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Transforming a "Splendid and Delightsome Land": Colonists and Ecological Change in the Chesapeake 1607–1820

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ABSTRACT

The modern Chesapeake Bay is radically different from the estuary observed by Captain John Smith in 1607. In this paper, historical and archaeological data are used to provide a new perspective on the early Chesapeake and its resources during the colonial period. For the first 150 years of settlement, the use of hoe-based agricultural practices produced little soil erosion. Fish exploitation focused upon benthic species, mostly caught with hooks and lines, and had little impact upon fish populations. About the time of the American Revolution, high population densities and economic factors brought about a change in land use to intensive plow agriculture. This produced major surface erosion and a greatly increased rate of siltation in the tributaries of the Chesapeake. It is hypothesized that this significantly altered the ecology of the tributaries and had an impact upon the reproductive success of a number of fish species. Data from sites on the St. Mary's River in Maryland suggest that the composition of fish species in this tributary was altered by the early 19th century. This paper represents an initial effort to synthesize the archaeological and historical data pertaining to the early Chesapeake and its resources. Through the use of these previously untapped data sources, a unique and detailed perspective on the changing ecology of estuaries can be produced.

The first European colonists in the Chesapeake region encountered a remarkably fertile land covered with virgin forests and interlaced with rivers and streams containing an extraordinary abundance of life. Today, the Chesapeake is a shadow of its former self, with species within its once bountiful waters dramatically reduced in both variety and number. To understand the Chesapeake Bay and its current condition, a perspective that extends beyond the span of a single human life is essential. Processes of change require time for their effects to become readily apparent and the transformation of the Chesapeake is no exception. In this paper, the nature of the estuary during the period of European colonization is explored through the historical and archaeological records. Questions to be ad-

dressed include: What species were exploited by the early settlers? How did fish resources and their exploitation change through time? Did colonial land use activities have any impact upon the ecology of the Chesapeake Bay? When did anthropogenic change become a significant factor?

Colonial Demography

The growth and distribution of the colonial population is important and a necessary beginning point. The process of colonizing the Chesapeake region, which began in 1607, was marked by an explosive rate of population growth. By 1635, there were 5000 colonists living in Virginia and this number increased to 60,000 by the end of the century.[1] Maryland experienced an equally rapid growth rate. Following its establishment in 1634 with about 150 settlers, the population grew to 34,000 by 1700, reached the 100,000 mark about 1740 and by the end of the colonial period, there were over 300,000 people in Maryland.[2]

During the 17th century, this population was concentrated in the Tidewater areas. Colonists lived on isolated plantations scattered along the numerous rivers and creeks of the region. Examination of cartographic evidence, especially the Augustine Herman map of 1673, strongly suggests that the colonists had a preference for waterfront property; nearly every plantation depicted by Herman lies immediately adjacent to the water. This distribution is confirmed by archaeological data on site location. Of the 211 known 17th-century sites, 97% lie within one mile of the water and three fourths of these are less than 1000 feet from the shore.[3] This settlement pattern was the result of readily available land, the agricultural focus of the economy, a marketing system reliant upon water transportation and a desire to live near the water for easier travel and exploitation of the estuarine resources.[4]

Only in the 18th century, as the preferred waterfront lands were completely occupied, did settlement expand into the interior sections of the tidewater area and begin in the Piedmont.[5] By the time of the American Revolution, all of the Tidewater and most of the Piedmont of Maryland and Virginia were occupied or actively being settled.

17th-Century Land Use

How did the colonists use the land and what impact did this have upon the estuary? For much of the colonial period, a single staple crop—tobacco—dominated the Chesapeake economy. Tobacco planters attacked the wilderness around them with the axe and hoe, using an agricultural method learned from the Indians. Called slash and burn agriculture, this method first required the cutting of the bark to kill the trees and then the burning of the ground litter to clear the land and release nutrients. Afterward, the rich soil was broken up with hoes, and formed into small hills about one foot high in which tobacco or corn was planted. Good tobacco crops could be obtained from these fields for four or five years, followed by a few years of corn production. The old fields were generally exhausted after six or eight years of use. They were then abandoned to permit reforestation and new fields were cleared. Documents suggest that after about 20 years of lying fallow, the fertility of the old fields was replenished and they could be brought back into production.[6] In essence, planters used a long-term fallow system by which the fields rather than crops were rotated.

