South Site and the Inverhuron-Lucas Site**

Based on the presence of netsinkers and a copper fish-hook, obviously it can be inferred that the occupants of the Inverhuron-Lucas site used nets for fishing and copper fish-hooks for angling. Based on the paucity of fish remains it is very difficult to be certain about the range of fish species harvested at the site and therefore, a direct comparison of procurement patterns between the Inverhuron-Lucas and the BWBS site is impossible. Certainly, if it is assumed that taphonomic factors or limited excavations are not an issue here, one can conclude that the fishery at the Inverhuron-Lucas site was not as intensive as that observed at the BWBS site and that it perhaps represents an occupation at a different time of the year. The rarity of fish remains and, as noted above, the floral remains recovered, combined with the wider variety of non-fish species has led to the suggestion the site represents a summer to fall occupation by dispersed groups who had left their spring to early summer fishery gatherings at sites such as Donaldson. One could argue this scenario also explains its major differences from BWBS which, as discussed above, also has evidence of an intensive spring to early summer fishery.

**The Schoonertown Site**

The Schoonertown site is located on the south bank of the Nottawasaga River near rapids, roughly seven km upstream from where the river meets Georgian Bay. It is a multicomponent site with Middle Woodland, Iroquoian and early 19th century British components. The Middle Woodland component was discovered by Wilfred Jury during the 1962 excavations of the Royal Navy winter base located on the site and was later excavated in 1973 and 1974 by the Historical Sites Branch, Ontario Ministry of Natural Resources (Conway 1975:1). The Middle Woodland component was thought to represent a spring fishing site occupied for a very brief period of time. Fish species recovered in terms of MNI include, from most abundant to least abundant, pickerel (MNI=6), bass (MNI=5) and freshwater drum (MNI=4) with the remaining species having an MNI of less than three each: lake sturgeon, whitefish, sucker, bullhead, catfish and pike (Hamalainen 1975:33). No fishing artifacts were recovered from the Middle Woodland component. It was proposed that most of the fish species at this site would have been caught in the shallow waters of the Nottawasaga River. The lake whitefish representation was thought to be insignificant and not suggestive of a fall occupation of the site and it was suggested the species probably was caught with a hook and line (*ibid* 1975:40). Based on overall contribution of meat, lake sturgeon, which were thought to have been caught at the rapids near the site during their spring spawning run, were argued to have been the most important to subsistence. Since a large proportion of the fish bone consisted largely of cranial elements with few vertebrae, it was suggested that fish may have been processed at this site for later consumption, perhaps at another location (*ibid* 1975:41-43).

### The Blue Water Bridge South Site and The Schoonertown Site

Both the BWBS site and the Schoonertown sites are located near rapids and both sites exhibit similarities in the species composition of fish recovered suggesting a spring to early summer fishery. However, the low numbers of faunal remains at this site suggests that, as with the Inverhuron-Lucas site, the fishery was less intensive than that of the BWBS site. Given the emphasis on fish processing for off-site consumption, it is probable that the site was occupied by a task group that inhabited the site for the primary purpose of catching fish for storage and transport to another site, perhaps a macroband base camp. Once the catch was preserved, the occupants would have moved on. It is difficult to infer fishing methods given the absence of fishing artifacts; however, it is likely that the sturgeon were captured at the rapids with spears or harpoons although they could just as likely have been killed with clubs or rocks while being stranded in the shallows. Although there is no evidence, the pickerel and freshwater drum may have been caught with nets. The other fish species, as with the Summer Island, Donaldson and BWBS sites, may have been caught incidentally within these nets or through angling.

### The Thede site

The Thede site (BcH1-7) is located on the west bank of the Saugeen river roughly nine km up stream from where the river drains into Lake Huron. It is inferred to be a relatively small site spatially in comparison to a site such as Donaldson. Because the site is adjacent to a series of rapids, it was thought to be a good location for fishing. Excavated by William Finlayson in 1969-1970 it is assigned to the Saugeen Culture (Finlayson 1977) with calibrated radiocarbon dates ranging from 300 B.C. to A.D. 700 (O'Neal 2002: Figure 6.1). A small sample (NISP=119) of fish remains have been identified from this site; however, no MNI totals are available. The fish species have been ranked according to importance to the diet based on NISP and include from most important to least important, lake sturgeon (NISP=70), pickerel (NISP=4), channel catfish (NISP=1) and sucker (NISP=2; Finlayson 1977:204-205). No fishing artifacts were recovered from the site. The fish represented within the assemblage were thought to have contributed only in a minor way to subsistence. The season(s) of occupation for the site is unclear based on the information at hand. However, it has been suggested that it is a winter camp site. Although all the fish species are spring to early summer spawners, they could have been caught earlier at another camp and stored for use during this winter occupation.

**The Blue Water Bridge South Site and the Thede Site**

Both the Thede site and the BWBS site have spring to early summer spawning fish present, however, the faunal evidence suggests that the Thede site's fish may have been from stored stocks that were not harvested during the site's occupation. Support for this interpretation comes from the relatively low numbers of fish remains recovered as well as the lack of fishing artifacts. Given such, this site contrasts sharply with the BWBS site where the fish harvested during the spring to early summer were quite a significant component of the subsistence and fishing may have been a primary reason for the site occupation.

**Summary**

Not surprisingly, those sites located in proximity to a number of diverse fish habitats such as rivers, lakes and marshlands or bays, that could support a large number of spring and summer spawning fish species in great numbers, tended to be larger and occupied for a greater part of the year. Examples of these sites include the BWBS, the Schultz, the Donaldson and the Summer Island sites. These sites have been inferred to have followed a spring to early summer macroband settlement pattern as proposed by Finlayson (1977) with perhaps a brief and small-scale, late fall early-winter occupation for the Donaldson, Schultz and BWBS sites based on the presence of whitefish and, with the Donaldson and the Schultz sites, lake trout remains. As suggested by the number and type of fish species identified and the fishing methods inferred for these sites, the fishery was diverse and intensive in terms of fish species procured and methods used to catch them during the spring spawning runs but, with the exception of the BWBS and the

Schultz sites, which have an extensive freshwater drum fishery, the summer fishery for these sites appears to be a rather minor opportunistic component of subsistence where fish would contribute in a very limited way to subsistence with terrestrial as well as other aquatic resources taking the lead role. However, since the entire faunal assemblage for the BWBS site has not been investigated, the relative importance of fish in comparison to other resources used is speculative.

Two additional macroband sites with an intensive fishery include the Boresma and the Wyoming Rapids sites; however, they are notably different from the other spring to early summer macrobands in having a relatively large number of sucker remains. The flora and fauna assemblage from the Boresma site suggests a spring summer macroband settlement with perhaps a minor occupation year round. Like the Donaldson and Summer Island sites, the fishery focused primarily on spring spawning fish with a shift after the spring spawning runs to other resources with a very minor opportunistic fishery for summer spawning fish species. The proposed fall and winter occupation for this site may have been supported by the preservation and storage of fish captured during the spring and summer occupation periods. And, given the low representation of bullhead, bass and freshwater drum and the fact that these species of fish may be available year round within the Thames River, it is also likely that these fish could have been caught at any time during the site's occupation. Although the Wyoming Rapids site has been defined as a spring to early summer macroband settlement, it differs from the other sites of this type in that the inhabitants appear not to have fished opportunistically during the spring or summer. Rather the spring fishery focused on sucker with perhaps incidental catches of walleye. It appears that resources other than fish played a larger role earlier in the subsistence pattern than the other macroband sites detailed. However, this interpretation is considered tentative given that it is based on a modest amount of data.

The Thede, Inverhuron-Lucas and Schoonertown sites are considered microband sites and differ from sites such as the Donaldson and the BWBS sites in terms of season of site occupation and in the intensity and pattern of their fishery. The Schoonertown site appears to be a special focus site occupied by a task group in the spring for the primary purpose of catching spring spawning fish for storage and transport. The Inverhuron-Lucas site is inferred as a summer to late fall site where fishing was very opportunistic and a minor contributor to subsistence and likely focused on those species of fish available year round at this site. The Thede site was a winter campsite where the fish were likely brought from another site, perhaps a late summer-fall site such as the Inverhuron-Lucas site, and contributed in a very minor way to subsistence.

Middle Woodland Settlement and Subsistence Variability

There appears to be a great amount of spatial variability in terms of fish procurement patterns during the Middle Woodland period within the central Great Lakes region. Although most sites did focus quite intensively on the spring spawning fish runs, their fisheries varied in terms of what species were captured and the methods used and the extent to which an opportunistic and/or summer fishery was practiced. It is also apparent based on the above discussion that there was a great amount of variation in terms of seasonal settlement and subsistence during the Middle Woodland period. The three part seasonal round as proposed by Finlayson (1977) although somewhat hypothetical (Ferris and Spence 1995:100), works well as an organizing concept. However, it appears to be too rigid to account for task group sites such as Schoonertown and the small scale late-fall early-winter occupations at the Schultz, Donaldson, and perhaps the BWBS site, as well as year round sites such as Boresma. Based on their research along the Thames River drainage Timmins (1989) and Wilson (1990, 1991) have proposed two different models to account for the patterns they have observed within that area. Timmins (1989) observed a pattern where macrobands occupied sites during the warm season to exploit fish and other resources within that locale. This settlement was then followed by large inland cold season sites at ponds which functioned as base camps from which special task groups would span out briefly to exploit a broader range of resources. However, none of the sites discussed above would fit within this pattern which suggests that, if Timmins' model is correct, Middle Woodland sites are more inherently variable. In contrast, Wilson saw large year round riverine base camps with the exploitation of the larger area accomplished by the brief forays of task groups. However, with the exception of Boresma, which is the type site for this model, the only other site that may fit within this pattern as a spring task group site is Schoonertown.

At some level, these potentially competing models might not be competing at all. It might be unreasonable to expect one overarching, rigid, settlement subsistence model. Variability in terms of seasonal occupation and settlement is well documented amongst modern hunter-gatherer populations. Ethnographic studies of groups such as the !Kung (Lee 1979) have demonstrated clear variability in settlement and subsistence patterns not only between groups but within them as well. Based on his examination of hunter-gatherer behavioural variability, Jochim (1991:93) has proposed that "not only may a group show several simultaneous sites that are very different from one another, but also the sequence of activities and sites may vary from one year to the next" which would no doubt be difficult to decipher from archaeological sites representing long periods of occupation.

Regardless, the variability in the fisheries noted above in terms of the numbers and types of species captured and the methods used to catch them appears to be due at least partially to differences in location with respect to varied aquatic environments in which fish are found. As would logically be expected, sites located within proximity to more varied aquatic environments tended to have evidence for use of a larger number of fishing methods and yield more fish species than sites located in areas with more limited local microenvironments. This factor may also explain why sites such as Schultz and BWBS, unlike many of the other sites, seem to suggest more emphasis on fish beyond the spring fishery. In his study of hunter-gatherer settlement and subsistence, Jochim (1976) describes many of the variables or sets of decisions presented to non-agricultural populations and concludes that, although many variables influence the selection of site locations, the primary factors are related to subsistence. Out of the resources that may be available, the less mobile would be fish and plant foods. Plant and fish resources would be highly predictable and would have played important roles in determining site locations. When a population is faced with choices such as the exploitation of competing resources, it is predicted that the site will be located closest to the less mobile or more predictable resource (Jochim 1976:60). The location of BWBS and Schultz at diverse microenvironmental locations where other fish species would still be available locally throughout the summer, might have continued to make the locations attractive for a longer part of the year. However, it is still possible the site locale also had additional and relatively plentiful and stable resources beyond fish such as aquatic mammals and plants which allowed continued use in tandem with the local fish populations.

The Middle Woodland period highlights differences in fish use not only in space but also, when compared to earlier occupations, in time. One of the defining characteristics of the Middle Woodland period is an increase in site size and occupational debris which suggests either an increase in population at certain sites and/or repeated occupation at sites (Spence and Ferris 1995:100) or increase in the prolonged use of the site (Spence et al. 1990:168). The intensified exploitation of local resources such as fish was proposed as an explanation for this increase in sedentism over earlier periods (Ferris and Spence 1995:100). Although most sites show evidence for harvesting the same spring and summer spawning fish species, there are differences in the frequency within which various species were procured. This variation has been found on a number of earlier Late Archaic sites such as the Rocky Ridge and the Crawford Knoll sites (Ellis et al. 1990:114). Yet, what is seen during the Middle Woodland period is larger sites with greater numbers of spring spawning fish such as walleye and sturgeon, as in the case of the Boresma, BWBS, Schultz, Donaldson and Summer Island sites, and suckers, as with the Wyoming Rapids site and the Donaldson site. It has been suggested that this indicates the growing importance of an early spring fishery for the Middle Woodland period which is absent during the Late Archaic period, although one can argue that the absence reflects inadequate sampling of earlier sites (Ellis et al. 1990:114)

In any case, Cleland (1982) has proposed that the invention of nets during the Middle Woodland period could account for the increasing presence of spring spawning species within archaeological assemblages given that it is much more efficient technology than the fishing methods such as harpoons, spears, gorges, and fish-hooks used during the earlier periods. However, as mentioned earlier, as evidenced by the presence of netsinkers at some Late Archaic sites, nets were being used prior to the Middle Woodland period. The increasing use of fish weirs is another possibility although again, there is evidence weirs per se were in use before the Middle Woodland (Johnston and Cassavoy 1978). Martin (1989:596) notes that fish weirs "demanded labor cooperation, implied population aggregation, and suggested timed, coordinated visits to a fixed locality, in fact the structural opposite of other [fishing] technologies" and this factor could explain the large Middle Woodland fishing sites. The use of weirs was proposed at both Boresma and Schultz and they could have been used at the BWBS site, the Summer Island site and the Donaldson site; however, there is no direct evidence to support their presence at these sites.

