Analysis of the Faunal Remains from the Sandy's Point Site Yarmouth, Massachusetts

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I. GENERAL INFORMATION

A seventeenth century Native cornfield was found in 1991 during a cultural resource management survey of secluded island in Yarmouth, Massachusetts. This was an important discovery in New England archaeology due to the fact that sites are rarely found as untouched and pristine as this one. Excavations by the University of Massachusetts at Boston revealed that occupation at the site extended as far back as the Late Archaic and extensive features representing hearths, postholes, roasting pits, and a storage pit were found scattered across much of the point. This work focuses on two features that contained the bulk of the faunal remains recovered. Feature 29 and feature 1 were situated on the eastern and western edges of the site respectively. Feature 29, a large, shallow deposit of shellfish, pottery, lithics and vertebrate remains, was dated to approximately 930 years before present. Feature 1, a smaller, discrete deposit of similar remains, was dated to approximately 360 years before present. Due to the similar nature and contents of these two features, it was felt that they could provide comparative information concerning the subsistence patterns of two groups of inhabitants at the site, centuries apart.

The present study seeks to understand the subsistence system of the Native people living at the Sandy's Point site at two points in its occupation. During the initial quantification of the data for this work, it was noted that while the features and their contents were similar in a number of ways they also differed significantly. Three main differences were noted and deemed worthy of further investigation. These were 1) the information that the faunal remains could provide on the changing nature of the cove from which the species were gathered; 2) the contribution to the total meat portion of the diet that was made by various species; 3) and the use of hook and line fishing technology versus nets to collect the fish resources.

The two features were compared using a wide variety of analytical techniques that have been employed on other shell-bearing sites, as a way of highlighting environmental and cultural differences. To do this, both the vertebrate and invertebrate species that were exploited, were examined in a number of different, but complimentary ways. By utilizing a number of analytical techniques, a more complete understanding of the subsistence patterns of the culture in question can be accomplished. Three main sources of evidence were used to do this; ethnographic and ethnohistorical records, environmental and habitat information, and the archaeological evidence from this, and other comparable northeastern sites.

Seventeenth century primary documents and more modern studies by Frank Speck of the New England Natives provided the ethnohistoric and ethnographic information for this study. By combining these sources with the archaeological data, the subsistence patterns of the southern New England Native people in the seventeenth century can be understood more fully.
Another way that the data was examined was through biological and habitat reconstruction. It was felt by the author that some of the differences noted between the assemblages could be most fully explained as the result of environmental changes and not human selection. As a way of investigating the role of the environment on the species selected, all of the species identified were examined with regards to their life cycles, habitats and other biological factors.

Finally, estimations were made of the live weights of all species. The weights of the shellfish, fish, mammals and birds were compared between the two features. This was done to ascertain the amount which each species contributed to the total meat portion of the diet. Seasonal variances in the hunting and collecting of the species were controlled through the estimation of the seasonal creation of each of the features. The meat contribution of each class of animals to the diet was compared to other sites of similar antiquity from New England to determine how well the finding s from the site compared with others. The estimation of live length and weights of the fish remains also allowed a reconstruction of the fishing techniques used at the site.

The ultimate goal of historical archaeology is to reconstruct cultures through the physical remains they leave behind and the historical documents relating to them. The use of a number of analytical techniques combined with the historical documents has created a fuller picture of the cultures, their subsistence patterns, and how the environment affected both at this site.

II. ENVIRONMENTAL CONTEXT

The Sandy's Point site lies on the northwestern tip of the island in South Yarmouth, Massachusetts. Buffeted by southeasterly winds, the site, like all of Cape Cod, is an ever-changing feature between Hyannis Harbor and the bay. the island, like most of the southern half of Cape Cod, was created as a result of outwash running from the glaciers which covered the northern half of Cape Cod during the Wisconsin glaciation, 14-15,000 years ago (Chamberlain 1964:97). This outwash plain is built upon ground moraine and outwash gravels laid down by the retreating glacier. As a result, soils on all of Cape Cod are sandy with gravel present at the lower reaches and in the bays.

The bay, in which the site is situated, was created at the same time as the retreat of the glaciers. In preglacial times, it was a stream valley and with the retreat of the glaciers, it carried the runoff from them (Fisher 1981:282). Around the shores of the the bay, Hyannis and the island itself, patches of bouldery ground moraine and outwash gravels can be found that were, by chance, not covered by the outwash plain (Chamberlain 1964:102). As a result, the soils at the site location tend to have gravel present in them. the point at the southern tip of the island is a relict of the glacial period. This point is a glacial kame, a mound of stratified glacial drift that was deposited by meltwarer (Fisher 1981:283). Glacial erratics, such as the ones located on the site, are also visible reminders of the moraine nature of these soils.

The point bears the brunt of the prevailing wind and currents with the waves striking this point and carrying material around it to the east and west. This is how the South Yarmouth became connected to the island. Over centuries, the longshore currents have washed sand from the point and redeposited it between the island and the mainland, eventually forming this barrier beach and creating the bay (Chamberlain 1964:226).

But the shape of the land that can be seen today on the maps is certainly not as it has always been. If there is one thing that everyone knows about Cape Cod is that it is shifting and changing (Chamberlain 1964:222). This barrier beach that connects the island with the mainland today appears to be in a tenuous position with the possibility that a large storm will wash a break through it. In centuries past, the thin, shallow valley connecting Sandy's Point to the island surely has been washed through, just as the barrier beach connecting the island to the mainland has been. The result of washing away of either of these barriers would have been an influx of saline water into the bay and the cove that had been created by a combination of the barrier beach, the island and Sandy's Point. This would have had dramatic effects on the species living in the bay and especially the cove.

The current also drives sand around the western tip of the point and eventually, much of Sandy's Point. The accumulation of beach dune sand present on the western shore of Sandy's Point and, in fact, the point itself, appear to be moving slowly north and east, eventually being redeposited and creating Egg Island. From the amount of sand movement that can be observed in the area today, it is safe to conclude that Sandy's Point probably is not an extremely ancient feature in the bay. Just as the point of Provincetown has been created over the last 2000 years, Sandy's Point may have begun to be a prominent feature at this time (Leatherman 1981:315). The point looks very similar to that of Provincetown and was created in much the same way. This may be why older archaeological remains, the Late Archaic material, have been recovered only from the southern portion of the point. At that time this may have been the northern extension of it with the rest of the point forming later as a result of changing current flows around 2-3000 years ago (Leatherman 1981:315). The present current flows rapidly between Cape Cod and Nantucket, bringing nutrients onto the Nantucket Shoals, creating bountiful fishing grounds and redepositing the sand where it is today (Chamberlain 1964:223).

There are fresh water sources on the island, which is why it has seen sporadic human occupation for at least 3000 years. The three small ponds located on the northern edge of the main island and the two small ponds and stream on its eastern edge are evidence of this. This stream sends fresh water and nutrients into the bay and the cove to its west and creates an estuarine environment in much of the southern western half of it. Estuaries such as these, shallow tidal embayments, and creeks are common in New England (Nixon 1973:464).

At the present time, the bay and cove here are protected from the ocean. The mouth and mid-portions of bays are great nurseries for many species of marine fish and invertebrates where their young find food and shelter (Amos 1985:79). This is due to the fact that as seawater enters the bay it is directed clockwise due to the earth's spin and the Coreolis Effect (Amos 1985:83). The fresh water coming out of the streams that feed this estuary is directed in the same way. As a result, the western side of the bay and the cove itself have a lower salinity than the eastern side (Amos 1985:83). This causes the wider, shallower areas of the bay and the cove to be an excellent habitat for oysters. The flow of the salt and fresh water in the bay and the cove creates many sub-habitats within a small area. This allows a number of different species with varying salinity preferences to thrive here. It also makes the ideal habitat for the development of salt marshes.

The salt marshes, such as those on the shores of the cove, can only form in quiet shallow waters around bays and coastal areas. They nourish the bay and the daily tides flood them, keeping them flat. But the location of this estuary, on the western edge of an ever-shifting barrier beach, made its existence changable. If the beach were to be washed away by a hurricane, then this would change the entire nature of the bay and cove.

William Bradford gives a description of one of these storms in 1635. He stated:

> "This year, the 14th or 15th of August…was such a mighty storm of wind and rain as none living in these parts either English or Indian, ever saw….

> It caused the sea to swell to the southward of this place above 20 foot right up and down, and made many of the Indians to climb into the trees for their safety….It beagn in the southeast and parted toward the south and east, and veered sundry ways, but the greatest force of it here was from the former quarters. It continued not (in the extremity) above five or six hours but the violence began to abate. The signs and marks of it will remain this hundred years in these parts where it was sorest." (Bradford 1635:279-280).

A storm such as this, striking Cape Cod from the southeast, surely changing many of the features on the Cape and may in fact have caused a break though of this barrier beach.

The site itself lies on the highest elevation of Smith's Point and extends on the higher ground from one edge of the point to the other. Much of the site appears to have been covered over time with windblown sand to a depth of 30-50 cm that was especially deep on the southeastern half of the point. This windblown sand is what allowed for the excellent preservation of the site and may have lead to its final abandonment.

III. PREHISTORIC CONTEXT

New England's prehistory is poorly understood relative to that of other regions in North America. Throughout the majority of the region's prehistory, river drainages defined physiographic units within which human communities operated. This pattern follows from the longitudinal diversity of habitats that occur along drainages, forming ecologically unique wetland habitats, together with the transportation routes afforded by their watercourses. In the clearest examples, rivers provide access to maritime and upland resources at each end of the drainage, and to the diverse habitats in between. The exploitation of those habitats can be integrated into a seasonal round that differs at various historical moments.

The prehistory of southern New England is divided into seven periods, each identified by characteristic projectile points, pottery and other artifacts. These periods are the Paleo Indian (10,500-9000 BP), Early Archaic (9000-8000 BP), Middle Archaic (8000-6000 BP), Late Archaic (6000-3000 BP), Early Woodland (3000-2000 BP), Middle Woodland (2000-1000 BP) and Late Woodland (1000-350 BP). These cultural periods also are distinguishable on the basis of changing patterns of site location, activities, and size.

Paleo-Indian Period 10,500-9,000 BP

Although there is new research being conducted all the time, the present theory is that the people who first settled in New England arrived in the New World during the end of the Wisconsin ice age, approximately 13,000 years ago. Before this time, New England and much of the northern half of the United States was covered by a mile and a half thick sheets of ice called glaciers. Ice ages are part of the Earth's natural warming and cooling cycle. Approximately 60,000 years ago for some unknown reason, the temperature dropped on Earth just a few degrees, just enough to cause the glaciers and ice caps located at the north and south poles to begin removing water from the oceans and growing. By approximately 20,000 years ago the edges of the northern ice sheet had reached its maximum extent, present day Martha's Vineyard and Nantucket, and began to recede. As the glaciers melted, they dropped millions of tons of sand, gravel and boulders that had accumulated during their journey southward. All this material, the moraine and outwash soils, became the sandy hills, the drumlins, eskers and kames, and basically all the lower layers of soil that make up our landscape today. Mixed in with the moraine and outwash were glacial erratics, these are the large boulders, like Plymouth Rock, that dot our landscape today.

Following the retreat of the glaciers, the climate in southern New England was a southern tundra. What is now Cape Cod would have been interior uplands. The area was cold, windy and barren and covered with large areas of wetlands. Scattered intermittently across the landscape were patches of grasses, shrubs such as sedge, alder and willow, and small stunted trees including spruce followed by birch and pine. There was also a lot more landscape than there is today because the oceans were approximately 300-400' feet lower than they are today, meaning that the coastline was up to 50 miles to the east of its present position. This left exposed large portions of land, like George's Banks, that are today underwater. The islands that we see today in many coastal harbors, were at this time hills on a barren landscape and many of the rivers that we know today were nothing more than springs or small streams.

Sites of the Paleo-Indian and Early Archaic periods are most frequently located across and around drained lake beds that formed at the end of the Pleistocene (Ice Age). These sites are generally small, and often represent single episodes or short events involving hunting and gathering, or natural resource processing. Archaeologically there is little evidence of the Paleo-Indian period on Cape Cod with one of the reasons for the paucity of finds possibly related to the fact that during this period the coastline was approximately 100 miles to the east and south of today's George's Banks. The result of this distant shoreline is that that more attractive sites may have been located near the paleo-shore and are now flooded. In addition, recently deglaciated areas were slow to develop soil and vegetative cover that would support game, and thus human settlement (Pielou 1991). Climatic considerations may also be important. Estimates for the date of the Sandwich Moraine range around approximately 20,400 BP, with the formation of the Lake Taunton and Lake Cape Cod ice margin by around 19,700 BP. By about 16,400 BP, the glaciers may have receded only about as far as Boston (Ridge 2003:30-34). No Paleo-Indian materials have been recovered in situ on the outer Cape, with one fluted point having been recovered from Eastham, constituting the total of the evidence on the Outer Cape for occupation at this time (Johnson 1997: 17). On the shore of the Bass River in Yarmouth, a cache of possible Paleo-Indian Eden blades of Mt. Kineo felsite from Maine was recovered from a tree fall (Dunford 1997: 32). Diagnostic late Paleo-Indian projectile points have also been found in kettle hole and riverine locations in Barnstable and in Harwich (Davin 1989; Mahlstedt 1987; Mahlstedt 1985).

Early Archaic 9,000-8,000 BP

The extinction of the megafauna and the changing climate led to a revamping of the Paleo-Native way of life around 10,000 years ago. The environment in the Early Archaic had warmed slightly and as a result, trees such as oaks, pitch pines, beeches and hazel began to flourish. It was during this time that the major rivers that are around today began to form as well and into these rivers anadromous fish species like salmon and herring began to run. This would have provided another food source for the inhabitants of New England. As New England began to become more forested, new mammalian species also would have moved into the area. These species would have included black bear, deer and moose.

Evidence of the Early Archaic peoples' process of "settling in" is evidenced in their use of local volcanic materials such as rhyolite and felsite for tools and projectile points and their possible use of quartz for quick, expendable tools. Hunting during this period may have taken the for of spear throwing with the use of the atl-atl, a weighted stick that was held in the hand onto which a long spears was placed and launched from. The atl-atl was basically an extension of the throwers arm and it effectively increased the distance, force and accuracy of the throw.

Like the preceding Paleo-Indian period, little evidence exists for occupation on the Outer Cape during the Early Archaic. One bifurcate base point was recovered from the Chase Farm site in Eastham and a bifurcate base point base was recovered from the Nauset trail on the Cape Cod National Seashore (Dimmick 2006: 2). During the Early Archaic the sea levels were still approximately 25 meters below their present level but the Cape was covered by a mixture of oak and pine forest.

Middle Archaic 8,000-6,000 BP

While the Early Archaic was a time of transition from the Paleo-Indian nomadic way of life to a more sedentary and permanent situation, the Middle Archaic can be seen as a time of more normality and permanency. It still was a time of many changes though. Oceans remained approximately 29 feet lower than they are today but the rate of rise had slowed enough for estuaries to begin forming. the formation of estuaries led to the establishment and proliferation of shellfish beds. Shellfish first settled in the warmer southern waters and eventually moved northward as the sea level rise slowed and waters warmed.

By 7000 years ago, forests with the same basic composition as today began to be established. The use of heavy stone woodworking tools such as axes, adzes and gouges increased during this period, possibly indicating the construction of log canoes or at least an increase in woodworking. Evidence for hunting using atl-atls first appears at this time as well. In fact, the oldest burial in New England, 7500 years ago, was located in Carver, Massachusetts and contained two atl-atl weights of the whale-tail variety. Sites from this period are fairly common, indicating that people had begun to spread out over larger areas. It also indicates that there may have been more people in Massachusetts than before.

Sites of the Middle and Late Archaic tend to appear at the edges of upland wetlands, ponds, and streams, and on the banks of rivers. The upland interior sites tend to be small and represent episodes of special activities, with larger, repeatedly used sites appearing next to large wetlands and at fords or rapids in rivers. Middle Archaic sites have been identified around kettle holes on the Outer and Inner Cape in areas distant from rivers and other reliable freshwater supplies (Davin and Gallagher 1987; McMannamon et al 1984). On the Lower Cape, the Upper Mill Pond Site in Brewster’s Stony Brook Valley yielded specialized tools, points, scrapers, hammerstones possibly used to harvest and process the more seasonally available resources of this time. The site lies on a kettle pond approximately 50 feet above sea level. On the Inner Cape Middle Archaic remains, Neville and Otter Creek points, have been recovered from Child's River at the head of Waquoit Bay in Falmouth (Mahlstedt 1985). Stark-like points were recovered during a cultural resource management survey of Camp Edwards at the Round Swamp Site and elsewhere on the property (Davin and Gallagher 1987; Herbster 2004). A possible Stark point was also recovered from the Fox Run 5 site along the Santuit River in Mashpee, although there is some dispute as to whether it is in fact a Stark or an Early Woodland Rossville variant (Shaw and McArdle 1987).

Middle Archaic sites on the Outer Cape are often located within estuaries or adjacent to tidal flats on the Bay side of the Cape with other sites being situated on rivers draining into Cape Cod Bay or on extensive salt marshes surrounding the confluence of a number of streams not far from Cape Cod Bay (MHC 1986: 28). Significant recoveries of Middle Archaic points have been made along the Herring and Bass Rivers in Dennis, Yarmouth and Harwich (Bells Neck Road I Site, Swan River [19-BN-31], Blue Rock [19-BN-562], Narrows River 2 and 4 sites [19-BN-761 and 763], Mayfair Narrows Site [19-BN-599], Bass River Lane Site [19-BN-566], Nickerson/ Bush Site [19-BN-563]). The Kelly's Bay [19-BN-570] and Sea Street Beach [19-BN-586] sites along the Dennis' southern coast indicate that Middle Archaic populations were also utilizing the areas that are today Cape Cod's southern coastline.

Late Archaic 6,000-3000 BP

The Late Archaic represents the period with the most identified and recorded archaeological sites in Massachusetts. This has been interpreted by many as indicating a very large number of people living in our area during this period, although archaeologists are not sure why this happened. The case may also be made that this proliferation of stone tools and sites may be more related to a wider variety of stone tools being manufactures for specific purposes and a wide variety of habitats being exploited as opposed to a population boom. The Late Archaic is also a time of greater diversification and specialization than was evident in the earlier periods. The tool kits of the people living on the south coast and its coastal forests differed from that of the people in Maine and further north. This in turn was similar but distinct from the inhabitants of the strictly boreal forests such as those in New York and inland Massachusetts.

Along coastal Massachusetts, the combination of stabilizing sea levels and estuary formation led to significant runs of anadromous fish by the Late Archaic. As a way of taking maximum advantage of these fish runs, Native people began using weirs in the rivers, streams and bays. In fact, one of the largest weirs found anywhere in the world was encountered in what was once Boston harbor. It is believed that the weir was constructed approximately 5000 years ago and covered several acres. Weirs of a smaller scale were undoubtedly employed in most of the bays, rivers and larger streams in southeastern Massachusetts.

Unlike the preceding periods, the Late Archaic is well represented on the Outer Cape, and throughout Southeastern Massachusetts. A number of Late Archaic shell midden sites were identified in the High Head section of Truro during McManamon's archaeological survey of the Cape Cod National Seashore, indicating possibly a greater use of shellfish during this period (McManamon 1984: 348). Other Late Archaic sites include a single Otter Creek projectile point, representing the Laurentian tradition, recovered during McManamon's Cape Cod National Seashore survey from site 19-BN-274 and another from Nickerson's Neck in Chatham (Mcmanamon 1984). Small Stemmed tradition sites are better represented on the Outer Cape with 20 of the sites identified by McManamon yielding Squibnocket Triangle and Small Stemmed points. Small Stemmed tradition sites occur in a wide variety of environmental settings. Susquehanna tradition sites, characteristic of the Transitional Archaic, have been identified in Orleans (the Coburn site), one possible Atlantic point, and seven Susquehanna/ Wayland Notched projectile points, and two Orient Fishtail points were recovered from McManamon's survey. All of these points are diagnostic of the Transitional Archaic period.

Early Woodland 3000-2000 BP

Following the Terminal Archaic is an ill-defined time labeled the Early Woodland by New England archaeologists. In the face of the date for the start of pottery production being back into the Late to Terminal Archaic and the absence of horticulture possibly until after 1000 A.D, some archaeologists, like Snow, do not view the designation of Early Woodland as a valid one (1980). They see no real change occurring that could be used to differentiate the Terminal Archaic and the next 1000 years. They merely see a continuation of tumultuous times that began after 3000 to 4000 years ago. In the words of Filios "... the chronological picture (for the Early Woodland) is more murky than previously suspected. ...the horizon markers (of this period) need to be reevaluated." (Filios 1989:87). Traditional horizon markers for the Early Woodland have included Vinette I pottery, which has been shown to have been produced before the Early Woodland, an absence of Small Stemmed points, which have been shown to have continued in use into the Early Woodland, and increased sedentism, which appears to have begun before the Early Woodland, and horticulture, which in New England was not intensively practiced until after 1000 A.D.

Some of the trends identified above, the decreased population and fragmentation, are based on the small number of Early Woodland sites that have been identified. This may be more a product of the criteria used to identify the sites, such as the presence of pottery and absence of Small Stemmed points, and number of Early Woodland sites may not be as small as thought. If one includes sites yielding Small Stemmed points but no pottery, as these may represent special purpose floral or faunal resource procurement task camps and not residential locations, the number of sites possibly attributable to the Early Woodland increases. Due to the increasingly long temporal use range for Small Stemmed points, their presence or absence can no longer be used as valid "datable" criteria to assign the site to one period or another. What is needed is more radiocarbon dates associated with specific materials. Until this occurs the Early Woodland will remain obscure and ill-defined.

A dramatic population collapse has traditionally been one of the defining characteristics of the Early Woodland. Filios (1989) came to a similar conclusion although her data shows a break in radiocarbon dates from 2700-2400 years B.P. possibly showing a population decline after 3800 years B.P. and a greater decline after 2800 years B.P. If there was in fact a population collapse, reasons for it have included climatic and environmental change, epidemics, the effects of plant and animal die-offs and socio-cultural factors. One of the main causes may have been if nut bearing trees, already in decline in the Terminal Archaic, were hit hard by plant disease or environmental change, then this may have caused a population reliant on this resource to die off. This would account for the drop in inland sites in the period. Alternately the populations living on the coast that focused their procurement strategies on river valley, estuarine and inshore resources may have remained relatively unscathed. These would be the Rossville and Lagoon point users, point styles that show a high concentration in coastal areas especially Cape Cod.

One of the most important Early to Middle Woodland sites excavated on the Outer Cape is the Carns Site on Coast Guard Beach in Eastham (Bradley 2005). This site yielded abundant evidence of Fox Creek phase occupation which were similar to sites in New York's Hudson valley (Dimmick 2006: 11). Seven other sites have been identified on the Cape Cod National Seashore dating to this period as well.

Middle Woodland 2000-1000 BP

This period is marked by a decrease in the number of exotic finished goods indicative of long-distance trade, and by changes in mortuary practice (increase in secondary interments, less use of ocher, fewer grave goods, more variation in preparation of the dead). While the roots of ceramic and lithic variability are found in the preceding periods, more rapid variation in sequence through time and more regional variation characterize this period. Ceramics vary more in decoration and form. Lithic projectile points are less important in the tool kit, and bone and antler tools are preserved at some sites where matrix conditions are appropriate (Shaw 1996:84-87). By the end of the period there is evidence of maize horticulture (Thorbahn 1982).

Fox Creek and Steubenville bifaces characterize this part of the period. There is some overlap in time between the Fox Creek and Jack's Reef points during this part of the Middle Woodland. Fox Creek points are relatively rare in Eastern Massachusetts with few known from the outer Cape (Truro and Wellfleet) and Martha's Vineyard These points are diagnostic of the Middle Woodland Period, occurring from AD 400-700, and they are often found on multi-component sites (sites with multiple time periods represented) and area associated with the growing of maize and decorated ceramics. On Martha's Vineyard, they have been found in association with postmolds outlining an oval-shaped house measuring 16' in diameter (Towle 1986: 30). Other projectile point styles such as Greene points are considered as being used contemporaneously with Fox Creek points in the earlier period of their use while Jack's Reef points and Levannas (the triangular points that are the hallmark of, and only point style occurring in, the Late Woodland period). The people who used the Fox Creek points are believed to have been seasonally migrational, spending the summers on the coast and the winters further inland, and they show many of the cultural characteristics evident with southeastern Massachusetts' Native people at the time of Contact. Other types of artifacts commonly found associated with Fox Creek points include exotic lithics like New York state cherts and Pennsylvania jaspers, Saugus jasper, Blue Hills hornfels and Great Lakes' copper.

Sites dating from this period have been identified from across Cape Cod including Round Swamp in Bourne, the Fox Run 5 and Santuit River I sites in Mashpee, and the Washburn II site in Falmouth (Davin and Gallagher 1987; Shaw and Savulis 1988; Ingham et al 2000; Mahlstedt 1987). A number of sites dating to this period have been identified on the Mid-Cape along the Herring and Bass rivers at the Narrows 2 and 4 and Nickerson/ Bush sites (Mahlstedt 1985). One of the most important Early to Middle Woodland sites excavated on the Outer Cape is the Carns Site on Coast Guard Beach in Eastham (Bradley 2005). This site yielded abundant evidence of Fox Creek phase occupation which were similar to sites in New York's Hudson valley (Dimmick 2006: 11). Seven other sites have been identified on the Cape Cod National Seashore dating to this period as well.

The Carns site, previously mentioned, contained a significant Middle Woodland component while three sites identified during McManamon's survey contained diagnostic Middle Woodland points and four sites contained diagnostic Middle Woodland pottery. Occupation of the Outer Cape appears to have had a significant coastal orientation to it, with most sites being located within one half kilometer of the ocean (Ingham 2004:20). This presumed coastal focus could also be a result of the other factors as well: much of the Outer Cape is coastal and thus more sites would be expected to be identified in coastal settings, the highest yield of natural resources are in coastal areas, and the collection/ survey bias caused by the Cape Cod National Seashore survey, which of course, was located in a coastal environment. Only a limited amount of archaeological fieldwork has been conducted on non-coastal sites on Cape Cod.

Jack's Reef points continue to be used into the Late Woodland. Exotic lithic materials increase in the Middle Woodland, except in the Champlain drainage. Jack's Reef points are often made of non-local chert (Shaw 1996:92-93). Some lithic tool types, such as Rossville (Shaw 1996:90) and Small Stemmed (Hasenstab et al. 1990) continue into the Middle Woodland. Middle Woodland artifacts have been recovered from the Mid-Cape along the Herring and Bass rivers, especially at the Blue Rock site in Yarmouth. In Dennis Middle Woodland material has been recovered from sites along the Bass River: Narrows 2 and 4, Seawall Midden 2 and 3 (19-BN-755 and 756), Mayfair Narrows, Nickerson/ Bush and Follins Pond Landing (19-BN-549).

Late Woodland Period 1000-350 BP

This is the period just prior to European contact and as a result, many of the historical reports written by the early explorers to New England (Verrazanno, Gosnold, Pring, Smith) present one way of understanding the late Late Woodland period. Some of their observations may be able to be extrapolated back into the Pre-Contact past through the use of ethnographic analogy. These analogies can be created with more confidence as pertaining to the culture of the Late Woodland period than any earlier one.

Ceramics are often shell-tempered or made with fine grit temper and thinner bodied; there is a shift to globular forms, and the addition of collars, sometimes decorated with human faces. Elaborate collars similar to those of Iroquois ceramics are found in the Merrimack and Champlain drainages. Triangular projectile points (smaller Madison points or larger Levanna points) are diagnostic for this period. This period is marked by an increasing importance in food production (maize, beans, squash, sunflower and other vegetables) in coastal or riverine zones, which begins by ca. 1100 BP on Martha's Vineyard (Ritchie 1969).

Numerous Late Woodland sites occur on the Outer Cape, with the best known and most extensively studied being the shell middens identified during McManamon's survey (Mcmanamon 1984). The shores of Salt Pond in Eastham are known to have been the focus of Late Woodland to Contact Period Native settlement as well. Levanna points are the most commonly recovered point type east of Harwich and generally there is less diversity in site locations than during earlier periods. These findings are consistent with the trend noted by the MHC where 65% of the Late Woodland/ Contact Period sites on Cape Cod are on the Outer Cape, 30% are on the Mid-Cape, and only 5% are on the Upper Cape (MHC 1986: 65).
On Cape Cod, material dating to the Middle Archaic period is often found around kettle hole ponds. This may indicate the potential importance of even isolated wetlands to Middle Archaic populations (Davin and Gallagher 1987; McManamon et al 1984). Significant concentrations of Middle Archaic sites have been identified along the Bass and Herring rivers in Harwich and Yarmouth (Herbster and Chereau 2003: 22). Late Archaic assemblages, especially those associated with Susquehanna phase occupations are also common on the Bass and Herring Rivers (Herbster and Chereau 2003: 23). Woodland period occupations are well represented in and around Dennis, especially along Bass River, with several shell middens dating from the period having been identified (Herbster and Chereau 2003: 24).

Prehistoric Settlement Patterns

Archaeological sites are found in a wide variety of environmental settings with new settings and the range of those settings is continually expanding, partly as a result of CRM surveys. The majority of sites are to be found in particular environmental contexts, and exhibit a preference for, and a measurable association with, specific environmental parameters (Funk 1972; Root 1978; Thorbahn et al 1980; McManamon 1984; Mulholland 1984; Thorbahn 1984; Nicholas 1990). Examining the environmental contexts and parameters of known sites allows archaeologists to predict the likelihood of additional sites in similar environments. These predictive models inform the location and testing interval of archaeological surveys.

In general, sites in southern New England appear to be linked to three variables: topography; soil characteristics; and proximity to water. These factors can be used to generate a predictive model showing a predominance of sites on flat to low slopes on well-drained soils near fresh or salt water (Robertson and Robertson 1978; Thorbahn, Loparto, Cox and Simon 1980). These factors can be combined with the proximity to natural resources (clay, lithic raw materials, and seasonal foods) and the use of transportation routes via waterways or land trails.

Prehistoric Archaeological potential can be stratified as follows:
High Potential: 100-200 meters (m) from a fresh water source on a 0-5 degree slope with well drained to excessively well-drained soils and minimal site disturbance;
Moderate Potential: 200-300 m from a fresh water source 5-10 degree slope with well drained to moderately well-drained soils;
Low Potential: >300 m. from a water source, >15 degree slope on poorly drained soils and in a heavily disturbed context.