With this approach, only a small amount of land was worked each year. One laborer could tend 2 or 3 acres of tobacco, or about 10,000 plants, and another acre or two of corn. In All Hallows Parish, Md., near Annapolis, less than 3% of the land was under cultivation at any one time during the late 17th century.[7] It has been estimated that by the turn of the 18th century in southern Maryland, only about 1.4% of the total land was used to produce the annual tobacco crop.[8] Despite the small quantity of land cultivated annually, a large acreage was needed for the fallow system to operate. To maintain continuous production, 40 to 50 acres of land was required for every laborer.[9]

This agricultural system and the employment of the hoe as the chief agricultural tool have important implications for the Chesapeake during this period. First, only a small portion of land was exposed to surface erosion each year. Second, the agricultural method of planting in hills created a land surface that resisted erosion since the many tiny hills and valleys served to trap much of the water before it could run off. Since the land was recently cleared, the stump-infested nature of the fields also acted to deter the erosional process. This would have been especially effective at retarding erosion on the low relief lands cultivated during the 17th century, but even on lands with greater slope, the hilled fields dotted with stumps would still have provided resistence to soil removal. A third factor is that this agricultural system created a patchwork of land, some being actively farmed, other fields recently abandoned, and former fields in the process of regeneration. Because of this, the cleared fields in production were bordered by vegetated tracts so that runoff water would often have to trickle through scrub or forested tracts before reaching streams, thus helping to trap sediment. An absence of huge open fields also meant that the forces of the wind could not act to erode and deflate the land. As a consequence, soil erosion produced by humans was minimal during the 17th and early 18th centuries and hence, the estuary probably experienced little increase in sediment loads.

Evidence suggests that this form of land use not only produced minimal erosion but preserved the soils' fertility. European travelers to the Chesapeake during the colonial period often commented on the abandoned, exhausted fields and viewed the planters as wasteful and negligent in agricultural matters. What they and many 20th-century agricultural historians failed to realize is that the fields were only temporarily exhausted and the apparent abandonment was merely a replenishment phase during which fertility was restored.[10] This shifting fields system was an efficient, self-sustaining approach that did not destroy soil resources so long as the proper ratio of laborers to land was maintained to allow a sufficient fallow period.[11] Instead of declining crop yields from exhausted soils, recent historical research has revealed that the amount of tobacco produced per laborer in Tidewater Maryland remained essentially constant throughout the colonial period, strong evidence that the soils' fertility was preserved.[12]

17th-Century Fish Usage

What fish resources were exploited during this period and how were they harvested? Historical accounts of the period frequently describe the varieties of fish encountered by the colonists. In 1614, Ralph Hamor wrote that

> For fish, the rivers are plentifully stored with sturgeon, porpoise, bass, rockfish, carp, shad, herring, eel, catfish, perch, flat-fish, trout, sheepshead, drummers, jewfish, crevises, crabs, oysters, and diverse other kinds.[13]

Unfortunately, these accounts cannot be considered solid evidence for the presence of a species since the names were often imprecisely applied, and they reveal little of how abundant different species were. The historical record is nevertheless quite valuable and provides important insights. Household inventories, for example, reveal the types of fishing equipment owned by the colonists at different times. Study of inventories from southern Maryland and York County, Virginia, dating between 1640 and 1745, indicates that the predominant fishing equipment was nothing more elaborate than hooks and lines. In the

sample of nearly 900 Maryland households, 95% of the homes with fishing gear only had this; the others had fish gigs or nets in addition to hooks and lines. Surprisingly, most of the homes with fish gear did not own boats or canoes. It thus appears likely that the major fishing method consisted of throwing the baited hook and line out from the shore, with the hook resting on or near the bottom. This is a significant piece of information because it indicates that for most of the colonial period, fishing efforts focused upon the benthic habitat in relatively shallow waters. What fish were being caught by the colonists with this simple technology?

Archaeological Data and Fish Usage

To learn about the nature and exploitation of fish resources in the past, it is necessary to consult the archaeological record which contains the physical remains of the species caught by the colonists. Through the study of these faunal materials, it is possible to reconstruct the meat diet of past peoples and gain insight into the environment they occupied. Archaeological data is especially valuable because it is independent of the historical record, can reveal the species actually exploited by the colonists and provides some insight regarding harvesting intensity.

Archaeological data are not without biases, however. The fish remains found at sites do not represent random samples of all the species in the estuary. Their presence is determined by a variety of factors. Some species, due to flavor or other reasons, may be preferred by a group of people and consistently exploited while other fish are used infrequently or not at all. Nevertheless, when similar species are found at multiple sites in a specific area, it is possible to make some inference regarding species availability in the past. The presence of an animal at a site is also related to the harvesting technology employed by the occupants because a particular type of equipment may be effective in only one habitat or only capture certain species. Fortunately, the study of household inventories and other documents reveals that the hook and line was the primary fishing gear used in the Chesapeake so that the fish remains from most colonial sites were obtained with the same technology and from similar habitats. Another potential bias is the differential preservation of bones. The effects of this problem can be partially accounted for by the analyst through careful selection of the samples and consideration of variables such as soil acidity and site hydrology that affect preservation. Faunal preservation on the sites discussed in this paper ranges from good to excellent.