One might also argue that since fish weirs and nets were definitely in use prior to the Middle Woodland that some factor other than technological innovation is more responsible for these large sites, perhaps population growth. As local groups became more packed on the landscape they were forced to make more intensive use of local resources and occupy certain locations for longer periods. It has been suggested that the processing of fish for use in later periods of the year, such as during the winter when resources are scarce, could have prevented starvation thereby increasing the rate of population growth (Spence et al. 1990:167). Potential winter sites such as the Thede argue for this pattern although these types of sites are rare. If this reliance on stored fish for winter subsistence began in pre-Middle Woodland times the resulting population growth and use of the spring fishery could be explained. More information is clearly needed to evaluate such possibilities.

# Chapter 8

## Conclusion

Although this thesis focused on gaining an understanding about the fishing methods used by the prehistoric inhabitants of the BWBS site, conclusions concerning the broader fishing strategies used at this site as well as Middle Woodland patterns of settlement and subsistence were made. Strategy is defined as a pattern of behavior generated by specific actions or decisions to capture and use resources (Bennett 1969:14, 1972:272; Molnar 1997:13-14). The fishing strategy employed at the BWBS site includes:

1) a spring to early summer macroband settlement of the site in order to harvest spring and summer spawning fish as well as utilize other resources available locally. Although information concerning plant and other animal resources is currently unknown for the BWBS site, based on what was observed at other Middle Woodland sites, and what was documented within the BWBS site archaeological record (e.g. wide range and large selection of fishing equipment, large samples of fish bone including a single extensive fish layer, focus on certain fish species) it can be inferred that spring spawning fish were a primary subsistence item during the spring time, and summer spawning fish, as well as non-spawning fish living with the area, contributed significantly to the diet;

2) taking advantage of the number of different aquatic environments located within close proximity to the site to exploit fish ;

3) a shift in focus from fish resources to other food items which may have necessitated site abandonment at certain times of the year; and

4) the use of mass capture fishing technologies, such as nets, to maximize the return as well as low energy technologies, such as the gorge and the composite hook, to allow for minimal energy expenditure for opportunistic fishing activities.

In the process of documenting these strategies it has been possible to recognize good candidates for leister components and composite fish-hooks not previously reported from other sites. The analysis has also recognized several netsinker types which previous authors had not noticed and suggested these may illuminate differences in hydrological conditions and may even be useful as spatial or temporal markers. Brose (1970) recognized the potential importance of netsinkers over 30 years ago but surprisingly few people have explored their potential utility and hopefully, the usefulness of such items suggested in this work will encourage others to examine and report such items in detail.

Based on the inherent variability among Middle Woodland patterns of settlement and subsistence, it is assumed that there were a number of viable options from which people had to choose and that all of the variation is not simply due to microenvironmental variation. However, the similarities in fishing strategies between the three occupational levels at K3 for the BWBS site suggest that people chose to follow a similar fishing strategy over a long period of time at this particular location. This evidence may suggest that the site was occupied by related people who, as a tradition, passed their knowledge concerning the location of the site, what resources were available there, and what was the best method of catching these resources, onto each succeeding generation. Our current view of Middle Woodland patterns of settlement and subsistence (e.g. that derived from Saugeen) is out of step with what we now know about these patterns today. What is observed is a highly variable pattern that is dependent both on the resources available within a given environment and human choice concerning whether or not those resources will be used and how they will be harvested. Instead of the static normative pattern we currently hold we should embrace a more dynamic and variable view of Middle Woodland settlement and subsistence. Despite such variation, the BWBS fish remains confirm the importance of the spring fishery in the Middle Woodland and suggest changing subsistence patterns from earlier times, perhaps due to increases in populations and changes in population density. Certainly, the introduction of new technological innovation at this time such as nets or weirs does not seem an adequate explanation for these changes as they were present in earlier times.

One of the more difficult exercises of this research was to find sites that had data that could be compared to that obtained from the BWBS site. As much as 50 years ago, and later in some places, fish as well as other fauna remains were not viewed as important components of the archaeological record and were often only briefly examined with only their presence being acknowledged within any subsequent report. The same could be said of certain kinds of artifacts such as netsinkers. Today, however, there is a greater understanding of the information potential of faunal remains and more and more studies are including analysis of the recovered assemblages. It is these more recent studies that provided much of the inspiration and ideas that shaped this current study.

Finally, the BWBS site with its large artifact assemblage, long and repeated periods of occupation, and its relatively undisturbed nature had a very large potential to contribute in many significant ways to our understanding of Middle Woodland lifeways. It could be argued that, despite it problems, much has been learned from this current study and the MA research of Paul O'Neal (2002). However, due to the inconsistent excavation methodologies employed at the site, much of the potential information that may have been available has been lost forever. Out of the roughly 150 one metre squares excavated, only 13 were excavated in such a way that would allow for the fine-grained analysis of the archaeological record. Given that much of Ontario has been impacted by developmental or agricultural activities of some kind, sites like the BWBS are extremely rare and every effort should be made to excavate them with methodologies that will maximize the amount and kind of information that can be gained from them. We are, however, fortunate that much of this extensive site remains intact for more refined excavation.

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# Appendix A: Blue Water Brid

## Side-notched Netsinkers for K3

| Pier Location | Catalog Number | Notch1 Width | Notch2 Width | Provenience | Depth Below Surface (cm) | Stone Type |
|---|---|---|---|---|---|---|
| K3 | 7313 | 12 | 0 | 195/405 ss10 | 51-78 | limestone |
| K3 | 1252 | 13 | 14 | 200/405 ss16 | 003-06 | limestone |
| K3 | 5940 | 26 | 5 | 195/400 ss 4 | 00-17 | limestone |
| K3 | 7786 | 13 | 13 | 195/405 ss3 | 41-58 | limestone |
| K3 | 7312 | 26 | 25 | 195/405 ss10 | 51-78 | limestone |
| K3 | 8382 | 20 | 0 | 200/405 ss22 | 40-55 | limestone |
| K3 | 3029 | 19 | 18 | 205/405 ss8 | 00-15 | limestone |
| K3 | 9322 | 11 | 15 | 210/410 ss1 | 23/36-72 | limestone |
| K3 | 8257 | 12 | 0 | 200/405 ss12 | 35-53 | limestone |
| K3 | 6699 | 11 | 0 | 195/400 ss23 | 20-00 | limestone |
| K3 | 4123 | 17 | 15 | 200/410 ss6 | 28-60 | limestone |
| K3 | 7275 | 18 | 18 | 195/405 ss9 | 51-75 | limestone |
| K3 | 3661 | 28 | 27 | 205/410 | 30-40 | limestone |
| K3 | 4939 | 23 | 26 | 200/400 ss11 feat 1026 | 38 | limestone |
| K3 | 3896 | 18 | 15 | 205/410 ss9 | 42-63 | limestone |
| K3 | 8150 | 26 | 24 | 200/405 ss9 | 00-15 | limestone |
| K3 | 1839 | 17 | 0 | 205/400 ss6 feat 146 | 35 | limestone |
| K3 | 6796 | 22 | 24 | 195/400 ss24 | 26-55 | limestone |
| K3 | 4848 | 23 | 15 | 200/400 ss10 | 30-50 | limestone |
| K3 | 1011 | 31 | 25 | 200/405 ss 6 feat 74 | 58 | limestone |
| K3 | 6624 | 19 | 19 | 195/400 ss19 feat 1048 | 35 | limestone |
| K3 | 8082 | 20 | 20 | 200/405 ss2 feat 864 | 27 | limestone |
| K3 | 2956 | 17 | 8.5 | 205/405 ss7 | 00-13 | limestone |
| K3 | 1229 | 29 | 22 | 200/405 ss16 | 00-03 | limestone |
| K3 | 6198 | 16 | 30 | 195/400 ss10 | 20-00 | limestone |
| K3 | 4506 | 27 | 20 | 200/400 ss4 | 35-60 | limestone |
| K3 | 3898 | 25 | 35 | 205/410 ss9 | 42-63 | limestone |
| K3 | 7763 | 19 | 21 | 195/405 ss25 | 50-63 | limestone |
| K3 | 7310 | 21 | 17 | 195/405 ss10 | 51-78 | limestone |
| K3 | 3940 | 26 | 32 | 205/410 ss9 | 42-63 | limestone |
| K3 | 6605 | 36 | 30 | 195/400 ss19 | 23-68 | limestone |
| K3 | 3899 | 16 | 20 | 205/410 ss9 | 42-63 | limestone |
| K3 | 4940 | 15.1 | 14 | 200/400 ss11 feat 1026 | 38 | limestone |
| K3 | 4509 | 23 | 29 | 200/400 ss4 | 35-60 | limestone |
| K3 | 8755 | 19 | 17 | 200/405 ss11 feat 1191 | 44 | limestone |
| K3 | 8256 | 26 | 30 | 200/405 ss12 | 35-53 | limestone |
| K3 | 7930 | 28 | 34 | 195/410 ss9 | 25-48 | limestone |
| K3 | 5902 | 24 | 0 | 200/400 ss9 & 14 | 100 | limestone |
| K3 | 9323 | 30 | 26 | 210/410 ss1 | 23/36-72 | limestone |
| K3 | 3327 | 28 | 24 | 205/405 ss18 | 40-60 | limestone |
| K3 | 2957 | 18 | 0 | 205/405 ss7 | 00-13 | limestone |
| K3 | 8709 | 26 | 20 | 200/405 ss3 | 25-30 | limestone |
| K3 | 8253 | 33 | 22 | 200/405 ss12 | 35-53 | limestone |