This predictive model relies on site characteristics identified by Dincauze and Meyer (1977) who compiled data on site location in Essex and Middlesex counties and found that 47% and 76% respectively, of the identified sites occupy land with less than an 8% slope on excessively well-drained soils; whereas 10-20% lie on well–drained soils on 8-15% slopes. In 1983 Kenyon and McDowell studied the distribution of sites along the Merrimack River drainage basin and found 30% of sites occurred on alluvial deposits, 40% on river terraces, and 20% on glaciofluvial deltas, outwash, and lakebeds (Kenyon and McDowell 1983). Almost 90% of all sites were situated within 1000 m. of the river with 60% situated within 200 m. and 75% of these no more than 20 m. in elevation above the river. This study concluded that during both the Archaic and Woodland periods, sites were situated close to the river on alluvial or terrace settings.

In order to understand the distribution of sites, it is important to consider the settlement systems that were employed by the prehistoric inhabitants. Generally, populations in southeastern Massachusetts changed from semi-nomadic hunters and gatherers to more sedentary horticultural populations over time. This change is evident from the distribution of known archaeological sites through time. Environmental change since the last Ice Age, led to increased diversity and stability over time, with the period of the fourth millennium (ca. 4,000 BP) being the time of maximum stability (Dincauze and Mulholland 1977). Beginning in the Late Archaic and concurrent with stabilizing environmental conditions, there was a shift from a simple foraging economy to a more complex collecting logistic strategy. Changes in economy throughout the prehistoric period have been explored through the use of two main models, one of which is territorial based and another which is logistical based.

Four behavioral aspects are associated with these models: 1) the geographic range of activities carried out by groups; 2) the specialization of resource procurement; 3) the function of specialization in the manufacture and maintenance of tools; 4) the bulk processing and storing of resources. The geographic range and minimum possible territory for a community was hypothesized by the Public Archaeology Laboratory Inc. during their I-495 survey (Thorbahn et al 1980), as 10 km for day trips, the minimum distance to another adjacent community would be 20 km, making the minimum local territory approximately 60 km (three times as large as the distance to next closest community) (Thorbahn et al 1980: 169). This means that archaeologically, the materials represented at a site came from five potential spatial intervals from the base camp: 1) on site; 2) off site local (10 km); 3) off site territorial (30 km); 4) non-local regional (100 km); 5) remote regional (300 km).

The **Territorial model** was first proposed by Dincauze (1980). This model hypothesizes that the response to increasingly stable, predictable and abundant resources in the fourth millennium BP, was marked by a reduction in foraging territories. Territory sizes were large during the Paleo-Indian and Early Archaic periods, but they shrank from 8,000 to 4,000 BP due to local groups becoming increasingly specialized at exploiting resources. After 2,500 BP, the environment became less stable and swidden horticulture was adopted as a way to maximize the return from these new smaller territories. A more generalist approach to exploiting the hinterland of the community came into fashion. Without the limits caused by reduced foraging and hunting territories after the fourth millennium, populations could have just expanded their subsistence area to cope with environmental instability. Now, because one community occupied one specific area, expansion without ensuing conflict (e.g. warfare) with neighboring communities, was more difficult. As a way of maintaining social cohesion and relationships, an intensification of the use of predictable, controlled resources was a better option to expansion. After 2,500 BP, adoption of swidden horticulture led to relatively permanent, high density settlements in core areas of arable land with foraging continuing over large areas that then became the community hinterlands.

In Dincauze's Territorial model, a decrease in foraging territory size of foraging correlates with increasing specialization of resource use in a stable, diverse and high resource dense environment. This should be visible archaeologically by a highly functional and diverse set of tool assemblages across space and through time. On both a seasonal and millennial scale, linked small territories will develop exchange networks for the procurement of essential and useful commodities unavailable locally. This exchange network will be partially visible through the occurrence of non-local lithics used for tool production, as well as an increase in non-local high status items.

In contrast, Binford (1980) proposed a **Logistic** based model. He hypothesized that hunter-gatherers have two distinct strategies available to them in time of environmental stress: move their base camp to key resources, or move their resources to the base camp. The Logistical organization of the hunter and gatherer settlement system reflects the size of the group and the duration of the occupation. This model predicts that in the face of increasing spatial and temporal variation in resources, such as those faced by New England Natives after the fourth millennium, hunter-gatherers are most likely to chose the second option, moving resources to a base camp. Binford termed this foraging and collecting. Foraging is characterized by low spatio-temporal variation in resources and high population mobility. Base camps are provisioned by individuals or groups moving between locations in the immediate vicinity (catchment area) of the base camp. Foraging is coupled with collecting, which is when the same base camp is maintained, but there are also field camps, stations and caches at a greater distance from the base camp. These collecting locales are maintained by smaller task groups who procure and process key resources in high bulk for use by all in the community. This model is concerned with the behavior of hunters and gatherers over their entire range, regardless of the group size. In Binford's model, territory size is not as much of a factor as he did not see a constriction in foraging areas over time. Binford explained an increased number of artifact concentrations at certain sites as being the result of tracking- the tendency for a group to return to the same spot year after year due to specific characteristics of the sites that make it attractive for recurrent settlement. People chose to use the site because it was attractive, not because they had fewer options for occupation.

Three types of sites are predicted for this type of system: **Residential Base Camps (RBC), Foraging Locations (FL),** and **Field Stations (FS)**. At RBCs, large groups of people within the community congregate for weeks or months forming the base to which resources foraged and collected in the local area are concentrated for redistribution. Within a hunter-gatherer territory, several of these RBCs exist for use during the course of the year. RBCs should not be functionally specific but should be places where a full range of activities related to the manufacture, processing and maintenance take place. FLs are places where people from the RBCs hunt and collect wild plants for use at the RBC. FLs are occupied for short periods of time, generally a day or less. FLs can be functionally and seasonally specific and have low archaeological visibility (i.e. low artifact density and little spatial cohesion of artifacts and features at one place). The third type of site, the FS, is a site where special task groups collect large quantities of resources (e.g., herring runs). These are occupied for longer periods of time, and are located more than one day's walk from the RBC. The FS resources are stored or processed and transported back to the RBC. FSs and caches are functionally specific for the kinds of activities carried out there and the season when they were carried out. Overall, because FS were occupied for a longer period by a larger number of people, there should be evidence of a range of activities comparable to that found at RBCs. Both RBCs and FSs should be marked by indications of high bulk procurement and processing of resources. After 3,000 BP there appears to have been an increase in the FLs and FSs possibly due to the fact that if territories were expanding then the increase in special task group occupations indicates that there was a concomitant increase in the complexity of the logistical organization of the settlement systems (Thorbahn 1984: 219).

During a CRM study for the I-495 project, Peter Thorbahn (1984) hand an opportunity to test both the territorial and logistical models with data from the Taunton Basin in southeastern Massachusetts. Thorbahn found that territory sizes changed over time. They were large from 9,000 BP to 4,000 BP when they shrank, only to expand after 3,000 BP. After the beginning of the Early Woodland, he also found that instead of becoming more specialized with decreasing territory area, as predicted by Dincauze's territorial model, groups underwent generalization creating fully developed, highly complex, logistic systems by 3,000 BP (Thorbahn 1984: 236). Logistical organization for the Early to Middle Archaic was unclear but there appeared to have been an increase in complexity during the Late Archaic to Early Woodland, and that overall, both Dincauze and Binford's models were supported. Approximately 10,000 BP the Paleo-Indian to Early Archaic inhabitants of southern New England operated within large group territories with low logistic complexity and low population density. Their resource economy was relatively specialized and exploited a limited range of resources. This was reflected in a low diversity of tool inventories per site (Thorbahn 1984:255).

Environmental stress as a result of a lowered water table during the hypsithermal climatic period led to high resource heterogeneity causing human groups to adopt a highly specialized approach to resource exploitation within localized habitats (Thorbahn 1984: 255). Territory sizes were still small at 4,000 BP, logistical complexity had increased to a medium level, but population density was still low. A more diverse tool inventory reflecting tool complexity and a generalized approach to resource utilization was evident during this period. At ca. 4,000 BP, territorial sizes were at a minimum with the minimum area for a group being approximately 1,040 square kilometers. Thorbahn (1984) estimated each RBC was located within 20 km of another. This indicated there were approximately 34 groups of 20 to 50 people each in southern New England (Thorbahn 1984: 253).

On the basis of the above discussion, the project area showed high potential for containing significant prehistoric archaeological resources. Predicted sites in the project area could be expected to be small, thin, single-episode sites occupied for a short period of time by a small number of people. These sites could correlate with Foraging Locations (FLs) in Binford's model (Binford 1980; Thorbahn 1984: 219). It was expected that these sites would date to the Late Archaic or later with a higher expectation for Late Archaic and Late Woodland compared to other periods. Cowen's (1999) findings indicate that Late Archaic people lived in small social groups that moved often to exploit a variety of resources with a mixed tool kit containing a broad range of tools and production methods. The resource being exploited and the tool that best suited the job determined the tools and methods used at various sites or times. Early Woodland populations were represented by extremely mobile groups that were exploiting resources and returning to a separate base camp. Their tool assemblages reflect this, being composed of bifaces and preforms without much core reduction. Late Woodland seasonal base camps appear to have been occupied by small family groups tending crops near a main village, while logistical camps were used for the procurement and processing of game and other forest resources to be transported away to the base camps (Cowen 1999:605). In Southeastern Massachusetts, the number and diversity of Late Archaic sites, and their distribution in riverine and inter-riverine, upland settings suggest a broad-based collecting approach to resource use and considerable attention to small-scale environmental features, including bogs and kettle-hole swamps (Binford 1980).

Prehistoric sites anticipated in the project area were small task camps expected to date from the Late or Transitional Archaic to the Contact period. Small sites were expected to relate to resource procurement such as the harvesting of floral and faunal resources from the adjacent wetlands and forest. Other predicted activities included lithic production and sharpening loci, as well as hearths. These sites have yielded evidence of lithic reduction, especially from the finishing of bifaces initially prepared elsewhere and the retouching/ resharpening of worn bifacial tools. Expedient tool production and use might be evident in the form of quartz shatter and unifacial tools. Subsoil features were expected to take the form of shallow surface hearths (patches of fire-affected soil and scattered charcoal) or possibly more formal hearths used to heat stones for stone boiling in steatite bowls, as well as discarded fire-cracked rock resulting from stone boiling. Calcined bone could be present in or near these hearths or scattered around the sites and carbonized botanical remains may be present in hearth deposits.

Due to the presence of 13 recorded archaeological sites within two kilometers of the project area, the proximity to kettle hole bogs, and the presence of well-drained soils, portions of the project area maintained a high sensitivity for ancient Native American archaeological resources. Potential sites located within the project area included small, short-term camps associated with the exploitation of surrounding resources, as well as larger seasonal base camps dating from the Middle Archaic to Late Woodland periods. Late Woodland occupation could include horticultural planting grounds. Evidence of occupation may consist of lithic scatters, shell middens, hearths, storage and processing pits, burials and architectural remains such as post molds.

IV. HISTORIC CONTEXT

The **Contact Period (1524-1620)** was a time a dramatic social, political and personal upheaval for southeastern Massachusetts Native populations. This period began with amiable trade relations with European explorers such as Verrazanno (1524) and Gosnold (1602), followed by a growing distrust of Europeans and an increase in hostility between the two, especially on Cape Cod (Pring 1603, Champlain 1605). This hostility was due primarily to the kidnapping of Native men by Europeans desirous of returning home with informants or curiosities from the New World (Weymouth 1607, Hunt under Smith 1614). By the time of the settling of the English at Plymouth, 1620, Natives in southeastern Massachusetts had been decimated by a European epidemic, from 1616 to 1619, with mortality rates possibly reaching 100% in some communities.

The first recorded trading encounter in New England occurred in 1524 and involved the Florentine sailor Giovanni da Verrazano who was sailing for France. Verrazanno arrived in Narragansett Bay in April of 1524 and traded with the natives (Parker 1968:14). He stated that the people were apparently unfamiliar with Europeans and were very willing to trade and host the visitors. The natives were first enticed to trade by tossing "some little bells, and glasses and many toys" (Parker 1968:14) to them as they came to Verrazano's ship in their own boats. The Europeans remained in the harbor until early May and Verrazanno stated that of all of the goods they traded to the natives "...they prized most highly the bells, azure (blue) crystals, and other toys to hang in their ears and about their necks; they do not value or care to have silk or gold stuffs, or other kinds of cloth, nor implements of steel or iron." (Parker 1968: 16). It was also noted that the natives here possessed ornaments of wrought copper which they prized greater than gold. The copper may have come indirectly through trade with natives to the north who traded with European fishermen, or it may have been native copper from the Great Lakes or Bay of Fundy regions.

The next explorer known to have visited southeastern Massachusetts was Bartholomew Gosnold who arrived at the Elizabeth Islands off Martha's Vineyard in May of 1602. There he traded with the first natives he encountered, giving them "certain trifles, as knives, points, and such like, which they much esteemed." (Parker1968:38). Gosnold's crew, in return for the "trifles" received many different types of fur from animals such as beavers, luzernes, martens, otters, wild-cats, black foxes, conie (rabbit) skins, deer and seals as well as cedar and sassafras, the later which was prized as a cure-all in Europe. Of particular note is his description of the great store of copper artifacts which he saw people wearing and using. He said that all of them had

> chaines, earrings or collars of this metall; they head some of their arrows here with , much like our broad arrowheads, very workmanly made. Their chaines are many hollow pieces semented together, ech piece of the bignesse of one of our reeds, a finger in length, ten or twelve of them

> together on a string, which they wear about their necks; their collars they weare about their bodies like bandoliers a handful broad, all hollow pieces, like the other but shorter, foure hundred pieces in a collar, very fine and evenly set together. Besides these they have large drinking cups, made like sculles, and other thinne plates of copper, made much like our boar head speares, all of which they little esteem, as they offered their fairest collars or chaines for a knife or trifle....I was desirous to understand where they had such store of this metall, and made signes to one of them....who taking a piece of copper in his hand, made a hole with his finger in the ground, and withall, pointed to the maine from whence they came (Parker 1968:44).

The native informant asked by Gosnold as to where they received the copper from was probably either signing that it came from the mainland, possibly he meant through trade with natives or Europeans or he may have been referring to a native historical tale as to the origin of the copper. What is interesting is the large amount of copper possessed by the natives and their desire to trade for metal knives. It would appear that between 1524 and 1602 they had begun to see a value in steel knives and they had expanded their use of copper to create beads and arrowheads, whereas in 1524 they were noted as having only breastplates of copper.

The presence of so much copper and the desire by the Natives to trade with the Europeans highlights early trade relations. Natives saw European goods as being different, special, in some ways technologically superior and spiritually empowering. Unfortunately, the power that the Natives felt could help them cope with the sometimes disturbing new relationship with these strangers could not preserve them from their diseases. Sometime around 1616, an epidemic swept south from Maine among the Native people. Various authors since the seventeenth century have sought to identify what this disease was with the most likely candidate being infectious hepatitis.

The seventeenth century Wampanoag were practicing what is well known to anthropologists as a mobile economy. These people migrated seasonally, moving from place to place throughout the year to coordinate the resources of their territory. To these people, the resources they are using are unevenly distributed so, as a result, they had developed a specialized successful economy that maintained higher population numbers than could be done if those resources were gathered in isolation by specialized groups (Higgs and Vita-Finzi 1982:28). In Frederick Dunford's view, the Cape Cod Natives practiced a unique human adaptation to the environment which he termed "conditional sedentism" (Bragdon 1996:58). This adaptation had the estuary as its primary focus with its human community, which moved with the seasons, "joining and splitting like quicksilver in a fluid pattern within its bounds." (Bragdon 1996:59).

A wide variety of plant and animal species could have been exploited by these people. A list of the plant and animal based on the writing of Roger Williams indicates that 10 species of birds, 8 wild plant species, 4 cultivated plants, 8 wild mammal species, 16 fish species and 5 shellfish species were exploited by the Natives in southern New England. This source gives a fairly complete inventory of the species. It does neglect many wild species that have been recovered archaeologically and some animal species that Williams did not note. All in all though it shows that the natives had a diverse diet of wild resources which they collected. At least 14 (Alewife, herring, bass, scup, eel, lampreys, chestnuts, acorns, walnuts, strawberries, lobster, clams, oysters, quahog) of the species noted, are known to have been extensively collected and stored for the winter by the Contact Period.

The hunting and collecting of any of these species and the storage of certain ones was not haphazard. People scheduled where and when they would return to various sites to make use of resources. Winslow noted this as early as 1621 when he stated that "by reason whereof, our bay affording many lobsters, they resort every spring-tide thither; and now returned with us to Nemasket.´(Young 1974:96). This springtime movement to the coast to catch lobster was mentioned by Morton; "savages will meet 500 to 1000 at a place where they come in with the tide to eat and have dried a store, abiding in the place for 4-6 weeks feasting and sporting together." (Morton 1972:90). According to William Wood, the drying of shellfish and fish took place in the spring and summer. "In summer these Indian women, when lobsters be in their plenty and prime, they dry them to keep for winter" (Wood 1977:114).

After foods were dried out, many of the vegetable foodstuffs were placed in storage pits (Auqunnash), what the English termed "barnes". The best description of this is by Thomas Morton in 1637.

> They are careful to store food for winter, they eat freely of it but put away a convenient portion to get them through the dead of winter. Their barnes are holes made in the earth, that will hold a hogshead of corn a peece in them. In these (when their corn is out of the husk and well dried) they lay their store in great baskets (which they make of sparke) with matts under, about the sides and on top; and putting it into the place made for it, they cover it with earth.. to be used in the case of necessity and not else (Morton 1972:42).

These are the type of storage pits which the colonists found in 1620 on Cape Cod wherein they found "a bottle of oil, bag of beans...2 to 3 baskets parched acorns" and several bushels of corn (Young 1974:141; 155). During the Late Archaic storage pits make their first appearances in the archaeological record in New England, possibly marking a change in subsistence patterns by these people due to increased population pressure.

The Contact Period in Yarmouth is poorly represented but this may be more of a result of the difficulty of separating Late Woodland from Contact Period occupations, the latter being defined solely on the presence of European trade artifacts. Little is known regarding the locations of Native trails, but trails are postulated to have followed the present day Route 6A with trails branching to the north and south along streams and the peripheries of estuaries. Other trails may have been located along the route of present day Route 28 and possibly along Bass River. Population centers were likely located in North Yarmouth. Bass River has yielded extensive archaeological deposits, but while several are dated to the Late Woodland, none that have definitely been dated to the Contact Period. Yarmouth and Dennis were the location of the Native community of Mattacheese/ Mattacheeset (originally more likely muttoteuket) a name that means "place of a great amount of planting land" (mutta- great amount + oteuk- field + et- place of), a name attesting to the potential substantial Native occupation in the area. This name was ascribed to the area that is now the eastern part of Barnstable and the western portion of Yarmouth. The name Hockanom (which means "the covered hollow") was attributed to the area from near White's Brook (South of Old King's Highway between Union Street and Weir Road) to the Yarmouth/ Dennis. border. It may refer to the fact that this part of Yarmouth is partially covered to the west by Sandy Neck, which may have once extended further to the east. Alternately it may refer to the extensive marshes along Cape Cod Bay in this area which at high tide are covered with water.

What is now the Town of Yarmouth included what is now Dennis during the **Plantation Period (1620-1675)**. European settlement began in 1638 when Stephen Hopkins was granted the right to build a house and cut hay in Mattacheese (MHC 1984: 6). His home is believed to have been located at the junction of Mill Road and Route 6A. The first permanent settlers arrived in 1639 and settlement was concentrated in the northern part of the town along Route 6A (MHC 1984: 5). These settlers appear to have been part of an organized and authorized settlement effort by Plymouth Colony. A total of three granters were listed with 10-15 settlers in 1639, with 10 more arriving in 1640 (MHC 1984: 6). By the end of the period the area's population likely numbers no more than 200 (MHC 1984:5). The town's economy was probably based on agriculture with some limited attempts at fishing and possibly the recovery of beached whales. The first meeting house was built in 1640 and measured 30 x 40' with 13 1/2' high posts (MHC 1984: 10)

Two sachems from Mattacheese are known to have sold land to the settlers: Masshantampaigne (sachem of the Nobscussets of North Dennis and East Yarmouth) and Janno, successor of Jannough (sachem of the western part of the Yarmouth and the southeast to the Bass River) (MHC 1984: 7). John Eliot began missionary work in Yarmouth in 1648. Native populations remained in town after European settlement with a Christian community located at Bass River by 1674 when Richard Bourne noted 70 individuals here (MHC 1984: 6).

The **Colonial Period (1675-1775)** saw population growth up to 1776 with a sharp decrease in the Native population (MHC 1984: 7). A Native reservation was created as the result of the 1710-1715 division of common lands (MHC 1984: 9). The reservation was located at what would later become South Yarmouth and was referred to as "Indian Town" in the records (MHC 1984: 9). The Native population decrease was a result of a 1763 epidemic that further devastated a dwindling community, leaving few persons by 1775 (MHC 1984: 7). All the Native lands were sold off in 1778. By 1765 there were only 31 Natives recorded in Indian Town with a cluster of Native-style houses present in the area as late as 1779 (MHC 1984: 12). One Yarmouth Native, Ichabod Paddock, was hired by Nantucket in 1690 to teach them about whaling and processing whales (MHC 1984: 10). European settlement density increased, and as a result, five divisions of the town of Yarmouth were created, with the East Precinct eventually becoming Dennis. The area around the project area eventually became known for its maritime related industries, especially shipbuilding and coastal trading. Another focus of the norther part of the town was salt making, which became very important for many Cape towns by the nineteenth century. One mill may have been located at Mill Pond during this period and one wind powered mill is known to have existed. The second meeting house was built in 1716 and was enlarged in 1768 by cutting it in two and adding 15' to the middle with a 14' porch on one end (MHC 1984: 10).

Highways that had been improved during the preceding period, continued in use during the **Federal Period (1775-1830).** The primary east to west corridor through the town was County Road and in 1795 a ferry service was added across Bass River. This ferry was changed to a toll bridge in 1815 (MHC 1984: 11). The maritime focus of the town intensified during this period with a town dock being built at Gray's beach in North Yarmouth in 1811 and another dock at Hockanom Road (MHC 1984: 11). A packet service also ran from North Yarmouth to Boston beginning in 1821 (MHC 1984: 11). By the 1790s the south shore focused around Bass River, was the most active in town with a rope walk, fish works, potter and five windmills being present here by 1795 (MHC 1984: 13). In the northern section of town, boat building became important along the Chase Garden River and agriculture remained and important part of town's economy. In 1791 a total of 897 acres were recorded as under cultivation representing 3.1% of the land area of Yarmouth and making it the third highest on Cape Cod (MHC 1984: 13). Captain John Sears (1744-1817) of East Dennis was a fisherman before the Revolutionary War but after the war he helped introduce the solar evaporation technique of salt production to Cape Cod (MHC 1984: 11). Yarmouth ranked third in salt production in 1802 with 16, 630' of evaporation pans present, in 1809 30, 50' of pan had been constructed (MHC 1984: 13-14).

The population of Yarmouth grew rapidly during the **Early Industrial Period (1830-1870)** especially between 1830-1840 and 1855-1860 with a growth of 30 persons per year (MHC 1984: 15). Along the south shore of the town, the economy focused on coastal trading and fishing while in the north, shipbuilding and salt making dominated the economy. The town was also the leader in the alewife fishery. The 1830s saw a boom in the production of salt with a total of 365, 000 pounds being produced by 1837 (MHC 1984: 16). Cod and mackerel fisheries were also very important, reaching their peak in

1845 when a total of 24 vessels and 297 hands were engaged in the industry (MHC 1984: 17). The railroad arrived in Yarmouth in 1854 and in 1865 was extended across the town.

Yarmouth experienced a serious population decline after 1865 and by the end of **Late Industrial Period (1870-1915)**, the population numbered 1,415 persons (MHC 1984: 18)**.** The maritime industry reached a peak in 1875 when 29% of the population were mariners and 18% were fishermen (MHC 1984: 19). At the time there were 16 schooners involved in coastal trading but after this date the maritime focus shifted to ocean traffic with a small percentage of ships departing to and arriving from Hong Kong, San Francisco, Liverpool and Japan among other places (MHC 1984: 20). Little new development was seen in the town but there was some growth as a summer resort destination. The economy of the town remained focused on coastal trading in the south, but the north was now more focused on cranberry production and agriculture (MHC 1984: 20).

The **Early Modern Period (1915-1940)**, in the 1920s, saw Route 6 being constructed and Route 28 being improved, both of which went through the town. The population decline ended in the 1920s when the automobile brought a steady and predictable flow of tourists and their much desired dollars, to Cape Cod in the Summer. Yarmouth's population experienced an 80% increase between 1920 and 1940. More manufacturing and agricultural jobs were created in the town, but the greatest development was institutional and summer resort oriented (MHC 1984: 22). The two most lucrative businesses soon became cranberry production and shellfishing.

V. ARCHAEOLOGICAL INVESTIGATION

Archaeological fieldwork at the Sandy's point was begun by Public Archaeology Laboratory of Pawtucket, Rhode Island during a cultural resources management survey of the property. Initial testing took the form of transect lines of fifty centimeter square shovel test pits and eight, ten meter blocks which contained 13 test pits each. Upon the recovery of significant archaeological materials, arrays of four test pits were excavated in the cardinal directions spaced five meters apart. Soils were excavated in 10cm artificial levels. Excavation ceased when features were encountered or culturally sterile soil was reached. Soil was screened through ¼" hardware cloth and all material was labeled and bagged in the field with provenience information. Profiles of one wall for each test pit were drawn.

The initial testing revealed Late Archaic Native materials concentrated on the southern half of the point and significant amounts of Late Woodland material from the entire point. These included ceramics, lithics and bone. Numerous features were also encountered. One concentration of early to middle seventeenth century European material was recovered near the center of the point and one glass trade bead was recovered separate from this concentration (Mrozowski 1994:47).

Eighteen larger test units measuring one meter by one meter square were excavated in areas that yielded high concentrations of artifacts or possible features. All soil was screened through ¼" hardware cloth and the artifacts subsequently bagged and labeled. Features noted during this phase of testing included hearths, shell deposits, postmolds and possible cornhills. Soil samples were taken for later flotation from significant features for each 10cm layer within each feature. Upon the completion of this second phase of testing, the decision was made that the site should become the focus of the 1991 summer field school for the University of Massachusetts at Boston.

It was decided that, to fully be able to understand the spatial placement of the features and how they related to each other, large scale excavations such as those carried out on sites in Britain would be employed (Mrozowski 1994:48). These excavations consisted of a series of contiguous six by six meter square units. After the shovel removal of the culturally sterile 30-50 centimeters of windblown sand, excavation proceeded in 5cm levels within each natural stratigraphic level present. Significant artifacts were piece plotted and the information was entered into a GIS program in the field. Artifacts were bagged separately from each level of the features and labeled with provenience information. Soil samples were taken from each 5 cm level within the features.

Excavations yielded the structural remains of two overlapping oval-shaped house forms associated with an intact cornfield (Mrozowski 1994). The house forms at this site measured six by seven meters and oriented north to south and southeast to northwest. The interior surface area of the houses would have been 33 square meters. Post molds varied in size from 10 to 15 cm in diameter and extended up to 20 cm below the ground surface. Spacing between the post molds was about one meter on average. Archaeologists located several larger post molds, measuring 30 cm in diameter and up to 70 cm below the ground surface, within the house form and they interpreted these to possibly be supports for bed platforms.

Features 1 and 29

The two features which form the focus of the present study were located on the eastern and western edges of the site and were composed predominantly of shellfish remains. Generally, each feature contained shell, bone, and artifactual remains including Native ceramics and lithic refuse and was the result of food procurement activities at the site. The features differed in their size, shape, function, and age.

Feature 29

Feature 29 was encountered during the initial testing of the site in 1991 in two judgmental test pits (JTP-1 and JTP-2), which were placed near a large glacial erratic at the eastern edge of the site. The test pits yielded high concentrations of shellfish and bone remains. During the subsequent site examination, a single, one meter by one meter square test unit (Excavation Unit 4) was placed near the erratic. This test unit also yielded high concentrations of shellfish, bone and ceramics. At the bottom of the test unit, a woodchuck burrow was encountered with remains of its former inhabitant present. Block A and B, both six meters square, were located in the area of this feature during the final phase of testing. These blocks succeeded in exposing the entire feature and subsequently, it was completely excavated.

The feature was found to be a distinct shell concentration located against the southern face of a glacial erratic boulder. Other features that may or may not have been created at the same time were located nearby. Feature 29 was encountered under approximately 30 centimeters of gray (Munsell 10 YR 5/1) to dark gray brown (10 YR 4/2) windblown sand. The last 10cm of sand probably represents sand deposited after the feature was created but present for a period of perhaps centuries before the upper layers of sand were deposited. This was probably the habitation layer of the later residents of the site. As a result they would not have seen the earlier feature. Below the windblown sand, the dense shell of the feature was present.

On the buried ground surface, at 25cm below the present day ground surface, the feature was visible as a dense concentration of shellfish remains in a roughly oval distribution measuring 230 cm north to south and 130 cm east to west. The concentration of shell became more focused adjacent to the erratic as the excavation proceeded. The feature was bisected along its east to west axis and excavated in 5 cm arbitrary levels. The soil was screened through ¼’ hardware cloth and soil samples were taken every level. At 45cm the feature measured 125 cm northwest to southeast and 70 cm east to west. The upper shell layer from 25-30 cm appeared more diffuse and thinly spread, while the shell deposit from 30-45 cm was thick and dense. The bottom of the feature was reached at 45 cm below the ground surface.

The feature was composed of shell, bone, large Native pottery fragments, lithics and large burned and unburned cobbles. The cobbles appeared at the base of the feature. The soil within the feature was black greasy, loamy sand. Dense pockets of specific species of shellfish were noted and appeared concentrated in the center and towards the erratic. This can be seen in the overall plan. A concentration of whelk shells and another of oysters were noted directly in association with the erratic in the 30-35 cm layer. These probably represent individual collecting and processing episodes.
A stain was discovered in the B horizon soils and was excavated to 80 cm below the ground surface. Within this stain were recovered shell, charcoal, snake bones and woodchuck cranial and upper vertebral fragments. This apparent rodent burrow measured 15cm by 8cm and continued to the west of the southern edge of the feature.

A sample of charcoal and a sample of shell from within the feature were sent out to Beta Analytic for radiocarbon dating. The returned dates were 930 +/- 60 B.P. (Beta 44990) and 860 +/- 70 (Beta 44991) respectively. This places the feature within the early Late Woodland period. One glass bead was recovered near the erratic, but was not in the feature. This bead dated to the first half of the seventeenth century and was probably lost near the feature at a later date.