Despite potential biases, if the archaeological remains from the Chesapeake are studied and interpreted with caution, they can provide a unique temporal perspective on the estuarine ecosystem and its changing resources. Samples of faunal materials are available from 24 households dating between c. 1620 and c. 1750 in Maryland and Virginia.[14] All of these sites are located near the shores of the Chesapeake's tributaries, mostly on the James and Potomac Rivers (Figure 1). Given the simple, agrarian nature of society during the colonial period, there is unlikely to have been much seafood marketing and little evidence exists for commercial fishing until the later 18th century. Most of the sites were tobacco plantations that were self-sufficient in food. Planters raised their own meat and grains and exploited the nearby forests and streams for wild game. Consequently, it is very likely that the species found on these rural sites were obtained locally. Faunal remains from 18th and 19th century urban sites, however, derive from complex marketing networks so that it is difficult or impossible to determine precisely where the fish were obtained. Hence, urban faunal samples offer less potential for evaluating ecological change in estuaries, except on the most general level.

An important variable in the sample of archaeological materials discussed here is

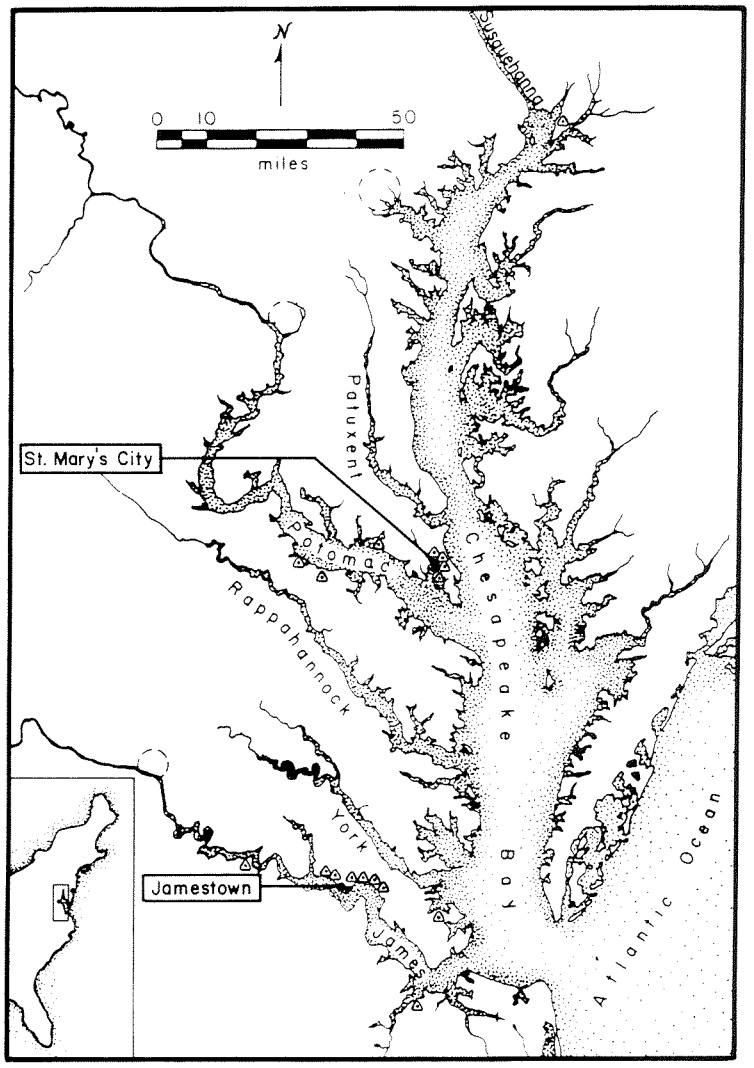

Fig. 1. Distribution of colonial archaeological sites from which faunal samples have been studied.

the geographic location of the sites. This is significant because one of the most powerful environmental factors in estuarine systems is water salinity, which changes from marine to fresh in a discernible gradient. A knowledge of prevailing salinities in the waters adjacent to sites therefore provides the means of dividing the sites into two ecologically meaningful samples. These are (1) sites along low salinity streams near the salt/fresh water interface (Tidal Fresh and Oligohaline), and (2) sites along moderate to high salinity waters (Mesohaline to low Polyhaline).

The low salinity samples are from sites on the James River in the vicinity of Jamestown, which is approximately at the salt/fresh water interface (Figure 1). Fish recovered from these sites are primarily fresh to brackish water species and anadromous fishes (Table 1). Catfish and white perch are the most abundant but bones of the striped bass and longnosed gar are also commonly found. Sturgeon appear consistently on sites located around Jamestown and at Flowerdew Hundred, located further upstream near Hopewell, Virginia.[15] They appear to be more abundant on sites in low salinity areas. Remains of oysters and the blue crab occur on most of the sites, sometimes in large quantities.

