COLONIZATION AND SUBSISTENCE CHANGE
ON THE 17TH CENTURY CHESAPEAKE FRONTIER

By

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ABSTRACT

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Colonization is a process by which people occupy and adapt to new lands and environments. In this study, a model of colonization is used to derive six hypotheses that predict how human subsistence patterns will change in frontier settings. These hypotheses are tested with archaeological data from 17th and early 18th Century colonial sites in the Chesapeake Bay region of Maryland and Virginia, scene of the earliest British settlement in the New World. Animal remains comprise the primary data base. The findings demonstrate that the diet altered dramatically during the 17th Century. Early subsistence was generalist in nature, relying upon a diversity of domestic and wild animals, and the diet was highly seasonal in character. Through time, subsistence patterns became focused upon two domestic animals - cattle and swine. Usage of wild game declined significantly as the diet became more specialized. Trends of change toward more complexity, greater stability and reduced seasonal variation in subsistence are also identified.

All but one of the hypotheses are supported. Increased subsistence variation between households through time due to socio-economic factors did not occur as predicted.

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Variation was most pronounced during the early phases of settlement and became less pronounced through time, despite evidence for greater social and economic stratification in Chesapeake society. This discovery suggests that dietary differences between socio-economic groups may not be an inevitable feature of social stratification.

Colonization is a distinctive, pervasive cultural process. Through a model of colonization, patterns of subsistence change are elucidated. Application of the colonization model to a particular historical setting reveals the importance of considering broad cultural process as well as specific historical factors in explaining change.

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CHAPTER 1

COLONIZATION THEORY AND SUBSISTENCE CHANGE

Introduction

The settling of new lands is a tough, demanding and exciting venture which has occupied peoples on practically every continent and over a large span of human history. For that reason, the subject of colonization has long attracted the attention of scholars, especially historians, who have struggled to understand the impact of the frontier on social and political development. Much of this effort has been directed to the study of specific frontiers and their unique characteristics while the study of colonization as a broader phenomenon has been largely neglected. Recently however, research by a growing number of anthropologists, geographers and historians has begun to reveal how truly worldwide and cross-cultural this phenomenon is. From the comparative study of frontiers in a variety of places is emerging an understanding of colonization not only as a way of occupying new lands, but as a process of culture change. In this dissertation, colonization as a cultural process will be the subject of investigation and a colonization model will be tested using archaeological data.

Most frontier research has dealt almost exclusively with historical documents or the ethnographic observation of contemporary colonization efforts and very few archaeology-based studies of this subject have been conducted. This is unfortunate because the time depth and pervasiveness of the archaeological record can permit the study of a vast sample of frontiers spread over thousands of years and in nearly every environment found on earth. It is hoped that this dissertation will help demonstrate the efficacy of an archaeological appraoch to colonization study. The region selected for investigation is the Chesapeake Bay of eastern North America. The earliest English colonization in the present United States took place in the Chesapeake, and the archaeological remains of these early settlements have been subject to more than a decade of intensive, systematic exploration.

The Concept of Colonization

The ways in which humans adapt to the challenges of the world is an issue of central importance in Anthropology and one of the most dramatic instances of adaptation occurs when humans settle new, unknown lands. One form by which these new lands are settled is the rapid movement of peoples known as colonization. It can be defined as the process by which a society rapidly occupies new territories and environments through migration and readaptation. Colonization by Western European cultures is the most well known and will be focused upon here, but this process has occurred throughout the world and with a variety of cultural systems. Indeed, the process has been so widespread that a historian has argued "It might be said that the history of colonization is the history of mankind itself" (Luthy 1961:485). While Luthy may have overstated his case, colonization has clearly played a central role in the settlement of vast regions of the planet.

The importance of this process is due not only to its repeated occurrence throughout human history, but because it is a prominent source of culture change. The value of studying colonization:

> ....lies both in the process whereby an already established socio-cultural system is extended, replicated, or reintegrated and in colonization as a creative process, since colonists must frequently accommodate themselves to a new ecological situation and to novel socio-political and economic arrangements (Cassagrande, Thompson and Young 1964:282).

Dramatically different environments are often ecountered upon migration to new lands and, of necessity, rapid adaptive response is an intrinsic characteristic of colonization. Such a situation can be an extremely valuable source of insight because adaptation and culture process are often most clearly observable under conditions of dramatic, forced change (Lewis 1975).

Interest in the "frontier process" has had a long tradition in the disciplines of history and geography from which an extensive body of literature has developed (cf. Turner 1893, Joerg 1932, Leyburn 1935, Webb 1952, Pelzer 1954, Wyman and Kroeber 1957, Billington 1967, Hudson 1977). These authors all used the term "frontier" in reference to the process of colonization as well as the physical space in which it occurs. In contrast to the field of history, anthropology has devoted little attention to the subject of colonization. Sahlins and Service (1960: 50) discussed the subject and conclude that it was a significant factor in general cultural evolution. Most anthropological research, however, has focused upon the impact of colonization upon aboriginal peoples while virtually ignoring the colonists (cf. Spicer 1962, Bohannan and Plog 1967). One of the earliest and most influential discussions of this subject from the colonists' point of view is "Colonization as a Research Frontier" (Cassagrande, Thompson, and Young 1964). Their article appealed for more research into the subject and since its publication, a significant body of literature has been produced (Doolittle 1973; Lewis 1973, 1975, 1977; Miller and Steffen 1977; Savage and Thompson 1979; Smith 1981; Thompson 1970, 1973, 1975). Each of these works focused upon specific aspects of the process by which colonizing cultures are changed through adaptation to the new physical and social environment of the frontier. As a result of this growing research effort, colonization is recognized as an important adaptive process with distinctive features that serve to distinguish it from other cultural phenomena. These findings have been distilled into a "Colonization Model" (Thompson 1973; Lewis 1975) which comprises much of the theoretical basis for this investigation. The goal is not to determine the ultimate causes of colonization or the unique characteristics of specific frontiers but rather to elucidate the regularities displayed by cultural systems engaged in the process of colonization.

One common feature of colonizing situations is a rapid and often pronounced adaptive response necessitated by new ecological and/or social settings. The significance of the environment in producing this change was recognized by Frederick Jackson Turner, a historian, who championed the view of the frontier as the causal factor in the emergence of American democracy. He wrote that:

> ...at the frontier the environment is at first too strong for the man. He must accept the conditions which it furnishes, or perish, and so he fits himself into the Indian clearings and follows Indian trails. Little by little he transforms the wilderness, but the outcome is not the old Europe...The fact is that here is a new product that is American (1893:546).

Turner recognized that colonization is a two-way process which involved the settlers' transformation of the environment as well as the environment having a significant impact upon the settlers. This same point has been acknowledged by many scholars and Thompson (1973:2) emphasized that adaptation necessitated by the new environment is the most fundamental cause of cultural change during colonization. Thus, adaptation lies at the heart of the colonization process and because of this, it is necessary to examine the concept of adaptation before more fully considering the colonization model.

Adaptation and Culture

The concept of adaptation is widely employed in the social and biological sciences. Adaptation has been defined as the process of change by which a better fit between an organism and its environment is achieved. The concept of adaptation is so intricately bound with evolutionary biology that a state of adaptation is considered the goal of evolutionary change (Grant 1963:563). This point is reinforced by Dobzhansky (1968:28) who referred to evolution as the adaptive responses to the challenges of the environment.

For humans, culture is the principal means of adaptation and culture can be defined as an integrated system of learned behavior patterns possessed by a group of people through which they adapt to the environment. The environment for humans involves not only the physical setting but also the social, for they must cope with both. Emphasis upon culture and learning as the primary method of human adaptation is responsible for the relatedness of culture, environment, and evolution and one aspect cannot be fully understood without reference to the others. As a consequence, evolutionary and ecological perspectives within anthropology have converged. A product of that convergence has been a strong emphasis upon the study of culture change processes, which has, in turn, accentuated the perspective of culture as an adaptive system (cf. Sahlins 1964; Alland 1975; Bennett 1976; Richerson 1977; Hardesty 1975, 1977; Kirch 1980). This view and the importance of adaptation for understanding cultural processes has been expressed succinctly by Binford (1968:136) who wrote that:

> ...Changes in cultural systems must be investigated with regard to the adaptive or coping situations which are presented to the human populations. If we are to profitably study process, we must be able to isolate cultural systems and study them in their adaptive milieu.

One approach to understanding the operation of adaptation utilizes concepts derived from systems theory. Rappaport (1968,1969) has taken this path and viewed cultural adaptation as a process by which a cultural system maintains homeostasis with the environment. This concept of homeostasis refers to a tendency toward a state of equilibrium in terms of energy and materials exchanges with the environment (Von Bertalanffy 1968:78), even though no ecological or cultural situation is ever totally stable. Also implicit within this definition is the belief that cultural systems have the goal of continuity or persistence through time, a goal which, along with stability, cultural systems seem to share with biological systems in general (Dobzhansky 1968; Odum 1969). Various means are employed in the achievement of these goals but the central mechanism in all adaptation is selection.

Cultural selection is a complex phenomenon and involves both human cognition and behavior (Alland 1975). Perceptions regarding the condition of the physical or social environment are linked in an intricate manner with information about alternative responses, results of past actions, human goals, and assessment of the costs and risks involved in order to produce an appropriate response. The efficacy of this response is, in turn, evaluated through various means, one of the most important being the processing of feedback. Behavior which is perceived as being an effective, thus suitable, response is retained and emphasized, while ineffective behavior or that which reduces adaptiveness is discontinued. Unfortunately for the archaeologist, the cognitive element in this process is not directly available for study, leaving only the physical evidence of behavioral responses. It is behavior, however, which interacts with the environment to bring about greater or lesser adaptiveness and hence behavior which is directly subject to selection. Therefore, the study of adaptation and the crucial relationship between culture and environment must focus upon the behavioral responses which are observable in the archaeological record and not upon cognition. Dependence upon the products of behavior does not deny the importance of cognition in adaptation or the necessity of considering decision-making criteria likely to have been employed by a past people. Rather, utilization of behavioral products, artifacts, emphasizes that the actual attempts to deal with environmental perturbations offer the greatest potential of revealing how cultural systems adapt.

Given the large range of environmental changes with which cultural systems must cope, it seems likely that the expression of the adaptive process will also tend to vary in unison. Environmental changes may be classified into three general types: 1) cyclic, 2) unidirectional/ continuous, and

3) revolutionary (Thoday 1953: 108-110). The adaptive responses to each of these differ, reflecting the magnitude of the change to which responses must be made. Cyclic change involves yearly or longer cycles of ecological alterations such as the seasons, or periodic but less predictable events such as drought or flood. These occur with sufficient regularity so that behavioral responses are integrated into the overall adaptation. Accordingly, relatively little modification of a culture's adaptation is required to cope with cyclic change if the culture has occupied that environment for a sufficent period of time to become harmonized with the cycles.

Unidirectional/continuous change on the other hand, tends to be long term and involves a more or less permanent alteration in the environment such as a gradual shift in rainfall patterns or the extinction of a plant or animal species. Some of the best known examples of such change are the slow succession from glacial to temperate climatic conditions and the rise of world sea levels following the last Ice Age. Adaptive responses to this type of change will at first tend to be relatively minor. Initially, responses are probably handled in the same manner as cyclic change. Over time, however, as the environmental shift progresses, the modifications of the culture's adaptation will become increasingly pronounced (Kirch 1980:125). New behavioral patterns will eventually evolve as the magnitude of the ecological shift increases. Slow reaction to this type of change is probably related to an inherent conservatism in cultures which tends to emphasize traditional patterns of behavior if possible. A significant segment of research in North American prehistory has been directed to the adaptations associated with this type of change (cf. Cleland 1966; Braun 1974; McMillan 1976).

In contrast to cyclical and unidirectional/continuous change, revolutionary change entails a rapid and extensive shift in ecological conditions. Consequently, this type of change exerts the strongest adaptive pressure and may necessitate a major reordering of the cultural system. Perhaps the best example of this occurs during colonization when a group is suddenly thrust into a new and often quite different environment from that to which they had been previously adapted.

Each of these types of environmental change differs in pace, scope and magnitude, and it seems likely that each will require differing degrees of adaptive response. Clearly, the necessity of response will be most compelling with revolutionary change, which will probably entail extensive modification throughout the cultural system. Revolutionary change encompasses all of the environmental alterations associated with cyclic and unidirectional/continuous change, but takes place much more suddenly and on a broader scale.

In order for cultures to respond to revolutionary environmental change, the existence of behavioral alternatives in the cultural system is essential, especially for a society engaged in the colonization of new lands.

From these behavioral alternatives new adaptive strategies will be forged. On a frontier, potentially adaptive behavior derives from several sources. One of the most important sources, the cultural heritage of the participants, provides a diversity of options that were developed over a long period in the homeland. Many of these alternatives will be inappropriate on the frontier, but some behavior which was perhaps marginal to the original adaptation and had been retained to cope with infrequent conditions of adversity, may prove highly adaptive in the new environment. An additional source of alternative responses is the heterogeneous nature of colonial populations which are usually made up of individuals from a diversity of origins, thereby further increasing the pool of behavioral possibilities. New means of adapting can also be obtained from other cultures through borrowing and diffusion. These sources are especially appropriate when obtained from indigenious peoples who are already adapted to the environment being colonized. Additionally, invention can be very important. New tools or ways of behaving can be invented and frontiers have long been regarded as loci of innovative behavior (Thompson 1973). Selection thus acts upon this large pool of behavioral options to create an appropriate adaptation to the environment.

But precisely where does selection of appropriate adaptive alternatives operate -- on the individual, a specific group of individuals or the entire population?

Individuals are frequently thought of as the focus of selective pressure, perhaps through analogy with biological and genetic selection. But while the individual may be the source of innovative behavior, it is unlikely that a person is the sole unit of selection in culture. Humans live in groups and information is exchanged between both individuals and groups. Major decisions regarding the adaptive strategy of a culture are probably rarely the prerogative of a single individual. In this study, and for most instances of colonization, two units of adaptation and selection seem relevant: 1) the household, and 2) the regional or ecological population.

The household is the basic unit of human domestic activity and, for many peoples, the primary economic unit (Goody 1971; Blum 1982). The household is also the level at which a great deal of decision making and experimentation occurs (Barlett 1980). Decisions about specific responses to a situation are often made jointly and are executed within the context of a household. It is at the household level that the beneficial or detrimental results of a response will be most rapidly perceived. In colonization, the household (not necessarily a nuclear or extended family) is the basic social and economic unit and is directly involved in coping with the new environmental conditions.

Human cultural systems operate within a much broader context, however, and a larger group than the household is essential for biological reproduction. It has been suggested that this larger unit should be called the "ecological population" (Kirch 1980: 111), a group of interacting people who are faced with the same adaptive pressures in the same general environment, and who share adaptive information and display similar behavioral patterns in adapting to that environment. This term aptly describes the population engaged in colonization within a specific region and thus has utility in the study of frontiers. The household may be considered the unit in which most adaptive behavior occurs and where the adaptive pressures bear most directly. However, it is the larger ecological population where the efficacy of an adaptation is ultimately judged since continuance of the group and culture, not a household, is the goal of cultural adaptation.

The Colonization Model

The type of cultural expansion being investigated here is the rapid, often large scale movement of peoples from settled homelands to new territories. Such movement is usually associated with stratified social systems and these have most frequently been at the state level of socio-cultural integration (Lewis 1975:32). In this study, colonization by western European states is the general focus, specifically of the British. There are other forms of expansion, such as the gradual movement of peoples into new lands, which is exemplified by the settling of the New World by the Indians. The stimuli, pace and characteristics of this and other forms of expansion, however, are likely to differ considerably from the process with which this study is concerned.

The colonization process occurs in several varieties and a typology of these was presented by Leyburn (1935). He found that each form of colonization or frontier type displays specific, unique traits but all can still be divided into two general categories - impermanent or permanent. Impermanent frontiers are those created for the exploitation of select resources, such as minerals, lumber or fur-bearing animals, and are generally of short duration. Individuals focus upon the exploitation of these specific resources, and when these are depleted, they migrate elsewhere. As a consequence, there is little emphasis upon becoming highly adapted to the natural environment, being self-sufficient in food production, or forming permanent social units.

Permanent frontiers, on the other hand, involve the long term settlement of a region. Colonists strive to become self-sufficient. The cultural response is to develop a stable, sustainable adaptation to the environment. While the nature of permanent frontiers varies widely, most of the known examples have involved agricultural or pastoral peoples. The resource they exploit is land, either through crop production or animal grazing. Since permanent frontiers involve an attempt to achieve stable and long term adaptations to the environment, they offer the most clearly discernable opportunity for observing the adaptive process and, therefore, will be the focus of investigation in this dissertation.

Not only have permanent agricultural frontiers been very common over the last several thousand years of human history, but they have also received the greatest attention from anthropologists. Ethnographic work on contemporary colonization efforts in South America and elsewhere has contributed much to our understanding of this process and has identified specific cultural patterns which seem to be associated with it (Cassagrande et.al. 1964; Thompson 1970; Ekstrom 1975; Gugler 1973; Smith 1981). Out of this effort has emerged a series of hypotheses regarding frontier settlement which forms a model of colonization. The characteristic features of the process and this model will now be examined.

Colonization can be characterized as a gradual process of cultural stabilization and social maturation. Colonization can occur in unoccupied lands, but most frequently the territories have been previously inhabited by peoples at a lower level of socio-cultural integration than the colonists (Thompson 1973:2). Thes space in which the process occurs is referred to as the "area of colonization" by Cassagrande et al. (1964:284) and here is called the frontier. The culture engaged in this type of expansion is characterized by fluidity and a rapid pace of change as the new environment is explored, knowledge about it is accumulated, and an adaptation emerges. It is important to stress that the process discussed here involves the movement of settlers who occupy the lands more or less permanently.

Colonization involves adaptation to a new natural and/or social environment that is usually very different from that found in the colonists' homeland. The traditional adaptation which the colonists carry as a sort of cultural model from their homeland, nevertheless, will have a clear and pronounced impact upon the adaptive response they make on the frontier. Tradition is a powerful force and one goal of the colonists is the reestablishment of familiar cultural practices to the extent possible (Thompson 1973). Thus, the colonial culture will represent a mixture of elements, some originating in the homeland and found to be operative on the frontier, and new adaptations necessitated by the frontier environment. The effort to continue basic themes from the homeland has been addressed by Doolittle (1973:41) who wrote that:

> ...the more highly specialized the culture, the more conservative it becomes. Ideologies arise to protect and preserve these adaptations and, given an environment even remotely capable of supporting the adaptation, the culture will make a herculean effort to maintain them.

This traditionalism will be most operative for the more conservative components of culture such as religion or legal systems. It also seems likely that a people who previously operated within a market economy will attempt to continue it.

Initially, however, colonists seem to abandon many of the more complex elements of their traditional culture. Abandonment of complexity, one of the most pronounced features of colonization, has been called "ruralization" by Cassagrande et al. (1964) and "cultural impoverishment" by Thompson (1970:198). This phenomenon refers to the loss of the most specialized and some of the more general components of the cultural system. In essence, the process works to simplify the culture upon its entry into the frontier environment. Thompson (1970:196) has suggested that reduced complexity is an inevitable concomitant of all colonizing situations, regardless of the economic base of the culture. Reduced complexity is probably an expression of the evolutionary principle proposed by Sahlins and Service (1960:52) which stated that a generalized, non-specific culture is more "highly efficient in dealing with extensive, relatively open environments." Sahlins and Service precisely describe the environmental situation confronting colonists.

Vitally linked to the cultural impoverishment phenomenom and central to the model is the concept of the colonization gradient (Cassagrande et al. 1964; Thompson 1973). This concept has both spatial and temporal aspects and encompasses one of the most distinctive features of colonization -- the rapid tempo of change and marked fluidity in frontier settlement, social structure, and economics. In spatial terms, a greater degree of cultural simplification, change and flexibility is witnessed as the distance from the homeland increases. Conversely, the nearer the homeland, the more stable and complex will the culture tend to be. Distance in this situation may refer more to the degree of access than to actual spatial separation. A distant frontier with excellent transportation links to the homeland may be culturally more complex than a region which is physically closer but which has poorly developed systems of communication and transportation.

The temporal aspect of the colonization gradient is particularily significant and refers to a sequence of cultural development that corresponds directly to the duration of permanent colonial settlement. As the duration of occupation in a specific area lengthens, the cultural system becomes increasingly complex and displays greater stability and social maturity. This notion of directional, regularized change by immigrant peoples on frontiers is at the core of the colonization model.

The gradient concept and cultural impoverishment are predicted to be visible in many different aspects of a society engaged in colonization, one of which is the settlement pattern. As Thompson (1973:11) observed:

> Most frontiers in the past and in the contemporary world have been characterized by relatively large-scale extensive agriculture on tracts substantially larger than those of the "settled area" or homeland.

The abundance of land results in a distinctive pattern of settlement that is typically highly dispersed unless restrained by a hostile social environment. The pattern is comprised of four settlement types which vary in size, complexity, function, and distribution (Cassagrande et al: 1964;312-314). These are: dispersed settlements, semi-nucleated villages, nucleated villages and frontier towns. Dispersed settlements are the most common and consist of isolated households or plantations. Less frequent, but larger in size, are the semi-nucleated villages which are loose assemblages of houses with no governmental functions and only limited services. Still larger in size but fewer in number are the nucleated villages which occur most commonly along major transportation routes. Clusters of houses and possibly a few public buildings with an organized government, and the capability to provide a number of commercial, social and medical services characterize nucleated villages. Finally, the largest in size but least common settlement within the area of colonization is the frontier town. The frontier town is the major supply and communications link with the outside world and the focus of most economic, political, social and religious activities. The frontier town also serves as the "jumping off" point for new colonists entering the area.

What is distinctive about frontier settlement and reflects the colonization gradient concept is the distribution of settlement types. The frontier town is only found in the longest settled portion of the frontier. Nucleated villages are most common in the longest settled areas but a few may be found in the more newly inhabited regions and are primarily located along the main transportation routes with the best access to the more settled areas. Dispersed settlements and semi-nucleated villages are found throughout the frontier but they are the only settlements in he more recently occupied sections. Basically, the simplest form of community is found at the edge of colonization and the more complex settlement types occur in the longest settled areas. These settlement types can also be seen as graded stages in the process of settlement system development. Through such a process, the cultural geography of the frontier region may eventually reach a level of complexity and integration equal to that of the homeland. The same developmental sequence can also apply to an individual community because a dispersed settlement can, if favorably located, grow into a nucleated village and perhaps even a frontier town.

Social structure in a colonizing culture should also reflect the key elements of the model. During the early stages of settlement, the structure of the society is very flexible and poorly integrated (Thompson 1970, 1973; Williams 1977). This combination of flexibility and poor integration is partially due to the small proportion of permanent social units and the mix of settlers from many different portions of the homeland. Both often act to reduce kinship as an integrating and stabilizing force. In some instances, kinship can also serve as a means by which immigrants are recruited in the Homeland, but in general, frontier populations are composed of mostly unrelated people. This mixture of settlers results in a clash of contrasting behavioral patterns and value systems which contributes to a high frequency of conflict and factionalism on frontiers (Williams 1977:259; Thompson 1973). Initially, interpersonal relations and the formation of permanent social bonds are hindered by other factors: an influx of new settlers, geographic mobility of individuals and a high death rate often found on frontiers that is responsible for a rapid turnover in personnel. The dispersed nature of early settlement serves to limit social interaction. The result of all of these factors working during the early phases of colonization should be a social structure that is weakly developed and poorly organized. Over time, as the mortality rate declines, settlements become more numerous and more closely spaced, and a greater number of family units are formed, the colonial social structure is expected to become more stable, better integrated, and more complex.

The amount of opportunity available to colonists also has a tremendous impact upon the nature of the colonization process. Abundant opportunity is integral to colonization and is probably the major stimulus for immigration to frontier areas (Billington 1967). Such opportunity is the product of the rich untapped resources, especially land, which are perceived to be available for exploitation. Economic, social, and political advancement which is unlikely in the colonists' homeland, becomes possible. As a consequence of this more ready access to resources when compared to the homeland, there is a high potential for upward social mobility during the earlier phases of settlement and hence, social stratification is weakly developed. Such fluidity in social position further contributes to the flexible nature of colonial society. As the available lands are occupied and other resources exploited, however, both opportunity and the potential for upward social mobility should decline (Williams 1977:265). The colonial social structure is predicted to become increasingly complex and there should be greater rigidity in status positions though time.

Another characteristic of colonization is a critical shortage of labor, especially during the earlier phases of settlement. Given the generally small size of the original colonizing population and the immense amount of effort in land clearance, construction and other labor intensive tasks needed to establish a new society, a shortage of personnel is inevitable. In some cases the problem has been solved by enslaving native peoples. Generally, though, population growth is necessary to eventually overcome the problem. The effect of the labor shortage on a frontier is to significantly raise labor costs above that paid in the homeland. This situation provides a better economic opportunity for laborers but means that other costs are also higher. One consequence is that labor-saving expedients are frequently necessary on frontiers. Another consequence is the emphasis upon large families or multi-family households, especially on frontiers engaged in market agricultural production (Thompson 1970:199-201).

A poorly developed transportation system is characteristic of most frontiers. This, along with a dispersed settlement pattern, creates pronounced limitations upon social interaction. Even more significant for the market-oriented colonist, however, is the fact that an inadequate transportation system serves to restrict access to markets, thereby limiting the crops or other products which can be effectively sold. Simultaneously, the variety of manufactured goods which is available is reduced while the cost of those goods is increased (cf. Miller and Hurry 1983).

Frontier demography is quite distinctive. Normally, a small number of people initially engages in colonization and the population density is very low when compared to the homeland's population density (Hart 1974; Thompson 1973). The population displays a quite unbalanced sex ratio and a heavily skewed age structure. Males greatly predominate and young adults form a majority of the population (Lefferts 1977). Children and the aged often comprise a small portion of the population during the initial phases of settlement. The emigration of families to frontiers also occurs but in most cases, young single individuals make up a major portion of the population. High mortality rates are usually associated with frontiers because of the colonists exposure to new disease environments (cf. Curtin 1968; Smith 1981). A often high death rate and the unbalanced sex ratio combine to hinder the formation of families.

As a result, the population growth rate is initially very low and is usually dependent more upon immigration than natural increase to sustain the population. Only after a period of time do the colonists physiologically adapt to the disease vectors in the new environment, achieve a balanced sex-ratio and form families. Population then increases through reproduction rather than immigration. Fertility rates usually begin to rise with the first generation of settlers, and often will peak with the second generation (Lefferts 1977:50). After the initial period of low reproductive increase, frontier populations tend to display rapid growth rates through natural increase.

Other important features of colonization to be addressed are the length of the process and the point at which it can be considered finished. The duration of the process is obviously highly variable and it will depend upon a number of factors including the degree of ecological difference between the homeland and the colony and the pace of immigration. Thompson (1973:11) stated that the process can continue for a generation or more but provided no criteria by which to measure its progress. As perceived here, colonization is never a very short term phenomenon and the complexity of the task of developing a stable adaptation will generally require a time frame on the order of decades rather than years to achieve.

The beginning of colonization is relatively easy to establish for it is initiated by the first movement of explorers and settlers into a region. Defining the termination of the process is a more formidable task, however, because the problem is essentially deciding when a cultural system is stable and has achieved a successful adaptation to a new environment. Although it is extremely difficult to devise direct measures of this, the colonization model suggests several features which should indirectly signify completion of the process.

One characteristic of successful colonization is the demographic composition of the colonial population. The expected pattern on frontiers is for unbalanced age and sex ratios, a low initial rate of reproduction and, often, a high mortality rate. Therefore, the achievement of a more normal age and sex distribution in the population can be seen as one significant and necessary step in the development of a stable, mature society. Population growth through natural increase rather than immigration, and the establishment of a native-born majority can also be considered crucial indicators of a colony's demographic maturity. The achievement of these features would seem to demonstrate that a viable adaptation to the environment has been made since reproductive success is one of the best indicators of positive adaptiveness in a population (Kirch 198:121).

In cultural terms, the ending of colonizaton may be indicated by the appearance of a similar and consistent pattern of adaptation throughout the area of colonizaton as well as by signs of increased cultural complexity. From the diversity of potential behavior available at the beginning of colonization, it is assumed that certain elements will be better suited to the new environmental conditions than others. Since successful cultural adaptation can be defined as the creation and maintenance of a state of stability or homeostasis, this would entail limiting the range of behavioral alternatives through selection to those which are most suited to the achievement of that goal. Because of this, colonization should result in the creation of an adaptation which is eventually shared by the colonists within the environmental setting.

The colonization process is, in summary, a distinctive cultural phenomenon which displays a number of characteristic features. The most important are:

A. Initially
1. unbalanced demographic structure
2. shortage of labor
3. abundant opportunity for participants
4. flexible social structure
5. cultural impoverishment

B. Through Time
6. directional change toward greater stability and adaptiveness
7. high rate of population growth
8. increased rigidity of social structure
9. increased cultural complexity.

All of these are essential elements which together comprise the colonization model, but cultural impoverishment and directional change are two of the most important features of the cultural process. Not only does the model enable prediction of a distinctive combination of attributes which should characterize colonial cultural systems, but the model also predicts that the changes should occur in a regular, directional manner. To reiterate, this trend of change should be from fluid, impermanent, "primitive" conditions toward greater stability, permanence, and complexity. The precise expression of the colonization process is likely to vary from frontier to frontier because each situation offers a unique set of environmental, economic and cultural factors. The general characteristics and patterns of change of any culture engaged in this process nevertheless should be similar.

The model and available ethonographic data suggest that the changes associated with colonization will be broad in scope and pervasive throughout the cultural system, with few components escaping some degree of modification. As early as 1935, Leyburn suggested that the changes in the subsistence and economic aspects of frontier culture would be the most pronounced. He summarized this view with the glib comment that "Man's most sensitive nerves seem to run to his stomach and to his pocketbook" (Leyburn 1935:235). The same conclusion was drawn by Lewis (1975) who offered an explanation as to why the economic aspect would be most profoundly affected:

> This is a consequence of placing a population into an environment so different from that in which it had formerly existed that the normal environmental inputs and outputs from the socio-cultural system are severed. This necessitates the immediate restructuring and simplification of those subsystems which are most closely related to the environmental component (Lewis 1975:57).

Both Leyburn and Lewis recognized the fact, also emphasized by Steward (1955) and White (1959), that culture is organized in a hierarchical manner based upon how closely a component interacts with the environment. Marvin Harris (1979) explained this hierarchical organization of culture with his "principle of infrastructural determinism" that states that the major source of change in cultural systems lies in those components which interact with the environment. This relationship exists because the procurement of energy to sustain life is the most important transaction which occurs between humans and the environment. For a colony to survive, it is essential that a rapid and effective adaptation be achieved to provide this energy ration. Most colonies initially subsist on foodstuffs from the homeland but these are always limited and the procurement of locally available foods is crucial. Lewis (1975:41) emphasized this and argued that of all the components in a colonial cultural system, probably none is more profoundly altered than subsistence. Subsistence is therefore one of the more crucial elements in frontier settlement, and it should clearly reflect the characteristics of the colonization process. Subsistence is also one of the more visible elements of past cultural systems in the archaeological record. For these reasons, subsistence is an appropriate subject with which to test the proposed colonization model.

Subsistence And The Frontier

Subsistence occupies a crucial position in the articulation between the cultural system and the natural environment. The term "subsistence" refers to the means of obtaining the necessities of life: food, clothing, and shelter. Normally food is the most critical element of the three and it is this investigation's central concern. Several schemes of classification have been proposed for the numerous approaches to meeting subsistence needs (Lowie 1938; Forde 1949; Murdock 1962). Although each classification differs slightly, each makes five similar divisions of subsistence into gathering, hunting, fishing, animal husbandry, and agriculture. Although there is some advantage to this approach from a general perspective, it is seriously flawed for the study of specific subsistence systems because few adaptations exclusively utilize one of these types. Adaptations instead generally rely upon a mixture of subsistence sources. Presumably subsistence during colonization will display such a mixture.

The various forms of human subsistence nevertheless do seem to share many features in common and can be investigated using similar assumptions and concepts. One important asssumption is that subsistence will be a patterned phenomenon because of the close association between ecology and the adaptive stance of a cultural system. As Cleland (1976:60) has noted, "Cultural adaptations are patterned and predictable because nature is patterned and predictable." As natural resources are available in a patterned form, subsistence varies in a repetitive, seasonal manner over the course of a year. This can be termed the subsistence cycle which is the annual sequence of food procurement strategies employed by a culture to meet the subsistence requirements.

All subsistence systems can be viewed in terms of the "adaptive strategies" they employ. Adaptive strategies are the choices in labor investment and resource utilization made by a culture to satisfy its subsistence needs. This sequence of choices as to which resources will be exploited serves to structure individual subsistence patterns:

> "Choices of usable resources, decisions as to their proportional use and time of utilization, and the demographic and spatial arrangements chosen in order to accomplish the exploitation, all allot human time and energy and are visualized as structuring the subsistence and settlement patterns of a human group" (Jochim 1976:4)

Every culture must select which foods to consume and because of the complexity of factors involved in the decision making process, Jochim (1976:12) has labeled the selection of the appropriate resource-use schedule one of the major problems to be resolved in adaptation. While the specific strategy chosen will depend upon the particular circumstances, it is assumed that there are general, underlying approaches and criteria employed by humans in making these decisions. Some authors (Clarke 1968; Jochim 1976) found that adaptive strategies can be profitably viewed as either maximizing or satisfying. Maximizing strategies attempt to achieve returns to the greatest extent possible and thus offer very high returns but at the cost of a much greater risk of failure. Due to the risk level and danger of totally depleting resources with this approach, non-market cultural systems probably rarely follow purely maximizing strategies. Even market oriented economies, which may maximize in the production of specific goods intended for exchange, will probably operate other elements of the subsistence system with a non-maximizing strategy due to the problems of labor and materials allocation.

A satisfying strategy, on the other hand, does not attempt to get the maximum return; it attempts to achieve an adequate return that will merely meet the subsistence requirements (Simon 1957). Although the payoffs are usually much lower than with maximizing strategies, this approach is safer since the risk factors are kept to a minimum. Clarke (1968:95) wrote that "It is highly probable that the procedure in most or all of the cultural sub-systems, in many different sorts of society, may equally operate on satisficer strategies." Acceptance of Clarke's statement therefore provides some general guidelines for considering adaptive strategies.

Selection of a specific procurement strategy, however, is based upon a number of criteria, one of the most important of which is cost (Earle 1980). Cost refers to the materials, energy and time expenditure necessary to obtain a unit of the resource, whether the unit is a deer, a fish or a basket of corn, and is thus closely related to efficiency. Costs can be divided into five major components: 1) technology, 2) transportation, 3) production, 4) processing, and 5) storage. Technological costs include the equipment necessary to procure a given food and the time required to maintain and repair this equipent. Such equipment might include a bow and arrows, baskets, a fishing boat, musket, oxen or a tractor. Transportation costs include the time and expense required to travel to the location of a given resource for exploitation. The effort necessary to produce or obtain a particular food is also a very significant cost.

Encompassed within the category of production costs is the labor required in agricultural production, the time and effort needed to dig roots or the time necessary to stalk game. Processing involves the time and effort required to prepare the food for consumption; this may be the butchery of game or livestock, efforts necessary to grind grain into flour or the cooking of food. Storage costs include not only the time needed to prepare food for storage, but also the labor and expense involved in building and maintaining storage facilities such as a corn crib. The investments necessary to meet the food requirements of a group will vary widely depending upon the culture, available technology, population size and the characteristics of the resources being exploited.

Cost vary according to the nature of the food resources and one especially important distinction is between wild and domestic food resources. Wild resources, especially on land, are limited in quantity and hence, subsistence efforts can only extract a finite amount of a particular plant or animal resource before that resource becomes depleted. There are some means available to increase the productivity of certain species, such as burning to create a more productive habitat or to concentrate scattered resources, but this merely raises harvestable quantities of that resource slightly without overcoming the limits on productivity. Relevant attributes of wild resources include their abundance, distribution, mobility, size and fat content (Jochim 1976:23). Domestic plants and animals, in contrast, are controlled by human efforts. Domesticated resources generally provide higher yields per unit of land and offer greater potential for the expansion of production. The major advantage of agriculture is that more calories can be obtained per unit of land per unit of time than with wild resources (Jochim 1976:23). Relevant attributes in considering domestic resources include their productivity, dependability, storability, labor requirements during growth and harvesting.

Initially in the colonization process, the cost of exploiting wild resources may be very low. The plants or animals will be abundant and many species will be more or less evenly distributed over the area, allowing of course for ecological variability in resource distribution. As exploitation significantly increases, however, the distribution of particular resources will become highly uneven and abundance will decline. With a decrease in resource density, there is a corresponding increase in the transportation and procurement costs of those wild food resources. At that point the "law of diminishing returns" becomes operative. Costs will increase as the output or yield approaches the limit of resource availability. A hunter for example, has to travel further and spend greater time and effort in capturing an increasingly scarce animal. The costs also rise with expanded agricultural production, but they do so at a slower rate and the maximum potential production level is much higher than for natural resources (Earle 1980:20).

Most studies of human subsistence have seen cost as one of the primary factors in the resource selection process. A widely applied theoretical position using this is the concept of optimal foraging strategy (Jochim 1976, 1979; Osborn 1977; Earle 1980), which assumes that cultures operate on the principle of cost minimization. A group will attempt to keep labor and other costs to a minimum while achieving the highest possible yields. Although this concept has been most frequently used with hunter-gatherer economies, it has also been applied to agriculturalists (Green 1980), and the idea of cost minimization, although not optimization, was important in Boserup's (1965) study of the evolution of Western European agriculture.

Unfortunately, the optimal foraging theory makes some assumptions of questionable validity. The theory requires that people assess the input-to-yield ratio for each resource before selection, and that people see cost as the prime factor used in decision making. This theory assumes, perhaps wrongly, that rationality is the basis for selection. Even more detrimental to the theory's validity is the necessary assumption that individuals possess a full range of knowledge regarding the local environment and the resources to make the "optimal" decisions. These assumptions are often of questionable validity, especially on frontiers where the level of ecological knowledge is very low. Jochim (1976:5) believes that decisions are made within the context of "partial uncertainty". Reidhead (1980:178) supports this view and suggests that the most acceptable position is that humans attempt to make rational decisions but are normally ignorant of the total situation. Another fact which seems to further compromise the concept is that resources may take on a prestige value, thereby making costs of secondary importance. Also, during seasonal periods when resource availability is low and access is restricted, such as winter in temperate climates, greater efforts may be required to obtain scarce foods with less consideration given to costs. Thus, a number of problems are associated with optimal foraging strategy. In spite of these problems, it remains likely that the concept of cost is valid in resource selection, especially in situations where labor is limited. Costs, therefore, must be employed as a relevant criterion in the evaluation of subsistence strategies.

Perhaps the major problem in dealing with the costs of human subsistence strategies is the difficulty of measurement. Necessary estimates of criteria such as resource abundance, distribution, procurement efficiency and processing efficiency are extremely difficult to obtain. Some reliable data may be derived through the investigation of living peoples. For example, Rappaport (1968) estimated energy costs by timing activities and then estimating the energy expended in accomplishing each task. For the archaeologist, however, no such precise measure of costs is possible. The approach most widely applied in archaeology has been to employ ethnographic analogy and the results of experimentation to rank various subsistence strategies in order by approximate cost (cf. Limp and Reidhead 1979;

Reidhead 1980; Earle 1980).

One of the most prominent of factors in resource selection, other than cost, is the risk associated with a particular strategy (Cancian 1972; Cleland 1976; Bartlett 1980). The fact that a resource has a high potential for failure, even though it is extremely productive, can serve to restrict or eliminate its use. At the same time, a resource that offers low yields at a high cost, but which is extremely reliable, may occupy a prominent position in the subsistence cycle. Security is very significant in the development of an adaptive strategy because stability and continuity are key goals of adaptation.

Cultural criteria also play a significant role in determining which resources are exploited. Among these are the food preferences and concepts of taste displayed by a group which may exclude certain foods from consideration. Ideology may require the consumption of specific foods at specific times of the year or may forbid the eating of particular plants or animals. Humans also seem to desire variety in diet and this may entail the use of costly resources to quench this appetite for diversity. In stratified societies, access to food resources or the technology to exploit them, may be restricted to individuals at a particular status or wealth level. Some foods may take on prestige connotations. Each of these potential factors can be extremely important in the decision making process, and along with cost and risk, must be considered when evaluating adaptive strategies.

As previously discussed, the scheduling of resource usage is central in the development of an adaptive strategy and timing factors can be of major significance in the selection process. When two or more resources become available at approximately the same time, a decision must be made concerning the allocation of labor and materials. Of particular importance in this decision is the demographic composition of the subsistence group. Specifically, the ratio of producers to consumers can have a marked effect upon resource exploitation. If there are many non-producers such as young children, the sick or the aged, there will be limited flexibility in subsistence since additional emphasis must be placed upon obtaining the necessary food requirements with a limited labor supply. If, however, there is a high ratio of producers to non-producers, economic roles can be more diversified and greater flexibility is potentially available in resource scheduling (Green 1980:210).

While it is extremely important that the criteria used in resource selection are clearly defined, it is equally essential that quantifiable means be found to evaluate the structure of adaptive strategies. One such means is provided by Hardesty (1975, 1979) who employed the concept of niche. He defined a niche as "the distinctive ways of using resources for subsistence that set cultural species apart" Hardesty (1975:7). The niche concept is valued for its measurement of two important variables -- how many resources are actually exploited, and how much each of these resources contributes to the total diet. Both measurable factors can be used to distinguish between adaptations. Resource diversity or richness refers to the number of different foods which are integrated into the diet, while "niche width" is the measure of the proportions in which these resources are utilized. Niche width therefore constitutes an index of evenness in a subsistence pattern. By utilizing both of these measures and combining them with data regarding the scheduling of resources during a yearly cycle, different adaptive strategies may be compared with some degree of precision.

The focal-diffuse concept (Cleland 1966, 1976) makes good use of niche width measures in subsistence evaluation. This concept views total subsistence systems in an adaptive framework and places adaptive strategies along a continuum ranging from highly specialized to highly generalized. Because this approach emphasizes the total subsistence pattern, a complete annual cycle of subsistence activities is the analytical unit to which the concept is applied. Focal adaptations are specialized and based upon the intensive exploitation of one or a few resources. Diffuse adaptations, on the other hand, are based upon the utilization of a wide variety of food sources in a regular, scheduled manner. As Cleland (1976:61) pointed out, few adaptations are totally focal or diffuse, but most tend to cluster toward either end of the continuum. Focal adaptations concentrate upon a few resources that have a high degree of reliability and productivity. Risk of total subsistence failure is reduced by intensified usage of the most dependable plants and animals with proven procurement strategies. Characteristic of focal adaptations is a tendency for conservatism and slow change (Cleland 1976:63). The major advantage of this type of economy is a stable cultural system, but conversely, the major disadvantage is its rigidity. Change occurs only under abnormal conditions. The change is difficult to accomplish and frequently results in major adaptive reorganizaton.

Diffuse adaptations can be characterized as flexible. Since they represent an attempt to utilize a wide diversity of resources without dependence upon any one, diffuse adaptations can occur only in areas of ecological diversity (Cleland 1976). Many alternatives are available; no single resource need be relied upon solely and new resources can be easily incorporated into the annual subsistence cycle. A diffuse strategy is based upon the exploitation of resources in a regular, carefully scheduled manner. Risk is minimized by maintaining sufficient alternatives so that compensation can be made for the unpredicted loss of one or more food sources.

By employing the measures of resource diversity and niche width, it is possible to calculate the relative positions of adaptive strategies along the focal-diffuse continuum. Focal adaptations would be indicated by low resource diversity and a high evenness index since only a few food sources comprise the diet. Diffuse adaptations should display high resource diversity but only low levels of dependence upon any specific resource.

Cleland (1976:66) believes that the long term evolutionary tendency is for focal adaptations to gradually develop from the diffuse type. This shift is due to selection over time of adaptive elements that are more productive, dependable and efficient. In situations of dramatic environmental change, however, focal economies may undergo extensive alteration and become more diffuse. The reason for this alteration is believed to lie in the flexible nature of the diffuse adaptation, its ability to combine new elements easily and its lower risk potential because of its wider variety of subsistence alternatives. Christenson (1980) supports Cleland's predictions and adds changing costs as a critical element in the emergence of focal economies.

The causes of change in human subsistence systems derive from many sources but the three principal ones seem to be 1) environmental, 2) technological/social, and 3) demographic. Changes in the environment can result from either natural or human induced causes. Natural changes could be climatic shift, the elimination of a species through extinction or variation in sea level. As previously discussed, environmental changes can take three basic forms - cyclical, unidirectional/continious and revolutionary - and the adaptive response to each will depend upon the specific circumstances. Cyclical change is a problem faced by all cultures. Its most common expression is seasonal variation in resources. Coping with these seasonal changes to ensure a constant food input is a major problem in creating a viable adaptive strategy. The specific procurement strategies employed to deal with cyclic change depend upon the nature of the environment, available resources and the procurement and storage capabilities of the culture.

Unidirectional/continuous and revolutionary change will also have varying impacts upon the subsistence pattern of a group. If the changes reduce plant and animal diversity, a likely occurrence in a situation such as the onset of arid conditions, the cultural response could be a greater emphasis upon the most dependable resources and a move toward a focal economy. Alternatively, if the climatic change produces an increased variety of resources, the response could be toward a more diffuse adaptation. It must be strongly emphasized that the response depends upon the specific changes taking place in a specific situation. The assumption is warranted, however, that these responses will be in conformance with the goals of cultural stability, risk reduction and cost minimization.

Human induced environmental changes include the overexploitation and possible extinction of particular species or habitats, and radical transformation of a habitat through land clearance or the use of fire (cf. Pyne 1982). Overexploitation normally results in reduced resource variety and can necessitate the development of a more focal economy or a shift in the usage of resources. Land clearance or fire alteration of the landscape, in contrast, may act to increase the variety of plant and animal species through creation of less mature ecological situations (Odum 1969). The potential for increased dietary diversity is thus created if the conditions are appropriate for a shift to a more diffuse adaptation.

Technological and social changes can be important in subsistence alteration. New techniques or tools can lower the procurement costs of resources so that they can be more widely exploited, or make previously untapped resources available. Social changes may also necessitate shifts in adaptive strategy. For example, a breakdown in social cohesion due to political factors may prohibit communal hunting activities or a shift in settlement location due to warfare or other causes can allow or restrict the exploitation of specific food resources (cf. Johnson 1977).

Changes in human demography will also have a significant impact upon the subsistence strategy because of alteration of the group's food requirements. An increase or decrease in population size simultaneously raises or lowers the quantity of foods necessary to maintain the group. Since a general trend throughout much of human history has been population increase, the subject of population growth has received the greatest scholarly attention (cf. Boserup 1965; Binford 1968; Cohen 1977). Christenson (1980) has developed a model of subsistence change specifically for situations where population increase is the principal causal factor. He assumed that during the process of adapting to growth, the culture will follow a least-costs approach. The model begins with a small population reliant upon wild food sources. In such a situation, Christenson (1980:36-37) predicted that the diet will be concentrated upon a few low-cost, highly dependable resources. As growth occurs, two responses are thought to be initiated: 1) the intensified use of the resources already being exploited, and 2) the addition of previously unused resources to the subsistence cycle. The result of this is an increase in resource diversity and a broadening of niche width. Costs of procurement rise, however, because the more intensively a natural resource is utilized, the higher the costs due to diminishing returns (Earle 1980). With continued growth, Christenson predicted that agriculture will eventually be adopted because agricultural output can be more easily expanded than can the output of naturally occurring resources. Wild food usage will continue but eventually, as overexploitation of the wild resources occurs and their procurement costs become prohibitive, the predominant food sources for the group will be agricultural. Accordingly, resource diversity declines and there is a major reduction in niche width. In essence, Christenson employed cost criteria to predict a shift from a very focal economy to a more diffuse one which, in turn, evolves into another focal economy but which is based upon completely different resources from the original adaptation. Christenson's evolutionary sequence is very similar to that proposed by Cleland (1976).

Boserup (1965) provided one of the first models for strictly agricultural populations undergoing growth. She postulated that the changes in agricultural practices from extensive, swidden type methods to intensive, multi-cropping of land was related to the increased demand for food stemming from a growing population. For agriculturalists, she uses three major costs - land, capital, and labor. The capital required for production in non-market economies is normally small and land is generally less expensive than labor (Green 1980:214; Clark 1967). Typically, a similar situation occurs on frontiers. If the least cost strategy is used, and this seems likely, then only the minimal required amount of the most expensive variable (labor) will be applied, while the use of the least expensive variable (land) will be emphasized. For societies engaged in colonization, Boserup's findings imply that the first stages of agricultural production will be extensive, possibly of the swidden type (also see Green 1980). However, as the density of the population increases, the cost factors reverse and land becomes an increasingly expensive input since it is no longer readily available. As the population continues to rise and more intensive agricultural methods are adopted to meet the rising food requirements, the output per man-hour of labor declines, but the output from a unit of land rises. Consequently, in situations of population growth where new lands are unavailable to expand production, the predicted response will be an intensification of subsistence practices with a focus upon a few highly productive resources, in short, a more focal adaptation (Boserup 1965:25-30). The fact that frontiers are the scenes of often explosive population growth suggests that colonization may offer a particularily valuable opportunity in which to investigate the adaptive responses to rapid population increase.

Colonization and Subsistence Patterns

The preceding discussion of human subsistence systems has revealed something of their complexity and has defined several of the criteria involved in the development and modification of adaptive strategies. While many characteristics of subsistence systems are dependent upon the specific culture and the particular environment to which an adaptation is made, there also seem to be general similarities between cultures in the manner of resource selection, responses to specific types of change and the evolution of subsistence systems over time. The implications of these characteristics are essential to the understanding frontier subsistence.

As previously emphasized, colonization is a very dynamic process with multiple factors stimulating culture change. Indeed, colonists are almost simultaneously faced with two major causes of change in human subsistence -- changes in environment and demography -- and colonization is thus one of the most complex adaptive situations known. They must cope with a new natural environment, a changed social environment, a shift in demographic structure and subsequent relatively rapid population growth. At the same time, the natural environment is altered by the colonists' attempts to adapt to it.

The task of adapting to this new setting is further complicated by the colonists' initial lack of knowledge regarding the ecology or the available resources. They poorly comprehend the types, quantities, distributions or seasonal characteristics of food sources, and risk assessment is unreliable because of limited data regarding cyclic change in the environment. The absence of ecological knowledge significantly hampers the decision making process which is so essential in the development of a viable adaptive strategy. Given these limitations to knowledge, and the necessity of the colonists to establish a stable and secure adaptation, the insights of Cleland (1976) regarding focal and diffuse subsistence strategies are particularily relevant. These insights enable the prediction that a diffuse strategy will be the most appropriate on a newly settled frontier since this type of adaptation offers the greatest security in the face of limited knowledge.

Adaptation to the new physical environment may be most immediate and pronounced source of change during colonization, but demographic factors, especially population growth, cannot be discounted. Immigration produces most of the initial growth, but as the colony matures, reproduction begins to contribute the major portion of the new individuals. Growth of frontier populations can be explosive in comparison to that found in more stable cultural situations, with a doubling or tripling of the population within a few decades or less. Large numbers of colonists may be settled with little difficulty during the earlier phases of colonization due to the labor shortage and the abundance of resources and unoccupied land. As the lands become occupied and population density increases, however, increased demands upon the subsistence system are inevitable. It seems unlikely that the colonists' original adaptive strategy will remain appropriate for a population three or four times its original size. Such pressure on resources may only gradually occur and it may not even become significant until the colonization process is terminating, but it seems certain that a modification of the original adaptive strategy will eventually become necessary. Wild food resource usage is a particularily sensitive indicator of population pressure since these resources could not withstand intensive usage without a real danger of overexploitation.

Rapid growth in population is accompanied by a gradual change in demographic structure. The majority of the individuals on newly settled frontiers are young adults, most of whom are male; consequently, there are few dependents and the producer-to-consumer ratio is very high. This ratio allows greater differentiation in economic roles which, in turn, provides the potential for much flexibility in resource use. Such flexibility is important because it increases the likelihood that a diffuse strategy, involving the scheduled use of many different resources, can be adapted. Through time, however, it is expected that age and sex structures comparable to the colonists' homeland will be established through reproduction and aging of the population, and this should act to significantly lower the producer-to-consumer ratio. Thus, at the same time that population growth increases the food requirements of the group, the shrinking percentage of producers within the total population reduces the potential flexibility in the resource use schedule.

These conditions make the theoretical work of Boserup (1965) and Christenson (1980) regarding subsistence response to population growth especially relevant in the study of frontier subsistence change. Both predict that there will be an intensification of subsistence activities with a gradual emphasis upon specific dependable, highly productive resources, in other words, an evolution toward a more focal economy.

Frontier subsistence can be assumed to generally follow a satisfier strategy and employ the least-cost principle as one criterion in the selection of resources. The usage of a satisfier strategy and the least-cost principle is applicable to the labor deprived frontier setting. A labor shortage should both limit the amount of effort which can be reasonably directed toward any specific activity and should put a premium upon the labor available. Colonies engaged in market production may employ a maximizing strategy with the resources intended for exchange. Because of the labor shortage, however, it is unlikely that maximizing strategies would be employed for subsistence resources. Indeed, an emphasis upon a "cash crop" would tend to reduce the labor available to exploit other necessary, but non-market resources, thereby making the satisfier and least-cost assumptions for subsistence even more likely on market-oriented than non-market oriented frontiers. Further increasing the likelyhood of this is the poorly developed transportation system on frontiers which limits the range of potential goods that can be shipped to a market. Often, a limited transportation network acts to select a small number of products for market which are easily transportable and non-perishable. Because of the perishability problem, many goods are simply inappropriate as market commodities on frontiers. As local market systems slowly develop within the area of colonization, some of these products may acquire an exchange value, especially those which can serve as a source of food for newly arrived colonists.

Hypotheses about Frontier Subsistence

As previously noted, the process of colonization is expected to have a significant impact upon most components of the cultural system, particularily subsistence. By combining the characteristics predicted in the colonization model with the information regarding human adaptive strategies discussed above, it is possible to formulate specific hypotheses regarding frontier subsistence. These hypotheses predict, in general terms, how the subsistence system will differ from the homeland and evolve within the area of colonization.

Hypothesis 1

> During colonization, subsistence practices will tend to be less complex and specialized than those practices found in the homeland.

Based upon environmental differences between the homeland and the colony, the cultural impoverishment characteristic and a frontier labor shortage, the colonization model predicts that subsistence practices will be relatively simple and non-specialized. Such a subsistence simplification phenomenon may be most directly observable in specialized aspects of subsistence such as animal husbandry, the production of luxury or variety crops, and in cooking practices.

Hypothesis 2

> The adaptive strategy developed during the early phases of settlement will be of the diffuse type when compared to the strategy used in the homeland.

The colonization model predicts a simplified, non-specialized culture in general, but it does not specify exactly how this will be expressed in subsistence. Fortunately, the focal-diffuse concept of Cleland (1976) provides a basis for predicting that a diffuse adaptive strategy will develop. Given the necessity of rapid adaptation, the limited knowledge available regarding the new environment and a simplified frontier culture, a diffuse strategy appears to be the most viable. Hardesty (1975:82) provided support for this prediction when he suggested that a wide niche width is most adaptive in uncertain environments. During colonization, this prediction may not involve the development of a fully diffuse adaptation as defined by Cleland. Rather, it may be expressed as a relative increase in niche width when compared to that of the homeland.

Hypothesis 3

> As the available lands are occupied and the population grows, emphasis will be increasingly placed upon dependable resources which can be intensively exploited; gradually the adaptive strategy will become more focal.

This response to the rise in population density and increased food requirements is predicted by the work of Boserup (1965) and Christenson (1980). During the colonization process, a stable, dependable adaptation is expected to have developed. But with population growth, there is pressure for greater exploitation of the resources to meet the increasing demand for food. Some resources can withstand greater harvesting for a period without severe depletion. Other food sources, though, have much lower depletion thresholds and, as the limits of exploitation are reached, the costs become prohibitive. Therefore, the expected response is the increased exploitation of the resources which are most dependable and for which production can be expanded without costs becoming too high. The result should be a reduction through time in resource diversity and a drop in niche width.

Hypothesis 4

> Colonial subsistence will display a directional change toward greater stability and complexity through time.

The colonization gradient concept is the basis for this prediction. The model suggests that the direction of change will be toward increased specialization and complexity in the cultural system and, as Cassagrande et al. (1964:314) noted "the overall process is one of increasing stabilization." The development of a stable adaptive strategy appropriate for the environment should be reflected archaeologically by the increasingly frequent appearance of uniform subsistence patterns in a region (Clarke 1968). It is also likely that more complex or specialized subsistence practices will be gradually added.

Hypothesis 5

> The general pattern of subsistence change will be the same throughout the area of colonization.

Colonization is thought to be a pervasive cultural process by which a population occupies and adapts to a new habitat. Provided that the environment is similar throughout, the pattern of subsistence change should be basically the same over the entire region. Variables such as wealth level or the date of a household's establishment may alter the magnitude of the changes, but every household is participating in the same general adaptive process so that the evolution of adaptive strategies should be quite similar between them.

Hypothesis 6

> Increasing differentiation in subsistence strategies and diet will occur between socieo-economic groups in the area of colonization through time.

Such a prediction is based upon the decline in opportunity available to individuals and the tendency for the social structure of a colony to become increasingly rigid and hierarchical over time. During the early phases of settlement, the fluid social structure and plentiful opportunity should tend to minimize these differences. As opportunity and the chances for upward social mobility decline, wealth and status differentiation should be accentuated (cf. Williams 1977).

Each of these hypotheses will form the basis for further discussion and will be tested in later chapters, following the presentation of necessary background information. Data to be used in this investigation are from the Chesapeake Bay region of North America. Early successful colonization efforts by the British began in the Chesapeake in 1607. Since these early efforts at settlement represent the first sustained British confrontation with the New World environment, it is likely that the colonization process will have operated fully there, and hence, it is an exemplary region in which to investigate the process.

CHAPTER 2

THE BRITISH HOMELAND AND BRITISH SUBSISTENCE PRACTICES

Before considering the colonization of the Chesapeake and the adaptive responses made by the English colonists, it is necessary to gain some understanding of the homeland and the settlers cultural background. The practices and perceptions an immigrant carries to the frontier will have a major impact upon the type of adaptation that emerges there. The subsistence practices of late 16th and early 17th Century Britain were themselves the result of adaptive responses to the changing, largely man-altered natural and social landscape. Only by having the emigrant's cultural background as the basis for comparison with the immigrant experience is it possible to gauge accurately the adaptations that were made in the Chesapeake. In this chapter, the climate, landscape, society and subsistence practices of late 16th and 17th Century Britain will be investigated.

Evidence suggests that the Chesapeake settlers came from many different places throughout Britain. Most appear to have been from the southeast and the west of England but others originated in northern England, some were from Wales, and a few even came from Scotland (Horn 1979). Such diversity of origin indicates that a range of knowledge of subsistence practices appropriate to many different environmental settings was transported to the Chesapeake, along with the settlers, and was thus available for potential application.

British Climate and Landscape

Seventeenth Century Britain had a cool, temperate climate with abundant precipitation, much as it is today. The most prominent factor in producing this moderate climate is the Gulf Stream system which brings warm, tropical waters across the Atlantic Ocean. Westerly maritime winds also convey warmth to the island, bringing generally equable temperatures which change slowly from month to month without abrupt shifts (Drury 1973:17-18). In the western portions of England such as Cornwall, the climate is directly influenced by the warm water temperatures that moderate the climate. In contrast, the temperatures tend to be slightly cooler and vary more between winter and summer on the eastern side of the island because the air has been cooled by its passage over the land. The average difference between mean winter and summer temperatures in Cornwall is 17° F while in Essex, on the east coast, it is 24° F (Miller 1967:22). On the whole, though, all of Britain experiences rather moderate temperatures throughout the year with mean January temperatures averaging around 40° F and temperatures in July averaging 60° F (Drury 1973:18).