When viewed in profile, feature 29 appears to be a shallow semi-circular basin. The greasy texture of the soil indicates that there was a substantial amount of charcoal present and this, along with the burned rocks, indicate that its function probably related to the processing and possibly drying of the shellfish and fish collected. The shallow pit may have been placed on the southwestern side of the boulder so that the erratic would provide a measure of wind break for the fire. This would allow the fire to be better controlled and its heat regulated. This would have been necessary for the slow roasting or slow smoking of shellfish and fish meat. Unfortunately, no postholes were found near the feature, which would support its interpretation as a smoke drying pit. As a result, it is probably best to interpret it as a roasting hearth for shellfish and possibly a cooking hearth for meals. The feature fill appears to have been deposited within a relatively short amount of time and probably represents several closely spaced depositional episodes.

Feature 1

Feature 1 possibly served a similar function as feature 29, but on a smaller scale. This feature was also located during the initial testing in 1991 and was first evidenced in the eastern test pit of block seven on the western edge of the site. Fairly deep concentrations of shell were noted as well as the presence of bone and Native pottery. During the subsequent phase of testing, one excavation unit (excavation unit 2) was placed near the initial test pit. An auger survey was also conducted around these test areas to determine the extent of the shell deposit. Unlike the southern and eastern portions of the site, a substantial layer of windblown sand did not cover this feature. There was only a 2-5 cm thick layer spreading from the northeast to southeast edges.

On the surface, a thin scatter of shell covering a total area of 105cm east to west and 115cm north to south was visible. A denser concentration of shell was noted extending from the center to the southern edge of the feature. This concentration measured 70cm north to south and 60cm east to west. Test pit 7 east excavated a small portion of the feature while EU 2 excavated a larger area of the western half. The eastern wall of this unit produced a profile of the feature.

Two components made up feature 1. The first was a rectangular shaped flat bottomed pit excavated into the subsoil. The soil within the feature was described as a black greasy fill with much shell, charcoal, bone with some lithic flakes, preforms, and Native ceramics present. The bottom of the feature was encountered at 65cm below ground surface. Charcoal from this feature was recovered and produced a radiocarbon date of 360 +/- 60 years B.P. (Beta 44989). The second was a dense shell layer that capped this feature and extended some distance away from it. Both components were considered to be contemporaneous with each other and were treated as such in the analysis.

It is believed that this feature had a purpose similar to that of feature 29, that of a roasting pit to steam open shellfish. Once all of the shellfish were opened the pit may have been filled in from the south side. This area of the feature had the highest concentration of shellfish remains. This feature is smaller than feature 29 and appears to have been used more intensively for a shorter period of time. The differences in their sizes may have had more to do with the size of the group using the feature and the duration of use for it. Subsequently the size of the feature needed and the amount of remains left behind would be different.

VI. THEORETICAL BACKGROUND: SHELL MIDDEN STUDIES

The excavations on Sandy's Point are only part of a study of Cape Cod shell deposits which goes back over 150 years. Some of the research trends that have been used in the past on Cape Cod are merely part of larger trends in midden analysis. The research tools used in this thesis are the current evolution of ones that began over a century and a half ago and although the specific questions are different the larger question is the same: What can we learn from these middens?

Around the world, shell midden studies have been going on for hundreds of years but it was only within the past one hundred and seventy years, that they truly came to the fore in American studies. Since the first excavations, research strategies and reasons for excavating into middens have changed a great deal. By looking briefly at the trends and history of shell midden studies in the United States, the history of excavations on Cape Cod can be put into a broader context.

The first general interest in middens in America must have begun with the first view of a midden by European colonists. Although we do not know for sure, the colonists' inquisitive nature that led them to wonder about other occurrences in the New World also must have made them curious about the heaps of shells that abound on our coasts. As early as 1643, Europeans pondered the question of the origin of shell heaps that they encountered in New England. The great Whaleback Midden of Damariscotta, Maine was viewed at this time as being some sort of natural accumulation of shell (Sewall 1859:17). This began an ongoing debate that centered on whether these mounds were naturally created or were the result of human hands. Articles on observations concerning the nature of middens in the New World were common by the 1830s (Christenson 1985:228). The common belief at the time was that they were created by the Natives of the New World in their quests for food (Christenson 1985:231).

Initial excavations into shell heaps appear to have been concentrated on either solving the question of whether they were of human or natural construction, or were conducted to recover artifacts such as pottery or arrowheads. In the early excavators' eyes, the shells and dirt constituted material that was in the way of the real prizes, the artifacts. This trend included middens on Cape Cod such as those that Thoreau saw in his walks there, although he felt they could also answer the question of whether oysters were native to the area (Thoreau 1908).

The trend of excavating middens to retrieve artifacts continued in the popular as well as the scholarly world until 1909, although there were a few archaeologists who began to quantify material from middens in an attempt to determine the rate of midden accumulation (Dall 1877). In 1909 the "California school" took the fore in the scholarly field. This school of midden analysis, championed by Nelson, Gifford and Cook, attempted to determine the rate of midden accumulation. They stressed the need to quantify all the materials that were recovered from the midden. The ash, broken rock, soil and other non-shell components were all weighed and it was believed that the rate at which the midden had formed could be determined using these weights (Waselkov 1987:141). These studies were specifically applied to middens within the San Francisco Bay area where the temporal significance of dominant shell species was noted (Claassen 1986:120). The advent of radiocarbon dating in 1946 did much, over the next quarter century, to eliminate the need for quantification to determine length of occupation.

By the 1960s the Normative thinking that led researchers to assume that all middens were created by the same means was being attacked and the internal complexity of middens began to be appreciated. With this, the study of midden formation processes came to the fore. These studies stressed that each midden was made up of many smaller depositional episodes, each of which could contribute to the understanding of intrasite activity areas. This meant that middens and features reflected not just the deposition of shellfish remains from consumption, but a broad range of activities ranging from the use of shellfish as food, bait and architectural debris as well as the differences between midden deposits and habitation midden deposits. This work exposed and attacked the fundamental weakness of the California school, that there is no internal site homogeneity and that similar looking middens may have been created for different reasons. By examining the different reasons, a greater understanding of the complexities of middens can be wrought. The new midden analysis stressed that various processes have affected the material which was deposited until, and during, its excavation. The study of the taphonomic processes became important as well to determine how much change had occurred to an analyzed assemblage (Waselkov 1987:146).

The 1980s saw attacks on the practitioners of midden analysis and these attacks echoed those heaped upon the California school. The fact that some analysts felt that Normative thinking continued to be the predominant means of analyzing middens, caused other researchers to stress the innumerable ways in which deposits could be formed (Claassen 1986; Will 1976). They hoped that analysts would acknowledge that every midden may be different and that to assume homogeneity was dangerous. This is where the study of midden analysis is at the present time.

Modern Midden Studies

In the broadest sense of midden study, today's analysts stress that there are essentially four recognized types of "midden" sites (Claassen 19Nornmat: 252, after Widmer 1989). They are the Shell Midden Site, the Shell Midden, the Shell-Bearing Midden Site, and the Shell-Bearing Habitation Site. The first describes thoise sites at which only secondarily deposited shell resulting from food consumption is recovered. This type of site contains only artifactual remains associated with shellfish consumption. The second, the Shell Midden, are discrete lenses or deposits of shell only with no other artifactual remains. The Shell-Bearing Midden Site, is composed of secondary refuse of many kinds of activities as well as shellfishing. Finally, the Shell-Bearing Habitation Site is where the shell recovered is the result of its use architecturally.

The research trends that characterize midden studies today in the Northeast, aside from formation and taphonomic processes are as follows. The first is the estimation of population sizes (Speiss 1983). Although the California school pioneered this work, some researchers still feel it has value today even though the vast number of variables that can affect it still can not be controlled for. Next is the determination of the season in which shellfish were harvested (McManamon 1984; Bernstein 1992; Speiss 1983; Barber 1982; Bourque 1975). This has been commonly accomplished by using quahogs, clams, oysters or through the use of seasonality by association with seasonally occurring vertebrate species. The third is understanding prehistoric settlement and subsistence patterns in a coastal setting. All researchers reviewed for this thesis seem to have this as an essential part of their research goal, whether it be the initial exploitation of shellfish in New England or just how the shellfish fit into the diet of the people.

The most commonly used research question concerns how the exploitation of shellfish has changed over time and what factors have affected it. Four factors have been put forward that singly, or in combination, are felt to explain the change in species occurrence within middens over time. First, human choice or gastronomical whim (Claassen 1986:126). This is the factor that is the hardest to control. Thisis due to the fact that it is based on cultural norms and taboos placed on shellfish in the recent and distant past and there is no way to know for sure if a population 2000 years ago had a cultural reason for not consuming a certain species of shellfish. This can be controlled for to a limited extent through the use of ethnographic analogy or the exploration of the ethnohistorical sources but it in this case, it must be assumed that the past was similar to the present .

The second explanation is the overexploitation of species over time. A popular cause noted for the decline of shellfish species from the bottom to the top of a midden is that the human populations, overtime, wiped out a given species in an area. To test for this, Claassen developed the following axioms to test for it (1986:227). If over exploitation has occurred then 1) the mean shell length will decrease from bottom to top of feature; 2) modal size of species when compared to modern unexploited population will be smaller; 3) less easily procured species will increase in number; 4) less easily processed species will increase in number. Unless at least one of these criteria are met, overexploitation can not completely account for the decreased number of a species over time.

The third explanation is technological advance. This theory was proposed by Dean R. Snow to explain the difference in the occurrence of oysters to soft-shells clams in New England middens after 2500BC (Snow 1972). Snow stated that after approximately 2500 BC, people realized the potential of clam beds and invented digging sticks to root out the clams. This then led them to favor clams over oysters. A similar theory has been presented to account for the presence of scallops in middens. This theory states that at a certain time people began using nets to catch the scallops, since it is assumed that they can not be procured without them (Claassen 1986:130). Both these theories fail to take into account the essential simplicity to the actual harvesting of these species and the effect that the environment has had on shellfish species

The final theory is that the environment can have dramatic effects on shellfish populations in a specific area. The theory that environmental changes could cause changes in the species of shellfish that were harvested, was first proposed by Braun to explain the change from oysters to clams in New England middens. Braun saw this as environmental change on a large enough scale to have affected a good portion of New England. This theory stated that natural changing environmental conditions have altered the composition of certain shellfish collecting locales over time. Increases and decreases in salinity, changes in tide, changes in currents, temperature changes and silting have all been given as reasons why certain species will replace others in a habitat (Claassen 1986; Bernstein 1992; Speck 1948). Currently this appears to be one of the best models to explain species change in some assemblages.

One avenue of midden studies that has been intensely pursued is the field of dietary reconstruction. There are five main topics that are addressed by these studies. They are: gathering strategies and procurement methods; nutritional importance of various foods to the overall diet; the seasonality and scheduling of certain resource procurement; the processing of the acquired resources and storage methods; and trade (Waselkov 1987). Obviously, this field covers a number of topics but they all relate to how and where resources were collected, how they were processed and stored and how much they contributed to the overall diet. One of its flaws is that it is based upon the normative assumption that all the invertebrate and vertebrate remains found at a site are food remains (Claassen 1986:269). These problems can be overcome by incorporating ethnographies and ethnohistorical sources into the analysis. Another problem with nutritional reconstruction is that there has been a trend to use the values for one molluscan species to generalize for all. By recognizing that the nutritional characteristics of mollusks varies by species and even by locale this can be overcome as well.

There have been a large number of shell middens excavated on Cape Cod. Unfortunately, avocational archaeologists or cultural resource management companies have carried out most of these excavations. This has resulted in a situation similar to that in the nineteenth century where the middens are seen as places to find artifacts with the shells and vertebrate faunal remains being relegated to mere counting and weighing if lucky. Many times, even today, shells are discarded with backdirt. McManamon conducted one of the most comprehensive studies on middens on Cape Cod in 1979-1981 on the Cape Cod National Seashore. His research questions mirror trends popular at the time of excavation and his work remains the best for midden work on Cape Cod. An overview of his research questions will help to establish a framework within which the middens from Sandy's Point can be placed.

Cape Cod Midden Studies

The focus of cultural resource management survey on the Cape Cod National Seashore properties was on collecting information that could be used to answer questions concerning cultural adaptation and temporal variation on Cape Cod (McMannamon 1984:339). A significant number of features were excavated that contained shellfish and faunal remains. Through the use of these remains, McMannamon hoped to answer questions which pertained to the length and seasonality of occupation and the diet of the occupants at the various sites. Unlike many others who work on New England Middens, this study steered clear of such issues as the genesis, extent and temporal variation in shellfish exploitation (McMannamon 1984:411). Deposits were recovered that spanned much of the time between the Late Archaic and Late Woodland Periods. Part of the research design was to examine the variation of the types of shell-bearing deposits from the Late Archaic to the Late Woodland Period. The study focused more on the variations in deposits, and changes in the seasonal settlement of coastal Cape Cod over time (McMannamon 1984:350).

One of the primary ways that the researchers organized their data on the shell-bearing deposits that they excavated, was by identifying four different types of shell-bearing deposits which were encountered. These deposits were characterized by looking at the amount of non-shell material recovered from each. The differences in the occurrence of Native ceramics, floral remains, lithics, bone and fire cracked rock were used as evidence that the varieties of deposits resulted from different activities at the site (McMannamon 1984: 348). For example the lithics indicated production, reworking or resharpening of various tools from a variety of materials while the pottery indicated production or use of these vessels. Faunal remains were identified as bird, fish, mammal, other or unidentified and were taken to indicate that these species were exploited for subsistence and from their presence, loci of food preparation could be discerned. Other sites contained primarily lithics and shells. These were interpreted as representing sites where people did not live but had merely stayed for a brief period of time while shellfishing.

Working from the general shell midden types outlined by Claassen, the shell-bearing deposits on Cape Cod, were differentiated by McManamon using the density of fire-cracked rock, vertebrate faunal, shellfish and floral remains (McManamon 1984:369). Four types were identified. The first was the Primary Deposit that had resulted from from limited activities These deposits contain a low density of materials, a low diversity of artifactual remains and a narrow range of types. The second was the Primary Deposit that had resulted from a wide range of activities. These deposits contained a higher diversity of artifact types and remains but less than the next two deposits. The third was the Secondary Deposit, shell midden. These deposits contain a high density of shell but a low density of other remains and the range of types of remains are not as wide or as diverse as the final type. The final type was the Secondary Deposit, general midden. These deposits can be characterized by a high concentration of many of the remains and a high diversity of artifact types.

Primary Deposits generally were found to characterize occupations of short duration. The creators of these deposits moved among a number of areas throughout the year with the result being few actual midden deposits (McMannamon 1984:401). Secondary deposits characterized people living a more settled way of life within a restricted geographic range. sedentary, long-tern occupations resulted in a diversity of subsistence activities representing the exploitation of a wide range of micro-environments (McMannamon 1984: 409). Essentially, the midden was located near the primary occupation loci from which people would travel to engage in subsistence activities. Upon completion of the activity, whether it be hunting, fishing, farming shellfishing, or gathering raw materials, the people would return to this base camp to process the items.

McMannamon found that Primary Deposits resulting from a wide range of activities characterized the Late Archaic. This indicated that the settlements during this period were of short duration and that the creators of these deposits moved among a number of collection areas with no set base camp (McMannamon 1984:401). This contrasted sharply with deposits dating from the Early to Middle Woodland. During this time, over half of the deposits encountered were Secondary general midden deposits. This indicated a more sedentary mode of life within a smaller area, possibly year round (McMannamon 1984:402). The evidence for year-round settlement at a site can be inferred by the porescence of dense midden deposits with a wide variety of remains and an absence of components with diverse Primary Deposits (McMannamon 1984:410). This was what was found during the survey. The Late Archaic components represented occupation at the sites for several months, but not for the entire year, while the Woodland Period occupations represent evidence for year round occupation.

Deposits from the Late Woodland were more evenly distributed between Primary and Secondary Deposits with the Secondary Deposits being slightly more common (McMannamon 1984:404). This indicated that people were traveling from a main base camp to collect and process materials but were also returning to the base camp with both processed and unprocessed items. This was probably the result of a number of an increase in the Native populations on Cape Cod, the increased use of horticulture and their tendency to focus shellfishing on the winter months (McMannamon 1984:392).

The finding that populations were remaining in one area for most of the year but shellfishing primarily from the winter into early spring, was one of the most important findings of this survey. By looking at the growth layers of the quahogs from a variety of features, it was found that from the Late Archaic to the Middle Woodland, from the winter to the summer, two-thirds of the year was spent shellfishing. This changed from the Middle to the Late Woodland when the shellfishing became more focused on the winter to early spring (McMannamon 1984:390). This may have occurred because of the increased reliance and labor that was placed on horticultural crops. Native crops of corn, beans, squash, watermelons and tobacco, require much of the late spring to early fall to plant, cultivate and harvest. This would leave the late fall through the early spring to shellfish. The collection of shellfish may have occurred to supplement the horticultural crops to provide food through the hard times of the winter.

Synthesis

The study of shell-bearing deposits has come far from its days of mere antiquarian curiosity. Today's researcher stresses that there is no homogeneity from one shell-bearing site to the next. Shell deposits are now appreciated as having been created as a result of a number of possible processes and generalizations can only serve to harm their study. This does not mean that the questions that are sought to be answered by midden studies have truly changed a great deal since the first serious attempts to study them. Temporal changes and variations and the study of the subsistence data that can be gained from midden studies continues today. one of the main differences is that the questions are of a more specific nature, focusing on formation processes of specific deposits and not on using one deposit to generalize about many.

The following analysis of the two shell-bearing deposits from the Sandy's Point site bears this in mind. What is hoped to be learned is not that these two features can provide data to generalize about Cape Cod middens in general, but that they may document changes at this one site over a period of six hundred years.

VII. INVERTEBRATE REMAINS

The excavation of shell middens results in the recovery of a variety of shellfish species that were harvested by the inhabitants of the site. There have been a number of cases when the number of species recovered has been remarkably low. This has been observed in Maine where many of the Woodland Period middens consist predominately of soft-shell clam, *Mya arenaria* remains (Sanger 1983). This was also the case at the Wheeler site on the Merrimack River in Massachusetts, which has been interpreted as a specialized soft-shell clam processing site (Barber 1982). One Cape Cod midden excavated in the middle twentieth century yielded mainly Northern Moon Snail, *Lunatia heros,* shells (Bradley 1994: 51). Generally though, middens are composed of a number of species that may or may not have been consumed by the collectors.

Some species can be assumed, in most instances, to have been deliberately collected. These include Northern Quahog (*Mercenaria mercenaria*), Soft-shell clam (*Mya arenaria*), Channeled Whelk (*Busycon caniculatus*), Knobbed Whelk (*Busycon carica*), Eastern Oyster (*Crassostrea virginica*), Blue Mussel (*Mytilus edulis*), Ribbed Mussel (*Geukensia demissa*), Bay Scallop (*Argopecten irradians*), Razor Clams (*Ensis directus*), Surf Clams (*Spisula solidissima*) and Northern Moon Snails (*Ploinices heros* and *Polinices duplicatus*). Others were likely accidental collections in the form of "hitchhikers" and commensural species. These would include Slipper Shell species (*Crepidula fornicata* and *Crepidula plana*), Eastern Mud Nassa/ Mud Whelks (*Ilyanassa obsoleta*), Oyster Drills (*Urosalpinx cinerea*), Periwinkles (*Littorina obtusata*), Common Jingle shells (*Anomia simplex*) and other small gastrods and bivalves that do not yield much meat. Although the possibility does exist that some of the smaller "accidental" species were collected for specific purposes.

Most shell yielding sites have assemblages that are composed of both purposefully and accidentally collected shellfish and vertebrate species. The variety and abundance of the various species varies between, and even within sites and features, but ultimately it is the end product of a process of cultural and environmental selection which brought them out of their habitats. An educated guess can be made of where various shellfishing activities took place around a given site by looking closely at the environmental conditions that the various species inhabit. The ideal modern conditions can then be compared with the information that was gleaned from the shellfish remains recovered from the site to determine what the conditions were like in the past.

Every culture that makes use of marine resources makes certain decisions when they select the species to be consumed. These decisions are based upon cultural norms as well as species availability. If one follows theories such as Optimal Forage, then the amount of energy expended during the hunt versus the amount yielded by various species and techniques also factors into a cultures choice of shellfish. The occurrence of various shellfish species on a site, whether they are the highest meat yielding "collected" species or the lowest meat yielding "accidental" species is often affected by how a culture views these species within their set of cultural norms and values. The way in which the Native people of Southern New England and especially Cape Cod viewed various species can be tentatively gleaned through the use of the ethnohistoric documents written by various explorers, colonists and European travelers in the seventeenth century and by modern day ethnographic work among Cape Cod Native people.

Shellfishing

The families who lived at the Sandy's Point site during both periods were products of their cultures and, as a result, they followed to a certain degree certain common cultural practices. By comparing the ethnohistoric documentation concerning shellfishing by the Native people of Southern New England with what has been recovered archaeologically, a better understanding of the position of shellfish in the seasonal cycle of these people can be pursued.

Unfortunately, little was written in the period concerning shellfishing. Most authors simply stated that the Natives ate shellfish or that they collected it. Rarely did they state at what time of the year or in what manner they did so. Roger Williams stated that, for clams at least, they were harvested winter and summer, although he probably was implying that they were used year round (Williams 1643:184). John Josselyn stated that in the spring, the first "fish" that was harvested were clams (Josselyn 1674:100). William Wood stated that Native women "…to the flats dance many a winter jig, to dive for cockles and to dig for clams." (Wood 1643:54). He also noted that "In winter they go to clam banks for their belly timber" (Wood 1643:114). Ethnohistorically it appears that shellfish were used throughout the year, possibly especially in the winter and spring. This may have been done to supplement the diet in winter for variety reasons or in times of scarcity and may have occurred in the spring after the hunting had ended following the move to the summer planting grounds.

Archaeologically, it has been found that shellfishing in the Late Woodland appears to have been favored during fall, winter and spring (Barber 1983:117; Bernstein 1992:143; Ritchie 1969: 82, 115, 156, 191, 201; McMannamon 1984:391). Hancock noted that for sites on Cape Cod, there appears to have been a gradual shift from the Late Archaic to the Late Woodland of shellfish harvesting from summer to winter/ spring (McMannamon 1984:391). It appears that the ethnohistorical records support what has been found archaeologically.

The two features that form the core of this thesis also support McMannamon's findings. Seasonality studies, which will be discussed in further detail in a later section, were carried out on the fish remains from the site. The seasonal availability of the various migratory fish species was tabulated to determine season of creation for these features. Any fish vertebrae that were in satisfactory condition were also examined for seasonal growth lines. Both sets of information indicated that the features were created at approximately the same season of the year, late summer into fall.

The only two species for which it was specifically stated as to how they were gathered were quahogs and clams. Concerning these shellfish, Roger Williams noted that the Natives waded deep and dove for them (Williams 1643:184). This correlates well with what the information which Speck collected among the Wampanoag in the 1940s. Speck's informants told him that quahogs were treaded out in shallow water, presumably with bare feet (Speck 1948:258). Williams stated that the clams were dug out of the mud at low water (Williams 1643:184). As stated previously, Wood also noted that the women would dive for cockles (quahogs) and dig for clams.

Shellfish Species

In the section that follows, the various species of shellfish recovered will be looked at in terms of the species present at the site with special emphasis on the physical and biological requirements of each and their use by the Natives. Each species was investigated with regards to any information that was recorded by various chroniclers as to their use and position in the southeastern New England Native diet. The information collected by Frank Speck among the Wampanoag in the 1940s, was also incorporated and evaluated with regards as to how it can add to the interpretation of the shellfish remains from the site. All of the available information was compared with the archaeological remains recovered from the site with the hope of gaining a fuller understanding of the position of shellfish in the overall meat portion of the diet from the site.

A total of thirteen species of shellfish were recovered from the two features. Seven of these were gastropods and the remaining six were bivalves. The following discussion is divided into gastropods and bivalves and arranged by the order of occurrence by total meat weight from the two features. The gastropod assemblage contained the following species: knobbed and channeled whelk, moon snail, slipper shell, mud whelk and oyster drill. The bivalve assemblage was composed of the following species: quahog, soft-shell clam, oyster, bay scallop, ribbed mussel and jingle shell.

Gastropods

Two species of whelk, the knobbed whelk (*Busycon carica*) and the channeled whelk (*Busycon caniculatum*), were recovered. Both species are common from Cape Cod to Georgia and occur from the shore to 30-50 feet respectively where they feed primarily on quahogs (Abbott 1986: 139). They are commonly found on the same sandy or muddy substrates as quahogs, and are often collected attached to quahogs or are accidentally found when quahogs are sought. The knobbed whelk is the larger of the two and can attain a size of 12 inches under favorable conditions (Sutton 1986:372). The channeled whelk can grow up to 7 ½ inches and is abundant in shallow bays (Amos 1986:372).

The most well known use for the whelk by Southern New England Native people was for the production of "wampum" beads. These beads were made from the central columnellae of the whelks which were ground round, cut to a length of approximately 1 centimeter and drilled with traded European awl blades (Ceci 1989). Roger Williams noted that "Meteauhock: the periwinckle. Of which they make their Wampum or white money of half the value of their suckawhock" (Williams 1643:212). The "suckawhock" being the dark colored shell beads (see quahog below) while the wampum, which means white or light colored, were the white beads. The white beads were noted by John Josselyn, a colonial traveler, as being good to staunch the blood (Josselyn 1673:36). At the Sandy's Point site, the production of wampum does not appear to have taken place (Hallahan 1992). The name for the whelk, as it does not appear that they differentiated between the two species, "meteauhock" comes from the root "mehtauog" which means ear, so the whelk was an "ear shaped shell" (Trumbull 1903:56).

Speck's work among the Wampanoag of Gay Head, Mashpee and Herring Pond stated that "Marine gastropods or snails also played a leading part in the economy of the Wampanoag." (Speck 1948: 261). Whelks had three purposes to the 1940s Wampanoag; they were cooked, ground up into a paste and put on bread, they were used as bait, and the larger shells were used as trumpets (Speck 1948:261). The use of the shells as "trumpets" probably is a more recent use as there is no documentation for this in any of the historical records or archaeological collections. But the use of the whelks as bait and there use as food both must be considered as having probably occurred in the past.

One species of Moon Snail was recovered. The common northern moon snail (*Lunatia heros*) occurs in shallow waters on sandy bottoms where it feeds on clams. (Amos 1986: 388). This species of moon snail can attain a maximum length of five inches and is often found at low tide on flats where clams occur. There are no seventeenth century references to the moon snail and all Speck says of them is that they, like the whelk, were used for food and bait (Speck 1948:261).

Two species of Slipper Shell (also called boatshells) were recovered, the eastern white slipper shell (*Crepidula plana*) and the common Atlantic slipper shell (*Crepidula fornicata*). Both attach themselves to shells, rocks, horseshoe crabs and other slipper shells. The eastern white slipper shell grows to 1 inch long and its shape appears to be influenced by whatever it is growing on. Commonly the shape is somewhat concave from growing within another gastropod shell, such as whelks, which is where it can be most commonly found (Abbott 1986:102). The common Atlantic slipper shell grows to a length of 2 1/2 inches and can occur in such great numbers that it may smother oyster beds (Amos 1986:394). Both species occur intertidally to a depth of approximately 50 feet.

There are no seventeenth century references to the use of slipper shells. Speck notes that slipper shells (boatshells) "have long been eaten and are commonly called 'sweetmeats'."

(Speck 1948 261). This indicates that the species present in archaeological sites, at least the larger ones, may not just be accidental inclusions. They may have been collected because they were considered a delicacy or "sweetmeat" even though there was a low energy return from it. This ranking of different species of animals and even different parts of the same animal was common among the Wampanoag and their neighbors. For example William Wood stated that the tail of the beaver was a treat fit for a Native leader and that the young deer were considered the best because they were so tender (Wood 1643). It is completely possible that the Wampanoag in the seventeenth century would collect the slipper shells not because they yielded so much meat but because they favored the taste. This may also explain the number of shells of dead oysters, whelks and quahogs recovered from the features; they may have been selected because they bore a high number of slipper shells. This could be an example of how a culturally selected food item may be mis-identified in the archaeological record because of how we can not know the emic views of people long gone.

One species of Mud Whelk/ Mud Nassa was also recovered. The eastern mud Nassa, also known as the mud dog whelk, (*Ilyanassa obsoleta*) is an active scavenger on intertidal mud flats in quiet bays and estuaries (Abbott 1986:140). They are also often found on salt marshes such as those that border the cove at the site (Amos 1986:110). These nassas grow to 1 ¼ inches (Amos 1986:383). No seventeenth century references to their use exists and Speck concludes that "…there is no evidence as to the nature of their use, if any." (Speck 1948:261). The fact that these nassas live on mudflat near the low tide line and not attached to shells means that for the number that were recovered. They are not easily accidentally collected unless it is on seaweed from the shore and their occurrence seems to point to them having been deliberately collected, possibly as another "sweetmeat".

One species of Oyster Drill (*Urosalpinx cinerea*) was recovered. Oyster drills, as their name suggests, prey upon oyster beds by using a radula to drill a hole and then inserting a proboscis into the shell to feed. This species attains a maximum length of 1 ¾ inches (Amos 1986:375). It is common in shallow water on oyster beds and will also prey upon bivalves, gastropods and crabs. It can do considerable damage and even destroy beds (Amos 1986:375). No seventeenth century references to this species were found and Speck states that he knows of no use for them (Speck 1948:261).

Bivalves

The Northern Quahog (*Mercenaria mercenaria*) is one of the most common shellfish remains from archaeological sites. Quahogs are found within sheltered bays and estuaries with a salinity of at least 10 parts per thousand, preferring to live in a sandy firm bottom that can provide attachment points for its young (Chesepeake 1988: 86). This large bivalve has a dark purple "eye" one inner edge of each shell, and as the quahogs grows and the shell thickens, so too does the eye. Quahogs can attain a maximum length of 4 ¼ inches long (Amos 1986:402).

There are numerous references to these shellfish in the seventeenth century records. Edward Winslow of Plymouth, noted that they could be found on Cape Cod at the Native village of Manomet, present day Bournedale, along with oysters, mussels, clams and razor clams (Young 1974:306). Roger Williams noted that the "Sequnnock, Poquauhock" or horsefish were what the "English call hens, a little thick shell fish which the Indians wade deep and dive for, and after they have eaten the meat there (in those which are good) they break out the shell, about half an inch of the black part of it, of which they make their Suckauhock, or black money, which is to them pretious." (Williams 1643:182).

As stated by Williams, one of the values of the quahog was the purple or black part that they used to make purple or dark colored "wampum" beads. There does not appear to have been any bead production at the Sandy's Point site. The name quahog is a corruption of the original native name "Poquauhock" which comes from the root "pohkeni" which means closed and "hogki" which means shell (Trumbull 1903: 131). The other name give by Williams "Sequnnock" refers to the dark color of either the shell or the "eye". "Sequn" reefers to dark and again "hogki" reefers to shell. Speck noted that quahog were obtained by treading in shallow water and were the commonest clam consumed in the area in the 1940s (Speck 1948:258).

