UNIVERSITY OF SOUTHAMPTON

FACULTY OF HUMANITIES

Department of Archaeology

Smoke on the Water:
An Historical Archaeological Assessment of
Maritime Sources of Productivity Change in the Early English Tobacco Trade

by

Scott A. Tucker

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ABSTRACT

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SMOKE ON THE WATER: AN HISTORICAL ARCHAEOLOGICAL ASSESSMENT OF MARITIME SOURCES OF PRODUCTIVITY CHANGE IN THE EARLY ENGLISH TOBACCO TRADE

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This thesis explores the interaction of numerous factors affecting economic productivity in England's 17th-century tobacco trade with its Chesapeake colonies, particularly with an eye to transatlantic shipping. This is achieved here through the use of a network inspired analytical framework to provide an assessment of a range of elements surrounding the trade over the course of the 17th century, how these elements interacted, and the degree to which they affected the overall productivity tobacco market. Data used to these means include the extant body of relevant literature, historical documentation, archaeological data, and a case study of an archaeological site near St. Mary's City, Maryland, USA investigated for the purpose of this thesis.

The tobacco economy is examined and analysed based on various inputs, along with various social and political factors. Settlement patterning is studied through geo-spatial archaeological data from Maryland to identify possible causes for the shift in the tobacco collection model from a plantation-front based system to a central warehouse model. Through this, it is argued that the dominant driver for this change was a spread of plantations to more inland sites owing to population growth as the dominant cause. Shipbuilding is scrutinised to identify trends in ship technology and construction methods, showing changes to be both purpose and resource driven. Passenger journals and logbooks are used to examine changes in sailing route throughout the 17th century from England to the Chesapeake, resulting in the identification of a previously unknown route of ocean passage in common usage in the latter half of the 17th century. This change provided generally faster crossings on a less hazardous route, necessitated largely by political and social causes. Making use of these same voyage accounts as a data source, a quantitative study of English merchant ship performance in terms of velocity made good and windward sailing capabilities is provided. Results of this study indicate that advances in ocean crossing times were largely route dependent, with little if any advance in sailing speed over this period. Lastly, the examination of a submerged ballast cluster has provided insights into possible focusses of maritime archaeology in the Chesapeake region. To date, no vessels dating to the early colonial period have been located in the region despite heavy maritime traffic in this era. Ballast discard sites dating to this period are a common yet virtually unexamined site type for this area, and should be afforded additional attention.

In sum, this thesis provides a detailed overview of the function of the English-Chesapeake tobacco trade, resulting in a series of network-based models of interaction examining foreign and domestic politics, crew size and mariner wages, tobacco production, the tobacco market, product collection models, sailing routes, hull and sail efficiency, ship construction, time spent at sea, and time spent in port. These are assessed on a temporal scale, allowing for summary of the function of the tobacco economy at various points throughout the 17th century and into the 18th century.

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List of Abbreviations

d – pence

ECU – East Carolina University

GIS – Geographical Information System

Hhds. – Hogsheads

HSMC – Historic St. Mary's City Museum

IMH – Institute of Maritime History

kn – knot(s)

MHT – Maryland Historical Trust

MMAP – Maryland Maritime Archeological Program

MSA – Maryland State Archives

nm – Nautical Mile(s)

NMM – National Maritime Museum (Greenwich, UK)

NRHP – National Register of Historic Places

RTK – Real Time Kinematic

s – Shilling(s)

SMCM – St. Mary's College of Maryland

SMRAP – St. Mary's River Archaeological Project

UoS – University of Southampton

USGS – United States Geological Survey

Vmg – Velocity Made Good

Academic Thesis: Declaration of Authorship

I, Scott Alan Tucker, declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

Smoke on the Water: An historical archaeological assessment of maritime sources of productivity change in the early English tobacco trade

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission.

Signed:

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Date:

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...after all, that the boat is a floating piece of space, a place without a place, that exists by itself, that is closed in on itself and at the same time is given over to the infinity of the sea and that, from port to port, from tack to tack, from brothel to brothel, it goes as far as the colonies in search of the most precious treasures they conceal in their gardens, you will understand why the boat has not only been for our civilization, from the sixteenth century until the present, the great instrument of economic development, but has been simultaneously the greatest reserve of the imagination.[1]

-Michel Foucault

[1] Michel Foucault, 1984 "Of Other Spaces, Heterotopias." *Architecture, Mouvement, Continuité* (5): 49. Translation from French to English language by Jay Miskowiec

Chapter 1 – Introduction to Research

Introduction

The British Empire has indisputably been a significant contributor to the present state of world politics. Beginning with the Tudor conquests of Wales and Ireland in the 16th century (Rowse 1957: 314-316), England (Britain after 1707) went on to amass a global empire with political territory on every inhabited continent. Achieving such a feat required vast wealth, which England largely obtained through the exploitation of resources far outside its traditional boarders. As Europe colonised the Americas, trade of resources from North America played a major role in the economic success of numerous European powers. Spain found wealth in precious metals taken from various Native groups in Central and South America (Hassig 2006: 15, 76), Portugal had success through its sugar plantations in Brazil (de Oliviera Marques 1972: 255), France carved out its niche in the fur trade in the northern reaches of North America (Innis 1999: 9-20), the Netherlands found prosperity through the shipment of goods (unfortunately including people) between the New World and Europe (Gray & Wyckoff 1940: 3; Pagan 1982: 485). England, the main subject of the coming pages, found its wealth through the new trend in Europe of pipe smoking (Middleton 1953: 105-107). Tobacco grown and exported from Virginia, England's first successful territory outside of Europe, provided the basis for England's rise in wealth (Middleton 1953: 105). The crop was of such importance by the end of the 17th century, that it accounted for over 90% of the value of Chesapeake exports, and over half of the value of all colonial exports to England (Price 1964: 496).

Perhaps perversely, it is this same crop and region that brought forth much of the economic independence necessary to allow a new country to form out of Britain's North American colonies (Middleton 1953: 382; Shepherd & Walton 1972: 165-166), yielding perhaps the most significant setback the British Empire would see for centuries. Without tobacco's economic influence, it is unlikely that the United States would have been able to split from Britain in the late eighteenth century. Of course, as the English colonial presence in North America increased, other resources such as cotton in the south and cod fisheries and shipbuilding in the north, as well as the early stages of the industrial revolution, further facilitated this financial independence (Shepherd & Walton 1972: 156-166). The tobacco trade was, however, the first successful mercantilist venture undertaken by England on the North American mainland, and its most significant (Middleton 1953: 105-107; Price 1964: 496).

A thorough understanding of the vehicles used to facilitate the movement of trade goods across the Atlantic is crucial to understanding the development of the tobacco trade and of English expansion into the New World. The vessels used to these ends were amongst the most technologically advanced machines that had, at that time, been created by human hands (Muckelroy 1978: 3). They were capable of carrying massive loads of trade goods distances further than traders had ever before thought possible—and they could do all of this relatively quickly as well. A common cliché amongst those who study matters of maritimity is that whilst mountains divide, water connects. The connective nature of water can only be realised though, if the culture of interest has the proper vehicles and knowledge to overcome the challenge of water transport. The great ships that were developed in the fifteenth century and beyond, along with the notes of the adventurous few who first went out to sea in search of passages to distant lands, allowed the Atlantic Ocean to transform from a great barrier into a vast highway (Adams 2013: 175).

Keith Muckelroy (1978: 216) saw ships as machines, mechanisms within a military or economic system, and as a community, but Adams (2001: 300; 2013: 22-24) goes on to point out the symbolic nature of ships from both an emic and etic perspective. Ships held both a functional and symbolic status as a vehicle of connection between vastly-separated lands for persons on both sides of the Atlantic. Following the departure of the *Godspeed* and *Susan Constant*, the first settlers of Jamestown in 1607 were left with only a small vessel of 20-tonnes burthen called *Discovery* (Smith 1608: 32; Percy 1607: 5-12). The earliest residents of Virginia were left on the shores of the Chesapeake Bay to fend for themselves with minimal supplies and no means of returning home, making them in essence maroonees. The only tangible connection to the homeland that they would have at this stage came but once a year in the form of supply ships which must have evoked strong feelings from the settlers. Two years after the founding of Jamestown during the 'Starving Time,' the longing for new ships to arrive must have been immense. One can only imagine how the 60 surviving Jamestown residents felt in 1611 on the day of the two-year-late arrival of *Sea Venture's* crew and passengers aboard the new Bermudian constructed vessels *Deliverance* and *Patience* (Hume 2009: 46-47). For them, the arrival of these two vessels meant salvation, as they intended to use them to travel home to England and to abandon the failing colony (Hume 2009: 48). Over the course of the seventeenth century, such strong feelings would have diminished as ships arrived more frequently, as the lives of those in the New World became less perilous, and as the colonists were increasingly born in the New World. To those earliest descendants of European settlers born within the colonies, the concept of England undoubtedly became more abstract with each progressing generation, but nonetheless, the ship in all certainty continued to represent a connection to England and Europe.

Ships brought familiar comforts of the Old World, new settlers with whom they would interact, befriend, and marry (or squabble, feud and sue); clothes, dishes, and other domestic goods; and of course payment for their crops that they spent so much time and care to produce. This last point would have been especially salient, as it justified their presence in such a distant and exotic land. For many of those in the New World, their purpose was to make their great fortune through the exploitation of the land, whether from the non-existent gold that motivated Jamestown's earliest arrivals, or the 'Golden Leaf' that after just a few years became their source of revenue (Middleton 1953: 105-106). Their houses were not meant to be permanent, evidenced by the nearly ubiquitous, quickly erected, 'post-in-ground' architecture, having a lifespan of only around 15 to 25 years, and earlier methods of Chesapeake construction resulted in shorter-lived dwellings (Carr et al.: 1991: 91; Graham et al. 2007: 470; Moser et al. 2003: 200). The goal for most was not to remain in the America's, but to return to England after earning enough money, although this was rarely achieved.

Research Goals

Aside from symbolism, ships also have a very obvious functional side, without which the European expansion into the Americas could not have occurred. It is this functional side which will be the primary focus of this work. This study will provide an examination of the Chesapeake tobacco trade from a variety of perspectives: from the planters, sailors, shipbuilders, merchants, and government bodies on both sides of the Atlantic. The intention in doing so is to provide an overview of how these aspects of the tobacco trade and early English colonialism functioned and changed together, resulting in what amounted to a very economically successful venture. The focus will begin with the 1580s, a time at which England was beginning its efforts to colonise areas of North America (Hayes 1583: 271-306; White 1587: 281-300). The 17th century will be the primary focus, but much of this work will extend through second decade of the 18th century to ensure a thorough understanding of the trajectory of trade productivity resulting from 17th century actions. Price (1964: 497) describes the period around 1720 as the point of maturity in the Tobacco trade, making this an appropriate end-point.

The assessment will be provided through a focus on *productivity change*. This term stems from economic theory, and Shawna Grosskopf (1993: 160) defines it as 'the net change in output due to change in efficiency and technical change.' Mark Rogers (1998: 15) adds to this concept that inefficiency is also an aspect of productivity, highlighting that the term productivity change is in itself not necessarily an indicator of positive trends. A definition more tailored to this work is that productivity change describes a change or shift in: production quantities; speed of shipment; efficiency of product collection or movement at sea; or income for planters, merchants or government bodies. Sources of change can stem from a wide variety of factors, and an attempt is made here to examine these sources of changes through the most comprehensive means possible. This concept will be used to assess the role of these varying factors in shaping the function of the English tobacco trade throughout its early period.

A wide breadth of scholarship on economic aspects of the English tobacco trade has been compiled by an array of researchers. This scholarship will be presented in the coming section, but is mentioned here to justify the focus of the original research offered herein on ships and seafaring. Research into sailing routes, vessel performance, and shipbuilding will be offered here, juxtaposed with the existing literature, in an effort to provide a more complete understanding of how each of these topics functioned both individually and as part of a complex system. A more complete discussion of this primary methodology will be given shortly, and methodologies for individual studies within this work will be provided in the appropriate chapters.

Core Themes and Background

The studies put forth in this document all fall within several core themes. This overarching thematic canopy includes topics of colonisation, mercantilism, and complexity, with sub-themes focussing on changes in society, economics, ideology, and technology which worked in tandem to grow England's overseas tobacco trade with its North American colonies, and will be the subject of some brief discussion here. This section will also provide definitions for several other concepts crucial to this work, including historical archaeology, colonialism, and

Chesapeake society. Generating a clear definition of how these concepts are understood and presented within this work will provide a suitable backdrop to the coming chapters.

The function of the tobacco trade was dependent on a wide variety of factors, which are perhaps best examined separately to allow an organised discussion prior to beginning a discussion of how they functioned as a whole. The scholarship described in this section is not meant to be an exhaustive list of all literature pertinent to the subject, as the body of available literature is far too vast for this to be feasible, but rather a list of key works most directly relating to the subject. What is offered here is an overview of scholarship most directly relating to certain themes relevant to sources of productivity change in ocean shipping during England's colonial period.

Historical Archaeology: Defining the field

The aims and goals of historical archaeology and how it should be defined has been widely discussed by various scholars within the field (Schuyler 1970, 1977; South 1988; Deetz 1991, 1996; Deagan 1991; Orser 1996; Little 2007). Although each of these authors seems to be in agreement that the field should include the use of non-archaeological sources—chiefly historical—Orser (1996: 23-28) notes that discussion has arisen over which cultures and time periods should be included in the field. Robert Schuyler (1977: 2-10) posited that historical archaeology as a term pertains to the study of all literate cultures around the world in the past, and should then be broken into smaller subdivisions based on region and time. Although this view is perhaps the most inclusive, noting that archaeologists focussing on many regions and periods make use of written sources in their studies, a view grew out of North American archaeology—so neatly divided between a pre-Columbian period of (classical) illiteracy (prehistoric period) and a literate post-Columbian period (historical period)—that historical archaeology would be a term well-suited to their own purposes (Deetz 1996: 5). With no apparent competing demand for its use from Classical Archaeologists, Medieval Archaeologists, Egyptologists, and myriad other persuasions of archaeologists studying literate peoples, historical archaeology has come to a rather specific definition regarding a place and time (Deetz 1996: 5, Orser 1996: 26).

James Deetz (1996: 5) described historical archaeology as 'the archaeology of the spread of European cultures throughout the world since the 15th century, and their impact on and interaction with the cultures of indigenous peoples,' further stating that the focus of historical archaeology must be global in nature—a concept furthered by others (Schuyler 1970: 87; South 1988: 25; Deagan 1991: 97-112; Orser 1996: 27). Orser (1996: 25) has put it more simply as the study of the modern world. This approach notes that the past is comprised of a series of events with no start or end points, as the limits that we place on various periods are constructs of our own interpretation of the past given that time is fluid. Thusly, the events of the recent past have led directly into our present. Here, historical archaeology is understood much in this vain. Deetz's definition given above will suffice here, taking note that historical archaeology must adopt a global view, and an eye towards the effects of the past on the modern world. This understanding of the aims of historical archaeology helps define the approach taken in this work toward the goal of studying England's tobacco trade.

Founding the Colonies

Almost immediately after Columbus stumbled onto the shores of North American territory, western Europe began a push toward exploiting this newly discovered land and its people. Spain and Portugal wasted no time in gaining territory in Central and South America, collecting precious metals and decimating the indigenous populations (Hassig 2006: 15, 76; de Oliviera Marques 1972: 255). Holland was also an early player, taking territory in modern-day Brazil in the 16th century (Gray & Wyckoff 1940: 3; Pagan 1982: 485). England's first attempts at colonisation began in the 1580s, starting with the exploration of areas of the North American Atlantic coast (Hayes 1583: 271-306). Elizabeth I granted a charter for colonisation to Sir Walter Raleigh, whose efforts led to a brief settlement on Roanoke Island in present day North Carolina from 1585 to about 1589 (White 1587: 281-300). The colonists had been left on their own with no ship arriving after 1587, and the next ship, arriving in 1590, found the colony abandoned (White 1590: 303-323). They planned to search a neighbouring island for any surviving colonists, but weather prevented this, and no further attempts were made to locate the colonists. This early failure would lead to a 15-year halt in colonisation efforts. This first colony was meant as a strategic base for attacking Spanish treasure fleets, and to exploit any local resources that may be present for the benefit of the Crown (Bruce 1896 (I): 1; Appleby 1998: 56). The next efforts toward colonisation, however, took a rather different form.

James I renewed efforts toward colonisation, and in 1605 established two competing companies, the Virginia Company of London and the Plymouth Company, giving land charters to each (Bruce (I): 1896: 69-70; Middleton 1953: 105; Brain: 2008: 69; Appleby 1998: 72). In 1607, both companies planted settlements, with the Virginia Company establishing the Jamestown settlement in the Chesapeake region, and the Plymouth Company establishing the Popham colony in present day Maine (Brain 2008: 69; Appleby 1998: 73). By 1609, the Popham colony was abandoned (*ibid.*), making Jamestown England's first permanent settlement (if one ignores the fishing outposts in Newfoundland), although the early years were wrought with hardships (Bruce 1896 (I): 129, 202-203, 272-273; Horn 1998: 174-175 ,183). Starting in 1620, several colonies were founded in New England, including Plymouth, Massachusetts Bay, and Salem (Bradford & Davis 1908: 95, 349-355). The Virginia Company was officially dissolved in 1624 after James I grew dissatisfied with handling of the colony, thereby making Virginia a Royal colony (Middleton 1953: 105-106). 1634 brought the second Chesapeake colony, just north of Virginia, with the border between them being set as the Potomac River (Carr et al. 1991: 8-10). This colony, called Maryland, was established by royal charter to the Calvert family. The production of tobacco was centred around these two colonies, although the Carolina colony, established in 1665, and other mid-Atlantic colonies produced some tobacco as well (Middleton 1953: 219-222).

When Jamestown was founded, the colonists were tasked with finding a suitable economic export in the interests of profits for the Virginia Company (Bruce 1896 (I): 9-22; Appleby 1998: 174). They first hoped to find gold, silver, or other precious metals, but found none (*ibid.*). John Rolfe, a colonist who had been aboard *Sea Venture*, which wrecked in Bermuda on its way to Jamestown, is widely credited with first planting tobacco in Virginia (Middleton 1953: 105-107). The crop had been produced in the Caribbean for European export for some years prior, and the demand in Europe for tobacco was growing (*ibid.*). Jamestown shipped its first crop of the plant in 1614, amounting to four hogsheads (barrels). In the subsequent years, Virginia tobacco was widely produced and exported to Europe, with the English government quickly establishing an import duty of 2 pence per pound on colonial tobacco (Middleton 1953: 123). The Crown continued to add regulation to the export and import of the crop to ensure profitability. This product remained the major export of the Chesapeake colonies throughout the 17th century, providing the bulk of the tobacco consumed in England and a significant share of what was sold on the European market (Middleton 1953: 105-107).

Chesapeake Life & Society

Life in the colonies was fraught with difficulties, especially during the first half of the 17th century. Simply surviving in the lower Chesapeake proved problematic. Disease was rampant, particularly in the first year of residency in North America as settlers were exposed to new viruses, commonly referred to as the 'seasoning' (Carr et al. 1991: 17-18). On top of threat of disease, early residents of Virginia struggled to produce enough food to sustain themselves, and there was considerable conflict with the native population (Smith 1624: 294-296), two factors that were not entirely disconnected. A wide breadth of scholarship is available on the topic of English society in the Chesapeake (Land 1965; Carr & Walsh 1977; Tate & Ammerman 1979; Kulikoff 1986; Carr et al. 1988; Horn 1988; Carr et al. 1991; Gibb & King 1991; Shackel, 1992; Yentsch 1994; King & Ubelaker 1996; Metz 1999; Hatfield 2007; Horn 2012;), and as such, the discussion here will be brief. The main areas to address include England's model of colonialism in this region, social structures within their settlements, demographics, and standard of living for the English settlers.

England's first permanent settlement in North America, Jamestown (1607), was rather unique amongst European overseas colonial holdings at its time, as its population was primarily composed of free English citizens who would be living oversees in a community setting for an extended period (Horn 1998: 175-176). This model of colonialism, often referred to as *settler colonialism*, stands in contrast to the *exploitation colonialism* model favoured by other European powers such as Spain and Portugal (Hassig 2006: 15, 76; de Oliviera Marques 1972: 255). For these nations, their colonial labour force was composed primarily of subjugated natives and Africans brought to the colonies, without attempt to settle significant numbers of its own people within the colony (*ibid.*). The land itself was not of particular concern here, and Spain and Portugal at that time had no ambition of annexing the land. Instead, they were interested in exploiting the resources of the region. Colonies established under the settler colonial model are formed out of the desire of the exploitative people for access to a territory for their own uses (Wolfe 2006: 388). At its most benign results in displacement of the indigenous people, but more often than not the result is far more sinister, entering the realm of genocide (Wolfe

2006: 387). In this vein, after the Indian uprising of 1622 which killed the majority of the residents of Jamestown and Henrico, Sir Francis Wyatt declared the necessity to clear the land of Native inhabitants and to expand their land holdings (Horn 1998: 175-176).

From England's first attempt at establishing a colony in North America, occurring on Roanoke Island in 1585, it was their intention to acquire land to exploit rather than to subjugate the Native population. Although the Roanoke colony had relatively (although not entirely) friendly relations with the local Indian population (White 1587: 291-292), the Jamestown experience was very different in this regard. The native Powhattan population and the English settlers engaged in what was often a violent struggle, including the massacre of nearly 350 English colonists in 1622 (Smith 1624: 357-373), and a reprisal attack in 1623 where English settlers poisoned and killed over 200 Indians under the pretence of a peace meeting (Rountree 1990: 77). Despite early violence, the Native population largely dispersed from this region in the first half of the 17th century, playing only a minor role in the Tobacco trade, notably by the teaching of traditional husbandry techniques to the English (Miller 1986: 174-175; Carr et al. 1991: 34-35).

The following chapter will provide a detailed discussion on colonial population growth and settlement patterns over the course of the period of interest, but brief mention of this theme will be made here in the interest of trends in demography. The first ships arrived in Jamestown in 1607 carrying 104 passengers to found the initial settlement. By the end of the 17th century, the population of the Chesapeake colonies had reached 100,000 persons of European origins (US Census Bureau 1910: 9). African slaves were not a particularly large segment of the population or work force until somewhat later, experiencing significant growth in the final quarter of the 17th century (Carr et al. 1991: 26, 70). This corresponds with changes to plantation size, moving from small family farms to large plantations and thusly requiring additional labour (Kulikoff 1986: 37-44). Throughout the 18th century, the bulk of slaves brought to the Chesapeake came directly from West Africa, with regional variation in exact points of origin, and were brought in small shipments as a secondary cargo (Walsh 2001: 144-148). Exact figures for the enslaved population though are difficult to estimate for this early period.

The social structure of the early colonies was largely organised around small family farms (Kulikoff 1986: 37-44). Indentured servitude was a key segment of the labour force, and it was not uncommon for several servants to work on a single plantation (Carr et al. 1991: 40-41). The vast majority of the citizenry spent their time tending to agrarian matters. This included not only their tobacco crop, but also in growing grains and fruits and raising livestock for sustenance, removing a reliance on England for most consumables (Carr et al. 1991: 34-35). The forests and waterways provided opportunity to supplement their diet with wild game, fish, and shellfish (Miller 1986: 177). England remained an important source of most manufactured products, including fashionable products such as clothing, ceramics, and glass-wares, and for wine. Colonial imports though, were quite minimal in relation to exports, with vessels arriving from England heavily ballasted and carrying little cargo, and returning with their holds filled to capacity (Rhodes 1670-1676 [Voyage of the *Constant Friendship*]; Davis 1956: 65).

Late in the 17th century, small family farms began to give way to large plantations, made possible only by the availability of slave labour (Kulikoff 1986: 37-43). This is perhaps the most significant change in the social structure of the region for the whole of the colonial period, allowing the region to diversify in occupations and products, and expand the territorial range, bringing settlements further away from navigable waterways and into the more mountainous areas of these territories (Smolek 1984: 6-7; additional evidence given in proceeding chapter). Tobacco remained a major export of the Maryland and Virginia colonies well into the 20th century, and for the colonial population, these agrarian ventures dominated their lives in almost all aspects. Although their lives were spent toiling in the dirt, McCusker & Menard (1991: 71) point out their reliance on maritime trade: 'Overseas commerce did not merely make colonial life comfortable; it made it possible.'

Tobacco Production

The process of cultivating tobacco is rather time consuming, and places considerable pressures on the environment (Miller 1986: 174; Carr et al. 1991: 52-53). Nonetheless, colonial settlers in the Chesapeake region became skilled at the activity. Carr et al. (1991: 41-43) note a mean increase in pounds of tobacco produced per hand, with production increasing from 911 lbs (413 kg) in the years between 1640 and 1649 to 1,296 lbs (588 kg) from 1650-1659, 1,539 lbs (698 kg) from 1660-1679, and 1,877 lbs (851 kg) from 1680-1699. Over the course of half a century, planters became more than twice as efficient at planting and harvesting tobacco. It is unclear what drove this increase, but Carr et al. (1991: 39-43) point to a hesitation in the early years to trim enough leaves from the young plants to bring each plant to maximum output, and also to the drastic fall in prices that necessitated the planters become more productive in order to maintain a suitable level of income.

These increases in agricultural productivity, coupled with population increases within the tobacco producing colonies, caused the quantity of tobacco exports to climb sharply throughout the century (figure 1-1). From the first crop sent from Jamestown of four hhds. (ca. 4,000 lbs, 1,800 kg), quantities rose to 60 hhds. (27 tonnes) in 1622, and then to 500 hhds. (225 tonnes) by the end of the same decade (Middleton 1953: 106-107). By the end of the following decade, production had tripled. By the 1670s, over 200,000 hhds. (9,000 tonnes) were being produced, finishing out the century at around 350,000 hhds. (16,000 tonnes) (Jacobstein 1907: 23; Morriss 1914: 35; Walsh 1999: 87-93). Exports plateau at this point, holding steady at roughly this quantity at least through the mid-18th century (Jacobstein 1907: 23). Middleton (1953: 106-107) reports production in excess of 100 million pounds (45,000 tonnes) in 1775.

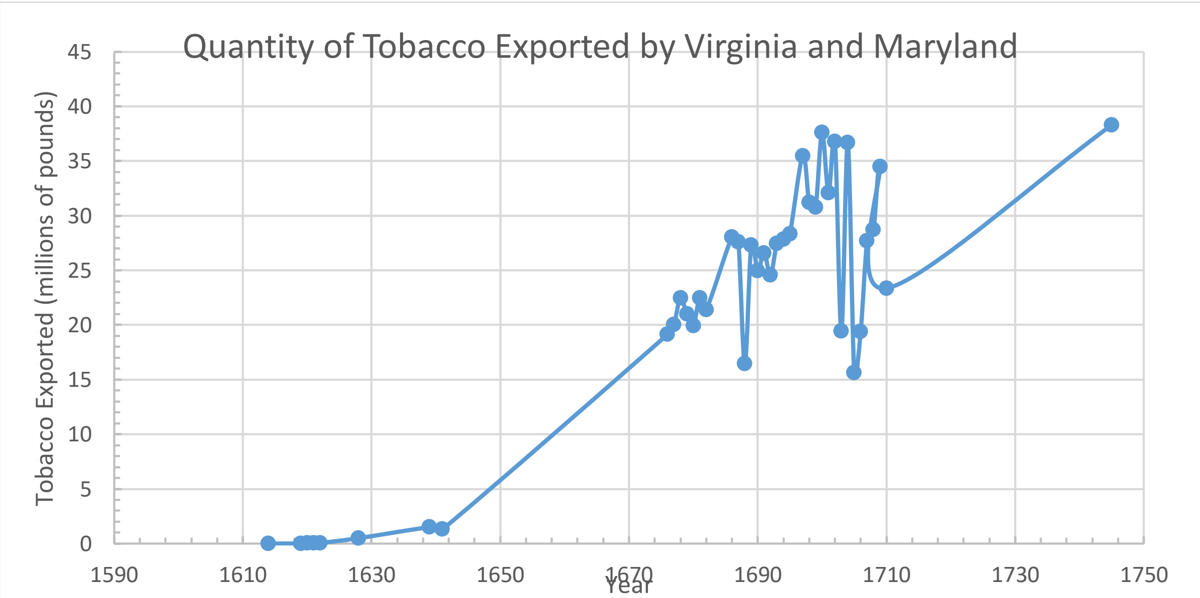


Figure 1-1 - Quantity of tobacco exported from the Chesapeake, 1614-1710 (Jacobstein 1907: 23; Morriss 1914: 35; Walsh 1999: 87-93, graphic by S. Tucker)

To find the causality of these dramatic price decreases, one only needs to compare price to the correlating data of production quantities (figure 1-2). The two data series indicate an inverse relationship, signifying a cause no more complicated than simple supply and demand. Although colonists growing tobacco constantly complained of low prices received for their crops (Menard 1976:404-408), the low prices were what made tobacco accessible to a wider range of the population in England. The expansion of production and the associated fall in prices were crucial to tobacco's overall success as a product, transforming it from a luxury item in the early decades of the 17th century to a mass-market consumer good by the end of the century. The result was the creation of a viable economy based almost exclusively on a singular trade good, made possible only though the scaling of the market. An average planter in the 1660s could expect to earn around £30 sterling per year through tobacco production, which was an ample living during the period (Carr et al. 1991: 78-84). Although prices fell slightly during this period, the increase in agricultural productivity would have kept earnings constant, if not increasing them over time, for a planter who could keep up with the average productivity. The ever-increasing production would necessarily place new pressures on transportation of the goods, requiring either more or larger vessels to carry the tobacco across the Atlantic. The following sections will examine shipping throughout the 17th century, drawing attention to some of the core economic aspects of this functional aspect of the trade.

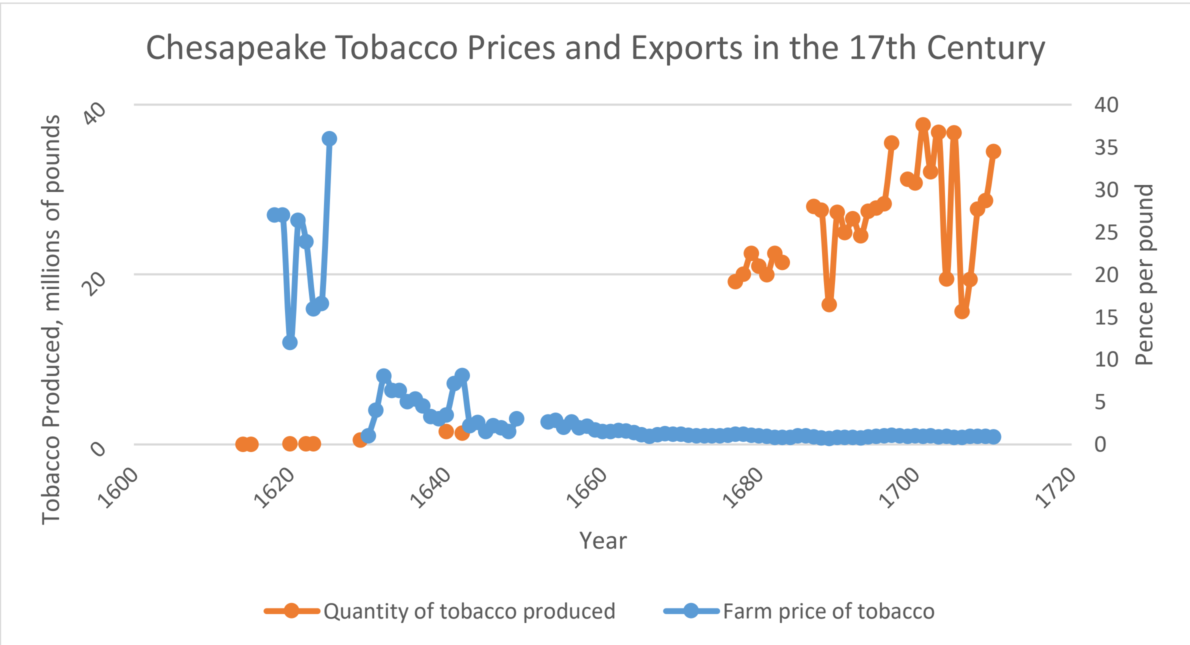


Figure 1-2 - Prices of tobacco over time compared with quantities of tobacco produced over time (Menard: 1976: 404-408; graphic by S. Tucker)

The Tobacco Economy

The term *Tobacco Economy* here is a rather complex term in an historical Chesapeake context. Tobacco was by far the major export of the region and the its cultivation was the primary occupation of the Europeans living there and functioned as the predominant currency. With the crop permeating virtually every aspect of early life in the Maryland and Virginia colonies, a suitable and clear definition for the purpose of this work is key. The focus will be placed on the tobacco market— chiefly in the farm price of the crop given its more visible presence in the historical record— and to include the various inputs into this economy such as shipping costs and related factors.

Shipping Productivity

Beginning in the 1950s, there was a wave of new research into shipping productivity for England and its North American colonies (Davis 1956; Walton 1966; Walton 1967a; Walton 1967b; Walton 1968; North 1968; Walton 1971; Shepherd & Walton 1972; Nash 1982). One of the earliest of these texts, authored by Ralph Davis (1956), discusses in depth English maritime trade throughout the late 17th century. The focus is broad, with the text discussing the entirety of England's Atlantic trade, containing comparisons between regions for purposes of examining sources of productivity changes and detail of trade patterns, routes, and seasonality of trading. His article outlines a useful methodology of measuring productivity of ocean shipping, suggesting certain key aspects being the main determining factors in productivity. These include time spent at sea, time spent in port, size of vessels, freight rates and necessary crew requirements (Davis 1956: 59-69).

Davis describes trade routes for the Chesapeake tobacco ships as unilateral (1956: 65). That is to say, it was exceptional for ships on the tobacco route to engage in 'triangular' trade, as is often claimed. This means not only were the ships only engaging in trade between two regions, but also the vast majority of trade goods were passing in only one direction. As ships left England for the Chesapeake colonies, they would travel mostly under ballast, as the manufactured goods being brought to the colonies would not occupy much of the hold's volume or weight requirements. A major determining factor of this was the seasonality of crops. Tobacco would be ready for shipment only once per year, in the spring (Shepherd & Walton 1972:58; Carr et al. 1991: 56-71). Freighting costs, he states, were very low on the outward journey compared to the return route when laden with tobacco. This is remarkable, as the price of goods being sold in the North American colonies were often 150 to 225 percent higher than the same goods in England (Shepherd & Walton 1972:58).

Gary Walton continues this theme with several papers (Walton 1966; 1967a; 1967b; 1968; 1971), feeding into a book co-authored with James F. Shepherd (Walton & Shepherd, 1972). These texts focus on the last quarter of the 17th century to the eve of the American war of Independence, with this temporal focus seems to be for an acute lack of documentary sources for the earlier period of England's North American colonisation. Walton builds on Davis' work, looking at eight factors for the purpose of quantifying American colonial shipping: ship size; crew size; seamen's wages; armaments; shipbuilding costs; insurance costs; time spent at sea; and time spent in port (Walton 1966: 596).

Through an analysis of primary source materials on various routes around the Atlantic World, Walton (1966: 596) makes a range of assertions regarding the colonial shipping experience over time, finding that labour and capital costs declined throughout this period, although wages for mariners and shipbuilding costs remained constant. The need for armament on ships decreased during this period, which correlates with a decrease in insurance rates, suggesting much of the relative calm of the political climate in the decades preceding the American Revolution was of factor in this, and showing evidence for a markéd decrease in piracy and privateering (Walton 1966: 596). Of the general productivity of shipping, Walton describes a forward trend in efficiency of shipping during this period, despite vessel sizes remaining constant and no increase in the speed of ships. Walton instead points to a decrease of time spent in port as the driving force behind this productivity increase (Walton 1966: 596-598; Shepherd & Walton 1972: 80-83). This becomes a major assertion in each of his works listed above, describing specifically a lack of technological improvement in ship design throughout the period examined. He later credits the increase in productivity in the Chesapeake tobacco trade mainly to the introduction of Scottish traders to the industry in 1707 (Walton 1967a: 73-75). This idea of technological stasis in shipbuilding and vessel performance will be heavily scrutinised throughout this work.

Lastly, to address costs of freighting, Bruce (1896 (I): 450) reports a cost to Virginia planters of around £12 per ton (understood to be four hogsheads) in 1630 to carry their tobacco to England. Several years later, the Virginia Council authorised a fine on all merchants and ship's masters charging more than £6 per ton (*ibid.*; Wyckoff 1938-1939, 33(4): 342). V. J. Wyckoff (1938-1939, 33(4): 342) suggests that although this fine served as a warning, it was not applied with any regularity since the planters who would report it were not in a position to negotiate on prices, and would have risked the sale of their harvest to do so. According to Bruce (1896 (I): 450-451, 631), freighting rates per ton ranged from £6-£16 for goods travelling eastbound to England, and remained constant at about £3 per ton on the voyage from England to the Chesapeake. Arthur Pierce Middleton (1953: 319, 323) describes a shortage of vessels in the 1690s which caused freighting rates to climb to £17 per ton, but these rates reduced again to around £14 per ton during the first decade of the 18th century, and then £8 in 1721 due to a surplus of vessels trading in the Chesapeake.

Trans-Atlantic Sailing & Ships

Examining aspects of shipping alone inherently provides an overtly economic perspective on the trade, ignoring many other important facets driving forward productivity. A concurrent focus on seafaring and shipbuilding are crucial to understanding technological and social drivers within this context, and without which will provide at best an incomplete study of this topic. With this in mind, this dissertation will cover a number of topics dealing with transatlantic sailing, shipbuilding, and vessel performance to provide a more holistic view of causes of change. This section will lay out some of the prior research into these themes by topic to establish points from which to expand later in this work. To these ends, this section will examine previous research into the numbers of ships trading in the Chesapeake region, types of vessels engaged in trade sailing routes, and sailing practices.

Morriss (1914: 85-89) reports a highly variable number of vessels trading in Maryland waters from 1689-1695, ranging from 48 to 98 and averaging 68, based on vessels cleared for entry as recorded in Maryland records. These figures do not include vessels trading on coastal routes, although Morriss states that the Maryland trade was almost exclusively with England directly (*ibid.*). She further states that the trade at this time was dominated by London, with just over half of the vessels trading in Maryland coming from England's chief port (Morriss 1914: 87-88). The remainder of the vessels came from a number of additional coastal outports (*ibid.*). Using calculations based on tobacco production quantities and average vessel size, Wyckoff (1938-1939, 34(1): 51-52) estimates around 70 to 80 vessels trading in Maryland waters in the

1660s, and an additional 90 to 100 vessels trading in Virginia, allowing 280-300 casks per vessel. Morriss' method of deriving these data are dependent on the availability of port records, which is not a universal. Wyckoff's method can be applied to any period where the quantity of tobacco exported is known, a data source which is much more available, but is also an imperfect method as it depends on a relatively constant understanding of average vessel tonnage, a topic for which data are also relatively sparse. Vessel tonnage will therefore be examined in the course of this work.

Sailing routes from England to the Chesapeake in the 17th century have been previously addressed by both Bruce ((I) 1896: 623-624) and Middleton (1953: 7-14), each of whom described two points of crossing. Bruce ((I) 1896: 623-624) described the use of two routes: a southern and a northern passage. The southern passage, requiring on average 5-6 weeks, takes the vessel on a southward heading from England, following the Iberian and North African coasts, then turning westward near the Verde Islands. Landfall is made near Barbados, where a course north by northwest is followed along the North American coast until reaching the entrance to the Chesapeake Bay. This route is also described by Middleton (1953: 7-8). Bruce's northern passage follows a similar course, but turns westward near the Canary Islands, passing near Bermuda, and continuing on to the Chesapeake (Bruce (I) 1896: 623-625). Bruce describes the northern route as the successor to the southern route after 1608. Middleton's second route travels due west from southern England, sighting land at Newfoundland, and proceeding then southward along the coast until reaching the Chesapeake (1953: 7-8). He describes the route as having shifted from the southern to northern passage around 1650.

These two descriptions are clearly not in agreement, and both are based on only limited evidence. Bruce bases his routes on the published narratives (Percy 1607; Smith 1608) of the founding voyages of the Virginia colony, and the discovery of the northern Passage in 1608 by Samuel Argoll and its subsequent use by George Somers (Hume 2009: 31; Strachey 1610: 17-18; Jourdain: 1610: 157) in 1609. Middleton's sourcing is unclear with his footnote leading to a book of romanticised short stories about life at sea, and specifically to a passage concerning a 19th century sailing vessel wrecking near the Alaskan coast (Chatterton 1928: 62). The seeming lack of relevance may stem from an issue of the consultation of an alternative edition; however, this tome is simply not a reliable academic source. As such, English sailing routes to the Chesapeake during this time period are poorly studied to this point and require additional attention, and will be the primary focus here in chapter 4.

Direct research describing the vessels of the tobacco trade is somewhat lacking. Wykoff (1938-1939 (33(4): 337-339) describes a range of vessels which were used in the 17th century, with his list covering vessels for transatlantic sailing and smaller vessels that would have been used in coastwise trade. In a 17th-century context though, vessel terms were rather confused and even their mention in primary source documents is not necessarily telling of any specific attributes of the vessel in question (Wyckoff 1938-1939 (33(4): 337). A more useful line of inquiry here is into size, hull characteristics, and rigging. Morriss (1914: 88) points to a typical tobacco vessel in the closing decade of the 17th century to have been about 170 tons for London-based merchants, and around 80tons for vessels sailing from the outports. Although an average is given, it is important to note the wide range in tonnage for these vessels, with London vessels from 50-360 tons, and vessels from the outports tending to smaller sizes not exceeding 250 tons. Chapter 3 will provide an in depth discussion of vessels, drawing from literary, iconographic, and archaeological sources.

A final aspect of transatlantic shipping to discuss here is that of convoying vessels. Even during the earliest period of discovery and colony planting and supply, the use of flotillas was common (Hayes 1583: 271-306; White 1587: 281-300; White 1590: 303-323; Percy 1607: 5-12; Smith 1608: 32; Strachey 1610: 17-18; Jourdain: 1610: 157), but was not by any means a universal (Bereton 1602: 327-340); Rosier 1605: 355-394; White, 1634: 29-40; Brown 1898: 9, 13-14). Safeguarding cargo was obviously a primary concern of all parties involved in the tobacco trade, particularly during periods of hostilities, and convoys were seen as a means of doing so. As the 17th century progressed, and specifically with regard to the various Anglo-Dutch wars, the idea of sailing in groups began to progress from good practice to legal obligation (Morriss 1914: 93-95; Middleton 1946: 183-185; Middleton 1953: 318-320). Morriss (1914: 91) points to piracy and privateering as the main concern of merchants, planters, ships' captains, and the Crown leading to a royal mandate requiring the ships to travel together.

Middleton (1953: 313-335) worked extensively with this topic and points to convoying the vessels as largely an 18th-century adaptation to the tobacco trade with roots in the last quarter of the 17th century. The convoy system was well-known and often utilised in other trades and regions by many European countries, but the perceived necessity seems to have not come about until the 1660s by the English in the colonial tobacco trade. Even after the push began to organise fleets, the system was not fully implemented until 1707 (Middleton 1953: 322). The complications to the system were numerous, owing to political and economic issues, fighting between merchants from London and the other outports, and complaints from the colonies and planters (*ibid.*). As the mandate for a convoy system progressed through the 1690s though, mistakes were made by allowing for licences to be granted to vessels deemed sufficiently armed to travel alone (Middleton 1953: 318-319). Further, armed escorts were permitted to carry a specified quantity of tobacco, thereby putting them in direct competition with merchants.

Questions of frequency of the fleet were amongst the greatest problems, with no solution suiting all parties. It was eventually settled on one fleet per year, which protected the planters from underhanded dealings by the merchants, who could otherwise attempt to take advantage of planters by keeping them uncertain of the timing of incoming fleets (*ibid.*). As the crop was only ready once a year during the spring for collection, it hardly made sense to not travel as a fleet—the exception to this of course being the departure point of the outbound ships from England. It would seem that the English legislature to some degree saw it fit to ensure profitability for the planters, on whose backs the entire industry was set. The tobacco trade was the most important of all of England's colonial economic ventures in the 17th century, supplying at that time around £300,000 sterling annually to the treasury (Middleton 1953: 318), and was therefore of great interest to protect.

Datasets

Much has been written concerning the tobacco economy of the 17th century, and some historians have made attempts at describing changes in shipbuilding through certain non-direct approaches such as through voyage duration and shipbuilding costs (Walton 1967a, 1967b, 1968, 1971; Shepard & Walton 1972; North 1968; Davis 1956). None of these studies, however, have focussed their attention to physical or historical evidence of changes to ship design, and some gloss over or dismiss the importance of technological change in the shaping of merchant practices throughout the period in question (Walton 1967a: 67; Shepherd & Walton 1972: 80). Nonetheless, much of the information discussed in the previous section is useful in this study, providing a thorough historical basis to examine ideological and economic conditions surrounding the tobacco trade. To explore other aspects of the trade, an examination of primary source documents and published first-hand accounts of voyages will provide a significant portion of the data used here. Ship's logs and passenger journals are used extensively herein to examine the some of the functional aspects of trade, allowing for reconstruction of trade routes and calculations of the performance of ships. Shepherd & Walton (1972: 77-80) have previously examined the speed of English ships on coastal routes from 1686-1765 using port records, but as will be demonstrated in chapter 4, this data source is problematic. The use of logs and passenger narratives to plot actual routes of travel is a major facet of this research, and has resulted in new data and the identification of previously undocumented trade routes. Additionally, such sources provide a level of detail and insight to practices and the choices of individuals that are not available through traditional archaeological source materials. These logs and journals provide the foundation for the much of the work contained herein.

Efforts will be made to explore the ship as a technological object, identifying areas of change within the ship structure by examining building methods and materials used in constructing the vessels used by English merchants in the tobacco trade. A review of archaeologically recorded English sailing vessels dating throughout the 17th century will provide data for these sections. Merchant vessels are of particular interest here, although there is a scarcity of relevant archaeological material. Some details from naval vessels will be used as comparison to determine any purpose-based differences in construction method. Changes in design over time will be examined with particular attention being paid to other outside factors, such as availability of building supplies and political changes. To supplement these data, information from port records detailing such areas as vessel size and cargos will be used.

Population growth and settlement patterns in the Chesapeake played a key role in the practices of merchants and mariners in the process of collection of tobacco, and may have affected the development of trade ports in the Chesapeake in the 18th century. This research includes a very limited study of settlement patterns in the Chesapeake based on archaeological site location data in several Maryland counties, focusing on the relationship of the sites to waterways over time. The data used here have been compiled by the Maryland

Historical Trust, and comprise the full bulk of archaeological sites identified within the State of Maryland. Data from the Maryland counties of St. Mary's, Charles, and Prince George's will be used to these ends, testing the notion that tobacco collection either became too large a task to be accomplished by sailing large vessels from plantation to plantation, or that planters moved away from navigable waterways, necessitating central points of collection for the trade process to remain feasible.

As with many locations, archaeological sites from submerged contexts in the Chesapeake have received less attention than their terrestrial counterparts for many reasons, largely logistical and financial. Environmental limitations also inhibit research here, notably underwater visibility which is less than a metre in most of the region, and often only a few centimetres (Hobbs et al. 1994: 353). Additionally, the Chesapeake Bay itself presents few navigation hazards and boaters enjoy generally calm waters; with this in mind, few ships can be expected to have been lost in the Bay region. Of the numerous tidal tributaries though, these carry a higher risk for entry by large vessels, despite many being navigable for very long distances by ships of any size (Middleton, 1984: 40). Although grounding was a concern in these rivers, outright loss in this area was simply not a likely event. Perhaps owing to these factors, there have been to date no finds in the Chesapeake region of vessels from the 17th century.

Several researchers in the past have suggested a site submerged just offshore from St. Mary's City, Maryland, identified in 1994 and given the designation 18ST647, to be the possible remnants of a vessel dating to the early colonial period based on some minimal testing of the site (Thompson, 1995; Embrey, 1999; Miller et al., 2001). Known materials on the site include a concentration of lithic cobbles believed to be ship's ballast, handmade brick fragments and bats, and several kaolin pipestems of tenuous association with the site (Thompson 1995:22; Embrey 1999: 67). The stones were arranged in a round or ovate pattern (Thompson 1995:22; Embrey 1999: 102-105), being the main bit of evidence supporting the vessel hypothesis. For the purposes of this research, four seasons of fieldwork have been undertaken on this site in an attempt to re-locate the site, identify a date of deposition, and to assess its nature and origin. The results of this investigation will be presented in due course.

Analytical Framework and Methodology

Networks have become an *en vogue* subject within archaeology in recent years, and for good reason (Brughmans 2010; Brughmans 2013; Brughmans 2014; Collar et al. 2015; Graham 2006; Graham & Weingart 2015; Isaksen 2008; Isaksen 2013; Knappett et al. 2008; Knappett 2011; Knappett 2013; Peeples et al. 2014; Terrell 2010). Archaeologists are beginning to take notice that the sites that they dig are rarely one-dimensional and most often contain the influences of multiple regions and cultures. Perhaps this has always been recognised, but it is only recently that the complexity of these ties and interactions has become a focal point of archaeological study. The archaeology of trade is one place in which taking a network approach seems almost intuitive, this work being no exception. Formal network analysis has been used recently to examine the exchange of goods between regions. Leif Isaksen (2008) and Tom Brughmans (2010) have, for example, shown the usefulness of this type of analysis when examining a singular, non-perishable trade good, such as ceramics, where evidence of this product in various places has been found archaeologically and a source for this product is known. Brughmans goes on to provide a critique of the use of network analysis in archaeology, noting its limitations.

While network analysis provides an obvious framework for visually modelling systems of exchange—both material and social—it is difficult to bring non-empirical data to such a model, or to demonstrate how multiple stimuli may affect exchange through formal network analysis. Brughmans (2010: 285) notes that formal network analysis is often too rigid to capture the full complexity of a dataset. Moreover, this work deals with many networks of conceptual interaction, not only with the movement of trade goods and people. While useful to some aspects of this work, formal network approach is not possible to employ throughout the whole of this work. A main position offered by Brughmans is that within archaeology, there is a need for a discipline-specific network analysis. This work will utilise a modified composite approach to network analysis and exploring complexity, drawing on methodological elements from several other scholars.

In his book *A Historical Archaeology of the Modern World,* Charles Orser (1996: 26-28) calls for historical archaeologists—those studying the Atlantic World post 1492—to begin focusing on the complex issues of culture and society through a global perspective. To Orser, historical archaeology is the study of the *modern* world (1996: 26), and the study of a vast and intertwined network of interactions and forces. His view on the state of historical archaeology is that it too often takes an atheoretical approach (Orser 1996: 12-16), and is far too focused on the minutiae of a site while failing to consider the broader implications thereof. He goes on to examine two settlements to make his point: Palmeres, a 17th-century village established in Brazil by runaway African slaves of the Portuguese, and Gottrroose – an 18th-and 19th-century Irish settlement. To Orser, despite a large temporal and spatial expanse, these two settlements were connected through the networks and forces of the modern world. He goes on to discuss the need for a mutualistic view on interaction, and identifies four underlying issues that are ever-present in this post-Columbian Atlantic world: global colonialism, Eurocentrism, capitalism, and modernity (Orser 1996: 57-88). He refers to these as the *haunts* of historical archaeology, and concepts that cannot be ignored in the analysis of culture. Orser later summarizes his central argument to be that historical archaeology 'should embrace the issue of global connections, providing empirical studies demonstrating the origin and earliest development of globalization, modernization, and colonial expansion (2005: 77).'

Orser is of course not the first to advocate a global perspective within historical archaeology. Robert Schuyler (1970: 87), Stanley South (1988), James Deetz (1991), and Kathleen Deagan (1991: 97) all spoke of issues of globalism prior to Orser's treatise (Orser 1996: 27). The focus here, lies on Orser as his studies are the first to move toward a multi-scaled network approach. A follow-up to Orser's initial work on this subject further expands his thoughts on networks and archaeology (Orser 2005), focusing on providing a framework through which to study globalism and networks. His suggestion is that the approach should be adapted from the network analysis being developed and used in contemporary sociology, anthropology and geography (Orser 2005: 78). He also includes elements, mainly terminological, of formal network analysis used in computer and complexity sciences in an attempt to make such studies empirical and therefore relevant within the archaeological community (Orser 2005: 83). Modelling networks using an interconnected series of nodes and links is common in formal network analysis. This is indeed the approach utilised by Brughmans and Isaksen, mentioned above. He argues that this is useful within archaeological thought, using nodes to represent place—the location where something is—and links to represent space—the location where something is not. Further, it can be used to demonstrate connections between human and non-human actors within the network, as relationships between humans, and between humans and environment, are 'social and spatial at the same time (Orser 2005: 83).' He again looks at Palmeres, identifying networks of interaction between the residents of Palmeres, the Portuguese colonists, the Dutch colonists, the African slave population held by both the Dutch and Portuguese, and the native Brazilian population, with an eye to scaling within the interactions.

The benefit of Orser's contribution to studies of globalism in historical archaeology is that it expands the aims and goals of the field, and provides a thorough discussion on topics of complexity in archaeology. While attempting to generate a framework though, it could be said that Orser's study is too generalised, giving an example of how one might go about addressing complexity, but not providing an actual framework to explore these networks in anything more than a qualitative sense. It is true that not all things within archaeology can be quantified, and it is clear that Orser and others attempting to address this topic have had issues in finding a demonstrable means of examining complexity. Moreover, it is not suggested here that a return to the processual movement is the ideal, but a solid framework is necessary to address complex issues in a practical manner. While Orser's work is an excellent starting point from which to begin developing a framework for the study of the vast networks at play within the English-Chesapeake tobacco trade, the influence of additional scholars is necessary to develop a cogent means of examining the data in this study.

To avoid the pitfalls of abstraction within the framework, allowing for a clear method of analysis, a conceptual model is key—particularly one which can be used within the analysis itself. To these ends, Jonathan Adams (2001: 301; 2013: 23) has identified seven interrelated constraints on the form, structure, and use of watercraft, which are particularly useful here. His work points to ideology, technology, tradition, economy, purpose, environment, and materials all playing a major role in the building and use of sailing vessels, displaying their interconnectivity in the familiar form of nodes and links used so often in network analysis. In Adams' view, these factors are all connected, but he points out that this is *not* a model (Adams 2013: 23), as any number of additional constraints within the imagination of the researcher could be added, and within these constraints exists an infinite, flowing stream of interaction. Despite this warning, he has offered a rather complete set of interacting concepts which are very useful in developing a concept for assessing relationships of complex interactions. It is argued here that this diagram does in fact represent a model for addressing complexity, suitable for topics far beyond the realm of shipbuilding as originally intended, especially on topics with a variety of data both qualitative and quantitative. While one can argue for different or additional constraints, the concept of an interwoven series of influences on the design of a product is perfectly viable, and the constraints provided by Adams are nearly adequate for the scope of this research. Orser's four *haunts* are ever present within this study, and the diagram below has been designed to show Adams' interconnected constraints over a backdrop of Orser's *haunts* (figure 1-3). It is this general approach which will be taken in analysing the data within this work, although several more concepts are necessary to frame this thesis. To fully understand the greater overlying issues of a holistic, globally-focused examination of the driving forces behind the tobacco trade and logistical and technological changes within it through a multi-scaled approach, it is perhaps necessary to turn to Jim Dolwick's recent introduction to Actor-Network theory in maritime archaeology to fill in the methodological gaps (Dolwick 2010).

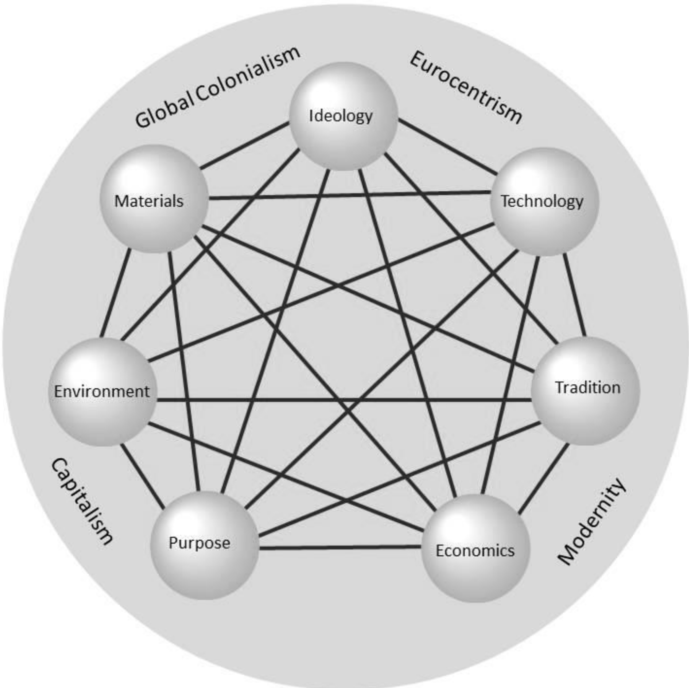


Figure 1-3 - A re-imagination of Adams' seven constraints of ship design combined with Orser's concept of the four 'haunts' of historical archaeology (graphic by S. Tucker, after Adams 2001: 301; 2013: 23; Orser 1995: 57-88)

The potential for the inclusion of aspects of Actor-Network Theory to this discussion lies in several points made by Dolwick of how it should be used within an archaeological framework. This leads him to a discussion of 'the social' and agency (Dolwick 2010: 35-43). This study is less concerned with issues beyond social interaction, but rather on large scale, interactive networks. Within Dolwick's writing, he brings up several points very pertinent to this research. The first is that an actor within a network has the potential to be a network itself, and a network can also play the role of an actor. What he means by this is that everything is scaled, and everything matters (Dolwick 2010: 39). The scaling of networks is truly important within this research, as it is important to finding empirical means to discuss many aspects of these networks which are largely unquantifiable. Dolwick (2010:39) points out that 'no actor is strong or weak. Strength comes from associations.' It is these associations and their strengths which will be the main focus of many aspects of the research described herein. Through a critical examination of the strength of associations between the various actors within our network—those listed above after Adams and Orser—this study seeks to identify the forces driving forward the changes in shipping between England and the Chesapeake Colonies throughout the 17th century through an assessment of potential sources of productivity change, with a view of how these factors interact with each other.

To summarise these concepts, each aspect of the tobacco trade is interwoven to some degree with each other part, although the strengths of these relationships—to be represented by line thickness—and weights of each aspect—to be represented by node size—are variable. The assessment of these aspects and their weights and relationships must therefore begin with the identification of each aspect to be included here. There is an old adage within archaeology that if one were to place four archaeologists in a room with an assortment of projectile points tasking them with the construction of a typology, they are likely to return instead with six or seven. With this in mind, the indicators of productivity change used here are a product of this author's imagination, designed to assess a specific set of factors which would affect productivity. It is likely that other researchers would come up with entirely different sets of gauges, although these are largely based on those notions put forth by Davis (1956: 59-69), but including elements from Adams (2001: 300-303; 2013: 22-23). Therefore, it is the intention of this work to assess the significance of the following factors affecting productivity change within the tobacco trade, as well as the strength of their relationships:

- Efficiency of route
- Efficiency of hull design
- Efficiency of ship construction methods and materials
- Ability of vessels to windward
- Time spent at sea
- Time spent in port
- Efficiency of product collection
- Size of a vessel's crew
- Mariner's wages
- Efficiency of tobacco production
- The tobacco economy
- Domestic political ideologies and pressures
- Foreign political ideologies and pressures

The end result of this thesis will be a series of network based models representing each of these indicators of productivity change, visualised as nodes, displaying their significance in the overall trade, and signifying a specific point in time (figure 1-4). Productivity change is used here to describe a change or shift in: production quantities; speed of shipment; efficiency of product collection or movement at sea; or income for planters, merchants or government bodies. Significance of each factor will be largely made on statistical analysis where possible, but for qualitative factors, this presents the classic issues of network analysis within archaeology. These will be handled on a case-by-case basis with clear methodology described. Relationships will be visualised as links, with relationships being demonstrated through line weights. Strength of relationships will be likewise qualitative, with a methodology for assessment of these associations addressed where appropriate, all while being mindful of the effects of Orser's four haunts. Through these methods, the outcome will be a stronger understanding of the complexity of factors affecting the trade, and the impact of maritime innovation in driving the trade forward.

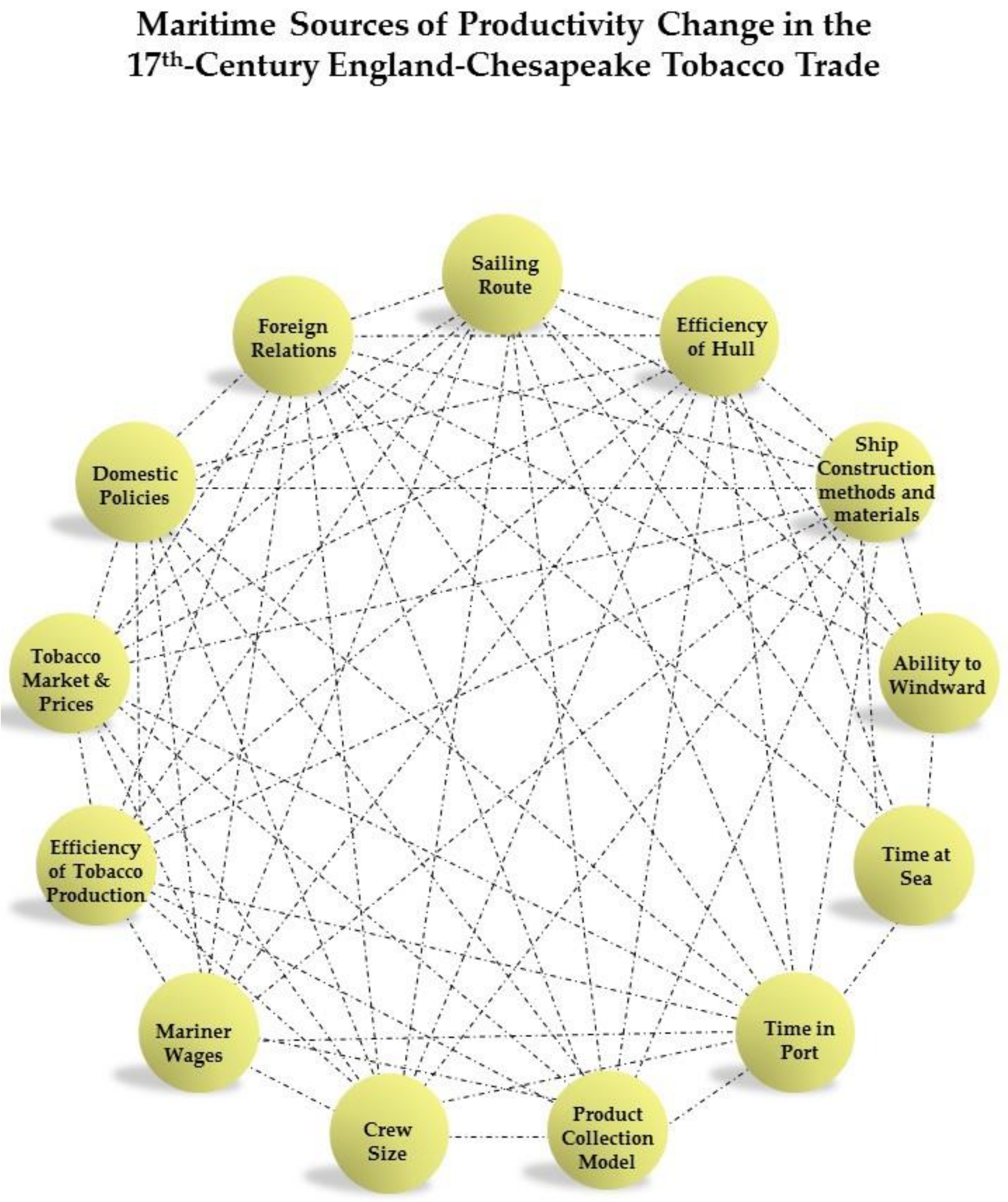


Figure 1-4 - Connect the dots! Incomplete model of interaction to be explored in the course of this document (graphic by S. Tucker)

Chapter 2 - Economics and Ideology: The Political Landscape of the Tobacco Trade

Introduction

At the very heart of English colonisation of the New World are issues of politics and economics. By the time England began its efforts to colonise the Americas, Spain had already been amassing wealth through its Central American exploits for nearly a century (Hassig 2006: 15, 76; Appleby 1998: 55-58). It must be noted, without oversimplifying the issue, that money is power. Although political and religious oppression are often attributed as the motivation for many of the early colonists making the perilous journey across the Atlantic from England, the fact is that these romanticised notions had in reality very little to do with early colonisation efforts. English colonisation of North America by both the merchants and the Crown were undertaken primarily for economic and political gain, evidenced by the politically endorsed merchant adventurer companies which carried out the earliest drive towards colonisation (Appleby 1998: 72). Motivators for individuals may have varied, with a heavy concentration of religiously motivated persons settling in the northern colonies beginning in the 1620s, but the original intent of England for the planting of colonies in North America was to find suitable sources of revenue for competing with the Spanish government (Bruce 1896 (1): 1; Horn 1998: 176-177).

The Crown allowed the Virginia and Plymouth companies and their shareholders to risk the capital, with promise of benefit to the government through tax revenue (Appleby 1998: 72-74). England needed an extended period of time to successfully plant a colony (Appleby 1998: 53-73), first achieving this in 1607, and the easy money they hoped for through gold and other precious metals did not exist (Bruce 1896 (I): 9-22; Appleby 1998: 174). Instead, in 1615, they found tobacco: an agricultural product with a fast-growing demand throughout Europe – which could be produced and distributed on a wide scale, provided they could entice people to venture across an ocean to an unfamiliar and undeveloped land to grow it (Middleton 1953: 105-107). By 1619, tobacco had become virtually the sole good produced in Virginia for export to England (Middleton 1953: 106). Once colony was established, there was plenty of land to be distributed, a factor that would have been a great motivator for potential settlers. In the early era of English colonisation, tobacco sold for a high price as well, further helping to entice potential colonists and planters. Throughout the 17th century, the numbers of tobacco planters in the Chesapeake, and the volume of the crop they produced for sale in the European markets increased drastically (Jacobstein 1907: 23; US Census Bureau 1910: 9; Morriss 1914: 35; Walsh 1999: 87-93).

Virtually all activities that take place on the water are related to activities on land though, and the movement of people and goods across the Atlantic for the purpose of tobacco production and distribution are no exceptions to this. Examining the agricultural aspects of the historic tobacco trade, along with the economics and logistics of transatlantic shipping of the product are key to understanding how these factors functioned as a while. Further, the political climate within England and of England's relationship to other states played an important role in the development of the trade as well. Through this chapter, changes in these themes will be explored, providing a backdrop for the research outlined in later chapters, and a study of settlement patterning in early Maryland will be provided.

England's Foreign Politics

To claim simply that England's relationship with its European neighbours throughout the 17th century was complex would be an understatement. As England's colonial period begins in the last quarter of the 16th century, this examination of its politics will be best served by beginning here, and continuing through the first quarter the 18th century to ensure adequate coverage of what occurred throughout the entirety of the 17th century. One obvious indicator of tensions between nations is military action, and England participated in a variety of wars throughout the period of interest. England experienced only about fifteen peaceful years throughout the 17th century, having been technically at war with Portugal for the majority of the period (Canny 1998: 482-505) (figure 2-1).

Both naval and merchant vessels of warring nations became targets of hostilities during this period. This made it particularly dangerous for English vessels to sail near any territory of a country with which they were engaged in hostilities at the time. For merchant vessels, it would be reasonably advantageous to avoid the territories of hostile nations, providing a possible explanation for changes in trade routes and will be explored at depth in chapter 4. At this time, a short overview of colonial holdings of European nations will be given to help set the scene for understanding the dynamics of England and other countries with overseas territories and their effect on English shipping throughout the 17th century. The most relevant nations to explore here as they relate to this work are with Spain, Portugal, The Netherlands, and France, given that these were the major maritime forces in Europe at the time, and England's most direct rivals in this period.

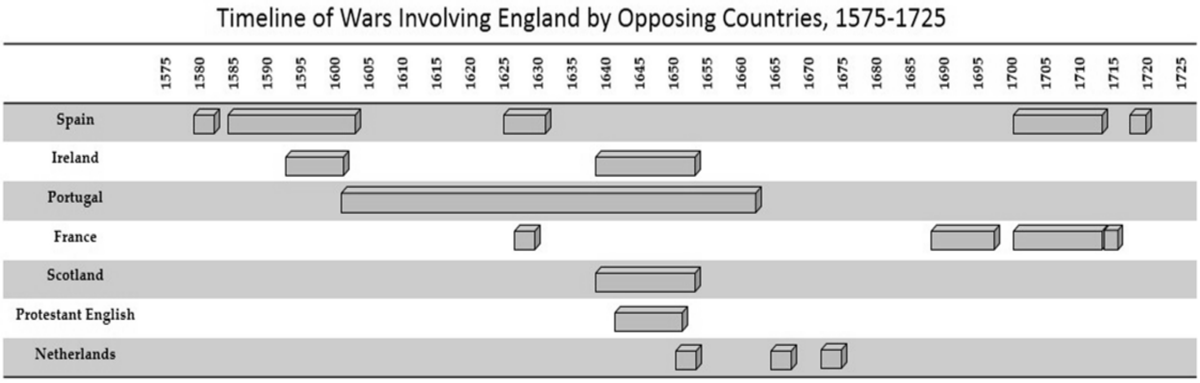


Figure 2-1 - Timeline of English wars from 1575-1725 (After Canny 1998: 482-505; graphic by S. Tucker)

Spain was the earliest player in European colonisation of the New World beginning with the Columbus voyages in 1492, and through their exploits of the land, and perhaps more so, of the indigenous people, began amassing wealth and power (Pagden 1998: 33-37). The land surrounding the entire Gulf of Mexico and many of the northern Caribbean Islands were all claimed as Spanish property (Hassig 2006: 15, 76). Spain's major economic activity in the New World was the collection and mining of gold and silver, which were then brought back to Europe (Appleby 1998: 55-58; Pagden 1998: 33-37; Hassig 2006: 15, 76). This newly obtained wealth and power naturally caught the attention of other European states, prompting others to follow suit and germinating a European age of global empires.

Portugal began its exploration of the newly forming Atlantic World around the turn of the 16th century (Feldman-Bianco 2001: 478-479). Portugal's Atlantic focus was primarily in South America and Africa though, with little attention paid to North America, though they had some minor activity near Newfoundland in the beginning of the 16th century. As England's foray into American colonisation occurred somewhat later, any existing rivalry with Portugal was in this sense indirect, not competing over land and resources, but rather as two European states competing for power. As England emerged onto the Atlantic seascape in the last quarter of the 16th century, Portuguese relations with Spain underwent some drastic changes.

In 1580, a 60-year period of joint Spanish and Portuguese rule for all of their associated territories began. (Israel 1998: 426). For this reason, both Spain and Portugal are treated here as a single entity, as the most overt effects on English colonial activity by these nations occurred during this period of alliance. While Portugal's overseas territories were mostly concentrated in South America and Africa where England held no claim, their union with Spain proved problematic for the English. While not officially at war with Spain after 1605, the Dutch-Portuguese War, in which the English supported the Dutch, kept England at odds with Spain, making English vessels travelling near Spanish territories a potential target (Brown 1890: 343-344; Bruce (I) 1896: 623-624; James & Jameson 1913:38; Wright 2013: 1). England's relations with Spain greatly improved in the latter half of the 17th century, prompting friendly relations and trade amongst the two formerly warring nations (McLachlan: 1940: 1-3).

While Spain and Portugal were perhaps the main rivals of England in terms of colonisation, English economic policy relating to colonial trade would result in soured relations in the 1650s with the Netherlands, whose maritime capabilities had until that time been helping to supply Europe with New World products (Bruce 1896: 349; Owen & Tolley 1995: 102; Israel 1998: 427-440). Levy & Ali (1998: 30) describe the Anglo-Dutch relationship in the first half of the 17th century as the devolution from a 'cooperative alliance' against Spain, into commercial competitors, then to strategic rivals, and finally into warring nations. The Dutch operated the settlement known as New Amsterdam on Manhattan Island in the early 17th century. The colony was mainly used as a fur trading outpost, but the Dutch were heavily involved in the transport and trade of other goods from the English colonies until the Navigations Acts made these activities illegal in the 1650s (Kupp 1973: 653; Pagan 1982: 485-487, 491).

Unhappy with being forced out of this market, of which tobacco was a main staple, the Dutch engaged England in three wars attempting to re-open direct trade with the English colonies (Braddick 1998: 301-302). The wars were fought from 1652-1654, 1665-1667, and 1672-1674 (Canny 1998: 494-498), taking place primarily via naval engagement in the North Sea (Jones 1996: 16). Some consequences were seen in North America though, namely the English seizure of the New Amsterdam settlement in 1664, which then became New York. These efforts by the Netherlands did not hinder England's trans-Atlantic trade; as will be shown, the English government only continued to pass laws strengthening their ban on direct foreign trade with their colonies (Owen & Tolley 1995: 101-108).

English relations with France late in the 17th century also devolved, causing additional issues for the colonial market. France had colonial holdings in the northern reaches of the North American continent and a small collection of other settlements, but perhaps the greatest issue for English overseas trade stemming from these conflicts lay much closer to home. The Nine Year's War (1688-1697) and Queen Anne's War (1702-1713) brought back the issue of control of the English Channel, a matter that had been at rest since the time of Henry V. Sharing the English Channel with France would prove difficult and complicated matters of shipping, to the point at which English merchant ships found it necessary to avoid the Channel altogether when travelling to London, despite its otherwise-convenient passage (Murphy 1867: 400-416; James & Jameson 1913: 275-291; Andrews 1907: 337-347). Evidence for this will be presented in the following chapter.

The relations between England and competing colonial powers clearly played a major role in shaping the function of overseas trade. Throughout this dissertation, this topic will continue to be a theme of interest and explored to a much greater depth. War is certainly not the only indicator of troubled relations, and this focus on bellicosity ignores the role played by amicable relations between nations, but it is perhaps more useful to explore the problematic and complicated relationships between England and relevant lands. Additionally, it must be noted that piracy was a major issue throughout the 17th century. Unlike privateering, piracy did not necessarily stem from any particular country, but it had a similar effect on trade as that caused by war between nations. England's reaction to these stimuli *vis-à-vis* trade and sailing routes is another theme explored in the coming chapters.

Domestic Regulation of Colonisation and Overseas Trade

Although the tobacco economy developed through merchant ideologies, the English Crown was heavily vested in ensuring its profitability (Middleton 1953: 107-108). In the coming discussion, it will be shown that throughout the majority of the colonial period, the English government repeatedly intervened to regulate colonial trade, and created a monopoly for tobacco which resulted in higher profits for both English merchants and the royal treasury.

These laws fall into three main categories: taxation, trade acts, and the indirectly related Town Acts.

Taxation of tobacco was initiated nearly from the start of the tobacco trade. Until 1685, the Royal treasury received 2d per pound (0.45kg) of tobacco imported from the colonies (Middleton 1953: 123). From this point, the duty per pound gradually increased, rising in 1685 to 5d, and again in 1703 to 7.33d. The final increase during the American colonial period was in 1758, rising to 8.33d per pound. The trade of this single crop yielded approximately £500 in 1622, £4,000 in 1628, £12,500 in 1639, and £415,000 by the end of the 17th century (*ibid*.). To the detriment of the Royal coffers though, from 1660-1723, the majority of the duties were rebated for tobacco exported from England to Europe (Middleton 1953: 124). Estimates indicate that two-thirds of the tobacco produced in the Chesapeake colonies was meant for further export, significantly reducing the Crown's potential net revenue.

The colonial governments of Virginia and Maryland also saw an opportunity for tax revenue through tobacco, receiving two shillings per hogshead of tobacco exported (Middleton 1953: 125; Morriss 1914: 47). The colonial administration of Maryland first began to collect this duty in 1672, having previously received no export revenue. This lack of revenue from direct export does not, however, equate with a lack of income. Port duties existed prior to the export duties, as evidenced by a 1660 admiralty court case regarding customs duties of an unknown ship mastered by Capt. Miles Cooke (Owen & Tolley 1995: 252). While not based on tobacco exported, these duties were likely based on ship tonnage, and acted as a vessel's license to operate in Maryland waters. The duties collected within the Maryland colony were enough to support the early government and its leaders, with half of the funds going to the colonial government and the other half directly to the proprietor (Morriss 1914: 47). During the royalist years (1689-1715), the proprietor continued to receive half of the duties, with the governor receiving three-eighths, and the final eighth going to defence of the colony. As will be seen shortly, the tobacco trade proved profitable for most involved, save for those directly involved in planting and harvesting the crop. Both the Crown and the colonial governments passed many laws to ensure profitability at the top, often in opposition to one another, divided between which side of the Atlantic should receive the income.