Another factor which has an important impact upon the British climate is topography. Britain may be divided into two principal regions based upon its topography: 1) an upland zone which covers most of northern and western England, Wales and Scotland, and 2) a lowland zone found in the eastern and southern portions of England (Figure 1). The uplands are cooler because of their higher elevation. The uplands also have more rainfall, largely because of their location in the west where the moisture laden westerly winds first strike land. This moisture content is reduced by the time a weather front reaches the lowlands of eastern England. The average annual rainfall figures clearly reflect this difference with rain on the west coast typically of 30 to 40 inches a year. In the central section of the country, appropriately named the Midlands, an annual average of 30 inches of rain falls while the lands on the eastern coast receive 20 to 25 inches in a typical year (Miller 1967:22; Drury 1973:27). There is no dry season and rainfall is evenly distributed throughout the year. The number of days with measurable precipitation ranges from 150 to 200 days a year in the lowlands and is generally over 200 days in the uplands.

Are these modern meterological data an accurate reflection of the climate in the 17th Century? Unfortunately, meterological data from the 17th Century are sparse, but there is one long term temperature record from central England which begins in 1659. Comparison of this with modern figures provided in Table 1 reveals that temperatures were cooler, especially in the winter season.

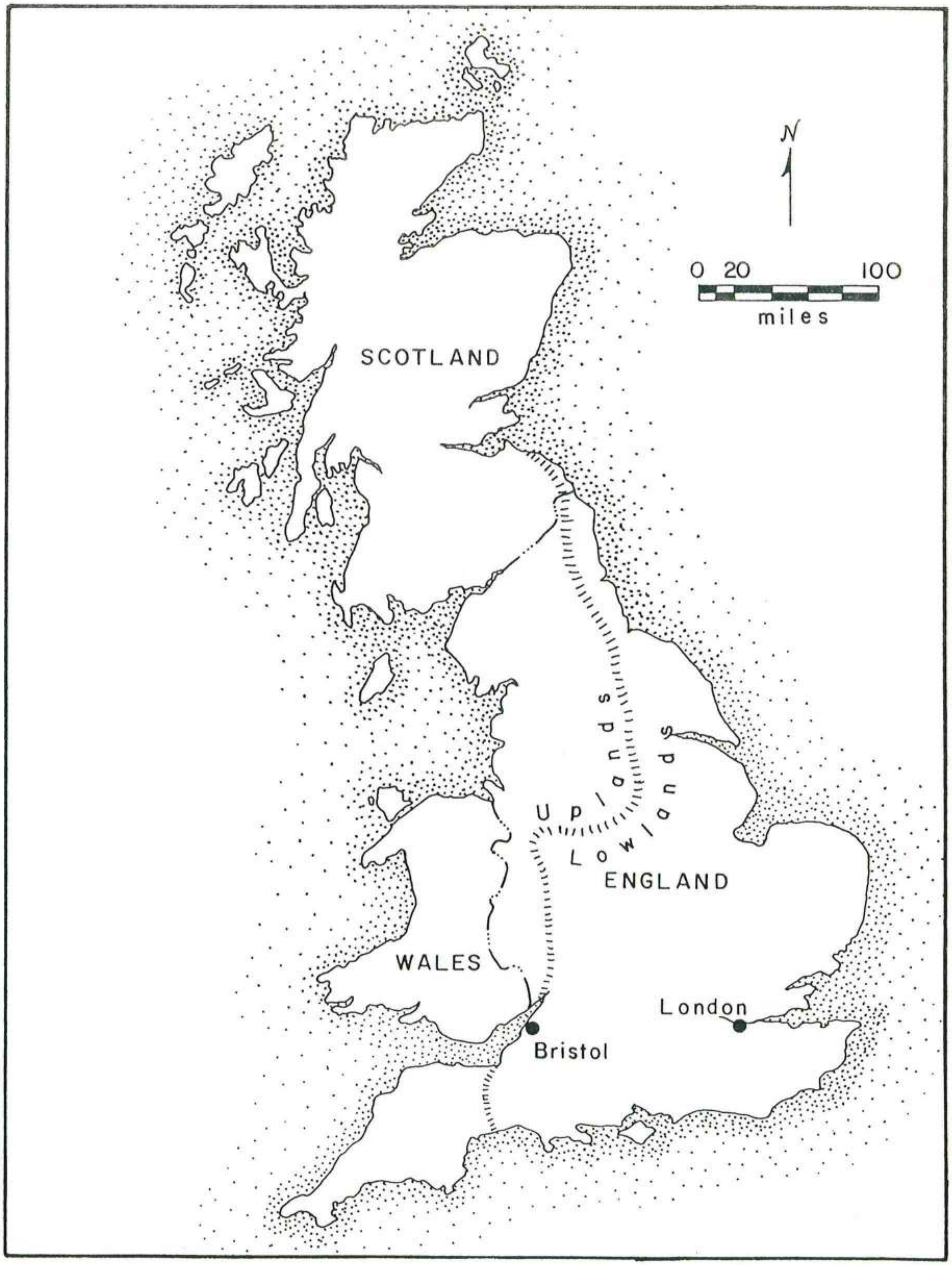

Figure 1: Britain, Showing the Upland and Lowland Regions

In a study of this and other available data concerning 17th Century climate, Lamb (1977) found that this period was in a "Little Ice Age". The world climate was apparently slightly cooler and the major impact of this upon Britain

Table 1: Summary of Seasonal and Annual Temperature Averages for Central England

	Winter	Spring	Summer	Fall	Year
1659-1690*	37.8°F	45.9°F	59.1°F	48.8°F	47.8°F
1851-1950**	39.2°F	46.8°F	59.4°F	49.3°F	48.6°F

*Lamb 1977:572 ***Lamb 1977:525

was a shortening of the growing season by a few days during the milder decades but by as much as three weeks during the coldest decade of the 1690s (Lamb 1977:476). This limited information suggests that Britain experienced slightly cooler conditions during the period. Given the general similarity in temperatures, however, it is unlikely that the climatic conditions were so different as to make the modern meterological data invalid. Therefore, modern information will continue to be used in later sections of this study, but with the caveat that the 17th Century conditions were probably slightly different.

The length of time between last and first frosts is highly variable depending upon locale. In southwest Britain, on lands warmed by the Gulf Stream, the time between frosts can last up to 9 months of the year. More typical of the lowland zone are periods averaging between 6 and 7 months. In the high upland areas of the west and especially in northern England and Scotland, this period is reduced to 5 or even 4 months. Growing season is closely related to this frost-free period, although it is usually slightly longer since the first frost may not necessarily be of the "killing" variety (Drury 1973:19-20).

Britain's weather conditions are quite variable. So to are its topography and ecology. The western and northern portions of the island are generally high, mountainous lands, often rugged in nature. A cool, damp climate typifies the uplands and, except for valleys and areas near the coast, the agricultural potential of the area is limited. The lowland zone, in contrast, has small hills, an undulating topography, and a climate much more amenable to agriculture (Thirsk 1967:2-3).

The types of soils found over Britain are diverse but essentially of two general types. One is a Podsol (humid climate type) while the other is a Brown Forest soil (sub-humid type) (Miller 1973:29). The podsol is found in the uplands, primarily, where the heavy rainfall has leached away many of the nutrients, leaving a thin, acidic and generally infertile soil. The Brown Forest soil predominates in the lowlands and is typically associated with deciduous forests. This Brown Forest soil is much deeper than the upland soil, generally has a high humus content, and consequently is quite fertile. However, leaching still occurs, especially under cultivation, and this makes fertilization necessary.

The parent material from which a soil is derived also has a major impact upon its qualities. Among the more distinctive soils that have developed due to underlying geological formations are acidic peat and moorland soil, and the chalk and clay soils of southeastern England. Glacial action has enhanced the variability of British soils with glacial drift covering portions of the east and the Midlands. The most common of these is a stiff "boulder clay" soil (Tansley 1949:25-28).

There are four basic ecological regions found in Britain: uplands, lowlands, forests, and fenlands. Athough there is a great deal of variation, the uplands primarily support a grass vegetation, with plants such as bracken and heather on the more acidic bog soils. The lowlands in the 17th Century were primarily agricultural or pastoral (Thirsk 1967:3-4).

Surviving throughout both of these areas were patches of forested lands, preserved primarily through royal edict or private ownership, and used as deer parks or coppice woods (Emery 1973:273). Forest had covered large portions of England in early medieval times, but clearing had been so extensive that by 1587, there was concern over a possible timber shortage (Harrison 1968). In the remaining patches of forest, dense woodlands were apparently rare. More typical were open forests with small meadows and cultivated areas scattered thoughout (Thirsk 1967:95-105). Principal trees included a variety of oaks (Quercetum sp.), hazel (Corylus avellana), hawthorn (Crataegus oxyacanta), beech (fagus sp.), elm (Ulmus sp.), and birch (Betula sp.) (Tansley 1949, Emery 1973:273). Another ecologically distinctive region occurred in the coastal lowlands and was known as the fens. Fenlands were often quite extensive areas of marsh which offered excellent pasture for livestock. Without drainage, however, the fenland soils are not especially productive agriculturally. The marsh vegetation did attract large numbers of migratory waterfowl during the spring and fall migratory seasons.

These four ecological regions, the uplands, lowlands, forests, and fenlands, are broad generalizations; a complexity of micro-environmental zones within them could be defined. Given the sparsity of precise ecological data from the 17th Century and the diverse origins of the British immigrants to the Chesapeake, however, a more detailed discussion is unwarranted. It is sufficient to observe that the distribution of soils, vegetation and climatic factors is highly variable and ecological diversity was a prominent feature of the British landscape. Human subsistence practices were also variable but they tended to be closely tied to the four basic ecological divisions discussed above.

Agriculture and Livestock Husbandry by Region

British subsistence in the 17th Century was based upon two means of food procurement, intensive grain agriculture and livestock husbandry. Although both grain and livestock were raised in almost all regions, the relative emphasis of each varied according to the region and its concomitant environmental potential. In the uplands, animal raising was the major emphasis. The principal animals were cattle (Bos taurus) and sheep (Ovis aries) although a few swine (Sus scrofa) were also kept. The rearing of these animals and dairying were the major activities of the upland farmer (Thirsk 1967:3). Largely due to poor soils and a damp climate, agriculture was of decidedly secondary importance in the uplands. In many areas, only enough grain was produced for local needs and, sometimes, not even that amount was produced. Major upland crops were barley (Hordeum sp.), oats (Avena satova), and peas (Pisum sativum and Pisum arvense) (Thirsk 1967:21,71; Emery 1973:139). Pasture occupied a great deal of the land and, significantly, most pasture was divided into parcels and enclosed by fencing or hedges. One result of this generally enclosed landscape is that a dispersed settlement pattern existed, comprised of hamlets or individual farmsteads. Only limited evidence of cooperative agricultural activities in the grass-farming areas has been found (Thirsk 1967:8). Pastoral farming required less labor than intensive grain agriculture and, perhaps as a result, the upland residents appear to have engaged in a variety of supplementary crafts such as mining, quarrying, clothmaking, and knitting (Thirsk 1967:12).

Lowland agricultural practices were more varied and can be described as a "mixed farm economy". Grain production and with animal husbandry were the hallmarks of lowland farming. Agriculturally, a basic division existed between the farming methods of the enclosed lands and the large, open field areas known as the "Champion" (Thirsk 1967). Large "common" fields were most prominent in the landscape of the lowlands and the residents of a village practiced a form of cooperative husbandry on these common fields. Typically, two or three large fields were divided into small strips representing individual holdings. In the three field system, one was planted exclusively in winter grain such as wheat or rye, one was used for spring-sown grains of barley or oats, and the third was left fallow annually (Emery 1973:263; Orwin and Orwin 1967). Although an individual household had the rights to small strips in each of these fields, communal agrarian practice required that the same crops be planted throughout a field in a specific year. This strip system also provided the household with the rights to graze livestock on the surrounding waste lands, fallow fields, and recently harvested fields. Such a system was especially common in the Midlands area. This complex system often divided the fields into one thousand or more separate holdings and considerable effort was expended to ensure that each household received holdings of equal quality (Thirsk 1967; Orwin and Orwin 1967). Many variations of this open field system existed but all were characterized by the communal management of agriculture and the possession by each household in a village of a right to both agricultural and pasture land. Nucleated villages were consistently associated with this form of agriculture.

Another type of agriculture was the infield-outfield system that involved the use of a small, intensively farmed field near the village. The fields' fertility was maintained through intensive manuring. The production of this small field was supplimented by a much larger pasture land that was farmed for a few years and then allowed to revert to pasture for a period of five or more years (Emery 1973:270).

In the southeast of England, the open field system was being eliminated by the enclosure of lands. Common fields were still used, but they were of irregular shapes and private fields frequently adjoined them (Emery 1973:264). Hedges demarcated many of these individual holdings, although others were marked by fences or ditches. In this increasingly partitioned landscape settlements tended to be more dispersed, and hamlets or individual farmsteads predominated instead of villages (Thirsk 1967). A shift from agrarian to pastoral economies and the increasing importance of market production were among the leading factors in the movement toward land enclosure. London was particularily influential and market gardening, along with dairying and fruit production, developed specifically for that city's consumption (Emery 1973:271). A result of enclosure was the drastic reduction or abolition of common rights, thereby creating a growing body of poor, landless people dependent upon wage labor for survival (Everitt 1967:399).

In the forests or open woodlands throughout England the subsistence practices differed markedly from those in nearby cleared areas. Indeed, period writers commented upon the difference between the open and the wooded, often enclosed, countryside (Emery 1973:255). The woodland economies, regardless of particular location, displayed a remarkably similar emphasis upon cattle raising, dairying, and pig keeping (Thirsk 1967:71). These woodlands were used primarily for pasturage with only small scale agriculture conducted within them. In fact, residents of some forest districts were reliant upon imported grain for their subsistence. One of the unique features of these wooded areas was the presence of many swine. Residents had pannage rights which permitted them to run the swine in the forests to feed on mast in the fall. In certain places such as the "New Forest" in Hampshire, the production of pigs was a specialty and Hampshire hams were widely acclaimed (Thirsk 1967:36).

A significant imigration of the poor into the forested areas took place during the late 16th and early 17th Centuries as enclosure forced people off the land. In many areas such as densely populated southeastern England, the woodlands were the only places with room for population expansion. The forest population was primarily comprised of small farmers and immigrants. Settlement in these woodlands was mostly dispersed with individual farms and small hamlets predominating (Thirsk 1967:95-96). The Commons for grazing were normally quite large and since the forest areas were not usually under firm manorial control, both land and individual rights to the commons were far more available than in the mixed farming area (Thirsk 1967:90-95).

The major settlement form in the extensive marshes and fenlands found in the coastal region was the nucleated village, which tended to occur on the scattered patches of high land. This high ground was also the location in which some wheat, flax, hemp, and beans were grown. In general, however, livestock raising and fattening of cattle and sheep on the rich marsh grasses was the primary economic activity of the residents. Agriculture was of minor importance during the 16th and early 17th Centuries (Emery 1973:268). In addition to being exceptionally fertile pasture, these salt marshes were considered excellent for sheep, since the salt helped prevent foot rot (Thirsk 1967:183-85). In areas such as the Essex marshes near London, dairying was also an important occupation (Trow-Smith 1957:193). Besides animal husbandry, fishing and fowling were important secondary activities and winter fowling provided both food and a marketable commodity if near enough to a market.

These four regions displayed the major variations in subsistence activities found in 17th Century Britain. It is particularly noteworthy that regional variations in subsistence activities were differences of emphasis rather than the selection of one or two activities to the exclusion of others. While the uplands were primarily pastoral, an open field type of agriculture was practiced in small isolated areas in stream valleys and along the coast in this region. Studies of individual counties reveal in even greater detail how these various activities were mixed. For example, the County of Kent in extreme southeastern England contained separate areas of mixed corn and sheep farming, fruit production and pig keeping, along with sheep and cattle fattening on the marshes (Chalklin 1965). A similar diversity of agrarian activities has been documented in Lincolnshire (Thirsk 1957), and the Welsh border counties (Sylvester 1969). In short, although there were general regional patterns, subsistence activities thoughout England were highly variable. Significant differences in subsistence activities could be found within the space of a few miles.

Methods of Agriculture and Husbandry

Despite these varied approaches to food production, English subsistence was based upon a rather small complex of plants and animals. Of the cereal grains and legumes, the most widely grown was barley (Hordeum sp.), although large quantities of wheat (Triticum sp.) and rye (Secale cereale) were also produced. Oats (Avena sativa) constituted a secondary crop in some areas but was particularily important in the higher lands in the west and north. Legumes included field peas (Pisum sativum and Pisum arvense), beans (Phaseolus vulgaris) and occasionally lentils (Lens culinaris). Although all of these legumes were consumed by humans, they were largely intended as animal fodder. English husbandmen also produced crops of hemp (Cannabis sativa) for rope, flax (Linum usitatissimum) for linen and dye plants like woad (Isatis tinctoria) and madder (Rubia tinctorum), which significantly broadened their economic possibilities (Thirsk 1967).

The raising of these crops was intimately linked with livestock husbandry. Plows and harrows were the principal agrarian tools and these required animal power. The specific use of oxen or horses depended upon the type of plow and the nature of the soil. Grain seed was typically sown by the broadcast method and a harrow was then used to cover the seed. Crop harvesting was performed with hand tools and this required large inputs of labor to cut and thresh the grain (Thirsk 1967:163-175).

In addition to providing traction, the livestock provided essential fertilization of the fields through their dung. Although a few alternative sources of fertilization were available, such as ashes, marl and river sludge, animal manures were the best, especially of sheep. In the mixed farming regions, sheep were crucial to the agrarian system and were valued as much for their manure as their wool or meat (Thirsk 1967:58, 168). To accomplish this fertilization of the fields, the movement of the cattle and sheep was carefully regulated to take maximum advantage of their droppings. Temporary pens were often erected to concentrate the dung on lands intended for heavy cultivation. This technique was employed the infield-outfield system. In other areas, animals were moved to fallow or recently harvested fields during the day and then returned to a fold at night (Trow-Smith 1957:239).

Of all the British livestock, cattle were probably the most desired farm animal due to their traction capability, milk production, and manure. Sheep were a close second choice, however, because of their manure, wool and lambs (Thirsk 1967:187). An English farmer would also raise swine, a few goats, pigeons, chickens, and occasionally, geese and rabbits (Markham 1648; Thirsk and Cooper 1972:166-167). The major animals - cattle and sheep - were not raised so much for their meat as for their other products. According to Trow-Smith (1957:173), it was only during the late 16th and early 17th centuries that English farmers began to regard an animal's meat of equal importance with its other products. Prior to this time, meat was considered the final function of an animal, appropriate only after it had provided wool or milk, been bred, or had pulled a plow for many years. While horses were highly valued animals, they were not considered an acceptable food source by 17th Century Englishmen and consequently, horse meat was never eaten except in the most extraordinary circumstances (Simoons 1961:83-84).

Even though animal husbandry methods varied among the separate regions of Britain, there were many basic similarities. In nearly every instance, management of the herds required personnel to guide the animals to the intended grazing areas, to keep them there, to protect them from harm, to inspect them for disease, and to fold them safely at night. While children sometimes performed these tasks, there were many professional herdsmen and shepherds throughout Britain (Tusser 1812; Markham 1648; Trow-Smith 1957). Only in open woodland areas were animals allowed greater freedom to range, but even there herdsmen apparently followed the animals. Contemporary accounts complained about the forest dwellers who lived primarily upon their cattle and "... wasted their days in sauntering after them" (Thirsk 1967:96).

The climate of England necessitated that every farmer store fodder to nourish his livestock during the winter season. As long as the fields offered any grazing potential, the animals were put out to eat. Eventually, though, this sparse diet had to be supplemented with hay, several varieties of straw, and occasionally grains like oats or a legume (Trow-Smith 1957:250-256). Although new fodder crops such as turnips, clover, and ryegrass were slowly being introduced to England, these were not widely used until the late 17th Century. Stock were usually given some shelter during the winter, especially at night, in byres, stables, and sheep houses (Trow-Smith 1957:239, 255-257).

Swine were kept by the majority of the households and this creature was regarded as:

> ...the husbandman's best Scavenger, and the Housewives most wholesome sink, for his food and living is by that which would else rot in the yard... (Markham 1648:126).

On most farms, a few pigs were raised. These animals were allowed to forage in the fallowed fields, common lands or marshes during the day and were enclosed in a sty at night (Markham 1648:128). Their diet was supplemented with all manner of household and farm waste. In many areas, the destructiveness of rooting swine in the fields and pastures was controlled by the method of piercing and ringing their noses. Large numbers of swine were only found in the forest districts or on commercial dairy farms where they were fed on dairy wastes such as whey (Thirsk 1967:192). Forest areas, with large ranges and abundant wild foods, provided for greater numbers of swine. This was especially true in the fall when the pigs were allowed to feed on the mast. Fattening in the woods normally took from six to eight weeks, with the swine under the care of a herdsman or hired hand (Thirsk 1967:193). Even in the enclosed regions of mixed farming, the inhabitants attempted to utilize the autumn windfall of foods to fatten their animals. As Gervase Markham advised in his Cheap and Good Husbandry (1648:129):

> ...at the fall of the leaf, it is good to drive them [swine] to hedges, where they may get Haws, Hips, Sloes, Crabs, or such fruit which is also very wholesome: and the poorer sort will gather their fruits and keep them to feed their swine with all the winter.

Both the agricultural and husbandry methods employed in Britain during the 17th century were complex and demanding of labor, skill and knowledge. Subsistence practices required a high degree of planning, and a careful allocation of all resources, be these land, manure, grass, forage crops or labor. In many areas the basis for survival was the cooperation of a large group of unrelated individuals who shared the land in common. In other regions, isolated homesteads were more frequent than villages, but the difficulty of resource allocation remained a central problem.

The complexity of subsistence activities was further accentuated by the ecological diversity of the British landscape that compelled farmers, often within a few miles of each other, to adopt radically different methods.

British Diet and the Yeoman Tradition

While an understanding of the agrarian economy in 17th Century Britain is essential for investigating the subsistence system, it does not reveal how food was incorporated into a diet. Hence it is necessary to identify the cultural preferences regarding food as well as the actual composition of the yearly diet. Both of these are important because the preferred diet constituted a subsistence model which the colonists carried with them to America. Their actual diet in Britain on the other hand, is of relevance because it represents the foods they were accustomed to eating, which may have been quite different from the preferred dietary items. Actual and preferred foods both influence the evaluation of new foods on the frontier, and can have a major impact upon the way in which the new subsistence pattern evolves.

England in the 16th and 17th Centuries was a highly stratified society which complicates the evaluation of diet since one of the key characteristics of a stratified society is differential access to resources (Fried 1974). The types of resources available to different social groups will vary, thereby producing differences in the types of foods which can be obtained and consumed. Certain foods have a status association and the consumption of these foods, the use of specific cooking methods and the use of certain spices and other seasonings take on social values (Garine 1972). Such status associations of food make consideration of England's social structure imperative.

Peter Laslett's investigation of 17th Century England in The World We Have Lost (1973) revealed that the society was divided into two major groups. The basic separation was between the "Gentry" and the "Commoners". The gentry included the royalty and aristocracy, knights, professionals, and gentlemen. At most, it comprised 5% of the population (Laslett 1973:27). The gentry owned most of the wealth and controlled the political and economic structure of the nation. The king stood at the pinnacle of this group with the nobility immediately beneath him. In the ranks below them were the knights, doctors, military officers, clergymen and some major merchants.

Most of the inhabitants of Britain were "commoners" who had much less wealth and were obligated to do manual labor for a living. Highest in rank within this group were the yeomen, who owned their land and generally operated agricultural enterprises. Artisans and tradesmen were slightly below them in social prestige, although not necessarily in wealth. Embodying the lowest levels of the society were poor husbandmen, landless and semi-skilled laborers, and paupers (Laslett 1973:47). Most of them owned or had access to only small patches of land and were at least partially dependent upon wages for survival (Fussel 1949).

Laslett observed that there was a significant gap between the gentry and the yeomen, expressed by a difference in outlook, behavior, and dress (1973:47). The difference between gentry and yeomen were also expressed in diet. The cuisine of the gentry derived largely from a medieval tradition with a strong influence from continental Europe, especially France. They ate heavily spiced dishes with many different ingredients cooked together to form often extremely sweet conglomerations (Aylett and Ordish 1965). Writing in 1587, William Harrison (1968:127) noted this:

> In number of dishes and change of meat, the nobilities of England (whose cookes are for the most part musicall-headed Frenchmen and strangers) doo most exceed".

In marked contrast to this was the cuisine of the yeomen and husbandmen. This dietary tradition was shared by the commoners who comprised nearly 95% of the English population. The English yeoman's cuisine has been analyzed in detail by Anderson (1971:275) who described it as:

> ...Home grown, the end product of centuries of experimentation with the procurement, preservation, and preparation of food on self-sufficient farms, clustered in and around isolated villages. Transmitted primarily by word of mouth and example, the tradition reached its perfection in the farms and kitchens of literate yeoman...

Although there were pronounced regional differences in subsistence methods, this yeoman cuisine seems to have been the fundamental dietary tradition throughout Britain.

Since yeoman cuisine is largely representative of British diet, and since few members of the gentry ever came to the Chesapeake colonies, attention will be focused upon the common fare.

What were the core elements of this widespread Yeoman subsistence tradition? In an early 17th Century play, The Witch of Edmonton, a line states that when a visitor arrives, "he shall be welcome to bread, beer and beef, yeoman's fare" (quoted in Anderson 1971:246). Other descriptions of yeomen food tend to agree with this and consistently refer to four major foods: beef, bread, beer and, dairy products. One of the best listings of the major foods in the yeoman's diet derives from the writings of Nicholas Breton who in 1618 described provisions stored in a farmer's house at the end of the harvest:

> Again we have . . . corn in the garner, cheese in the loft, milk in the dairy, creme in the pot, butter in the dish, ale in the tub, aqua vitae in the bottle, beefe in the brine, brawne in the sowce, and bacon in the roofe, herbs in the garden, and some money in the copher and having all this, if we serve God withal, What in God's name can we desire more? (quoted in Anderson 1971:24).

Other period writers repeat these basic items and add mutton, legumes and domestic fowl to the group (Harrison 1968:126-235 [original 1587], Tusser 1812 [original 1573], Markham 1615).

Food Resources in British Subsistence

A number of pertinent questions arise as to where these various foods were obtained, how they were typically prepared and how they were integrated into an annual subsistence cycle. Fortunately, yeomen and prosperous husbandmen are an appropriate group to which these questions should be addressed since their diets incorporated the widest range of subsistence resources. In addition, their diet is better documented than other commoners' diets, and yeomen were very nearly self-sufficient in subsistence. This latter point was emphasized by William Webb in 1656 when he wrote regarding the typical yeoman of Cheshire.

> They lay out seldom any money for any provision, but have it as their own as Beef, Mutton, Pork, Capons, Hens, Wild Fowl, and Fish. They bake their own bread and brew their own drink" (quoted in Campbell 1942:244).

Being self-sufficient in food was a trait for which the yeoman was particularily admired and period writers often celebrated it in often terms (Anderson 1971:27).

The items normally purchased from a market included a few essentials, namely salt and salted fish, and sometimes the difficult to make malt for brewing, and luxury items such as spices, sugar, dried fruits, almonds and wines to be used in special dishes (Anderson 1971:83:84). These few exceptions aside, the subsistence system was based upon foods obtained on or near the yeoman's farm.

While subsistence practices over England display some variability due to ecological differences, the key elements in the diet typically derived from three primary sources: 1) the fields and pastures, 2) the farmyard and garden, and 3) the orchard, and two secondary sources: 4) the woodlands and hedgerows, and 5) the waterways and marshes.

As may have been surmised from the earlier discussion of agricultural and husbandry practices, the fields and pastures lay at the heart of English subsistence. From fields were obtained barley for bread and beer; wheat, rye and oats for bread; and peas and other legumes for pottages. These same fields provided grazing for the livestock during the fallow years and after the harvest. The fields, pastures and forest lands, through cattle, also provided the dairy products that were key dietary items. Milk, butter and cheese were prominently noted in all descriptions of diet during this period and they were clearly an important source of nutrition for the yeoman and poorer people (Anderson 1971; Wilson 1973:150-168). Inhabitants of the uplands region had a more pastoral oriented economy than those of the lowlands during this period, but they were also dependent upon the agricultural products of the soil, and frequently had to import grain from more agriculturally oriented areas (Thirsk 1967:60-70).

Of only slightly less importance were the foods produced in the immediate vicinity of the yeoman's home. In the farmyard, the yeoman's wife maintained domestic fowl such as chickens and ducks and occasionally kept geese which provided meat, eggs and feathers. Swine were stied in the area and they consumed the waste from various household and farm activities. Bee hives were also located near the house and provided the principal sweetening agent used in cooking.

The garden was located in the farmyard area and it seems to have been a significant source of food. Herbs of both dietary and medicinal value were grown there. Food plants were also raised but relatively few descriptions have survived and vegetables were only occasionally itemized. One of the best sources of information regarding garden plants is John Gerard's The Herbal or General History of Plants, written in 1587 and expanded in 1633 by Thomas Johnson. In this massive work, every plant known in England was described in detail and illustrated. Among those specifically noted as "Garden Plants" are artichokes, garden beans, cabbages, carrots, cucumbers, lettuce, melons, onions, parsnips, radishes, skirrets, spinach and turnips. Richard Gardiner in his Instructions for Manuring, Sowing and Planting of Kitchen Gardens (1973, original 1603) listed the same plants, as did William Harrison (1968:264), clearly suggesting that these were the most commonly grown vegetables in England. Although the garden may have provided only a minor portion of the diet when compared to that obtained from the fields, it was certainly the major source of vitamins in the yeoman diet.

Typically, an orchard was also planted near the house. Trees bore fruit and nuts that were of increasing importance in the English diet, for as Harrison (1968:269) stated:

> And even as it fareth with our gardens, so doth it with our orchards, which were never furnished with so much good fruit not with such variety as this present. For besides that we have more delicate apples, plums, pears, walnuts, filberts, etc. and those sundry sorts, planted within forty years past ....

Apples and pears seem to have been the most common types. The sale of fruit and nuts was also an important source of income for some Yeomen as well as the poorer husbandmen (Anderson 1971:51; Baxter 1926:182), while the spoiled fruits from orchards were used to fatten swine in some areas (Anderson 1971:102).

The woodlands and hedgerows were of decidedly secondary importance as a source of food to the yeoman. Both areas provided food on which swine could fatten and thus, indirectly supplied food for the table. Few wild animals could be found in England by the early 17th Century except in the major forests and deer parks maintained by the wealthy. The most famous game animals were the red deer (*Cervus elaphus*) and fallow deer (*Dama dama*), but hunting them was ostensibly the privilege of the gentry. In spite of this restriction, the yeomen, husbandmen and poorer laborers apparently poached for deer when the opportunity arose, (Anderson 1971:79, Drummond 1958:98). More commonly trapped or hunted were hares, rabbits, fox, badgers and small birds such as quail and woodcock. Collection of wild plants was apparently of little importance and was limited to a few wild herbs, nuts and berries (Everitt 1967:452).

Perhaps of somewhat greater significance than the woodlands were the waterways, marshes and ponds since they yielded fish, molluscs, and fowl. Obviously, there was a strong regional pattern in the use of these resources since the yeoman living along the coast or in the fenlands had much better access than inland farmers. Hunting and fishing were popular recreations for yeomen that contributed some diversity to their diet, but which cannot have provided a major food source for the typical farmer (Campbell 1942:311).

Much seafood was transported inland, usually in a preserved state. One factor which greatly increased the consumption of fish in 16th and 17th Century Britain was religion. There were weekly fish days, in addition to the season of Lent, during which meats were not to be consumed. The number of fish days and their enforcement had significantly declined by the 17th Century but they still exerted an influence on eating habits (Wilson 1973:44). In 1587, William Harrison (1968:322-323) discussed the kinds of fish obtainable during each season of the year: among the freshwater varieties he listed were perch, pike, and trout. Salt water fish included mackerel, haddock, herring, cod and sole. Molluscs eaten included oysters, scallops, mussels and clams. Many varieties of ducks and other waterfowl were hunted or snared in the marshes but their consumption was generally limited to yeomen dwelling in that vicinity.

Each of these areas was a principal source of food for the yeomen and contributed to a diet that was largely of domestic origin with only a minor addition of wild foods. Beef, pork, mutton, fowl, bread, beer, pulse and dairy products predominated and, along with occasional vegetables, fruits and wild game, they comprised the regular diet of the 17th Century English Yeoman.

17th Century English Yeoman.
Methods of Food Preparation and Consumption

Of all of the foods listed above, grains were probably the most important in the diet (Ashley 1928; Campbell 1942:245). Grains were used in a number of ways, but without doubt, the most common form was as bread. The particular grain used for bread depended upon the region, for as Harrison (1968:133) related in 1587:

> The bread throughout the land is made of such grain as the soil yieldeth: nevertheless, the gentility commonly provide them seleves sufficiently of wheat for their own table whilst their household and poor neighbors in some shires are enforced to content themselves with rye or barley, yea, and in times of dearth, many with bread made from either of beans, peason or oats or of all together and some acorns among.

Elsewhere, he commented that in the open champion country:

> . . . much rye and barley bread is eaten, but especially where wheat is scant and geason (Harrison 1968:135).

Examination of agricultural accounts and other sources of information indicates that wheat-based bread was most common in the southeast, although even there it was often mixed with rye. In the north and the west, rye, barley and oat breads were most frequently consumed (Ashley 1928). The most popular types of bread in the lowland area were called "maslin" and "brown" bread. The first was a mix of wheat and rye while the second contained rye and barley mixed with ground peas (Anderson 1971:164). Pure wheat bread was rarely eaten except by the wealthy, and there were strong social connotations associated with its consumption. Besides bread, grain was a main ingredient in many pottages, puddings, and gruels, and flour was essential for pastries and pies. Oatmeal was consumed by itself and was also used as a thickening agent in other pottages (Markham 1615:48, 64-68).

Although cereal grains were of first order importance in yeoman nutrition, meat and fish occupied the premiere position in food preference (Campbell 1942:246, Anderson 1971:185-186). Freshly butchered meat was especially relished and the favorite method of preparing it was by roasting. In Markham's The English Housewife, published in 1615, recipes for roasting a large variety of meats were presented, among which are mutton, beef, pork, veal, capon, swan, and other fowl, and venison (pp. 54-59). English cooks were widely acclaimed for their ability at roasting and roast beef came to characterize the epitome of English cookery (Wilson 1973:89-91). Indeed, it was traditional to serve it twice a week, on Thursday and Sunday (Anderson 1971:260).

In spite of the popularity of roasting, boiling was probably more common because of its simplicity and the fact that it produced a rich broth. Boiling is particularily appropriate for salted meats such as corned beef or salted fish. The widespread usage of this cooking method is indicated by Markham (1615:47):

> ...we speak of boild meats and broths, which for as much as our Housewife is intended to be general, one that can as well feed the poore as the rich, we will first beginne with those ordinary wholesome boild meats, which are of use in every good man's house...

A boiled meat might be cooked as a single large piece with a few herbs, onions and finely chopped vegetables, or cut up and made into an "ordinary pottage". Markham (1615:47-48) gave recipes for several types of pottages which contained varying amounts of herbs and usually included oatmeal as a thickening agent. Stews differed from pottages chiefly in the fact that they had great quantities of meat; rabbit, hare and chicken were often consumed in this manner (Anderson 1971:206).

Meat was also baked, generally in the form of pies. These were made through the careful preparation of pastry which matched the characteristics of the meat. Virtually any available meat was used in pies and there are surviving recipes for venison, beef, bacon, lamb, mutton, chicken, waterfowl, fish and oyster pies (Markham 1615, Avery 1688). One final method of meat cookery was by frying. Frying was quite common and often used to make "fricasses" which were

> . . . dishes of many compositions, and ingredients, as flesh, fish, eggs, herbs, and many other things, all being prepared and made ready in a frying pan . . . (Markham 1615:42-43).

Dairy products were employed in many different dishes as well as being eaten in the forms of buttermilk, milk, curds, butter or cheese. However, recipes that emphasize dairy products are not common, being limited mostly to custards made with fruit, and semi-solid drinks such as syllabub and posset. Cheese was principally eaten by itself in several forms ranging from firm, hard cheese that had been well aged to soft, curded new cheese, and occasionally cream cheese (Wilson 1973:158-163). Butter was eaten on bread as well as used in cooking.

Vegetables from kitchen gardens were employed in several manners, depending upon whether they were "pot" or "sallet" herbs. Pot herbs were for the most part root crops like carrots, parsnips, or turnips, but cabbage and onions were also included in this group. Potherbs were usually added to pottages, stews and other boiled meat dishes (Anderson 1971:219; Markham 1615). Legumes represent another group that was widely consumed, often in the form of pottages; indeed, pease pottage was a national dish throughout this period (Wilson 973:196). Beans were also baked, especially during the winter months.

Salad herbs, on the other hand, were more often eaten fresh. Cucumbers, small carrots, cauliflower, lettuce, radishes, and spinach were all grouped into this category and could be eaten hot or cold, individually or mixed together into a "compound sallet" and served with oil, vinegar and spices (Markham 1615:39-40). Some of these vegetables were also preserved by pickling and those most generally used in this manner were onions, cabbage and cucumbers (Wilson 1973:306, 321-325).

Fruit was eaten fresh, cooked, dried or preserved in the form of various drinks. William Harrison (1968:139) wrote in 1587 that:

> In some places of England there is a kind of drink made of apples which they call cider or pommage, but that of pears is

> named perry, and both are ground and pressed in presses made for the nonce. Certes these two are very common in Sussex, Kent, Worcester and other steads where those sorts of fruits do abound...

Apples and pears were also roasted, made into sauce and baked in tarts or pies. Other fruits such as cherries, peaches, gooseberries and plums were cooked in tarts and used to flavor puddings and other dishes; some fruits were pickled (Wilson 1973:310-315).

Food Preservation

Because Britain has a temperate climate, the availability of many of the foods discussed above varied in a distinct seasonal pattern. Food had to be stored for the slack seasons, and hence, numerous subsistence staples were preserved. The four principal preservation methods drying, salting, pickling and potting (Anderson 1971:86-87, 100-115; Markham 1615). Drying of grains, beans and fruit was common and generally effective. Meat was also dried, although this was usually done in association with other treatments such as smoking. The most widely used method of meat preservation was by salting, either dry or in a brine. The brining method produced corned beef, hams or salt pork while the dry salting of beef yielded "powdered beef" which apparently stored well. Smaller animals such as sheep, fowl and rabbit were normally eaten fresh and were rarely salted. Pickling was most commonly employed to preserve vegetables, oysters and some meats. Of all the methods, potting seems to have been the most successful. This involved the cooking of pork, beef or chicken, placing it in an earthenware vessel and covering it totally with some type of fat to form a seal. Potted foods were especially popular on ships since these foodstuffs tended to preserve longer (Anderson 1971:105). Cow's milk was preserved in the form of butter and cheese which, if stored in a cool dry environment, would keep well. Through the careful application of these varied preservation methods, the yeoman could depend upon a supply of food throughout the year.

The Annual Subsistence Cycle of the Yeoman

Based upon the annual shifts in climatic conditions, 17th Century Englishmen divided the year into four seasons. These were the winter (late October to early February), spring (February to late April), summer (May to early August), and the harvest season (early August to October) (Anderson 1971:86). Such a division provides a convenient and reasonably accurate means of discussing the subsistence cycle. The following discussion is based upon a synthesis of many works: Drummond 1958; Gerard 1633; Harrison 1968; Markham 1615, 1648; Anderson 1971; Tusser 1812; and Thirsk 1967.

The widest variety of foods was available to the yeoman during the winter period following the harvest. During this season, grain and legumes were abundant and October was a traditional brewing month. Fruit drinks such as cider, perry and various fruit wines were widely consumed duing this period along with stored fresh fruits. Cheese and butter, products of the long dairying season that ran from May to late September, were plentiful. Meat consumption was greatest during the winter. Butchery was traditionally conducted in November when the weather was suitably cold and before the fattened livestock could lose weight because of the poor winter fodder. Much freshly slaughtered beef and pork were preserved for the coming months, but the butchery process yielded organ meats, blood and many small cuts that were eaten immediately. Perhaps the highpoint of the winter season was the Christmas celebration when elaborate meals were served. Thomas Tusser (1812:73), writing in 1573, describde this festive feasting:

> Good bread and good drink, a good fire in the Hall, brawn, pudding, and souse and good mustard withall.
>
> Beef, mutton, and pork, shred pies of the best, pig, veal, goose, and capon, and turkey well drest, Cheese, apples, and nuts, jolly carols to hear, As then in the country, is counted good cheer.

In the spring months, the yeoman's fare differed considerably from that of the previous season. Preserved meats were emphasized and bread was abundant in the early spring. March was also the traditional month for brewing strong beer. Also, sufficient grain was available to continue the weekly or bi-weekly brewing of "small beer" which was drunk almost immediately. In contrast, cider and other fruit drinks would have been in short supply. Punctuating this season was the observance of Lent from late February or early March to early April. During this 40 day period of penance and prayer, individuals were to abstain from the consumption of meat. Instead, cheese, pease pottage, other grain or legume dishes and salted or occasionally fresh fish predominated in the diet. Notably lacking throughout this entire period were any fresh vegetables or fruit. The long months of salted meat and Lenten fare came to an end at Easter when geese, other fowl, young lambs or a sheep were slaughtered for the Easter feast. Overall, the spring period was one of adequate food, but with a significant shortage of fresh meat, vegetables and fruit.

The summer diet contrasted sharply with that of the winter or spring and was the leanest period for the yeoman. Supplies of wheat, barley, rye, pease and beans ran low, and, if the harvest were late, hunger could result. Fortunately, this was also the period during which garden produce became available and dairying was at a peak. Some preserved meats may have still been on hand but these were probably badly tainted. Occasionally, a fowl, a pig, or a sheep was probably consumed during this period along with the yield of the dairy. Gooseberries, strawberries and other garden fruits ripened in the summer months along with the vegetables and provided a much needed source of vitamins in the diet. Dairy products, vegetables and fruit, some meat, and rapidly shrinking stores of grain and legumes comprised the normal summer diet.

Harvest was the shortest season and was marked by a significantly more varied diet due to the differing ripening dates of the various grains, legumes and fruits. During the early weeks of the harvest, the summer diet probably continued almost unchanged. A variety of vegetables and fruits would have been available along with new cheese. But as the harvest progressed, the plethora of new provisions enabled a shift back to the "Beef, Bread, and Beer" style of diet which characterized the winter pattern of subsistence. The completion of harvest was often marked by a feast for all the workers. One such meal hosted in 1641 by Henry Best, a Yorkshire farmer described that:

> . . . and then have they puddings, bacon or boiled beef, flesh or apple pies, and then cream brought in platters, and everyone a spoon, then after all they have hot cakes and ale . . . (Thirsk and Cooper 1972:125).

This then was the annual subsistence cycle of the English Yeoman farmer of the late 16th and the early 17th Centuries. There were certainly regional variations in this diet with the types and proportions of specific grains, meats, fruits and vegetables differing according to the section of the country. Nevertheless, the yearly subsistence cycle was undeniably based upon the core components of domestic meats, bread, legumes, beer and dairy products. For the prosperous husbandman or yeoman, such a diet apparently provided "solid sufficiency" and enabled a reasonably healthy existence. Furthermore, the yeoman and his cuisine served as a cultural ideal toward which others aspired.

The Diet of the Commoners and the Importance of Meat

If such a diet was typical of the more prosperous yeoman farmers, what of the people below that rank? These were the craftsmen, small scale farmers, and wage laborers who either owned or rented small tracts of land. As the enclosure movement spread, their rights to commons pasture were slowly reduced or eliminated. Many laborers in the more urban areas were almost totally dependent upon their wages for food. How did the diets of these people differ from that of the virtually self-sufficient yeomen?

One way of answering this question is to determine how widespread was the yeoman subsistence tradition. Sources of information are the foods that repeatedly appear in menus of institutions such as poor houses, hospitals or military organizations. Such data are relevant because "incorporation into an institutional fare usually indicates that a commodity is firmly entrenched in the diet of the general population" (Shammas 1983:97). Data are available concerning the foods typically served in 17th Century poor houses and hospitals (Shammas 1983:98), jails (Anderson 1971:246), the army during the English Civil War (Firth 1921), English soldiers during the second half of the 17th Century (Thacker 1894), and the Royal Navy (Drummond 1958). Each of these reveals a remarkable similarity in foods. The same components of beer, bread or biscuit, meat (beef, pork or mutton), cheese, butter and oats or peas appear in nearly every menu or ration. For example, dinner fare at a jail in

1588 consisted of "bread made of rye . . with a pynte of porredge, a quarter pound of fleshe, and a pinte of beare" (cited in Anderson 1971:246). The standard foods served in poor houses between 1570 and 1650 were bread, cheese, peas, meat or salted fish, beer, occasional milk or butter and a few vegetables when in season (Shammas 1983). While there was probably little comparison in quality between these institutional meals and those served in a yeoman's household, the consistency of ingredients strongly argues that these were indeed the key components of the diet of commoners thoughout Britain. Practically all ate bread, cheese, butter, and legumes, and drank beer. What seems to have differentiated the diet of the yeoman from that of the poor people were the proportions of meat and vegetables they consumed.

Meat in 17th Century England was the most desired food in the diet (Anderson 1971:185-186). Indeed, as Drummond (1958:102) states, ". . . the standard of living was judged to a considerable extent by the amount of meat eaten". It is clear that the amount of meat consumed was a central factor in differentiating between the diets of the rich and the poor. In 1587, Harrison (1968:126) indicated that the rich ate a variety of meats while dairy products were deemed more suitable for the poor

> . . . white meats, as milk, butter and cheese, which were . . . wont to be accounted of as one of the chief Stays throughout the island, are not much reputed as food appertinent only to the inferior sort, whilst such as are more wealthy do feed upon the flesh of all

> kinds of cattle accustomed to be eaten, all sorts of fish taken upon our coast and in our fresh rivers, bred in our island or brought unto us from other countries in the main.

The most esteemed of all meats was venison. Deer could only be found in some forest areas where they were under royal ownership or in private deer parks and as Harrison (1968:255) declared:

> ...that vain commodity ... venison in England is neither bought nor sold as in other countries but maintained only for the pleasure of the [deer park] owner and his friends....

In other words, deer meat was a food of the gentry and had elite social connotations for those who could serve it (Wilson 1973:99-100). William Harrison (1968: 131-132) also observed that when poor people at a festival:

> . . . happen to stumble upon a piece of venison and a cup of wine or very strong beer or ale . . . they think their cheer so great and themselves to have fared so well as the Lord Mayor of London . . .

This cultural preference for meat and its high status was accompanied by a low opinion of vegetables. This disfavor derived in part from medieval beliefs that fruits and vegetables were sources of melancholy and fevers (Drummond 1958:125). This view began to change during the 17th Century but it still had influence. Such a negative attitude was clearly expressed by Thomas Fuller in 1642:

> Still at our Yeomans table you shall have as many joints as dishes; no meat disguis'd with strange sauces; no straggling joynt of a sheep in the midst of a pasture of grasse, beset with sallads on every side, but solid substantial food (Fuller 1938:106).

This attitude was changing and some of the wealthier members of society, "were eating more vegetables and importing exotic varieties of plants to stock their gardens (Harrison 1968: 264). For the most part, however, vegetables possessed a reputation as a food suitable for times of hunger, and were associated with the diet of the poor. Such a cultural association clearly contributed to the low esteem in which vegetables were held. Nevertheless, the importance of vegetables as a food for the poor was stressed by several writers during the period. Harrison (1968:216) told that:

> ...sometime a poor man ... think himself very friendly dealt with if he may have an acre of ground assigned unto him whereon to keep a cow or wherein to set cabbages, radishes, parsnips, carrots, melons, pompions, or such like stuff, by which he and his poor household liveth as by their principal food, sith they can do no better. And as for wheaten bread, they eat it when they can reach unto the price of it, contenting themselves in the meantime with bread made of oats or barley: a poor estate, God wot

A similar attitude was expressed by Richard Gardiner in his Instructions for Manuring, Sowing and Planting of Kitchen Gardens (1603) who wrote the book specifically "to provide sufficient victuals for the poore and greatest number of people to relieve their hungrie stomachs". He described in detail the growing of garden beans, carrots, cabbages, cucumbers, lettuce, onions, parsnips, radishes and turnips. Gardiner was convinced that the poor could improve their diets and health by eating these plants.

Hunger among the poor was due largely to their lack of access to land to raise crops and graze animals. The small husbandman or farm laborer may have owned or rented a little land, but this was seldom more than five acres (Everitt 1967:401). More typical was an acre or so surrounding their cottages (Fussell 1949). Upon this amount of land, they could maintain a small garden, perhaps a few livestock, and several fruit trees. Normally, however, this was insufficient space to produce grains or legumes in quantity, and the cottager was forced to purchase these at the market (Fussell 1949:26-29). As Harrison noted in 1587 (1968:216), their bread was usually of barley or mixed grains but rarely wheat, due to its cost. Peas or other legumes were often mixed with the barley flour to stretch it (Fussel 1949:30). Accounts suggest that dairy products, rather than meat, were the chief source of protein in the diet of the poor (Everitt 1967:451). Some kept a cow if they had sufficient land or access to common grazing, but for most people, milk, butter, and cheese had to be purchased. The livestock of the poor was often limited to a few swine, sheep, or some fowl. Many commoners did not attempt to raise swine on the small amount of land available to them and occasionally purchased a flitch of bacon or some salt pork (Everitt 1967:452). This lack of meat in their diet was emphasized by Richard Baxter in 1691 in his discussion of "poor racked husbandmen":

> The poor tenants are glad of a piece of hanged bacon once a week, and some few that can kill a bull eat now and then a bit of hanged beef, enough to try the stomach of an ostrich. He is a rich man

> that can afford to eat a joint of fresh meat (Beef, Mutton or Veal) once in a month or fortnight. If their sow pigs or their hens breed chickens, they cannot afford to eat them, but must sell them to make the rent. The cannot afford to eat the eggs that their hens lay, nor the apples or pears that grow on their trees (Save some that are not vendible) but must make money of all. All the best of their butter and cheese they must sell and feed themselves and their children and servants with skimmed cheese, and skimmed milk and whey curds (Baxter 1926:182).

No doubt these poor laborers supplemented their meat diets through fishing, fowling, hunting rabbits, and, if near a forested area, poaching deer (Everitt 1967:452). Given such a diet, though, the importance of vegetables in supplementing the food supply is obvious and the garden was one of the few subsistence resources which could be controlled by the "poorer sorts." In a study of the diets of "cottagers", Fussel (1949:32) found that there was relatively little variation in their diets from one part of England to the other. He summarized the pervasive dietary regime of the laborer thus:

> Usually the cottage staple would be bread of mixed flour, white meats, milk, buttermilk or whey, and skim milk cheese, occasional meat meals, mainly derived from pig, or at festivals beef, mutton and possibly poultry; for example a Michaelmas goose, perhaps a wild rabbit. Home-made ale, and various home-made wines, cider the most usual . . . and all sorts of concoctions made from flowers, berries and vegetables were common drink (Fussell 1949:35).

Wages were clearly crucial for these laborers. A study of pay rates and their correlation with the prices of foods indicates that laborers in the early 17th Century spent over 50% of their income on food (Shammas 1983:93). Of course, workers in rural areas could supplement this with garden produce, some livestock, wild foods, and poached game, but the urban dweller could probably only keep a tiny garden and a few fowl. Data suggest that the small but rapidly growing population of poor urban workers depended upon bread, preserved fish, cheese, butter and a few low quality cuts of meat for their subsistence (Drummond 1958:100). Nutritionally, they were probably worse off than their rural counterparts.

The skilled urban craftsmen, on the other hand, generally fared much better. Even though they were not self-sufficient in food, their trades were sufficiently rewarding to allow them a diet roughly comparable to that of yeomen of moderate means. One description of the foods eaten by this group stated that they:

> ...make greatest account of such meat as they may soonest come by and have it quickliest ready...Their food consisteth principally in beef and such meat as the butcher selleth, that it to say, mutton, veal, lamb, pork, etc. whereof he findeth great store in the markets adjoining, besides souse, brawn, bacon, fruit, pies of fruit, fowl of sundry sorts, cheese, butter, eggs, etc... (Harrison 1968:131).

Urban dwellers also ate butter and cheese in increasing amounts during the 17th Century and consumed breads of higher quality than in the rural areas (Drummond 1958:105-106).

More difficult than identifying the types of food eaten by 17th Century Englishmen is ascertaining from infrequent and imprecise information the quantities in which such foods were consumed. What information is available has been synthesized by Jay Anderson (1971:262) who referred to the daily consumption of adults. His estimate, which is probably as accurate as the limited data will allow, puts the daily consumption of adults at:

> ...one-half pound each of butter or cheese, meat or fish, one-quarter pound of porridge meal, one pound of bread, moderate quantities of what ever vegetables and fruits were available, and one gallon of a beverage--skim milk, whey, beer or cider.

Of course, the exact quantities of meat, grain and vegetables in the diet would tend to vary widely around this average, depending upon the locale, wealth level of the individual and the season of the year.

Summary

Late 16th and early 17th Century British diet was based upon a core group of foods produced through intensive agriculture and animal husbandry practices. Although definite regional variations in the agrarian economy existed, data suggest that there were fundamental similarities in the diet throughout Britain. Grains used in making bread, beer, and pottages; dairy products; meat, primarily beef and pork; fish; and legumes constituted the key elements in the subsistence of rich and poor alike. A variety of other foods supplemented this core diet but they displayed more pronounced seasonal and regional variability. Waterfowl and fresh fish, for example, were more important in the coastal and fen areas, while the use of vegetables was generally limited to a specific season. Relatively few wild foods were eaten.

These foods were clearly ranked in terms of their cultural value, with meat at the top of this value system. Meat had a distinct status association and the types eaten along with the quantities and frequency with which it could be consumed were major demarcators between the diets of the rich and the poor. Vegetables, on the other hand, were widely consumed but regarded with lower esteem unless they were exotic imports.

Although the actual diets varied according to individual preferences, economic status and the region in which a person lived, all diets shared a common subsistence tradition based upon a small group of domesticated plants and animals of which meat was the premiere component. Immigrants to the Chesapeake carried the same tradition with them and it thus provided the framework from which a new subsistence system on the frontier could emerge.

CHAPTER 3

THE 17TH CENTURY CHESAPEAKE: THE SETTING FOR COLONIZATION

The first successful British colonization in the New World took place in the Chesapeake region of North America. In this setting the British first confronted the American wilderness and struggled to devise ways of adapting to it. In this chapter, the nature of the Chesapeake environment will be discussed and some comparison with that of Britain will be made.

History of the Colonies

The settlement of the Chesapeake has been thoroughly discussed elsewhere (cf. Craven 1949; Morgan 1975; Carr, Menard and Peddicord 1978) and for this reason, only a brief summary of the general facts regarding the colonies of Virginia and Maryland will be presented here.

The first British settlement was established in May of 1607 when three ships entered the waters of the Chesapeake. After a brief period of exploration, the settlers chose a low, marshy island up a large river some 60 miles from the mouth of the Chesapeake Bay where they established the colony of Virginia (Figure 2). They named the river the James and called the first settlement Jamestown in honor of King James, constructed a fort, and began exploration. Establishment of

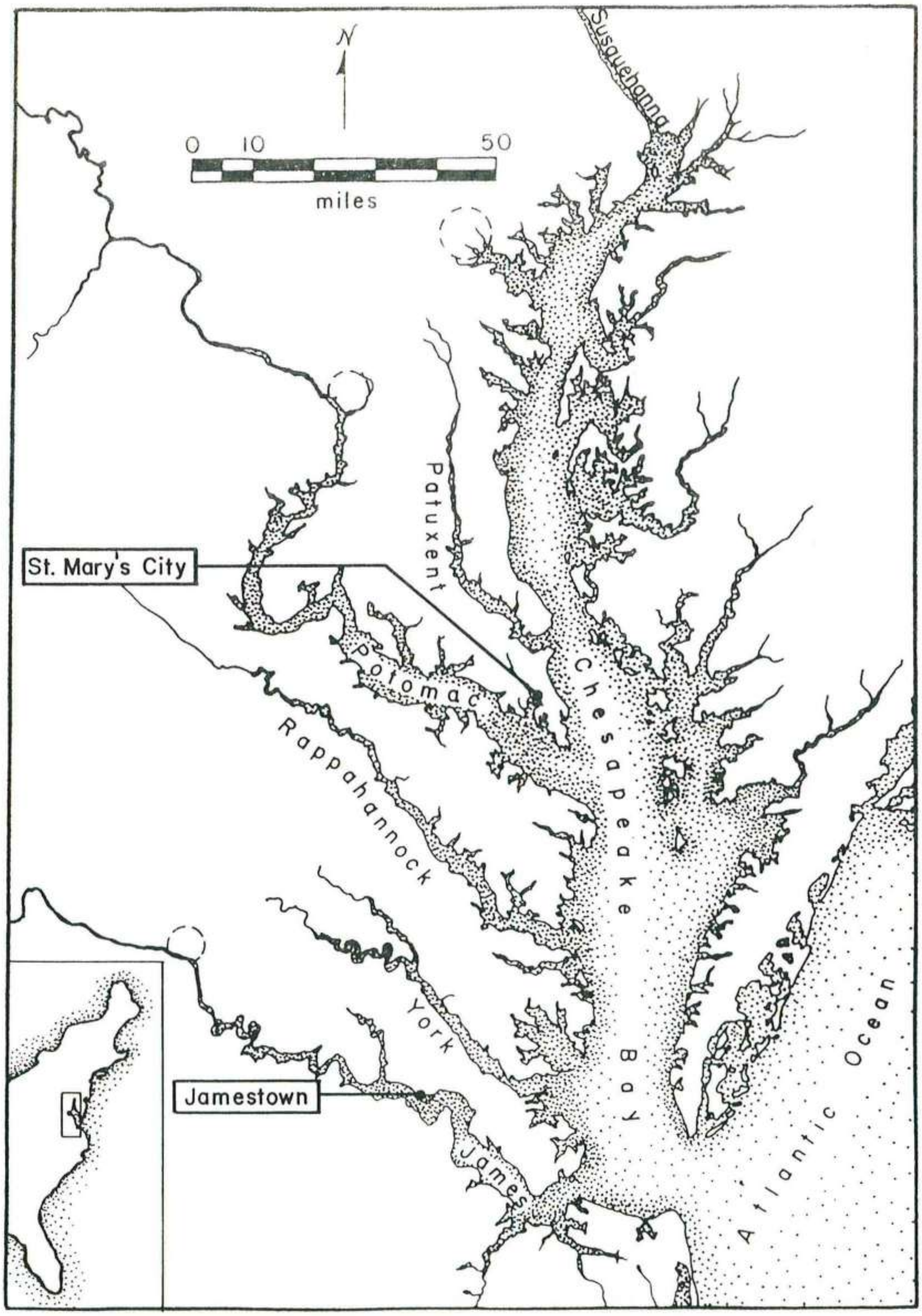

Figure 2: The Cheasapeake Bay, Jamestown, and St. Mary's City

an English claim to territory in the New World was one of their primary reasons for colonization. These first settlers thought Spain would be a major threat to the new colony because of Spanish claims to that portion of North America. A Spanish threat, however, never materialized.

Instead, trouble came from the native Indians. Relations were originally good between the British and the local Algonquians united under a chief called Powhatan. Indeed, the colonists became dependent upon the Indians for food during the first decade of settlement. Cultural differences between these groups, politics and a domineering attitude on the part of the English, however, produced conflict and relations steadily deteriorated (Fausz 1977). Animosities culminated in the "1622 Massacre" during which several hundred of the colonists and much of their livestock were killed in a surprise attack. The English quickly recovered from this, waged a guerrilla style war against the Indians and subdued them. The Indians attacked the settlers again in 1644, but this attempt failed and the resulting counterattacks by the English completely eliminated the native Indians as a threat to the James River settlements.

Although royal land claims and religious conversion of the Indians were general reasons given to justify colonization, the major concern of the Virginia Company, the enterprise's sponsor, and its settlers was the acquisition of wealth from the new lands. The first colonists were apparently so intent upon gaining quick riches, such as gold, that Virginia was regarded as a temporary stopping place, and a mining camp type of mentality pervaded the original Jamestown settlement (Morgan 1975). Such an attitude, combined with poor leadership, a conservative attitude toward change and an exceptionally high death rate, made the first decade of settlement a fiasco. Little effort was exerted to produce food since trade with the Indians was easier, and consequently starvation remained a continuing threat during the early years.