Soft-shelled clams (*Mya arenaria*) represent the second most common bivalve recovered from the site. This species lives in sandy, sandy-mud or sandy clay substrates of bays and inlets intertidally to depths of up to 30 feet, generally preferring stiff sands and mud (Abbott 1986:256, Abraham 1986:18). They prefer a near shore habitat in an estuarine environment where salinity changes from 10-25 parts per thousand occur although they do need a salinity of at least 4-5 parts per thousand (Abraham 1986: 18). Soft-shell clams average from 7-150 millimeters long with most of them being under 100 millimeters and adults can number from six to eight per square foot, burrowing up to 30 centimeters into the sand (Abraham 1986: 18). Predators include the moon snail, the oyster drill and the blue crab.

This shellfish, along with the quahog and the oyster were preferred fare for the colonists as well as the Natives. As a result, they were widely commented on by explorers and colonists alike. Edward Winslow noted their abundance in Manamet along with other shellfish species and mentioned that in March of 1623 the colonists ate clams as well as mussels (Winslow 1623: 306, 329). John Pory, an early visitor to the colony, noted in 1622 that they had clams and mussels in that place all the year long (Pory 1622:09). Thomas Morton, during his stay at Merrymount (present day Quincy), took note that every shore was full of clams and that the Natives took great delight in them (Morton 1637:90). William Wood noted, in somewhat derisive terms, that raccoons and "Indian women" feed upon clams at the sea shore, that they were not much unlike a quahog (cockle) and occurred in great plenty (Wood 1643:44, 56). Once again Roger Williams provides us with our most detailed commentary upon the Native use of clams "Sickissuog Clams

> This is a sweet kind of shellfish, which all Indians generally over the country, winter and summer delight in; and at low water the women dig for them: this fish, and the natural liquor of it, they boil, and it makes their broth and their Nasaump (which is kind of thickened broth) and their bread seasonable and savory instead of salt: and for that the English swine dig and root these clams at low water wheresoever they come, and watch the low water." (Williams 1643:182).

Finally, John Josselyn noted that clams were one of the first marine resources to be gathered in the spring (Josselyn 1674:100).

Regarding the entomology of the name of the clam "sickissuog" it comes from 'sohkissu' which means he spits or squirts (Trumbull 1903:149). This comes from their habit of expelling water from their burrows when the ground above them is trod upon. Speck notes only that the soft-shell clam was not as important on Cape Cod as it was to the north due to the presence of quahogs here (Speck 1948:260). He does note that they were used in much the same way as the quahog except that the belly was the only part eaten. They were also used for bait (Speck 1948:260).

The Eastern Oyster (*Crassostrea virginica*) is a species with fairly demanding requirements for growth and reproduction. Oysters need a salinity of at least 5 parts per thousand and as a result are found at estuary mouths and even several miles up rivers where there is considerable mixing with seawater (Cake 1983:37). Along with their salinity requirement, oysters are one of only two bivalves from the site that require firm substrate, preferably one with a minimum of 50 percent clutch to anchor onto. The clutch can be in the form of rocks, shells, gravel, shell hash, or old oyster beds (Chesepeake 1988:86). They can grow up to eight inches long, or longer if you believe the seventeenth century reports, and occur in water intertidally to 40 feet deep (Amos 1986 406). Oysters are preyed upon by oyster drills and whelks (Chesepeake 1988: 86).

Oysters were one of the mains shellfish consumed by the English in England and they appear to have been carefully watching for them when they came to New England. As early as 1605 explorers were noting the presence of oysters on Cape Cod (Weymouth 1605:149). Edward Winslow reports dining on oysters with some Natives on Cape Cod in 1621 and bemoans the fact that there are no oysters around Plymouth, although he does say that they buy them from the Natives when possible (Winslow 1621: 208, 233). John Pory gave a detailed account of the oysters of New England when he visited in 1622. He stated that "Oysters, there are none, but at Massachusetts, some 20 miles to the north of this place, there are such huge ones, by savages report, as I am loth to report. For ordinary ones, of which there may be many, they make to as broad as a bushel, but one among the rest they compared to the great cabin of the Discovery, and being sober and well-advised persons, grew very angry when they were laughed at or not believed! I would have had Captain Jones to have tried out the truth of this report. And what was the reason? If, said I, the oysters be so great and have any pearls in them, then must the pearls be answerable in greatness to the oysters, and proving round and orient also, would far exceed all other jewels in the world!" (Pory 1622:06).

William Wood stated that he had seen oysters up to one foot long (Wood 1643:56). John Josselyn, in the late seventeenth century, supported Wood's estimation by stating that he had "…found some 9" from joint to toe, containing an oyster that had to be cut in 3 pieces to fit in the mouth, sweet and fat." (Josselyn 1674:79). While Thomas Morton stated that there were great stores of them at the entrance to every river and that he had seen an oyster bank 1 mile long (Morton 1637:90). Josselyn also stated that the Natives would dry the oysters as they did lobsters and lampreys (Josselyn 1674:79).

The Native name for the oyster was "apwonnah" which comes from the root "apwonat" which means to roast, so oysters are the shellfish that were roasted (Trumbull 1903:14). Speck merely noted that the Natives favored the oysters in his study area (Speck 1948:258).

The Bay Scallop (*Argopectans irradians*) is usually found in bays that are protected from high winds, storms and tides, especially in estuarine environments (Fay 1983:17). The bays must have eelgrass, as this provides a base on which the young anchor themselves until old enough to swim (Abbott 1986:210). The adults live in water from .3 to 10 meters deep and usually remain within a fairly confined area during the 20-26 months of their lives (Fay 1983:17). By the time they are 26 months old, they have achieved a length of 55 to 90 millimeters, growing at a rate of approximately 3.8 to 4.5 millimeters per month (Fay 1983:17). Unfortunately, the rate of growth varies by the time of year, with the maximum period of growth occurring in the middle of summer, so it can not be used to seasonally age the scallops at the site (Fay 1983:17). Scallops are preyed upon by blue and green crabs and the oyster drill (Fay 1983:17). Speck noted that scallops were favorites among the Natives he spoke with (Speck 1948:258).

One species of mussel was recovered from the excavations. The Atlantic Ribbed Mussel (*Geukensia demissa*) commonly makes it home embedded in muddy sand flats at the low water mark in salt marshes and bays (Abbott 1986:198). It prefers brackish water and can attain a length of 5 inches (Amos 1986:408). The only fragment of ribbed mussel recovered from the site was in the form of a piece of clutch attached to one of the oysters. There are no definite seventeenth century references to the ribbed mussel, although a number of references state that mussels were seen or were eaten. Unfortunately they do not specify which species of mussel and they likely relate to the edible blue mussel (*Mytilus edulis*) and not the ribbed mussel. Speck stated that the Wampanoag obtained these shellfish by digging them out at low tide (Speck 1948:260).

The final bivalve species present at the site is the jingle shell (*Anomia simplex*). This species attaches itself to rocks, shells and logs from the low tide water line to a depth of 30 feet (Amos 1986: 405). They can grow up to 2 ¼ inches long and are comonly found attached to oyster or whelk shells. Speck states that they were not eaten but did figure into the Wampanoag oral history. He stated that the jingle shells were called "Granny Squanit's toenails" in reference to the wife of the giant Moshop who lived on Martha's Vinyard before the coming of the Europeans (Speck 1948: 260).

Collection areas/ Substrate Analysis

Looking at the different types of habitats that are favored by each species, it can be seen that there is a great deal of similarity between the substrates and locations of occurrence between the various species (Table 1). As can be seen, all of these species

Table 1. Habitat data for shellfish species recovered

Species	**Substrate**	**Location**
Whelk species	Sand/ Mud	Shallow Bays
Moon Snail	Sand/ Mud	Estuaries/ Clam flats
Slipper Shells	N/A	Shallow waters
Mud Whelk	Mud Flats	Bays/ Estuaries
Oyster Drill	N/A	Estuaries
Quahog	Firm Sandy	Bays and Estuaries
Soft-shell Clam	Sandy Mud	Shallow Estuaries
Oyster	Firm/ Rocky	Estuaries
Bay Scallop	Sand/ Mud	Bays/ Estuaries
Ribbed Mussel	Mud/ Sand	Salt Marshes/ Bays/ Estuaries
Jingle Shell	N/A	Shallow Water

prefer the shallow water of bays and estuaries. None of the species present are found in open or deep water. The ideal location from which the species present at the site could have been harvested from is the cove and bay immediately to the east of the site. Feature 29 in fact lies but a few feet away from the cove itself. The bay has a fresh water stream to its south which provided the lowered salinity that species such as the bay scallop and oysters thrive in. There are salt marshes on the western shore of the cove immediately adjacent to the site and it can be assumed that there is a sandy mud substrate adjacent to those to their east. This would have provided a substrate for the ribbed mussels and the oysters. Species such as the soft-shell clams, the moon snail, and the mud whelk would dwell here. Perhaps in the same area or even slightly to the north towards the mouth of the cove, quahogs, and whelks could be found.

Within any of these area the jingle shell and the slipper shells could have been found clinging to live shellfish or dead shells. Several oyster shells from the site showed boreholes from oyster drills but, while the oyster drill likely would have been found among the oysters, but it could have also preyed upon many of the other species as well.

The soft-shell clam and oyster remains can be used to ascertain the substrate present with even more confidence. By looking at the thickness, the amount of surface deformation and the length to width ratios for the clams, the substrate in which they grew could be determined. It was initially hoped that all three of these techniques could be used on the assemblages. Unfortunately, there were no whole clamshells that could be reliably measured to look at the length to width ratios. All had suffered various degrees of taphonomic damage. The other two techniques were relied upon.. The study of the oyster remains from the site relied on the degree of various species of sponge damage to the exterior of the shell and the length-width ratios. These data, combined with the substrate preferences noted when the various species were discussed allowed a better understanding of the areas within the cove which were being exploited.

Soft-shell Clams

Barber noted that soft-shell clams "…produce differently shaped shells when grown in different habitats." (Barber 1983:113). He cited D.R. Belding 1916 report on clam fisheries. In this study, Belding noted that three things happened in different clam substrates. As the substrate changes from sand to sandy mud to gravely mud the clamshells become thicker, their surfaces become rougher and they become rounder (Belding 1916:150). Characteristically sand clams have a shell so thin that it has been called a "paper shell". The shell thickness and degree of texture to the shell for a sandy mud clam can vary little from a purely sand clam whereas the mud clam has the heavier shell and greater width. This is due to the fact that they have grown at a slower rate than the other types. The gravel clam is the most textured and thickest of the four varieties. It typically has a rough and heavy shell with marked deformities. By measuring the thickness of the shell at the posterior abductor scar, as Barber did, an average thickness for the clamshells can be determined. Using Barber's data on the Merrimack River sites that he looked at, the following table was generated for comparison with the Sandy's Point data (Table 2).

Table 2. Soft shell clam substrate analysis

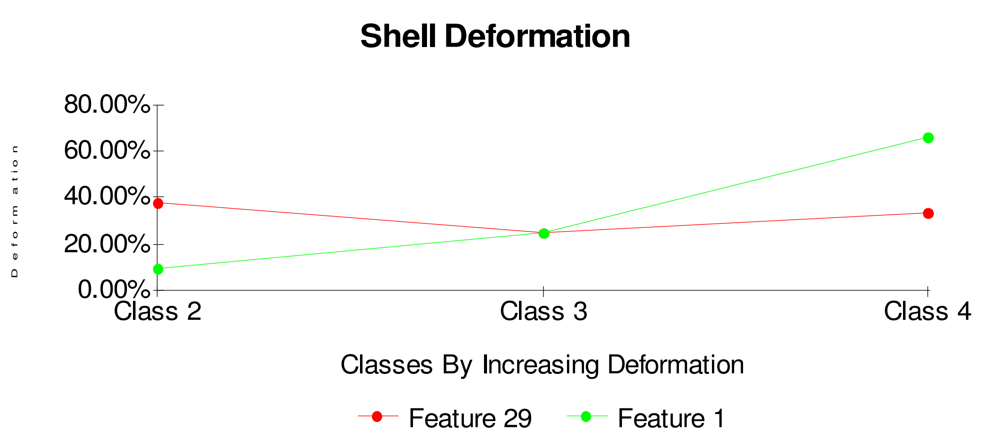
Site	Shell Thickness	Shell Texture/ % Deformed	Projected Substrate
Wheeler's	1.3mm	Smooth/ 9%	Sand to Sandy mud
Morrill Point	2.1mm	Rough/ 3%	Muddy
Rosebush	2.4mm	Rough/ 23%	Mud/ Gravely Mud
Three Snakes	1.7mm	Rough/ 17%	Mud/ Gravely Mud

The degree of shell texture was determined by visual observation as to the degree of "rippling and relief sculpturing" (Barber 1983:113). Most of the soft-shell clams from the site are in fragments so it was somewhat difficult to quantify the degree of rippling observed. The following procedure was used. Shell fragments that represented at least half of a complete shell were selected. These shells were ranked as to their degree of surface deformity present. The degrees were 1) smooth shell with no surface deformation; 2) mostly smooth with a moderate amount of surface deformation; 3) rough surface shell without marked deformations; 4) rough surface with evidence of deformation. The shells exhibiting the various degrees of deformation were counted and the counts for the entire feature converted to percentages of occurrence.

Belding's description of the surface deformation exhibited on clamshells was followed during this procedure. Belding stated that "…shell is rough and heavy and often shows marked deformities, possibly due to irritating nature of the environment." (Belding 1916:150). Deformities are also due to the fact that "every time a clam is disturbed in its burrow there occurs a more or less pronounced growth line which is due to a slight check in its shell formation." (Belding 1916:199). Finally, deformation can occur when there is any injury to the shell such as its growth against stones or gravel or if they are growing in very thick beds where there is not a great deal of room for them to spread. As a result, the tight packing of the growing shells against gravel or other shells causes them to exhibit a high degree of deformation. Barber observed this at the Wheeler's Site (Barber 1982).

Figure 1 illustrates a graph of the two assemblages by the different classes of surface roughness and shell deformation outlined above. These results were compared with Barber's findings, and a gravely mud substrate is postulated as having been that which the clams were harvested from. This identification is supported by Belding's studies on existing 1915 clam beds on Cape Cod. He found that clam areas on the south shore of Cape Cod were restricted to narrow strips due to certain geologic features which created the circumstance that there are not many real flats, but merely beaches (Belding 1916:173). The clams in Buzzards Bay for example were found wherever they could grow. This usually meant gravely stretches, among rocks on the shores of coves and in small areas of mud and rocky beaches all along the coast (Belding 1916:178).

Figure 1. Shell deformation



The thickness of the shells can also be used to determine the substrate. The shells from feature 29 averaged 1.8 millimeters thick on the posterior abductor scar, while those in feature 1 averaged at 1.9 millimeters thick. The fact that these two thickness averages are 95% the same indicates that the same beds, or at least beds which were very similar, were exploited by people living at the site 600 years apart. The degree of deformation also supports this (figure 1). Although the numbers from feature 29 are slightly different, this may have more to do with the density of the shell bed and the small sample size available (N=21) for study. Feature 1 had a far greater number available (N=194) and as will be shown, it is believed that the bed was more productive during its exploitation circa 360 AD.

Comparing the degree of deformation and the shell thickness to the sites Barber sampled from Morrill Point (table 3) it appears that the identification of the substrate as a gravely mud is supported due to the thickness of the shell, 1.8 and 1.9mm, and the degree of extreme deformation to both assemblages, 33.3% and 66%. These percentages

Table 3. Comparison of soft shell clam substrate analysis

Site	Shell Thickness	ShellTexture/ % Deformed	Projected Substrate
Wheeler's	1.3mm	Smooth/ 9%	Sand to Sandy mud
Morrill Point	2.1mm	Rough/ 3%	Muddy
Three Snakes	1.7mm	Rough/ 17%	Mud/ Gravely Mud
Rosebush	2.4mm	Rough/ 23%	Mud/ Gravely Mud
SP Feature 29	1.8mm	Rough/ 33%	Gravely Mud
SP Feature 1	1.9mm	Rough/ 66%	Gravely Mud

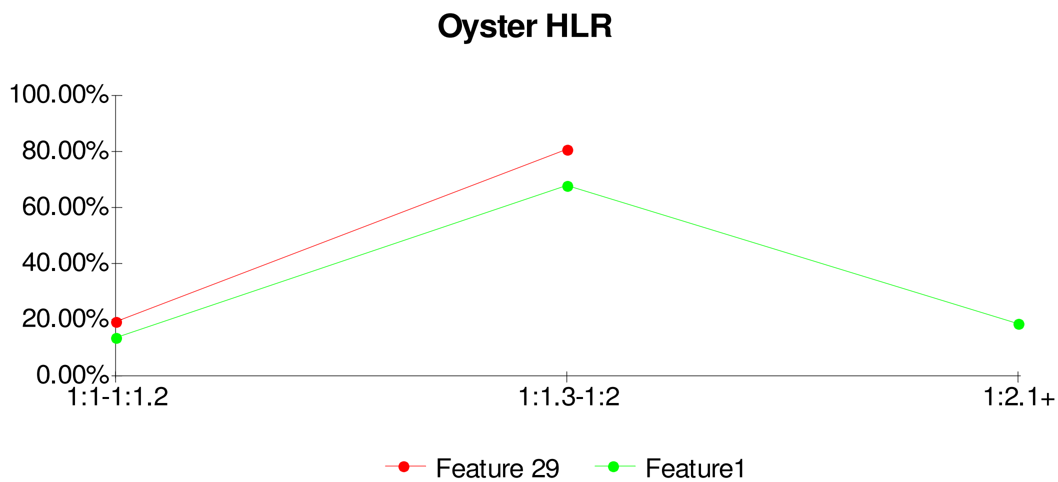
compare favorably with the assemblages from the Three Snakes and Rosebush site, which were identified as a mud or gravely mud.

Oysters

In order to determine what information the oysters could provide regarding the substrate, from which they were collected, two forms analysis needed to be done. The first was the determination and comparison of the height to length ratios. This was done to determine what types of oysters were present, whether they were sand, bed, channel or reef oysters. The height was measured from the chondrophore to the edge of the lip of the left or right valve (Appendix 1). This is typically the longest dimension of the oyster. The length is the width of the left or right valve at its widest point (Appendix 1). The height-length ratio (HLR) is calculated by dividing the height by the length and expressing this as a ration, e.g. 1:2. This procedure follows that outlined by Kent (1992:25). Kent states that "The HLR can vary from less than 1.0 to greater than 4.0 and is strongly affected by the environment in which the oyster grew." (Kent 1992:25). Sand oysters generally have HLRs that are less than 1.3 and come from beaches with a firm sand substrate. These are intertidal or in very shallow water (Kent 1992:25). Bed oysters have an HLR between 1.3 and 2.0 and occur in mixed muddy sand, often times alone or in small clusters. Channel oysters are large and elongated with an HLR greater than 2 and occur in the soft mud in deep channels (Kent 1992:25). Finally, reef oysters are small and elongated with an HLR greater than 2.0 and come from densely packed intertidal oyster beds (Kent 1992:25). There is overlap between the various types of oysters but HLR allows a researcher to gain a better understanding of the substrate in which the oysters grew.

The oyster HLR that was calculated for the two features indicated that even though there was a significant difference in the amount of oysters harvested in each of the periods, 20.6% of the totals as opposed to 9.7%, the types of oysters remained remarkably the same. Most of the oysters yielded ratios between 1:1.3 and 1:2.0 (feature 29 N=42; Feature 1 N=25) with only a few falling below this in both features (Feature 29 N=9; Feature 1 N=5). In feature 1, a few fell above this (N= 7) and these were only greater than 2.0 by .1 to .3, not a significant difference (figure 2).

Figure 2. Oyster height to length ratios



This indicates that the oysters probably were bed oysters occurring in mixed muddy sand. None of the oysters apparently were attached to others, as one will often find in bed oysters, they all appear to have existed singly. There were notable ridges on the lower and some of the upper shells as well as purple coloration on the upper valves. This indicates that, like the reef and sand oysters, they were intertidal and being exposed to the air and sun each day. This fact, coupled with the attachment of at least one of the oysters to a ribbed mussel, indicates that the oyster bed that these were harvested from was probably on the salt marshes encircling the cove.

Shellfish from the features

The excavation of feature 1 and feature 29 yielded thirteen species of shellfish, seven gastropod species and six bivalves (Table 4).

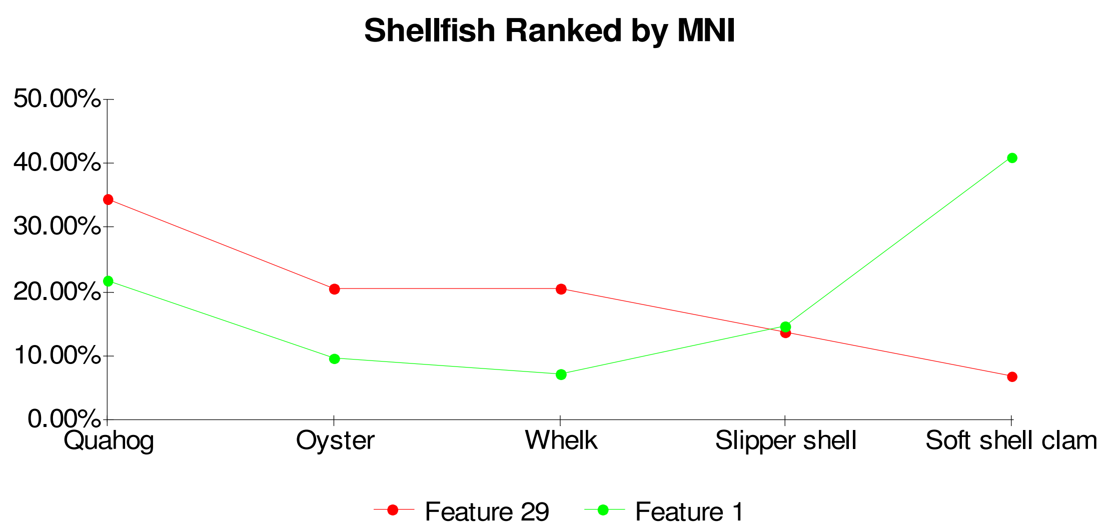
Table 4. Shellfish remains recovered from feature ontexts

Species	Feature 29	Feature 1

Knobbed Whelk	71/ 9.6%	19/ 3.1%
Channeled Whelk	26/ 3.5%	13/ 2.1%
Whelk sp.	55/ 7.5%	11/ 1.8%
Moon Snail		1/ .2%
Crepidula fornicata	101/ 13.7%	91/ 14.7%
Crepidula plana		1/ .2%
Mud Whelk	23/ 3.1%	
Oyster Drill	1/ .1%	
Quahog	254/ 34.5%	135/ 21.8%
Soft-shell Clam	51/ 6.9%	254/ 41%
Oyster	152/ 20.6%	60/ 9.7%
Bay Scallop	1/ .1%	32/ 5.2%
Ribbed Mussel	1/ .1%	
Jingle Shell	1/ .1%	2/ .3%
Totals	736/100%	619/ 100%

From this quantification, which is based on the minimum number of individuals, it appears that in feature 29, the older feature, the ranking of the contribution to the total diet by shellfish species should be quahog, oyster, whelk, slipper shell and soft-shell clam. Whereas from feature 1 the ranking should be soft-shell clam, quahog, slipper shell, oyster, whelk and scallop (Figure 3). Both of these ranking are based merely on the

Figure 3. Shellfish ranked by Minimum Number of Individuals (MNI)



number of individuals whose shells were found at the site. As will be seen when the meat weights are discussed, to do this would be a mistake. Minimum numbers of individuals can provide a gross comparison of abundance of various species in an assemblage, but it will not provide a true accounting of the contribution of the species to the diets. This can only be done using the meat weights of the various species.

Contribution of the Species to the Diet: Meat Weights

All shellfish are not equal and should not be ranked using the MNI technique. A better, more objective ranking system was used with the assemblages from this site to understand more completely the extent to which the various species were utilized. This technique is known as meat weight ranking.

This section shows the practical application of the meat weight calculations to the assemblages from the two features in question. This technique provided a more balanced presentation of the relative contributions that each species made to the diet of the creators of the features. Species such as the oyster drill, white slipper shell, jingle shell and ribbed mussel were not included in the calculation of the meat weights. It is this author's opinion that they are most likely accidental inclusions to the assemblage and function only as habitat indicators and not food items. The inclusion of the common slipper shell (*Crepidula fornicata*) in the meat weight calculations was based on the large number of larger, over 2 centimeter, examples in the assemblage. Smaller specimens would not have produced any appreciable amount of meat. These specimens over 2 centimeters were the ones included in the meat weight calculation. The inclusion of the mud whelk (*Ilyanassa obsoleta*) was based on the presence of an appreciable number of this species. Because this species does not attach itself to shellfish, it could not have been brought to the site accidentally upon the shell of another species. This species is free roaming and would have had to have been purposefully collected on the mud flats at low tide. The possibility is raised that these too were considered "sweetmeats" and collected as a treat or that children in imitation of the adult women's collecting activity collected them. Bullen noted a concentration of approximately 25 of these found in one square of the Clark Pond shellheap in Ipswich, Massachusetts which he interpreted as "…a meal of mud flat snails." (Bullen 1949:131).

The meat weights for the quahog and soft-shell clam species were calculated using the allometric regression formula found in David Bernstein's work *Prehistoric Subsistence on the Southern New England Coast* (1992). Measurements were taken of the hinge beak heights of the quahog shells (see appendix 2) and these were used in the allometric equation Y=83.7426X{\up(2)2} – 78.4984 + 34.5839. In this equation X is the hinge beak height in millimeters and Y is the quahog meat weight for a shellfish with that size hinge beak. The gross numbers for all quahog hinge beak heights used in this calculation and their resulting meat weights are given in Appendix 2. The total of all of the hinge beaks heights was divided by the total number of hinge beaks used. This gave an average of 46.9g of meat per quahog for the feature 29 quahogs and 55.4g of meat for the feature 1 quahogs. These averages were then multiplied by the MNI calculated for the quahog calculated for each feature. This gave a total of 11912.6g from feature 29 and 7473.6g for feature 1. Feature 29 was excavated in its entirety and 86.8% of feature 1 was excavated. The meat weights given below are adjusted to overcome this sampling difference. The numbers have not been changed for feature 29, but for feature 1 all meat weights have been divided by .868 to yield a truer meat yield. This gave a total of 11912.6g for feature 29 and 8610.1g for feature 1.

An allometric equation similar to that used for the quahogs was used for the soft-shell clams. This was also taken from Bernstein's work. The equation was Y=13.6824xsquared – 4.6912x + .5686 where x is the chondrophore length and Y is the total meat yield for a clam with that length chondrophore. Values were calculated for all the various chondrophore lengths (Appendix 3). These were then added together and divided by the total number of measurable chondrophores for each feature. This resulted in an average meat weight of 12.6g for feature 29 and 10.9 grams for feature 1. The averages were then multiplied by the MNI for each feature yielding 642.6 grams for feature 29 and 2768.6 grams for feature 1. The meat weight from feature 1 was then divided by .868 to yield 3189.6 grams adjusted.

The meat weights for the other species were averages that were multiplied by the MNI for each species. All averages came from Bernstein's work. Oysters were averaged at 16.536 grams, whelks at 50.5 grams, slipper shells at 3.5 grams, moon snail at 40g, mud whelk at 1 gram, and 7 grams for the bay scallop. The computed meat weights are given in table 5

Table 5. Shellfish Meat Weights

Species	**Feature 29**	**Feature 1**	**Feature 29**	**Feature 1**
Quahog	11912.6g	8610.1g	51.9%	54.2%
Clam	642.6g	3189.6g	2.8%	20.1%
Whelk	7676g	2501.7g	33.4%	15.8%
Oyster	2513.5g	1143.1g	11.0%	7.2%
Boat Shells	178.5g	125g	.8%	.8%
Bay Scallops	7g	258.1g	.03%	1.6%
Moon Snail		46.1g		.3%
Mud Whelks	23g		.1%	
Totals	22953.2g	15873.7g	100%	100%

The only species that contribute an appreciable amount of meat to the diet are the quahog, soft-shell clam, whelk and oyster. The other four species contributed less than 1% to the total in feature 29 and 2.7% to the total in feature 1. These four species may have all been considered "sweetmeats" and were not a regular part of the diet but were only collected when something extra was wanted.

The main meat yielding species are summarized in Table 6 and the percentage to which the contributed to the total meat weights of just these four species is given.

Table 6. Meat Weights for largest meat bearing species

Species	Feature 29	Feature 1	Feature 29	Feature 1
Quahog	11912.6g	8610.1g	52.4%	55.8%
Clam	642.6g	3189.6g	2.8%	20.7%
Whelk	7676g	2501.7g	33.7%	16.2%
Oyster	2513.5g	1143.1g	11.1%	7.4%
Totals	22744.7g	15444.5g	100%	100%

Quahogs yielded the largest amount of meat in both of the features with percentages that were quite comparable. It can be safely assumed that these were the main shellfish harvested by the inhabitants during both periods. The presence of large and dense quahog beds in the immediate vicinity of the site is attested to by the very large number of whelks recovered from the site. Because the whelks prey upon the quahogs, their presence indicates one of two things. Either there were beds which were large enough that they were not taxed by the harvesting by people and predation by the whelks, or that the Natives were actively searching out the whelks and eating them as a way of protecting the beds. This is a common practice today among quahogers and the concept of eliminating a competing species was not unknown to the Natives. Roger Williams stated that when he observed the natives setting up snares to catch deer, they would sometimes catch the wolf in the act of eating the deer and kill him (Williams 1643:225).

Oysters, Clams, and Scallops

One of the most interesting differences between the two features was found to be the differences in the occurrence of oysters, clams and scallops. The percentage of oysters to clams in the feature 29 as compared to feature 1 exhibits a pattern that is fairly common in the north east. In feature 29, the older of the two, oysters make up a greater percentage of the total shellfish present than in feature 1. The reverse is true for the soft-shell clams. The different percentages of clams to oysters in older versus younger features has been observed at a number of sites in the northeast but this shift generally occurs much earlier on other sites than it does here. Bernstein found the shift in his work at the Greenwich Cove site (Bernstein 1992). Here the percentage of oysters as compared to soft-shell clams dropped dramatically following the Terminal Archaic into the Early Woodland, approximately 2500 years ago (Bernstein 1992:71). Various researchers have attempted to explain this shift and their explanations take the form of either cultural or environmental.