Sites located along higher salinity waters yield a quite different assemblage of species. These samples derive primarily from the lower Potomac area, although data are also available from a site on the lower James River and one on the lower Chesapeake near the York River. Marine species predominate on these sites, especially the sheepshead and black drum (Table 1). The sheepshead is the most abundant of all the fish, accounting for a large proportion of the bone and identified individuals. This is consistent with the historical record which suggests that the sheepshead was both abundant and considered an excellent tasting fish. One traveler in 1676 observed that

> A Planter does oftentimes take a dozen or fourteen [Sheepshead] in an hours time with hook and line.[16]

White perch and red drum are consistently recovered from these sites and striped bass bones occur occasionally. Sturgeon remains are rare. Oyster and blue crab, on the other hand, are found in abundance on most sites. It is notable that at the one site on the lower Chesapeake, located adjacent to high salinity waters, sheepshead and red drum predominated with black drum also present in considerable numbers. The remains of blue crab and oyster were also found at this site but no other fish were identified.

Since fishing during this period focused on bottom habitats, it is not surprising that the pelagic feeders such as bluefish, weakfish, and sea trout are absent. It is notable, however, that several species that are present in the modern benthic community were not identified in any archaeological samples. Among these are spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias oundulatus*), and the kingfishes (*Menticirrhus* sp.). Their absence is surprising since they can be taken with the same gear used to catch the species that were present on the sites. This may indicate that the populations of these species were much smaller during the 17th century.

Table 1—Fish identified in 17th-century archaeological deposits in the Chesapeake region.

	Upper James River	Lower Potomac River
Abundant[1]	Catfish *Ictalurus* sp. White Perch *Morone americana*	Sheepshead *Archosargus probatocephalus*
Common[2]	Striped Bass *Morone saxatilis* Longnosed Gar *Lepisosteus osseus* Sturgeon *Acipenser sturio*	Black Drum *Pogonias cromis* Red Drum *Scianops ocellata* White Perch *Morone americana*
Present[3]	Black Drum *Pogonias cromis* Red Drum *Scianops ocellata* Sheepshead *Archosargus probatocephalus* Sea Trout *Cynoscion* sp. White Sucker *Catostomus commersoni*	Striped Bass *Morone saxatilis* Longnosed Gar *Lepisosteus osseus* Sturgeon *Acipenser sturio* Oyster Toadfish *Opsanus tau*

[1]Species represented by multiple individuals at all sites.
[2]Species represented by one or more individuals at most sites.
[3]Species occasionally represented by a single individual.

Overall, the species found at sites matches those to be expected on the basis of the prevailing salinities in the adjacent waters. Occasionally, however, marine species such as the black drum and sheepshead occur on sites located in areas where modern water salinities are too low for them. Black drum bones were recovered at a site occupied c. 1660–1680 on the Elk River at the head of the Bay, miles beyond the modern range of this species. Similarly, a few remains of black drum, red drum, and sheepshead have been recovered at 17th-century sites near Jamestown, Virginia, where the waters today are of very low salinity. The presence of these bones could be explained by the marketing of fish caught in higher salinity waters but there is no historical evidence for this and it is unlikely given the settlement pattern and simple economy of the period.

On the other hand, these bones may be evidence that high salinity waters once extended further up the Bay and its tributaries during the summer and early fall, thus extending the range of these marine species. Before the lands in the James and Susquehanna River watersheds were extensively cleared by settlers, it is likely that the rate of fresh water inflow was considerably less than today. This would have permitted saltier waters to move further up the estuary, especially during years of dry weather. Although data from many additional sites are necessary before this can be further evaluated, it does suggest that insights regarding past species and salinity distributions can be derived from the archaeological record.

During the 17th century, seafood was a very important component of the colonists' diet. Archaeological evidence reveals that fish, oysters, and crabs were heavily exploited and they account for up to one fifth of the total meat at some sites; seafood may have been even more significant seasonally.[17] Sheepshead, black drum, sturgeon, striped bass, and catfish were the major contributors to the diet. Nevertheless, given the small number of humans in the Chesapeake during the 17th and early 18th centuries compared to the abundance of resources, is unlikely that the colonists had any impact upon the fish populations.

What about resources that are non-migratory, such as oysters? Shells from most sites of the period are large, suggesting that oysters were abundant and under little harvesting pressure. With the colonists living in plantations thinly scattered along the rivers and creeks, it is unlikely that oysters were overexploited. Was this any different in the vicinity of the few colonial towns?