Added to these problems was the difficulty of finding a suitable market commodity to sustain the colony. This is always a problem for newly established, market-oriented frontiers since the potential of the new environment and its resources cannot be immediately assessed. In Virginia, the early dreams of gold, silver and jewels went unrealized. Timber was extraordinarily abundant but its bulk prohibited economical transport to England. Furs were important during the first years but were only available in limited quantities. The solution to the nagging problem of finding a marketable commodity was finally discovered in 1612 when John Rolfe began experimenting with tobacco. A market already existed for this newly introduced substance in England, where it commanded high prices, and the Chesapeake climate was well suited to tobacco production (Herndon 1957). Tobacco was rapidly adapted by the colonists as a market commodity and it soon became the sole basis of the Virginia economy. From the first full cargo of 20,000 pounds shipped in 1617, production soared to over one million pounds by 1630 and reached 18 million pounds by the 1680s (Herndon 1957).

Discovery of a good market commodity, however, did not resolve the many problems of the Virginia settlement. Leadership was a recurring problem during the early decades. Agents of the Virginia Company stole company supplies and labor to amass private fortunes. As a consequence, the company saw little profit from its investment. A very high death rate was a continuing problem. After news of the 1622 Indian Massacre reached England, complaints about the Virginia Company increased to such an extent that in 1624, King James revoked the charter. He made Virginia a royal colony under the leadership of an appointed governor. This action eventually helped to improve the popular perception of Virginia, and propelled by the profits from tobacco, the colony began to grow at a rapid rate. Settlement first spread beyond the James River in the 1630s and by mid-century, English occupation was well established on every major tributary of the Chesapeake in Virginia. Jamestown remained the capital of the colony until 1699 when the goverment was moved to the healthier site of Williamsburg.

As settlement in Virginia expanded beyond the James, the second Chesapeake colony of Maryland was founded under a royal charter granted to George Calvert, the first Lord Baltimore. Maryland was to be a proprietary colony under the control of the Calvert family. The colony was established because the Calverts, who were Catholics, desired to create a refuge from the religious hostilities which pervaded England at that time. Secondly, they and other investors hoped to make large profits from the Maryland venture. Lord Baltimore planned for the colony to be based upon the English manorial system, with a hierarchical society ruled by himself and select manorial lords.

George Calvert died before the expedition could be organized, but under the direction of his son, Cecilius, approximately 150 colonists sailed from England in 1633. They reached the waters of the Chesapeake in March 1634 and explored for a suitable settlement location. Expedition leader Leonard Calvert negotiated with the local Indians and purchased land along a small stream just a few miles from the mouth of the Potomac River. There, at a place they named St.Mary's, the colony of Maryland was founded. They constructed a fort and immediately began to plant crops. It seems likly that the Calverts learned from the mistakes of the Virginia Company and they particularly sought to maintain good relations with the Indians. Because of this, the fort proved unnecessary and the colonists gradually dispersed to build houses scattered along the shores of the nearby streams.

Although Lord Baltimore had directed that the colonists develop a diversified economy and a manor-based society, neither came to be. Tobacco was too lucrative for resources to be diverted to other enterprises, and the fortunes of Maryland were soon wedded to that of the "sotweed." Ample opportunity for immigrants to acquire abundantly available land made the manorial system unworkable. Despite military and political attacks during the 1640s and 1650s by Protestant enemies of the Calverts, the colony prospered and settlement expanded from the capital of St. Mary's City at a rapid pace. Lord Baltimore was able to retain control of the colony until 1689 when a rebellion by the Protestant settlers resulted in the monarchs William and Mary making Maryland a royal colony. Shortly after this, in 1695, the capital was moved from St. Mary's City to Annapolis for political reasons as well as the more central location of Annapolis.

Geology and Geography of the Chesapeake

The region in which the first colonists settled is located along the eastern seaboard of the United States (Figure 3). The Chesapeake is within the Atlantic Coastal Plain physiographic province and the nature of its geological makeup is of significance for understanding the region. Underlying the entire Chesapeake are ancient igneous and metamorphic rock formations that slope to the east. Upon this basement of crystalline rock are several thousand feet of unconsolidated to semi-consolidated Cretaceous and Miocene sediments. These are topped with a thin mantle of Pleistocene and Holocene deposits of gravel, sand, clay and silt (Vokes and Edwards 1968).

The western edge of the coastal plain is defined by the emergence of the crystalline rock formations from beneath the thick coastal sediments. These erosion-resistant formations rise above the coastal plain, causing numerous falls or rapids where streams cross over. This junction is called

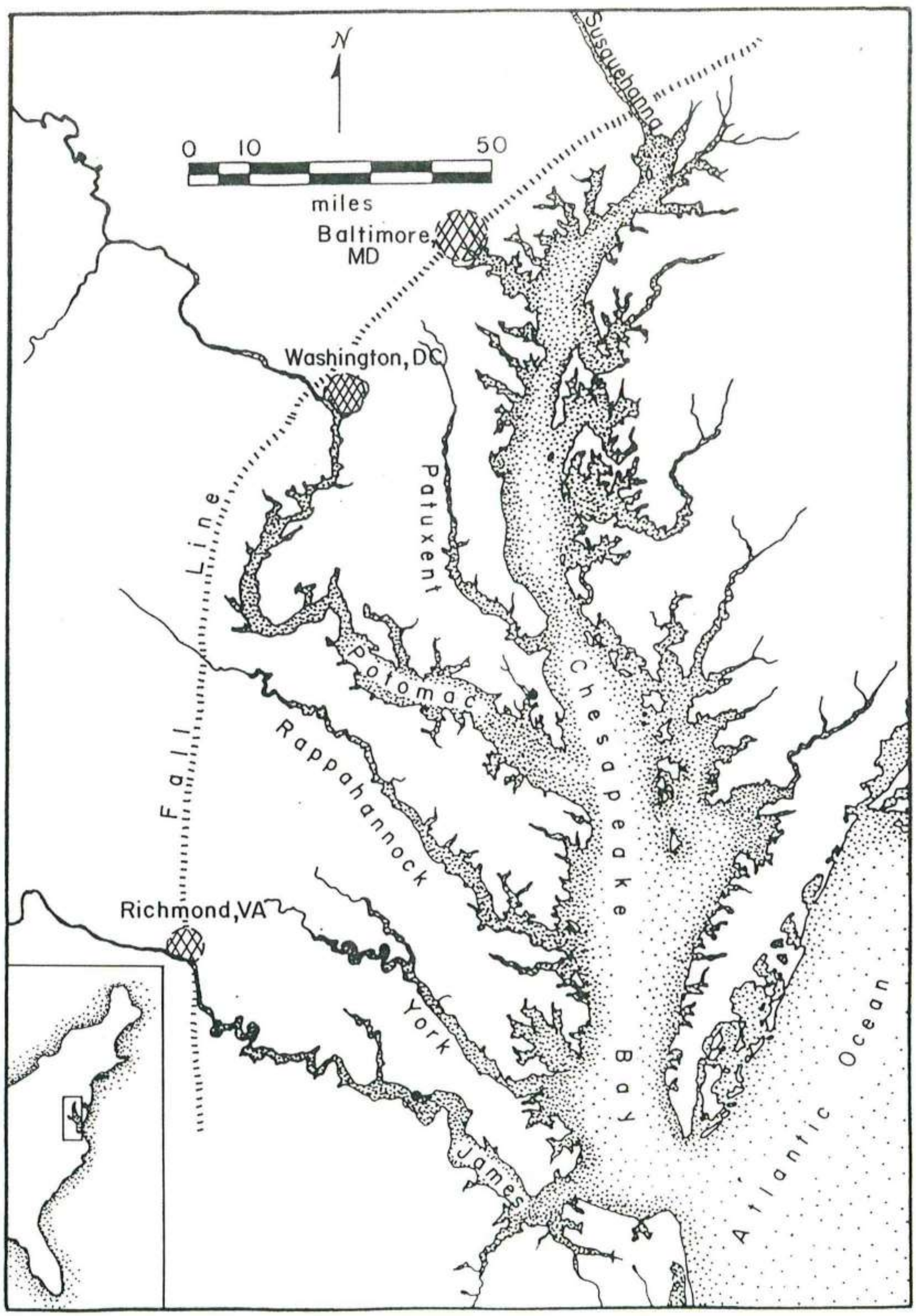

Figure 3: The Chesapeake Bay and Environs

the "fall line' and it serves as the dividing line between the Piedmont and Coastal provinces.

The coastal plain is a low, generally flat surface with elevations rarely above 300 feet. Terraces of Pleistocene age provide most of the relief and account for a division of the landscape into lowland and upland areas. The uplands are level to gently rolling tablelands, which have been highly dissected by streams. The lowland terrces are mostly level or gentle in slope, are smaller in extent, and are not as dissected by stream action (Vokes 1957; Glaser 1968).

Cutting through the coastal plain sediments are a series of innundated rivers and streams which flow into the Chesapeake Bay. The Bay is the most prominent feature of the entire region and has an important impact upon most aspects of the environment (see Figure 3). The Chesapeake is of recent origin, being formed some 10,000 years ago at the end of the Pleistocene by sea level rise. These marine waters flooded the Susquehanna River Valley and its tributaries to form one of the largest estuaries in the world, measuring 195 miles in length and averaging 15 miles in width (Hack 1957; Wolman 1968). An estuary is defined as a "semi-enclosed body of water that has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage" (Pritchard 1967:3). The Chesapeake conforms precisely with this definition since it connects at its southern end with the Atlantic Ocean, and the inflowing salt waters of the ocean are diluted by fresh waters coming from six major rivers and over 40 secondary tributaries. The major river systems lie on the western side of the Bay and are, in order from the south, the James, York, Rappahannock, Potomac, Patuxent and Susquehanna Rivers. Innundation of these river valleys has produced a body of water that extends over 2120 square miles of surface area but which is remarkably shallow, with a mean depth of the bay and its tributaries of 21.4 feet (Wolman 1968:8).

As sea level rose at the end of the Pleistocene and created larger bodies of open water, wind-produced waves along with tidal action began to erode the unconsolidated geological deposits of the coastal plain. This erosion has produced a heavily indented, sinuous shoreline with many small creeks, coves and wide bays. The shoreline length of the Bay and its tributaries in the coastal plain is over 4600 miles (Wolman 1968:8).

One major attribute of this innundated river system, of which the colonists took advantage, was that it allowed ocean going ships to travel far inland. European settlements during the 17th and early 18th Centuries concentrated along sections of the rivers that were subject to daily tidal action. This tidewater region includes large portions of Maryland, Virginia and the entire Eastern Shore. On the western side, this tidal zone extends to just below the fall line. In terms of modern geography, this is demarcated by a line through Richmond, Virginia, Washington, D.C, and Baltimore, Maryland to a point just above the mouth of the Susquehanna River. Because 17th Century settlement only occurred in the Tidewater Chesapeake, this study focuses upon that region.

Climate of the Chesapeake Region

The Chesapeake Tidewater region has a humid, temperate climate of the continental type with marked seasonal variability (Gibson 1978:2; Hall 1973). The proximity to the Atlantic Ocean and Chesapeake Bay serves to moderate winter and summer temperatures while producing high humidity during the summer (Hubbard 1941:1168). The Appalachian Mountains to the west also moderate winter temperatures by diverting major winter storms from the region.

Temperature varies in a distinct seasonal pattern with the highest temperatures in July and August and the lowest in January and February. John Smith (1907:80-84) described the climate he experienced in early 17th Century Virginia.

> The sommer is hot as in Spaine; the winter colde as in Fraunce or England. The heat of sommer is in June, Julie and August, but commonly the coole Breeses asswage the vehemencie of the heat. The chiefe of winter is halfe December, January, February, and halfe March. The colde is extreame sharpe...

Average January temperature in the Maryland Tidewater is 36°f while the Virginia average is 39°f. Temperatures may drop to as low as -15 or -18°F but these occurrences are rare. July temperatures in Maryland and Virginia average 76°f and 77°f respectively (Weeks 1941: 909; Hubbard 1941:1164). High temperatures range up to 109°f and days over 100°f are common in July and August. Monthly temperatures for various locations in the region are provided in Table 2.

Directly related to temperature is the length of the growing season, defined as the time between the last and first freezing temperatures of the year. The average length of the growing season in the Tidewater ranges from 190 days near the fall line to 230 days around the mouth of the Bay (Weeks 1941: 913; Hubbard 1941:1118; Gibson 1968).

Precipitation is one of the most crucial climatic variables since vegetation, wildlife and agricultural potential are directly linked to it. In this region, precipitation is abundant and generally distributed throughout the year with no pronounced dry or wet seasons. Average annual precipitation ranges from 39 to over 48 inches (Crockett 1974; Moyer 1974). As Table 3 illustrates, greater amounts of precipitation tend to fall in the summer than in the winter. There is considerable variation from year to year in rainfall amounts but major droughts or periods of exceptional rainfall are not common (Weeks 1941:913). Data from the central Chesapeake along the Potomac River suggest, however, that short term droughts which cause some crop losses occur about one year in three (Potter 1982:12).

Because no meteorological data from the 17th Century Chesapeake exist and there is little information from England, it is not possible to directly compare the climatic conditions in the colonization area with conditions in the homeland. Instead, reliance must tentatively be placed on modern data to gain some insight. Such reliance is not

Table 2: Average Monthly Temperatures at Various Locations in the Chesapeake (^{o}F)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	YEAR
Annapolis, Md.	36.1	36.4	43.1	53.8	64.1	73.2	77.5	76.0	69.9	59.2	48.1	36.6	56.3
Crisfield	39.3	39.9	46.5	56.9	66.9	75.3	79.4	77.0	71.1	60.2	52.1	43.2	59.1
Solomons	38.5	39.0	44.8	55.2	64.9	73.1	77.1	75.5	69.4	58.8	48.3	38.5	56.7
Washinton, D.C.	36.9	37.8	44.8	55.7	65.8	74.2	78.2	76.5	69.7	59.0	47.7	38.1	57.0
Diamond Spring, Va.	43.7	44.0	50.0	59.1	67.9	75.7	79.0	77.9	73.2	63.2	53.5	44.6	61.0
Hopewell, Va.	41.5	42.7	49.3	59.7	68.5	76.1	79.2	77.8	72.2	61.3	51.0	41.9	60.1
Norfolk, Va.	41.2	41.6	48.0	58.0	67.5	75.6	78.8	77.5	72.6	62.0	51.4	42.3	59.7
Richmond, Va.	38.7	39.9	47.7	57.1	67.0	75.1	78.1	76.8	70.2	58.7	48.5	38.7	58.1

*Data taken from Moyer (1974) and Crockett (1974)

Table 3: Average Monthly Precipitation at Various Locations in the Chesapeake (in Inches)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	YEAR
Annapolis, Md.	3.54	2.61	3.62	3.33	3.83	3.51	4.14	4.56	3.46	2.63	2.78	2.85	40.34
Crisfield, Md.	3.20	3.15	4.01	3.56	3.69	3.31	5.05	5.05	3.83	3.37	3.24	2.92	44.84
Solomons, Md.	3.58	2.59	3.61	3.50	3.76	3.45	5.57	5.00	3.59	3.11	3.33	2.97	44.22
Washington, D.C.	3.03	2.47	3.21	3.15	4.14	3.21	4.15	4.90	3.83	3.07	2.84	2.78	40.78
Diamond Spring, Va.	3.63	3.45	3.93	3.37	3.66	3.79	6.19	6.58	4.48	3.17	3.13	2.96	48.54
Hopewell, Va.	3.07	2.76	3.16	3.34	3.97	4.23	5.86	5.10	3.73	2.88	2.80	2.78	43.68
Norfolk, Va.	3.33	3.21	3.45	3.16	3.36	3.61	5.92	5.97	4.22	2.97	3.05	2.80	39.87
Richmond. Va.	3.46	2.90	3.42	3.15	3.72	3.75	5.61	5.54	3.65	3.00	3.04	2.97	44.21

*Data taken from Moyer (1974) and Crockett (1974) ideal because 17th Century conditions were apparently slightly cooler than at present (Lamb 1977:461-63), but both Europe and North America appear to have experienced these cool conditions at the same time. John Smith related that "In the yeare 1607 was an extraordinary frost in most of Europe and this frost is found as extreme in Virginia "(Smith 1907:81). Comparison of the growth rates of bristlecone pine trees in California with 17th and 18th Century temperature data from central England reveal a remarkable correspondence which suggests that the climatic shifts occurred on both continents at about the same time (Gates and Mintz 1975:152). Although the magnitude of these temperature changes cannot be determined specifically for the Chesapeake area, it is unlikely that they were much greater than corresponding changes found in England.

Comparison of modern temperatures from England and the Chesapeake is presented in Table 4 and a precipitation comparison is presented in Table 5. These comparisons indicate that the range of temperatures in the Chesapeake is greater than found in England and temperatures in the Chesapeake have more pronounced seasonal shifts. Winter temperatures differ little but summer temperatures are markedly higher. Precipitation amounts, on the other hand, are generally similar, although the pattern in which precipitation occurs is different. Peak precipitation in England is during the autumn and winter with the summer months having relatively less rain. This situation is reversed in the Chesapeake where peak rainfall occurs in the

Table 4: Comparison of Temperatures in England and the Chesapeake (^{o}F)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	YEAR
England	38.5	39.4	41.8	46.6	52.0	57.5	60.7	59.9	55.9	49.2	42.8	39.6	48.7
Chesapeake	39.5	40.1	46.7	56.9	66.5	74.7	78.4	76.8	71.0	60.3	50.0	39.5	58.5

*Data taken from Lamb (1972:525), Moyer (1974) and Crockett (1974)

Table 5: Comparison of Precipitation in England and the Chesapeake (in Inches)*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	YEAR
England	3.42	2.56	2.44	2.20	2.40	2.48	3.03	3.30	3.63	3.89	3.54	3.58	35.90
Chesapeake	3.35	2.89	3.55	3.32	3.76	3.60	5.31	5.33	3.84	3.02	3.02	2.88	43.31

*Data taken from Wallen (1970:86), Moyer (1974) and Crockett (1974) summer and the winter is somewhat drier. These findings suggest that adaptation to the Chesapeake climate probably did not require any major changes but the minor climatic differences were significant. In particular, the ecological cycles which were initially unknown to the colonists, seem to have differed from the homeland and it took time for the colonists to learn these new cycles. The Chesapeake region was notably warmer in the summer but as John Smith (1907:80) wrote "The temperature of this countrie doth agree well with English constitutions being once seasoned to the countrie".

Soils

The soils found in the Chesapeake region are highly variable due to the complex geological processes which created them. Parent materials consist of semi-consolidated and unconsolidated marine sediments that have been altered by the action of climate and vegetation. In general, it is a podzol type of earth which develops under temperate, humid climatic conditions and which is usually leached and mildly acidic in nature (Vokes 1957:149). The combination of varying parent materials, drainage conditions, erosion and alluvial deposition has produced an intricate patchwork of soil types in the region. In the uplands, soils range from sandy clay to loams of medium texture and are generally well drained except in areas where an underlying clay strata or fragipan exists (Fenneman 1938:25; Glaser 1968; Vokes and Edwards 1968). Lowland soils consist of loams, sandy loams and silt loams of light to medium texture that are mostly well drained due to the granular nature of the subsoils (Vokes and Edwards 1968; Newhouse 1980).

When the English colonists arrived in the early 1600s, most of these soils were capped with a thick layer of exceptionally fertile humus. In a description of early Maryland written in 1635 (Hall 1910:81), Jerome Hawley noted that:

> The soil generally is very rich...and in very many places you shall have two foote of blacke rich mold, wherein you shall scarce find a stone, it is like a sifted garden mould...and under that, there is found good loame....

Today, this humus cap has been removed by agriculture and erosional processes so that the soils in the region are significantly less fertile that those found by the 17th Century colonists.

Terrestrial Vegetation

A complex mosaic of plant associations and micro-environments existed in the early Chesapeake but land clearance, erosion and other factors have acted to dramatically alter these relationships in the past 300 years. For example, pine is probably much more common today than it was when the colonists arrived (Braum 1950). In spite of these changes, it is possible to recognize the major components of the earlier Chesapeake vegetation and these will be discussed here.

One of the most pronounced aspects of the early Chesapeake vegetation was the fact that a massive deciduous forest covered the land. Descriptions by the first settlers revealed something of the nature of this mature forest. John Smith related that:

> Virginia doth afford many excellent vegitable and living Creatures, yet grasse there is little or none but what groweth in lowe Marshes: for all the Countrey is overgrowne with trees....The wood that is most common is Oke and Walnut...(1907:90).

A similar picture is provided by Father Andrew White, who accompanied the first Maryland expedition in 1634. He wrote that "All is high woods except where the Indians have cleared for corn" (Hall 1910:45) and that there was:

> ....great variety of woods, not choked up with undershrubs but commonly so fare distant from each other as a coach and fower horses may travel without molestation (Hall 1910:40).

Several other colonists also commented upon the lack of thick understory growth in many areas of the forest (Morgan 1975:56-58).

The forest of the Chesapeake Tidewater region is classified as the Oak-Hickory type by Shelford (1963:56-57), but his work is based upon modern botanical research. Determining the original composition of this forest is difficult since there are no uncut stands remaining in the entire region. Fortunately, one pollen analysis of sediments from an estuarine pond in St. Mary's City, Maryland has been conducted and the results can provide some insight. This palynological record, which extends over a 5000 year period, indicates that a mixed deciduous forest with some pine covered the area during the 16th-18th Centuries (Kraft and

Brush 1981:10-11). Oak (Quercus sp.) and hickory (Carya sp.) were the most important genera with maple (Aceri sp.), birch (Betula sp.), beech (Fagus sp.), ash (Fraxinus sp.) and sweet gum (Liqudamber sp.) of secondary importance; together these genera comprised the major components of the forest. Minor components in the St. Mary's sample were chestnut (Castanea sp.), walnut (Juglans sp.), cedar (Juniperus sp.), and alder (Alnus sp.). Based upon a late 19th-early 20th Century survey of relic stands of timber (Shreve 1910) and modern vegetation in the region (Brush 1980), it is likely that the following trees were found in these early forests: white oak, black oak, post oak, southern red oak, chestnut oak, hickory, sycamore, loblolly pine, virginia pine, red maple, black gum, sweet gum, black locust, tulip popular, black walnut and persimmon.

The clear open ground under the trees noted by Father White may have been partially related to the existence of an old, mature forest setting. It is also likely that the aboriginal inhabitants contributed to this situation by periodically burning the fallen leaves, limbs and trees to drive wild animals or simply to clear out the understory to facilitate travel (Day 1954). In areas that were excessively well drained, and thus often dry, this occasional burning killed the trees along with the other undergrowth and created small grasslands known as "barrens"(Stone 1982:13). These barrens represented another environmental unit that was of considerable importance because their presence created a forest edge effect which permitted low forage plants to grow. These forage plants probably served to increase the number of deer and other animals that fed upon them (Paradiso 1969:171). Among the forest edge species were greenbriars, maple leaf, viburnum and sassafras. Other non-tree flora probably included a wide variety of thorns and haws, blackberries, strawberries, laurel, pawpaw and black cherry (Vokes 1957).

Marshes

Wetland environments were and are common in the Chesapeake region. They are produced through two processes: the innundation of land by sea level rise that creates extensive shallows areas conducive to marsh formation and the deposition of sediment from upstream land erosion. Two general types of marsh environments - inland and coastal - are created by these processes.

Inland marshes or swamps are usually exclusively fresh water. Most common is a wooded swamp that occurs along sluggish streams, on low floodplains or in poorly drained uplands (Lippson 1979:89-91). These marshes are often innundated by runoff waters during the spring and summer. Some of these are characterized by dense growths of deciduous trees including river birch, sweet gum, black gum, red maple, willow oak, and swamp oak (Chrysler 1910:163). Other swamps are more open with fewer large trees but a variety of shrubs and small trees such as dogwood, alder, black willow and small red maple (Lippson 1979:89). Less common is an inland open freshwater wetland which is found along the upper portions of streams in shallow water and above the zone of tidal action. Plants associated with this include water lilies, pondweeds, cattails and a variety of grasses (Lippson 1979: 89).

Coastal marshes tend to be larger, more common and more diverse than inland marshes; some 20 different varieties have been defined (McCormick and Somes 1982). Coastal marshes are found in large patches today, but geological evidence from southern Maryland suggests that erosion and sedimentation caused by land clearance since the 17th Century have significantly increased the size of some of these (Froomer 1980). The salinity level of the water is a primary influence upon coastal marsh vegetation. Wetland plants have varying tolerances to salt and few are physiologically adapted to high salinity. Hence, marshes are divided into fresh, slightly brackish, or brackish types.

Fresh marshes occur in generally shallow waters along creeks, rivers and bays. They typically occur in the upper portions of streams where the water is fresh to somewhat brackish. The soil remains waterlogged year-round and, at high tide, the bases of plants in them are generally covered by water (Lippson 1979:88). Plants in these marshes include a number of grasses or grass-like plants (wildrice, big cordgrass, common reed, bulrushes, cattails, threesquares), broad leaved plants (arrow-arum, spatterdock, burreeds, pickerelweed) and other types including smartweeds, rice cutgrass and rosemallow (McCormick and Somes 1982). These plants do occur in some pure stands, especially cattail and arrow-arum, but they are more commonly mixed (Lippson 1979: 88).

Brackish coastal marshes are found along the middle and lower courses of streams, rivers and coastal bays. They more often contain large stands of single species than the fresh marshes, although there is always some mixture of plant types. Most are high marshes located upon waterlogged soils which are not innundated except by unusually high tides. These marshes contain meadow cordgrass/spikegrass, needle rush, cattail, threesquares, big cordgrass, and marsh elder (McCormick and Somes 1982:25). Low marshes, on the other hand, tend to be wholly or partially innundated during daily high tides. These are typically comprised of large stands of smooth cordgrass. Water hemp is also a common component of the low brackish marsh (McCormick and Somes 1982:25; Wass 1969).

Fauna in the Chesapeake Region

In contrast to England, the Chesapeake offered a diversity of wildlife to the early colonists. Indeed, the accounts of John Smith (1907:93-95), Andrew White (1910:80-81), George Alsop (1910:346-348) and other 17th Century writers emphasized the abundance and variety in which animals could be found. The Chesapeake ecology has been significantly altered since that time and many of these animals can no longer be found in the region. Many of these now expatriated species,however, are refered to numerous times in historical accounts so that their former presence can be established. In the following sections, these species are discussed in reference to five major habitats found in the Chesapeake region: forests, transitional zones, inland swamps, coastal marshes and the aquatic environment.

Chesapeake Mammals

Wild mammals in the 17th Century Chesapeake were much more common than in Britain. From the forests, colonists obtained black bear, several types of squirrels and the opossum. Coming out of these woodlands to prey upon domestic animals were gray wolves, bobcats, and an occasional mountain lion. Along the edges of streams, in the barrens, and small meadows in the forests, and around open fields were found a few elk, white tailed deer, rabbits, woodchucks and the gray fox. The wetlands of the Chesapeake yielded beaver, mink, muskrat and otter. Most of these animals were occasionally found in the other habitats and one, the raccoon, utilized all of them (Paradiso 1969; Bailey 1946; Handley and Patton 1947; Lippson 1979). In Table 6, these animals are listed by their primary and secondary habitat preferences and their scientific names.

The colonists were unfamiliar with most of these species since England contained so few wild mammals. Although many of these creatures had been described and some were even illustrated (cf. Topsell 1607, 1658) it is unlikely that many of the colonists had any acquaintance

Table 6: Principal Mammals and their Habitat Preferences *

Animal	Forest	Transition Areas	Inland Swamps	Coastal Marshes
Black Bear (_Ursus americanus_)	X			
Flying Squirrel (_Glaucomys volans_)	X			
Gray Wolf (_Canis lupus_)	X			
Bobcat (_Lynx rufus_)	X	-		
Gray Squirrel (_Sciurus carolinensis_)	X	-		
Fox Squirrel (_Sciurus niger_)	X	X		
Mountain Lion (_Felis concolor_)	X	X	-	
Gray Fox (_Urocyon cinereoargenteus_)	-	X		
Striped Skunk (_Mephitis mephitis_)		X		
Woodchuck (_Marmota monax_)		X		
Cottontail Rabbit (_Sylvilagus floridanus_)		X	-	-
White Tailed Deer (_Odocoileus virginianus_)	-	X	-	-
Raccoon (_Procyon lotor_)	X	X	X	X
Beaver (_Castor canadensis_)	-		X	X
Mink (_Mustela vison_)			X	X
Muskrat (_Ondatra zibethicus_)			X	X
River Otter (_Lutro canadensis_)			X	X

Data is compiled from: Bailey 1946; Handley and Patton 1947; Hamilton 1963; Paradiso 1969; Lippson 1979 and McCormick and Somes 1982.

with them. Exceptions to this were deer, rabbits, and the foxes that were also found in Britain.

Chesapeake Birds

Many birds were observed by the early colonists and some of these were familiar to them while others were previously unknown. One description of the avifauna appeared in A Relation of Maryland (1635)

> Of Birds, there is the Eagle, Goshawke,Falcon, Lanner, Sparrow-hawke and Merlin, also wild Turkeys in great abundance, whereof many weigh 50 pounds and upwards; and of partridge plenty.... In Winter there is great plenty of Swanes, Cranes, Geese, Herons, Ducke, Teale, Widgeon, Brants, and Pidgeons, with other sorts, whereof there are none in England (Hall 1910:80).

Today there are over 380 bird species listed for the Chesapeake region, and there were probably more in the 17th century (Gusey 1976:15). Such a large number of species is found in the region because the Chesapeake is an important segment of the Atlantic Flyway along which millions of fowl migrate in the spring and fall of each year. The extensive marshes and estuarine resources of the Chesapeake attract many of these birds as feeding and resting grounds during their annual migrations and some species spend the winter on the bay (Stewart 1962: Lippson 1979). The principal game birds are listed in Table 7.

The largest migratory game birds are the whistling swan and canada goose, both of which tend to spend most of the winter on the bay. Many of the migratory waterfowl are ducks

Table 7: Principal Chesapeake Game Birds by Habitat Preference*

Bird	Open Estuarine Bays	Fresh Estuarine Marshes	Brackish Estuarine Marshes	Inland Swamps	Forest
Whistling Swan (*Olor columbianus*)	X				
Canvasback Duck (*Aythya valisineria*)	X				
Old Squaw (*Clangual hyemalis*)	X				
Scoter (*Melanitta perspicillata*)	X				
Brant (*Branta bernicla*)	X				
Ringneck Duck (*Aythya collaris*)	X	-			
Coot (*Fulica americana*)	X	-			
Redhead Duck (*Aythya americana*)	X		-		
Greater Scaup (*Aythya marila*)	X	-	-		
Lesser Scaup (*Aythya affinis*)	X	-	-		
Canada Goose (*Branta canadensis*)	X	X	-		
Mallard Duck (*Anas platyrhynchos*)	X	X	-		
Black Duck (*Anas rubripes*)	X	X	X	-	
Green Wing Teal (*Anas carolinensis*)		X	X		
Blue Wing Teal (*Anas discors*)		X	X		
Pintail Duck (*Anas acuta*)		X	-		
Baldpate (*Mareca americana*)		X	-	-	
Shoveler (*Spatula clypeata*)		-	X		
Gadwall (*Anas strepera*)		-	X		
Wood Duck (*Aix sponsa*)		-	-	X	
Passenger Pigeon (*Ectopistes migratorius*)					X
Bobwhite (*Colinus virginianus*)					X
Mourning Dove (*Zenaidura macroura*					X
Turkey (*Meleagris gallopavo*					X

X = Primary Habitat   - = Secondary Habitat

* Compiled From: Bailey 1913; Stewart and Robbins 1958; Stewart 1962; Meanley 1975; Lippson 1979.

and these can be divided into two general groups on the basis of feeding practices and habitat preferences. The diving ducks feed, as their name implies, by diving under the water to obtain submerged aquatic plants, insects, small molluscs and crustaceans. These birds are found primarily in deeper, open water, often a considerable distance from shore. They include the following ducks: canvasback, old squaw, several types of scoters, the ringneck, and the redhead. In contrast, the surface feeding ducks or dabblers seldom dive for food but eat what is available within 12 to 18 inches of the water's surface. As a consequence, they generally feed in shallow waters close to the shore, especially in marshy environments. Surface feeders in the Chesapeake include the mallard, black duck, baldpate, pintail, shoveler, and gadwall ducks. Blue and green winged teal also inhabit shallow waters and are primarily creatures of marsh habitats (Stewart 1962; Robbins and Velzen 1968; Lippson 1979). One extinct species which had occupied the forests and open woodlands was the passenger pigeon which traveled through the Chesapeake region primarily during the fall (Schorger 1973).

Among the avifauna that are found in the region year round are those that occupy the forests and open woodlands. Among these are the quail or bobwhite, mourning dove and the turkey. Other birds include water-related species such as the herons, bitterns, gulls, egrets, ospreys, bald eagle, red-winged hawk, several types of owls, the turkey vulture, blackbirds, woodpeckers, crows and many types of songbirds (Stewart and Robbins 1958).

Reptiles and Amphibians

A number of these creatures occur in the Chesapeake Bay region and most tend to be aquatic. The largest reptile is the atlantic loggerhead turtle that occasionally enters the Bay from the ocean during the warmer months of the year. Also found in the water as well as brackish and salt marshes is the diamond-back terrapin. In freshwater, tidal fresh and brackish rivers, streams and marshes occur a number of other turtles including the florida cooter, red bellied terrapin, snapping turtle, eastern mud turtle and the painted turtle (McCauley 1945; Schwartz 1967; Hardy 1972a; Bierly 1954). The only turtle that occupies the woodlands is the eastern box turtle.

Many snakes dwell in the Tidewater region, including the blacksnake, kingsnake, milksnake, several varieties of water snakes and the dangerous copperhead (McCauley 1945). A large variety of small amphibians also inhabit the Chesapeake region and these include small lizards and skinks, salamanders, toads and frogs (Hardy 1972b).

Aquatic Animals

The Chesapeake Bay is the most prominent natural feature of the region and its waters offered a vast profusion of fish and other creatures to the early colonists. In 1635, Maryland settler Jerome Hawley described them.

> The Sea, the Bayes of Chesopeack... and generally all the Rivers, doe abound with fish of several sorts; for many of them we have no English names: There are Whales, Sturgeons very large and good, and in great abundance; Grampuses, Porpuses, Mullets, Trouts, Soules, Place, Mackerell, Perch, Crabs, Oysters, Cockles and Mussles; But above all these,the fish that have no English names are the best (Hall 1910:80).

Modern zoological data support these observations although the quantity of fish has declined significantly since the colonial period. The most recent tabulation of Chesapeake fish counts 285 species, but many of these are infrequent transients from the Atlantic (Musick 1972). The reason for such abundance is the fact that the Chesapeake is one of the most productive estuarine systems in the world. Nutrients brought from the land by the rivers and streams support an extremely rich flora in the Bay which in turn nourishes a diversity of animals. These plants and animals are part of an extremely complex and dynamic ecosystem with many variables acting to control their distribution and abundance within the system.

The presence of an organism in a particular area of the Chesapeake is determined by many factors such as temperature, bottom sediment and water turbidity, but the most significant factor is water salinity. Within the estuary, the high salinity waters of the Atlantic are gradually diluted by fresh water flowing into the Bay from its tributary rivers. This dilution effect is observable in a salinity gradient that extends from the mouth of the Chesapeake up the rivers to a point just below the fall line. It is possible to divide this gradient into five zones based upon salt concentration: 1) Tidal Fresh waters (< 0.5 parts salt per thousand of water ("ppt")), 2) Oligohaline waters (0.5 to 5.0 ppt), 3) Low Mesohaline waters (5.0 to 10.0 ppt), 4) High Mesohaline waters (10.0 to 18.0 ppt) and 5) Polyhaline waters (18.0 to 30.0 ppt) (Lippson 1979: 14). The significance of these zones lies in the fact that organisms have varying salinity tolerances and hence, different species are found within each zone. As Figures 4 and 5 indicate, the locations of these salinity zones vary during the year, according to the quantities of fresh water flowing into the bay. Salinity is lowest in the spring when the Tidal Fresh--Oligohaline boundary may be pushed as much as 20 miles down the bay or a

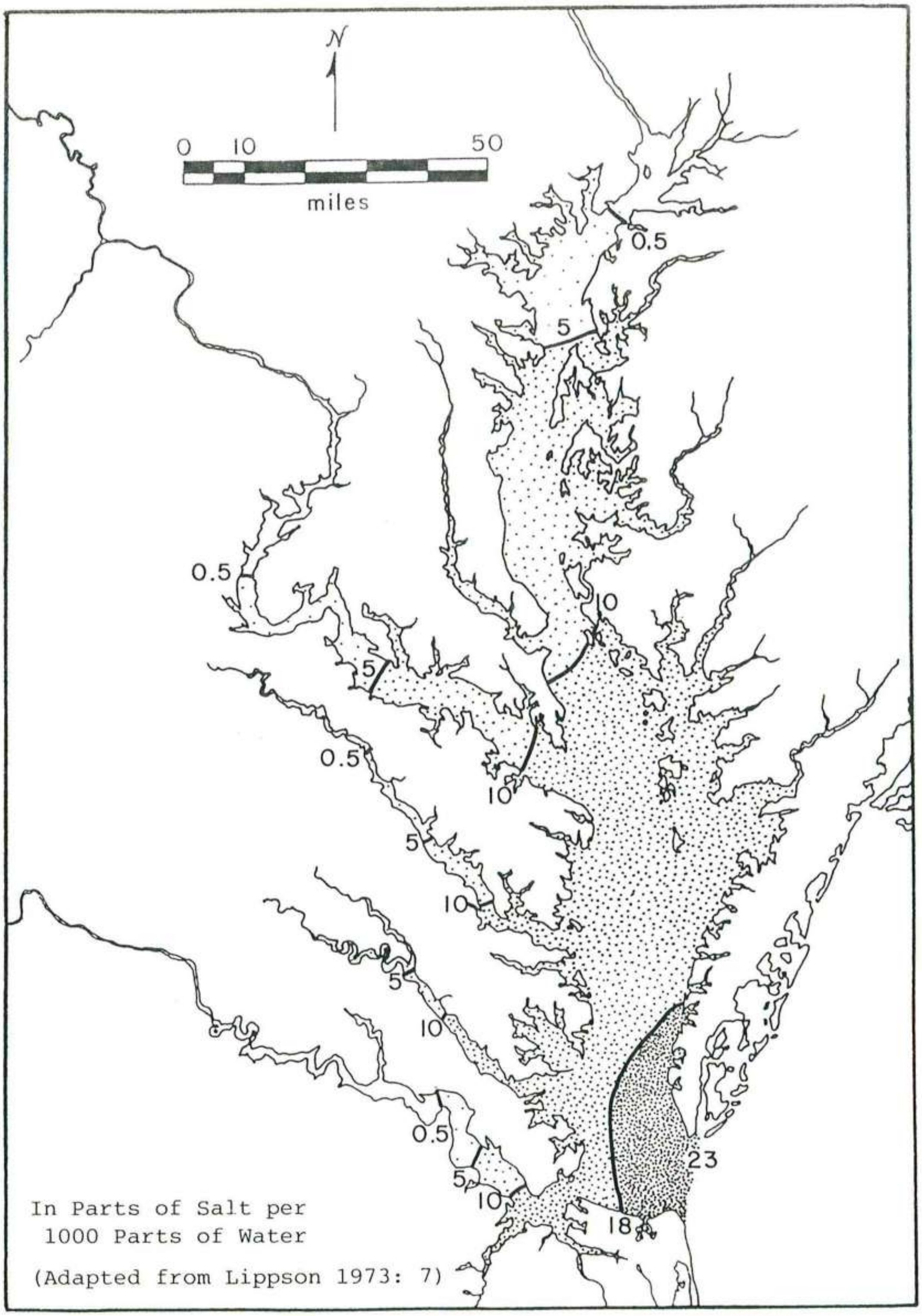

Figure 4: Chesapeake Bay Spring Surface Salinity Levels

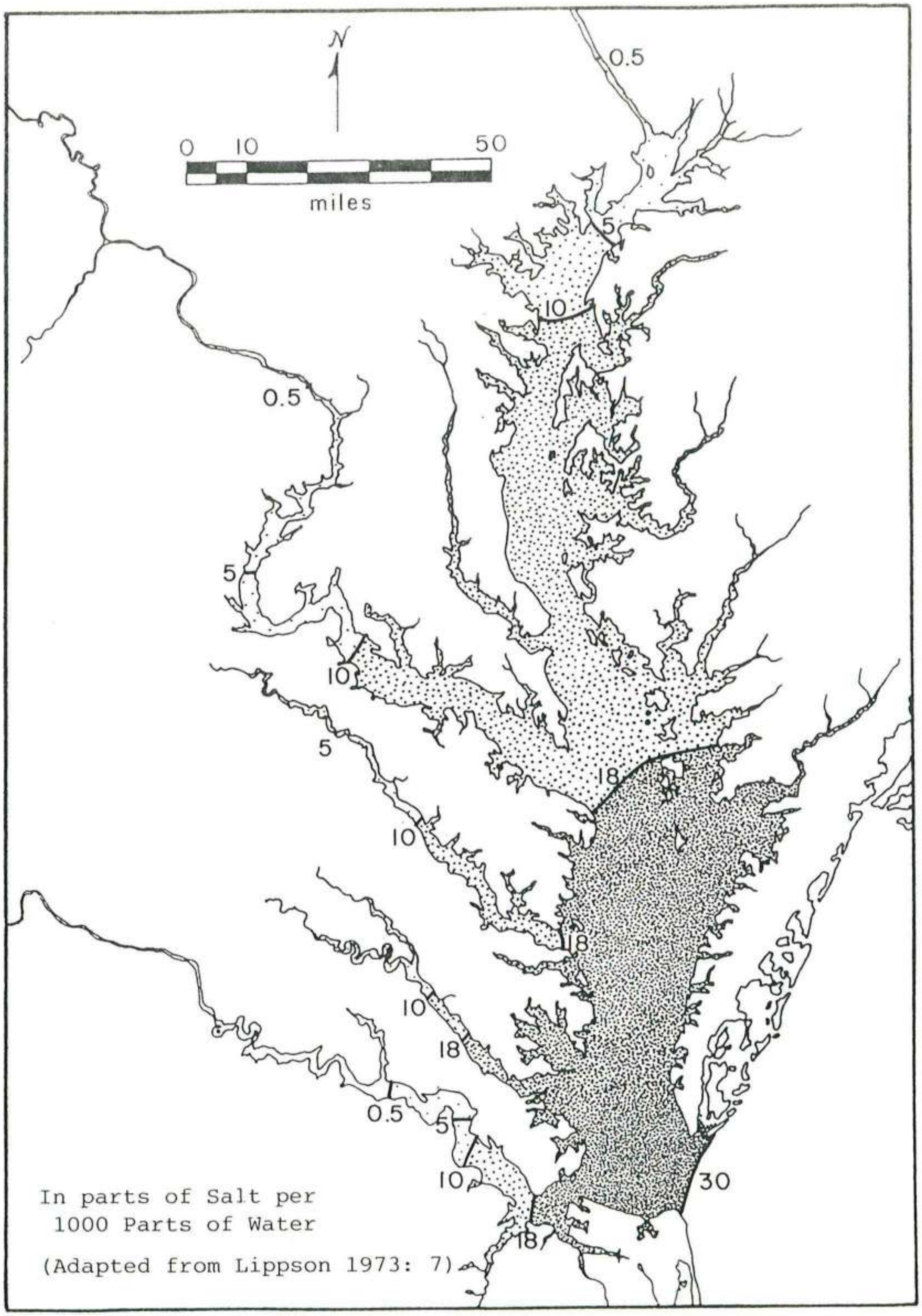

Figure 5: Chesapeake Bay Fall Surface Salinity Levels

river from its location in the fall. The highest salinities commonly occur in the fall, following dry summer conditions when the evaporation rate is high.

Temperature is the second most influential factor on Chesapeake wildlife. Water temperatures closely follow seasonal changes in air temperature because of the shallowness of the estuary and tributaries (Lippson 1979:47). Water temperture fluctuations, however, tend to be much slower and more moderate than do those of the air. Animal life cycles are closely tied to these seasonal shifts in water temperature and biological activity, including fish migrations and spawning, is regulated by it. Most animal and plant activity slows during the late autumn and many fish either migrate from the bay or move into deeper channel habitats where the water is warmer. Few aquatic animals are active during the winter. This situation comes to a sudden end in March as temperatures begin to rise. Animals leave their winter habitats, other fish enter the bay from the Atlantic, and spawning begins. Biological activity typically climbs to a peak between May and September.

Since salinity is the principal determinant of where aquatic species occur, the variable can be employed to divide the fish into groups. Freshwater fish have a limited salt tolerance but may occasionally descend into the Oligohaline zone, especially in the winter and early spring (Lippson 1979:140). Freshwater fish primarily inhabit the upper portions of rivers and streams above the tidal zone.

Spawning for these species occurs during the spring and summer months in non-tidal waters. Common freshwater species include the longnosed gar, chain pickerel, white sucker, white catfish, brown bullhead catfish, yellow perch, and the large mouth bass (Lippson 1979; Hilderbrand and Schroeder 1928).

Estuarine fish, in contrast, are adapted to the full range of salinities and can go from seawater to completely fresh water. They are most common, though, in the Oligohaline and higher salinity waters where they spawn. Most of these are small fish that provide food for predatory species (Lippson 1979:145). Species include killfishes, silversides, the bay anchovie, hogchokers, and the oyster toadfish.

During the warmer months of the year, many oceanic fish migrate into the Chesapeake. Adults occupy the Oligohaline, Mesohaline and Polyhaline zones and use the Bay as a feeding ground. Juveniles may enter the tidal fresh waters during the early stages of their growth (Lippson 1979:139). Spawning for these species either occurs in the Atlantic or in the waters near the mouth of the Bay, and the juveniles use the Chesapeake as a nursery area. Among the marine species are the atlantic menhaden, bluefish, spot, atlantic croaker, sheepshead, weakfish, spotted sea trout, red drum, black drum, kingfish, and the winter and summer flounders (Lippson 1979: 155-162; Hildebrand and Schroeder 1928).

Two additional groups found in the Chesapeake are the anadromous and semianadromous fish. Anadromous fish spend most of their lives in the Atlantic but must return to fresh water to spawn, usually in the spring. After spawning, the adults gradually return to the Atlantic after feeding in the bay for a time. Juveniles remain in the Chesapeake during the early stages of their growth. Principal species of this type are the alewife and blueback herring, the american and hickory shad, and the atlantic sturgeon (Lippson 1979:164). The semianadromous species are mostly estuarine oriented, normally reside in the Oligohaline and Mesohaline waters but have spawning behavior similar to the Anadromous fish. They move into the riverine tidal fresh and fresh waters during the spring to spawn and then return to the saltier waters. Chesapeake species are the striped bass, white perch, gizzard shad, and yellow perch (Lippson 1979:164).

Feeding habits form the basis of another important ecological distinction between fish. Some feed throughout the water column, often near the surface and are termed pelagic species. Pelagic types divide into forage fish and the predator fish that eat them; both tend to live in schools and can be frequently seen breaking the surface of the water. Principal forage fish include the killfish, silverside, bay anchovie and atlantic menhaden, while their predators include bluefish, striped bass (when young), white perch, weakfish, and spotted seatrout (See Table 8).

Benthic species are oriented toward the bottom of the estuary. These types are more common and include the white

Table 8 : Distribution of Major Pelagic Fish by Salinity Zone

Species	Tidal Fresh	Oligo-Haline	Low Meso-Haline	High Meso-Haline	Poly-Haline
Longnosed Gar (*Lepisosteus osseus*)	X	-			
Largemouth Bass (*Micropterus salmoides*)	X	-			
Pickerel (*Esox niger*)	X	-			
Yellow Perch (*Perca flavescens*)	X	-			
Bay Anchovie (*Anchoa mitchilli*)	X	X	X	X	X
Atlantic Menhaden (*Brevoortia tyrannus*)	X	X	X	X	X
Silversides (*Menidia* sp.)	-	X	X	X	X
Herrings (*Alosa* sp.)	-	X	X	X	X
American Shad (*Alosa sapidissima*)	-	X	X	X	X
Striped Bass (*Morone saxatilis*)	-	X	X	X	X
White Perch (*Morone americana*)	-	X	X	X	X
Blue Fish (*Pomatomus saltatrix*)		-	X	X	X
Kingfish (*Menticirrhus* sp.)			-	X	X
Weakfish (*Cynoscion regalis*)			-	X	X
Spotted Sea Trout (*Cynoscion nebulosus*)			-	X	X

X = Primary Habitat - = Secondary Habitat

Data Compiled From: Hildebrand and Schroeder 1928; Schwartz 1960, 1962, 1964; Lippson 1979.

Table 9 : Distribution of Major Bottom-Oriented Fish and Shellfish

Species	Tidal Fresh	Oligo-Haline	Low Meso-Haline	High Meso-Haline	Poly-Haline
Brown Bullhead (Ictalurus nebulosus)	X	X			
White Catfish (Ictalurus catus)	X	X			
White Sucker (Catostomus commersoni)	X	X			
Gizzard Shad (Dorosoma cepedianum)	X	X	X	-	
Hogchoker (Trinectes maculatus)	X	X	X	X	X
Sturgeon (Acipenser oxyrhynchus)	-	X	X	X	X
Oyster Toadfish (Opsanus tau)		X	X	X	X
Spot (Leiostomus xanthurus)		-	X	X	X
Atlantic Croaker (Micropogon undulatus)		-	X	X	X
Spadefish (Chaetodipterus faber)			X	X	X
Sheepshead (Archosargus probatocephalus)			X	X	X
Winter Flounder (Pseudpleuroneccetes americanus)			X	X	X
Summer Flounder (Paralichthys dentatus)			-	X	X
Black Drum (Pogonias cromis)			-	X	X
Red Drum (Scianops ocellata)				X	X
American Oyster (Crassostrea virginica)			X	X	X
Soft-shell Clam (Mya arenaria)			-	X	X
Quahog Clam (Mercenaria mercenaria)				-	X

X = Primary Habitat — - = Secondary Habitat

Data Compiled From: Hildebrand and Schroeder 1928; Richards 1973; Schwartz 1960, 1962, 1964; Lippson 1972, 1979.

sucker, catfish, oyster toadfish, hogchoker, spot, atlantic croaker, sheepshead, red drum, black drum, winter and summer flounders and the sturgeon. These fish eat the many benthic invertebrates such as crustaceans, worms and molluscs (Hildebrand and Schroeder 1928; Lippson 1979). Tables 8 and 9 present the distributions of pelagic and benthic species by salinity zones along with the scientific names for each.

Besides fish, the Chesapeake contains a variety of molluscs and crustaceans which the colonists noted in their descriptions. Molluscs include the American oyster, hard clam, and the softshell clam. The largest crustaceans are the blue crab, which is especially prolific in the Chesapeake, and the horseshoe crab.

These then were the chief resources available to the newly arrived settlers. While some of the species resembled European varieties sufficiently for the colonists to recognize them, most were unknown. Aside from these new animals, one of the most striking differences between the Chesapeake and Britain was the sheer abundance of wildlife available. How the colonists utilized these resources will be investigated in a later chapter, but first there remains one final element in the Chesapeake environment that has not yet been considered -- the aboriginal peoples.

The Chesapeake Indians

When the colonists arrived in the Bay, they found the land sparsely occupied by Algonquian-speaking Indians. Native peoples are of significance in this study of colonization for two major reasons. First, they were a potential threat to the colonies existence, a menace that became a reality during the "1622 Massacre". The threat alone of hostile action may have limited or precluded the use of certain subsistence resources by the colonists. Second, the Indians had developed an efficient adaptation to the Chesapeake environment and their expertise regarding this natural environment was of great potential value to the colonists trying to cope with it for the first time. These Indians were a subject of interest to a number of the colonists who left a small but detailed body of ethnohistoric data which is of great use in understanding their culture. This record has been thoroughly described and studied by several scholars (McCary 1957; Garrow 1974; Turner 1976; Fausz 1977; Feest 1978; Potter 1982) and will not be repeated in great detail here. Instead, a brief summary of the more relevant facts concerning Tidewater Algonquian settlement and subsistence will be provided.

The Indian population of the Tidewater Chesapeake at the beginning of European settlement has been estimated at between 20 and 25,000 individuals (Feest 1973). Dispersed village settlements, scattered along the rivers and streams of the Chesapeake characterized the region. The most distinctive feature of the political organization of the Virginia Tidewater Indians was a chiefdom that encompassed the James and York Rivers and probably the Rappahannock (Turner 1976; Potter 1982). This chiefdom, often incorrectly referred to as a "confederacy," was controlled by Powhatan.

Under him were district chiefs known as "werowances" who ruled local populations, paid tribute to Powhatan and supplied him with warriors. Along the Potomac River in Maryland, the various Algonquian-speaking groups were united under an entity known as the "Conoy". This was probably another chiefdom, although much smaller than that of Powhatan (Potter 1982: 45-46). The major chief of this group was called a "tayac" while the less powerful district chiefs were "wizoes".

In spite of political differences, the Indians of Maryland and Virginia appear to have been quite similar in most respects. All lived either in villages where the Werowance or Wizoes resided or in smaller hamlets. According to John Smith (1907:101), settlement sizes ranged from two to 100 houses. Domestic structures were longhouses which were not tightly grouped together except in fortified villages. Historical and archaeological evidence indicates that these villages were located near streams and rivers, on high ground with freshwater springs and marshland in the vicinity, and next to or upon lands of good agricultural potential (Turner 1976:137-138).

The subsistence system of the Chesapeake Tidewater Algonquians was complex and based upon the utilization of a variety of plants and animals. Domesticated plants, which occupied a major role in the diet, included corn or "maize," beans, squash, pumpkins, gourds and sunflowers. Maize was probably the most important crop (Garrow 1974; Feest

1978:258). Turner (1976:182-185) has argued that corn contributed fifty percent or more of the Indians' annual diet. These plants were produced through slash-and-burn cultivation methods. Trees were girdled near their bases by removing the bark. Later the ground was burned to clear it of leaves, brush and dead wood. The soil was broken up with wooden hoes and the seeds planted with digging sticks in April, May and June. Corn and beans were often planted together in fields that reportedly ranged in size from 20 to 200 acres (Smith 1907:95-96), while the other crops were grown in smaller gardens.

The seasonal cycle of subsistence incorporated many wild plants and animals. During the early spring, anadromous fish, turkeys, some deer, oysters, nuts and acorns were prominent in the diet. Corn and beans stored from the previous season were probably still consumed although those supplies may have been low. In May and June, many wild berries such as strawberries and mulberries ripened and were added to the diet (Smith 1907: 102; Garrow 1974). The summer diet consisted of many kinds of fish, deer, turkeys, crabs, green corn, nuts, a starchy tuber called tocknough, and berries. In the late summer, squash and other garden crops ripened. Harvest of the major crops began in September and continued to November, which was the principal period of feasting and population aggregation. The diet during this period included corn and beans, waterfowl, acorns, nuts, deer and some fish (Garrow 1974:22-26). In the late fall and winter, hunting expeditions went up rivers to the inland areas where major deer drives, often using fire, were conducted. In addition to many deer, some bear and smaller mammals were killed in these drives. Corn and beans continued to be eaten during the winter along with occasional turkeys and waterfowl (Garrow 1974:22-26; Potter 1982:79-82).

Deer and fish were extremely important to the Indians and a number of methods were employed to obtain them. Deer were taken by stalking, deadfalls, drives and fire surrounds. Fishing was conducted using weirs, nets, hook and line, bow and arrrow, and spears. It appears that the natives primarily utilized the anadromous species, non-migratory Bay fish and the marine species (Smith 1907:103).

Two Indian activites proved especially fortuitous for the colonists. The Indian practice of establishing villages, clearing fields, and then moving to a new location as the soils became exhausted or weed infested created openings in the forest. These "old Indian fields" were the focus of early colonial settlement wherever they existed (Pory 1907:283; Stone 1982; Stephen Potter: Personal Communication 1983). They provided a cleared area upon which buildings could be easily constructed and the first season's crops planted, thereby reducing to some extent the labor required in beginning a plantation. In addition, these abandoned fields created a forest edge effect that allowed a variety of browse plants to grow. This increased the preferred food supply of the White Tailed Deer and may have served to increase the abundance of this animal.

More widespread, and probably of even greater significance, was the aboriginal practice of burning to drive game or clear the forest floor. Several early writers commented upon the open nature of the forest floor (Smith 1907; Hall 1910:40, 79). The ecological effect of this burning, as noted by Day (1954) and Paradiso (1969), would have been to greatly enlarge the edge environment, thereby tending to increase the number of edge animals such as deer. Cronon (1983) has found that the forests of New England were heavily modified by this practice and it is probable that the Chesapeake forests were similarly modified. Hence, the colonists seem to have entered a woodland environment that was not completely "primeval", but which had been purposefully altered and was probably richer in potential food resources than it would have been otherwise.

Summary

This chapter has considered the nature of the Chesapeake environment and the plant and animal resources it offered to the colonists. How different was this from their homeland of Britain? In general, the Chesapeake shares many attributes of the British climate. Both are temperate climates with similar amounts of precipitation, although the Chesapeake temperatures in the summer were markedly warmer. The British were accustomed to deciduous forests, even though their woodlands were open and not directly comparable to the mature forests of the Chesapeake. Many of the plants and animals were sufficiently similar to British types for the first settlers to recognize them. Migratory waterfowl also visited the shores of Britain during the spring and fall of the year and portions of the Thames and other rivers were estuarine.

With these characteristics, however, the similarities end. The ecological cycles seem to have been different in such features as rainfall patterns. As noted in Chapter 2, most of Britain was pastoral or agrarian with only a few remnant woodlands of large size. Although the data are scant, it is likely that most of the Chesapeake settlers came from these pastoral or agricultural areas (Horn 1979). Grappling with a thick, mature forest such as covered the Chesapeake lands was almost certainly beyond the experience of most of the colonists. The wide diversity of wild animals in the Chesapeake was an even greater contrast from their homeland, since only a few varieties of land animals existed in Britain. The most striking differences for the new settlers, however were probably the unaccustomed abundance of resources and the presence of an alien human culure within the area being settled.

In some aspects the Chesapeake was not a completely unfamiliar, unknown setting for the colonists. A number of similarities in general aspects of the environment probably permitted some traditional English practices to be applied. There was, however, a greater number of differences that required new approaches. With these differences and similarities firmly in mind, attention will now be turned to the colonial society which evolved in this new environment.

CHAPTER 4

17TH CENTURY CHESAPEAKE SOCIETY AND THE COLONIZATION PROCESS

The previous section discussed the physical aspects of the Chesapeake area but not the society created by the colonists adapting to it. In this chapter, the major characteristics of colonial Chesapeake society and the trends of change it experienced will be set forth. An attempt will be made to determine whether these characteristics and changes correlate with the colonization model presented in Chapter 1.

Although the broad outlines of Chesapeake history have long been known, it is only within the past two decades that systematic research by archaeologists and historians has explored the evolution of these colonies in an attempt to understand them in a holistic manner. Archaeological excavations, which began with the work at Jamestown and St. Mary's City (Forman 1938; Cotter 1958), have increased in both number and scale since 1970 and are beginning to provide a new perspective on colonization in the region (cf. Carson 1981). During the late 1960s, historical study of the Chesapeake underwent a renaissance and major new investigations have been conducted into the nature of economy and society in the 17th Century colonies (Tate 1979). Utilizing the fragmentary documentary record, historians have now identified the salient characteristics of the Chesapeake frontier, thereby providing a firm basis of knowledge upon which to build this study.

Besides enhancing our understanding of colonial history, these recent findings are important because they permit the applicability of the colonization model to the Chesapeake to be assessed. In an earlier study, Lewis (1975) investigated the colonization process with data from Jamestown and concluded that a "frontier model" did apply. However, his study was hampered by insufficient and unreliable data and a vast quantity of new information has become available since then. Therefore, it seems appropriate to review the salient characteristics of the 17th Century Chesapeake in light of the colonization model presented earlier.

17th Century Settlement Patterns

One of the most distinctive features of the early Chesapeake in the eyes of contemporaries was the almost complete absence of towns or villages and the highly dispersed nature of settlement. This stood in marked contrast to much of contemporary Britain and Europe where population concentration in villages and towns was the norm (Blum 1982). Only two settlements of any size existed in the region, the colonial capitals of Jamestown in Virginia and St. Mary's City in Maryland. In terms of the colonization model, both can be classified as frontier towns, even though they were not centers of economic activity. At its peak, Jamestown had a permanent population of perhaps 500 people while St. Mary's City had about 200 residents (Carr 1974: 128). For comparison, the average population of English villages during this time has been estimated at 200 (Blum 1982:13). Both St. Mary's City and Jamestown were primarily political and administrative centers with relatively minor economic roles (Carr 1974).