Culturally, the oyster harvest could have declined over the years due to the intensity of the harvesting. It is generally held that when a resource is harvested, the collectors will pick the largest of the species to provide the largest return for the least amount of work. It takes the same amount of time to harvest an oyster 15 centimeters long as it does to harvest one six centimeters long, then the larger one will be harvested first. Over time, the largest ones will cease to be present at a site and the collectors will shift to the next largest ones and so on until there are none left. This would be visible in the archaeological record as a clear shift in the size of the oyster shells represented in deposits over time. Larger shells would be in the older features and smaller ones in the more recent features if exploitation of the resource was an ongoing process. When the length of the oyster shells were compared between the two features and the sizes graphed, it was found that this was not the case.

The plot of the two features shows that in fact the two features were fairly evenly distributed in the oyster sizes present with some points matching up almost exactly. In fact, the largest oysters harvested actually came from the more recent feature 1 (360+/-60 BP). The oysters just did not appear in feature 1 in the same abundance. Clearly as was stated previously, there were oysters in New England in the Late Woodland/ Contact Period. Explorers and colonists noted the large size and abundance of both the oyster beds and the oysters themselves. Overexploitation of the resource does not seem to account for lower percentage of oyster shells in feature 1.

Other researchers such as Dean R. Snow (1972) have cited technological change as having caused the shift. This theory proposes that the exploitation of soft-shell clams requires special technology to be developed and used before a culture will begin to harvest them. This is due to the fact that they have to be dug out of the mud. It assumes that the people had no knowledge of the act of digging before the Early Woodland. As there are numerous roots and tubers that the Natives had used probably before this time, it does not seem feasible that they would need to suddenly learn how to dig before they could exploit them. This still leaves the question unanswered as to why they ceased to use the oysters to the extent they formerly had.

The most popular explanation which has been put forward has to do with a change in the environment during the Terminal Archaic to Early Woodland. David Braun (1974) relying on studies conducted by Andrews, put forward the idea that the lowering of the seawater temperature around 2500 B.P. was "..responsible for reducing the availability of such 'warm water' species as oysters and quahogs" (Bernstein 1992:74). This cooling of the waters eliminated the oysters and quahogs as species that were readily available to Native collectors while it caused an increased awareness of soft-shell clams. Bernstein points out though, that this probably only affected species to the north of Boston where the effect would be more dramatic (Bernstein 1992:74).

Bernstein sees a more localized reason for the shift from oyster to soft-shell clams in the Greenwich Cove assemblages. He felt that local environmental conditions changed. Silting up of bays and estuaries would have caused an unsuitable habitat for the oyster sprat to live. Oysters need a firm substrate and he feels that even a few millimeters of mud would have been enough to disturb them (Bernstein 1992:75). He stated that today's Greenwich Cove substrate is a silty mud which is unsuitable for oysters. This silting created an environment favorable for clams.

A factor related to Bernstein's work at Greenwich Cove that was considered as and explanation for the Sandy's Point differences, was a change in the substrate and salinity of the cove. Sandy's Point is part of the island in Yarmouth, and as a result, the cove located there may have been silted up and the salinity may have changed due to storms or a change in the run off pattern of the streams feeding it. This should be reflected by a change in the height to length ratios (HLR) for the oysters and a change in the epibiont species present on the their shells. This is in fact what was seen.

This fact, along with a number of other observances concerning the differences in the shellfish species between the two features indicates that the salinity within the cove did change. It was also noted that the cove probably began to silt up between 900 AD and 360 AD. Coupled with the change in salinity, this would have led to a gradual decline in the oyster population. Unfortunately, it is not known what the salinity, the substrate or the species of shellfish present within the cove are today.

The examination of the oyster height to length ratios indicate that the inhabitants who created feature 29 and those who created feature 1 harvested oysters from the same location, which probably was the salt marshes bordering the cove. During the time when feature 29 was created, it appears that the cove was an hospitable place for the growth of oysters. Oysters need "tolerable temperature, adequate food and water currents strong enough to retard silting." (Kent 1992:11). They thrive in brackish water with a salinity between 5 and 40ppt with an optimum of 10-20ppt (Cake 1983:37). The salinity in the cove at the time was probably below 15 ppt for most of the year and above 20 ppt for one quarter to half of the year. This was determined by looking at the epibiots present on the exterior surface of the oysters.

The use of epibiont analysis as presented by Kent allows the salinity of the cove to estimated for the two periods (1992:29). Epibionts are organisms that attach themselves to shellfish such as horseshoe crabs and oysters and slowly destroy their shells. They are useful in the study of oysters because they are fairly salinity specific and can help to determine the salinity range which the oysters inhabited (Kent 1992:31). Two species of sponges that were used for this analysis were *Cliona trutti* and *Cliona celata*. Both species leave boreholes in the shells of the oysters they live on. *C. Trutti* leaves small bore holes while *C. celata* leaves large ones. Kent states the salinity regimes indicated by the combination of small and large boreholes as follows: No boreholes indicates a salinity below 10ppt for about half the year and rarely above 20ppt; Valves with small boreholes but no large indicates a salinity below 10 ppt for about one quarter of the year below 15 ppt for one half the year and rarely above 20 ppt; Valves with small boreholes more common than valves with large boreholes indicates a salinity occasionally below 15 ppt and above 20 ppt for one quarter to half of the year; Valves with large boreholes as common or more common than valves with small boreholes indicates a salinity rarely below 15 ppt and above 20 ppt for most of the year (Kent 1992:30).

The presence of epibionts was quantified by taking all the upper and lower valves as the sample and counting the presence of *C. trutti* and *C. celata* on them. The upper shells were found to be similar in both features regarding the presence of both species, with an increase from 1.2% to 2.9% for the presence of *C. celata* and a decrease from 55.7% to 46.1% for the presence of *C. trutti* . This suggests that over the course of the centuries, a change had occurred within the cove that increased the salinity of the water and made it more favorable for the sponge species. The lower shells exhibit the same changes as the upper but more dramatically. It can be seen that the presence of *C. celata* increased from 2% to 13.7% over the course of 600 years. The reason that the increase in salinity is more apparent on the lower shells than the upper probably has to do with the fact that the upper shells are continually exposed to the sun during their intertidal periods. This may have inhibited the growth of the sponges, whereas the lower valve was more protected and the sponges were able to spread on the bed easier. Some small clam beds would have occurred as Belding found in 1915 among rocks and gravely beaches, but no extensive beds that could have been harvested. A gravely mud is also not conducive to the establishment of eelgrass communities.

By the time of the creation of feature 1, the environment within the cove had changed. The presence of a greater number of *C. celata* sponge holes on the oysters indicates that the salinity had changed. It now was probably rarely below 15 ppt and above 20 ppt for most of the year. This would have created conditions more favorable for these sponges to reproduce. This change in salinity may have been due to a change in the current flow within the cove. A stronger current would have brought more saline water from the ocean into the cove.

If the currents had changed within the cove and a larger, more saline volume of water entered the cove then this would have created a situation in which the clams would have fared better. Belding found that clam growth was faster on the north shore near Boston due to the higher tide flow over the flats. He found that "Current is the main essential for rapid clam growth as it transports food." (Belding 1916:173). The colder water and tides which could be as much as six times that on the south shore of Cape Cod creates larger flats to the north of it (Belding 1916:173). Sandy's Point is part of the island and on the southeastern edge of the cove there is a natural valley which leads to Nantucket Sound. It appears to be the type of spot that would periodically wash out and make Sandy's Point an island itself. If this had occurred between the creation of the two features this would have changed the current flow and salinity within the cove. Perhaps even a slight change that resulted from it washing out and the filling in again soon after would have changed the currents, even if it was just with their circulation within the cove. The presence of the scallop remains supports a change in the nature of the cove.
Feature 29 contained only one individual bay scallop whereas feature 1 contained at least 32 individual scallops. Scallops require a salinity of at least 10ppt but the minimum for eggs to develop is 22.5ppt. The increased harvesting of scallops by the inhabitants of feature 1 may have to do with the increasing salinity within the cove as indicated by the

epibiont analysis. Scallops also need eelgrass for their young to attach to. According to the study of the clam remains from the site, the substrate consisted of a gravely mud. This is not the best substrate for clam development and this may account for the low percentage of soft-shell clam remains in older feature. If the substrate was too gravely and not muddy enough then they would not have been able to develop as extensive beds as they could under more favorable conditions.

The paucity of eelgrass within the cove during the formation of feature 29 is supported by the lack of scallop remains in the feature. If the clam beds that were present at the site during the creation of feature 29 continued to grow over the next 600 years, it may have been due to the presence of eelgrass within the cove. Belding stated that there were two types of unproductive flats, permanent and temporary. It is suggested that the flats in the cove, limited as they probably were, were temporarily unproductive before the changes that occurred between the creation of the two features. Temporary flats are those on which clams have never set, but will, owing to the natural changing character of the sea. (Belding 1916:211). This type of flat can become productive although they may become unproductive again if the old conditions return. Two biological factors have the ability to change the character of an unproductive flat, the presence of mussels and the increase in eelgrass (Belding 1916:210).

While there is no evidence of significant mussel beds, aside from the one mussel fragment attached to the oyster shell, the presence of eelgrass is assumed due to the presence of the bay scallops. If we assume that the bay scallops were harvested purposefully or accidentally through the use of fishing nets, within this cove, then the presence of eelgrass within the cove can be assumed. Eelgrass can help an unproductive flat become productive through its tendency to become a lodging place for silty materials and when it decays, it forms a layer of mud upon a previously hard flat (Belding 1916:209). As mud flats are more productive than sand flats, the presence of eelgrass can make a less productive flat more productive. The presence of the eelgrass is brought upon by natural changes in tides and currents (Belding 1916:211). These changes are indicated by the changing oyster HLR between the two features and the increased *C. celata* presence on the oysters. Too much eelgrass can cause heavy deposits of soft mud which raises the surface above its natural level and can leave productive flat barren, but some eelgrass is beneficial as it prevents erosion and makes some flats inhabitable (Belding 1916:212).

Speck noted the disappearance of the eelgrass from Menemsha Pond on Martha's Vinyard and noted that such declines, which he felt were probably periodic, could have affected the molluscan species collected in the past (Speck 1948:260). He stated that "Such drastic changes in the natural resources and the consequences of an upset ecological balance are bound to be reflected in the economy of a people who depend wholly or largely on local resources such as the Wampanoag did at one time." (Speck 1948:260). This is exactly what is represented between feature 29 and feature 1. The harvesting of the quahogs and their predatory companions the whelks remained fairly constant between the two features but the occurrence of the scallops, clams and oysters varied.

Size Differences

While this theory explains the occurrence of a greater number of oysters to clams in the older deposit as well as the greater percentage of scallops in the more recent deposit, it does not help to explain the size differences seen in the quahogs, clams and oysters, between the two features.

All three species exhibit a pattern that showed that the inhabitants at the time of the creation of feature 1 were harvesting a wider variety in terms of size of individuals from the different species. This can be explained in one of two ways. First, if it is assumed that there has been continual seasonal occupation at the site from circa 1100 AD to circa 1640 AD, then the inhabitants could not have been making use of the same beds for that entire time. If they were then a marked decrease in the size of the shells present at the site between these two occupations should be observed. The shells harvested should be largest in the older feature, which represented the earlier exploitation of the beds. The shellfish harvested should have become increasingly smaller if the same beds were harvested year after year. Since this is not in evidence at the site, it must be concluded that one of the other explanations must be true.

If the people who created feature 29 had been using an old bed and the people who created feature 1 had been harvesting from a newer, different bed, then the size increase could be explained. The people who created feature 1 were the initial exploiters of a new shell bed and as a result were able to harvest a number of larger specimens from each species. This does not seem to be the case for a number of reasons. The analysis of the HLR for the oysters indicated that the two assemblages originated from the same type of bed oysters occurring in mixed muddy sand or more likely on the salt marshes where they were exposed intertidally. The HLR averages are fairly comparable at 1:1.4 for feature 29 and 1:1.7 for feature 1. Both indicate the same type of substrate.

The same can be said for the soft-shell clams. Both assemblages indicate that the substrate was a gravely mud with the only real difference being the degree of deformation. This can be explained as having resulted from crowded growing conditions among the clams in the more recent feature except for the fact that the average size for the clams found is 5.6cm. Clams can attain a size of 15cm and the clams from the site have a range of 3.6-9.7cm. Barber feels that clam beds yielding clams this size would not be "…massive enough in sub-optimal beds to create regular deformation from crowding by shells." (Barber 1983:121). This size difference may be accounted for by the fact they were in sub-optimal beds and as a result they did not attain the maximum size they could. Unless the occupants of the site found a collection site (or sites) nearby which had virtually the same substrates, this explanation does not adequately explain the occurrence of the larger specimens in the more recent feature. The next hypothesis seems to do so more consistently.

Second, the site was abandoned or at least not as intensively harvested between the use of these two features. If the site had been abandoned for some amount of time, not necessarily 600 years, but for an amount of time as little as a generation or two, then the beds would have had a change to mature to the state that the harvest profiles show. Feature 29 may indicate that around 1100 AD, the site had been used consistently as a place to spend the summer and early fall to make use of the shellfish and fish in the area. This would account for the size of the shellfish remains found, those leaning towards the smaller end of the scale. At sometime after this and for a significant time before the creation of feature 1 the site had virtually "laid fallow" and the beds were allowed to grow and change as the naturally do. By circa 1640 AD, a date supported by the contact period European artifactual remains, the site was either re-inhabited as a planting site or merely as a fall shellfish gathering site. The new inhabitants were able to take advantage of beds that had not been intensively harvested for a number of years. A site which, through its own natural course, had seen an increased salinity in the cove and a resulting lower oyster population, but one which still yielded large oysters. Unlike those who created feature 29, the inhabitants selected larger quahogs and oysters but selected a wider range of clam sizes possibly due to the fact that the clam bed, although more productive during the creation of feature 1, was still a fairly unproductive bed due to the gravely mud present. This may have been why quahogs appear to have been the favored shellfish at the site.

One thing that did not seem to change a great deal between the two features was either that the inhabitants had a size preference for certain size specimens of each shellfish type, or that the particular sizes were the most abundant. Quahogs with a hinge beak width of 1.1-1.3cm (total shell length of approximately 7.1-8.3cm), clams with a chondrophore width of .9-1.1cm (total shell length of approximately 4-4.9cm) and oysters between 7.1 - 8cm in height were most heavily harvested.

Processing

After the harvested shellfish were returned to the site, they were processed either for immediate consumption or for winter storage. A little more is known concerning the way in which species were processed than is known about shellfishing itself. It was stated that "…this fish and the natural liquor of it, they boile, and it makes their broth and their Nasaump (which is a kind of thickened broth) and their bread seasonable and savory in stead of Salt…"(Williams 1643:184). Oysters were commonly roasted, as the Native name for them was "apwonnah" which comes from the root "apwonat" which means to roast, so oysters are the shellfish that was roasted (Trumbull 1903:14). Which of course is not to say that other species were not roasted, only that these were the most common ones to be roasted.

A number of sites have yielded information concerning the processing of various shellfish species. Barber found at the Wheeler site that many of the moonsnails (*Lunatia heros*) recovered were broken on the top of their shell though the outermost whorl (Barber 1983:62). He took the breakage of the shells in this fashion to mean that this was done to gain access to the meat. Speiss saw a slightly different pattern on moonsnails from the Kidder Point site in Maine (Speiss 1983:113). He hypothesized here that a stone was used to break off the spire and the meat was extracted this way. Bradley found a pattern of breakage similar to that noted by Barber on whelks from the Indian Neck Shellheap in Wellfleet (Bradley 1994:48). The whelks had holes in the outer whorl or large sections of the whorl removed. The moonsnails also exhibited damage to the aperture and the whorl, theoretically from extracting the meat (Bradley 1994:53). As far back as 1949, patterns of breakage in archaeological moonsnails had been noted. At this time, Bullen noted in his excavation of the Clark Pond Shellheap in Ipswich, Massachusetts that the moonsnails had their lips broken off to remove the meat (Bullen 1949:113).

Concerning the other species of shellfish, only Barber cited an archaeological example of a feature that he believed was used to process bivalves. He described small fire pits in which were found burnt periwinkle shells and the charred reproductive sacs from rockweed (Barber 1983:21). These features were identified as clam roasting pits. Beaudry discovered a similar feature in her 1987 survey of an archaeological site on Plimoth Plantations property (Beaudry 1987). Although not identified as such, subsequent analysis by the author identified small periwinkles, a good deal of charcoal and a large number of burned soft-shell clams and edible blue mussels from the feature.

Feature 1 at the Sandy's Point site has been described previously and it is believed that this feature represents a larger shellfish-roasting pit. This is believed for two reasons. The first is the presence of a large number of burned shell fragments of various species of shellfish from the feature as compared to feature 29 (table 7). While most of

Table 7. Burned shell

	Clam	Oyster	Whelk	Scallop	Quahog
Feature 1	230.7g/ 8.6%	14g/ .5%	73.9g/ 2.9%	.6g/ .4%	884.1g/ 8.8%
Feature 29	6.3g/ 1.8%				

the shell from the site was not burned, almost 10% of the clams and quahogs were burned. There may have been more burned shell from feature 29, but due to the shells chalkier nature than those from feature 1, it was not possible to discern it. The burning and spalling that the quahogs from feature 1 exhibited was definitely not present on any of the shells from feature 29. The creators of feature 29 may have boiled the shellfish to release the meat as opposed to roasting them or the roasting may have been done at a slower rate at a lower temperature. As a result, the evidence of burning was not present.

The second reason for the belief that feature 1 was a roasting pit concerns the presence of very small specimens of several species of shellfish, primarily slipper shells (*Crepidula fornicata*). These specimens ranged in size from .6 to 1.7cm (N=48) much too small to have been eaten. The presence of 1 very small (1cm) quahog, 4 small oysters (1-2cm) and two jingle shell (Anomia simplex) upper valves leads to the possibility that these shells were all carried to the site accidentally on some seaweed species collected from the beach sand at low tide. These shells may have all been mixed with the seaweed and used to cover the roasting pit. Barber postulated the use of seaweed for this process at the Wheeler site (Barber 1983:21).

Although no reddening of the soil was noted at the bottom of feature 1 the presence of charcoal and black earth suggests that the feature either was a roasting pit or that it received the contents from hearths associated with roasting. The shape of the feature is similar to two found by Bullen at the Clark Pond site which contained much charcoal and shell (Bullen 1949:112).

The whelk and quahog species exhibit some patterns with regards to the burning on the shells. The burned fragments of both the channeled (*Busycon caniculatum*) and the knobbed whelks (*Busycon carica*) appear to be from the dorsal "top" side of the penultimate whorl. Apparently the whelks were placed on the coals of a fire dorsal side down so that they would basically boil in their shell. Once this was accomplished, the shells were removed, possibly cooled and then the meat may have been removed by breaking the penultimate whorl or it may have been removed by teasing it out with a knife or stick. Most of the shells showed some degree of breakage but not all of the shells were burned or even broken. Table 8 shows the location of breakage on the shells

Table 8. Areas where damage noted on Whelks

	None	**Dorsal side**	**Ventral side**	**Whorl**
Feature 29	3	5	2	7
Feature 1	2	2	5	4

present in the collection. This small sample of the entire whelk collection illustrates that the whelks were very broken up during processing or that they most were damaged during excavation. In most cases all that remained intact was the columnellae. The breakage patterns from this site fit well with those from the Indian Neck shellheap and the sites on which moonsnails were processed. The exception being the presence of burned dorsal shell.

The quahog shells exhibit patterned burning localized on the posterior at the hinge. The degree of burning ranges from heat spalling on the hinge to both valves of the shell to complete burning to the point of being gray and crumbly. Such patterned burning probably resulted from processing in much the same way that Meehan reported for Natives in Australia (Meehan 198x:87). Among the Australians, the shells were stacked on a cleared patch of sand with their hinges facing upward and their lips in the sand.

Sticks and grass were placed on them and it was ignited on the end from which the wind was coming from. The wind spread the fire fast and hot and it was reported to last only a few minutes (Meehan 198x:87). Since this fire was fast and hot, it may not have burned the shells to the degree they were at the Sandy's Point site. Alternately, the quahogs may have been placed on a hot bed of coals within feature 1, hinge down and covered with seaweed until they were roasted open.

After the meat had been liberated from the shells, it appears that it was often smoke dried over an open fire such as was described by William Wood

> " In the summer these Indian women, when lobsters be in their plenty and prime, they dry them to keep them for winter, erecting scaffolds in the hot sunshine, making fires likewise underneath them (by whose smoke the flies are expelled) till the substance remain hard and dry. In this manner they dry bass and other fishes without salt, cutting them very thin to dry suddenly before the flies spoil them or the rain moist them, having a special care to hang them in their smoky houses in the night and dankish weather." (Wood 1643:104).

Although Wood stated that this was used for lobster, Edward Winslow noted that on their way to Massasoit's house in the spring of 1621, he and Stephen Hopkins had ",…a small string of dried shell-fish, as big as oysters" (Winslow 1621:67), so we know that the process was also done for shellfish. Barber found evidence of what he believed was a shellfish drying complex at the Wheeler site. What he found was a 90 centimeter wide shallow pit with a number of 12cm wide postholes around it (Barber 1983:22). This fits well with Wood's description of the smoking complex he saw in use. These shellfish and fish would have been used throughout the winter as Champlain noted in 1605 "a large number of savages were encamped in cabins near us, engaging in fishing for eels… all the savages subsist on this food, and dry enough of it for the winter to last to the month of February...when the eels and other things which they dry have been prepared, they go and hunt for the beaver until the beginning of January." (Champlain 1605:141).

While the shellfish remains were the most common types of faunal remains recovered at the site, the vertebrate remains indicate a wide range of species that were caught both on land and in the sea. The vertebrate remains actually contributed more to diet than the shellfish remains, at least in the earlier feature, they were just not as numerous. By considering these remains in conjunction with the invertebrates, a fuller picture of the diet of the two separate Native peoples inhabiting the site can be created.

VIII. VERTEBRATE FAUNAL REMAINS

Fish Remains

Throughout the written recorded history, the Natives of southern New England were well known for their skill in fishing. As early as 1643 Roger Williams noted that “The natives take exceeding great pains in their fishing especially in watching their seasons by night; so that frequently they lay their naked bodies many a cold night on the cold shore about a fire of two or three sticks, and oft in the night search their nets; and sometimes go in and stay longer in frozen water.” (Williams 1643:182). They were not, as Byers and Johnson had noted in 1940 “a rather undeveloped fishing and hunting people” (Byers 1940:17). They knew where when and how to hunt the diverse species of fish which contributed to their diet. The species which are present at the site represent species which the Wampanoag consciously caught using techniques which they knew would yield them.

There were three main ways in which the Wampanoag caught the fish that they used: Hook and line; Traps/Nets; Spear/Arrow. The use of these three techniques varied by season and by the types of fish that were being caught. Some fish appear to have been caught mainly by using one technique over another while others may have been caught by more than one means. This is described by Pory when he speaks of fishing for bass and bluefish. He stated that fish one and a half to three feet long were caught with dip nets while those four to five feet long were caught with hooks. Alternately the bass may be caught with nets as they chase smaller fish into the rivers (Pory 1622:8-9). This description fits well with the species from the site. The smaller species may have been caught with nets while the larger species may have been caught with hooks and lines.

The first method is the simplest, the use of hook and line. One of the best descriptions of hook and line fishing for the Wampanoag comes from Samuel de Champlain “The natives came in a boat who had been fishing for cod, which are found in very large numbers. These they catch with hooks made of a piece of wood to which they fasten a bone in the shape of a spear, and fasten it very securely. The whole has a fang shape, and the line made of the bark of trees. The bone is fastened on with cordage, plant used is gathered, not cultivated and grew to a height of 4-5'." (Champlain 1605:82-83). The hooks he describes were of a compound design, meaning that they were made of two pieces. He was describing a fishing hook made of wood with a bone point fastened onto it into a V shape. The bone was either a splinter of mammal bone, or could be a fish spine. The hooks would have been called 'Hoquanun/ Hoquanunash', 'om (aum)', or 'Uhquan' in the Native language (Williams 1643; Trumbull 1903:28, 194, 278). Literally these words come from the adjective 'uhquae' which means "at the point", therefore an 'uhquan' would be "the thing at the end or at the point of the line" (Trumbull 1903:168). There were also sizes to hooks just as we have today, larger hooks called 'maumacocks' (Maumuhquanash- (m) great (aum) fish (uhquaanash) hooks for larger fish and 'peewasicks' (Peawe-small sohk-prevailer) or small hooks for smaller fish (Williams 1643; Trumbull 1903: 121,151).

The hooks did not always need to be made from wood and bone, they could also be carved from solid bone or antler. It is not known if the solid bone or antler hooks would have been used for different fish than the two piece type, but from Champlain, we do know that the natives would catch at least cod with the two piece hooks. There was also one example found on Cape Cod of a two-part hook with both parts made of bone or antler. At the Sandy's Point site, one bone fish hook, probably made of a fragment of medium mammal longbone, was recovered. The overall length of the hook was at least 3 centimeters and its overall width was at least one and a half centimeters. Obviously this was a hook for a larger fish such as the cod, hake, bluefish, dogfish or even possibly the sand tiger shark. It is not known what the size differences between the larger and the smaller hooks was.

The lines used for fishing, the 'Aumanep/ Aumanapeash' (aum- fishook anepnapeash- line) or 'peminneaht ome' (peminneaht- that which is twisted (line) ome- fish were probably made from the inner bark of the basswood tree as Champlain says, and the cordage used to tie the two piece hooks together was milkweed or dogbane cordage (Trumbull 1903:18, 329). It is interesting to note that they did not appear to have made the lines out of milkweed or dogbane, possibly because the long strips of basswood would produced a stronger line. On the line would be a weight or sinker that causes the bait and hook to sink in the water and not to be blown by any current.

Finally the bait, the 'Onawangonnakaun', which would be used would, of course, vary by the types of fish which one was fishing for, but we do know that they would use lobster to catch bass and cod, and mackerel to catch bass (Wood 1643: 56, 113; Morton 1643: 87).

Probably the most labor saving method of catching fish for the Wampanoag was with the use of fish traps, nets and weirs. Each of these devices could and were used separately but often there was a combination of weirs and traps or nets and traps. Weirs were a common occurrence in rivers, bays and estuaries and they had been used by people in New England for at least 3-4000 years. This is the age of the Boylston Street fish weir in Boston that covered at least 2 acres (). This is one of the largest fish weirs ever found, but most weirs probably occurred on a smaller scale. Weirs would have been used during the two turns of the tide. Josselyn reported the English at Charlestown had built a weir "… where they catch Bass, shad, alewives, frost fish and smelts, in 2 tides they have gotten 100, 000 of these fish." (Josselyn 164x:117). When the water is coming into a river or bay at high tide, a trap door or gate was opened at the end of the weir that faced the mouth of the river. Once the tide had finished coming in, the gate was closed and the fish that came in with the tide would be trapped inside the weir to be speared or netted at the convenience of the fishermen.

The shapes and sizes of the weirs would vary depending on the nature of the river or bay in which the weir has been made, the amount and size of the fish which were hoped to be caught, and the amount of labor which was wished to be expended on the weir. Josselyn stated that the fish called Alewives "come in the end of April into fresh rivers and ponds, where they have taken in two hours without any weir at all, save for a few stones to block the passage of the river, above 10,000 of these taken." (Josselyn 1674:77). Some may have been strait fences across the river to direct the fish and others may have had arches and loops similar to those from Virginia. Speck stated that temporary weirs could be constructed using nets which had stone sinkers attached to the bottom (Speck 1948:263).

Weirs appear to have been used especially in the late spring and summer. Their use is noted when the alewives are running in April and when the bass are running in July. When the English of Plymouth journeyed to Pokanoket in 1621, the said that they found many natives fishing upon a weir set up in the Taunton River at a place called Titcut. Possibly more common for people living on the coast was the use of nets

Nets were commonly made of some strong plant fiber such as what the English called 'hemp' (Williams 1643:180). Most likely this fiber was milkweed or dogbane. The nets that the Natives made were of three types. The first were simple purse nets that were attached to a round hooped stick. Josselyn stated that these were used in fresh ponds, where they were used for catching herring and other anadramous fish that entered these ponds in the spring (Josselyn 1674:100).

Tidal nets were also used. These were often set in a harbor between the shore and a sand bar at the mouth of a river (Josselyn 1674:140). nets such as this would have been similar to the ones depicted by Champlain in his drawing of Nauset harbor. They were used for catching bass and sturgeons (Pory 1622: 9; Wiliams 1643:180; Wood 1634: 107). The Wampanoag whom Speck interviewed in the 1940s still made nets with which to catch herring. The weave of nets was two fingers wide and he stated that the spacing was still measured with the fingers and not a wooden gauge (Speck 1948:263). Tidal nets such as these were weighted in the seventeenth century with notch net sinkers and this was a practice which Speck noted as still being done in the 1940s (Speck 1948: 263).

One other type of large net was a conical shaped net that was placed in the mouth of a river with its taper pointing upstream. This type of net would have been anchored at the two edges closest to the shores with stakes and would have had stone net sinkers attached to the bottom edge. Nets such as this were still in use until the middle part of the twentieth century by the Wampanoag in Mashpee (Hendricks 1994). A net fitting the description given by a present day Wampanoag is depicted in use in Nauset harbor on Cape Cod by Champlain (Champlain 1605).

The final technique that was described for catching fish was the use of arrows or spears to impale the fish. This was especially noted for catching sturgeon. Wood stated that the men would go out at night with torches and they would …"carry a 40 fathom line with a sharp bearded dart fastened at one end." (Wood 1634:107). This was also noted by

Williams who stated that they would use a 'harping iron' to do so (Williams 1643:180). Flat fish such as flounder and possibly skate were caught from a canoe using a long spear, similar to the type used to catch lobster, two or three yards long Speck 1948:263; Josselyn 1674:100). Alternately, they may have been speared in shallow water with a spear make from a horseshoe crab tail (Speck 1948:262). Fish were also shot with arrows when nets had been set in a little cove or river (Williams 1643:180). Winslow noted a Native doing this in July while journeying in Wampanoag territory (Winslow 1621:211)

Fish remains Methodology

The fish remains from the two features were analyzed in much the same way as the shellfish remains. Most of the remains from feature 29 (79.5%) had been hand collected from quarter inch screens in the field during the three phases of the excavation. While most of the remains from feature 1 (96%) were recovered from soil samples collected for flotation from the this feature. This obviously biased the assemblage which was analyzed to a degree, but the differences that were noticed between the two features appear to be real and not the result of different sampling strategies.

After the remains had been cleaned and initially cataloged, all of the fish remains were sorted from the entire assemblage. Then, by provenance, the remains were sorted in identifiable and unidentifiable pieces. The unidentifiable pieces consisted for the most part of ribs, fin rays, gill rays and cranial fragments too small to be identified to species. The potentially identifiable pieces were then identified using the author's faunal collection, supplemented by the collection at the University of Massachusetts at Boston. During identification, the individual pieces were identified as to species, element, side of body, degree of fragmentation, weighed and measurements were taken of key anatomical features for comparative purposes.