Data are available from Maryland's 17th century capital of St. Mary's City. Founded in 1634, it was the center of government and chief town in the colony until 1695 when the capital was moved to Annapolis. At its height in the 1680s and 1690s, St. Mary's had perhaps 200 permanent residents, and the population was considerably larger for short periods each year when the courts and Assembly met. Following the move to Annapolis, most of the people left St. Mary's and the former townland was slowly transformed into an agrarian landscape.

Through excavations at several sites in St. Mary's, well dated samples of oyster shells have been obtained from throughout the 17th and early 18th centuries. Analysis of these shells by ecologist Bretton Kent[18] has revealed a significant temporal change in their size (Figure 2). The median size class of shells in the early 17th

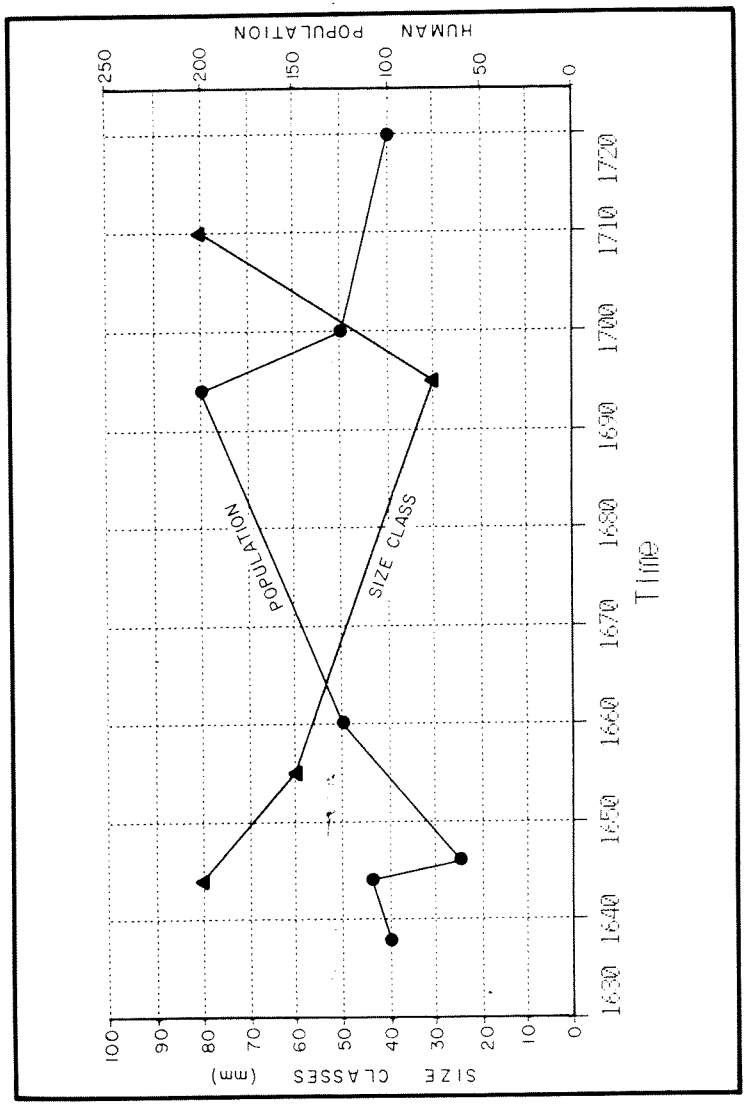

Fig. 2. Relationship of oyster shell size to the human population at St. Mary's City, Maryland.

century was 80 mm, but by the late 17th century, this fell to only 30 mm. In the early 18th century, the size again rises to 80 mm. This rapid change over the course of 60 years is in all probability the result of harvesting pressure on the St. Mary's River oysters. A plot of the estimated human population reveals that there is a strong inverse relationship between shell size and the number of humans. Such a relationship is probably due to the intense exploitation of the oysters so that there was insufficient time for them to reach a large size. When the government moved to Annapolis, the harvesting pressure was quickly reduced. This is the earliest evidence yet found for the overexploitation of a Chesapeake resource and reveals that even small numbers of humans could have a serious impact if harvesting of shellfish was uncontrolled.

18th-Century Fish Usage

Did the 18th-century colonists use the Chesapeake resources in a similar manner and with the same intensity? Archaeological excavations on sites occupied between c. 1700 and c. 1750 indicate a dramatic decline in the frequency of fish remains. On the lower Potomac sites, fish make up only 1.5% of the bone samples, compared to an average of 34% on the 17th-century sites.[19] James River sites display a similar decline. The reasons for this remarkable change are not fully understood, but it is likely that the colonists began to place more emphasis upon domestic animals. Remains of domestic species predominate on the post-1700 sites and they account for over 90% of the estimated available meat. Consequently, wild species no longer served as major staples of the diet in the way they had during the earlier decades of settlement. Thus, the change in the intensity of seafood usage probably relates to a shift in the cultural adaptation of the colonists. Seafood was still consumed but it was more of a supplement than a staple in the diet.