To these ends, England continually passed laws limiting who could be involved colonial trade, with each new law further monopolising it. Owen & Tolley (1995: 101-102) report the passage of more than twenty such *Acts of Trade* between 1651 and 1776. Regulation of trade began somewhat earlier than this though, with the first such political act was the banning of the cultivation of tobacco within England after 1619 (Jonsson 2014: 123-124). This act was repeatedly challenged by English farmers, and was often reiterated in laws ranging up to 1663. Further restriction of trade began in 1651 under the Cromwellian government. The 1651 act—the first in a series of regulations popularly known as the *Navigation Acts*—served primarily to ban foreign ships from trading with the colonies (Bruce 1896: 349). The act was intended to create a trade monopoly between England and its colonies, ensuring that England was the sole beneficiary of wealth attained through its overseas ventures (Owen & Tolley 1995: 102). Numerous loopholes existed in this law, however, which foreign nations, merchants, and the English colonists sought to exploit. Further, this act stipulated that colonial goods must pass through English ports before being re-exported in Europe. After the royal restoration, the laws of the commonwealth were repealed. It would appear though, that Charles II found the original 1651 Act of Trade to be beneficial, as a new, nearly identical act was passed in 1660 (Owen & Tolley 1995: 104-105). In 1664 another act was passed which required ship's masters and three-fourths of the crew to be English (*ibid.)*. Such was the pattern of these acts: each time strengthening the previous act, was quite likely a reaction to the exploitation of a weakness or loophole in the previous legislation. The various Anglo-Dutch wars were the result of Holland's grievances over being excluded from trading with England's colonies, although in each, England came out the victor. The end result of these acts was that England had achieved its original goal of blocking foreign nations from benefiting financially from its colonies. Of course illicit trade was not completely eliminated, and enforcement was very sporadic in the colonies, as will be discussed in the next section. Nonetheless, it is clear that English merchants and the Royal Government benefitted greatly from these laws.

Within the colonies there was a resistance to residing in structured towns, with the planters wishing to settle nearer to their crops (Riley 1950: 306). Riley (1950: 306-307) attributes this both to the large land requirements for planting tobacco — at an average of 250 acres per family in 1659 (Carr et al. 1991: 35) — and to the geography of the region, with its vast waterways making the bulk of the region accessible by ships (Riley 1950: 306-307; Middleton

1953: 38-42). This unusual ease of access for vessels encouraged settlement to spread along the various riverbanks. The earliest days of Virginia followed a somewhat different pattern, with many colonists residing in settlements with nearby forts, such as Jamestown and Henrico, but it was not long before they began to spread themselves thinly across the land. In early Virginia, this practice was rather unsafe, evidenced by the massacre of several hundred English colonists by the native population in 1622 (Middleton 1953: 106; Riley 1950: 306). A 1623 letter to the Virginia Company of London from Jamestown states that the colonists at Martin's Hundred were forewarned by a young Native American, and were able to then meet in the Jamestown fort and stave off much of the attack, but those who received no warning in the outlying settlements did not fare as well (Kingsbury vol. IV: pp. 98). This highlights one of several issues surrounding the colonists' choice not to reside in tightly packed settlements. Following the massacre, the colony received a royal directive that future towns should be erected with dwellings in close proximity to each other for security (Bruce 1896: 532). Safety aside, the merchants and colonial governments quickly saw another negative aspect to the colonial settlement pattern: the sparseness of the population simply made the process of trade more cumbersome.

Time needed to collect tobacco was of much greater concern to the government and merchants in London than it was to the colonists. Edward Riley (1950: 306-307) suggests that from the planter's perspective, residing on the land which they worked was advantageous, and life would be made burdensome should they be made to reside in towns or villages away from their plantations. For merchants and traders, the time spent collecting tobacco from the numerous plantations on the banks of the Chesapeake Bay and its myriad tributaries was a major encumbrance. An examination of the 1671 map of Maryland and Virginia by Augustine Herman illustrates just how difficult tobacco collection would be when lacking any system of centralisation (figure 2-2). A 17th-century logbook of six voyages on tobacco vessels shows that four months was a fairly average amount of time to spend collecting tobacco (Rhodes 1670-76; Wing 1999: 21-22). Time spent within the capes of the Chesapeake Bay in this log range from 108 to 158 days, averaging about 119 days.

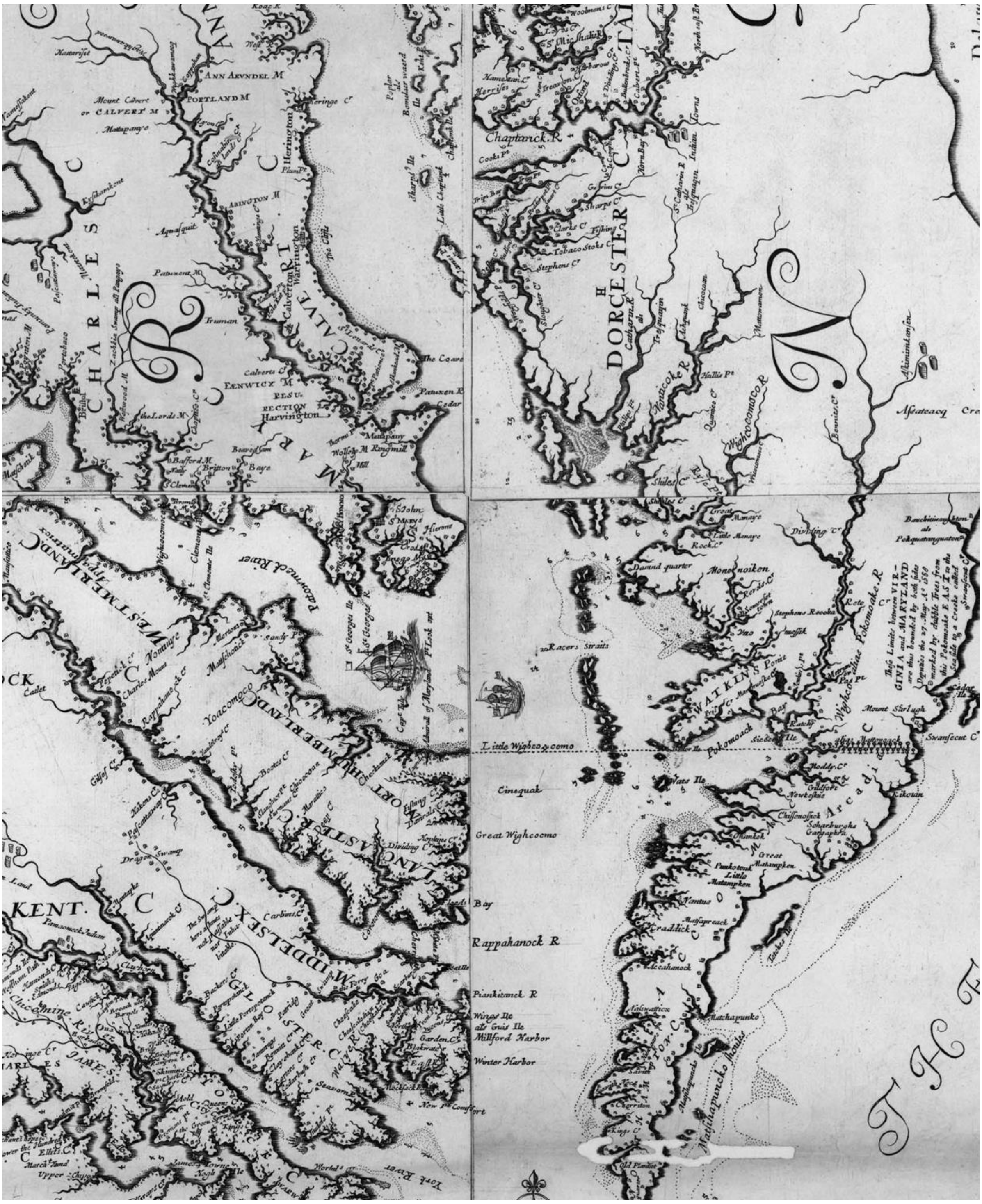


Figure 2-2 - Detail of the 1672 Augustine Herman Map of Maryland and Virginia showing locations of plantations and other landmarks (Maryland State Archives, SC 5339-1-172)

It is obvious that the collection of tobacco by ships directly from plantations was a time-consuming and inefficient process. Had central ports been a feature of the 17th-century Chesapeake landscape, tobacco could be collected by vessels within the colonies as it was readied, allowing the English ships to simply arrive, load, resupply, and return. The bulk of the labour in collecting the tobacco would then necessarily fall on the colonies, necessitating a dedicated fleet to achieve this. Alternatively, it would fall directly on the planters, whose time was already stretched thin by the cultivation of the crop. Numerous laws were passed in both Virginia and Maryland at the insistence of the Crown ordering the establishment of towns to these ends (Riley 1950: 308). The passing of legislation and the execution of the directive, however, were two very different things. The establishment of storehouses for tobacco was already a topic of discussion in 1638, but there was great resistance from the colonists, and little desire to construct such buildings (Bruce 1896: 532). Such storehouses would not become a key feature of the tobacco until well into the 18th century (Middleton 1953: 137). Middleton (*ibid.*) describes this shift being the result of regulations requiring the inspection of tobacco, which is also likely a cause of the reluctance of planters to agree to the establishment of warehouses.

The first related piece of legislation came from the Virginia General Assembly in 1662 ordering a town to be established along every major river. The law failed to take hold, as the colonists were seemingly not interested in moving into towns, their top priority being the raising of tobacco (Riley 1950: 308-309). Moving into towns would require farmers to be further from their land, and therefore from their work. This can understandably be seen as an inconvenience, and lacking a serious threat to safety, was likely not a seen as a necessity. This was followed by several more acts throughout the 17th century and well into the 18th century with names such as *Towns Act*, *Cohabitation Act*, and *Act for Ports*. None of these were successful in creating towns within the colony of Virginia. Maryland's attempts at establishing towns proved slightly more successful, but had little immediate effect on the process of tobacco collection (Maryland State Archives 1667-87/8, volume 5: pp. 31-32, 47-48, 92-94). Governor Charles Calvert made several attempts to pass an act to establish towns and ports. His efforts began in 1668, but those efforts, and later efforts in 1669 and 1671 proved unsuccessful. In 1683, *An Act for Advancement of Trade* was finally ratified, calling for port towns to be established in twelve locations along the tributaries of the Chesapeake Bay (Maryland State Archives, 1678-1683, volume VII: pp. 609-619). Of these, only a few were established, with those towns which were established not functioning as intended. Two such towns which were founded by means of this legislation included Port Tobacco and Londontowne (Beisaw 2007: 3). While the act intended for towns to serve as places for 'all

Shipps & vessells tradeing into this Province [to] vnlade... & Trafficke away all goods... imported into [the] Privince' and for 'all Tobaccos goods wares & Merchandizes of... [the] Privince... to be brought to said Ports & places,' little evidence exists to suggest that planters and mariners changed their practices at all. A journal of a 1705 voyage to Maryland shows that vessels were still in port for extended periods, with this particular ship arriving in late December among a fleet of about 80 vessels, and returning in early June, just behind the main fleet (Andrews 1907: 327-328, 337).

Enforcement of Navigation Acts within the Colonies

The Navigations Acts provided a legal framework for the enforcement of the monopolistic regulations which England had imposed on its colonial commodities. It would appear that the crown intended for the colonies to enforce these acts on their own when violators were found within their jurisdictions. No courts of Admiralty were set up in the colonies until 1696 (in Maryland), but matters of maritime law were handled within general sessions of the established colonial courts (Owen & Tolley 1995: 25). The colonists though, and it would seem the colonial leaders as well, were strongly opposed to the regulations put in place through the Navigations Acts, as it decreased revenues within the colonies. The Crown and England-based merchants were the true benefactors of the newfound legal monopoly of tobacco within Europe, a fact that did not sit well with those who took the risks of venturing to the Chesapeake, spending the time and energy to cultivate this product. The necessity for the continual passage of new and stronger regulations on colonial trade should be taken as an indicator that there was a failure somewhere in the system. Given the small number of Navigations Act violators tried in Maryland courts in first decades of their introduction, it would appear that the failure occurred at the colonial level (Owen & Tolley 1995: 111-113). Despite this apparent failure of enforcement, almost one-half of maritime matters handled in Maryland courts from 1663-1773 were related directly to the Navigations Acts (Owen & Tolley 1995: 5). The Crown was not unaware of the colony's failure to enforce the regulations; the colonial governors received a stern warning in 1669 reminding them to actively enforce the Acts of Trade. Later, in 1682, Governor Charles Calvert, proprietor of Maryland, received another letter from Charles II, this time assessing him a fine of £2,500 for failure to enforce the

Acts, specifically for failure to collect duties from three ships, and threatening to revoke the colonial charter.

Lack of cooperation in enforcing the various Navigations Acts was a major annoyance for the Crown, but a review of maritime cases handled in Maryland courts, as compiled by Owen and Tolley (1995: 243-305) shows that during the relevant years of Maryland's first proprietary period in which Navigations Acts had been passed (1651-1691), only ten of forty-two total maritime cases involved violations of the Navigations Acts. By comparison, the royalist period (1691-1715) saw thirty-seven maritime cases, twenty-two of which being for violations of the Navigations Acts. It is true that new laws had been repeatedly passed as time went on, giving the courts of the royalist period more strength to act, but the jump from 24% of total cases to almost 60% is significant. The first decade of the royalist period was especially active with cases of violations of the Navigations Acts, indicating a wilful negligence on behalf of the proprietary government to prosecute such cases.

The reluctance of Maryland's proprietary governors to enforce the various acts of trade is a rather curious feature within the early colonial government. Starting with the 1660 act, ships caught trading illegally were subject to forfeiture, and the value of the vessel and cargo would be divided; one-third going to the colonial governor, one-third to the Crown, and one-third to the informer (Owen & Tolley 1995: 104). One would expect that these financial inducements would have provided adequate motivation for colonists and the colonial government to attempt to curb illicit trading, but this does not appear to be the case. There was most likely an unseen motivator driving the virtual silence, which if one were to identify the simplest explanation, is likely monetary in nature. The Navigations Acts and England's new monopoly on tobacco had no doubt driven up prices of tobacco on the European mainland. Illicit trade takes place by necessity without record, but it stands to reason that the planters likely received higher prices for their tobacco from foreign ships than from English ships, and for this reason were not quick to report foreign vessels trading in their waters. The colonial government ignoring it is stranger yet. For ships trading legally, the Maryland government received two pence per pound of tobacco exported, and after 1685, 6.33 pence per pound as duty (Middleton 1953: 123). Further, vessels were required to pay port fees within the colony. Foreign ships operating without license in Maryland and Virginian waters were directly drawing money away from the colonial governments, as well as the Crown. While the question cannot be answered definitively, it raises the question of what unseen benefit the colonial government was receiving by not addressing this issue on a wide scale.

When the laws were enforced and successfully prosecuted within the colonies, they resulted in excellent gains for the colonial governments and the whistle-blowers. An example of this is in the 1672 case of a Swedish ship, *The Burgh of Stade*, which was caught in St. Mary's County, Maryland, after unloading 50,000 yellow bricks at Thomas Notley's estate (Forte et al. 2004: 96-100). The sheriff of neighbouring Charles County, Benjamin Rozer, commanded the master of the ship *Hopewell* of London to seize the *Burgh of Stade*. The ship, its captain, and its 13 crew members were taken into custody, and brought to the court. The case was a very clear violation of the Navigation Acts; it was a Swedish vessel, could show no license to trade, and the crew was comprised entirely of Swedish citizens. Numerous conflicts of interest existed between both the prosecution and defense. Forte et al. note that Notley, the recipient of the cargo, served as the defence attorney (2004: 98-99). Prosecution of the case was successful and the vessel was seized. The ship itself was valued at 199 pounds sterling, ten shillings, giving 66 pounds each to the royal coffers, Governor Calvert, and Benjamin Rozer. For an average planter in Maryland at the time, this amounts to nearly two-year's earnings from tobacco (Carr et al. 1991: 77), and this for a vessel with a 25-30-year-old hull (Forte 2004: 107). Notley received at least a portion of the bricks as payment for representing the Swedish mariners in court. Recent archaeological investigations of his property and neighbouring properties have yielded concentrations of yellow bricks that are higher than average for 17th-century sites, indicating that Notley retained some of the bricks for personal use, and sold or otherwise distributed these bricks to his neighbours (Bauer et al. 2013: 46-47). Even though all parties, the Swedish mariners excluded, benefitted enormously from this case, such prosecutions remained rather uncommon throughout the first proprietary period. This is a good indication that the colonial government and planters alike saw the Navigation Acts as detrimental in the long term to the overall health of the tobacco market at the colonial level. Whether the colonial government was receiving additional benefits of any sort for ignoring illicit trade cannot be known, but it required royal intervention in the colony to truly bring Maryland into compliance with the Navigation Acts

Prices of Tobacco – Farm and Wholesale

Numerous historians have examined to some extent prices of tobacco in Maryland and Virginia, all noting a marked decrease in price over time (Bruce 1896: 456-458; Carr et. al 1991: 77-90; Menard 1973: 80-85, 1976: 401-410; Middleton 1953; 123-124; Morriss 1914: 23-26, 37-40; Price 1964: 499-501). Studies of actual prices though, as Menard points out, are exceptionally problematic (1973: 81-82). The numerous and differing types of sources from which scholars have drawn their conclusions are often contradictory, with one scholar demonstrating a low price in a particular year, and another scholar showing an exceptionally high price in the same year (*ibid.)*. Many factors went in to the price which a planter may receive for his crop, including the quality and quantity of tobacco, or whether the tobacco is being shipped as a consignment to be paid in consumable goods or to be paid for directly. Further, Menard states that prices paid at the farm have little in common with English wholesale and market prices (*ibid*.).

Despite the lack of a reliable series of colonial prices for tobacco in these differing marketplaces, Menard (1976) has attempted to control for the numerous issues surrounding the data, and has provided what is likely the most complete and reliable studies on this subject. He notes that his data prior to 1660 is not as strong as the data for the post-1660 period (Menard 1976: 401-402). Few data are available for the wholesale market in England, but for that which is available, English wholesale prices follow a similar trend to farm prices. Prices of tobacco both on the farm and wholesale market started very high in the 17th century, with each subsequent decade characterized by prices exponentially less than those of the preceding decades (figure 2-3). There are two major points where prices drop, the first taking place around 1632, where the prices mostly stabilise with a slightly negative trend before falling once again in the 1660s. This second period of price drop proved then stable for the bulk of the century, with prices hovering between one and two pence per pound farm value. For the few years in which data for wholesale values are available, the percentage of product mark-up ranges between 33% and 126%, with the average mark-up being around 98.5%.

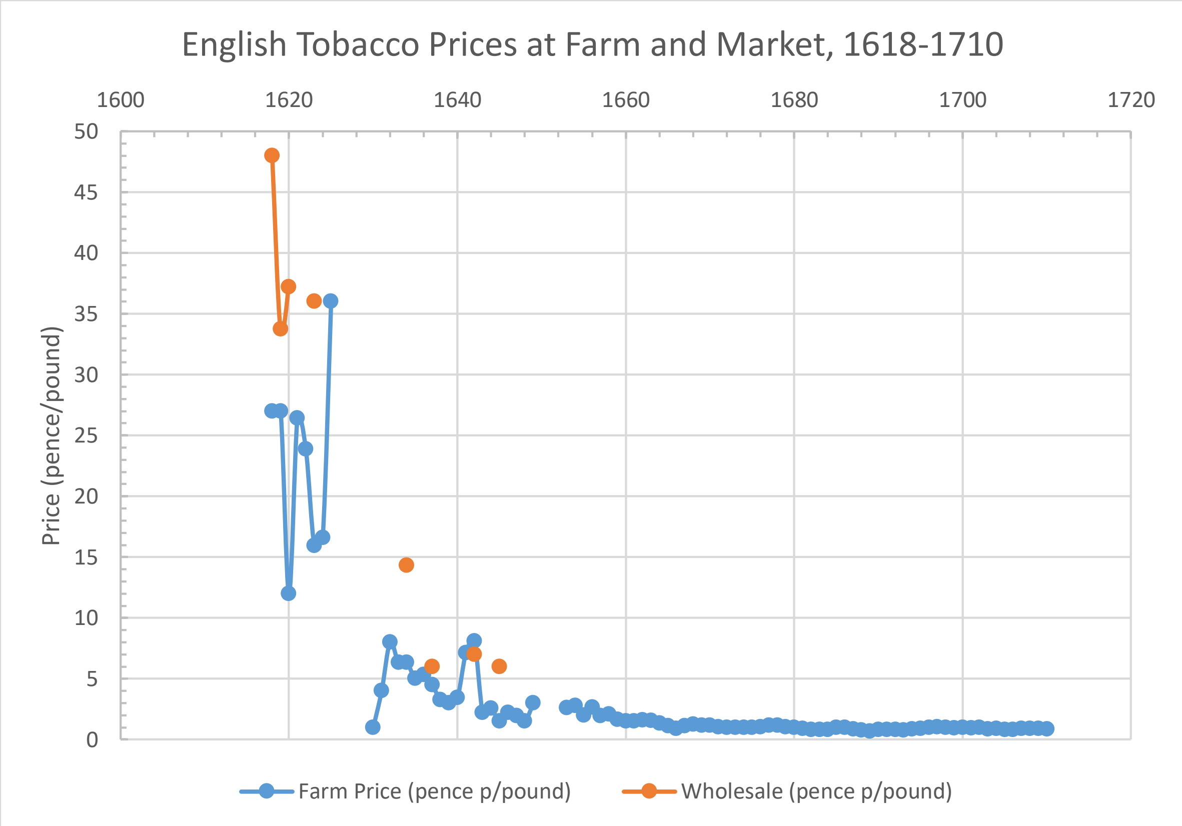


Figure 2-3 - Prices of English Tobacco at Farm and Market (Menard 1973 & 1976) (graphic by S. Tucker)

As seen in the preceding chapter (figures 1-1, 1-2), the dramatic drop in price is almost certainly created by an increase in production with a drop in production costs. The dates of the price decreases coincide with Price's assertion that three main economic periods existed in the time period being explored (1964: 497). Price classifies the first period, from 1607 to 1637, as a period of settlement and establishment, where output was low, but the foundations were set for the large-scale production of goods. The following thirty years, from 1638-1668, were a period of major growth in the tobacco industry, seeing a significant increase in the amount of tobacco being produced. During this period, tobacco prices drop gradually, coming to rest at the end of this period at an essentially static price. The final thirty-two years of the 17th century saw a slowing of growth in production and of tobacco prices, perhaps indicating that demand was finally met through production, and the market was growing at what might be classified as its normal rate. To better understand the economic situation of the trade, brief attention will be paid now to tobacco production, both in terms of quantities produced and of the husbandry practices which helped to drive productivity on land.

Transportation of Trade Goods

It could be said that transportation is the central theme to this entire work, but it is necessary to touch on a general discussion of transportation here for the purpose of establishing the extant body of knowledge on this subject. A number of studies of economic history have investigated a wide array of factors affecting productivity in ocean shipping. Many of the central themes of these works were discussed in the previous chapter, but it is worth noting them here again in this context. Perhaps the most important aspects of oceanic shipping to productivity are volume and distance (Davis 1956: 59). In the tobacco trade though, distance is perhaps better replaced with time spent away from the home port, as the merchant's capital is tied up in the vessel throughout the entirety of its voyage. For the trade to be profitable, the cost of shipping must not exceed the profits gained from sale of the commodity. Higher shipping costs can of course be recouped by increasing the wholesale price of the product, but the resulting higher retail prices in England would then make the product available to a smaller subset of the population, thus reducing overall profitability for the market. As discussed earlier, reduced prices were necessary to the overall growth of the tobacco economy. Keeping shipping costs sustainable is clearly the better option, and this is indeed the trend throughout the colonial period. As multiple factors affect shipping costs, each of these will be examined here, with attention paid to trends over time and known areas of change and improvement. These will include time spent away from the home port, crew members needed, crew wages, ship-building costs, and insurance costs (Walton 1966: 596). Overall, a decrease in freight rates over time has been noted in the tobacco trade (North 1968: 954; Walton 1968: 279).

Time away from home port involves two factors: time at sea, and time in port abroad. These will be discussed here both separately and as they relate to each other, as overall productivity is dependent on the relationship of these factors to each other, but determining strengths or weakness of each individual factor helps in isolating areas of change. The coming chapter addresses time spent at sea in depth, measuring it over multiple routes which were in use at various times in the 17th century. Suffice it here to say that some degree of improvement did occur in days spent at sea, although this appears to have been more dependent on route than on an improvement to actual vessel speed. Time spent in port on Chesapeake voyages improves dramatically from the late 17th century to the late 18th century (North 1968: 963; Walton 1967a: 75). This is generally explained by the early lack of centralisation in tobacco collection points around the Chesapeake, and a later move toward a centralised model. Between 1694 and 1701, ships trading in Maryland and Virginia required an average of 100 days to collect tobacco before returning to England (Walton 1968: 75-76). Observations from 1762 to 1768 show this figure to have decreased by over 50 per cent to an average of 53 days. This decrease in time spent in port made it possible for vessels to occasionally make two voyages per year as opposed to the single journey which was characteristic of English-Chesapeake trade in the 17th century (Price 1954: 189).

A major cost for any employer are the wages paid to its employees. The tobacco trade was no exception to this, with the wages and victualing expenses representing a significant cost for merchants. Perhaps the most effective means of cutting total wage costs is having fewer employees. For a ship of 250 tons, Davis (1962: 370) and North (1968: 962) show a markéd decrease in crew members over time, from a figure in excess of 35 members typically aboard a vessel at the beginning of the 17th century to fewer than 30 persons around mid-century, and finishing off the 17th century at just over 20. Such a decrease cannot occur simply by hiring fewer crew members. A minimum number of sailors are necessary to ensure that each crew position is covered throughout a 24-hour sailing day, which includes gunners. Although there was likely an initial overestimation of crewing requirements, changes to rigging requiring fewer seamen to handle the vessel may have been a driving factor in reductions in crew members on board, and will be duly explored in the forthcoming chapter. Further, reduced risks of hostilities would reduce the number of crew necessary on board to man ordnance. Of wages paid to individual crew members, these remained roughly constant throughout the 17th century (Walton 1967a: 68-69), meaning that the reduction in crew costs was proportionate to the reduction in crew members. Insurance costs were noted by Walton as having fallen moderately from the last quarter of the 17th century through the third quarter of the 18th century, although little additional detail is given (Walton 1967a: 71).

Turning now to shipping expenditures, Wyckoff and Walton have each provided data concerning freighting rates for tobacco throughout the majority of the 17th century (Walton 1968: 279; Wyckoff 1938-39 34(1): 60-61). Early freighting rates were high, at around £12 per shipping tun (£3/hhd), but dropped to around £7 per tun by mid-17th century (figure 2-4). From this point, they remained fairly constant at least through 1740. The timing of the change is again consistent with Price's theory of a second economic era for the Chesapeake, strengthening the argument that this is a significant marker of maturity in England's overseas trade and the beginning of the scaling of the Chesapeake economy.

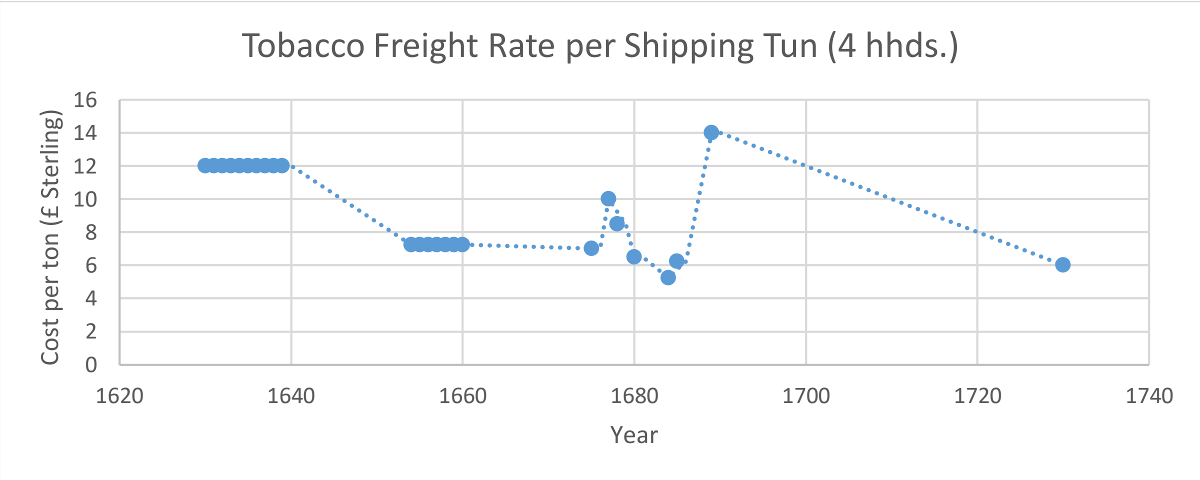


Figure 2-4 - Freighting rates for tobacco per ton (graphic by S. Tucker)

Of further concern was ensuring that goods could be transported safely across the Atlantic. Losses could happen by several means. Using appropriate vessels in a good state of repair mitigated against much of the loss, but losses from privateers, pirates, and hostile nations were a major concern and occurred with some regularity. England had several responses to these losses. Alterations to trade routes were amongst them, and will be discussed at length in chapter 4. Another form of response came via mandated travel in fleets or convoys as discussed in the previous chapter.

Colonial Population & Settlement

Factoring into the above discussion concerning the various 'Town Acts,' settlement patterning in the Chesapeake played an important role in shaping logistical aspects of tobacco collection within the colonies. 'Though ships are designed to sail on and navigate the ocean, their true cultural purpose links them closely to human activities on land' (Rodgers et al. 2005: 27). All human activity on the water is inherently connected to life on land, as no culture is purely aquatic. The ship is at its core a tool used as an extension of land. The realm of the ship ends where physical land begins, and therefore a study of ships must not ignore the context of the land masses that it links. Understanding the ways in which colonists utilised their landscape is key to understanding some of the changes that would occur to the tobacco trade over time.

As was previously discussed, any large-scale improvements to vessel speed could be easily rendered moot by longer times spent in port (Davis 1956: 60). This is an absolutely crucial factor in measuring productivity increases. The resistance to settling into towns and insistence on the part of the colonists to have their product collected directly from their plantation were a hindrance to improving time spent by vessels in port. Major declines in days spent in port have been observed occurring in the second quarter to half of the 18th century (North 1968: 961-963), corresponding with the establishment of the first storehouses for tobacco produced in the Chesapeake. It seems clear that these are related issues, with a central warehouse collection model being key to the most meaningful productivity increases seen in the pre-revolutionary Chesapeake tobacco industry. It is, however, uncertain what led to the eventual passage of the Town Acts, and why after so much resistance a centralised collection model was adopted. That the Crown and Local governments understood the importance of adopting this model is clear, evidenced by the continual, albeit failed, attempts at establishing port towns. Names of these acts, such as *'An Act for the Advancement of Trade'* indicate a full awareness of economic impact of the plantation collection model. The resistance to these efforts by the colonists and some politicians is more curious, but likely rests on their desire to barter directly with the merchants for prices, and to stagger the sale of crops over time to avoid a flooded market and therefore, lower prices for the planters. Nonetheless, the efforts of the Crown and legislatures eventually prevailed, and along with the passing of the Town Acts came the expected result of a more efficient trade.

With such a drawn out resistance to these measures though, one might be compelled to ask what it was which led to the eventual success of the Town Acts. It is hypothesised here, and will be duly explored, that main causation for the acceptance of these acts of legislature was simply logistical necessity. That being, the population of the tobacco-producing colonies had simply grown too large, forcing newly arrived planters to more inland land parcels, and removing the option of plantation-front collection of their product. If the 1672 map of Maryland and Virginia produced by Augustine Herman (figure 2-2) is at all accurate in its representation of plantation location and density, it would appear that by this date the bulk of potential waterfront properties in the colonies had been patented. Subsequent newcomers to the Chesapeake would necessarily be relegated to less desirable inland locations to plant their crops, thereby forcing these colonists to seek alternative means of having their product loaded into ships for transport.

To date, only limited work has been performed on settlement patterning in the Chesapeake during this period using physical archaeological data. The most relevant such work, (Smolek 1984) utilising both historical and archaeological data, is over thirty years-old. A second and much more recent work focusing on St. Mary's County, Maryland, also uses site location data to examine settlement patterns over time (King & Strickland 2015: 30-38), but focuses only on one small sub-region. In an effort to bolster the strength of the data, a small-scale study is offered here examining known archaeological sites from the 17th and 18th centuries. The study will focus on Charles County, St. Mary's County, and Calvert County, Maryland.

Colonial Population

Perhaps an appropriate starting point to this discussion lies within colonial population statistics themselves. The US Census Bureau (1910: 9) reports that colonial populations and growth rates were rather low throughout the bulk of the 17th century. Naturally, growth rates during the initial decades of colonisation are exaggerated due to the small size of the initial colonies, with the years between 1610 and 1620 resulting in more than a 1000% increase for Virginia, but once reaching the 1660s, growth in Virginia slowed to around 20-25% each decade until 1710 (figure 2-5). Maryland experienced a similar growth pattern, although growth stabilised slightly later due to its later founding. The turn of the 18th century brought about significant increases in population growth, first hitting Maryland with 38.7% of growth from 1700-1710, and an additional 44% increase in the following decade. Virginia's growth boom began in the decade between 1710 and 1720, experiencing a 33% increase, and a similar growth rate in each of the next decades to follow until reaching the point of the American War of Independence.

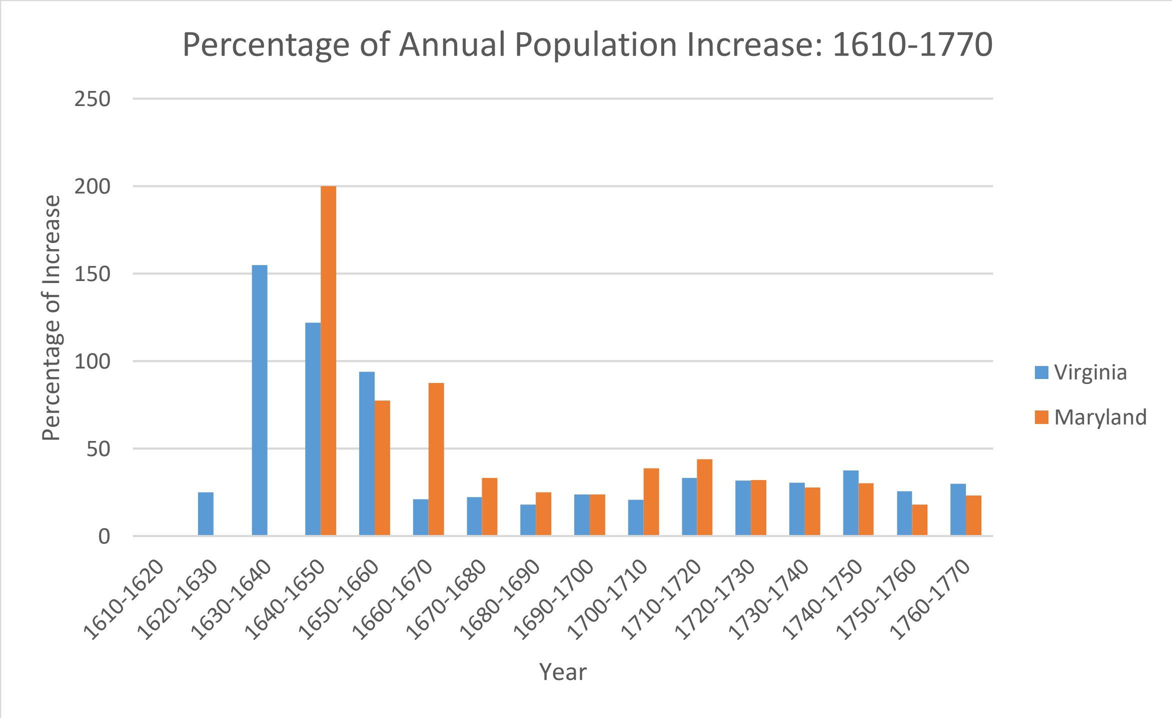


Figure 2-5 - Percentage of population increase by decade in Virginia and Maryland throughout the colonial period (data from US Census Bureau 1910: 9; graphic by S. Tucker)

Growth percentages show one side of the population data, but total population is another important factor to examine here. Virginia's meagre population of 210 in 1610 rose to 17,000 by mid-century, 72,000 at the beginning of the 18th century, and 50 years later, numbered over 275,000 individuals (figure 2-6) Maryland's population was always smaller, but experienced similar trends. Pressures on the available land by the English population were few in the first decades of Chesapeake colonisation. With over 13,000km of shoreline along the bay and its navigable tributaries, there was certainly plenty of waterfront property to go around. Although Herman's map shows that most waterfront property was taken by 1670, it also shows that inland sites are nearly non-existent in the Chesapeake. The overall validity of this map can of course be drawn into question, but Michael Smolek (1984: 8) points out that his review of 17th-century archaeological site locations as understood in the 1980s matched fairly well with Herman's distribution of plantations, and that nearly 90% of the 17th –century sites known in Maryland at the time of his writing were within 5,000ft (1.5km) of the modern shoreline (Smolek 1984: 8). Further, 62% of Maryland sites and 73% of Virginian sites known to Smolek dating to the 17th century are located within 1000ft (300m) of a navigable waterway. Clearly, water was a key factor in selection of land, and was so specifically for the purpose of trade. Charles Calvert, governor of Maryland and the third Baron Baltimore wrote in 1678 describing exactly this phenomenon: 'The people there are not affecting to build nere each other but soe as to have Their houses near the Watters for convenience of trade... (Maryland State Archives, V, 266).' Of spacing between plantations, he goes on to say that 'there are not fifty houses in the space of Thirty myles' (Ibid.). Smolek argues that in this case, the Augustine Herman map, the description of settlement patterning by Governor Calvert, and the archaeology—at least that available at the time—all appear to be in agreement (Smolek 1984: 6-7).

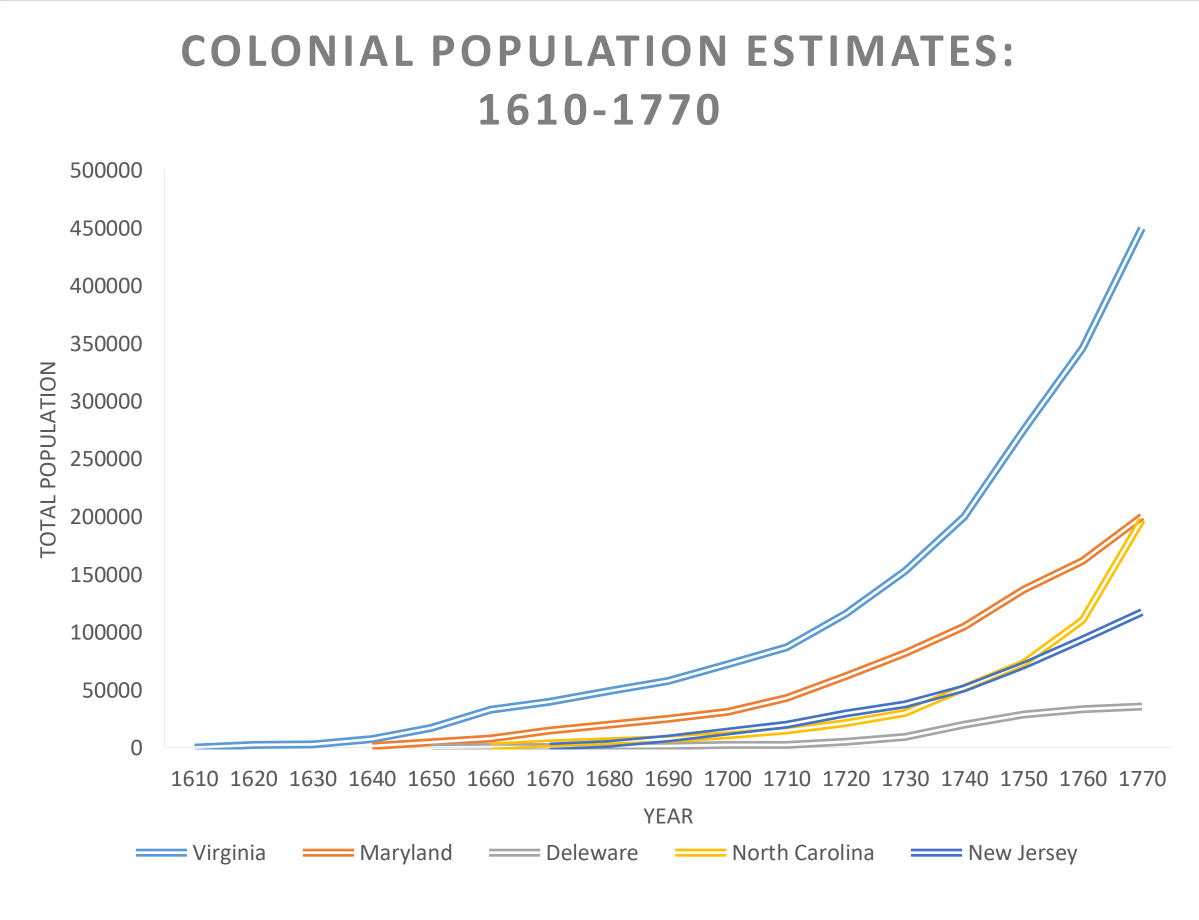


Figure 2-6 - Colonial population estimates throughout the American colonial period (graphic by S. Tucker)

Naturally, proximity to navigable water was not the only factor assessed by the colonists when selecting their land. Smolek (1984: 11-22) also points to soil quality and location of fresh drinking water as major considerations in land selection. Economic factors, namely cost of land, should also be added to this list. Smolek's work, along with earlier work by several scholars (Fausz 1971; Earle 1975; Kelly 1979; and Davidson 1982) shows how the 17th-century colonists had chosen to occupy the spaces around them, but lacks a comparison to 18th-century patterning as is needed here. King & Strickland (2015: 37) provide a comparison for the 17th and 18th centuries, but focus only on one Maryland county. The following study expands on this slightly to include three Maryland counties using a virtually similar methodology.

Using archaeological site location data compiled by the Maryland Historical Trust (MHT) of all known archaeological site locations (current to 2014), the locations of archaeological sites dating to the 17th and 18th centuries in the Maryland counties of St. Mary's, Charles, and Prince George's are plotted here using the freeware Geographical Information System (GIS) software QGIS. Within the metadata for these shapefiles (.shp) are qualitative data based on site type and period, which can be used to filter sites by these parameters. All 17th and 18th century sites have been selectively displayed here. It is possible that some Native American sites dating to this period (1600-1799) are included, but these are not thought to be numerous enough to skew the results. Additionally, some non-dwelling sites are likely to appear in the data as well. Simple visual analysis is enough here to provide an overview of the patterns of site locations, and no additional digital analysis has been performed.

It appears that what was observed by Smolek of similar data in the 1980s has not changed much despite the benefit of three additional decades of archaeological investigations. In the following map (figures 2-7), the site location data has been filtered to display firstly the sites in this region known to have been inhabited in the 17th century. Naturally, bias exists in the ways in which sites are found and reported, but these represent the best and most recent data available in these areas. Site locations are considered privileged information in Maryland, and therefore the scale has been set to one which will not jeopardise the sensitive nature of these data.

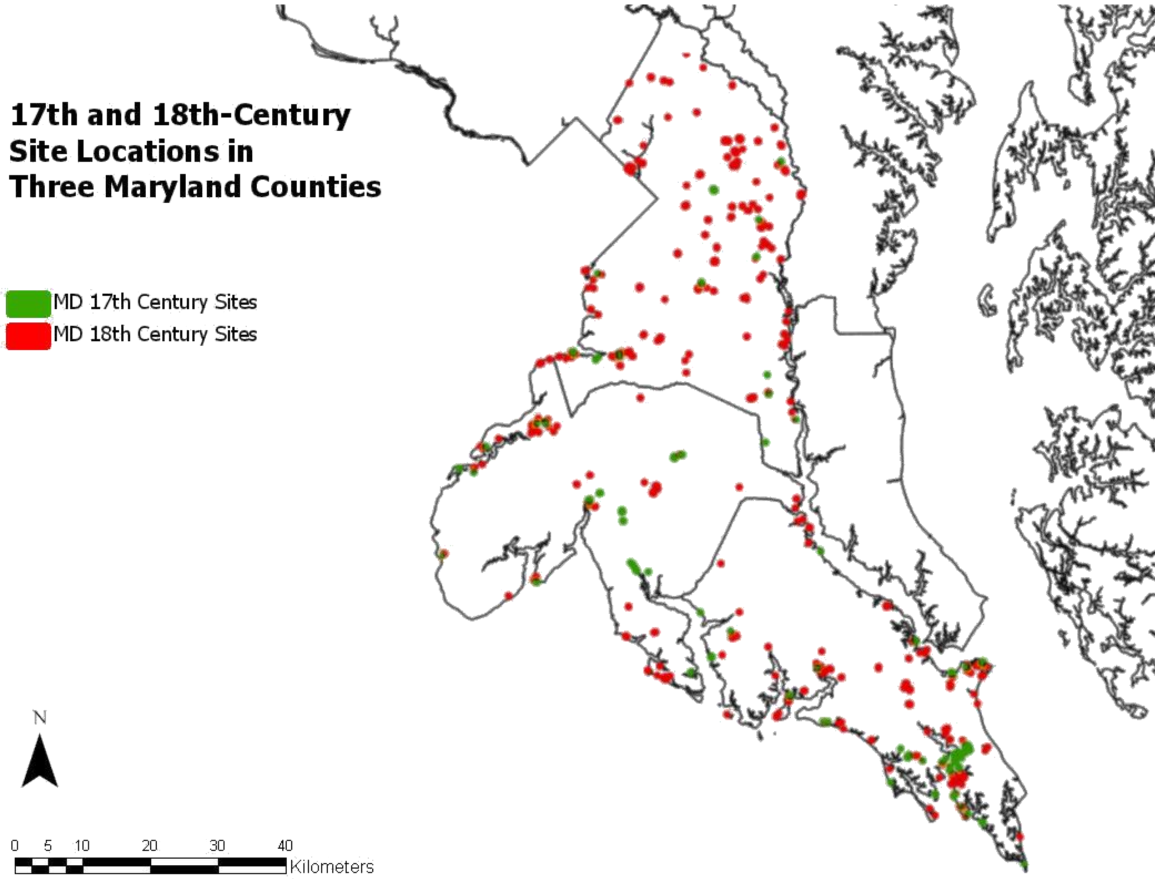


Figure 2-7 - 17th and 18th-century archaeological site locations in St. Mary's, Charles, and Prince George's Counties in Maryland (map by S. Tucker; data from Maryland Historical Trust)

The 17th-century sites, displayed in green, often continued to be occupied into the subsequent centuries. As these waterfront properties were prime sites for occupation in the 17th century, it can be said that the vast majority of these early sites enjoyed continual occupation. The red markers indicate settlement first in the 18th century. Some sites along the shorelines were first occupied in this period; however, it is clear that occupation was moving more inland during this period. Many of the sites found to be first occupied by Europeans during the 18th century are located a significant distance from navigable water. Clearly, producing tobacco in such a location far from water would make difficult the early model of trade and tobacco collection, and it is posited here that this was indeed the factor finally forcing the colonies to adopt a new means of distributing their goods despite years of pressure from lawmakers and merchants. Had waterfront trade continued to be logistically possible, the planters would have likely remained resistant to this change.

Discussion and Conclusion

Throughout this chapter, a number of core aspects of the tobacco trade have been addressed through a review of past works. It is clear that the politics of England, both domestic and external, played a very significant role in the shaping of the tobacco trade. The effects of England's foreign relations on the movement of goods across the Atlantic are a main focus of the following chapter. Regulations enacted by England increased the tobacco's profitability for the Crown and ensured its benefit for the English merchants, but these gains came at the expense of profits for planters. Possibly owing to these factors, colonial governments and settlers were reluctant to assist the crown with the enforcement of the Acts of Trade, even in the face of significant rewards for reporting vessels trading illegally.

Despite falling prices, both at the farm and wholesale on the English market, tobacco remained profitable through improvements in husbandry methods, resulting in more tobacco being harvested per hand and per acre. The growing demand for tobacco in Europe, aided by the fashionable image and the addictive nature of the product, allowed for the economy to scale, changing tobacco from a luxury product affordable only by the gentry classes to a product which could be purchased by people of nearly every economic standing. Shipping costs, themselves determined by a wide array of interrelated factors, were an important element in ensuring the affordability of the product on the mass market. The cost of moving tobacco across the Atlantic declined throughout the 17th century, and continued to do so until the American Revolution. The most significant reduction in shipping costs came in the 18th century through a major decrease of time spent in port, which in turn reduced inputs to seamen's wages paid per journey, and allowed in some cases two voyages per ship per year to the Chesapeake. Although it cannot be fully determined through the limited data examined here, settlement patterning was likely largely to blame for the early reluctance to adopt a warehouse model of collection, with planters choosing to sell their products directly from their waterfront plantations. Eventually, it would appear that the rise in population forced a more inland pattern of settlement, further from navigable water, and making impractical the universal plantation-front collection method. This in turn likely provided the pressure for change which had been so long sought by English merchants and legislatures on both sides of the Atlantic. In the coming chapters, working from the substantial data provided by the numerous economic historians presented in this and the previous chapter, several areas unaddressed or under-addressed will be examined to determine the possible benefit of archaeological study on this subject. For the moment though, attention will be given to the ships and other vessels which carried tobacco from the Chesapeake to Europe.

Chapter 3 – Vessels of the Tobacco Trade

Introduction

To this point, this thesis has examined the tobacco trade from a land-orientated perspective, providing a suitable background from which to address and better understand maritime aspects of trade. From this point forward, the focus will be placed on vessels and ship technology, practical aspects of navigation and sailing, and the potential for benefit of archaeological study of the early Chesapeake colonies from a maritime perspective. This chapter is meant to explore the ships that were used on tobacco routes through an examination of relevant literature and archaeologically investigated examples of English merchant and naval vessels, undertaken through a view of the ship as a technological object.

More so than simply describing the vessels used in the tobacco trade, this discussion has wider implications toward a better understanding of the English shipbuilding industry in the 17th century. Past studies focus principally on vessels from the larger naval ship yards. Although England's naval fleet was extremely important in the shaping of the Atlantic World and the development of the British Empire, it is again the trade networks, facilitated largely by the merchant fleet, which made the British Empire economically viable. The vessels used to transport England's colonial products across the various oceans and waterways played a hugely important role in shaping the Empire to come.

While the 15th century solidified the great changes to shipbuilding technology first allowing for trans-Atlantic sailing to take place (e.g. clinker to carvel), smaller developments continued to be made in shipbuilding and rigging throughout the 17th century. While some scholars have painted this era as a period of technological stasis (Shepherd & Walton 1972: 80; Winfield 2009: xi), Adams demonstrates that although technological improvement may have slowed during this time, it had by no means ceased (2013: 153-191). Walton and Shepherd base their claims on an apparent lack of increase in sailing speed during their period of study, but the data in the previous chapter indicates that their conclusions may be misguided. Further, speeds attainable by vessels are far from the sole indicator of technological change in ship building, and certainly not the only potential technological factor in productivity change within England's tobacco trade. The work presented in this chapter is meant to describe what changes were taking place in English shipbuilding during this timeframe and explore differences in building techniques between naval and merchant shipyards, relating directly to England's overseas shipping ventures in the Chesapeake and other colonial regions. Further, this chapter will explore whether the observed changes constitute technological innovation for the sake of improving vessel performance or a response to diminishing resources, and whether these alterations in ship design had any effect on productivity change within the English tobacco trade.

Vessel Types of the 17th Century

Perhaps the earliest scholar to attempt a through description of vessels used in the context of the tobacco trade is V. J. Wyckoff (Wyckoff 1938-39 33(4): 334-342). In his work published in the *Maryland Historical Magazine,* he mentions a number of vessel types used within the merchant fleets; examples of which certainly reached the Virginia and Maryland shores throughout the 17th century. This list, whilst specific to the Chesapeake, can be used generically to examine most trade vessel types used by England at this time. In general, Wyckoff states that these vessels would have been referred to simply as 'ships,' although a number of sub-classifications were used, and at times also present in the historic literature. Amongst these vessels, one might find a Bark (or Barque), Brig (or Brigantine), Flyboat (or Flute), Hagboat, Ketch, Pink, Pinnace, Frigate, or Schooner. Differences between these vessels could involve hull shape, stern shape, tonnage, and rigging. Moreover, the definitions of what constituted each ship type had not been at all standardised. Middleton (1953: 235) notes that although these descriptors offered a distinct definition of a vessel's type in the 19th century, the terminology was confused and conflated in the 17th and 18th centuries.

Square sails were the dominant sail shape on vessels of this period, including those used to carry tobacco from the Chesapeake to Europe, and virtually the only type one would find on the main and foremast of a larger ship (Moore 1912-13 2(3): 268). Gaff and lateen rigged mizzen masts were common, however. The most easily visually distinguishable vessel of the 17th century would be the single-masted sloop, which were common throughout the century on colonial coastwise and Chesapeake-Bermuda trade routes, but would have been too small for regular use on trans-Atlantic routes. Although these vessels were largely equipped with square sails, specific rigs differed, and were a source of innovation throughout the century that will be discussed in detail later in this chapter.

With rigging being such a confused matter, hull shape, the number and position of masts, and tonnage were much more telling features for determining the type of vessel. Wyckoff writes, for brief example, that a bark would be square-sterned, while a pink would be very narrow at the stern (1938 33(4): 337-338). Ships would carry three masts, whereas a pinnace would have generally only two (Baker 1983: 74-79). William Baker (1983) has written rather extensively on the topics of hull form and rigging of vessel types, and will be discussed in the coming pages.

Transatlantic Vessels of the Tobacco trade

Wyckoff's list of vessels used in the tobacco trade is rather thorough, but does not identify which vessels would be used on transatlantic or coastwise routes. This is an important distinction to make, as some vessels simply could not handle the rigors of oceanic crossing, nor would it be economically viable for the smallest of these vessels to transport such a minimal cargo to England. Determining which vessel types were actually engaged in trans-oceanic trade activities in the colonies will assist in simplifying this discussion. Early port records for Maryland and Virginia have unfortunately not survived the centuries, hampering these efforts to some degree. In lieu of port records, Owen & Tolley's (1995: 238-303) compilation of 17th century maritime law cases in Maryland is useful for examining boat types used in Maryland waters on a temporal scale and allowing in most cases to determine if the vessels were being utilised for coastwise or overseas trading. A total of 63 court cases, ranging from 1634 to 1710 have been examined here to these ends, consulting the original documents in the Maryland State Archives for clarification when necessary, to determine reported vessel type, year of use, and locus of operation for the vessel. It is possible that some of these vessels, although not appearing in this dataset as such, could have been at times used in transatlantic trade. Nonetheless, the data below should identify the most common types used in this manner.

Table 3-1 Observations of Vessel Types from Maryland Admiralty Court Cases, 1634-1710

	Ship	Pinnace	Ketch	Frigate	Sloop	Bark	Pink	Brigantine	Vessel
1634-1650	-/-/1	2/1/-	-/1/-	-/-/-	-/-/-	-/-/-	-/-/-	-/-/-	-/1/-
1651-1665	14/-/-	-/1/-	-/-/-	-/1/-	1/1/-	-/1/-	-/-/-	-/-/-	-/3/-
1666-1680	9/-/-	-/-/-	1/2/-	-/-/-	-/1/-	-/-/-	1/-/-	-/-/-	-/-/-
1681-1695	8/1/1	-/-/-	-/-/-	-/-/-	-/-/1	-/-/-	1/-/-	-/-/-	-/-/-
1695-1710	6/1/2	-/-/-	-/-/-	-/-/-	-/2/-	-/2/-	3/-/-	-/2/-	-/-/-

Locus of operation: Overseas / Coastwise / Local or Undetermined

Examining Table 3-1, clear trends can be observed in vessel types used in the Chesapeake throughout the 17th century. Those observed in this dataset having been involved in transatlantic trade include the: ship, pinnace, ketch, and pink, and each of them shows a clear period of use. This narrows the scope of the vessel types described by Wyckoff. As this work is focussed on transatlantic trade, the four vessel classes listed above will be the subject of this discussion herein, without the intention of giving an appearance of diminished importance to the vessels used for coastal trading. Worthy of note is that although the term 'ship' is often spoken of as being used as a generalisation, this does not seem to be the case within the records used for the preceding table. It appears that the authors of the original documents made every effort to be specific when discussing vessel types, choosing to use the term *vessel* when the type was unclear. Some evidence of this can be seen in the 1666 case of the *Hopewell* (Owen & Tolley 1995: 263; Maryland State Archives 49:558-563). At several points, the *Hopewell* is referred to as a vessel, but at one point it is described as 'the shipe or Vessell Hopewell of King saile.' That the effort was made here to make the distinction indicates that the practice, at least in the proceedings of the Provincial Court of Maryland, was to use the term *vessel* generically, and *ship* to refer to a specific vessel type.

Ship

The ship, in its standard definition is a larger vessel, square-sterned, and carrying three (sometimes four) masts (Baker 1983: 1-3). Ships would have been the largest of the vessels used in the trade, although no true minimum burthen was set. Determining a small ship as opposed to a ship-rigged pinnace, for instance, is complicated and may be the source of some of the confusion leading to the use of the term 'vessel' to describe some of the above court cases. A ship would carry square sails on the fore and mainmasts, a lateen or gaff-rigged mizzen, and a bowsprit.

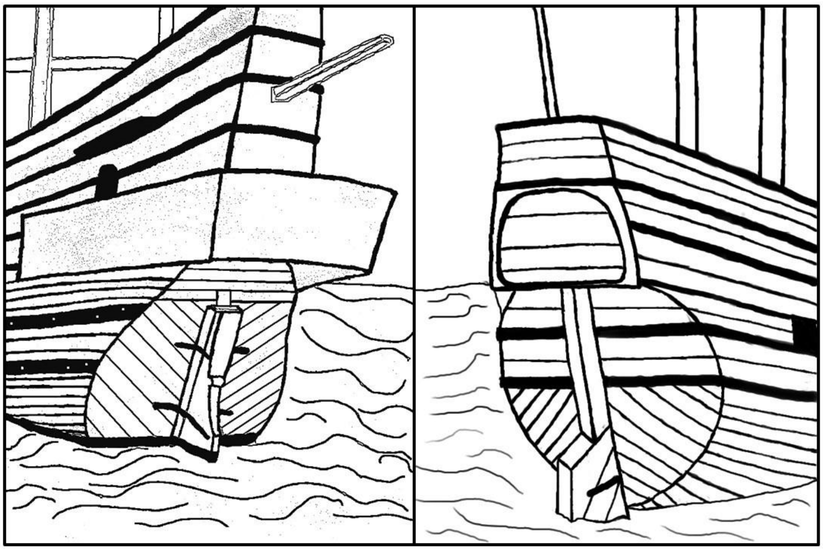


Figure 3-1 - Stern profiles of two modern 17th century reconstructions. Left, flat stern profile of the *Susan Constant* (original in use by 1606), right, curved stern profile of the *Maryland Dove* (original in use by 1633). (Drawn by S. Tucker)

Although the ship is the iconic archetype of oceanic vessels in the golden age of sail, it should not be thought of as a static form. Innovation to the design was likely a constant in some manner or another. Several changes were made to the ship's hull design during the 17th century. Baker notes that ships built in the first half of the 17th century (and indeed later in the 16th century as well) had a very flat transom and were wide at the bow. During the second quarter of the century, these features appear to have given way to a slight rounding at the lower transom to improve hydrodynamics and manoeuvrability, along with a narrowing of the bow profile (1983: 7-8). Of the changes to stern profile, one could not be faulted for making the comparison from cylindrical to barrel-shaped, at least when observed above the waterline (figure 3-1). Through this change, the transom was lifted from the water, reducing drag. From the available literature, this feature, along with narrowing of the bow profile, appears to be the most outwardly visible improvement to hull design of a classic ship during the period of study.

Pinnace

While the ship was a constant in this time period, at least in name, other vessels mentioned in these records (Owen & Tolley 1995) appear only for a certain period, showing a clear range of usage of terminology and design on a temporal scale. The pinnace has a rather short life in this table (3-1), appearing only to around mid-century and appears to have been used both for overseas and coastal trading purposes, some examples of which were colonially owned. While the records used above begin with the planting of the Maryland colony (the first of these court records involved the wages for the mariners aboard the 40-ton pinnace *Dove,* which participated in the founding voyage), the use of Pinnaces for voyages from England to the New World was common much earlier. An example of this is the *Discovery*, a pinnace of 20 tons which accompanied the first colonists to Jamestown in 1607 (Smith 1608: 32).

Figure 3-2 - Detail of *'Embarkation of the Elector Palatine in the 'Prince Royal' at Margate, 25 April 1613.*' Ship to right, pinnace to left. Painted by Adam Willaerts, 1622. National Maritime Museum, Greenwich, obj. ID: BHC0266

On the pinnace, Baker notes that it derives its name from the Latin *pinus*, meaning pine (1983: 75). The earliest pinnaces were lightly constructed vessels of pine, and early examples were constructed in the clinker tradition. As late as 1626, it was still necessary to specify one's desire for carvel-style planking when commissioning the building of a pinnace. These vessels were quite small for long voyages by modern standards, but appear to have crossed the Atlantic with relative frequency, albeit, typically accompanied by larger vessels in a fleet. The hull form was similar to that of a ship, but tended to be a bit narrower (Baker 1983: 76). As is the case with most of the vessels to be described here, the rigging is a rather confusing topic regarding the ocean-going variant. While noting that the pinnace was perhaps the cause of the greatest confusion in discussion of the rig, Baker describes a typical pinnace as a two-masted vessel, carrying a main and foremast, with both masts flying square sails. For every 'typical' pinnace though, there were likely several atypical variants. The vessel described as a pinnace in figure 3-2 (left) carries a four-masted rig mirroring that of the ship next to it. The reality is that most small, decked vessels of the early-to-mid-17th century could have easily been called a pinnace while generating little discussion.

Ketch

The ketch appears in the above listed data at an early date, ranging well into the second half of the 17th century. It had a similar hull form to both the pinnace and ship, generally under 80-tons burthen (figure 3-3), although it tended to have more rounded hull lines than a pinnace (Baker 1983: 121-126). The ketch has a more specific associated rigging though, when compared to the pinnace. Generally speaking, where a ship carried a three-masted rig, and a classic pinnace a two-masted rig consisting of a fore and main mast, the ketch, typically carried a two-masted rig consisting of a main and mizzen mast. Baker has suggested that the name Ketch, often spelled *Catch* in early documents, was named so for its relative speed and agility amongst 17th century vessels, comparable to the roots of the term *Yacht*, being 'Jagt' in the Dutch language, meaning 'to hunt.'

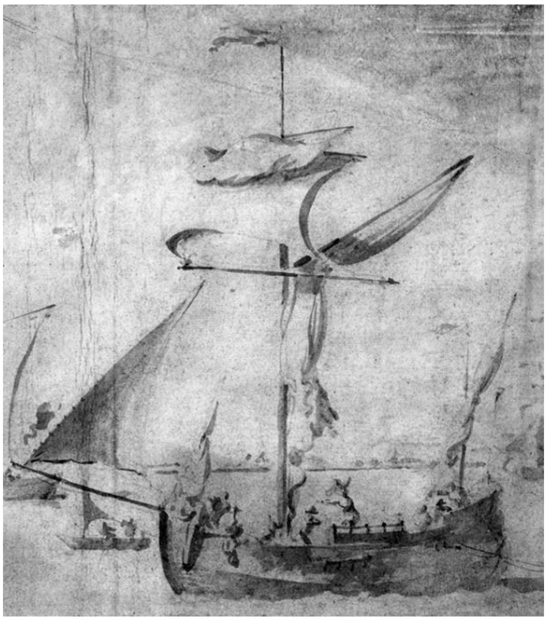
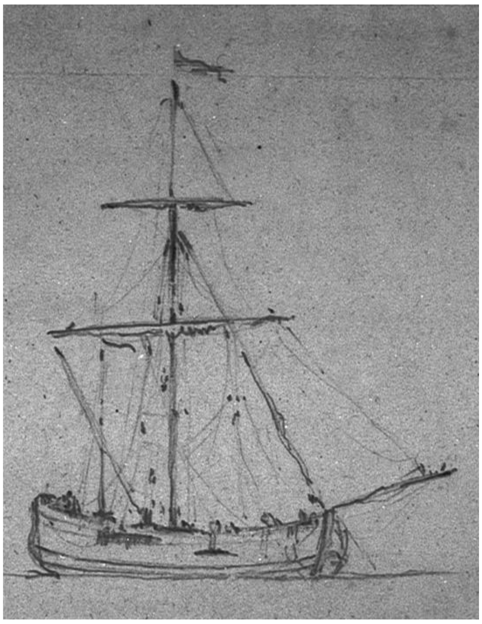



Figure 3-3 - Two 17th century oceanic English ketches. Drawings by Willem van de Velde, National Maritime Museum, Greenwich. Left: ca. 1681, obj. ID: PAG6249; Right: ca. 1675, obj. ID: PAE5267

Pink

In the latter half of the 17th century, the Pink begins to appear in the documentation, apparently gaining popularity at the turn of the 18th century. Wyckoff describes the pink as a ship with a 'very narrow or round stern (1938-39 33(4): 338),' originating from small fishing vessels. The majority of contemporary depictions of pinks held in the NMM show pinks in this smaller vessel type, single-masted, undecked, and with a rounded stern. These are clearly not vessels sturdy enough for trans-Atlantic sailing, and they lack the cargo capacity for use as trade vessels. Only a single 17th century depiction of an ocean-going pink is held at the NMM, shown in figure 3-4 (right).

The rounded stern profile was not limited to the smaller fishing form of the pink, as can be seen in several pieces of contemporary Dutch iconography, but this may not extend into the English-built vessels, nor is there any indication that these Dutch vessels were referred to as pinks. Nonetheless, it was common for England to add Dutch vessels to both the merchant and naval fleets after capturing them in battle, so even after the exclusion of Dutch merchants from the trade by means of the Navigation Acts, Dutch vessels were almost certainly visiting the shores of the Chesapeake. Figure 3-5 shows Dutch whaling vessels from the turn of the 18th century with heavily rounded sterns, like that of the earlier *Fluit* (Flute) type. Flutes, or

Flyboats were almost certainly involved in the tobacco trade to some degree, even from the Dutch side early on, but do not show up in this dataset. While no description of the flute is therefore offered here, attention will be paid to this vessel type later in the chapter.

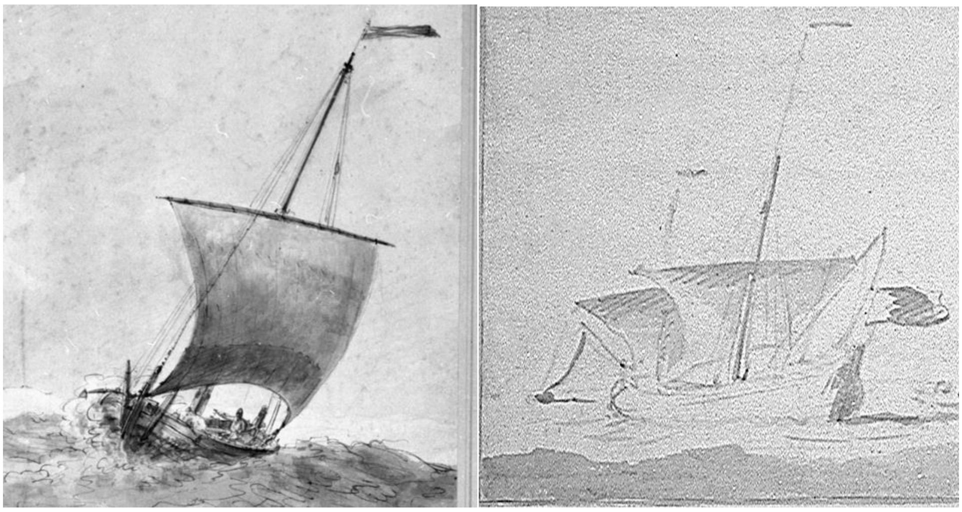


Figure 3-4 - Left - Small fishing pink, single masted, rounded stern (ca. 1685) - National Maritime Museum Object ID PAF6975; Right, Three-masted pink, narrow, flat sterned (ca. 1673) - National Mairitme Museum, Object ID PAF6880 (images processed to increase visibility)

Figure 3-5 - Stern view of Dutch whaling vessels, ca. 1701-1705, Het Scheepvaartmuseum collection (S.0081(02)), Detail of pen painting by Adriaen Cornelisz van der Salm. Photographed by S. Tucker

Although this section has explored the vessel types most commonly used within the trans-Atlantic tobacco trade, numerous issues have been highlighted with attempting to distinguish between vessels types. Rigging was an ever-changing feature of 17th-century vessels. Even speaking in generic terms on this topic is difficult, and no clear delineation between each of these vessels is possible. With such muddied definitions, it demonstrates that a strong focus on taxonomy may not be particularly useful in studying the vessels of this period. This leads to the question of how this topic should be approached. Rather than separating out vessels by conflated terms of type, they are perhaps best described by size in terms of tonnage, adding further detail where possible with the aid of physical archaeological evidence and iconography.

The Case of the *Sparrow Hawk*

The debate over the classification of vessel remains recovered in 1863 provides a view into the issues surrounding vessel types of this period, making it an excellent case study to examine this point. In 1627, William Bradford recorded the grounding event of a vessel on Cape Cod in the previous year. Local oral tradition in the 19th century held the vessel to have been called *Sparrow Hawk*, although this name is not mentioned in William Bradford's account. While the ship's name could be up for debate, this work will continue to use it for ease of argument. While *Sparrow Hawk* is typically associated with the history of New England, the vessel holds an equally important connection with Chesapeake history, as it was bound for Virginia. The vessel described by Bradford was almost certainly meant to return to England with a cargo of tobacco.

Sparrow Hawk reportedly made its outbound voyage laden with 'many passengers in her and sundrie goods (Bradford & Davis 1908: 218).' After becoming lost at sea due to a severely ill master, the vessel ran safely aground near Cape Cod, and was then damaged shortly thereafter in a storm before the ship could be re-floated. Bradford relates that the vessel was then repaired, but again broke loose from its anchors in a storm and washed onto a beach, damaging it beyond repair. The vessel was subsequently abandoned. The following summer, 'several barks' provided passage for the passengers and servants to Virginia (Bradford & Davis 1908: 222). The story begins anew after a storm in 1863 exposed vessel remains on a beach in Orleans, Massachusetts, known to those in the area at that time as 'Old Ship Beach.' The beach is in the general area of the ship's location according to Bradford. The lower hull remains were attributed immediately to the vessel from the Bradford account and dubbed the *Sparrow Hawk*. The structure was then recovered, studied, and placed on public display in Plymouth, Massachusetts.

The vessel was reported at the time of their discovery as measuring 29.83 ft. (9m) at the keel (35 ft./10.6m according to Otis), 12 ft. (3.6m) at the beam (9.5 ft./2.9m according to Baker), and assumed to have had a depth of hold around 9.5 ft. (2.9m) (8 ft./2.4m by Baker's estimation) (Otis 1864: 5; Livermore & Crosby, 1865: 9; Baker 1980). Using the standard formula for tonnage calculation for the early 17th century, ($tonnage = \frac{keel\ x\ beam\ x\ hold}{100}$) the vessel was around 34 tons burthen (22t by Baker's measurements). Deck measurements are estimated to be around 40 ft. (12.2m), having an estimated stem rake of 1:3. The remains of the vessel included the majority of the lower hull, including the full length of the keel, floor timbers, first and second futtocks, hull planking, a partial ceiling, and rudder (Livermore & Crosby 1865: 10-11). Construction materials are listed as English oak (quercus) for the frames and planking, and English elm (ulmus) for the keel. The vessel was held together using mostly oak treenails, with iron bolts used to fasten the stem post, stern post, and keelson to the keel. Twenty-nine sets of framing timbers extended from the keel, or one frame per foot (1 per 30.48cm) (Livermore & Crosby 1865: 28-29). Otis describes the floor timbers and frames as 6 in. (15.24cm) on a side, and laterally braced for stability using stringers (1864: 5) (figure 3-6). The first futtocks were joined alongside the floor timbers, overlapping by around 2 ft. (61cm). A particularly interesting feature of this construction is that the frames were reported to have been given an unusual system of additional bracing. Of this, Otis writes:

> *'At the head of each timber, a piece of plank about seven inches wide and nine long was spiked to the timber and to the ceiling. These pieces of plank, or gluts, were fitted to the adjoining timbers and driven hard, the object being to prevent the timbers from moving or working in their places. The top of the glut was bevelled and resembled a wedge with a very thick edge. On the top of this the next timber was placed, and fastened into the glut. A similar plan has recently been introduced in ship building, and considered a great improvement.'*

Larger vessels of the 17th century typically had frames consisting of overlapping, but unattached futtocks (Adams 2013: 175-176). *Sea Venture,* and *Warwick*, for example, both exhibit this trait. *Sparrowhawk*, being of a much smaller size, does not share the trait of overlapping timbers, but from the above quote, it does appear to have had commonality with these other two early 17th-century vessels in that the futtock sections were not directly joined with each other. In 1623, Sir Henry Mainwaring wrote of a feature in shipbuilding in this period called a *spurket* (Manwaring & Perrin 1922: 233). Typically, certain timbers of a frame, such as a 1st and 3rd futtock, would meet each other in a butt or scarf joint, but space was sometimes left between the timbers rather than bringing them together, this gap being the spurket. Although *Sparrowhawk*'s remains do not show evidence for overlapping timbers, but rather single frames made up of two or possibly more contiguously arranged futtocks, it would seem that a space was left, but then filled with this 'Glut' as Otis describes it. It is put forth here that this may have allowed for easier shaping of the hull angles on this rather small craft with the bevelled head of the glut being evidence for this speculative claim.

The aft-most frames were constructed from single pieces of 'y-shaped' timbers, noted by the earliest observers of the vessel remains as peculiar. Adams describes this feature of construction as comparable to that found in *Sea Venture* (w. 1609) (Adams 2013: 128). Otis further reports deadwood found by the stem (1864: 6). It was described at the time of discovery that the vessel was heavily ballasted, indicating that little cargo was carried from its point of departure, in line with what is known of vessels trading from England to the Chesapeake colonies. The researchers at the time note the single mast step, set amidships, stating that the vessel carried only one mast, which they mistakenly thought would have been lateen-rigged.

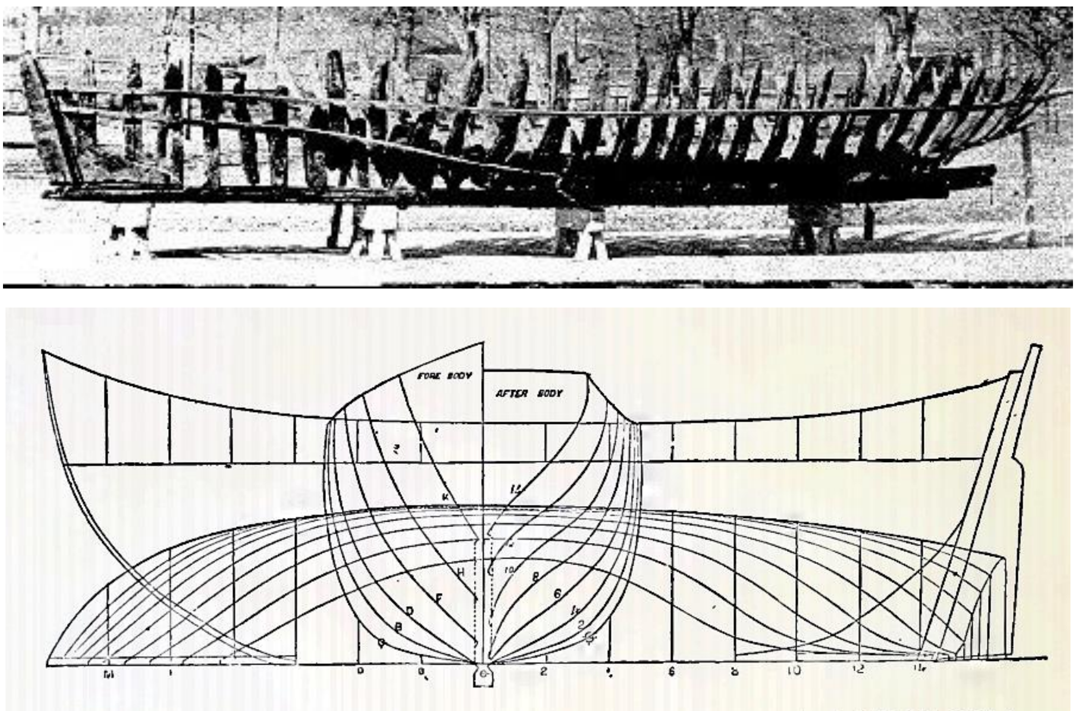


Figure 3-6 - Top: Sparrow Hawk in 1865 on the Boston Commons after its initial recovery and re-assembly (author unknown, public domain); below: original hull line drawing by Dennison J. Lawlor, 1865 (public domain)

Modern discussion over how to classify *Sparrow Hawk* has seen various scholars identifying the vessel as a bark, pinnace, ketch, and ship, with the bulk of the argument concerning its rigging. The single-masted premise was rejected by modern scholars, as no contemporaneous English vessels were known to have been rigged as such. The debate began in the mid-20th century with H. H. Holly (1969) describing the vessel as a Ketch. Baker refuted this assertion in 1980 in a note to the Pilgrim Society, citing the location of the mast step amidships. In his opinion, a ketch should have its mainmast located further fore, but comparing the two ketches in figure 3-3, it suggests that mast placement could be variable, and the mainmast could indeed be located amidships. He suggests *Sparrow Hawk* may have been a pinnace, but that its hull was likely too 'chunky' with its near semi-circle mid-ship hull lines (Baker 1980; Baker 1983: 76). Turning then to rigging, Baker discusses the possibility of three masts, but based on pictorial evidence, Baker leaned toward a two masted rig and thusly dubbed *Sparrow Hawk* a bark. Although Bradford referred to the vessel as a ship no fewer than five times in his original account of the wrecking event, Baker dismisses this as a Bradford writing in generalities. What is overlooked though, is the specific terminology with which Bradford describes other vessels, even mentioning that several barks took the passengers and crew to Virginia. As Baker noted though, the mast step is located amidships, in his opinion allowing for only a full ship's rig, or an early bark rig. Baker does not elaborate here on what he means by a bark rig, but he discusses at length in another document his vision of the colonial bark (1983: 106-118). It appears his definition of a bark is a vessel with a mid-ship-stepped mainmast and a foremast set very near the bow.