| | | | | | | |
|---|---|---|---|---|---|---|
| K3 | 2924 | 34.2 | 31.1 | 205/405 ss6 | 35-50 | limestone |
| K3 | 6470 | 24 | 20 | 195/400 ss15 | 38-64 | limestone |
| K3 | 3767 | 29.4 | 16 | 205/410 ss4 | 15-35 | limestone |
| K3 | 1099 | 35 | 28 | 200/405 ss8 | 31-50 | limestone |
| K3 | 4807 | 18 | 18 | 200/400 ss9 | ??-55 | limestone |
| K3 | 3449 | 25.9 | 29 | 205/405 ss22 | 35-38 | limestone |
| K3 | 6152 | 25 | 30 | 195/400 ss9 | 27-41 | limestone |
| K3 | 5599 | 22 | 18 | 200/400 ss21 feat 976 | 39-49 | limestone |
| K3 | 5598 | 31.8 | 26.6 | 200/400 ss21 feat 976 | 39-49 | limestone |
| K3 | 8258 | 19 | 24 | 200/405 ss12 | 35-53 | limestone |
| K3 | 7219 | 24.4 | 14 | 195/405 ss8 | 50-51 | limestone |
| K3 | 4938 | 25 | 26 | 200/400 ss11 feat 1026 | 38 | limestone |
| K3 | 3791 | 24 | 28 | 205/410 ss4 | 40-60 | limestone |
| K3 | 8254 | 24 | 26 | 200/405 ss12 | 35-53 | limestone |
| K3 | 5339 | 33 | 25 | 200/400 ss18 | 00-20 | limestone |
| K3 | 8810 | 26 | 15 | 205/405 ss10 | 40-55 | limestone |
| K3 | 7636 | 17 | 26 | 195/405 ss20 feat 24 | 006-30 | limestone |
| K3 | 3614 | 29 | 25 | 205/410 ss1 | 40-60 | limestone |
| K3 | 6084 | 31 | 17 | 195/400 ss 8 | 25-32 | limestone |
| K3 | 4507 | 25 | 13 | 200/400 ss4 | 35-60 | limestone |
| K3 | 8578 | 20 | 52 | 200/404 ss19 | 33-60 | metamorphic |
| K3 | 4806 | 24 | 22 | 200/400 ss9 | ??-55 | limestone |
| K3 | 1254 | 15 | 16 | 200/405 ss16 | 003-06 | limestone |
| K3 | 8809 | 14 | 0 | 205/405 ss10 | 40-55 | limestone |
| K3 | 8203 | 30 | 18 | 200/405 ss10 | 30-50 | limestone |
| K3 | 7162 | 29 | 23 | 195/405 ss5 | 39-62 | limestone |
| K3 | 7612 | 25 | 26 | 195/405 ss20 | 40-60 | limestone |
| K3 | 7611 | 21 | 22 | 195/405 ss20 | 40-60 | limestone |
| K3 | 7787 | 21 | 19 | 195/405 ss3 | 41-58 | limestone |
| K3 | 4125 | 26 | 27 | 200/410 ss6 | 60-65 | limestone |
| K3 | 3448 | 22 | 22 | 205/405 ss22 | 35-38 | limestone |
| K3 | 3479 | 21 | 0 | 205/405 ss23 | -60 | limestone |
| K3 | 5654 | 30 | 29 | 200/400 ss22 | 25-30 | limestone |
| K3 | 3093 | 28 | 0 | 205/405 ss9 | 40-50 | limestone |
| K3 | 3603 | 16 | 20 | 205/410 ss1 | 00-15 | granit |
| K3 | 6915 | 27 | 21 | 195/400 ss25 feat 985 | 25-50 | limestone |
| K3 | 4505 | 24 | 12 | 200/400 ss4 | 35-60 | limestone |
| K3 | 688 | 21 | 25 | 195/405 ss 20 feature 28a | 003-06 | metamorphic |
| K3 | 3714 | 14 | 25 | 205/410 ss3 | 15-30 | limestone |
| K3 | 2951 | 28 | 27 | 205/405 ss6 fea 511 | 32dbs | limestone |
| K3 | 4666 | 29.2 | 21.9 | 200/400 ss7 | 21-39 | limestone |
| K3 | 2215 | 21 | 27 | 205/400 ss18 | 35-54 | limestone |
| K3 | 7414 | 16.5 | 23.7 | 195/405 ss14 feat 60 | 40-58 | metamorphic |
| K3 | 3129 | 18.7 | 20.4 | 205/405 ss10 | 00-05 | limestone |
| K3 | 8372 | 29 | 15 | 200/405 ss21 feat 263 | 38 | limestone |
| K3 | 5670 | 24 | 14 | 200/400 ss22 | 30-42 | limestone |
| K3 | 4937 | 27.4 | 21.2 | 200/400 ss11 feat 1026 | 38 | limestone |
| K3 | 7985 | 19 | 20 | 200/405 ss1 | 41-51 | limestone |
| K3 | 5109 | 29.7 | 20 | 200/400 ss15 | 35-55 | limestone |
| K3 | 9106 | 28.3 | 55 | 195/405 ss19 feat 60 | 00-15 | limestone |
| K3 | 3480 | 43.1 | 32.2 | 205/405 ss23 | -60 | limestone |
| K3 | 3900 | 28.4 | 36.8 | 205/410 ss9 | 42-63 | limestone |

| | | | | | | |
|---|---|---|---|---|---|---|
| K3 | 4380 | 22 | 24 | 200/400 ss2 feat 667 | 8 | metamorphic |
| K3 | 9290 | 38.8 | 33.5 | 205/400 ss25 feat 9b | 50+ | limestone |
| K3 | 5941 | 32 | 0 | 195/400 ss 4 | 00-17 | metamorphic |
| K3 | 6476 | 27.2 | 28 | 195/400 ss15 feat 1065 | 33-38 | metamorphic |
| K3 | 1686 | 27 | 32 | 200/410 ss8 | 006-30 | limestone |
| K3 | 8252 | 50 | 30 | 200/405 ss12 | 35-53 | limestone |
| K3 | 1573 | 65.5 | 44 | 200/410 ss2 | 30-35 | granit |
| K3 | 1419 | 30.6 | 29.7 | 200/405 ss21 | 30-35 | limestone |
| **Totals** | **103** | | | | | |

## End-notched Netsinkers for K3

| Pier Location | Catalog Number | Notch1 Width | Notch2 Width | Provenience | Depth Below Surface (cm) | Stone Type |
|---|---|---|---|---|---|---|
| K3 | 7748 | 14 | 7 | 195/405 ss25 | 40-50 | limestone |
| K3 | 1798 | 19 | 16 | 200/400 ss4 | 00-25 | limestone |
| K3 | 1799 | 18 | 17 | 200/400 ss4 | 00-25 | limestone |
| K3 | 1800 | 20 | 18 | 200/400 ss4 | 00-25 | limestone |
| K3 | 1228 | 19 | 20 | 200/405 ss16 | 00-03 | limestone |
| K3 | 1253 | 19 | 16 | 200/405 ss16 | 003-06 | granit |
| K3 | 5726 | 24.2 | 22.7 | 200/400 ss23 | 7-25 | limestone |
| K3 | 1801 | 14 | 18.5 | 200/400 ss4 | 00-25 | limestone |
| **Totals** | **8** | | | | | |

## Side-notched Netsinkers for K2

| Pier Location | Catalog Number | Notch1 Width | Notch2 Width | Provenience | Depth Below Surface (cm) | Stone Type |
|---|---|---|---|---|---|---|
| K2 | 9817 | 12 | 0 | na | na | limestone |
| K2 | 9999 | 29.3 | 0 | na | na | limestone |
| K2 | 11255 | 24 | 40 | na | na | limestone |
| K2 | 10606 | 15 | 0 | na | na | limestone |
| K2 | 10138 | 20.5 | 23 | na | na | limestone |
| K2 | 10605 | 12 | 17 | na | na | limestone |
| K2 | 9799 | 20 | 22 | na | na | limestone |
| K2 | 10001 | 25 | 22 | na | na | limestone |
| K2 | 10792 | 11 | 13 | na | na | limestone |
| K2 | 10682 | 29 | 20 | na | na | limestone |
| K2 | 9964 | 21 | 20 | na | na | limestone |
| K2 | 9660 | 21 | 22 | na | na | metamorphic |
| K2 | 10824 | 22.3 | 32 | na | na | limestone |
| **Totals** | **13** | | | | | |

## Atypical Netsinkers for K2

| Pier Location | Catalog Number | Notch1 Width | Notch2 Width | Provenience | Depth Below Surface (cm) | Stone Type |
|---|---|---|---|---|---|---|
| K2 | 10756 | 13 | 12 | na | na | limestone |
| K2 | 9659 | 22 | 12 | na | na | limestone |
| K2 | 10000 | 15 | 26 | na | na | metamorphic |
| K2 | 9542 | na | na | na | na | limestone |
| **Totals** | **4** | | | | | |

na= not available

## ge South Site Netstinker Data

| Notching Technique | Weight (gm) | Length (mm) | Width (mm) | Thickness (mm) | Internotch Width (mm) | Average Notch Depth (mm) |
|---|---|---|---|---|---|---|
| chipping | 32.9 | 49 | 36 | 14 | 28 | 4 |
| chipping | 46.5 | 48 | 33 | 19 | 31 | 1 |
| chipping | 60.7 | 56 | 44 | 19 | 43 | 0.5 |
| chipping | 61 | 80 | 45 | 11 | 37 | 4 |
| chipping | 62.1 | 71 | 55 | 12 | 43 | 6 |
| grinding | 63 | 79 | 41 | 14 | 37 | 2 |
| chipping | 67.6 | 70 | 46 | 13 | 40 | 3 |
| chipping | 69.1 | 68 | 52 | 12 | 50 | 1 |
| chipping | 72.5 | 78 | 51 | 15 | 46 | 2.5 |
| chipping | 74.9 | 66 | 50 | 20 | 41 | 4.5 |
| chipping | 79.3 | 92 | 38 | 19 | 31 | 3.5 |
| chipping | 81.5 | 70 | 49 | 20 | 42 | 3.5 |
| chipping | 84.2 | 91 | 63 | 13 | 50 | 6.5 |
| chipping | 95.1 | 98 | 70 | 13 | 60 | 5 |
| chipping | 100 | 81 | 70 | 13 | 61 | 4.5 |
| chipping | 107.7 | 69 | 66 | 18 | 56 | 5 |
| chipping | 117.5 | 101 | 53 | 16 | 52 | 0.5 |
| chipping | 129.5 | 93 | 72 | 14 | 57 | 7.5 |
| chipping | 134.5 | 101 | 83 | 13 | 76 | 3.5 |
| chipping | 139 | 71 | 57 | 34 | 49 | 4 |
| chipping | 140.9 | 82 | 73 | 17 | 66 | 3.5 |
| pecking | 142.3 | 91 | 46 | 21 | 46 | 0 |
| chipping | 154.4 | 105 | 60 | 18 | 51 | 4.5 |
| chipping | 154.7 | 85 | 71 | 21 | 55 | 8 |
| chipping | 164.4 | 99 | 66 | 21 | 55 | 5.5 |
| chipping | 166.1 | 112 | 70 | 16 | 63 | 3.5 |
| chipping | 166.9 | 91 | 66 | 19 | 58 | 4 |
| chipping | 167.8 | 78 | 75 | 23 | 62 | 6.5 |
| chipping | 170.3 | 93 | 69 | 21 | 57 | 6 |
| chipping | 171.4 | 92 | 70 | 19 | 55 | 7.5 |
| chipping | 171.5 | 95 | 64 | 20 | 50 | 7 |
| chipping | 174.7 | 103 | 66 | 16 | 60 | 3 |
| chipping | 176.2 | 90 | 64 | 26 | 61 | 1.5 |
| chipping | 183 | 93 | 70 | 21 | 61 | 4.5 |
| chipping | 184.7 | 107 | 75 | 18 | 62 | 6.5 |
| chipping | 185.8 | 94 | 84 | 20 | 58 | 13 |
| chipping | 186.2 | 109 | 78 | 16 | 64 | 7 |
| chipping | 187 | 80 | 70 | 24 | 66 | 2 |
| chipping | 187.1 | 97 | 71 | 17 | 62 | 4.5 |
| chipping | 190 | 91 | 73 | 21 | 61 | 6 |
| chipping | 190.9 | 88 | 71 | 29 | 68 | 1.5 |
| chipping | 196.9 | 99 | 88 | 17 | 64 | 12 |
| chipping | 197.5 | 97 | 68 | 20 | 56 | 6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| chipping | 198.3 | 101 | 73 | 21 | 62 | 5.5 |
| chipping | 200.1 | 100 | 53 | 27 | 42 | 5.5 |
| chipping | 204.2 | 121 | 72 | 22 | 64 | 4 |
| chipping | 213.6 | 110 | 95 | 14 | 72 | 11.5 |
| chipping | 214.1 | 88 | 79 | 24 | 70 | 4.5 |
| chipping | 214.7 | 86 | 80 | 23 | 71 | 4.5 |
| chipping | 215.1 | 99 | 79 | 18 | 72 | 3.5 |
| chipping | 217.2 | 95 | 70 | 22 | 57 | 6.5 |
| chipping | 219.2 | 87 | 78 | 26 | 61 | 8.5 |
| chipping | 224.1 | 121 | 68 | 22 | 57 | 5.5 |
| chipping | 225 | 87 | 67 | 24 | 65 | 1 |
| chipping | 225.2 | 101 | 69 | 19 | 58 | 5.5 |
| chipping | 225.4 | 110 | 80 | 19 | 63 | 8.5 |
| chipping | 227.3 | 105 | 76 | 19 | 67 | 4.5 |
| chipping | 228.5 | 111 | 93 | 16 | 84 | 4.5 |
| chipping | 229 | 98 | 77 | 19 | 71 | 3 |
| chipping | 229.6 | 89 | 72 | 25 | 63 | 4.5 |
| chipping | 231 | 98 | 73 | 31 | 54 | 9.5 |
| chipping | 234.8 | 102 | 80 | 25 | 70 | 5 |
| chipping | 244.3 | 100 | 72 | 27 | 66 | 3 |
| chipping | 248 | 122 | 85 | 16 | 72 | 6.5 |
| chipping | 255 | 125 | 85 | 23 | 75 | 5 |
| chipping | 260 | 106 | 79 | 22 | 72 | 3.5 |
| chipping | 260.6 | 96 | 72 | 24 | 69 | 1.5 |
| chipping | 260.6 | 92 | 88 | 24 | 81 | 3.5 |
| chipping | 267.6 | 111 | 74 | 25 | 63 | 5.5 |
| chipping | 277 | 112 | 77 | 24 | 65 | 6 |
| chipping | 285.9 | 92 | 69 | 30 | 60 | 4.5 |
| chipping | 289.6 | 109 | 80 | 22 | 69 | 5.5 |
| chipping | 295.6 | 108 | 82 | 28 | 72 | 5 |
| chipping | 297 | 90 | 78 | 30 | 63 | 7.5 |
| chipping | 300 | 98 | 78 | 30 | 67 | 5.5 |
| chipping | 302.1 | 126 | 76 | 30 | 63 | 6.5 |
| chipping | 304.4 | 104 | 89 | 24 | 82 | 3.5 |
| chipping | 333.1 | 87 | 85 | 23 | 77 | 4 |
| chipping | 337.4 | 103 | 77 | 29 | 69 | 4 |
| chipping | 343 | 107 | 97 | 29 | 88 | 4.5 |
| grinding | 354.7 | 107 | 65 | 33 | 60 | 2.5 |
| chipping | 360 | 97 | 76 | 35 | 69 | 3.5 |
| chipping | 372.7 | 121 | 96 | 27 | 83 | 6.5 |
| chipping | 373.8 | 120 | 96 | 24 | 75 | 10.5 |
| chipping | 388 | 110 | 94 | 25 | 80 | 7 |
| chipping | 393.7 | 105 | 95 | 25 | 85 | 5 |
| chipping | 405 | 103 | 92 | 29 | 72 | 10 |
| chipping | 411.2 | 93 | 90 | 34 | 81 | 4.5 |
| chipping | 436.6 | 97 | 83 | 31 | 76 | 3.5 |
| chipping | 437.2 | 117 | 91 | 30 | 77 | 7 |
| chipping | 444 | 127 | 85 | 30 | 79 | 3 |
| chipping | 444.5 | 102 | 85 | 39 | 73 | 6 |
| chipping | 451.3 | 120 | 87 | 67 | 32 | 27.5 |
| chipping | 461.7 | 147 | 81 | 30 | 67 | 7 |
| chipping | 495.5 | 142 | 100 | 23 | 88 | 6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| chipping | 545.6 | 117 | 90 | 37 | 73 | 8.5 |
| chipping | 603 | 123 | 98 | 32 | 81 | 8.5 |
| chipping | 616 | 120 | 97 | 38 | 83 | 7 |
| chipping | 641.2 | 146 | 89 | 29 | 75 | 7 |
| chipping | 656.6 | 125 | 86 | 42 | 76 | 5 |
| chipping | 685.7 | 126 | 99 | 37 | 86 | 6.5 |
| chipping | 1100 | 180 | 140 | 30 | 115 | 12.5 |
| chipping | 1200 | 240 | 177 | 43 | 157 | 10 |
| | **265.0961165** | **100.82524** | **75.252427** | **23.58252427** | **64.36893204** | **5.441747573** |