Most of the sites studied from this period are located on the lower Potomac River. The few faunal samples from the James River sites contain the remains of catfish and sturgeon. Sites along the Potomac continue to yield bottom-oriented species such as sheepshead, black drum, red drum, white perch, and oyster toadfish, along with summer flounder (*Paralichthys dentatus*). Examination of household inventories from this period reveal that the hook and line remained the predominant fishing method but suggests a slight increase in the usage of nets. From the John Hicks and Van Sweringen sites in St. Mary's City, Maryland, have come the first identified elements from the bluefish (*Pomatomus saltatrix*) and the herring family (Clupeidae) in the Chesapeake. The later specimens appear to be from menhaden (*Brevoortia tyrannus*), although species identification in this family is difficult with faunal remains. Both are pelagic fish that often feed near the surface, and menhaden are a favorite food of bluefish. Significantly, most members of the herring family cannot be taken with a hook, but must be netted. Examination of the historical situation in St. Mary's and household inventories from the area suggests that these fish were taken with a seine, owned by the most wealthy man in the vicinity. Seine hauling appears to be the only type of net fishing method used with any frequency during the colonial period, and inventories reveal that the seines were generally owned by the very wealthy. Such an ownership pattern is probably due to the fact that the cost of purchasing, maintaining, and using a seine was considerable, and that preparation of the catch required much labor and large amounts of high quality salt for preservation. Lack of good salt was a serious problem throughout the colonial period and it probably deterred the development of commercial fishing.[20] References to the use of seines by wealthy plantation owners, including George Washington, become more common in the second half of the 18th century, and some commercial fishing ap-

pears to have begun in the 1760s and 1770s, primarily for herring and shad.[21] Prior to that time, there seems to have been little harvesting of the pelagic fish species in the Chesapeake Bay.

Oyster remains evidence another change in harvesting technology. Shell shape reflects the environment in which an oyster grew and this fact can be used to determine the habitat from which they were harvested. On the 17th century sites, all shells tend to be round or oval in form, indicative of growth on firm bottoms. Certain features of the shells suggest that they were collected from reasonably shallow waters, probably using short rakes or by wading out at low tide. On the 18th century sites, however, a new shell form appears. At the John Hicks site in St. Mary's City (occupied 1721–c. 1740), long narrow shells of large size were recovered. These are the shells of channel oysters, so called because they are found in deeper water habitats with silty bottoms, such as channels. Their form is a product of the oysters' need to rise above the turbidity layer caused by daily tidal action so that their gills are not repeatedly clogged with silt. Their presence at the Hicks site is evidence for the use of a new type of equipment in harvesting—tongs. Historical data from Maryland shows that oyster tongs first appear in household inventories in the early 18th century, and there is evidence that tongs were being used in Virginia by this time.[22] Thus, a new harvesting technology was being employed that permitted oyster beds in deeper waters to be exploited for the first time.

18th-Century Land Use

Evidence regarding human exploitation of the Chesapeake during the colonial period suggests that these activities had minimal impact upon the abundant aquatic resources. What about the resources of the land? Slash and burn agriculture in a long-term fallow system continued throughout much of the 18th century, along with some plowing. During the last decades of the 1700s, however, a complexity of factors—demographic, economic, and social—led to the abandonment of this traditional agricultural system.

The major factor was human demography. By the last quarter of the 18th century, the size of the human population in the Tidewater areas reached the point at which traditional agriculture could no longer continue. Population densities in areas such as All Hallows parish, near Annapolis, Maryland, increased from 18 people per square mile in 1705 to 42 at the beginning of the Revolution. A similar pattern occurred in Prince Georges County, Maryland where the population density reached 39 per square mile by 1776.[23] As such densities were reached, planters essentially ran out of space in which to continue the long-term fallow system. Along with this increased population and reduced availability of lands came a predictable rise in land values. A result was that the system of land tenure changed from one based on long-term leases for up to three lifetimes at low annual rents to short term leases with high rents.[24] This may have been intensified by inflation and the unstable grain and tobacco markets that followed the Revolution, when land owners opted for quick, short-term profits from their holdings. Plantations worked by a tenant family and perhaps a few laborers in a rotating field system often gave way to small leaseholdings intensively cropped by gangs of slaves.