More recently, Mark Wilkins (2011) has given new life to the debate. Wilkins brings in a point relating to physical evidence relating to deadwood located near the stem. Although not recognised at the time of the vessel's recovery, and undiscussed prior to Wilkin's argument, the deadwood at the stem was likely a support for a foremast (Wilkins 2011: 86-88). If this is the case, then Sparrow Hawk was certainly not ketch rigged (Wilkins mistakenly claims that Baker argued for a ketch rig). Baker seems to have always supported the presence of a foremast, although not recognising the deadwood by the stem as physical evidence of this. While Wilkins states though that general consensus argues that the vessel carried a mizzen, Baker's argument seems to be centred on the presence or absence of a mizzen. Although the vessel's dimensions are quite bulky at the beam for a typical pinnace, if it were three-masted, it would have likely been called as such by a contemporary observer, given the loose definition of the term and the vessel's slight size. With only a fore and mainmast, Baker's argument for it being a bark seems likely.

The simple fact here is that further accuracy regarding rigging cannot be achieved. The presence of a mizzen has not manifested itself within the surviving structure of the vessel. Many vessels of this size and time period have been depicted with both bark and ship's rigs, making either one perfectly viable. Bradford's description of a 'ship' seems to suggest a three-masted model, but for this one must accept that the remains of the vessel known as *Sparrow-Hawk* are indeed belonging to the same vessel described by Bradford. While some physical evidence points to the vessel remains belonging to the early 17th century tradition of shipbuilding, and the location of deposition being in the general area described by Bradford, there are some inconsistencies between its size and the 'many passengers' it was reported to be conveying. Further, some of the physical evidence has been taken on assumption of accuracy based on the 19th century reports. An example of this is the description of wood used, said to be English elm and English oak. Modern microscopy is incapable of this sort of accuracy in wood speciation, so to assume the qualifier of 'English' here is suspicious at best. Given the importance of this vessel in modern archaeological study, the opinion of this author is that new analysis using modern scientific methods be undertaken on *Sparrow Hawk*. The significance of this vessel to this study lies in it being potentially an example of an early vessel used in the tobacco trade, providing physical evidence of the state of shipbuilding technology at an early point in the English colonial experience. An affirmation or negation of the remains as an early English trade vessel would be deeply useful for myriad reasons.

Rigging

As can be ascertained from the above discussion of the types of vessels used in the tobacco trade, and strengthened by the debate over *Sparrow Hawk*, there were a wide variety of rigging styles in use throughout the 17th century. Alan Moore, along with several other scholars, wrote in the first half of the 20th century some of the most valuable literature describing English sailing rig and the changes made to it in the course of the early modern period (Moore 1912-13; Moore 1914; Brindley & Moore, 1921; Moore, 1956; 'T-Hooft 1922; Robinson 1929). Moore writes that sail technology in the 17th century can be characterised by minute changes, as the major steps toward technologically advanced rig design had taken place in the previous two centuries (Moore 1912-13 2(3): 268). Nonetheless, it is clear through the wide variety of rig, and furthered by the frequent eschewing of certain rigs for newer rigs, that this was a period of innovation, where shipbuilders were searching for the most effective sail for various environments and purposes. As in the case of human evolution, where not each species of hominid which had existed is a direct ancestor of anatomically modern humans, many of these styles were similarly dead-ends in the 'evolution' of rigging.

During the Elizabethan period, the standard rigging for a ship consisted of a bowsprit supporting a single spritsail, a fore and main-mast carrying each two courses of square sail, and a lateen rigged mizzenmast (Moore 1912-13 2(3): 268). Larger ships may have carried a second mizzen, the aftermost of which was known as the bonaventure mizzen. Amongst the first changes to rigging to occur in the 17th century is the addition of a spritsail topsail, which Moore describes as an 'astonishingly unseamanlike contrivance' (Moore 1956: 16), although this became a long-standing feature of sailing craft. Further, the spritsail topsail grew in size throughout the 17th century (Moore 1912-1913 2(3): 271). Topsails also grew in the course of the century, first in height, and later in width (Moore 1912-13 2(3): 269-272). The bonaventure mast largely disappeared in the early 17th century, and other mast positions changed slightly, with the foremast moving slightly forward and the mainmast being stepped amidships. The fore- and mainmasts received a third course of sails, and the lateen-rigged mizzenmast also received a square topsail, and staysails became a common feature of rigging starting in the 1670s (Anderson 1994: 352-355).

A final area of change was in the cut of the sail. The term *square sail* is somewhat of a misnomer in discussion of English sailing rig post 15th century. *Square* has a rather rigid geometric meaning of four equal length sides with corners measuring each 90 degrees, but in regards to sail shape, it is applied more liberally. Thusly, the term is perhaps better defined here as meaning simply as a four-sided sail, to include rectangular and trapezoidal shapes. As a result of differential preservation, archaeological evidence of specifics of sail shape are lacking, but iconographic evidence can provide very detailed insight into how sail shape changed over the course of time. Julia King (2007: 6-8) notes the value of using Dutch still-life artworks in the historical archaeology of the Chesapeake. The collection of Dutch paintings and drawings of vessels contemporary to this era held at the National Maritime Museum in Greenwich is a similarly viable data source, and is used here to demonstrate the changes taking place in rigging. Sails meeting the geometrical definition of square (or at least very close to it) did exist, and were present on vessels in the 17th century, particularly as the mainsail. Figures 3-2 and 3-4 above show very well the use of sails of roughly a classical square shape. Trapezoidal sails begin to appear in the iconography by the mid-17th century, particularly in the upper courses of sail, evidenced here in figure 3-7. The general trajectory of sail shape from similar evidence is that over the course of the next century, individual sails became shorter in the vertical measurement to accommodate additional courses of sail (figure 3-8). This allowed the sail to function in a similar fashion to a triangular sail, where the wind catches it from the bottom edge first, allowing it to act as an air foil and make more efficient use of the wind, the main benefit of the triangular shape, but without requiring a swinging jib arm.

Figure 3-7 – The *Amelia* Engaging English Ships, 1652-53, painting by Jan van Leyden (NMM Object ID BHC3190). Note the largely square shaped mainsails, and occasional trapezoidal topsails.

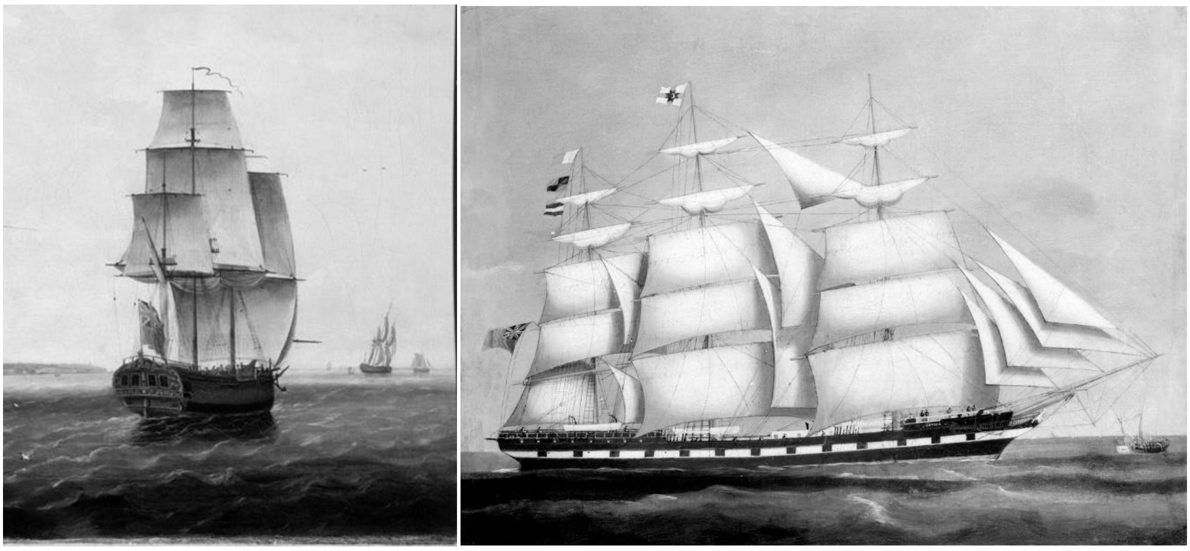


Figure 3-8 – Left, detail of painting ' Ships off Dover,' ca. mid-late 18th century by Francis Holman (NMM Object ID: BHC1062). Note the height of the mainmast and tall, but trapezoidal sail shapes. Right, 'The ship *Corona*,' (NMM Object ID: BHC3270) from an unknown artist, 19th century. Note here the squatter shape of the sails with a trapezoidal cut on all courses above the main sheet, with five courses per mast.

In essence, the most notable changes to English sailing rig in the 17th century were to increase sail area, but some smaller changes to the cut of the sail were made during this period showing an advance in sailing technology. Rigging of smaller vessels continued to follow 16th century styles (Moore 1956: 17-18), such as with the Pinnace and Ketch, but as was established earlier in this chapter, these styles fall out of use around the 3rd quarter of the 17th century. As Middleton puts it though, 'innovation was in vogue (1953: 235).' The wide variety of vessels types in use shows that innovation in rigging was a major characterisation of 17th century shipbuilding in England, although not all styles were advantageous or marked for long term use or further development. With this in mind, it is clear that shipbuilders were searching to improve on earlier designs, albeit not always successfully.

Although potentially attributable to other factors such as decreases in hostilities at sea and an early tendency to over-crew a vessel, the drastic decrease in crew members aboard English merchant vessels over the course of the 17th century (Davis 1962: 370; North 1968: 962) is likely in part due to changes made in rigging of vessels. Certainly having fewer masts, such as with a pinnace, ketch, sloop, or brigantine, would contribute to a smaller crew size, which in turn, contributes to lowered shipping costs. Further, smaller, less visible changes may have also been made to rigging to allow sailing to be undertaken more easily, such as having fewer lines to manage. Of two-masted vessels, however, these had a tendency to be on the smaller side, and as Shepherd & Walton (1972: 75) point out, smaller vessels require more crew per ton than larger vessels. What should be taken from this is that many aspects of the transatlantic movement of tobacco fall within a delicate give-and-take to achieve a more profitable or productive system of exchange.

Vessel Size and Form

With regard to the sizes of the vessels chosen to comprise the tobacco fleet, merchants were left with several theoretical options. Firstly, they could opt for large vessels, requiring fewer of them, but putting a larger amount of trade goods in peril per vessel. Conversely, many smaller ships would risk a smaller amount of cargo per vessel, but require more capital in vessels and sailors. Mid-sized vessels would naturally mitigate against the extremes of either side. Records shows that vessels of a wide range of sizes were used in the tobacco trade (Morriss 1914: 87). Of course, other factors were at play in this as well, such as larger ships having issues with being able to adequately fill their holds and requiring even longer in port, although crew to tonnage ratios improved with increases in vessel size. These factors have already been established earlier in this work as problematic.

Through Morriss' study of English port records from 1689 to 1701, she concluded that ships sailing from London tended to be larger than those from the smaller outports (Morriss 1914: 87-88). The London ships were reported at an average of 120 tons, and those of the other outports averaged around 80 tons. London vessels from these years ranged from 50-360 tons, and the outport ships did not exceed 250 tons. While the average tonnage for vessels departing London may have been 120-160 tons, this is not to say that it was the norm, or even typical size of a London ship, but does show, perhaps unsurprisingly, that there was a tendency for the larger vessels to be London based.

Whether Morriss' work on vessel sizes can be applied to the earliest days of the tobacco trade is unknown, as port records or other suitable records are unavailable prior to 1689. One might be compelled though to consider that government subsidies were paid to merchant ships over certain tonnages to act as an incentive to build and purchase battle-capable vessels. This practice began under Elizabeth I (r. 1558-1603), granting a bounty of five shillings per ton to ships over 100-tons burthen, and was continued under James I (r. 1603-1625), although he raised the minimum tonnage to 200 in 1626 (Meeker 1905: 2; Davis 1975: 305; Adams 2013: 150). This would amount to £5 sterling on a 100t vessel prior to 1626, and £10 sterling for a 200t vessel thereafter. Using a building cost of around £10 per shipping ton on a newly built vessel in England (Shepherd & Walton 1972: 237-388; Goldenberg 1976: 94-95), the rebate on a 200-ton vessel was only around two percent.

These subsidies were eventually replaced by reductions in customs duties, beginning in 1662, with a 10 percent reduction in duties owed in a vessel's first two years of service for watercraft having two-and-a-half to three decks and carrying thirty or more guns. This subsidy remained unchanged until 1694, when the period of duty reduction was extended to three years. While this would have been a greater incentive than the previous rebate on building costs, the incentives in both cases can be seen as rather meagre. Further, building such a vessel made it more likely to be commandeered from the owners for military use – not an ideal situation for merchants relying on this vehicle to transport their goods. Meeker (1905: 2) suggests that these policies likely had little to no effect on shipbuilding, but as these inducements were somewhat of a disadvantage to merchants and ship owners, it may be that it had had the opposite effect than what was desired. Conversely, these subsidies may have in reality encouraged the building and use of smaller merchant vessels throughout the 17th century. Although no evidence can be offered to support this at this time, it is indeed worthy of consideration. There were certainly plenty of vessels engaging in the tobacco trade in excess of 200 tons, but that they averaged well below the threshold for receiving these subsidies is compelling. Whether the inducements were viewed by ship owners and merchants as positive or negative, it is likely is that they were considerations in selecting appropriate vessels for use in trade capacities.

Adams has noted a divergence in form between trade and war vessels in the early 16th century following the adoption of the carvel building tradition, but that these two classifications quickly remerged in the last quarter of the century (2013: 149), coinciding with England's earliest colonial ventures. The necessity for defensible vessels capable of moving trade goods was clear in this period. As New World politics became less volatile, these two forms were able to once again diverge. England's introduction of a purely naval fleet began around the mid-17th century as the necessity for merchant vessels being capable of functioning as warships diminished. This corresponded with the increasing privatisation of colonial and overseas trade and the rise of the independent merchant; this being an important step in the maturation of trade functionality for England. It is clear here, and has been well established previously by Adams (2001; 2013) that such ideological principals affected English shipbuilding during this era. This is all to say: form follows function. The early period of English colonial efforts required that a vessel trading in the Caribbean and North America be capable of defending itself, whereas by the latter half of the century the New World trade routes crossing the Atlantic were relatively safe from hostile threats (evidence for this presented in the coming chapter), and the ships trading on these routes could develop a form better-suited to moving goods. Pascoe (2006) has demonstrated that this divergence was a process, but became effectively actuated in the 1690s, meaning that the second half of the 17th century can be viewed as a transitional period.

Port Records and Vessel Tonnage: Practical applications

Questions of average vessel size and a range of vessel sizes used in the English tobacco trade have been satisfactorily answered by Morriss (1914: 88-89). When dealing with records of individual vessels though, it is often found that no tonnage figures are given. Port records typically show such information, but as seen in alternate source types discussed later in this work, such data is often omitted. Occasionally other data may be present which can provide clues to cargo capacity whilst not stating it overtly. Two such examples of this are the Edward Rhodes logbook (Rhodes 1670-1676) and the narrative of a voyage to Maryland in 1705 (Andrews 1907: 337-340), with which the reader will become duly familiar in the following two chapters (Rhodes 1670-1676; Andrews 1907: 337-340). In both of these documents, ship size is given in number of hogsheads carried by a particular vessel without a tonnage being stated. Being able to work out an estimated size for vessels in such cases is useful, but also in some ways problematic.

A main issue relating to this practice lies in reported vessel tonnage versus actual vessel tonnage. McCusker (1967: 86-90), Walton (1967b: 395-397) and French (1973: 495) each note that the registered tonnage of ships in the first three quarters of the 18th century was reported at an average of two thirds actual measured tonnage. This was indeed noted by a contemporary observer, Thomas Irving, perhaps leading to the changes in tonnage registration in the last quarter of the 18th century (McCusker, 1967: 82). French asserts that this became common practice as a means of reducing duties paid at ports and lighthouses (1973: 434). These studies do not show if this was the case in the 17th century as well; however, one 15th-century account, detailed by William Salisbury (1966: 32), does describe an instance of a vessel being reported as 400 tons and after inspection being found to be around 600 tons.

To examine this issue further, port records are extremely useful as they provide both the reported tonnage and the number of tobacco hogsheads carried. Firstly though, a mathematical calculation of actual tonnage is necessary. Tonnage calculations for English vessels were originally based on early figures of the number of wine tuns that could fit into a ship (Salisbury 1966: 41-42). With some simple calculations, knowing the quantity of tobacco hogsheads allows for tonnage to be estimated. A standard wine tun was 252 wine gallons (equivalent to US gallons) (950 litres), often shipped in hogsheads with a volume of ¼ tun. In theory, for every ton of a vessel, four hogsheads with a volume of 63 wine gallons (238 litres) could be placed in the hold.

Tobacco hogsheads were larger than their wine porting counterparts and not given a similar standardisation in size during the 17th century, making comparisons with size more complicated. A number of attempts were made to fix the size of a hogshead, but the mandated sizes varied between Maryland and Virginia, and were changed somewhat frequently in the latter half of the century (Carr, et al., 1991: 64-65). Despite this, a good standard to use for these purposes, based on mid-century Maryland standards is 122cm (48 in.) in height and a diameter at the ends of 76cm (30 in.) (Middleton 1953: 112). Volume would naturally vary with diameter at the bulge (centre) of the barrel. A rough estimate of internal capacity based on these dimensions would be around 530 litres (140 US gallons), making a tobacco hogshead around 2.2 times greater than a standard wine hogshead. It can therefore be estimated that a ship in the 17th century could carry approximately 2.2 hogsheads of tobacco for each ton to which the vessel was rated.

With this theoretical standard set, port records from the Potomac River taken from 1 August, 1689 to 2 August, 1690 will be examined to test the possible under-reporting of vessels, at least in the late 17th century (Maryland State Archives, MS2258). It should be noted that these records were taken just after the revocation of the Calvert's charter of Maryland and directly on the first day in power for Governor John Coode. In this record, thirty-eight vessels are named giving both hogsheads and tonnage measurements, although it is not clear where the vessels are destined. These vessels range from 7 to 300 tons, carrying between 25 and 932 hogsheads each. Unsurprisingly, there is a nearly linear trend in the ratio of hogsheads carried per shipping ton when viewed with a polynomial trendline (figure 3-9). Although this is not a particularly useful figure, it does show that the data is sound, and that despite the mix of vessel types, their ability to carry a cargo was similar. Outliers likely represent higher extremes in under-reporting of tonnage for those above the trendline, and under-filled hulls for those below the trendline.

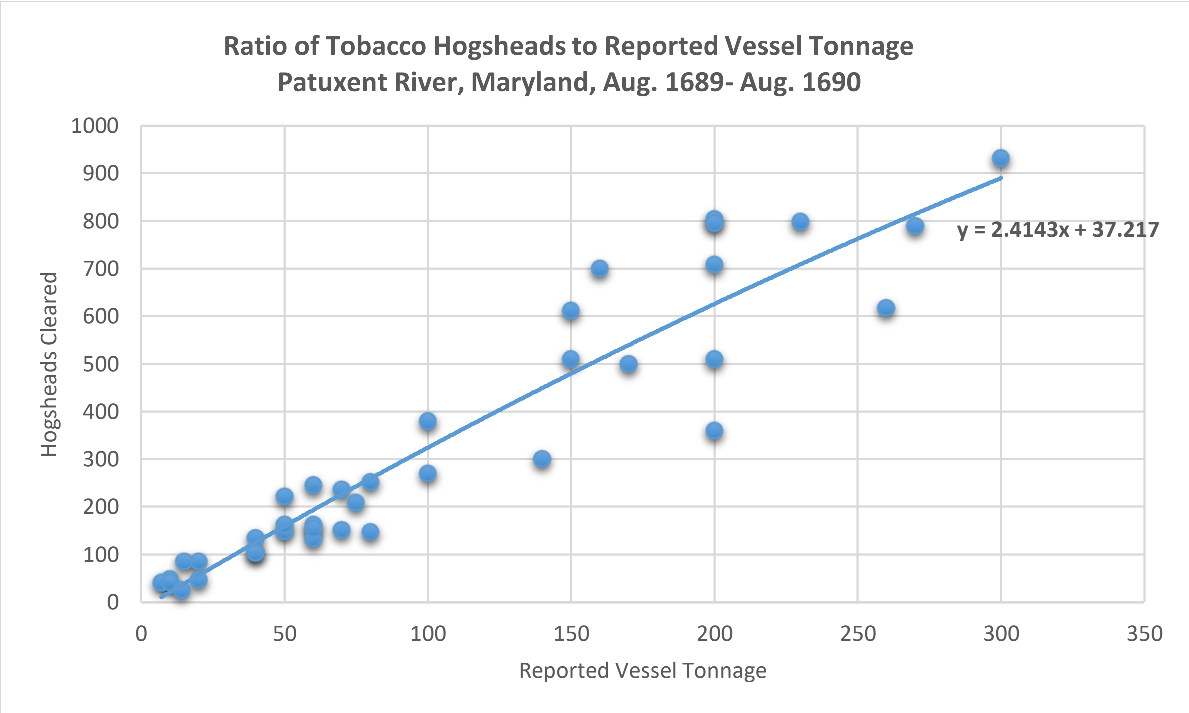


Figure 3-9 - Hogsheads Carried to Vessel Tonnage in 1689-90 Potomac River port records (graphic by S. Tucker)

A more meaningful way of examining these data is by hogsheads carried per shipping ton. This also allows for the testing of under-reporting in vessel size. Figure 3-10 shows an interesting trend in the data when examined in this manner. Small vessels, those under 20 tons, were capable of carrying significantly more cargo per ton than larger vessels. These vessels were likely travelling shorter distances, necessitating fewer supplies, but may have also made better use of their space by having more open deck plans. Further, it may have been easier to under-report tonnage on the smallest of vessels. When the smallest vessels are removed though, vessels of ocean-going sizes (50 tons or more) seem to congregate around 3 hhds. per ton, with variation from around 2-4 hhds. per ton. As discussed above, theoretical calculations based on wine tuns and hull volume indicate a calculation of 2.2 hhds. per shipping ton. Although variation in hull dimensions could account for some of this, these data seem to show that vessels were in fact under-reporting their tonnage at the customs offices. With an average of around 3 hhds per ton as reported, the figures can be estimated at an average rate of 36% under-reporting, falling roughly in-line with what was noted in the following century. With the similarities in numbers, this work will continue to use the figure of 33%.

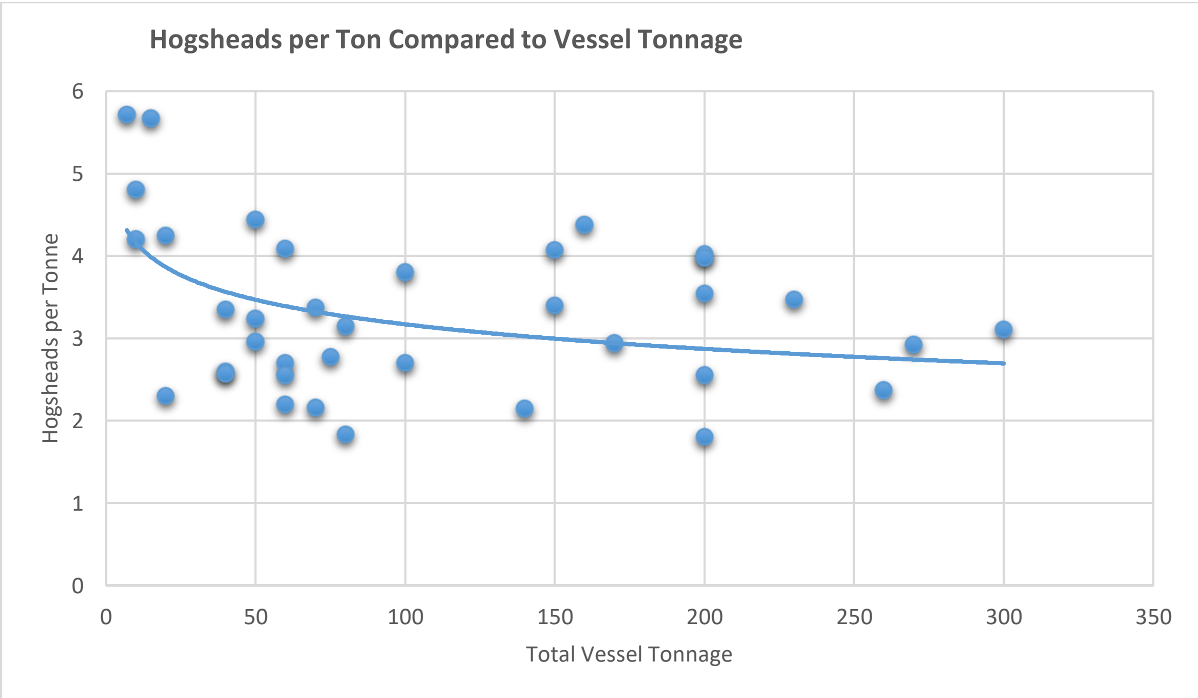


Figure 3-10 - Hogsheads per Ton, 1689-90 (graphic by S. Tucker)

Working out these two issues is crucial to efforts of establishing tonnage when the only known figure is a vessel's cargo. As mentioned at the beginning of this section, it is fairly common to encounter early colonial documents listing the cargo in lieu of the capacity, making it useful to be able to estimate tonnage based on these figures. Using these calculations, to work out tonnage figures, one must simply divide the number of hhds. by 2.2 for the calculated tonnage, or by 3 for an approximate reported tonnage. Table 3-2 shows calculations for vessels observed in the Edward Rhodes log and the 1705 narrative of a voyage to Maryland examined in previous chapters.

Table 3-2 - Tonnage calculations for several vessels reporting only cargo on board

Vessel Descriptor	Hhds on board	Calculated tonnage	Likely reported tonnage
***Constant Friendship* (1672)**	726	330	~240
Large Ship (1705)	800	360	~260
Pink (1705)	400	180	~130
Ship 'of good force' (1705)	700	320	~230
'Small ship' (1705)	100	45	~30
Author's vessel (1705)	500	220	~160

English Shipbuilding

A central theme to this chapter is that whilst the state of shipbuilding in England throughout the 17th century has been criticised by some authors for a lack of innovation and technological improvement, this is an inaccurate viewpoint. The discussion thus far has already highlighted changes to rigging and form which took place in English ships during this time which indicate a definite trend toward innovation. The less-visible changes to the internal structure of the ship have to this point been left out, but will be explored at this time with an eye to certain specific aspects of ship design which were subject to change throughout the 17th century. These can be categorised as the result of any one of Adams' constraints on shipbuilding (2001: 301; 2013: 23), and will thusly be discussed with attention to these concepts.

These less obvious details of shipbuilding are for the most part not evident in documentary sources, necessitating an examination of several archaeologically investigated vessels to scrutinise the changes occurring in ship design at the time. Adams (2013) has already offered a comprehensive study of early-modern European shipbuilding, English included, with an eye to the more nuanced technical side. This discussion can therefore be somewhat abbreviated, choosing instead to focus on a few smaller areas of change that are designed to highlight areas of social, ideological, environmental, and material change through shipbuilding. The discussion will begin in the late medieval period, examining two of England's early attempts at constructing large ships, moving to several early 17th-century merchant vessels, and concluding with mid-to-late 17th-century warships. It should be noted that none of these vessels have been physically examined by this author and all information concerning these vessels has been garnered from their respective archaeological reports and literature.

Ships of Kings—Grace Dieu & Mary Rose: a transition to modernity

Only a few English war vessels from the late medieval period are known archaeologically, perhaps partly owing to England's lack of stature and effort in maritime matters during this era. A turning point to this came through England joining an alliance against France in the early 15th century. Henry V, in an effort to improve England's standing in Europe and to gain control of the English Channel, ordered several great ships to be built for naval operations. Amongst these was a vessel of particularly immense size, called *Grace Dieu*, completed in 1418. By the time construction was complete, England had already defeated the French and gained control of the Channel. Thusly, *Grace Dieu* never entered into conflict and is only known to have sailed in open water once (in the Solent) (Prynne 1968: 125-126 Friel, 1993: 10). At around 1400 tons, the vessel's exaggerated crewing requirements would have made it uneconomical for use in most conflicts. By 1430 it was moved up the River Hamble and placed in a mud berth, burning to the water line in 1439, reportedly the result of a lightning strike (Adams 2013: 61-63).

Being partially excavated by R. C. Anderson in the 1930s, the vessel was found to have been around 130 ft. (40m) at the keel, and was estimated to have had a centre beam measurement of around 50 ft. (15m) (Anderson 1934: 161-167; Prynne 1968: 116-117). The hull planking was curious, having no analogy in any known ship remains. It was constructed in the clinker tradition using overlapped strakes to form the outer hull, but these strakes were constructed from three radially-split oak planks clenched together with iron spikes and roves, then attached to the frames with treenails. Anderson reports the length of the outer planking to be around 7 ft. (2.1m), although subsequent investigations in 2008 found longer segments (Jonathan Adams, personal communication, 28 Sept. 2015), and the overall thickness of each strake was around 4.5 in (11.4cm) (Anderson 1938: 165). Shorter strakes would certainly assist in creating a shell-first vessel of this size, as significant bends of any individual set of strakes would be difficult to achieve with such thick planking. Subsequent work on the vessel has revealed evidence of individual strakes being tacked together with nails prior to being assembled as a set (Clarke et al. 1993: 27-29). Anderson argues the ratio of nail spacing to planking timber dimensions as evidence that the strakes were clenched prior to fitting. This logic is somewhat hard to follow though, and the short tacking nails are possible evidence that the strakes were compiled as matched sets, and then individually fitted before being caulked and clenched together. It would stand to reason that doing so would make the shaping process easier and remove pressure from the nails that would occur when bending a pre-assembled set of strakes, although to this point only conjecture can be made of the assembly process.

Measured frames were recorded at 11 in. (27.94cm) on a side, spaced 5 in. (12.7cm) apart, and 'joggled' to accommodate the clinker planking. Recesses were cut in the outboard edge of the observed framing timbers to accommodate roved nails, evidence that this vessel was indeed constructed in a shell first manner (Anderson 1938: 169; Clarke et al. 1993: 31). In some instances, wedges were placed between the planking and frames prior to treenailing, presumably to tighten a poor fit. A layer of ceiling approximately 1.25 in. (3.1cm) thick provided lateral support, along with a stringer on either side of the vessel, sided 11x4 in. (28x10cm) located 8 ft. (2.4m) from the keelson.

Although England had only recently started to use a second mast on its large vessels, a 1420 inventory suggests strongly that *Grace Dieu* carried a third sail (Friel 1993: 7). Friel (*ibid.*) suggests that *Grace Dieu* was perhaps England's first three-masted vessel, although contemporary iconography would show that this feature was already established in Northern Europe. The third mast was almost certainly a foremast, projecting from the vessel's exaggerated forecastle, that being the ship's main defence at this early point when archers had not yet been replaced by cannon.

Around a century later, shipbuilding had changed significantly in England's dockyards, as well as in Western Europe. Open-ocean transatlantic sailing had been first accomplished several decades earlier, and the ideology of shipbuilding and maritime activity changed with this feat. While Henry V's world may have been one where physical power and political strength were shown via extravagantly large vessels, Henry VIII seems to have existed in a world where practicality was beginning to take over ship design. When he ordered ships to be built for his navy in 1510, he chose to construct his flagship of a significantly smaller size than Henry V's. Although still large, *Mary Rose* palled in comparison to the *Grace Dieu* at only 600 tons. It was later overhauled in 1536, and was rated at 700 tons after the re-fitting. This is not to say though that larger vessels were not built by the English Navy at this time. *Henry Grace Dieu*, also built in 1510, was rated at 1,000 tons. Although the ship bore the King's name, in addition to having a name harkening back to the grandest ship ever built by one of his predecessor's, Henry VIII did not choose this vessel as the hallmark of his new fleet for the vast majority of its working life (although it was at times used as the flagship in its later days). It was not simply about having the largest vessel leading the group; there were clearly other considerations taken in this matter.

Mary Rose, which sank in 1545 during a naval skirmish in the Solent near Portsmouth, was subject to large scale excavation in the 1970s and 1980s, leading to the vessel's remains being raised in 1982. Having the remains above the surface has allowed for *Mary Rose* to become one of the best studied vessels from the early modern period. *Mary Rose* had a total keel length of 105 ft. (32m) after the 1536 rebuild. The keel was found to be of mixed wood species, with elm fore and aft, and oak in the centre (Marsden 2009: 81-82). The beam measured 38 ft. (11.58m) amidships. Planking was robust, constructed of oak, measuring 3.7 to 4.1 in. (9.4-10.5cm) thickness below the waterline, and fastened using wedged treenails. The framing was constructed of heavy timbers, with floor timbers and first futtocks sided to between 7.8 and 19.5 in (20-49.7cm) in., and spaced between 8.6 and 17.6 in. (22-44.7cm) apart (Marsden 2009: 98-100).

Amongst the most notable differences is that *Mary Rose* had a hull constructed in the carvel tradition, a major advancement over the clinker design used in *Grace Dieu*. *Grace Dieu* was built during a transitional phase of shipbuilding in England, and a long-used and well-understood design was selected for its hull, although it was modified to account for its size. This tradition though, was in its waning days. *Grace Dieu* may have been the pinnacle of Shipbuilding in England at the time of its construction, but it was decidedly medieval. *Mary Rose,* 94 years later, represented the state of the art in war ships, reflecting a new era not just in shipbuilding, but for the European world. Overall hull design had changed, with huge towering forecastles which gave an advantage to archers in combat yielding to a design more conducive to combat by ordnance. The one-masted Carrack which dominated the medieval waterscape had been replaced by a three-masted Galleon. For larger vessels at this time, carvel construction had become the standard. It would be smaller vessels built in the tradition of the *Mary Rose* which became the 'defensible ship' (or Elizabethan Galleon) which dominated English colonial efforts in the latter 16th century, thereby making *Mary Rose* an excellent early example of the coming about of the Early Modern world as represented through English sailing vessels. As the century progressed and the seeds of New World colonialism were spread in England, a new ideology of ship design became necessary, represented in its early stages by two wrecks in particular belonging to the Virginia Company of London.

Ships of Trade—Sea Venture & Warwick: questions of moving forward or clinging to tradition in the early 17th century

England's foray into transatlantic sailing and the background of its colonial efforts have already been widely discussed in this work. The vessels used to bring England's North American ambitions to fruition were of a similar tradition to the *Mary Rose*, although with the benefit of an additional century of shipbuilding knowledge (Adams 2013: 117-130). *Sea Venture*, and *Warwick,* were both vessels used by the Virginia Company in connection with Jamestown and both were lost near Bermuda. These two vessels mark the earliest English trade vessels known archaeologically in connection with the New World, and will be discussed alongside *Sparrow Hawk*, described above, as it is thought to be roughly contemporaneous with these two Bermudian wrecks.

Sea Venture was famously wrecked in 1609 on a reef off the northeast end of Bermuda after encountering a hurricane on its way to Jamestown to deliver new colonists and goods. Historical research suggests that the vessel was likely built in 1603, with a reported burthen of 300 tons (Adams 2013: 117-118). The ship ran hard aground and stuck fast in a crevice on a reef, allowing the passengers to make their way safely to the main island. The site was visited multiple times over the following two years and largely salvaged for shipbuilding materials and smaller items of material culture (Wingwood 1982: 333, Wingwood 1986: 158). The remains of the vessel were initially discovered in 1958 by Edmund Downing, with only a small portion of the hull still intact (Wingwood 1982: 333-334; Adams 1985: 275-276). Proper archaeological investigations of *Sea Venture* took place from the late 1970s to early 1980s, resulting in a thorough investigation of remaining hull structure and the recovery of various small finds and objects of armament.

The excavation of *Sea Venture* revealed a section of the oak keel 50 ft. (15.5m) in length, and various timbers relating to the lower hull of the vessel, mostly from the port side of the ship (Adams 1985: 143). Jon Adams, the archaeological director of the project who had recently completed extensive work on the recovery of the *Mary Rose*, reports that the two vessel's construction methods were drastically different. The angles of the hull had sharpened dramatically on *Sea Venture*, necessitating a completely new means of making the vessel structurally sound (Adams 1985: 290-291). Adams found *Sea Venture*'s futtock sections to be much shorter than those of the *Mary Rose*, a response necessary to accommodate the sharper angle of the chine on *Sea Venture*. Floor timbers were sided to 12-13 in. (30-33cm) amidships, becoming somewhat slighter toward either end of the vessel (Adams 2013: 122). Degradation of the wreck has made collection of futtock dimensions impossible, but it is likely that at least the first futtocks were cut to the same or similar dimensions as the floors. A fairly robust ceiling was in place that would have added to the structural stability of the vessel. Additional longitudinal strength on *Sea Venture* was added to the lower hull in the form of *sleepers*. First futtocks were added in such a way that their positions were staggered in relation to one another, reducing points of weakness in the framing system laterally along the hull, and were given no horizontal fastening. Second futtocks appear to have abutted the floor timbers (Adams 2013: 124).

A second Virginia Company Ship, *Warwick,* was lost during a hurricane in Bermuda in 1619 whilst sheltering in Castle Harbour on the north-eastern end of the island (Adams 2013: 128-129). The vessel had made a planned stop in Bermuda before it was to venture onward to Jamestown to distribute some trade goods and return to England with a cargo of tobacco. Immediately following its wrecking, some early attempts at salving were made, and some of its cargo and guns were removed. Interest soon waned though, and the vessel was all but forgotten. The late shipwreck enthusiast and salvor, Teddy Tucker, is credited with locating the remains of the vessel during a 1966 magnetometer survey of the bay under cooperation with the Smithsonian Institution's National Museum of History and Technology (Bojakowski & Custer Bojakowski: 2011: 43). After diving on a particular anomaly the following year and probing with an airlift, the Warwick site was found, with initial observations showing ballast, ship structure, and wooden cargo elements. Archival research indicated that the site was likely the wreck of *Warwick*.

Subsequent survey in the 1960s uncovered numerous early 17th century artefacts typically found on English sites, and drawings were made of the ship structure which had been uncovered. The vessel remains included the majority of the starboard side of the vessel minus the keel and lower strakes to a point just above the turn of the bilge. Framing elements and internal structure were also located. Recordings at the time show the apparent second futtocks to measure 5.5 x 5.7 in. (13.9cm-14.47cm) thickness, with spacing between frames about 5 in. (12.7cm) apart with occasional gaps of about 15 in. (38.1cm), possibly to accommodate gun ports. More recent survey undertaken by Texas A&M University have added new data and insights to this vessel's construction. In the course of the survey, it became apparent that the framing elements were irregularly spaced (Bojakowski & Custer Bojakowski 2011: 47-48). Like *Sea Venture*, the frame elements were not attached horizontally, but were butted together. Lateral strength was increased through a system of alternating heavy ceiling planks and stringers, with possible runs of heavy sleepers running over the joins of the floor timbers and first futtocks (Adams 2013: 128-129; Bojakowski & Custer Bojakowski 2011: 51).

Researchers involved with the *Warwick* project tentatively compare the vessel's construction to that of *Mary Rose*, finding *Sea Venture* to have been formed of a drastically different building tradition despite their nearly contemporaneous dates of construction (Adams 2013: 128-129; Bojakowski & Custer Bojakowski 2011: 51). Although the vessels share many similarities in hull form, the internal structures bare very little resemblance to each other. The builders of *Warwick* chose a somewhat lighter transversal framing system, opting for adding strength laterally to make up for any deficiencies. *Sea Venture's* designers chose a more robust means of adding transversal strength which did not necessitate as much lateral bracing to attain suitable strength. *Sea Venture* displays new and innovative means of construction. *Warwick*, with its similarities to *Mary Rose*, stands in stark contrast to this. Current thought on construction dates of the two vessels place *Sea Venture* at around 1603 and *Warwick* at shortly before its wrecking in 1619 (Adams 2011: 117-118, 129). With *Warwick* being built at a later date than *Sea Venture,* it serves to highlight the notion that for societal aspects so steeped in tradition as shipbuilding, changes occur via lengthy process rather than swiftly at the first instance of innovation. Whilst *Sea Venture* represented the future of shipbuilding, *Warwick* was a contemporary relic of the past.

Ships of War—HMS Dartmouth & HMS Northumberland: Innovating with limited resources

Adams (2011) and Pascoe (2006) have already established that there was a split in form between English merchant vessels and naval vessels, through a process beginning around the middle of the 17th century and ending by the 1690s. This point therefore does not need to be dwelled on further, but a short examination of two vessels which have been investigated archaeologically will be of use to explore what features were deemed more suited to warships over merchant vessels. England's warships benefit from a much greater presence in both the historical and archaeological record, giving much more information concerning their original form than would be seen in an anonymous vessel in the merchant class. The two vessels to be discussed here are *HMS Dartmouth* (b. 1655), a fifth rate frigate, and *HMS Northumberland* (b. 1679), a third rate ship of the line.

HMS Dartmouth was built as part of a major shipbuilding project to create a strong, dedicated naval fleet that began in the 1650s. Six frigates were ordered in 1653, and another six in 1654, at a prescribed cost of £6/10s per ton (Adnams 1974: 272; Martin 1978: 29-30; Winfield 2009: 154-156). *Dartmouth* was built in the second batch of these vessels and commissioned in 1655. The vessel was rated at 260 tons, had a keel 80 ft. (24.38m) in length, and a beam of 24.75 ft. (7.54m). The vessel was to be crewed by 90-135 men depending on the time period and circumstances. In 1688 the frigate was converted to a fireship, and it sank in 1690 off the Isle of Mull, Scotland, leaving most of the crew dead. The wrecking was the result of snapped anchor cables in a particularly strong gale which then drove the ship stern first against a cliff. The wreck was found by divers in 1973 and later excavated and partially salvaged to study the construction methods more thoroughly (Adnams 19 73: 289; Martin 1978: 41-42).

Dartmouth was considerably slighter beam-wise than the earlier vessels discussed in this chapter and was of a drastically different build than what was observed earlier in the century. Framing methods had also changed considerably, along with the hull lines (Martin 1978: 43-

49). The elm keel was strengthened by a massive piece of deadwood running above it, acting as a keelson by holding the floor timbers in place (which did not cross the keel), but also providing additional longitudinal strength and securing the keel scarfs, which had also received some improvement in the form of tabled butt-ends. The design of this central lateral support system was noted by Martin as being rather ingenious, increasing strength in the keel, garboards, and flooring timbers, although it is now believed to have been added during the 1688 rebuild as opposed to a feature of the original construction (Batcharov 2007: 350; Pascoe & Peacock 2014: 137). The narrow lines of the hull were formed by 10 x 8 in. (25.4 x 20.3cm) oak framing timbers spaced 12 in. (30cm) apart. The starts of the first futtocks had been staggered in distance to the keel so adjacent frames would have their weakest points at different locations as was seen in *Sea Venture*. A single line of stringers ran the length of the ship on both sides of the keel connecting the flooring timbers. Chocking was used liberally in this vessel in various capacities, including chocked scarfs. Batcharov argues that these were likely added during the 1688 rebuild (2007: 351). The outer hull was constructed of 2.5-3 in. (6.3-7.6cm) thick elm planking, and efforts had been made to sheath the vessel in several areas. Firstly, a false keel was added to the underside of the keel to protect against abrasions. The outer hull also received a sheathing of thin fir planks below the waterline, 0.5 in. (1.2cm) thick, which was meant to serve as a sacrificial covering for protection from shipworm (although this was apparently not terribly effective).

Two decades following the first major push by England to build up its naval fleet, another effort was warranted due to aging vessels and major losses in the three wars with the Netherlands. Thirty new vessels were ordered during the 1677 construction programme to include 20 third rate ships, nine second rates, and a single first rate (Winfield 2008: 61; Pascoe & Peacock 2015: 132). The brainchild of Charles II and Samuel Pepys, this project saw the first push toward standardisation of rigging, crewing, and ordinance. This was a major step toward modernisation, attempting to remove some of the idiosyncrasies of any particular vessel, although the construction methods were still left in the hands of the shipwright. These vessels were in reality seldom used in hostilities due to the peaceful period immediately following their construction, and many of these fell into a state of disrepair at their moorings, having never been used. Of these vessels, two are known archaeologically, having wrecked in the same storm event in 1703 with one possibly causing the sinking of the other. Both third rates, *Northumberland* and *Stirling Castle* lie in the English Channel off the coast of Kent on the Goodwin Sands.

The remains of these vessels were discovered in 1980 by a dive club working with a local archaeology authority and undertook initial survey work. Of the two, *Stirling castle* has been subjected to far more survey given that the ship was in a remarkable state of preservation upon its discovery (although it is now severely deteriorated), but the overwhelming majority of that work has gone unpublished in widely accessible formats allowing for study (HWTMA 2009). Only a single note concerning the vessel's discovery and some cursory discussion of some early small finds has been published (Lyon 1980). *Northumberland* has received far less attention and notoriety, and only a small fraction of the vessel's remains have been observed, but it has recently been the subject of some peer-reviewed study (Pascoe & Peacock 2015), and is therefore to be the subject of this discussion.

Only the lower portions of *Northumberland's* hull have been discovered, making full discussion of its construction difficult, but there are several important areas of note that are visible within the remains. The keel, floor timbers, and first futtocks from a fraction of the ship have been recorded along with their associated inner and outer planking. The keel was specified at the time of building to be 121 ft. (36.88m) in length and remains were recorded as 15.75 in. on one side (Winfield 2008: 64; Pascoe & Peacock 2015: 135-138). The depth of keel was recorded at nearly 24 in. (60.96cm), but this likely included a false keel whose seam was obscured by marine growth. In reality, the keel was likely nearly square, with a profile of about 16 x 16 in. (40 x 40cm) using the 8 in. (20cm) deep false keel of *HMS Dartmouth* as a template. Remnants of an iron bolt were observed, probably having held a flooring timber in place. Flooring timbers were arranged in the standard fashion, crossing over the keel, unlike what was observed in *Dartmouth*, and were sided to around 13.5 in. (34.3cm). First futtocks were also of 13.5 in. (34.3cm), and were again staggered for strength. A large, triangular chock was located near to the section of lower hull. The chock is thought to be from a chocked scarf joint in the framing system, and Pascoe & Peacock (2014: 137) point to an historical account of the vessel's building mentioning the use of chocks. Although *Dartmouth* was found to have similar chocks within its framing system, it is unclear if these were included in the original design, and recent work suggests that they were a later addition (Batcharov 2007: 351). In

Northumberland though, it appears that they were associated with the original 1677 build, making this the earliest known use of chocking being used in scarf joints in English shipbuilding. Little outer planking was observed, and did not lie in a manner which allowed for measurements, and therefore it cannot be said if *Northumberland* was sheathed in a similar manner to *Dartmouth* to combat worm intrusion.

Discussion

The case for 'medieval to modern' has been well laid out by Adams (2011), and is very evident through a comparison of *Grace Dieu* and *Mary Rose*. *Grace Dieu* is characterised by numerous features as being of an earlier era: clinker planking, an exaggerated forecastle with nearly no castling aft, and lightly rigged with only a single course of sail. This also sets a benchmark for wood use from an availability standpoint. Shipbuilding had not yet taken its toll on England's forests, reflected by the amount of wood used in this vessel. Such a vessel would have been hardly possible two-hundred fifty years later, and the costs would have been extraordinary. *Mary Rose* was of a new era; an early example of the vessels from the 'golden age' of sail, although its builders were able to make liberal use of wood as well as suitably grown timbers were not yet becoming scarce. Ships had become vastly more sophisticated than what they were a century earlier, and carvel construction techniques had firmly taken hold.

While *Mary Rose* was a significant departure from a typical medieval ship, there were additional advances made prior to England's foray into colonial trade. This is particularly apparent in *Sea Venture*, which bears little resemblance internally to the aforementioned ship. Whilst *Mary Rose* was meant for use in the coastal waters of Europe, *Sea Venture* was born of a time in which open seafaring was becoming widespread. It also wasn't meant as a war vessel, but could double as one. It maintained a wide beam to keel ratio, slightly more so than *Mary Rose* (table 3-3). This made sense for a merchant vessel, providing more space in the hold for cargo. The framing of the vessel was robust and utilised new methods for strengthening the hull. Stringers running along the hull would have worked in tandem with both the ceiling and outer planking to provide lateral strength, and the framing timbers themselves were very heavy. Staggering of the points of attachment between floor timbers and first futtocks in distance from the keel served as an ingenious means of reducing weakness in the hull, and has been observed in some other notable vessels such as *Vasa* (b. 1628), *HMS Dartmouth*, and the *HMS Northumberland* (Pascoe & Peacock 2015: 137). This is one feature in particular which can be seen as true technological innovation in shipbuilding of the 17th century. For the most part though, *Sea Venture* drew its strength from the sheer amount of wood used in its construction, with heavy, closely-spaced timbers and thick planking both internal and external.

Warwick stands in contrast to *Sea Venture* though, composed of what appears to be a heavier lateral framing system making use of stringers and ceiling to strengthen the hull, but with slighter framing timbers spaced at greater intervals running transversely through the hull. It is difficult to speculate on the lower hull construction as this has been lost to time, but the upper reaches of the hull which survive give this appearance. The floor timbers and first futtocks are certain to have been heavier than the 5.5 in. sided third and fourth futtocks, but unlikely to have matched the bulk of those observed in *Sea Venture*. One must ask if the regression to earlier techniques was a result of stubborn adhesion to tradition on the part of the shipwright, if this was a response to diminishing resources, or stemming from some other cause.

Another area often discussed in light of diminishing resources is the use of chocks in the framing system. Chocking allowed for straighter timbers to be used in framing, especially around the turn of the bilge, and was particularly important in times of heavy stress on Europe's timber supplies. Times of heavy naval conflict, such as the three Anglo-Dutch wars, would be a major stressor on timber supplies. Constructing vessels for the various navies of Europe left forests depleted of quality shipbuilding materials, and shipwrights needed to innovate to continue to construct sea and battle worthy vessels. *HMS Dartmouth* is often discussed as the earliest known English ship to employ this technique, but as discussed, it is thought to have received these chocks as an addition during its 1688 refitting. Chocked scarf joints are, however, thought to be a main feature of vessels throughout the last quarter of the 17th century, evidenced by their presence in the *Northumberland*. In archaeology though, the earliest known example is very rarely the first instance of use. It is posited here that this development originated at a somewhat earlier date, and quite likely in the merchant fleets, as the best sources of timber would have been reserved for the military shipyards.

Table 3-3 - A Comparison of certain construction features of vessels discussed

Vessel	Beam (ft.)	Keel (ft.)	Beam : Keel	Lower Frames	Frame spacing	Primary Building materials	Lateral Supports	Chocks
Grace Dieu (b. 1418) 1400 tons	~50	~129	1:2.58	11 x 11 in.	5 in.	not described	Stringers	No
Mary Rose (b. 1510) 700 tons	38.25	105	1:2.74	floors 8.6 – 19.5 in.	8.6-17.6 in.	oak planking, oak/elm keel	Stringers	No
Sea Venture (b. ~1603) 300 tons	29.16	~75	1:2.5	~12 in.	not described	oak, oak frames	Ceiling, Sleepers	No
Warwick (b. ~1617) ~300 tons	----	----	----	5.5 x 5.7 in. 2nd & 3rd futtocks	13 in	not described	Ceiling, Stringers, poss. Sleepers	No
Sparrow Hawk (w. 1626) ~40 tons	~12	28.5	1:2.4	6 x 6 in	~6 in.	elm keel & planking, oak frame	Stringers	No
HMS Dartmouth **(b. 1655) 260 tons 5th Rate Frigate**	25	80	1:3.2	10 x 8 in.	12 in.	elm keel, oak frames, elm planking, pine sheathing	Floor stringer	Yes
HMS North-umberland **(b. 1677) ~1000 tons 3rd Rate**	40	121	1:3	13.5 in.	'very closely'[2]	not described	none visible	Yes

A more recent find along the coast of North Carolina, dubbed the Corolla Ship, may offer the first clues as to the trajectory of merchant shipbuilding in England in the 17th century. A number of coins found in association to the vessel's remains in 2010 provide a *terminus post quem* of 1643, with the age of the majority of the coins dating to significantly earlier periods (Brown 2013: 166-169). The remains consist of a section of the keel approximately 8.7m (28.25 ft.) in length, with ten floor timbers, sided at 27.6cm (11 in.) and moulded at 26.4cm (10 in.) (Brown 2013: 172, 192). Fourteen first futtocks were present, having slighter dimensions than the floors, being sided to around 21.3cm (8 in.). Heavy ceiling planking and stringers were noted, but unfortunately lost prior to recording and recovery of the remains from the surf (Brown 2013: 172, 190). The vessel's construction is described as being remarkably similar to

[2] No exact measurement is given, but frame spacing is described as 'very close' in Pascoe & Peacock 2015: 136

Sea Venture (Brown 2013: 199), using non-composite frames, and futtock joins at an even distance from the keel, providing a contiguous wall of solid timber along the turn of the bilge. A key difference though, is that the frames were horizontally fastened using treenails, rather than detached as is the case in *Mary Rose, Sea Venture,* and *Warwick.*

The vessel remains have unfortunately been left to rot outside a North Carolina museum, most likely having now lost all hope of dendrochronological dating, but coins found with the vessel suggests a mid-17th century wrecking date. The hull is quite possibly older than this, given the accumulation of coins in the hull dating back as far as the 16th century, but the horizontal joining of the framing timbers is compelling in that it does not appear to be a common feature of early 17th-century vessels, but is common on those of the late 17th century in conjunction with composite framing structures. As more vessels from this time period are uncovered and studied, more clarity should be shed on the questions of shipbuilding practices in the mid-17th century and the divergence of merchant and naval vessels around this time.

All of these innovations in hull construction seem to follow certain patterns. The 16th and early 17th centuries were times of true innovation for the sake of technological advancement. Resource based constraints were few, and shipwrights were learning how to make more efficient vessels capable of operating in new environments. As the 17th century progressed, knowledge had increased, but suitable wood stocks were dwindling. Naturally, this slowed technologically driven change to ship design, making innovation a resource driven goal. Important to note though, is that shipbuilding had by no means stagnated. Divergent merchant and naval fleets allowed for specialisation in design based on intended function. The defensible merchant ship was no longer the sole design, and shipwrights in the naval yards were able to focus on producing faster, sleeker, and stronger hulls for warships. Goals of merchants remained to carry as much cargo as possible, and were able to remain relatively slow and bulky. Unfortunately, archaeological examples of later 17th century or 18th century merchant vessels are lacking for comparison, but it is likely that they suffered heavily in materials due to the unavailability of choice timbers. The most suitable woods would naturally be used for the naval fleets, and merchants would be forced to accept inferior materials or to look elsewhere. An important feature of 17th-century life was that the world had become smaller in many ways. Cultural interaction, and therefore, diffusion, was at an all-time high between countries, and shipbuilders and sailors were looking beyond their own political borders for new sources of technology and information.

An Outside Factor? Holland's Influence on English Merchant Vessels

As England was by no means a closed society in the 17th century, English merchants, sailors, and shipbuilders no doubt took note of the activities and technology of their neighbours. A typical 17th-century English shipwright almost certainly had at least cursory knowledge of the anatomy of Dutch and French vessels. This would only become truer during periods of hostilities when vessels built elsewhere were frequently captured by the English. Likewise, the mariners were likely aware of sailing routes taken by the vessels of other countries. Often overlooked, the Netherlands played an interesting and important role in the 17th century English tobacco trade. Until the Acts of Navigation took hold, Dutch ships were visiting the Chesapeake colonies with some frequency, bringing in goods from the European continent and returning to Europe with tobacco. The Netherlands had been involved with the tobacco trade since its earliest inception, starting in the 16th century, trading in tobacco from Brazil and the Caribbean (Gray & Wyckoff 1940: 3). The earliest known trade voyage to Virginia by the Dutch was in 1619, with a 160-ton man-of-war trading African slaves for local goods, with some tobacco likely brought back to Holland (Pagan 1982: 485). The following year, regular merchant voyages from Holland to Virginia began through the Company of Merchant Adventurers of Middleburg, with several Dutch vessels visiting the English colony each year (Kupp 1973: 653; Pagan 1982: 485). The first two decades of Virginian trade proved rather unsuccessful for the Dutch, who found themselves unable to gain adequate footing within the colony, but the disruption to commerce caused by the English Civil War opened the trade for the Dutch, although this still only amounted to a small handful of voyages per year (Pagan 1982: 486, 491). Further, Virginian tobacco was taxed at a higher rate in Holland than Brazilian and Caribbean tobacco, perhaps making the import of Virginian tobacco less economically viable in the home market (Gray & Wyckoff 1940: 3). Still, there was a preference in the colonies for Dutch traders, as they were able to pay higher prices for the tobacco, owing to lower shipping costs stemming from cheaper vessels and smaller crews (Barbour 1930: 275, 282; Pagan 1980: 487). As discussed in Chapter 2 of this work, the Interregnum government brought a swift end to legal trade for the Dutch in the Chesapeake by means of the Acts of Navigation, but this apparently did not deter all foreign ships from trading in the Chesapeake.

Despite gaining an increasing share in the Chesapeake tobacco market, the Netherlands never truly became an integral part of the process. In the 1640s, at the height of their involvement, only around 4-6 Dutch vessels were trading in the Chesapeake (Pagan 1982: 485). By comparison, during the same period seven-to-eight thousand Dutch vessels were operating in the Baltic (Barbour 1930: 267). Although not many ships were arriving in the Chesapeake annually from Holland in the first half of the century before the Acts of Navigation, Dutch vessels were to play a less visible, but important role in the trade, especially in the latter half of the century, spurred on by the three Anglo-Dutch wars.

England's navy captured a great number of Holland's vessels during the aforementioned hostilities. Many of these vessels, including *fluits* and doggers, eventually made their way into the merchant fleets. Records show that twenty-one *fluits* and five doggers were taken as prize during the second Anglo-Dutch war from 1665-1667 (Winfield 2009: 217-220). The third Anglo-Dutch war (1672-1674) resulted in the capture of five *fluits* and twenty-three doggers. Nearly all of these vessels were sold after a short while into the merchant fleets. Amongst the doggers taken as prize during the second Anglo-Dutch war is a vessel called *Johanna*. It is very possible, given the unusual spelling of the name in the English language, that this is the same vessel described in the final three voyages of the Edward Rhodes log, appearing first in that document in 1674, just six years following the decommissioning of the dogger *Johanna*. Aside from Dutch vessels and hulls entering the English merchant fleet by means of war prizes, some vessels and bottoms were purchased directly from Holland, and, in line with the Acts of Navigation, were naturalised English (Barbour 1930: 271-272). Further, the clandestine purchase of Dutch vessels was also somewhat common.

Shipbuilding was considerably cheaper in Holland than in England, owing mostly to lighter construction and what has been deemed inferior materials (Barbour 1930: 275-276). Barbour points to the cost of a 200-ton Dutch *fluit* at around £800, whereas an equivalently sized English constructed vessel cost around £1,300. Winfield lists costs of English war vessels constructed from 1659-1670 at £8 ½ per ton for fourth rates, £6 ½ - £7 ½ per ton for fifth rates, and £6 ½ per ton for sixth rates and ketches (Winfield 2009: 286). Barbour places the cost per ton of a 250 ton English merchant vessel at around £7 2s. 6d per ton, but the purchase price of a new 200 ton *fluit* in the same year at £4 10s. per ton (Barbour 1930: 275). Various incarnations of the Navigations Acts carried stipulations for the use of English-built hulls in an attempt to bolster the English shipbuilding industry, but with such clear fiscal benefits, it is easy to see the appeal of using Dutch vessels. That *fluits* and doggers required significantly smaller crews for sailing than English vessels was an additional advantage. In 1620, a 200 ton *fluit* needed only nine to ten mariners to sail, whereas an English ship of similar size was typically crewed by thirty or more men (Barbour 1930: 282; Davis 1962: 370; North 1968: 962). English vessels became more effective with crewing over the course of the century, but never came close to reaching the efficiency achieved by the Dutch, still requiring over 20 crew members on a 250-ton ship at the close of the 17th century.

Despite the perceived lower quality of a Dutch hull, Holland's vessels were still very sea-worthy. Three main Dutch vessel types were likely to have been used in the Chesapeake tobacco trade: The man-of-war, the *fluit*, and the dogger. Early voyages made by Dutch merchants were likely to have been made via Dutch war vessels, in a similar vein to that of the defensible merchant ship preferred by the English. This would be owing to an increased likelihood of encountering hostile vessels in ocean passage early in the 17th century. These vessels were typically three-masted, square-rigged, and had a limited cargo capacity, although they were constructed in a wide variety of sizes, but they had an increased operating cost compared to the *fluit* (figure 3-11). The *fluit*, however, with its light construction, sluggish sailing qualities, and small capacity for armament, was not suitable for trading in regions where hostile action was likely (Barbour 1930: 265, 279-280). Finding a route of passage suitable for the more economical *fluit* would be advantageous, and the timing of the shift in sailing route from a southern to northern passage coincides with the rise of the Dutch in the Chesapeake tobacco trade and the heyday of the New Amsterdam settlement (1624-1664) in modern-day New York, a relatively short distance to the north of the Chesapeake. With these thoughts in mind, the influence of Dutch merchants and mariners may offer a possible source for the discovery of a new passage to the Mid-Atlantic colonies.

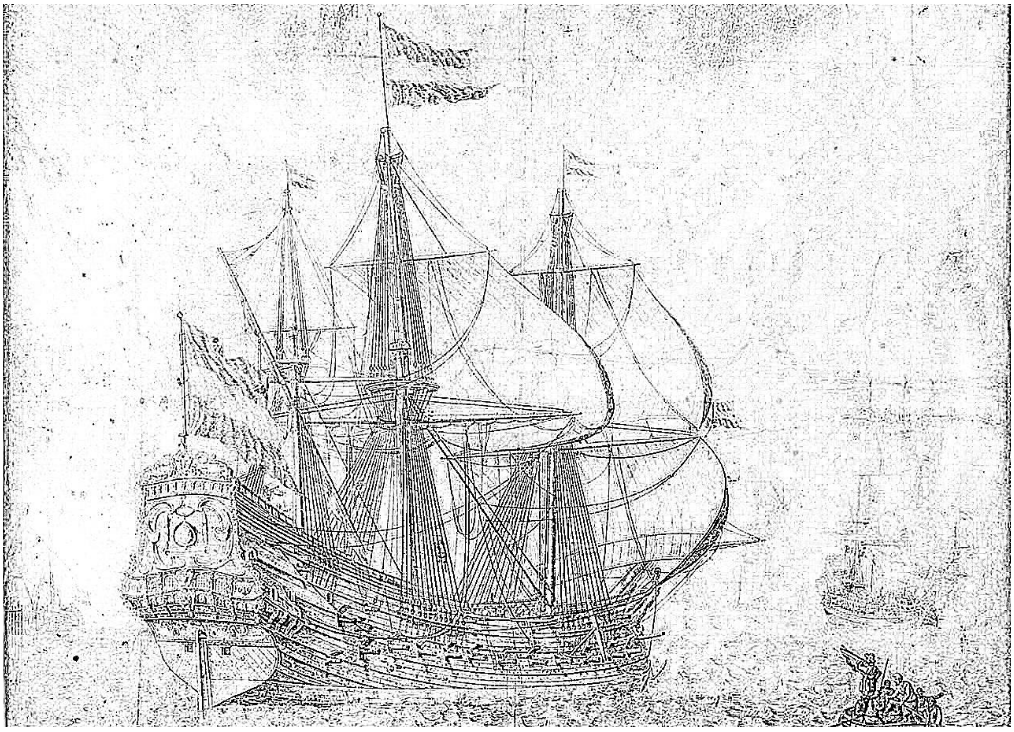


Figure 3-11 - Dutch Man-of-War, 1651, by Johannes Storck. National Maritime Musem, Greenwich Object ID: BHC2229 (colours altered to enhance visibility)

The *fluit* was rigged in a similar fashion to a standard ship, having three short masts and a simple rigging. The stern and bow profile were both very rounded, the main cause of the lower attainable speeds of the vessel, but the cargo capacity was greatly increased by these features (figure 3-12). The ratio of length-to-beam varied between 4:1 and 6:1, with an English merchant ship typically having a 3:1 ratio (Barbour 1930: 279-280; Pagan 1982: 487). A typical example would have only one deck, maximising cargo capacity, but making life aboard the vessel less comfortable. Most examples were unable to carry significant armament, owing to light deck structures, making them vulnerable in the more hazardous trade routes. Construction was of continentally-sourced oak, pine and fir, and they often utilised lesser quality, poorly seasoned woods cut to slighter dimensions than English vessels used. Although Dutch construction methods were criticised by some, other contemporary sources attested to the seaworthiness of Dutch vessels when properly cared for (Barbour 1930: 276). Aside from potential flaws in construction, *fluits* were well regarded for their ability to perform in harsh sea conditions.

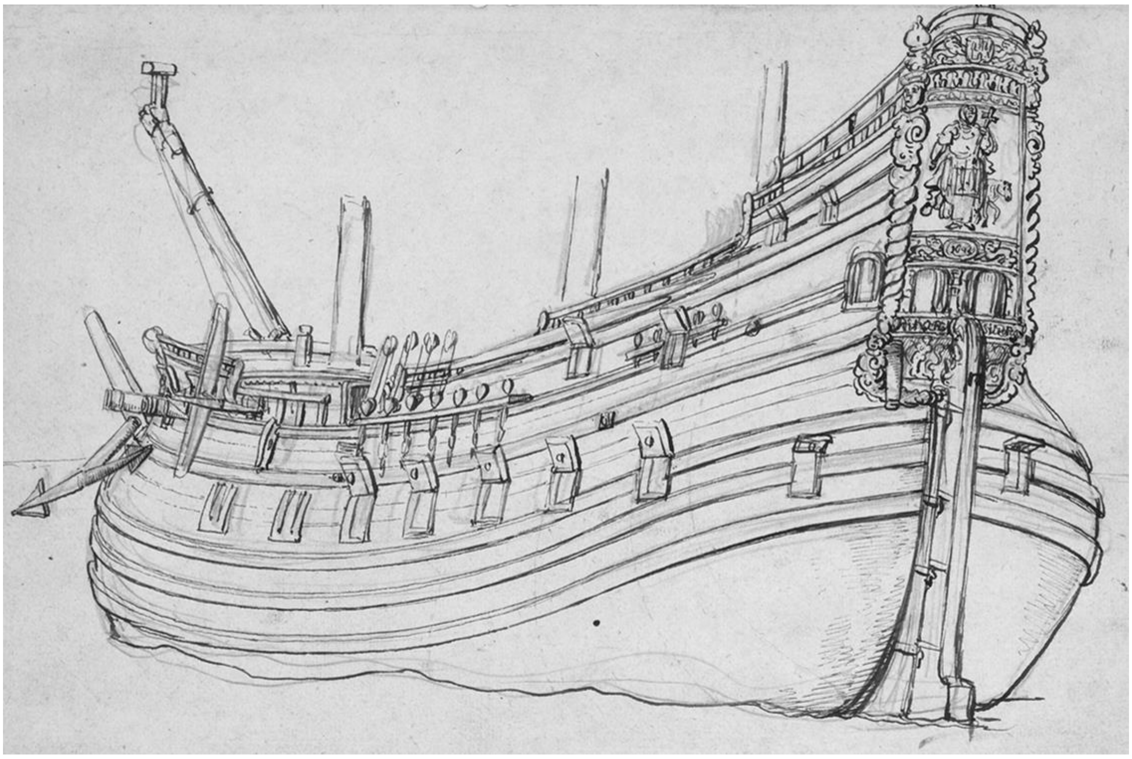


Figure 3-12 - Dutch fluit from stern view, ca. 1650 by Willem van de Velde. Note the heavily rounded stern profile. National Maritime Museum, Greenwich object ID: PAH712

Doggers were used by the Dutch predominately as fishing vessels along the Dogger coast, and were likely not widely seen on most trade routes (Winfield 2009: 217). The English acquisition of doggers via the Anglo-Dutch wars and subsequent reuse on transatlantic trade routes was probably unusual for this vessel type, although Sir Laurens van Hemskirke, a Dutch defector and the recipient of several of the captured doggers from the second Anglo-Dutch war, described the dogger as more seaworthy than most British vessels (Barbour 1930: 276-277). These vessels were rigged in a similar fashion to a ketch, carrying a main and mizzen mast, although doggers drawn by Van de Velde the Younger show variation in the mainsail (figure 3-13). The mizzen is depicted as a small lateen sail in most of the drawings. The mainmast rig varied between a simple square sail, square mainsail with a gaff-rigged sail, and a gaff mainsail without a square sail.[3] With a rig similar to an English ketch, these were likely well received amongst mariners accustomed to ocean passage aboard smaller vessels, and by merchants who were able to save money on crew wages and victualing.

[3] Various drawings by the younger Van de Velde, held in the National Maritime Museum, Greenwich. Pertinent object IDs: PAF6601, PAF7033, PAF7000, PAH3924, PAF6798

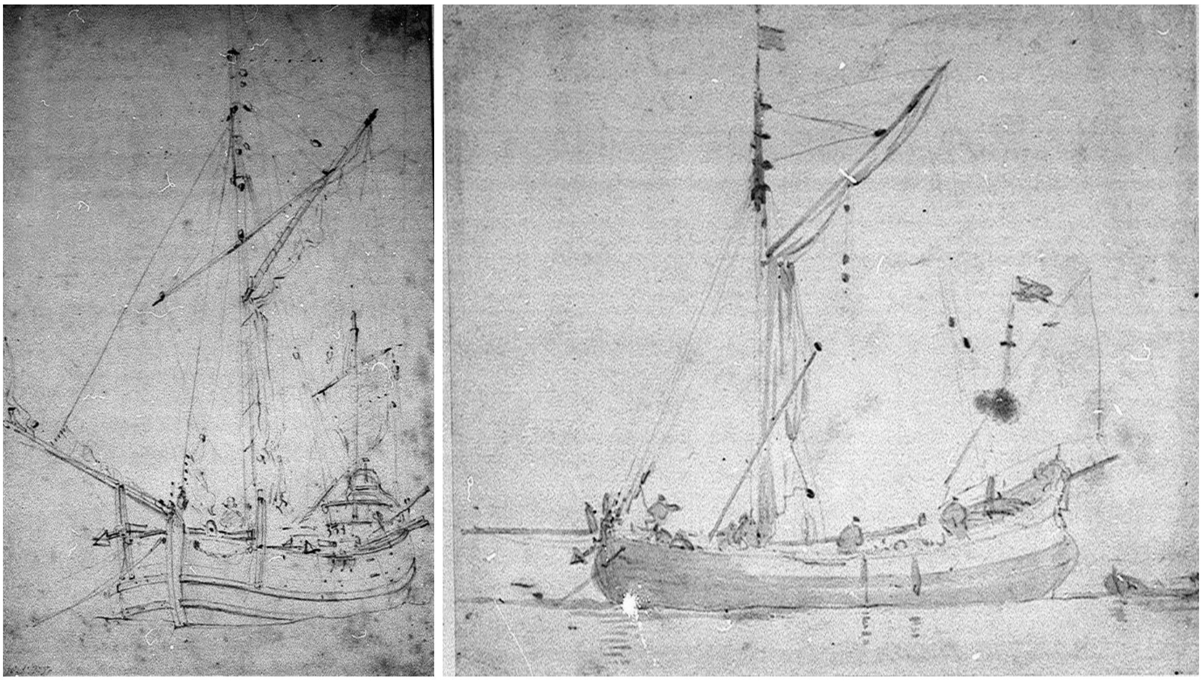


Figure 3-13 – Two Dutch doggers showing variation in rigging. Left (NMM ID: PAF7033, van de Velde, ca. 1700) is a dogger with both a yard for a square sail and gaff rigged from the mainmast. Right (NMM ID: PAF6601 , van de Velde, ca. 1675), a simpler gaff-rigged dogger.

Although legal participation by the Dutch in the Chesapeake tobacco trade was short-lived, Holland appears to have made a lasting impression on the tobacco trade, possibly influencing trade routes, ship design, vessel choice, and the rigging of English vessels. The *fluit* offered many significant advantages over the majority of English ships, provided that the passage was safe enough for unarmed ships. Although the *fluit* was regarded as slow, this has been demonstrated to be a moot point within the context of the early English tobacco trade, as time spent acquiring and loading cargo in the Chesapeake was the most significant factor affecting time spent in transit. Edward Rhodes notably describes interaction with several English flyboats (the English term for *Fluit*) in his 1672 journal of his voyage aboard the *Constant Friendship* (Rhodes 1670-76; Appendix C). The influence in rigging, very likely inspired by Dutch vessels, was a significant factor in reducing costs to merchants, which can be viewed as technological innovation increasing productivity.

Conclusion

The vessels used in England's early tobacco trade were an oft-changing visage on the seas. Different rigging and hull forms came in and out of style with some frequency during this era.

That certain types, specifically those with narrower hull forms such as the pinnace and frigate, were infrequently used in long distance trade is of little wonder. The following chapter will show that faster vessels were not necessary for the tobacco trade, particularly once trade routes had moved away from Portugal, Spain, Africa, and the Caribbean where they were likely to encounter hostile vessels, thus allowing for vessels designed to maximise cargo capacity such as pinks and flyboats to be selected for these routes. The rigging of these vessels underwent several changes toward the goal of a simplified system that allowed for fewer mariners to manage the ship, thereby reducing costs in crewing. Improvements to the cut of the sails were made in small increments during the 17th century. These changes were minor, but set the trajectory for the more efficient square sailing rigs of the 19th century.

Morriss' study (1914: 88-89) demonstrates well the range of vessel sizes which would have entered the Chesapeake Bay from England. Most of the vessels were relatively small, around 80-100 tons. Ships from England both smaller and larger would be seen in Maryland and Virginia, with some as small as 40 tons and some in excess of 400 tons. The smaller the vessel, the more efficiently it could fill its hold with tobacco and return to England, but for suitable economic gain, along with safety of crossing, there would naturally be limits to the lower range of a vessels size. The introduction of mandated travel as a fleet would also place limitations on how long a vessel could stay in Chesapeake waters, forcing the ships to leave after a previously agreed upon time. In the case of the 1705 voyage to Maryland (Andrews 1907), the fleet left in early June to return for England, and the author's vessel did not arrive in time to depart with the fleet.