| Notching Technique | Weight (gm) | Length (mm) | Width (mm) | Thickness (mm) | Internotch Width (mm) | Average Notch Depth (mm) |
|---|---|---|---|---|---|---|
| chipping | 115.8 | 75 | 51 | 20 | 70 | 2.5 |
| chipping | 139.3 | 81 | 60 | 18 | 70 | 5.5 |
| chipping/grinding | 342.5 | 97 | 70 | 37 | 91 | 3 |
| chipping | 214.3 | 101 | 83 | 19 | 95 | 3 |
| chipping | 140 | 75 | 70 | 20 | 69 | 3 |
| chipping | 124 | 71 | 52 | 25 | 63 | 4 |
| chipping | 246.8 | 83 | 77 | 27 | 66 | 8.5 |
| chipping | 175.7 | 108 | 56 | 18 | 101 | 3.5 |
| | **187.3** | **86.375** | **64.875** | **23** | **78.125** | **4.125** |

| Notching Technique | Weight (gm) | Length (mm) | Width (mm) | Thickness (mm) | Internotch Width (mm) | Average Notch Depth (mm) |
|---|---|---|---|---|---|---|
| chipping | 113 | 81 | 60 | 16 | 58 | 1 |
| chipping | 272.5 | 112 | 64 | 25 | 60 | 2 |
| chipping | 42.7 | 63 | 52 | 11 | 46 | 3 |
| chipping | 142.6 | 81 | 65 | 24 | 59 | 3 |
| chipping/grinding | 100.4 | 72 | 48 | 28 | 40 | 4 |
| chipping | 110.5 | 64 | 47 | 28 | 38 | 4.5 |
| chipping | 159.7 | 96 | 68 | 21 | 59 | 4.5 |
| grinding | 54.2 | 63 | 45 | 14 | 35 | 5 |
| grinding | 64.1 | 66 | 55 | 13 | 45 | 5 |
| chipping | 322.3 | 128 | 81 | 20 | 70 | 5.5 |
| chipping | 189.7 | 100 | 68 | 19 | 56 | 6 |
| chipping | 160.1 | 125 | 71 | 13 | 58 | 6.5 |
| chipping | 140.8 | 88 | 61 | 21 | 47 | 7 |
| | **144.0461538** | **87.615385** | **60.384615** | **19.46153846** | **51.61538462** | **4.384615385** |

| Notching Technique | Weight (gm) | Length (mm) | Width (mm) | Thickness (mm) | Internotch Width (mm) | Average Notch Depth (mm) |
|---|---|---|---|---|---|---|
| chipping | 45 | 56 | 46 | 15 | 32 | 7 |
| chipping | 119.6 | 84 | 50 | 23 | 40 | 5 |
| chipping | 129.6 | 85 | 65 | 17 | 57 | 4 |
| grinding | 106.7 | 103 | 45 | 15 | 34 | 5.5 |
| | **100.225** | **82** | **51.5** | **17.5** | **40.75** | **5.375** |

| Average Notch Width (mm) | Form |
|---|---|
| 6 | water rolled |
| 13.5 | water rolled |
| 15.5 | water rolled |
| 13 | water rolled |
| 25.5 | water rolled |
| 10 | water rolled |
| 18.5 | water rolled |
| 13 | water rolled |
| 6 | water rolled |
| 5.5 | water rolled |
| 16 | water rolled |
| 18 | water rolled |
| 27.5 | water rolled |
| 24.5 | water rolled |
| 16.5 | water rolled |
| 25 | water rolled |
| 8.5 | water rolled |
| 23 | water rolled |
| 19 | water rolled |
| 28 | water rolled |
| 19 | water rolled |
| 20 | water rolled |
| 12.75 | water rolled |
| 25.5 | water rolled |
| 23 | water rolled |
| 23.5 | water rolled |
| 30 | water rolled |
| 20 | water rolled |
| 19 | water rolled |
| 29 | water rolled |
| 33 | water rolled |
| 18 | water rolled |
| 14.55 | water rolled |
| 26 | water rolled |
| 18 | water rolled |
| 28 | water rolled |
| 31 | water rolled |
| 12 | water rolled |
| 28 | water rolled |
| 26 | water rolled |
| 9 | water rolled |
| 23 | water rolled |
| 27.5 | water rolled |

| | |
|---|---|
| 32.65 | water rolled |
| 22 | water rolled |
| 22.7 | water rolled |
| 31.5 | water rolled |
| 18 | water rolled |
| 27.45 | water rolled |
| 27.5 | water rolled |
| 20 | water rolled |
| 29.2 | water rolled |
| 21.5 | rough |
| 19.2 | water rolled |
| 25.5 | water rolled |
| 26 | water rolled |
| 25 | water rolled |
| 29 | water rolled |
| 20.5 | water rolled |
| 21.5 | water rolled |
| 27 | water rolled |
| 24 | water rolled |
| 19 | water rolled |
| 36 | water rolled |
| 23 | water rolled |
| 15.5 | water rolled |
| 7 | water rolled |
| 24 | water rolled |
| 26 | water rolled |
| 25.5 | water rolled |
| 21.5 | water rolled |
| 20 | water rolled |
| 26.5 | water rolled |
| 22 | water rolled |
| 10.5 | water rolled |
| 29.5 | water rolled |
| 14 | water rolled |
| 18 | water rolled |
| 24 | water rolled |
| 18 | water rolled |
| 23 | water rolled |
| 19.5 | water rolled |
| 27.5 | water rolled |
| 25.55 | water rolled |
| 24 | water rolled |
| 20.1 | water rolled |
| 19.55 | water rolled |
| 22 | water rolled |
| 19 | water rolled |
| 24.3 | water rolled |
| 19.5 | water rolled |
| 24.85 | water rolled |
| 41.65 | water rolled |
| 37.65 | water rolled |
| 32.6 | water rolled |

| | |
|---|---|
| 23 | water rolled |
| 36.15 | water rolled |
| 16 | water rolled |
| 27.6 | water rolled |
| 29.5 | water rolled |
| 40 | water rolled |
| 54.75 | rough |
| 30.15 | water rolled |

**22.68349515**

| Average Notch Width (mm) | Form |
|---|---|
| 10.5 | water rolled |
| 17.5 | water rolled |
| 17.5 | water rolled |
| 19 | water rolled |
| 19.5 | water rolled |
| 17.5 | water rolled |
| 23.45 | water rolled |
| 16.25 | water rolled |

**17.65**

| Average Notch Width (mm) | Form |
|---|---|
| 6 | water rolled |
| 14.65 | water rolled |
| 32 | water rolled |
| 7.5 | water rolled |
| 21.75 | water rolled |
| 14.5 | water rolled |
| 21 | water rolled |
| 23.5 | water rolled |
| 12 | water rolled |
| 24.5 | water rolled |
| 20.5 | water rolled |
| 21.5 | rough |
| 27.15 | water rolled |

**18.96538462**

| Average Notch Width (mm) | Form |
|---|---|
| 12.5 | water rolled |
| 17 | water rolled |
| 20.5 | water rolled |
| na | water rolled |
| **12.5** | |