Most of the colonists lived on isolated farms or "plantations" scattered along the shores of the Tidewater streams. These plantations were generally not huge estates but small farms of a few hundred acres or less, which were typically occupied by the owner. In Maryland, land holdings generally ranged between 50 and 250 acres (Wyckoff 1937), although much larger estates of thousands of acres did exist. In Surry County, Virginia, estates of less than 500 acres were the most common throughout the 17th Century (Kelly 1972:130). The dispersed nature of the plantations and their proximity to the water was noted by several contemporary observers. One Virginia reference of 1649 noted that:

> They have in the colony Pinnances, Barkes great and small boats many hundreds, for most of their Plantations stand upon River sides or up little creeks, and but a small way into the land so that for transportation and fishing they use many boats (Wodenth 1947:6).

A 1678 description of the Maryland settlements by Governor Charles Calvert revealed the same coastal orientation and dispersed nature of the plantations:

> The people there not affecting to build nere each other But soe as to have their houses nere the Watters for convenience of trade and their lands on each Syde of and behynde their houses by which it happens that in most places there are not fifty houses in the space of Thirty miles (Archives of Maryland 5:266).

The earliest cartographic evidence of the Chesapeake settlement system is a remarkable map drawn by Augustine Herman in 1670. The map illustrated the entire Chesapeake Bay region with exceptional detail and clearly indicated houses scattered along the shores of rivers and creeks. A portion of this extraordinary document, showing "St. Mary's" in the upper right hand corner, is presented in Figure 6. A study of the 2586 houses illustrated on this map revealed that they were nearly equally distributed along rivers (46.9%) and creeks (45.2%) with only 8% found on the Chesapeake Bay proper (Smolek and Clark 1982).

Archaeological research has recently confirmed the accuracy of this map and indicated other characteristics of the settlement pattern. A survey of all known 17th Century sites in the Bay region revealed that the typical site location is remarkably close to navigable water. For Virginia, half of all the sites are within 500 feet of the modern shoreline and only 1% occur a mile or more away from water. Maryland sites display a similar pattern with 43% within 500 feet of the shore. Confirmed sites in Virginia number 182 and there are 37 sites in Maryland (Smolek and Clark 1982).

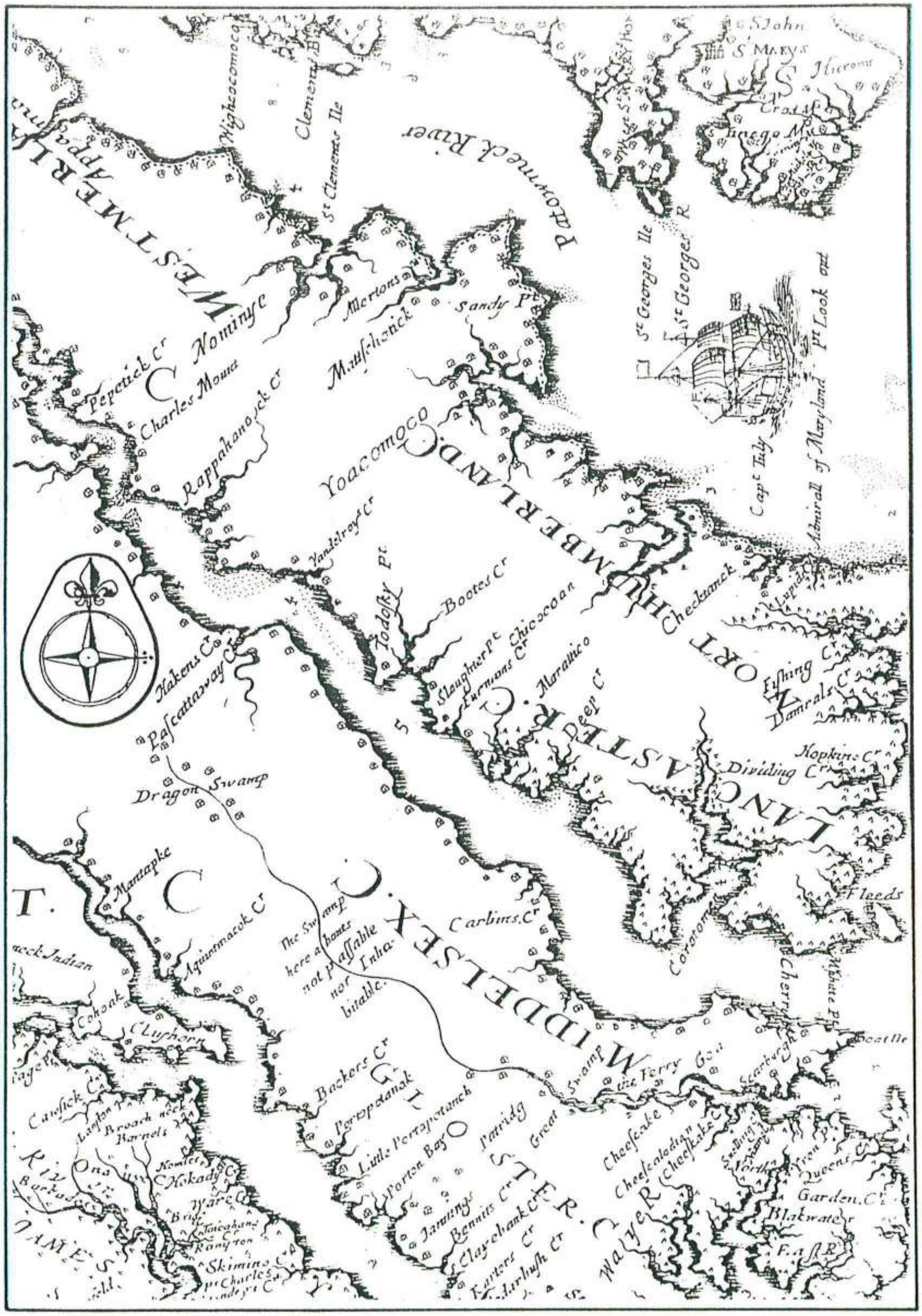

Figure 6: Portion of Augustine Herman's 1670 Map of Chesapeake Bay

Why did the Chesapeake settlement system develop in this dispersed pattern and why were there so few towns? The colonization model predicts that dispersed settlements should occur on a frontier, especially during the early phases, but villages and towns are also expected to develop. In the Chesapeake, this process of settlement evolution seems to have been retarded; towns did not prosper until the 18th Century (Reps 1972). Two principal factors served to intensify the dispersed settlement pattern and deter town formation -- the geography of the Chesapeake and the tobacco economy. The Chesapeake is perhaps the largest natural harbor in the world and virtually every portion of the Tidewater region lies within easy access of navigable water. The fact that this excellent natural transportation system had an influence upon settlement location was recognized by the colonists themselves. Robert Beverley, a native born Virginian, wrote in 1705 that the dispersed settlement pattern was due to:

> The ambition that each man had of being Lord of a vast, tho' unimproved territory, together with the Advantage of the many Rivers, which afford a commodious Road for Shipping at every man's Door (1947:57).

Further enhancing the value of the water routes to Chesapeake planters was a landscape dissected by numerous creeks and marshes which made land travel difficult, especially given the poorly developed road network and small number of bridges. The fact that tobacco was a bulky crop vulnerable to damage during land transportation made water conveyance even more desirable (Menard 1975:61).

Partially due to the availability of this water transportation, a decentralized marketing system developed which alleviated the need for commercial establishments. Each year European ships, or smaller vessels, came to each individual plantation to collect the annual tobacco crop in exchange for merchandise, thereby giving practically every planter equal access to the European market. A few local merchants did attempt to collect some tobacco in central locations, and any planter living away from the water had to arrange for the transportation of his crop, often through one of these merchants. Most trade, however, occurred directly between an English merchant's agent, often the ship's captain, and the planter, thus obviating the need for a middlemen (Carr 1974).

With such a marketing system, and the relatively small amounts of capital available in the Chesapeake, there were few stores where goods could be purchased. A planter's needs for manufactured goods and other merchandise were met by ships sailing directly from Europe and consequently there was little local manufacturing which might have contributed to town development. Few specialized craftsmen worked in the Chesapeake economy. The only commonly found craftsmen were joiners, carpenters, and housewrights, who constructed homes and tobacco barns, along with coopers who produced the large wooden barrels called hogsheads in which tobacco was shipped. Such a situation fits precisely with the frontier characteristic of cultural simplification.

Tobacco and the Chesapeake Economy

Tobacco not only influenced the settlement system, but it had a profound effect upon most other aspects of 17th Century Chesapeake life. Tobacco was so much the mainstay of the economy that the region was called the "Tobacco Coast". Tobacco was an attractive crop to the colonists for several reasons. Initially, it brought high prices. During the early years of commercial production, one man's efforts with tobacco returned about six times more profit than could be obtained from wheat (Herndon 1957:3). Little equipment was necessary to grow, harvest, or process the crop, so that capital outlay for materials was low. It gave a high yield per acre, an important point because the labor costs of land clearance were high. The Chesapeake climate was well suited to its production with sufficient rainfall and proper temperatures. Tobacco was not so bulky that shipping costs were prohibitive. Finally, a rapidly expanding market for the crop existed in Europe.

Dependence upon a single crop as the foundation of the economy had a major drawback, however, since any variation in price on the European markets had an immediate and direct impact upon the entire Chesapeake economy. Besides the normal agrarian risks of drought and storms, the tobacco planter's economic welfare was highly susceptible to downturns in European economic activity, saturation of the market due to overproduction and international conflicts which disrupted trade. The overall trend in tobacco prices throughout the 17th Century was downward, but the prices moved in a distinct cyclical pattern (Menard 1975:280). From the first tremendous boom around 1620, the Chesapeake economy experienced recurring periods of prosperity and depression at regular intervals of approximately 22 years between boom times. Prosperity occurred in the mid-1630s, mid-1650s, the late 1670s, around 1700, and about 1720 (Menard 1975:310-312). During the depressions, attempts were made to limit production so as to reduce the supply and thereby increase prices, but these attempts failed each time. Planters generally responded by producing more tobacco in an attempt to keep their incomes from falling, thereby pumping still more tobacco into an already saturated market (Menard 1975: 290). Half-hearted attempts to diversify the economy were made during the depressions but for most of the century, these efforts failed; as soon as prices rose, planters returned to tobacco. From a careful study of the timing of these changes in price, Menard (1975) has been able to demonstrate significant correlations between tobacco profits and other aspects of the colonial society such as labor supply, availability of capital and credit, and land acquisition rates. Clearly the pulse of Chesapeake society was controlled in large measure by the price of tobacco.

The agricultural approach used in tobacco production was a long term fallow system of shifting cultivation. Since tobacco rapidly depletes the soil by heavy consumption of nitrogen and potash, it could only be grown for three or four years on a plot before the land became exhausted (Craven

1926:32). Alternatives such as manuring were known but cow dung was thought to impart a strong taste to the tobacco that smokers found unpleasant. Thus, a large quantity of land was necessary to grow tobacco and this was readily available in the Chesapeake. After a field had been depleted from growing the "sotweed", good corn crops could be obtained from it for another year or two, and after that, the land was abandoned for a period of 15 to 20 years. This fallow time permitted replenishment of the soil's fertility and it could once again produce good crops of tobacco (Earle 1975:25). One effect of using an agricultural system which required large amounts of land was that the distances between individual plantations tended to be necessarily large, thus accentuating and prolonging the pattern of dispersed settlement.

As might be expected, the annual cycle of activities was dominated by the requirements of tobacco production (cf. Herndon 1957; Clayton 1965; Earle 1975). The cycle began in February or March when a seed bed was prepared in which to start the plants. At the same time, work began to prepare new land and the already established fields for planting. Slash-and-burn agriculture was employed to clear the largely deciduous forest. The colonists probably adopted the method from the local Indians. Girdling the trees and later burning the fallen leaves and undergrowth served to clear the land as well as to release nutrients into the soil. Ground was broken up and worked with hoes almost exclusively (Earle 1975:27-28), so that the only essential tools needed for growing tobacco were hoes and an axe. Plows were seldom used because of the many tree stumps. Since only five or six years worth of crops could be expected from any plot of land, there was insufficient time for the stumps to rot, and the short production period did not warrant the expenditure of labor to remove them.

Transplanting of the small tobacco plants from the seed bed occurred in May when they were placed into small "hills" spaced approximately four feet apart. During the summer months, repeated cultivation and inspection of the plants was necessary to control weeds and tobacco worm infestations. By July or early August, the upper portions of the plants needed to be broken off or "topped" so that seeds would not form, and the large bottom or ground leaves were removed. These actions caused the plant to put energy into leaf production, thereby giving a better yield.

By the end of the summer, the tobacco was ready to harvest. This entailed the severing of each plant at its base, carrying the plants to a barn where the plants were attached to long stick, and then hanging these sticks in the barn to allow the tobacco to slowly air cure. Curing normally took until late October or early November when the tobacco was taken down, and the leaves were stripped from the stalks and packed into large wooden hogsheads for shipment. These operations were timed for completion by late November or early December when the ships of the "tobacco fleet" arrived to collect the year's crop.

What is particularly relevant in the above discussion is the fact that tobacco production required a great deal of attention throughout most of the year and was an extremely labor intensive crop. Productivity per worker varied according to soil conditions, weather, and the methods used, but a crop of 1500 pounds per worker was considered typical by the second half of the 17th Century (Menard 1975:320; Morgan 1975:143). This meant that each laborer had to plant, cultivate, inspect, top, and harvest over 10,000 individual plants. In addition, the same worker was expected to plant, tend, and harvest several acres of corn and beans.

Immigration and the Labor Supply

When dependence upon a very labor intensive crop is combined with the tremendous effort needed to clear a wilderness and establish a new society, it follows that a labor shortage would occur. The Chesapeake colonies experienced such a shortage throughout most of the 17th Century (Menard 1975:90), exactly as predicted by the colonization model. Labor costs were sharply higher than in Britain, and wages in the Chesapeake were sometimes so high, they nearly equaled what a worker could be expected to produce (Carr and Menard 1979:213). One example of the central role of labor comes from Surry County, Virginia. In that county during the 1680s, it has been estimated that nearly 90% of the total investment in tobacco production was for labor (Kelly 1972:213). With land easily available, and minimal equipment needed to raise tobacco, control of a supply of labor was the key to economic success and the real measure of wealth in the Chesapeake colonies.

Where did the planters obtain these workers? Most of the laborers in the 17th Century were English indentured servants. These individuals agreed to work for a specified period of years, usually four or five, in exchange for their passage to the New World. Of the estimated 150,000 persons who immigrated to the Chesapeake colonies in the 1600s, between 70% and 85% arrived as servants (Menard 1975:162; Horn 1979:51-54). Some individuals were able to pay their own passage and arrived as free men, but most immigrants had to spend their first years toiling for a planter who took all profits of the servants' labor. Families also came to the Chesapeake, but their numbers were quite small when compared to the number of single immigrants.

Much research has been directed toward determining the origins and character of these servants (Campbell 1959; Menard 1977a; Salerno 1979; Galenson 1978; Horn 1979), which has revealed that they came from all portions of England and Wales, and a few from Scotland and Ireland. Throughout the century, the ports of London and Bristol were responsible for the bulk of the servant trade. Liverpool became important only during the final decades of the century. Lists of servants sailing from these ports constitute the best information available regarding their origins, occupations, and social backgrounds. Although they came from all portions of Britain, the vast majority of the emmigrants originated in the southeastern sections of England, near London, and in the

West country, especially the area surrounding Bristol (Horn 1979:66). The Bristol and Liverpool lists indicate that nearly half of the immigrants came from villages, one quarter to one third from small market towns, and the remainder originated in larger urban communities (Horn 1979:68).

The social origin of these servant immigrants has been the subject of debate, but it is now agreed that most were "commoners" -- the offspring of yeomen farmers, tradesmen, small merchants -- not paupers, convicts, or vagabounds from the lowest stratum of English society (Campbell 1959; Galenson 1978). One of the few measures of immigrant status comes from the occupations of the immigrants listed in the port books of Bristol and London. The trades of many are not listed and it has been suggested that up to half were only semi-skilled or unskilled workers (Galenson 1978:502). The remainder had a wide diversity of occupations with some 66 different trades listed in one register alone. A majority had agricultural backgrounds (46.9%), but a significant number were skilled in textile manufacture (14.5%) and other trades such as leatherworking, construction, and metalworking. Fewer immigrants who embarked from London had agricultural backgrounds but they displayed a like diversity of trades.

Most of the immigrants from English ports were young, single adults. Between 70% and 80% of them were less than 25 years of age (Horn 1979:62). In addition, the population displayed a pronounced sexual imbalance, with males greatly predominant. The proportion of male to female servants was as high as 6:1 in 1635 and remained at 3:1 or slightly less until the end of the century (Menard 1975:194). While a population skewed toward young males is typical of frontiers, it is likely that the tobacco economy intensified and prolonged this general tendency. Young males were considered capable of greatest productivity in the tobacco fields, and consequently English merchants and ship captains emphasized recruitment of them (Horn 1979:63).

Recruiting servants was relatively easy during the first three quarters of the 17th Century, due to several factors. During the first half of the century, England experienced a high rate of population growth while a recurring series of crop failures took place (Craven 1971:20). These events produced a sharp rise in food prices and a fall in the purchasing power of wages. Unemployment significantly increased due to increased population, the enclosure movement, and a major depression in one of England's prime industries -- textile production (Horn 1979:75; Salerno 1979). All of these factors worked in unison to propel a stream of migrants to the Chesapeake colonies in search of better opportunities. While religious and political persecution helped swell the stream of immigrants, and specific individual factors, such as the loss of support through the death of parents, or escaping prosecution for a crime also contributed to the peopling of the colonies, lack of economic opportunity was the primary motivating factor.

Population growth slowed and the English economy improved in the mid-17th Century, thereby reducing the unemployment problem. Consequently, fewer individuals were willing to emigrate from England. At the same time, there was a constantly increasing demand for more labor in the Chesapeake as 1) indentured servants were freed and replacements were sought, and 2) Freedmen (ex-servants) established plantations of their own and sought their own servants. The founding of new colonies in the Carolinas and Pennsylvania intensified this problem by siphoning off a significant portion of the servants that were available. The combined outcome of these factors was a sharp reduction in the availability of servants from the middling ranks of English society after about 1670 (Menard 1977b:344).

This problem became acute after 1680 and in response, recruiters began sending servants of a strikingly different social origin -- the poor, the Irish, and convicts -- to meet the planters' labor needs. These efforts were not totally successful, however, and the planters began turning to African slaves for labor. Menard (1975, 1977b) has presented a convincing argument that this severe labor problem accounted for the adoption of slavery in the Chesapeake. Beginning about 1680, the small population of slaves expanded dramatically and climbed from roughly 5% of the population to nearly 20% by 1710 (Menard 1977b:381). Evidence from Maryland indicates the rapidity with which this transition in the labor force took place. The ratio of English servants to slaves in probate inventories dated 1674-1679 was 4:1 while 20 years later it was 1:4 (Menard 1977b:337). During most of the 17th century, though, it was English men and women who voluntarily spent years in servitude for a chance of social and economic advancement in the New World.

Opportunity is predicted to be a key characteristic of colonization, but how real was it for the British immigrants to the Chesapeake? The documentary record suggests that opportunity was substantial for most of the 17th Century and the region was an excellent "poor man's country." Carr and Menard (1979) have demonstrated that Maryland servants who became free during the middle third of the century had excellent chances of becoming landowners, establishing households, and even purchasing servants of their own. Newly released servants known as "freedmen" could, by working for a few years as paid laborers or as sharecroppers, accumulate sufficient capital to purchase land, livestock, and household necessities. Freed servants also had political opportunities that were far greater than they could have ever expected in Britain. Maryland freedmen during the 1640-1680 period served on juries and held many minor goverment offices; some were elected to the Assembly and two were even appointed to the Governor's Council (Jordan 1979:266). Virginia immigrants similarly experienced substantial political opportunity, especially before 1670, and several former servants were elected to the House of Burgesses and held other goverment offices (Morgan 1975:209). Immigrants to the Chesapeake had excellent prospects for upward economic and social mobility, if they lived long enough.

Life and Death on the Chesapeake

One of the most striking aspects of the Chesapeake was the dramatically high death rate experienced by the colonists. High mortality is a common characteristic of frontiers but it reached truly exceptional proportions in Maryland and Virginia. All newly arrived colonists underwent a "seasoning" period during which they physiologically adapted to the new disease environment, climate, and diet. There are no accurate statistics on the number who died during seasoning, but contemporary accounts suggest that it was substantial. Walsh (1977:130) estimated that between 20% and 40% of the indentured servants in Charles County, Maryland died before completing their terms. In Virginia between 1618 and 1624, the estimated annual death rate was a staggering 28%, and it ranged upwards to 37% in the Jamestown area (Earle 1979:118). The Jamestown figure was probably exceptional but mortality still remained at 14% for the next decade. Even if a servant managed to survive seasoning and the years of indenture, life expectancy remained short. Walsh and Menard (1974:220-224) have constructed life tables for Maryland immigrants during the 17th Century which reveal that a 20-year-old man could only expect to live another 20 to 24 years. Women may have experienced slightly longer lifespans. Life expectancy was less than in England and from 10 to 20 years shorter than an individual could expect in the New England colonies. Child mortality is poorly documented but estimates suggest that from 40% to 55% of the children born in the Chesapeake colonies died before they reached 20 years.

High mortality rates were probably due to multiple causes. Malaria seems to have been a major disease, striking between March and December when the mosquito populations were active (Rutman and Rutman 1976). This disease could affect a large portion of the population during the season of peak agricultural activity, thereby potentially disrupting planting and possibly causing the economic ruin of a small planter if he and/or his servants were stricken. Malaria itself, however, was probably not an especially virulent killer; it served to weaken the body's defenses and made the person more vulnerable to other diseases such as typhoid, influenza, and dysentery (Rutman and Rutman 1976:50); Walsh and Menard 1974: 225; Earle 1979).

The exceptional death rate has far reaching implications. The risks and costs of importing servants were increased since the servants might die before any labor could be extracted from them, thus resulting in a total loss of the planters' investment. The social implications, however, are especially profound. In one Maryland county, half of all the recorded marriages ended within seven years due to death of one of the partners (Walsh 1979:128). For children, nearly three fourths of those studied lost one parent before they reached the age of 21 and almost 20% were orphans before the age of 13 (Rutman and Rutman 1979: 158, 161). A tremendous amount of instability was thus interjected into an already unstable frontier situation. As a consequence, the maturation of Chesapeake society was made even more difficult and the transmission of cultural traditions from elders to youth was severely hindered (Rutman and Rutman 1979: Walsh 1979).

Despite this death rate, the population of the colonies expanded at a rapid pace, fueled largely by immigration. Growth had begun slowly. In 1622, there were only 1240 Europeans living in Virginia, even though a total of 4270 people had come to the colony (Morgan 1975:101). From this low, the number of inhabitants climbed to over 8000 by 1640. With the founding of the Maryland colony, population growth became even more rapid. Over 35,000 colonists lived in the Chesapeke by 1660, and the 100,000 mark was reached by the end of the century the increase fueled partially by immigration and partially by natural population growth (Menard 1977a:88).

Annual growth rates reveal the magnitude of this increase. The Virginia population increased at a rate of over 33% per year between 1624 and 1634 and remained at nearly 10% over the next two decades (Morgan 1975:404). Maryland's experience was nearly the same with an annual increase of over 25% between 1648 and 1657 and over 14% during the 1660s (Menard 1975: 215). By comparison, England's population during the late 16th and early 17th Centuries grew at a rate which averaged 0.4% to 0.5% annually (Menard 1977b: 378). The colonization model predicts that a frontier society will normally display rapid, even explosive population growth, and this was undeniably the case in the Chesapeake.

Development of a Stable Society

Clearly the Chesapeake colonies displayed many of the characteristics predicted for a society involved in colonization. It remains to establish how long the process continued and when a stable, non-frontier society developed. Determination of the beginning point of the process is a simple matter for it is the founding date of the colony. The ending date, however, is not as precisely defined or easily determined. The colonization model fortunately suggests several features that should signify the termination of the process. One important marker should be the achievement of population growth through natural increase, since a key indicator of adaptiveness is a viable, reproducing population. Although the Chesapeake colonies grew at a rapid rate during the 17th Century, this growth was due primarily to immigration and not to reproduction. Only in the final decades of the century did the population begin to grow by natural increase (Menard 1975:160; Morgan 1975:409-410). Why was this crucial achievement in the colonization process delayed so long?

Four factors seem to have been responsible for the slow accomplishment of reproductive increase: 1) high mortality, 2) late age of marriage, 3) the skewed immigrant sex ratio, and 4) low fertility (Menard 1977a:92). The high death rate for immigrants clearly hindered reproduction but the nearly 50% death rate for children was crucial. The shortage of women throughout most of the century obviously limited the potential for increase. Data from Southen Maryland for the period 1635-1650 indicate that over 60% of the men who left wills were unmarried. This number declined appreciably over the second half of the century, but still over 20% of the men who died during that time were unmarried (Menard 1977a:95). Compounding the problem was the fact that most women in the colony lost a significant portion of their child-bearing years due to the necessity of working as servants for four or five years after their arrival. Many of the immigrant women were in their mid-twenties before they began reproducing (Carr and Walsh 1977:551). The prevalence of malaria and the high child mortality rate imply that women experienced chronic ill health, especially during pregnancy, which almost certainly lowered fertility (Rutman and Rutman 1976; Menard 1977a: 95). Any one of these factors could have limited reproductive increase, but with all of them operating simultaneously, the reproductive potential of the Chesapeake population was severely curtailed.

Probably the most significant element in the final achievement of a viably reproducing population was an increase in the number of Chesapeake-born individuals (Walsh and Menard 1974). Although reproductive rates had been low throughout the century, a significant number of native born children did survive to adulthod. These individuals were better adapted to the disease environment and native born men experienced longer lives than their immigrant fathers; the experience of women in this regard is still unclear. The sex ratio of native borns was essentially equal, and since the women did not need to spend years completing an indenture, they could marry much earlier and so had longer reproductive spans. Historical data suggest that Chesapeake born individuals increased rapidly during the last decades of the century and they became the majority of the population just before 1700 (Menard 1977a:98). The establishment of this native born majority was aided by a decrease in the number of British immigrants during the last decades of the century and emigration of many newly freed men from the Chesapeake to the new colonies of Pennsylvania and the Carolinas (Menard 1975:417).

Population density should also increase as the frontier is settled and this is significant because higher densities allow more community development and greater social interaction. Data from two portions of the Maryland colony, St. Mary's County and All Hallow's Parish (near Annapolis) are available and given in Table 10.

These densities were calculated using the estimated population and the amount of land purchased and surveyed; this is the land that was probably at least marginally utilized. The large, uninhabited, and essentially unused interior sections have been excluded since these were not settled until the 18th Century. Although there was clearly regional variation, Maryland data and information from

Table 10: Estimated 17th-Century Population Densities
(in persons per square mile)

	St. Mary's County, Md*	All Hallows Parish, Md.**
1642	7.6	-
1667	11.5	-
1675	12.8	8.8
1685	12.4	12.3
1695	12.9	16.2
1705	15.3	18.6

* Menard 1971 ** Earle 1975

Virginia (Kelly 1972, 1979) all demonstrate that densities of 12 to 15 persons per square mile were reached during the final decades of the 17th Century, figures that are double those seen during the earlier decades of settlement. Although the cultural implications of this change are not yet fully understood, the rise in population density was certainly a significant factor in the transition from a frontier to an established provencial society.

It can also be inferred from the colonization model that as a stable society develops, the rate of population growth will decline from the often high levels seen on newly settled frontiers. From rates of 7% to 10% during the third quarter of the 17th Century, both Maryland and Virginia experienced a significant drop in growth during the final decades of the century. The average annual rate of increase was slightly over 2.5% in Virginia between 1682 and 1696 (Morgan 1975: 404), while in Maryland this rate held during the late 17th and early 18th Centuries (Menard 1975:215).

When compared to the 25% and 33% growth rates which prevailed during the early decades of settlement, these late 17th century figures clearly indicate that a major reduction had occurred. Thus, all of the available demographic data indicate that the process of colonization was terminating in the Tidewater Chesapeake just before 1700. Does other evidence support this?

The colonization model also predicts that opportunity in the settled region will decline, social stratification will become more pronounced, and social structure will become much less flexible as the process is ending. Historical research indicates that these changes did, in fact, occur in the Chesapeake during the late 17th Century. As noted earlier, the immigrants to this area during the second and third quarters of the 17th Century experienced substantial opportunity for social advancement and wealth accumulation. Maryland in the 1650s and 1660s was a relatively open society of farmers among whom social distinctions were not pronounced. Although there were rich men, former servants and poor immigrants helped form a growing, upwardly mobile group of "middling" planters (Menard, Harris and Carr 1974:182-184; Menard 1975:233). Virginia also saw the rise of planters from humble origins who established plantations and accumulated substantial estates during the same period (Morgan 1975). Opportunity began to slowly decline during the late 1660s, and became pronounced by the 1680s, resulting in the emigration of freedmen from the Chesapeake to other colonies during the late 1680s and 1690s (Carr and Menard 1979:233- 236). A major depression in the tobacco economy 1680 clearly influenced the magnitude of this decline in opportunity and had a major impact upon the entire Chesapeake region.

This change in opportunity can be measured in several ways, one of which is the rate of tenancy. During the mid-1600s, land occupied by tenants in southern Maryland comprised about 10% of all holdings. For most of these individuals, this was an intermediate status until they could save money to purchase land of their own. Tenancy was thus a step of capital accumulation in the process of land acquisition and eventual economic success. By the early 18th Century, however, almost 30% of the households were on leased land; for most of these individuals, the status of tenant was becoming more or less permanent (Menard 1975: 425-426). A similar decline occurred in Virginia. In Surry County, over 37% of the homes were occupied by tenants in the early 1700s (Morgan 1975:221).

Another gauge of declining opportunity lies in the distribution of labor ownership. In mid-17th Century Maryland, many small planters were able to purchase a few servants. Indeed, over half of all the servants listed in southern Maryland for this period were owned by planters whose total wealth was less than 200 pounds sterling (Menard 1975:431). This situation altered dramatically over the next 30 years. By the early 18th Century, more than half of the labor supply was in large estates valued at over 700 pounds sterling and nearly one third of the workers were on plantations which owned 20 or more laborers. Three decades earlier, only 6.5% of the workers were owned by such large plantations. Labor, the most direct source of wealth in the colonial Chesapeake, became concentrated in the hands of the rich over time.

The change in labor distribution went hand in hand with the rise of elites in the colonies, especially as the native born individuals inherited estates from their parents. This familial concentration of land and power was quite clearly expressed in political affairs. The gap between the elected rulers and the ruled was not extreme before about 1680. Many small planters and even newly freed servants sat on juries, served in goverment offices, and were elected to the to the Assembly. These individuals had quite extraordinary political opportunities compared to their counterparts in England (Jordan 1979:248). As the 17th Century ended, however, opportunities declined and power became increasingly concentrated in the hands of the wealthy, native born planters. The chances for small planters of modest means to participate in goverment significantly diminished as wealth and family connections rose to central importance in the political process. The rapidity of this change is indicated by the composition of Maryland's elected goverment. Native born individuals comprised less than 2% of the Assembly members between 1660 and 1689 but over half of the Assembly was made up of native born sons by 1700-1715 (Jordan 1979:252). These members also began to serve longer terms and therefore, had greater opportunities to accumulate political power. One important effect of this longer service was that a measure of continuity and stability was finally achieved in provincial politics. These shifts in opportunity and power can probably be considered indicative of a fundamental change in the nature of social status from being largely determined by achivement to being more ascribed (Menard 1975:434). This change can, in turn, be related to the development of a more rigid social structure which is predicted by the colonization model.

These shifts toward greater stability and a more hierarchical society are important indications of the completion of the frontier process. One significant characteristic predicted by the model, however, has not yet been considered -- that of increasing cultural complexity. Investigation of the colonial economy should provide some insight regarding this because, over most of the century, the economy was extremely simple. As noted earlier, a single money crop, tobacco, dominated commerce and English merchants controlled the trade. Planters were dependent upon England for practically all manufactured goods. As a result, there was virtually no economic buffer to protect the colonists from downturns in the tobacco trade. Efforts were made to diversify the economies of Virginia and Maryland many times during the 17th Century, but these met with little success (Morgan 1975; Carr 1974). Only during the final decades of the century did indications of increased economic diversity and complexity begin to appear.

This can be illustrated by examining a single locality - All Hallow's Parish, near Annapolis, Maryland (Earle 1975). Settlement began in the 1650s and this parish was typical of the tobacco coast with dispersed plantations and a tobacco based economy. No evidence exists for craft activity during the first 25 years of settlement in the Parish. Change occurred in the late 1680s when the first blacksmith and millwright started working there. Shipbuilding also began about this time and by the end of the century, it was a significant activity in the parish (Earle 1975: 68,93). In the early 18th Century, woodworking and commercial activities increased and some concentration of these occurred in the settlement of Londontown. Even more noticeable was a diversification in farming from just tobacco to other crops, especially wheat. Wheat was prominent in the parish economy by the early 18th Century and it made new methods of agriculture, particularly the use of plows and harrows, necessary. Estate inventories reveal that plows became common only after about 1710 (Earle 1975:122). At the same time, the All Hallow's planters began raising sheep in greater numbers and tools for the spinning and carding of wool appear more frequently in inventories. All of this resulted in a mixed, more diversified economy that was not as totally at the mercy of the tobacco merchants and the European market.

Similar efforts at economic diversification began to appear throughout Maryland at about this time. Sheep raising and wool spinning increased markedly between 1680 and 1710 and crafts such as shoemaking began to appear, at least in the more wealthy households (Carr and Menard 1979:215). Many Maryland counties added wheat to their agricultural products during the last decades of the century (Main 1977:142), and on the Eastern Shore of Maryland a pattern of economic diversification and intercolonial trade appeared in the early 1690s (Clements 1977:153). Still another signal of greater economic development was the establishment in the 1690s of a few stores operated year-round in Maryland, with greater numbers of these stores appearing after the turn of the 18th Century (Carr 1974:143). Shipbuilding activities also increased in Virginia and Maryland during this period (Evans 1957:26-29). While tobacco remained the mainstay and the early 18th Century economy cannot be described as fully diversified, there were important signs of the development of more local crafts and a more mixed agriculture than had been the case during most of the 17th Century.

Increased complexity is also apparent in other aspects of the culture. One example is the establishment of a printing press at St. Mary's City in 1685, thus introducing this highly skilled craft to the region. Regular postal service was initiated between the Potomac River and Philadelphia in 1695 (Scharf 1966:361). Creation of educational institutions is also an indicator of both cultural stabilization and increased complexity. Virginia contained an increasing number of private schools by the late

17th Century (Ames 1957), and private schools in Maryland were functioning before the 1680s (Earle 1957). Within three years of each other, Virginia and Maryland established publicly supported institutions, the College of William and Mary at Williamsburg in 1695, and King William's Free School (the predecessor of St. John's College) at Annapolis in 1696 (Ames 1957:28; Scharf 1966:353).

All of the available evidence suggest that a major transformation occurred in Chesapeake society during the final decades of the 17th Century. Within 20 years, the native born became a majority of the population, natural population increase occurred, and a measure of cultural stability occurred. At the same time, opportunity significantly declined; the economy began to diversify; and cultural complexity increased while the social structure became less flexible, and a ruling elite emerged. All of these changes are predicted as indications of the close of the colonization process in a region. These factors' nearly simultaneous appearance throughout the Tidewater Chesapeake strongly suggests that the process of colonization ended during the ca. 1680-1700 period.

From the above discussion, it is obvious that the model of colonization presented in Chapter 1 is applicable to the Chesapeake region. While the 17th Century Chesapeake has long been recognized as a frontier, clear demonstration that the colonization process operated there was necessary before this study could proceed. This exercise has set forth the key attributes of the Chesapeake culture and established a factual foundation for exploring and attempting to understand the subsistence practices of the colonists. Subsistence and the data used to explore that subject are now adressed.

CHAPTER 5

SOURCES OF INSIGHT: THE HISTORICAL AND ARCHAEOLOGICAL RECORDS

In this chapter, the data used to test the hypotheses proposed at the beginning of this dissertation will be discussed. Relevant historical materials and archaeological collections will be described and the methods used in analysis outlined. First, however, some consideration of the information obtainable in the documentary record is necessary.

The Need For Archaeological Data

Given the fact that the 17th Century is a period encompassed by written history, it might be expected that the documentary record can provide the necessary data to test subsistence hypotheses. This, however, is not the case. Much historical data is available pertaining to domestic foods. Documents reveal that "Indian corn" supplanted English wheat, rye, and barley, and domestic cattle, swine, and chickens thrived in the New World environment. Beyond this, it is difficult to gain a precise knowledge of the subsistence system from documents. For example, contradictory statements regarding the usage of wild foods occur. Accounts range from promotional literature that speak of the incredible abundance of game and the ease with which it could be obtained (cf. Hamor 1957:20-21; Rolfe 1971:5-6) to the complaint of Thomas Niccolls in April of 1623 that:

> If the [Virginia] Company would allow to each man a pound of butter and a po. of cheese weekely they would find more comfort therein than by all the Deere,Fish, and Fowle is so talked of in England, of which I can assure you your poore servante haue not had since their coming into the Countrey so much as the s[c]ent...
> (Kingsbury 1935:231-232).

Nicolls wrote one year after the 1622 Massacre, which also decimated the domestic livestock population. Meat from domesticated animals was in very short supply and wild game would presumably have been a practical substitute.

The accuracy of these viewpoints and their relationship to the actual subsistence pattern of the colonists can not be resolved without substantial and quantifiable data, and such data are not obtainable from the surviving documentation. The usage of wild food resources is simply not a topic which 17th Century writers gave much attention. Fortunately, remains of the actual animals eaten by the colonists are available from Chesapeake archaeological sites. When information derived from the study of these materials is combined with the documentary data, it should be possible to gain a much more complete and accurate understanding of the adaptation actually developed by the colonists.

<u>The Historical Data Base</u>

To test the hypotheses, it is necessary to marshal as wide a variety of information as is possible. The documentary record constitutes one information source and it can be divided into two basic forms, narrative accounts and legal records.

Travelers' journals, personal letters and publications describing the colonies comprise the narrative record. Such documents are not quantifiable because of the idiosyncratic nature of their creation but they can still provide important insights regarding husbandry practices, seasonal foods and methods of food preparation. Two major problems with this source of information are identifying and accounting for the personal biases of the writer. Comments relating to diet are often incidental in such accounts and, thus, are probably not intentionally biased. In other writings, however, especially promotional literature, descriptions of diet can be greatly exaggerated. Therefore, a researcher must investigate the potential sources of prejudice of each document's author before utilizing these data. Even meticulous, exhaustive evaluation cannot "prove" the accuracy of such a document, but evaluation does greatly reduce the potential for bias and hence provides a means of improving the reliability of narrative accounts.

The second class of documentary data, legal records, has less potential for distortion due to individual bias but must still be carefully evaluated. The most valuable of legal documents are probate inventories, although transcripts of court cases can occassionally provide useful data. Probate inventories in the Chesapeake are a listing of a man's movable property. Women's estates were rarely inventoried because of women's subordinate legal status. Inventories were taken after a man's death to insure that the rights of heirs and creditors would be protected. Potential biases in this type of data include variation in the reporting rates among the various wealth groups and shifts in mortality rates which could alter the structure of the inventoried population (Carr 1976). Inventories typically reveal the assets of people at the end of their careers, and thus could suggest to the unwary scholar that a population was more wealthy than it actually was. Fortunately for researchers, the high death rate of the Chesapeake colonists somewhat counteracts this tendency.

Despite these problems, household inventories offer invaluable insight regarding domestic foods and food preparation equipment owned by 17th Century tobacco planters. This study will focus upon inventories from St. Mary's County, Maryland. St. Mary's County inventories will be utilized for the following practical reasons, 1) St. Mary's was the first county established in Maryland and inventories survive from 1638 through the 18th Century, 2) All of the 17th and early 18th Century inventories have been transcribed, 3) The entire series of inventories has been tested for reporting rates and other biases and found to be generally free of these problems (Menard, Harris and Carr 1974; Walsh and Menard 1974; and Menard 1975).

Food Remains and the Meat Diet

Food remains are currently available from a variety of 17th Century archaeological sites in Maryland and Virginia but practically all of these are animal bones. While flotation samples have been taken to retrieve floral remains from several sites, results of only one such analysis are available (Johnson 1978). Preliminary sorting of other samples from sites in St. Mary's City, Maryland indicates that most of the floated material is wood charcoal; few seed, nut, or corn cob fragments are present. Because of the limited amount of floral information, no reliable conclusions can be drawn . References to the vegetable diet occasionally appear in documents but these are sporadic and mostly pertain to domestic crops. This information will be employed where possible in hypothesis testing but it cannot be considered a completely reliable data source. Therefore, due to the paucity of data relating to food plants, this study will concentrate upon the meat component of the colonial diet.

The archaeological and historical records provide a large and varied body of data pertaining to the meat diet that will permit hypothesis testing. Meat is also appropriate because of its traditional role in British subsistence. As discussed in Chapter 2, meat in Britain had a high cultural value associated with it, and was a major factor differentiating the diets of the rich and poor. In fact,it has been argued that "...the standard of living [in Britain] was judged to a considerable extent by the amount of meat eaten" (Drummond 1958:102). Given the fact that the Chesapeake settlers were mostly from Britain, it is likely that these cultural attitudes toward meat were transferred to the colonies. Thus, not only does the meat diet comprise the central focus of this study because of the data base, but it was probably a central focus of the diet in the minds of the colonists.

Some Necessary Assumptions

Animal remains from archaeological sites constitute the major information source for this study and to utilize this data, several assumptions regarding the nature of faunal remains must be made. First, the surviving faunal record is assumed to be representative of the animals that were used at the site. Differential preservation or severe recovery problems can completely invalidate this assumption but, as will be shown, these do not seem to be serious problems with the Chesapeake data. The second major assumption is that the relative contribution of species used at a site can be determined from the faunal assemblage. This assumption can be invalidated by preservation problems and difficulties with bone recovery, but again, the nature of the Chesapeake data seems to warrant its acceptance.

The final major assumption is that changes in overall subsistence patterns at sites are related to cultural rather than natural factors. Of course there can be seasonal changes due to annual climatic shifts, and sites in different ecological zones may have different animals in their respective assemblages. Nevertheless, overall changes at a site or at multiple sites within the same ecological zone are to be attributed to cultural factors. The temporal period under study is quite short - 125 years - and there is no evidence for major climatic alterations within this period. Indeed, the pollen record from St. Mary's City (Kraft and Brush 1981) suggests that the climate and vegetation in the region was reasonably stable from c. 1400 to 1800 A.D., considerably longer than the period under investigation. Small-scale changes certainly occurred but none appear to have been of sufficient magnitude to have altered the faunal resources in the region.

The Archaeological Data Base

Archaeological materials from 15 sites in the Chesapeake region are used in this study. They range in time from c. 1620 to c. 1740 and represent 21 separate occupation phases. Figure 7 illustrates the temporal ranges of these occupation phases in ascending order beginning with the earliest, and shows the division of the entire temporal range into three major study periods: c. 1620-1660, c. 1660-1700, and c. 1700-1740. Each of these 40 year study periods is represented by faunal remains from six or more sites. Faunal samples were recovered from more than 50 major features and many smaller units, and include remains of birds, fish, mammals, reptiles, amphibians, and crustaceans. Animal remains from all but two of these sites were analyzed by the author

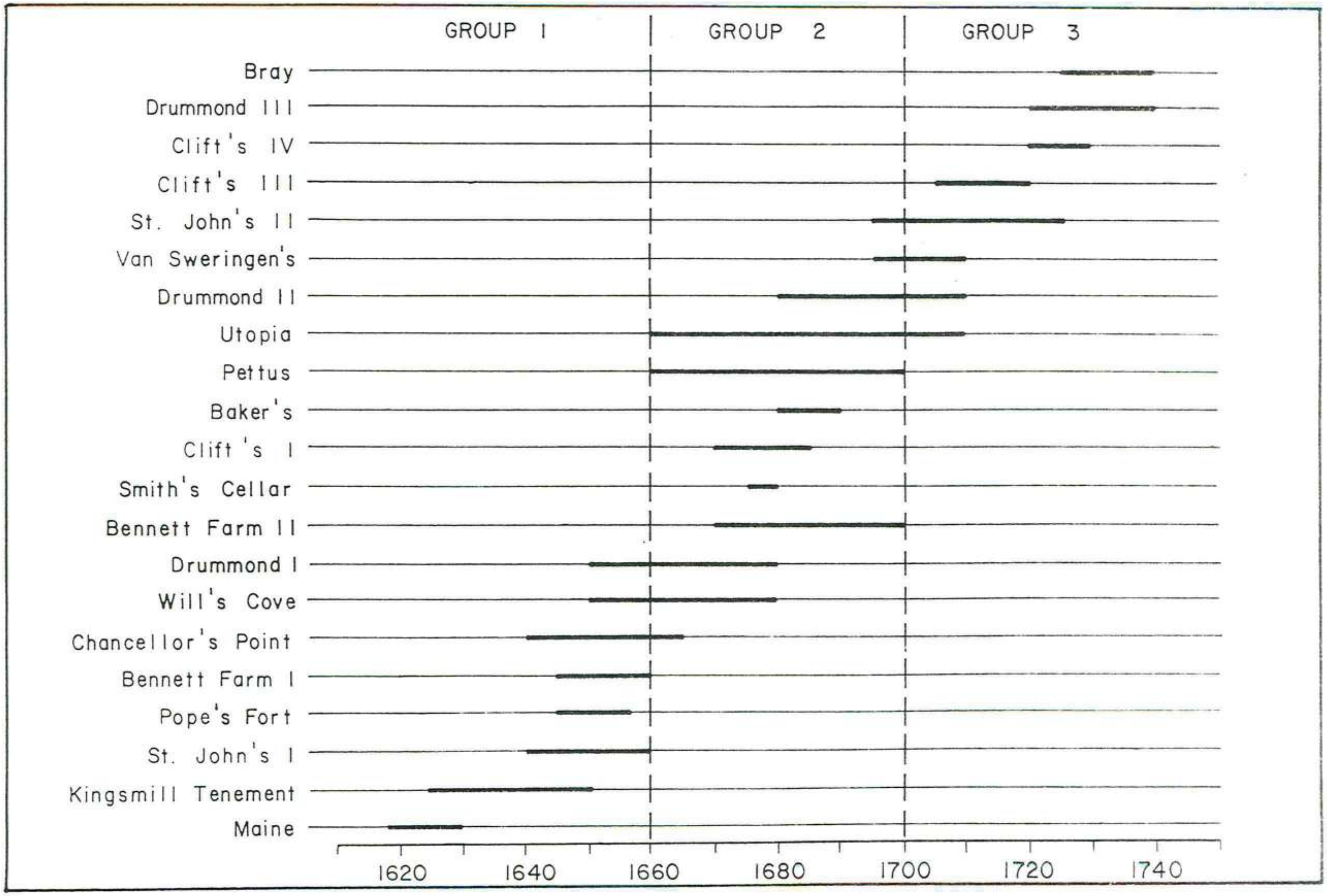

Figure 7: Archaeological Samples by Temporal Period

Geographically, these sites divide into two clusters, those along the Potomac River and the James River (Figure 8). Five of the Potomac sites are located in Maryland's first capital of St. Mary's City while the Clifts Plantation site lies on the Virginia shore of the Potomac. Most of the lower Virginia sites occur on the James River near Jamestown. Exceptions are the Wills Cove site, which lies on a small tributary of the lower James, and Bennett Farm, located on the Chesapeake Bay near the mouth of the York River.

Occupation at all of these sites was domestic. Food preparation and consumption occurred at each. Most were private, self-sufficient households. Three of the St. Mary's City sites also served as "ordinaries" for at least a portion of their occupations. An "ordinary" in the 17th Century provided lodging, drink and an "ordinary" fare to travelers at a rate established by the goverment. Those in St. Mary's City, however, served for most of the year as the home of the innkeeper, his family and servants, and an occasional guest. Major influxes of visitors only occurred periodically when the courts met or the Assembly was in session (Carr 1974). For much of the year, these ordinaries were as much private dwellings as commercial establishments. Given this fact and because food serving was a primary purpose of an ordinary, it seems unlikely that the faunal remains from these establishments will be so different as to preclude their use in this study. Identified species, bone counts, and other

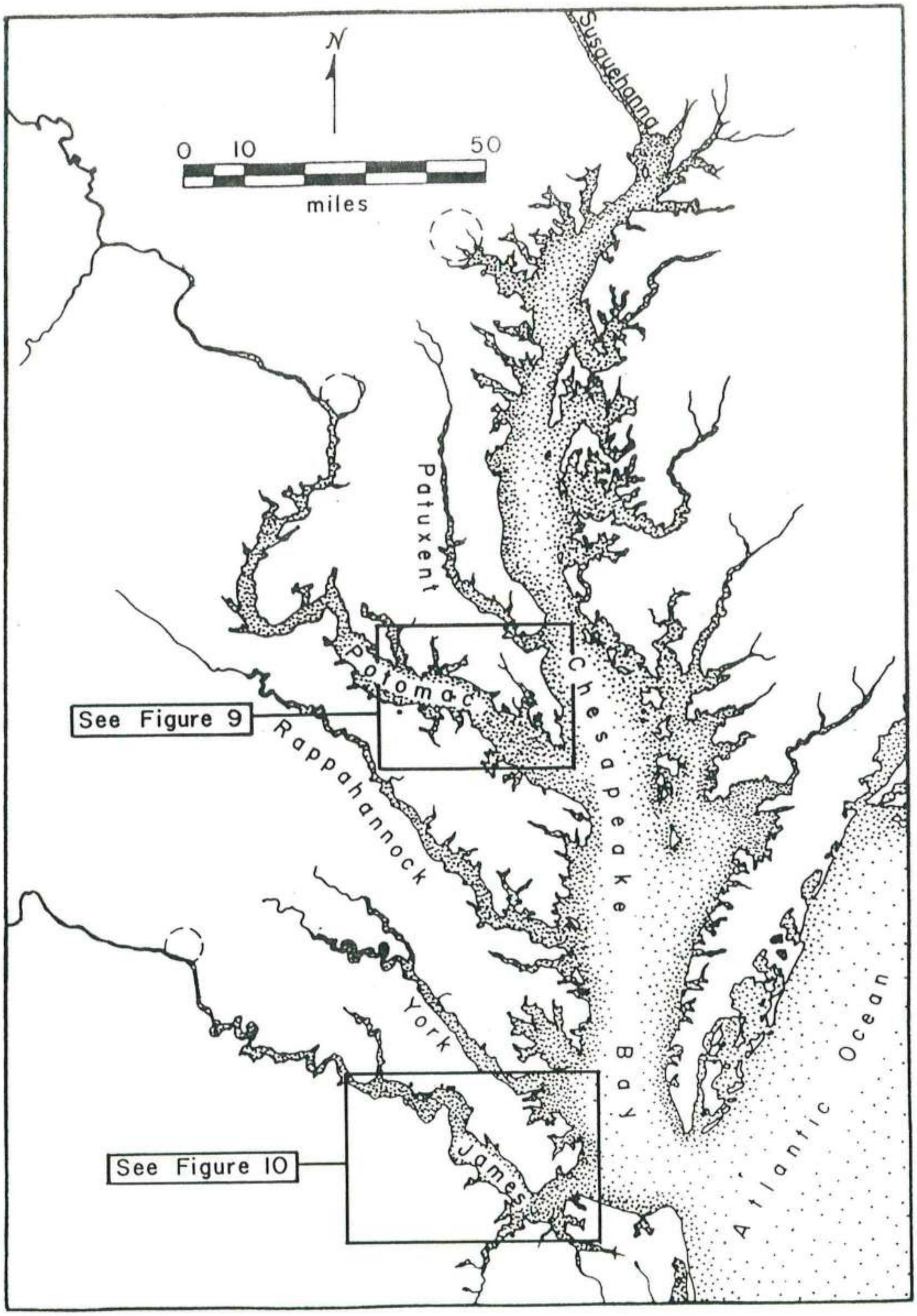

Figure 8: The Two Sample Areas in the Chesapeake

quantitative data for each of the sites are presented in Appendix 1.

POTOMAC RIVER SITES (Figure 9)

St. John's (18 ST1-23), St Mary's City, Md.
A house was constructed at this site in 1638 by John Lewgar, Maryland's first Secretary of State, and it served as a private domestic residence, ordinary, and tobacco plantation at various times during its 85 year occupation. The house was destroyed around 1725. Study of the artifacts and feature seriation has permitted the archaeological findings to be divided into three phases of occupation. Two of these phases have adequate faunal samples to be utilized in this study. Phase I encompasses the period from c. 1638-1660 during which the site was occupied by affluent individuals, John Lewgar and a Dutch merchant named Simon Overzee. During this time, St. John's a was private home, working tobacco plantation, and occasional goverment meeting center. Faunal materials come from a trash filled privy pit, a borrow pit, and several smaller features. The second sample used in this study, dates to the c. 1695-1725 period. During these final decades of occupation at the site, St. John's was inhabited by a family of middling status who ran it as a tobacco plantation. Faunal materials derive from a number of small units, and two major features - fill layers in the cellar under the main house and a trash filled pit. All faunal materials at this site were recovered by the screening of

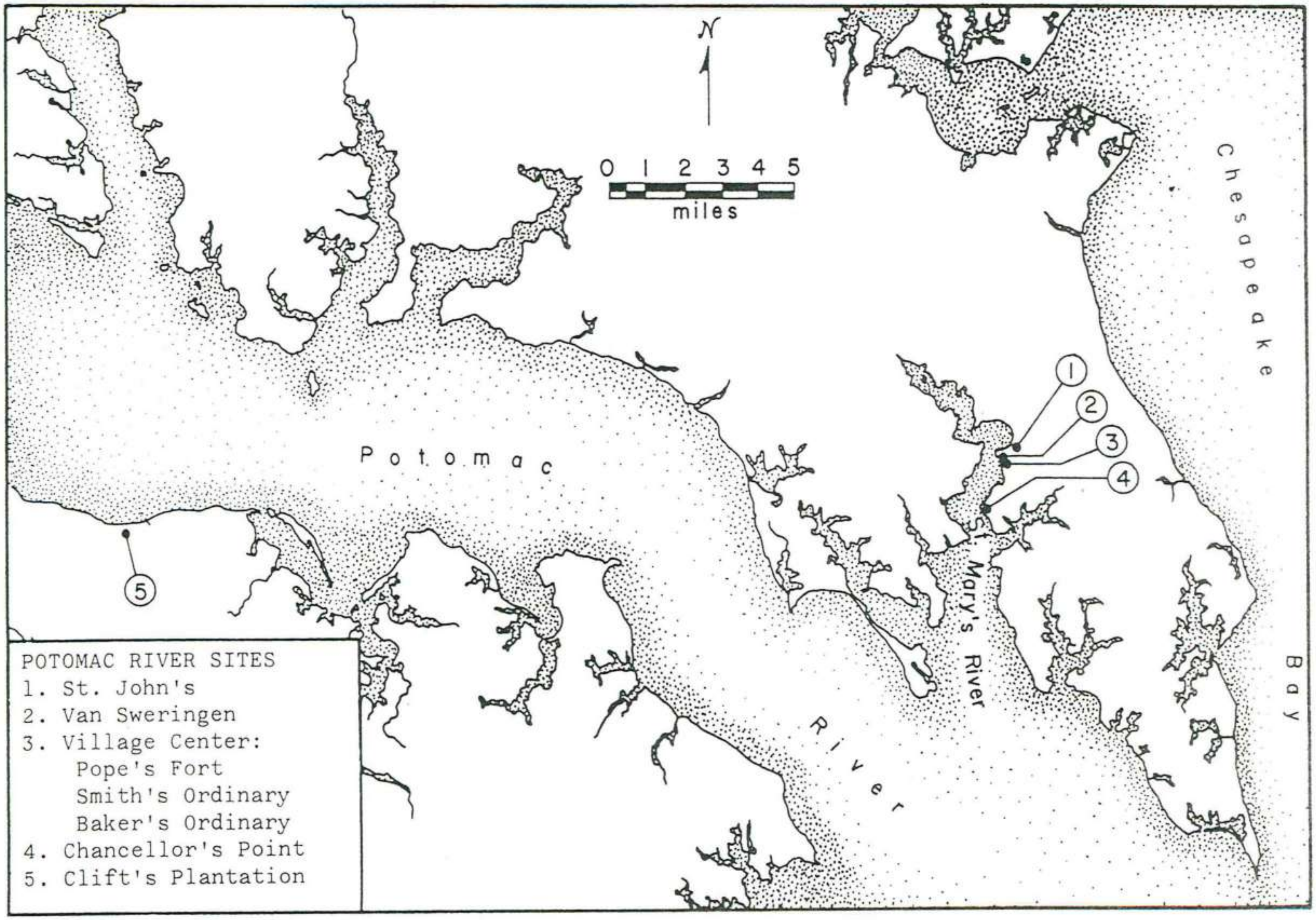

Figure 9: Potomac River Sites

soils through one-fourth inch mesh. In addition, water screening of samples through window mesh was conducted to provide greater control over recovery. Excavations were conducted by the St. Mary's City Commission ("SMCC") from 1972-1975 under the direction of Garry Wheeler Stone.

Popes Fort (18 ST1-13), St. Mary's City, Md.
Animal remains were recovered from a large feature that excavation and analysis have demonstrated is part of a fort built in 1645 when Nathaniel Pope fortified Leonard Calvert's home. The fort was erected following an attack on the Maryland colony by a Protestant privateer but events proved that is was unnecessary and the fort stood for only a brief time. The ditch component of this fort was filled with domestic garbage in the years between 1645 and c. 1655. During that time, the house was occupied by individuals of high social status - Governors Leonard Calvert and William Stone. The archaeological sample derives from one portion of this ditch, located directly behind the house. All soils were screened through one-fourth inch mesh, and substantial samples of the soil were water screened through window mesh. Excavations were conducted during 1981-1982 by SMCC under the direction of Garry Wheeler Stone and Alexander Morrison II.

Van Sweringen's (18ST1-19), St. Mary's City, Md.
Only one feature from this site has been analyzed and it dates to c. 1700. At that time, this site was occupied by Garrett Van Sweringen, a Dutch immigrant, and his family. Van Sweringen lived at the site, which also served as a

private lodging house used mostly by members of the Governor's Council. Although some brewing activites were possibly conducted at the site, it was, first and foremost, a private domestic residence. Archaeological explorations of the site have been conducted over a long period (1974-1983) by the SMCC under the direction of Stone and Morrison.

Chancellor's Point (18 ST1-62), St. Mary's City, Md. Located approximately 1.5 miles from the other St. Mary's sites, Chancellor's Point was occupied between ca. 1640 and 1680. The site was a tobacco plantation and possibly the location of the first iron forge in Maryland. Artifact analysis suggests that the residents were above the median wealth level in colonial society but little historical data exist regarding them. Faunal materials derived from several small features and the fill of a grave. All of these were sealed by a midden that contained many fragments of c. 1660-1680 locally made pottery which indicates that these animal remains largely derive from the first half of the occupation. Excavations were conducted by the SMCC in 1973 and 1979 under the direction of Stone and Morrison. All soils were screened through one-fourth inch mesh and samples were water screened.

Baker's Ordinary (18 ST1-13), St. Mary's City, Md. During the late 1670s and the 1680s, John Baker leased Leonard Calvert's former home and ran it as an ordinary. Baker's Ordinary was one of the most prominent lodging places in the 17th Century capital. A single sample of faunal materials dating to the Baker period has been obtained from a large pit. Associated artifacts and documentary data suggest that this feature was filled in the period c. 1680-1690. Soils were all screened through one-fourth inch mesh and large samples were processed through window screen by water screening. Excavations were conducted in 1982 by the SMCC under the direction of Stone and Morrison.