In terms of technology in ship building, there was no apparent stasis during this period; rather, it appears that quite the opposite was occurring. Average speed of crossing may have been roughly static on any specific route (to be shown in Chapter 5), but this is hardly the sole indicator of technological change, or the only one affecting the tobacco economy. There were constantly modifications being made to ship design, altering hull dimensions, and changing framing techniques. With economics in mind, a standard end-goal would be to do more with less. To shipbuilding, this would mean building stronger ships with fewer, or less specialised materials. It is exactly these types of changes to shipbuilding which were observed during this time period. Vessels began to opt for smaller framing timbers, utilising new methods to add strength to the hull such as staggering the ends of adjacent futtocks or adding new systems of lateral reinforcement. The use of chocking in framing systems allowed for futtocks to be built from straighter timbers than had been previously possible, reducing the strain on compass timber stores at a time when the availability of shipbuilding materials was stretched thin. Although this response was resource based, it can absolutely be viewed as an important technological step in ship design

England's relationships to its neighbours were almost certainly a source of the changes in ship design and sailing routes used during this period. Aside from hostilities driving the loss of available shipbuilding materials, Dutch trade vessels offered significant advantages over English merchant vessels in certain conditions. The unparalleled efficiency of the *fluit* in cargo capacity, crewing requirements, and building costs offered significant advantages over the English defensible ship, and Holland's desire to use these vessels in overseas trade is one potential source for a change in trade route to one offering a decreased chance of encountering pirates or privateers given its lowered defences. There is a significant likelihood that the move to the more direct sailing route across the Atlantic to be seen in Chapter 4 was a direct result of Dutch merchants looking to trade with the Chesapeake colonies, although more direct evidence is necessary to draw this conclusion. It is clear that numerous technological changes took place over this century, driven in some way by ideology, technology, environment, materials, tradition, economics and purpose, owing to each of Adams' constraints on shipbuilding (2001: 301). New efforts to locate and study archaeological examples of merchant vessels dating to the second half of the 17th century would be helpful in strengthening these arguments. Technical aspects of these vessels are largely unknown, owing to a lack of documentary sources showing building methods and a virtual lack of archaeological examples. Future attention to archaeological evidence here, is an absolute necessity.

Introduction

The central theme of this work is the changing nature of English colonialism and overseas trade throughout the 17th century, particularly in the Chesapeake tobacco trade as it moved from its infancy in the early 17th century to a point of maturity in the 18th century. To this point, this theme has been explored as it relates to English domestic and foreign policy, settlement patterning in the Chesapeake, economic development of tobacco as a trade good, and advances in shipbuilding. Continuing on the maritime theme, this chapter will explore the changes in navigation and sailing routes across the Atlantic by English seamen, and impetuses for changes seen in shipping routes throughout the American colonial period. Gaining an understanding of shipping routes and changes made to them throughout time is vital to understanding how goods and people moved around the Atlantic World, how people perceived and interacted with their environment, and to what degree political and other pressures affected movement on the Atlantic seascape.

On the sailing course chosen, two main scholars, Phillip Alexander Bruce and Arthur Pierce Middleton, have identified routes of passage between England and the Chesapeake. Bruce first addressed this topic, identifying a southern and a northern passage (Bruce (I) 1896: 623-624). His southern passage, which is later echoed by Middleton (1953: 9-14), describes vessels travelling in a southerly course from England and turning near the Verde Islands off the coast of North Africa, making a direct westward run to the Caribbean, and then redirecting northward until reaching the Chesapeake (Figure 4-1). Bruce's northern passage followed a similar pattern, but with vessels turning westward at a more northerly point near the Canary Islands (Bruce (I) 1896: 623-624). Bruce (*ibid.*) asserts that this was the passage used after 1609 following its discovery by Samuel Argall.

Middleton's (1953: 7-9) routes included the southern route of Bruce, but offer also a northern route sailing westward from England directly to Newfoundland, then setting a southerly course along the North American coast. He (ibid.) writes that vessels travelled along the southern route until around the mid-17th century, at which time vessels began using the northern passage, making no mention of Bruce's second passage by way of the Canary Islands. Curiously though, and as mentioned in Chapter 1, Middleton offers no concrete references or sources through which these claims can be verified.

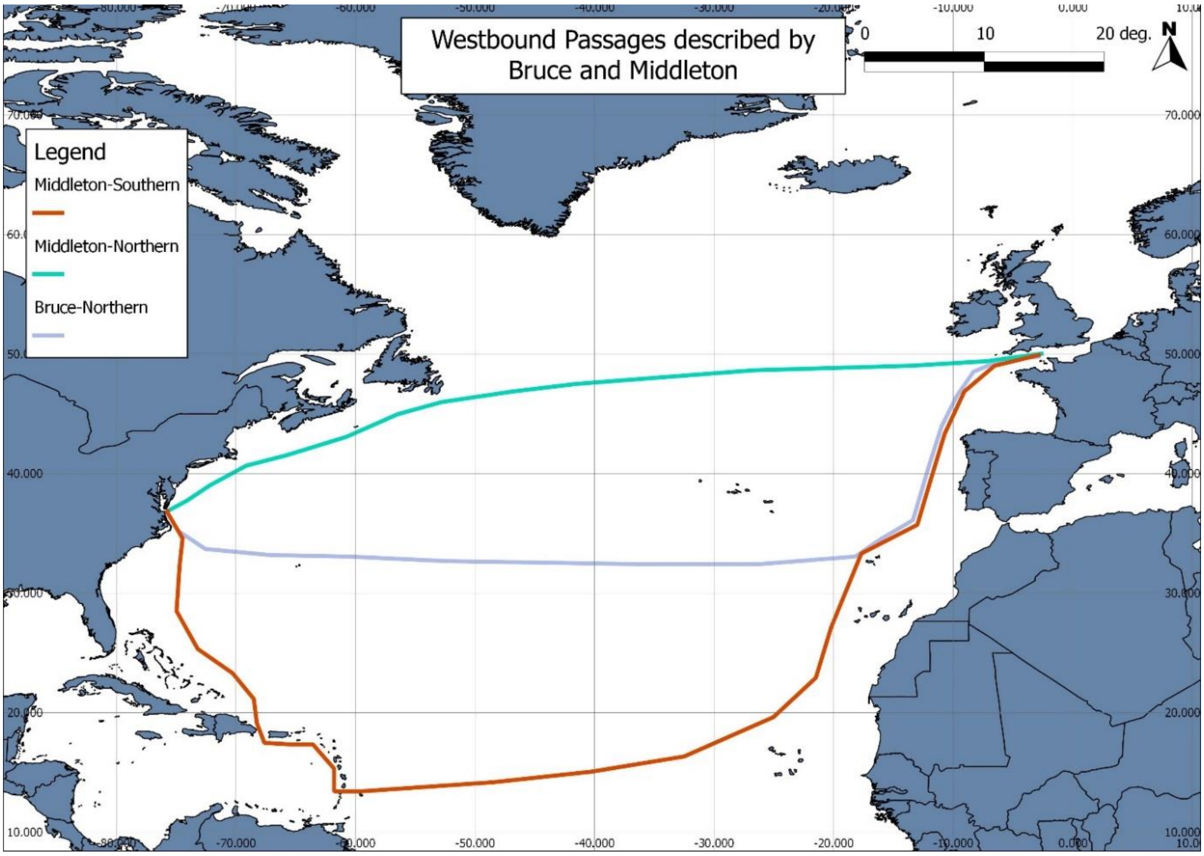


Figure 4-1 - Routes of westbound passage identified by Bruce (Bruce (I) 1896: 623-624) and Middleton (1953: 9-14)

Little to no traditional archaeological evidence has been left to examine these sailing routes, but new analysis of primary source documents and published accounts of voyages is adding clarity to this subject. Fortunately, from a source perspective, literate people were often present on voyages to the New World throughout the 17th century, and some of whom recorded their experiences and observations making it possible to reconstruct their voyages. An examination of available logbooks, passenger journals and voyage narratives from various points throughout the 17th century indicates that the routes previously identified are not entirely accurate, and that in the latter half of the century, a heretofore undescribed route was in common use. Further, several of the passages may not qualify as standard points of crossing, but served rather as points of crossing which sailors had attempted in their search for more efficient routes.

The narratives and logs here do not all describe voyages ending in the Chesapeake region, but those that do not are nonetheless useful in understanding routes from England to various colonies, and any similarities or differences that exist in ocean crossings of differing endpoints. The sources containing plottable voyages used herein include:

- The 1583 fleet from Plymouth to Newfoundland led by Sir Humphrey Gilbert (Hayes 1583)
- The 1605 voyage of the ship *Archangel* to Nantucket and Maine (Rosier 1605)
- The 1607 voyage of *Susan Constant, Godspeed* and *Discovery* to Virginia (Percy 1607; Smith 1608)
- The 1609 voyage of *Sea Venture* to Virginia (wrecked *en route* near Bermuda) (Jourdain 1610; Strachey 1610; Hume 2009)
- The 1634 voyage of the ships *Ark* and *Dove* to Maryland (White 1634)
- Six roundtrip voyages aboard 4 ships bound for Virginia and Maryland recorded by Edward Rhodes from 1670-1676 (Rhodes 1670-76)
- A voyage aboard the ship *Charles* in 1679 to Long Island (Murphy 1867; James & Jameson 1913)
- Voyage of the vessel *Submission* from Liverpool to Pennsylvania in 1682 (Genealogical Society of Pennsylvania, 1895)
- A Narrative of a Voyage to Maryland, 1705-1706 (Andrews 1907)

Due to variations in the information provided in each of these sources, they do not each carry the same potential for further analysis, but those in the above list can to some degree be used to plot a route taken from England to the Americas, and at times, the reverse as well. The voyages used in this section were selected for several criteria. Firstly, the sources needed to show English vessels or English-crewed vessels in their journey between England and the North American mainland, with preference given to those visiting the Chesapeake or mid-Atlantic region. They had to provide at least some positioning coordinates such as latitude/longitude, latitude/distance travelled since previous day/heading, or a series of locations visited or observed. Thirdly, the sources needed to provide data for further analysis, such as dates of sailing or prevailing winds. Lastly, the body of sources should represent dates encompassing as much of the 17th century as possible. This final criterion proved the most difficult, as sources from the late 17th and early 18th centuries are very rare, likely due to voyages across the Atlantic at this time being so frequent that they were no longer something worth recording. Only the Edward Rhodes logs and the 1679 voyage of the *Charles* provide daily coordinates, but much can be inferred from the other sources to better understand the changing dynamics of English-North American sailing and sailing routes throughout the 17th century. Another rather useful factor is that these logs record some of the human element in selecting a route for crossing, which would always be absent within the archaeological record.

It should be noted that all dates given for voyages in this work are given as they were reported in the original documentation, likely within the Julian calendar system. As such, the dates given here are likely twelve days earlier than they actually occurred based on the modern Gregorian calendar.

In addition to the logs and narratives listed above, documents exist detailing numerous other English voyages to the New World throughout the 16th and 17th centuries which are not necessarily plottable, but from which generalisations about their intended voyages can be made. Statistics and information from these voyages will be included in the analysis, but do not need to be discussed in any great detail. Voyages in this group are listed below:

- 1584 voyage of Arthur Barlowe to explore the Virginian Coast (likely Roanoke) (Barlowe 1584)
- 1587 voyage of M. John White to Roanoke (White 1587)
- 1590 voyage of M. John White to Roanoke (White 1590)
- 1602 voyage of Bartholomew Gosnold to the northern extents of Virginia (Massachusetts) (Bereton 1602)
- 1606 voyage of Henry Challons on the ship *Richard*, destined for Maine, captured in W. Indies (Brown 1898: 9, 13-14)
- 1638 voyage of the ship *New Supply* of London (alias *Nickolas,* 300 tons) to New England and return voyage in the same year aboard the *Queen of Bohemia* (Josselyn 1672: 5-13, 27-29)
- 1663 voyage of the ship *Society* to New England, and the return in 1671 aboard *New Supply* of Boston (120t) (Josselyn 1672: 31-35, 162-164)

It is acknowledged here that there is an unfortunate gap in the available sources between 1638 and 1663, encompassing the era identified by Middleton as the period of change. At present, no appropriate sources have been identified to examine this time period, but would indeed be useful in this study should such accounts exist. The available sources are also clustered around the early trial period of English colonisation in the New World, and the 1670s and 1680s, at a time at which the colonies had been firmly planted. This obviously inserts some bias to the data, which must be recognised and accounted for throughout analysis. This study will begin by introducing the various voyages listed above, plotting their routes based on data included in their voyages via QGIS, a freeware geographical information systems programme, and followed by an extensive discussion of advantages and disadvantages of each passage.

Introduction to Source Materials and Voyages

Fleet of Sir Humphrey Gilbert – 1583

Details of the earliest attempts by the English to cross the Atlantic bound for the North American mainland are quite sparse. Prior to 1605, no sources located to this point provide ample detail for the voyage to be mapped with a reasonable assumption of accuracy, but some clues are left behind. The earliest voyage found with information on an *intended* route was one made by a fleet commanded by Sir Humphrey Gilbert in 1583 from Plymouth to Newfoundland (Hayes 1583: 271-306) (figure 4-2). The following passage from an account of this voyage, written by one of the vessel's owners, Edward Hayes, provides a bit of detail of their route and why this route was chosen over an alternative.

> "*The last place of our assembly, before we left the coast of England, was in Cawset Bay, near unto Plymouth, then resolved to put unto the sea with shipping and provision such as we had, before our store yet remaining, but chiefly the time and season of the year, were too far spent. Nevertheless, it seemed first very doubtful by what way to shape our course, and to begin our intended discovery, either from the south northward or from the north southward. The first, that is, beginning south, without all controversy was the likeliest, wherein we were assured to have commodity of the current which from the Cape of Florida setteth northward, and would have furthered greatly our navigation, discovering from the foresaid cape along towards Cape Breton, and all those lands lying to the north. Also, the year being far spent, and arrived to the month of June, we were not to spend time in northerly courses, where we should be surprised with timely winter, but to covet the south, which we had space enough then to have attained, and there might with less detriment have wintered that season, being more mild and short in the south than in the north, where winter is both long and rigorous. These and other like reasons alleged in favour of the southern course first to be taken, to the contrary was inferred that forasmuch as both our victuals and many other needful provisions were diminished and left insufficient for so long a voyage and for the wintering of so many men, we ought to shape a course most likely to minister supply; and that was to take the Newfoundland in our way, which was but 700 leagues from our English coast. Where being usually at that time of the year, and until the fine of August, a multitude of ships repairing thither for fish, we should be relieved abundantly with many necessaries, which, after the fishing ended, they might well spare and freely impart unto us. Not staying long upon that Newland coast, we might proceed southward, and follow still the sun, until we arrived at places more temperate to our content* (Hayes 1583: 277-278)."

The significance of the above passage is that it shows that even at this early date, certain key aspects of trans-Atlantic crossings are understood. A thorough understanding of the winds and currents, and seasonal changes to both, is critical to selecting the best means of passage at a given time. The choice in route was ultimately between the two routes described by Middleton, with Gilbert opting for the northern passage. This particular passage to Newfoundland was well known even at this date, as the English fishing industry had been utilising it for quite some time. This is evidenced by the line in Hayes's account of the voyage: 'we resolved to begin our course northward, and to follow, directly as we might, the trade way unto Newfoundland (Hayes 1583: 279).' The actual route ultimately taken by Gilbert cannot be plotted given the lack of any type of longitudinal data in the voyage narrative, but their intended route is quite clear. The voyage was meant to depart from Plymouth, heading west to the Isles of Scilly, then heading WSW until reaching 43 to 44 degrees' latitude. They were then to travel north-west to about 46 degrees' latitude, then head westward until reaching Cape Race in Newfoundland (Hayes 1583: 278-279). After this, they hoped to sail south along the North American coast and into the Caribbean. The route was rather poorly chosen for a voyage extending down the entire North American coast, as they would spend the whole of the voyage sailing against prevailing winds and currents, although as evidenced by the above excerpt, they were clearly aware of this. Ultimately, the fleet made it no further than Nova Scotia before high winds caused their largest ship to be grounded and broken apart, resulting in the loss of over 100 men. It is possible that this narrative became a sort of cautionary tale for English sailors, as no additional attempts at this route are made for voyages to the mid-Atlantic in the remaining voyages in this study, although it was almost certainly in continual use for vessels travelling to Newfoundland and other more northern points.

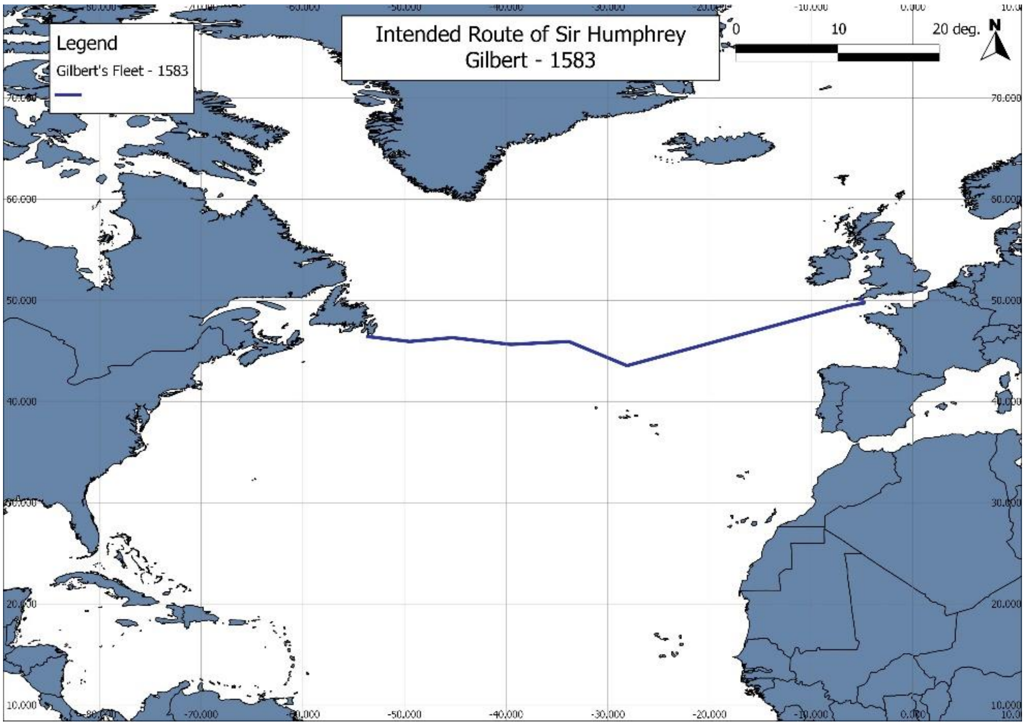


Figure 4-2 - Route of passage intended by Gilbert from England to Newfoundland, 1583 (map by S. Tucker)

Voyage of Archangel – 1605

In 1605, a voyage set out to explore the Northern extents of Virginia, which at the time contained areas as far north as the present day US state of Maine (Rosier 1605: 355-394). The area explored here was later selected for settlement by the short-lived Popham colony (1607-1609), founded by the Plymouth Company, the Virginia Company's main competitor. The ship *Archangel* was chosen, mastered by George Weymouth and the voyage was recorded by James Rosier. Captain Weymouth and his crew of 29 men departed Ratcliffe on the River Thames on 5 March, 1605, arriving at Gravesend. The following day they departed Gravesend, arriving on 16 March in Dartmouth Haven (Rosier 1605: 359-363). Rosier writes that they were forced to remain in Dartmouth until 31 March due to a continual wind from the South and South West. On the first of April, they sailed by the Lizard Peninsula on the Cornish coast (figure 4-3). Nearly two weeks were needed from that point to reach the island of Corvo in the Azores, sighting it first from a distance of 7 leagues, and coming within 2 leagues of the island. For the next 300NM, the course was held at latitude of 40 degrees, 7 minutes. On 6 May, two currents were observed converging at 39 degrees, 50 minutes.

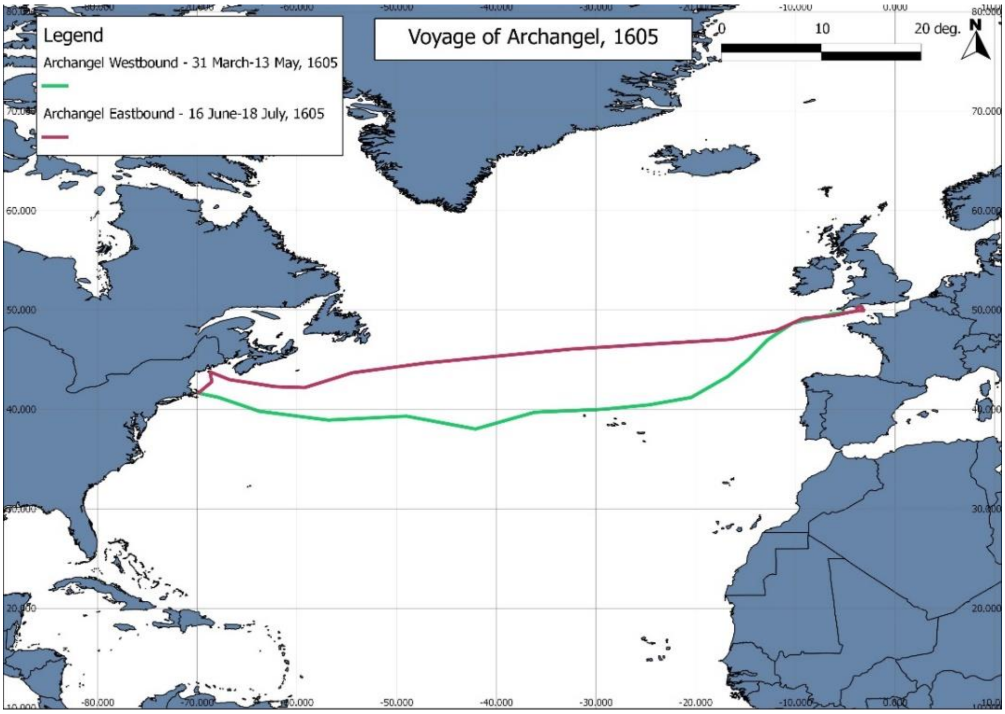


Figure 4-3 - East and west-bound voyages of the ship Archangel, 1605 (map by S. Tucker)

Captain Weymouth felt that the ship was nearing land on 13 May, and the following day, land was sighted. The sighting was likely Nantucket Island, given the description. Following a brief exploration of the coast line, a storm pushed the ship north to the coast of present day Maine, which the crew explored extensively for the following month, interacting and trading with the local population and noting the resources available in this region. The crew also kidnapped five Native Americans, amongst them being the famed Squanto, all of whom were brought back to England. The return voyage offers much less detail—simply that *Archangel* departed from what is likely Penobscot Bay on 16 June, sailing a direct course for England, arriving in Dartmouth on 18 July (Rosier 1605: 389-391).

1607 voyage of Susan Constant, Godspeed and Discovery to Virginia

On 19 December, 1606, a fleet of three vessels – *Susan Constant* (100-ton ship), *Godspeed* (40-ton ship), and *Discovery* (20-ton pinnace) – departed London bound for the Chesapeake Bay, where they would found England's first permanent settlement in the North American mainland. The voyage was recorded by two observers, Captain John Smith (Smith 1608: 32), and George Percy (Percy 1607: 5-12). Their accounts of the voyage are brief, but when compiled, one will find the date of departure, that they took on supplies in the Canary Islands, and that they visited the Caribbean Islands of Dominica, Guadalupe, Monica, Nevis, Mona, and the Virgin Islands (figure 4-4). After the Virgin Islands, no land was cited until reaching Cape Henry on 26 March, 1607, one of two capes comprising the mouth of the Chesapeake Bay.

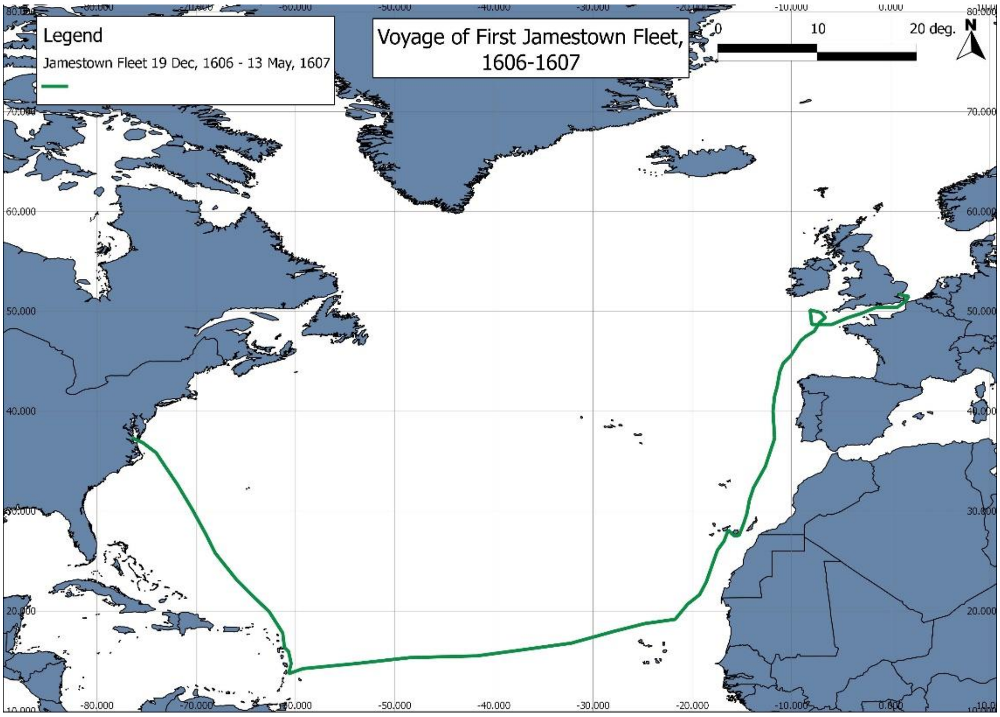


Figure 4-4 - Route of the founding fleet of Jamestown, 1606-1607 (map by S. Tucker)

This is the first plotted voyage in this study following Middleton's southern route, but this route was previously known and used. The 1584 voyage of Arthur Barlowe and 1587 voyage of John White followed this passage, and Gilbert considered using it. This was the also the route of the *Richard*, which in 1606 was being sailed to Maine with the intentions of founding the first colony for the Plymouth Company, and to return two of the Native Americans captured by Captain Weymouth on the voyage of the *Archangel*. The *Richard*, captained by Henry Challons with Master Daniel Tucker (2nd governor of Bermuda), was captured by the Spanish in the West Indies (Brown 1890: 9, 13-14), showing that a southern route was considered at times even for Northern destinations.

1609 voyage of Sea Venture to Virginia (wrecked en route near Bermuda)

Sea Venture was the 300-ton flagship of a fleet of vessels sent from England in 1609 for Jamestown in what was known as the third supply. The fleet had chosen a new route, based on Captain Samuel Argall's findings from a voyage earlier that year in which he had received instruction to avoid all Spanish territory by passing west of the Canary Islands and turning there west, avoiding the Caribbean and sailing near Bermuda (Brown 1890: 343-344). Argall completed this passage in about nine weeks, slightly faster than the first fleet's voyage to Jamestown. Through this passage, it was hoped that they could arrive more quickly at their destination, avoid hostile vessels, and save on supplies (Wright 2013: 1). This passage is referred to by Alexander Brown (1890: 93) as the 'Canaries route', although no mention of stopping in the Canaries is made in any of the original accounts (Hume 2009: 31; Strachey 1610: 17-18; Jourdain: 1610: 157). The voyage is known from three narratives, written by two men aboard *Sea Venture*, William Strachey and Silvester Jourdain. The third account has been attributed by Ivor Noël Hume (2009: 1-29) to William Strachey as an earlier draft version of his better known account. In keeping with Hume's writing, this version of the letter will be referred to as the 'B' version. Between these three accounts, a fairly clear picture of the voyage emerges, along with a very clear description of the wrecking event by two different parties.

The voyage begins from Plymouth Sound, and according to Strachey's A account, the fleet sailed south from England on 2 June, 1609 until reaching 26 or 27 degrees' latitude, then turning west, noting that this course was 'alter[ing] the trade and ordinary way used heretofore by Dominica and Nevis (Strachey 1610: 18) (figure 4-5).' The winds were found favourable at these latitudes for westward sailing, and it was noted that this route would help them avoid the Spanish around the West Indies. The hurricane which struck them occurred at an estimated distance of around eight day's sail from Virginia, striking the fleet on 24 July, 1609 (Strachey 1610: 19-20). Jourdain's (1610: 157) account adds that the storm struck when they were around 30 degrees' latitude. Sea Venture began leaking badly, with hull becoming so filled with sea water that it covered a stack of hogsheads two high above the ballast. Tremendous efforts were made to pump out the sea water over the four-day ordeal, with all male passengers taking shifts with buckets and the bilge pump. As the ship was pushed northwards, they came to find the Bermuda Islands, where the ship was steered toward two rocks where it could be grounded and the passengers and crew could be safely offloaded. Incredibly, nearly all persons aboard survived, save for two persons swept overboard in the storm.

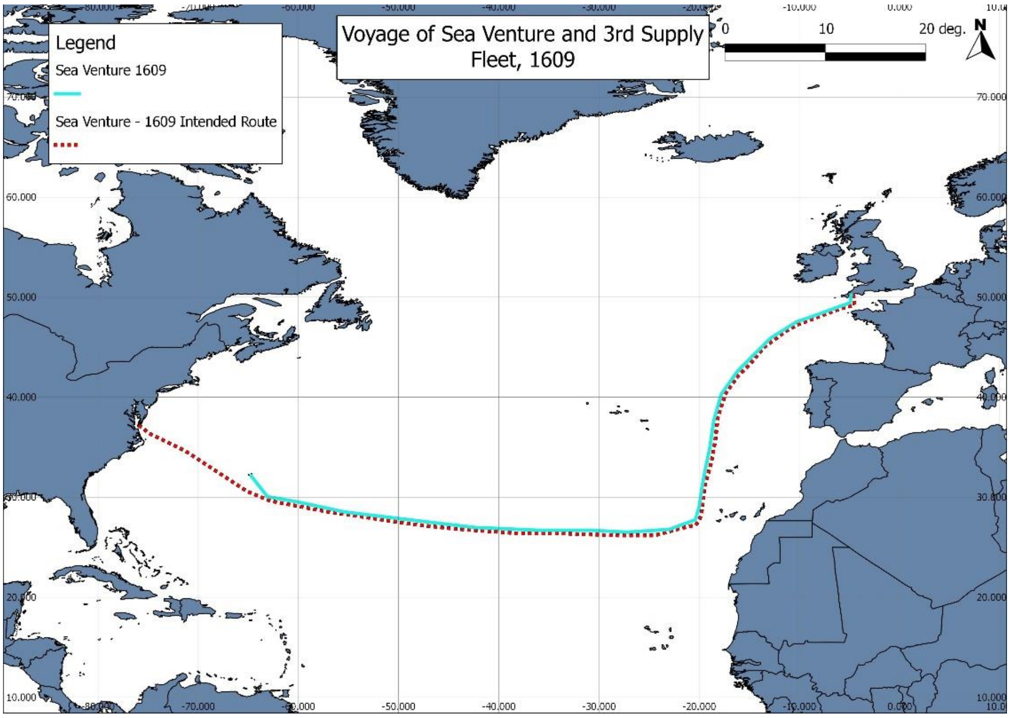


Figure 4-5 - Route of the Sea Venture to its wrecking point in Bermuda, and the route which had been intended for passage to Jamestown, 1609 **(map by S. Tucker)**

Most of the accompanying vessels, save for two others in the fleet which were lost in the storm, arrived in Jamestown safely. The crew and passengers of *Sea Venture* were stranded for a full year in Bermuda until they were able to build two vessels, called *Patience* and *Deliverance,* from parts of *Sea Venture* and local woods (Bermuda Cedar, *Juniperus bermudiana*), and sailed to Jamestown. Once arriving in Jamestown, they found that unfortunately, their patience had not been rewarded with deliverance, as Jamestown was in a dire situation of famine and disease which had killed the majority of its residents.

1634 voyage of the ships Ark and Dove to Maryland

In November, 1633, two vessels called the *Ark* and *Dove* departed from the Isle of Wight with supplies and approximately 130 passengers on a mission to found the proprietary colony of Maryland, just to the north of Virginia using the Potomac River as the border (White, 1634: 29-40). A Jesuit priest aboard the *Ark*, Father Andrew White, composed a narrative of their voyage. *Ark* was a ship of around 300 tons, which was to return to England after delivering its passengers. *Dove*, a small pinnace of about 40 tons, was to remain in the colony.

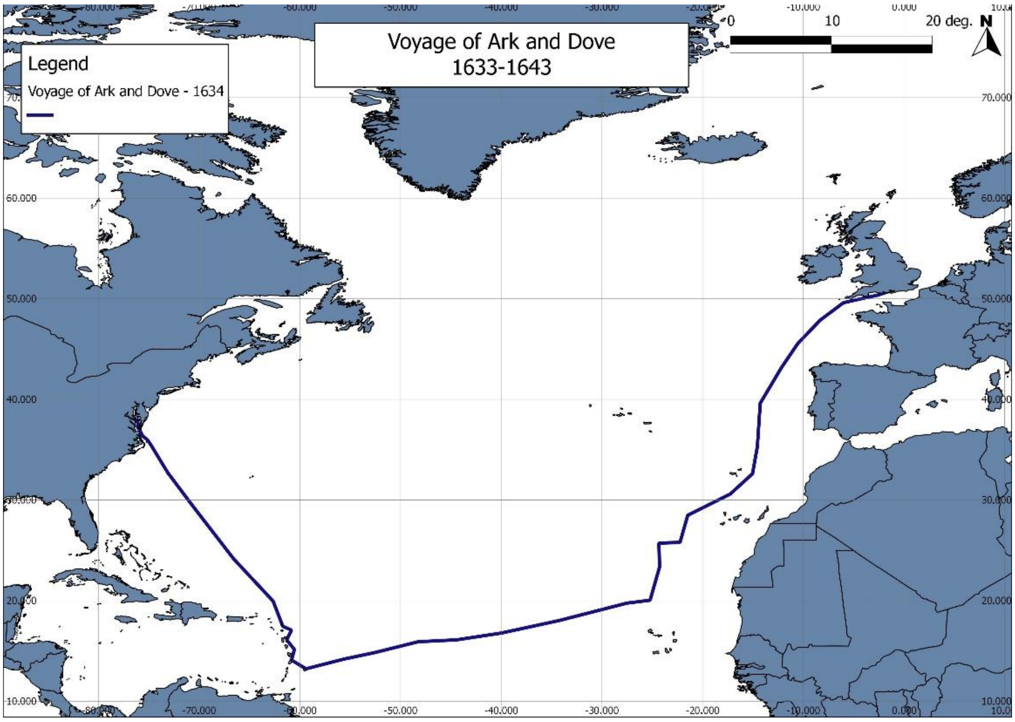


Figure 4-6 - Voyage of the Ark on its mission to found the colony of Maryland, 1633-1634 (map by S. Tucker)

The description of the voyage takes the ships from the Isle of Wight, turning south after sighting the Isles of Scilly, and then sailing south along the coasts of Spain and Portugal (figure 4-6). Around this point, the *Ark* lost sight of *Dove*, believing the pinnace to have sank in a storm. They continued south, passing the Canary Islands, turning west toward St. Christopher Island (St. Kitts), but then decided to continue their path south to Bonavista (Boa Vista) in the Verde Islands to acquire salt. Shortly thereafter, they thought better of it, and changed course to the southwest, making first landfall in the Caribbean island of Barbados. Here *Ark* finds *Dove* just a few days later, surprising the passengers and crew aboard *Ark.* They then spent several weeks sailing around the Caribbean Islands, stopping in St. Lucia, Martinique, the Antilles, Guadalupe, Montserrat, Nevis, and St. Kitts. From there, they sailed north by northwest until finding the capes of the Chesapeake Bay, eventually making their way into the Potomac and the St. Mary's (then known as the St. George's) Rivers, and settling St. Mary's City in the eponymous river's northern navigable stretches. Although nearly thirty years had passed since the Jamestown fleet, it appears that this southern passage was still very much in use in the approach to mid-century, and language used in the narrative would suggest that it was *the* standard route.

Voyages of Edward Rhodes aboard 4 ships bound for Virginia and Maryland from 1670-1676

The Edward Rhodes log is the first logbook to be examined in this study; the previous examples each being classified as narratives. In the thirty-six years between the voyage of *Ark* and *Dove* and the voyages in this log, many changes had occurred. The voyages to the Americas were no longer based on discovery, colony planting, and supply delivery, but had been largely replaced with voyages of trade, as several English colonies were well established by this period. The colonies were growing in population, valuable goods were being produced within the colonies in large quantities for export, and England's colonial holdings in North America had become the profit mills that the Virginia and Plymouth Companies had hoped for, although both companies had been long since dissolved. The newly restored Crown benefited greatly as well. Import duties on tobacco were adding significant amounts of money to the Royal treasury, and the various Navigation Acts, at least in theory, ensured that all of the tobacco produced in the colonies for export to Europe was taxed. The logbook of Edward Rhodes, housed in the Bodleian Library in Oxford (MS. RAWL, D.702), contains details of six round trip voyages from London to the Chesapeake between 1670 and 1676 (Rhodes 1670-76). Rhodes was the first mate aboard the first four voyages, and the vessel's Master on the final two. The book mostly describes technical details of the voyage, such as dates, daily positioning, wind directions, and distances travelled. Occasionally other details are offered such as deaths aboard the ship and idiosyncratic happenings like catching a dolphin. The log also contains details of the time spent within the Maryland colony and the quantity of tobacco hogsheads collected on one voyage, and the wrecking of a ship, the *Baltimore*, against the coastal rocks at Plymouth Sound on its return journey. The daily positioning coordinates are given in both latitude and differential longitude, despite longitude not being able to be reliably calculated for another century. The longitude is calculated from zero degrees, beginning at the origin point of the sea voyage, either Land's End on the westbound or Cape Henry on the eastbound. His longitudinal calculations are very badly off, indicating between 47 and 62 degrees of separation between Land's End and Cape Henry. In reality, the two points are separated by 70 degrees. The coordinates have nonetheless been plotted, with some correction added to each voyage, allowing the plotted route to extend to the known start and end points. To achieve this, the coordinates were entered into data tables as given in the log, and inserted into QGIS. An algorithm was then applied to stretch the voyage in a proportional means from Plymouth to the Chesapeake Bay. It should therefore be understood by the reader that the daily longitudinal positions should be taken *cum grano salis*, although the latitudinal coordinates are most likely accurate for days in which an observation was possible.

The westbound voyages are rather concentrated in a line heading southwest from England to the Azores and a bit beyond before levelling out to head westward to the capes of the Chesapeake (figure 4-7). The grouping of these voyages is rather important, because it shows that a concerted effort was made to follow a general route. The significance is strengthened as this log represents the voyages of five different Masters rather than a Master who knew a route and sailed a particular way out of habit. There is a large variation in days spent at sea between voyages, which will be discussed at length later in this chapter, but it is worth noting here that there appears to be a correlation between voyage length and month of departure for westbound voyages on this northern route.

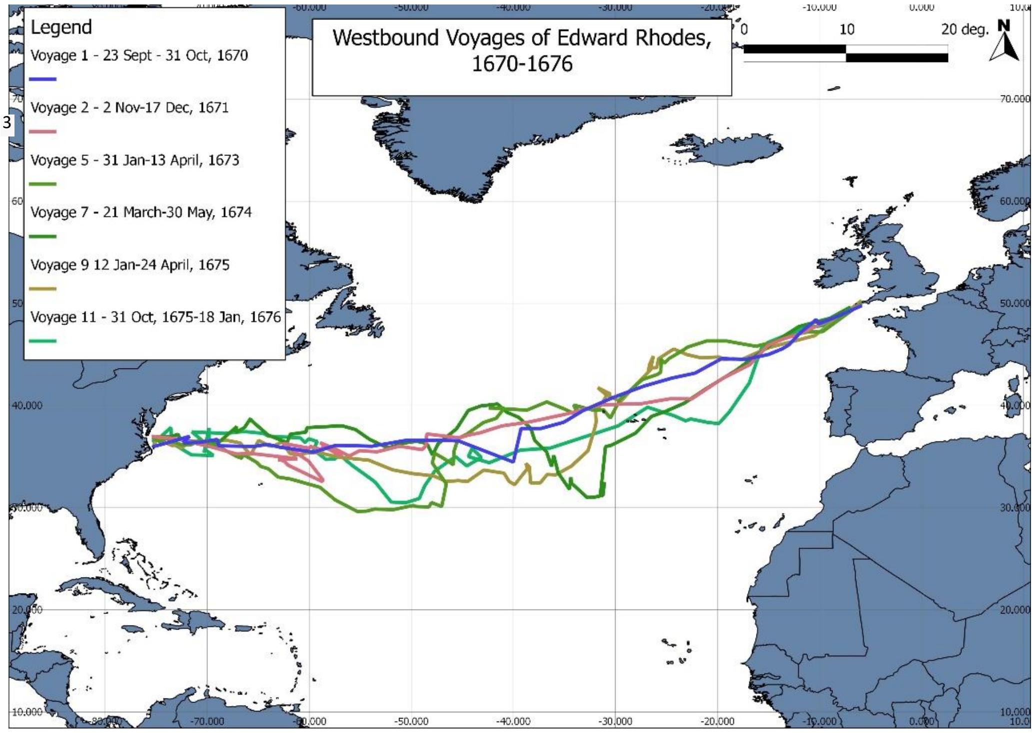


Figure 4-7 - Westbound voyages from the Edward Rhodes logbook, 1670-1676 (map by S. Tucker)

Rhodes's eastbound voyages show a similar concentration along a specific path, taking what is almost a direct line east by northeast to England (figure 4-8). Despite departures ranging from mid-April to mid-August, days spent at sea are much more regular between voyages indicating less significance in seasonality on the return passage, although voyages in August and September would be more at risk of encountering a hurricane. The lines of travel on eastbound routes are much straighter in this direction compared to those of the westbound voyages, demonstrating the difference between voyages into, and with prevailing winds.

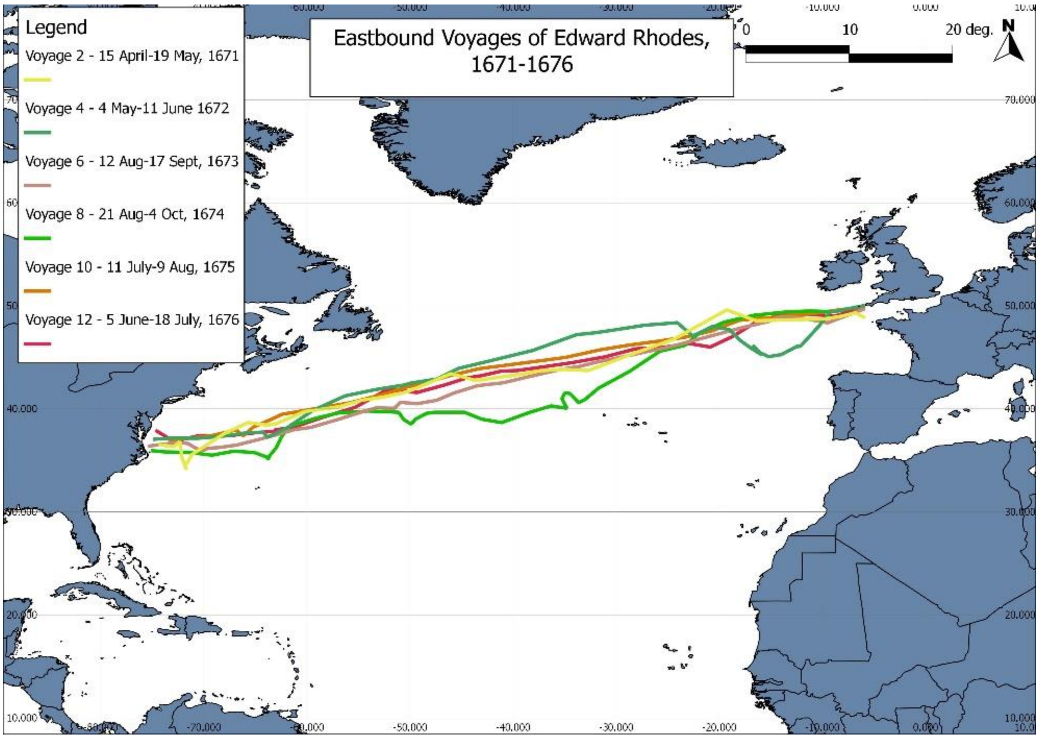


Figure 4-8 - Eastbound voyages of Edward Rhodes (map by S. Tucker)

A voyage aboard the ship Charles in 1679 to Long Island

In 1679, Dutchman Jasper Danckaerts recorded a voyage from Amsterdam to New York and Boston as a passenger (Murphy 1867; James & Jameson 1913). The journal was found in the mid-19th century in a bookstore in Amsterdam, and translated to English and published by Henry C. Murphy. In the journal, Danckaerts keeps a fairly elaborate record of the voyage westbound, including latitude and longitudinal points[4]. His longitudinal calculations appear

[4] Calculations of Longitude and Latitude for the entire voyage are only found in the earlier 1867 edition. A month long gap appears in the voyage in the later James & Jameson edition, ostensibly as they found the details too mundane to print.

to use the Ferro Meridian, which was a common prime meridian outside of England in this period. The meridian lies about 17.4 degrees west of the current Greenwich meridian, centred in El Hierro, the westernmost of the Canary Islands. Danckaerts makes it clear that he is calculating longitude on his own, rather recording it from the ship's official record (James & Jameson 1913: 42). He also states that he at times compares his calculations to those of sailors on board, and admits wide discrepancy between them. The westbound ship, *Charles*, was a Dutch ship, but to comply with the Navigation Acts, the ship switched its captain and some crew in Falmouth (James & Jameson 1913: 28). The return voyage from Boston in an English ship called the *Dolphin* was recorded, following a route to England similar to that of the Rhodes logs across the Atlantic, but coming then north of Ireland and Scotland, then south through the North Sea. Danckaerts was an exceptionally pious Labadist, a fact which figures strongly in his writing, with Danckaerts constantly rebuking sailors and passengers for their language and behaviour. In 1683, he returned to the Americas, this time founding a small religious colony called Bohemian Manor at the northernmost point of the Chesapeake Bay with the help of a well-known cartographer, Augustine Herman. Apparently, records of this voyage and the founding of the colony were also in the original document obtained by Murphy, but were not translated or published, and the original has subsequently been lost.

Danckaerts discusses seamanship and best sailing practices in his journal, describing two passages to the New World, which he understood to be the best possible routes:

> *"Therefore, in navigating this passage for this place, it is best, when there are no reasons to the contrary arising from the Turks or otherwise, to run just above or below the Azores, to latitude 34 and 33, and even to 32 and 31, in order to get into the stream, and yet I also consider it well to sail to the eastward of these islands; or if you avoid the Azores, then to sail from Newfoundland or its latitude, due south, or S.S.E., to the before mentioned latitude; but, in returning, it is best to follow the coast to Newfoundland, in order to fall into the stream and wind. The home voyage is almost always the shortest, inasmuch as the stream runs mostly along the coast (*James & Jameson 1913*: 38)."*

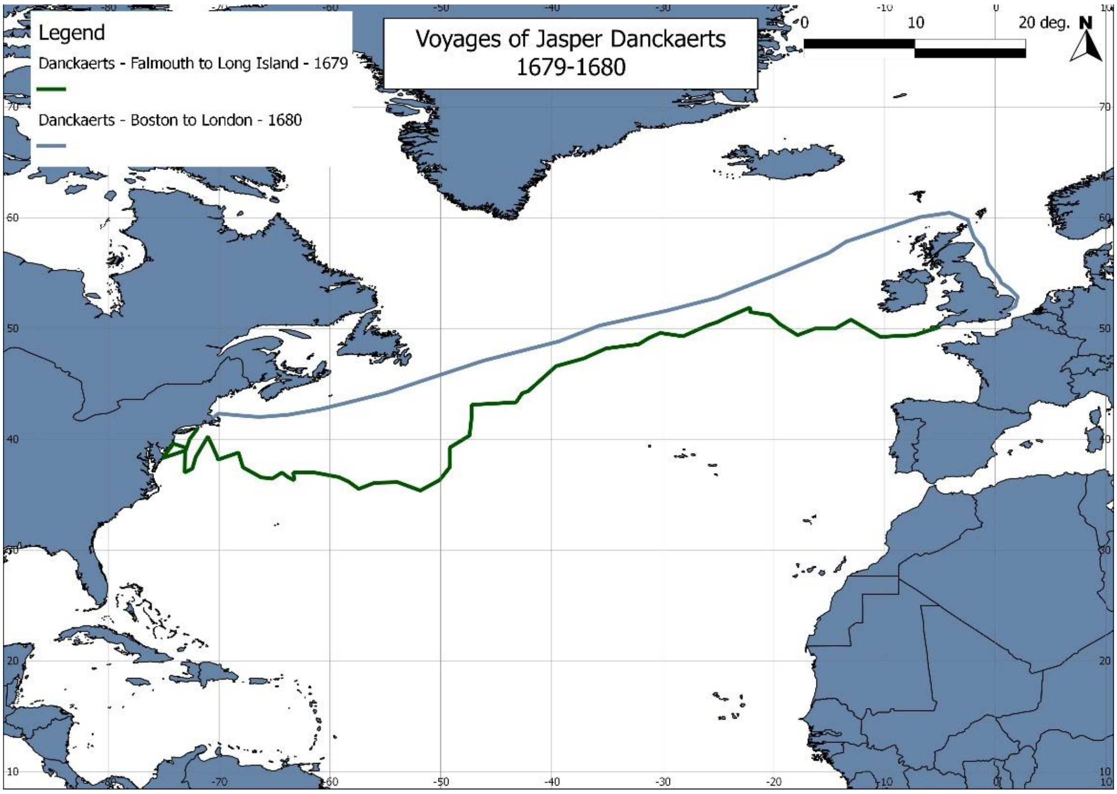


Figure 4-9 - Voyage of the ship, Charles, as recorded by Jasper Danckaerts, 1679 (map by S. Tucker)

The routes described are very similar to those taken by Rhodes, and that of Gilbert and Weymouth's voyages. As plotted, Danckaert's voyage resembles something of a hybrid between these two routes, but it does not appear that the actual crossing was according to plan (figure 4-9). Some allusions are made which would suggest that the intended route was the more northern route, as Danckaerts expected at one point of the journey to observe the banks of Newfoundland (Murphy 1867: 149). They intended to take the northern passage and to make landfall around Sandy Hook, a coastal feature located at 40 degrees' latitude, just south of Long Island, New York. Instead, difficult winds pushed them further south than intended, leading them to spend time around the Atlantic coast of Maryland and Delaware before pushing northward to New York.

Voyage of the Submission from Liverpool to Pennsylvania in 1682

The ship *Submission* sailed from Liverpool on 4 September, 1682, bound for Pennsylvania, arriving on 21 October, 1682 (Genealogical Society of Pennsylvania 1895: 9-13). The account does not provide much information about the voyage. Almost daily entries were made, but most give only information on daily wind direction. Regardless, some periodic latitudinal positions are given, and even more occasionally, some information on longitudinal positioning. From the limited data available, the voyage can be roughly plotted, and appears to a rather direct route similar to the voyages in the Rhodes logs. Rather than sailing to Plymouth before turning westward, *Submission* remained in view of Ireland until passing Cape Clear Island (figure 4-10). They voyage stayed well north of the Azores, but takes a fairly abrupt southwest dive around Bermuda until reaching 30 degrees latitude, then continues northwest to Cape Henry.

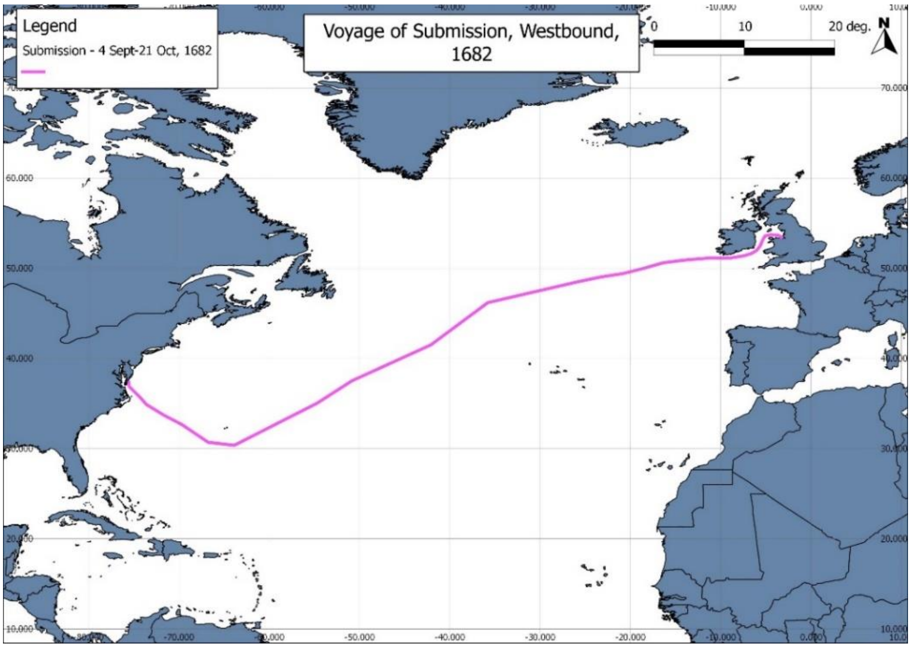


Figure 4-10 Voyage of the ship, Submission, 1682 (map by S. Tucker)

Narrative of a Voyage to Maryland, 1705-1706

The final source to discuss here is a 1705 narrative of a voyage to Maryland, written by an unknown author aboard an unknown ship. Again, little detail of the voyage is offered, but the route can be estimated based on the description (figure 4-11). The ship departs on 2 October, 1705 from Plymouth in a fleet of about 80 ships (Andrews 1907: 327-328). The fleet stayed together five or six weeks, but were separated in a storm which lasted seven days. On 26 November, the author's ship arrived in Bermuda and found that several other members of the fleet were also there. After three days, they departed Bermuda, arriving at the capes of Virginia on 22 December, 1705. From there, the ship continued north in the Chesapeake Bay to Annapolis.

The return voyage offers more useful information, particularly about the ship. The vessel remained in Maryland until early June, when it sailed down the bay to Cape Henry to meet the rest of the fleet, which was estimated to be at least 100 vessels (Andrews 1907: 337-340). Upon arrival, they found that the fleet had sailed five days previously, so they anchored near the capes waiting for other ships. They were joined by four other ships, whose sizes are expressed in hogsheads, guns, and crew members. The author also inserts details of his own ship here, which carries six guns, 20 men, and 500 hogsheads of tobacco. The following is a list of the other ships which sailed with them:

- 'large ship' carrying 800 hogsheads, 22 crew, and 14 guns
- Pink carrying 400 hogsheads 12 crew, no guns (Quaker owned, therefore not armed)
- Ship carrying 755 hogsheads, 20 crew, 16 guns
- Small ship carrying fewer than 100 hogsheads, bound for Bristol

An exact date is not given for their departure, but it was around mid-June. The vessels sailed from the Chesapeake Bay, passed the Azores and neared England. As they approached England, the captains conferred on how to best travel to their final destinations, deciding to sail a northward route around Scotland to avoid privateers in the English Channel. The small ship heading to Bristol opted to break from the group at this point, sailing directly for Bristol, and was reportedly taken the following day by French privateers. It is almost certain that the return voyage took the remainder of the group to the west of Ireland rather than through the Irish Sea, as the author's ship was bound for Plymouth, and would have otherwise sailed very near its home port. The vessels then sailed for the Orkney Islands, where they remained for six weeks before continuing to Newcastle, and then Grave's End, which they reached on 2 October, 1705. The final leg of the voyage was undertaken under armed naval escort, reaching Plymouth on 12 October. It is significant that a Plymouth-bound ship would sail around the entirety of the British mainland, extending the voyage considerably. This speaks volumes for the political situation between England and France at the time.

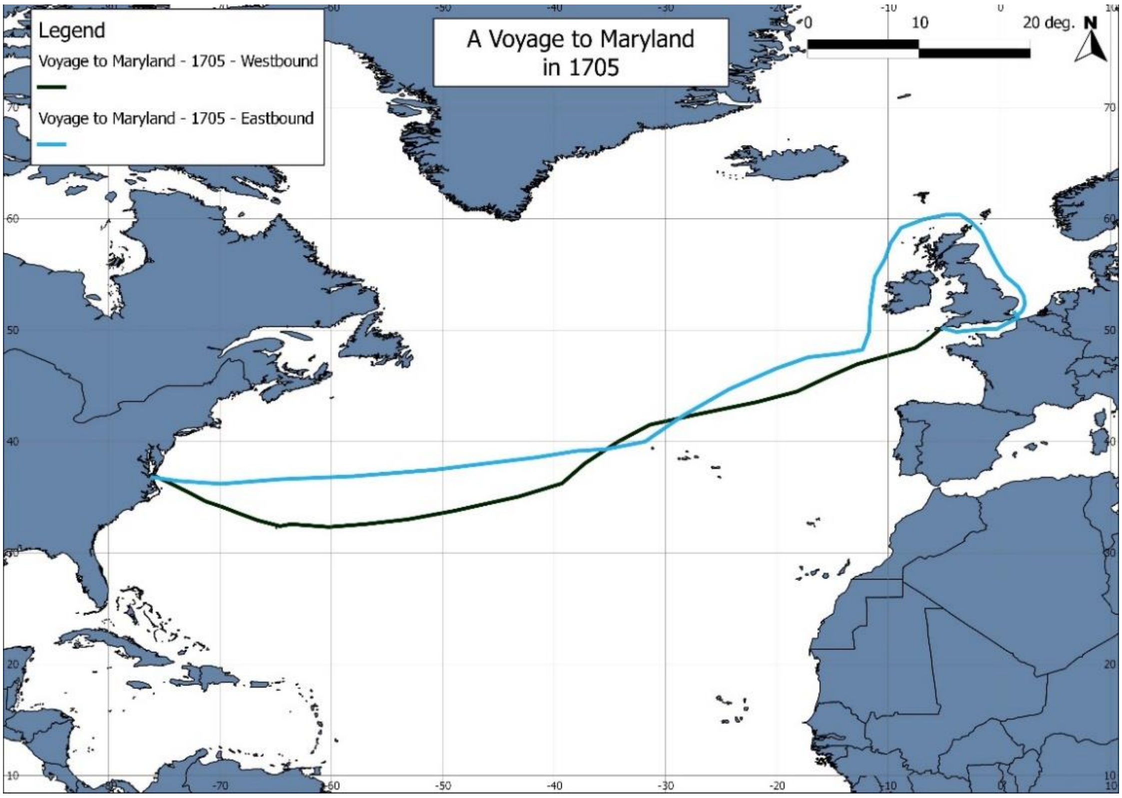


Figure 4-11 - Route of an unknown vessel as recorded by an anonymous seaman in 1705 (map by S. Tucker)

Discussion

In total, this study has examined twenty-one westbound voyages from the years of 1583-1705 (table 4-1), fourteen of which are plottable, but all of which have an identifiable route (figure 4-12). Of these, fifteen are voyages to the mid-Atlantic region, and six are to areas more north. From these voyages, a total of five generalised routes can be plotted. These routes have all received a letter, A-D, ordered only by chronology of which they appear in these sources (figure 4-13). While routes A and C were used, these were both on very early attempts at crossing and there is to date no evidence points to their continual, long-term use. Route E is similar to route C, with the exception that E turns west at a more northerly position as the destination of these voyages lies further to the north. Passages C and E can therefore be grouped and examined together.

Table 4-1 - List of voyages logs and narratives

Date	Voyage	Region	Route	Days at Sea	Purpose	Plottable?
11 June-30 July, 1583	Humphrey Gilbert	Northern	A	49	Discovery	Yes
27 April-13 July, 1584	Arthur Barlowe	Mid Atlantic	B	65	Discovery	No
5 May-22 July, 1587	John White	Mid Atlantic	B	67	Colonisation	No
20 March-17 Aug., 1590	John White	Mid Atlantic	B	Uncountable	Privateering	Limited
20 March-14 May, 1602	Bartholomew Gosnold	Northern	E	56	Discovery	No
5 March-14 May, 1605	George Weymouth (*Archangel*)	Northern	E	44	Discovery	Yes
22 Aug-??? 1606	Henry Challons (*Richard*)	Northern	B	Not Completed	Colonisation	No
19 Dec. 1606-13 May 1607	Jamestown Fleet (*Susan Constant)*	Mid Atlantic	B	ca. 76	Colonisation	Yes
2 June-28 July, 1609	Jamestown Third Supply (*Sea Venture*)	Mid Atlantic	C	Not Completed	Supply	Yes
22 Nov. 1633-25 March 1634	*Ark* & *Dove*	Mid Atlantic	B	66	Colonisation	Yes
6 May-3 June, 1638	*New Supply*	New England	A	38	Unknown	No
23 May-27 July, 1663	*Society*	New England	E	62	Unknown	No
23 Sept-31 Oct, 1670	Rhodes (*Duke of York)*	Mid Atlantic	D	39	Trade	Yes
2 Nov-17 Dec, 1671	Rhodes (*Constant Friendship)*	Mid Atlantic	D	46	Trade	Yes
30 Jan-13 April, 1673	Rhodes *Baltimore*	Mid Atlantic	D	74	Trade	Yes
29 March-30 May, 1674	Rhodes (*Johnanna* – 1)	Mid Atlantic	D	62	Trade	Yes
12 Jan-24 April, 1675	Rhodes (*Johnanna – 2)*	Mid Atlantic	D	71	Trade	Yes
31 Oct 1675-18 Jan 1676	Rhodes (*Johanna* -3)	Mid Atlantic	D	81	Trade	Yes
26 July-23 Sept, 1679	Danckaerts (*Charles)*	New England	A	60	Unknown	Yes
4 Sept - 21 Oct, 1679	*Submission*	Mid Atlantic	D	47	Unknown	Limited
2 Oct-22 Dec, 1705	Voyage to Maryland	Mid Atlantic	D	78	Trade	Limited

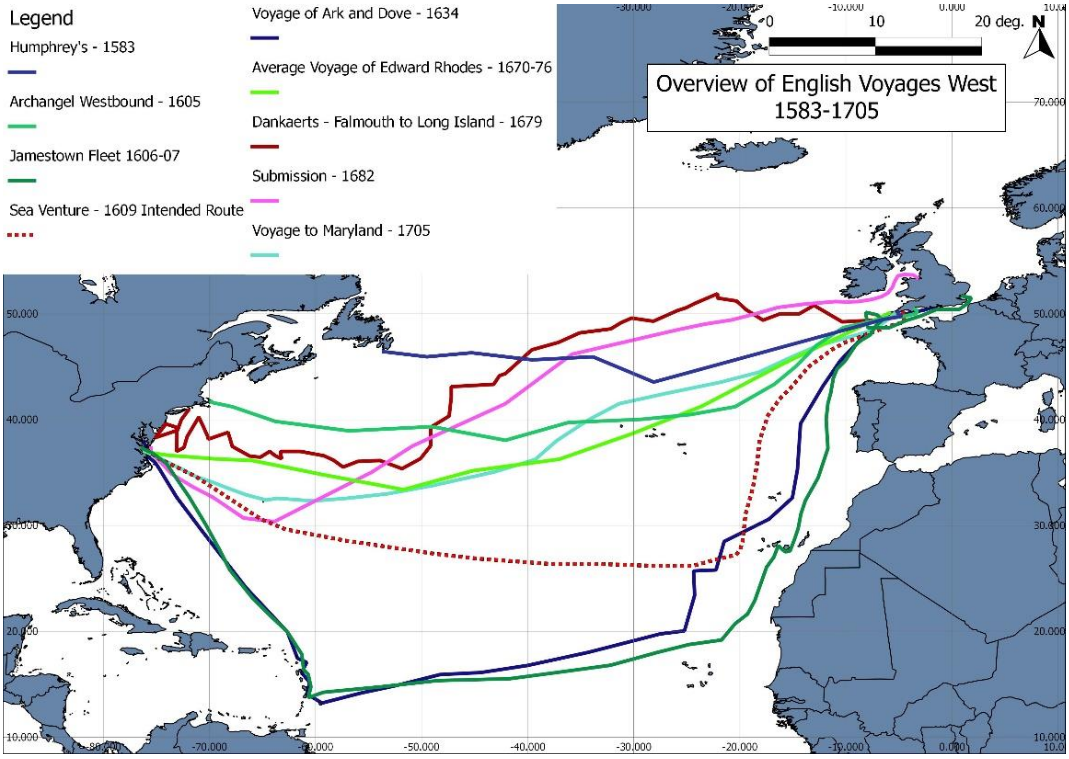


Figure 4-12 - Overview of all westbound voyages discussed in this chapter (Rhodes voyages conglomerated into an average voyage) (map by S. Tucker)

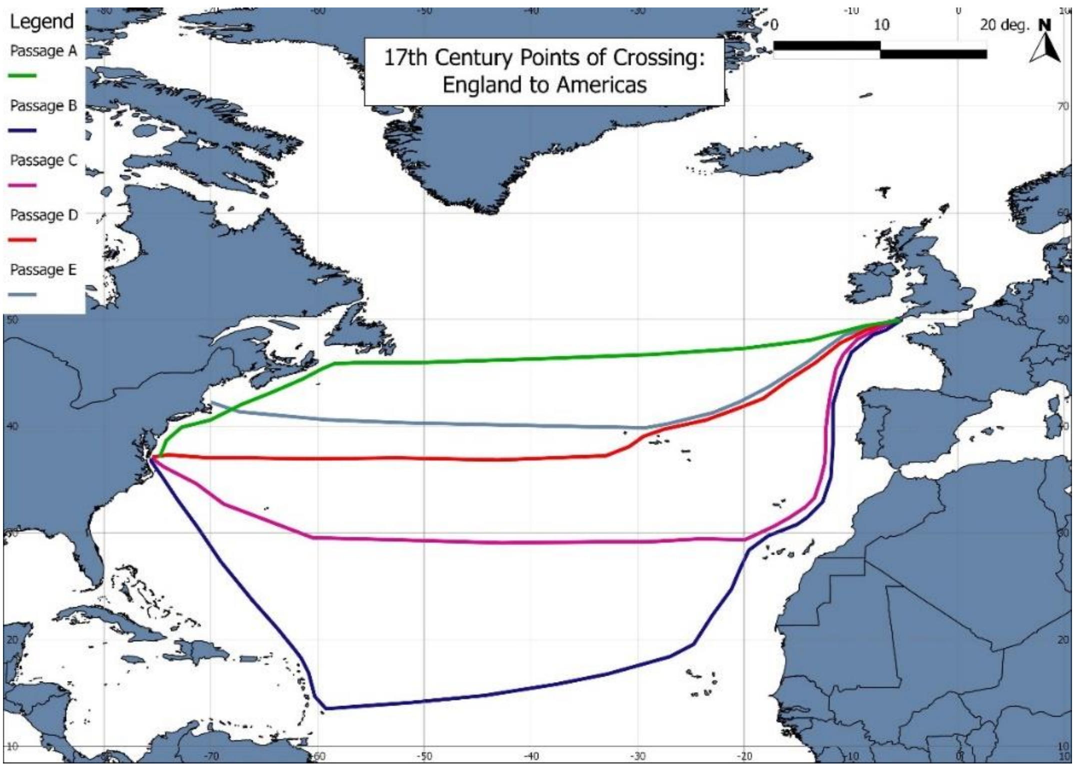


Figure 4-13 - Generalised routes of passage, England to Americas (map by S. Tucker)

To return briefly to Middleton's (1984: 8) assertions of oceanic passages during the colonial period, he states that 'there were two routes or passages between England and the Chesapeake, the southern and the northern. The former, used extensively in the first half of the 17th century, was gradually superseded by the shorter, more convenient northern passage after 1650'. From the routes plotted in this study, it is clear that Middleton's description is not accurate. He appears to be correct in identifying a time period for changing the dominant route of B, but it is clear that passage A was not the route utilised during this time, or even a viable route for the Chesapeake. Passage D appears to be the actual replacement for the southern passage. For destinations of New England and Newfoundland, Passage A is indeed in use even in the latter half of the century, although a second route sailing south in sight of the Azores (route E) is also clearly in use.

One piece of circumstantial evidence supporting either some degree of use of Middleton's northern route (passage A), or alternatively prolonged usage of Bruce's northern route (passage C) lies with the wreck of *Sparrow Hawk* on Cape Cod in 1626. The indented route of this vessel is not known; however, a contemporary report of the grounding event by William Bradford states that the vessel was heading for Virginia and came to rest on the shoals of Cape Cod after six weeks being lost at sea with an ailing Master (Bradford & Davis 1908: 218-220). The vessel was almost certainly not travelling along passage B given the time of six weeks' passage given without sight of land. That landfall was made so far north offers the suggestion that they had taken a more northern route, but this cannot be known with any certainty. Passage A or D seem the most likely, but one cannot rule out this being an early example of a voyage along route C either.

Having established ocean passages throughout the 17th century, and confirming that a shift in route does indeed occur mid-century, it raises the question of why the change took place. Danckaerts offers one scenario driving forward the change in the passage quoted above (James & Jameson 1913:38). Piracy and privateering presented a major threat throughout the entire 17th century, although the centres of these activities shifted to some degree during the period in question. Barbary pirates were certainly an issue for many sailors, with many of the narratives examined here addressing a fear of 'Turks' in the east Atlantic. Piracy constituted a major threat not only to sailors and ships, but to the greater merchant economy England was trying so hard to establish.

Further, as in the case of the ship *Richard,* ships were not in the clear after turning westward out to sea along passage B either. With the majority of the Caribbean being controlled by Spain, the threat of Spanish privateers during war-time was quite high along this route, although the two countries were only at war from 1600-1604 and 1625-1630 during the whole of the 17th century (Israel 1998: 426). England's relationship with Portugal complicated the relationship with Spain, however. Piracy became an issue in the Caribbean during the 17th century, but peaked after the route from England to the Chesapeake had apparently moved northward.

While the documentary evidence clearly points to piracy as a major concern, it is possible that the shift in route had other driving forces as well. Once colonies had been successfully planted in the New World, mercantilist interests became top priority. Europe's growing demand for tobacco added pressure to the Virginia Company, and later, the various merchants involved in the trade, for the product to be moved as quickly and efficiently as possible. Piracy certainly affects the efficiency of trade, but finding quicker passages would also be a major cost-cutting measure. To examine this, the voyages described in this section will be examined based on days spent at sea, calculated as the dates of the Atlantic leg of a voyage, not including days spent in port.

Voyages along passage B are quite consistent in voyage time, from those examined in this study (figure 4-14). It appears one could expect a voyage of about 65 days by this route, although these voyages often lasted much longer due to extended stops in the West Indies for supplies and trading. *Ark* & *Dove*, for example, spent 66 days at sea on a voyage which took place over a period of 123 days. In contrast, voyages along passage D exhibit more variance in days required, but have the potential to be much shorter. The shortest voyage along passage B is 65 days, compared to a crossing in 39 days with passage D. Passage D also accounts for the longest voyage in this study though, at 81 days. The average number of days is 68.5 on passage B (sample of 4), and 62.25 (sample of 8) on passage D. While passage D averages six fewer days, this number loses significance when compared to the distance of over 7,000 nautical miles travelled on passage B, compared to the 3,400 nautical miles travelled on passage D.

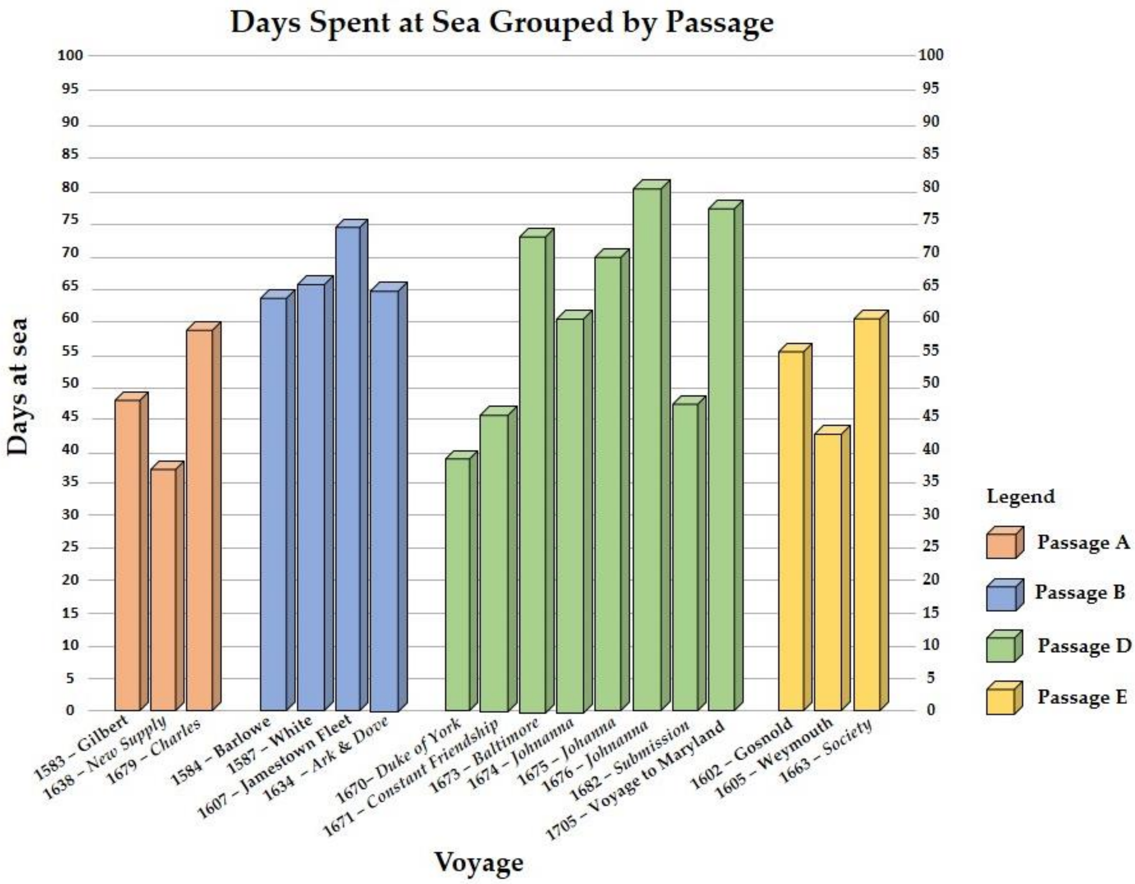


Figure 4-14 - Days at sea by passage (graphic by S. Tucker)

While no statistics are available for passage C, it is worth mentioning that if those aboard *Sea Venture* were accurate in their estimation of being seven-to-eight-days' sail from Cape Henry when the hurricane struck, they would have made the 4,700 nautical mile crossing in about 59 days. While this is somewhat faster than could be expected along route A, it was not much faster. The Spanish in the West Indies ceased to be a threat in 1604, and only again briefly from 1625-1630 became an opposing force. Passage C does continue to put the ships in jeopardy of attack by pirates along the South European and North African coasts, with the disadvantage of not allowing for re-supplying of the vessel along the way. The exception to the re-supply factor is Bermuda, which had a well-deserved reputation amongst mariners throughout the 17th century as being highly dangerous. Additionally, English vessels visiting were tasked with supplying Bermuda, not the other way round. The vessel *Warwick* wrecked in Bermuda *en route* to Jamestown in 1619, indicating that there was some continuity of this route (Bojakowski & Bojakowski 2011: 41-42). It would seem though, that this route was eventually abandoned with Virginia becoming the main supplier of goods to Bermuda rather than the island receiving goods directly from England.

Passage A, though identified as a route to the Chesapeake by Middleton, has not been proven through this work to have ever been used to access latitudes more southerly than about 40 degrees north. While it was attempted by Gilbert in 1583, his fleet did not make it south of Newfoundland before one of the ships was wrecked and the voyage abandoned. Passage E, also for vessels bound for the more northern latitudes, proves nearly as efficient as A in reaching these destinations. Obviously, passages to Newfoundland are best along route A, where the destination also happens to be the first landfall, but on voyages to the New England colonies, either would be equally valid based on the limited data used in this study.

It would also be pertinent here to discuss efficiency of voyages on a temporal scale. An examination of days spent at sea over time is useful in observing trends in the efficiency of trans-Atlantic trading throughout the early colonial period (figure 4-15). Shepherd and Walton (1972: 77-79) have pointed to a lack of increase in sailing speeds on routes between the north-east English and Caribbean colonies in the 17th and 18th centuries. This will be examined in greater depth in the following chapter, but is worthy of note here. Amongst the eighteen voyages in this study where days at sea can be calculated, there is no trend of improvement or otherwise between the period of 1580 and 1705. There is also no obvious trend amongst similar voyages.