Good markets for grain and the need for greater yields per acre encouraged many planters to turn to grain production and intensive plow agriculture. The shifting field agricultural system, which had yielded good crops for over 150 years, rapidly gave way to a new method of intensive cropping that essentially mined the soil of its fertility while providing little opportunity for it to be renewed through natural processes. Plow agriculture had been used by a growing

number of planters since the early 1700s, but it became widespread throughout much of the Tidewater area in the last quarter of the century. A dramatic example of this comes from the tenants inventoried on a tract of land in Charles County, Maryland. In the decades before 1776, only 21% owned plows whereas of those tenants inventoried between 1776 and 1820, 73% owned at least one plow and most possessed several. It has been estimated that the amount of land in agricultural production in southern Maryland rose from about 2% of the total in 1720 to nearly 40% in the early 1800s.[25]

The 18th century also saw the settlement of the Piedmont and clearance of vast tracts of land for agriculture in that area. At the same time, settlement in Pennsylvania resulted in large scale deforestation and the beginnings of agriculture along the Susquehanna River and its tributaries.[26] Most of the agriculture in these areas focused upon grain production using plows. Hoe-based agriculture appears to have given way to the plow much more rapidly in the Piedmont than in the older Tidewater areas.

An understanding of these changes in agriculture is essential because they produced the first major human-induced changes in Chesapeake ecology. In the Piedmont, the large-scale clearance of lands and use of plow agriculture greatly increased rainwater runoff. Hence, the fresh water input into the Chesapeake almost certainly began to increase during the later 18th century. At the same time, soil erosion of the hilly piedmont lands became a serious problem. It was estimated that within 25 years of being cleared, the topsoil on Piedmont fields was washed away,[27] and there are accounts of the large volume of sediment carried by the James river during periods of high water, when it reportedly looked like "a Torrent of Blood."[28] Much of this sediment was probably deposited long before it reached the Chesapeake but it certainly increased turbidity in the streams in the upper Tidewater. This suspension of the chemically rich Piedmont topsoil probably also increased the nutrients in the waters flowing toward the Chesapeake.

In the Tidewater, soil erosion and siltation increased dramatically in a very brief time. Before the Revolution, creeks draining into the Potomac such as Port Tobacco in Charles County and Mattawoman, Piscattaway, and the East Branch creeks in Prince Georges County were all navigable. By 1807, they were silting up and the small ports located along them were being abandoned.[29] Streams on the Eastern Shore of Maryland and near the community of Joppa, north of Baltimore, experienced a similar problem at this time. In Baltimore itself, the port had to be regularly dredged after about 1780.[30] One Tidewater resident, a John Taylor of Carolina County, Virginia, wrote in 1813 that

> . . . few of the channels of the seaboard streams retain any appearance of their natural state, being everywhere obstructed by sands, bogs, bushes and rubbish, so as to form innumerable putrid puddles, pools, and bogs upon the occurrence of every drought.[31]

Most sedimentation in the Chesapeake Bay is a product of natural processes such as shore erosion, which have occurred over thousands of years. Sedimentation produced by the late 18th and 19th century agriculture was different. Consisting largely of fertile topsoil, with a high phosphorous and nitrogen content, this sediment was mostly deposited in the tributaries of the Bay, especially the smaller rivers and creeks. Such a major increase in siltation and the nutrient content of these waters must have had a profound impact upon the ecosystem, especially the benthic habitat. Analysis of sediment samples by Grace Brush confirms that the increased siltation had a serious effect upon the epifauna of these streams (Brush: this volume).

A knowledge of the type of siltation and its location during this period is valuable because it was focused precisely upon the

habitat used by many fish species for spawning or as nursery areas for the young. These include forage fish such as killifishes, silversides, and menhaden, and food fish like flounders, herrings, shad, and white perch. The sudden impact of massive quantities of silt and soil chemicals into the tributaries must have had an impact upon the reproductive success of these and other species. The demersal eggs of some fish, for example, would have been more frequently covered by sediment. There is a strong possibility that the reduction in the populations of some species began in the late 18th and early 19th centuries. A brief survey of historical documents failed to uncover any evidence of a change in fish abundance but this is not surprising. Given the extraordinary abundance of fish that originally existed in the Chesapeake, it would have taken a major reduction in their numbers to be noticeable to the casual observer and thus warrant comment. Accurate records of Chesapeake fish harvests only begin in the mid-19th century and the best data are from the 20th century.

This is of relevance because the later 19th century data cannot be considered indicative of the original abundances. Our fisheries records may begin in the midst of a decline rather than before it started. It is also likely that by the mid-19th century, the composition of the Chesapeake fish population was significantly altered from what it had been when colonization began. More research is clearly necessary but the available data imply that changes in the Chesapeake due to anthropogenic factors were well advanced by the time the first accurate fisheries data became available.

What impact did the extensive siltation have on the fish populations in specific tributaries? Is there any real evidence of a change? To answer this, data are necessary from 19th century sites in the same area where earlier sites have also been excavated. Unfortunately, little effort has been directed at sites of this period in the Chesapeake region but there are some data from 19th-century sites in St. Mary's City that warrant consideration.