<u>Smith's Ordinary (18 ST1-13)</u>, St. Mary's City, Md.
In 1667, William Smith constructed several buildings near the center of St. Mary's City, one of which was an ordinary. Following Smith's death in that year, a series of proprietors ran the ordinary until it burned in 1678. Archaeological materials associated with this ordinary came from a nearby cellar that was filled with garbage in the period c. 1675-1680. Artifacts were recovered by screening through one-fourth inch mesh. Excavations were conducted by the SMCC in 1979 and 1982 under the direction of Stone and Morrison.

<u>Clifts Plantation (44 WN 33)</u>, Westmoreland County, Va.
This isolated tobacco plantation was established along the Potomac River about 1670 by Thomas Pope and occupied almost continuously by tenants from that time until c. 1730. Artifact analysis has permitted the seriation of the many features at this site into four phases of which three have adequate faunal samples to be incorporated into this study. These periods are Phase I (c. 1670-1685), Phase III (c. 1705-1720), and Phase IV (c. 1720-1730) (Neiman 1980). Animal remains deriving from each phase were analyzed by Joanne

Bowen (1979). While composite faunal data is available for each phase, information regarding the composition of bones from individual features is not accessible and hence can not be used in this study. Among the features at this site are several cellars, borrow pits, a privy, possible storage pits, and many smaller units. All soil was screened through one-fourth inch mesh. Excavations were conducted by Fraser D. Neiman during the period 1976-1978 for the Robert E. Lee Memorial Association.

JAMES RIVER SITES (Figure 10)

The Maine (44 JC 41), James City County, Va.

This early site is located approximately two miles upriver from Jamestown. The Maine is the earliest site in the sample with occupation dating from c. 1618 to 1624, and possibly extending to 1628 (Outlaw 1978). The inhabitants were apparently tenants of the Virginia Company. Analysis of the faunal remains was conducted by Michael Barber (1978). Because of the short duration of occupation, he combined all the units into one phase and consequently, data regarding the composition of individual features at this site are unavailable. Most of the faunal materials derived from small trash filled pits. Artifacts were recovered by careful combing of the excavated soil with a trowel and hand picking of the exposed objects. The site was excavated under the

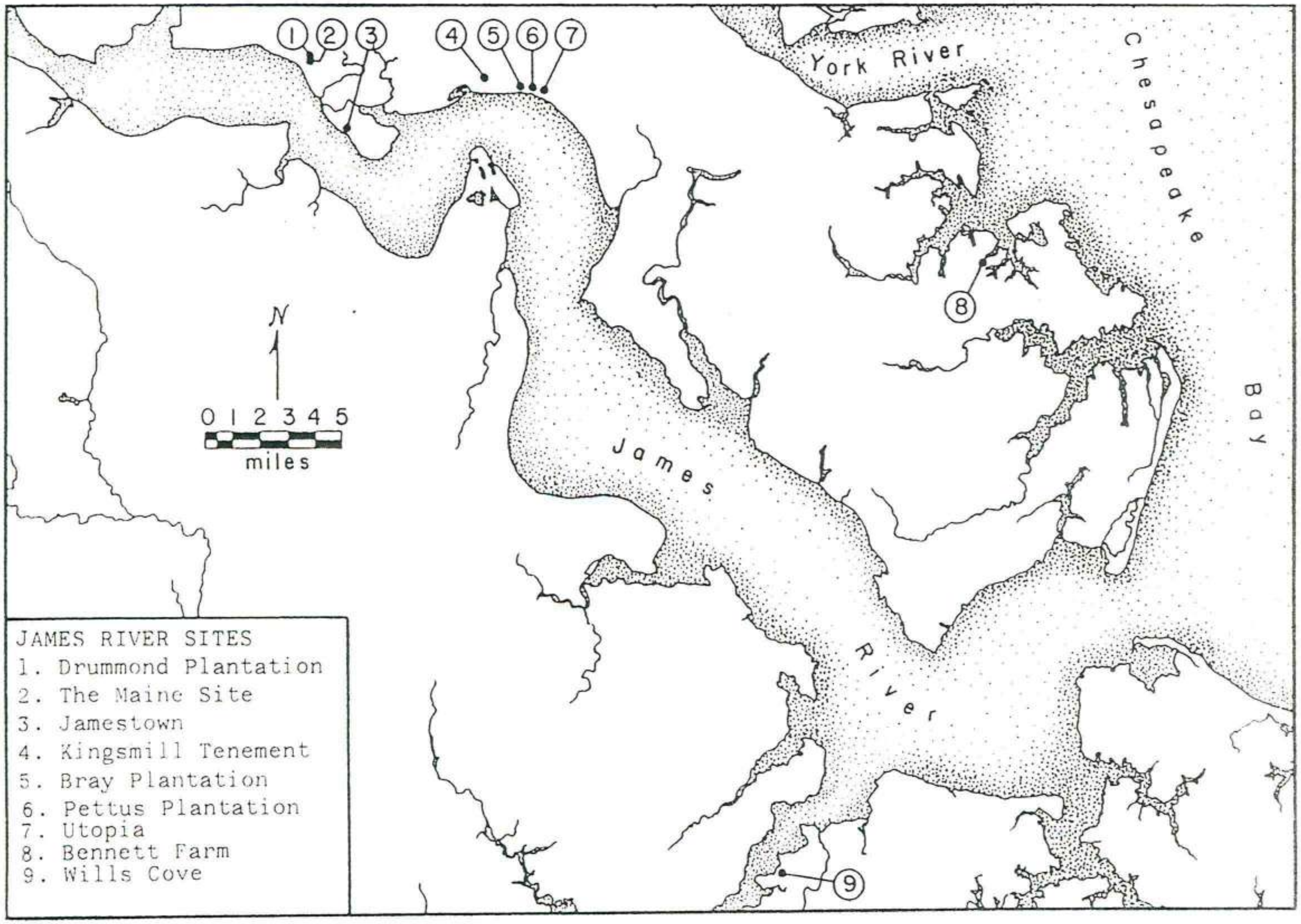

Figure 10: James River Sites

direction of Alain Outlaw for the Virginia Historic Landmarks Commission's Virginia Research Center for Archaeology ("VRCA").

The Drummond Site (44 JC 43), James City County, Va. Only a few hundred feet inland from the Maine site are the remains of a major plantation founded by William Drummond about 1650. Drummond was a major planter and served as the Governor of North Carolina. He was also a central figure in Bacon's Rebellion of 1676. He opposed the Virginia Governor and after Bacon's defeat, Drummond was hung, drawn, and quartered. Drummond's wife and family continued to occupy the site until the early 18th Century. Artifacts suggest that the family maintained their wealth in the period following Drummond's death and continued to operate a prosperous plantation. After c. 1710, there is no historical information regarding the inhabitants, but it is probable they were tenants (Alain Outlaw: Personal Communication 1983). Because of the long occupation span, the features at this site have been grouped into three phases: Phase I (c. 1650-1680), Phase II (c. 1680-1710), and Phase III (c. 1720-1740). Faunal materials come from two cellars, four wells, and several trash filled pits. Artifacts were recovered through troweling and hand picking of excavated materials. Excavations were directed by Alain Outlaw of the Virginia Research Center for Archaeology ("VRCA") between 1977 and 1981.

Kingsmill Tenement (44 JC 39), James City County, Va. Located approximately five miles downriver from Jamestown along a tidal creek, this site dates to the second quarter of the 17th Century (Kelso 1976). The occupants were tenants who leased the property from Richard Kingsmill of Jamestown. Several exceptional artifacts from the site suggest that the occupants were probably not at the bottom of the wealth scale, but were of middling status (Carson 1981: 179-180). Faunal materials derive from five large trash filled pits and several smaller features. Recovery methods involved the troweling and hand picking of artifacts from the soil. The excavations were directed by William Kelso of the VRCA in 1972-1974.

Pettus Plantation (44 JC 33), James City County, Va. This site is located directly on the James River, roughly seven miles downriver from Jamestown. It was apparently built in the 1640s by Colonel Thomas Pettus and continued to be occupied until about 1700 when it burned (Carson 1981: 180). Pettus was a major landowner and a member of the Governor's Council; he was prominent in Virginia's social hierarchy (Kelso 1974). Faunal remains came from a well, a cellar, and several pits. Associated artifacts indicate that most of these bone deposits are from the later periods of the occupation and are assigned a c. 1660-1700 date. Recovery methods were by troweling the soil and hand picking. The site was excavated under the direction of William Kelso in 1972-1973 for the Virginia Research Center.

Utopia (44 JC 32), James City County, Virginia

This house site is also directly on the James, and one half mile downriver from Pettus. Utopia is located on land owned by Pettus. Analysis of the artifacts and faunal materials suggests that it was occupied by tenants (Carson 1981: 180). Artifacts also indicate that the site was inhabited from c. 1660-1710. Faunal remains came from two major features - a cellar under the house and a well. Both features contained artifacts that suggest that these bones were deposited during the c. 1675-1710 portion of the occupation. Artifact recovery was by troweling and hand picking. This site was excavated under the direction of William Kelso for the VRCA in 1974 (Kelso 1976).

Bray Plantation, James City County, Va.

Following the end of the Pettus occupation, another large plantation was established on the same property, just one quarter of a mile to the west. The land was acquired by James Bray II in the early 18th Century through marriage to a relative of Pettus. Bray built a large and successful tobacco plantation that survived into the late 18th Century. Faunal materials come from a large, trash filled pit complex, probably originally dug for clay in the 1720s and filled before 1745. William Kelso directed the excavations in 1972 for the VRCA.

Wills Cove (44 SK 56), Suffolk County, Va.

Archaeological remains of a 17th Century occupation were found at this site in 1977. Wills Cove is located on the

Nansemond River, approximately five miles from the confluence of the lower James River and the Nansemond River. Excavations revealed two large pits which date c. 1650-1680. Documentary research has not been able to establish the identity or status of the occupants of this site, but the associated artifacts suggest that they were not extremely wealthy. Materials were recovered by screening through one-fourth inch mesh. The site was excavated by Keith Egloff and Edward Bottoms of the VRCA in 1978.

Bennett Farm (44YO68), York County, Va.

This is the only site in the sample that is not located along a major river system. Instead, it is on a small inlet directly off the Chesapeake Bay and near the mouth of the York River. Occupation at this site could have begun as early as 1644, and a structure was certainly standing at the site in 1648 when a Humphrey Tompkins acquired the land through marriage. Tompkins lived there until his death in 1673. His son, Samuel, then inherited the plantation and occupied it till his death in 1702. Artifact analysis suggests that occupation terminated at that time. Historical and archaeological evidence both indicate that the Tompkins were not wealthy and should be classified as "middling planters" of only modest means (Luccketti 1983). Five large pits and several smaller features yielded quantities of faunal remains. Most of these date to the period 1670-1700 but one large, multiple strata pit is earlier, dating c. 1645-1660. Because of this difference, the features are divided into two phases and are assigned these time spans. Artifact recovery was by troweling and hand picking. Excavations were directed by Nicholas Luccketti of the VRCA in 1977 and 1978.

A wide range of archaeological sites and faunal remains is thus available for study from the Chesapeake region. Details regarding these are summarized in Table 11. Each 40 year period is well represented by sites from different areas of the Chesapeake. Sample sizes of bones identified to the genus or species level vary significantly and this must be borne in mind as the data are discussed. The sites also vary in regard to the wealth level of their occupants. This is an important factor for it will permit evaluation of the diets of households that presumably had different resources available to them.

Units of Analysis

Decisions regarding which materials from a site should be studied and how they should be grouped for analysis will have an important impact upon the results. In this study, the decision has been made to utilize only faunal materials that derive from sealed contexts in features. These features are not arbitrary but are empirical, culturally produced components of sites and they will constitute the basic unit of analysis. The orginal functions of them included storage cellars, wells, ditches, clay borrow pits and privies, but all were ultimately used for the disposal of domestic garbage. There are a number of reasons for concentrating

Table 11: Summary of Archaeological Sites

Sites	# of Bones	Associated Waterway	Wealth Level	Recovery Method	Dug By
1620-1660					
The Maine	196	James	Low/Middle	Hand	VRCA
Kingsmill Tenement	863	James	Middle	Hand	VRCA
St. John's I	598	Potomac	High	Screen+	SMCC
Pope's Fort	770	Potomac	High	Screen+	SMCC
Chancellor's Point	143	Potomac	Middle	Screen+	SMCC
Bennett Farm I	1237	Chesapeake	Low/Middle	Hand	VRCA
1660-1700					
Drummond I	535	James	High	Hand	VRCA
Wills Cove	415	James	Middle?	Screen	VRCA
Bennett Farm II	1689	Chesapeake	Low/Middle	Hand	VRCA
Smith's Ordinary	302	Potomac	Low/Middle	Screen+	SMCC
Baker's Ordinary	118	Potomac	Middle	Screen+	SMCC
Utopia	994	James	Middle	Hand	VRCA
Pettus Plantation	707	James	High	Hand	VRCA
Drummond II	2834	James	High	Hand	VRCA
Clifts I	419	Potomac	Middle	Screen	Neiman
1700-1740					
Van Sweringen	104	Potomac	Middle	Screen	SMCC
St. John's II	739	Potomac	Middle	Screen+	SMCC
Drummond III	507	James	Low/Middle	Hand	VRCA
Clifts III	560	Potomac	Middle/High	Screen	Neiman
Clifts IV	1421	Potomac	Middle/High	Screen	Neiman
Bray Plantation	256	James	High	Hand	VRCA

+ Samples also processed by water screening through window mesh upon feature materials; one reason is that deposition took place over a relatively brief time. Associated artifacts such as clay tobacco pipes and bottles permit bone samples to be tightly dated, frequently down to periods as short as 5 or 10 years. When investigating change in such a dynamic situation as colonization, such precise temporal control is essential.

An equally important reason for concentrating upon sealed context materials is that some control over taphonomic processes can be obtained. Taphonomic processes result in the formation of the archaeological record and include many factors which may bias the surviving bone remains and their research potential (Lyman 1982). Among these are depositional processes (human, carnivore or geological), breakage and alteration of the bones (by butchery, carnivore, or mechanical processes) and preservation factors. Any of these can significantly bias the faunal record recovered by archaeologists and it is necessary to recognize and account for them to the extent possible (Binford and Bertram 1977; Lyman 1982).

Utilizing only feature materials will provide some control over several of these potential biases. For example, bone materials from sealed contexts have not been broken since their original deposition by factors such as carnivore and rodent activity, or mechanical processes such as human foot traffic or plowing. Midden materials, in contrast, were originally subject to further breakage due to foot traffic. Bones in middens may have also been gnawed by dogs. Compounding this problem is plow disturbance, ranging from eight inches to two feet on all of the sites, so that any midden materials have been disturbed and subjected to probable mechanical breakage.

Feature materials are also not subject to physical weathering in the way that midden artifacts are. A bone in a midden may lie on the surface for a period of months or years before being buried. During this time it is exposed to extremes of moisture and temperature as well as carnivore destruction. Even after burial, shallow surface middens that are typical in the Chesapeake area are still subject to freezing in the winter, which can further break down fragile bones. Freeze depths in the Chesapeake often reach 12 to 18 inches below grade. Feature materials come from depths generally below this freeze line, and are in a relatively stable physical environment where changes occur only slowly.

Of particular significance is the fact that faunal materials from features are primarily deposited by human activity. All the bones used in this study were found in association with domestic garbage, such as ceramic and bottle glass sherds, and it seems likely that the bones, which frequently display evidence of butchery, also derived from domestic activities. Carnivores may have contributed or removed bones from a feature prior to its filling but this is something for which it is difficult to compensate. Removal of bones by dogs and similar actions while while the deposit was exposed cannot be readily determined but evidence of gnawing on bones was rare in most features, generally ocurring on less than 1.0% of the total identified elements. Several features or strata were encountered in which the bones displayed a much higher frequency of carnivore alteration and/or the presence of bones only from small, inmature animals and few other artifacts. These appear to have been produced by non-human depositional processes and are excluded from this study.

Individual features appear to offer samples of faunal remains that date to relatively brief periods. These deposits are almost entirely deposited by human activity and they seem to be less biased by destructive processes than midden or surface deposits. For these reasons features are the most appropriate unit of study. However, since these deposits may have been filled over a relatively short period, and many do not contain large samples, a broader analytic unit is required to gain a perspective on the overall subsistence pattern.

In order to gain an overall perspective on animal usage, materials from various features which date to the same period at a site are combined to produce a site faunal assemblage. This task is easily achieved at sites occupied for relatively short periods (15-30 years) by combining all of the feature materials. Other sites, however, were occupied for 50 to 100 years so this procedure would be inappropriate without modification. In these instances individual features have been dated as precisely as possible, and the occupation divided into phases. These phases may not necessarily indicate any break in the actual occupation but offer a means of temporal discrimination to investigate change. Feature materials are then grouped by phase and analyzed as a single assemblage.

Division of the analytic units into site and feature levels is also necessary since it permits the investigation of different problems. The overall meat diet and patterns of resource usage through time are best addressd with the site level assemblage. While features can be used to study these questions, they offer the best opportunity for investigating seasonal shifts in the diet. Additionally, through their spatial association with structures of identifiable function, such as the "main house" or "servants' quarter", features provide excellent data for studying variation in diet related to status.

Bone Preservation

Bone preservation is related to several factors of which the most important is soil acidity. Gordon and Buikstra (1981) have demonstrated a strong positive correlation between soil ph level and the condition of human remains; good bone preservation is consistently associated with a high ph level and alkaline soils. When bone is deposited in soils with a ph below the neutral level of 7.0, decay through acid leaching and decalcification becomes a problem. At levels below 6.3, faunal materials simply do not survive (Cornwall 1956: 204-208).

This factor should have serious consequences for faunal materials in the Chesapeake region where the soils are naturally acidic (Vokes 1957: 149). But surprisingly, the faunal materials from most of the sites range from good to excellent in condition. Fragile fish bones and scales, bones of immature birds, and even egg shells survived in most of the features. Examination of feature cross-sections and soils data indicates that human activity may be directly responsible for this. Specifically, the introduction of oyster shell and ash to the sites are the agents that appear to allow bone to survive in often excellent condition. Oysters (Crassostrea virginica) were extraordinarily abundant in the Chesapeake Bay and the colonists consumed them in large quantities. The shells were also utilized as a source of lime. Scatters of oyster shell are visible on the surface of practically every 17th and 18th Century site in the Tidewater region. After being deposited at a site, these shells were acted upon by the soil acids which release calcium carbonate. Movement of this calcium into the soil served to neutralize acids and raise the ph level of the soil (John Foss: Personal Communication 1978).

This phenomenon is clearly illustrated by soil data from two 17th Century sites in St. Mary's City, Maryland. Some soil samples were taken a considerable distance from the structures at the St. John's site in areas with little cultural deposition and low calcium levels. These soils had ph levels ranging from 4.9 to 5.5 and averaged 5.2; such values are probably indicative of the original soil conditions. In contrast, the soils in the vicinity of the structures where many artifacts and oyster shells were scattered had ph levels averaging 6.9. Still higher ph levels occurred in features where oyster shells and ash concentrations were typically scattered throughout the strata. Four major features at this site in which large numbers of excellently preserved bones were recovered had soil ph levels averaging 7.80, 7.76, 7.87 and 7.9. These alkaline soils are very conducive to bone survival.

A duplicate pattern occurs at the nearby Van Sweringen site where soils at the periphery of the site have a ph range from 5.0 to 6.1 and average 5.46. Cultural features, on the other hand, yielded soils that ranged from 7.6 to 8.4 in ph. Clearly the deposition of oyster shells in features at a site notably affects soil acidity and thus, directly aids in the preservation of fragile faunal materials.

Ash concentrations occur in many pits and seem to have originated as hearth sweepings. Although the precise relationship is unclear, it seems likely that potash and other chemicals found in the ash also help reduce soil acidity. A good example comes from the Kingsmill Tenement site, where several pits were excavated which did not contain large quantities of oyster shell. Instead, concentrations of ash were found in most of the strata where the bone survived in good condition. The ash either changes the acidity of the surrounding soil or provides a more alkaline matrix in which the bones can survive.

Detailed soils data are not available from sites outside of St. Mary's City but examination of feature profiles and excavation notes reveals that most of the features used in this study contained oyster shell, ash concentrations, or both. In most cases it is obvious that these materials were intentionally dumped into the features along with the bones and other artifacts. Hence, the widespread presence of shell and ash in features seems to account for the good to excellent condition of the bones and means that the use of feature-derived faunal materials can provide some measure of control over preservation biases.

Despite the generally good condition of the faunal assemblages, several features were encountered that yielded poorly preserved bones. Only the more rugged remains of mammals survived in good condition from these. Excavation records indicate that the features in question contained few oyster shells and little ash, and hence soil acidity may have destroyed the more fragile remains. Because these units are not comparable with the others, they are either excluded from analysis or only used in discussion of mammalian remains.

Recovery Methods

Two data recovery methods were utilized in the excavation of sites refered to in this study. The first involves the screening of feature materials through one-fourth inch wire mesh. All sites in Maryland and several in Virginia were excavated with this method. Screening results in the recovery of many small fish and bird bones and provides a measure of control in the recovery process. Very small bones nevertheless may be missed with this size of mesh (Thomas 1969). To check for this potential bias, samples of soil were water screened through fine window mesh. Such a procedure has been employed at four sites in St. Mary's City and the results indicate that while some small bone fragments are missed, few of these are identifiable to the genus or species level. The majority of the materials are small fish ribs and tiny vertebra, mammal and bird bone splinters, and occassionally an element from a small rodent. Similar results are apparent from the faunal materials found in flotation samples from the Drummond site. In summary, this procedure indicate that recovery is not significantly biased toward large animals in these sites, there are simply not that many small species present.

In the lower Chesapeake, a different method of artifact recovery is sometimes employed. Soil is carefully picked through by placing it on a dustpan, breaking it up with a trowel, and removing the bones and other artifacts that are visible. Screening procedures are not used. This method can result in excellent recovery of small bones as evidenced by the materials from Bennett Farm and the Drummond site. The time alloted to artifact recovery and the skill of the excavator, however, can produce radically different recovery rates. These factors provide the basis for the classic argument against hand picking soils, but although not widely recognized, the same holds true for screening. If unskilled people do the screening or a sample is hurriedly picked over, the loss of cultural data will undoubtedly result. This is especially true in the situation where the least skilled people are given the task of screening, with little or no background in the types of artifacts they are expected to recognize and retrieve. Screening does make the artifacts more visible, unless the soil is extremely wet, and so provides more control in recovery. Nevertheless, where time and care are taken to meticulously hand pick soils, and skilled excavators are used, the recovery of bones can be very good. It is the opinion of Alain Outlaw (Personal Communication 1983), who directed excavations at the Drummond site, and Nicholas Luccketti (Personal Communication 1983), who conducted the Bennett Farm excavations, that the hand picking procedures used at those sites resulted in the recovey of practically all of the faunal materials. Comparison of the frequencies of mammal, bird, fish, and reptile bones from these sites with carefully screened data from St. Mary's City (Table 12) fails to reveal any notable differences in the recovery of these bones and tends to support the belief that the data from these sites are not unduely biased.

This difference in recovery methods is a problem, one of which the writer has long been aware. The information from Bennett Farm, Drummond, the Maine, and Kingsmill Tenement does not appear to differ appreciably from the screened St. Mary's data although some loss of small bone remains from these sites seems inevitable. Because this bias does not

Table 12: Comparison of Bone Recovery By Class

Site	Mammal%	Bird%	Fish%	Reptile%
St. John's I	57.46	1.65	39.98	.90
Pope's Fort	56.93	8.45	34.27	3.30
St. John's II	88.39	6.53	2.98	2.00
Drummond I	79.31	6.93	10.59	3.15
Drummond II	55.76	5.15	37.97	1.10
Bennett Farm	38.62	2.04	59.11	.21

does not seem to be great, and preservation of bones at these sites was quite good, they will be used in the study but with the reservation that the recovery rates may be slightly different.

Data from the Kingsmill sites of Pettus and Utopia, in contrast, had very few bird, fish, or reptile remains, and the size of bones in the collection was significantly biased toward medium and large animals. These differences were recognized during the analysis. Hence, data from these sites can only be used in the comparison of large and medium mammals and they will be excluded from many of the following discussions for this reason.

Methods of Analysis

Of the 15 sites included in this study, all but two were analyzed by the author. Michael Barber (1978) studied the Maine site materials and Joanne Bowen (1979) analyzed the faunal remains from the Clifts Plantation site. While methods will always vary slightly between individual researchers, it has been established through conversations with Barber and Bowen and by statements in their reports that the methods they employed are comparable with those used by this author. Some of their meat calculations have been adjusted to conform with the other sites, but this is the only change considered necessary before adding their findings to the data base.

All faunal data was analyzed by provenience unit. Materials from strata in a pit were recorded separately, but if no temporal differences were apparent, the data from that feature was combined and treated as a single unit. Working procedures were as follows. All bags of material from a provenience unit were combined and sorted into identifiable and unidentifiable components and some attempt was made to find recent excavation-produced breaks. The materials unidentifiable to genus or species were then sorted into zoological classes of mammal, bird, fish, reptile, amphibian, and crustacean, or an undetermined category, each was counted, and rebagged. Identifiable bones were then divided into classes and subgroups by size. Beginning with the largest mammals, generally cattle, the bones were grouped by element and an attempt was made to link unfused epiphyses with their respective bones. No effort was expended to find glue fits between bone elements unless the breaks were of modern origin. The type, side, degree of development, and other attributes of the bone were then recorded on a form.

The primary comparative collection used in this analysis was one developed by the author and housed at the St. Mary's City Commission. Access to larger samples of mammal, bird, and reptile skeletons was provided by the Divisions of Mammals, Birds, and Reptiles, United States National Museum, Smithsonian Institution, Washington, D.C. These extensive collections were invaluable in the accurate identification of the rarer species and provided essential data on the range of variation present in the more common animals.

In spite of these excellent resources, it was still not possible to identify many bones to the species level. Among the domestic animals, sheep and goats are remarkably similar and are therefore referred to as sheep/goat throughout this study. It is also very difficult to distinguish 17th Century domestic turkeys from wild specimens. Because of the apparent abundance of wild turkeys in the early Chesapeake, and the sparsity of references to domestic ones in estate inventories, all turkeys are counted as wild. Wild birds can be extremely difficult to tell apart, especially ducks. Many duck species can only be distinguished through careful study and consideration of size variation. For some, such as the mallard and black ducks, it is not possible. Hence, while every effort was made to identify the ducks as accurately as possible, errors are unavoidable; identification of several of the duck species should be regarded as best guesses rather than positive species attributions.

Fish also offer a challenge because of the variety of species found in the Chesapeake and the lack of any large comparative collections. Through construction of a collection of the principal species by the author and use of the small collection at the Division of Fishes, Smithsonian Institution, it was possible to identify most of the fish bone. Some remains have probably gone unrecognized due to the absence of extensive comparative material but these can only be a very small number.

A major problem addressed during this phase of the analysis is determination of cultural as opposed to naturally deposited bone (Thomas 1971). To resolve this, the following criteria were employed. Only bone that came from contexts that were clearly of cultural deposition were utilized. This was determined by the presence of domestic artifacts such as ceramics, bottle glass fragments, and pipe stems in association with the faunal materials. In addition, significant numbers of bones in an assemblage had to display evidence of butchery, burning, or other alteration. A few strata contained bones but few other artifacts, the bones displayed no evidence of butchery, and most were of inmature individuals. These bone deposits may not be of human creation and, since they did not meet the above criteria, they were excluded from the analysis. While burials of animals are often the result of human activity, they have not been included in this study because the animals were not eaten and could potentially bias the faunal data recovered from other contexts.

Finally, bones which displayed radically different weathering from others in a sample were noted and usually omitted from the analysis on sites of long term occupation. The longer a site is occupied, the greater the potential that older materials will become mixed with newer bones during the process of deposition. While these bones were originally deposited by cultural activity, their presence in a feature is probably due to redeposition and thus bears no temporal relationship to the other materials. It is not always possible to identify these elements and the potential for contamination of faunal assemblages from later phases at long inhabited sites is recognized. Methods of identifying such contamination is clearly a subject that deserves further study.

Faunal Quantification

In order to derive greater insight from the faunal assemblage, the analysis must be taken beyond the construction of a species list. The data must be quantified and converted into forms that can yield meaning. Several methods are available for this including fragment counts, bone weight, bone measurement to estimate the live weights of the animals, and the minimum numbers of individuals. Each of these has merits and drawbacks.

The fragment count is the most elementary method of quantifying and evaluating an assemblage, and it has been critized several times (cf. Chaplin 1971; Grayson 1979). Fragment counting assumes that all species are equally represented with no differential breakage or preservation to bias the sample. The method also gives as much importance to a femur of a rabbit as that of a cow, although they are clearly not of equal importance in the diet. Nevertheless, the fragment count can provide insight. When data from multiple sites are to be compared, the method is of value because it can reveal general patterns of resource usage.

Some faunal analysts have suggested that weighing the bone and converting the weight into a meat figure provides a useful method of determining the importance of a species (Reed 1963; Uerpmann 1973). Recently, a refinement of this technique using allometric scaling has been proposed and utilized to a limited extent (Casteel 1978; Wing and Brown 1979; Reitz 1979; Reitz and Honerkamp 1983). Difficulties with this approach are twofold. First, comparability can be a problem at a single site due to differential leaching and demineralization of bone. When attempting to compare sites over an entire region with different soils, hydraulic conditions, and depositional environments, comparability becomes an even more significant problem. Although most bones in the Chesapeake samples were well preserved, variations in weight of the same elements of a species were observed between features during analysis. Some of this may result from the cooking method to which the bone had been subjected (Chaplin 1971: 15-18, 68-69), but it is even more likely that small variations in soil ph and water percolation rates between features will result in differing degrees of decalcification. Also, since some bones are more dense and heavier than others (metapodials and teeth as opposed to scapulas), a concentration of heavy bones in one assemblage and light weight bones in another due to chance could produce quite different results. Equally serious is the problem of which meat weight conversion figures to use. Do either simple weight conversions or those based upon allometry make accurate predictions for 17th Century livestock if the baseline data derive from modern, improved breeds? It is undeniable that recent animal breeding efforts with cattle and swine have produced significant changes in biomass distribution relative to bone. An even more practical and immediate problem is that the data necessary to employ this method are unavailable for most of the sites in this study. Hence, due to the major problems of data comparability, and other questions regarding this approach, it is not utilized here.

The final method of estimating the relative importance of species has several variants but is based upon determining the minimum number of individuals ("MNI") represented in a faunal assemblage, and calculation of the meat weights they would have provided. The MNI method was first introduced by White (1953) and has been modified by Chaplin (1971). Problems associated with this method derive from several sources including differences in the way the MNI figure is calculated, the units used in analysis, and sample size variation (Grayson 1973, 1978; Casteel 1977; Lyman 1982). When the same methods and units of analysis are employed and sample sizes are similar, however, this method offers results that are quite comparable from site to site, assuming that preservation and other factors are controlled. It is perhaps the most widely used method for estimating species importance (cf. Cleland 1966, 1970; Guilday 1970; Smith 1975; Bowen 1975; Barber 1976; Mudar 1978; Shapiro 1979).

An alternative to the minimum numbers of individuals method has been proposed by Binford (1978) and Lyman (1979) which purports to yield better estimates of species importance. Instead of individual animals, the alternative method focuses upon an estimated minimum number of "butchery units" or "anatomical parts" represented in a bone assemblage such as a forelimb, shank, or hindquarter. The method is claimed to provide more reliable meat figures because it only accounts for meat represented by the actual bones in a sample. Both Binford and Lyman argued that the MNI method provides less accurate data because hunters may only carry choice portions of a kill back to camp or, in a complex market economy, individual cuts may be purchased from a butcher. In either case, estimating the meat available from an entire animal will not yield correct figures of what was actually consumed. In spite of the logic of this, there remains a number of problems with such a method that are yet to be resolved. For example, how are butchery units defined that have relevance for the culture being investigated? How many bones or bone fragments are required before one anatomical portion can be considered present? And what meat figures should be used for each butchery unit? Lyman uses data for 20th Century livestock which is almost certainly inaccurate for the primitive, unimproved livestock of the

17th and 18th Centuries. Despite these unresolved problems, Binford and Lyman correctly address a most thorny problem -- the differential utilization of an animal. Accordingly, every faunal analyst must consider carefully the probable nature of the food supply available to a site's occupants before selecting the analytic method used to determine species importance.

Fortunately, historical and archaeological data provide a clear answer to this problem for the 17th Century Chesapeake. As discussed in the previous chapter, households in this region were not involved in a market food economy but were generally self-sufficient farms or "plantations." They grew tobacco for a market but only purchased manufactured goods, salt and luxury items such as spices and liquor - not basic foodstuffs - from Europe and the West Indies. Contributing to the necessity for self-sufficiency was the dispersed settlement pattern that tended to isolate households, especially in newly settled areas. Little evidence exists for active local markets, even in the major settlements of St. Mary's City and Jamestown. Some local exchange undoubtedly occurred between plantations, and there was some selling of food as ship provisions, but there is no evidence for large scale, organized marketing of food. In Earle's study of All Hallow's Parish, Maryland (1975:64-68), he found that not one commercial butcher is reported for the entire colonial period. Given these facts, it seems likely that animals were typically slaughtered at plantations and consumed in their entirety by these households.

Such a proposition can be tested with archaeological data. If home butchery and consumption were practiced, all skeletal elements from animals should be found at those sites. Where a market existed, more meat rich bones might be expected at domestic sites, but there would be few hoof elements, mandibles, and other butchery waste. Differential breakage may render some elements less identifiable than others with the result that they will be present in lower frequencies. Of course, samples will tend to vary, but all elements should be at least minimally represented at sites. To test this, bone data from selected sites of various time periods were gathered for cattle and deer and are presented in Tables 13 and 14 respectively. The results clearly indicate that all elements from these species are found at the sites. Examination of the bones from other mammals, birds and fish reveals that all portions of their skeletons are also regularly encountered at sites. Since both the historical and archaeological data indicate that animals were slaughtered and consumed on-site in the Chesapeake, the minimum number of individuals method is judged to be the most appropriate for this study and will be employed here.

The minimum numbers of individuals ("MNI") was calculated at two analytic levels - the feature and the site. One method of MNI determination was used for all features and all but two of the sites. The procedure follows that outlined by Chaplin (1971). Individuals were determined by grouping elements by species, type, and side; taking

Table 13: Cattle Bones By Major Skeletal Elements

Element	Pope's Fort	Kingsmill Tenament	Wills Cove	Pettus Plant.	St. John's Phase II
Skull	19	116	43	89	118
C.Vertebra	8	17	14	22	7
Scapula	2	9	14	24	12
Humerus	1	5	3	17	8
Radius/Ulna	11	9	7	22	7
Metacarpal	-	4	5	22	14
Phalanges	16	44	18	48	32
T.Vertebra	4	6	3	9	5
L.Vertebra	14	4	8	25	5
Pelvis	2	7	10	25	10
Femur	2	3	5	23	3
Tibia	5	2	6	19	9
Calcaneous	3	3	5	14	1
Astragalus	2	4	3	18	3
Metatarsal	1	4	9	26	11

Table 14: Deer Bones By Major Skeletal Elements

Element	Pope's Fort	Kingsmill Tenament	St. John's Phase I	Wills Cove
Skull	6	10	31	10
C.Vertebra	5	4	2	1
Scapula	16	1	13	-
Humerus	11	2	5	1
Radius/Ulna	11	10	15	4
Metacarpal	-	2	4	-
Phalanges	8	3	1	-
T.Vertebra	4	-	-	-
L.Vertebra	6	-	2	-
Pelvis	9	1	2	1
Femur	8	5	7	2
Tibia	14	6	18	1
Calcaneous	1	4	4	-
Astragalus	1	4	5	1
Metatarsal	1	4	4	-

into account size, age, and sex differences, and arriving at the minimum number which could account for the assemblage. Analysis of both long bone development and dental eruption/wear criteria were utilized. Within each sample, all bones from a particular genus or species were inspected and a comparison of the elements was performed to assure an accurate MNI calculation.

Grouping of materials at the site level varied according to the length of the occupation. For short term occupations (less than 30 years in most cases), all feature materials were considered as one sample and were combined to form the population from which an MNI figure was derived. At sites where the occupation extended over a 50-100 year period and was divided into phases, all feature materials from the same phase were combined for MNI determination. It should be stressed that site or phase MNI figures are not simple multiples of the individual feature calculations; site and phase MNI figures were calculated independently. While each feature probably contained the bones of different animals, this cannot be assumed.

This procedure was used for all features and sites except Pettus and Utopia. Insufficient space was available to lay out the large quantities of bone from these sites at the same time. Also, since each bone was not individually labeled by provenience, there was no mea pable of yielding MNI data were measured using the methods presented by von den Driesh (1976). The total site calculations were then made by reference to the notes and measurements.

Estimating Consumed Meat Weights

In converting MNI data for a species to meat weights, it is assumed that all edible portions of an animal were consumed. Lyman (1979) has pointed out the potential error of such an assumption but it is considered valid for the Chesapeake region. The British, along with much of Europe, traditionally consumed most portions of an animal from prime meat cuts to skulls, lower legs, and organs (Anderson 1971; Wilson 1973). Blood was saved to make blood pudding and stomachs and intestines were utilized to hold boiled puddings and sausages. This tradition was carried by the colonists to the Chesapeake. The 19th and early 20th century Maryland descendants of these early settlers are known to have followed a similar practice, consuming nearly every portion of an animal (Morgan 1977; Stone 1977). Archaeological data also support this assumption; butchery marks and evidence of intentional breakage have been seen on bones from every portion of an animal's body, even phalanges and mandibles.

Meat weights assigned to each individual are averages for a species, derived from published zoological data, values widely used in zooarchaeological literature, data regarding specimens in comparative collections at the St. Mary's City Commission and the Smithsonian Institution, and information collected from local Chesapeake fishermen. These are listed and discussed in Appendix II. Although some techniques are available that permit estimation of the live weight of an individual through bone measurement (Casteel 1974, 1976;

Emerson 1978), these "precise" methods are not considered appropriate. In the rare instances where archaeologists can isolate the remains of a single meal or a few days' meals (cf. Huggins 1970:91-94), precise estimation of the animals live weight would be of considerable value. However, most archaeological bone assemblages represent the accumulation of many meals over weeks, months, or even years with many different animals being consumed over such a period. It is assumed that a given bone sample from a site is representative of the diet over the period of deposition, and usually, due to limited samples, to a much longer span of time. During that period, it is reasonable to assume that the animals will display a degree of variation in weight. Both domestic and wild species vary in weight due to genetics, age, sex, and season of the year, and the actual individuals incorporated into the diet will display this. Placing too much emphsis upon the live weights of measurable individuals within a specific deposit, while displaying analytical virtuosity, fails to consider that animals of different sizes were no doubt taken. Indeed, if the bones of a particularly large or small individual happen to be present in a particular assemblage, precise live weight data could skew the overall interpretation. An equally serious problem with this method is that bones sufficiently intact to yield good measurements cannot be relied upon to be present in every feature. Such anomalies become quite serious when attempting to compare a number of sites. In addition, the relationship between live weight and bone dimensions has not yet been worked out for all species. Due to these factors, it is likely that the use of average weight figures will yield better results and will also provide a standardized means of comparing sites.

One of the most crucial problems that must be resolved before meat weights are calculated is deciding which animals were actually consumed. Clearly, 20th Century values concerning what animals are edible cannot be automatically applied to a past context. Fortunately, historical data are available which identify species not regarded as edible by the 16th-18th Century British. Simoons (1961) has summarized most of this, and other data can be gleaned from the writing of William Harrison (1968), William Shakespeare, and the Virginia colonists. Animals not considered food species include horses, dogs, cats, rodents, ravens, crows, buzzards, falcons, hawks, wolves, foxes, frogs, and snakes. A good listing of the things the English considered repulsive foods comes from the "Witches Brew" Shakespeare describes in the play MacBeth. Ingredients included toads, newt, frog, bat, dog, snake, lizard, wolf, shark, baboon blood, and tiger. Descriptions of "The Starving Time"in Virginia add further evidence of those animals that were culturally unacceptable as food. Hunger was so "sharp" that the colonists were forced to eat "Doggs, Catts, Ratts, Snakes, Toadstooles, and Horse Hides", and even human flesh (Tyler 1907:423). Clearly, these were animals only to be consumed in the most extraordinary circumstances. The evidence is sufficient to exclude these species from consideration as food animals.

Seasonality

Another goal of analysis is to identify any seasonal variation in the diet. To detect such variation, discrete faunal assemblages deposited over a relatively brief time are necessary. On colonial Chesapeake sites, which are unquestionably occupied year round, such data can only be derived from features. This assumes that features would not be filled at the same time each year and thus, have the potential to reveal any seasonal shifts in subsistence behavior which occurred.

Fortunately, the Chesapeake region has an abundance of seasonal indicator species; data concerning the more prominent ones are presented in Appendix III. One major group is the many migratory waterfowl that pass through the area in the spring and fall of the year. Since the Chesapeake Bay is an integral part of the Atlantic Flyway, the bones of these animals can be excellent indicators of the season of feature filling. Fish are also valuable because most of them enter the Chesapeake in the late spring and depart in the fall. Even fish that remain in the bay throughout the year display some seasonal behavior; they either migrate to deeper water or stop feeding during the winter months and are therefore difficult to obtain. Reptiles and amphibians hibernate during the winter and thus, tend to be unavailable during that period. The presence or absence of these species in a feature can therefore enable the season of deposition to be established with varying degrees of confidence.

A second method of seasonal determination is by identifying the season in which some non-migratory animals died. Analysis of the growth lines on oyster shells, for example, will permit the identification of the time of their harvesting and death to within a few months (Kent 1984). The season in which male deer were killed can be determined by studying the degree of antler development. The time at which young mammals died can be roughly determined through study of the degree of tooth development since birth (Silver 1963).

Any of these indicators can yield clues regarding when a pit was filled but establishing the season of deposition with any degree of certainty requires careful consideration of all the available data and potential biases. Several factors can complicate seasonal identification. A pit may not be completely filled and sealed in any one season but may remain open for many months and contain a mixture of indicator species. Only detailed study of the stratigraphic profile and the associated artifacts can provide control over this problem. Another difficulty is the potential for accidental mixture of materials during the filling process. Soil that was shovelled or that had eroded into a pit may contain a few bones from earlier in the occupation and of a different season. The possibility of such admixture occurring obviously becomes greater with the increasing length of site occupation. Due to these potential problems, it is imperative that a range of evidence be considered before the fill period is estimated. To aid in this task, the following criteria were established and utilized throughout the study.

a. Artifacts from a feature should reveal no temporal differences between the strata. If so, the strata must be considered separately. In addition, there should be no stratigraphic indications that the pit stood open for a long period.

b. Several different seasonal indicator species should be present for the most reliable seasonal estimates.

c. If only one indicator species is present, however, it must be well represented by bones and by multiple individuals.

By employing these criteria, some control over admixture problems is achieved and trustworthy seasonal determinations are possible.

Livestock Aging Methods

Livestock husbandry methods utilized at a site are an integral part of subsistence behavior. One of the basic means of investigating this with faunal materials is by determining the ages at which animals were slaughtered. This information can be obtained by two means: 1)long bone development and epiphysial fusion, and 2)tooth eruption and wear. Chaplin's methods (1971) can be used to tabulate the number of long bones of a species with fused or unfused epiphyses and the frequency of animals by age group can then be calculated. Bone fusion ages, and tooth eruption and wear data are obtained from Silver (1963). Inferring husbandry practices is difficult under the best of circumstances, but by carefully weighing all the evidence from multiple sites, valid insights regarding this importance aspect of human subsistence may be obtained.

With this review of the data base and analytic methods completed, it is now time to turn attention to what actually happened in the 17th Century Chesapeake colonies and to test the hypotheses regarding subsistence presented in the first chapter.

CHAPTER 6

SUBSISTENCE AND CULTURAL IMPOVERISHMENT

In the earlier chapters, information regarding the British subsistence heritage of the colonists, the ecology of the Chesapeake Bay region, and the nature of 17th Century Chesapeake society has been presented. These data provide an essential foundation from which to investigate the trends of cultural change and stability in the 17th Century Chesapeake. They are now put to use with the historical and archaeological evidence outlined in the previous chapter to test the six subsistence hypotheses.

The first hypothesis is

> **During colonization, subsistence practices will tend to be less complex and less specialized than contemporary practices found in the homeland.**

This hypothesis is derived from the predicted frontier characteristics of cultural impoverishment and a labor shortage. A small population of settlers faced with the tremendous task of establishing themselves in a new setting is hypothesized to be unable to support the more specialized and complex activities which occur in the homeland. The lack of craftsmen and the simple nature of the Chesapeake economy has already been noted in Chapter 4, but what about subsistence practices?

First, a review of the nature of British subsistence can identify characteristics that might be expected to change with colonization. The British subsistence system was based upon intensive animal husbandry and agricultural methods. Livestock were carefully managed. They were often watched during the day and, were returned to folds, cowpens, barns, or sties in the evenings. Fodder was cut and stored along with grains such as oats to feed them during the winter. Farmers erected barns, sties and sheep sheds to protect the animals during the winter. These practices served to maintain the health of the stock and yielded a better return for the farmer (Trow-Smith 1957; Thirsk 1967). An intensive, plow-based agricultural system was utilized with careful rotation of fields, regulation of livestock grazing to help fertilize the fields, and cultivation of multiple grain crops. The colonization model suggests that these complex animal husbandry practices and agricultural methods would be simplified in a frontier setting. Were these practices simplified in the Chesapeake? Unfortunately, archaeological data cannot be brought to bear on this question but the historical record provides a variety of relevant evidence.

All sources agree that the colonists brought their domestic animals and plants with them to America. Cattle, swine, horses, and poultry thrived in the new environment. These same data indicate that the colonists not only simplified, but largely abandoned most of the British husbandry practices. Cattle, swine, and horses were allowed to run free with little control over their movements. Numerous estate inventories from the Chesapeake area bear witness to this practice. For example, inventories from Southern Maryland taken in the 1660s told there were

> 2 cowes with calves and one Steere of about fower years ould in the woods and not seene by the appraysers.(SMCC #30)
>
> Item Two Bulls in ye Woods.(SMCC #116)
>
> ...also all the Stock of hoggs, being unable att present to make appraisement thereof, the most part being in the woods (SMCC #284).

In 1679, it was necessary before appraising Thomas Stagg's estate to hire two men for two full days to find and to "gett up ye Cattle Hoggs and Horses at Chaptico to be Seed" (SMCC# 526). Identical references to animals "in the Woods" are found in other inventories from throughout Maryland and Virgnia. Livestock were distinguished by natural markings as well as by distinctive patterns of cuts and punctures on the ears. Apparently, a few colonists attempted to pen their livestock in the early years of settlement and the more wealthy hired cowkeepers to tend them (Morgan 1975:136). These attempts to replicate British practice quickly ended and nearly every planter turned to the woodland pasture type of husbandry. A similar use was made of the open woodlands in Britain but animals in that situation were tended during the day and returned to enclosures at night (Thirsk 1967).

All evidence from the Chesapeake indicates that the livestock, with the possible exception of horses, were rarely given any care, and were neither tended nor provided with shelter. Thomas Glover wrote in 1676 that Virginia cattle:

> Might be larger than they are, were the inhabitants as careful in looking after them as they in England are. All that they give their Cattle in winter is only the husks of their Indian Corn...neither do they give any more of these than will keep them alive, by reason thereof they venture into the marshy grounds and swamps for food, where very many are lost (Glover 1904:18-19).

A Protestant minister, John Clayton, lived in Virginia during the 1680s and was appalled at the poor husbandry practices of the colonists. He wrote regarding the planters

> But tis strange in how many things besides they are remise, wch one would think English men should not be quilty of. They neither house nor milk any of their cows in Winter...(1965:88).

Clayton continued to offer suggestions as to how husbandry could be improved and complained that the colonists collect little or no fodder for the animals, and only gave them a little corn during the winter. Clayton also confirmed Glover's observation that many cattle were lost in the spring when they tried to reach new grass in the marshes.

A French traveler to the Chesapeake in 1687 wrote regarding livestock that

> ...it costs nothing to keep or feed them, they do not know what it is to mow hay, Their animals all graze in the woods or on untilled pasture of their plantations, where they seek shelter nightly rather by instinct than from any care given them (Durand 1934:123).

This nearly maintance-free method of husbandry became a standard Chesapeake practice. It continued almost unchanged into the early 18th Century when Robert Beverley, a native Virginian, wrote regarding cattle that:

> I can't forbear charging my Countrey-men with exceeding Ill-Husbandry, in not providing sufficiently for them in Winter, by which means they starve their young cattle, or at least stint their growth, so that they seldom or never grow as large as they would do, if they were well manag'd ...(1947:203).

Beverley indicated that swine were treated in the same manner and given little care for

> Hogs swarm like Vermon upon the Earth, and are often accounted such...The Hogs run where they list, and find their own support in the Woods, without any Care of the Owner (1947:318).

Clearly, animal husbandry was quite different from that practiced in Britain. It is notable that the British winters, which necessitated the yeoman to cut and store fodder and erect structures to protect his livestock, were in fact no harsher than winters in the Chesapeake. Colonists did castrate male cattle and swine because steers and barrows are noted consistently in the inventories. But with only a few such exceptions, the colonists seem to have largely practiced a husbandry of neglect. A simpler and less labor intensive method of livestock management is difficult to imagine.

While cattle and swine were mentioned in most inventories and other 17th Century Chesapeake documents, sheep were virtually absent. This is of note because sheep had been such an integral element in British subsistence. Of

45 St. Mary's County, Maryland inventories from the years 1638-1665, only 3 inventories listed sheep. Evidence from Charles and Calvert Counties, Md. and York County, Va. inventories reveal the same situation; sheep were extremely rare during the early 17th Century. In Virginia, goats were apparently kept in some numbers during the first years of settlement and, as late as 1619, no sheep were listed in the Virginia colony (Rolfe 1971:14-15; Pory 1907:284). This situation had changed by 1638 when Virginian Richard Kemp gave Lord Baltimore ten ewes and a ram from his own flock (Kemp 1638).

Wolves were apparently a major factor in the absence of sheep. Thomas Glover noted that "As to sheep, they keep but few, being discouraged by the wolves, which are all over the Country, and do much mischief amongst their flocks" (1904:19). John Clayton confirmed this in the 1680s when he noted that a few sheep were being kept by the wealthy but the animal "hitherto has not been much regarded, because of the Wolves that destroy them..."(1965:106). Archaeological support for these statements comes from a ewe skeleton found at the St. John's site. The ewe was missing most of her hind quarters and the nature of the bones strongly suggested that she had been killed by wolves (Miller 1978).

Wolves had been present in medieval England and they were still found in Scotland during the 17th-century (Harrison 1968), but this did not stop the British from raising sheep in huge numbers. Why then did the colonists not succeed at raising sheep? The probable reasons are labor shortages and time commitments. Sheep could have been raised in the Chesapeake with little difficulty if the labor had been so allocated. The colonists, however, chose to emphasize tobacco production; they did not invest their limited labor in the management of sheep. Only animals that required a minimal labor investment, and were able to defend and care for themselves, became integral elements of the early Chesapeake subsistence system.

Agricultural practices are another aspect of subsistence that might be expected to experience simplification. Historical evidence suggests that the agricultural system adapted by the colonists was a technological step backward. Human labor replaced the work of oxen and horses; the hoe replaced the plow; and a simple, swidden agriculture replaced the complex field systems used in the homeland. Even in late 17th Century Virginia, agriculture was described in this manner:

> It is but in very few places that the Plow is made use of, for in their first clearing they never grub up the stumps, but cut the trees down about two or three foot from the Ground; so that all the roots and stumps being left, that ground must be tended with Hoes, and by that time the Stumps are rotten, the Ground is worn out, and having fresh land enough...they take but little care to recruit the old Fields with Dung (Hartwelll, Blair and Chilton 1964:9).

The near absence of plow agriculture in the early 17th Century Chesapeake is clearly expressed by estate inventories. For comparison, inventories from the

c. 1635-1665 period in St. Mary's County, Md., Essex County England (Steer 1969), and Gloucester County, England (Moore 1976) were studied and the number of households with plows was tabulated. In the Essex sample of 37 inventories, 18 of the households (48.6%) had plows while ten of 30 Gloucester households (33.3%) owned them. In Maryland, a sample of 42 inventories is available but only one plow is listed in any of them. Significantly, that single plow was owned by Lord Baltemore.

The hoe was the agricultural tool of the Chesapeake and it was employed in a long-term fallow system of cultivation. There are a few late 17th Century references to the fertilization of small plots of land by the penning of cattle (Clayton 1965:86; Michel 1916:32), but the standard practice seems have been to let the soil naturally regain its fertility through reforestation. This method stands in marked contrast to the British system where an animals manure was often prized as much as the animal itself and livestock pasturage was therefore carefully regulated (Trow-Smith 1957; Thirsk 1967). The complex British agricultural practices were unnecessary given the abundance of land in the Chesapeake, and, due to the labor shortage, such methods were not practical.

Not only were British agricultural methods largely abandoned, but so was the production of multiple grain crops. Early attempts to grow English grain in Virginia met with some success (Hamor 1957; Rolfe 1971) and nearly every promotional tract describes the abundance of traditional British grains in the colonies (Hammond 1963: Shrigley 1963). As early as 1629, however, most of the planters seem to have focused upon "Indian Corn" or maize. John Smith noted that the colonists "finde the Indian Corn so much better than ours, they beginne to leave sowing it [wheat, barley, oats] (Smith 1910:886). This emphasis upon corn continued and John Banister wrote in the late 1680s that "...the staff of the Country is Mayze or Indian Corn; with it the great part of the Inhabitants are supported..."(1965:356). Household inventories also support this; barrels of corn are listed quite commonly while wheat, except for very small quantities, is rare. The Frenchman Durand in 1687 addressed the question of why more corn than wheat was grown. He wrote that:

> In the County of Gloucester [Va.] wheat generally yields ten to one; Indian Corn Two Hundred to one; the farmers reap only about a bushel of wheat each on their plantations for making pies...As for barley, they grow little of it...In some places Indian corn yields as much as Five Hundred to one, which I could not have believed had I not seen it (Durand 1934:115).

He asked the planters why they did not grow more European grains such as wheat and:

> They answered it yielded but ten to one, whereas Indian Corn gave at least two hundred to one...(Durand 1934:115).

Corn was apparently a more productive crop in the Chesapeake environment than wheat. Corn yielded a much greater return for the labor and, because it was not broadcast sown like the English grains, it did not require equipment such as plows, harrows, and reap hooks. In other words, corn was a simpler and more efficient crop that well suited a labor and equipment-short frontier setting.

Gardens and orchards were also planted by the colonists and promotional literature mentioned their productivity. While the same plants were raised in Britain, there is some indication that the colonists gardens and orchards were not as well maintained. A Dutch traveler to the upper Chesapeake in 1679 reported that:

> A few vegetables are planted, but they are of the coarsest kind, and are cultivated in the coarsest manner, without knowledge or care...(Danckaerts 1913:134).

A Swiss visitor at the beginning of the 18th Century also commented that "The inhabitants pay little attention to garden plants, except lettuce..."(Michel 1916:32). Danckaerts (1913:137) noted that the orchards "...all bear well, but are not properly cultivated". Thomas Glover (1904:15) also emphasized the abundance and productivity of orchards and wrote that this occurred "...without any pains-taking of digging about them, or pruning them" as was done in England (1904:15).

Thus, each of these documentary sources reveals that the husbandry and agricultural practices of the Chesapeake colonists were less complex than those in Britain, and in most cases, they were markedly so.

Food processing and preparation are other aspects of subsistence that are expected to undergo a loss of complexity on the frontier. Pertinent data are difficult to obtain archaeologically, but household inventories again offer an alternative. From these listings of household goods, it is possible to determine whether equipment to perform specific tasks was available, and thus how common these activities might have been in the community. Examples were again taken from two areas of England and St. Mary's County, Md. The English inventories come from Essex County in the eastern lowlands region (Steer 1969) and from Gloucester County in the West Country (Moore 1976). All inventories were taken from the same general time period (1630-1665). Since all of the Maryland inventories are from self-sufficient plantations, only English inventories that appear to have been of food producing, reasonably self-sufficient English households were selected to ensure data comparability. The presence or absence of the following equipment was noted:

a. Dairying Equipment (Milk Pans, Butter Pots, Churns)
b. Cheesemaking Equipment (Cheese Press, Cheese Wringer)
c. Boiling Equipment (Kettles, Pots, Skillets)
d. Frying Equipment (Frying Pan)
e. Roasting Equipment (Spit, Dripping Pan)

The findings are presented in Table 15. As was discussed in Chapter 2, dairy products, especially cheese, were staples of the English diet. Most farm households maintained a dairy and processed milk into butter and cheese (Fussel 1966:1971). The British inventory data support this statement. All but a small number of the households had some facility for processing milk and over two-thirds of the households could

Table 15: Foor Processing and Preparation Equipment

	England				Maryland	
	Essex (1635-1665) N=37		Gloucester (1625-1665) N=30		St. Mary's (1638-1665) N=42	
	#	%	#	%	#	%
Dairying	31	83.78	26	86.66	13	30.95
Cheese Making	24	64.86	22	73.33	2	4.76
Boiling	37	100.00	30	100.00	41	97.62
Frying	17	45.94	13	43.33	29	69.04
Roasting	29	78.37	22	73.33	16	38.09

make cheese. Although these inventories are from the opposite sides of England, both areas show similar proportions of dairying and cooking equipment. The Chesapeake sample is significantly different. Less than one third of the Maryland households had dairying equipment and only two households possessed cheese making equipment.

This lack of cheese making equipment implies that this activity was not widely practiced in the Chesapeake and other data support this. In 1672, nearly forty years after the founding of the colony, Governor Charles Calvert wrote to his father, Lord Baltimore, that he could not find decent cheese anywhere in Maryland. With the exception of one skilled woman:

> Noe other housewife in Maryland can [provide any] for the Cheeses Generally made here are soe Ranke and soe full of

> Eyes that yo' Lordship would be angry with me should I send such... (Calvert 1672:263).

Travelers accounts also indicated that good cheese could not be found in the Chesapeake (Danckaerts 1913:135; Durand 1934: 122). The Swiss traveler Michel wrote in 1701 that "Butter is also made as needed . But most of the people Know nothing of cheese" (1916:36). This specialized activity that was widespread in Britain and that provided a staple item in the British diet was largely abandoned in the Chesapeake. Why did this happen?

Cheesemaking cannot have been abandoned because the colonists lacked cattle. Indeed, there are more cows with calves in the Chesapeake inventories than there are in English inventories. One likely factor is the composition of the Chesapeake population. Women traditionally did the gardening, cooking, and dairying in Britain (Hole 1953; Fussell 1971) and, as John Hammond stated in 1656, women in the Chesapeake colonies:

> ...occupie such domestique imployments and housewifery as in England, that is dressing victuals, righting up the house, milking, imployed about dayries, washing, sowing, ec. (1910:290).

A serious shortage of women existed in the 17th Century Chesapeake, as noted in Chapter 4, and it is possible that there were simply few women in the colony who could make cheese. A rigid sexual division of labor existed in the 17th century and there were probably few men skilled in dairying since this was a female task. It seems likely that there was a shortage of people with the skill to produce good cheese.

Although most dairying activities are not especially complex activity, making anything more than soft cottage cheeses is more demanding. Cheesemaking requires the addition of rennett, careful monitoring of the process, and the slow pressing of the whey from the cheese until the correct moisture content is achieved. Making hard cheese requires not only skill but time. With the many other laborious tasks a woman had to do -- tending the fire, cooking meals, tending the garden, washing, milking -- cheesemaking may have required too much labor to be carried out in most households. The more wealthy households could probably afford the labor to conduct this, but for most planters, this seems to have been a British practice that was inappropriate on the Chesapeake frontier.

Evidence regarding cooking equipment reveals that, as in England, boiling was the most common method of cookery in Maryland. In many plantation inventories, an iron pot or small kettle is the only piece of cooking gear present. This is not unexpected because boiling is the easiest, least demanding method of food preparation. It is also an appropriate means of preparing corn and beans, two widely consumed crops in the Chesapeake colonies. The frying and roasting utensils, however, show some surprising differences. Frying pans are more common in the Maryland inventories than in those from England, while roasting gear is less frequent. Reasons for these differences may also lie in the availability of labor and cooking skills. After boiling, frying is the easiest method of food preparation and it is also the quickest. Little skill is required to fry. Frying permits food to be prepared in a very short amount of time, and in small quantities appropriate for small frontier households. Roasting in the traditional manner, on the other hand, is a longer process, requires frequent attention and some skill. To roast over an open fire, the cook must have the skill to properly regulate the size and intensity of the fire, and know when to turn the meat, how often to baste it, and when it is cooked thoroughly (Harriet Stout: Personal Communication). Unlike a gently simmering pot of stew, a roast cannot be left unattended for long periods in open hearth cookery. The effort and time required for roasting over an open hearth made it less appropriate on the labor short frontier. The lack of skilled cooks due to the sexual division of labor and the skewed sex ratio probably compounded this problem. In such a situation, an emphasis upon one pot boiled meals and fried foods is to be expected.