Of westbound voyages, one final facet of these data to explore is the seasonality of sailing. Early voyages tend to be centred around spring departures, whereas the later voyages tend to depart in late fall. Much of the reason for the change lies within voyage types during these time periods. The earlier voyages are largely undertaken in the name of discovery or colony planting, where the sailors and passengers would want to arrive in late spring or early summer. In doing so, they could take advantage of warm weather and depart fairly soon thereafter. The later trade voyages departed in fall or winter, ensuring that they would be in the Chesapeake by early spring to collect the year's tobacco crop as early as possible. An examination of these voyages ordered by month of departure shows that voyages departing between March and September enjoy a significantly quicker passage than those voyages departing October to February, regardless of route (figure 4-16). Voyages following passage D falling within this time frame are the quickest voyages to the Chesapeake by a significant margin over passage B, and had the ships followed a more regular schedule of departure during these months, would have likely proven passage D to be much more efficient than B, showing a general trend of improvement in sailing speeds over the course of the 17th century. Sailing out of season, no matter the route, would inevitably result in longer and less efficient crossings.

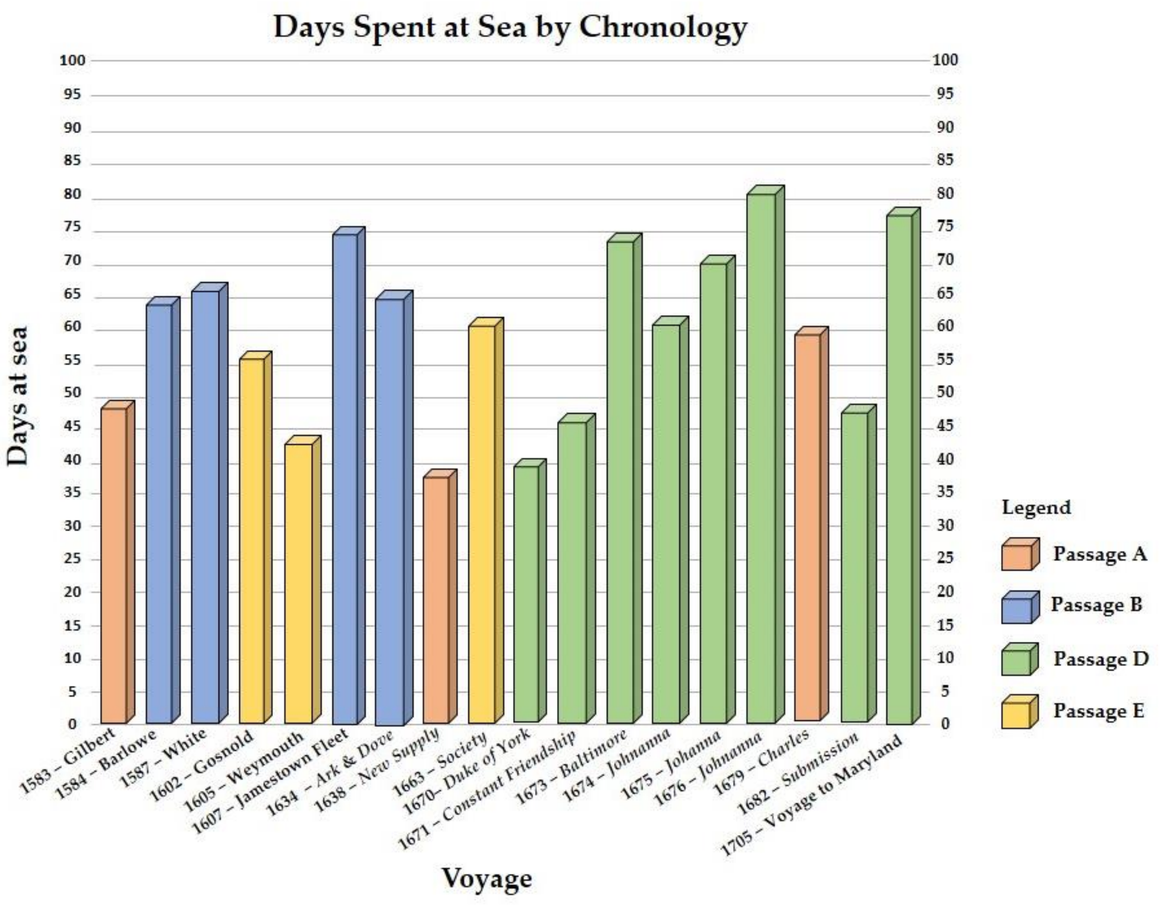


Figure 4-15 - Voyage lengths by chronology (graphic by S. Tucker)

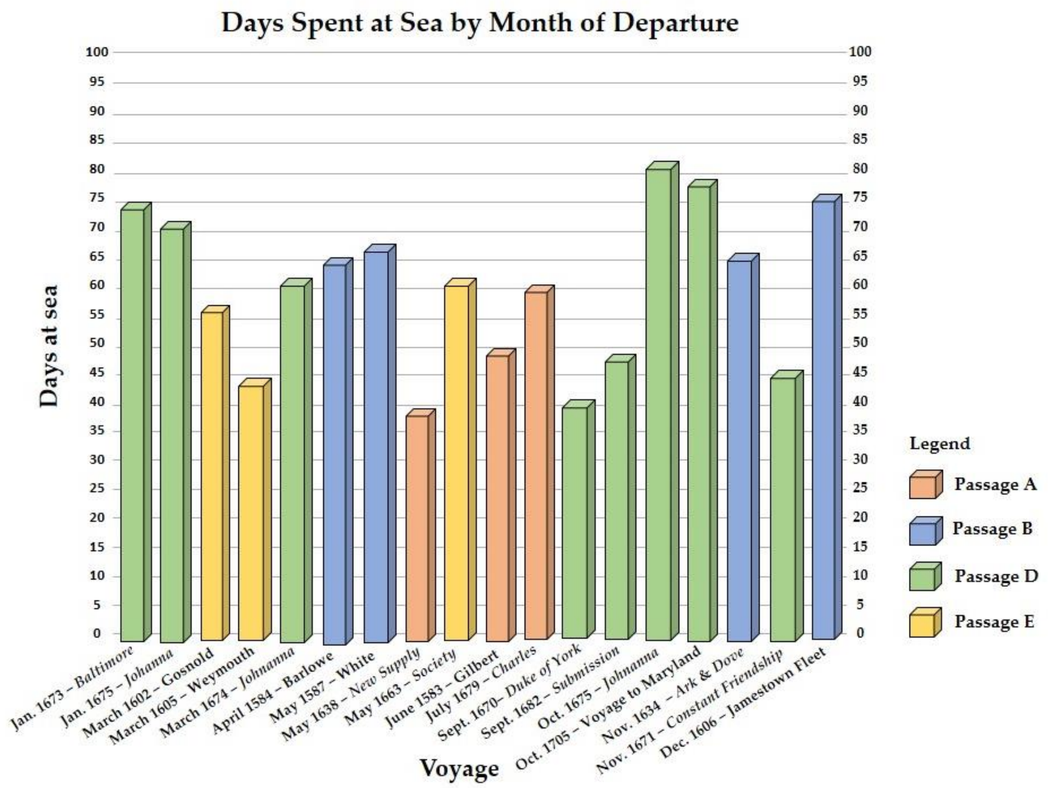


Figure 4-16 - Voyages ordered by departure month (graphic by S. Tucker)

Data for eastbound voyages are not as plentiful as westbound passages amongst these sources. Of the logs and narratives examined here, ten voyages contain enough data to plot the return passage, and a total of twelve contain data to calculate days spent at sea (table 4-2). The general route of the eastbound passages is very similar over the entirety of the period of study, making more or less a direct bearing for England from the point of departure (figure 4-17). Although the route does not seem to change on a temporal scale whilst ships are at open sea, late in the 17th century, some voyages begin to take a northern route over Scotland to reach London, avoiding the use of the English Channel. The 1705 narrative specifically cites a fear of French privateers in the Channel as the reason for their use of a route over Scotland. Danckaerts does not give reason for sailing above Scotland and into the North Sea in his 1680 voyage, but does discuss a great fear of 'Turks', even in the North Sea. The crew and passengers aboard the ship *Dolphin*, on which Danckaerts was sailing, mistook two Dutch ships for pirates, and readied for battle after coming south of the Orkney Islands. To this point, it is unclear if the term *Turk* used here was belonging to the author or to the translator, but it is almost certain that in this context, it was used as a general term for pirates rather than to refer specifically to persons originating from the eastern Mediterranean region.

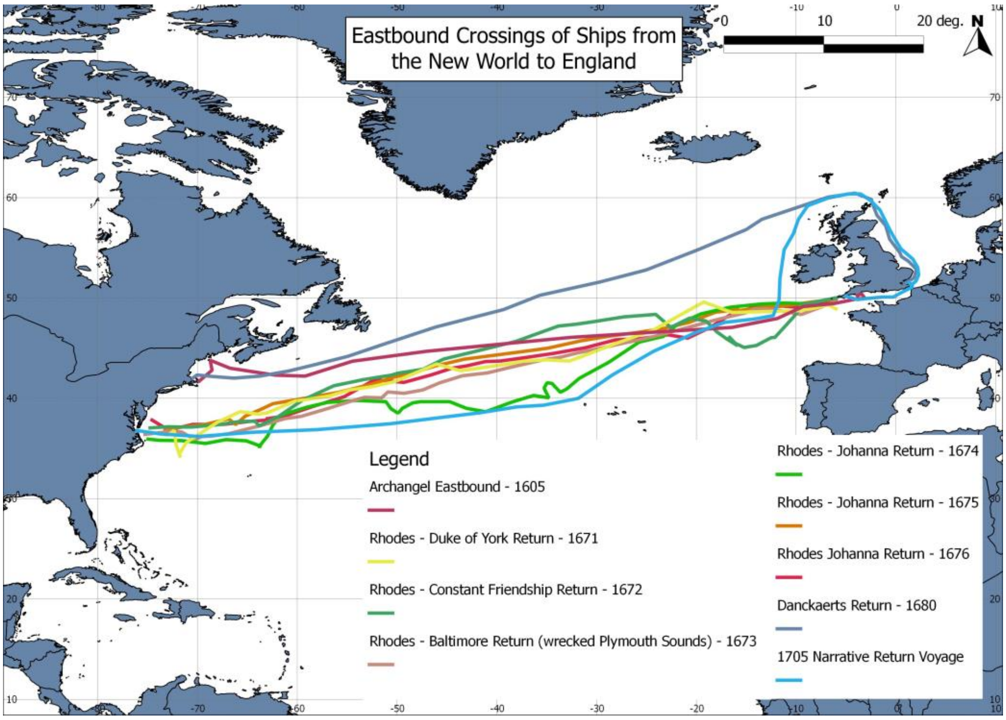


Figure 4-17 - Eastbound voyages to England (map by S. Tucker)

Table 4-2 - Days at sea on eastbound voyages

Voyage	Departure Date/Location	Arrival Date/Location	Days at Sea
Gilbert, 1583	31 Aug., 1583/Newfoundland	22 Sept. 1583/Orkney Islands	22
White, 1587	27 Aug., 1587/Roanoke	5 Nov. 1587/Cornwall	60
Gosnold, 1602	18 June, 1602/Maine	23 July, 1602/Exmouth	35
1638 – *New Supply*	15 Oct., 1638/Boston	24 Nov., 1638/Bideford	40
1671 – *Society*	10 Oct., 1671/Boston	22 Nov. 1671/West Country	43
1671 – Rhodes	15 April, 1671/Virginia	19 May, 1671/Plymouth	35
1672 – Rhodes	4 May, 1672/Virginia	11 June, 1672/Plymouth	39
1673 - Rhodes	12 Aug., 1673/Virginia	17 Sept., 1673/Plymouth	37
1674 – Rhodes	20 Aug. 1674/Virginia	4 Oct., 1674/Plymouth	46
1675 – Rhodes	11 July, 1675/Virginia	9 Aug., 1675/Plymouth	29
1676 – Rhodes	5 June, 1676/Virginia	18 July, 1676/Plymouth	30
1680 – Danckaerts	23 July, 1680/Boston	30 Aug., 1680/Orkney Islands	38
Average days at sea			**37.83**

Along with the regularity of route comes a general regularity of crossing times. The departure dates of all twelve measurable voyages fall between April and October, so nothing can be mentioned of differences in the colder seasons, but for the six-month time span available, seasonality does not appear to have any significant impact on days spent at sea. This comes as little surprise, as this crossing is with prevailing winds and currents. As with westward crossings though, reason would dictate that peak hurricane months be avoided, although several of the voyages in the sample above fall within this timeframe.

Conclusions

Throughout this chapter, various routes across the Atlantic from England to the New World have been explored. It has been noted that a change in route does indeed occur in the mid-17th century as postulated by Middleton, but that the later passage was not the same as Middleton (1953: 7-8) has presented. Further, the passage used by *Sea Venture*, and identified as a passage by Bruce, was not a commonly used route, and likely only in regular use during the period of time in which English ships were supplying Bermuda prior to Virginian vessels took over this practice. The northern passage provided by Middleton appears to have only been in use for reaching the northern colonies, and an alternative route southwest from England, and then directly west, was also in use for these locations.

Swiftness of passage did not experience any great changes throughout the 17th century, but this is likely an artefact of ships commonly sailing out of season. It has been observed here that departing in spring and early summer resulted in the quickest passages for all routes. It is for this reason that the vessel *Johanna* is responsible for both the fastest and slowest voyages examined herein. It should also be noted here, that the hurricane season in the Atlantic runs from June to November with a peak between August and October, coinciding with the otherwise-best time for departure. This may have been factored into decisions of when to sail, as it would be better for a ship and crew to endure a long crossing than be lost outright in a storm.

Eastbound routes were constant across the Atlantic throughout the entire period. Entering English territory through a northern route above Scotland became common late in the 17th century due to political instability with neighbouring countries rather than general efficiency of passage. Seasonal changes in wind had little effect of eastbound routes, as the winds are almost always favourable for passage, and sailors could assume a rather simple crossing from North America to England, which could be made in around 40 days.

The use of primary source documents and published first-hand accounts of voyages has proven beneficial toward answering questions of archaeological significance otherwise unanswerable through traditional archaeological materials—chiefly, what sailing routes were used, how they changed over time, and how much time was required for passage. In this way, the Atlantic Ocean—space—has been examined as vessels navigate their way between points—place. The sailor's use of the waterways demonstrates a carefully calculated set of factors in selecting their passage, utilising knowledge gained through the experiences of others over a relatively short period of time. The remarks of Edward Hayes quoted above in recording Gilbert's 1583 voyage demonstrate a detailed understanding of Atlantic winds and currents only nine decades following the European discovery of the New World. Adding to this fact, that few Europeans had yet visited points north of Florida and south of Newfoundland in their exploration of this new continent only strengthens the significance of this information.

Chapter 5 – English Ship Performance in the 17th Century

Introduction

As seen in the previous chapter, the historical record can offer a great wealth of information that is not necessarily evident in the archaeological record. The logbooks, narratives, and journals already explored in this work can additionally be used for examining the performance capabilities of the ships they describe. Time spent in crossing has already been examined, but this chapter will explore in greater depth the themes of performance with a focus on vessels. The ship is, in this perspective, a place, and will be explored in its interactions with various spaces—in this case, waterways. The technological merits of ships will be examined on a temporal scale to examine any changes to sailing capabilities, technological or otherwise, that may have occurred within English ship design over the course of the 17th century. The study of past ship performance usually requires expensive replica ships or computer-aided modelling, but it is the intention of this study to demonstrate the usefulness of engaging historical records where available to investigate these highly technical themes, especially when budgetary constraints limit possible testing.

Individual logs and narratives naturally vary greatly in content, but many of those explored in the previous chapter can be used toward the common theme of quantifying the abilities of a ship, albeit to differing degrees. This methodology is not without precedent. Several other researchers have used such materials in the past to examine similar topics (Englert 2007; Whitewright 2007, 2010); however, their focus is on much earlier periods for which such materials are extremely rare. Englert's work on historic accounts of a Viking voyage focuses on distances a ship could travel in a given day on particular legs (2007: 119-129). Whitewright (2007, 2011), using similar data from Roman period voyages, has used these sources to calculate base speeds. Further, Palmer has written much on the sailing capabilities of ancient ships, bringing forth a detailed technical understanding of the dynamics of forces which affect ship performance (2009a; 2009b). Parameters for this study draw significantly from the work of these authors.

Whilst the examples presented herein apply to English expansion into the New World during the 17th century, the methodology and aims should be considered universal for all regions and time periods for which similar sources exist. The goal here is to begin a quantitative discussion of English ship performance in the 17th century, adding a data set not yet utilized to these ends. Quantifying ship performance will be applied to two core objectives: establishing the 'velocity made good' (Vmg) of voyages, and establishing the effective points of sail for a vessel. Vmg is the figure achieved when the direct distance between two points is divided by the time needed to travel between them (Whitewright 2010: 3), giving an average speed between two points, although not the actual speeds attained. Englert points out (2007: 121-122), that describing actual speeds that may be attained at any leg of a voyage is unimportant, as a ship's course is by nature not constant, and cannot, under most conditions, sail in a direct line between two points. Further, Davis notes that distance travelled is of far less consequence than is time spent between ports of call, making it equally necessary to examine both Vmg and actual days spent at sea (1956: 60). Determining the Vmg of each voyage is therefore of importance here, as the merchants involved in the oversight of transatlantic shipping would necessarily make calculations of routes based on these two correlating factors. Additionally, establishing a range of Vmg for similar ships will shed some light on the capability of larger merchant vessels during this period. For each of these, data is unfortunately missing for comparison, such as the sizes of some of the vessels, hull types and rigging. While the actual sizes and shapes of hulls and number of masts cannot be determined in most cases, the vessels can be assumed to have carried square-sails, of the design most common in 17th century English ships. Wind and weather will be used where available to examine the capabilities of the ship sailing with different winds and compared then to trials of similar reconstructed vessels. Again, the rigging styles of these particular vessels are not known, but analysis of wind angles and performance of the vessel in certain conditions may help in identifying how a particular ship was rigged based on established, broad parameters.

The Problem with Port Records

Past works dealing with this era of English shipping, mainly authored by economic historians, have made attempts to quantify ship performance using port records as their source material (Walton 1966; Walton 1967a; North 1968; Walton 1968; Shepherd & Walton 1972; French 1987). These works each deal with sources of productivity change in ocean shipping in the British Atlantic world; however, the source materials used are in many ways problematic, and quite possibly ill-suited for ship-performance research. If one were to have the records of two or more ports that were quite well connected, such as Boston and Barbados, and for overlapping years, it would at the surface seem that this would be an effective source for quantifying ship performance. In this case, one must only look at the date of departure from one port and match that with its arrival in the next. The problem is, however, as even Shepherd and Walton (1972: 197) who extensively use this method point out, records of vessels entering and clearing port were not always accurately or punctually recorded. A ship may register its departure from port on a particular day, but remain in the harbour waiting for appropriate winds, or perhaps a storm to pass. Ships may also arrive at their destination, but take care of other matters before making their way into the customs port for registration. The addition of only one extra day to a shorter journey such as one from New England to the Caribbean that takes on average five to seven days would cause a significant flaw in the data. Shepherd and Walton (1972: 77-79, 197) show fluctuating periods of improvement and regression in Vmg between England's northern American colonies and its Caribbean colonies between the 1680s and 1760s. The actual figures given describe an average Vmg for vessels engaged in trade between the northern colonies of British North America and the Caribbean as averaging between 1.67 and 1.97kn on the north-south route, and 1.3 to 2.09kn on the return route for the period between 1686 and 1770. The inconsistency of voyages over the years and lack of a discernible trend makes their data suspect.

One must nonetheless note that port records are not without their merit. These records are indeed a worthy source for studying the trade of various commodities. One can easily see the quantities of goods entering and leaving ports and where those goods have come from or are going, or to examine the tonnage or similar features of vessels engaging in trade. They also allow for large numbers of examples to be reviewed very rapidly for macro-level analysis. In chapter 3 they were used to examine the sizes of vessels trading in Maryland. With logbooks, narratives and journals, this is a luxury unfortunately unavailable, forcing studies using these source materials into micro-level analysis until such a time, likely far in the future, when enough sources have been pulled together to examine them as a group rather than individually. Additionally, if port records were found to exist for opposite ends of longer voyages, such as trans-Atlantic ones, the addition of a day or two would have very little effect on the Vmg of the voyage. As an alternative to port records for determining vessel performance in the past, this study will make use of passenger journals, narratives, and logbooks to examine the potential performance of England's 17th-century ships.

Source Materials and Method

This chapter will draw from the same pool of source materials as the previous chapter, compiling data from narratives, journals, and logbooks. Only seven of these documents contain sufficient information for examining performance data, but will account for two voyages on passage A (by way of Nova Scotia), two voyages on passage B (by way of the Caribbean), and eight voyages on passage D (by way of the Azores). The data for passage D will naturally be stronger based on sample size bias when compared to passages A and B, but unfortunately no other logs from passages along these routes provide adequate detail to use to these means. In all cases though, the available data do not allow for statistically strong analysis to be made, but these do provide the best and most direct information possible in these circumstances. The voyages to be used are (figure 5-1):

- Passage A
    - 1583 voyage of Sir Humphrey Gilbert to Newfoundland (Hayes 1583)
    - 1638 Voyage of *New Supply* to Boston (Measured to Newfoundland) (Josselyn 1672: 5-13)
- Passage B
    - 1606-1607 founding voyage to Jamestown (measured to Cape Henry) (Percy 1607; Smith 1608)
    - 1633-1634 founding voyage to Maryland (measured to Cape Henry) (White 1634)
- Passage D
    - Six round trip voyages of Edward Rhodes, 1670-76 to Maryland and Virginia (measured to Cape Henry) (Rhodes 1670-76)
    - Voyage of *Submission*, 1682 to Pennsylvania (measured to Cape Henry) (Genealogical Society of Pennsylvania, 1895)
    - Voyage to Maryland, 1705 (measured to Cape Henry) (Andrews 1907)

Passage A does not provide any voyages to the Chesapeake, but is being included in this study as it has been suggested as a potential route of Atlantic Passage (Middleton 1953: 7-8), although the previous chapter has shown that it was not likely seen as viable passage to the Chesapeake, and it was in fact passage D which replaced passage B as the common route to the mid-Atlantic (figure 5-2). The data that are available for this route will perhaps help to clarify why this route was not used in practice, despite being the shortest physical distance of all routes examined.

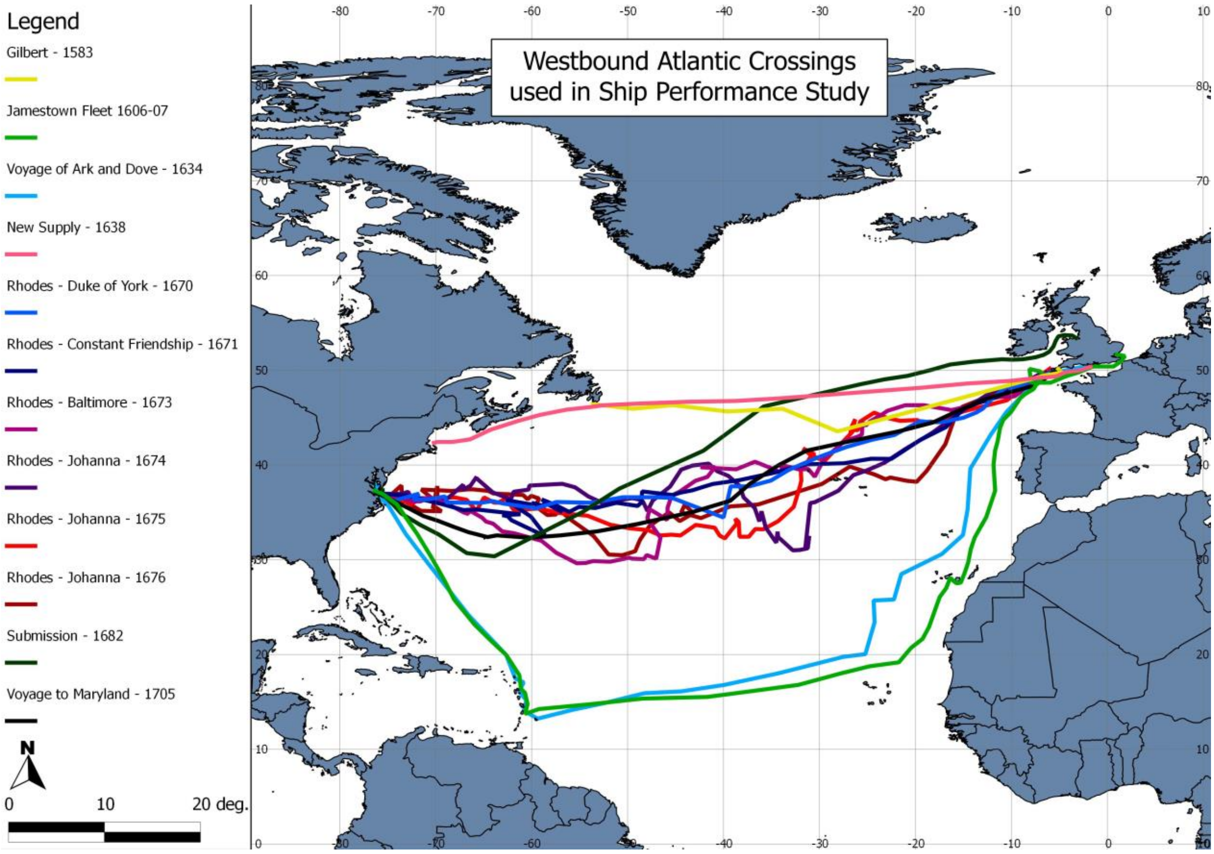


Figure 5-1 - Westbound voyages used in study of vessel performance along various routes to the New World (map by S. Tucker)

These data will be analysed in several ways. Firstly, toward the goal of examining Vmg, the various routes will be measured based on estimates of total distance travelled along a particular route, and divided by days spent at sea. The figures will be expressed both as average distance travelled per day, and as velocity made good in nautical miles covered per hour. Another figure of Vmg will be given based on the direct distance between Land's End, England, and the mouth of the Chesapeake Bay for passages B and D, and Land's End and St. John's, Newfoundland for passage A. Measurements have been made using the path measuring tool on a popular freeware satellite imaging programme (Google Earth) to approximate routes, and then rounding the figure to the nearest 100 nautical miles (nm). Table 5-1 shows the calculated distances which will be used to these ends.

Table 5-1 - Calculated distances between points on westbound passages

Passage A	Passage B	Passage D	Newfoundland to Massachusetts Bay	Direct distance England to Chesapeake Bay	Direct distance England to Newfoundland
1,900 nm	6,000 nm	3,500 nm	800 nm	3,000 nm	1,900 nm

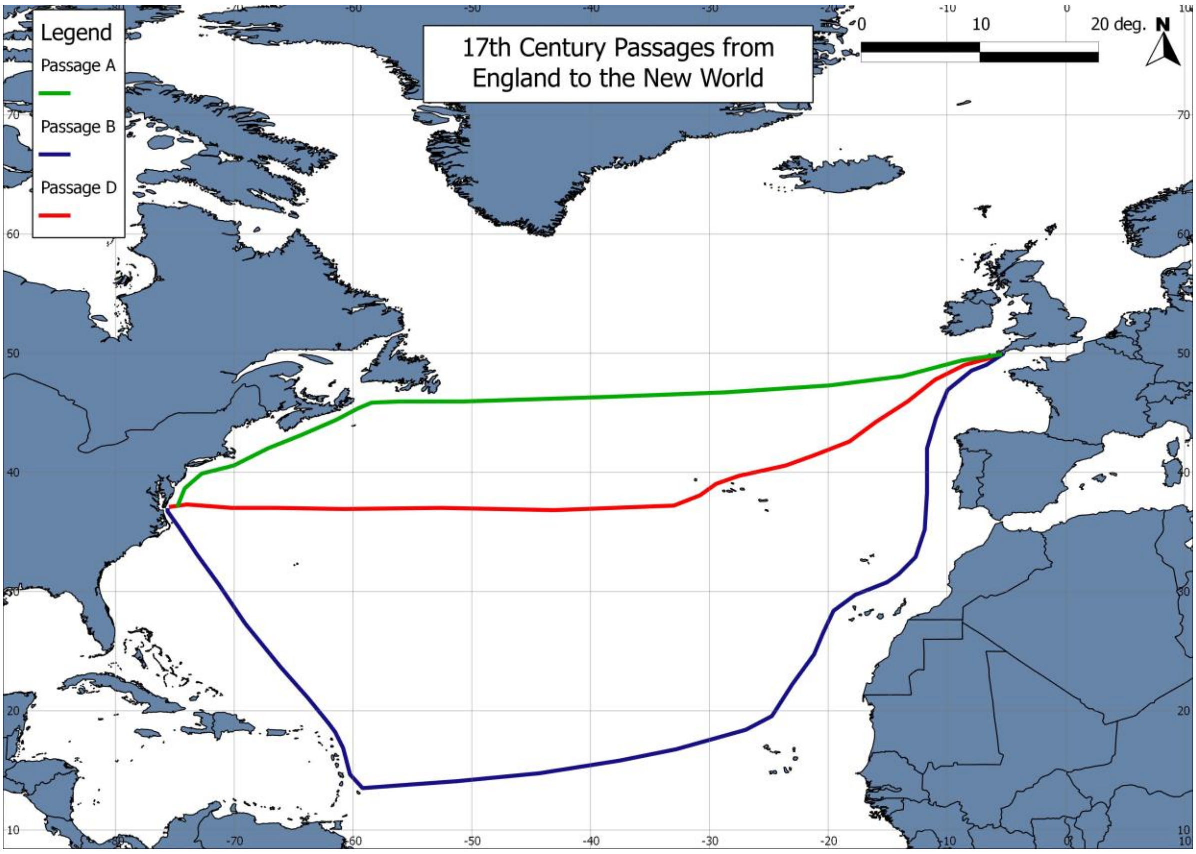


Figure 5-2 - Passages from England referred to in this chapter (map by S. Tucker)

Eastbound voyages given will also be explored from twelve voyages, although some are different voyages than those on the westbound. As eastbound voyages were seen in the previous chapter to travel in a direct route from their starting point to England (figure 4-17), these will be measured in a similarly straight path. The majority are departing from the Chesapeake, but some others are travelling from Newfoundland, Maine, and Boston. Distances used in these calculations are 3,000 nm from Chesapeake departures, 2,700 nm for Boston departures, 2,600 nm for Maine departures, and 1,900 nm for Newfoundland departures. As these voyages utilise roughly the same path following prevailing winds, they provide an important glimpse into potential upper limits for English sailing craft for the entirety of the 17th century. The voyages used in this section will include only those for which start and end dates are provided, although this encompasses the bulk of the return voyages examined over the course of this study. The following is a list of the eastbound journals used herein:

- 1583 return voyage of Sir Humphrey Gilbert – Newfoundland to England (Hayes 1583)
- 1587 return voyage of John White – Roanoke to England (White 1587)
- 1602 return voyage of Bartholomew Gosnold – Maine to England (Bereton 1602)
- 1638 return voyage of *New Supply* – Boston to England (Josselyn 1672: 27-29)
- 1671 return voyage of *Society* – Boston to England (Josselyn 1672: 162-164)
- 1671 return voyage of Rhodes in the ship *Duke of York* – Chesapeake to England (Rhodes 1670-76)
- 1672 return voyage of Rhodes in the ship *Constant Friendship* – Chesapeake to England
- 1673 return voyage of Rhodes in the ship *Baltimore* – Chesapeake to England
- 1674 return voyage of Rhodes in the ship *Johanna* – Chesapeake to England
- 1675 return voyage of Rhodes in the ship *Johanna* – Chesapeake to England
- 1676 return voyage of Rhodes in the ship *Johanna* – Chesapeake to England
- 1680 return voyage of Danckaerts – Boston to England (Murphy 1867; James & Jameson 1913)

Dates will be given as expressed in the journals, without reconciliation between Julian and Gregorian calendars. Days at sea are to be calculated as days spent west of Land's End, and East of the Chesapeake Bay on passages B and D, and Newfoundland on passage A. Days spent at harbour in the Caribbean or other islands have been omitted from these calculations, giving as close to the actual number of days spent actively underway as possible. Through these methods and controls, a clear picture of a ship's potential forward speed can be achieved at various points throughout the early colonial period. Forward speed though is very dependent on wind direction and speed, and a vessel's ability to move forward in winds from a variety of angles.

To address this, data from the round-trip voyage of Edward Rhodes in the *Duke of York* will be examined. The log provides daily information on the vessel's heading, wind direction, and distance travelled. Based on these, qualifying terms for speed and the angle of the wind to the hull will be used to examine the potential of a square-rigged vessel to make forward motion in various winds. From this voyage, 66 days' entries include adequate data for inclusion in this study, providing a fairly strong data set. Wind angles will be generalised to divisions of 16 points around the compass, expressed in degrees anti-clockwise from the direction of travel (e.g. 0, 22.5, 45 etc. degrees), and then further grouped into corresponding sets, such as 45 and 315 degrees, and 90 and 270 degrees, as they are essentially the same wind angle, but from the opposite side of the hull. Speeds are grouped into seven qualifying groups, ranging from 'no forward progress,' to 'top speed,' and then compared to each day's corresponding wind angle, showing the range of winds in which a square-rigged ship could ascertain forward movement and the speeds which can be expected in various winds. This will then be compared to data of sea trials of the ship *Maryland Dove*, a modern built vessel (launched 1978), meant to replicate a small 17th-century merchant vessel. At only 40 tons, *Maryland Dove* is likely much smaller than *Duke of York*, but should nevertheless provide real data for what can be expected of a square-rigged ship. Data from *Maryland Dove* provide a control for the study, in that the performance to wind angle is measured as simply the best angle for forward motion rather than a general ability to windward. This is similar to the difference between actual speeds attained and velocity made good, but is useful in that it displays the performance of a vessel in more realistic terms.

Voyage Performance

Expectations for voyage lengths have been discussed in the previous chapter. It has been demonstrated that westbound voyages are far slower than eastbound voyages, but that a potentially faster crossing had been discovered by the 1670s. Voyage duration was highly variable during this time, but by the end of the century, the Chesapeake could be reached from England in as little as five-and-a-half weeks, and voyages eastbound could be made in as little as four weeks. Merchants and mariners would have been most concerned with this data, as the amount of time spent between ports of call was of greater economic importance than actual speeds which could be attained by a particular vessel (Davis: 1956: 60).

It would stand to reason that ship builders would have been more concerned with creating a vessel that could move faster. Faster ships have an obvious tactical advantage in naval warfare, and although a necessity for marginal increases in hull efficiency would be less pronounced in a merchant vessel, this would put them at an advantage for outrunning or outmanoeuvring hostile vessels. As merchant vessels were the main targets of piracy, this was obviously a concern, evidenced by the frequent practice of arming merchant vessels. By 1705, it is clear that most merchant vessels operating between England and the Chesapeake carried some type of armament (Andrews 1907: 337), which was of course carried for a reason. As discussed in the previous chapter, Winfield points out that the English (later British) Navy effectively experienced two centuries of technological stasis in terms of agility and speed (2009: xi), choosing instead to increase firepower and hull strength to defeat enemy ships. This period of performance-based stasis is described as ending in the late 18th century, with the introduction of frigates and schooners, but it is worth exploring in terms of merchant vessels, which have would have different interests and abilities from naval vessels.

Armament on merchant ships was relatively light by comparison to their naval counterparts. Of the ships listed in the 1705 voyage to Maryland, the most heavily-armed ship, with a 755 hogshead capacity (ca. 300 ton) carried only sixteen guns. This is about the same level of armament carried by the most poorly armed sixth-rate ships of the line, in a ship which would have been rated as a sizable fifth-rate (Winfred 2009: 146-211). Comparable ships in the English navy carried around 40-60 guns. This particular fleet, with five vessels and 36 guns between them felt that they would be easily taken by a single French privateer with fourteen guns (Andrews 1907: 338). With merchant vessels carrying lesser armament than ships intended for use in hostilities, a merchant vessel would be better suited to attempt to elude an enemy vessel than engage it. Further, a fully laden vessel would be slower than one which is perfectly trimmed, further putting merchant vessels at a disadvantage. For these reasons, increasing speed and agility through changes to hull form and sailing rig would be the better option for any merchant vessel operating in areas where piracy and privateering is a resounding issue. To answer the questions concerning the capabilities of merchant ships throughout the 17th century, Vmg on merchant voyages will be examined with particular regard to top performance and temporal trends beginning with westbound voyages (table 5-2).

An examination of the raw data indicates that passage A resulted in the lowest average speed of travel, and from this small sample, appears to have the lowest potential for distance covered per day. Passage B, also seen only from a very small sample, appears to have the highest potential for consistently high distances covered per day. The samples are far too small to draw significant conclusions, but it is still worthy of note. Passage D is highly variable in both speed and distance per day, having the potential be as slow as voyages in passage A, or as quick as those on passage B. When the distance travelled is removed and replaced by the direct distance between the point of origin and destination, it is clear that passage D resulted in the fastest speeds. From a perspective of the best route, this is probably the more important figure, as Davis points out, the number of days spent between ports of call is what will actually affect trade from an economic perspective (1956: 60).

Table 5-2 - Data table for performance on voyages westbound to England

Passage	Voyage	Days at Sea	Total dist. (nm)	Dist. per day (nm)	Vmg (knots)	Direct Vmg (knots)
A	Gilbert – 1583	49	1,900	38.77	1.61	1.61
A	*New Supply – 1638*	41	1,900	46.34	1.93	1.93
B	Jamestown – 1607	76	6,000	78.94	3.28	1.64
B	*Ark & Dove – 1634*	66	6,000	90.90	3.78	1.89
D	Rhodes – 1670	39	3,500	89.74	3.73	3.2
D	Rhodes – 1671	46	3,500	76.08	3.17	2.71
D	Rhodes – 1673	74	3,500	47.29	1.97	1.68
D	Rhodes – 1674	62	3,500	56.45	2.35	2.01
D	Rhodes – 1675	71	3,500	49.29	2.05	1.76
D	Rhodes – 1676	81	3,500	43.20	1.8	1.54
D	*Submission* – 1682	47	3,500	74.46	3.1	2.65
D	Voyage to MD – 1705	78	3,500	44.87	1.86	1.6

Analysis of these data show compelling results. On westbound voyages, there is an increase in Vmg when calculated from a direct distance, indicating that time spent at sea decreased between England and the Americas throughout the 17th century (figure 5-3). Conversely, when calculated based on distance travelled along a specific route, it is clear that ships achieved lower Vmg throughout the same period. This is reflective of vessels utilising a more direct route in the latter half of the 17th century, but one which is against prevailing winds and currents. It must be noted here that this does not indicate a waning of the vessel's capabilities throughout this period, but rather the selection of a more challenging, but shorter route.

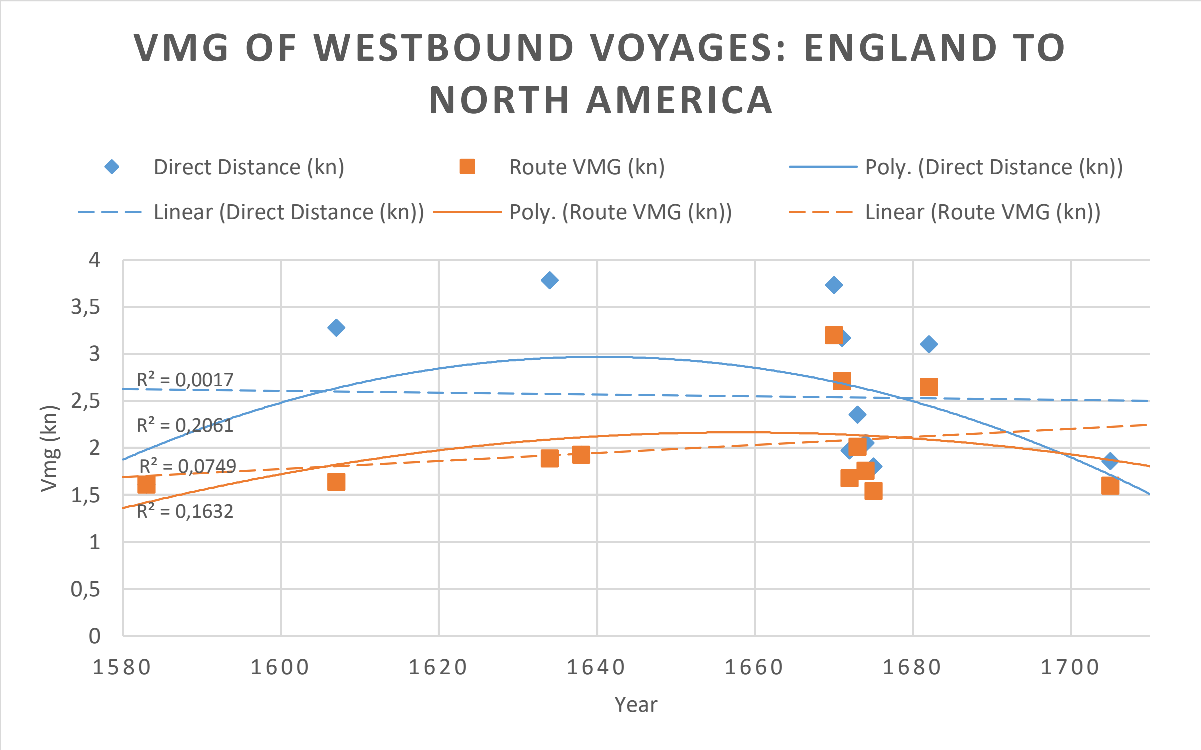


Figure 5-3 - Vmg of westbound voyages with associated trend lines (graphic by S. Tucker)

This trend speaks mostly for limitations of the rigging on these vessels, giving the first indication of a lack of improvement in performance to windward throughout this period, although this theme will be explored further later in this chapter. From a purely performance-based perspective, which is relevant here in that ships would benefit from being able to out-manoeuvre hostile vessels, it would appear that westbound merchant vessels follow a similarly stagnant trend of performance as English naval vessels experienced. Voyages eastbound following prevailing winds and currents should on the other hand provide information of hull performance, helping to isolate the sources of any change in ship performance. What is shown though through this examination of westbound voyages, is that English ships were not any more capable of sailing to windward at the end of the 17th century than they were 100 years earlier. It is known that rigging remained relatively unchanged in larger sailing vessels throughout the 17th century, varying mostly between numbers of masts proportionate to the size of the vessel and numbers of sails per mast. The staysail was one of the few major changes to rigging on larger English ships during the early colonial period, first appearing around the mid-1660s (Anderson 1994: 352-355). As the vessels were almost exclusively square-rigged, this lack of improvement to windward is hardly surprising.

Voyages eastbound are much more comparable with each other as they follow the same general routes. From these data, it gives a fairly significant overview of changes in ship performance over time, and as was established above, corresponding predominately to hull design rather than rigging. As seen in the previous section, the data table provides little insight of trends within the figures (table 5-3). An examination of eastbound voyages using a scatter plot and a linear and polynomial trend lines reveals some degree of improvement over time (figure 5-4). The improvement is rather slight, but is present within the data. The micro-scale of analysis here makes trend data suspect, but the trend toward temporal improvement is compelling.

Table 5-3 - Data table for the performance of eastbound voyages to England

Point of Departure	Voyage	Days at Sea	Total Distance (nm)	Dist. per day (nm)	Vmg (kn)
Newfoundland	Gilbert – 1583	22	1,900	86.36	3.59
Roanoke	White – 1587	60	3,100	51.66	2.15
Maine	Gosnold – 1502	35	2,600	74.28	3.09
Boston	*New Supply* – 1638	40	2,700	67.5	2.81
Boston	*Society* – 1671	43	2,700	62.79	2.61
Chesapeake	Rhodes – 1671	35	3,000	85.71	3.57
Chesapeake	Rhodes – 1672	39	3,000	76.92	3.2
Chesapeake	Rhodes – 1673	37	3,000	81.08	3.37
Chesapeake	Rhodes – 1674	46	3,000	65.21	2.71
Chesapeake	Rhodes – 1675	29	3,000	103.44	4.31
Chesapeake	Rhodes – 1676	30	3,000	100	4.16
Boston	Danckaerts – 1680	38	2,700	71.05	2.96

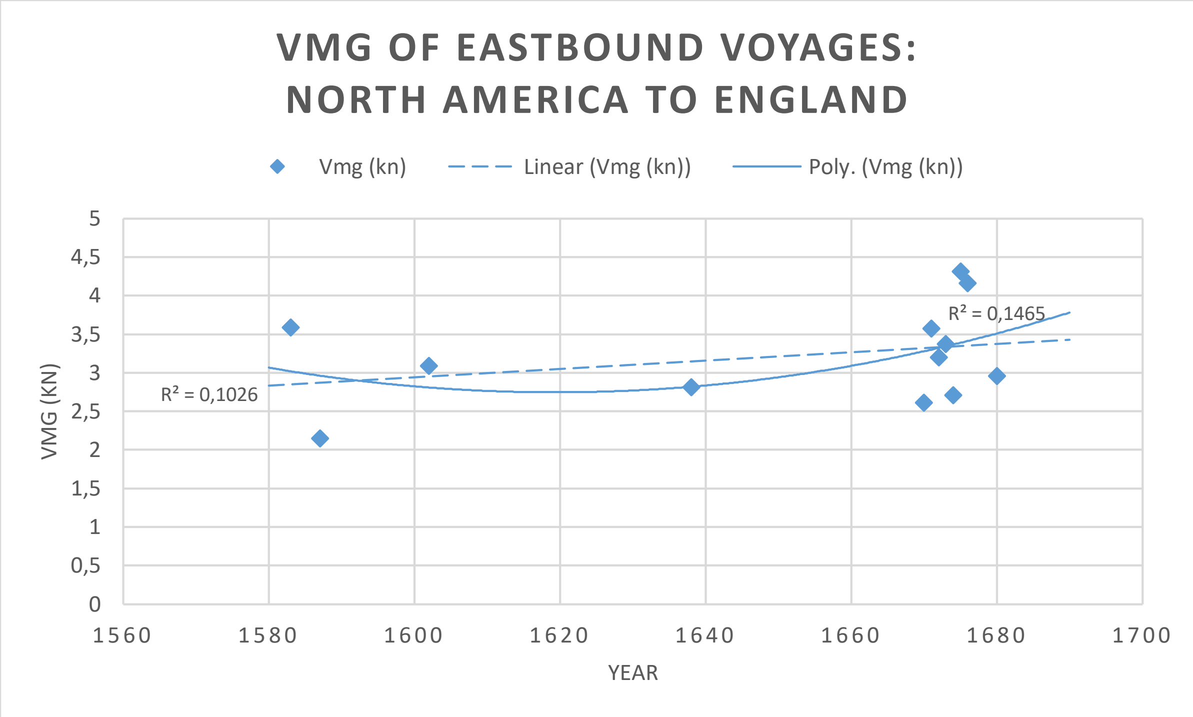


Figure 5-4 - Vmg of eastbound voyages with associated trend line (graphic by S. Tucker)

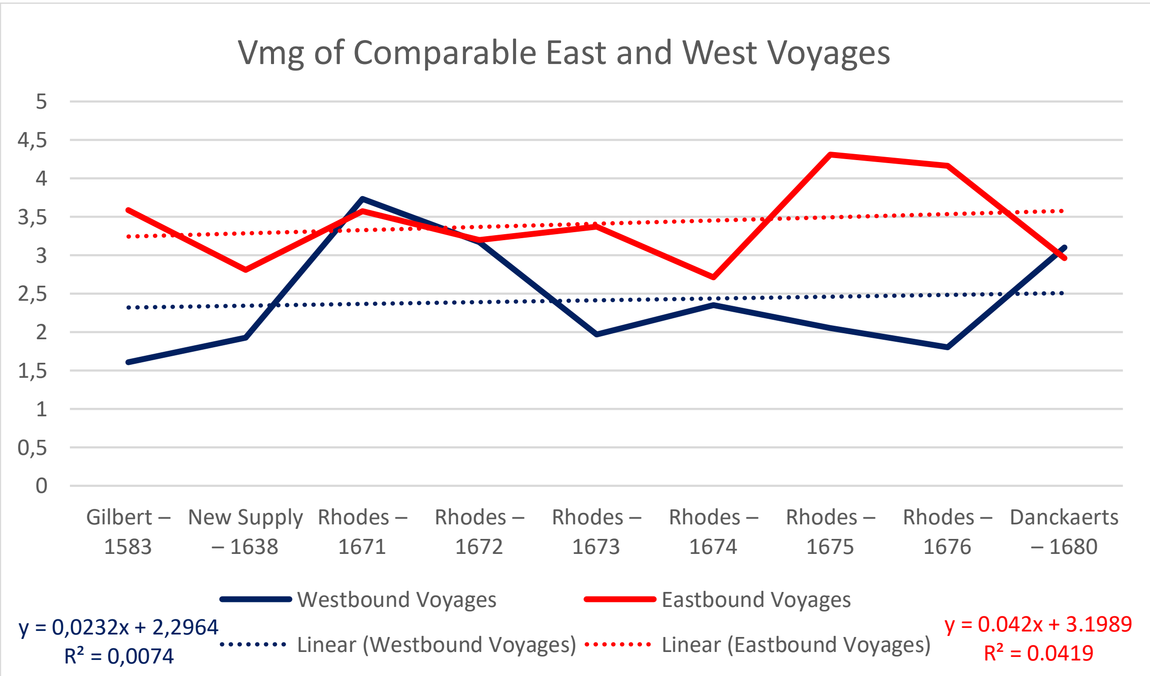


Figure 5-5 - Comparison of east and westbound voyages of the same vessel (graphic by S. Tucker)

Side-by-side comparisons of voyages giving data for east and westbound crossings also provide interesting results (figure 5-5). With one notable exception, ships achieving fast crossings in one direction tend to perform poorly on the opposite direction. The inconsistent performance of the same vessel must be well emphasized here, as further caution that sailing vessels, particularly those with square sails, are always heavily limited by environment and weather. Trends for these data are not statistically significant, but are generally reminiscent of those observed for the entire dataset.

Performance to Windward

The examination of Vmg over the course of a voyage has revealed some compelling correlations, indicating that hulls did perhaps become slightly more efficient over the course of the 17th century, but the technology of sailing rigs appears to have remained largely unchanged in terms of speed to windward. This is not to say that there were no changes to rigging during this period, but rather that any changes to sailing rigs did not help English ships achieve faster speeds in unfavourable winds throughout the period in question. This does however, raise the question of how well a square-rigged vessel is capable of moving in various wind conditions, to observe if lack of ability to windward was viewed as enough of an issue for ship builders to address. To examine this, data from sea trials of *Maryland Dove* are examined here. After establishing standards for performance based on the capabilities of this modern replica, data from the log of the ship, *Duke of York*, in the Edward Rhodes log will be studied and compared. Through this study, the subject of potential performance in comparison to actual performance will be highlighted.

Maryland Dove was designed in the mid-1970s by William Avery Baker, relying on the best known information on naval architecture at that time. Launched in 1977, the ship is meant to represent a mid-17th-century trade vessel, built in similar dimensions to those of its namesake, *Dove*, one of the two ships involved in the founding of the Maryland colony. Based on the information on-hand at present, it is known that there are some anachronistic or even inaccurate features on this vessel; however, this should create only a minimum effect on the data for comparison. *Maryland Dove* has a burthen of 42 tons and carries two fully square-rigged masts and a gaff-rigged mizzen. The masts have been noted by the vessel's captain, William Gates, (personal communication, 16 August, 2012) as being excessively tall for the ship. This was done to achieve optimal performance on the protected waters of the Chesapeake Bay and its tributaries, but they do cause stability problems on the open ocean. *Duke of York,* designed to be sailed on open seas, would likely have a greater range of windward ability than *Maryland Dove*, as well as likely being a much larger vessel, but the comparison is nonetheless a useful exercise. *Maryland Dove* carries eighteen tons of ballast including its motorised propulsion system, which while anachronistic, is necessary due to local health and safety regulations.

Data from trials of the *Maryland* Dove have been provided by Capt. Gates, who has sailed *Maryland Dove* since 1989. The vessel sails regularly during the warmer months, making this information the product of frequent and extensive experience. Attempting to sail into the wind, close hauled, and with a close reach are ineffective with the *Maryland Dove* (figures 5-6 and 5-7). The vessel a requires a wind angle of 67° to 75°, between a beam and close reach, to begin to achieve forward motion. Between 90° (beam reach) and 135° (broad reach), it is at peak performance. As the wind moves beyond 135° to 180° (from broad reach to running position) it becomes less efficient. The unstable nature of *Maryland Dove* due to the height of its masts causes the ship to slow more quickly from broad reach to running than other square-rigged vessels built for use in open sea conditions, creating a downward pressure on the bow and increasing resistance from the surrounding water. Open sea conditions reduce the *Maryland Dove*'s ability to windward, although this would not be the case with a vessel with shorter masts, and therefore this performance aspect is not transferrable to 17th-century sailing vessels. This information will serve as a control to what is discernible within the logbook examined herein. With the limitations and peak performance points of a square rigged vessel established, the *Duke of York* log will be examined and compared to the data for *Maryland Dove,* with the intention of demonstrating differences in potential forward progress to actual ability to windward, as this data is far more useful in the study of economics and productivity changes in ocean shipping.

In total, 62 days of sailing from the *Duke of York* log are observed here, noting direction of travel, direction of wind, and distance sailed in a 24-hour period. Direction of travel and direction of wind have then been extrapolated into wind angle to the hull. From this, nine groups have been created for the wind angle to hull (table 5-4). Wind groupings were chosen based on the sixteen standard directions on a compass and established terminology of points of sail.

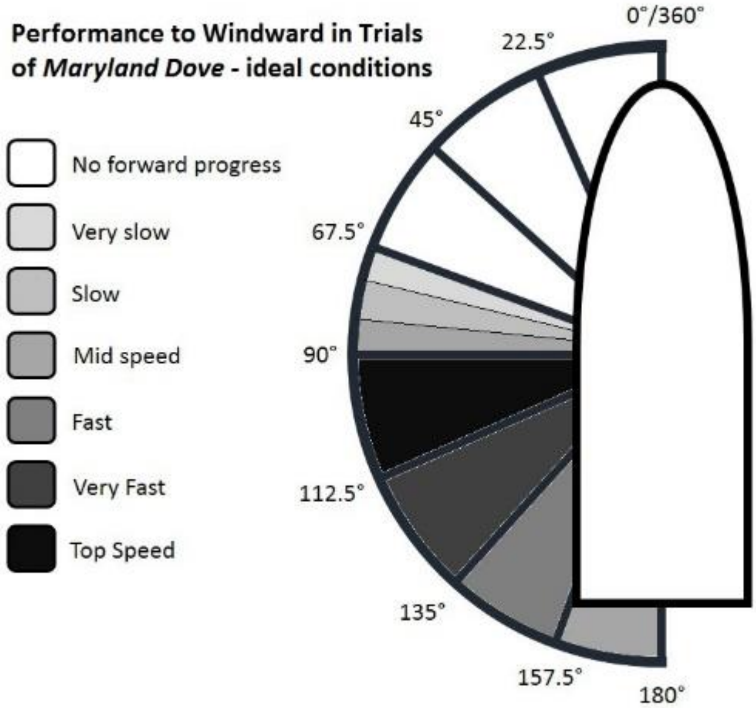


Figure 5-6 - Windward capability of the *Maryland Dove* under ideal weather conditions, 12kn winds, calm seas (graphic by S. Tucker)

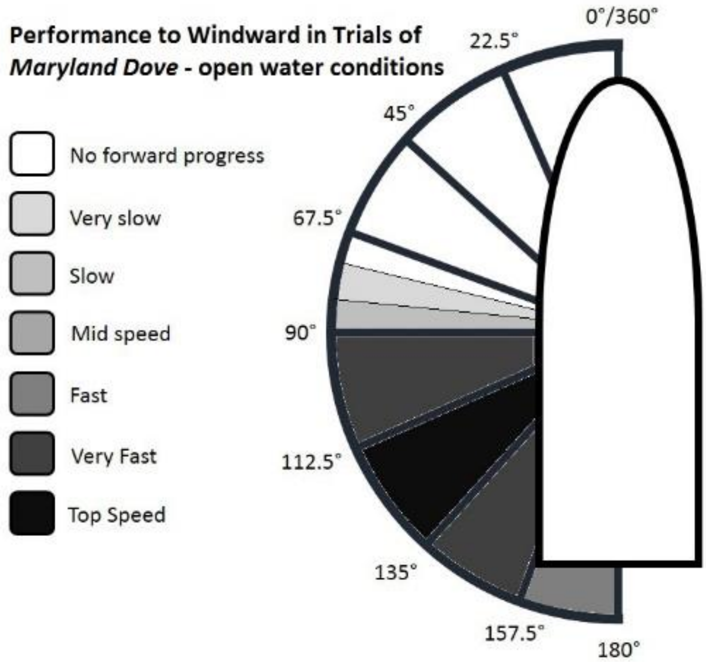


Figure 5-7 - Windward capability of the *Maryland Dove* under open water conditions, 20-22kn winds, one-metre seas (graphic by S. Tucker)

Table 5-4 Definitions of wind groupings used in this study

Wind Group	Definition	Point of Sail
1	0/360 degrees to hull (direct to bow)	Head to Wind
2	22.5/337.5 degrees to hull	Close Hauled
3	45/315 degrees to hull	Close Reach
4	67.5/292.5 degrees to hull	Close Reach
5	90/270 degrees to hull	Beam Reach
6	112.5/247.5 degrees to hull	Beam Reach
7	135/225 degrees to hull	Broad Reach
8	157.5/202.5 degrees to hull	Broad Reach
9	180 degrees to hull (direct to stern)	Running

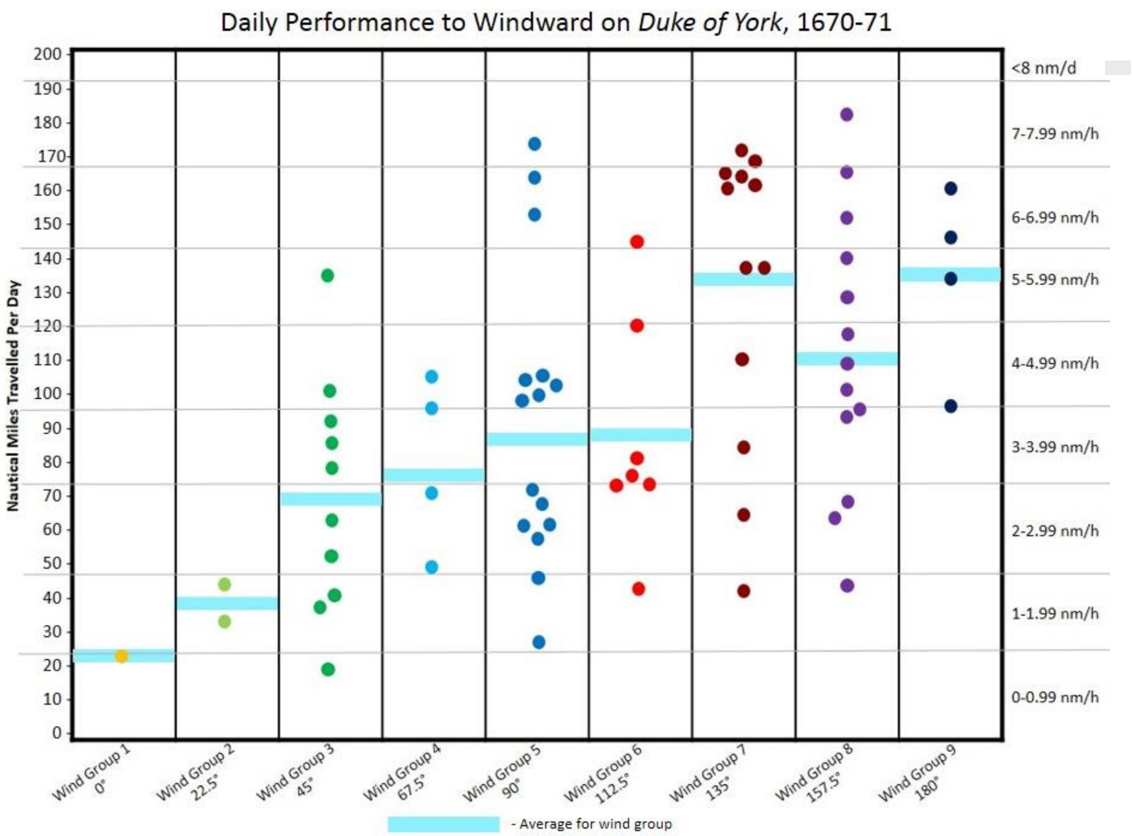


Figure 5-5-8 - Distance travelled per day on *Duke of York*, sorted by wind group with averages noted (graphic by S. Tucker)

Of these daily figures, distances travelled range from 21 nm to 180 nm. It should be mentioned here, as an addendum to the discussion of velocity made good, that travelling 180 nm in one 24-hour period is an average speed of 7.5 kn, a significantly higher figure than was observed through voyage averages. On average, *Duke of York* made good about 96 nm/d, or 4kn Vmg.

A definite correlation can be observed in this data for the distances covered in a 24-hour period and angle of the hull to windward (figure 5-8). It is apparent from the groupings that headwinds in groupings 1 and 2 provide very little ability to windward, although some progress was able to be made nonetheless, although with a Vmg below 1kn. The averages give an almost linear increase in speed from wind groups 1 to 4, plateauing from 4 to 6, and then making a very large jump to wind group 7. Wind group 8 has a very wide range of performance with no clear pattern shown, but a lower average than group seven. Group 9 has a very small sample, but the highest performance average in the data. As it is well established within the modern sailing community that a direct tail wind results in lower speeds, and corroborated by sea trials of *Maryland Dove*, this figure is likely artificially high due to sampling bias. The two lowest figures in wind group 7 are also the result of partial days of sailing, where the weather was calm for the majority of the day. When these two outliers are removed, the average for wind group 7 rises to 145, making the highest performing point to wind in this data set. From these data, it is possible to determine the general effectiveness of this vessel in various wind directions in the realistic terms of forward motion made good to windward (figure 5-9).

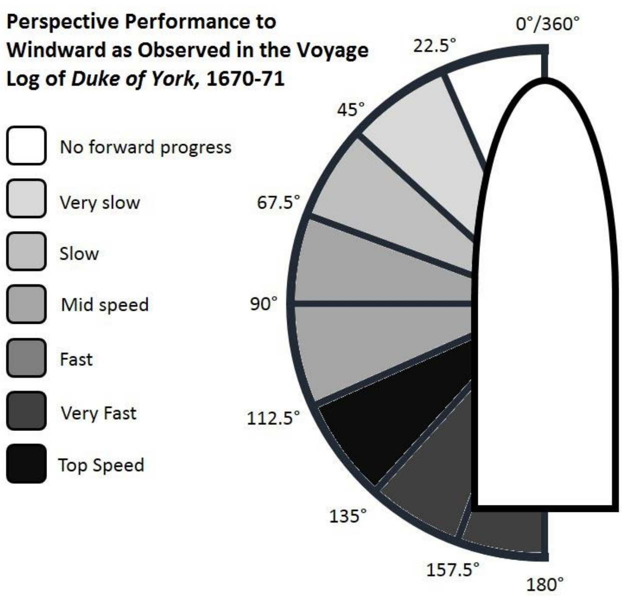


Figure 5-5-9 - Effectiveness of sailing in various wind-to-hull angles as observed in the log of the *Duke of York* (graphic by S. Tucker)

Through this study, it is clear that *Duke of York* was capable of achieving some forward progress in a very acute headwind. Sailing close-hauled was not tremendously effective, but it is clear that in such winds the ships could often make some headway. Ideally, the wind should range between 112.5° and 135° to the hull when blowing to starboard. Sailing into the wind requires very broad tacking manoeuvres with a square rigged ship, meaning that to make a small amount of forward progress, the ship must travel a much greater distance back and forth across that heading (figure 5-10). As wind angles to the hull increase, the vessel can travel in a more direct route. The drastic difference between *Duke of York* and *Maryland Dove* in sailing into the wind shows that this process was being used effectively to move forward in unfavourable winds. *Duke of York* was in reality almost certainly just as incapable of sailing into the wind as *Maryland Dove*, but examining the voyage by means of forward progress over a path, rather than a direct measurement from the hull allows for a more realistic discussion of sailing routes and what could be expected by mariners and merchants for the overall performance of their vessels.

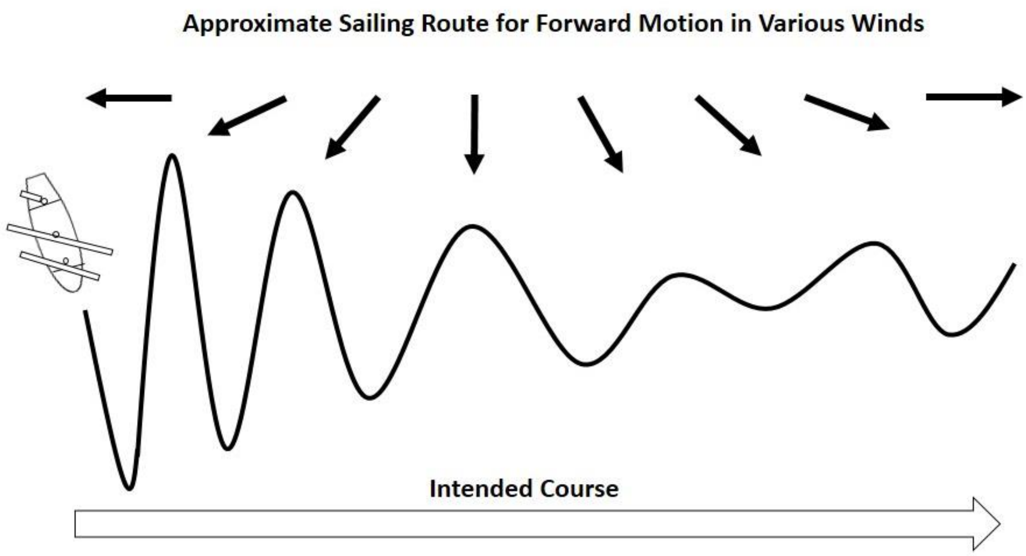


Figure 5-10 - Pathway of a vessel sailing a straight course in various wind directions (graphic by S. Tucker)

Discussion and Conclusions

This study has examined the 17th-century English ship as a product of technology, and as a place interacting with its environment. Ship technology is largely marked by two main themes: potential speed of a particular hull design and the ability of the vessel's rigging to sail into the wind. Time spent in crossings was a factor in the overall productivity of the tobacco trade, but bringing the product, ships and crews back safely and minimising the risks of loss to hostile parties was also an essential element of the trade. Loss of a vessel and product would be highly detrimental to a merchant, although insurance schemes were common. As is the case with insurance today though, premiums increase alongside risk, and therefore merchants would be better served minimising all possible risks. A decrease in insurance premiums has been noted for merchants from the late 17th century to the mid-18th century, indicating that the risks had decreased over this time as well (Walton 1967a: 71).

The data examined in this chapter suggests that ships became slightly faster throughout the 17th century when crossing the Atlantic with favourable winds. This is likely the result of improvements to hull design, but may also be a product of the collective knowledge of English mariners, gained through decades of experience in Atlantic crossings. On westbound crossings, it would appear that a voyage with an average Vmg of 2-3kn was the norm—roughly walking speed for a normal adult. On the reverse leg, speeds of 3-4kn could be reasonably expected with the potential for faster speeds made good. From the data examined in the log of *Duke of York*, it is clear that a vessel could achieve speeds of 7-8kn with a good wind, further demonstrating that English ships during this period were much more limited by their rigging than by their hull design. This would have been assisted to some degree by the addition of staysails, but not truly remedied. It becomes a great curiosity in English shipping that the Bermuda rig with triangular sails was developed in the 17th century, achieving much better performance to windward, but not being adapted to larger sailing vessels. Even in the 19th century, many of the frigates and clippers operating on Indian trade routes continued to use square sailing rigs, although these had undergone some changes since the 17th century (Baker 1983: 6-8). An exception to this was the sloop, although this vessel type was more common on vessels operating in coastal trade rather than trans-Atlantic (Baker 1966: 38-55). Vessels on coastal and inter-colonial routes were more prone to run-ins with pirates though, which may further demonstrate the point, that when English vessels truly needed to be quicker and more manoeuvrable, the technology to achieve this was available and was put to use.

Despite the limitations of the rigging, these ships were perfectly capable of reaching destinations, even when sailing routes against prevailing winds. Although a square-rigged ship cannot sail with a wind angle to hull of less than around 67°, proper use of nearly any wind will allow for some forward progress to be made. Using the northern reaches of the Atlantic allowed them to avoid most pirates and the navies of hostile nations, and even though the ships were poorly suited for these crossings, it was perhaps the best way to avoid loss. As little change was made to the vessels to increase speed and manoeuvrability, avoiding confrontation was the best defence these ships had. Armament was light on merchant ships, and a merchant crew lacking military training would not have been terribly effective against attackers, but the concept of safety in numbers eventually took hold with ships travelling in large fleets along a route already optimised for safety. As tobacco was a once per annum crop, and the lack of ports made it common for vessels to require four months to fill their holds, increasing speeds in crossing does not appear to have been terribly important within the early tobacco trade. This sentiment was previously noted by Shepherd and Walton (1972: 80-83), who identified the lack of centralised trade ports in the Chesapeake region as the greatest hindrances to productivity increases in the tobacco trade.

If ships did not need to become faster, it would suggest that the trade of goods across the Atlantic did not suffer due to ship design or slow crossings. Innovations in ship design could therefore be freed for other areas, such as simplification of rigging to reduce necessary crew, or reduction in materials necessary for ship construction. This clearly exemplifies the need for studies using a multi-disciplinary approach to understanding historical or archaeological topics. Studying these documentary materials is a worthy exercise toward the understanding of trade and ocean voyages in historic periods; however, examinations of hull remains are of equal importance. As these methods are employed on a wider scale, the data assembled through this methodology will become both more useful and significant. Hull design is suspected here as being the cause of slight improvements in crossing times on voyages in favourable winds, but will require large-scale comparative studies of archaeologically investigated merchant vessels for the whole of the 17th century to confirm this hypothesis. It is for these reasons that further archaeological study of historical period ships is necessary to better understand the nuances of rigging and hull design. More modern methods, such as computer modelling are also helpful to these ends, along with experimental archaeology studies utilising reconstructed vessels.

Chapter 6 – The St. Mary's River Archaeological Project: A case study of early colonial maritime archaeology in the Chesapeake

Introduction

The Chesapeake region has long been a major centre for historical archaeology in North America (Davey & Pogue 1979; Kelly 1979; Hume 1983 Miller 1986; Horn 1988; Miller 1988; Riordan 1988; Gibb & King 1991; Shackel 1993; Shackel 1994; Shackel & Little 1994; Yentsch 1994; Deetz 1995; King & Ubelaker 1996; Brush, 1997; Metz 1999; Monroe 2002; Moser 2003; Monroe & Mallios, 2004; Wall 2004; Bell 2005; Graham et al. 2007; Lucas 2008; Gallivan 2011; Horn 2012; Hall 2015). This is unsurprising given its significance in the history of English overseas expansion and long period of occupation by Europeans beginning in 1607. Places such as Jamestown, Williamsburg, and St. Mary's City have been subjected to rather extensive archaeological testing over the course of many decades owing to the foundations and museums dedicated to exploring their histories, and the historical landscape of this region has been very well studied. In contrast though, archaeological investigations of the region's early maritime past have been minimal. Underwater archaeology performed in this region is primarily under a small number of state or federal agencies with groups of avocational divers providing support. To date, no known vessel remains or in-water structures dating to the early colonial period have been identified within the Chesapeake tide-water region.

In an attempt to identify such remains, fieldwork was conducted from 2011 to 2014 on a submerged feature located just offshore from the St. Mary's City, Maryland town centre in the St. Mary's River. The site was identified first in 1994 and was long hypothesised to be the remains of an early colonial vessel (Embrey 1999: 130; Miller et al. 2001: 5-4, 5-19). The work was undertaken as a joint project between the University of Southampton (UoS) and the Historic St. Mary's City Commission (HSMC) with this author serving as principal investigator. The Maryland Maritime Archeology Program (MMAP) and the Institute for Maritime History (IMH) provided additional material support, labour and expertise. The following sections will give background to this site, outline the work undertaken both in the past and for the purpose of this thesis, and provide interpretation of what the site represents and its broader implication to the understanding of maritime activity in the 17th-century Chesapeake.

Historical Background

St. Mary's City, the first settlement of the English Colony of Maryland, was founded in 1634 following a Royal charter granted to Cecil Calvert, the 2nd Baron Baltimore (Miller et al. 2001: 2-6). Human occupation of the land extends back far earlier with Native American sites in the area dating to the early Archaic period (8000-6000 BC) with an apparent continuous period of occupation through the present day (*ibid*.). Earlier occupation is possible, with several known Paleo-Indian sites known in the area (Barse 1985: 22-26; Dent 1995: 75-82; Miller et al. 2001: 2-4—2-5). At the time of arrival of the English colonists in 1634, the land was the site of a Yaocomico Indian village (Miller et al. 2001: 2-6, 2-9). The English negotiated with the Yaocomico for land, and the Natives moved away, half immediately and the remaining half after about 18 months (*ibid*.). Contact between the English settlers of Maryland and Native groups persisted throughout the colonial period, with Cecil Calvert directing that a town known as Choptico—in essence America's first Indian reservation—be established in 1651 to serve as a land reserve for several native groups (King et al. 2014: 1). In 1681, Choptico was officially named as a port of trade in *an Act for the Advancement of Trade* and the Native population residing there were given license to conduct business with English ships (King et al. 2014: 17-18). Settlement of this town by Native groups continued into the 18th century. Although this settlement was located some distance to the north of St. Mary's City, the Native Americans residing here are shown in documentary evidence to have been in regular contact with the English along the lower stretches of the Potomac River, including at Point Lookout at the mouth of the St. Mary's River, where a party of Native Americans from Choptico Town were travelling via canoe to various plantations in the area to build canoes for the English settlers (King et al. 2014: 16-17; MSA 15: 364-373). Findings from a recent archaeological investigation of the site show significant mixing of Native and European culture, materially speaking (King et al. 2014: 45-61, 76).

Upon the arrival of the English in 1634, a fort was erected and the settlement of St. Mary's City began to develop around it (Miller et al. 1999: 2-9). The fort was not long lived, its location remaining one of the lingering mysteries of the city, and a second fort was then erected further downriver near St. Inigoe's Creek (Riordan 2004:202-204). The proprietary family and most of the settlers were catholic, and a Jesuit Mission was quickly founded. Although reliance on a singular trade good for production was initially discouraged, tobacco quickly took hold as the major economic product of the fledgling colony (Morriss: 1914: 21-23). Maryland became known for its production of *Oronoco* tobacco as opposed to Virginia's more preferred *sweet scented* variety, as the soil in Maryland was unsuitable for the large scale planting of *sweet scented* (Middleton 1984: 109-110).

As the Province of Maryland grew and flourished due to its success as a tobacco colony, its population spread along the coasts of St. Mary's, Calvert, and Charles counties (Miller 1986: 174). St. Mary's City remained the most politically important of these, serving as the first capital of Maryland. With St. Mary's City being the centre of politics for the colony, ships wishing to trade in Maryland visited the settlement to register their presence upon entry to the colony (Rhodes 1670-1676 [voyage of *Constant Friendship*]; Wing 1999: 6). Wyckoff (1938-39, 34(1): 48-53) indicates that the numbers of vessels trading in Maryland waters started small at fewer than ten vessels per year, but by the 1670s Maryland was visited by 80-90 vessels trading on overseas routes. Morriss (1914: 85-88), discussing trade from the last decade of the 17th century through about 1715, estimates around 60-90 vessels to have been trading in Maryland on transatlantic routes, and many more on coastal routes. Ships from England would typically arrive in late autumn to early winter, collecting tobacco directly from plantations, and would then return to England between April and June when their hulls had been sufficiently filled (see chapter 3 of this work).

It is unclear how much interaction the colonists had with the sailors and merchants aboard these vessels. It is known that prices for the tobacco were negotiated directly at plantation sites, and goods from England were purchased or delivered when a consignment had been made in the previous year (Middleton 1953: 116-121). Some details of the time spent in the Provence of Maryland are given in the Edward Rhodes log from the voyage of the *Constant Friendship* (see appendix C), providing details of their arrival in St. Mary's City on 21 December 1671 (Rhodes 1670-76, Voyage of the *Constant Friendship*)—'our Master went on Shore at St Marys to cleare ye Shipe'—but provides no additional detail. The next entry shows the vessel leaving St. Mary's after dispatching their business on 30 December, sailing back into the Chesapeake Bay and then into St. Jerome's Creek near the mouth of the Patuxent River. Several entries are given over the following days giving little detail of their activities. On 7, 1672, when they sailed from 'potuxon' (Patuxent River) at 2 in the afternoon, arriving in 'Seavorne' (Severn River) at 2 in the night, located some 40nm to the north near Annapolis, and then the log goes silent for several months. It resumes on March 25 with their location once again being St. Jerome's Creek. At this point they had 550 hogsheads on board, and sent their shallops ashore for tobacco at 'patuxant'. They returned to St. Mary's on 2 April, 1672 loaded the remainder of their cargo, filling their hold to capacity at 724 hogsheads on this date, but did not depart from St. Mary's until 27 April. It can be assumed that the sailors were ashore for at least a portion of this time, but their exact activities cannot be known.