Once the initial sorting of the fish remains was accomplished, the entire collection was divided into those elements that could be identified and those that could not. Out of a total of 596 fish fragments from feature 29, 62.4% (N=372) could not be identified beyond the level of teleost fish. Of the 134 fish bones recovered from feature 1, 64.2% (N=86) could not be identified beyond the level of teleost fish. The overall low identification rate was due to the fact that most of the elements that were not identified consisted of ribs, gill rays and fins rays and ray spines.

The bones that were deemed to be potentially identifiable were then compared with the author's personal fish faunal reference collection and the collection at the University of Massachusetts at Boston. The only bones that could not be identified using these two resources were the remains of the smooth dogfish, sand tiger shark, and hammerhead shark. These species were represented by vertebrae and or teeth and the identification of these remains as having come from the species present depended upon two sources. The source which was used to identify the tooth remains from the site was Robert Purdy's 1196 article entitled "A Key to the Common Genera of Neogene Shark Teeth"" The source which was used to identify the vertebrae was Laura Kozuch and Cherry Fitzgerald" 1989 article " A Guide to Identifying Shark Centra from Southeastern Archaeological Sites".

The identification of the tooth remains from the site is fairly strait forward. Morphological characteristics of the teeth were compared with those represented in Purdy's guide and positive identifications were made. The identifications were of one lower lateral tooth of a sand tiger shark and one lower anterior tooth of the same species.

The identification of the vertebrae to species was a little more difficult. Sharks are a member of the one of the most primitive types of fish classes the cartilaginous fish. These fish essentially have no bone in their bodies, their entire skeletal system is made up of cartilage. The only remains of fish such as this are the vertebral centra that ossify with age and the teeth. The centra that could not be identified with the author's collection were identified using the criteria for each species vertebrae as identified by Kozuch and Fitzgerald. The first step would be to determine from which portion of the vertebral column these vertebras came from. Unfortunately, the centra that have been identified as Sand tiger shark were too fragmentary to be able to measure the dorsal and ventral interforaminal spaces. This is due to the nature of the centra themselves. Being septate centra, they are not solid like the other centra but the center is filled with strait columns of ossified cartilage, which break easily. The vertebrae did appear relatively thick cranio-caudally so they are probably not anterior centra. This is fortunate because according to Kozuch and Fitzgerald, the anterior centra are the least identifiable to species.

The next step was to look at the various characteristics that are outlined by Kozuch and Fitzgerald and determine which of those characteristics are present on the vertebrae to be identified. The characteristics included the type of septae present, the shape, the length, the rim shape and characteristics, and the shape, length and width of the foramina. The nature of the septae is either septate which are those centra which have partitions all around the centra or aseptate which are those vertebrae which are solid with only the foramina holes. The shape can be a cylinder, modified cylinder, fluted cylinder or hourglass. The length is the cranio-caudal length divided by the medio-lateral breadth. Long is greater than .95, short is less than .625. The rim shape can be thick, absent or frilly. These observations are all made when viewing the centra dorsally. The foramina are holes that are present on the dorsal and ventral sides. This is where the vertebral spines would attach. The foramina can be oval, square or rectangular and may extend either partially or completely from one edge of the dorsal or ventral surface to the other. The width of the foramina is compared with the distance between the foramina to determine if it is wide or narrow. The characteristics which Kozuch and Fitzgerald noted for the sand tiger shark were observed on the unidentified centra. These have been identified as sand tiger shark.

Fish Comparisons

There were six fish species represented in feature 29 and seven species present in feature 1. A number of these species probably did not contribute to the diet but were the gut contents of larger species. Barber proposed this as well for the herring vertebrae he recovered from the Wheeler site (Barber 1982: 64). Remains that may have entered the site through the stomachs of large fish could conceivably account for most of the fish remains from the features. From feature 29, all of the smaller species may have entered the site in the stomachs and gut of the four sharks present. In feature 1 all of the smaller species may have entered the site from the gut and stomach of the dogfish. At the present time, there have not been many studies done to account for this dilemma so the present study will take into account the meat weights of all of the species present. This is done with the caveat that it is possible and extremely likely that some of these species represent merely gut contents and not actual species caught.The season of capture was determined for a number of species using the growth rings on the vertebrae. Season of capture was looked at throughout the feature to determine if the features were short or long term depositional events. This data is presented in more detail below.

It was hoped that the fish remains could corroborate some of the findings from the shellfish analysis with regards to season of capture, substrate identification, and the dietary importance of various faunal species to the inhabitants of the site. Many of the same techniques were used for the fish remains as were used for the shellfish. Modern documents were consulted that describe the habitat preferences and seasonality of the various species present. These were combined with the ethnohistorical record with the hope that together they could provide a full picture of the importance of the species present. Seventeenth century historical documents were consulted to determine the position and importance of the various fish species to the Native people as well as their methods of capture. This information was then compared with the various species present at this and other sites to see how well the documented preferences and techniques meshed with what had been found archaeologically.

The occurrences of all of the species of fish were compared between the two features. This was done to determine if there were any differences in procurement strategies and techniques, preparation techniques and contributions to the diet. This was done by quantifying all of the fish remains by a variety of techniques which included the minimum number of individuals present, the meat weights of the various species, the presence of burned bone, and the determination of which elements of the species were present. Possible differences were noted in all aspects of the role and the use of fish in the diets. Before this data is presented, the various species of fish present and their importance to the Natives of southern New England will be lexamined.

Species Present

A total of eleven species of fish of various sizes were recovered from the two features. They ranged in size from one herring, average adult size seventeen inches, up to one sand tiger shark, average adult size seven feet. Obviously, the different sized species are going to contribute differentially to the diet, but without knowing the habits and habitats of the various species as well as their ethnohistorical circumstances, there is the possibility of misrepresenting them. The species will be presented by order of decreasing occurrence at the site. The most commonly occurring species is presented first followed by those that occurred less frequently.

Scup

The scup (*Stenotomus chrysops*) is a member of the Sparidae family and is one of only two members of this family that frequents New England waters. These fish have large incisors and broad rounded molars that are adapted well for their diet. Scup are browsers that nibble on invertebrates that live on bottom. They grasp them with their incisors and crush with their molars (Bigelow 114). This diet includes clams, crabs, and sea worms. Scup can have been recorded as living up to 15 years, by which time they may reach a maximum length of 46 centimeters and 1870 grams. Specimens found which are over 20cm can be considered adults. Scup prefer a substrate of smooth sand with weeds such as eelgrass (Bigelow 1953:413). The scup's main predators are bluefish, weakfish and striped bass, sharks and hake.

The schools of scup arrive inshore off of Woods Hole, Massachusetts from their offshore wintering grounds in early May when the water temperature gets above seven degrees Celsius. They appear to travel in schools segregated by size and although it has not been proven, it is said that the larger ones arrive in the spring with the smaller ones following later (Bigelow 1953:413). Spawning occurs inshore from May to August with a concentration in June. During this time, as the water temperature warms, the schools become more widely spread out, only to congregate again in the fall as the temperature cools. They are also not known to feed as much or bite bait during the spawning time but afterwards will (Bigelow 1953:413). Their congregation and feeding patterns indicate that the optimal time to catch the scup without spending a great deal of effort would be in the spring before they disperse of in the fall when they re-congregate. The scups spawning period coincides with that of the weakfish, searobin and tautog and they are often found together. Scup remain in the New England waters, mainly on the southern shore of Cape Cod until late October when they begin their offshore migration (Bigelow 1953:413).

Ethnohistorically Roger Williams (1643) writes that the Native name for scup is Mishcup from which our word scup is derived. He stated that "Of this fish there is abundance, which the natives dry in the sun and smoke, and some English begin to salt; both ways they keep all the year; and it is hoped it may be as well accepted as Cod at a market and better, if once known.” (Williams 1643). Archaeologically, scup have been found on Martha’s Vinyard (Ritchie 1969:44).

Northern Searobin

The second most common species of fish remains recovered were those of the Northern Searobin (*Prionotus carolinus*). This is a non-schooling fish that is commonly caught as a bottom feeder rarely on mud or rocky bottoms (Bigelow 1953:469). They appear to favor smooth hard sandy grounds are as comfortable in estuaries as they are on the edge of the continental shelf. The searobin feeds on shrimp, crabs, squids, bivalves, worms, herring, menhaden, flounders, annelids, seaweed, and bivalves (Bigelow 1953:469). The searobin can reach a maximum size of 406 millimeters and weigh up to 170 grams. Most commonly specimens approximately 305 millimeters are caught. They are one of the food species of the Dusky and the Sandbar sharks (Bigelow 1953:469).

The northern searobin in a warm weather visitor primarily to the waters on the southern shore of Cape Cod. They arrive with the warming waters in May and stay in the area until October with July and August being the peak spawning months (Bigelow 1953:469). There are no ethnohistoric references to northern searobins but they were definitely known to the Native people in southern New England, as their remains have been found at a number of sites (Ritchie 1969; Carlson 1986, 1990; Bernstein 1992).

Black Bass

The black bass or rock bass (*Centropristis striat)* is one of the more pelagic species that was recovered from the excavations. The juveniles are often found in the more saline areas of estuaries but the adults are less often found here, unless there are oyster beds present. Black bass like the other species present at the site, are seasonal residents in northern waters. They arrive off of our coast in Early may and are most abundant around Woods Hole from July to September, although they remain here until early November (Bigelow 1953:408). Black bass are most plentiful in waters under 20 fathoms deep over a hard or rocky bottom. Here they feed on crabs, lobsters, shrimp, mollusks, small fish and squid (Bigelow 1953:408).

The adult black bass can reach a maximum length of sixty centimeters and weigh up to 3.4 kilograms. Here in their northern range they rarely achieve a weight greater than 2.5 kilograms and the bass which are commonly caught are approximately 700 grams (Bigelow 1953:408). A general rule of thumb regarding the length to weight ration for bass is that a specimen 30 centimeters long will weigh approximately .5 kilograms whereas one 45 to 55 centimeters long will weigh 1.4 kilograms (Bigelow 1953:408). There also seems to be a degree of sexual dimorphism between the sexes because the adult males develop a fatty hump on the back in front of the dorsal fin whereas the females will not (Bigelow 1953:408). Interestingly this was noted in the seventeenth century as well. William Wood in 1634 noted that bass were “…one of the best fish, meat delicate, fine, fat, fast fish with a bone in its head which contains a saucerful of marrow, sweet and good, pleasent to the palate and wholesome to the stomach. When there is a great store we only eat the heads and store up the rest for winter." (Wood 1634:55). Although he and other writers of the period do not make a distinction between striped bass (*Morone saxatilis*) and the black bass his description of the fineness of the fish could apply to either.

The seventeenth century sources are replete with European comments on the bass of New England. Unfortunately most of the "bass" descriptions are probably referring to the striped bass for they mention its tendency to pass up into the rivers and chase the smaller fish. Generally a few things can be said of them. The techniques used to catch bass were generally described as being of four types, they were either caught with hooks, with seine nets, with larger tidal nets or they were speared. The hooks on which bass were caught were baited a piece of lobster meat which the women would have collected or with mackerel (Wood 1634:113; Altham 1623:87). Individuals caught this way were over two feet long (Pory 1622:9). Seine nets were used for smaller individuals one foot to one and one half feet long (Pory 1622:9). This was often done from sandbars at the mouths of rivers (Josselyn 1674:14). Larger tidal nets were used, probably for striped bass, across the mouths of small creeks. It was said people could catch 500 to 700 at a time (Pory 1622:9). They were finally speared "…at the mouths of barred rivers (the Natives) being in their canoes, striking them with a fishgig." (Josselyn 1674: 100). This was supported by Roger Williams who stated that they would use Ashop (nets) "Which they will set in some little river or cove wherein they kill Bass (at the fall of the water) with their arrows, or sharp sticks, especially if headed with iron." (Williams 1643)
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After they were caught they were oftentimes smoke dried like lobsters an scup were (Wood 1634: 114). They were also used to make …"a dainty dish of Uppanquontup or heads of fish; and well they may, the brains and fat of it being very much and sweet as marrow." (Williams 1643).

Period sources state that bass were most plentiful in May, June, July and August (Pory 1622: 9). It was reported that there were different places from which to catch the bass. When the herring and alewives passed up the rivers, they could be caught there, in the early summer when the Natives would gather lobsters they could be caught around the rocks, and in the fall around Michelmas (September 29) they could be caught in the seas (Wood 1634:55). This pattern reflects the seasonal migrations of both the black bass and the striped bass and could refer to either species.

Archaeologically, black bass have been found at the sites on Martha's Vineyard investigated by Ritchie (1969:41-44) and on Calf Island in Boston Harbor (Luedtke 1980).

Sharks

Two species of sharks were recovered from the two features. While it would initially seem unusual that so many species were recovered it really is not. Shark remains have been recovered from numerous other sites in New England and there are probably an equal number of sites at which shark remains were present but not identified as such. Ritchie when reporting the findings from his work on Martha's Vinyard does not report any shark remains as having been recovered, yet on the cover of his book he shows a number of vertebrae "beads" which are obviously from a species of shark (Ritchie 1969). Another example is the Portanimicutt site in South Orleans on Cape Cod. In the Massachusetts Archaeological Society Bulletin article on the site they are identified as "round beads made from bony fish vertebrae" (Eteson 1982:9). Kozuch and Fitzgerald note that in collections from Florida, hundreds of shark vertebrae were not identified as such (Kozuch 1989:146). Shark remains are much more common in the archaeological record than has been previously thought, they just have not been identified, so it should be no surprise that five species were identified from this site. Nantucket Shoals, to this day, is famous for the amount of sharks which congregate in this area to feed on schooling fish, in fact, the annual shark fishing derby is held here each year.

Spiny Dogfish

It should especially be of no surprise that the remains of the Spiny Dogfish (*Squalus acanthus*), were recovered from both features. The spiny dogfish, like all sharks is a warm weather resident to Cape Cod arriving in May and staying until November (Bigelow 1953:48). During the warmest months they withdraw from the bays and coves and stay on the outer banks of Cape Cod so that few are caught from June to September (Bigelow 1953:50). Spiny dogfish received their name from the sharp dorsal spine located just before their anterior dorsal fin. This spine and the ossified cartilaginous vertebrae are all that remain of the dogfish archaeologically.

Spiny dogfish can grow up to 160 centimeters long and weigh 9.1 kilograms (Fishbase). They are probably the most abundant living shark and it is said that for every one of the other species of sharks there are thousands of this type (Bigelow 1953:47). Dogfish prefer to live near the bottom of the ocean but they are also common at the surface and at midwater and while they are generally pelagic by nature, they are common in enclosed bays and estuaries (FishBase).

Dogfish travel in large packs. It is from this schooling behavior that they get the name dogfish, because it is said that they will attack schools of other fish like a pack of dogs. They have been described as being "Voracious beyond belief" when they are attacking schools of cod, mackerel, haddock, herring and other bony fish (Bigelow 1953:48). They also feed on squid, worms, shrimp, crabs and mollusks (Bigelow1953:48). They have no known predators aside from man due to their pack nature and are today considered nothing more than a nuisance to the fisherman. This was much the same way that the Europeans viewed the dogfish and all sharks.

European explorers very early on noted the presence of dogfish and “thornbacks” in New England waters with Bartholomew Gosnold being the first in 1602, followed by George Weymouth in 1605 (Gosnold 1602:48; Weymouth 1605:110). Both noted that they saw or caught dogfish, most likely when they were fishing for cod or other fish. Wood noted that dogfish and skates had no value to the Europeans and were fit for nothing more than dog food (Wood 1634:55). John Josselyn echoed these sentiments and went on to say that the only use of them was that the thorn could be used to scarify the gums to relieve pressure from infected teeth and the skin was good to cover boxes and instrument cases (Josselyn 1673:33). The Native name for the spiny dogfish may have been “anishamog” *which* comes from “anussu/ anishu”, which means ‘it is tainted or smells’ (Trumbull 1903:235). Trumbull identifies this as possibly being a word to describe old salted codfish, but the dogfish will smell very bad if it is not gutted immediately and the liver begins to break down producing strong ammonia like smell. Speck noted that the Wampanoag that he spoke with in the 1940s extracted the oils from the liver of the spiny dogfish (Speck 1948:263).

Archaeologically dogfish have been recovered from numerous sites including Calf Island and Spectacle Island, both in Boston Harbor (Luedtke 1980;Timelines) and the Quidnet site on Nantucket (Carlson 1990:2).

Sand Tiger Shark

The other species of shark present at the site is a large one. This species is the Sand Tiger shark (*Odontaspis taurus*). This shark is present in New England from June to early November (Bigelow 1953:19). They arrive when the water has warmed and depart when it is cooling.

After the sandbar shark, the sand tiger shark is the second most common of the larger sharks in New England. Adults may reach up to 320 centimeters and 154 kilograms in the southern part of their range, but in New England most which are caught are immature and around 120 to 180 centimeters although some of the larger ones have been reported from the Nantucket Shoals (Bigelow 1953:18). These sharks live singly or in schools on the bottom near the coast and may come right up to the tide lines of beaches (Bigelow 1953:19). They feed on bony fish, small sharks, skates, rays, squids, crabs, lobsters, menhaden, cunners, mackeral, hake, flounders, alewife, scup, weakfish, bluefish (Bigelow 1953:19). They have never been reported to attack humans, this is probably due to their sluggish nature.

It appears that any species of shark, whether it is the dogfish or the larger species, were considered a nuisance by European standards and were not even eaten, although they occurred in great numbers. It is not know how the New England Natives felt about the shark but from the remains which have been found archaeologically it appears that they were used for food, the vertebrae centra as a source of raw materials for beads and the teeth as arrowheads and possibly decoration. Shark remains which have been identified as such have been recovered from Nantucket (Carlson 1990:3), Rhode Island (Bernstein 1992) and as noted before, Ritchie and Eteson illustrate them but do not identify them as such. There are probably many other sites at which sharks occurred but were not identified.

Bluefish

The bluefish (*Pomatomus saltatrix*) arrives in New England waters in late May and by late June the schools of thousands of fish will work themselves inshore (Bigelow 1953:384). The smaller ones under 1.4 kilograms will run up into harbors and estuaries while the larger ones, being more oceanic in nature, will generally stay offshore, only sometimes occurring in estuaries and brackish water (Bigelow 1953:386; Fishbase). Adult bluefish can reach 120 centimeters in length and weigh up to 14 kilograms (Bigelow 1953:384). They feed on menhaden, mackeral, herring, alewives, scup, hake, butterfish, cunners and squid (Bigelow 1953:384). Bluefish leave New England as the water begins to get colder and are gone by early November.

Sources from the seventeenth century record that bluefish and bass were often caught at the same time and in much the same manner. Pory noted that both bass and bluefish were caught with seine nets and hooks in mid-May when they arrived. Concerning the bluefish specifically, he stated that "…in delicacy it excelleth all kind of fish that ever I tasted; I except the salmon of the Thames in his prime season, nor any other fish. We call it by the compound name of black, white, blue, sweet, fat- the skin and scale, blue; the flesh next under the scale for an inch deep black and as sweet as the marrow of an ox; the residue of the flesh underneath, purely white, fat, and of a taste requiring no addition of sauce. By which alluring qualities it may seem dangerously tending to surfeit, but we found by experience that having satisfied (and in a manner glutted) ourselves therewith, it proved wholesome unto us and most easy of digestion. " (Pory 1622:09).

The Native name for the bluefish is similar to that described by Pory when he stated that it was called by a compound name. The Natives with whom Josselyn was in contact called it 'osacontuck', the fat sweet fish (Josselyn 1674:110). Bluefish have found archaeologically at the Hornblower II site on Martha's Vinyard and at the Quidnet site on Nantucket (Ritchie 1969; Carlson 1990).

Cod

The Cod (*Gadus morhua*) is the best known fish from the New England area. The great abundance of the cod off of the coast of Cape Cod and Georges Banks was one of the primary impetuses that led to Europeans to come to New England in the seventeenth century. Cod are another migratory species of fish that spends the winters inshore and the summers offshore. As a result of this pattern, they are believed to generally be available in the summer. A number of European sources note their presence year round in New England and especially in Plymouth Harbor though, so possibly due to their great numbers or to a different seasonal migration pattern they were available throughout the year. The larger ones appear at the mouths of rivers in late summer and winter on Cape Cod, approximately around early November and continue here until April (Bigelow 1953:193). They are just visitors though with no spawning occurring off of southern Cape Cod (Bigelow1953:192).

Cods favor rocky, pebble ground, gravel, or sand and clay with broken shells, basically a hard substrate near which they generally remain to feed. They feed on herring, and other small fish but the largest part of their diet consists of mollusks and crustaceans such as crabs, lobster, shrimp, starfish, sea urchins, and surf clams (Bigelow 1953:185). They feed on these fish at dawn and dusk with the crab being the primary food they eat on the Nantucket Shoals. Cod, in turn, are fed upon by large sharks, spiny dogfish, pollock and larger cod (Fishbase).

Because the cod were very important to Europeans, there are many references to them. The first was by the man who named Cape Cod, due to the abundance of the cod, Gosnold. He merely stated in 1602 that he saw them here in great abundance (Gosnold 1602:48). Champlain, in 1605, commented on the Native technique to catch cod, and probably other large fish as well. While anchored in Plymouth harbor in July, he noted that "The natives came in a boat who had been fishing for cod which are found in very large numbers. These they catch with hooks made of a piece of wood to which they fasten a bone in the shape of a spear, and fasten it very securely. The whole has a fang shape, and the line made of the bark of trees. The bone is fastened on with cordage, plant used is gathered, not cultivated and grew to a height of 4-5'." (Champlain 1605:82-83).

As was stated earlier Europeans stated that they saw cod in a number of months that we today do not see them. Champlain saw them in July in Plymouth harbor in 1605, Weymouth took them in May off of Maine in 1605, Pring saw them on Cape cod, where he stated there were many in June in 1606, John Smith stated that in March, April, May and the first half of June they were in great abundance, and Winslow stated that from March to October the sea is full of cod (Champlain 1605:82; Weymouth 1605:110; Pring 1606:60; Smith 1614:231; Winslow 1622: 294). These observations differ from the occurrence of cod in the area today that is from early November to April. The difference may come from a number of sources. It may be that some explorers mistook other fish that the Natives were fishing for cod. It may also be that the explorers were not specific about where they saw the cod and as many of them traveled from Cape Cod to Maine, they may have seen them in June in Maine and assumed that they were present off of Cape Cod at the same time.

Winslow's statement is interesting in that it reverses almost exactly the present day occurrence of cod in southern New England. He states that they are present from March to October when in fact he may have meant they were present from October to March. This may have been his own mistake or it may have been an error on the part of the typesetter for the original publication. Small, young cod are present in the summer at the mouths of rivers, but the larger ones do not appear until the fall (Bigelow 1953:192). Seasonality work which has been done on cod indicate that they appear to have occurred at the same time as they do today (Barber 1982: 79-81). It is probably safe to assume that the reasons for the differences in the occurrences noted in the period and today are due to human error and generalizations on occurrence.

Many of the European comments on the cod are very similar. They generally state that they occur in great abundance and are commercially fished for. Morton, for example, stated that at one time you could see 300 ships from various countries employed in fishing off of Maine (Morton 1637:86). He stated that they were so common that they were used by the inhabitants to fertilize the ground, much in the same way that sharks could be (Morton 1637:86). The Native name for the cod is "pakonnotam". This name comes from the Native words for clean or white (pak-) and the word for a fish caught on a line (not-) so it translates as the clean or white fish caught on a line (Trumbull 1903:16). This name fits well with the cod as the meat is very white and Champlain describes the fishing technique as being hook and line.

Archaeologically cod have been recovered from a great number of sites. The one that is closest to the Sandy’s Point site is Hornblower II site on Martha’s Vinyard (Ritchie 1969). It has also been recovered from the Calf Island and Long Island sites in Boston harbor (Luedtke 1980; 1986).

Hake

The hake is often a companion fish to the cod. In many of the modern descriptions of distributions and the ethnohistorical sources, cod and hake are often paired up, compared and contrasted. This probably has to do with the fact then when the cod disappear in the summer, the hake appear and when the cod reappear in the fall the hake disappear. They are similar in shape and appearance as they are both Gadiformes and this may account for Europeans noting the occurrence of cod in the summer when they are not present. They were merely seeing hake and mistaking it for cod at times.

The silver hake (*Merluccius bilinearis*) is most plentiful in June around Cape Cod, it disappears in August, reappears in October, and then is permanently offshore until the following spring after November (Bigelow 1953:180). This odd pattern of migration is due to the fact that hake prefer warmer waters than most gadids and is even known to move into shallow water in the summer. Hake reach a maximum size of 37 centimeters for males and 65 centimeters for females and on average are 33 centimeters by three years old. They reach a maximum weight of 2.3 kilograms (Bigelow 1953:174).

Silver hake generally feed by night and rest during the day. This appears to be the pattern for larger individuals, although the smaller ones are known to feed throughout the day as well. They prefer to feed over a substrate that is the opposite of the cod’s. While the cod prefers a solid substrate, the hake prefers a muddy one. Here they feed on herring, small schooling fish species, menhaden, mackeral, alewives silversides, cunner, scup, launce and smaller hakes (Bigelow 1953:174). As testament to their voracious appetite, one 60 centimeter long adult had 75 eight centimeter long herring inside its belly (Bigelow 1953:174). Silver hake, in turn, are fed upon by cod, pollock, swordfish, spiny dogfish and larger silver hake.

There are almost as many references to hake in New England as there are to cod. The first reference to them again was made by Gosnold in 1602 when he stated that he saw them off of Cape Cod (Gosnold 1602:48). The fact that hake feed at night was also noted by Pory in 1622, he stated that the cod bite during the day and the hake bite at night. He also noted that after the cod have left, the hake arrive to be fished (Pory 1622:14). Morton noted that the hake was a "…dainty white fish which is an excellent vittell fresh." (Morton 1637:90). The Native name for the hake, or possibly the pollock, is "osacontuck". This name comes from the words 'osa' which means always, 'con', which means speared and tuck which means sea or river. The compound name for the hake (or pollock) was the fish that was always speared in the sea (Trumbull 1903:110). The habit of the hake to stay in shallow water in the summer may have led to this name, for it could have been easily speared in the shoals.

Alewife/ Herring

The remains of either an alewife (*Polobus pseudoharengus*) or a herring (*Clupea harengus*) were recovered from the site. Mrozowski (1994) initially reported that they were recovered from the cornhills at the site (thus confirming the seventeenth century accounts of Native people using the fish as fertilizer), but the scant remains were, in fact, recovered from feature 29, a midden deposit. Due to the fact that there were no cranial bones recovered, identification could not be made beyond this. Both fish are similar in size, shape and appearance with the alewife having a larger belly than the herring. Both herring and alewives can achieve a maximum size of 44 centimeters and a weight of 1 kilogram. Herring and alewives move from the open ocean into fresh water rivers and streams to ponds in order to spawn. This migration begins between April and June (Bigelow 1953:103). This is the only time that herring and alewives may be caught close to shore. Any other time they are out to sea. Both species feed chiefly on plankton but they may also feed on fish smaller than themselves (Bigelow 1953:102). These species in turn are preyed upon by sharks, bluefish, cod, and hakes (Bigelow 1953:103).

Herring and alewives are names which in the period, and to a degree today, are interchangeable even though they are two different species. Many of the seventeenth century reports on their occurrences may pertain to either species, although they did recognize a distinction in the period. These fish are best known as having been the fish of choice to manure fields of Native corn. This was due to their occurrence in great numbers. Winslow stated that when the herring and alewives travel into the Town Brook in April and May "The inhabitants during the said two months take them up every day in hogsheads. And with those they eat not they manure the ground, burying two or three in each hill of corn- and may, when they are able, if they see cause, lade whole ships with them." (Winslow 1621:07). This practice was also noted by Thomas Morton who stated that "Inhabitants dung their ground with them every acre taking 1000 fish. This practice is only for Indian maize, not for English grains."(Morton 1637:89).

The settlers at Plymouth constructed a simple weir in this brook with which to catch the fish. They had it "shut in with planks, and in the middle with a little door, which slides up and down, and at the sides with trellice work, through which water has its course, but which they can also close with slides." (De Rasieres 1627:75). This would have been similar to the Native practice of shutting the river with a few stones to direct the fishes course. They then would have scooped the fish out of the water in front of the rocks with a "…net like a purse net put upon a round hooped stick with a handle." (Josselyn 1674: 100).

Fish such as herring, alewives and menhaden were called 'munnawhatteaug', which comes from 'munnohquohteau' (Trumbull 1903:69). This means 'he who enriches the earth'.

Little Skate

The little skate (*Raja erinacea*) migrates into shoal water in April and May and remains here until approximately December (Bigelow 1953:70). They can grow up to 52 centimeters long and prefer a substrate of sand or sand with pebbles but have also been found on muddy bottoms from the tide line to 75 fathoms deep (Bigelow 1953:70). The primary foods of the skate are crabs, shrimp, worms, bivalves, squid, small fish, alewife, herring, cunner, silversides, tomcod, and silver hake (Bigelow 1953:69). They are preyed upon by dogfish and other larger sharks. Although it is not known for sure, the Natives probably speared them from canoes.

Winslow reported that skates were a common fish around Plymouth, while Wood noted that skates, along with thornbackes are not worth dressing and are fit for dogs (Winslow 1621:164; Wood 1634:55). Speck stated that these fish were often speared from boats and that they were used for bait (Speck 1948:263).

Comparison of Features

The fact that some of the species may have entered the site though the gut of other species will have more relevance later in this work. At the present time, the identification of the fish species present is enough to postulate at what time of the year the two features were used. Seasonality studies have been conducted on materials from shell middens using a variety of techniques that rely on the use of either the fish or shellfish. Techniques that use the shellfish remains rely on the annual growth rings present on the shell. These growth rings, or annuli, are laid down with each tide. During the warmer months, they are laid down more rapidly and as a result they are wider. During the cold months the are laid down slower and are closer together. This results in a series of wide and narrow bands that can be seen when the shell is cut in half and polished. The narrow bands appear dark while the wide bands appear light. Studies have been made of modern shellfish collected throughout the year that allows for seasonal studies to be applied to shellfish recovered archaeologically.

Studies of this sort in New England have been made by Speiss (1982), Barber (1983), Bernstein (1982), Kerber (1984), and McMannamon (1981) to name a few. They have been carried out on oysters, soft-shell clams and quahogs. Due to time constraints and the level of expertise needed for studies of this sort, it was decided that at the present time they would not be carried out. It was decided that the fish species would be relied upon to determine the seasonality of the features.