In a detailed study of 17th Century foods and dining habits using Virginia inventories, Maryellen Spencer concluded that in comparison to England:

> Virginia's cuisine was rough and rudimentary, lacking technical complexity and aesthetic refinement...(1982:264).

Her statement is precisely in keeping with the findings discussed above, and summarizes well the culinary standards of the early Chesapeake.

All of the evidence discussed here indicates that the 17th Century Chesapeake subsistence system was less complex and elaborate than that found in the colonists' homeland. The wealthier planters may have retained more of the traditional British practices, but nearly everyone seems to have employed the woodland pasture form of husbandry, used hoe agriculture in a long-term fallow system, and dispensed with at least some of the more complex methods of food processing. Most planters seem to have prepared their food in a straight forward, non-elaborate manner. All this evidence reflects a significant simplification of the subsistence system in comparison to that of the homeland. Therefore, the available data strongly support and appear to confirm the first hypothesis.

CHAPTER 7

CHANGING ADAPTIVE STRATEGIES

This chapter explores the adaptive strategies employed by the colonists in their struggle to adapt English culture to the Chesapeake environment and the adaptation which emerged as the colonization process terminated. The first of two hypotheses to be tested here states that :

> **The Adaptive Strategy developed during the early phases of settlement will be of the diffuse type when compared to that of the homeland.**

The colonization model predicts that, in the early phases of settlement, the adaptive strategy will focus upon a broader range of resources than that which was utilized in the homeland. A broad, multiple resource strategy is thought to provide greater security in uncertain environments. A number of species should be exploited with a variety of procurement strategies and these species should be utilized in a scheduled manner. The colonist, however, may not practice a fully diffuse strategy as defined by Cleland (1976); it may be a relative increase in niche width in comparison to the homeland's strategy.

The second hypothesis to be tested concerns the evolutionary trends in subsistence predicted to occur as the colonizing culture adapts to new environmental conditions and develops a stable and appropriate adaptive strategy for that setting. The hypothesis is that:

> **As the available lands are occupied and the population grows, emphasis will be increasingly placed upon dependable resources which can be intensively exploited; gradually the adaptive strategy will become more focal.**

Some food resources will be found on a frontier that are quite dependable and can withstand a high degree of exploitation due to abundance and a high reproductive rate. Other resources, however, may have a much lower depletion threshold. As the colonial population increases, and additional pressure is put on these resources, their availability will quickly decline and the costs of their exploitation will increase. The predicted response of the colonists to this situation is a concentration upon the the more dependable and efficiently exploited natural resources, such as fish, and/or those species for which production can be controlled, i.e. domestic animals. Given the British subsistence heritage with its emphasis upon domestic animals, it is likely that these species would be one focus of the colonists. These responses should result in the emergence of an adaptive strategy that is more specialized and focal in nature with a concentration upon a few major species that provide both a stable and secure food supply.

To investigate these hypotheses, the archaeological data from the previously discussed Chesapeake sites will be utilized. For temporal control, the samples have been divided into three general periods: Period 1 (1620-1660), Period 2 (1660-1700) and Period 3 (1700-1740). Animals identified in the samples from each of these periods are summarized along with their scientific names in Table 16.

From the Period 1 samples, a total of 51 different animal types was identified. Domesticated animals were cattle, swine, sheep or goat, chicken, horse, dog and cat. Forty-four wild species are found in these collections. Mammals include white tailed deer, raccoon, opossum, gray fox, gray squirrel, fox squirrel, woodchuck and cottontail rabbit. Birds were well represented with 18 types identified. Among these are Canada goose, turkey, brant, eight types of duck, passenger pigeon, double crested cormorant, red tailed hawk, and bald eagle. Fish were also numerous. The 11 species found include Atlantic sturgeon, striped bass, catfish, sheepshead, black drum, and white perch. Turtles were present in the samples with five species identified. The most common of these were the eastern box turtle and the snapping turtle. Only one crustacean, the blue crab, was recovered.

From the Period 2 assemblages, many of the same animals were found. Additional animal types were gray wolf, several types of birds such as the coot, a loon, turkey vulture, and bobwhite. Two types of turtles which occur only in this phase are the diamondback terrapin and the Atlantic loggerhead. Some of the same species occurred in Period 3 samples. Additional animals were owl, yellow perch, domestic goose, and a pigeon or dove.

Table 16: Animals Identified From Chesapeake Sites
(By Temporal Period)

Animal	Period 1	Period 2	Period 3
DOMESTICS			
Cattle (*Bos taurus*)	X	X	X
Swine (*Sus scrofa*)	X	X	X
Sheep or Goat (*Ovis aries* or *Capra hirca*)	X	X	X
Horse (*Equis caballus*)	X	X	X
Dog (*Canis familiaris*	-	-	X
Cat (*Felis domesticus*)	X	X	X
Chicken (*Gallus gallus*)	X	X	X
Goose (*Anser domesticus*)	-	X	X
Duck (*Anas* sp.)	-	X	-
Pigeon/Dove (Columbidae)	-	-	X
WILD MAMMALS			
White Tailed Deer (*Odocoileus virginianus*)	X	X	X
Beaver (*Castor canadensis*)	X	-	-
Raccoon (*Procyon lotor*)	X	X	X
Opossum (*Didelphis marsupialis*)	X	X	X
Fox Squirrel (*Sciurus niger*)	X	X	X
Gray Squirrel (*Sciurus carolinensis*)	X	X	X
Gray Fox (*Urocyon cinereoargenteus*)	X	X	X
Woodchuck (*Marmota monax*)	X	X	X
Cottontail Rabbit (*Sylvilagus floridanus*)	X	X	X
Gray Wolf (*Canis lupus*)	-	X	X
Rat (*Rattus* sp.)	-	X	X

Table 16: continued

Mouse (Cricetidae)	–	–	X
WILD WATERFOWL			
Canada Goose (*Branta canadensis*)	X	X	X
Brant (*Branta bernicla*)	X	–	–
Goose (*Chen* sp.)	X	–	–
Mallard/Black Duck (*Anas* sp.)	X	X	X
Redhead Duck (*Aythya americana*)	X	–	–
Shoveler Duck (*Spatula clypeata*)	X	–	–
Scaup Duck (*Aythya marila* or *affinis*)	X	–	–
Pintail Duck (*Anas acuta*)	X	–	–
Ringneck Duck (*Aythya collaris*)	X	–	–
Canvasback Duck (*Aythya valisineria*)	X	–	–
Blue Wing Teal (*Anas rubripes*)	X	X	X
Green Wing Teal (*Anas carolinensis*)	–	X	–
Baldpate Duck (*Mareca americana*)	–	X	–
Coot (*Fulica americana*)	–	X	–
Double-Crested Cormorant (*Phalacrocorax auritus*)	X	–	–
Loon (*Gavia immer*)	–	X	–
Bald Eagle (*Halioetus leucocephaalus*)	X	–	–
WILD TERRESTRIAL FOWL			
Turkey (*Meleagris gallopavo*)	X	X	X
Bobwhite (*Colinus virginianus*)	–	X	X
Grackle (Quiscalus quiscula)	–	X	X

Table 16: Continued

Passenger Pigeon (*Ectopistes migratorius*)	X	–	X
Mourning Dove (*Zenaidura Macroura*)	X	–	–
Turkey Vulture (*Cathartes aura*)	–	X	–
Red-tailed Hawk (*Buteo jamaicensis*)	X	–	–
Red-shouldered Hawk (*Buteo lineatus*)	X	–	–
Barred Owl (*Strix varia*)	–	–	X
Crow, Jay ? (Corvidae)	–	–	X
Woodpecker (Picidae)	–	–	X
FISH			
Sturgeon (*Acipenser oxyrhynchus*)	X	X	X
Striped Bass (*Morone saxatilis*)	X	X	X
White Perch (*Morone americana*)	X	X	X
Catfish (*Ictalurus* sp.)	X	X	X
Brown Bullhead (*Ictalurus nebulosus*)	X	X	–
White Sucker (*Catostomus commersoni*)	–	X	–
Longnosed Gar (*Lepisosteus osseus*)	X	X	X
Toadfish (*Opsanus tau*)	X	–	–
Sheepshead (*Archosargus probatocephalus*)	X	X	X
Black Drum (*Pogonias cromis*)	X	X	X
Red Drum (*Scianops ocellata*)	X	X	–
Sea Trout (*Cynoscion* sp.)	X	–	–
Ray or Skate (Rajidae or Myliobatidae)	–	X	–
Yellow Perch (*Perca flavescens*)	–	–	X

Table 16: continued

TURTLES			
Eastern Box Turtle (*Terrapene carolina*)	X	X	–
Snapping Turtle (Chelydra serpentina)			
Cooter Turtle (*Pseudemys* sp.)	X	X	–
Painted Turtle (*Chrysemys picta*)	X	–	–
Musk Turtle (*Sternotherus* sp.)	X	–	–
Diamondback Terrapin (*Malaclemys terrapin*)	–	X	–
Atlantic Loggerhead (*Caretta caretta*)	–	X	–
Mud Turtle (*Kinosternon* sp.)	–	–	X
OTHER			
Toad (*Bufo* sp.)	X	–	X
Spadefoot Toad (*Scaphiopus holbrooki*)	X	–	–
Water Snake (*Natrix* sp.)	–	X	–
Blue Crab (*Callinectes sapidus*)	X	X	X
Oyster (*Crassostrea virginica*)	X	X	X

X = Present — = Absent

<u>Measures of Niche Width</u>

One means of determining the adaptive strategy used at a site and how the strategies varied between sites is to calculate the niche width. This concept has been discussed by Hardesty (1975:71) who refers to it as the "distinctive ways of using resources for subsistence that set cultural species apart". Integral to this concept are the number of resources utilized and how much dependence is placed upon each resource. One of the least complex means of calculating niche width is with the formula suggested by Hardesty (1975:77) which is:

$$\text{Niche Width} = 1/\sum_{1}^{n} (p_i)^2$$

where p_i is the proportion of the total subsistence base contributed by resource i and n is the total number of resources utilized. With this measure, a diffuse strategy should be indicated by a higher number (<u>i.e</u>. a broader niche width) while a focal strategy is suggested by a low number. Niche width estimates for the Chesapeake sites were calculated using the minimum number of individuals per species; these results are given in Table 17.

As predicted, some of the largest niche widths are found in the Period 1 group with the Maine, Kingsmill Tenement, and Pope's Fort all displaying this. Unexpectedly, however, the Chancellor's Point and Bennett Farm I assemblages of this same period have the smallest values found in the total sample of sites, suggesting that not all subsistence behavior was as predicted. The Period 2 sites

Table 17: Niche Width Estimates for Chesapeake Sites

Site	# Species	Niche Width
PERIOD 1 SITES		
The Maine	22	15.92
Kingsmill Tenament	30	21.42
St. John's I	18	6.89
Pope's Fort	28	11.90
Chancellor's Point	7	4.19
Bennett Farm I	15	2.71
PERIOD 2 SITES		
Drummond I	30	17.82
Wills Cove	18	12.39
Bennett Farm II	21	7.55
Smith's Ordinary	10	7.07
Baker's Ordinary	8	6.77
Drummond II	33	5.53
Clifts I	13	4.62
PERIOD 3 SITES		
St. John's II	23	10.00
Van Sweringen's	8	6.26
Drummond III	17	9.13
Clifts III	12	6.85
Clifts IV	23	8.00
Bray	16	9.99

also display a wide range of variation. The Drummond I assemblage has an especially large niche width, but since this occupation is the first at the site and it partially overlaps with Period 1 (the occupation began about 1650), this is not completely unexpected. Overall, the niche width estimates appear to correspond to the predictions of Hypotheses 2 and 3, with the widest niche widths generally occurring earlier. The variation in width estimates between sites also displays a notable trend with the largest variability (2.71 to 21.42) in Period 1, a smaller range (4.62 to 17.82) in the Period 2 sites, and the smallest variation (6.26 to 10.00) in the Period 3 assemblages.

To determine whether these niche widths represent more diffuse strategies than the strategies employed in Britain, it is necessary to turn to British faunal data. Unfortunately, there are very few studies of 17th Century British assemblages available. Several small samples have been studied from Surry (Harman 1975:114-116), Southampton (Noddle 1975), and Essex (Chaplin 1970), while reports on large assemblages are available from two sites in Edinburgh, Scotland (Chaplin and Barnetson 1975, 1980). All of these were analyzed by Chaplin or used his methods (Chaplin 1971), and since the same methods have been employed in this study, the results of this analysis are comparable. Regrettably, the methods of bone recovery are not discussed in any of these reports and that variable remains an unknown factor. These sites, nevertheless, provide the best data currently available from Britain and they will, of necessity, be utilized here.

Domestic species predominate in all of the British assemblages with cattle and sheep comprising most of the individuals. One group from a privy in Essex is especially interesting because the bones are apparently from a single meal (Chaplin 1970). The entire remains of this particular meal, including dining equipage, were deposited in the privy in 1669, following a raid on the house by authorities for illegal activites. All of the bones in the assemblage were domestic and represent cattle, swine, sheep, chicken, rabbit and duck. The only non-domestic food reported were the shells of a dozen oysters. Another sample from Southampton further attests to the high domestic composition of the British diet. Species identified include cattle, sheep, swine, goat, chicken and teal, the only wild animal (Noddle 1975). Faunal remains from Richmond Palace, Surry (Harman 1975) included bones from cattle, sheep, chicken, and rabbit. The only wild creatures were a duck and a badger. Nearly all of the identified bones were from sheep and chicken.

The best samples come from the city of Edinburgh and date to the early 17th Century. The species and MNI counts from the Tron Kirk and St. Mary's Street sites, along with the Southampton data, are presented in Table 18. Domestic bones make up most of these assemblages and in terms of MNI's, cattle and sheep predominate. Swine are very poorly represented as are wild species, of which there are only

Table 18: British Faunal Data and Niche Widths

	MNI's		
Species	Tron Kirk	St. Mary's	Southampton
Cattle	10	12	3
Swine	2	2	1
Sheep	44	26	3
Goat	–	2	2
Horse	1	1+	1
Hare	2	1+	–
Rabbit	1	1+	–
Cat	2	1+	–
Dog	–	1+	–
Chicken	6	–	1
Goose	3	–	–
Teal	–	–	1
Bird	–	1+	–
Fish	1+	2	–
Total	72+	52+	12
Niche Width	2.47	3.33	5.54

1+ = Animals only listed as present in reports.
Data From: Chaplin and Barnetson 1975, 1980,; Noddle 1975

hare, waterfowl and fish. The niche width estimates from these assemblages are low, and, in comparison to many of the Chesapeake sites, very low. It is unfortunate that more 17th Century British assemblages from rural sites have not been analyzed. The available data are mostly urban and hence, may not indicate of all British practices. However, this data is in keeping with the historical information regarding British subsistence, as discussed in Chapter 2. Therefore, while additional and more appropriate samples are desirable, these findings appear to match the historical data on British subsistence, and indicate that the Chesapeake subsistence strategy utilized many more species and had a much broader niche width than did the traditional strategy in the homeland.

This approach in measuring niche width has revealed differences between subsistence in the homeland and the colonies, but there are other means of calculating this statistic. The traditional measure of diversity, the Shannon-Weaver Information Statistic, can be used by defining niche width as a relationship between species richness (the number utilized) and species evenness (how evenly individuals are distributed among them), two variables which in principle are distinct.

The Shannon-Weaver formula is:

$$H = - pi (\ln pi)$$

where p is the relative proportion of the i'th species. A measure of evenness is derived from calculation of the maximum value H could have if for a given number of species, it is assumed that all the individuals were evenly distributed between the species. This is:

$$H\ max = -\ \frac{n/s}{n}\ \left(\frac{\ln n/s}{n}\right)$$

$$= -\ 1/s\ (\ln 1/s)$$

$$= -\ \ln s$$

where s is the number of species (richness) and n is the total number of individuals in all species (Vandermeer 1981:241). Evenness then becomes:

$$J = H/H\ max$$

$$= H/\ln s$$

Species richness and evenness can then be considered to be two potentially orthogonal components of niche width. If they were always positively correlated, then the diversity (H) measure could be used alone, but this is probably not always the case. Both will likely vary according to the nature of the adaptive strategy being employed and thus, the relationship must be empirically determined.

It is necessary, however, to recognize a potentially serious problem with these measures. Indices of both richness and evenness may be influenced by sample size. Indeed, Grayson (1981) has empirically demonstrated such a correlation for diversity. As sample size increases (here measured as the number of bones identified to a level more specific than zoological class) the chance for inclusion of more species in the sample also increases. This relationship allows for the prediction that there will be a positive correlation between sample size and richness. At the same time, since ecological communities and most species of animals are not evenly distributed (Pielou 1977: 269), most ecological situations as well as archaeological samples contain a few species in abundance while most species are relatively rare. Therefore, as sample size increases, so do the chances of sampling the rarer species. It is unlikely that these rare species will be represented by more than a few individuals, and thus the evenness estimate will decline accordingly. The expectation is that sample size and evenness will be negatively correlated in some manner.

Using the above formulas, species richness and species evenness were calculated for the 19 faunal assemblages using the SAS (Helwig and Council 1979) and SPSS software packages. The existence of a sample size effect was tested for using Spearman's r and in both cases, the values are in the predicted direction and are significant past the .01 level (Richness: r= .759, significance = .0002; Evenness r= -.785, significance = .0001). Without question, the estimates of richness and eveness are affected by sample size.

Scatter plots of these measures against sample size reveal that the relationship is linear. Among the Period 1 sites, Chancellor's Point and Bennett Farm were well below the trend in evenness suggested by the sample size effect. These two sites also had the smallest niche widths using the Hardesty formula. Above the trend line in richness were three Period 1 sites and one of the Period 2 sites (The Maine, Kingsmill Tenement, Pope's Fort and Drummond 1), the same sites that displayed the highest niche width indices with the Hardesty formula. These sites are truly less even and more rich than any of the others in the sample.

At the suggestion of Fraser D. Neiman, an attempt was made to statistically remove the effect of sample size bias on the two measures. Least-squares regression lines were fitted to both, with sample size as the independent variable. The slopes for both regressions were significantly different from zero past the .01 level (See Appendix VI for statistics regarding this and other tests). These regressions offer the best estimates of the sample size effects for these assemblages (Richness r-square= 0.446, Evenness r-square= 0.518). Therefore, residuals from these regression lines, it can be argued, offer the best estimates of richness and evenness with that effect removed.

A scatter plot of residual values for richness and evenness was constructed and is presented in Figure 11. A positive relationship exists between these two measures for Period 1 sites. The Period 2 and Period 3 sites display little indication of any such relationship. Period 1 sites also display the greatest variation in distribution. Their

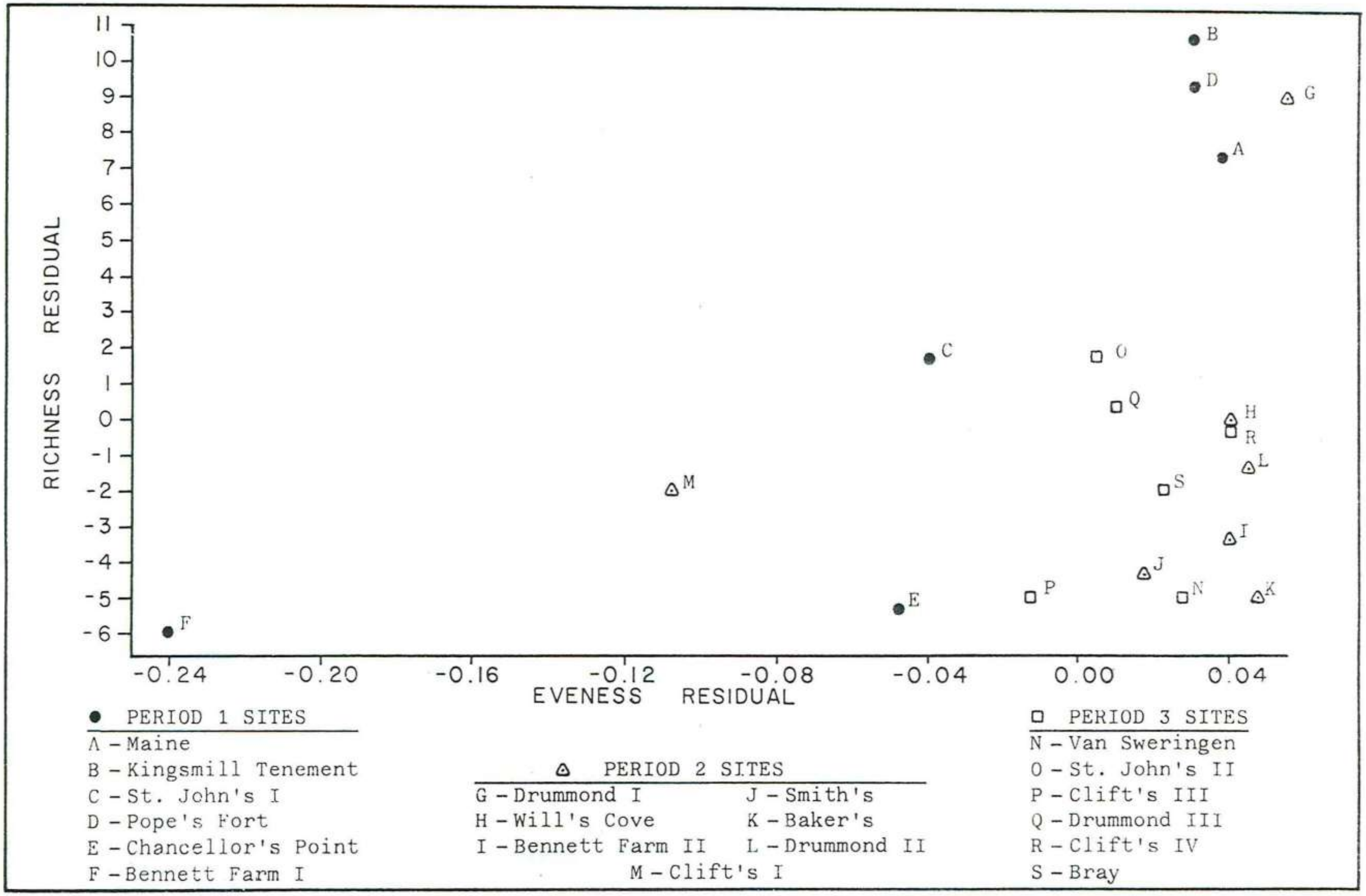

Figure 11: Plot of Richness and Eveness Residuals Based Upon M.N.I. Counts

distribution can be perceived as a continuum of diversity. The early sites in the upper right corner of the graph have both the greatest richness and the highest evenness of any sites in the sample. These sites, The Maine, Kingsmill Tenement, Pope's Fort and Drummond I, evidence a reliance upon a broad variety of species including small mammals, birds, and fish, in short, a more diffuse strategy. Further along this continuum, a display of moderate richness and evenness is shown by St. John's I. At the bottom of the scale are the sites of Chancellor's Point, Bennett Farm I and the Period 2 site of Clifts I. These sites have low richness and the lowest evenness of any sites in the sample. These indices apparently represent strategies that concentrated upon the exploitation of a few species. Examination of the identified species and MNI's from these sites (see Appendix I) suggests that the principal focus of subsistence was upon three species of large, bottom dwelling fish, the sheepshead, black drum, and red drum.

The dichotomy between diffuse and specialist strategies among the early sites is surprising. The variation provides strong evidence that a diffuse strategy did occur at most sites during the early decades of settlement. Many different species were integrated into a generalist strategy at the early sites (The Maine, Kingsmill Tenement and Pope's Fort) a strategy that appears to have provided security through diversity. The low diversity at other early sites, however, suggests that more specialized adaptive strategies were also employed during this period. At each site, certain species of fish account for a substantial portion of the MNI's. This fish-oriented strategy may have been developed as an alternative in the Chesapeake as the dependability of the estuarine resources became known.

In contrast, the Period 3 and most Period 2 assemblages tend to be less rich than the samples from the Period 1 generalist sites. The variability between sites is small compared to the earlier sites and a clustering effect is apparent. Subsistence may have become more specialized and have focused upon a smaller number of species. Most of the households employed this strategy, a trend that was predicted by Hypothesis 3.

The above findings appear to generally support the predictions of the hypotheses, but there is a potentially serious problem with this approach. The traditional means of measuring diversity is based upon the MNI count. This measure ignores the differences in the sizes of species, an obviously crucial variable when evaluating human subsistence patterns. With the MNI approach, one cow is equally as important as a small gray squirrel. Clearly, this can create difficulties in assessing the actual importance of species in subsistence.

Fortunately, as Hardesty (1975) has pointed out, there are other means of calculating diversity. The most appropriate in this instance is the estimated pounds of meat provided by a species. Of course, the meat estimate is also based upon the MNI count and is subject to the same problems, but it has the benefit of adequately compensating for the natural size differences between species. Therefore, the estimated meats provided by each of the species identified at the sites were subjected to the same statistical procedures to calculate richness and evenness.

To test for a sample size effect, Spearman's r was again employed and it was found to be significant past the .01 level and in the directions predicted (Richness r = .7518, Evenness r = -.5640). Scatter plots of richness and evenness against sample size revealed that the relationship was again linear. Least-squares regression equations were calculated for each with sample size as the independent variable. This calculation revealed that sample size accounted for less of the variation in evenness (Richness r-square = .427, Eveness r-square = .256), but the slopes for both equations were still significant at the .01 level. Residuals from the richness and evenness equations were then plotted against each other. The result presented in Figure 12 is quite different from the MNI plot. One of the most readily apparent changes is that while the Period 1 sites still display evidence of a relationship between richness and evenness, it is negative. The distribution of sites, however, remains similar with the three earliest occupations (Maine, Kingsmill Tenement and Pope's Fort) an obvious group at the upper end of the graph. Drummond 1 still displays the characteristics of these early sites. St. John's I remains

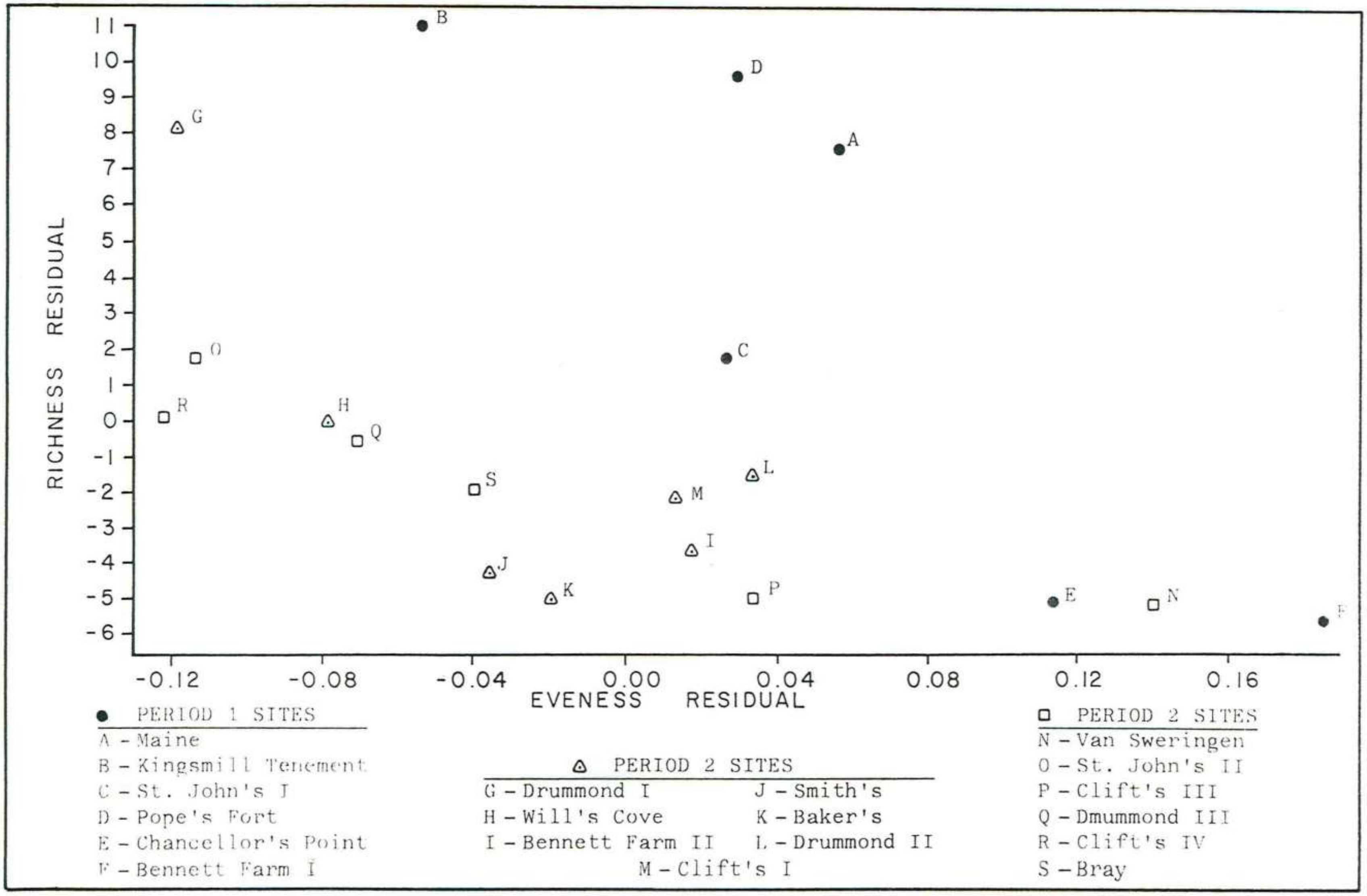

Figure 12: Plot of Richness and Eveness Residuals Based Upon Meat Estimates

in the center while at the bottom is found Chancellor's Point and Bennett Farm I. Thus, the overall distributional characteristics of the Period 1 sites have not changed but the nature of their relationship and their interpretations have. The earliest sites display high richess but their evenness is near the trend line and is thus lower than suggested by the MNI residuals. The two specialist sites display the highest evenness, whereas they had been the lowest in the sample for evenness.

Both of these differences exhibit a correlation, but why should meat weights give a negative correlation while the MNI relationship was positive? The answer relates to the types and sizes of animals exploited by the colonists. Every site yielded, in varying proportions, the remains of cattle, swine and deer - the largest bodied mammals available; together they accounted for over 60% of the estimated meat at all sites. Hence, subsistence richness was increased in the Chesapeake environment through the inclusion of smaller animals. With many small animals added to subsistence, evenness will decrease because of the bias imparted by the large mammals, and thus, a negative relationship between richness and evenness is found. At Kingsmill Tenement, the Maine and Pope's Fort, cattle, swine, and deer predominated in terms of meat but not in terms of MNI. Nearly all of the other species, with the exception of sturgeon, were small creatures, each contributing only a few pounds of meat.

In contrast, at Chancellor's Point and Bennett Farm I, the assemblages are characterized by low richness and high evenness. Fewer species are found at these sites and nearly every species makes an important meat contribution. In both cases, large bottom-dwelling fish and the large mammals account for nearly all of the estimated meat. Thus, a specialization upon select, dependable resources seems to be evident at these sites.

The distributions of Period 2 and 3 sites are still difficult to distinguish, but there is some indication of a negative correlation for the Period 3 assemblages. This visual impression is produced by the St. John's II, Clifts IV, and Drummond III assemblages located on the left side of the graph. These sites have higher richness and lower evenness indices than any of the other Period 3 sites and most of the Period 2 sites. While this might suggest a broadening of resource usage in the early 18th Century, another possibility must be considered. It may not be coincidence that each of these assemblages is from the final phase of long occupations. A process that is certain to occur on long, intensively occupied sites, but that is seldom given any consideration, is redeposition. The longer and more intensively a site is occupied, the greater the chances that earlier materials will find their way into later deposits. The effect of this on faunal materials would be the addition to the assemblage of a few elements from different species that represent one or two individuals. For species that remain abundant in these later assemblages such as cattle, the inclusion of a few earlier bones would probably not significantly alter the MNI counts. For example, the number of swine might be raised from 10 to 11. For poorly represented speices, however, the earlier materials could significantly change the MNI estimates, such as raising the number of sheepshead from none to two. Richness at the sites would be increased while evenness would be lowered.

It is essential to recognize the operation of this phenomenon, even if it is difficult to account for it. If it occurred, such a process will be best evidenced by the appearance of other well dated artifacts from earlier phases in late contexts. At both the St. John's and Clifts sites, this unquestionably happened. Ceramics from the first phase of occupation at both were found in later pits. Data from the Drummond site are not available to determine whether a similar situation occurred, but it seems likely. Therefore, the richness indices for these three late sites are probably artifically inflated due to a recognizable but hard to control taphonomic process. This suggests that these assemblages are less rich and more even than indicated by the residual plot.

This exercise has revealed that there are substantial differences between the assemblges in this sample. The Period 1 sites display the greatest variation and tend to cluster into two groups representing different adaptive strategies. One is a generalist approach that is in keeping with the prediction of a diffuse strategy on the frontier while the other appears to be more specialized than expected. Most Period 2 and 3 assemblages, on the other hand, are notably less rich and less variable than the earlier samples. This suggests that, overall, subsistence became more uniform and focal through time.

The MNI and meat weight residual plots produced different results but the overall interpretations are similar. In both, the distinction between the early generalist and specialist sites is apparent, as is the greater uniformity of the later sites. These differences are so pronounced that they were even recognizable with the simple Hardesty formula for niche width. These statistical procedures have detected patterning that would have gone unrecognized by a consideration of diversity alone. The use of MNI counts and meat weights to measure eveness provides different perspectives on subsistence and each method is of value. The meat weight residuals arguably yield a more detailed and accurate measure since they deal with a variable of more direct relevance for subsistence than the MNI -- the amount of food an animal represents in the diet.

Seasonality In Subsistence: 1620-1660

While the estimates of niche width indicate that early 17th Century subsistence strategies tended to be diffuse, additional evidence for a diffuse strategy should be found in the seasonal variability of the diet. All subsistence systems undergo some seasonal variation because most plants and animals have seasonal cycles, but for people employing a diffuse strategy the carefully scheduled use of resources throughout the year is crucial. Only in this way can they exploit a wide variety of resources without rigid dependence upon any single item (Cleland 1976). Therefore, if the early colonists employed a diffuse adaptive strategy, evidence for marked variations in subsistence throughout the year should be present.

Archaeologically, the seasonal, scheduled use of resources will be indicated by variability in the composition of faunal samples. At permanently occupied sites, detection of this rests upon the assumptions that features filled at different portions of the year will contain the remains of animals utilized during that period and that these seasonal fill periods can be identified. Of course a feature may not be completely filled at one season of the year and bones from an earlier portion of the subsistence cycle could be mixed in. Moreover, if features are not closely associated in time, changes in the overall adaptation could be erroneously interpreted as seasonal changes. Despite these potential problems, it is probable that evidence for seasonal variations in the diet can be found in features that appear to have rapidly filled and which date to the same general period.

Feature data from four sites dating to the pre-1660 period are available (seasonality data along with species lists for each feature are provided in Appendix III). The earliest site is Kingsmill Tenement from which faunal materials from five pits have been analyzed. The artifacts were sufficient to date these pits to a relatively brief period (c. 1625-1650), but their precise sequence of deposition could not be determined. To gain some preliminary indication as to whether there are any seasonal differences between these units, the overall composition of the bone assemblage by zoological class is considered. See Table 19 below.

Table 19: Class Frequencies in Kingsmill Tenement Pits

Feature	Total Bone	Mammal%	Bird%	Fish%	Turtle%
425	261	12.26	24.90	54.90	8.42
154	302	67.88	2.65	15.56	13.90
369	203	83.74	7.88	4.43	3.94
393	1077	97.30	1.67	0.46	0.55
430	148	100.00	-	-	-

Even at this general analytic level, the degree of variation between these units is striking. Mammal bones display the largest range of variation but the frequencies of every class differ importantly from pit to pit. Such variation is expected to be found if the diet altered in a seasonal manner.

To determine the cause of this variability, the individual animals present in each feature must be studied. In order to link the differences to seasonality, various indicator species should be found in the pits. These are certain animals available only during specific portions of the year. The presence of different groups of seasonal indicators in each of the features, such as crabs and migratory waterfowl, would strongly suggest that the pits were filled at different times of the year. This was, in fact, found to be the case in most of the units and it was possible to assign seasonal depositional periods to them. The pits and their estimated fill periods are as follows:

Feature 425 = Late Summer to Fall

Feature 154 = Summer

Feature 369 = Spring to Summer

Feature 393 = Fall to Winter

Feature 430 = Most Likely Winter

Thus, the appearance of different seasonal indicators in these features strengthens the attribution of variation to seasonality in subsistence.

If the feature materials do represent different portions of the yearly subsistence cycle, as seems likely, the usage of mammals, birds, fish and other animals can be expected to differ; some indication of this has already been obtained from consideration of the class frequencies. To evaluate this, the bones identified to genus or species from each pit have been divided into seven groups: domestic mammals, domestic fowl, wild fowl, fish, turtle, crab and wild mammals. This division is based upon recognized ecological differences and, more importantly, the crucial distinction between domestic and wild food resources. To better assess the implications of these differences in terms of diet, the MNI counts for each species were converted to estimates of consumed meat. Since the samples are small, these meat estimates are probably not especially precise, but they can still provide a rough indication of the overall emphasis of subsistence at different portions of the year. The results of this investigation are presented in Figure 13 and Appendix III).

The proportions of both bones and meat vary substantially among these features. Figure 13 displays the percentages of animal groups by pit in the order suggested by seasonal indicators. The spring filled pit is at the top, the summer deposits are in the middle and the fall or winter deposits are at the bottom. The high degree of variation in resource exploitation is striking. In the spring deposit (Feature 369), domestic bones and meat predominate but wild species contributed over one third of the bones and estimated meat. The diversity of animals is even wider in the summer deposits (Features 154 and 425) and wild species contributed much of the meat in Pit 425. It should be noted that the domestic mammal meat estimates in Feature 154 and especially Feature 425 are probably much too high. Two cattle bone fragments in Feature 425 displayed some indications of

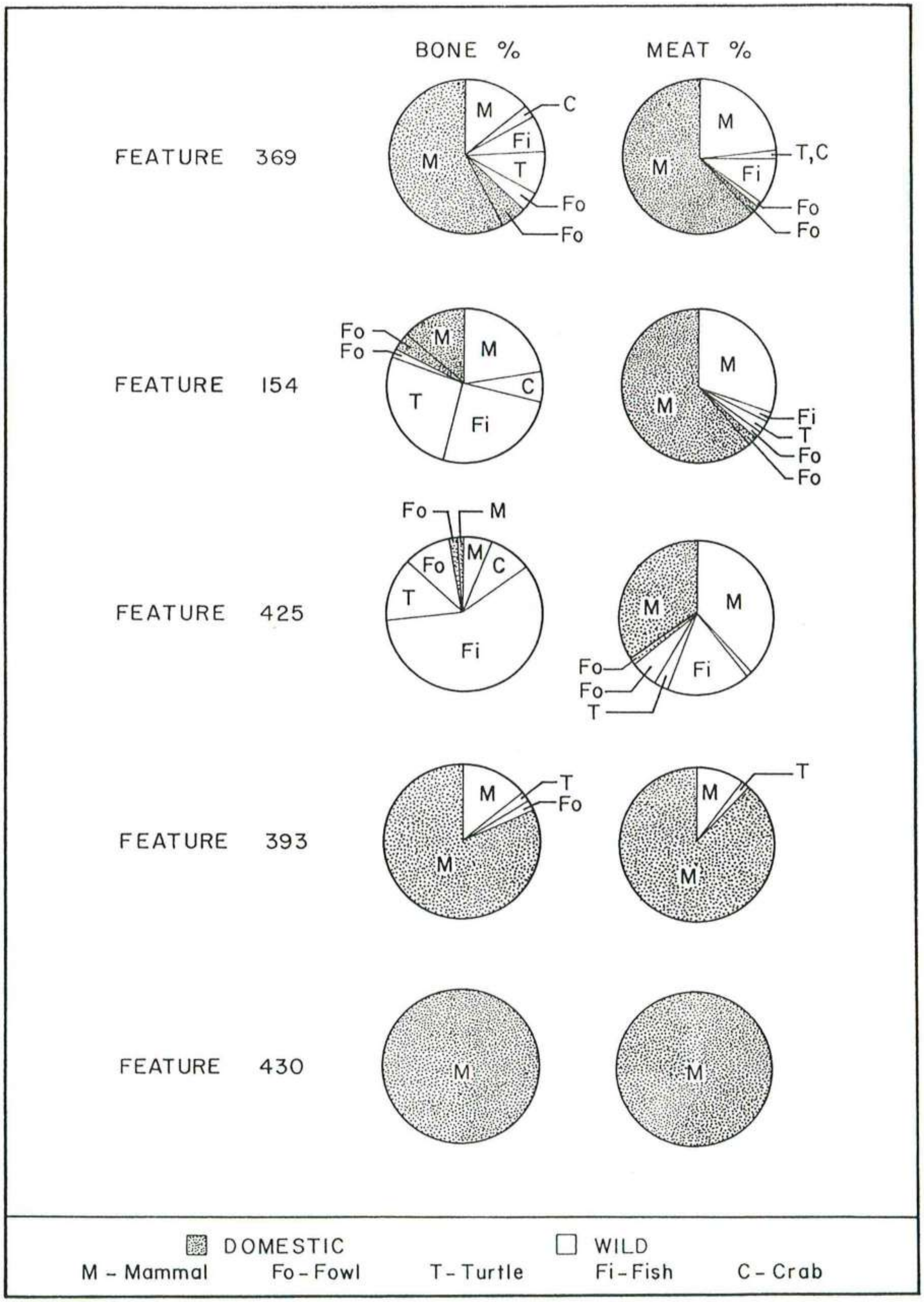

Figure 13: Bone and Meat Composition of Kingsmill Tenement Features

carnivore activity and almost certainly do not indicate that an entire cow was consumed at that time. This instance points to a limitation of the MNI method when used with small bone deposits. Hence, the domestic contributions for these two units are probably significantly inflated.

The fall-to-winter deposit (Feature 393) differs dramatically from the summer assemblages by a greatly reduced proportion of wild animal bones and meat. Only deer were of any significance. The total absence of wild species in Pit 430 can be interpreted as a continuation of the shift toward domestic resources in the fall to winter. Even if the Pit 430 assemblage is biased by unknown preservational factors, a condition not suggested by the bones, the overall trend is clear.

Therefore, all of the means of viewing these assemblages - class composition, seasonal indicators, bones identified, and meat estimates - reveal substantial differences between the samples. Since all the pits date to the same general time period and contain different seasonal indicators, it is reasonable to attribute this variability to seasonal differences in resource use. The magnitude of this shift is large, judging from the bone frequencies and meat estimates, and provides strong evidence that resources were utilized in a scheduled manner.

The subsistence cycle suggested by this data is as follows. In the early spring, reliance was placed upon domestic cattle and swine, probably in the form of preserved meats, with the consumption of some deer, raccoon, fish and wildfowl. With the approach of summer, an even greater emphasis was placed upon the exploitation of wild animals. Deer and small mammals continued to be of importance along with turtles, crabs and a variety of fish. The contribution of domestic species was relatively minor, especially considering the likely overemphasis of domestic meats in these assemblages due to analytic methods. Heavy usage of wild resources continued into the fall when migratory waterfowl were added to the diet. During the October-November period, a major shift in subsistence occurred with heavy reliance once again placed upon domestic resources. Late October to early December was the traditional time for livestock slaughtering in England (Anderson 1971) and documents (Spencer 1983:112), as well as the archaeological record indicate that this tradition continued in the Chesapeake. During this time of the year, deer were the only wild resource of importance although some wild meat may have been obtained through the trapping of beaver and raccoon. In general, the winter diet appears to have been overwhelmingly domestic in composition.

If subsistence did shift in such a scheduled manner, evidence for it should be found at other early sites in the Chesapeake. Bennett Farm is the only other Virginia site from this period from which feature data are available. One large multi-layered trash filled pit (Feature 28) from Bennett Farm dates to c. 1645-1660. Although there is apparently a mixture of materials in this feature, data from one major stratum (28A) appear to represent an unmixed summer

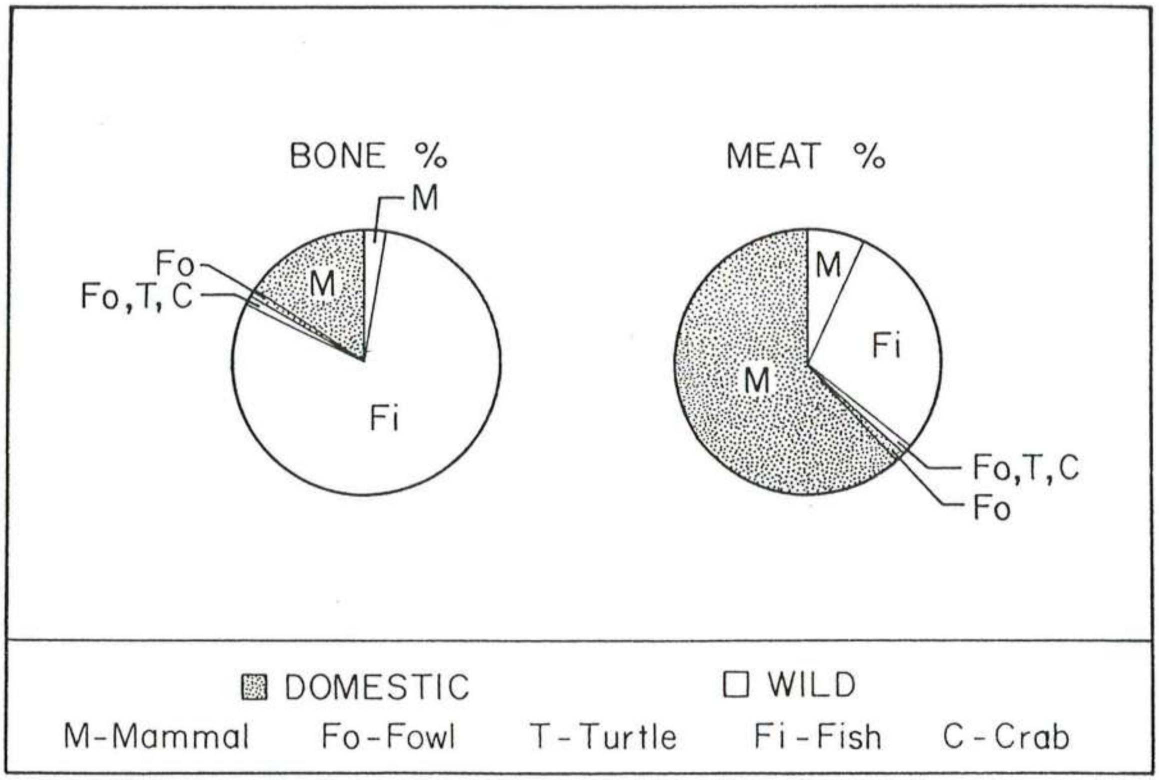

Figure 14: Bone and Meat Composition of Feature 28, Bennett Farm

deposit and are used here. Bone and meat proportions are illustrated in Figure 14 (See Appendix III for data). This assemblage indicates that, as at Kingsmill Tenement, the wild meat imput into the summer diet was extremely important. Wild animals account for over 85% of the bone and over 35% of the estimated meat. The earlier discussion of niche width indicated that a specialized strategy was utilized at this site. Importantly, nearly 28% of the estimated meat in this sample came from three species of fish - the sheepshead, red drum, and black drum. These species also accounted for over 80% of the bone. Domestic cattle and swine, however, contributed the majority of the meat. The proportions of wild to domestic meat seen here are almost identical to that found in the spring-to-summer assemblage (369) at Kingsmill Tenement. While the ecology of these two sites is different, the same pattern of resource usage, at least for the summer, is suggested at both.

Does this same pattern occur at early sites in Maryland? To answer this question, data from two pits at the St. John's site (dating ca. 1640-1660) and one apparently unmixed stratum from the Pope's Fort ditch (ca. 1645-50) are available. Unit 50M/50P from St. John's yielded remains of a variety of species and seems to have been filled sometime between the late summer and early winter. Nearby Feature 55C/G, originally a privy, was filled with refuse during the spring or early summer. The single stratum from the Pope's Fort ditch (1222N/P) contained many species, including a wide variety of migratory waterfowl, and the stratum seems to be a summer-to-early-fall deposit. Bone and meat compositions of these features are graphically displayed in Figure 15 while the species counts and seasonal evidence can be found in Appendix III.

The compositions of these units are comparable to those from the Virginia sites in that many different species are represented. Feature (55C/G), a probable spring deposit, shows a heavy reliance upon deer with some fish consumption. The domestic meat estimate from this feature is nearly 50%. Since domestic mammals account for only a tiny proportion of the bones (there are only two elements from the entire feature and both are of cattle), the possibility exists that

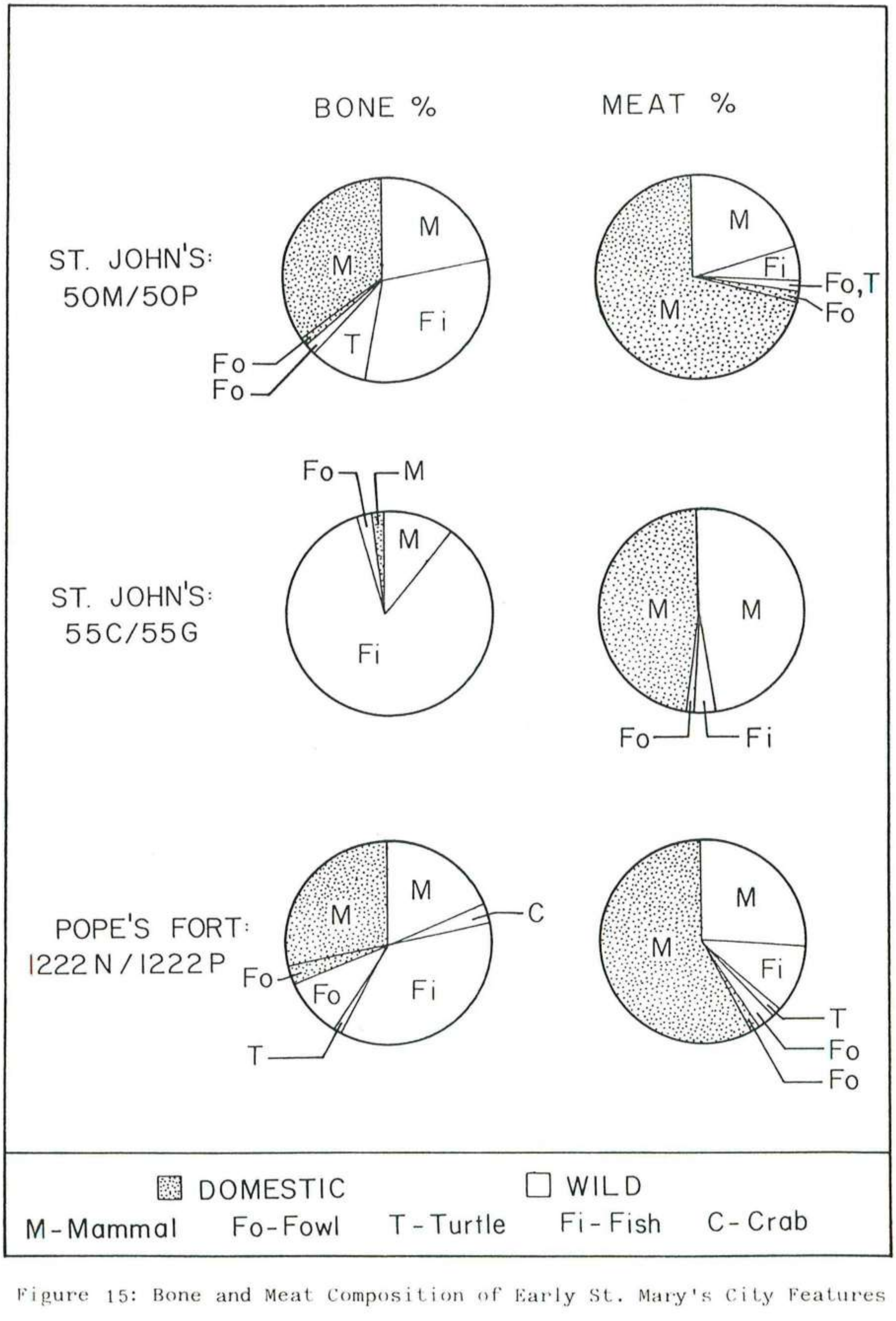

Figure 15: Bone and Meat Composition of Early St. Mary's City Features

the actual contribution of the domestic animals is greatly overestimated. The evidence, nevertheless, does indicate that deer and fish were of importance in the spring diet. The composition of the other assemblages suggests that the summer and early fall diets incorportated a wide variety of species from many sources; almost all of these species were wild. The meat estimates from 50M/P and 1222N/P are based upon substantial samples and indicate that deer and fish, especially sheepshead, were major components of the diet. The Pope's Fort sample appears more likely to be a summer to early fall deposition and the quantities of migratory fowl and fish are greater than seen in Unit 50M/P. Domestic animals constitute a larger proportion of the meat in Unit 50M/P and the seasonal indicators suggest that deposition in this feature continued to late November or longer. Therefore, while the St. Mary's data are slightly more limited than that from Virginia, the data are sufficient to demonstrate that similar variations in the diet occurred during the year. The summer was a period of heavy reliance upon wild food resources. Comparison of the Pope's Fort and St. John's features also indicates a trend toward greater domestic mammal reliance in the late fall.

Investigation of the feature data from early 17th Century sites in the Chesapeake reveals that the colonists did exploit resources in a seasonally varying, probably scheduled, manner. This evidence, along with the data concerning species richness and evenness presented earlier, appear to confirm that the adaptive strategy during the early decades of settlement was diffuse. Certainly the variety of resources far exceeded those used in England. Some early specialization upon certain resources such as deer and several species of fish is apparent but, in general, the data indicate that a diffuse strategy prevailed at most sites. This is as predicted, and hence the available data argue for the acceptance of Hypothesis 2.

Resource Depletion and Focal Adaptations

Hypothesis 3 predicts that the diffuse adaptation identified above would gradually shift to a focal adaptive strategy. As population grows, food requirements increase and additional pressure is placed upon subsistence resources. With a much larger population, many of resources upon which the colonists originally relied would not be sufficient to meet food needs. Depletion of some resources will almost certainly occur, and more abundant and dependable resources would probably be emphasized in the diet. Over time, the adaptation is predicted to concentrate upon a few highly reliable and efficiently exploited resources, so that a focal adaptive strategy will eventually emerge in the area of colonization.

A necessary step in evaluating this hypothesis is to ascertain that population increase and resource depletion did occur. The tremendous and rapid growth of the Chesapeake population has already been thoroughly discussed in Chapter 4 and need not be further explored here. Evidence regarding resource depletion, on the other hand, is harder to find.

A survey of a large number of 17th and early 18th Century documents has yielded few direct indications of depleted resources. A lack of documentation is not unexpected since depletion is a gradual process and probably attracted little attention. A few references of note, however, do exist. In 1705, Robert Beverely wrote that while much wildlife could be obtained, "Deer are commonly sold at eight, ten or twelve shillings a head, according to the scarcity"(1947:291). Since deer do not migrate, this implies that deer were more common in some localities than in others. Two decades later, Hugh Jones (1956:78) observed that:

> Their venison in the lower parts of the country is not so plentiful as it has been, though there be enough and tolerably good; but in the frontier counties they abound with venison, wild turkeys, etc.

The "lower parts of the country" to which he referred is the Tidewater area, which includes the area from Jamestown eastward, where all of the Virginia archaeological samples were excavated. Jones clearly indicated that the deer population had been depleted in the longest settled areas and left the impression that turkeys were also less available.

Archaeological evidence of the over-exploitation of naturally occurring resources is equally difficult to obtain. Nevertheless, one striking example from a 17th Century context emerged from a study of oyster shells found at the St. John's site in St. Mary's City (Kent 1980; Kent and Miller n.d.). Questions addressed in this study, included that of harvesting intensity. If the colonists were having an important impact upon the oyster populations near St. Mary's City, the study predicted that an increase in the intensity of harvesting would be reflected by a decrease in the size of oysters. The oysters would be harvested before they could grow to large sizes. To evaluate this, the height of the shells (i.e. the longest dimension) was measured from four features at the site: the privy (55C/G), the circular pit (50M/P), a large rubbish pit (75C/S), and the cellar of the main house. Together these samples span the site occupation from c. 1640- 1720. The results of this analysis are presented in Figure 16 which shows the distribution of oysters by modal size class against the human population. There is a strong inverse relationship between oyster shell size and human population size. Human population fluctuated during the first decades due to political turmoil, but from the 1650s onward, the number of colonists residing in the St. Mary's City area rose, and peaked just before 1695 at 200-300 inhabitants. When the capital was moved to Annapolis in 1695, the human population rapidly declined. Many of the remaining inhabitants left in the early 18th century when the county goverment moved to another location. This strong inverse relationship suggests that the colonists were having a substantial impact upon the local oyster populations through over-exploitation. Other explanations for this decline and sudden rise in shell size are unsatisfactory. Shell shape, an attribute that indicates the habitat from which the oysters were obtained, remained relatively constant throughout the century. No indication exists for any

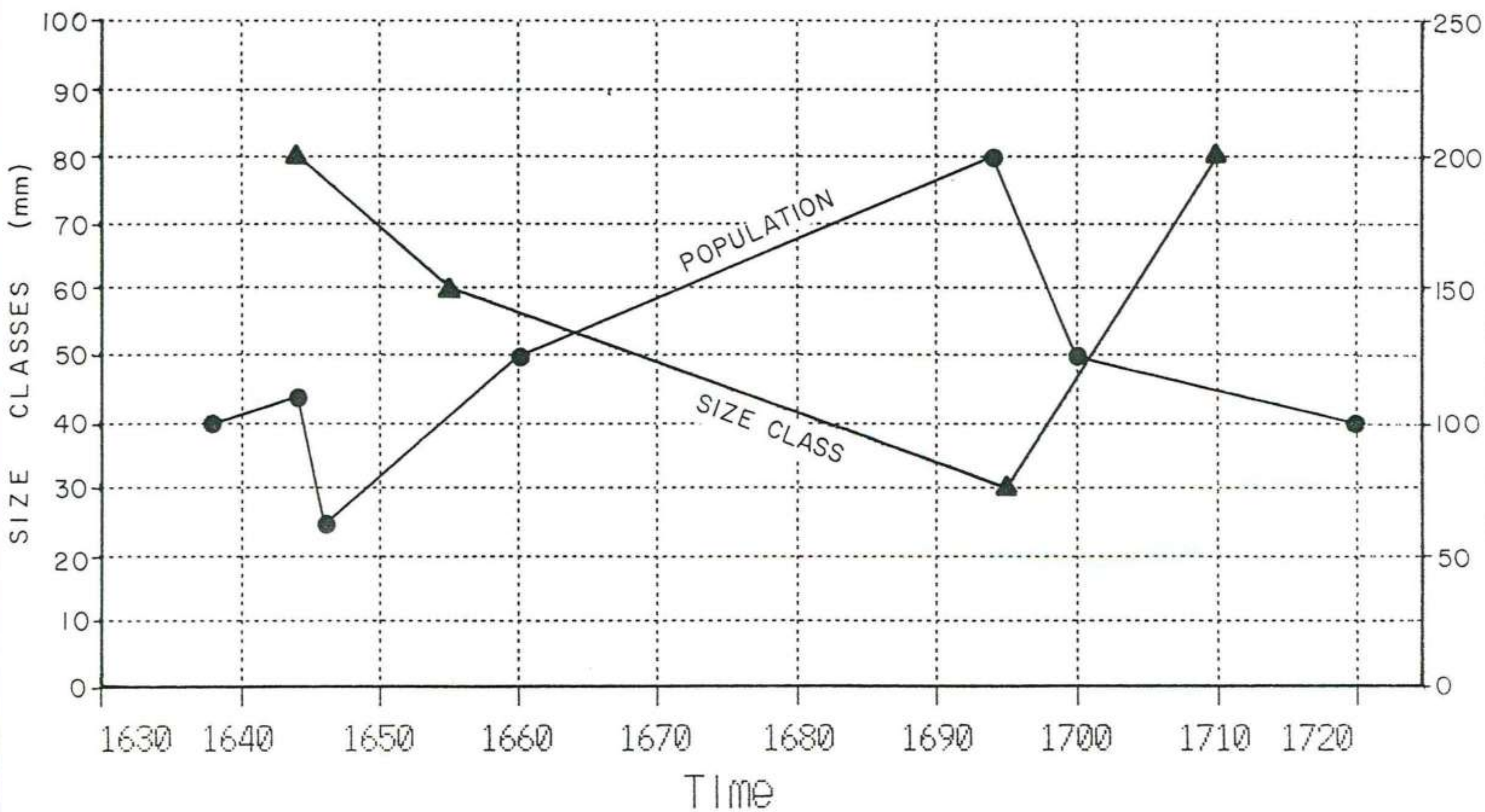

Figure 16: Relationship of Oyster Shell Size and Human Population at St. Mary's City

year period. Evidence for this comes from the organisms that grow on the shells and which are sensitive to changes in the estuarine environment; their frequencies vary little between the samples.