As for the colonists living in St. Mary's City, evidence points to only minimal interaction with the water. Their days were mostly spent tending to a time-consuming crop (Miller 1986: 174). Amongst its residents were politicians, a small handful of merchants, and a few other specialist professionals such as printers and smiths, but by and large, the people living along the edge of the St. Mary's River were engaged in agrarian ventures (Carr et al. 1991: 9-17). A review of probate inventories for ownership of watercraft has yielded few results, although some residents certainly owned boats. William Smith (d. 1668), a merchant and prominent resident of St. Mary's City, had several craft mentioned in his inventory (Table 6-1). Further, the account of the Indian Party mentioned above shows that some settlers were traversing the waterways using canoes crafted by the Native population, and likely home-built rafts, skiffs, and canoes as well.

Table 6-1 - Boats in the 1668 probate inventory of William Smith (MSA. *Probate inventory of the estate of Captain William Smith, 11 August 1668*. TP 3, f, 127-59, ID No. 00156). Value given in pounds of tobacco

Att the Landing	
One old Sloope with two old Suites of Sailes two grapnels one Anchor and all of the rigging to her wit… two Old Small Boates	03000
One hull of an old sloope runn on shoare about the clifts	01000
One new flattbottom boate	00800

Evidence abounds that many colonists relied on the waterways as a source of sustenance (Miller 1986: 176-178). Archaeological sites from this period contain almost ubiquitously oyster shell, and when samples of plough-zone soils are water-screened, fish remains are common finds (*ibid*.). Miller (1986: 176) reports that probate inventories indicate that most households had some sort of fishing equipment, but predominately only line and hooks, with five percent of the homes with fishing equipment having nets or fish gigs. He also reports a general lack of small watercraft amongst the settlers, indicating that fishing was primarily taking place from shore.

Maryland enjoyed a relatively peaceful period throughout the bulk of the 17th century, although there were occasion outbreaks of conflict and hostilities. During the English Civil War (1642-1651), protestant raiders from Virginia, initially led by merchant Richard Ingle aboard the aptly named ship *Reformation*, laid siege to the Maryland colony from 1645-46, causing the Maryland's colonial population to drop from around 500 individuals to 100 (Riordan 2004: 3-4). After nearly two years, order was restored in late 1646, and Proprietary rule by the Calvert family once again took hold. The catholic background of the colony was in fact much of the cause of the issues it faced both during the aforementioned hostilities known as the *Plundering Time* (Carr et al. 1991: 11-12). As the settlement, and indeed the colony, grew, political forces continued to change around it. Just as the colony, located about 6,000km away from London, had been caught up in the hostilities between royalists loyal to Charles I and Cromwell's Roundheads, they continued to be affected by political issues stemming from various forces of factionalism in the motherland. In the wake of a second protestant coup in 1689, itself a manifestation of the *Glorious Revolution* in England, St. Mary's City lost its status as capital in 1694 to the city of Anne Arundel's Town north of the Severn River (Middleton 1953: 49-50; Miller et al. 2001: 2-7). Arundel's Town was then re-named Annapolis, and continues to serve as the current state capital.

During the period between the coup and the moving of the capital, St. Mary's City became largely de-populated (*ibid.*). A small number of families remained in the area, and land was divided amongst these remaining planters (Miller et al. 2001: 2-7). In the mid-18th century, the former colonial town centre was owned exclusively by William Hicks, who sold the land to John Mackall in 1775. The land remained in the Mackall Family, which through marriage transferred to the name Brome in the early 19th century. By 1850, the Brome's labour force included 39 slaves to tend to their crops of grains, tobacco, and livestock (Miller et al. 2001: 2-8). Through the 1860s, they operated an economically successful farm. This family remained the primary landowner until the end of the 19th century, although the St. Mary's Female Seminary was founded on the land in 1840 by the State of Maryland (*ibid*).

At present, the surrounding properties are primarily owned by the Historic St. Mary's City Commission (HSMC), St. Mary's College of Maryland (SMCM), and Trinity Church on the east bank, with several private residences along the west bank (Figure 6-1). The bulk of the east bank property is owned by HSMC and SMCM, both publically funded Maryland institutions, and the adjacent shoreline, 0.4 km north of the site to 1.3 km south of the site is owned and maintained by HSMC. HSMC operates and open air living history museum on this land. SMCM is a residential, four-year higher educational facility with approximately 2,000 students living on campus, and with an active water-front area to the north of Church Point. The river receives significant use by the college, mainly with small sailing vessels and kayaks, although some motorized boat traffic related to collegiate activities occurs on a regular basis. Pleasure boaters frequent the river, but remain predominately in the main channel. The breadth of the river measures approximately 1.2 km east to west from the lateral position of 18ST1647, owing to cove features on either side of the river at this point (Figure 6-2). Occasionally, large river cruise vessels enter the river, turning around in the wide bend of the river just north of the site (Horseshoe Bay). The annual Governor's Cup yacht race, held each August, ends in the St. Mary's River, just north of 18ST647, bringing hundreds of motorised yachts to the area.

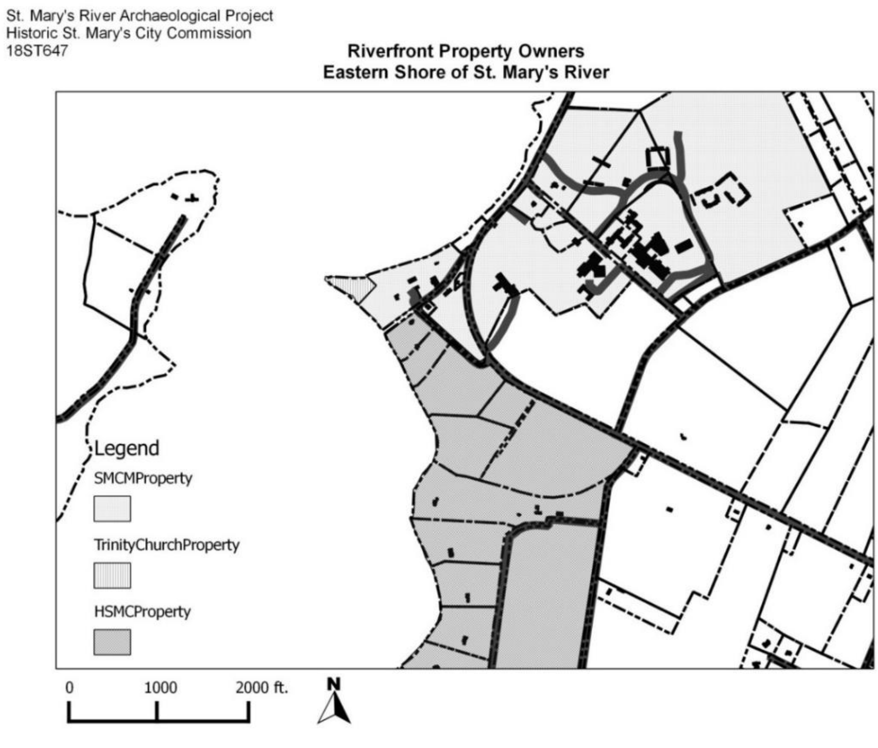


Figure 6-1 - Current Ownership of properties adjacent to 18ST647 (map by S. Tucker)

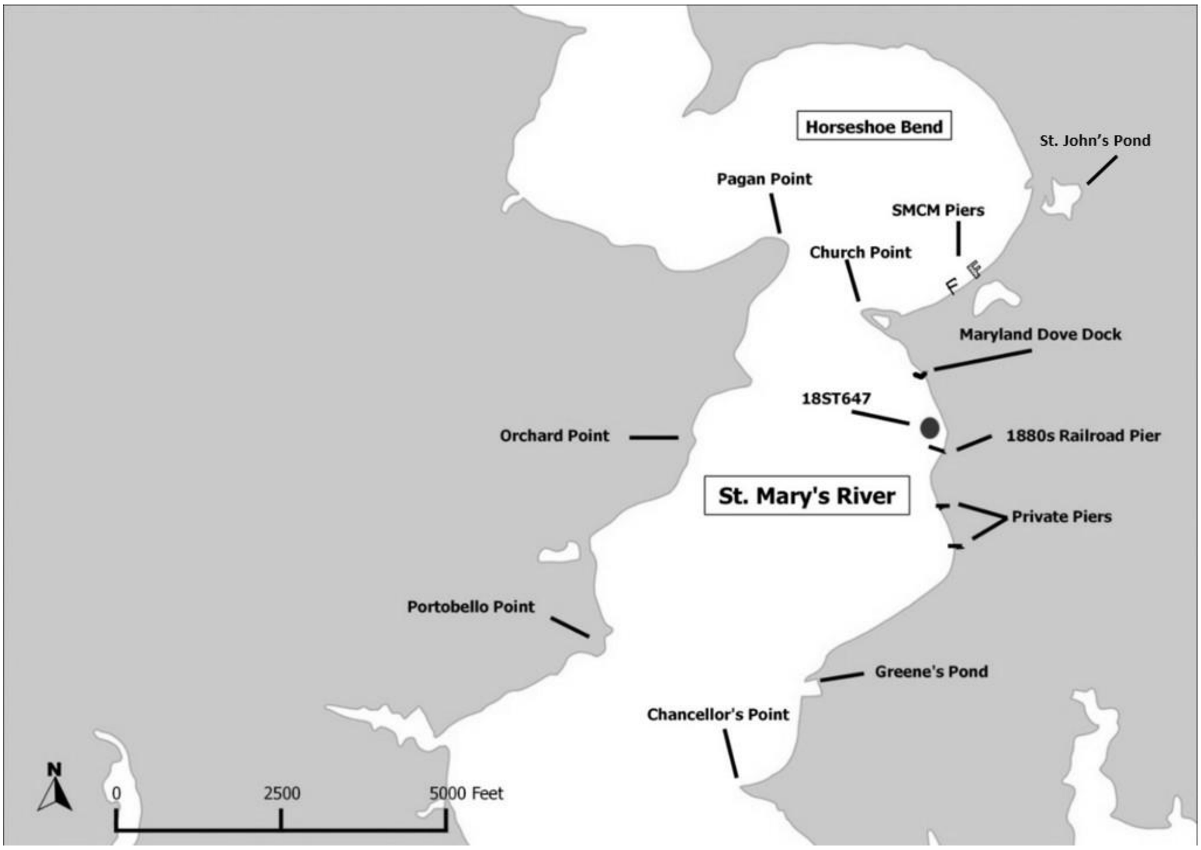


Figure 6-2 - Overview of site area with nearby riverine features (map by S. Tucker)

Commercial fishing boats are frequently observed within the site area and the surrounding areas during the winter months, operating power dredges to harvest oysters (Figure 6-3). Power dredging involves dragging a weighted metal bar, often with teeth, across the bottom substrate. A chain net is attached to the bar to collect oysters, which are lifted periodically onto the boat via wench. An oyster sanctuary exists 500m north of the site area, beginning between Church and Pagan points and extending northward. Downriver, by the mouth of the St. Mary's River, near Cherryfield Point, there is a power dredging exclusion zone. Oyster fishing is permitted in this area, but only via hand-tonging methods. The remainder of the river, including the site area, is within a public oyster fisheries area. An active oyster bar, annually subjected to power dredging, is located directly adjacent to 18ST647.

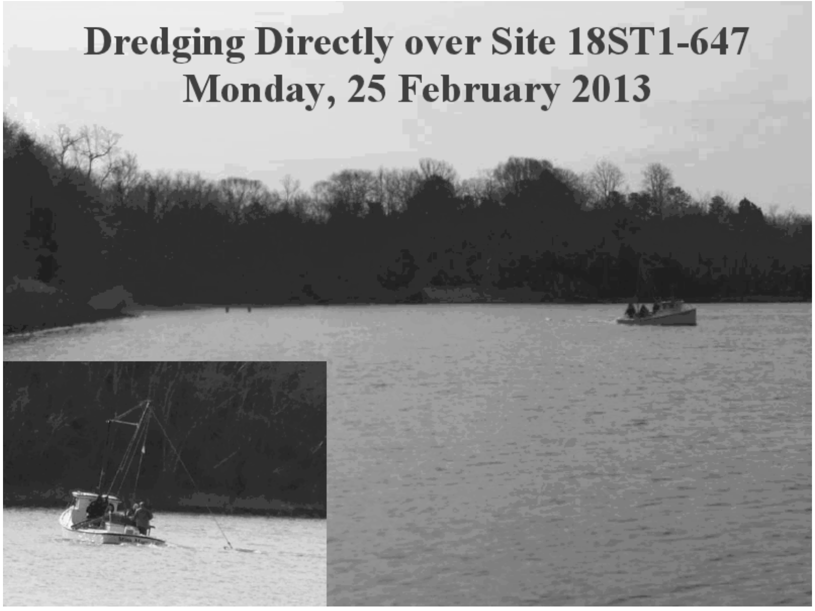


Figure 6-3 - Oyster dredging over the site area (Photographs by H. Miller, used with permission)

Land Usage at Site Area

18ST647 lies adjacent to the colonial town-centre of St. Mary's City, below the cliffs of a plot of land known as Smith's Townland, named after William Smith (excerpt of probate inventory given above in Table 6-1) who owned this land until his death in 1668. The land near the site, being the town's centre, was rather metropolitan in nature. The area would have been a generally high traffic area within the settlement with numerous dwellings in the immediate vicinity, including the Governor's House (Miller et al. 2001: 2-11). Adjacent to the site location, at present submerged, is the head of a freshwater spring, assumed to have been the main supply of fresh water for the town (Miller et al. 2001: 6-5 – 6-6). At present, this is one of only a few beaches along the eastward bank of the St. Mary's River in the town centre area, and has a rather convenient natural ravine leading from the top of the cliffs to the shoreline (Miller et al. 2001: 2-11), providing a potential point of both landing and access to the town in the historical period (Miller et al. 2001: 2-9). This landing is somewhat closer and more convenient to the town centre than the beaches along Horseshoe Bend, but lacking the natural bay for anchorage provided by Horseshoe Bend or St. John's Pond.

There is no evidence for the presence of any in-water or near-shore structures in the area dating to the 17th century. The first instance of such construction comes in the 1840s, when John Mackall Brome had a wharf built to accommodate steam ships, which began to regularly visit St. Mary's City (Miller et al. 2001: 2-17). The wharf was destroyed during the civil war. A new wharf structure and storehouse was constructed in this location in 1872 and remained in use through the 1930s. This second wharf's structure can be seen on a 1910 photograph showing the pier and a storehouse (Miller et al. 2001: 2-19). An additional wharf structure was built in the 1870s at the entrance to Key Swamp, adjacent to the site of 18ST647, to service a railroad which was intended to terminate at this point. Although the land was graded and the wharf was constructed, plans were abandoned due to financial difficulties experienced by the Broome Family (Miller et al. 2001: 2-17).

Land-based Archaeology at St. Mary's City

The first archaeological research at St. Mary's City was carried out in the 1930s by Henry Chandlee Forman, who continued his investigations sporadically into the 1960s (Forman, 1938: ix; Embrey 1999: 51). The Historic St. Mary's City Commission was formally created by the Maryland State Government in 1966, and has been responsible for carrying out archaeological and historical research into Maryland's early past since this time (Poor & Smith 2004: 219). The commission has stewardship of more than 850 acres of land and over 200 individual archaeological sites (*ibid.*). The results of many of the archaeological investigations have led to the creation of exhibits within the open-air museum operated by HSMC, with reconstructed buildings at or near their original location or 'ghost-framed' buildings at site locations. These building frames indicate the presence of many known sites, built in an attempt to recreate the town-centre from its peak period of occupation in the 1670s (*ibid*). Reconstructions of the 1676 state house, the dwelling of local merchant Garrett van Swerengen, a brick chapel from 1667 (rebuilt on its original foundation), William Smith's Ordinary, and William Nuthead's print house have been built for exhibition purposes (figure 6-4), each based on prior archaeological research. To the south of the site near Chancellor's Point is a functioning period-themed tobacco plantation operated by the museum based on the estate of Robert Cole. Northward along Horseshoe Bay, the dwelling site of John Lewger, a prominent early resident, has been excavated and is on display at the St. John's Archaeological Site exhibit.

Figure 6-4 - Reconstructed buildings at Historic St. Mary's City. Upper left: William Smith's Ordinary, upper right: 1676 State House, bottom left: Garrett van Sweringen's dwelling site (ghost frame in background), bottom right: 1667 brick chapel (Photographs by S. Tucker).

With over fifty years of continuous research, a site-by-site overview of archaeological data is not practical here. Instead, prior archaeological and historical research will be discussed in terms of land usage and urban development within the town proper. As virtually all land falling within the jurisdiction of HSMC has been previously used for agricultural purposes, the upper reaches of soil deposits have been ubiquitously disturbed via plough (Riordan 1988: 2-3). With rare exception, stratigraphy here is generally a deposit of topsoil overlaying 20-30cm of plough-zone soils with a mixture of cultural materials from prehistoric periods through to the present time, underlain by a thick deposit of culturally sterile clay referred to as *sub-soil*. Spatial data collected in the city is based on the 1984 US Geological Survey (USGS 84 ft. US) projection, and archaeological units are dug in 10x10 ft. (3x3m) units separated into four 5x5 ft. (1.5x1.5m) quadrants. Current standard practice is to remove soils systematically by strata, with all sediments being sifted through a screen of ¼ in. (6mm) mesh, whereby artefacts are separated from the soils and collection is standardised (Figure 6-5). Upon reaching the layer of subsoil, the unit floor is scraped cleanly via trowel, revealing the presence of any features extending into the sub-soil such as structural post holes, fence lines, or cellars. Drawings of any features are made in the plan view, and features may or may not be excavated systematically. Other methods of survey such as controlled surface collection and shovel test pit survey are at times employed for the purpose of locating sites. Water-screening sediment samples through a fine mesh is occasionally employed, useful for collecting smaller, finer artefacts such as fish remains, pins, or lead shot.

Figure 6-5 – Archaeology in practice at HSMC. Left, two contiguous 5x5 ft. units with numerous subsoil features, overlain by several layers of construction fill and plough-zone deposits. Upper right, archaeologists screening plough-zone deposits for artefacts. Lower right, excavation of a structural post hole feature. Photographs by S. Tucker

The city's early abandonment and its subsequent years spent in a rural setting without significant development has allowed researchers the opportunity to obtain an understanding of St. Mary's City's colonial landscape that is rarely afforded to urban archaeologists. These factors have permitted the city to be examined in terms of overall form and internal structure (Miller 1988: 57, 62). Miller (1988: 64) has found through extensive excavation of the settlement that the city was arranged in a planned method, using a geometric arrangement with the state house and Catholic chapel being significant focal points of the city. This Baroque town plan based the city on two triangles extending out from a singular axis at an intersection of four roads. The northward facing triangle was anchored by the state house and the gaol, and the roughly eastward facing triangle by the chapel and school building. The distance from the town centre to both the state house entrance and chapel entrance are equal at 1,400 ft. (425m). Although the exact locations of the gaol and school are not at present known, evidence points to them also being at a similar distance from the town centre. This has been interpreted as a symbolic representation of the separation of church and state (Miller 1988: 68).

Most of the buildings in St. Mary's City were simplistic post-in-ground structures, and as such, were not long lived, having an estimated lifespan of around 15 to 25 years (Carr et al.: 1991: 91; Graham et al. 2007: 470; Moser et al. 2003: 200). Settlement was likely haphazard prior to the 1660s when the Baroque plan was laid out, and was less urban in nature. The amount of agriculture taking place within the city almost certainly lessened as it became more urban, with only small plots of land being occupied within the town centre. These served as dwellings for government officials, merchants, inn keepers and persons of other non-agrarian professions (Miller 1988: 63). One exception to this may be in a plot of land known as the Governor's Field which likely remained an active tobacco plantation (Miller et al. 2001: 2-9 – 2-10).

The relative urbanity of the landscape here is key to understanding how it was used and how visitors and settlers alike interacted with it. The city was never densely populated. At its peak only around 200 colonists called it home (HSMC n.d.: 12). It was, however, a centre for government and commerce. The governor and general assembly conducted their business there, and the provincial court was held there. Ships visited only briefly to register and pay duties. Although it was the heart of the colony, and a relatively busy place, the vast majority of early Maryland's commerce and trade took place at more rural settings along the shores of the Bay and the Potomac, St. Mary's, Patuxent, and Severn rivers, directly at plantation landings (Morriss 1914: 89).

Underwater Archaeology at St. Mary's City

Archaeological investigations in the St. Mary's River have their roots at a very early period, dating around 130 years prior to the first modern underwater archaeological investigations at Cape Gelidonya (Bass 1961). In 1824, Father Joseph Carberry, a Jesuit priest from the St. Inigoes Parish, undertook a search for cannon that were housed at the Fort of St. Inigoes (Schomette 1998:482). Carberry was able to locate and raise several cannon from the site, one of which now sits outside the Maryland State House in Annapolis and another which is on display at HSMC along the path to the chapel. These cannon are perhaps the original guns brought aboard the Ark and the Dove upon their 1634 voyage to Maryland bringing the first colonists. While Father Carberry's methods were not up to modern standards, recording next to nothing of the undertaking, it can be argued that this effort was archaeological in nature in that it was driven by an intellectual curiosity of the past settlement rather than for monetary gain.

The first controlled underwater archaeological investigation in Maryland was undertaken in 1969 under the direction of Alan Albright of the Smithsonian Institution's Underwater Archaeology Section, and conducted by Melvin Jackson (Jackson 1969). The research was intended to locate remnants of wharves, piers, and ship anchorages relating to the 17th-century settlement. This included three test pits dug in the river bottom at a minimum of 80m or more off shore, at a depth of 1.6 to 2.6 m. No finds of cultural importance were made during this testing, and vegetation prevented testing of the near-shore area. Sedimentary data was collected, but no artefacts or sites were located. One particularly pertinent outcome of this testing showed that the bottom substrate in each of the test areas consisted of a loose layer of silt approximately 15-30cm thick overlying a layer of marine clay which became increasingly compacted with depth (Jackson 1969: 1; Embrey 1999: 54).

Researchers for the Historic St. Mary's City Commission conducted shoreline testing in the following years; however, most research in the river was site-specific and partially with the goal of gathering museum display pieces. Few finds were made in the river and a lack of funding caused underwater research to be abandoned (Embrey, 1999:51). In the late 1970s, HSMC planned to install a pier for the newly constructed *Maryland Dove*, a replica of the smaller of two ships that brought the first colonists to Maryland. Donald Shomette undertook a survey project in support of the proposed dock and located and recorded the remains of a previously unknown wharf and a wooden vessel (Schomette 1978). The vessel has been determined to be a sailing craft dating from the late nineteenth-century that was pulled against shore and abandoned. The wharf was determined to likely be associated with this vessel (Embrey 1999: 65). These finds caused the location of the dock to be moved slightly to avoid these features.

A palynological and geological study was conducted in 1981 to gather data on the St. Mary's City shoreline in the areas of the Broome/Howard wharf and in St. John's Pond (Kraft & Brush 1981). Through this research, it is estimated that the water level has risen around 50cm since 1634, and showed the shoreline to have moved slightly toward the shore. Shoreline erosion has acted from the opposite direction in shoreline change, further pushing back the present day shoreline.

Site Location and Environment

18ST647 is located underwater in the St. Mary's River, a tidal tributary of the lower Potomac River. The water is brackish and subject to tidal currents, although these are rarely strong. Water temperatures range between 0°C (32°F) in the winter months and 30°C (86°F) and higher in the summer (Paul 2008: 19). Salinity in the river varies between 10 and 20 ppt (Paul 2008: 22). The bottom substrate consists mainly of sand and silt with heavy concentrations of oyster shell throughout. In previous visual inspections of the site, it has been found both exposed and buried the layer of lose sediment, apparently the result of storm activity (Embrey 1999:102). The temperature and salinity of the river make it a hospitable environment for shipworm (*Teredo navalis*) and other marine borers during the warmer months, causing potential detriment to exposed wooden objects.

The locations of archaeological sites are considered privileged information in the State of Maryland. As such, coordinates for 18ST647 will not be given here, but can be obtained through the Maryland Historical Trust. For this work, it will suffice to say that the site lies approximately 45 m from the present shoreline below a cliff feature near the St. Mary's City town centre.

The surface layer of the river substrate over the site was observed in 2013 extending to a depth approximately 15-20cm (6-8 in.), consisting of a sandy silt loam, mixed with pebbles, broken shell, and heavily included with full shells from both living and deceased oysters (*Crassostrea virginica*). Below this lies a dense layer of medium grey marine clay. This is consistent with the findings from the 1969 survey discussed above (Jackson 1969: 1; Embrey 1999: 54). Numerous handmade bricks have been observed exposed on the river bottom near the site area, with some modern debris present.

Site Specific Archaeology: 18ST647

Past exploration of 18ST647 has been carried out by MMAP, a graduate researcher from East Carolina University (ECU), James Embrey, and HSMC. Their contributions consisted as a base for the research carried out for the purpose of this dissertation, adding spatial, environmental, and material cultural foundation to this study, and provided a working hypothesis for potential site interpretation. Their work consisted of an initial remote-sensing survey, test excavation, and a subsequent site mapping and shoreline survey project, followed by semi-annual site reconnaissance. MMAP and HSMC both provided substantial material support and advice on the work outlined herein. Embrey unfortunately passed away in 2004, but his 1999 master's thesis provides a thorough outline of his work on-site.

The Maryland Maritime Archeology Program undertook a five-day reconnaissance survey of the St. Mary's River in April, 1994 (Thompson 1995). The methodology of this survey involved collection of side-scan sonar data along the shoreline and visual inspections by divers of select anomalies. Two historic period sites were located in the course of this survey, one of which was identified as a potential colonial period site and given the designation 18ST647. The second site is the aforementioned remains of a 19th-century sailing vessel. 18ST647 was described at the time as a heavy concentration of riverine ballast stone in a 10x10m (33x33 ft.) area a distance of 22m (75 ft.) from the shore (Thompson 1995:22). Brick and mortar were noted within 4m (15 ft.) of the site at this time. In August 1994, the site was revisited by Jim Embrey and Bill Faxon on MMAPs behalf, and a 1x1m area was tested via hand-fanning to a depth of 0.5m. No map or other spatial data are provided for the location of their test area. Thompson states that an early kaolin pipe bowl fragment was found within the stone concentration, and suggests that the concentration could represent a ship's ballast, noting that additional future testing may determine the site's eligibility for inclusion in the National Register of Historic Places (NRHP).

Embrey later states that the testing of the site yielded fifty-eight stone cobbles and three paving-sized red brick bats, measuring about 1.5 in. (3.8cm) thick and 3.5 in. (8.9cm) wide (1999: 67). Two of these bricks were found in the upper reaches of the ballast, and the third found within, making their association with the site affirmative (Figure 6-6). Embrey describes a single white-clay pipe stem found near the site, although the association of the pipe stem to the site is uncertain. The bore diameter is given as 8/64 in. (3.175mm). Embrey makes no mention of a pipe bowl, nor is one found amongst the artefacts in the collection at HSMC. It is likely that the pipe bowl was misreported by Thompson.

Figure 6-6 - Artefacts recovered from the 1994 test excavation (photograph by S. Tucker)

In 1997, Embrey, then a graduate student at ECU working with researchers from HSMC, undertook a survey designed to identify the 17th-century shoreline of St. Mary's City. Having previously tested 18ST647, Embrey focused some attention on the submerged lithic concentration, attempting to further map and identify the site. In the MA thesis that followed, Embrey describes the concentration as running almost parallel to the shoreline, approximately 110 ft. (33m) offshore, and beneath 6-10 ft. (2-3m) of water (1999: 67, 102). Embrey describes the paving sized bricks as 'sugar brick,' a term used mainly by researchers at HSMC. Sugar bricks are a small red brick, believed to have been imported to Maryland from the Netherlands during the 17th century, given their size and frequent appearance within 17th-century contexts in St. Mary's City. The name is derived from the fine, sugar-like texture of the clay used to make the bricks. The size is consistent with that of Flemish yellow bricks, also imported to the Chesapeake throughout the 17th-century, this being the main evidence suggesting Dutch origin. According to Hume, a Flemish yellow brick measures on average 7 1/8 in. x 3 1/4 in. x 1 3/8 in. (18x8.2x3.5cm) (1969: 82-83). The bricks recovered from Embrey's test area can only be measured in their width and height dimensions due to their incomplete nature. These measure 3 1/2 in. x 1 1/4 in. (8.9x3.2cm), very similar to the size of Dutch bricks described by Hume. This artefact type is represented in numerous sites in the city. Embrey describes a white clay pipe stem with an 8/64 in (3.175 mm) bore found near, but not within, the stone concentration. The collection of artefacts for this site has two pipe stems labelled as originating near 18ST647, with bore holes measuring 8/64 in and 7/64 in. (3.175mm, 2.78mm). It is likely that the second pipe stem was overlooked during the writing of Embrey's thesis.

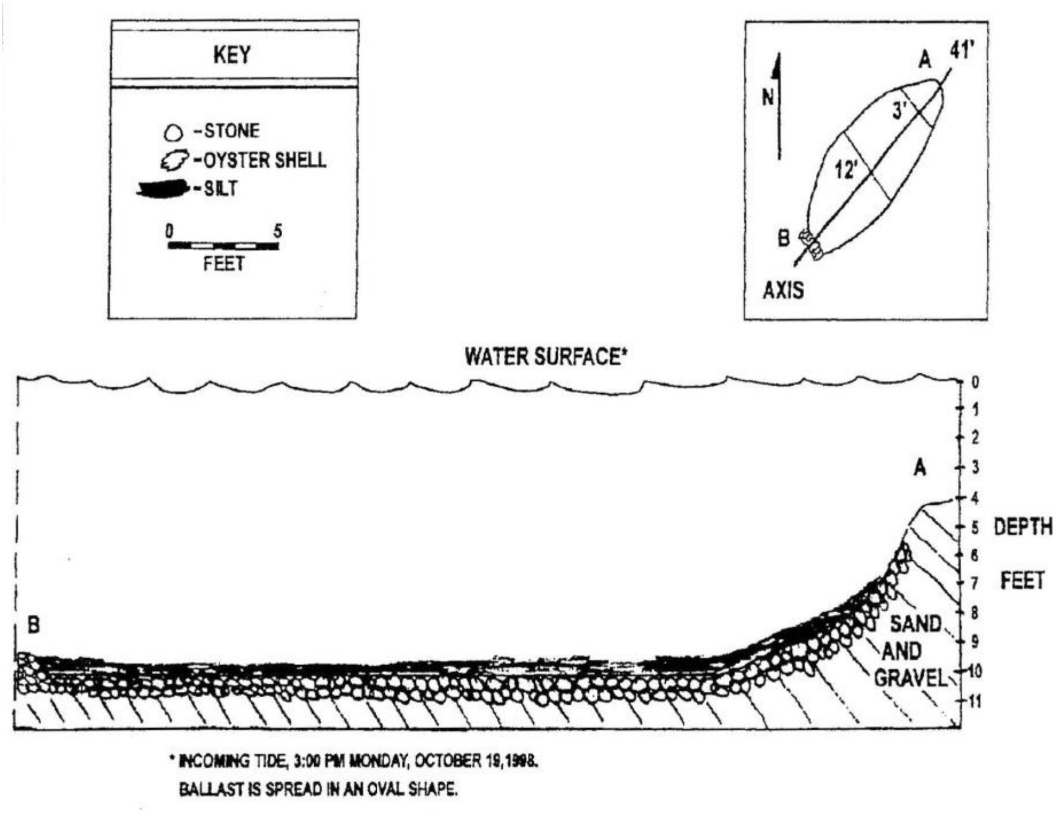


Figure 6-7 - Profile and plan of 18ST647 (Drawn by J. Embrey: Embrey, 1999: 104)

During the re-examination, 18ST647 was mapped, although this process was hindered by 15-30cm (6-12 in.) of sediment overlying the site (Embrey 1999: 102-105). Embrey describes the inshore edge of the feature resting beneath 2m (6ft.) of water, and the concentration extending at least 12.5m (41 ft.) in a southerly direction, ending in 3m (10 ft.) depth (Figure 6-7). Mapping was performed via visual inspection, using probing rods where necessary to delineate the edges where obscured by sediment. The deeper end of the concentration could not be adequately mapped due to excessive oyster shell overlying the site, but was suspected at the time to extend further. The width of the site was found to range from 1-4m (3-12 ft.). Metal detector survey over the ballast concentration yielded no indication of ferrous material. Samples of the ballast stone recovered in 1994 were examined by Dr. Gerald Johnson, a geologist at the College of William and Mary, Virginia, who identified the stones as European in origin, but no additional details are given in any of the reports. The recovered ballast stones have been subsequently lost, making further petrological analysis or description from these samples impossible.

The next phase of fieldwork was undertaken in 2000 by HSMC, and included an extensive Phase I survey of the St. Mary's City shoreline for the purpose of assessing potential cultural resources. 18ST647 was not subjected to new surveying or testing during this fieldwork, but additional details and suppositions of the data from the past surveys are given in the site report (Miller et al. 2001), and a new map plotting the location of the site was rendered (Figure 6-8). It should be noted that there appears to have been some confusion of the site number in this report, with 18ST647 often being referred to as '18ST1-641,' although it is clear through the description of the sites and location that both numbers refer to the same feature. Part of this confusion is likely to stem from site numbering practices in Maryland. The number 18 denotes the state of Maryland, and ST the county of St. Mary's. St. Mary's City as a whole was given the designation of 1, and sites within St. Mary's City are then given an additional number. A typical St. Mary's City site would then be 18ST1-13 (Town Centre), whereas a site in another location in St. Mary's County would be written simply as 18ST647. Underwater sites, however near to St. Mary's City they may be, do not fall within the designation of 18ST1, which could cause confusion for persons not accustomed to working with numbers outside of 18ST1. Writing 641 instead of 647 is likely simply an error of reading or typing.

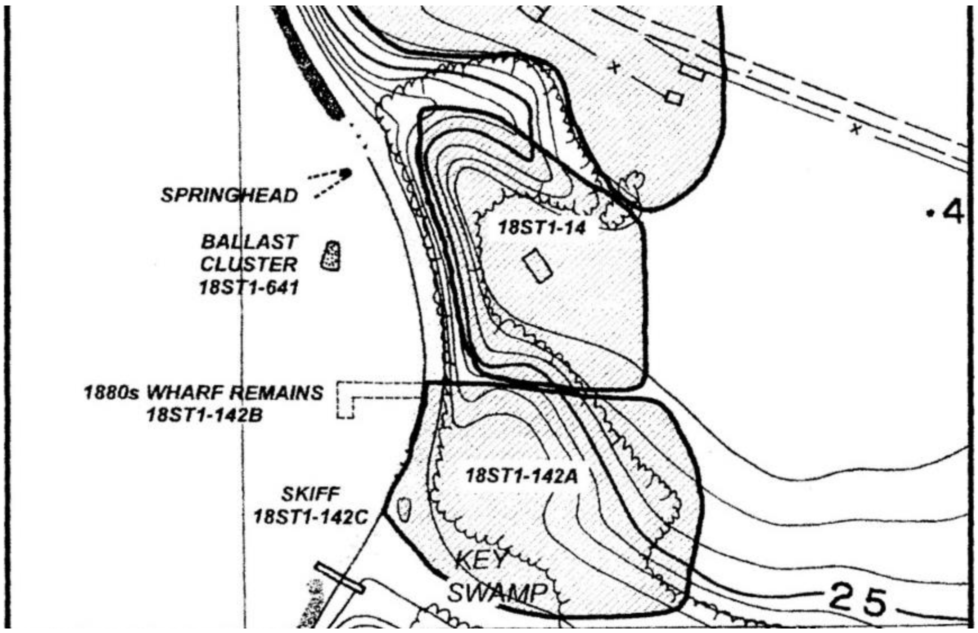


Figure 6-8 - Location of 18ST647 as mapped in 2001 (Miller et al., 2001: 6-5)

A springhead found during the 1997 survey and located very near to the stone concentration is presented here as likely being the main water supply for the 17th-century settlement, referred to in the 1666 survey laying out Smith's Town Land (Miller et al. 2001:6-5). This would indicate that the springhead was not submerged in the 17th century, pushing the earlier shoreline further into the river. The implication of this is that the ballast cluster is believed to be resting against the 17th century shoreline (Miller et al. 2001:2-30). Readily available shoreline data for GIS programs for the shoreline in 1853 confirm that this area was roughly the location of the shoreline as late as the mid-19th century (figure 6-9). The ovate pattern of distribution is cited to suggest the stone concentration to be ballast from on board a vessel, rather than off-loaded ballast (Miller et al. 2001:5-19).

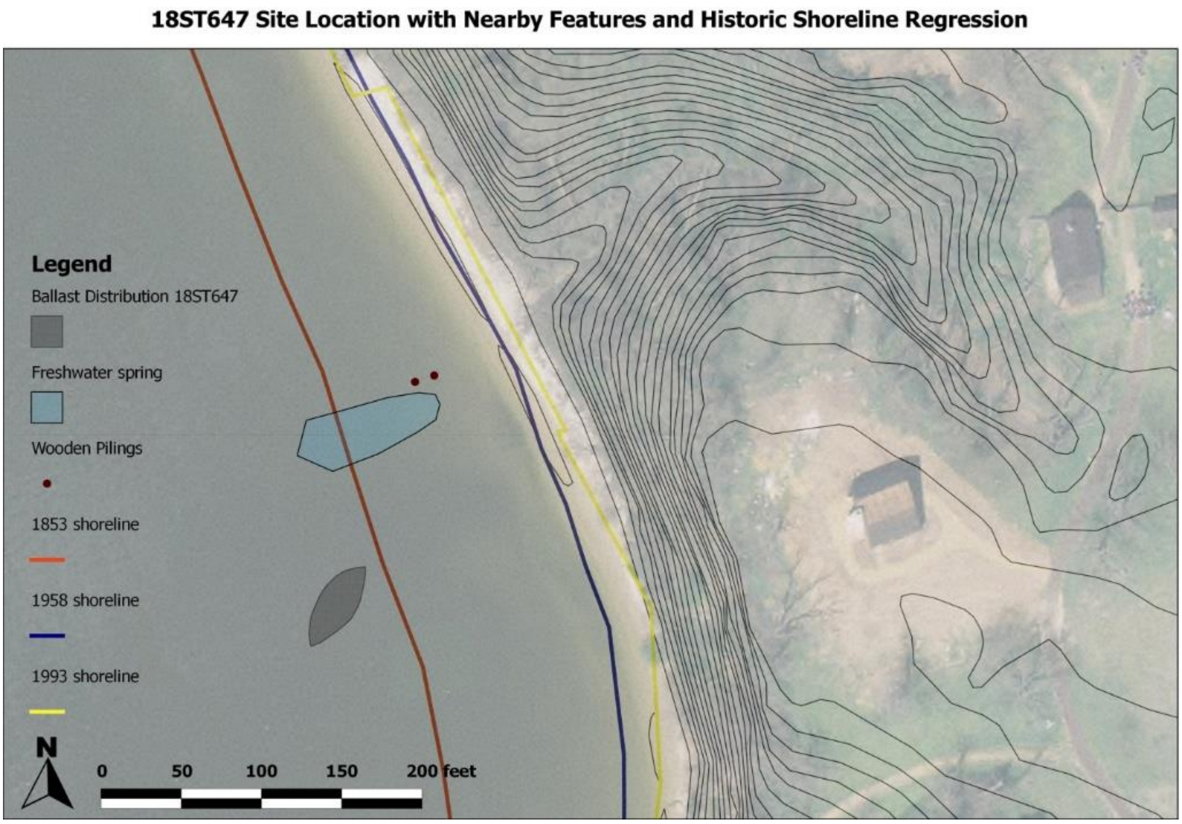


Figure 6-9 - 18ST647 and historic shoreline regression (map by S. Tucker, Data from Maryland Geological Survey)

Informal visual inspections continued on 18ST647, led by Embrey until his death in 2004. The purpose of this was to monitor the site for change. No formal reports were made of these observations, but details were passed orally to researchers at HSMC. During this time, the site was observed as being periodically covered and uncovered by fluvial forces. The site was seen largely uncovered following Hurricane Isabel in 2003. Several storms of comparable force have struck the region in the years since Isabel, although no annual monitoring of the site has occurred since 2004, so the effect of these storms is not known.

St. Mary's River Archaeological Project

The St. Mary's River Archaeological Project (SMRAP) began in 2011 with the primary goal of further investigating 18ST647. The major project objectives were to obtain a firm date for this site, determine if the site does indeed represent the remains of a vessel as has been theorised, and to formulate a site management plan if the site is a significant cultural resource, including nominating the site to the NRHP. Fieldwork was undertaken in the summer months of each consecutive year from 2011 to 2014. The work included reconnaissance survey in 2011, systematic surface survey in 2012, systematic site testing in 2013, and a sub-bottom profiler survey and diver inspection in 2014. Side-scan sonar was also utilised each year of the survey.

Field Season 2011

Early in 2011, a plan for fieldwork to be undertaken on 18ST647 was discussed by this author with HSMC Director of Research, Dr. Henry Miller. It was decided that a series of fieldwork seasons would be undertaken, each building off the previous, to re-locate and assess the site. Work began in April 2011 to lay the groundwork for the next field seasons. Goals of the 2011 survey included establishing datum location markers on the beach near the site area, locating the site, and attaining accurate geospatial coordinates for relocating and mapping the site in the future (Tucker 2011).

Work was performed primarily by the author, then under the sole affiliation of HSMC, with assistance from local archaeologists Scott Strickland and Patrick McKitrick. Two days in April 2011 were spent attempting to establish locational markers on the beach. This had been attempted before in past surveys, but heavy vegetation on the cliffs above the beach proved prohibitive to these efforts. The early spring start was intended to bypass the vegetative issues in setting accurate points using a TOPCON Total Station. Beginning from a known USGS datum nearby, a series of points were surveyed until reaching the cliffs, from which two points were set through the trees and onto the beach below. These were intended for use in planned surveys in the upcoming years.

The following day was spent on visual diver inspections of the conditions of the river an attempt to locate the site. A large area was covered, but no visible sign of the site could be made. It had been mentioned that one indication of being near the site was a decrease in water temperature from the flow of the submerged springhead. As surrounding water temperatures were quite cold and the divers were clad in dry suits, this location could not be observed at this time through a change in water temperature. No vegetation was observed in the site area, and the substrate was noted as a silty sand layer with an abundance of oyster shell. Following several hours of unsuccessful searches, the site was assumed to be covered by sediment, necessitating alternate means for locating the site. In June 2011, it was discovered that one of the survey stakes placed during the April fieldwork had been removed by an unknown person, rendering the second survey marker useless as there was no longer a means of aligning the transit to the established grid.

The site was revisited in July 2011, this time including David Howe and Dawn Cheshaek of the Institute of Maritime History (IMH), then being formally associated with the project. Using a Hummingbird sonar device, large linear transects were made on the river searching for indication of the site. A GPS unit was linked in to the sonar, giving a location of the boat for the sonar, although an approximately 10 second lag existed for the GPS signal from the boat's actual location, meaning images and location were not precisely synchronized. Additionally, the GPS receiver was set several meters forward from the sonar transducer, further introducing error in location.

Sonar imaging revealed a number of anomalies, being mostly linear features already identified by Thompson in 1995, and observed by divers to be fallen pilings of a 19th century pier structure. None of these linear objects appeared to be associated with 18ST647. One image showed a faint oval-shaped feature approximately 18m in length and 8-10m in width, near the location mapped in earlier surveys (Thompson 1995:21-22; Embrey 1999:67, 102-110; Miller et al. 2001:2-29 – 2-30). A buoy was deployed in this area, which was then investigated by divers. The bottom substrate of this area was found to be silt with a heavy concentration of oyster shell. Heavy oyster shell concentrations were present in all areas investigated by divers at this time, far larger than the sonar anomaly, making it unlikely that the signature from the sonar image was simply an oyster bed. Two handmade bricks of a size roughly consistent with sugar bricks were observed in the vicinity of the sonar anomaly resting on the riverbed. As this artefact type is known to be associated with 18ST647, it was believed that the site had been located, despite no ballast having been physically observed. This was the final phase of fieldwork undertaken at this phase, and planning began for a second season of survey to follow in 2012.

The location of the anomaly (Figure 6-10) is close in relation to the position of the ballast distribution as mapped during the 2001 shoreline survey (Miller et al.:6-5), and appears to be in very close relation to the ballast distribution as it was found in 2013. It is, however, at a false orientation to the site as it is now known, and the signature is characteristic of a soft feature rather than the brighter return which would be expected from a hard surface. Diver investigations have revealed a bed of soft silty sand with seagrass in the area adjacent to the spring head, providing a possible explanation for this area of darker return. Based on this evidence, it can be assumed then that the feature in Figure 6-10 is not 18ST647 as previously thought.

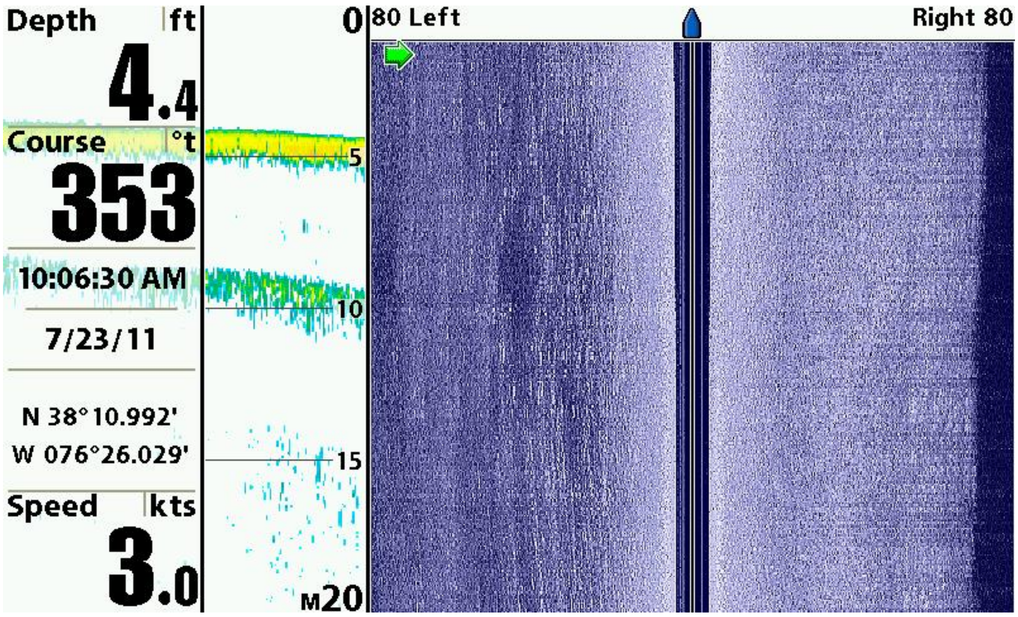


Figure 6-10 - 2011 sonar image of presumed ballast distribution (centre left)

Field Season 2012

In May 2012, a new phase of fieldwork began on site, again attempting to create a site map with an accurate location of the stone concentration (Tucker 2012). This marks the first season of involvement from researchers associated with the University of Southampton. Firstly, new survey markers were set on the beach near the site area. This was accomplished with the efforts of a local professional surveyor, Kevin Norris, on 31 May, 2013, using a TopCon RTK device. Eight consecutive days were spent in the river, from 3-10 June. The fieldwork began with visual inspections. Despite Hurricane Irene's heavy impact to the area in September 2011, the site appeared to have remained covered. A thin, 2 m fiberglass probe rod was used in hopes of locating the site beneath the substrate, although due to heavy oyster shell concentration, this method proved ineffective. Calculations of distances from known objects to the previously mapped site were made via GIS mapping software. Following visual inspection of this area, several handmade bricks, some with the appearance of sugar brick (Figure 6-11), and stone cobbles were observed. At the time, this was determined to likely be the site area, and an attempt was made to delineate the site based on what could be visually observed, probing inspections, and observations and maps from previous researchers. After marking out a site area, the locations of the site were taken (Figure 6-12). Due to time limitations with a Total Station on site, artefact locations could not be captured using this device, meaning the only artefacts that could have their geo-spatial locations described were those falling within the gridded site area, as their locations could be plotted with a reasonable accuracy. Numerous un-plotted bricks and stone cobbles were observed just outside of this area.

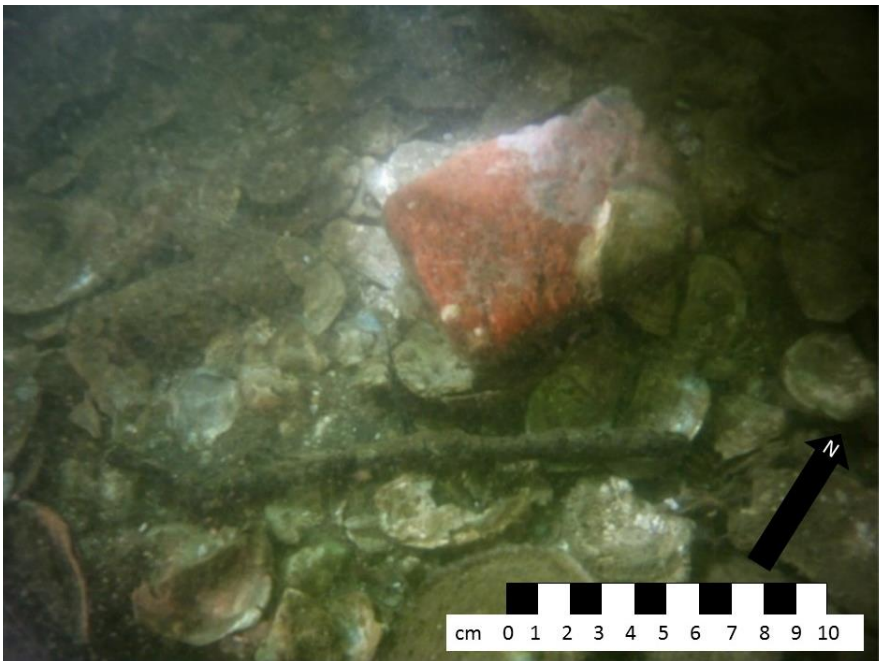


Figure 6-11 - Dutch sized red brick observed in the survey area, June 2012. Pattern of shell encrustation indicates that the brick was recently moved from a partially buried, vertical orientation in the riverbed (photo by S. Tucker)

Three bricks and three stone cobbles were removed from the site. These are housed in the collection of archaeologically curated goods from St. Mary's City. Dr. Henry Miller of HSMC analysed the faunal remains adhering to these artefacts and concluded that they were not exposed for a significant period of time prior to collection; they likely were exposed within the last several years. The cobbles were examined by Professor David Peacock of the University of Southampton, who identified the stones as quartzite, a rather ubiquitous lithic type for which sourcing is nearly impossible in all cases. These stones are most likely of native origin; as subsequent work has observed numerous similar cobbles sporadically scattered about the river. Miller et al. (2001:2-2) describes the availability of quartzite cobbles in the streams and riverbanks around the St. Mary's region.

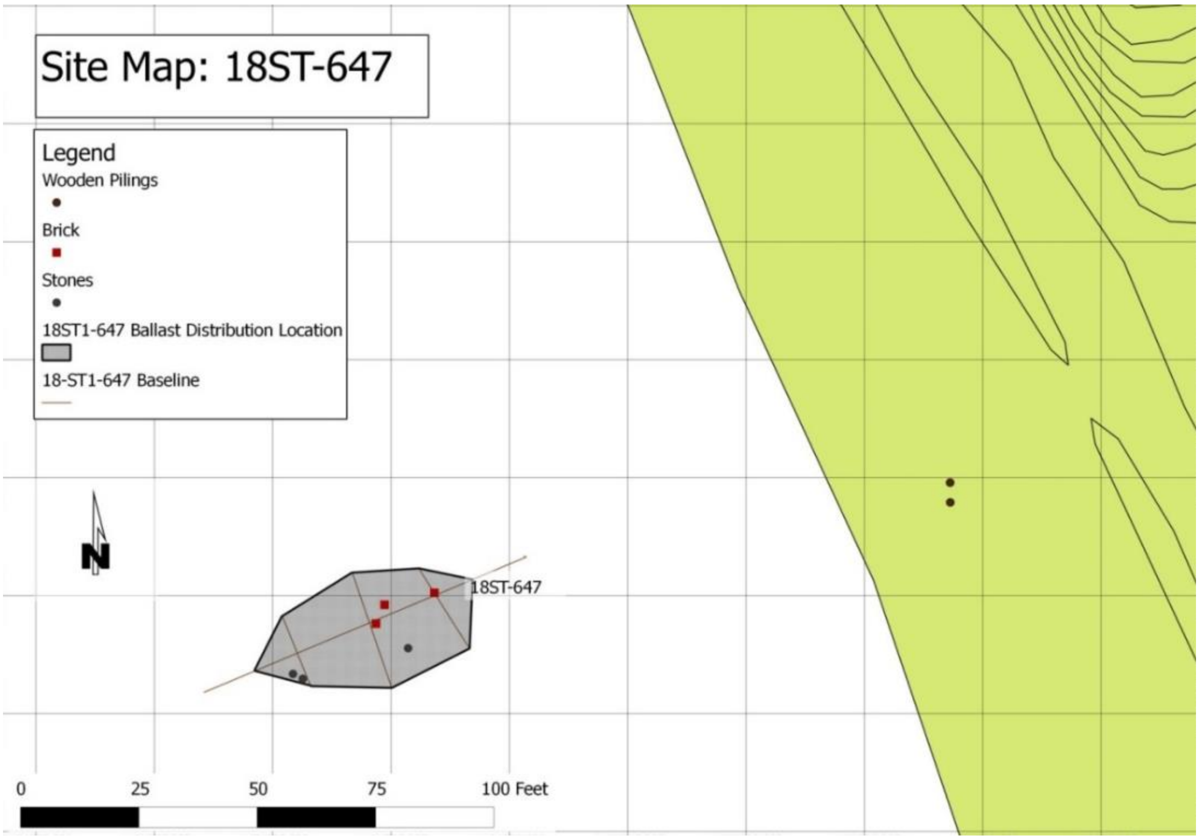


Figure 6-12 - Survey area as mapped in 2012 (map by S. Tucker, for map containing spatial data, see site reports on file with MHT and HSMC (Tucker 2012; Tucker & Howe 2013))

Figure 6-13 - Location of concentrated survey efforts in 2012 in relation to the ballast as mapped in 2001 (map by S. Tucker)

It has since been determined that while this area had overall a concentration of colonial-period artefacts, this location does not match with either the previously recorded site area or the re-calculated position of the side scan anomaly identified as 18ST647 (Figure 6-13). The concentration of artefacts present on the surface of the riverbed appears to be approximately 30m (100 ft.) north-west of the area previously mapped as the site area. As oyster harvesting is known to occur in this area in the form of power dredging, it offers one explanation for the scatter of exposed artefacts.

Field Season 2013

Prior to excavation efforts beginning, a new sonar survey was conducted on 11 June 2013 in conjunction with MHT to identify and define the site area. A Sea Scan 600kHz side-scan sonar was used to examine the site area and other coves along the eastern bank of the St. Mary's River. Despite running seven transects over the expected site location, no anomalies were noted anywhere near the area described by Thompson or Embrey. Another possible site was noted during the course of the survey, having a very strong sonar reflection indicating a hard bottom in a linear distribution, approximately 18x6 m (60x20 ft.) (Figure 6-14). It is possible that this is an area of heavy oyster shell; however, this has not been confirmed through visual inspection.

As no indication of the site was given via remote sensing, reconnaissance dives were made on 14-15 June, 2013 to search for any exposure of ballast material, or a concentration of artefacts. Two areas were identified to focus the search efforts. The first was the area indicated by Thompson, just south of the two exposed pilings, and the second in the area indicated in the 2001 HSMC shoreline survey. Neither area yielded visible artefact concentrations, but an area between the two points was noted as having features similar to those described by Embrey. This area was chosen, despite not matching with previous site maps, as it seemed the better fit, and a rigid grid was deployed over this area and mapped in place.

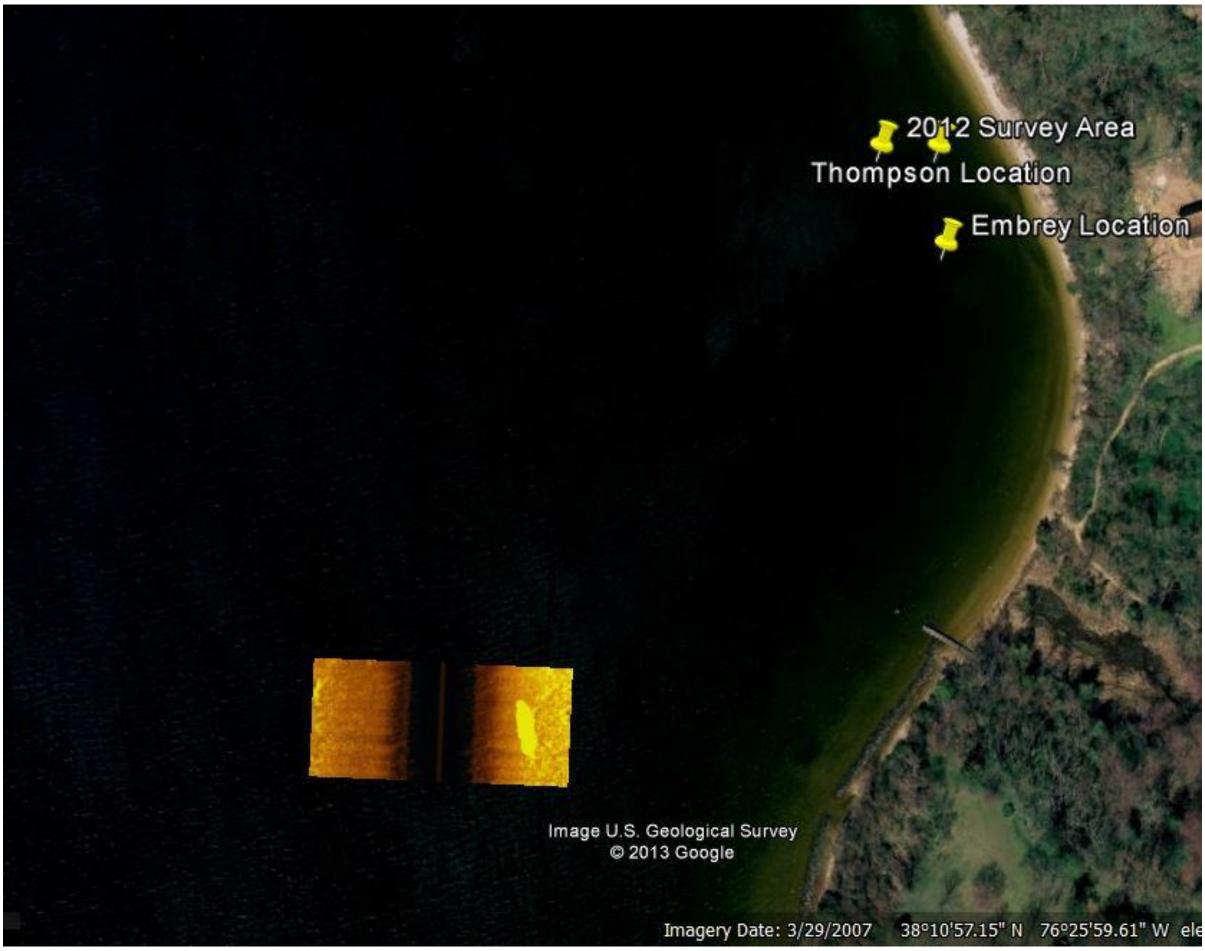


Figure 6-14 - Sonar anomaly south of site area. Pins indicate location of the site as reported by previous researchers and the 2012 survey area (map by S. Tucker)

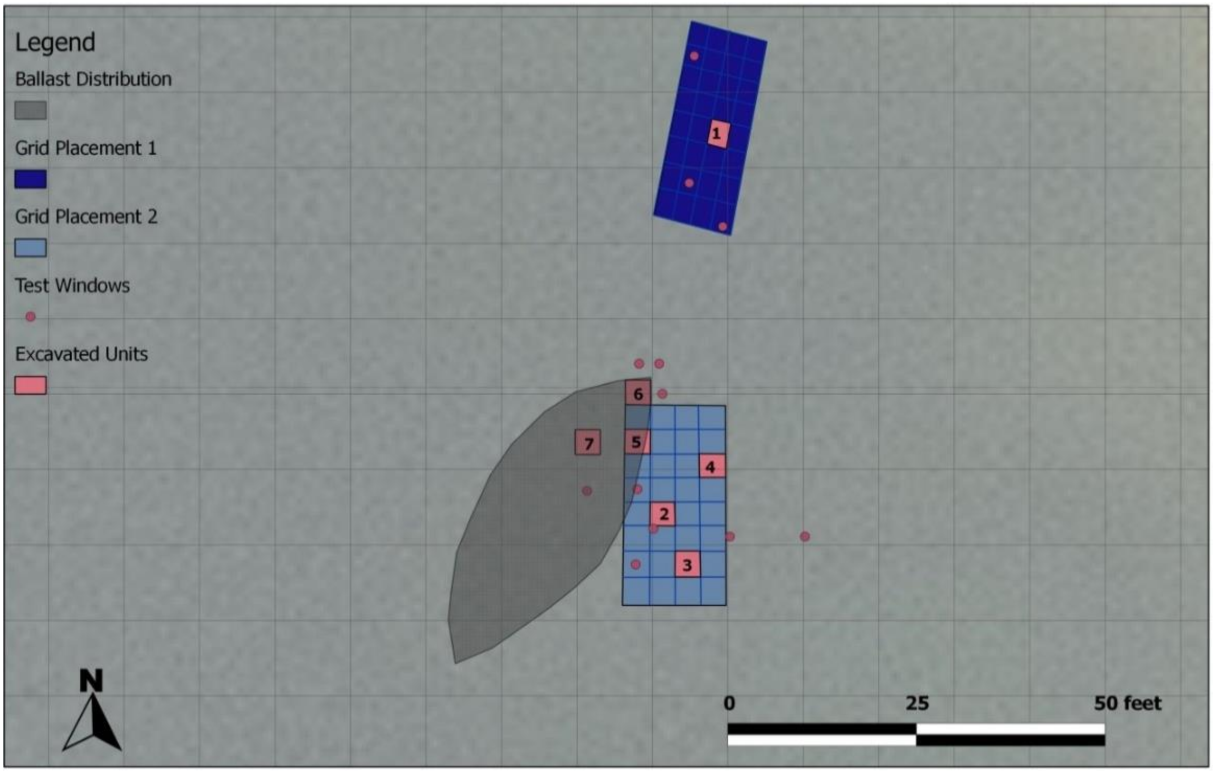


Figure 6-15 - Excavation grids, test units, and test windows with the presumed map of ballast distribution 18ST647 (map by S. Tucker, map with spatial data available from the Author, or from the field reports on file at HSMC and MHT)

Excavations efforts began on 19 June and one test unit was excavated in this area (Figure 6-15). One fragment of handmade brick was found in this test unit, but no ballast material was present. It was decided that several test windows, similar to shovel test pits common on terrestrial sites, should be made around the grid area, as the number of permitted test units was limited. Each test window measured approximately 35cm in diameter, and was hand excavated using fanning techniques to a depth of around 15-20cm. Artefacts found in test windows were to be left *in situ* and reburied with sediments. No indication of ballast material or other artefacts were found within the grid area. A decision was then made to attempt this same methodology in the area south of the grid, around the area mapped as the site location in the 2000 HSMC survey. Three places were marked using trilateration from the exposed pilings to fix their locations, and the areas were tested. The two more westerly locations were positive for non-native cobbles and handmade brick, indicating that this was the site area. This was 7m west of the area mapped in the HSMC shoreline survey, which was also tested in this phase with negative results. Based on what was found, the grid was moved to fit within the two positive test windows.

Excavations resumed, and three more areas were opened (Test units 2, 3, and 4). Each of these units contained ballast stones, but not the heavy concentrations reported by previous researchers. What was found would be better described as a scatter than a concentrated distribution. Test unit 5 moved to the northwest area of the excavation grid, and exposed a heavy concentration of cobbles running through most of the unit. The southeast potion of the test area was virtually cobble free, indicating that this unit was on the edge of the main feature, which was running southwest as indicated by Embrey (Figure 6-16). The ballast showed signs of ordered stacking, with larger cobbles at the top of the feature (Figure 6-17).

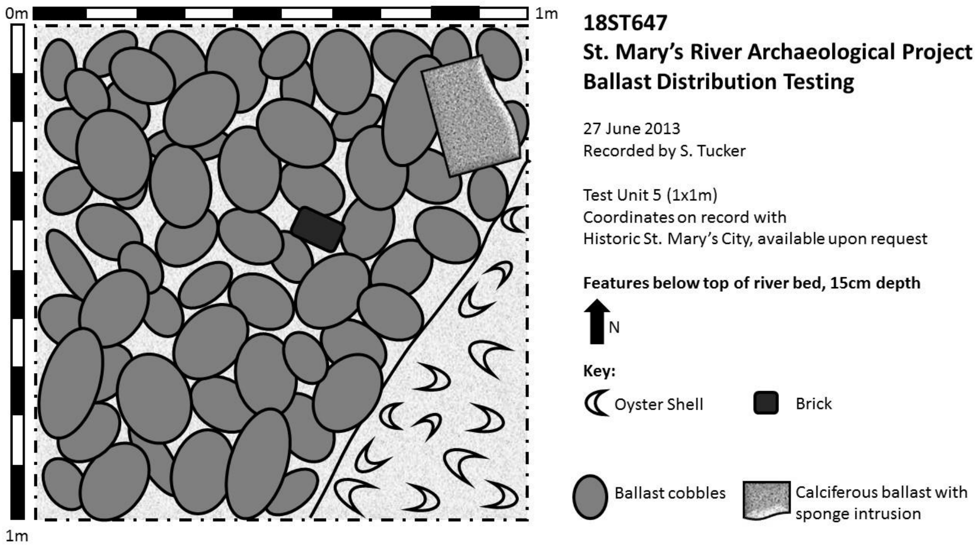


Figure 6-16 - Plan view of Test Unit 5 (graphic by S. Tucker)

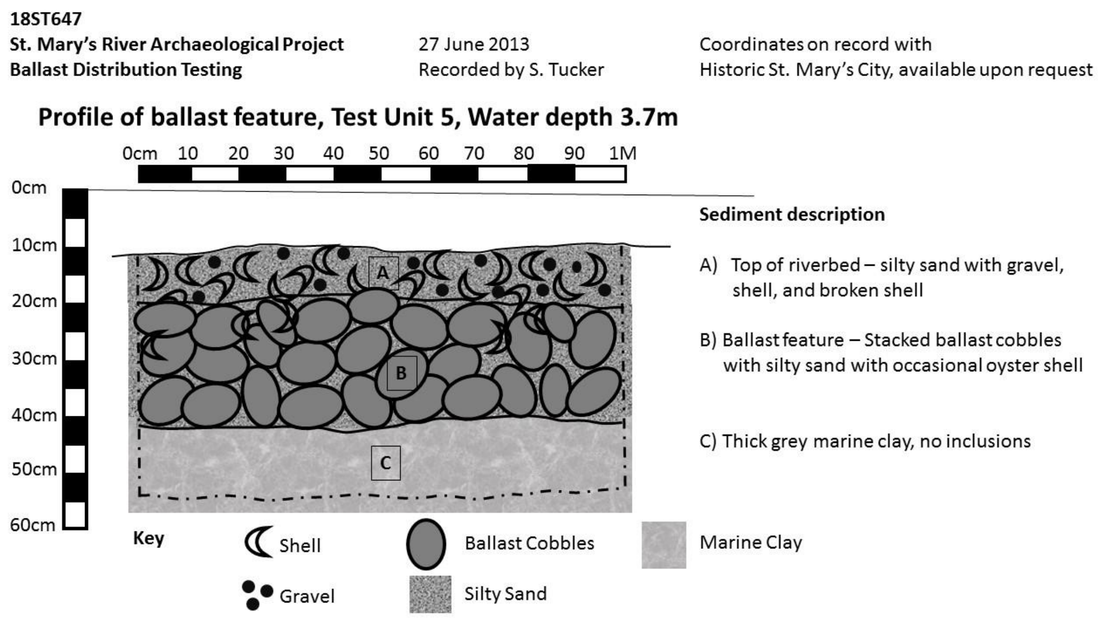


Figure 6-17 - Profile of ballast material found in Test Unit 5 (graphic by S. Tucker)

In all, 60 cobbles were excavated from this unit. The materials were mostly fine-grained sand stones and quartzite, and will be discussed further in the following section. A single sherd of ceramic was also found in this unit, mixed in amongst the stones in the centre depths of the ballast feature and beneath a cobble (Figure 6-18). The ceramic is a jug-form sherd of North Devon Sgraffito Ware, a slipware produced in the North Devon towns of Barnstaple and Bideford in the 17th and 18th centuries. Stylistic differences exist between the 17th and 18th century variants, and this ceramic type is very rarely found on New World sites post 1700.

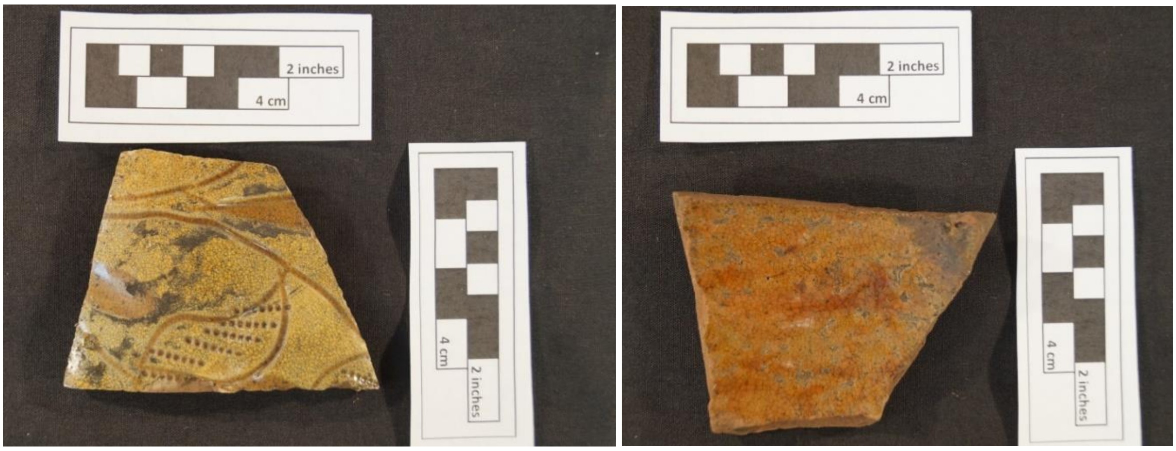


Figure 6-18 - North Devon Sgraffito sherd from test unit 5, ca. 1660-1690 (photographs by S. Tucker)

As it was noted that the grid was only partially covering the heavy distribution of stones, several test windows were excavated outside of the test areas to ensure that additional work would land within the feature. Two meters north of test unit 5, the sixth unit was opened, also revealing a very heavy concentration of stones. Three test windows excavated just north of this unit yielded no ballast material, indicating that this is the northern limit of the site. Work in test unit 6 showed further evidence of ordered stacking of the cobbles, again with the larger stones positioned in the top layer of the ballast. Two wood fragments were found within the 86 cobbles and stones observed within this unit. The two pieces mend together, and have two small holes bored through them (Figure 6-19). The wood appears to be worked, has a rounded profile on each of its longer sides, and of a shape consistent with a fragment of a hollowed log. The wood is in a well preserved state, with no visible evidence of worm damage. While slightly softened, the cellular integrity is well intact.

Figure 6-19 - Wooden fragment found within test unit 6, possibly a fragment of an elm bilge pump (photograph by S. Tucker)

Test unit 7 proved to have a more complicated stratigraphy. The ballast stones were again very heavily concentrated in a layer 25cm thick, starting about 15cm below the top of the riverbed (Figure 6-20). Again, the largest of these stones were found at the top of the distribution. No small finds were observed within the ballast. Below the ballast in test unit 7 was a thin lens of dark silt, and below this was a thin layer of an undetermined material, possibly being a heavily compacted clay. The material is reddish-yellow in colour, and very brittle. Samples of this material were taken and are housed in the collection. Most clay in this area is light grey in colour. The excavation continued through this layer, into a gravel deposit, and finally, into the thick marine clays below. Within this layer, wood was observed, first thought to be ship architecture. As the wood was further exposed, the wood proved to be submerged, likely ancient, tree roots. Being determined that this was a non-cultural layer, excavation of this unit was ceased.

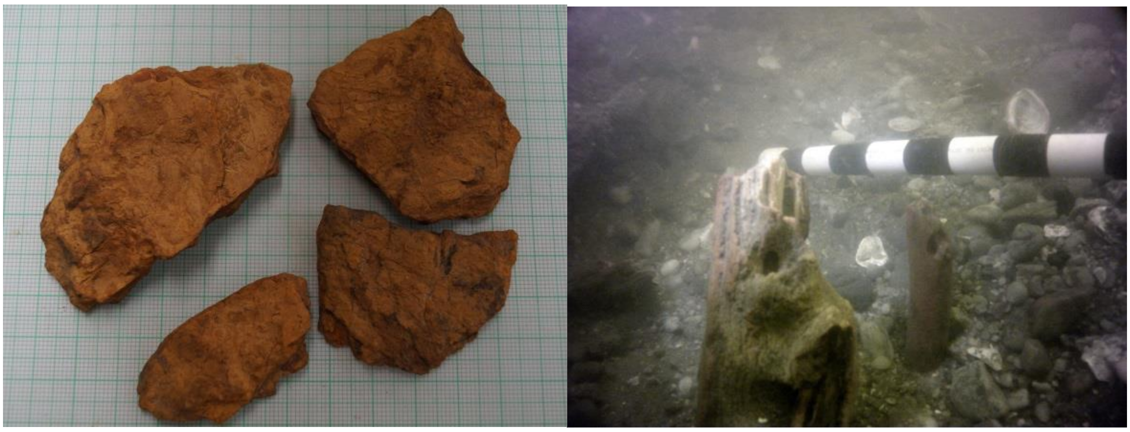


Figure 6-20 - On left, samples of compressed clay sediment, Test Unit 7, strata D. On Right, submerged tree roots found below ballast, Test Unit 7 (photographs by S. Tucker)

Numerous handmade bricks were found both within and around the site. Some were mixed in with the ballast, many of which were mostly complete bricks. There was no evidence of mortar on any of the bricks, indicating that these bricks are part of the ballasting material, rather than ruins of any assembled structure such as a ship's hearth or a building along the shoreline. Despite being broken, the bricks are mostly of substantial size. They would have been unsalable in this condition, but still useful as ballast. Further suggesting that these represent ballast material is that bricks were found within the ballast stones, indicating that they were not part of a cargo. One brick, found in test unit 7 within the ballast, is of a very curious size. Two measurements are possible on this brick, the width and height, and may offer clues to its origin, to be discussed in the next section. The measurable dimensions of this brick are 12.7x4.4cm (5 in. x 1.75 in.).

Several of the ballast stones, found only at the top of the concentration, are of a very different lithic make up (Figure 6-21). These stones are comprised of calcium carbonate with evidence of marine sponge intrusion. The stones are generally very heavy in comparison to the other ballast material, weighing as much as 4.5kg (10 lbs), bordering the geological description of a boulder. Only five such examples were found from the 218 cobbles collected.

Figure 6-21 - Calciferous ballast stone with sponge intrusion (Cliona vastifica) (photographs by S. *Tucker*)

Field Season 2014

One final phase of fieldwork was undertaken in July 2014 in an attempt to create an accurate plan-view map of the ballast distribution. Conclusive delineation of the ballast boundaries would be helpful in interpreting this site, as Embrey was unsure of some of the limits. To these ends, an Edgetech SB-216s (2-16 kHz) sub-bottom profiler was employed. It was planned to pass the profiler over the feature numerous times from different angles, and the profiles could then be overlaid to create a plan-view map of the ballast feature. Unfortunately, numerous problems prohibited adequate data collection. Shallow water depths necessitated the survey vessel to turn out of the path of the ballast feature prematurely, causing it to miss the site with each pass. Further, the water depths proved too shallow for adequate recording. Side scan sonar data taken at the site on the same day also failed to produce a signature of high resonance which may have been able to provide an outline of the site. It is likely that the high concentration of oyster shell in this area is responsible for the lack of acoustic signature on 18ST647 in the four attempts which have been made to locate the site via these means. Without physically uncovering the site, it appears that a rendering of the site in plan-view will not be possible. Given the hurdles of obtaining permits through the several layers of government agencies necessary for invasive survey, it is perhaps best to halt mapping efforts until the site is uncovered again via natural forces, as would be observed through annual inspection dives.