## Appendix B: Blue Water Bridge South Site Freshwater Drum Otolith Data

| Component 1 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Quadrant** | **Subsquare/ Feature** | **Depth (cm)** | **Number of Otlotiths** | **Cat. No.** | **No.** | **Weight (gms)** | **LB (mm)** | **Side** |
| 195-405 | 25 | 0-15 | 1 | 6873 | 212 | 0.62 | 328 | left |
| 195-405 | 3 | 41-58 | 1 | 7793 | 251 | 0.63 | 330 | right |
| 195-405 | 18 | 0-15 | 1 | 6511 | 101 | 0.68 | 341 | right |
| 195-400 | 13 | 30-35 | 1 | 7334 | 365b | 0.85 | 375 | left |
| 195-410 | 23 | 26-47 | 1 | 6753 | 166 | 0.95 | 393 | right |
| 195-405 | 23 | 26-47 | 1 | 6753 | 162 | 0.99 | 400 | right |
| 195-400 | 23 | 26-47 | 1 | 6753 | 155 | 1.01 | 404 | left |
| 195-400 | 3 | 15-20 | 1 | 6958 | 238 | 1.02 | 405 | right |
| 195-400 | 8 | 0-20 | 1 | 6067 | 39 | 1.05 | 410 | left |
| 195-400 | 13 | 6-30 | 1 | 614 | 360b | 1.06 | 412 | right |
| 195-400 | 13 | 30-35 | 1 | 7334 | 368 | 1.14 | 425 | left |
| 195-400 | 3 | 0-15 | 1 | 6949 | 235 | 1.14 | 425 | left |
| 195-400 | 18 | 19-44 | 1 | 6542 | 118 | 1.15 | 427 | left |
| 195-400 | 13 | 6-30 | 1 | 614 | 362b | 1.17 | 430 | right |
| 195-400 | 23 | 35-43 | 1 | 6768 | 171 | 1.2 | 523 | left |
| 195-400 | 18 | 19-44 | 1 | 6542 | 117 | 1.23 | 439 | left |
| 195-400 | 5 | 0-10 | 1 | 7818 | 304 | 1.23 | 439 | left |
| 195-400 | 3 | 20-40 | 1 | 6968 | 243 | 1.24 | 440 | left |
| 195-400 | 23 | 26-47 | 1 | 6753 | 158 | 1.28 | 446 | left |
| 195-400 | 23 | 26-47 | 1 | 6753 | 161 | 1.29 | 448 | left |
| 195-400 | 18 | 19-44 | 1 | 6542 | 108 | 1.29 | 448 | left |
| 195-400 | 23 | 26-47 | 1 | 6753 | 157 | 1.3 | 449 | right |
| 195-405 | 23 | 26-47 | 1 | 6753 | 152 | 1.31 | 451 | left |
| 195-405 | 13 | 6-30 | 1 | 614 | 358b | 1.32 | 452 | right |
| 195-405 | 4 | 6-30 | 1 | 790 | 538 | 1.33 | 454 | left |
| 195-405 | 18 | 19-44 | 1 | 6542 | 112 | 1.34 | 455 | right |
| 195-405 | 13 | 0-13 | 1 | 6313 | 78 | 1.37 | 459 | right |
| 195-405 | 13 | 13-15 | 1 | 6281 | 82 | 1.4 | 464 | right |
| 195-405 | 3 | 20-40 | 1 | 6968 | 241 | 1.41 | 465 | left |
| 195-405 | 13 | 6-30 | 1 | 614 | 359b | 1.43 | 468 | right |
| 195-405 | 13 | 3-6 | 1 | 604 | 355b | 1.46 | 472 | right |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 195-405 | 23 | 26-47 | 1 | 6753 | 145 | 1.46 | 472 | left |
| 195-400 | 23 | 35-43 | 1 | 6768 | 172 | 1.47 | 530 | left |
| 195-405 | 23 | 26-47 | 1 | 6753 | 154 | 1.48 | 475 | right |
| 195-405 | 25 | 0-15 | 1 | 6873 | 215 | 1.49 | 476 | left |
| 195-405 | 23 | 26-47 | 1 | 6753 | 160 | 1.52 | 480 | right |
| 195-405 | 23 | 26-47 | 1 | 6753 | 156 | 1.56 | 486 | right |
| 195-405 | 14 | 0-19 | 1 | 6355 | 86 | 1.62 | 493 | right |
| 195-400 | 13 | 27-29 | 1 | 6339 | 84 | 1.62 | 520 | left |
| 195-405 | 13 | 6-30 | 1 | 614 | 363b | 1.63 | 495 | left |
| 195-405 | 13 | 30-35 | 1 | 7334 | 366 | 1.64 | 496 | right |
| 195-400 | 23 | 0-15 | 1 | 6715 | 142 | 1.65 | 497 | left |
| 195-405 | 23 | 26-47 | 1 | 6753 | 163 | 1.67 | 500 | left |
| 195-405 | 5 | 0-10 | 1 | 7818 | 305 | 1.67 | 500 | right |
| 195-400 | 3 | 41-58 | 1 | 7793 | 249 | 1.7 | 504 | left |
| 195-400 | 13 | 22-38 | 1 | 6301 | 83 | 1.74 | 509 | right |
| 195-400 | 13 | 30-35 | 1 | 7334 | 369 | 1.76 | 511 | left |
| 195-405 | 23 | 26-47 | 1 | 6753 | 147 | 1.76 | 511 | left |
| 195-405 | 18 | 19-44 | 1 | 6542 | 114 | 1.76 | 511 | left |
| 195-405 | 13 | 3-6 | 1 | 604 | 354b | 1.77 | 512 | right |
| 195-400 | 5 | 0-20 | 1 | 7113 | 306 | 1.77 | 512 | right |
| 195-405 | 3 | 41-58 | 1 | 7793 | 248 | 1.79 | 515 | right |
| 195-400 | 13 | 6-30 | 1 | 614 | 361b | 1.79 | 515 | left |
| 195-405 | 3 | 20-40 | 1 | 6968 | 242 | 1.79 | 515 | left |
| 195-405 | 25 | 0-15 | 1 | 6873 | 213 | 1.8 | 516 | left |
| 195-400 | 18 | 19-44 | 1 | 6542 | 119 | 1.81 | 517 | left |
| 195-400 | 18 | 19-44 | 1 | 6542 | 107 | 1.81 | 517 | right |
| 195-400 | 23 | 35-43 | 1 | 6768 | 169 | 1.81 | 537 | right |
| 195-400 | 23 | 35-43 | 1 | 6768 | 168 | 1.82 | 527 | right |
| 195-400 | 23 | 26-47 | 1 | 6753 | 149 | 1.85 | 522 | right |
| 195-400 | 18 | 19-44 | 1 | 6542 | 110 | 1.86 | 523 | left |
| 195-400 | 5 | 0-10 | 1 | 7818 | 303 | 1.88 | 526 | right |
| 195-400 | 25 | 0-15 | 1 | 6873 | 216 | 1.92 | 530 | left |
| 195-400 | 8 | 0-20 | 1 | 6067 | 38 | 1.94 | 533 | right |
| 195-400 | 14 | 0-19 | 1 | 6355 | 87 | 1.95 | 534 | left |
| 195-400 | 3 | 41-58 | 1 | 7793 | 250 | 1.95 | 534 | left |
| 195-400 | 18 | 19-44 | 1 | 6542 | 111 | 1.98 | 537 | left |
| 195-400 | 18 | 19-44 | 1 | 6542 | 105 | 1.98 | 537 | left |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 195-400 | 3 | 15-20 | 1 | 6958 | 237 | 2.01 | 541 | left |
| 195-400 | 18 | 19-44 | 1 | 6542 | 109 | 2.03 | 543 | left |
| 195-400 | 5 | 20-30 | 1 | 7132 | 307 | 2.03 | 543 | left |
| 195-400 | 13 | 30-35 | 1 | 7334 | 364b | 2.04 | 544 | left |
| 195-400 | 23 | 26-47 | 1 | 6753 | 165 | 2.04 | 544 | right |
| 195-400 | 23 | 26-47 | 1 | 6753 | 148 | 2.06 | 546 | left |
| 195-400 | 18 | 19-44 | 1 | 6542 | 106 | 2.08 | 549 | left |
| 195-400 | 13 | 3-6 | 1 | 604 | 357b | 2.09 | 550 | right |
| 195-405 | 23 | 26-47 | 1 | 6753 | 146 | 2.09 | 550 | left |
| 195-405 | 23 | 26-47 | 1 | 6753 | 164 | 2.11 | 552 | right |
| 195-400 | 3 | 20-40 | 1 | 6968 | 244 | 2.17 | 559 | right |
| 195-405 | 18 | 19-44 | 1 | 6542 | 116 | 2.19 | 561 | left |
| 195-405 | 18 | 19-44 | 1 | 6542 | 115 | 2.22 | 564 | left |
| 195-400 | 23 | 35-43 | 1 | 6768 | 170 | 2.31 | 542 | right |
| 195-400 | 13 | 30-35 | 1 | 7334 | 367 | 2.32 | 575 | left |
| 195-405 | 13 | 3-6 | 1 | 604 | 356b | 2.35 | 578 | left |
| 195-400 | 18 | 0-15 | 1 | 6511 | 102 | 2.41 | 584 | right |
| 195-405 | 23 | 26-47 | 1 | 6753 | 150 | 2.5 | 593 | left |
| 195-405 | 18 | 19-44 | 1 | 6542 | 113 | 2.51 | 594 | right |
| 195-400 | 3 | 20-40 | 1 | 6968 | 245 | 2.53 | 596 | right |
| 195-400 | 3 | 20-40 | 1 | 6968 | 240 | 2.74 | 617 | right |
| 195-400 | 3 | 41-58 | 1 | 7793 | 247 | 2.77 | 620 | left |
| 195-405 | 25 | 0-15 | 1 | 6873 | 214 | 2.86 | 628 | right |
| 195-400 | 3 | 41-58 | 1 | 7793 | 246 | 2.94 | 636 | right |
| 195-400 | 23 | 26-47 | 1 | 6753 | 151 | 3.05 | 646 | right |
| 195-405 | 5 | 0-10 | 1 | 7818 | 300 | 3.44 | 679 | left |
| 195-400 | 3 | 20-40 | 1 | 6968 | 239 | 3.45 | 680 | left |
| | | **Total NISP** | **95** | | **Average Length** | | **504** | **MNI = 73** |

| **Component 2** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Quadrant** | **Subsquare/ Feature** | **Depth (cm)** | **Number of Otoliths** | **Cat. No.** | **No.** | **Weight (gms)** | **LB (mm)** | **Side** |
| 195-400 | 14 | 33-51 | 1 | 6372 | 91 | 0.68 | 341 | right |
| 195-405 | 13 | 60 | 1 | 7371 | 381 | 0.7 | 345 | left |
| 195-405 | 13 | 60 | 1 | 7371 | 384 | 0.81 | 368 | right |
| 195-405 | 13 | 60 | 1 | 7371 | 374 | 0.83 | 371 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 359 | 0.91 | 386 | right |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 195-410 | 4 | 30-44 | 1 | 7879 | 552 | 0.94 | 391 | left |
| 195-410 | 4 | 30-44 | 1 | 7879 | 551 | 0.95 | 393 | left |
| 195-405 | 3 | 41 | 1 | 7004 | 253 | 0.98 | 566 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 364 | 1.1 | 419 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 360 | 1.13 | 423 | right |
| 195-410 | 4 | 30-44 | 1 | 7879 | 546 | 1.17 | 430 | right |
| 195-400 | 8 | 43 | 1 | 6123 | 44 | 1.19 | 433 | right |
| 195-410 | 4 | 30-44 | 1 | 7879 | 547 | 1.19 | 433 | right |
| 195-405 | 13 | 48-70 | 1 | 7356 | 373 | 1.19 | 433 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 342 | 1.21 | 436 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 331 | 1.22 | 437 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 265b | 1.24 | 440 | right |
| 195-400 | 8 | 32-43 | 1 | 6106 | 58 | 1.25 | 442 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 341 | 1.31 | 451 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 349 | 1.33 | 454 | left |
| 195-405 | 13 | 60 | 1 | 7371 | 380 | 1.33 | 454 | right |
| 195-410 | 4 | 30-44 | 1 | 7879 | 542 | 1.34 | 455 | right |
| 195-410 | 4 | 30-44 | 1 | 7879 | 545 | 1.34 | 455 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 338 | 1.35 | 457 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 344 | 1.36 | 458 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 343 | 1.36 | 458 | left |
| 195-410 | 4 | 30-44 | 1 | 7879 | 550 | 1.37 | 459 | right |
| 195-405 | 13 | 60 | 1 | 7371 | 383 | 1.39 | 462 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 328 | 1.39 | 462 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 363 | 1.39 | 462 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 358 | 1.4 | 464 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 357 | 1.4 | 464 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 336 | 1.42 | 467 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 337 | 1.44 | 469 | left |
| 195-410 | 4 | 30-44 | 1 | 7879 | 555 | 1.47 | 473 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 324 | 1.48 | 475 | right |
| 195-405 | 3-4 | 54 | 1 | 7802 | 255 | 1.48 | 613 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 335 | 1.53 | 482 | left |
| 195-405 | 13 | 60 | 1 | 7371 | 379 | 1.54 | 483 | left |
| 200/400 | 16 | 32-54 | 1 | 5232 | 762 | 1.56 | 486 | left |
| 195-400 | 8 | 32-43 | 1 | 6106 | 46 | 1.58 | 488 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 329 | 1.6 | 491 | left |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 195-405 | 5 | 39-62 | 1 | 7170 | 361 | 1.62 | 493 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 355 | 1.62 | 493 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 320 | 1.65 | 497 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 356 | 1.65 | 497 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 340 | 1.65 | 497 | right |
| 195-410 | 4 | 30-44 | 1 | 7879 | 556 | 1.69 | 502 | left |
| 195-400 | 8 | 43 | 1 | 6123 | 43 | 1.7 | 504 | right |
| 195-405 | 3-4 | 54 | 1 | 7802 | 254 | 1.7 | 578 | left |
| 195-400 | 8 | 32-43 | 1 | 6106 | 51 | 1.75 | 510 | left |
| 195-400 | 8 | 32-43 | 1 | 6106 | 57 | 1.76 | 511 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 352 | 1.8 | 516 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 322 | 1.83 | 520 | right |
| 195-410 | 4 | 30-44 | 1 | 7879 | 539 | 1.84 | 521 | left |
| 195-405 | 13 | 60 | 1 | 7371 | 375 | 1.85 | 522 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 362 | 1.86 | 523 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 351 | 1.86 | 523 | left |
| 195-400 | 8 | 32-43 | 1 | 6106 | 59 | 1.9 | 528 | right |
| 195-410 | 4 | 30-44 | 1 | 7879 | 548 | 1.91 | 529 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 334 | 1.92 | 530 | right |
| 195-400 | 8 | 32-43 | 1 | 6106 | 56 | 1.93 | 531 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 330 | 1.95 | 534 | left |
| 195-400 | 8 | 32-43 | 1 | 6106 | 47 | 1.95 | 534 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 327 | 1.96 | 535 | right |
| 195-410 | 4 | 30-44 | 1 | 7879 | 543 | 1.97 | 536 | right |
| 195-410 | 4 | 30-44 | 1 | 7879 | 549 | 1.97 | 536 | left |
| 195-405 | 13 | 60 | 1 | 7371 | 378 | 1.97 | 536 | right |
| 195-400 | 8 | 32-43 | 1 | 6106 | 60 | 1.98 | 537 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 353 | 2.07 | 548 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 347 | 2.08 | 549 | left |
| 200/400 | 16 | 32-54 | 1 | 5232 | 761 | 2.08 | 549 | right |
| 195-400 | 8 | 32-43 | 1 | 6106 | 55 | 2.09 | 550 | right |
| 195-405 | 13 | 60 | 1 | 7371 | 376 | 2.1 | 551 | left |
| 195-410 | 4 | 30-44 | 1 | 7879 | 553 | 2.13 | 554 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 325 | 2.17 | 559 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 326 | 2.18 | 560 | left |
| 195-400 | 8 | 32-43 | 1 | 6106 | 48 | 2.19 | 561 | right |
| 195-400 | 8 | 32-43 | 1 | 6106 | 49 | 2.2 | 562 | right |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 195-400 | 8 | 32-43 | 1 | 6106 | 50 | 2.24 | 566 | right |
| 195-400 | 8 | 32-43 | 1 | 6106 | 53 | 2.24 | 566 | left |
| 195-400 | 8 | 32-43 | 1 | 6106 | 45 | 2.24 | 566 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 323 | 2.3 | 573 | left |
| 195-400 | 8 | 32-43 | 1 | 6106 | 52 | 2.35 | 578 | right |
| 195-410 | 4 | 30-44 | 1 | 7879 | 540 | 2.37 | 580 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 346 | 2.39 | 582 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 345 | 2.4 | 583 | right |
| 200/400 | 16 | 32-54 | 1 | 5232 | 763 | 2.52 | 595 | left |
| 195-410 | 4 | 30-44 | 1 | 7879 | 554 | 2.53 | 596 | left |
| 195-405 | 13 | 60 | 1 | 7371 | 382 | 2.54 | 597 | right |
| 195-400 | 8 | 32-43 | 1 | 6106 | 54 | 2.55 | 598 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 348 | 2.63 | 606 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 354 | 2.66 | 609 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 333 | 2.76 | 619 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 339 | 2.78 | 621 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 350 | 2.78 | 621 | left |
| 195-405 | 13 | 60 | 1 | 7371 | 377 | 2.82 | 624 | left |
| 195-410 | 4 | 30-44 | 1 | 7879 | 541 | 2.85 | 627 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 332 | 2.86 | 628 | left |
| 195-405 | 5 | 39-62 | 1 | 7170 | 321 | 2.91 | 633 | right |
| 195-405 | 5 | 39-62 | 1 | 7170 | 319 | 3.13 | 653 | left |
| 200/400 | 16 | 32-54 | 1 | 5232 | 764 | 3.33 | 670 | right |
| 195-405 | 3 | 58-79 | 1 | 6993 | 252 | 3.47 | 682 | right |
| | | **Total NISP** | **103** | | **Average Body Length** | | **515** | **MNI= 82** |