Two techniques were used to do this. The first and simplest was the determination of the migratory patterns of the species present. The fact that all of the species present are migratory lends them to this sort of research. If there was only one or two species present within the feature, then there is less certainty as to when it was used. But the presence of numerous species allows a fairly tight range of time to be established for the creation of the feature. This seasonal range is not as tight as it would be if seasonality studies were made using the shellfish. These seasonality estimates were checked using the vertebrae of a number of fish species to determine what season of the year they were harvested in. It was hoped that though this simple but fairly efficient system, the seasonality of the features could be determined.

In order for the seasonality studies using the species and the vertebrae to be relevant, each feature was looked vertically to determine the distribution of the various species throughout the features. The proposition was this: If the same species occurred throughout the feature then the feature was probably created in a relatively short time within the same season.

In feature 29 most of the species except for the searobin and the dogfish occur throughout the feature. This may be due to different catches from different days being processed or it may be due to the a slight seasonality difference with the sand tiger shark leaving at the end of the summer and fishing continuing with the dogfish returning on the southern migration at this time. All in all though the feature represents what appears to be either a single fishing episode or series of episodes occurring close together in time. Feature 1 appears to be much the same with the dogfish and scup occurring throughout the feature and bass occurring at the top. This may be due to the gutting of different fish that may have deposited the bass and scup in the feature.

The seasonal availability of the various fish species was determined using a modern fisheries guide (Bigelow 1953) and is the same seasonal data presented in the discussion of the species presented above. The months when the various species in total are present in southern New England is presented in table 9.

Table 9. Seasonal availability of fish species

Species	1	2	3	4	5	6	7	8	9	10	11	12
Herring	*	*	*	*	*				*	*	*	*
Cod			*	*	*				*	*	*	
Hake				*	*	*	*		*	*	*	
Scup					*	*	*	*	*	*		
Searobin					*	*	*	*	*	*		
Bass					*	*	*	*	*	*	*	
Dogfish					*	*	*	*	*	*	*	
Bluefish					*	*	*	*	*	*	*	
Shark						*	*	*	*	*	*	

Each of the features was then considered separately. The way this was done was that the months were selected in which all of the species present in the feature could have occurred together. Months where one species or another was absent were not considered initially. The results are presented in table 10 below.

Table 10. Overlapping monthly availability of fish species

Feature 29						Feature 1			
Species	6	7	8	9	10	Species	5	9	10
Scup	*	*	*	*	*	Herring	*	*	*
Searobin	*	*	*	*	*	Cod	*	*	*
Bass	*	*	*	*	*	Hake	*	*	*
Dogfish	*	*	*	*	*	Dogfish	*	*	*
Bluefish	*	*	*	*	*	Scup	*	*	*
Shark	*	*	*	*	*	Bass	*	*	*

The months shown are those during which time all of the species present within the feature were available in the local area. The use of this technique indicates that feature 29 and feature 1 were used at approximately the same time of the year. The presence of the sand tiger shark from layer 45cmbs to the bottom of feature 29 indicates that these layers of the feature were created during the warmer months when sharks are in the area. From 45 cmbs to 30 cmbs dogfish appear. This may indicate that this portion of the feature was created as the weather began to get cold in the fall. Generally, an occupation from June to October is suggested by the seasonal occurrence of the species.

A similar situation may be present to account for the presence of cod and hake in feature 1. This feature may have been in use during a later part of the year when the cod and hake are present. It might be alternately true that the feature was created during the spring around May when all the species are also present. An occupation either in May or from September to October is suggested for this feature.

As a means of resolving whether the features were created in the spring, early fall or late fall, the vertebrae from as many species as possible were examined under a 100x microscope to observe seasonal growth rings.

A total of six vertebrae from feature 29 were well enough preserved for the growth rings to be read. This sample was of three black bass vertebrae from 40 cmbs, two scup vertebrae from 45 cmbs and one searobin vertebra from 40 cmbs. All of these examples had wide growth bands that were nearly as wide as those of the year before they were harvested. This indicates that they were caught in the fall before the winter. When this is compared with the seasonality available from the migratory patterns then it can be fairly safely said that they were caught between September and early November. The highest probability is that they were caught during the later end of these months. Unfortunately there were no vertebrae from deeper in the feature which were suitable to observe the growth bands on. The presence of the shark, a warm water fish may indicate that this portion of the feature was created slightly earlier than the upper portion.

Feature 1 yielded similar results. There were only two vertebrae from this feature, one cod and one hake, on which the outer most growth band was intact. Both of these vertebrae showed the wide band as wide as the previous years. This would indicate that they were caught in the fall and not the spring as was suggested as a possibility by the migratory pattern data. This feature seems to have been created in a shorter span of time than feature 29 and may have had a more specialized use. This would account for the presence of a small number of species and a short occupation.

The differences between the two features in terms of their seasonal occupation may be due to a few different factors. It may be that the features were in fact used at slightly different times, as the seasonal data appears to indicate. Feature 29 may have been used from the late summer to fall while feature 1 was used just in the fall. Alternately, the differences in the species composition of the two features may have to do with different fishing goals of the inhabitants. Fishermen using hooks and lines set out to catch specific types of fish during their forays. If the features were in use at the same time of the year but the fishermen were not trying to catch sand tiger sharks at feature 1 and those at feature 29 were not trying to catch cod and hake, then this too could account for the differences. If the year was colder during the occupancy of feature 1 than feature 29, this too could cause different species to be present and available to be caught. In the future, the shellfish from the site should also be examined for seasonality evidence. At the present time, suffice it to say that feature 29 and feature1 both appear to have been created in the late summer or fall.

Species Comparison

The next question to be addressed concerns the relative abundance and use of the various fish species between the features. The remains were quantified using the Minimum Number of Individuals (MNI) present, the Number of Individual Specimens Present

(NISP) which is essentially a count of all of the fragments of a species, and the weights of the bone fragments for each species. It can be seen that depending on the quantification used for comparison the amount that the species contributed to the diet varies. The alewife remains from feature 1, for example, may have contributed either 2.1%, 19.2% or 20% to the diet depending on what percentages are compared.

This has been a long-standing dilemma in zooarchaeology. Taphonomic processes such as processing, disposal, scavenging, and excavation affect the NISP. This is compounded by the fact that fish bone, by its very nature, is thinner and less durable than mammal or even bird bone. This results in a lower probability of survival and recovery of fish remains. These factors also hold true for comparisons based on bone weight. The archaeological decay of fish bone that results in it loosing much of its fresh weight will also hamper comparisons. The MNI is no better for comparisons due to the fact that one alewife will not contribute the same amount to the diet as will one sand tiger shark will.

Table 11. Total Identified Fish Species

	Feature 29			Feature 1		
Species	**MNI**	**NISP**	**Weight**	**MNI**	**NISP**	**Weight**
Herring				1/ 20%	5/19.2%	.1g/2.1%
Searobin	4/18.2%	60/27.1%	7.3g/18.6%			
Scup	13/59.1%	114/51.6%	28.5g/72.5%		2/7.7%	2g/41.7%
Black Bass	1/ 4.6%	31/14%	1.6g/4.1%		3/11.5%	.2g/4.2%
Cod				1/20%	8/30.8%	.8g/16.7%
Hake				1/ 20%	6/23.1%	.7g/14.6%
Bluefish	1/ 4.6%	1/.5%	.4g/1%			
Skate				1/ 20%	1/3.9%	.1g/2.1%
Spiny Dogfish	2/ 9.1%	10/4.5%	.8g/2%	1/ 20%	11/42.3%	.9g/18.8%
Sand Tiger	1/ 4.6%	5/2.3%	.7g/1.8%			
Totals	22	221	39.3g	5	26	4.8g

The calculation of the meat weights for the species present was determined to be the most reliable way to compare the contributions of the various species to the diet. This technique had its origins with Theodore White in 1953. The question which faced White and which still faces us today is “What percentage does each species contribute to the diet of the people?” (White 1953:396). As a means of answering that question, White proposed that the MNI be determined for each species present and that this MNI be calculated by the pounds of usable meat from each species. This then yields the pounds of usable meat present at a site that can be broken down by species to determine each species contribution to the diet. Unfortunately, this technique as White stated it, does not take into account a number of factors. These include the use of bones for marrow and grease and the fact that individuals of different ages and hence different weights will be present at a site. Finally it does not account for the fact that large mammals were not necessarily returned whole to the campsite but may have been butchered in the field and only the meatiest parts returned.

As a way of compensating for these short coming researchers recently have applied allometrical techniques to determine the contribution of species to the diet. Currently, this has only been done on collections from the southeastern United States (Reitz 1983, 1988; Bowen 1998). There are no comparable sites for the northeastern United States. As a result, the bone weights that can be used in such calculations are present in this study but the technique was not used. This allows sites that are in New England to be compared with the current work more easily.

White's method was not followed exactly as he stated it either. Researchers in New England have attempted to compensate for the shortcomings of White's original estimates by generating estimates that account for age and size and the recovery of only certain parts of mammalian skeletons. The work of Bernstein (1983), Speiss (1983) and Barber (1982) has been used as examples of how to add to White's work. The application of these studies to the other vertebrate remains from the site is reviewed in the sections on those species. When the meat weights were calculated for the fish remains from the site, the sizes of the individuals were determined when possible. This provided a more reliable estimation of the contribution of the various species to the diet. The sizes and meat weights are presented in table 12 below. The determination of the sizes was

Table 12. Estimated fish sizes and weights

Species	**Length**	**Meat Weight**
Herring	*25 cm	.3kg
Searobin	*30 cm	.1 kg
Scup	20.5-25.5 cm	.7 kg
	32-43.5 cm	.9 kg
Black Bass	30 cm	.5 kg
Cod	58 cm	1.8 kg
Hake	58 cm	1.8 kg
Bluefish	60 cm	1.8 kg
Skate	*40 cm	.5 kg
Spiny Dogfish	*75 cm	3.9 kg
Sand Tiger	.7-1m	48 kg

* Denotes average sizes based on literature

based on either example which are the collections used for this work or average sizes from the literature pertaining to fisheries. The weights are based on the available fisheries literature that states the average weight of a fish of a certain size. Interestingly, the length of the sand tiger shark is close to the size that Bigelow stated was commonly caught in New England waters.

A comparison of the meat weights between the two features is presented in table 13. The sand tiger shark provided the bulk of the meat to the inhabitants at the time of the creation of feature 29, while during the time when feature 1 was created the spiny dogfish contributed the most to the diet. It is interesting that sharks, two species that have not been extensively identified from archaeological collections in New England should provide the bulk of the meat from the fish remains. The identification of the fish species present and their weights and sizes allows another aspect of the habitation at the site to be investigated. That aspect is the fishing techniques and strategies used by the occupants.

Table 13. Comparison of meat weights between features

Feature 29 Feature 1

Species	(MNI/ Meat Wt)	(MNI/ Wt)
Herring		1 (14.3%)/.3kg (3.2%)
Searobin	4 (18.2%)/.4kg (.6%)	
Scup	13(59.1%)/10.7kg (15.5%)	1(14.3%)/.7kg (7.4%)
Black Bass	1(4.6%)/.5kg (.7%)	1(14.3%)/.5kg (5.3%)
Cod		1(14.3%)/1.8kg (19%)
Hake		1(14.3%)/1.8kg (19%)
Bluefish	1(4.6%)/1.8kg (2.6%)	
Skate		1(14.3%)/.5kg (5.3%)
Spiny Dogfish	2(9.1%)/ 7.8kg (11.3%)	1(14.3%)/3.9kg (41.1%)
Sand Tiger Shark	1(4.6%)/48kg(69.4%)	
Totals	22/ 69.2g	7/ 9.5g

Fishing techniques and strategies

The habitats and the sizes of the fish present in the two features were compared. This was done to determine what fishing technology was used to procure them and any differences in procurement strategies between the two features. These factors have been noted by a number of other researchers as being the main determinants to what sort of fishing techniques are used (Balme 1983; Colley 1983; Luedtke 1980; Whyte 1988). The fishing strategy that was used by the Natives was the result of several interconnected elements. These included the size, weight, shoaling behavior and depth range, seasonal migration of the fish as well as the potential yield, the cost the technology and the social organization needed (Colley 1983:157). It is fairly obvious that different fishing methods will select for different size fishes. This was stated by Pory in 1622. The fishing strategy is the result of the interaction of environmental characteristics and the attributes of the fish and the goals of the society (Colley 1983:159). By combining this data with the ethnohistorical data gathered on Native fishing the technology which was employed at this site can be determined. The following table outlines the habitats of the species present.

Table 14. Habitats of species present

Species	Inshore	Offshore	Substrate	Max size	Schooling
Scup	*		Sand	46 cm	*
Searobin	*		Sand	40 cm	
Alewife	*	*	Varies	44 cm	*
Skate	*		Sand with rocks	52 cm	
Black Bass	*		Rocky	60 cm	
Bluefish		*	Varies	120 cm	*
Cod		*	Rocky	200 cm	*
Hake		*	Muddy	65 cm	*
Dogfish	*	*	Varies	160 cm	*
Sand Tiger	*	*	Sand	270 cm	Varies

There appears to be fairly distinct distribution types of fish that suggest two techniques of fishing. The smaller fish that prefer inshore waters were probably taken with one method and the larger deeper water species were probably taken with another. Ethnohistorically, it does not appear that nets were used in deep water. Hook and line must have caught any species that exist in deep water then. While the Wampanoag did make smaller fish hooks, we do not know how small but looking at the medium with which they were making them it is likely that they were not too small. As a result they probably used nets to catch smaller species of fish, specifically those which school in the shallows. When the estimated sizes for the fish that were present archaeologically is plotted with the MNI for each size range, it can be seen that they fall into two groups. The first are those fish that were under 45 centimeters in length. Five species fit these criteria: Alewife, Searobin, Scup, Black Bass and Skate. The second are those species that are over 45 centimeters. These include Cod, Hake, Bluefish, Dogfish, and Sand Tiger Shark. Comparing the natural habits and habitats of these species it appears that the schooling fish which occur over sandy bottoms, the scup and searobin, were probably taken with a net.

The use of nets and weirs is less selective than hook and line. In the former, the nets are set out and whatever the tide drives into them is caught. With the later fishermen specifically used certain types of bait and hooks and searched for the species in locales which they favored. The nets which the Wampanoag hundreds of years ago used may have been similar to the nets made in the 1940s on Gay Head and in Mashpee with the two finger mesh. These possibly could be classified as gill nets. Gill nets are more selective than other nets in the fact that they are designed to trap fish by the gills. The nets weave though allows fish smaller than the weave size to escape and usually does not trap larger species (Balme 1983:28). They are still less selective than hooks. Luedtke has noted that the presence of a grater variety of species of fish in the archaeological record appears to coincide with the occurrence of net weights in the Early Woodland (Luedtke

1980:66). This is probably due to the increased use of nets as opposed to hook and line and spears.

The other species, the larger ones and those occurring offshore or over rocky bottoms were most likely fished with hooks and line. This would include the black bass, dogfish, cod, hake, bluefish and sand tiger shark. Fishing with hooks and lines from boats is more selective but it also has a higher risk associated with it. At the same time there is a higher potential yield with the larger fish occurring offshore. One would not expect to find a great number of individuals of each species at a site due to the labor-intensive nature of the technique.

The fish remains from feature 29 indicate that both techniques were in use during the time of that features formation. The large number of scup and searobin remains (77.3% of the MNI) indicate that nets were probably set at the mouth of the cove to catch the fish as the tide turned. They were probably set in the same area as where the quahogs occurred, as this seems the area with a hard sandy substrate. The presence of a greater number of scup, a schooling fish, as opposed to the searobin would be expected with the use of nets. The other species, bluefish, black bass, dogfish and sand tiger shark (22.9%) were the larger species or were caught offshore from boats probably in the Nantucket shoals. The length of the hooked fish indicates that hooks of a certain size were used. This can safely assumed because the fish all appear to be under or close to one meter long. Possibly the hook fragment which was recovered was of the size to be used for this size fish. The greater yield of the hooked fish remains can be seen in the fact that the possibly netted species yielded only 11.4 kilograms of meat (16.5%) while the hooked species yielded 57.8 kilograms of meat (83.5%).

The fish remains from feature 1 indicated a slightly different situation. The remains of the scup, herring, skate, and the rock crab may indicate that these species arrived at the site via the stomach and gut of the spiny dogfish, cod and or hake. The occurrence of a meager number of smaller fish bones at a site which also yields the remains of larger predatory fish has been postulated as having resulted from the gutting and subsequent disposal of the contents (Barber 1982: 64). Wheeler states that "Fish guts often contain large numbers of bones of species recently ingested. Midden deposits may contain bones, usually small ones, of fish discarded with the guts of large species." (Wheeler 198x: 68). If this was the case then the inhabitants at the site primarily fished using hook and line. This does seem likely and may have had to do with the season of the year. In the fall when it was determined that this feature was created, the scup would have been beginning their offshore migration and the alewife would have already been living offshore. As a result, these species would not have been present in the estuary where the nets would have been used. It does make sense that the nets would be used in the spring summer and early fall and that any fishing which was done in the fall before the winter move inland would have been done with hook and line.

The differences between the two features regarding the species present may also have to do with the changes in the nature of the cove itself over the 600 years. It was observed when the shellfish were looked at that while the occurrence of quahogs remained the same, the occurrence of clams increased and that of oysters decreased. This was postulated as having been the result of changing water conditions within the cove. This may also account for the reliance on hook and line fishing during feature 1's occupation. Fish like scup and searobins prefer hard sandy substrates and for the searobin especially, they are rarely found on mud.

The locations where the various species were procured can be postulated. The dogfish and the sand tiger shark were probably caught to the east of the island on what is now called 'Dogfish Bar'. This area is relatively shallow and known for the occurrence of dogfish and shark species. The cod, hake, bluefish and black bass may have been taken to the east of the island as well, where the water drops off near Dogfish Bar. Alternately they may have been taken to the immediate west of the site towards Hyannis Harbor, although this involves travel further from the shore. The net that was used to catch the searobin and scup may have been placed in one of two locations. The largest and most permanent location would have been to the northeast of the site at the mouth of the larger cove into which Uncle Robert's Cove empties. It may have also been stretched in the narrow space between Sandy's Point and the island. This channel does not appear to have been continually closed and may have had access to the sea. The opening and closing of this channel may have affected the substrate in the cove and lead to the fluctuations seen in both the shellfish and fish populations.

Processing

Once the fish were caught, either using a net or hooks and lines, they were processed. The processing was either for immediate consumption of for storage for winter. The drying of the fish would follow a process similar to that described above for the drying of shellfish. Ethnohistorically, Wood and Williams recorded the drying of lobster, bass and scup (Wood 1634:114; Williams 1643:181). Larger fish, such as cod, hake and shark may have been eaten soon after they were caught or they may have been cut into strips and dried as Wood stated for bass. Speck stated that herring were still smoked and dried by the Wampanoag at Mashpee in the 1940s. After they were salted, which is a modern practice, they were strung up on a stick run trough their eyes with about a dozen on one stick. These were then placed over a smoky fire of white oak, sugar maple, and sweet fern (Speck 1948:263). Archaeological evidence of smoke drying may be represented at a site by a low occurrence of burned bones of smaller fish and possibly a majority of fish cranial bones as opposed to vertebrae. The occurrence of more cranial bones would be due to their possible removal before smoking, possibly if they were larger fish.

Fish were also commonly roasted or boiled (Winslow 1621:212; Morton 1637:56). Gookin, living among the Natives near Boston, gave the best description of the boiling of fish. He stated that "Their food is generally boiled maize or Indian corn, mixed with kidney-beans, or sometimes without. Also they frequently boil in this pottage fish and flesh of all sorts, either taken fresh or newly dried. These they cut in pieces, bones and all, and boil them in the aforesaid pottage. I have wondered many times thay they were not in danger of being choked with fish bones; but they are so dexterious to seperate the bones from the fish in their eating therof, that they are in no hazard." (Gookin 1674:10).

The fish bones from the two features exhibit various types of alteration that may be the result of processing and consumption activities. These fall into three categories: Deformation; Burning; Calcification. While none of these types of alteration are unique to this site, taken together they allow a reconstruction of how the fish were processed and consumed.

The hake and cod vertebrae from feature 1 all exhibit varying degrees of deformation due to having been chewed. Wheeler states that crushed bones, usually vertebrae are commonly found in archaeological deposits (Wheeler 198x:69). If the cod and the hake from the site had been boiled in a 'sabaheg', a soup or stew (literally that which is boiled), as Gookin stated, bones and all then this would explain why more of the remains of these fish were not present. According to Wheeler's experimental work, for the bones to have been deformed as they were they would have had to have been boiled for one to two hours to be softened and then chewed and spit out as the fish soup was being consumed. This scenario fits quite well with the ethnohistorical and the archaeological evidence. It appears that the cod and the hake remains from the site were boiled in soup, most likely with corn from the season's harvest and possibly other plants, and then consumed at or near this feature. The bones were then discarded into the feature as it was filled. Possibly the cod and hake were part of a meal which was eaten while the shellfish were being processed.

Damage caused by the fire on which the fish were cooked takes two forms burning and calcification. The distinction between the two types of alteration is basically one of degree. Burned bone ranges in color from yellow-brown to black. Calcined bone is bone that has been heated to such a degree that all of its combustible organic compounds have burned away leaving the inorganic non-conbustibles. Calcined bones range in color from indigo-blue to white (completely calcined). The heat range that causes bones to become burned is from 130-340 degrees Celsius with the bones becoming black at 240-340 degrees Celsius. Bones begin to become calcined between 440-600+ degrees Celsius. Basically bones which are burned white had to have been in a fire which was at least 600 degrees. Bones which were burned were either from a fire which was either under 600 degrees or the fire was 600+ degrees but the bones did not spend a great deal of time in the fire.

All of the fire damaged bones from feature 1 were calcined white gray to white (N=7). The bones from feature 29 were predominantly burned black (N=30) but a fair number were calcined white gray to white (N=15). When the difference between the burned and calcined bone between the two features is plotted, it can be seen that in feature 29, ribs and fin rays constituted the predominant amount of calcined material.

The bulk of the burned bone from this feature is evenly split between the cranial fragments and the ribs and rays. In feature 1 the bulk of the calcined bone is vertebrae. This indicates that at feature 29 the fish were being roasted and those parts of the fish that were more directly exposed to the fire were burned and calcined more often. The ribs and rays were burned as they roasted and then, when the fish were removed from the fire the rays and ribs, which have no meat on them, were thrown as trash onto the hot roasting fire where they calcined. The rest of the fish was removed, possibly allowed to cool and then eaten. The remaining vertebrae, cranial fragments and ribs and rays were then thrown onto the fire to dispose of them. By this time the fire had possibly died down to below 600 degrees Celsius and these fragments were not calcined but only burned.

At feature 1 the larger fish were boiled in a pot while their guts may have been either thrown into the hot fire to dispose of them. The fragments that became calcined were in the guts and subsequently remained in the fire. As the feature was being filled, the remains of the fire were deposited in it along with these calcined fragments. This would account for the larger fish vertebrae, the cod, hake and dogfish, not being burned or calcined at all.

Synthesis

The study of the fish remains from the two features has allowed several important deductions concerning fishing and the use of fish between the two features. Five areas relating to the use of fish between the two features were investigated. These were the species present, their method of capture, the seasonality of their capture, their contribution to the diet and how they were processed. It was found that significant differences occurred between the two features. Feature 29 had more species present (N=7) when compared to feature 1 (N=3 consumed species) and it appears that at feature 29 the fish were netted and hooked while at feature 1 they were just hooked. The seasonality between the two features was very close though, with feature 29 having been used during the late summer and into fall while feature 1 was used in the fall, possibly later than feature 29.

At the time of the creation of both features, it appears that fish, as well as the shellfish, contributed an appreciable amount to the diet. The amount appears to have been less for feature 1 than feature 29. This may have to do with an increasing reliance on horticulture between the time of the creation of feature 29 and feature 1 and a decrease in the reliance on fish and shellfish to get the people though winter. Finally, it appears that the fish may have been processed differently between the features. The lack of a great amount of calcined bone and the abundance of burned bone indicates that the fish may have been roasted here. While at feature 1 the presence of no burned bone and only calcined bone from either gut content fish or ray spines and ribs indicates that the fish was probably boiled here as opposed to roasted.

Two of the meat components of the diet of the inhabitants at the site have been investigated thus far, the shellfish and the fish. The remaining vertebrate fauna from the site, the mammals, birds and reptile remains, remain to be discussed. These components represent a minor contribution to the bone counts from the site but have the potential to contribute more meat than either of the other two categories. After these species have been discussed, the entire faunal assemblage from the features will be combined and compared.

Mammals, Reptile and Bird

Three species of mammals were recovered from feature 29 and one species from feature 1. These species are White-Footed Mouse (*Peromuscus leucopus*), Woodchuck (*Marmota monax*) and White-Tailed Deer (*Odocoileus virginianus*). The first two species were comensal while the final one, the deer, was hunted, probably on the mainland and consumed.

Commensural Species

Mammals

The presence of commensural species at a site is not uncommon and most archaeological faunal assemblages have a commensural component. The woodchuck from the site came from feature 29. This individual is represented by a partial cranium, a cervical vertebra and a first rib. During the excavation of feature 29, a rodent hole was found on the eastern edge of the feature and in this rodent hole was the woodchuck bones. The presence of the woodchuck burrow and remains may substantiate the hypothesis that this feature was created in the fall. Woodchucks hibernate in the early autumn and he has been noted to be insensible to touch or movement (Boettger 1989:57). Possibly the occupants of the site noted the open woodchuck hole and they began to throw the refuse from their fishing and shellfish activities into it, suffocating the sleeping woodchuck. This may have happened if this was not a summer burrow but a winter one. This consists of merely a tunnel and sleeping chamber (Whitaker 1988: 385).

The white-footed mouse remains were recovered from feature 29 as well. White-footed mice are active year round but may den up in cold weather. They feed on bugs, berries, nuts, fruits, caterpillars and insects (Whitaker 1988: 471-472). Possibly this mouse had denned up in the midden for the winter or had died there while searching for the bugs and insects which would have been present.

Reptile

One common garter snake (*Thamnophis sirtalis*) was recovered from the excavation of feature 29. The remains consist of 75 vertebrae. The common garter snake is the most common type of snake encountered within its range. They are commonly found around near water and as such it is not surprising to find the remains of one at this site. Garter snakes feed on mice, small fish, frogs, toads, earthworms and salamanders (Bebler 1995:676). This snake may have died hunting for food within feature 29. The remains were found within the woodchuck hole in the eastern portion of the feature and they may represent an animal which was denned up for the winter, although it has been noted that they can remain active until the coldest part of the winter (Belber 1995:676).

There were not many uses noted for snakes in the seventeenth century. One was the use of their skin for wrappings, as witnessed when the Narragansetts sent a bundle of arrows wrapped in a great snake skin to the colonists at Plymouth as a war threat in 1621 (Bradford 1621:96). Another was described by Wood "Indians, when weary of travel, will take them up with their bare hands and with their teeth tear off the skin on their backs and feed on them alive, which refreshes them." (Wood 1634:38). Archaeologically, remains of a garter snake or ribbon snake were recovered from Bernstein's excavations at Greenwich Cove (Bernstein 1982:93). Bernstein interpreted the remains as having been part of the diet. Due to the presence of so many articulated vertebrae in feature 29, it is more likely that it was a commensural species that happen to die here.

Hunted/ Food Species

Deer

The white-tailed deer remains were the only mammal species consumed at the site. This is not surprising as the site is situated on an island and appears to have a very marine focus. White-tail deer can reach a maximum length of 206 centimeters long and a maximum weight of 135 kilograms (Whitaker 1988: 654). They prefer farmlands and brushy wooded areas. Deer were the most common animal that was hunted by Native people in the northeast and as a result their bones are fairly ubiquitous at Native occupied sites.

The deer provided the Natives with many raw materials for producing a vast array of their material culture. The meat was eaten of course, the marrow was eaten and used for grease, the hide was tanned with the hair on or off for clothing, the antlers and bone were used as a raw material for tools such as arrow heads and fishhooks, the sinews were used for sewing, the hooves were used for glue and the bladders were used to contain oil. Seventeenth century sources are replete with references to deer. This probably has to do with the fact that they were present in England so the Europeans knew of them, but they had never seen them in such great numbers as they did here.

Deer were hunted either by single hunters or by bands of hunters. When hunting singly, deer may have been stalked a by the hunter much as hunters do today. By observing their habits throughout the year, the hunters would know what locations the deer favored (Williams 1643:224). He would then either hunt the deer with his bow or would set snares and return to check them every day or two. The second way in which deer were hunted was communally. This could be done either by stalking or by setting snares as well. These would be large parties who went out to do this. Williams stated that 20 to

300 men might go out to pursue the deer on foot. During the trap hunting the men would bring their wives and children if they did not need to travel far and build a small impermanent house which was their hunting lodge. They would then stake out their bounds for their family that might be 2-4 miles and would set 30-50 traps and check these every few days (Williams 1643:224).

The importance of the deer to the people can be seen in the number of names that they used to describe them. The general name for deer was 'ahtuk' but the people further differentiated between ages and sexes. A 'paucottauwat' was a buck while a 'Wawunnes' was a young buck. A 'qunneke' was a doe and a 'moosqin' was a fawn (Williams 1643:224). Distinctions were made for a number of reasons. One may have had to do with different qualities of the meat of the deer. Josselyn stated that the flesh of the fawns was considered the best (Josselyn 1672:99). It also may have had to do with the spiritual connection that the people felt they shared with the deer. Unfortunately this was not explicitly stated by any of the seventeenth century authors, merely hinted at. For example, Williams wrote that the Natives were "…very tender of their traps and where they lie, and what comes at them; for they say, the deer (whom they conceive has a divine power in them) will soon smell and be gone." (Williams 1643:224). Deer skins were also used as tribute to the sachems of the communities. The sachems had the right to the skin of any deer that was killed either by the hunter or by wolves in water (Williams 1643:224).

Josselyn gives a good description of the hunting done by the Natives to the north of Boston. These people often hunted moose in this area, but the description of their hunting practices. He stated that "They go 30-40 miles up into the country and run down a moose. When he has tired, they cut his throat and skin him, the women take out the heart, cut off the left rear foot and draw the sinews out, and cut out his tongue and as much venison as will deserve to satiate them. At the same time the men pitch camp near a spring and scrape the snow to the bare earth. In the middle they make a fire near a tree and hang their kettle from one of the branches of the tree and boil the venison...They do not trouble themselves with the horns of the moose or the deer because they are weighty and cumbersome. They leave the carcass out there for the wolverines." (Josselyn 1672:99). This was probably much the same way that the Natives in southeastern Massachusetts hunted deer during the large drives in the fall. They would slay a large number of deer, take the meat and other parts they wanted and leave the rest. In fact, the Pilgrims found a deer near Plymouth in 1621 that had its horns cut off and nothing else (Friday Febuary 9th Mourt's).