Conservation and Curation

Objects from all phases of fieldwork on this site, beginning with the 1994 testing, are housed together at HSMC, where they can be accessed by appointment. Conservation measures were prescribed for each artefact type by the project conservation consultant, Lisa Young. Lithics were cleaned, soaked in fresh water for two weeks to remove any salts from the cortices, and then dried. This includes all 218 ballast stones removed from test units 5, 6, and 7. As these stones have been quantified and are unlikely to yield any additional information, only representative samples and anomalous examples are to be permanently retained in the collection. Samples which will not be retained in the collection are planned for use as educational materials at HSMC's waterfront exhibit of the *Maryland Dove*. Brick and ceramic finds began desalination in deionized water immediately after recovery. This process was completed after a period of six months. Chloride testing was used to ensure that desalination was complete prior to the termination of treatment.

The wooden fragment recovered from Test Unit 5 required the most in-depth treatment of the artefacts recovered. As this artefact is small and the cellular structure well preserved, Young suggested ethanol dehydration rather than more standard polyethylene glycol based methods. Speciation was completed prior to the process beginning to ensure that any loss of cellular shape would not affect the data which could be obtained from this object. Following a one-month soak in deionized water baths (changed weekly), chloride testing of the water indicated the object to have been fully desalinated, and treatment began. Following Young's recommendation, the artefact underwent a series of baths in a solution of ethyl alcohol and deionized water, beginning at 10% ethyl alcohol, and increasing by 10% every three days, until reaching 100% ethyl alcohol. After this time, the object was wrapped tightly in aluminium foil to ensure that its shape would be retained, and air-dried. Thin slice samples from this artefact have been retained in a fixed microscope slide within this collection to aid any future analysis.

Analysis of finds

From the data collected on 18ST647 between 2011 and 2014, compiled with the data collected during earlier projects, several of the main research questions can be answered, but many continue to be left open. Aside from heavy concentrations of stone cobbles, testing of 18ST647 yielded very little material for analysis. The ballast must therefore the primary focus of analysis herein, with the few other artefacts found adding information where possible.

Samples of the ballast material have been examined and described by geolgist Dr. Ralph Eshelman. The ballast is comprised predominately of medium to light grey, fine-grained sandstone and quartzite (Figure 6-22; Tables 6-2 & 6-3). These two types are difficult to distinguish based on the appearance of the cortex, and therefore have been counted together. The stones fit within the standard geological definition of cobble-sized, and have a well rounded appearance, indicating a coastal source. Eshelman suggests these stones to have likely come from England's west coast, or the Atlantic Coast of Canada. Both of these areas have incredibly similar geologies, having been connected during the last supercontinent.

Figure 6-22 - left, collection of ballast from test unit 7, right, close up of several cobbles (photographs by S. Tucker)

The overwhelming majority of stone beaches in England consist of pebble sized stones. Only a few sources for similarly-sized stones exist. Several cobble beaches exist in the area of the Bristol Channel, comprised of geologically similar lithic material to the stones found on 18ST647. The Northam Burrows Pebble Ridge in North Devon was identified as a potential source of ballast for 18ST647, and examined in the course of analysis for this project (Figure 6-23). The stones on this beach were similar in material to the lithics found within 18ST647, but those from the pebble ridge have a more rounded appearance. This feature bears the full power of the Atlantic several times daily, shaping the cobbles. Because of this, it is unlikely to be the actual source of the ballast, but it does appear to be in the correct region. Several beaches along the Bristol Channel consist of similar lithic material, but are more protected from wave action, making a beach within the channel a more likely source. A large swath of the Welsh side of the channel, from Cardiff to Newport, consists of such cobbles. Further, Wales is well known for its limestone, and some coastal lime outcroppings exist in this region.

Figure 6-23 - Northam Burrows Pebble Ridge, North Devon, England - Lens cap for scale, 55mm (photographs by S. Tucker)

The several calciferous stones found in the ballast provide stronger evidence that the vessel carrying this ballast had recently departed English waters. First suspected to be fossilized coral as seen in many of the caribbean islands, closer examination showed these to be limestone and chalk rather than coral, although they showed significant signs of intrusion by marine organisms (Figure 6-24). Further analysis showed skeletal remains of a sponge from the *Cliona* genus. Tenatively, the species can be identified as *Cliona vastifica*, although more in depth analysis is necessary to confirm the species. Evidence of a burrowing worm, *Polydora* (tentative species, *cilliata)*, is also visible on the surface of these cobbles. The faunal remains from these stones indicate that they originated in the north-to-mid North Atlantic, between ca. 30 and 55 degrees north of the equator. Both of the identified species require salinities greater than 20ppt. These samples must therefore originate from a limestone or chalk outcropping in a marine environment, most likely intertidal to allow for human collection of these stones.

Figure 6-24 - Calfiferous ballast material and close up of worm and sponge intrusion (photographs by S. Tucker)

Such chalk outcroppings do not exist on North America's Atlantic coast, and the overwhelming majority of littoral calciferous reefs in Europe are in England. Several such reefs also exist in locations around France, Germany and Denmark (Ospar Commission 2009:5); although these locations are unlikely as there was no direct trade between the Chesapeake colonies and these countries. This evidence almost certainly demonstrates an English origin for the calciferous ballast material present on 18ST647 and provides some circumstantial evidence that the remainder of the ballast originates in England rather than Newfoundland. Several places around the coast of England could be the source for the calciferous samples, but it should be noted that intertidal limestone reefs exist around the Bristol Channel. Samples from a reef in Bideford Bay, located at the mouth of the Bristol Channel, and others like it frequently bare markings from sponge and worm activity, most notably species of *Cliona* and *Polydora* (Ospar Commission 2009:3-4).

Table 6-2 - Quantity and weight of ballast stones

Quantities and Weights of Ballast Stones			
Area	**Quantity of stones**	**Total weight per unit (lbs/kg)**	**Average weight per stone (lbs/kg)**
Test unit 5	62	114.12/51.76	1.84/0.83
Test unit 6	86	167.68/76.06	1.94/0.88
Test unit 7	72	190.62/86.46	2.65/1.2
Total quantity	**219**	**Total weight (lbs/kg)**	**472.42/214.28**
Average quantity	**73.33**	**Average weight**	**157.47/71.42**
	2.14/0.97		

Average weight per stone (lbs/kg)

Table 6-3 - Ballast material by lithic type

Ballast by lithic type					
Lithic type	**Test Unit 5 (Qty/%)**	**Test Unit 6 (Qty/%)**	**Test Unit 7 (Qty/%)**	**Total quantity (Qty/%)**	**Percent of total**
Sandstone/Quartzite	53/88.3%	78/90.6%	6694.6%	197	90.3%
Mudstone	1/1.6%	2/<1	0	3	1.3%
Chert	2/3.3%	2/<1	1/1.3%	5	2.3%
Calcium Carbonate	1/1.6%	1/<1	3/4.1%	5	2.3%
Limestone	0/0%	1/<1	0/0%	1	<1%
Quartz	2/3.3%	3/3.4%	0/0%	5	2.3%
Granite	1/1.6%	0/0%	0/0%	1	<1%
Total Qty	**60**	**86**	**72**	**218**	

The ceramic sherd found within the ballast has offered the strongest evidence towards dating this site. The pipe stem finds (8/64 in and 7/64 in bore diameters) from 1994 had been much of the basis for the suggestion that the site was of a 17th-century date, but these pipe stems were found only near the ballast. As such, their association with the site is dubious at best, and therefore must not be included in this analysis. No study has taken place to date on the paving sized red bricks, but these are known to occur on 17th-century sites around St. Mary's City, giving a suggestion of a date to the early Colonial period, although this does not provide a strong date. The sgraffito ware sherd was found approximately 15cm below the top of the ballast feature, beneath a stone as it was lifted from the site. There was no indication that the cobble covering the sherd was disturbed in any way from its original place of deposition, and additional cobbles were found directly beneath the ceramic sherd, meaning that this sherd could not have been an intrusive artefact. Therefore, the context of the sgraffito ware sherd is undoubtedly associated with 18ST647.

This sherd is stylistically consistent with features of 17th-century examples of North Devon Sgraffito, most notably in the stippling present in the leaf design (figure 6-25). John Allan, who has produced much of the existing literature on this ceramic type, has given a date of 1660-1690 to this sherd following an examination of photographs of the artefact (Personal communication, 16 October, 2013). This single artefact offers a both a strong *terminus post quem* and *terminus ante quem*. The abandonment of St. Mary's City after 1691 and the movement of the capital to Annapolis in 1695 suggest a date no later than the early 1690s, as after 1695 ships would no longer need to visit St. Mary's City directly upon arrival in Maryland waters to settle port fees and duties.

Figure 6-25 - Left, North Devon Sgraffito Ware Jug dated 1669 (image courtesy of The British Museum); Upper right, sgraffito ware sherd found on 18ST647; Bottom right, profile of sgraffito ware sherd indicating jug form (photographs by S. Tucker)

Direct trade between North Devon and Maryland is well documented throughout the 17th century. Port books from Barnstaple and Bideford indicate multiple ships per year travelling to the Chesapeake colonies from these two towns, carrying consignments largely comprised of ceramics and wool to merchants located within the colonies. These ships would return laden with a cargo of tobacco for sale within England and Europe (Watkins 1960:25-28). Morriss writes that Barnstaple and Bideford were amongst the handful of outports most heavily engaged in the tobacco trade (1914:88-89). The size of ships engaged in transatlantic trade was highly variable throughout the 17th century, but Morriss' study indicates that ships from London averaged around 170 tons, while vessels from the smaller outports average not more than 80 tons. A vessel with a keel of around 45 to 50 ft. (13.7-15.2m), such as what might be possible based on the distribution of 18ST647, would likely fit around the range of 70-80 tons, roughly average for ships from England's outports.

The purpose of the wooden fragment recovered from test unit 6 is unknown, but bears resemblance to the end of a hollowed log given its curved shape. The object is constructed of hardwood, identified through thin slice microscopy as a species of elm (*ulmus*), with a smooth finish on the outer surface, roughly rounded on the interior (Figures 6-19 & 6-26). Two small stitching holes are drilled through the artefact, and it has the general appearance of being part of a hollowed log. Elm is a highly favoured wood for shipbuilding as it grows tall, rigid, is generally straight-grained, and is highly resistant to rot when wet. These characteristics made it an ideal wood for several specific parts of a ship: the keel, lower planking, and the bilge pump, although it was used for other small ship parts as well. The fragment is small, and no conclusive determination of its use can be made, but the shape of the fragment is consistent with what would be expected of a bilge pump. The placement of the object within the ballast is also indicative of being a bilge pump, as the bottom of the pump would extend through the ballast material and into the bilge.

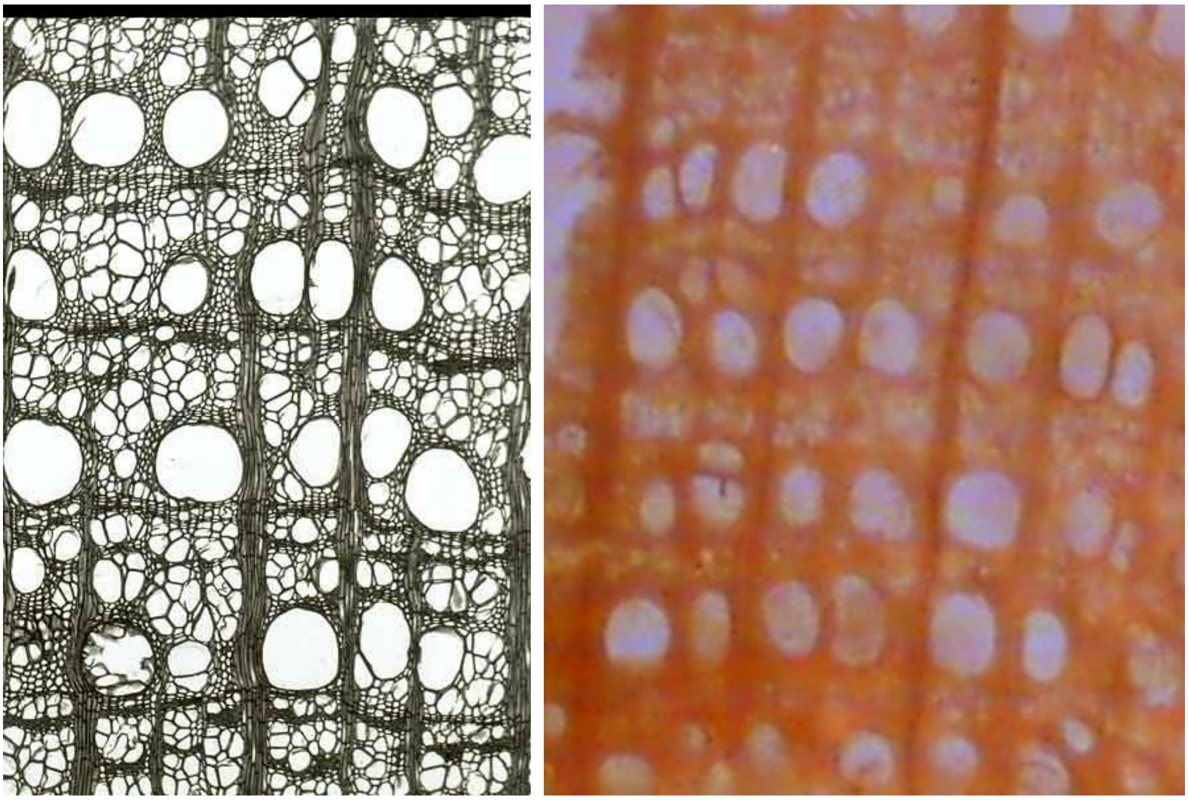


Figure 6-26 - Left, Sample of Ulmus campestris L. (Common English Elm) (image from Schoch et al. 2004); Right thin slice microscopy from wooden artefact (photograph by S. Tucker & S. Hurry)

Handmade bricks are found extensively in and around 18ST647. Many of these constitute nothing more than fragments, although brick bats have been observed, and several collected.

Of those that have been collected, it should be noted that these are mostly unusual sizes for an early colonial site in North America. Aside from Thompson's brief mention of brick with mortar being observed 4m inshore from the site, no other mortar has been seen on any of these brick, suggesting that the brick was not part an assembled structure. The bricks found are of sizes uncharacteristic of locally made bricks. Interestingly, many of these bricks are thin, measuring less than 2 in. (5cm) in height. The previously mentioned bat measuring 5 x 1.75 in (w x h) (12.7x4.4cm), and having a length of at least 9 in (22cm) (centre of Figure 6-27) was viewed as especially anomalous. Brick was very infrequently imported to the colonies during the colonial period, but some specialty brick was imported. This could, therefore, mean that this brick represents cargo. Much of the brick has been found at the top of the site, although some examples are from within the ballast. Those found within the ballast are likely not part of the cargo, but it remains a possibility for the brick on the upper reaches of the ballast. As the scatter of brick constitutes such a large area around the site, it is very possible that the brick comes from two or more sources. Some of the brick is certainly associated with 18ST647, although it is likely that there was a brick structure near the shoreline at some point in the past, given the quantities and wide distribution.

During the examination of features around North Devon, efforts were made to examine 17th-century brickwork in the area. Only one such building was located in the town of Barnstaple, dated by English Heritage to the early-to-mid-17th-century (English Heritage Building ID 485625). It was constructed in English bond and consisted of many inconsistent sizes of bricks (Figure 6-28). Many of these bricks were rather thin, less than 2 in. (5 cm), and approximately 9-10 in. (22-25cm) in length. Of those which could be observed in the width dimension, they measured around 3-4 in. (7-10cm). This is mentioned as the bricks found are inconsistent with commonly observed bricks of New World origin, but consistent with a size observed in at least one 17th-century English site.

Figure 6-27 – Representative sample of artefacts collected from 18ST647

Figure 6-28 - 17th century brick building in Barnstaple, England constructed of bricks in similar dimensions to those found within 18ST647. Hand for scale, length ca. 20cm (8 in.), finger ca. 2.5cm (1 in.) per joint (photographs by S. Tucker)

Interpretation

The work undertaken on 18ST647 from 2011 to 2014 outlined here sought to answer three primary questions: when was the material deposited, what does it represent, and why is it in this location? The evidence gathered in the course of this project, along with artefacts collected in the 1994 testing strongly suggest a date of deposition from around 1650-1690. Although few datable artefacts were located, the lack of artefacts of any other time period and the clear association of these 17th-century artefacts makes this a strong likelihood. Ship's ballast was by necessity offloaded from trade vessels in the Chesapeake during this era, meaning ballast deposits or ship remains would be carrying a freshly loaded supply of ballast, making the sgraffito ware likely a bit of recent cargo broken en route rather than from an older cargo that had been in the lower hull for some extended period of time. The 'Dutch' bricks, another 17th-century import, strengthen this date.

The maps produced by Embrey (1999: 104; Figure 6-5) of the ballast distribution being arranged in an ovate pattern are suggestive of the ballast being the remnants of a vessel. As the ballast distribution could not be physically observed due to a cover of 15-20cm bottom substrate, attempts were made to proof the accuracy of Embrey's site map. Following a similar methodology to that used by Embrey, probing the sediment around the ballast with a thin fibreglass rod, divers in 2013 were unable to reliably differentiate between ballast beneath the substrate and the oyster shell which is heavily present within the silt. With this observation, one must call into question the reliability of Embrey's site plan. Further attempts to map the site through both side-scan sonar and sub-bottom profiler surveys failed to assist in these efforts.

Although only a small portion of the ballast was uncovered, the lack of any ship architecture observed both during this project and in the past provides a clear indication that 18ST647 is not the remains of a colonial vessel. The thick marine clays located just 20-30cm below the surface sediments simply would not allow for a vessel to become so deeply buried as to obscure it from view. Although *T. Navalis* has been observed in the St. Mary's River, its semi-annual presence would not be enough to allow for the whole-scale destruction of a vessel in this area. Well preserved wharf pilings from the mid-19th century provide further evidence of what level of preservation one could expect in this area. For these reasons, it is put forth here that 18ST647 does not represent a vessel, but rather a 17th-century ballast offload site. The location of the ballast so close to the 17th century shoreline is curious. Two other ballast sites are known in the general vicinity, one around 100m downriver near Green's Pond, and another has been reported in Milburn Creek, a small inlet in nearby St. Inigoes Creek (Personal communication, Scott Strickland, 28 Sept. 2013).

Given the necessity of offloading ballast before loading tobacco, an abundance of such ballast sites are certain to be found throughout the Chesapeake. A 1664 ordinance passed by the Maryland General Assembly prohibited the dumping of ballast in waterways (Embrey 1999: 105). This decree was likely largely ignored, as Maryland's government passed additional acts forbidding the discharge of ballast into the waterways in 1692 and 1704 under penalty of 2,000 lbs of tobacco (Middleton 1953: 99). Virginia passed an act against the dumping of ballast in 1691 with a £10 penalty for violation (*ibid.*). Middleton (*ibid.*) reports that the Maryland laws were ineffective, pushing lawmakers to again pass another law forbidding the discharge of ballast into the Chesapeake Bay or rivers under a penalty of £50 in 1735. With the continual passage of such acts, it can be assumed that these were ineffective and ships continued to dump ballast into the waterways throughout the colonial period. Had it been carried ashore, it could be assumed that ballast cobbles would be present on land, perhaps repurposed as building material, but this remains virtually unseen in the archaeological record for this region, although several early buildings within the 1607 James Fort have been found to have been set on masonry foundations constructed of ballast stone (Graham et al. 2007: 463). Despite having a frequently manuported source for potential construction material, earthfast buildings were ubiquitous throughout the region and period (Carr et al.: 1991: 91; Graham et al. 2007: 470; Moser et al. 2003: 200), and more permanent structures such as St. Mary's City's Statehouse and Chapel were set on foundations of locally made bricks (Miller 1988: 63-64).

Although shipping accidents certainly occurred in this region, the conditions within the Chesapeake Bay and its tributaries generally afforded mariners a safe environment with which to conduct their business, thereby depriving modern maritime archaeologists of shipwreck sites to explore. Instead, ballast sites such as 18ST647 are the remnants of the lading of tobacco for export aboard the ships which would transport the crop throughout the Atlantic World, providing evidence for the locations of anchorages in around the region. Such sites provide the most abundant evidence of early colonial maritime activity in the region, and are deserving of additional attention in the future. This is not to say though that the search for colonial era vessels in this region should be abandoned, but rather that such sites are unlikely to be found in the rivers around the Chesapeake Bay. Places where many ships would congregate at anchor, such as at the mouths of rivers or at Point Comfort where vessels would await the departure of fleets. Such circumstances caused the wrecking of numerous vessels described in this document, including *Warwick*, *Sparrow Hawk*, *HMS Northumberland*, *HMS Stirling Castle*, and *Baltimore* (Adams 2013: 128-129; Bradford & Davis 1908: 218; Pascoe & Peacock 135; Rhodes 1670-76, Voyage of the *Baltimore*).

Although the work described here on 18ST647 has not yielded an abundance of artefacts, limited testing has provided enough data to establish a date and a likely source of origin for the ballast. Estimates for the amount of ballast on site were able to be made, useful in determining how much tobacco was to be collected at a particular point. When many sites similar to this one have been located and had their positions recorded, preferably with the added detail of a date of deposition, this will prove useful in examining tobacco collection points on a wider scale and allow for analysis of how they relate to the landscape and locations of plantations.

Project Impacts

Impact to the site and surrounding environment from this project was minimal by design. Although intrusive testing was necessary to assess the site, only around five percent of the total known site area was disturbed. Backfilling measures taken should eliminate the risk of site scouring by wave action. As no wooden remains were found below the ballast in the areas tested, there is no anticipated risk for exposure of delicate ship structure to destructive marine organisms. No foreseen effect on the local ecology was noted for this project, and care was taken to ensure that the environment was returned to its pre-project state.

Recommendations

Given the lack of ship structure, significant assemblage of artefacts, and the likelihood of numerous similar sites existing throughout the Chesapeake region, it is the opinion of this author that 18ST647 is not eligible for nomination to NRHP or for significant protections to be afforded it. Further, additional testing of this site is not likely to provide new significant data, and therefore, future research on 18ST647 is not recommended at this time. Efforts to search for new ballast sites in the area or to test the other known ballast sites are, however, encouraged. With this in mind, it is recommended that additional protections be granted to the St. Mary's City shoreline to prevent damage to sites, stemming primarily from oyster fishing by means of power-dredge.

18ST647 is disturbed via this process each year, evidenced by the scatter of ballast material at least 5m (16 ft.) from the main concentration of stones. At present, an oyster sanctuary is in place 300m (1000 ft.) north of this site. It is recommended, in the interest of preserving all submerged cultural sites associated with the early colony of St. Mary's City, including but not limited to 18ST647, that the southern boundary of the current oyster sanctuary be moved south by a distance of 2.2km (1.3 miles), ending in a direct line stretching between Chancellor's Point and Portobello Point (Figure 6-29). Such an action would protect the entire shoreline of HSMC. There are numerous other identified archaeological sites along the shores of HSMC, and likely more to be identified in the future. Providing a full assessment of 18ST647 would provide a useful basis for creating additional protections for cultural resources around St. Mary's City's colonial town centre.

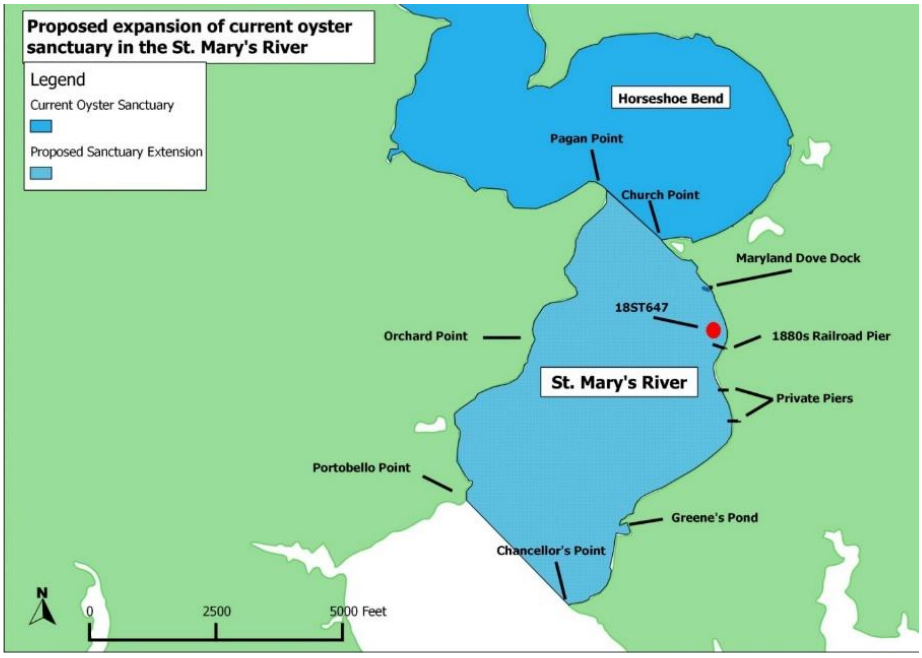


Figure 6-29 - proposed expansion of oyster sanctuary (map by S. Tucker)

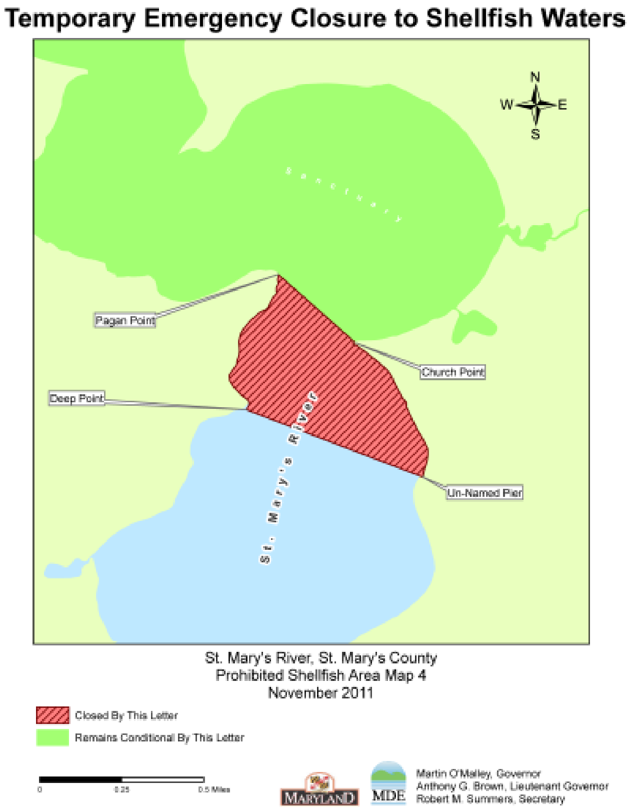


Figure 6-30 - Areas closed to shellfish harvest in 2011 (Maryland Department of Natural Resources)

More minimally, other options designed to protect only this site could be taken. During the fall of 2011, the oyster sanctuary was extended by the Maryland Department of Environment (MDE) and the Maryland Department of Natural Resources (DNR) due to a cruise ship being docked in the area serving as temporary housing for HSMC students (Figure 6-30). This was done over concern for contaminants released into the water by the ship. Permanently closing this area to oyster harvesting would protect this site, and other known archaeological properties. Other options would include creating a power dredging exclusion zone to the area around HSMC or to, at bare minimum, closing the cove between Church Point and the old railroad wharf to oyster harvesting.

Chapter 7 – Concluding Discussion

Introduction

On attempting to understand a complex archaeological dataset, Brughmans (2010: 285) writes, '…to understand a complex structure, one needs to understand what it is made up of, what its organizing principles are, and how it evolves.' In the first chapter of this work, a discussion was presented leading to the identification of certain criterion which were deemed to be potential sources of productivity change within the early English tobacco trade. The following chapters explored each of these factors to varying degrees in an attempt to describe how each of the factors functioned individually throughout the 17th century, affecting productivity in the process. With evidence for each of these factors—or perhaps more appropriately, actors—now presented, it is necessary to discuss how these behaved in conjunction with each other, forming a network of interaction. Rather than individual factors, it was this network which drove early English colonial trade from its infancy to a point of maturity in the 18th century. As discussed, tobacco is perhaps the most appropriate trade good to examine to these ends. It was England's first successful colonial product, and remained highly important throughout the American colonial period, thusly allowing for the process of growth to be observed. This final chapter will therefore offer a summary of changes observed in each individual actor, followed by a discussion of how trade functioned as a whole at various points of time throughout the 17th century and 18th centuries when this market had reached maturity (Price 1964: 497). Models of interaction are provided to assist in visualising the network of interaction at play, displaying a subjective assessment of the importance of each criteria and connection.

Foreign Politics

England's relationships with its neighbours played a dominant role in shaping and changing the ways in which its ships, people, and goods moved about the Atlantic World. A central factor in England's original drive toward colonisation of the New World was as a response to Spain and Portugal's economic ventures in Central and South America. England's first North American colony of Roanoke, settled 1585, was meant to serve as an outpost for attacking Spain's treasure ships (Bruce 1896 (I): 1; Appleby 1998: 56), but with its early failure, England moved toward efforts of producing its own goods for export in the early 17th century. England saw several of its neighbours prospering greatly from their New World exploits and wanted to follow suit, although doing so by means of sending their own people to work the lands was at the time a novel concept, with the aforementioned nations predominately using slave labour comprised of the indigenous people and displaced African populations.

With the successes of the Jamestown colony in the second and third decades of the 17th century, English trade was beginning to show great promise of economic viability. New colonies and settlements began to appear, but relations with Spain continued to place a strain on trade. It was simply too dangerous to sail near the shores of Spanish colonies or indeed along the coasts of Spain and Portugal out of fear of being attacked, causing England to seek new routes across the Atlantic. This was taking place as early as 1608 when the middle passage by way of Bermuda was found. Although relationships with Spain were mended by mid-century, the lasting effects of changes to trade routes had fully taken hold.

Relations with the Dutch began to sour by the mid-17th century, owing to England wishing to be the sole economic benefactor of its colonial products. That Holland was participating in trade with the English colonies was a great annoyance to London merchants and the English government. Early efforts to curb this unwanted trade by the Cromwellian government were well received in England, to the effect that the laws were essentially upheld and continued after the Restoration. The wars that ensued with the Dutch caused little disruption to trade, and laws aimed at keeping other nations (perhaps specifically Holland) out colonial trade were strengthened. What resulted was a much more profitable trade for both English merchants and the Crown. The merchants in England could be ensured that all (or at least most) of the Chesapeake tobacco was theirs to import, and the Royal government could be certain that the tobacco would land in their ports for the appropriate duties to be assessed and collected.

As the 17th century came to a close, fighting with France became a major disruption to trade as control over the English Channel was challenged. Evidenced by the late 17th and early 18th century voyages discussed in chapters three and four of this work, it was apparently no longer safe for trade vessels to arrive in England via the Channel. Even ships bound for Plymouth had taken to sailing north of Ireland and Scotland and then south through the North Sea to reach their desired port, receiving an armed escort from London through the channel (Andrews 1907: 340).

Although this discussion has focussed on troubled relations between England and other European powers, it was these negative relations which had the largest effect on trade. English colonisation was born out of hostile attitudes towards Spain, and the search for viable economic products to be produced in the colonies was primarily driven by a desire to compete with its Iberian neighbours in hopes of gaining similar power and wealth. The results of these conflicts had some of the most visible effects on the tobacco trade, acting as an impetus for change in trade routes, although other factors, predominately economic, were driving these changes as well. Foreign politics held one of the most significant roles in the course of the trade, having particularly strong influence over trade routes, vessel design and the tobacco economy.

Domestic Politics

England's internal politics regarding trade typically fall within the lines of economic policy. In a similar fashion to the externally focussed Navigations Acts, the political actions of England and the colonial governments in this respect were meant to ensure profitability, mainly for merchants and the government. Early regulation began with taxation measures and some degree of monopolisation in the form of forbidding tobacco to be cultivated within England proper (Jonsson 2014: 123-124). From the start, it was recognised that internal competition would be detrimental to the nation's colonial holdings. Taxation of tobacco from nearly the inception of the crop's cultivation resulted in dramatic monetary gains for the English government. Throughout the period of interest, increasingly higher taxes were levied on the crop on both sides of the Atlantic (Middleton 1953: 123, 125; Morriss 1914: 47). When coupled with efforts to isolate competing nations from participating in the exchange of tobacco, the result was that tobacco became the most profitable trade product in England (Price 1964: 496). Gains for the royal government from tobacco had reached over 400,000 pounds sterling by the end of the 17th century (*ibid.*). Port fees and export taxes on tobacco at the colonial level were also profitable for the governments of Virginia and Maryland, providing significant revenues for the colonies.

Colonists fought hard against attempts to control the placement of their plantations and homes around the Chesapeake (Riley 1950: 306-307). Adopting a more streamlined and centralised approach to tobacco collection was of great appeal to merchants wishing to spend less time in port, but was not of benefit to the colonists who wished to space themselves sparsely over the landscape. Following decades of attempts by the colonial governments at the behest of London, port towns began to emerge in the region and transport of tobacco from the farm to these settlements fell on the shoulders of the planters. These regulations ultimately brought about some of the most important gains in productivity seen in the tobacco trade, drastically reducing the lengthy period of time needed in port. This, however, was not a characteristic of the early period of trade, but rather a development of the 18th century, coming about in the second quarter of said century. The cause of the eventual successes of the adoption of warehousing as a method of distributing tobacco appears to be a product of logistical necessity caused by the spread of the settlement from predominantly waterfront locations to more inland areas, owing to a lack of available waterfront property, the main cause of which being population growth. These domestic policies led primarily to a lack of productivity increase throughout the trade, allowing for an inefficient system of tobacco collection and leading to longer periods spent in port.

Crew Size

Employment costs are a significant factor for any business; the early tobacco trade being no exception. In the modern period, efficiency consultants are often used to find excesses in employment, ensuring that a company is employing the exact number of persons necessary to reduce excess costs, and periods of economic decline are often marked by mass reductions in labour force. 17th century English merchants were of a similar mind-set to modern businesses in these regards. Early 17th century vessels were heavily crewed with a typical 250-ton vessel having more than 35 crew members, but this number dropped through time to around twenty by the century's end (Davis 1962: 370; North 1968: 962). Similar trends in crew reductions have been noted by Shepard and Walton on smaller vessels during the 18th century (1972: 75-77).

Crew size was dependent on a several of factors. The base number was determined by crew needed to operate the vessel, but other factors such as extra hands for loading and managing cargo, manning ordnance, and providing relief for any crew members who may have taken ill or became injured on the voyage were also considerations. Early vessels were almost certainly over-crewed. The waters were hostile, the vessels were fairly heavily armed, and it was likely that it was simply uncertain how many persons were truly needed on board, and they therefore erred on the side of caution. These additional considerations could be mitigated by finding safer routes or organising labour in port for loading, but the base crew would be a fixed number by necessity and could only be reduced via change in sailing rig to simplify handling of the vessel. This was almost certainly of factor in reducing crew over time on English vessels, working in conjunction with safer routes of travel to significantly reduce crew, and therefore, merchant costs to shipping. With this knowledge though, one must ask why English merchants did not take further steps toward reducing labour costs stemming from crewing. Vessels such as *fluits*, available already in the early 17th century, could be utilised to these means with a typical 200-ton example being able to be crewed by only ten persons (Barbour 1930: 282; Davis 1962: 370; North 1968: 962). Flyboats were indeed used by English merchants in the late 17th century, but nothing observed in this study would indicate that it was an overly common vessel type, despite the obvious gains which could be made here in reductions to shipping costs. Crew size was of only a little consequence in the tobacco economy, producing gains in productivity only as it reduced, but reductions were the result of a large number of factors ranging from technology to route and politics.

Wages of Mariners

Mariner's wages, along with victualing costs, present an obvious cost to merchants relative to crew size. Each of these factors would be weighed together to determine shipping costs. With little to no inflation occurring in these early economies, wages remained constant (Shepard & Walton 1972: 69-70), but victualing costs are unknown for this time period. It is known though, that these rose during the 18th century, with a nearly 60% increase between the years of 1720 and 1775. Shorter crossings would mean that fewer supplies would need to be carried from port to port, and that these costs would have likely fallen to the vessels crew during periods in port, thus making faster crossings a cost saving measure regardless of time spent in port. Although data is not available for the 17th century, the concept of crew wages can be discussed in a concrete, theoretical manner as the effects of higher or lower costs have an overt effect on shipping costs. It is likely a safe assumption that these costs were rising to some degree over time per individual sailor, but that they were offset by means of reduction in crew members travelling on the vessels. Mariner's wages were, as is the case of crew size, of little influence in the trade, but did of course factor into shipping costs in a significant way. This is, however, connected in this theoretical network mostly through inputs rather than being itself a significant output.

Tobacco Production

The amount of Chesapeake tobacco produced throughout the 17th century increased significantly each year following its introduction to the markets in 1614. The increases stemmed from several points: the amount of tobacco planted per farm, the number of farms where tobacco was planted, and changes to husbandry practices allowing for increased production per plant. There was a definite trend toward increased efficiency in tobacco produced per hand/per acre over the course of the 17th century (Carr et al. 1991: 39-40). The gains in quantity of tobacco produced had a direct effect on shipping as more or larger vessels would be necessary to carry the crop back to England, and although husbandry practices and increases to population are not maritime in nature, they were nonetheless of noteworthy factor in the overall success of the early tobacco industry. The increase of tobacco being produced was a major driver in the scaling of the tobacco economy leading to its widespread availability and lowered costs.

The Tobacco Market and Prices

As tobacco production increased, an entire economy developed based on the crop. Tobacco was currency in the Chesapeake, and virtually the only export of the Virginia and Maryland colonies. Changes to the tobacco market are fairly simple to understand. Early tobacco sold for high prices both at the farm and at wholesale due to its relative rarity. At this point it was a luxury item for a wealthy few in Europe. Only a small number planters were cultivating the crop during its inaugural seasons of production in the Chesapeake, but early profits for these planters encouraged thousands of individuals to cross the Atlantic to join in the cultivation. The glut of tobacco produced with the influx of new planters naturally drove the market prices down, and although planters complained of low prices paid by merchants for their goods, these low prices produced an economy of scale allowing wide-spread use of the product. Once tobacco began to receive extensive use, it was important to keep consumer prices down, and it was at this point that certain concessions had to be made in farm prices and shipping costs. Finding faster and safer passage and using fewer crew members were among the concessions adopted by merchants to these ends. Loss of product would also drive up costs, leading to the adoption of convoying methods to help protect the ships and their cargoes.

The tobacco economy—used here to refer to farm and market prices of the crop along with individual inputs and outputs such as shipping costs—was unsurprisingly one of the most important factors in determining productivity increase, and well connected to nearly all aspects of trade. It drove politics on both a domestic and international level and was a determining factor in changing sailing routes and technology. Perhaps most significantly, the tobacco economy is the linking node between matters of planters on the western side of the Atlantic, and the merchants on the eastern side. Both of these groups were fully vested in tobacco as a source of economic gain, and certainly both were actively seeking ways to make their efforts more profitable for themselves.

Efficiency of Tobacco Collection

Amongst the most important factors affecting the movement of tobacco was the speed at which it could be collected for export to England. Throughout the colonial experience, this was hindered by the way in which planters had chosen to spread themselves over the landscape. Although shipping tobacco first to warehouses in ports would have made logistical sense for the purposes of streamlining the collection process, colonists refused to move into towns to facilitate this. As most people coming into the colonies were doing so to cultivate tobacco, this may have been one significant reason for why they chose to settle in this manner. It may have also stemmed from a desire by the planters to bargain personally with the merchants for a price rather than have market values dictated to them by merchants, in addition to likely losing some profits to the short-term storage facilities and local transporters of the goods from the farm to port.

The exact cause cannot be determined through the evidence at hand, but it is clear that ships were routinely in port for extended periods, averaging around four months. Coupled with uncertain crossing times, this essentially meant that a vessel used on tobacco routes to the Chesapeake would be in service for the bulk of the year. Upon returning to England, a vessel may have had a few months to operate on other short-distance trade routes, but was more than likely docked until it was time to return to the Chesapeake again. Tobacco was, however, a once per annum crop, typically made ready in the spring of each year. A well timed vessel may have been able to make two journeys in one year, and some reportedly did beginning in the 18th century after times in port were shortened (Price 1954: 189), but in reality, attempting to do so made little sense.

Times spent in port were heavily reliant on domestic policy, namely the various Towns Acts, which sought directly to address these issues, but few gains were made on these topics during the 17th century, as previously discussed. Naturally, these long periods of time spent in port were costly to the bodies financing the journey, as this affected the mariner's wages and other similar time-dependent cost inputs. The product collection model was simply the point at which all other aspects of productivity were hinged. Until well into the 18th century when these issues were corrected, the effects of all gains in other areas were dramatically muted.

Efficiency of Route

With transatlantic sailing being in its infancy in the 17th century, especially to northern North American destinations, it comes as little wonder that these were in a state of flux during this period. Trade routes began from a fairly logical standpoint: one following prevailing winds. Early exceptions were made to this, with attempts at crossings being made at more direct routes, but the southern route from England, past the Portuguese and North African Coasts, then to the Caribbean and north along the North American eastern coast became standard. This was convenient during this early period, as it allowed for trade goods to be collected from the Caribbean as well, creating a sort of circular trade. Some alterations were made to this in the early days of the Virginia colony, with vessels turning westward at a more northern point to travel to Jamestown by way of Bermuda.

Various pressures though, mostly external and relating to England's relationship to Spain and Portugal, led to direct routes across the Atlantic becoming the norm. It appears to have taken place somewhere around mid-century, as had been previously identified by Middleton (1953: 7-8). This route appears to have been a more-or-less direct path southwest from Plymouth to the Chesapeake, which endured at least through the end of the 17th century. Hostilities with France in the early 18th century made sailing through the English Channel hazardous, and ships departing from northward ports in England, grew in significance in the Tobacco trade (Price 1954). This likely led to an altered route of crossing by means of Newfoundland and southward along the North American coast as first presented by Middleton (1953: 7-8).

Politics played a central role in the shaping of trade routes, but economics were of course also involved. The faster and more safely a vessel could cross the Atlantic, the sooner it would be back in port with its trade goods, saving costs in crewing and wages. A typical crossing along the southern routes required four months or longer when time spent in Caribbean ports was included, but crossings of six weeks to two months became common along the more direct route used in the latter half of the 17th century, though this was not always the case. Eastbound routes from the Chesapeake to England, with the benefit of travelling with prevailing winds, were almost always easy and relatively short from the earliest period on with only minor gains in speed being made throughout the course of the century. The route taken in this direction did not appear to have been altered throughout the 17th century, save for late in the century when the British Isles were approached to the north to avoid the English Channel.

The changes in routes westbound were almost certainly affected by factors involving the colonial population. Until the English colonies had become large enough and sufficiently rooted to engage in trade on their own accord, vessels departing England needed to visit a wide range of territories, collecting trade goods along the way. As the colonies matured, New England rose to prominence in coastwise trading, especially with the Caribbean. This allowed English ships to forgo visits to the southern islands to acquire sugar, rum, and molasses as this could now be collected from New England. As a circular trade became obsolete, unilateral routes from England became possible, viable, and the standard.

Efficiency of Hull

Speed of a vessel is determined by a multitude of factors, but for ease of discussion, the focal points will be on hull design, materials, and sailing rig. With so few archaeological examples of English ships from the 17th century, little can really be said about the changes which were taking place over time. What is known is that there was a transition in hull shape from the Elizabethan Galleon which were the standard in the late 16th century, to the less bulky and somewhat more streamlined ship of the 17th century with its more angled hull lines (Adams 2013: 175). These earlier designs were certainly a feature of the early tobacco trade, with the wrecked vessel *Warwick* serving as archaeological evidence of this. The defensible ship was ubiquitous for a period of time, but a split occurred over the course of the 17th century between merchant and naval vessels making these two separate classes progressively more specialised to their intended use.

Data presented in chapter four of this work concerning Vmg on eastbound voyages with the prevailing winds suggest that some minor gains were made in drag reduction through hull shape over time, but these were of only minor importance in the overall functionality of the trade. More important than hull shape for the purpose of speed in these circumstances was using a hull shape which was conducive to carrying cargo. English warships in the mid-to-late 17th century began to utilize long, narrow hull forms for gains in speed and agility. This was simply not necessary for trade vessels, and would be counter-productive on routes void of hostile aggressors. For trade vessels operating on open stretches of the North Atlantic, bulky designs were appropriate, and the carriage of only a small number of guns per vessel, particularly when travelling in fleets, should have been enough to mount some defence against privateers. More performance-minded designs, such as the sloop, only became the norm on coastwise trade where the likelihood of encountering pirates and privateers would have been increased, and was worth the trade off in stowage capacity.

Construction Methods and Materials

Of greater significance than hull form to the productivity of the tobacco trade, and indeed the transport of all of England's long distance trade products, were the architectural methods used in vessel construction. Shipbuilding was a primary cause of forest depletion throughout Europe, working against itself by making scarce the materials needed to build more ships and thusly driving up the prices of timber and shipbuilding. Further, suitable compass timber for building specific vessel components became increasingly difficult to obtain. During the 16th century and first half of the 17th century, this was not a terribly significant problem as shipbuilding had not yet grown to the point at which it was putting tremendous pressures on available resources. Vessel construction methods in these early vessels reflect a wide availability of compass timbers. As the 17th century progressed, English efforts to build ships for a dedicated naval fleet, loss through naval warfare, and increases in overseas trade made necessary new construction methods using less specialised timber. Changes to hull construction, with more heavily angled chines, allowed for shorter, straighter framing timbers to be used, and were a reaction to resource-based stresses (Adams 2013: 175-185).

Small changes to construction methods included the introduction of chocked joints in the framing timbers to allow for straighter timbers to be used, and changes to the arrangement of flooring timbers to alternate the distance of framing joints in relation to each other, allowing for a stronger hull with the use of less timber (Adams 2013: 180-183). Although *HMS Dartmouth* usually receives credit for being the earliest example of an English vessel using this method (Batcharov 2007: 351), it is entirely likely that this feature was introduced at an earlier date, and most likely first in merchant vessels, which would have been affected by the timber shortage earlier than vessels built for the Navy. It is not evident if efforts were made to extend hull and keel life in merchant ships by means of sheathing with lesser quality sacrificial woods, but this was a feature added to some naval vessels of the era, particularly evident in the *HMS Dartmouth*. In all, changes to ship architecture can be summarised as efforts to reduce building costs and materials, all working toward lowering inputs to shipping costs, thereby increasing productivity in trade—factors connected most significantly to foreign politics and available resources.

Ability to Windward

A final point to consider in the realm of ship technology is the ability of a sailing rig to make progress to windward. The 17th century saw many attempts at finding a more efficient sailing rig, characterised predominantly by increases in sail area. Early rigs were simple, carrying typically only two courses of sail per mast, but more courses were added through time and staysails were placed between masts. Perhaps most curiously, sail shape remained square throughout the entire period. Other sail shapes were known, and triangular sails were in use on some English vessels during this period (Baker 1966: 38-55), but on long distance trade there was no change, even throughout the 18th century. Despite the poor ability of a square-rigged vessel to achieve forward motion in a headwind, it is clear that these vessels were able to accomplish a voyage against prevailing winds. Speeds were naturally much slower against the wind, evidenced by comparison of crossing times east versus west, but were still manageable. Improving windward ability simply did not seem to be a major priority in these circumstances, with such improvements likely only being capable of reducing a voyage by a few days in the face of seven to eight months in total.

Time Spent at Sea

Time spent away from a vessel's home port is the most important factor in determining the cost of a voyage and economic inputs and outputs of overall productivity. This breaks down into two factors: time spent sailing, and time spent in port. Time spent at sea is determined by a vessel's performance capabilities, route sailed, and cooperation of the weather, especially in the case of wind-powered vessels. Through changes in route, potential time spent at sea between England and the Chesapeake was greatly improved over the course of the 17th century. The change from the southern passage to the passage by way of the Azores brought the potential for huge gains to these ends, although the route also had the potential for costing more time at sea, and without the possibility for stopping for supplies in between. Even so, the removal of stops in the Caribbean ports made the overall length of a westbound voyage shorter when compared to the longest of the Azores route crossings. Gains in travel time were less a factor of technological improvement as was one of foreign politics. Finding this new route—by far the biggest source of change in time spent at sea—was a matter of necessity due to conflicts with the Spanish, and perhaps spurred on by contact to Dutch sailors. Although changes to hull shape and rigging had the potential to be sources of gains in crossing times, they had in reality very little to do with this matter. Eastbound route and travel time remained relatively static throughout the entire 17th century, and indeed continued into the 18th century. The sole alteration to this came in the late 17th century when hostilities with France made the English Chanel unsafe, and ships began sailing north of England. Through such sacrifices in time at sea, it becomes clear that ensuring that the cargo reaches its intended destination outweighed any potential cost savings that may have resulted by the vessel returning to its home port several weeks earlier.

Time Spent in Foreign Ports

Heavily tied to the efficiency of product collection, the most important factor affecting trade productivity in the English tobacco trade was the time spent within the capes of the Chesapeake Bay. The significance of this factor lies within its ability to hinder productivity, and hinder it did. Times spent in port in the Chesapeake colonies were exceptionally long throughout the 17th century, being encumbered by an inefficient system of product collection. Another factor to consider on this point were seasonal winds which made it difficult to enter and leave the Chesapeake at certain points of the year, although this could have been overcome with relative ease had it been deemed necessary. A point already heavily discussed, it simply did not meet the needs and desires of the planters to alter the system they had in place to distribute their product, and acts of legislation designed to create a more streamlined system of trade failed repeatedly. Planters were rarely the benefactors of gains made through systematic changes to matters of trade, but in this case they were able to make the system work in their favour, and they did so until it was simply no longer feasible owing to population growth. Although this was a point holding back gains in productivity, the network as a whole continued to allow for growth throughout the whole of the colonial experience.

Network Assessment Models

With each individual factor here having been presented, it is now necessary to discuss trade as it functioned as a whole. As this varied over time, the discussion will be presented on a temporal scale. The period of focus in this work begins in the 1580s, starting with England's first attempts at New World colonisation (Hayes 1583: 271-306), as the story of the English tobacco trade is largely interwoven with the story of English overseas expansion. After the planting of the colony in Jamestown in 1607, it took another seven years before the first (meagre) crop of tobacco was sent to England (Middleton 1953: 105-107). Even after this, it took several more years before the shipment of tobacco from Virginia to England became a significant export (*ibid.*). For these reasons, the discussion here will begin in 1625, advancing in 25 year increments for ease of discussion, until 1725. The models are based on the network assessment model presented in the first chapter of this work (Figure 1-4), displaying significance of each factor through node size, and significance of connections through link weight. Those familiar with network analysis will note a divergence from the norm of indicating nodal significance by position on the network map, and strength of connections by distance of nodes. This stylistic difference has been made in an attempt to increase legibility, but achieves the same overall goals in visualising interconnected concepts and strength of connections found in traditional network models. The majority of the information produced within this thesis is reliant on qualitative data, making a thoroughly figures-based analysis of these factors a practical impossibility. Brughmans (2010: 298) has noted this as a primary issue in using network analysis for many archaeological datasets as they inherently include qualitative data. The following graphics are therefore representative models of the function and interconnectivity of the various topics presented in the course of this work.

1625

At this early point, quantities of tobacco being produced for export in Virginia were low (Figure 7-1). In 1622 only sixty hogsheads were shipped from the colony to England, and the following years did not bring great advances in these numbers (Jacobstein 1907: 23; Morriss 1914: 35; Walsh 1999: 87-93) (see Figure 1-1). Prices were very high in relation to what would be seen later in the century, and indeed, to what would be seen already in the 1630s (Menard 1976: 401-410). Few ships were necessary at this point, with a single vessel of average size being able to carry back an entire year's tobacco crop from the colony, although freighting costs were high (Bruce 1896 (I): 450). Vessels were reaching Virginia from the southern or Bermuda route, requiring three-to-four months of travel time from England to reach the Chesapeake, and around six weeks on the return route. This route was not only time consuming, but also dangerous. Issues with Portugal made sailing the southern passage risky, but English ships tended to trade for various commodities in the Caribbean before heading north to their own colonies to collect tobacco. It is unclear through this research how frequently the Bermuda route to Virginia was used, but based on Andrew White's 1634 account of the voyage to found Maryland, the southern route was more common (White, 1634: 29-40). Sailing routes and foreign politics are particularly interwoven here in this regard.

The primary areas for advancement here came in the form of increases in production, driven at this point by population increase in the Chesapeake. Policy and regulation regarding tobacco focussed both inwardly and outwardly provided a significant new income source for the Crown and Virginian government. Specific maritime factors were tertiary, enabling the trade to occur and factoring into market costs, but not yet bringing significant advances to the trade. Policy and regulation both inwardly and outwardly focussed. It is important to see this time as a foundational period, where the idea of tobacco cultivation for the European market is firmly cemented, but the implementation of it is still underway. From here, many advancements are made in a variety of areas toward an increase in overall productivity in the English tobacco market.

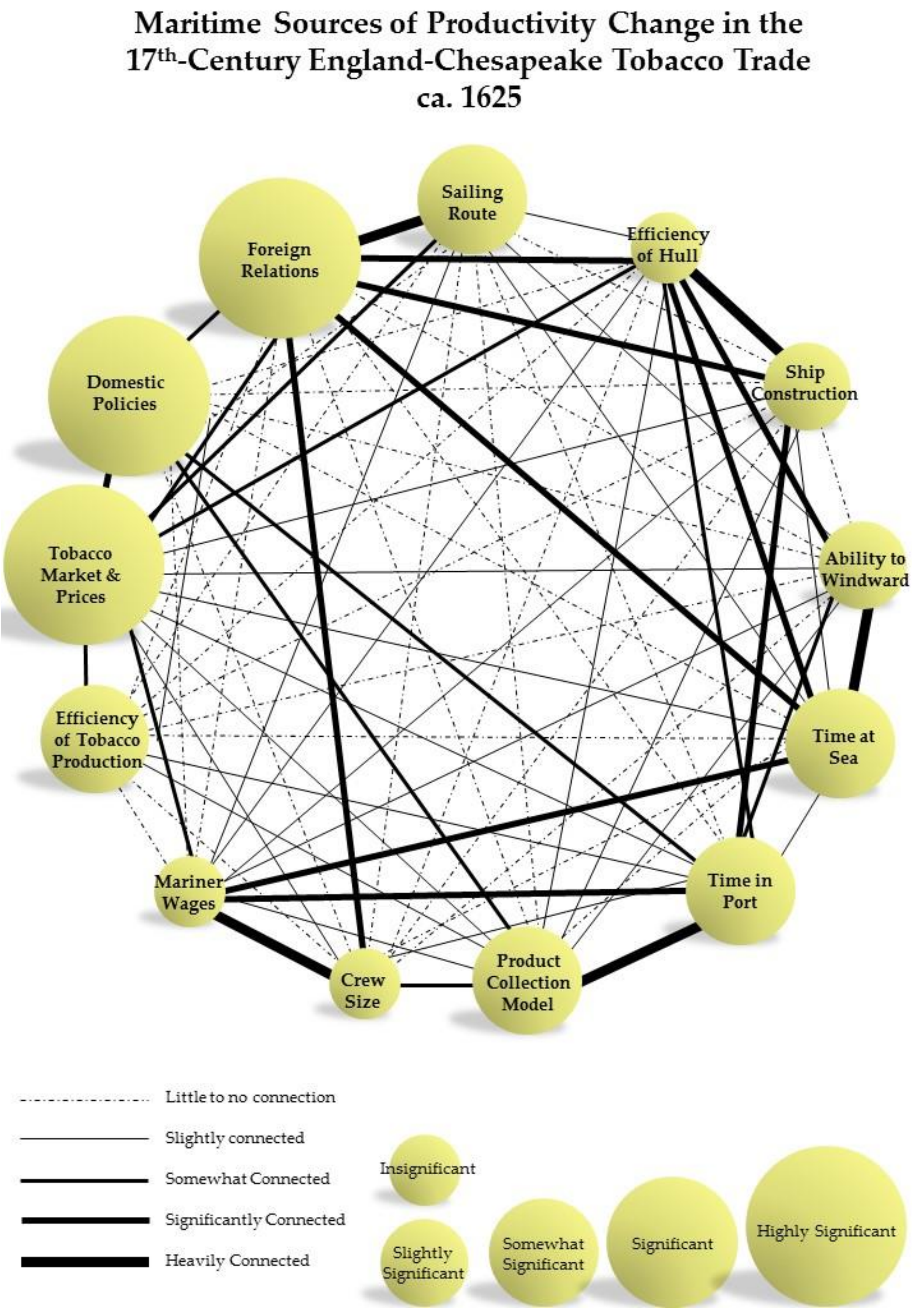


Figure 7-1 - Network model of the function of England's tobacco trade, ca. 1625 (graphic by S. Tucker)

1650

The mid-17th century was a critical point in English history. From 1642 to 1651, England was engaged in a civil war between Catholic Royalists and Protestant Parliamentarians, resulting in the execution of Charles I in 1649 and the establishment of the Commonwealth of England from 1649-1653 and the Protectorate from 1653-1659 (Canny 1998: 482-505). These events had a disruptive effect on colonial trade, and also resulted in turmoil between the largely Protestant colony of Virginia and the freshly established, largely Catholic colony of Maryland (Car et al. 1991: 11-12; Riordan 2004: 3-4). During this time, Dutch traders had become more active in the Chesapeake tobacco trade (Pagan 1982: 486, 491), which itself had become far more established and profitable (Menard 1976: 401-410). The populations of Virginia and Maryland were growing, but the total population was still rather low (US Census Bureau 1910: 9). Tobacco prices were still comparatively high, but not what they had been in the preceding decades (Menard 1976: 404-408), and quantities of tobacco produced per hand were also increasing (Carr et al. 1991: 41-43).

Around this period, maritime factors started to become drivers of productivity change in the tobacco trade (Figure 7-2). New England's rise to prominence in the Caribbean sugar trade was changing the entire Atlantic trade system model, with unilateral trade routes replacing earlier multi-lateral routes (Anderson 1998: 193, 209-212). In this way, trade was becoming more specialised. These developments allowed new sailing routes across the Atlantic to be sought out, and as established in chapter 4, a more direct route was discovered around this time. By the 1660s, the route by way of the Azores was the favoured passage to the Chesapeake from England. The colonies had become largely self-sustaining, and supply voyages from England were no longer needed. Also around this time, England began efforts to build a dedicated naval fleet. This brought major changes in shipbuilding, allowing for merchant vessels to adopt a form more suited to freighting than the earlier multi-purpose designs had allowed. This was a process though, and required some fifty years to be fully realised (Adams 2013: 149-151). In this regard, elements relating to seafaring were at this point the primary drivers of productivity change, with the tobacco market still growing at a high rate, and total output increasing largely from population growth (Price 1964: 497). England's internal struggles were threatening growth, but Dutch involvement allowed trade to continue through this period of conflict. This development would be, however, rather short-lived.

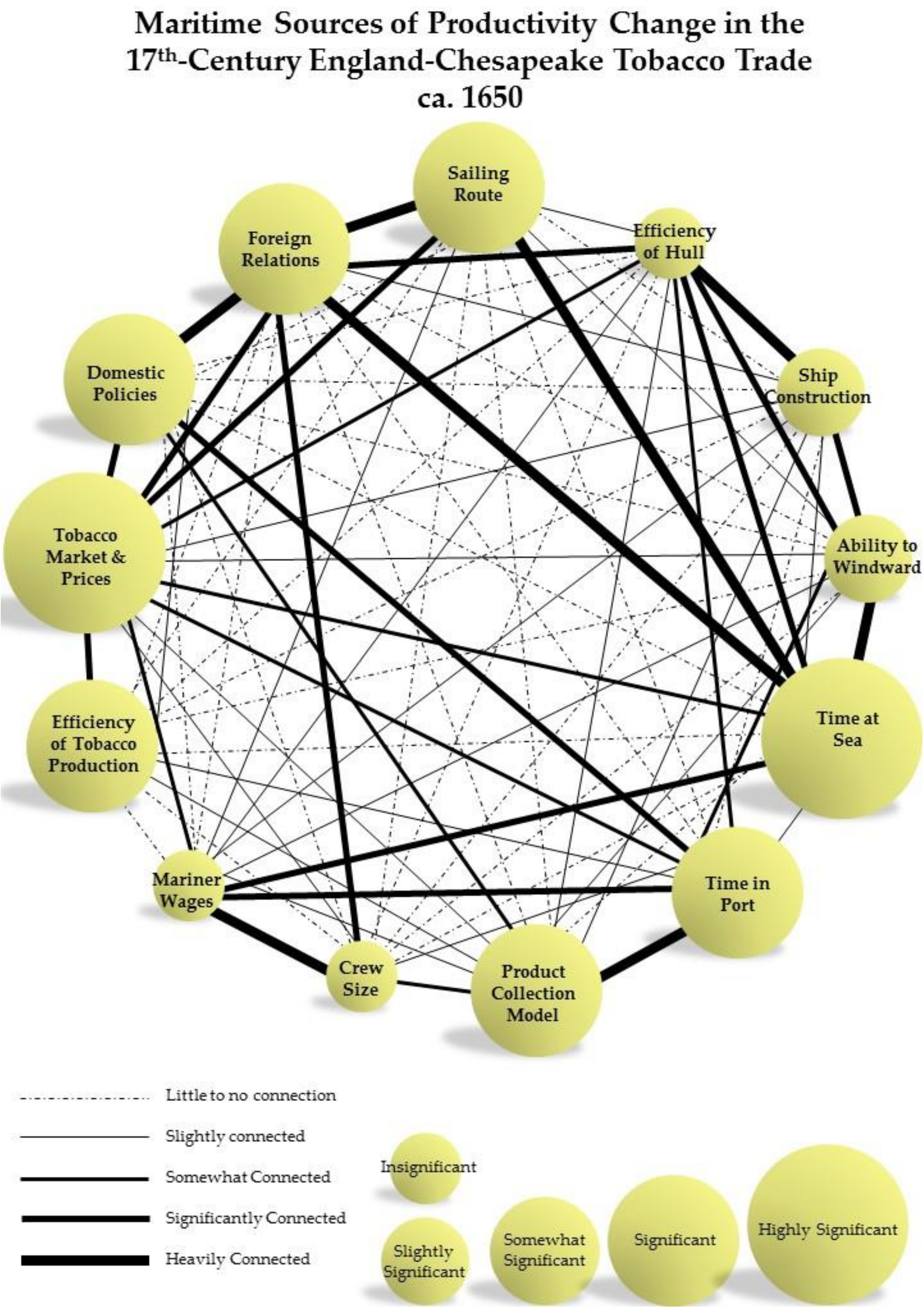


Figure 7-2 - Network model of the function of England's tobacco trade, ca. 1650 (graphic by S. Tucker)

1675

Six decades after the Chesapeake tobacco trade began, it was reaching its adolescent phase. Perhaps the most noteworthy events relating to the tobacco trade in the third-quarter of the 17th century were the three Anglo-Dutch wars, fought over the exclusion of foreign traders from English colonial trade through the various Navigation Acts. Tobacco prices at farm had fallen dramatically since the beginning of its cultivation, and prices would remain roughly constant from this point throughout the end of the colonial period (Menard 1976: 401-402). Overall production had risen starkly though through both population increases and overall efficiency of farming techniques (US Census Bureau 1910: 9; Carr et al. 1991: 41-43), creating an economy of scale which kept it profitable. Tobacco use in Europe was growing drastically at this time owing to the low market prices. At this point, it is appropriate to say that agricultural aspects of the trade had reached a peak, not advancing further until the family farms with relatively high labour costs gave way to the plantation model utilising slave labour in the 18th century (Kulikoff 1986: 37-44). Further advances at market prior to this shift came from increases in population and reductions to shipping costs.

The reduction in shipping costs is perhaps the *Zeitgeist* of this period in the tobacco trade (Figure 7-3). New trade routes were reducing time at sea (see chapter 4), and new aspects of shipbuilding were allowing for less specialised wood to be used, keeping costs relatively steady despite diminishing timber supplies (Adams 2013: 175-185). Ship's crews were reducing in size during this period due to lowered risks at sea through the new routes and changes to rigging, further reducing inputs to shipping costs (Davis 1962: 370; North 1968: 962). Streamlining the trade was the main focus of advancement here, and it was at this point recognised that one specific factor was impeding these efforts in a significant way: time in port. The spread of plantations along the waterways of the Chesapeake region had removed the necessity for towns and ports to develop (Riley 1950: 306-307). Trade was decentralised, and vessels required an inordinate amount of time to collect the year's tobacco for the return to England (Shepard & Walton 1972: 80-83). The Maryland and Virginia governments attempted to remedy this through the establishment of towns, but this required a half-century to truly bring about this change. Due to lengthy time at port, other advances made to aspects of the trade were effectively muted.

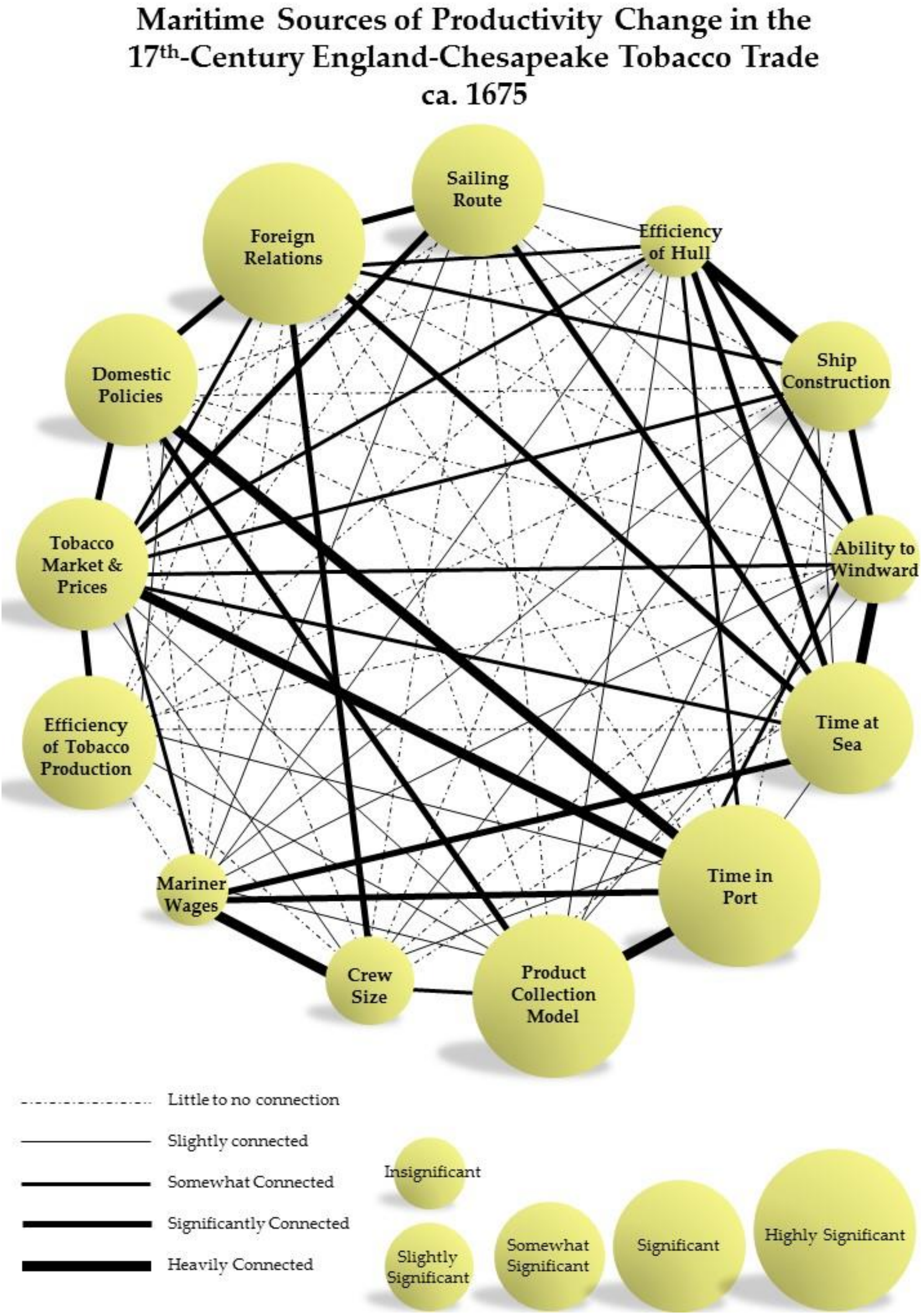


Figure 7-3 - Network model of the function of England's tobacco trade, ca. 1675 (graphic by S. Tucker)

1700

The period around the turn of the 18th century was the era of least productivity change observed within this study. The final decade of the 17th century was fraught with turmoil in both England and the Chesapeake colonies. Through the Glorious Revolution of 1688, relations with the Dutch were mended, but tensions between Catholics and Protestants once again caused conflict in the Chesapeake, particularly in regard to Maryland (Middleton 1953: 49-50). As such, the Calvert family lost their proprietorship over the colony from 1689 until 1715. A major consequence of this was that the new royal government of Maryland began to enforce regulations that were largely ignored under the proprietary government, specifically violations of the Navigations Acts (Owen & Tolley 1995: 111-113). It is unknown how significant the share of trade in violation of the Navigations Acts in Maryland was, but given the stark increase in court cases concerning such violations after 1689 (Owen & Tolley 1995: 243-305), it would appear that this was diverting a significant share of tax revenue away from the royal coffers (Figure 7-4).

The Nine Year's War (1688-1697) and Queen Anne's War (1702-1713) fought against France disrupted trade, particularly in the English Channel and the surrounding waters. English ships took to avoiding the use of the Channel or seeking military escort (Murphy 1867: 400-416; James & Jameson 1913: 275-291; Andrews 1907: 337-347). One response to the threat of privateering by French-flagged vessels was to send trade vessels in a single, massive, annual Fleet. Fleeting had to some degree already become common practice during the period of conflict with Holland, but at this point it became a legal requirement, and was better organised (Morriss 1914: 93-95; Middleton 1946: 183-185; Middleton 1953: 318-320). This allowed for safer transport of valuable goods, and also benefitted the planters in the Chesapeake, assisting them in their negotiations for fair prices from tobacco merchants, as they could then be certain whether additional vessels would be arriving. Time in port remained a source of impedance in the advancement of trade productivity, but the drastic increase in colonial population at this time was soon to bring an end to this issue (US Census Bureau 1910: 9). Further, the aforementioned change in agricultural model to a plantation-based one was beginning to take hold, but had not yet overtaken the family operated farm in terms of popularity.

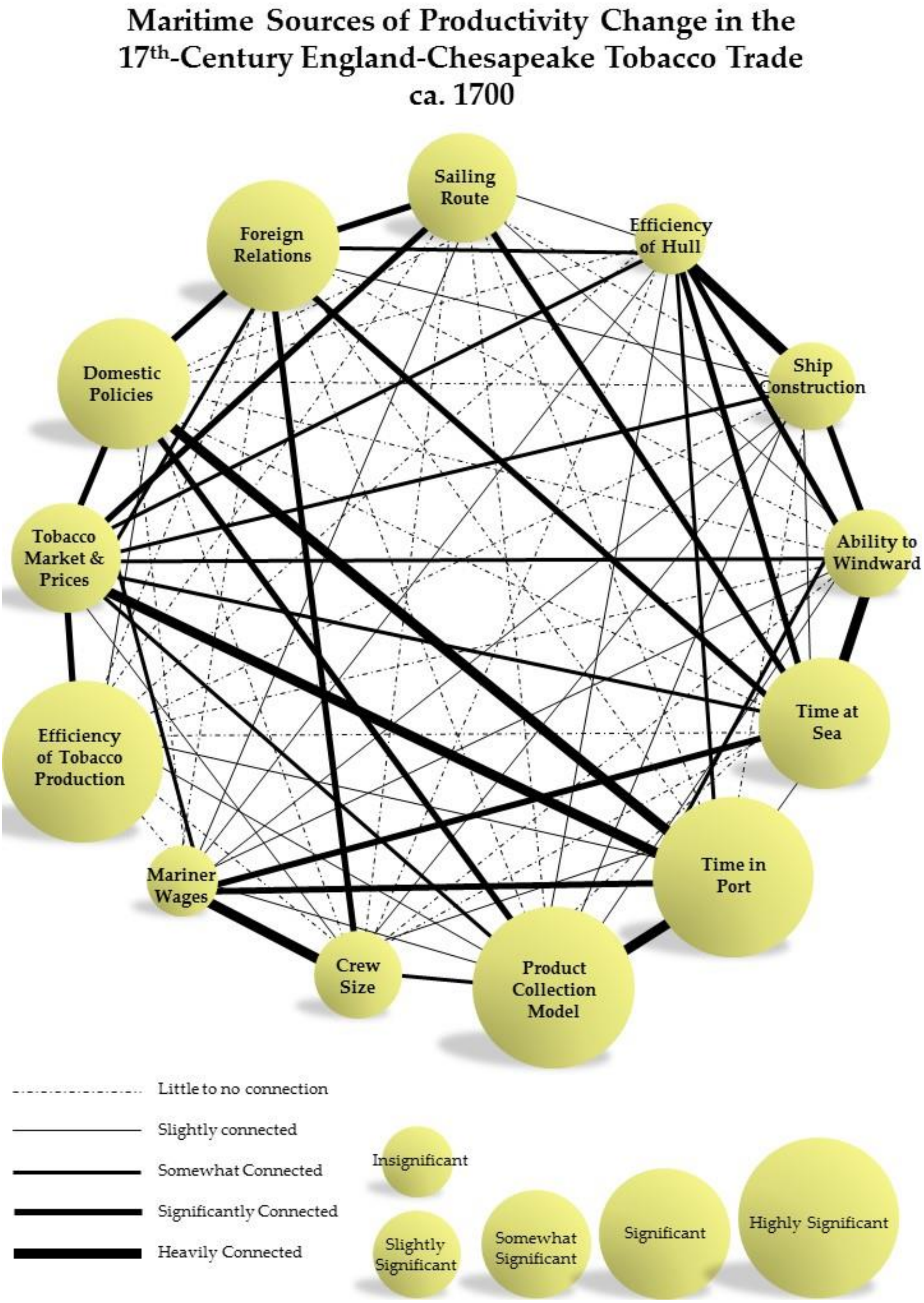


Figure 7-4 - Network model of the function of England's tobacco trade, ca. 1700 (graphic by S. Tucker)

1725

As the 18th century advanced, so again did productivity in the tobacco trade. The rise of plantations, using an ever increasing proportion of slave labour, increased productivity whilst reducing costs. The economies of Maryland and Virginia had begun to diversify, with a smaller portion of the free population farming tobacco. Settlement began to move away from waterways, and so did a large portion of tobacco cultivation. As shown and discussed in chapter 2, this change in settlement patterning made the heretofore system of plantation-front tobacco collection ineffective. Towns began to appear along the Chesapeake coasts, also made possible by the diversification of the economy. Through this development, tobacco storehouses and ports for the centralised collection and inspection of tobacco emerged. It was through this that the British-Chesapeake tobacco trade finally reached full maturity, and thereby, productivity. Advances in time spent at sea in the latter half of the 17th century, and time spent in port in the second quarter of the 18th century allowed for significantly shorter voyages, drastically reducing shipping costs (Figure 7-5).

This feat required a full century to achieve, but proved nonetheless a profitable industry from its inception for traders and the English government. Numerous advances were made in seafaring and shipbuilding driving forward this productivity at various points along the way. Over this period, the vessels carrying tobacco underwent a variety of changes, bringing them from vestiges of the late medieval period to the forerunners of the final ships of the *Age of Sail*, driven by technological advances, changes in the availability of resources, and the purposes for which they were designed. Specialisation was key here. As wind-driven vessels intended to carry heavy cargoes across the ocean, England's trade vessels remained relatively slow, but this was not overly problematic. When faster and more manoeuvrable vessels were needed, England built them, evidenced by the divergence of trade and naval vessel forms in the third-quarter of the 17th century. It is clear here that the developments made in the tobacco trade are the sum of many intricately woven elements, each performing its own role in growing the Chesapeake tobacco market from its initial production of a meagre four hogsheads to over 350,000 hogsheads at the end of the period of interest (Jacobstein 1907: 23; Morriss 1914: 35; Walsh 1999: 87-93).