| Fish Layer | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Quadrant** | **Subsquare/ Feature** | **Depth (cm)** | **Number of Otoliths** | **Cat. No.** | **No.** | **Weight (gms)** | **LB (mm)** | **Side** |
| 195-400 | 25 | 23-50 | fl | 6920 | 220 | 0.85 | 375 | left |
| 195-400 | 25 | 23-50 | fl | 6920 | 228 | 1.1 | 419 | right |
| 195-400 | 25 | 23-50 | fl | 6920 | 217 | 1.12 | 561 | right |
| 195-400 | 25 | 23-50 | fl | 6920 | 227 | 1.2 | 434 | right |
| 195-405 | 13 | 45-48 | fl | 7347 | 372 | 1.3 | 449 | right |
| 195-400 | 9 | 22 | fl | 6182 | 64 | 1.35 | 457 | right |
| 195-400 | 25 | 23-50 | fl | 6920 | 224 | 1.4 | 464 | left |
| 195-405 | 13 | 45-48 | fl | 7347 | 371 | 1.51 | 479 | right |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 195-400 | 25 | 23-50 | fl | 6920 | 218 | 1.66 | 499 | right |
| 195-400 | 25 | 23-50 | fl | 6920 | 225 | 1.68 | 501 | right |
| 195-400 | 25 | 23-50 | fl | 6920 | 226 | 1.69 | 502 | left |
| 195-405 | 13 | 45-48 | fl | 7347 | 370 | 1.79 | 502 | right |
| 195-405 | 24 | 27-28 | fl | 7703 | 521 | 1.83 | 520 | left |
| 195-400 | 25 | 23-50 | fl | 6920 | 219 | 1.86 | 523 | right |
| 195-400 | 25 | 23-50 | fl | 6920 | 221 | 1.89 | 527 | left |
| 195-400 | 25 | 23-50 | fl | 6920 | 222 | 1.92 | 530 | right |
| 195-400 | 25 | 23-50 | fl | 6920 | 223 | 1.98 | 537 | right |
| 195-400 | 8 | 25-32 | fl | 6089 | 41 | 2.02 | 542 | right |
| 195-400 | 25 | 30-48 | fl | 6929 | 231 | 2.06 | 546 | right |
| 195-400 | 25 | 23-50 | fl | 6920 | 229 | 2.19 | 561 | right |
| 195-400 | 25 | 23-50 | fl | 6920 | 230 | 2.24 | 566 | left |
| 195-400 | 8 | 25-32 | fl | 6089 | 42 | 2.35 | 578 | right |
| 195-405 | 24 | 27-28 | fl | 7703 | 520 | 2.7 | 613 | right |
| 195-405 | 5 | 37 | fl | 7203 | 308 | 3.65 | 697 | left |
| | | **Total NISP** | **24** | | **Average Body Length** | | **516** | **MNI = 23** |

## Features

| Feature # | Occupational Level | Weight (gm) | LB (mm) | Side |
|---|---|---|---|---|
| feature 1022 | 1 | 1.62 | 519 | left |
| feature 1022 | 1 | 1.2 | 523 | left |
| feature 1022 | 1 | 1.82 | 526 | right |
| feature 1022 | 1 | 1.47 | 530 | left |
| feature 1022 | 1 | 1.81 | 537 | left |
| feature 1022 | 1 | 2.31 | 542 | right |
| feature 985 | fish layer | 2.06 | 546 | right |
| feature 985 | fish layer | 1.12 | 561 | right |
| feature 977 | 2 | 0.98 | 566 | left |
| feature 944 | 2 | 1.7 | 578 | left |
| feature 944 | 2 | 1.48 | 613 | right |
| feature 888 | fish layer | 3.65 | 697 | right |
| **Total NISP** | **12** | **: Body Length = 562** | | **MNI = 12** |

OL = Occupational Level

LB = Live Body Length in mm

# Appendix C: Analysis of Fish Remains in Features

## Component 1

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6577 | 18 f1035 | 195\400 | 26-30 | freshwater drum | atlas vertebrae | NA | 1 | > |
| 9387 | 18 f1035 | 195\400 | 36 | freshwater drum | caudal vertebrae | NA | 1 | > |
| 6577 | 18 f1035 | 195\400 | 26-30 | freshwater drum | caudal vertebrae | NA | 8 | > |
| 6577 | 18 f1035 | 195\400 | 26-30 | freshwater drum | dentary | R | 1 | > |
| 6577 | 18 f1035 | 195\400 | 26-30 | freshwater drum | maxilla | L | 1 | > |
| 6577 | 18 f1035 | 195\400 | 26-30 | freshwater drum | maxilla | R | 1 | > |
| 6577 | 18 f1035 | 195\400 | 26-30 | freshwater drum | pharangeal | NA | 7 | na |
| 9388 | 18 f1035 | 195\400 | 26-30 | freshwater drum | premaxilla | L | 1 | = |
| 9388 | 18 f1035 | 195\400 | 26-30 | freshwater drum | premaxilla | R | 3 | = |
| 9388 | 18 f1035 | 195\400 | 26-30 | freshwater drum | quadrate | L | 1 | na |
| 6577 | 18 f1035 | 195\400 | 26-30 | walleye | atlas vertebrae | NA | 3 | na |
| 9388 | 18 f1035 | 195\400 | 26-30 | walleye | caudal vertebrae | NA | 3 | na |
| 6577 | 18 f1035 | 195\400 | 26-30 | walleye | precaudal vertebrae | NA | 1 | na |
| 6577 | 18 f1035 | 195\400 | 26-30 | walleye | thoracic vertebrae | NA | 6 | na |
| 6577 | 18 f1035 | 195\400 | 26-30 | sturgeon | scute | na | 5 | na |
| 9388 | 18 f1035 | 195\400 | 26-30 | walleye | dentary | L | 4 | > |
| 9388 | 18 f1035 | 195\400 | 26-30 | walleye | dentary | R | 5 | 1=, 4 > |
| 9388 | 18 f1035 | 195\400 | 26-30 | walleye | premaxilla | L | 6 | 1 <, 5 > |
| 9388 | 18 f1035 | 195\400 | 26-30 | walleye | premaxilla | R | 3 | > |
| 9388 | 18 f1035 | 195\400 | 26-30 | walleye | quadrate | L | 1 | > |
| 9388 | 18 f1035 | 195\400 | 26-30 | walleye | quadrate | R | 5 | = |
| | | | | | | Total | 67 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6769 | 23 f1022 | 195\400 | 35\43 | freshwater drum | caudal vertebrae | NA | 1 | na |
| 6770 | 23 f1022 | 195\400 | 35\43 | freshwater drum | caudal vertebrae | NA | 2 | na |
| 6770 | 23 f1022 | 195\400 | 35\43 | freshwater drum | maxilla | L | 2 | > |
| 6769 | 23 f1022 | 195\400 | 35\43 | freshwater drum | pharyngeal | NA | 5 | na |
| 6770 | 23 f1022 | 195\400 | 35\43 | freshwater drum | pharyngeal | NA | 7 | na |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6770 | 23 f1022 | 195\400 | 35\43 | freshwater drum | premaxilla | L | 3 | > |
| 6770 | 23 f1022 | 195\400 | 35\43 | freshwater drum | premaxilla | R | 2 | > |
| 6770 | 23 f1022 | 195\400 | 35\43 | freshwater drum | quadrate | L | 1 | > |
| 6770 | 23 f1022 | 195\400 | 35\43 | freshwater drum | thoracic vertebrae | NA | 2 | na |
| 6770 | 23 f1022 | 195\400 | 35\43 | walleye | atlas vertebrae | NA | 1 | na |
| 6770 | 23 f1022 | 195\400 | 35\43 | walleye | thoracic vertebrae | NA | 2 | na |
| 6770 | 23 f1022 | 195\400 | 35\43 | sturgeon | scute | NA | 1 | na |
| 6770 | 23 f1022 | 195\400 | 35\43 | walleye | angular | L | 1 | > |
| | | | | | | Total | 30 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 7185 | 5 f 698 | 195\405 | 5 | sturgeon | cranial/scute | NA | 1 | na |
| 7185 | 5 f 698 | 195\405 | 5 | freshwater drum | pharyngeal | NA | 3 | na |
| 7185 | 5 f 698 | 195\405 | 5 | walleye | maxilla | L | 1 | > |
| 7185 | 5 f 698 | 195\405 | 5 | walleye | dentary | R | 1 | > |
| 7185 | 5 f 698 | 195\405 | 5 | walleye | premaxilla | L | 1 | > |
| | | | | | | Total | 7 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 7193 | 5 f 730 | 195\405 | 28 | freshwater drum | assorted vertebrae | NA | 2 | na |
| 7195 | 5 f730 | 195\405 | 28 | freshwater drum | dentary | R | 1 | > |
| 7195 | 5 f730 | 195\405 | 28 | freshwater drum | maxilla | R | 1 | > |
| 7194 | 5 f730 | 195\405 | 5 | freshwater drum | pharyngeal | na | 1 | na |
| 7195 | 5 f730 | 195\405 | 28 | freshwater drum | pharyngeal | na | 20 | na |
| 7374 | 13 f60 | 195\405 | 60 | freshwater drum | post temporal | L\R | 2 | > |
| 7195 | 5 f730 | 195\405 | 28 | freshwater drum | premaxilla | L | 8 | 1< |
| 7195 | 5 f730 | 195\405 | 28 | freshwater drum | premaxilla | R | 9 | > |
| 7373 | 13 f60 | 195\405 | 60 | freshwater drum | assorted vertebrae | NA | 2 | na |
| 7195 | 5 f730 | 195\405 | 28 | freshwater drum | assorted vertebrae | NA | 12 | na |
| 7374 | 13 f60 | 195\405 | 60 | freshwater drum | assorted vertebrae | NA | 17 | na |
| 7374 | 13 f60 | 195\405 | 60 | largemouth bass | articular | R | 1 | > |
| 7195 | 5 f730 | 195\405 | 28 | largemouth bass | hyomandibular | na | 1 | > |
| 7194 | 5 f730 | 195\405 | 5 | sturgeon | cranial/scute | NA | 1 | na |
| 7195 | 5 f730 | 195\405 | 28 | sturgeon | cranial/scute | NA | 26 | na |
| 7195 | 5 f730 | 195\405 | 28 | walleye | articular | L | 1 | > |
| 7195 | 5 f730 | 195\405 | 28 | walleye | articular | R | 1 | > |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7195 | 5 f730 | 195\405 | 28 | walleye | dentary | L | 3 | > |
| 7195 | 5 f730 | 195\405 | 28 | walleye | dentary | R | 5 | > |
| 7194 | 5 f730 | 195\405 | 5 | walleye | dentary | L | 1 | > |
| 7195 | 5 f730 | 195\405 | 28 | walleye | maxilla | L | 1 | > |
| 7195 | 5 f730 | 195\405 | 28 | walleye | premaxilla | L | 5 | > |
| 7195 | 5 f730 | 195\405 | 28 | walleye | premaxilla | R | 9 | > |
| 7195 | 5 f730 | 195\405 | 28 | walleye | vomer | na | 1 | > |
| | | | | | | Total | 126 | |