The deer remains from feature 29 consisted of seven fragments. these represented one rib, one femur, one metatarsal, and one dew claw (Table 15). All of these fragments appear to be from one right rear leg and part of the rib cage of an adult deer. These were the only elements found so it seems likely that since the island is so small and could not have supported a viable deer population this deer came from the mainland. The deer was hunted on the mainland and then the hunter returned with one of the meatiest pieces and possibly a rack of ribs from the deer. Perhaps it was hunted with a few other men and each took a piece of the deer home with them. Alternately these pieces may have been given to the family by another family in repayment of a debt. However they arrived at the site, it appears that the entire deer was not butchered here.

Table 15. Deer elements present

	Feature 29	Feature 1
	NISP	NISP
Humerus		1
Ribs	2	
Femur	1	1
Tibia		1
Astragelous		1
Metatarsal	2	
Metapodium	1	
Dew Claw	1	
Total	7	4

This also seems to be the case for the deer remains from feature 1. In this feature deer are represented by one humerus fragment, 1 femur fragment, one tibia fragment, and one complete astragelous. These parts all appear to be from the left front upper leg and the entire left rear leg an adult deer. The lack of any teeth or other skeletal elements also supports the notion that the deer arrived at the site in two pieces. Luedtke documents the presence of only deer leg elements on an island site from Calf Island in Boston Harbor (Luedtke 1980:61). She assumed that the island was too small to support a viable deer population and that the selected deer remains were transported to the island.

Hunters traveling a great distance from their homes will not return with the entire carcass a large mammal. Usually it can be safely assumed that when all of the elements of skeleton are present at a site, then the entire animal was brought to the site and butchered. This will hold true if considerations such as the taphonomic affects on bone, the site of the sample and the distribution of the elements on a site are kept in mind (Whyte 1952:337). When only certain elements are present then it is possible to assume that the hunter butchered the animal in the field and returned with certain, probably the meatiest, elements (Metcalf 1988:486). Binford in 1978 published the first real studies concerning the different quantities of food yielded by different elements of an animal (Binford 1978:12). As stated by Metcalfe, food refers to the meat, bone marrow and bone grease that can be utilized from an element.

Using Binford modified general utility index (MGUI) Metcalfe in 1988 simplified the comparisons between different elements to create the food utility index (FUI)(Metcalfe 1988:486). The assumption behind either of these comparative indices is that bone and

the associated meat are transported and abandoned as a unit and the presence of a particular bone indicates the presence of a particular element of meat (Metcalfe 1988:487). Using the FUI the body parts are ranked in order of their food utility from 1, the lowest utility, to 100 the highest utility (Metcalfe 1988:498).
Applying FUI values to the remains from feature 29, it can be seen that the complete hindlimb of the deer has the following utilities: Femur- 100, Tibia-62.8, Metatarsal-37.0, Phalanges-19.4, this gives a total of 219.2 on the index of utility. The hindlimb is the meatiest and has the most utility of any body parts. Obviously, for this to be the only body part present in the feature, then the hunter had selected the meatiest part to bring back to the camp. The bone from feature 1 indicated much the same except in this case, the hunter also selected for the humerus which has a value of 36.8 combined with the hind limb giving a total value of 256. Obviously the people who created feature 1 used more deer at the time of the feature's creation than those at feature 29.

It would be a mistake to use the MNI for the deer in each feature as the unit with which the available meat from deer was determined. If this was done and the average adult deer weight was considered to be 27.5 kilograms (Bernstein 1982:89) then the amount of meat which was contributed by deer would be far greater than it actually was. Another method to determine the contribution of the deer elements to the diet is to estimate the amount of meat that would be contributed by each element. The percentage that each element contributed to the total meat weight of the deer was calculated using the following technique. All of Metcalfe's FUI indices were added together taking into consideration the fact that there are two hindlimbs and two forelimbs for each animal. This yielded a figure of 980.3 for an entire animal. Each of the indices for each element was then divided by this figure to yield a percentage of the total index value for an animal. For example, the index for a humerus was stated to be 36.8. This was divided by 980.3 and this was multiplied by one hundred to yield a figure of 3.8% of the total. This percentage was then multiplied by the average weight of a deer cited by Bernstein to yield 1.1 kilograms of meat, marrow and bone grease from a humerus. The same was done for a hindlimb to yield 6.2 kilograms per hindlimb. These are the figures that were used to compare the contribution to the diet by deer meat, grease and marrow. For feature 29, deer contributed 6.2 kilograms and for feature 1 it contributed 7.3 kilograms.

The unidentified mammal remains consisted chiefly of medium mammal longbone fragments. These are probably from the same deer as the identified medium mammal fragments. Their fragmentation was probably the result of the reducing of the bones to extract marrow. This was comonly done by the Natives in the northeast. For example, among the Micmac of Canada, it was noted that when a moose was killed " they collected all the bones of the moose, pounded them with rocks upon another of larger size, reduced them to a powder; then they placed them in their kettle, and made them boil well. This brought out a grease which rose to the top of the water, and they collected it with a wooden spoon. They kept the bones boiling until they yielded nothing more, and with such sucess that from the bones of one moose, without counting the marrow, they obtained 5-6 pounds of grease as white as snow, and firm as wax. It was this they used as their entire provision for living when they went hunting. We call it Moose butter..." (Denys 1672:118). The bone fragments were then disposed of in the midden. The fractured bones may have been placed in a boiling pot as well and the grease added to soup for immediate consumption.

Bird

No identifiable bird species were recovered from the excavation of these two features and feature 29 was the only one yielding and bird remains at all. All of the fragments found (N=6) appear to have come from a medium to large species. Three of these fragments were burned black, indicating as they did with the fish species that they either were roasted or were thrown on a cooling fire.

While the species can not be identified some things can be generally stated concerning birds in the seventeenth century. Winslow stated that the best time for fowling was from October to March as the fishing tapered off (Winslow 1622:294). There were two ways in which birds were caught. They were shot with arrows or they were netted. Williams noted both of these techniques. He stated that they would lay nets "…on shore and catch many fowle upon the plains, and feeding under okes upon acorns as Geese, Turkeys, Cranes and others." (Williams 1643:172).

The paucity of bird remains at the site is somewhat odd considering the time of the year that the features were occupied and the setting of the site. Possibly the focus of the occupation at the time the features were created was not on bird procurement but on fishing and shellfish. As a result the bird species which were present in the general vicinity were virtually ignored. The occupation of the site may not have occurred within the scheduling of the harvesting of migratory wild fowl as well, and for that reason they are not represented. The weight of the bird in feature 29 was estimated at 2 kilograms due to the fact that the species is not known and it appears to represent a medium to large species.

Synthesis
Dietary Reconstruction

The vertebrate and invertebrate faunal remains from the features in question were used to estimate the amount which each class of remains, fish, shellfish, mammal and bird, contributed to the overall diet of the people during the two occupations. It was found that the features differed in a number of areas. While both features contained all of the same faunal classes except, the amount to which the contributed to the diet differed. It is felt that this has to do with similar but slightly different specialized harvesting strategies that the occupants used. This in turn was may have been due to the introduction of horticulture and the reliance on the Native corn crops during the later period. Because the people had the corn, bean and squash crops to see them through the winter, they did not collect as much as the occupants of the site 600 years before.

The inhabitants of the site during both of the occupations investigated, probably selected its location not due to its ease of access but more because of the high productivity which the location afforded. The estuarine environment is one that creates a situation where the mixing of the salt and fresh water leads to a nutrient rich location. Due to the mixing of these waters, the salinity often times is changing rapidly. As a result, the estuary supports fewer varieties of species than the ocean or a river does. The estuary makes up for this though by having populations that, while not too diverse, are enormous in number (Amos 1985:85). When the presence of salt marshes is added to the estuary then even larger populations may be supported.

The cove on which this site is situated is just such a location. A stream at the southern end of it feeds it and all along its shores are salt marshes. These are evidenced in the past by the presence of the ribbed mussel fragment and the mud nassas. Such a location then becomes an ideal location for Native people to have spent the spring summer and fall months, returning to the mainland in the winter. It is proposed here that the two features in question are representative of the subsistence strategies of two groups of people operating under similar but slightly different needs.

The Native people who met the Europeans in the sixteenth and seventeenth century were practicing a subsistence pattern that had its precursor at least 600 years before contact, as evidenced at this site. Various authors have attempted to pigeonhole subsistence strategies of hunter-gatherers into either specialized or generalized (Cleleand 1976, Barber 1982). Looking back at the ethnohistoric record, it can be seen that the strategy that the people practiced in this area was neither one nor the other, it was a combination of the two.

Cleland has characterized a focal, intensive, specialized subsistence system as one that focuses on a limited number of resources to the exclusion of many others. When a system such as this develops, preservation and storage technology to make this resource last for a substantial portion of the year also develops (Cleland 1976). Specialized technology is also developed to maximize the amount of return and minimize the amount of energy that needs to be expended to procure it (Barber 1982: 96). For example, the use of nets allows fishermen to catch a great number of fish by merely knowing when and where to put these devices.

Alternately, a diffuse, extensive, generalized subsistence system relies upon a broad range of resources and no great effort is placed on maximizing the return through technology or storing it for the winter (Cleleand 1976). Diffuse systems are continually on the move to arrive at the next resource that is seasonally scheduled to be exploited. Systems such as this have no true home bases and must acquire food as they can.

In southern New England in at least the last half of a millennium before the arrival of Europeans, it appears that Natives followed neither of these systems purely. Ethnohistorically, it was recorded that the Native people lived with a community territory that for the most part supplied their needs. Being on the coast or within a coastal environment, the Native people of Cape Cod and southeastern Massachusetts participated in a seasonal migration that was probably very similar to that which they had done for centuries before. This seasonal system incorporates elements of both an intensive and an extensive subsistence system. The people exploited a diffuse range of plants and animals but did so that as each species came into season it was intensively harvested and stored for the winter. In order to do this, the people would split up during the spring, summer and early fall and each family would venture out to their planting fields, which became their seasonal bases. They would then move out from these to exploit various resources. In the fall they would all join up again and move as a community to a sheltered valley or into the woods and establish a winter seasonal base from which to venture out and exploit winter resources. Come spring the entire process would begin again.

A list of the plant and animal based on the writing of Roger Williams indicates that 10 species of birds, 8 wild plant species, 4 cultivated plants, 8 wild mammal species, 16 fish species and 5 shellfish species were exploited by the Natives in southern New England. This source gives a fairly complete inventory of the species. It does neglect many wild species that have been recovered archaeologically and some animal species that Williams did not note. All in all though it shows that the natives had a diverse diet of wild resources which they collected. Of these species, at least 14 (Alewife, herring, bass, scup, eel, lampreys, chestnuts, acorns, walnuts, strawberries, lobster, clams, oysters, quahog) are known to have been extensively collected and stored for the winter.

The hunting and collecting of any of these species and the storage of certain ones was not a haphazard affair. People scheduled where and when they would return to various sites to make use of resources. Winslow noted this as early as 1621 when he stated that "…by reason whereof, our bay affording many lobsters, they resort every spring-tide thither; and now returned with us to Nemasket.´(Winslow 1621). This springtime movement to the coast to catch lobster was supported by Morton "…savages will meet 500 to 1000 at a place where they come in with the tide to eat and have dried a store, abiding in the place for 4-6 weeks feasting and sporting together." (Morton 1637:90).

The drying of shellfish and fish took place in the spring and summer as William Wood observed "In summer these Indian women, when lobsters be in their plenty and prime, they dry them to keep for winter" (Wood 1634:114). Vegetable foods did not need to be dried with the use of smoke, they were usually placed on mats on the ground in the sun. Corn was probably the most common vegetable food dried for storage. Roger Williams recorded the process for drying corn in 1643 "they doe carefully upon heaps and mats many dayes, before they barn it up, covering it up with mats at night, and opening when the sun is hot. The woman of the family will commonly raise two three heaps of twelve, fifteen, or twentie bushels a heap, which they dry in round broad heaps; and if she have the help of her children or friends, much more." (Williams 1643: 171). The corn is simply piled up in heaps and allowed to dry during the day. The corn may have been left on the cob to dry this way, or it may have been taken off and the heaps were turned over each morning, so that the whole heaps dries evenly.

Nuts and berries were probably dried in a similar way. Specifically for the Native people in southern New England, we know that they used cherries, strawberries, cranberries, barberries, grapes, blackberries, blueberries, and hurtleberries (Williams 1643:169). Archaeologically, raspberries, and hack berry can be added (Wheeler, Greenwich Cove). Among the Iroquois, huckleberries, thimble berries, high bush cranberries, nannyberries, mulberries, elderberries, gooseberries, dewberries, wintergreen, and June berries were also used (Parker 1968:95). It does not appear that all of these were dried for the winter though. The Iroquois dried cherries, blackberries, black raspberries, huckleberries, blueberries, strawberries and elderberries (Parker 1968:97). It is known that in our area, Currants (Attitaash) were dried, and it can be expected that the same berries as were dried by the Iroquois, most probably were dried in this area as well.

The nuts appear to have been shelled and dried out hard to be stored away. The nuts most commonly used were Acorns, Beechnuts, Black Walnuts. Any of the nuts, once gathered were shelled and/ or processed immediately. Hickory nuts may have been dried with the shells on, as they were among the Natives in Virginia. In this case, the whole nut, shell and all, was crushed in a mortar and then all was placed in boiling water and the shells fell to the bottom (Smith 1612:). Once the meat was removed, it was crushed in a wooden bowl and thrown into boiling water, the oil skimmed off and the meats dried (Parker 1968:101).

This was also the case for the acorns, which needed special boiling in lye to remove the oils (Williams 1643:168). Following the removal of the oil, the acorns were parched on the hot coals of the fire and then either stored or ground in a mortar and used (Parker 1968:101: De Bry 1588:19). Acorns that had been parched, were placed in baskets and stored in storage pits, to be used in the winter. This is what the colonists discovered on Cape Cod in 1620 (Winslow 1620: 145) Chestnuts were boiled and the meats dried, this is probably what Roger Williams meant when he stated that "The Indians have an art of drying their chestnuts, and so to preserve them in their barnes for a daintie all yeare." (Williams 1643: 168). The drying of the nuts may have been similar to that noted for hickories among the Powhatan in Virginia " Then doe they dry them again upon a mat over a hurdle.." (Smith 1612:)

After these foods were dried out, many of the vegetable foodstuffs were placed in storage pits (Auqunnash), what the English termed "barnes". The best description of this is by Thomas Morton in 1637 "They are careful to store food for winter, they eat freely of it but put away a convenient portion to get them through the dead of winter. Their barnes are holes made in the earth, that will hold a hogshead of corn a peece in the. In these (when their corn is out of the husk and well dried) they lay their store in great baskets (which they make of sparke) with matts under, about the sides and on top; and putting it into the place made for it, they cover it with earth.. to be used in the case of necessity and not else." (Morton 1637:42). These are the type of storage pits which the colonists found in 1620 on Cape Cod wherein they found "a bottle of oil, bag of beans...2 to 3 baskets parched acorns" and several bushels of corn (Winslow 1621:141; 155). One storage pit was identified archaeologically at the Sandy’s Point site in an area containing predominantly Late Archaic remains.

There appeared to be seasons for collecting diverse sorts of foods. This largely depended upon the arrival of the species in the area. For example, Winslow stated that "As fowl decreases in March, so the fish increases" (Winslow 1621:294). Whereas Josselyn stated that for fishing at least “Their fishing follows spring, summer, and fall of the leaf first for lobsters, clams, fluke, lumps or plaise, and alewives, afterwards for bass, cod, rock, bluefish, slamon, lampreys and such." (Josselyn 1674:100).

After the arrival of Native corn circa 1100 AD the Natives appeared to have cut back on some of their collecting practices. The species that had been collected more heavily in past times, such as nuts, were now used more as a fall back when the corn crop did not do well. Williams stated that in some years, more nuts would be harvested than in other years, depending on how well the corn crop had done that year (Williams 1643: 168).

The centuries prior to the incorporation of horticulture into the culture of the Wampanoag can be seen as setting the stage for it. The collection and storage of the wild plants and animal meats and the scheduling of a seasonal migration cycle to exploit them, meant that the planting and tending of crops was just another activity to carry out in the spring, summer and early fall. The Natives would have been camped by the rivers and sea during the summer even before they had horticulture. The best soils for planting are in these same locations as well so the burden placed upon the society would not have been seen as having been so excessive that they would not have bothered. It was stated in a number of sources that the fields did not require a great deal of tending as well. Williams stated that oftentimes they would sometimes have fields a mile or two apart and would work on one field and then move to the other and work that one (Williams 1643:128).

The faunal remains from Feature 29 and feature 1 show how the nature of fishing and shellfishing changed after the incorporation of corn into the Native diet. At feature 29 hooked and netted fish accounted for 68.9% of the total meat which was contributed to the diet while at feature 1 fish accounted for only 25.6% (Table 16). The difference has

Table 16. Comparison of dietary contributions between features

	Feature 29	Feature 1

Fish	69.2 kg (68.9%)	8 kg (25.6%)
Shellfish	23 kg (22.9%)	16 kg (51.1%)
Mammal	6.2 kg (6.2%)	7.3 kg (23.3%)
Bird	2 kg (2%)	0
Totals	100.4 kg	31.3 kg

to due with the lack of netted fish at the site, the capture of one sand tiger shark that yielded 48 kilograms of meat and a greater amount of shellfish harvested. The differences between the two features in general may also relate to the arrival of corn in the northeast after the creation of feature 29.

Feature 29 was probably created at the same time as one house and several firepits/ roasting pits which are located very close to it. This portion of the total site area excavated probably represents a family or two of Natives living on the point with their primary motivation being the collection of shellfish and fish for winter use. This resulted in the creation of the fairly large shell midden near the erratic. There was a variety of shellfish and fish species that were intensively harvested and stored for the winter.

Feature 1 on the other hand is located some distance away from the other features. This may have been due to the fact that the creators of this feature were more focused on ocean fishing than on making use of the fish in the cove. It appears that they continued to harvest shellfish from the cove but the feature's location suggests that it was no longer a main focus. The shift away from the cove and the harvesting of net fish at the site may also relate to the planting and harvesting of cultigens in this more recent occupation.

It is not known if this feature was created at the same time as the cornfield at the site, but if it was then this might explain the lack of net fish. If the occupants at the site were now planting and harvesting even the eighth of an acre field represented at the site, this probably would have provided the family with an appreciable amount of storable food for the winter. The family would then not have relied on the netted fish to as great of an extent as the people who created feature 29. They do still appear to have focused on the harvesting of shellfish possibly for winter storage. It also may be possible that this feature was more specialized than feature 29. If feature 1 was used solely as a shellfish processing pit whereas feature 29 was possibly a processing pit but also seems to have received a wider variety of domestic trash, then feature 1 would not have had the debris from a wide range of activities present.

In either case, it is fairly apparent when the chart of the percentages of available meat are graphed that the two features are dissimilar enough that something different must be going on during the respective periods. When these features are compared with two other sites the differences are even further highlighted.

The available meat present from feature 29 and feature 1 was compared with the available meat percentages from the Calf Island site in Boston Harbor (Luedtke 1980) and the Wheeler site on the Merrimack River (Barber 1982). The plotting of the meat weights for the various classes of faunal remains for the four sites resulted in the Calf Island site and feature 29 having similar plots and the Wheeler site and feature 1 having similar plots.

Both feature 29 and the Calf Island site have been interpreted as having a significant portion of their faunal remains in the form of fish. The use of nets with which to capture the fish has been posited for both assemblages as well. The two assemblages do differ in the occurrence of the bird remains. The Wheeler site and feature 1 have both been interpreted as having shellfishing as their primary focus. This can be seen on the plot by the high percentage of shellfish remains to other types.

Looking back at the ethnohistoric data presented for the southeastern Natives subsistence system, it is believed that these assemblages all represent specialized procurement sites that were part of a larger generalized procurement system. The focus at the Calf Island site appears to have been fish and birds. This seems fairly logical given the site location which was prime for the harvesting of diverse fish species and the hunting of birds, cormorants especially. Feature 29 was located on the western edge of an estuarine cove in which seasonal runs of a small variety of fish species would have been present. The Wheeler site is notable for its extensive evidence of the harvesting and processing of soft-shell clams while feature 1 appears to have been created specifically to process various types of shellfish. All of the sites had other species present as well. These species were collected during the occupation of the site to provide food for the creators while the species most intensively harvested provided winter stores. Once the harvesting of those specific resources for winter was completed, the site was abandoned and the inhabitants left for their winter quarters where they would prepare for the winter hunt of deer.

IX. CONCLUSION

The excavations at Sandy' s Point resulted in the recovery of a large number of interesting and unique features. These ranged from a complete Native contact period planting field to series of postholes outlining houses. The two features that form the basis of this work were two of the largest and certainly the most densely packed with faunal remains. Feature 29 and feature 1 differed in many ways such as their size, age and specific faunal composition but they were similar in many ways as well. It was noted during the analysis of these features that while the specific composition of the features differed they generally contained the same types of faunal remains. Both yielded abundant shellfish remains of most of the same species. Both contained sizable vertebrate faunal assemblages as well. As the analysis progressed it was determined that both features may have had very similar functions as well.

Noting the differences and similarities of these assemblages it was determined that they could provide data relating to the subsistence practices of two separate groups of people at a critical time in northeastern history. The people who created feature 29 live approximately 930 years ago while those who created feature 1 lived approximately 360 years ago. the period between these two dates corresponds with the introduction of maize horticulture in the northeast. Because the faunal remains were such a large element of these features, it was hoped that a comparison of the remains between the two features would highlight differences in subsistence strategies prior to and after the introduction of horticulture.

The differences which were found between the features were found to revolve around three central issues: 1) the occurrence between clams and oysters; 2) the evidence of hook and line and net fishing; 3) the relative contributions to the total diet of fish and shellfish. The investigation into these differences used three main sources of evidence to explain them. These were ethnographic and ethnohistorical records, environmental and habitat information, and the archaeological record from this and other comparable northeastern sites.

Each species was investigated fully by providing information from each of these sources for all of the invertebrate and vertebrate species present. This information was compared and contrasted to determine what taphonomic processes may have work to create the assemblage being investigated. When this was controlled for and the species that were accidental inclusions or commensural species were eliminated, analysis of the differences could proceed.

From the features a total of seven gastropod and six bivalve species were recovered. It was determined that of the seven gastropods, the channeled whelk, the knobbed whelk, the mud whelk, and the Atlantic slipper shells were the only ones that contributed to the diet. the others being accidental inclusions. The bivalves presented similar situation.

The quahog, soft-shell clam, oyster and scallop were determined to be the only species consumed. The occurrence of the quahog and whelk species differed between the features but the proportion of clams to oysters showed the greatest difference. The proportion in feature 29 of clams to oysters was 1:3.9 whereas in feature 1 it was 2.8:1. The proportion of occurrence shows an almost complete reversal. The determination of why this was so was considered important enough to warrant further investigation.

The clam and oyster assemblages were further studied using a variety of analytical techniques that sought to determine what factors led to this decline over time. The techniques used focused on three premises which would explain the decline over time: 1) the change was the result of simple over harvesting of the species over time; 2) the change was the result of a technological advancement which led to the Natives ability to harvest the clams, formerly an inaccessible resource; 3) the change was the result of local environmental/ habitat changes in the collecting area which led to less favorable conditions for oysters and more favorable conditions for clams. Each of these scenarios was investigated.

The assumption that the change was the result was from over harvesting was investigated by comparing the sizes of the clams, oysters and quahogs from the two features. The quahogs were included in the comparison to provide a third test of the over harvesting hypothesis. If any of the three species showed a decline in size over time then it could be possible that this was the reason for the difference. This was not found to be the case. In fact, it was found that the relative sizes of the species actually increased between the creation of feature 29 and feature 1 indicating a period when the shellfish were not harvested at all before the feature 1 harvesting.

The issue of technological change was the most tenuous of the three propositions and because of the fact that both species had been harvested during the earlier period and the fact that the ethnohistorical record does not state that any special tool was ever used, this theory was dismissed.

The final issue, that of habitat change between the time of the creation of the two features was investigated and found to be the most likely explanation. The first step was to determine the habitats that the two species had inhabited during their respective periods. This was done for the clams using techniques outlined by Barber (1983) for his study on the clams from Morrill Point. These were the comparison of the thickness of the posterior abductor scar and the comparison of the roughness and degree of deformation of the surface of the shell. The findings from the two features were then compared with Barber's findings and it was determined that the substrate for the clams for both of the features was a gravely mud and the source of both assemblages was most likely the cove adjacent to the site.

The oysters were analyzed using techniques outlined by Kent (1992). These techniques were the determination of the type of oysters present and the analysis of the epibiont species present on the shells. It was determined using the height to length rations that the oysters from the site were intertidal bed oysters from mixed muddy sand. The presence of one ribbed mussel fragment on an oyster indicates that they were probably anchored on the salt marshes bordering the cove. The epibiont analysis indicated that between the creation of the two features the salinity in the cove had changed and become more saline.

The scallops from the site were determined to also bear evidence of a change at least in the amount of material being deposited within the cove. Because their presence increased over time, it was determined that the eel grass within the cove must have increased. This was probably due to the silting of the cove. This change in salinity and increased silting may have been the result of the opening of a channel either at the western edge of the cove off to the east on the southeastern edge of the island. This rift may have had a detrimental effect on the salt marshes and caused the to deteriorate, causing the silting of the cove. This may have created an environment in which the oysters still survived but did not flourish as they had before.

The vertebrate faunal species also showed significant differences between the features. The presence of two mammalian species, the woodchuck and the white-footed forest mouse, were determined to have been accidental and commensural. So too were the reptilian remains recovered. All of these species were recovered from feature 29. The deer remains were remarkably similar between the features but the fish remains were very different.

Feature 29 contained the remains of six fish species while feature 1 contained seven. Three of the species from feature 1 were determined to have most likely arrived at the site within one of the larger fish. These were the herring, scup and little skate. The main difference between the fish remains in the two features was the presence of the cod and the hake in feature 1. It was felt that the presence of these two fish might have indicated a difference in the seasonality of the creation of the features. This seasonality could have accounted for the differences in shellfish as well as fish species present.

As a means of controlling for seasonality, three techniques were used. First, the distribution of the species with the features, especially feature 29, was explored. It was felt that is the same species occurred throughout the feature then it could be safely said that the features were created in a relatively short span of time. It was found that this indeed did appear to essentially be the case. The only difference was the occurrence of the tiger shark in the lower levels of feature 29.

The second means of controlling for seasonality was by looking at the habitats and migration patterns of the various species to determine when they would have been present at the site. Using this technique it was determined that feature 29 was created in the late summer to fall while feature 1 was created either in the spring or the fall.

As a way of narrowing the seasonality down further, fish vertebrae that had their outer growth margins preserved were selected for seasonality determination. It was found that all of the vertebrae from both features were from fish captured in the fall, just before the winter growth began.

Because both of the features appeared similar as to the time when they were created the differences between the species present must be due to something else. Once the smaller fish that may have been gut contents were eliminated from feature 1, it was noticed that the other fish all represented larger species. The technology that was used to catch the fish present was suspected to have played a role in the species present. In order to investigate this, lengths and preferred substrates of each of the species were determined.

It was found that the fish from the two assemblages fell into two types, larger ocean species and smaller estuarine species. The differences between the two features were determined to have probably been the result of the use of hook and line and net at feature 29and just hook and line at feature 1. Ethnographic and ethnohistorical data supported this assumption as did work by other researchers.

The final major difference between the two assemblages was noted when the total meat weights for all utilized species were tabulated and graphed. An appreciable difference was noted between feature 29 and feature 1 in the amount that the shellfish and fish contributed to the total weights. At feature 29 it was found that fish contributed the most meat to the diet while at feature 1 shellfish did. This difference was investigated by looking at the assemblages in terms of specialized intensive procurement systems versus generalized diffuse systems. Intensive specialize systems focus on a few resources to the exclusion of other. Generalized systems utilize a wide range of species but do not store them or have specialized technology for procurement, processing and storage.

When the ethnohistoric record was looked at, it was found that neither of these systems completely explained the southern New England Native procurement system. It was determined that the system in effect during the historic period was one that can be described as a diffuse intensive procurement system. This is one that utilizes a variety of resources but does so intensely when they are available. Many of them are procured using special technology such as nets and are stored for the winter. When the Native system is viewed this way, it explains the ethnohistorical record as well as the occurrence of sites at which specific resources have a high occurrence. It also helps to explain how horticulture may have been incorporated into their procurement system as merely another resource to store for winter.

In total, the two features looked at for this thesis represent the exploitation of similar resources by similar people at approximately the same time of the year. However, due to environmental as well as possibly cultural factors, the various resources were not exploited to the same extent during the two periods. Ethnohistorically and ethnographically the people known today as the Wampanoag made extensive use of the marine resources available to these "People of the dawn". Spring through fall marked the time when the majority of people's collecting and hunting strategies focused on the sea. Fish were hunted and trapped and a variety of shellfish were collected with many of both classes being smoke dried and stored for the winter. With the winter move into sheltered valleys slightly inland, their procurement focus then shifted to deer and other mammals whose thick layers of fat would supplement their own for the late winter.

Shellfishing continued in the winter it appears both ethnohistorically and archaeologically. Many of the middens identified on Cape Cod containing extensive remains of their forays to the shore. This was possibly done during less severe winter months or when food supplies ran low. This was a pattern that was probably followed for much of the Late Woodland and into the contact period. The introduction of maize horticulture circa 1100 AD does not appear to have changed their patterns to a great degree. This may have to do with horticulture not having been practiced as extensively as it was among more inland Nations such as the Iroquois.

The features at this site do appear to possibly show some degree of change on a smaller scale. It is known that horticulture was being practiced at this site at approximately the same time as feature 1 was created. However, it is not known if this feature is contemporaneous with the field at the site. If it is then possibly this feature represent a decreased reliance in the fall on smaller fish which could be caught with nets and a greater reliance on larger fish which may not have been dried and stored. These larger fish, like the deer, may have been consumed soon after they were caught. This fact may have to do with the reliance on horticultural crops for the winter stores supplemented by shellfish or it may be a response to changing conditions within the cove that did not allow for netting of fish. In either case, the faunal remains from these two features highlight differences that form part of the larger study of New England middens and from which studies that look closer at the individual differences between middens should begin.

All of the available data seems to fit this final hypothesis quite well. the island is a fairly secluded location. At one time it was in fact an island although a bridge now connects it to the mainland and the amount of area available on Sandy's Point was never enough to have supported a large number of people for a great amount of time. The site initially circa 1100AD may have had more importance as a shellfishing and fishing location, whereas by 1640AD with the settling of English towns on Cape Cod and a gradual dwindling of the Native population it had become a planting site. Far enough away from the mainland for the Natives to not be troubled by the English but close enough to remain with village territory. It was probably only one family that planted here at this time for two years or so and then it appears the site was not inhabited again until much later.

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