Other archaeological studies of molluscs have found similar changes in shell size through time (Klein 1979; Straus 1980) but never in such a short time span. This evidence argues strongly that the colonists had a rapid and pronounced impact upon the oyster resources in the St. Mary's City area. The precise correlation between human population and oyster size constitutes a remarkably clear example of the relationship between population size and harvesting pressure. The nature of the relationship indicates that the colonists not only could, but did have, a substantial impact upon the the naturally occurring resources. Of course, the St. Mary's City vicinity did experience human population densities rarely found elsewhere in the 17th Century Chesapeake, and resource exploitation was therefore more intense in that locale. The process was not any different in St. Mary's City, however. The process was only more rapid and pronounced there. As the Jones reference indicated, resources were also being depleted elsewhere in the region. Therefore, even though the data are sparse, they are sufficient to conclude that depletion of natural resources was occurring in the longest settled portions of the colonies by the late 1600s.

Trends in Relative Faunal Frequencies

Were there any significant temporal changes in animal utilization in the Chesapeake, and if so, were these in the direction predicted by the third hypothesis? To answer these questions, it is necessary to employ statistical tests to determine whether any of the perceived changes are truly significant. Unfortunately, the nature of the data base makes this a perilous task. To correctly apply inferential methods, the samples used must be randomly drawn from the population under investigation. This is not the case with the archaeological samples discussed here. Therefore, strictly speaking, the use of parametric statistical tests is meaningless. This problem, however, is not unique to the Chesapeake region but is virtually universal in archaeology. The seldom stated, but necessary, justification for importing statistical inference into a domain where its use is questionable is that the non-random samples are somehow "representative" of the population and behave sufficiently as a random sample for the tests to be employed. This defense is offered here. Determination of the validity of this assumption is not possible but it is unlikely that the data from this archaeologically large sample are hopelessly biased.

To begin evaluation of trends in the relative abundance of species, bone frequencies were used instead of MNI counts. Bones are the primary data base and their use provides much larger samples than are obtained with the number of individuals. In addition, by combining species into larger groupings (i.e. waterfowl or fish), sample error is lessened. This action also greatly reduces the number of zero frequencies and makes it possible in principle to successfully apply normalizing transformations of the data. Equally importantly, this approach can help mitigate the effects of sample size on the estimates of relative abundance. Abundance estimates of less common animals will be related to sample size for the same reasons that diversity measures are.

The species were divided into ten groups or classes for analysis, based upon habitat preferences of some wild animals and the domestic nature of others. These classes are **Cattle, Swine, Sheep/Goat, Domestic Fowl, Deer, Small Wild Mammal** (raccoon, opossum, squirrel, etc.), **Wild Waterfowl** (ducks, geese), **Wild Terrestrial Fowl** (turkey, bobwhite, mourning dove, passenger pigeon), **Turtles**, and **Fish**.

The number of bones in each of these groups was totalled and converted to relative frequencies. To test for any sample size effect, the Spearman's r test was again employed with sample size equalling the total number of identified elements. None of the correlations was found to be significant at the .05 level. A reasonable conclusion is that sample size effects, if they exist for these materials, are small.

Inspection of normal probability plots and calculation of the Shapiro-Wilk W statistic (Shapiro and Wilk 1965) indicate significant departures from normality for all of the variables except Sheep/Goat. Most variables are skewed to the right, a common phenomenon with archaeological materials. An arcsine, square root transformation was applied to bring in the upper tails and to reduce the dependence of variances upon means, a characteristic associated with proportions. In addition, the rows of data were not forced to sum to unity since this practice can produce artificial negative correlations between variables (Sokal and Rholf 1981: 427-428; Chayes 1971:3-5). This procedure considerably improved the forms of the variable distributions although five classes (Cattle, Domestic Fowl, Deer, Waterfowl and Terrestrial Fowl) still displayed skewing according to the Shapiro-Wilk W statistic. Some caution is therefore advisable when evaluating the results of parametric tests. The transformed values are listed in Appendix V.

To identify any temporal changes in the relative frequencies of the classes, the division of the samples into the three temporal periods was continued. Schematic plots (Tukey 1977) were constructed for all variables by period, based upon the transformed relative bone frequencies. Figure 17 displays the plots for Cattle, Swine, and sheep/ Goat. The Deer, Small Mammal, and Fish plots are presented in Figure 18, and the distributions of the three types of fowl are illustrated in Figure 19. Since this means of data presentation may be unfamiliar to the reader, some explanation is in order. The schematic plot presents visually the mean, median, and variability around these for a given group. The box represents the area within which 50%

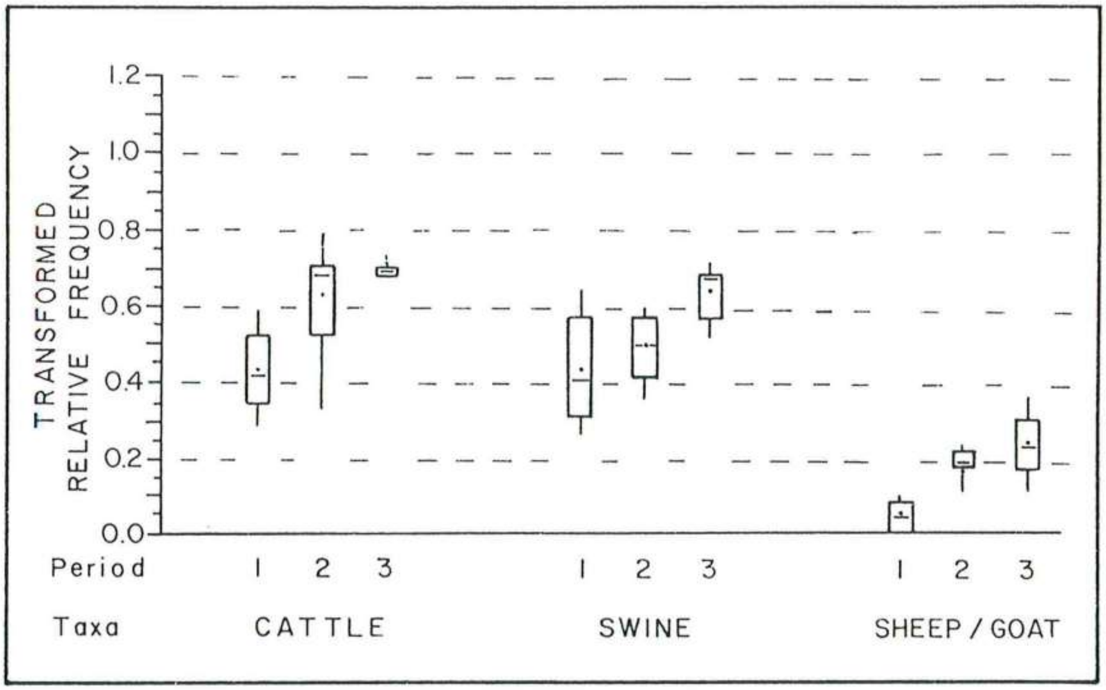

Figure 17: Schematic Plot of Domestic Mammal Bone Frequdncies

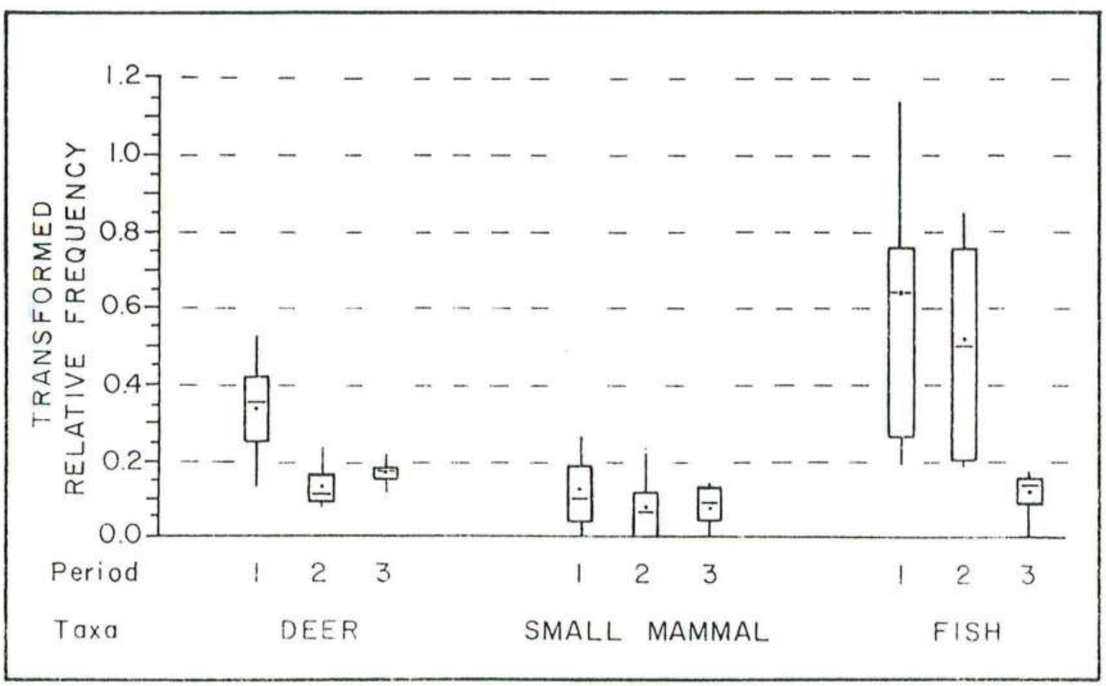

Figure 18: Schematic Plot of Wild Mammal and Fish Bone Frequencies

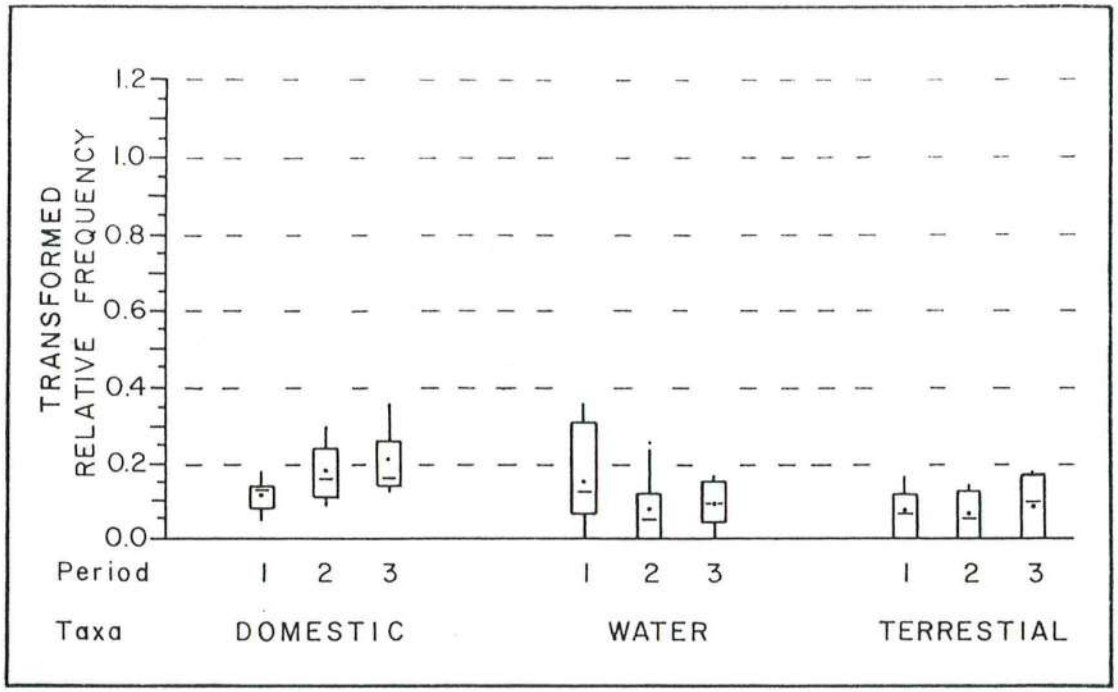

Figure 19: Schematic Plot of Domestic and Wild Fowl Bone Frequencies

of the sample occurs. The mean is indicated by a bar within the box while the median is represented by a dot. The single lines extend from the box to the extremes of variation.

Major changes are apparent in the frequencies of Cattle, Swine, and Sheep/Goat bones with notable increases through time. A one-way Analysis of Variance test (ANOVA) indicates that these differences are all significant above the .05 level. Since there remains some question regarding the normality of the data, the Kruskal-Wallis test (a non-parametric ANOVA based upon variable ranks (Sokal and Rholf 1981: 429-432), was also performed and the results are essentially the same. Both these statistical tests suggest that there was a greater emphasis upon domestic species through time in colonial subsistence.

In contrast, the frequencies of deer and fish decline through time. One-way ANOVA and Kruskal-Wallis tests on both of these reveal that the differences are significant above the .01 level. Deer elements become much less frequent after Period 1, while the abundance of fish bones declines strikingly in Period 3. Although these animals were important initially, the data suggest that their exploitation decreased substantially over time. The frequency of Small wild Mammal bones does not differ significantly over time, although there is some suggestion that they were more frequent in the first period.

Surprisingly, frequencies of bones from the three bird groups display no statistically significant differences between periods. Visual inspection suggests, however, that domestic fowl became more important through time while the use of waterfowl declined somewhat after Period 1. The plot of turtle frequencies is not shown because they display no visual or statistically significant differences.

One of the most striking trends apparent in this data is the increasing abundance and probable importance of domestic animals through time. But was this trend really significant? To determine this, a one-way ANOVA and a Kruskal-Wallas test were performed using the combined relative frequency data from all domestic species. These tests reveal that the differences between the periods are highly significant ($p = .001$). Hence, domestic animals appear to have occupied an increasingly important position in the overall adaptive strategy of the Chesapeake colonists. Such a trend is expected because these are controllable, dependable resources that offer relatively large quantities of meat per individual. The increasing importance of deomestic animals is in keeping with the prediction of Hypothesis 3 that a more specialized and focal adaptation would arise.

To gain better temporal control over these changes, comparisons of the group means between Period 1 and 2 and Periods 2 and 3 were conducted with the use of T-tests. These tests revealed that there are significant differences (p= .05 or over) in bone frequencies between Periods 1 and 2 for Cattle, Sheep/Goat, and Deer. The transformed mean frequency of bones for Cattle rises from .434 to .616, while for Sheep/Goat, the increase is from .038 to .165. The increase in Cattle bone frequencies probably reflects the rarity of this large, slow reproducing animal during the first decades of settlement and the gradual development of cattle herds. Sheep/Goat, on the other hand, were apparently difficult to maintain during the early decades because of predators, the lack of pastures, and the shortage of labor. The slow increase can be associated with the elimination of many of the predators, and perhaps a lessening of the labor shortage. Deer bone frequencies, in contrast, show a precipitous decline from .341 to .128. This decline is likely related to the slow reduction in their populations due to hunting. Large bodied animals in general have slower reproduction rates than smaller creatures, and this makes population replacement more difficult for them under the same harvesting pressures. In addition, large species tend to have lower population densities. Deer were apparently heavily exploited during Period 1 and this hunting pressure may have made the species an unreliable or more costly resource to exploit in the longest settled areas.

Between Periods 2 and 3, significant differences were identified for Swine and Fish ($p = .01$). The mean for Swine shows an increase from .486 to .632 . This increase in swine usage correlates with the already identified trend toward domestic resources and suggests that pigs were of increasing importance. Fish show a tremendous drop in the mean frequency of bones from .517 to .114. This surprisingly dramatic decline strongly suggests that the use of fish as a key component of subsistence ended. This change is curious since there is no documentation of fish depletion and because the Chesapeake was extremely productive in terms of fish during the 18th and 19th Centuries (Wharton 1957). Also, it is unlikely that the migratory marine species would be depleted because they wander throughout the Bay during the summer and are not restricted to one locality (Hildebrand and Schroeder 1928; Lippson 1979).

If this decreased frequency of fish is truly caused by a decrease in human exploitation of fish, evidence for this phenomenon should also be found in the total faunal assemblages. There is a possibility that this decline in the number of identified bones could be related to factors other than reduced exploitation of the resource. A change in cooking practices, such as chopping up of the fish for stews, or a shift in depositional behavior such as throwing fish remains on middens, may have rendered the bones less identifiable. There could be large quantities of fish bone in the samples, but few of them may have been identifiable below the class level. Such a possibility can be tested by considering the fish bones in the total bone assemblage. While fish bone can be identified as to class relatively easily, genus or species identifications are much more difficult. To determine whether this is the case, the total fish bone from the sites from each Period was assembled (see Table 20). Note that these are untransformed values.

The tables data confirm that the same decline seen in bones identified to the specific level also occurs in the total samples. Fish bones are rare on sites after 1700 (Period 3), a fact which strengthens the conclusion that a real decrease in fish usage occurred. The colonists did not stop eating seafood, for oyster shells and some fish bones are found in later contexts, but the proportion of fish in the diet seems to have been greatly reduced from earlier levels.

These changes in bone frequencies suggest that major transformations occurred in the colonial subsistence. An important unanswered question is what impact these apparent changes had on the diet. Bone frequencies have a general

Table 20: Fish Bone In Assemblages By Temporal Period

Sample	No. of Fish Bones	% of Total
Period 1		
Maine	93	6.90
Kingsmill Tenament	262	11.80
St. John's I	1643	39.98
Pope's Fort	1252	34.27
Chancellor's Point	469	38.34
Bennett Farm I	3227	78.19
Period 2		
Drummond I	292	10.59
Wills Cove	234	19.27
Bennett Farm II	1552	38.17
Smith's Ordinary	354	9.20
Baker's Ordinary	76	4.28
Drummond II	3954	37.97
Period 3		
Van Sweringen	36	4.64
St. John's II	107	2.98
Drummond III	127	4.58
Bray	11	1.34

relationship to species importance, but analyzing bone frequencies alone has a major flaw similar to that of MNI counts -- equal importance is given to every bone. Even though there are major and clearly important differences in the dietary implications of a rabbit bone versus that of a cow, they are counted the same. This problem makes consideration of estimated meat weights imperative. Meat estimates are obviously related to both the original bone counts and to the MNI counts, but they provide a different perspective on dietary composition by correcting for the size bias between animals, a bias which can distort perceptions of relative species importance in subsistence. If the trends displayed by relative bone frequencies signify real shifts in colonial subsistence, then these same trends should also be apparent in the meat estimates. The meat figures, however, have not been subjected to statistical transformations to improve normality distributions. While any body of data can be transformed, this was considered inadvisable for meat estimates since biases due to sample size and skewness are already known to exist with the bone and MNI counts. The meat weight approach, nevertheless, is the best means available for evaluating the relative dietary importance of species. Accordingly, it seems likely that if the major trends displayed by bone frequencies are real, those trends should also be expressed in the meat frequencies.

The mean proportions of meat contributed by each of the previously described ten animal groups were calculated by temporal period and these proportions are presented in Table 21. Cattle and deer both show major differences between Periods 1 and 2, parallelling the changes shown by the bone freqencies. The contribution of Sheep/Goat also shows an increase between the first two periods but an equal jump is evidenced between Periods 2 and 3 that was not apparent in the bone frequencies. The decline of fish is as clearly revealed in meat estimates as in bone counts although there is some suggestion that the decline was greater between Period 1 and 2 than between Period 2 and 3. As suggested by the schematic plots of their bone frequencies, domestic fowl display a tiny but steady increase through time while

Table 21: Estimated Meat Frequencies By Temporal Period

Animal Group	Mean Percentage Period 1	Period 2	Period 3
Cattle	44.26	65.39	62.62
Swine	24.65	21.94	25.46
Sheep/Goat	.74	1.95	3.50
Domestic Fowl	.18	.30	.35
Deer	16.83	5.38	6.17
Small Mammal	1.38	.31	.26
Waterfowl	.65	.19	.16
Terrestrial Fowl	.29	.28	.23
Turtle	.25	.32	.23
Fish	10.66	3.92	.90

while Small Wild Mammals and Waterfowl again show a decrease after Period 1. Terrestrial Fowl and Turtles display no temporal trends, as is the case with their bones. Hence, estimated meat frequencies display essentially the same patterns of change as seen in the transformed bone frequencies.

To determine whether these differences in meat proportions are statistically significant, the non-parametric Kruskal-Wallis test was again employed. The results indicate that differences in the mean estimated meats for Cattle and Deer between Periods 1 and 2 are significant above the .05 level while the frequencies of Swine and Fish between Periods 2 and 3 are significantly different at the .05 level. No statistically meaningful differences occur through time for Domestic Fowl, Small Wild Mammals, Waterfowl, Terrestrial Fowl, and Turtles. The differences in Sheep/Goat frequencies through time were not significant but they approached it (p = .07). Another K-W test comparing Sheep/Goat frequencies from Period 1 and Period 3 was conducted and it revealed that the overall differences were significant (p = .015). To further confirm the apparent trend toward greater consumption of domestic animals, the total domestic meat contribution was combined for each period and was found to be significantly different (p = .003).

The meat proportion data make it clear that the same trends detected in the relative frequencies of bones are also clearly identifiable in the relative frequencies of meat. Despite the sample size biases and non-normal data distributions, the bone and meat frequencies reveal the same general patterns in resource usage. Such close correspondence is somewhat unexpected, but argues strongly that the identified trends are real. Despite a demonstrated sample size bias, these findings suggest that the bias does not conceal the patterns of change that were occurring in colonial subsistence and imply that meat weight data can also yield meaningful insights into adaptive strategies.

These archaeologically based discoveries give evidence of a significant shift in resource usage through time. Domestic mammals became increasingly important. The Cattle contribution rose substantially between Periods 1 and 2. This shift is probably related to the fact that cattle were difficult to acquire during the early decades of settlement (Stone 1982:29-30). Because cattle are large, they are difficult to transport. They reproduce at a slow rate, and they had a high economic value. Swine, in contrast, quickly reproduce and are easier to transport. Swine frequencies display no significant changes between Periods 1 and 2, but they do alter between Periods 2 and 3. The reasons for this shift are obscure.

Sheep/goats differ importantly over time and appear to have become increasingly common. Documents provide evidence that predators, which were a major problem during the early decades of settlment, were slowly exterminated. John Clayton (1965:106) wrote in the 1680s that "Most persons of Estate Begin to keep Flocks" because the wolves were less of a problem. The Swiss traveler Michel (1916:37) noted in 1701 that "Sheep are raised in constantly increasing numbers," and also made reference to the declining number of wolves. An increased use of wool in home industry is also likely (Carr and Menard 1979:215).

The trends in domestic animal usage revealed here by bone and meat frequencies appear to indicate a real alteration in the colonial subsistence. But are these findings accurate reflections of the real situation? Archaeological inferences are rarely verifiable by independent data, but fortunately such an opportunity is possible in the Chesapeake region through study of household inventories. Livestock are listed in nearly every inventory of the time and this provides the means of comparing archaeological trends with those in the historical documents. Therefore, 335 households inventoried in St. Mary's County, Maryland from 1638 to 1700 were studied. The numbers of plantations owning cattle, swine and sheep were tabulated and the results are presented in Figure 20 as a percentage of the households in each period that possessed these animals. The relative frequencies of plantations with these three animals apparently changed over time. During the early decades, everyone had swine, but only one third of the householders owned cattle, and sheep were almost totally absent. This pattern changed dramatically by the 1660s when cattle were more commonly owned than swine. By the late 1660s, these two animals were present in more equal frequencies and despite some variation, their frequencies remain similar throughout the rest of the samples. Why swine ownership declined so prominently in the early 1660s is not yet known, but plague is a possibility. Close inspection of the figure reveals two downward fluctuations in households with cattle and swine. One fluctuation occurred in the early 1670s and the other downturn is in the 1695-1700 period. The cause of the first downward shift was probably a major cattle plague in 1672-1673 that killed many thousands of animals in Virginia and Maryland (Craven 1949: 376). The plague prompted Governor Calvert in 1674 to restrict shipment of "any Corne, Beefe, Porke or other provisions whatsoever" from the colony without special provisions whatsoever" from the colony without

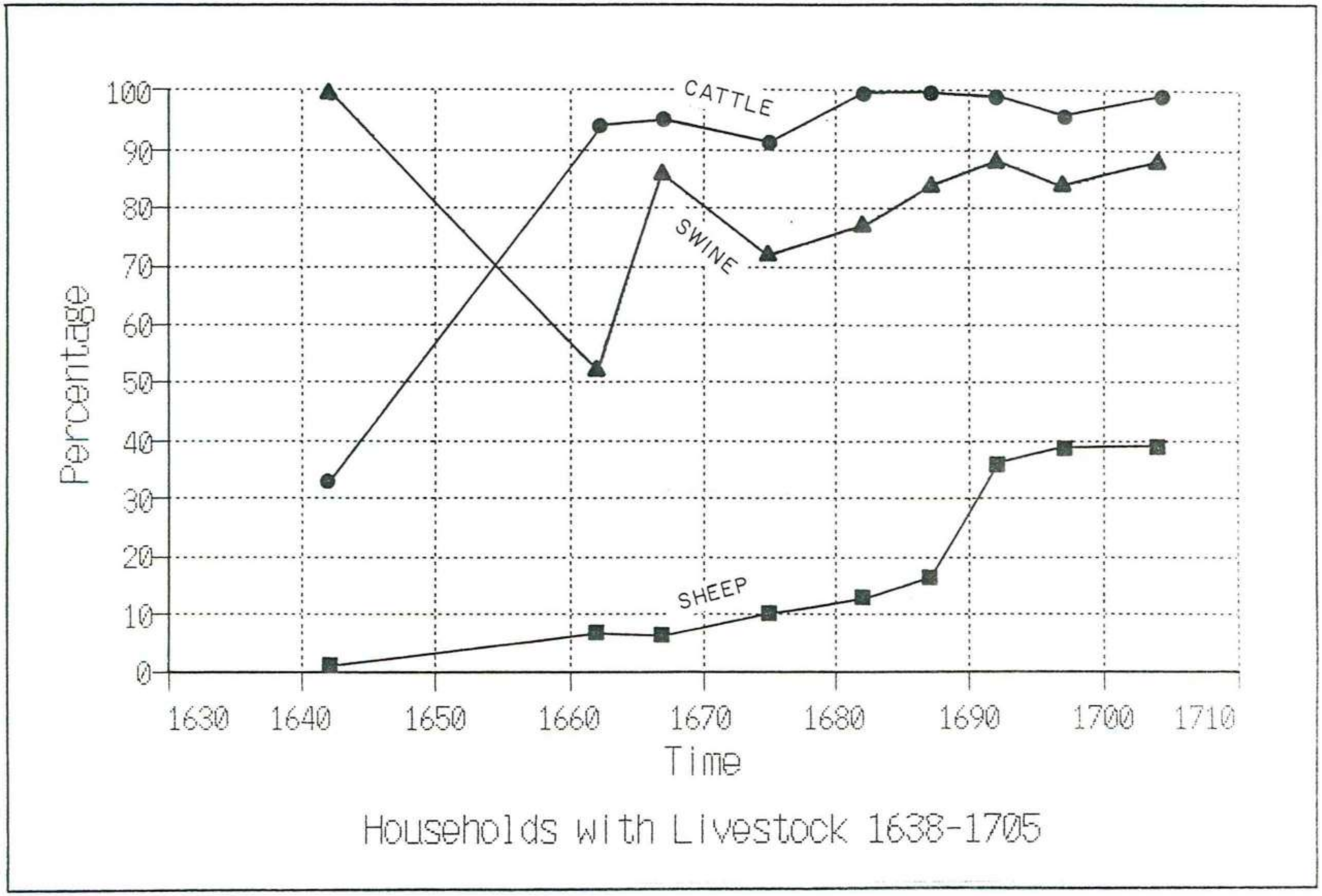

Figure 20: Livestock Trends in Household Inventories, St. Mary's City, Maryland

special permission (Archives of Maryland 15:44). The sharp drop in swine population at this same time may indicate that they were affected by the plague, but it could also be attributed to the increased slaughter of pigs to replace the missing beef. The decline in the late 1690s is explained by the onset of extremely cold conditions during the winters. During the winter of 1694-1695, at least 25,429 cattle and 62,373 swine died in Maryland while the toll for St. Mary's County was 3551 Cattle and 7758 pigs (Archives of Maryland 20:269-270). Despite these tremendous periods of death, the trend of subsistence toward domestic animal reliance continued. Domestic livestock appear to have been sufficiently dependable that even major plagues or other causes of death did not interject sufficient instability to cause a return to usage of wild resources.

Sheep frequencies in the inventories correspond very closely with the pattern indicated by the archaeological evidence. Sheep were very rare during the early period. Their numbers slowly increased until the 1680s when an abrupt increase occured, and by the end of the century over one third of the inventoried estates owned sheep. It should be noted that goats were not mentioned, suggesting that most of the animals in the Sheep/Goat category were Sheep.

The inventory data therefore correlate very well with the archaeological evidence regarding changes in domestic livestock. Considerable variability in livestock ownership is found in the period between 1638 and circa 1675 but, after that date a consistent pattern emerges. The apparent rarity of cattle during the early period and the increase in their numbers through time is confirmed by the documents. The constancy of swine in households is also indicated by both sets of data. Sheep display a similar pattern of availability in both data sources, i.e. a slow increase through time.

It is therefore possible to identify significant changes in subsistence -- a greater emphasis upon domestic species and a corresponding decline in the exploitation of wild resources. Bone and meat frequencies both indicate that two species -- cattle and swine -- completely dominated the diet during the post-1700 period. This evidence strongly supports the prediction that the adaptive strategy would become more focal through time. To confirm this, however, the evidence for one other type of change should be present in the archaeological record - reduced seasonal variability. A focal adaptation is based upon the intensive exploitation of a few species <u>throughout</u> the year, rather than the seasonal, scheduled exploitation of many different animals.

Seasonality: 1660-1740

Reduced seasonal variation is one predicted result of a focalization of the adaptive strategy. Less overall variation in subsistence through time is also expected, however, because another trend of the colonization process is increasing stability and uniformity through time. Fortunately, it is possible to associate a reduction in seasonality more closely with the ppearance of a focal adaptation. While a focal adaptation can display only a limited amount of seasonality due to the emphasis upon a few resources, reduced seasonal variation is not necessarily associated with increased stability. An adaptation can be stable and yet vary during the year due to a dependence upon reliable but seasonally available resources.

To investigate this, data derived from features are necessary, and samples are available from a number of sites. The earliest site in Period 2 is Drummond I, with three features dating between ca. 1650 and 1680. Drummond's occupation therefore overlaps slightly with Period 1 and indications of seasonal variability might still be expected. Seasonal indicators from the three features revealed that each was apparently filled at a different time of the year. Feature 265 materials were apparently deposited in the summer. The assemblage from Feature 255 is a winter to spring deposit and Pit 332 yielded a sample of bones that suggest a winter fill period (species lists and other data regarding seasonality are provided in Appendix III). Comparison of the estimated meats from these features

(Table 22) reveals that regardless of the season, domestic mammals predominated with meat inputs ranging from 74% in the summer deposit to 96% of the total in the winter.

Table 22: Estimated Meat From Features At Drummond I

	265 Summer		255 Winter/Spring		332 Winter	
Animal Group	Lbs.	%	Lbs.	%	Lbs.	%
Dom. Mammals	1035	74.66	1035	88.31	2785	96.04
Domestic Fowl	5	0.36	5	0.42	-	-
Wild Fowl	11.5	0.83	31	2.64	14	0.46
Turtle	1.1	0.06	-	-	-	-
Fish	133.5	9.61	-	-	-	-
Crab	-	-	-	-	-	-
Wild Mammal	200	14.43	100	8.59	100	3.45

Among the domestic mammals, swine and sheep appear to have contributed a fairly consistent proportion of meat to the diet with a range of pork from 17% to 21% of the total, and of sheep from 1.2% to 2.9% of the total. Beef, on the other hand, varied from 74% in the winter deposit to 50% in the summer assemblage. Beef was apparently more important in the cooler months of the year, a not surprising situation since such a large quantity of meat (about 400 lbs.) would have been difficult to preserve during the summer with high temperatures and the near absence of cooling facilities. The smaller bodied swine and sheep would have been more appropriate for summer butchery since they could be consumed before spoilage occurred.

Usage of wild animals also varied during the year. Wild species contributed 24% of Feature 265's estimated meat, mostly from deer and fish, but in Feature 332 only 3.6% of the meat was from a wild source. The summer wild input of nearly 25% is still substantial but less than the 36% to 65% wild contribution seen in the summer deposits at the earlier sites. Thus, the data suggest that seasonal variability in the diet continued into the third quarter of the century but that the seasonal variability was not as pronounced.

Supporting this is information from the Wills Cove site on the lower James River. Two large features were excavated and both date to ca. 1650-1680. Analysis of the seasonal indicators reveals that Pit 5 was primarily a summer deposit while Pit 6 was more likely a winter deposition (see Appendix III). The frequencies of estimated meat from these features by animal group are presented in Table 23. Domestic animals apparently contributed the majority of the meat. Deer is second in importance while fish only make a contribution

Table 23: Estimated Meat From Features At Wills Cove

	Feature 5 (Summer)		Feature 6 (Winter)	
Animal Group	Lbs.	%	Lbs.	%
Domestic Mammal	1120	79.69	2035	90.62
Domestic Fowl	5	.35	-	-
Wild Fowl	2	.14	-	-
Turtle	-	-	10.5	0.46
Fish	60	4.26	-	-
Crab	-	-	-	-
Wild Mammal	215	15.30	200	8.91

in the summer deposit. The same pattern of greater wild animal usage in the summer is evidenced here but it accounts for only 20% of the meat, slightly less than at Drummond I. While swine input remains the same in both features (17%), the proportion of beef is lowest in the summer assemblage (56%) and increases to 71% in the winter deposit, a pattern similar to that seen at the Drummond site. Overall, the Wills Cove data support the findings from the Drummond site and show that seasonal variation during the 1650 to 1675 period is still identifiable although it is less pronounced than in the earlier sites.

What form did subsistence take during the last quarter of the 17th Century? Evidence from this period is available from Bennett Farm II and several sites in St. Mary's City. At Bennett Farm, there are four features dated to this time -- Pits 6, 8, 16, and 30. Analysis of seasonal indicators reveals that all of these pits are summer deposits since the remains of marine fish (sheepshead, black drum, and red drum) are present in each. Remains of migratory waterfowl, however, were also found in Pit 6, which suggests that some deposition occurred in the spring or fall. Meat weight estimates are provided in Table 24. Meat input by domestic animals in these samples varied surprisingly little. Only in Feature 16 is domestic animal meat input below 90%. Fish remains are found in all of the features, suggesting that their exploitation continued to be an important adaptive strategy. The relative contribution of fish ranges from 2% to 9%, a far smaller percentage than found during the first

Table 24: Estimated Meat Frequencies from Features at Bennett Farm II

Feature:	6 #	6 %	8 #	8 %	16 #	16 %	30 #	30 %
Domestic:								
Mammal	1535	92.10	3330	90.18	2935	84.61	2785	90.26
Fowl	0	.0	12	.32	0	.0	2.5	.08
Wild:								
Fowl	2	.12	7.5	.20	0	.0	0	.0
Turtle	0	.0	.25	.006	83.85	2.41	0	.0
Fish	129.5	7.77	219.5	5.94	335	9.65	83	2.68
Crab	0	.0	0	.0	0	.0	0	.0
Mammal	0	.0	123	3.31	115	3.31	215	6.96

period of occupation at the site. Deer and an occasional raccoon also provided some meat. The total wild animal input reaches 15% in Feature 16 but wild animals account for less than 10% in the other features. These figures are much less than the 37% figure from in the early feature, Pit 28 and are less than the wild animal input seen at Drummond I or Wills Cove. Domestic animal meat quantities in Pits 6, 8 and 30, was consistent with beef making up 72%, 69.6%, and 69% respectively, and swine accountsing for 18%, 18.9%, and 19.6% of the total estimated meat. In Feature 16, the proportions are 62% beef and 21.6% pork, quite similar to the other features at Bennett Farm II.

Other samples dating to the same period from St. Mary's City are Smith's Tavern (ca. 1680), Baker's Tavern (1680-1690) and a large pit at St. John's (ca. 1695). Analysis of the seasonal indicators has revealed that the assemblages from Smith's and Baker's are probably summer deposits while the St. John's pit is a winter deposition. Meat estimates for these samples are given in Table 25, while evidence

Table 25: Estimated Meat From Features In St. Mary's City

	Smith's		Baker's		St. John's	
Animal Group	Lbs.	%	Lbs.	%	Lbs.	%
Dom. Mammals	1750	90.62	1035	90.15	2520	92.02
Domestic Fowl	10	0.52	5	0.43	10	0.36
Wild Fowl	15	0.77	-	-	7.5	0.27
Turtle	10	0.52	-	-	.2	0.03
Fish	46	2.38	7.5	0.65	-	-
Crab	-	-	.6	0.05	-	-
Wild Mammal	100	5.18	100	8.71	200	7.33

regarding the seasonal attributions is given in Appendix III. Although these units appear to have been deposited at different portions of the year, the meat estimates from them are nearly the same. Domestic mammals provided over 90% of the total while deer contributed from 5% to 7% of the total meat. The St. Mary's City frequencies are similar to those from Bennett Farm II, although the fish input is less. The St. Mary's City features indicate little notable seasonal variation.

Such consistency in relative proportions of meat continued unchanged into the early 18th Century. Evidence from features at the Drummond site, the Bray plantation, Van Sweringen's, and St. John's II all display remarkably similar patterns with little detectable seasonal variation (See Appendices I and III for data regarding these features).

This discussion, resulting from the investigation of a large quantity of data, has demonstrated that seasonal variation in the colonial Chesapeake gradually became less pronounced through time. In an effort to summarize and visually display this trend in seasonality, the wild meat percentages for every feature used in this study are plotted in Figure 21.

Wide variability existed during the period between circa 1620 and 1660 with the largest differences between features found in the earliest sites. Variation slowly declined until about 1680, when a consistent pattern appeared. Meats from wild animals make up less than 10% of any sample after that date and the variation is minimal.

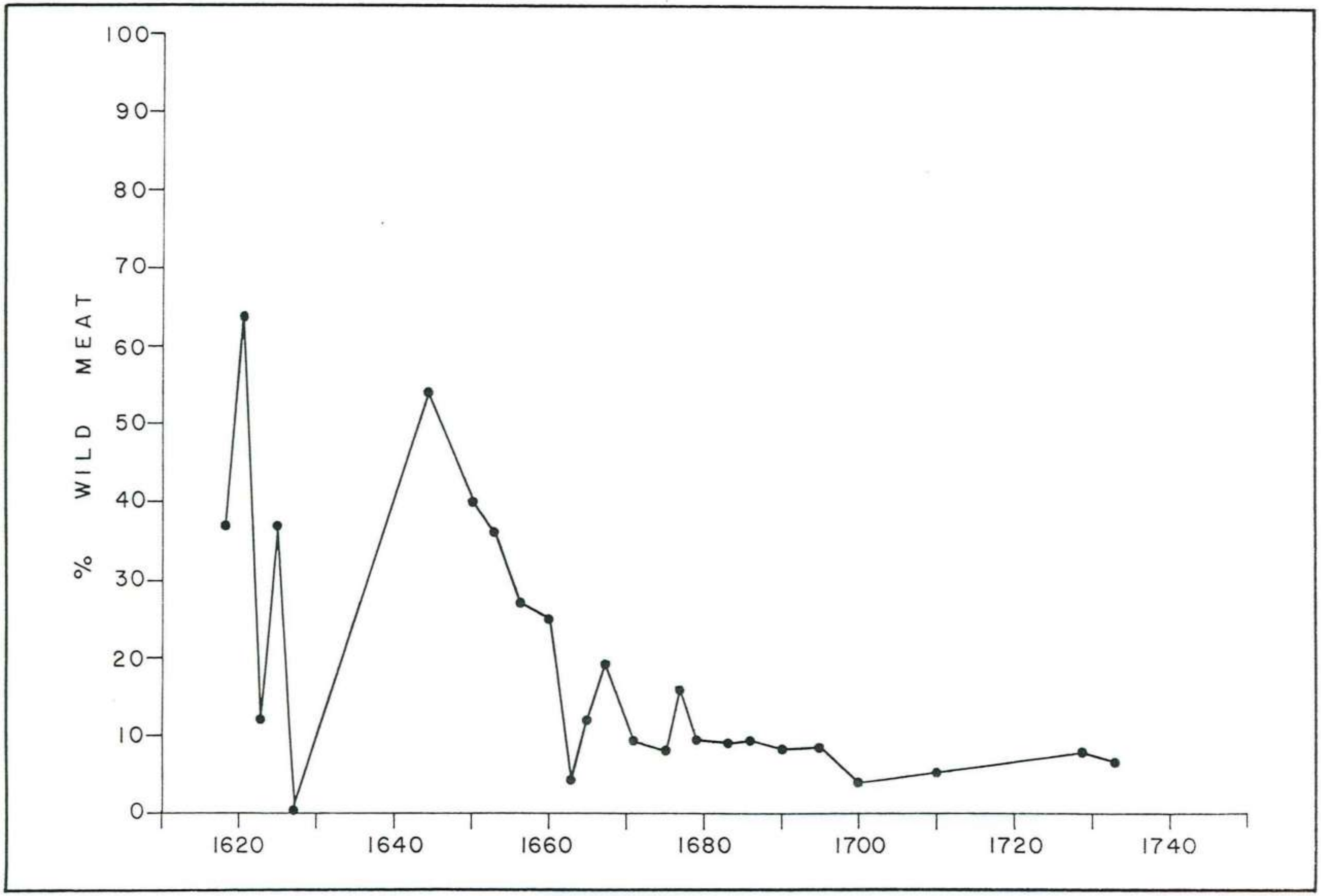

Figure 21: Percentage of Estimated Total Wild Meat in Features

Summary

The data presented in this chapter indicate that the adaptive strategy in the pre-1660 Chesapeake was, as predicted, diffuse. A wide variety of species was incorporated into the diet and these species were used in a scheduled, seasonal pattern. Evidence indicates that strategies shifted dramatically during the annual subsistence cycle from a focus upon domestic species and in some instances deer, during the winter, to a major emphasis upon many wild species during the summer and early fall. Most of the early Period 1 sites have a high degree of species diversity, but a few, especially Bennett Farm, have little diversity and may have specialized upon large, bottom dwelling fish. Domestic livestock were an important component of the diet during all periods with cattle and swine utilized as the major species. Cattle, however, were less abundant in the early decades.

During the course of the 17th Century, this diffuse strategy gave way to a quite focal one. Three domestic species -- cattle, swine and sheep/goat -- accounted for most of the bones and all but a minor portion of the estimated meat in the early 18th Century assemblages. At the same time, seasonal variation in subsistence was reduced to a very minor fluctuation. During the late 17th Century, alternative strategies that had buffered the subsistence system against failure were gradually abandoned. The abandonment of a diffuse, seasonally varying strategy was probably due in part to the depletion of resources. The substantial reduction in use of wild resources that were not depleted, however, is surprising. This suggests that domestic livestock populations may have reached a threshold level over which they became a very dependable food resource and thus, buffering strategies were no longer necessary. The results of archaeological and historical analysis therefore indicate that the predictions of the colonization model did occur in the 17th Century Chesapeake, thus constituting strong support for the acceptance of Hypotheses 2 and 3.

CHAPTER 8

PATTERNS OF STABILITY, UNIFORMITY AND COMPLEXITY

The fourth hypothesis states that

> **Colonial Subsistence will display a directional change toward greater stability and complexity through time.**

This hypothesis is based upon the colonization gradient concept which suggests that a cultural system should become increasingly complex and specialized over time. In addition, "...the overall process is one of increasing stability"(Cassagrande 1964:314) so that a more stable adaptation should develop by the end of colonization. Archaeologically, the development of a more stable adaptive strategy might be indicated by the increasingly frequent appearance of uniform subsistence patterns throughout a region (Clarke 1968) and the endurance of this pattern over a period of time. The following indices should be found: 1) the increasing similarity of species content on sites through time, 2) the integration of only the dependable, efficiently exploited wild species as subsistence staples, and 3) the gradual addition of more complex subsistence activities in areas such as animal husbandry, food processing, food processing, and cooking methods.

Stability and Uniformity in Subsistence

The remarkable consistency in bone and meat proportions in features after ca. 1680 has already been presented in Chapter 7, and these data certainly suggest the appearance of uniform subsistence patterns. Compared to the pre-1680 features in which wide variation is found, the later features are strikingly consistent in content over a 60 year period.

To better determine if a trend toward greater uniformity operated, the faunal materials at the broadest analytic level - the zoological class - can be used. Unbiased by problems of species or genus identification, these data can reveal to what degree the overall adaptive strategies became similar at various sites. Therefore, information regarding the number of bones in each class was gathered from the sites. These frequencies were converted to proportions and the means and standard deviations for each period were calculated to more precisely measure the variability. The results are presented in Table 26.

These figures reveal that the amount of variation decreased over time. Standard deviations in all classes are much lower in Period 3 than in Period 1. Indeed, the frequencies of bones from the different Period 3 sites are remarkably homogeneous, a fact which argues for the appearance of uniform subsistence patterns. Variability in the faunal materials identified to the genus or species level also displays a similar trend. This variability will be discussed in greater detail in Chapter 9, where ecological and socio-economic factors are considered.

Table 26: Variability in Faunal Classes By Period

	Mammal	Bird	Fish	Reptile
Period 1				
Mean	57.15	6.79	34.91	1.12
S.D.	23.19	5.15	24.57	1.26
Period 2				
Mean	74.42	3.76	19.91	1.88
S.D.	15.36	1.93	14.87	2.09
Period 3				
Mean	89.62	5.80	3.38	1.16
S.D.	3.29	2.25	1.56	.70

Evidence for increasing uniformity might also be found in animal husbandry practices. Such an issue can be addressed archaeologically by studying the ages at which livestock were slaughtered, since the age of death has important implications regarding the manner in which animals were utilized. The proportions of cattle killed within given age ranges were calculated from long bones by employing a method developed by Chaplin (1971). Remains of swine and sheep were not consistently present in high enough frequencies to warrant the use of this approach.

The results for the early sites of Kingsmill Tenement and Pope's Fort are presented in Figures 22 and 23 (Data used to construct these figures may be found in Appendix IV). Although the samples used to calculate these figures are

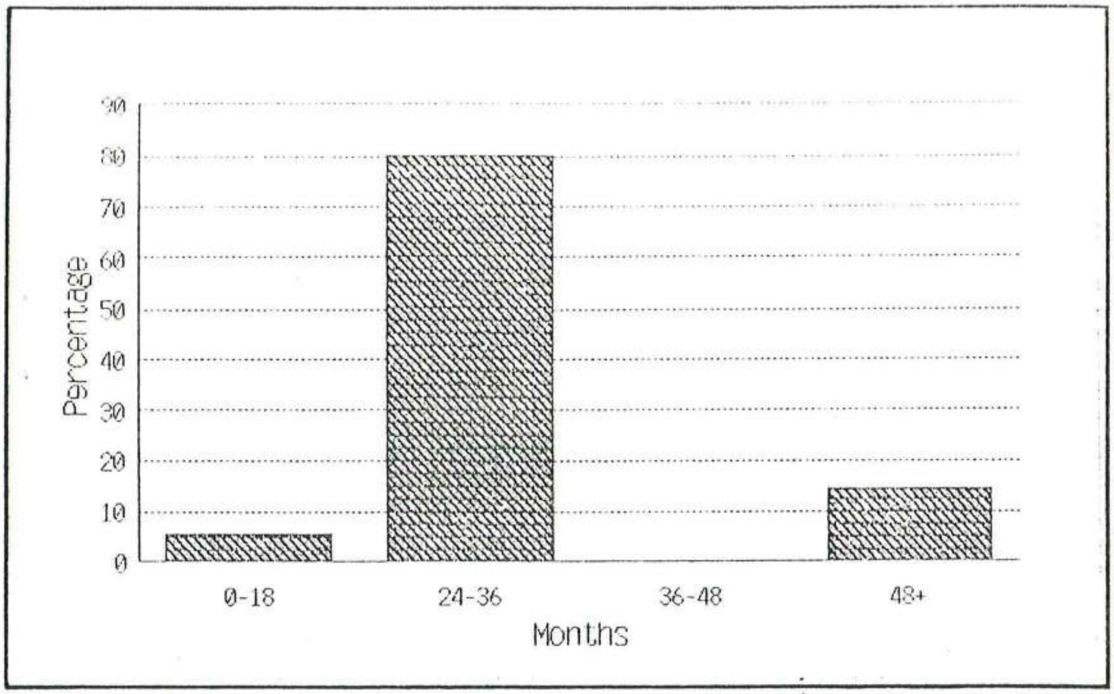

Figure 22: Percentage of Cattle Killed By Age Range, Kingsmill Tenement

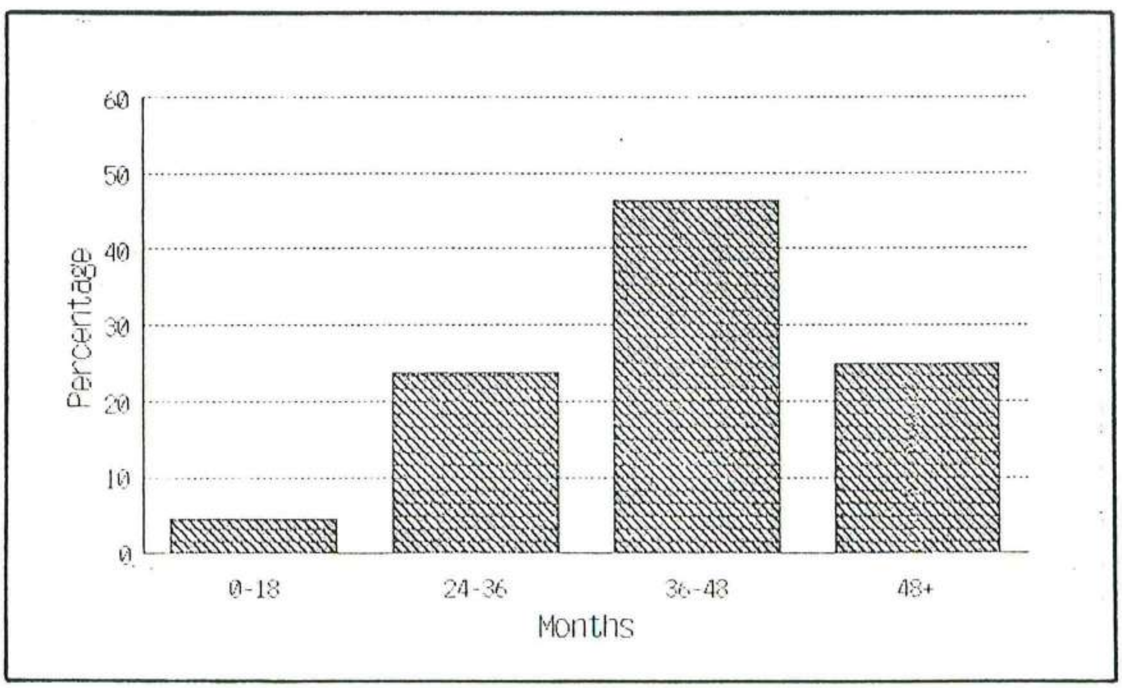

Figure 23: Percentage of Cattle Killed By Age Range, Pope's Fort

small, and the results must consequently be used with caution, they suggest that most of the cattle died before they reached 48 months of age. This pattern would be expected if animals were slaughtered at their prime ages for beef. In such a situation as the early Chesapeake, where cattle were in short supply, the low frequency of older animals should not be interpreted as the killing of male and females before they reached old age. Instead, it is more likely attributable to the slaughter of male animals and barren cows for beef and the sale of most of the cows and some bulls to freedmen or recently arrived colonists starting their own herds. Unfortunately, the sexes of the animals in these samples have not and, in most cases, cannot be determined, and this hypothesis cannot be pursued further. The differences in the peaks on these two figures may be partially related to the small bone samples, but they do suggest that there was variation in the age of slaughter at different plantations.

Slightly later in date of deposition are materials from the Drummond Phase 1 occupation (ca. 1650-1680). The cattle age structure calculated from these bones (presented in Figure 24) suggests that a change had occurred in husbandry with nearly half of the sample from cattle older than 48 months at death. Evidence from the second phase of occupation at Drummond (1680-1710) suggests that this trend continued; nearly 70% of the sample is from cattle older than 48 months (Figure 25). But is this a widespread trend?

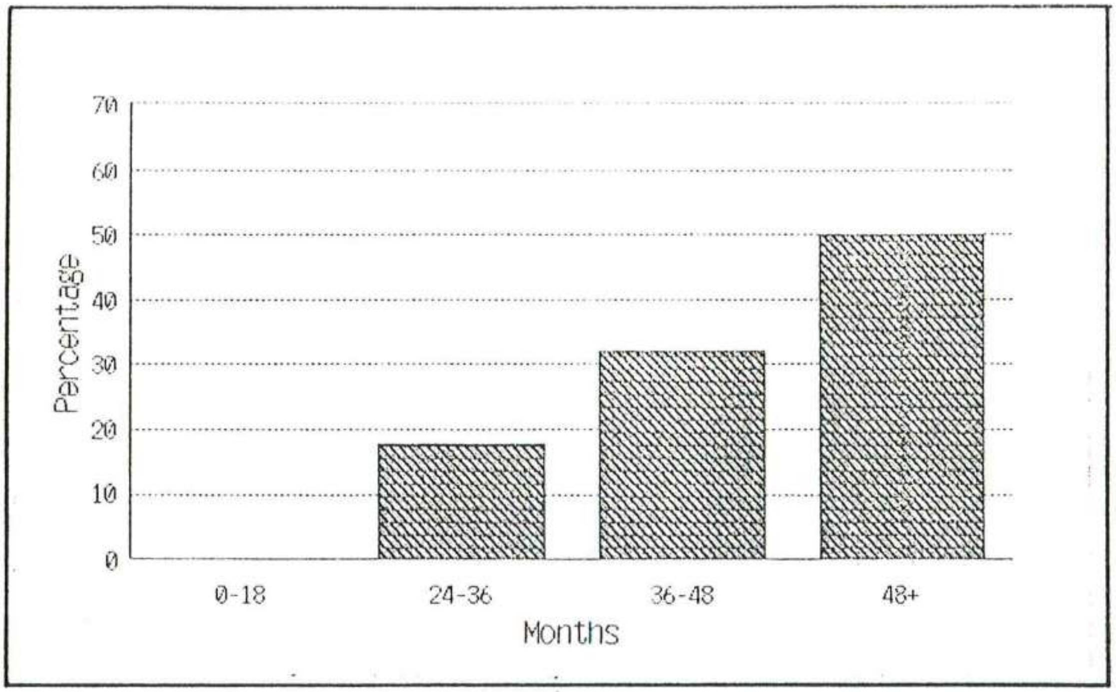

Figure 24: Percentage of Cattle Killed By Age Range, Drummond I

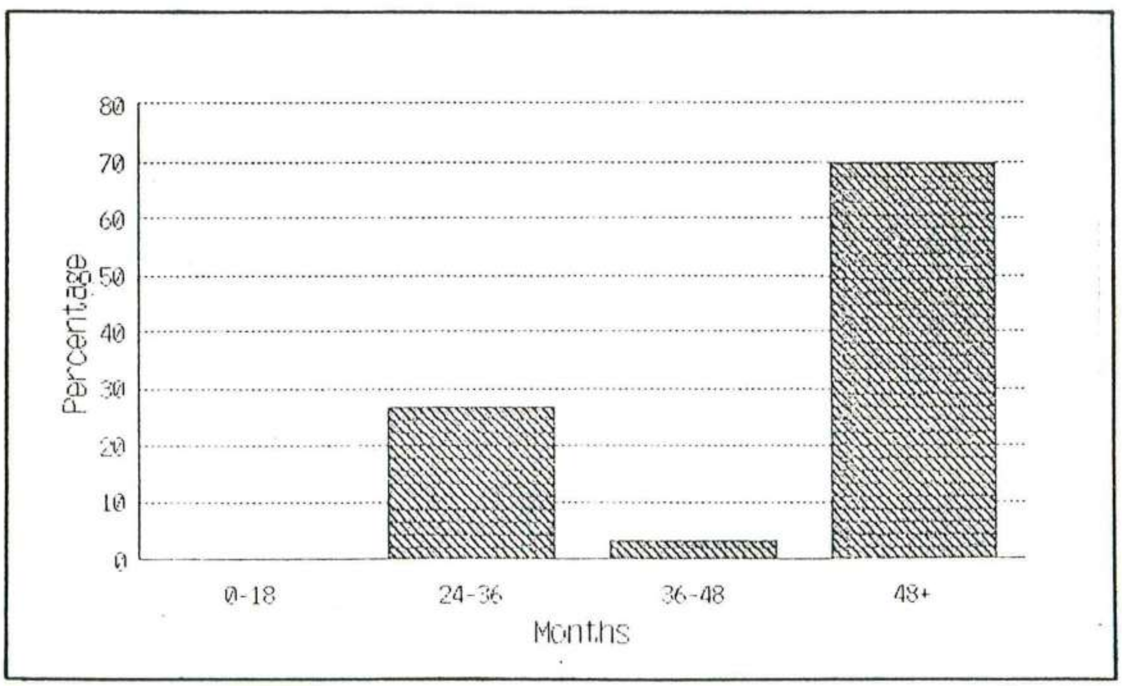

Figure 25: Percentage of Cattle Killed By Age Range, Drummond II

To investigate how common the practice might have been, the cattle age structures were calculated for three other sites dating to the last decades of the 17th Century. These sites are Pettus Plantation (Figure 26), Utopia (Figure 27), and the second phase of the Bennett Farm occupation (Figure 28). Each of these samples displays very similar cattle age distributions. The fact that four late 17th Century sites from various parts of Virginia have essentially the same cattle age profiles is a strong indication that a uniform husbandry strategy was employed. Bone fusion data clearly suggest that most cattle were permitted to reach an age greater than 4 years. Further evidence comes from a study of the dentition of these animals which found many heavily worn teeth, probably indicative of an age of over 5 or 6 years. An age structure such as this strongly implies that the animals were used for purposes other than just meat sources.