## Component 2

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6397 | 14 f1100 | 195\400 | 33\51 | freshwater drum | caudal vertebrae | NA | 1 | na |
| 6403 | 14 f1100 | 195\400 | 33\57 | freshwater drum | dentary | L | 1 | > |
| 6397 | 14 f1100 | 195\400 | 33\51 | freshwater drum | premaxilla | L | 1 | > |
| 6397 | 14 f1100 | 195\400 | 33\51 | freshwater drum | thoracic vertebrae | NA | 1 | na |
| 6397 | 14 f1100 | 195\400 | 33\51 | walleye | caudal vertebrae | NA | 2 | na |
| 6397 | 14 f1100 | 195\400 | 33\51 | walleye | precaudal vertebrae | NA | 1 | na |
| 6397 | 14 f1100 | 195\400 | 33\51 | walleye | thoracic vertebrae | NA | 1 | na |
| 6403 | 14 f1100 | 195\400 | 33\57 | sturgeon | scute | NA | 1 | na |
| 6397 | 14 f1100 | 195\400 | 33\51 | sturgeon | scute | NA | 2 | na |
| 6397 | 14 f1100 | 195\400 | 33\51 | walleye | quadrate | L | 1 | > |
| | | | | | | Total | 12 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6411 | 14 f1111 | 195\400 | 33\63 | freshwater drum | caudal vertebrae | NA | 1 | na |
| 6411 | 14 f1111 | 195\400 | 33\63 | walleye | caudal vertebrae | NA | 1 | na |
| 6411 | 14 f1111 | 195\400 | 33\63 | sturgeon | scute | NA | 4 | na |
| 6411 | 14 f1111 | 195\400 | 33\63 | walleye | angular | R | 1 | > |
| 6411 | 14 f1111 | 195\400 | 33\63 | walleye | maxilla | R | 2 | > |
| 6411 | 14 f1111 | 195\400 | 33\63 | walleye | premaxilla | L | 1 | > |
| 6411 | 14 f1111 | 195\400 | 33\63 | walleye | quadrate | R | 1 | < |
| | | | | | | Total | 11 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6567 | 18 f1047 | 195\400 | 44 | freshwater drum | brachial arch | na | 2 | na |
| 6567 | 18 f1047 | 195\400 | 44 | walleye | vomer | NA | 2 | > |
| 6567 | 18 f1047 | 195\400 | 44 | bass | vomer | NA | 1 | > |
| 6567 | 18 f1047 | 195\400 | 44 | bass | epihyal | R | 1 | > |
| | | | | | | Total | 6 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| HF float | 18 f1047 | 195\400 | 44 | freshwater drum | articular | L | 1 | > |
| HF float | 18 f1047 | 195\400 | 44 | freshwater drum | articular | L | 1 | > |
| HF float | 18 f1047 | 195\400 | 44 | freshwater drum | pharangeal | na | 4 | na |
| HF float | 18 f1047 | 195\400 | 44 | freshwater drum | post temporal | na | 1 | > |
| HF float | 18 f1047 | 195\400 | 44 | freshwater drum | post temporal | na | 1 | > |
| HF float | 18 f1047 | 195\400 | 44 | freshwater drum | premaxilla | L | 4 | > |
| HF float | 18 f1047 | 195\400 | 44 | freshwater drum | premaxilla | R | 2 | > |
| HF float | 18 f1047 | 195\400 | 44 | sturgeon | scute | NA | 4 | na |
| HF float | 18 f1047 | 195\400 | 44 | walleye | dentary | L | 4 | > |
| HF float | 18 f1047 | 195\400 | 44 | walleye | dentary | R | 4 | = |
| HF float | 18 f1047 | 195\400 | 44 | walleye | vomer | NA | 1 | > |
| | | | | | | Total | 27 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6577 | 18 f1048 | 195\400 | 35/86 | freshwater drum | caudal vertebrae | NA | 2 | na |
| 6577 | 18 f1048 | 195\400 | 35/86 | freshwater drum | maxilla | L | 1 | > |
| 6577 | 18 f1048 | 195\400 | 35/86 | freshwater drum | premaxilla | R | 1 | > |
| 6577 | 18 f1048 | 195\400 | 35/86 | walleye | thoracic vertebrae | NA | 1 | na |
| 6577 | 18 f1048 | 195\400 | 35/86 | sturgeon | scute | NA | 1 | > |
| | | | | | | Total | 6 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6776 | 23 f1028 | 195\400 | 47\57 | freshwater drum | premaxilla | L | 1 | > |
| 6776 | 23 f1028 | 195\400 | 47\57 | freshwater drum | premaxilla | R | 1 | > |
| 6776 | 23 f1028 | 195\400 | 47\57 | freshwater drum | premaxilla | R | 1 | > |
| 6776 | 23 f1028 | 195\400 | 47\57 | sturgeon | scute | NA | 1 | na |
| 6776 | 23 f1028 | 195\400 | 47\57 | walleye | angular | L | 1 | > |
| 6776 | 23 f1028 | 195\400 | 47\57 | walleye | dentary | R | 1 | > |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6776 | 23 f1028 | 195\400 | 47\57 | walleye | premaxilla | L | 1 | > |
| 6776 | 23 f1028 | 195\400 | 47\57 | walleye | premaxilla | R | 1 | > |
| 6776 | 23 f1028 | 195\400 | 47\57 | walleye | quadrate | L | 1 | > |
| 6776 | 23 f1028 | 195\400 | 47\57 | walleye | quadrate | R | 1 | > |

Total 10

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6931 | 25 f985 | 195\400 | 30\40 | freshwater drum | caudal vertebrae | NA | 1 | na |
| 6931 | 25 f985 | 195\400 | 30\40 | freshwater drum | pharyngeal | na | 1 | < |
| 6931 | 25 f985 | 195\400 | 30\40 | freshwater drum | quadrate | R | 1 | > |
| 6931 | 25 f985 | 195\400 | 30\40 | walleye | caudal vertebrae | NA | 2 | na |
| 6931 | 25 f985 | 195\400 | 30\40 | walleye | thoracic vertebrae | NA | 3 | na |
| 6931 | 25 f985 | 195\400 | 30\40 | sturgeon | scute | NA | 3 | n |
| 6931 | 25 f985 | 195\400 | 30\40 | walleye | quadrate | R | 1 | < |

Total 12

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6125 | 8 f1138 | 195\400 | 43 | walleye | dentary/premaxilla | na | 1 | > |
| 6125 | 8 f1138 | 195\400 | 43 | walleye | vomer | NA | 1 | > |

Total 2

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 7803 | 3,4 f944 | 195\405 | 54 | freshwater drum | pharyngeal | na | 1 | na |
| 7803 | 3,4 f944 | 195\405 | 54 | freshwater drum | premaxilla | R | 1 | > |
| 7803 | 3,4 f944 | 195\405 | 54 | freshwater drum | premaxilla | L | 3 | > |
| 7803 | 3,4 f944 | 195\405 | 54 | walleye | dentary | R | 2 | > |