Like many other streams in Maryland during the late 18th and early 19th centuries, the St. Mary's River experienced a greatly increased rate of siltation. A good example is a small tidal stream, known today as St. John's Pond, which flows into the St. Mary's River at the site of the 17th-century capital. This stream was open to the river in the mid-18th century and sufficiently deep for sailing vessels to enter and tie up at a landing on the interior. Over the course of the next sixty years, this pond filled with a great amount of sediment and the opening to the river began silting shut. An 1824 map reveals that this entrance was so clogged with sediment that a road was constructed across it.

Faunal materials dating to the 19th century are available from the Tolle-Tabbs site, located one quarter mile from St. John's Pond and within a mile of many of the 17th and early 18th-century sites discussed previously. Tolle-Tabbs was a private home, constructed about 1740, and that stood until about 1860. The vast majority of the archaeological deposits on the site date between about 1830 and 1860, when the structure was occupied by a series of tenants. Faunal remains from these deposits have been studied and they display a strikingly different composition from that found on the nearby colonial sites.[32] Elements from striped bass and bluefish are present, along with bones from members of the Family Clupeidae, probably the American shad (*Alosa sapidissima*). The most abundant remains, however, are from the oyster toadfish (*Opsanus tau*) and especially the striped burrfish (*Chilomycterus schoepfi*). No bones of the readily identifiable burrfish have been found on any colonial site in the area, and toadfish remains are rare. Sheepshead and drum bones are completely absent from the Tolle-Tabbs site, in striking contrast to every colonial site in St. Mary's City.

The absence of these species is almost certainly not due to a reluctance to consume them; the sheepshead was widely regarded as one of the best eating fish in the Chesapeake. Both the sheepshead and drum could be easily taken with the simple hook and line, which even a poor tenant family could have afforded. It is inconceivable that they would have ignored such an easily caught and delicious food source if available, while consuming less desirable species such as toadfishes and burrfishes. The most likely explanation is that sheepshead and drums were no longer present in the waters near the site. Toadfish and striped burrfishes may have become more abundant.

Although not yet analyzed, another sample of animal remains from this period has been excavated at the c. 1840 Brome Plantation, also in St. Mary's City. A preliminary examination indicates that sheepshead and drum remains are very rare or absent in this sample. All of this suggests that there was a significant change in the ecology of the St. Mary's estuary between the mid-18th century and the mid-19th century. In particular, the benthic habitat appears to have been significantly modified. Sediment core analysis by Grace Brush (this volume) reveals that the flora and microfauna in the benthic environment of tributaries was severely affected by sedimentation, thus lending support to the archaeological findings. Although the evidence is still quite limited, it suggests that major transformations of the ecology and the fish populations in the St. Mary's River were occurring during the early 19th century. Almost certainly, other tributaries of the Chesapeake were undergoing similar changes.

Archaeology and Ecological Insights: The Potential

Archaeological sites contain a virtually untapped record of past ecosystems. Fish remains from sites attest to the presence of various species and provide some means of inferring relative abundances. Identifying changes in fish distributions and populations is therefore possible. Determining why they changed is a harder task that requires data on many other aspects of the ecosystem, data that are either non-existant or difficult to extract from the historical record. Fortunately, the same pits and cellars that yield fish remains also contain a diversity of ecological data locked in the shell of the oyster.

Oysters can be thought of as small environmental monitors, constantly recording data about the surrounding aquatic environment during their lives. Through the archaeological excavation and dating of the shells, these molluscan sensors can be placed into a precise temporal sequence and their data banks on the Chesapeake environment decoded. Work by Bretton Kent has revealed the diversity of insights obtainable from the shells.[33] Analysis of the various organisms that lived on or in the shell, for example, can reveal the water salinities and nature of the benthic habitat. Many benthic organisms, such as the burrowing sponges *Cliona* sp., have specific salinity requirements and leave indications of their presence on the shells. By identifying and counting their frequencies on shells, an indication of the prevailing salinities in the waters near a site at specific times can be obtained.

Oyster shells can also tell of the bottom conditions in which they grew. Shell shape, for example, reflects the nature of the substratum upon which an oyster lived. By studying this and other attributes of the shell, the changing bottom conditions in specific locations can be traced over hundreds and perhaps thousands of years. There is the possibility that many collections of oysters from sites can also provide precisely dated samples of bottom sediments. This is due to the activities of the oyster mud worm (*Polydora websteri*) which burrows into the edges of the shell and creates cavities that later fill with sediment. On many shells from colonial sites, these "mud blisters" remain intact and when opened, are found to contain sediment. With sufficient shell collections from a given locality, it is possible that a se-