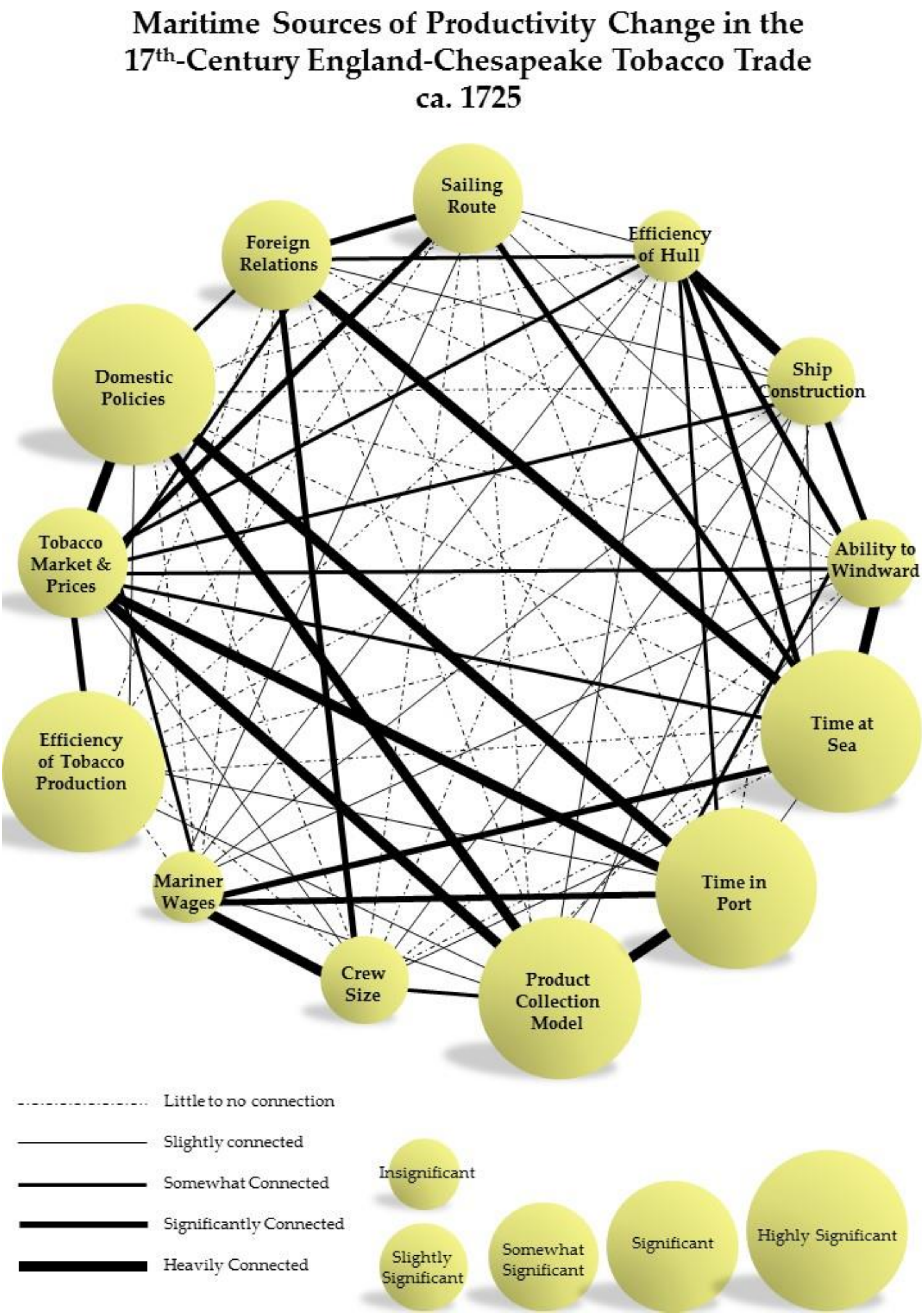


Figure 7-5 - Network model of the function of England's tobacco trade, ca. 1725 (graphic by S. Tucker)

Final Remarks

Exploring each of these topics individually has led to fascinating insights into a complex network of interaction explaining the economic functionality of England's early tobacco trade. Ships and maritimity are at the very core of this subject, although scantly discussed in many earlier explorations of this topic. An examination of technological change to vessels and the routes which were used has brought new light to this discussion, showing that these are in fact significant points of productivity change in early English transatlantic trade, contrary to the conclusions of some earlier research (Shepard & Walton 1972: 77-80), although it is strongly agreed here that extended times spent in port greatly subdued potential changes to productivity through technology and knowledge of seafaring until the problems were remedied in the 18th century.

Nearly two decades prior to this writing, Charles Orser called for studies to begin to address the complexities of change in the post-Columbian Atlantic World (1996: 26-28). Returning to the discussion from the first chapter of this work, he called for archaeologists to embrace global connections and to provide studies addressing the development of globalisation, modernisation, and colonialism (Orser 2005:77). This study offers a modest attempt of accomplishing these goals by addressing this important topic of English colonial expansion through a globalistic, networks-based approach, and by exploring ideas of mutualism and interaction while understanding that Eurocentrism, capitalism, and modernisation lie at the very heart of these issues.

Archaeology has still a substantial role to play in this discussion, particularly in terms of identifying technological changes to vessels throughout this period. There are simply too few English vessels from this period which have been examined to adequately discuss changes in construction in a meaningful way. A bias seems to exist within English archaeology to fund studies of naval vessels rather than the merchant fleet, indirectly ignoring the role of English mercantilism in the shaping of the Atlantic World and the rise of the British Empire. The identification and investigation of English merchant vessels dating to after 1650 is crucial to understanding these topics at their core, and research to these ends is greatly encouraged here. For New World archaeologists, particularly those in the Chesapeake Bay region, such a find would be of great significance and hugely exciting, but such sites are unlikely to be located due to the nature of the region. An effort must therefore be made to investigate the sites that are known, many of which are in the form of ballast piles which are scattered along the shores of the Chesapeake Bay and its numerous tributaries. For these, the fieldwork described here in Chapter 6 demonstrates that studies of ballast distributions can be conducted with a small budget, producing compelling results.

Though the product is much reviled in the modern world, tobacco's historical role in shaping the Atlantic World has been far reaching. England's dominance in the North Atlantic grew almost solely from this crop, and the small island nation's economic gains and welfare were direct results of tobacco. This highly complex network of exchange drove forward Britain's 18th-century ability to expand its Empire around the globe, using lessons learned through its North American colonies to do so. This new system of mercantilism, developing later into capitalism, was the driving force behind these changes. Although governments and merchants benefitted greatly from this system, it must be remembered that the system was built on the backs of the planters, slaves, indentured servants, and mariners who toiled in fields and risked their lives at sea for little economic reward, paving the way for Britain's 18th-century imperialist ideology.

Appendices

Appendix A – Glossary of Terms

This glossary is compiled from terms used within this document with which the reader may not be necessarily familiar. For more complete glossaries of ship terms, see Steffy 1994, or Manwaring & Perrin 1922.

General Terminology

Atlantic World
The term used to refer to the post-Columbian arrangement of Nation States, Empires, Colonies, and the peoples living on the land masses bordering the Atlantic Ocean from the Early Modern Period onward, and the systems of interaction between them.

Brick Bat
Incomplete, yet sizeable fragment of brick with complete, measureable sides in at least two dimensions.

Etic
A point of view as understood through the perspective of an insider within a cultural group.

Emic
A point of view as understood through the perspective of an outsider observing a cultural group.

Historical Archaeology
A sub-discipline in archaeology with several definitions. In North America, the term is generally used to refer to the archaeology of a specific period, peoples, and locus, studying European activities in the New World post 1492, in contrast to *Prehistoric Archaeology* or *post-Contact Archaeology*, which focus on native populations. European definitions focus more on methodology, where historical documents are used to help inform archaeological studies. This term is used in this document joining both of these definitions as a period, locus, and methodology.

Hogshead
A large barrel used in the 17th century used for transporting goods such as tobacco.

Link
A concept within Network Analysis of a connection between actors.

Node
A concept within Network Analysis of an actor within the network, connected via links.

Productivity Change
A change or shift in: production quantities; speed of shipment; efficiency of product collection or movement; and income for planters, merchants, or government bodies.

Seasoning
A generic term for a host of illnesses, often fatal, which were frequently contracted by Europeans when first arriving in the New World.

Starving Time
The period from 1609-1610 in the Jamestown Colony in which food became extremely scarce. Starvation and disease decimated the colonial population during this time, leaving around 60 survivors of approximately 500 colonists.

Terminus Post Quem
Latin phrase meaning 'Time after which.' Commonly used within archaeology to describe a date after which the deposition of an artefact must have occurred, typically based on the date of production of the most recent associated diagnostic artefact.

Tun
Term for a cask of wine used as an early standard for describing a vessel's stowage capacity. Equal to 252 gallons (950 litres).

Ship and Nautical Terminology

Anchorage
An area such as a cove or natural harbour in which a ship might anchor safely, away from shore or port structures.

Bark
A type of vessel common in England in the 16th and 17th centuries. According to W.A. Baker, a Bark was a smaller, decked vessel with a mid-ship-stepped mainmast and a foremast set very near the *bow*. *Sparrow Hawk* is a possible archaeological example of this vessel type.

Beam
The transversal measurement of a vessel at its widest point. Also, a thick timber used in support of structural elements of a vessel, such as a deck beam.

Bilge
The lowermost part of the hull.

Bow
The foremost part of a ship.

Bowsprit
The foremost spar of wood extending from a vessel's *stem* used for attaching sailing elements such as the *spritsail*.

Brig/Brigantine
A two-masted, square-rigged vessel, with one *foremast* and one *mainmast*.

Butt joint
The meeting of two square-finished *timbers* squarely on their ends.

Carvel
Method of shipbuilding which became popular in Europe in the 15th century, characterised by a *frame-first* building sequence and outer *planking* laid in a manner in which the edges abut each other without overlapping.

Castle
A raised structure fore (forecastle/fo'cs'el) or aft (stern castle) typical of larger medieval vessels, used to gain a defensive vantage point for archers or gunners.

Caulking
The sealing of a seam between two planks in order to prevent water from passing through. The substance used was variable, from moss, to oakum, to animal hair, and other such materials, mixed with a pitch or tar.

Ceiling
A layer of internal *planking* covering or partially covering a vessel's *framing* timbers. This feature often functioned as a source of lateral stability within the *hull* structure, working in conjunction with other laterally organised components.

Chine
The point of the *hull* at which it curves upward from the *keel*. Also called the 'turn of the bilge.'

Chock
A triangular block of wood used in some framing methods to join sections of the *frame*. The chock would be placed between two frame segments with mitred ends, effectively creating a three-piece *scarf*.

Clench
To secure a fastening element such as a nail by deforming it, often achieved by bending the nail at its point.

Clinker, clinker-built
A *shell-first* method of vessel construction common in Medieval Europe, especially in the Nordic countries. This building method is characterised by overlapping strakes of radially

split timber, which are spiked together using *clenched*, and often roved, nails. After the outer planking is complete, *frames* are added to provide transversal strength to the vessel.

Compass timber
Purposely grown curved *timber* for shipbuilding, specifically used within *framing* elements.

Course of Sail
A sail on a particular mast. A mainmast with two sails would be said to have two courses of sail.

Deadwood
Wood added to the lower section of the *hull* fore or aft allowing *futtocks* to be placed to accommodate the decreased area for *floor* timbers at either end of the vessel.

Dogger
A type of Dutch vessel common in the 17th century fishing industry, named for its prevalence along the Dogger Coast.

Draught
The distance below the waterline which a ship's structural elements extend. This factor determines the water-depth necessary for a boat or ship to remain safely afloat without running aground.

Floor
The lowermost and most robust of *timbers* comprising *frames* which cross over the *keel* transversely.

Fluit, Flute, Flyboat
A type of large merchant vessel originating in the Netherlands, but also constructed in England, characterised by a long *hull*, a wide *bow* and *stern*, single deck, short masts, and simplistic *rigging*. Known as slow vessels, they had increased stowage capacity over other similarly-sized hull forms, and a low construction and operating cost.

Fore-and-Aft
A descriptive term for a sail with a general alignment laterally (*keel*-wise) along the ship rather than transversely (*beam*-wise).

Foremast
The foremost mast of a vessel, thought to originate in the early 15th century.

Frame
The structural element of a vessel running transversely to the *keel*, often consisting of multiple elements including *floors*, *futtocks*, and *top-timbers*. In frame-first construction, the frames provide the bulk of a vessel's strength.

Frame-first construction
A type of vessel construction in which a *frame*, or partial frame of a vessel is erected, with *planking* elements laid over the frame at a later time. Vessels of this type of construction derive the bulk of their strength from their framing elements. Typically associated with vessels built in the *Carvel* tradition.

Frigate – A ship of war popular in Europe in the Early Modern period. In England, this term was first used in the 1650s to refer to a ship with a long, slender hull profile, typically designated as a third-rate vessel, such as *HMS Dartmouth*.

Futtock, foot-hook
The central segments of a vessel's frame laid between the *floor* and the *top timber*. These are numbered (1st, 2nd, 3rd) relative to their distance from the *keel*.

Gaff-Rigged
A mast is said to be gaff-rigged if it carries a sail supported by a spar stemming from one side of a mast.

Hagboat
A three-masted vessel similar to a *fluit* with a wide, rounded stern.

Hold
The lowest area of a vessel used for stowage of cargo or other goods.

Hull
The outer body or 'shell' of a vessel.

Keel
The central-most, and typically lower-most, laterally aligned *timber* of a vessel, which joins the *sternpost* to the *stem*.

Keelson
A *timber* added above the centre of the *floors*, running parallel to the *keel*, assisting in strengthening the keel and securing the floors.

Ketch
A smaller fishing or trade vessel common in the 16th and 17th century in England with a stout *hull*, typically two-masted, with a *mainmast* and *mizzen*.

Lateen
A triangular-shaped sail which is rigged *fore-and-aft*.

Mast step
A support for the lowermost part of a mast, either built onto, or cut into, a robust lower feature such as a *keelson*.

Mainmast
A mast set at or near the centre of a vessel, typically the largest mast on the vessel.

Mizzen
A mast set near to a vessel's stern, typically having a small sail which assists in steering.

Pink
A small, three-masted English vessel common in the second half of the 17th century, having a very narrow or rounded *stern*.

Pinnace
A small two- or three-masted English vessel common in the first half of the 17th century, having a *hull* closely resembling that of a *ship*.

Plank
Generally used to describe thinner segments of sawn or split wood used most frequently in vessels to form the outer or inner shell of the *hull*. Technically, this refers to wood sawn to dimensions between 1.5 in. (38mm) and 4 in. (101mm) thickness.

Points of sail
A term describing a sailing vessel's orientation to the direction of the wind. Various points of sail are as follows: 'Head to wind' or sometimes 'In Irons' (directly into the wind), 'Close Hauled' (wind slightly to one side of the bow), 'Close Reach' (wind slightly fore of the beam), 'Beam Reach' (wind directly from the side of the vessel), 'Broad Reach' (wind to the side, but aft of the beam), and 'Running' (wind directly to the stern).

Port
A semi-terrestrial feature at the edge of a body of water created for vessels to engage in commerce. Also, the left side of a vessel when on-board facing the *bow*.

Rig
Generic term referring to a sailing vessel's system of propulsion, specifically its configuration of masts and sails.

Rigging
Various elements of ropes, lines, tackle, and chain which are used in the support and operation of the masts and sails.

Rudder
An steering element outboard of a vessel at its *stern* extending through the waterline, which actuates steering through side-to-side movements as controlled by a steering mechanism on board the vessel.

Scarf
A join between two pieces of *timber*, where the ends are cut so that the pieces overlap in a way in which they continue onward as if one articulated piece. This is commonly seen in vessels with angled scarf joints on the *keel*, *keelson*, or *futtocks*, or in the join of the *stem* or *sternpost* to the keel.

Schooner
A smaller, two-masted vessel, carrying a *fore-* and *mainsail* which were both *gaff-rigged*.

Shallop
A small transport boat commonly used as tender for persons and cargo from a lager vessel's anchorage to the shore, or to move goods a short distance such as from farm to port.

Sheathing
A layer of *planks*, boards, or metal added to the exterior of a hull to protect the structural *hull* elements from damage, especially to abrasion or damage from shipworm (teredo navalis).

Shell-first construction
The building of a vessel using one of several methods in which the *hull* of the vessel is assembled and shaped prior to *framing* elements being added. Examples include *clinker*, sewn lap-strake, and mortise-and-tenon construction methods.

Ship
A large sailing craft having at least three masts. Often used generically to describe any large sailing craft regardless of *rig*.

Sleeper
A heavy form of *stringer* which runs laterally along a vessel's lower *hull* parallel to the *keel*, used to brace the joins between the *floors* and first *futtocks*, typically around the turn of the bilge. Also referred to as a footwale.

Sloop
A small trade vessel, typically decked, and having a single mast, although arrangement of *rigging* could be highly variable.

Spritsail
A rectangular sail supported at the lower end of the *bowsprit*. A spritsail *topsail* was often added in the 17th century to the top of the bowsprit.

Spurket
A space sometimes left between two otherwise contiguous *framing* elements, such as a 1st and 3rd futtock.

Stay
The lines running from the upper reaches of a mast to points on deck supporting and stabilising the mast.

Staysail
A sail attached between masts, made fast on the *stays* of a mast.

Stem
The *timber* rising from the foremost section of the *keel* which shapes the *bow*, and from which the outer *planking* is attached.

Stern
The rear of a vessel.

Sternpost
The *timber* rising from the aft-most end of the *keel* from which the outer *planking*, and often the rudder, are attached.

Stringer
A robust *timber* or timbers running inboard lengthwise the entire length of a vessel adding stability to the *frames*.

Tacking
A technique used in sailing to cut back and forth across the wind to find the most effective wind angles in order to achieve forward motion in less than favourable winds.

Timber
Any large wooden structural element of a vessel, such as *frames*, deck beams, or the *keel*.

Ton, Tonnage
A calculation or approximation of volume within the hold of a vessel, commonly used to describe a vessel's size, based on the number of wine casks or 'tuns' which could be stowed. Various formulas were used from the 17th century onward to calculate this mathematically, based on the multiplication of the dimensions of the ship in *keel*, *beam*, and depth of *hold*, divided by a specified number around 100, dependent on when the vessel was built.

Topsail
The topmost *course of sail* carried by a mast *rigged* with multiple courses of sail.

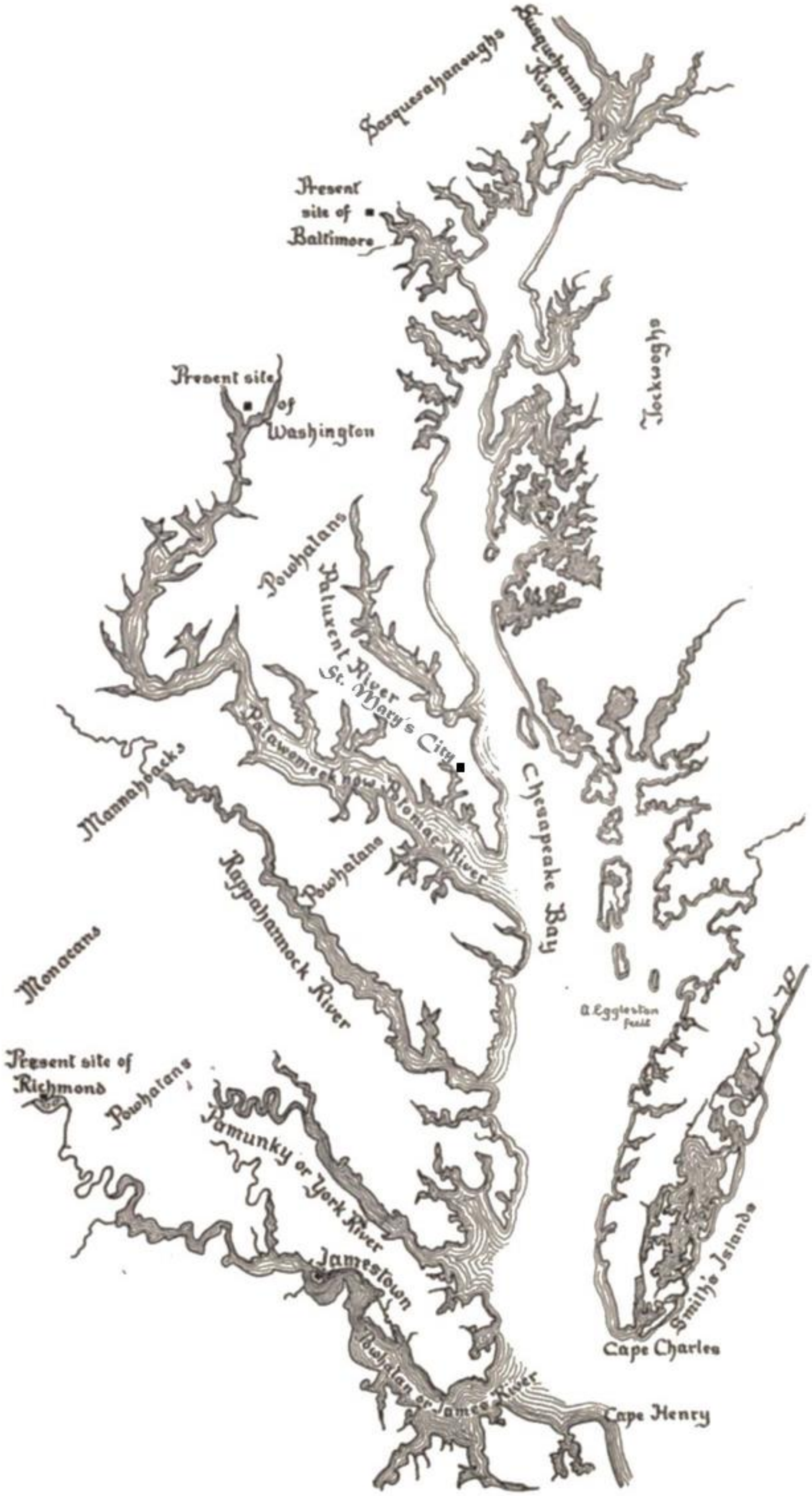
Top Timber
The uppermost *timber* of a vessel's frame.

Transom
The heavy *timbers* set on top of the *sternpost* from which the shape of the *stern* is derived.

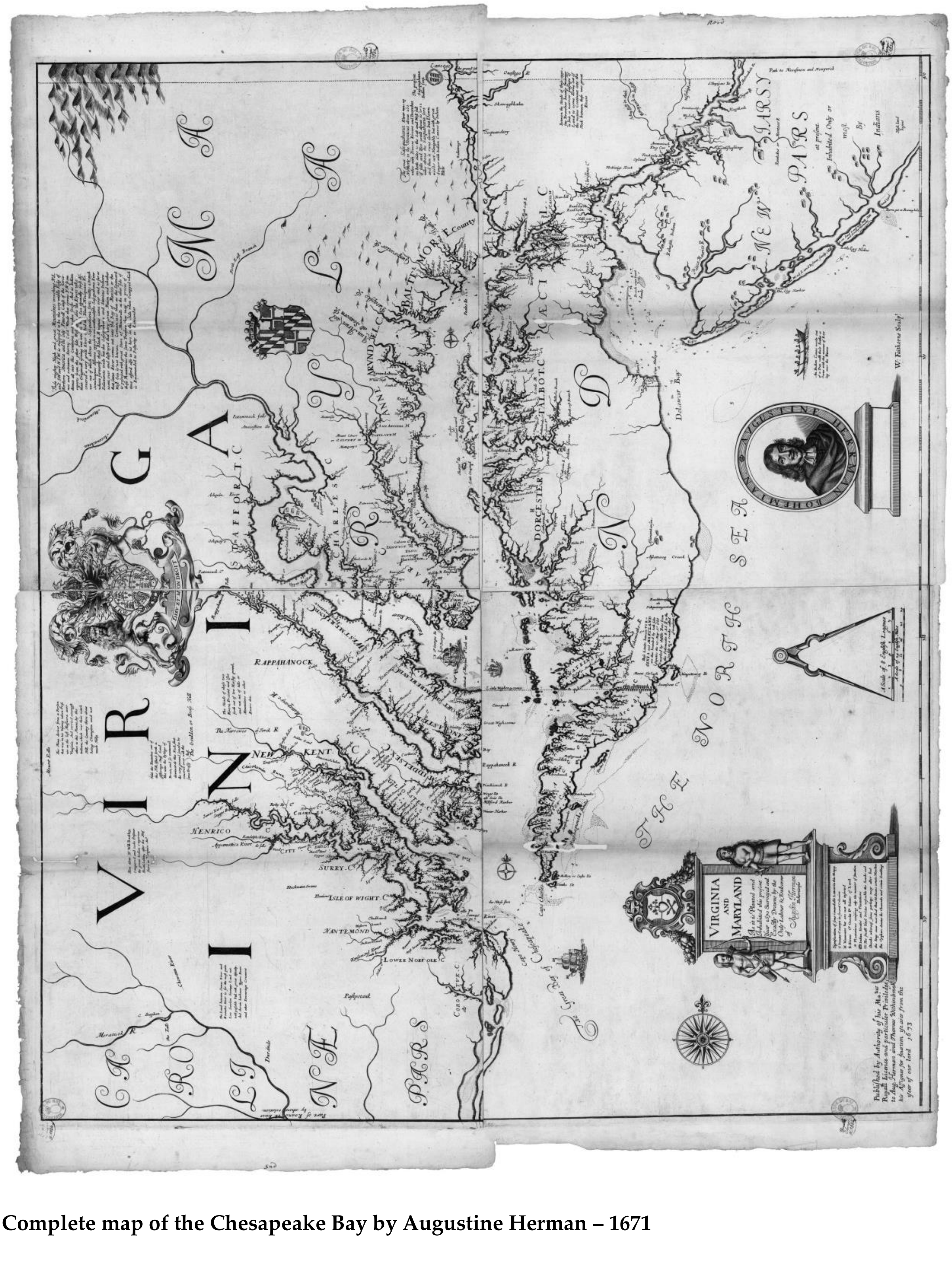
Treenail, trunnel
A wooden fastening element carved in a cylindrical shape which is driven through pre-drilled holes for fastening *frames* and *planking*.

Velocity made good (VMG)
The measurement of the speed of forward progress a vessel makes in a given period of time as calculated between two points. This measurement ignores actual speeds attained and focusses rather on the effective speed by removing the distance covered through the process of *tacking*.

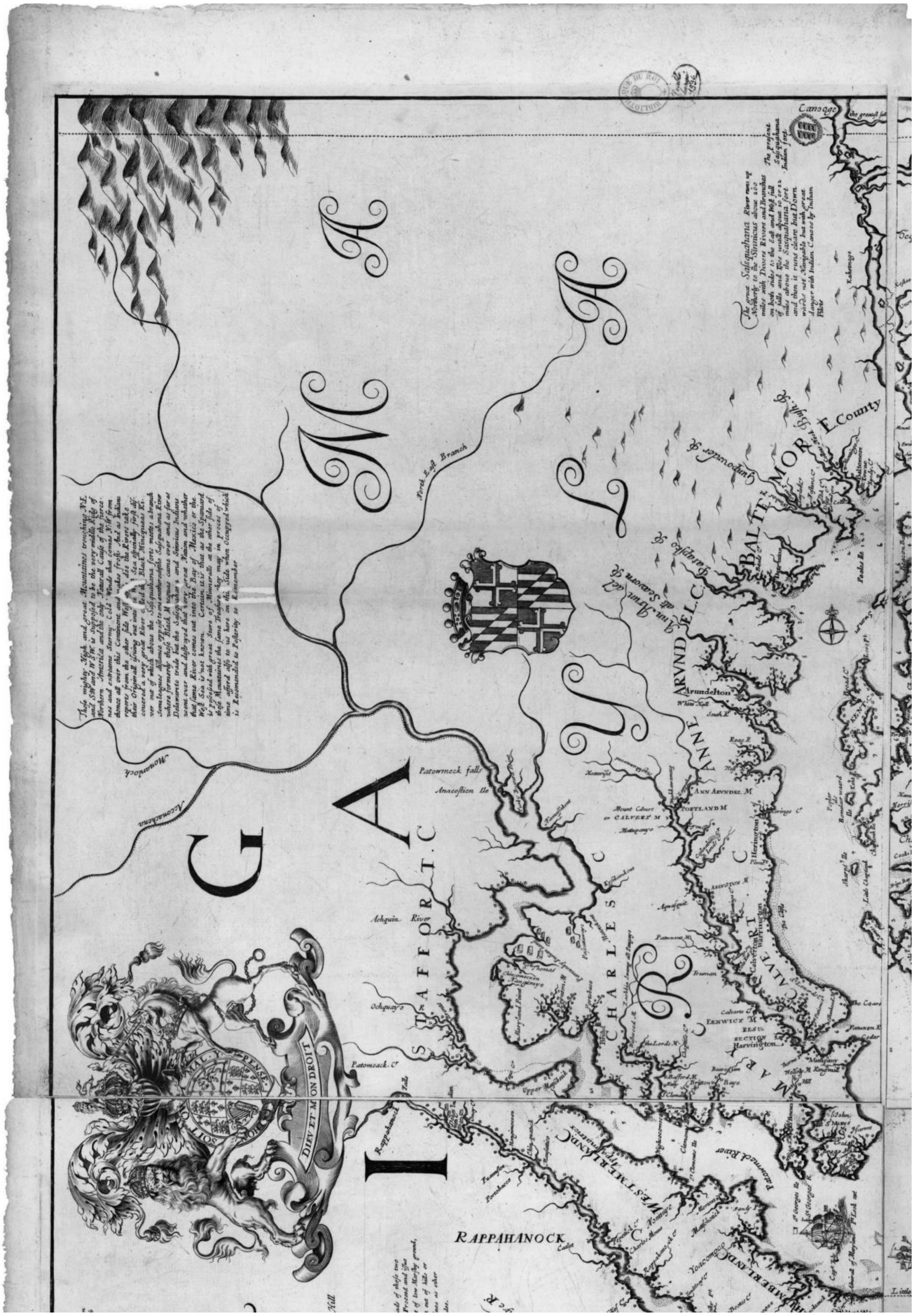
Appendix B – Relevant Maps


Sasquesahanoughs
Susquehannah River
Present site of Baltimore
Tockwoghs
Present site of Washington
Powhatans
Paluxent River
St. Mary's City
Patawomeck now Potomac River
Chesapeake Bay
Mannahoacks
Rappahannock River
Powhatans
Monacans
A. Eggleston fecit
Present site of Richmond
Powhatans
Pamunky or York River
Jamestown
Smith's Islands
Cape Charles
Powhatan or James River
Cape Henry

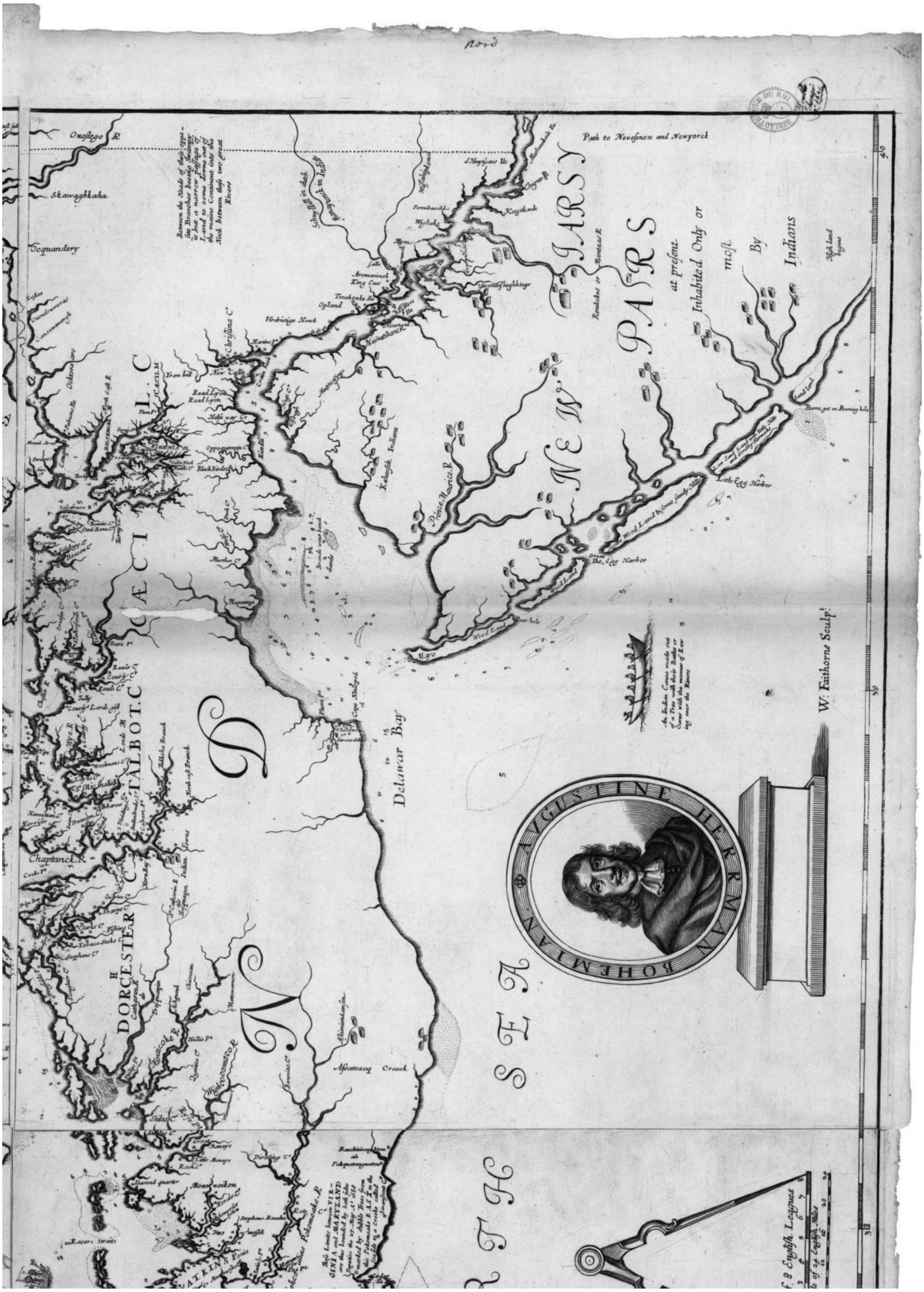
Map of the Chesapeake Bay (Eggleston, 1896: 1). Location of St. Mary's City added by the Author.



Complete map of the Chesapeake Bay by Augustine Herman – 1671

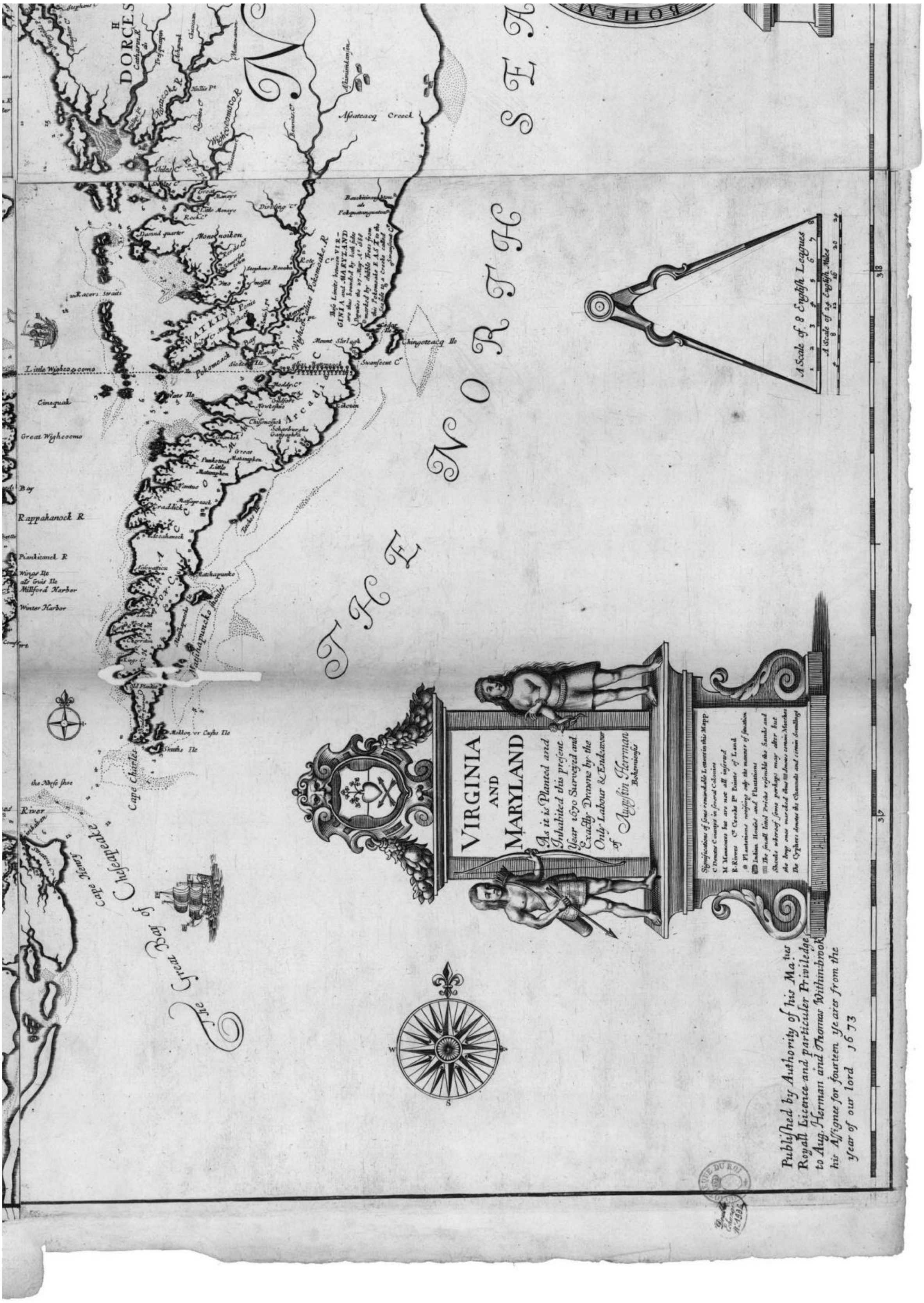


North-eastern quadrant of the 1671 Augustine Herman map of the Chesapeake Bay



South eastern quadrant of the 1671 Augustine Herman map of the Chesapeake Bay

Northwestern quadrant of the 1671 Augustine Herman map of the Chesapeake Bay



South western quadrant of the 1671 Augustine Herman map of the Chesapeake Bay

Map of the British Isles with relevant locations marked (by Author)

Appendix C - Transcription of the Voyage of the Constant Friendship in the Edward Rhodes Logbook, Bodleian Library, MS Rawl. D.702

Transcribed by S. Tucker with occasional assistance from an earlier transcription by John Wing (1999: 16-26).

		A Journall of our outward bound passage in ye Constant Friendship Mr Wm Wheatley Commander bound by gods assistance For merryland with in ye capes of Virginia in ye Latt of 37-00 Cept by mee Edward Rhodes – 1671
8[Oct]ber ye	25	we broke ground from Gravesend with ye wind att W N W and ran downe below ye boy off ye new ore & there ankored
	26	we weyed from thence with ye wind fare att SSW and got over ye flatts and ran to ye forland and there ankored with the
	27	we could non stire ye wind blew fresh southerly
	28	we weyed from ye north forland with littel wind and towed downe into the downes with our boats ahedd
	29	we lay still in ye Downes ye wind being contrary faire weather
	31	we weyed out of ye downes with ye wind easterly att 10 of clocke in ye night with a floyboat in our company caled ye Tho[mas] and Mary Mr Boddy master bound for virginia
9 [Novem]ber	1	att 6 of clocke in ye morning beachey bare nnw of us ye wind att E S E a fresh gaile and att 8 of clocke att night we weare twart of ye white
~~50~~ ~~10~~ ~~54~~ ~~24~~ d – 4th 49-40 Lon 00-00	2	we had ye wind still easterly a fresh gaile we were twart of plymouth sound att 12 in ye day and att 8 of clocke in ye night we judged ye Lizard to bare north frome us 8 leagues off being 24 miles to ye south of it
48 . 46 Lon 1 - 23	3	we made our way this 24 hours by ded reckoning SW by W dist 100 miles difference of lattd – miles departure – miles we had ye wind between ye NE and ye SE a fresh gaile with raine and thick weather
Lattd 47 06 Long 03-52	4	we steered all this 24 hours SW by W and ran 181 miles by ye Logg which differences in Lattd 100 miles and in Longitude 149 miles we had ye wind easterly a fresh gaile with raine sometimes
La 46 – 32 Lo 04 : 57	5	we made our way good this 24 hours WSW 5d S and ran 74 miles we differenced in latt 34 miles & in Longitude 65 miles we had ye wind verable sometimes littell wind
Latt 45 53 Lon 5-58	6	we steared SW by W and ran 73 miles by ye Logg which we found she had gone 49 miles to ye southward and 61 miles to ye westward we had ye wind easterly and then in proved NE

Lattd 49 – 60 Long 06 – 43	7	we had ye wind this 24 hours between ye NW & ye N it blew very hard in squalls of raine : we ran 120 miles by ye log we differed in lattd 113 miles diff of longitude 45 our course SSWest we had a grave NWest sea which threw us away more southerly than we did expect
Lattd 42 – 39 Longd 08 : 24	8	we made our way this 24 hours NW by W dist 130 miles diff lattd 82 miles dist Longitude 101 miles we had ye wind betweene ye WNW & ye East a fresh gaile ye weather broke up att 8 of clocke in ye night and proved moderat weather
Lattd 4[0?] 39 Long 08 : 24	9	we made our way good by observation & dist by ye log W 30 degrees S dist 118 miles diff lattd 59 diff Long 102 we had ye wind Easterly faire weather we left Mr Body ye fly boate which ranne out in company with us att 4 of clocke we fired a gunn and put abroad our Anckant he being a leaga asteren of us
Latt 40 – 40 Lon 11 – 58	10	we had ye wind Easterly until 8 in ye morning and then it southward w made our way this fore & twenty ours dist miles dist lattd 59 m dist Longitud 112 miles we had very faire wea
Lattd 40 : 11 Long 13 : 54	11	We made our way this 24 hours Wst 13d S dist 128 diff Lattd 24 miles dist Longitude 121 miles we had ye wind southerly untill 12 att night and then it shifted att once northerly and then it vered easterly and blew fresh
Lattd 40 – 04 Lon 17 : 05	12	we stered away west this 24 hours but we found by observation that we had gone 7 miles of ye So of our Latd which we had ye day before so that we made our way Wst 2d South and runn 186 miles diff Longitd 86 miles we had ye wind betweene ye east & ye SE a fresh gaile att 1 of clocke in ye after no one we saw Corves it bare SSW from about 7 Leages off so I judg that it lyeth no farther northerly then 39 de 45min then we steared WSW
Lattd 34 : 11 Longd 19 : 26	13	we made our way good this 24 hours W 2 d So dist 154 diff lattd 53 miles diff longt 141 m ye wind Soly it blew very fresh we sailed with our top sayles furled all night and this morning it proved less wind and faire weather

November ye Lattd 38 – 24 Longd 22 : 05	14	we had ye wind southerly this 24 hours with some raine we made our way good W 17de and ran 166 miles by ye Logg we diff in Lattd 47 miles and in Longitud 159
Lattd 38 : 04 Longd 24 : 09	15	we had ye wind Southerly we lay up WSW bit it blew So hard that it put us by our top sayles and having a great Southern Sea we could not make by eastimation more then a wt way we handed our foresayle and lay by 2 glasses and then oroving Littell wind we got itt againe we ran by ye log 124 miles W by S we could not have any observation and was thick weather with raine and ---
Lattd 37 : 40 Longd 24 : 54	16	we mad our way this 25 hours according to our observation WSW dist 50 mile Latd longtd 48m we had ye wind btween ye S & ye SSE until 4 of clocke yesterday in ye Afternoon and then it came about Northerly with much raine we find that we have a currant setts southward for wee by our corse could not have gone so fare southerly
de m Lattd 37 : 20m Longd 25 – 40	17	we had ye wind Easterly but vered Southerly very littel wind and faire weather we saw weeds being ye first time of our seeing them we made our way SW dist 50 diff Lattd 20 Doff Longitude 46 miles
Lattd 37 : 05 Lond 25 – 49	18	we made our way good W 12d S dist 71 dist Lattd 15m dist Longitud 69 miles we had ye wind WSW until 7 of clocke last night and then it came about Northerly with raine and blew fresh for a spurt
Lattd 36 : 48 Longd 27 : 40	19	we mad our way good west 4 de So dist 112 miles diff Lattd ye Dist Longtd 111 we had ye wind Southerly a fresh gaile with showers of raine sometimes
Lattd 37 : 13 Long 28 – 56	20	we made our way good this 24 hours SW 12d North and ranne 78 m by ye Logg we dist in Lattd 15 miles and in Longd 76m we had ye wind Southerly untill 2 of clocke in ye morning then it came about Northerly but proved calme until 8 of clocke yen sprang up againe att NE a fresh gaile and cleared up we got a very good observation
Latt 36 : 03 Long 31 : 19	21	we made our way good by our dist & diff of lattd SW 1/2 and ran 108 miles diff 70 miles 83 miles we had ye wind easterly west but having a great N W Sea we mad our way ½ point more S

November ye Lattd 35 – 49 Longd 32 : 05	22	we made our way good W 18de S dist 47 miles diff Latt 14 m we had ye winds betweene ye SE & ye SW fair weather and littell wind with a good observation diff Long 46
Lattd : 36 : 01 Longd 33 : 36	23	we made our way good w 7d S dist 92 miles diff Latt 12 miles diff of Longd 91 miles we had ye wind SW until 2 of clocke in ye morning then it ran about NW and after vered to ye NE and blew very fresh with snake raine
de m Lattd 35 : 28 Long 36 : 17	24	we made our way W by S dist 169 miles diff Lattd 33 miles diff long 161 miles we had ye wind betweene ye E & ye So a fresh gaile and faire weather and a good observation
de m Lattd 35 : 35 Longd 37 : 30	25	we made our way good this 24 hours W 5d No Dist 82 m diff Lattd 7 miles diff Longitude 81 miles we had ye wind between ye S and ye West until 11 of clocke in ye night and then it vered ye northwards of ye west att 12 we tacked and steered to ye southward it came about with little rainne but after cleared up
Lattd 35 03 Long 38 20	26	we mad our way Wst 38d S dist 52 miles diff lattd 32 miles diff longd 41 miles we had ye wind NNW until 8 in ye morning and then itt vered Southerly very littell wind and very faire weather I being upon ye pope espied 5 or 6 dolphins and with a hooke & line presently catched one and after that ye master struck another with a fizgig
Latt 35 46 Long 39 : 32	27	we mad our way this 24 hours W 31d S dist 84 miles diff Lattd 43 miles diff Long 72 miles we had ye wind SW it blew very fresh in squalls of raine & wind
Latd 36 : 23 Long 39 : 46	28	we mad our way this 24 hours NNWst dist 39 diff Lattd 36m diff Longd 14 miles we hat ye wind betwine ye SWest and ye NW it blew very hard we handed our fore sails att 5 of clocke last night and tryed to ye NW this morning the wee tacked and stood to ye Southward with our maine saile and mizon at 10 of clocke we sett our foresayle againe it proving less wind it being then at NNW blowing in squalls of raine and cold weather
---35 : 12 ----- . 01	29	we mad our way good this 24 hours by ded recconning S by W dist 70 miles Lattd 70m diff Long 15 miles we had ye wind NW & NNW blowing hard in gusts we tried 6 hours of ye time
November ye Lattd 36 . 03 Longd 40 : 08	30	we made our way by Judgement this 24 hours N 14d W dist 30 miles diff Lattd 29 miles diff Longd 7 miles; but by my observation I find that she hath 51 miles to ye norward from my yesterdays ded reckoning so that I find that theare is a northerne corrant Sett in mor then our course will gieve by 21 miles So that I do heare Alow hir westing to be ye Same and alow diff of Lattd 51 miles and our Dist ran 52 miles and course No 8d Wst : we had ye wind betweene ye SW & ye W it blew very hard we tried from 10 in ye night untill 7 in ye morning Nowards then we bore up and layd our hed to ye Soutward ye wind being then att WNW itt blew very hard but theare wea-

10[Decem]ber ye Lattd 95 38 Long 40 : 44	1	we made our way good this 24 hours SW by W dist 41 miles diff Lattd 25 miles diff Long 36 miles we had ye wind N West blew very fresh untill 12 in ye night then it proved Littell wind & then calme and att 11 of clocke to day ther Sprang up a gaile Southerly we mett with a flyboat Mr Baker Ma[r] we spake with him and he hoysted out his boat and came on board of us we spared them tobacco to pipe for it was very sparce with them about 5 of clocke the went aboard againe ye Master of hir was Sufficiently in drink before he went
Lattd 36 – 00 Longd 41 – 17	2	we made our way by estimation NW by W dist 40 miles diff Lattd 22 miles diff Longitude 33 miles we had ye wind between ye SSW & ye N Westwards and it blew very hard we hand our forsaile at 12 in ye night ye wind SW we tryed norwards until 8 this morning and then we bord up and handed our mainsayle and lay on hull to ye Southwards ye wind being att N W blew hard with many great gusts of haile and very cold we could not se ye flyboart in ye morning we had lost sight of hir in ye night it blow so hard
de m Latt 35 : 49 Long 41 : 38	3	we had ye wind this 24 hours between ye N West & ye N it blew very hard 4 watches we hulled by judgement So 30 miles and att 3 in ye morning we mad sayle and ran 21 miles west by ye log buy having a good observation we found our Latt by judgt ye day before So that I doe alow hir way to be W 2d S dist 24 miles diff Lattd 11 miles and diff Long 21 miles

att observation Lattd 36 10 Longd 42 : 57	4	we ran this 24 hours 82 miles by ye Logg and by estimation we made our way West 15 de Northerly which diff in Lattd 21 miles and in Longtitude 79 miles we had ye wind verable untill 12 in ye night then thear sprang up a fresh gaile att SS West and freshened on that att 12 noone we handed our forsayle and tryed
att observation Lattd 36 : 16 Longd 43 : 06	5	we had ye wind from yesterday att no one until 7 att night at SW it blew very hard we tryed with our Maynsayle and Mezan 16 miles No then it proved Littell wind and came about northerly yn we tacked and stood fo ye westward but we had such a hed sea that we cold not make sayle until 12 in ye night then we Sett our foresayle and main topsayle and ran 16 miles So yt we nade our way NW by W by esteem and ran 11 miles diff Lattd 6 miles diff Longid 9 we hadcloudy weather and littell wind with raine
att observation Latt 34 : 34 Longd 43 : 47	6	we had ye wind this 24 hours verable round ye compass but from 12 att night we had ye wind NW it blew fresh we rann upon all courses by ye logg southerly 86 miles and 8 No West but ~~not~~ having an observation to day and not having any 3 days before we found our selves to be gone 102 miles to ye Southward from our Latt by Judgment ye day before So that I alow hir cours to be S by W untill I diff in Lattd 102 miles diff 110 diff Longitd 41 miles and 4 ye morning it blew very fresh with raine we handed our mainsayle and in handing of it got over ye yard end and split
att observation Lattd 32 : 42 Long 44 : 32	7	we had ye wind this 24 hours betweene ye West and ye NW it blowed fresh we couldcary byt our courses we mad our way by ye log all leeways alowed SW by S and ran 100 miles by ye Log but having a good observation found our Selves to be gone 113 miles to ye Southward of our yesterdays Lattd so that we sopose ther to be a curant Sett foward; and I alow our way to be SSW untill I diff as much as my observation giveth in which runn will be 122 miles and ye departure 45 miles from ye Merridian ye day before today att 5 in ye afternoone our man being in ye mainetopp espeyed a gleare to ye westwards and cryed out land upon Som of our Ships companybeleeved an we tacked and stood up to ye Eastwards untill 12 in ye night then we tacccked againe and stood to ye westward ye wind att ye North and rainne

Lattd 32 – 37 Longd 44 : 46	8	we had ye wind northerly we Stood to ye Westward until 5 of clocke yesterday in ye afternoone yn we tacked and stood to ye Eastward until 12 in ye night and ran 18 miles E by S yn we tacked and stood southwards againe and at 10 in ye morning I guged our selves to be much above ye same meriddian weare we taked when we soposed to have seene bermoodas but we cold See nothing we made our course good this 24 hours all leeways alowd W 19 de dist 15 moles diff latd 5 miles diff longitd 14 miles we had ye wind betweene ye NW and ye East faire weather
att observation Lattd 34 : 20 Long 46 : 19	9	we made our way this 24 hours NW dist 132 miles diff Lattd 93 miles diff Longid 93 miles we had ye wind Southerly blow very hard with raine it put us by our top Sayles at 4 in ye morning ye weather Sheet of our maine top Sayle broak butwe Saved ye Sayle hole
att observation Lattd 34 : 35 Long 46 : 05	10	we had ye wind westerly untill 12 in ye night we stood to ye No yn it vered NW and we taccked and handed our forSaile att 10 of clocke we Set our forsaile yn we Spied a Sayle our Starne yn we tacked and stood to ye Eastwards and and two glasses yn taked agane and Lay musled untill he ran up with us and wass a bristow flyboat which had beene 8 weekes att sea we mad our way good all Leeways alowed No 29d E dist 29 miles diff Lattd 25 miles diff longd 14 miles ye wind vered northerly we set our topSayles it proved very faire weather and Littell wind
Lattd 34 : 43 Longd 46 : 26	11	we made our way this 24 hours SW 4d N dist 23 miles diff Latt 8 miles diff Longitude 21 miles we had ye wind verable between ye No & ye So Westwards fare weather and with Littell squales of raine att 10 of clocke ye Master of ye bristow man came onboard us to whom I delievered all ye Letters which I had for ye Dike of Yorke in Rappahanoke River
att observation Lattd 34 58 Long 48 : 28	12	we made our way this 24 hours W 13d N dist 64 miles all Lee ways aloud with diff in Lattd 15 miles and in Longitude 62 miles we had ye wind verable betweene ye SSW & ye No Westwards with Littell squalls of Raine but after they were over we had fayre weather againe and Litt winds our SE part of ye time

{damaged corner} Lattd 35 19 Longd 47 : 59	13	from yesterday in ye after noone we stood for ye Nowards untill 11 in ye night we Lay but N by E ye Wind NW by W yn we taccked and stood to ye westwards with ye wind att NNW a fresh gaile we made our waygood with our Lee way aloued NW diff 38 Miles diff Latt 21 diff Long 31 miles this morning we saw ye bristo man againe to Leward and att 12 he got up very near our wake att 7 in ye morning our for top Sayle Split but we Saved it all and brought too another
Att Observation Lattd 35 15 Longd 49 : 22	14	we mad our way good this 24 hours by observation and distance W 3d S dist 94 miles diff Lattd 4 miles diference of Longitd 93 miles we had ye wind between ye NW & ye North faire weather and not much Sea
by ded recc 35 54 Long 49 : 54	15	we stood to ye Norwards with ye wind ENE untill 4 in ye morning then ye wind Shrank to NWe that we lay but NNW in at 6 this morning we taked and stood to ye Eastwards and ran 20 miles ofe SE ½ E & 74 miles NW both courses being worked I find that we dit make a NW 4d Noway dist 54 miles diff Lattd 39 miles diff Longd 37 miles ye wind betweene ye N & ye East blew hard with raine
By ded recc Lattd 36 : 45 Long 50 : 24 we Saw gulls and divers	16	from 12 yesterday untill 4 in ye after noone we stood to ye East yn we taccked and Stood to ye westwards ye wind att NNE it proved Littell wind in ye night and towards day calme & att _ of clocke this morning ther Sprang up a fresh gaile westerly we Stood to ye Norwards att noone we tooke in our top Sayles it blowed very fresh with Drops of raine we made our way by Judgment all Lee ways aloud W 26d N dist 28 miles diff Lattd 12 miles different Longd 24 miles we Saw Severall gulls we vered downe ye Led being calme at 6 in ye morning being Calme but had no ground we could not have anny observation
att observa. Latt 36 : 58 Long 51 . 13 we saw many gannets and other foules we saw a saile but know not what flagg	17	from 12 yesterday untill 8 att night we stood to ye norwards with our courses and ran 35 miles N by W yn we tryed E NE untioll 12 in ye night yn we taccked and Styood to ye Westward and ran till noone and ran 40 miles So that we mad our way good all Lee ways alowed NW 1d N dist 71 miles diff Lattd 51 miles diff Long 49 miles att 9 of clocke this morning we strucke ground 23 faand att 1 in ye after-noone we Saw ye Land att ye att ye topmast head about 7 Leagus off

from ye Lizard to Cape Henry I mad 51 ½d 37 ½m of merridean distance ye Cape being S 1 League	17	We steared om West it prpved calme then ye wind went about Southerly a Smale gaile att _ of clocke we Judged Cape Henry to beare South off us 7 Leagus ofe we found 10 & 9 & 8 fadam water in Stearing in West which it id bare att 5 in ye Evening and when we came neare ye Cape we found 12 13 fadem we ran in in that depth W by N until ye cape bare SE by S and then we steaded NNW yn we had 9 : 8 : 7 : 6 : 5 ½ fad 7 & yn 6 ½ : 6 upon ye west shore yn we bore of to ye eastward and fell into 7 : 9 : 11 : 17 : 14 : 15 : 16 fad water yn we haled up to ye wesward and Sholened ye water to 8 fad & cept in that depth eging off and on as we saw fit
	18	this morning as soone as it was light we Saw new poynt Comforte we being Shatt up 2 leagus above it yn we Saw ye bristo Shiype that was in our company att Sea & Spake with him he being going in to rapphanoke river we halled into 5 : ½ fad to speak with him yn we edged off into 7 fad and kept in that depth having very good sounding all along we got uo above ye dividing creeke and came to anckor being calme and thicke wea but affter Sprang up a gaile southerly we getting our ankor againe but before we had Sett our Sailes ye wind came northerly Some ranne to ankor again and rid all night in 9 fad water
	19	ye wind blowing hard att NW & NNW we cold not weyhh but ridd all day off ye dividing creeks
	20	att 8 in ye morning we weyed ye wind northerly and turning ip ye bay it proved clame and yn ye wind came about Southerly we ran up a long in 7 or 8 fad water untill we came to wiccomico poynt then it Sholends 6 5 4 ½ 3 ¼ we run right off and had 10 fad presently pritty steep to : yn we steered over for poynt Lookout and found noe more then 9 fad yn crossing ye potomake river yn we got ye sounding of ye North side of ye river and ran up alongst in 6 fad got into 8 untill we came abrest off a poynt which lyeth 2 leagues below ye mouth of St Marys yn it shol to 4 fad att once butwe edged off into 7

	20	So after we found good Soundings all along to ye mouth of St Marys wheare we ankored in 5 ½ fad water & mud all along
	21	our Master went on Shore at St Marys to cleare ye Shipe
	30	having dispatched our busness at St Marys we sailed from thence with ye wind at No it blew fresh we ankored ofe of point Lookout in 7 fad water
	31	we weyed proving Littell wind and got 2 leagus to ye nowards of St Jarams pond and thare ankored being calme
January ye	1st	we weyed with ye wind att SSW and ann into petuxon to doe some busnesse theare we we ran close on board off Seader pouint be steem too with in halfe a mile & less att ye point this day we buryed one of our Seamen Henry Miller
	3	we buryed one of our passengers named John Sippse
	5	we buryed our second mate name Gabrill Hamon
	7	we weyed from potuxon att 2 in ye after noone ye wind Southerly and about 2 in ye night we gott to Seavorne and ran into ye Creek being moone light and faire weather
   March ye	 Sunday 25	we stowed in our hold 440 hhds of tobacco with our breddroome voyd & ye space of our Lazorette 46 Square with ye low beames on hedd all we Sayled out of Joarmme for potuxon having then about 550 hhds on board and ye 26th we Arived at potuxon – where we sent our Shalups for tobacco which had to take in there
April ye	1	we sayled from potuxon in ye Eveninge with ye wind westerly and in ye night it vered Easterly so that we carryed it about pount Lookout
	2	we gott to Saint <aryes where we sent our shalups abrode for ye remainder of our Laiding which we had to take in and when all wass onboard we had by my account 708 hole hhds stowed bysides whatt yebred roome would have held which ye master Judged it to hold 16 hhds which makes 724 in all

		A Journall of our homewarde –bound Voyage from Virginia in the Constant Friendshipe William Wheatley Commander Kept by me Edward Rhodes in ye yeare 1672
April ye	27	We sayled from St Marys in Maryland with ye wind easterly and turned downe to poynt Looke out and theare ankored
in company with capt Payne	28	in ye morning we weyed from theare with ye wind easterly and got about wiccomoco poynt and Ankored of ofe great Wicccommico River with ye wind then Soly in 7 fadam water
	29	in ye mroning we weyed from theare and got downe abrest of poynt Comford and came to ankor att 12 in ye night
	30	we weyed from thence being Littell wind we gott doune twarte of old poynt Comford and there ankored as we droved downe with ye ebb we espyed a bwoy which proved to be fast to an ankor and Mr Paynes men tooke it up and I wass theare att ye taking of it up with our Smale boate and 2 of our hands with mee ye ankor weyed 1006 pounds
May ye	1st	we weyed from thence with ye wind att SSW we stretched downe to ye Cape but yn ye wind came about to NE & EME and blew a fresh gaile we ran up againe and ankored a littell below Lindhaven in seaven fadom water
ye	2 & 3	having ye wind Easterly we lay still ye wind blowing very fresh and a great sea comming in upon us
ye Lattd 37 – 03 Longd 00 : 30	4	att 3 of clocke in ye morning we weyed with ye wind att SSE being high water we streched it out into ye Sea att 4 of clocke ye Capt bore South of us 3 miles ofe we ran by 12 att noone by judgment 30 miles East So thatt we are now 3 miles to ye Nowards of Cape Henry and 30 miles to ye Eastward
Lattd 37 – 10 Longd 01 – 57	5	we steered east and east by south this 24 hours but by ovservation we found hir to be gone 7 miles to ye norwards so that I alow our way to be East 5 degrees Northerly dist 88 miles difference Latd 7 miles diff Longitude 87 miles we had ye wind betweene the South & ye West faire wea
Lattd 37 : 08 Longd 03 : 51	6	we made our way this 24 hours East 1d Southerly and ran 113 miles which differs in Lattd 2 miles and in Longitude 114 miles we had ye wind att SW & SSW faire weather
Lattd 37 – 23 Longd 06 - 10	7	we made our way this 24 hours east ½ North and ran 140 miles by ye Logg our falfe minute flase being somthing to longe which I judge to be 1/10 part longer than it should be I alow no more then what ye Loge giveth which is 140 miles we differe in Lattitude 15 miles and in Longitud 139 miles we had ye wind between ye south West and ye West a fresh gaile and very faire weather we spared Mr. payne a great deale of sayle at topsaile or more

Lattd 37 – 42 Longd 07 – 48	8	we steared East this 24 hours and ran 96 miles by ye Logg but by reason of a currant that is commonly found to sett NEast I do alow our way to be East by N and I alow our run to be 100 miles which differs in Lattd 19 miles and in Longitude 98 miles we had ye wind westerly faire weather and a steddy gayle but cloudy we had no observation
lattd 37 : 43 Longd 09 : 00	9	we made our way East this 24 hours and ran 72 miles by ye Logg we had ye wind westerly Sometimes a fresh gaile and sometimes Littell wind we had a good observation and found but very Littell currant setting norwards having no observation in 2 days before
Lattd 37 – 15 Longd 09 - 27	10	we had the wind this 24 hours between ye South an ye West Littell wind we ran 44 miles by ye Logg we stered away East until 8 of clocke in ye evening ye 9th day and ran 8 miles yn we steered East North East untill this day at noone and ran 36 miles upon that corse but having a good observation we found our selves to be gone 27 miles to the Southwards not withstanding our course wass northerly so by the streames upon the water I judged ye currant to sett S East so I alow hir a S East way untill we differ 27 miles in Lattitude & ye like in Longitude and our dist 39 miles att noone we Altered our Course and steered NE
Lattd 38 – 11 Longd 10 – 50	11	we steered N East & by East this this 24 hours and Ran 101 miles by the Logg which differs in Lattitude 56 miles & in Longitude 83 miles we hat ye wind Southerly a fresh gaile it wass Closse weather we could have no observation
Lattd 39 : 49 Longd 12 : 28	12	we Steered Away NE by East and Run 130 miles by ye Logg but having a good observation we found that we had gon more Northerly then ye course we steered would give so I alowed hir way to be NE and hir dist to be 139 miles with differs on Lattitude 98 miles and in Longitude ye same we had ye wind Southerly a fresh gaile with mizelling raine
Lattd 41 – 15 Longd 14 : 35	13	we stered East N East all this 24 hours and ran but 110 miles by ye Log but having a good observation we found that we had gone 86 miles to ye norward which must be a great currant setting NEastwards I alow hir way to be NE by E dist 154 miles difference of Lattd 86 miles difference of Longitude 127 miles we had ye wind between ye South and ye West with showers of raine
by obsn Lattd 41-51 Longd 16 – 49	14	wee made our way this 24 hours East 15de Northerly and runn 139 miles we differed in Lattitude 36 miles & in Longitude 134 miles we had a good observation & very cleare weather it wass foggy in ye Evining and likwise this morning byt it cleared up att 8 of clocke yesterday in ye Evining ye wind came forward to SSEast but in ye night it vered againe to SS West and S West and so it stood
by Estimation Lattd 42 – 08 Longd 18 – 11	15	we steered away E by N & Ran 90 miles by ye Logg which differs in Lattd _ miles and in Longitude _ miles we had the wind between ye West and the North thick Cloudy weather with long showers of Raine – we cold have noe observation

May ye 42 – 18 Lon 19 – 04	16	we had ye wind this 24 hours between ye No & ye NW Sometimes a fresh gaile & other times Littell wind we stered E by N and Ran 54 miles by ye Logg we difered in Lattitude _ miles and in Longitude) miles this morning at 6 of Clocke wee Saw 2 Islands of Esce one to ye norward of us and ye other to ye Southward with many Land fowles it proved thick fog wea att noone
Latt 40 – 30 Long 19 . 34	17	We had ye wind this 24 hours verable Somtimes a Littell brease but when we had a gaile it was so that we Lay our Course we had it Northerly untill night yesterday & this morning we had a gaile Sprang up southerly but very foggy we ran 32 miles by ye Logg and alow our way to be East NE by reasen of a great Southerne Sea which I judge might have us pount more northerly
Latt 42 – 54 Long 22: 06	18	we steered Away E By N and Ran 124 miles by the Logg which differs in Latt 24 miles & in Longitude 122 miles we had ye wind between ye S & ye West thick foggy weather and a fresh gaile towards day
Latt 42 – 54 Long 21 – 36	19	we made our way good having corrected our 5 days worke by our this days observation E 37de Northerly dist 100 miles difference of Lattd 69 miles difference of Longitude 80 miles we had ye wind Round about ye Compass and came Above to ye SSE very faire weather we Spake with a New England Vessall wich informed us that we had wars with ye holander and had beene one Ingagement Alreddy and that som of our men of war met Som of theirs comming out of ye straights and tooke 3 Sayle of them
Latt 44 – 34 Longd 25 : 15	20	we made our way this 24 hours East 8d N dist 145 diff Lattd 44 miles difference of Longitude 139 we had ye wind betweene ye South & ye West wit Raine and hazey weather but we had a very good observation
Lattd 45 48 Longd 28 : 24	21	We had ye wind all this 24 hours at SW and blew very fresh we caryed our topsayles Reefed and Run 190 miles but I alow our Run to be 200 miles by Reason of ye Sea which might heave us faster then we Ran we had an observation and differed 69 miles in Lat from our yesterdays obsn our Course I alow to be E 19de Northerly and difference of Longitude 188 miles
Lattd 47 12 Longd 31 – 25	22	We steered this 24 hours E by No but having a great Southern Sea we Could not make our way better than East 25 de N by Estimation our Ran allowed to be 200 miles which differs in Lattd 84 miles & in Longitude 181 miles & we had ye wind at S & SSW & SW itt blowed very hard and put us by our top sailes and a very great Sea Runn att noone this day ye wind dullered with raine
Latt 47 – 23 Longd 32 52	23	We made our way this 24 jours E 9de N dist 88 miles difference inLattd 11 miles diff Longitu 87 miles ye wind betwn ye SE and ye West we had a good observation this morning we spake with a Ship from ye bay of Campeachy belonging to Flushen and bound for some port in

		Holand or Hamburg we spared them an English insene and other necessaryes which they wanted

May ye Lattd 47 . 30 Longd 34 . 15	24	we Made ourway East 9 degrees No dist 85 Miles difference of Latt 11 miles difference of Longitude 83 miles we had ye wind SW until 12 in night a gaile then it proved Calme and at 6 this morning there sprang up a gaile at SE and vered more Southerly toward Noone and was over Cast with Clouds we have no observation
Lattd 48 . 07 Longd 36 : 42	25	we Mad our way this 24 hours by Judgement East by No and ran 150 miles we differe in Lattd 29 and in Longitude 147 miles we had ye wind between ye SSE & SSW with Raine and drissiling weather we could have no observation
Whitsonday Lattid 48 – 12 Longd 39 : 21 On this Sunday	26	we made our way this 24 hours East 5 de Southerly dist 160m dist of Lattd 15 miles diff of Longitude 159 miles we had ye wind verable between ye SSW & ye N Westwards Cold Cloudy weather we had an observation but not trew
Lattd 47 14 Longd 41 : 13	27	we made our way by Judgement East 15 degrees Southerly and Ran 120 miles by ye Logg diff Lattd 34 miles differes of Longitude 112 miles we had ye wind att N & Sometimes att N by East & N N East Cold Cloudy weather we could have no observation .
Att ob Lattd 48 – 00 Longd 42 27	28	we Made our way this 24 hours E 7d No dist by Logg 80 Miles but Alowed 75 miles diff Lattd 9 miles diff Longitud 74 miles we had ye wind northerly very faire weather and a good observation
By ded Lattd 47 – 42 Longd 44 : 00	29	we nade iyr way tghus 24 hours by estimation E by South dist by ye Logg 101 miles but by Judgement 95 miles which diff in Lattd 18 miles and in Longitude 93 miles we had ye wind att N & N N E and indiff fresh gaile with Showers of Raine
Lattd 46 . 40 Longd 45 . 06	30	we mad our way good by Eastenatuion all lee ways alowed SE by E and distance Streight 91 miles diff Lattd 62 miles difference of Longitude 66 miles we had the wind betwee ye NNE & ENE faire weather but towards noone it blew fresh we handed both our topsails
Att ob Lattd 45 . 55 Longd 46 : 07	31	we mad our way good East 36 de Southerly dist by ye Logg 76 miles diff Lattd 45 miles diff Longitud 61 miles we had ye wind att NE Sometimes Littell wind & sometimes a fresh gaile Last night att 9 of Clocke we saw a Saile to windward of us we know not what he wass he stood upon a wind to ye northward
June ye Lattd 45 19 Longd 47 - 10	1st	we mad our way good SE by E and Run 81 miles by ye Logg but I alow but 75 miles we diff in Latt by observation 41 miles and in Longitude 63 miles we had ye wind att NNE & NE it blow fresh faire cleare sometimes att noone this day we taccked ye wind att NE we lay NNW

Today ye 9th of May at 8 of Clock in ye Evening we Struck ground 75 fad Smale Red Sand with Spotts of Shells we were then in ye Lattd of 49-25 and from Cape hennery to that time I mad of 52de – 16m of Longitude -- -- we were ye first shipe in ye Company that struck our Master being onboard ye Friggate

Monday ye 10th att 6 in ye morning we have ye Led again and had a bout 70 fad very fine white Sand & ousey then we had Runn 16 Leagus E by N from ye place where we first struck ground

35
41

76

June ye Sonday Lattd 46 – 11 Longd 46 : 13 we Saw Small birds	2	we had ye wind this 24 howers at NE & NNE Sometimes Littell wind & Sometimes it blowed fresh we lay up sometimes N by W and NNW & NW I alow our way to be NW we runn 80 miles by ye Logg which differed in Lattitude 51 miles and in Longitude 57 miles t was thick Cloudy weather we could have no observation
Lattd 45 – 36 Longd 46 : 41	3	we made our way this 24 hours SE ½ S dist 45 miles diff Latt 35m diff Longd 28 miles we had ye wind att NNEast & NE & ENE we stood to ye westwards until 8 of Clocke in ye night and espieing 3 Saile to leeward of us we tacced and stood to ye Eastward as they did this mor-ning we bare away upon them and Spake with them it proved to be ye Welcome and 2 Smale vessels more com from Jamaca our master went onboard of ye welcome
att obsn Lattd 45 04 Long 47 : 44	4	we made our way good this 24 hours E 24 deg Southerly dist 70 miles diff Latt 32 miles diff Longitude 62 we had ye wind att NE vering to & againe about thatpoynt very faire weather
att observation Lattd 45 : 16 Longd 48 : 42	5	we mad our way this 24 hours E by North dist 60 miles difference of Lattitude 12 miles diff of Longitude 58 miles we had ye wind between ye NNEast & ye N West faire weather with Some gentle Showers of raine we had a very good observation we saw a Sayle to ye Eastward but spake no with her
att observ Latt 46 : 03 Longd 49 : 46	6	We made our way this 24 hours East 3d6m dist 80 differ [latitude] 47 miles diff Longitude 64 miles we had ye wind at N by W & NW & NNW blow very fresh in Squalls of raine
att obsn Latt 46 – 40 Longd 50 – 03	7	we mad our way this 24 hours NE ½ E dist 60 miles diff L 37 m diff Longitude 46 miles we had ye wind between ye NNW & ye W Squaly weather & Sometimes almost calm we had a good observation
att obsevn Lattd 48 : 06 Longd 51 – 09	8	we made our way good E by NE and our dist alowed to be 94 diff of Lattd 86 miles difference of Longitude 37 miles we had ye wind between ye SW and NW with Rainy Squaley weather but we had a good observation
att Observaton Lattd 49 – 22 Longd 51 - 41	9	we mad our way NNE distance 82 miles difference of Latt 76 miles difference of Longitude 32 miles we had ye wind between the NW and the South very faire weather and a good observation --- ground 75 fad
att obsn Lattd 49 – 49 Longd 53 : 28	10	we mad our way this 24 hours E 13d N dist 110 miles diff of Lattd 25 miles : diff Longtd 107 we had ye wind we had ye wind Southerly faire weather an a good observation
Lattd 50 – 00 L 54 - 15 Silly north att 12 of Clocke	11	we mad our way from yesterday att noone untill this day watt 5 of Clocke in ye morning ~~East~~ E3d N we lay up E by S & ES East Smouth water not with standing we Saw Silly att 6 this morning about 2 Leagus of West we run 55 miles and differ from our yesterdays Latt

		28 miles and in Longitude 47 miles So that we made from Cape Henry to Silly 54 degrees of meridian distance

June ye	12	we had ye wind this 24 hours between ye West and ye North faire weather & very Littell wind at noone ye Lizard bare N East from us about 4 leagus
June ye	13	we sailed in plymouth we we found a freat fleet of Merchant man which lay for Convoy
June ye	18th	we weyed from Plymouth with ye wind att WSW we left 7 of our men on Shore 4 of them came after us in Capt Perce we came out in all about 60 Sayle small & greate
June ye	20th	we ranne in to ye East end of ye Isle of Whit and Ankored att ye Spitt hedd with ye wind att WSW it blowed very hard
July	2	we Sayled by order from ye Spit Head into Portsmouth harbor with all ye rest of our fleet to the number of 70 Sayke we found very going in and good ankoring with in ye harbor ye marks for sayling into ye harbor are these you must bring South Sea Castle and ye windmill shut in togeather and run with ye Casell until ye flagstafe which standeth att ye bullworcke an gosper poynt be shutte in with ye brewhause which is a long white house standing att ye south end off gosper then you may run boldly in with ye harbors mouth alongst ye shore about 2 cables length from ye shore then you will have not less then 5 fadom water and att ye harbors mouth 7 fad and so you may runn up above ye docke a mile and ankor in 7 : 6 : 5 fad water all along from ye harbors mouth upward you may sayle all with ye wind anny way betweene WSW and ENE it bloweth in and South there hole Tides
July ye	13	we Sayled out of Portsmouth harbor with most of ye fleet ye rest ranne out ye next morning we ankored at ye Spitt hed ye wind, NNWt
July ye	17	we Sayled from ye Spitt hed with ye new cassell and nightingaile and welcome 3 friggotts in our company with about 30 Sayle more in all of great ships ye smale ships sayled about 10 days before with other convoys

Appendix D – Images of Complete Logbook of Edward Rhodes

This section is attached in companion disk as a digital file.

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