Total 7

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| HF F977 | 3 | 195\405 | 41 | freshwater drum | pharyngeal | na | 13 | na |
| HF F977 | 3 | 195\405 | 54 | freshwater drum | pharyngeal tooth | na | 1 | na |
| HF F977 | 3 | 195\405 | 41 | freshwater drum | premaxilla | L | 2 | > |
| HF F977 | 3 | 195\405 | 41 | freshwater drum | premaxilla | R | 8 | 1<, 7> |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| HF F977 | 3 | 195\405 | 41 | freshwater drum | pharangeal | R | 1 | na |
| HF F977 | 3 | 195\405 | 41 | freshwater drum | vertebrae | NA | 4 | na |
| HF F977 | 3 | 195\405 | 41 | sturgeon | cranial/scute | NA | 19 | na |
| HF F977 | 3 | 195\405 | 41 | walleye | articular | R | 1 | > |
| HF F977 | 3 | 195\405 | 41 | walleye | maxilla | L | 2 | 1=, 1 > |
| HF F977 | 3 | 195\405 | 41 | walleye | premaxilla | L | 2 | > |
| HF F977 | 3 | 195\405 | 41 | walleye | vomer | na | 1 | = |
| | | | | | | Total | 54 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | atlas vertebrae | NA | 2 | na |
| 6341 | 13 f1112 | 195\400 | 27\29 | freshwater drum | caudal vertebrae | NA | 3 | na |
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | caudal vertebrae | NA | 32 | na |
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | dentary | L | 6 | 2<, 1 > |
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | dentary | R | 1 | > |
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | maxilla | L | 2 | > |
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | maxilla | R | 2 | > |
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | pharangeal | NA | 24 | 5<, 19 > |
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | precaudal vertebrae | NA | 4 | na |
| 6341 | 13 f1112 | 195\400 | 27\29 | freshwater drum | premaxilla | L | 1 | > |
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | premaxilla | L | 4 | > |
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | premaxilla | R | 21 | 2=, 19 > |
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | quadrate | L | 4 | > |
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | quadrate | R | 4 | > |
| 6342 | 13 f1112 | 195\400 | 27\29 | freshwater drum | thoracic vertebrae | NA | 1 | na |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | atlas vertebrae | NA | 17 | na |
| 6341 | 13 f1112 | 195\400 | 27\29 | walleye | caudal vertebrae | NA | 3 | na |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | caudal vertebrae | NA | 65 | na |
| 6341 | 13 f1112 | 195\400 | 27\29 | walleye | precaudal vertebrae | NA | 1 | na |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | precaudal vertebrae | NA | 23 | na |
| 6341 | 13 f1112 | 195\400 | 27\29 | walleye | thoracic vertebrae | NA | 3 | na |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | thoracic vertebrae | NA | 38 | na |
| 6342 | 13 f1112 | 195\400 | 27\29 | sturgeon | scute | NA | 52 | na |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | angular | L | 5 | > |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | angular | R | 3 | > |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | dentary | L | 44 | 3<, 41 > |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6341 | 13 f1112 | 195\400 | 27\29 | walleye | dentary | R | 1 | > |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | dentary | R | 19 | 3<, 16> |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | maxilla | L | 11 | 1<, 10 > |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | maxilla | R | 6 | 1<, 5 > |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | premaxilla | L | 14 | 2<, 12 > |
| 6341 | 13 f1112 | 195\400 | 27\29 | walleye | premaxilla | R | 1 | > |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | premaxilla | R | 22 | 2<, 20 > |
| 6341 | 13 f1112 | 195\400 | 27\29 | walleye | premaxilla | L | 1 | > |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | quadrate | L | 20 | 2<, 18 > |
| 6342 | 13 f1112 | 195\400 | 27\29 | walleye | quadrate | R | 19 | 1<, 18 > |
| | | | | | | Total | 479 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6384 | 14 f1074 | 195\400 | 26 | freshwater drum | caudal vertebrae | NA | 1 | na |
| 6386 | 14 f1074 | 195\400 | 26 | freshwater drum | maxilla | L | 2 | > |
| 6386 | 14 f1074 | 195\400 | 26 | freshwater drum | pharangeal | NA | 18 | na |
| 6386 | 14 f1074 | 195\400 | 26 | freshwater drum | pharangeal tooth | NA | 1 | na |
| 6386 | 14 f1074 | 195\400 | 26 | freshwater drum | premaxilla | L | 1 | > |
| 6386 | 14 f1074 | 195\400 | 26 | freshwater drum | pharangeal | L | 2 | na |
| 6384 | 14 f1074 | 195\400 | 26 | walleye | thoracic vertebrae | NA | 1 | na |
| 6386 | 14 f1074 | 195\400 | 26 | sturgeon | cranial/scute | NA | 20 | na |
| 6386 | 14 f1074 | 195\400 | 26 | walleye | articular | L | 2 | > |
| 6386 | 14 f1074 | 195\400 | 26 | walleye | articular | R | 7 | 1=, 6 > |
| 6386 | 14 f1074 | 195\400 | 26 | walleye | dentary | L | 44 | 3=, 41 > |
| 6386 | 14 f1074 | 195\400 | 26 | walleye | dentary | R | 18 | 1=, 17 > |
| 6386 | 14 f1074 | 195\400 | 26 | walleye | maxilla | L | 7 | > |
| 6386 | 14 f1074 | 195\400 | 26 | walleye | maxilla | R | 10 | > |
| 6386 | 14 f1074 | 195\400 | 26 | walleye | premaxilla | L | 11 | 1=, 10 > |
| 6386 | 14 f1074 | 195\400 | 26 | walleye | premaxilla | R | 17 | 1=, 16 > |
| 6386 | 14 f1074 | 195\400 | 26 | walleye | vomer | NA | 2 | > |
| | | | | | | Total | 164 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 5244 | 16 f 987 | 200\400 | 32 | walleye | vomer | na | 1 | > |
| | | | | | | Total | 1 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 9388 | 18 f1035 | 195\400 | 30 | walleye | dentary | na | 1 | > |
| | | | | | | Total | 1 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6738 | 23 f 1024 | 195\400 | 35\39 | freshwater drum | atlas vertebrae | NA | 1 | na |
| 6566 | 18 f1047 | 195\400 | 44 | freshwater drum | caudal vertebrae | NA | 1 | na |
| 6565 | 18 f1047 | 195\400 | 44 | freshwater drum | caudal vertebrae | NA | 1 | na |
| 6738 | 23 f 1024 | 195\400 | 35\39 | freshwater drum | caudal vertebrae | NA | 20 | na |
| 6566 | 18 f1047 | 195\400 | 44 | freshwater drum | dentary | L | 1 | > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | freshwater drum | dentary | L | 1 | > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | freshwater drum | dentary | R | 3 | > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | freshwater drum | maxilla | L | 3 | > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | freshwater drum | maxilla | R | 4 | > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | freshwater drum | pharyngeal | na | 322 | na |
| 6738 | 23 f 1024 | 195\400 | 35\39 | freshwater drum | precaudal vertebrae | NA | 2 | na |
| 6738 | 23 f 1024 | 195\400 | 35\39 | freshwater drum | premaxilla | L | 13 | > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | freshwater drum | quadrate | L | 7 | > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | freshwater drum | thoracic vertebrae | NA | 1 | na |
| 6738 | 23 f 1024 | 195\400 | 35\39 | walleye | atlas vertebrae | NA | 8 | na |
| 6738 | 23 f 1024 | 195\400 | 35\39 | walleye | caudal vertebrae | NA | 17 | na |
| 6738 | 23 f 1024 | 195\400 | 35\39 | walleye | precaudal vertebrae | NA | 9 | na |
| 6566 | 18 f1047 | 195\400 | 44 | walleye | thoracic vertebrae | NA | 1 | na |
| 6738 | 23 f 1024 | 195\400 | 35\39 | walleye | thoracic vertebrae | NA | 10 | na |
| 6738 | 23 f 1024 | 195\400 | 35\39 | sturgeon | scute | NA | 52 | 3<, 49 > |
| 6565 | 18 f1047 | 195\400 | 44 | walleye | dentary | L | 1 | < |
| 6738 | 23 f 1024 | 195\400 | 35\39 | walleye | dentary | L | 14 | 2<, 12 > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | walleye | detary | R | 12 | 3<, 9 > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | walleye | maxilla | L | 7 | 1<, 6 > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | walleye | maxilla | R | 3 | > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | walleye | premaxilla | L | 12 | 1<, 11 > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | walleye | premaxilla | R | 19 | 7<, 12 > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | walleye | quadrate | L | 9 | 1<, 8 > |
| 6738 | 23 f 1024 | 195\400 | 35\39 | walleye | quadrate | R | 9 | 1< |
| | | | | | | Total | 563 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| HF float | 23 f1024 | 195\400 | 35 | freshwater drum | maxilla | L | 2 | > |
| HF float | 23 f1024 | 195\400 | 35 | freshwater drum | pharyngeal | na | 9 | na |
| HF float | 23 f1024 | 195\400 | 35 | freshwater drum | premaxilla | L | 3 | 1=, 2 > |
| HF float | 23 f1024 | 195\400 | 35 | freshwater drum | premaxilla | R | 3 | > |
| HF float | 23 f1024 | 195\400 | 35 | freshwater drum | assorted vertebrae | NA | 4 | na |
| HF float | 23 f1024 | 195\400 | 35 | sturgeon | cranial/scute | NA | 1 | na |
| HF float | 23 f1024 | 195\400 | 35 | walleye | dentary | L | 1 | > |
| HF float | 23 f1024 | 195\400 | 35 | walleye | maxilla | L | 1 | > |
| HF float | 23 f1024 | 195\400 | 35 | walleye | maxilla | R | 1 | > |
| HF float | 23 f1024 | 195\400 | 35 | walleye | premaxilla | L | 1 | > |
| HF float | 23 f1024 | 195\400 | 35 | walleye | premaxilla | R | 1 | > |
| HF float | 23 f1024 | 195\400 | 35 | freshwater drum | dentary | L | 1 | = |
| | | | | | | Total | 28 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6736 | 23 f1024 | | 35\39 | freshwater drum | maxilla | R | 1 | > |
| 6737 | 23 f1024 | 195\400 | 35\39 | freshwater drum | pharyngeal | na | 1 | na |
| 6736 | 23 f1024 | | 35\39 | freshwater drum | quadrate | L | 1 | > |
| 6738 | 23 f1024 | 195\400 | 35\39 | largemouth bass | hyomandibular | L | 1 | > |
| 6738 | 23 f1024 | 195\400 | 35\39 | largemouth bass | hyomandibular | R | 1 | > |
| 6736 | 23 f1024 | | 35\39 | walleye | caudal vertebrae | NA | 1 | na |
| 6736 | 23 f1024 | 195\400 | 35\39 | sturgeon | cranial/scute | NA | 1 | na |
| 6736 | 23 f1024 | 195\400 | 35\39 | walleye | dentary | L | 1 | > |
| 6736 | 23 f1024 | | 35\39 | walleye | dentary | R | 1 | > |
| 6738 | 23 f1024 | 195\400 | 35\39 | walleye | maxilla | L | 1 | > |
| 6738 | 23 f1024 | 195\400 | 35\39 | walleye | vomer | NA | 4 | 1=, 3 > |
| | | | | | | Total | 14 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 6922 | 25 f985 | 195\400 | 23\50 | freshwater drum | atlas vertebrae | NA | 2 | na |
| 6921 | 25 f985 | 195\400 | 23\50 (23\41) | freshwater drum | caudal vertebrae | NA | 2 | na |
| 6922 | 25 f985 | 195\400 | 23\50 | freshwater drum | caudal vertebrae | NA | 29 | na |
| 6922 | 25 f985 | 195\400 | 23\50 | freshwater drum | maxilla | L | 4 | > |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6922 | 25 f985 | 195\400 | 23\50 | freshwater drum | maxilla | R | 1 | > |
| 6922 | 25 f985 | 195\400 | 23\50 | freshwater drum | pharyngeal | na | 9 | na |
| 6922 | 25 f985 | 195\400 | 23\50 | freshwater drum | precaudal vertebrae | NA | 5 | na |
| 6922 | 25 f985 | 195\400 | 23\50 | freshwater drum | premaxilla | L | 2 | > |
| 6922 | 25 f985 | 195\400 | 23\50 | freshwater drum | premaxilla | R | 3 | 1<, 2 > |
| 6922 | 25 f985 | 195\400 | 23\50 | freshwater drum | quadrate | R | 3 | > |
| 6922 | 25 f985 | 195\400 | 23\50 | freshwater drum | thoracic vertebrae | NA | 6 | na |
| 6922 | 25 f985 | 195\400 | 23\50 | freshwater drum | pharyngeal tooth | na | 1 | na |
| 6922 | 25 f985 | 195\400 | 23\50 | walleye | atlas vertebrae | NA | 2 | na |
| 6922 | 25 f985 | 195\400 | 23\50 | walleye | caudal vertebrae | NA | 12 | na |
| 6922 | 25 f985 | 195\400 | 23\50 | walleye | precaudal vertebrae | NA | 8 | na |
| 6921 | 25 f985 | 195\400 | 23\50 (23\41) | walleye | thoracic vertebrae | NA | 2 | na |
| 6922 | 25 f985 | 195\400 | 23\50 | walleye | thoracic vertebrae | NA | 9 | na |
| 6930 | 25 f985 | 195\400 | 30\40 | walleye | thoracic vertebrae | NA | 1 | na |
| 6922 | 25 f985 | 195\400 | 23\50 | sturgeon | scute | na | 5 | na |
| 6922 | 25 f985 | 195\400 | 23\50 | walleye | dentary | L | 4 | > |
| 6922 | 25 f985 | 195\400 | 23\50 | walleye | dentary | R | 5 | 1<, 4 > |
| 6922 | 25 f985 | 195\400 | 23\50 | walleye | maxilla | R | 1 | > |
| 6922 | 25 f985 | 195\400 | 23\50 | walleye | premaxilla | L | 2 | > |
| 6922 | 25 f985 | 195\400 | 23\50 | walleye | premaxilla | R | 2 | > |
| 6922 | 25 f985 | 195\400 | 23\50 | walleye | quadrate | R | 1 | > |
| | | | | | | Total | 121 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 7007 | 3 f977 | 195\405 | 41 | freshwater drum | maxilla | L | 1 | > |
| 7007 | 3 f977 | 195\405 | 41 | freshwater drum | maxilla | R | 4 | > |
| 7007 | 3 f977 | 195\405 | 41 | freshwater drum | brachial arch | na | 1 | > |
| 7007 | 3 f977 | 195\405 | 41 | freshwater drum | pharyngeal | na | 28 | na |
| 7007 | 3 f977 | 195\405 | 41 | freshwater drum | post temporal | na | 2 | > |
| 7007 | 3 f977 | 195\405 | 41 | freshwater drum | post temporal | L | 2 | > |
| 7007 | 3 f977 | 195\405 | 41 | freshwater drum | premaxilla | L | 6 | > |
| 7007 | 3 f977 | 195\405 | 41 | freshwater drum | premaxilla | R | 4 | > |
| 7007 | 3 f977 | 195\405 | 41 | largemouth bass | hyomandibular | na | 1 | > |
| 7007 | 3 f977 | 195\405 | 41 | largemouth bass | vomer | NA | 1 | na |
| 7007 | 3 f977 | 195\405 | 41 | sturgeon | cranial/scute | NA | 39 | na |
| 7007 | 3 f977 | 195\405 | 41 | walleye | articular | L | 1 | > |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7007 | 3 f977 | 195\405 | 41 | walleye | dentary | L | 11 | > |
| 7007 | 3 f977 | 195\405 | 41 | walleye | dentary | R | 5 | > |
| 7007 | 3 f977 | 195\405 | 41 | walleye | maxilla | L | 2 | > |
| 7007 | 3 f977 | 195\405 | 41 | walleye | maxilla | R | 2 | > |
| 7007 | 3 f977 | 195\405 | 41 | walleye | premaxilla | L | 8 | > |
| 7007 | 3 f977 | 195\405 | 41 | walleye | premaxilla | R | 1 | > |
| 7007 | 3 f977 | 195\405 | 41 | walleye | vomer | NA | 4 | > |
| | | | | | | Total | 130 | |

| Cat. # | Subsquare/ Feature (f) | Square | Depth (cm) | Common Name | Element | Side | Total | Size |
|---|---|---|---|---|---|---|---|---|
| 7206 | 5 f888 | 195\405 | 37 | freshwater drum | assorted vertebrae | NA | 42 | na |
| 7206 | 5 f888 | 195\405 | 37 | freshwater drum | cerahyal | L | 1 | 1> |
| 7205 | 5 f888 | 195\405 | 37 | freshwater drum | dentary | R | 1 | 1< |
| 7206 | 5 f888 | 195\405 | 37 | freshwater drum | maxilla | L | 3 | 2>, 1 > |
| 7206 | 5 f888 | 195\405 | 37 | freshwater drum | maxilla | R | 4 | 4> |
| 7206 | 5 f888 | 195\405 | 37 | freshwater drum | pharyngeal | na | 35 | na |
| 7206 | 5 f888 | 195\405 | 37 | freshwater drum | post temporal | na | 1 | na |
| 7206 | 5 f888 | 195\405 | 37 | freshwater drum | premaxilla | L | 6 | > |
| 7206 | 5 f888 | 195\405 | 37 | freshwater drum | premaxilla | R | 5 | > |
| 7205 | 5 f888 | 195\405 | 37 | freshwater drum | vertebrae | NA | 1 | na |
| 7206 | 5 f888 | 195\405 | 37 | largemouth bass | premaxilla | R | 1 | > |
| 7206 | 5 f888 | 195\405 | 37 | largemouth bass | vomer | NA | 2 | > |
| 7205 | 5 f888 | 195\405 | 37 | sturgeon | cranial/scute | NA | 3 | na |
| 7206 | 5 f888 | 195\405 | 37 | sturgeon | cranial/scute | NA | 23 | na |
| 7206 | 5 f888 | 195\405 | 37 | walleye | articular | R | 2 | > |
| 7206 | 5 f888 | 195\405 | 37 | walleye | dentary | L | 11 | > |
| 7206 | 5 f888 | 195\405 | 37 | walleye | dentary | R | 7 | > |
| 7204 | 5 f888 | 195\405 | 37 | walleye | dentary | R | 1 | > |
| 7205 | 5 f888 | 195\405 | 37 | walleye | maxilla | L | 1 | > |
| 7206 | 5 f888 | 195\405 | 37 | walleye | maxilla | L | 8 | 1=, 7 > |
| 7206 | 5 f888 | 195\405 | 37 | walleye | maxilla | R | 7 | > |
| 7206 | 5 f888 | 195\405 | 37 | walleye | premaxilla | L | 5 | > |
| 7206 | 5 f888 | 195\405 | 37 | walleye | premaxilla | R | 21 | 3=, 18 > |
| 7205 | 5 f888 | 195\405 | 37 | walleye | premaxilla | na | 2 | > |
| 7206 | 5 f888 | 195\405 | 37 | walleye | vomer | NA | 5 | 1=, 4 > |
| | | | | | | Total | 198 | |

"=" equal to comparitve specimen in size
">" greater than comparatvie specimen in size
"<" less than comparative specimen in size
HF = heavy fraction of float sample
L = left side
R = right side
NA = not applicable
na = not available