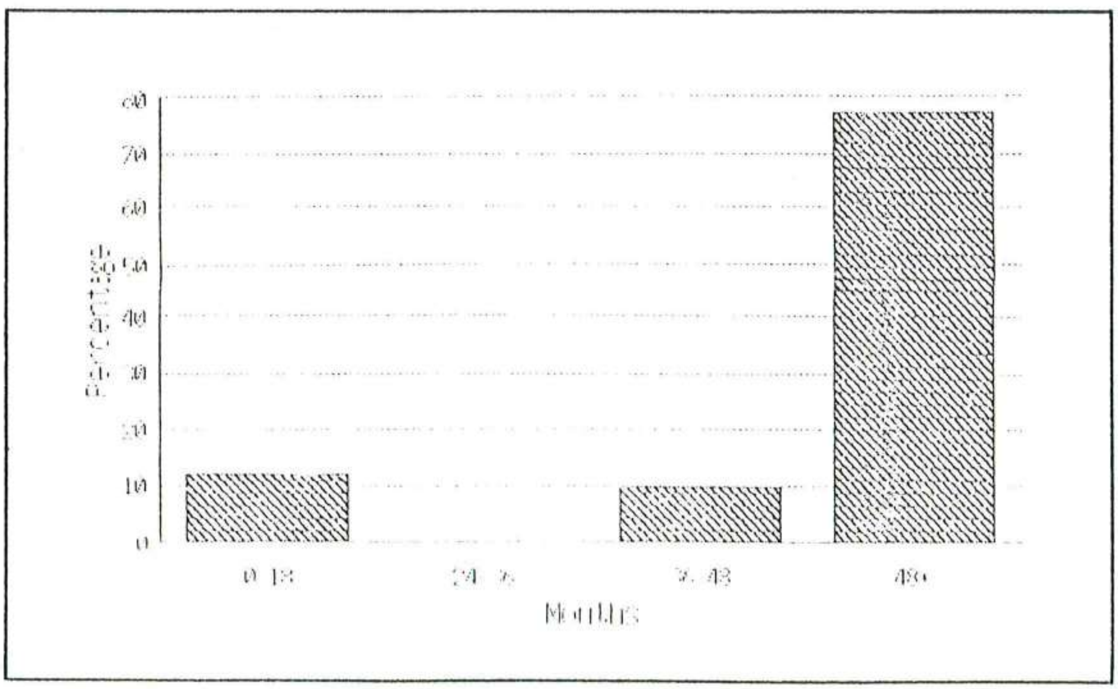

Figure 26: Percentage of Cattle Killed By Age Range, Pettus

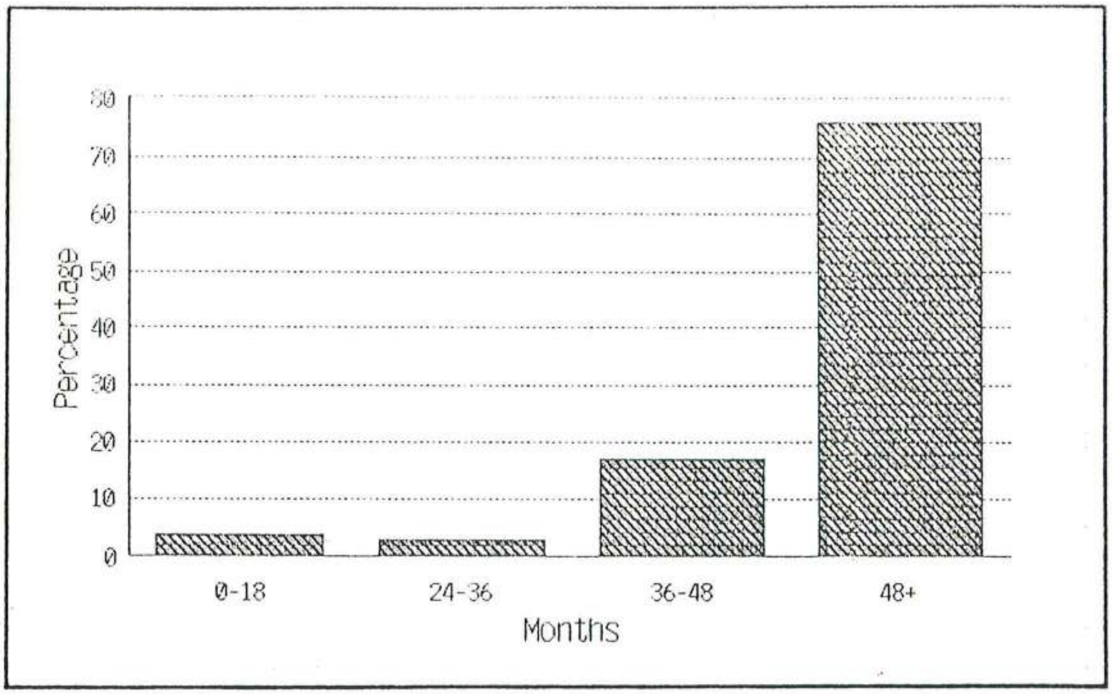

Figure 27: Percentage of Cattle Killed By Age Range, Utopia

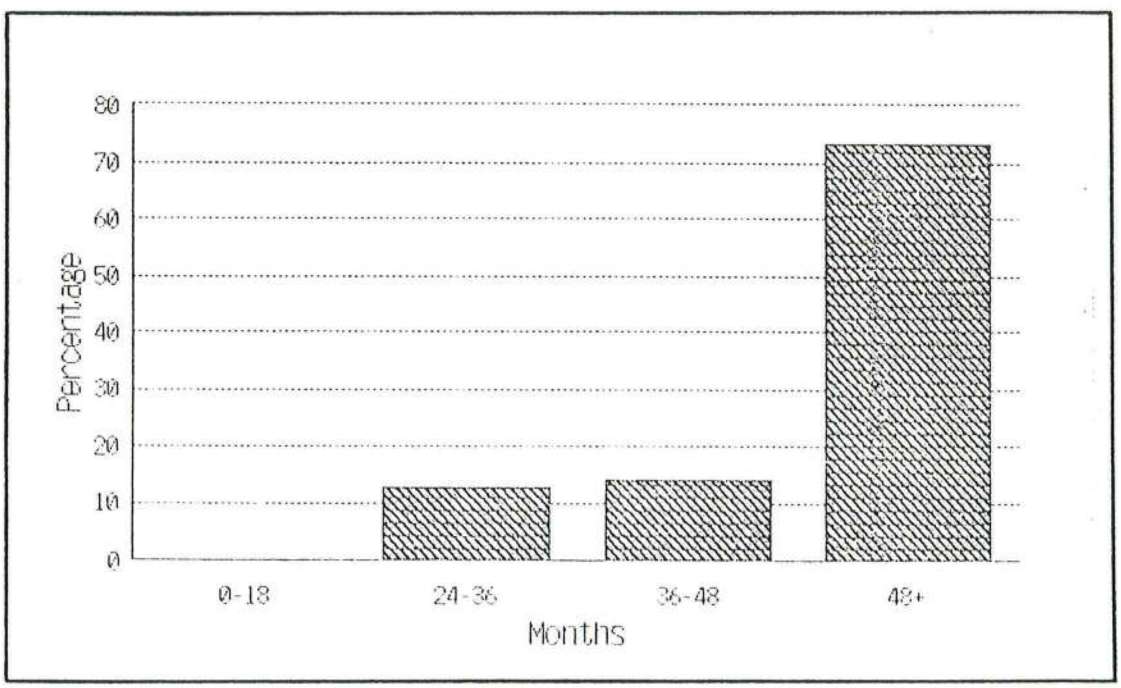

Figure 28: Percentage of Cattle Killed By Age Range, Bennett Farm

Cattle bones from occupations dating after 1700 and in samples large enough to calculate age structures are available from St. John's II, Drummond III, Clifts III, and Clifts IV. The results of these calculations are presented in Figures 29, 30, 31 and 32, respectively. The St. John's and Drummond assemblages are similar, with the largest group in the 48+ month class. The concentration of animals in that class, however, is not as pronounced as seen at the late 17th Century sites. The Clifts III sample bears some relationship to the others in that the most well represented group is also the 48+ month class, but substantial numbers also died in their second and third years.

The Clifts IV data are completely different from the other assemblages. The 24-36 month class is the most well represented. Over one-third of the slaughtered animals are in the 48+ month class, but this proportion is much lower than that seen at the other late sites. The Clifts livestock during this period were apparently raised as much for beef as for breeding or milking, and hence were used in a manner different from that seen at the other Virginia sites. The significance of this variation cannot be evaluated at this time due to a lack of other 18th Century comparative data. Only one later 18th Century assemblage is currently available to the author. The assemblage is from the Kingsmill Plantation site which is located less than a mile from Pettus and Utopia. The faunal materials derive from contexts dating to the 1760's. Cattle bones from this site indicate an age structure nearly identical to that seen at Pettus and Utopia,

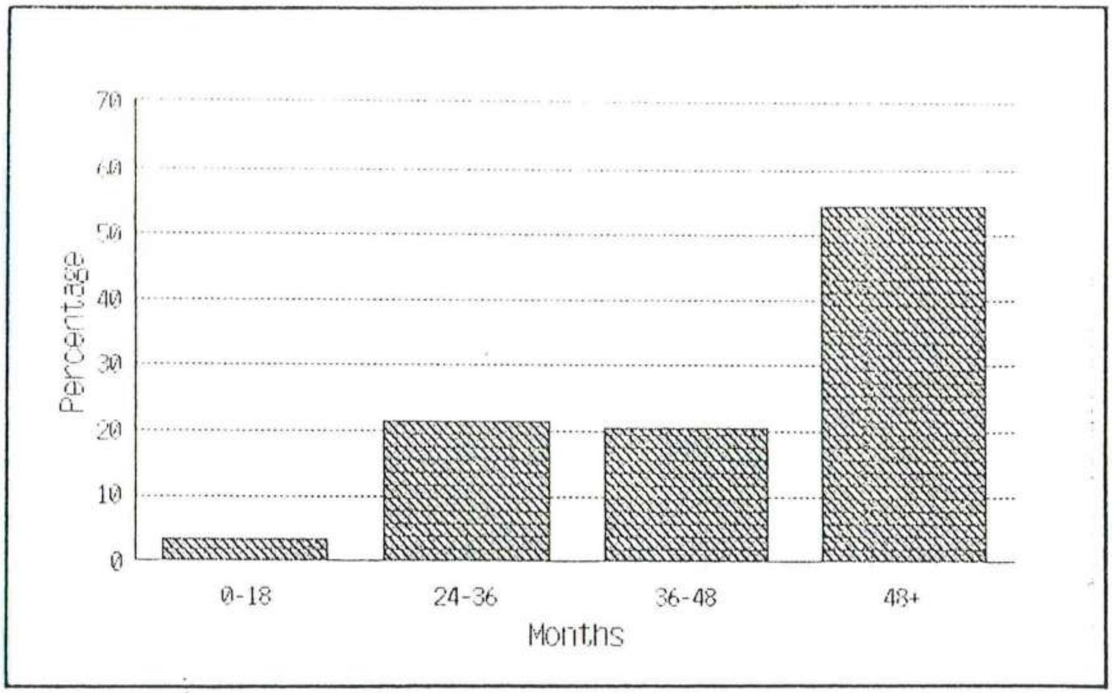

Figure 29: Percentage of Cattle Killed By Age Range, St. John's

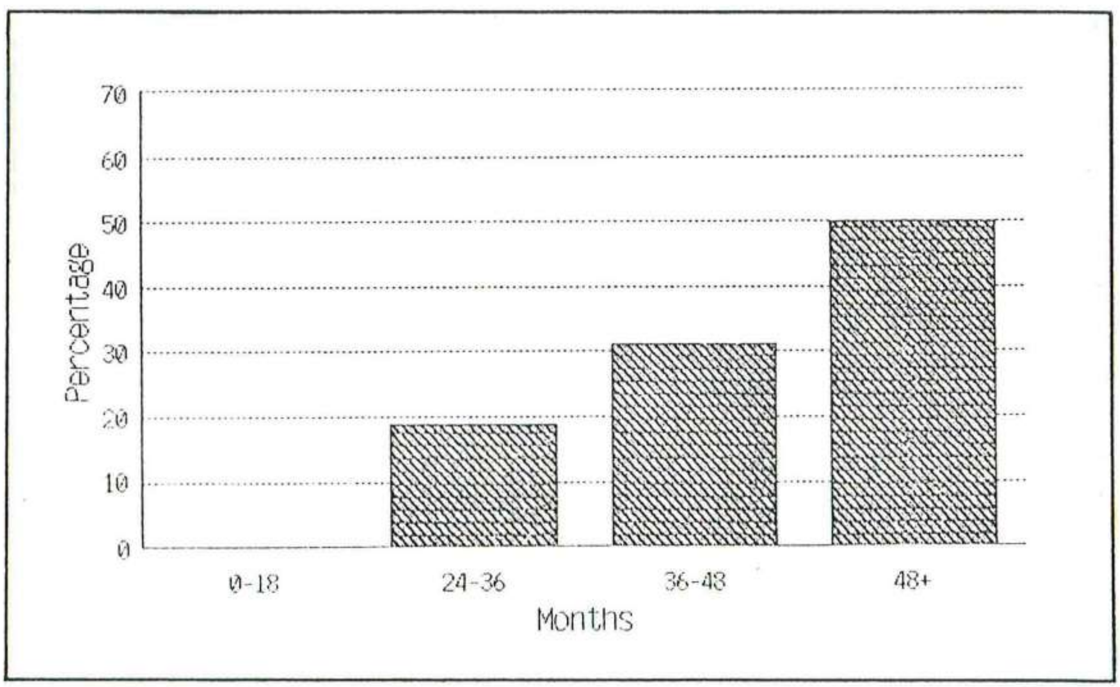

Figure 30: Percentage of Cattle Killed By Age Range, Drummond III

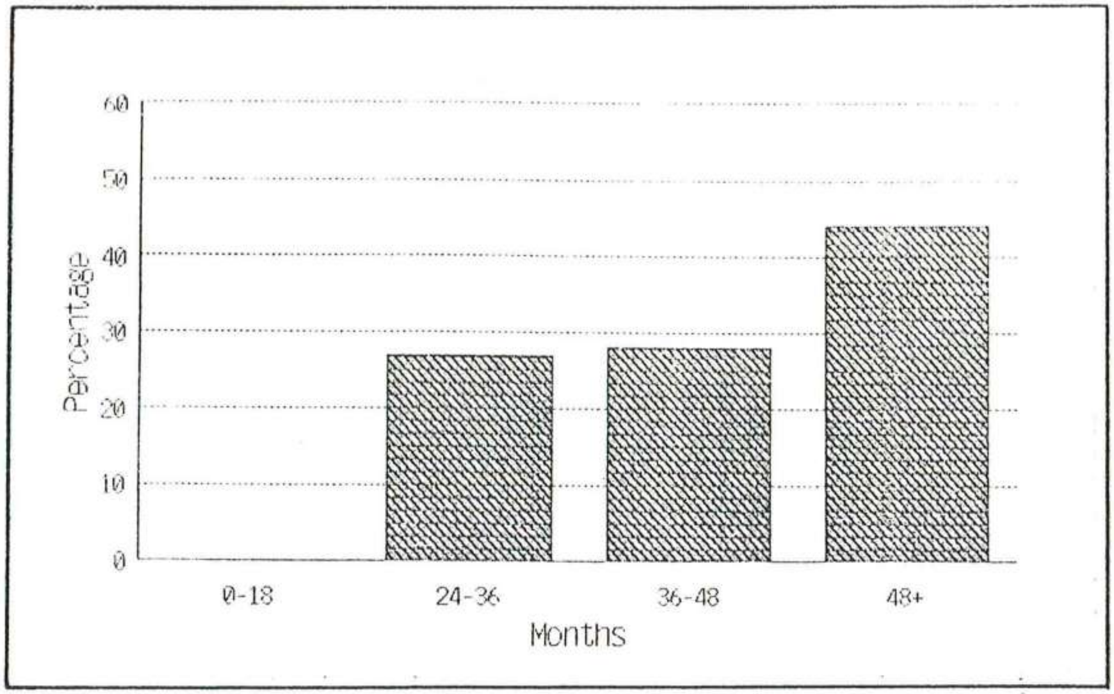

Figure 31: Percentage of Cattle Killed By Age Range, Clifts III

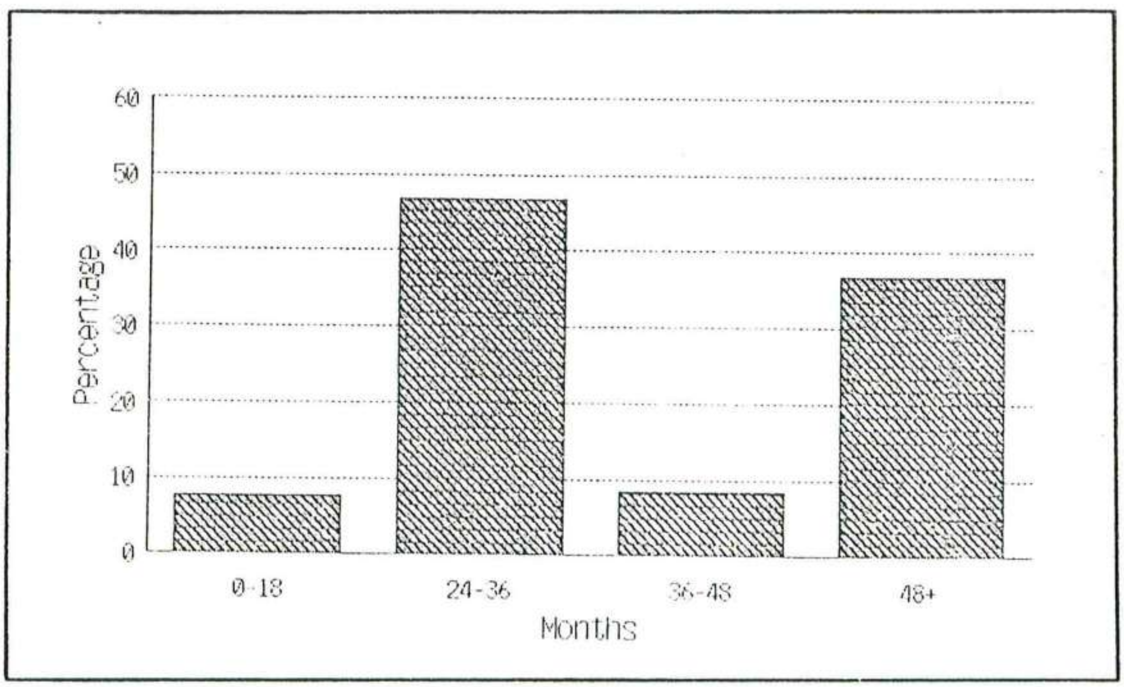

Figure 32: Percentage of Cattle Killed By Age Range, Clifts IV

suggesting that the pattern of cattle usage remained consistent in that area.

With the exception of the Clifts site, archaeological data indicate that cattle husbandry practices became increasingly uniform during the late 17th and early 18th centuries. Indeed, the patterns obtained from the lower Virginia sites are remarkably similar, and the St. John's data are generally comparable. These findings suggest that cattle were slaughtered at relatively young ages during the early and mid-17th Century but that this changed during the last quarter of the century when the cattle were kept to greater ages.

While these trends seem clear, it is difficult and dangerous to interpret livestock husbandry practices from small, potentially biased samples. The critic could argue that these apparent trends and age structures have no firm basis in fact. To explore this possibility, an independent data source is needed; this exists in the form of household inventories. Nearly every estate in the 17th Century Chesapeake owned some cattle, but unfortunately the ages of most animals were not recorded with any consistency. Cow ages range from three to 12 years while bull ages range from one to seven years. Only steers (castrated males) are normally listed by age, however, since steers are the animals most likely to be kept for meat, any change in their age structure would probably be reflected in the archaeological record. Cows and bulls would not be normally killed when young, unless barren. To investigate this, all household inventories from St. Mary's County, Maryland from 1665 to 1699 were studied and the ages of 601 steers were obtained. The inventories before 1665 contained too few steers to be reliable. The information is presented below.

Table 27: Steers By Age in St. Mary's County Inventories (In Percentage By Sample Group)

Date of Inventories	Years of Age 2	3	4	5	6	7	8
1665-1669 N = 65	38.46	38.46	15.38	7.69	-	-	-
1670-1674 N = 56	53.57	37.50	5.35	1.78	1.78	-	-
1675-1679 N = 177	30.11	38.06	18.75	8.52	4.54	-	.56
1680-1684 N = 62	30.64	32.25	25.80	11.29	-	-	-
1685-1689 N = 85	41.17	35.29	17.64	3.53	-	2.35	-
1690-1694 N = 82	17.07	32.92	20.73	23.17	3.65	2.43	-
1695-1699 N = 74	4.05	37.83	21.62	12.16	8.11	8.11	8.11

As the data indicate, in the 17th Century few steers survived beyond four years of age. A consistent and sharp drop in the number of steers between the ages of three and four took place. Such a pattern is expected if they are being slaughtered primarily for beef since younger animals yield more tender and flavorful beef. Steers surviving beyond four years in the earlier inventories are few, ranging between 3% and 13% of the total.

A considerable change took place during the 1690s. A drop in numbers of steers between three and four years continued but the proportion that survived beyond four years is striking. In the 1690-1694 sample, almost 30% of the steers survived beyond four years, and for the period 1695-1699, older steers comprise 36% of the total. The increase in the proportion of older steers provides strong evidence that the slaughter age for steers rose during the late 17th Century and this increase agrees with the upward trend in slaughter ages observed in the archaeological record.

Why this change occurred is more difficult to explain. The most likely reason is that as the colonial society matured, road systems developed, agricultural methods became more complex and male cattle again took on the role of draft animals as they had in Britain. This hypothesis can be tested by calculating the frequency in which carts, plows and harrows occur in the inventories. While horses could also be used for draft purposes, Earle (1975:121) suggests that steers were preferred for these tasks in the colonial period. Certainly, the simultaneous appearance of older steers and greater numbers of carts and plows in the 1690s would suggest some relationship. Once again, the St. Mary's County inventories were consulted; the results are given in Table 28. The inventories indicate that both plows and carts were rare during most of the 17th Century. A dramatic change, however, took place by the early 1690s when the proportion of households owning carts jumped to one-third and one plantation in five owned plows or harrows.

Table 28: Carts and Plows in St. Mary's County Estates

Sample Period	# Inventories	# Carts	%	# Plows,etc.	%
1666-1669	29	-	-	1	3.44
1670-1674	21	2	9.52	2	9.52
1675-1679	48	3	6.25	-	-
1680-1684	45	4	8.88	2	4.44
1685-1689	64	8	12.50	4	6.25
1692-1694	27	9	33.33	5	18.52
1695-1699	30	9	30.00	7	23.33

In summary, the archaeological data indicates that husbandry practices became more uniform through time. Historical data support the argument that cattle were used for more purposes during the late 17th and early 18th Centuries. Agricultural methods also became more complex during the final years of the 17th Century. It should be noted that cattle have been emphasized here for several reasons. Their bones are so large and rugged that neither recovery techniques or preservational factors are significant problems. In historical documents, the ages of cattle are more commonly specified than for other livestock. Finally, while swine and sheep bones were found, they were not consistently recovered in large enough quantities from sites and they were more broken than the cattle bones so that the ageing method could not be successfully employed.

Evidence of Increasing Subsistence Complexity

Did any changes toward greater complexity in agricultural methods or cooking practices occur? As just discussed, there is evidence that plow agriculture became more common at the end of the 17th Century. Other documentary data suggest that this movement toward more complex agricultural methods can be associated with the addition of wheat and other broadcast sown grains as plantation crops (Maine 1977:142; Earle 1975:122).

A comparison of data regarding food processing and cooking equipment in early and late 17th Century inventories from St. Mary's County is presented below.

Table 29: Comparison of Dairy and Cooking Equipment

	1638-1665 (N = 47)		1692-1705 (N = 72)	
Equipment	#	%	#	%
Dairying	14	29.78	22	30.55
Cheese Making	2	4.25	2	2.77
Boiling	47	100.00	71	98.61
Frying	30	63.82	45	62.50
Roasting	16	34.04	36	50.00

What is most remarkable about these figures is the almost complete lack of change. The indicies of dairying and cheesemaking equipment remain at a low level and boiling remains the most common means of food preparation. The only difference of note is that roasting equipment becomes more common in the later period. Since roasting is the most time consuming method of cookery, this change might be associated with the less pronounced labor shortage. There are also more frequent references in inventories to specialized dining equipment such as salts and punchbowls and more specialized ceramic forms are found in late 17th and early 18th Century ceramic assemblages from sites.

One unexpected source of evidence regarding increasing subsistence complexity comes from oyster shells. Through the study of oyster shells excavated from sites, it is possible to determine the estuarine environment from which they were taken. Shells from low salinity environments are generally thin, and have few indications of external organisms, such as small burrowing sponges (Cliona sp.), having lived upon them. Shells from high salinity waters, in contrast, tend to have much thicker shells. One reason for this is that the oyster can more easily absorb calcium carbonate from saltier waters. In addition, oysters in high salinity environments tend to develop thicker shells as a defense against the many hostile organisms found there. These shells also display evidence of more types of organisms that grew on them (Kent 1984).

Historical documents indicate that colonists utilized oysters harvested in the vicinity of their plantations, and in a study of colonial fishing, Wharton (1957:41) concluded that "Consumption of oysters was limited to those who lived on the spot." Among the historical references supporting this is a comment by the Frenchman, Durand, who lodged along the York River in 1686. His host apparently ate oysters nearly every Saturday. To get them "He had only to send one of his servants in one of the small boats & two hours after ebb-tide, he brought it back full"(Durand 1934: 124). Study of the abundant oysters from St. Mary's City sites also confirms that they were obtained locally (Kent 1980; Kent and Miller n.d.).

For colonists living along the upper portions of rivers, where the waters are oligohaline to tidal fresh, however, oysters were not readily available. Oysters do not survive in waters that remain below 5 parts per thousand salt for any extended period of time (Galtsoff 1964; Andrews 1973). On the James River, the extreme upper boundary of oyster distribution is just below Jamestown. Hence, the inhabitants of the Jamestown vicinity or above had access to only small quantities of this resource.

Oyster shells from early sites in the Jamestown area all display the characteristics of locally obtained oysters. One sample from the Maine site is composed of generally small, thin shells with half of them displaying no evidence of burrowing organisms and the others only have a few polydora and the low salinity sponge Cliona trutti. In addition, the shells have well defined radial ridges and some display a purple coloration in these ridge areas. These features indicate that the oysters were harvested in shallow waters (Kent 1984). Thus, these shells display all of the attributes expected of shells from the low salinity waters near Jamestown. Growth lines suggest that they were harvested in the fall or early winter.

Other early samples come from the Phase 1 features at the Drummond site. In a well (Feature 332), a group of shells was found that had the same characteristics as those from the Maine. These oysters were apparently taken in the fall and spring and thus represent a mixed group. Shells were also found in another well (Feature 265), and most of these were again similar to the Maine collection. Two shells, however, were thicker and one displayed evidence of burrowing worms, sponges, and encrusting bryozoans. These shells were probably obtained from saline waters. Clearly, most of the oysters came from waters within a few miles of Jamestown. Growth line evidence is not as clear on these shells, but most seem to have taken in the spring.

In striking contrast to these are shells from the next occupation phase at Drummond (ca. 1680-1710). A large number of shells was obtained from a cellar (Feature 224) and some of these possessed the characteristics of locally obtained oysters. The rest, however, are large thick shells.

Many of these shells were infested with organisms indicative of an origin in high salinity waters. Among these are burrowing sponges, some polydora, and an unidentified genus of burrowing clam. This variety of clam is especially important because it leaves large, readily identified holes in the shell and is only found in waters with a salinity of over 15 ppt. None of these occurs in the samples from St. Mary's City where the salinity ranges from 9 to 15 ppt over the year. Neither are these clam marked shells recovered from 18th Century contexts at Yorktown, Virginia, where the sea water ranges from 14 to 20 ppt of salt. This information suggests that these shells derive from the lower James near its mouth or from the Chesapeake Bay proper, where salinity levels are 16 to 22 ppt or higher. This distance is, at a minimum, over 45 miles from the Drummond site.

As a check to see if these shells represented a rare, perhaps unique importation of oysters, a shell sample from the Phase III occupation at the Drummond site was studied. These shells display the same characteristics as those in the earlier sample. The number and unbroken condition of these shells indicates that they are not merely a redeposition of some Phase 2 materials. The shells are thick and heavy, and display the same large burrowing clam holes. Identical shells have also been found at sites on Jamestown Island.

Since these shells were found in different contexts, separated by several decades of time and certainly deposited by different individuals, it is improbable that they represent a single temporal event or a practice engaged in by only one family. The fact that the shells came from high waters and were deposited in features on sites at and above Jamestown suggest some type of marketing. While a servant or slave might be sent in a small boat a few miles down river to to collect a few bushels of oysters, as the Durand quote indicated, getting oysters from 40 or 50 miles distance was an entirely different matter. First, the time expenditure would be substantial since currents and unpredictable winds can make travel on the James River a lengthy affair; at least several days of time would be involved. Secondly, shipping quantities of oysters would require a vessel of some size, since oysters are a bulky and heavy commodity. A vessel of any size would require more than one person, so that a considerable expenditure of labor and equipment would be needed. Only once a year did large ships enter the bay in any frequency, when the Tobacco Fleet arrived in late November or early December. Perhaps the crews of these ships collected oysters as they sailed upriver to supplement their wages. This hypothesis, however, is quickly rejected because a study of the oyster growth lines indicates that the shells were collected in the spring, a time when the Tobacco Fleet ships had already departed for England.

More likely, the oysters were collected by smaller, colony owned vessels, perhaps those which carried on a trade with the West Indies. The existence of this oyster marketing is completely undocumented. Only one reference, from Thomas Glover in 1676, might be germane. Glover described the incredible numbers of oysters around the Elizabeth and lower James Rivers and noted that "Here are such plenty of Oysters as they may load ships with them"(1904:6). The archaeological discovery is the earliest evidence for oyster marketing in the Chesapeake region and was not specifically predicted by the colonization model. However, oyster marketing indicates that subsistence was becoming more complex during the late 17th Century, as imports began to supplement the more locally available resources.

Summary

The evidence presented in this chapter indicates that subsistence patterns did become more uniform through time. The small variation in bone frequencies and the strong similarity between sites in meat estimates discussed earlier all argue that a more uniform, and probably more stable adaptive strategy developed in the Chesapeake. Indications for increased complexity are also found in both the archaeological and historical records. The addition of other crops, especially wheat, entailed the use of different and more complex agricultural methods. In turn, cattle were utilized for an increasing number of purposes, as reflected in the archaeologically-obtained husbandry data as well as the estate inventories. Marketing of foods within the colonies also suggests a growing level of economic and subsistence complexity. In other aspects, however, such as food processing and cooking, there is only slight evidence of change. Overall, increased complexity seems to have occurred but it was not pronounced. The continued persistence of the one crop tobacco economy may have hindered the development of greater complexity in subsistence. Reasonably self-sufficient plantations remained the typical form of settlement and there were few towns to stimulate production of marketable foodstuffs. The available data, nevertheless, suggests that greater uniformity, stability and complexity occurred through time and thus, supports Hypothesis 4.

CHAPTER 9

VARIATION IN SUBSISTENCE BEHAVIOR

In this chapter, the final two hypotheses will be addressed. The first to be considered is Hypothesis 5 which predicts that

> **The general pattern of subsistence change will be the same throughout the area of colonization.**

Colonization is a pervasive cultural process. Every household on the frontier participates in the process and must cope with similar problems in occupying the new habitat. Some variation can be expected due to ecological differences but within a specific geographic region, the same general trends should be expressed in all faunal assemblages. Another potential source of variation is the cultural heritage of the colonists, but since nearly all of the planters in the Chesapeake came from Britain, this should not be of importance here.

Geographic Variation

Since significant differences have been identified in the total site samples across time, similar patterns of change should have occurred in the sub-regions of the Chesapeake. It is possible, however, that by combining all the faunal samples from the same period, significant differences between areas could be masked. The plot of residuals for diversity discussed in Chapter 7 revealed that Period 1 sites were the most variable, but that notable differences also occurred in samples from Period 2. Is this variation geographically related? Trends that are expected to occur in all areas are: 1) the increasing importance of domestic species through time, especially a substantial increase in the cattle between Periods 1 and 2, 2) a pronounced decrease in deer frequencies between the same periods, and 3) a decline in fish frequencies across time with a major drop in Period 3. To investigate this, the mean frequencies of bone and estimated meat from sites along the James and Potomac Rivers were calculated by period, and are presented in Tables 30 and 31. Note that while the actual bone frequencies are used here with the meat figures, the transformed bone frequencies displayed the same patterns (See Appendix V).

The trends indicated by both bone frequencies and meat weights are similar. Domestic species in all but one instance comprise more of the bone and meat in Period 3 than in the first period. The exception is the proportion of estimated pork in the James River sample, which was higher in Period 1. Cattle show substantial increases between the first and second periods in both samples and sheep increase at a slow but constant rate in bone and meat frequencies. Deer decline markedly between Periods 1 and 2 in both areas, although this is more pronounced in the Potomac sample. Use

Table 30: Mean Bone Frequencies by Geographic Area and Temporal Period

	James River			Potomac River		
Period:	1	2	3	1	2	3
Cattle	20.79	33.35	40.13	19.01	29.20	40.75
Swine	30.96	16.13	38.37	13.27	27.10	32.03
Sheep/Goat	0.48	3.10	6.56	0.27	3.06	5.67
Deer	11.03	2.81	1.36	16.13	1.07	4.75
Fish	10.96	20.01	0.68	39.39	29.49	1.53

Table 31: Mean Meat Frequencies by Geographic Area and Temporal Period

	James River			Potomac River		
Period:	1	2	3	1	2	3
Cattle	37.10	68.67	60.57	49.95	62.64	63.64
Swine	37.78	19.76	26.71	16.95	23.93	24.84
Sheep/Goat	1.44	2.00	3.37	0.52	1.88	3.57
Deer	13.31	5.07	6.06	22.75	6.64	6.23
Fish	5.16	3.24	1.63	7.98	3.49	0.54

fish also diminishes through time along the James and Potomac Rivers, with one exception. Fish bone in the Period 2 sample from the James River sites displays a marked increase. Reference to the individual site data indicates that this anomaly was produced by a huge quantity of catfish bones found in a cellar at the Drummond site. Although these accounted for 32% of the total bones from the Drummond II occupation and represent a minimum of 100 individuals, their meat contribution was minimal, making up less than 2% of the total. Comparison of the estimated meat frequencies provided by fish during this period with the Drummond I sample suggests that their subsistence contribution actually declined slightly.

These data indicate that the same general patterns of change occurred at settlements on both the Potomac and James Rivers. Differences in the scale of these changes, however, may be related to ecological variation. While the terrestrial environments in both areas were similar, the aquatic environments were not. All but one of the James River sites come from the Jamestown area where the waters are tidal fresh to low oligohaline in nature. Spring salinities are well below 1 ppt of salt and the salinity content seldom rises above 3 or 4 ppt in the fall (Lippson 1973: 7). The Potomac sites occur along waters that have a much higher salt content with spring salinity ranging from 5 to 10 ppt and which rise to 12 to 16 ppt in the autumn. Due to this, the colonists along the James had available to them only the small freshwater fish, and the anadromous and semianadromous species. The Potomac River inhabitants, in contrast, had access to many marine fish, especially the large, bottom dwelling species, in addition to the anadromous and semianadromous fish.

The size differences between these fish species are substantial. The principal marine fish taken along the Potomac -- the sheepshead, black drum, and red drum -- provided an estimated 7.5 lbs., 25 lbs. and 18 lbs. per individual. In contrast, the fish available to the James River colonists were generally smaller: the striped bass was one of the larger varieties with an estimated meat weight of 7.5 lbs. More common were catfish that averaged two lbs.each, and white perch and white suckers which yielded about one lb. each. The only really large fish available in the Jamestown area was the sturgeon that averaged about 100 lbs., but this animal could also be obtained in the Potomac. Therefore, in general, the larger fish could only be obtained in saltier waters.

Tables 30 and 31 indicate that fish bone and meat frequencies are higher on the Potomac sites, suggesting that the residents of the Potomac concentrated more effort on the exploitation of fish resources than did their James River counterparts. The data suggest that a procurement strategy focusing upon large, and presumably dependable fish was incorporated into the early adaptation along the Potomac. The ease with which the large, bottom-dwelling fish could be procured is revealed in a 1676 observation by Thomas Glover regarding sheepshead. He wrote that

> A Planter does oftentimes take a dozen or fourteen in an hours time with hook and line (1904:5).

Glover also noted that there were a great many "Drum" that were easily obtained, at least during the warm months of the year. Because of a high return, low cost and dependability, these species were focused upon.

If correct, it is expected that subsistence strategies at sites in the higher salinity zones, where these marine species were more abundant, would have focused even more intensely upon them. Fortunately, one sample from this high salinity environment, the Bennett Farm site, is available. The site is located along waters with spring salinities of 15 or 16 ppt and autumn salinites of over 21 ppt, which are substantially higher than for any of the other sites in this study. Relative frequencies of bone and meat for the Period 1 and 2 assemblages from this site are given below.

Table 32: Frequencies of Bone and Meat at Bennett Farm

	Period 1		Period 2	
Animal	Bone%	Meat%	Bone%	Meat%
Cattle	8.56	41.49	42.21	63.78
Swine	7.43	21.51	20.13	22.54
Sheep/Goat	-	-	2.84	1.99
Deer	1.94	6.14	1.18	2.58
Fish	79.93	29.67	30.48	7.20

Bennett Farm displays the same general trends of change as seen at the other sites with the increasing importance of domesticated animals and the decline of both deer and fish over time. Fish bone and meat frequencies, however, are far higher than found on comparable James or Potomac River sites. Only three species account for this fish input - sheepshead, black drum, and red drum. Even though the usage of fish declines importantly, the Period 2 contribution is still higher than that found in the James River samples from Period 1 and is similar to that seen on the Period 1 sites along the Potomac. Thus, while Bennett Farm conforms to all the major shifts in subsistence detected at other sites, it displays a greater emphasis upon fish exploitation. This difference suggests that at sites located along the more saline waters, the availability of extremely dependable and cost efficient resources in the form of specific varieties of fish permitted a more focal adaptive strategy at a time when a more diffuse adaptation would otherwise be predicted. Certainly in terms of the MNI based niche width calculations, Bennett Farm is more focal than any other Period 1 site. The niche width calculated using meat weights also indicated that this site had a higher evenness of resource usage than the others. Fish apparently provided sufficient security against subsistence failure due to their dependability. Other factors such as economic status might be involved in the high frequency of fish at Bennett Farm, but the general association of higher fish usage with higher salinity waters suggests that this trend was related to Chesapeake ecology.

Overall, the data from the James and Potomac Rivers and the Chesapeake Bay indicate that the same trends of change occurred in each area. Variability does occur and some of it may be related to site location and the resources available. Although some variation remains to be explained, the similarity of changes throughout the Chesapeake is pronounced and this supports the acceptance of Hypothesis 5.

Resource Exploitation and Wealth

The preceeding discussions have addressed the trends of change in subsistence at the regional and sub-regional levels, and identified variability which may be related to ecological differences. Variation between households possibly resulted from differences in the wealth of the occupants as well. This possibility is addressed by the final hypothesis which predicts that:

> **Increasing differentiation in Subsistence Strategies and Diet will occur between socio/economic groups in the area of colonization over time.**

The basis for this hypothesis is that opportunity declines as a frontier is settled and the tendency is for differences between social and/or wealth groups to become more pronounced and fixed over time. Plentiful opportunity and a fluid social structure during the initial decades of settlement should be reflected in minimal differences between wealth groups. Over time, however, the chances for upward social and economic mobility decline and wealth/status differences tend to be accentuated (Williams 1977). Such a tendency has already been identified in household inventories in St. Mary's County where differences in material culture between wealth groups becomes increasingly apparent during the late 17th and early 18th Centuries (Carson and Carson 1976). Since a central element in the definition of status is differential access to resources (Fried 1974), and wealth and status were closely linked in the colonial Chesapeake, it is reasonable to expect that this would be expressed in subsistence. With an open environment during the early phases of settlement, there should be little restriction upon resource usage. As available land is occupied and population grows, however, resources will tend to be less available and differential access to them should occur. Although the overall trend in faunal assemblages seems to have been toward increased similarity through time, wealth related differences may have been masked by the procedure of combining sites into temporal or geographical groups.

Before looking at possible wealth related variation, it is important to have some insight into whether households established at different times in the colonization process undergo similar patterns of change. Since each household on a frontier is subject to similar environmental and social conditions, it is expected that they will undergo similar patterns of change. Sites occupied during the initial phase of settlement should display these changes to the fullest extent, but what about those homes established 15 or 20 years later in the same general area? Does the same sequence of changes occur in these households? Is the sequence modified, or do the changes not occur at all because conditions have altered? To investigate this, data from several different phases of occupation at the same site are required, and fortunately such information is available from St. John's, Bennett Farm, Drummond and Clifts. In Table 33 below, the percentages of meat derived from domestic and wild sources at these sites by temporal period are given. The sites are arranged in the order of their founding: St. John's, (1638), Bennett Farm (c, 1645), Drummond (c. 1650), and Clifts Plantation, the latest (c. 1670). Clearly, major differences between these sites require more study, but the sites also display some characteristics in common. In every case, domestic animals become more prominent through time. During the first phase, however, St. John's and Bennett Farm have

Table 33: Estimated Meat Frequencies at Multi-Phase Sites

	Occupation Phases					
	First		Second		Third	
Sites	Dom.%	Wild%	Dom%	Wild%	Dom%	Wild%
St. John's	62.14	37.86	a	a	94.51	5.47
Bennett Farm	63.08	36.92	88.51	11.49	b	b
Drummond	89.08	10.92	93.93	6.07	92.21	7.78
Clifts	84.92	15.07	88.79	11.02	95.58	4.42

a = Bone Quantities Insufficient for Analysis
b = No Third Phase of Occupation Identified

domestic frequencies that are appreciably less than found at Drummond or Clifts. Since both Drummond and Clifts were settled somewhat later, these figures may reflect the scarcity of domestic animals during the initial period of settlement. Meats derived from wild animals display a pronounced decline in frequency from the first phase of occupation at all sites. This drop is most clearly expressed in the earlier settled sites, but even Clifts displays a decrease in wild resource usage through time. Notably, Drummond was occupied by an extremely wealthy family, while the Clifts residents were tenants, and yet both households display similar patterns of change. These differences suggest that households founded at different times during colonization underwent the same patterns of subsistence change, but the magnitude of these changes decreased through time.

To gain a better perspective on household variation through time and by wealth group, it is necessary to look at all of the sites, beginning with the earliest - The Maine and Kingsmill Tenement. The Maine was occupied by tenants of the Virginia Company and that Kingsmill Tenement was also occupied by individuals who did not own the land. Artifacts suggest that neither group was exceedingly poor, and their wealth levels can be best described as low to middle. In the absence of historical data, a more precise estimate is not possible.

Cattle occur in quite different frequencies at these sites, making up 11% of the total at the Maine but 30% at Kingsmill Tenement. In terms of meat, beef accounts for 25.95% at the Maine, and it is from a single animal. This beef frequency is the lowest for any site in the entire sample. In contrast, beef represents 48% of the meat at Kingsmill Tenement. This substantial difference may be explained by the difference in the dates of initial site occupation.

Cattle multiplied slowly during the early decades of settlement in Virginia and it took time to develop large herds. Virginia Company tenants probably had only limited access to what beef was slaughtered. The scarcity of cattle was made even worse by the "1622 Massacre"in which the Indians not only killed many colonists but a large number of their livestock. The low frequency of beef at the Maine, whose occupation spans the massacre time, may be partially related to this event and the consequent shortage of cattle. If this is correct, however, it seems that recovery was rapid, for cattle contributed an important portion of the meat at Kingsmill Tenement.

Swine, in contrast, accounted for a large number of the bones and a large amount of meat at both sites. At the Maine, pork was more important than beef, making up 38.93% of the total estimated meat. Pork was not as prominent as beef at Kingsmill Tenement but it still contributed 36.64% of the meat. These figures clearly indicate a heavy dependence upon pork. Indeed, they are the highest frequencies obtained from any sites in the sample. Why such an emphasis upon pork at these early sites?

The answer again appears to relate to the reproductive capabilities of the animal. On a new frontier, livestock are available in an inverse proportion to their size. Cattle were more expensive than swine, harder to obtain and more difficult to transport. Cattle also reproduced more slowly than swine (Stone 1982:30). Swine are much more prolific than cattle, often having two litters a year with five or six pigs in each. In addition, pigs were splendid foragers in the forests and swamps of the Chesapeake region. Swine would have been more abundant and more quickly ready for slaughter due to a faster growth rate. Hence, swine would be the animal of choice for a newly established or poor household. A period of years would be required for a cattle herd to increase and the new animals to reach butchering size, but after that, the slaughter of steers and older cows would have been feasible. From the inventories of freedmen who had not yet established plantations of their own, it is obvious that acquisition of livestock and the development of a herd were essential preliminary steps for starting a household; such herd development often began well before a plantation was purchased.

Wild animals at The Maine and Kingsmill Tenement are well represented with nearly half of the bones at The Maine and 40% of those at Kingsmill Tenement from wild species. In terms of estimated meat, wild animals contributed 32.69% and 14.35%, respectively. The significance of wild game at

Kingsmill Tenement is lower, principally because cattle were of much greater importance at this site.

If this pattern of domestic animal use is typical of newly established households, it should be found at other sites in the Chesapeake region. To explore this possibility, the frequencies of bones and estimated meats in assemblages known to represent the first decades of a household's existence were collected and compared to The Maine and Kingsmill Tenement sites in Table 34. For cattle, there is considerable variation in the bone and meat frequencies. None of the other beef frequencies is as low as seen at The Maine, perhaps supporting the massacre-related hypothesis. Drummond I has an unusually high beef frequency, but the remaining sites are quite consistent with a range of less than ten percent between them. With swine, however, there

Table 34: Bone and Meat Frequencies from the First Phase Of Occupation at Sites

	Cattle		Swine		Total Wild	
	Bone%	Meat%	Bone%	Meat%	Bone%	Meat%
The Maine	11.22	25.95	34.69	38.93	49.50	32.69
Kingsmill	30.36	48.26	27.23	36.64	40.56	14.35
St. John's I	15.55	42.55	13.20	17.91	69.74	37.86
Pope's Fort	17.01	49.36	8.83	11.22	70.27	38.96
Bennett FarmI	8.56	41.49	7.43	21.51	83.85	36.93
Drummond I	38.32	67.73	21.30	19.14	34.42	10.92
Clifts I	10.26	48.35	29.59	36.26	58.70	15.09

is a striking division between the sites. Swine bone and meat frequencies are high at two early and one later occupation. Clifts is the only later sample in which pork frequencies equal those found at The Maine and Kingsmill Tenement. All of the sites yielded substantial quantities of wild animal bones. Meat frequencies, however, vary widely from 10% to nearly 39% of the estimated total. Each of these assemblages differs from the Maine and Kingsmill Tenement sites, with the notable exception of Clifts. Clifts surprisingly yielded frequencies of beef, pork, and total wild game that are virtually identical to Kingsmill Tenement.

How are these differences between households to be explained? One clue comes from comparing the Clifts and Kingsmill Tenement sites. In spite of the fact that nearly 50 years separate the founding dates of these two sites, they have nearly identical beef, pork, and wild meat frequencies. Both sites were established in localities with little previous occupation and, importantly, both were inhabited by tenants. All other sites in the above sample, except the Maine, were occupied by the owners, and, with the exception of Bennett Farm, these plantation owners were also members of the colonial elite.

St. John's was built by John Lewger, the Secretary of the Maryland colony, and the site later served as the residence of a wealthy Dutch merchant. Maryland's first governors lived within Pope's Fort, and Drummond was occupied by one of the wealthiest men in Virginia, who later served as the governor of North Carolina. Only the Bennett Farm residents were planters of modest means. Bennett Farm has the lowest beef frequency of the four, although marginally so, and a high wild meat imput, primarily from fish. As previously noted, however, the difference in its ecological setting from the other sites may warrant caution in comparing Bennett Farm with them.

The fact that Kingsmill Tenement and Clifts are identical in not just one, but three frequencies is unexpected. Since these sites were founded decades apart, similar forces and constraints appear to have been operating upon subsistence. This similarity implies that the phase of household development may be an important variable influencing subsistence behavior, at least for households that are not extremely wealthy. The emphasis upon swine is reasonable given the reproductive and growth capabilities of that animal. Surprisingly, however, wild resource usage at Kingsmill Tenement and Clifts is lower than seen at the other newly founded sites.

The highest wild inputs are found at Pope's Fort and St. John's. Beef is also quite significant at both of these sites, but pork, in contrast, accounts for less of the estimated meat than seen at any other site in the entire sample. Inspection of the faunal tables (Appendix I) indicates that venison makes up the major portion of the wild meats estimated for both sites. Deer contributed 31% of the total meat at St. John's and 22% at Pope's Fort, the largest of any of the sites. Why are these proportions so high?

Investigation of the historical documents from the early 17th Century provides a likely answer. In Maryland during January of 1643, a license was granted "...to an Indian called Peter to carry a gonne for vse of John Lewger" (Archives of Maryland 3: 143). A professional hunter was thus employed at the St.John's site and research by Stone (1982) suggests that Governor Calvert probably also employed a hunter. Many of the wealthier households apparently hired Indians and provided them with "gonne, powder and shott" to hunt deer. Evidence indicates that this practice, which required a license from the Governor, became widespread and resulted in so large a number of Indians possessing firearms that fears were raised. Consequently, Governor Stone in 1650 banned the practice in Maryland (Archives of Maryland 3: 260).

A high percentage of deer meat was also evidenced at the Maine site in Virginia. The suggestion has been made that before the Massacre of 1622, deer were probably obtained as much through trade with the Indians as by actual hunting (Lorena Walsh: Personal Communication, 1983), and this may account for the high frequency of deer at The Maine. Distrust of the Indians after the 1622 Massacre almost certainly ended this practice. The wealthy continued exploiting deer by employing experienced Englishmen, known as "Woodsmen", to hunt for them. One revealing document comes from Norfolk County, Virginia. In August of 1640, an agreement was made for a wealthy planter to hire a professional hunter named William Burrougs who would kill:

> ...so many deer as there are weeks between this present date and Christmas, killing every week one deer and one turkey... (Norfolk County Records 1640:136).

In return, the hunter was to receive food, drink, lodging, powder, and shot. This suggests that hiring a hunter was was a common practice in the more wealthy households.

For those who could afford the labor and/or other expenditures, deer could be focused upon as a major subsistence resource. An important but previously unrecognized factor of wild animal usage in the Chesapeake is thus indicated. The high frequency of deer remains at St. John's and Pope's Fort suggests that this resource may have constituted an important buffering strategy against subsistence failure in the poorly known environment. As the deer were more heavily exploited, however, their populations would have been depleted in a given area. Continued usage of this resource would have necessitated more time for hunting and travel, as well as increasing problems of transportation as the deer were killed at greater distances from the plantation. The lack of evidence for any such deer emphasis at later sites may indicate that continued reliance upon such a strategy was too costly.

For households with limited labor, such as tenants or small scale planters, this time consuming and somewhat unpredictable practice may not have been feasible. Instead, the persistent but low frequencies of deer and small mammals on most Period 1 and Period 2 sites may indicate a more casual taking of these animals rather than active hunting. In the 17th Century as today, deer, raccoons, squirrels and opossums enter corn and bean fields to eat the crops. Indeed, deer foraging has been found to be especially heavy on small fields surrounded by woods (Flyger and Thoerig 1962:51), precisely the situation produced by 17th Century agrarian practices. These animals could have been taken as they came to the fields to feed, rather than being purposefully hunted. Such a practice is similar to what has been called "Garden Hunting" in South America (Linares 1976), where gardens and fields serve to concentrate artificially the densities of various species by attracting them to feed on the crops. This presumably unintentional effect of 17th-Century agriculture would have acted to bring a variety of game to the planter and hence reduce the time needed for hunting.

Faunal materials indicate that the tenants at Kingsmill Tenement and Clifts occasionally took game but apparently the occupants of neither site concentrated upon deer. The Clifts planters took the easily caught sheepshead while the inhabitants of Kingsmill Tenement exploited a wide variety of game but did not concentrate upon any single group of animals. For tenant planters, swine probably provided the most dependable meat supply since pigs required little care, bred rapidly and, with occassional feeding of household waste, could be kept near the plantation. Through time, however, as evidenced by the Clifts III sample, livestock herds developed and beef occupied a more prominent position in subsistence. Swine continued to be important but their contribution was less than found during the initial phase of settlement.

Drummond I is the one site that does not fit the above explanations. Drummond I displays a higher beef proportion and less wild game than any of the other newly founded households. Beef accounts for 67.73% of the estimated meat and pork is 19%, but all wild resources make up only 10.92%. Domestic usage increases in the next phase and wild usage declines, and hence the broad subsistence trends are still apparent. Nevertheless, the difference between this sample and the other first phase assemblages is substantial. One essential factor is that when the Drummond plantation was established in the early 1650s, the area had already been occupied by colonists for over 40 years and nearby Jamestown had the highest population density of any location in Virginia. Wild game, especially deer, were probably more depleted in that area than anywhere else in the colony. Many wild species are present in the faunal assemblage but most are migratory fowl and fish that are not as susceptible to depletion.

Another significant factor, which may help explain this assemblage is that William Drummond lived in Virginia for a number of years before constructing a plantation at the site. With his wealth, he probably acquired cattle soon after his arrival and may have had well established herds before moving to the site. Hence, the early reliance upon swine may have been either unnecessary because of his wealth or may have occurred at a previously occupied site. By the 1650s and 1660s, sizeable cattle herds were abundant in Virginia.

The above discussion indicates that there is a wide range of variation among the early faunal assemblages, although all display the same general trends of subsistence change. Tenants during the first phases of settlement seem to have consumed larger quantities of pork than land owners, along with a substantial quantity of beef, but a relatively small amount of wild meats. Very wealthy households in Maryland and Virginia seem to have emphasized cattle and deer over pork. At Bennett Farm, a "middling planter" site, domestic animal usage was comparable to that at the wealthy Maryland sites but the exploitation of easily-obtained fish resources was emphasized rather than deer. Does this variation persist and become more pronounced through time as predicted by the hypothesis?

Several sites from Period 2 are available to elucidate this. The most wealthy sample from this period is Drummond II, which was still a major plantation occupied by the Drummond family. At the other end of the wealth scale are the Bennett Farm and Wills Cove sites, both of which were apparently occupied by people of low to middling wealth. In addition, there are two assemblages from St. Mary's City, Smith's Ordinary and John Baker's Ordinary. The same variables used in discussing the early sites are again employed here, with the data provided in Table 35. Some variability is evident between these sites, especially in bone frequencies. If the Drummond II sample is removed, however, there is greater consistency. The bone proportions from Drummond are so distinctly different because of the large number of catfish bones found there, a situation previously discussed. In terms of meat, however, the sites display relatively little variation. Ranges between these samples in cattle, swine and wild meats are 9%, 5% and 5%

Table 35. Cattle, Swine, and Wild Animal Frequencies in Period 2 Assemblages

	Cattle		Swine		Total Wild	
Sites	Bone%	Meat%	Bone%	Meat%	Bone%	Meat%
Drummond II	22.45	72.16	11.44	19.36	57.42	6.08
Benn. Farm II	42.21	63.78	20.13	22.54	33.58	11.51
Wills Cove	39.28	66.14	15.66	20.78	37.84	11.00
Smith's	32.45	69.91	27.15	18.12	26.80	8.85
Baker's	44.91	69.68	24.57	17.42	21.19	9.41

respectively. Considering the degree of sample size variation, there is a remarkable regularity between the sites. Wild resources may have been somewhat more important at the middling wealth sites of Bennett Farm and Wills Cove. The lower percentage of wild meat at Drummond might also be related to resource depletion in the Jamestown area, but additional samples are necessary before this suggestion can be tested.

The archaeological samples from the two ordinaries in St. Mary's City are similar to the faunal remains from the other sites. This similarity indicates that subsistence patterns at ordinaries did not differ appreciably from private homes, suggesting that the identification of a 17th-Century ordinary on the basis of faunal materials will be very difficult if not impossible.

Data presented thus far suggest that socio-economic related differences in faunal remains between sites were not substantial. It is significant, however, that none of the later sites discussed above was a plantation occupied by tenants, and it was the tenant sites that displayed the greatest differences in Period 1. Fortunately, data from two quite comparable sites are available and can be used to investigate tenant versus major planter subsistence in the late 17th Century. The two comparable sites are the Pettus Plantation and Utopia. Pettus is located just downriver from Jamestown and was the home of a very wealthy planter and his family. Utopia stood half a mile away on land owned by Pettus. Agreement has been reached that a tenant occupied the Utopia site (Carson 1981). The differences between these two sites in architecture and ceramics are substantial. The main structure complex at Pettus was large with the ground floor covering some 2500 square feet of space (Kelso 1974), while the single structure at Utopia was much smaller, covering only 550 square feet. In ceramics, large quantities of high quality imported wares in specialized forms were recovered from the Pettus site, but fewer vessels were found at Utopia. Utopia lacked specialized vessel forms and a substantial portion of the pottery was locally manufactured. Thus, there seems little doubt that the Utopia occupants were poorer than the residents of Pettus.

Due to possible data recovery problem for small bones at these two sites, they have not been compared with the others. Since the excavation methods at each were similar, however, the data from them, especially the remains of large mammals, can be compared. Artifacts indicate that the faunal assemblages from both sites date primarily to the last quarter of the 17th Century.

Species found at these sites are similar, with cattle, swine, sheep/goat, chicken, turkey, deer, raccoon, opossum, and cooter turtle identified at both (See Appendix I for species lists, bone counts and other data). More varieties of fish were found at Utopia, suggesting that this resource may have been more important there. In Figure 33, the frequency of cattle, swine, sheep/goat and total wild animal bone from each site is graphically presented, and only minor differences are apparent. Swine remains are somewhat more abundant at Pettus but the difference is small.

Proceeding to a higher analytic level, the minimum numbers of individuals were calculated and converted to estimated meat frequencies. The meat frequencies from the two sites are compared in Figure 34. Once again, the sites are quite similar, but with even less variation than in the bone counts. Beef comprised most of the meat at both sites and pork accounted for a quarter of the total but sheep/goat made only a small contribution. Wild meats make up 4.7% of the estimated total at Pettus and 6.2% at Utopia. These

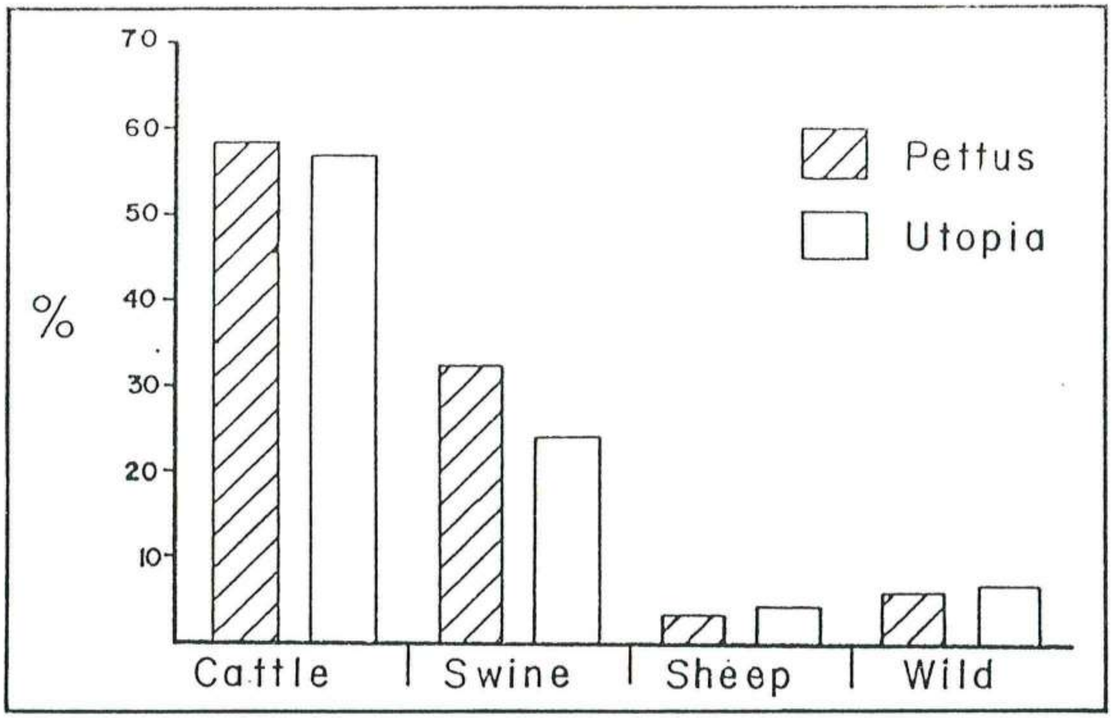

Figure 33: Comparison of Bone Frequencies from Pettus and Utopia

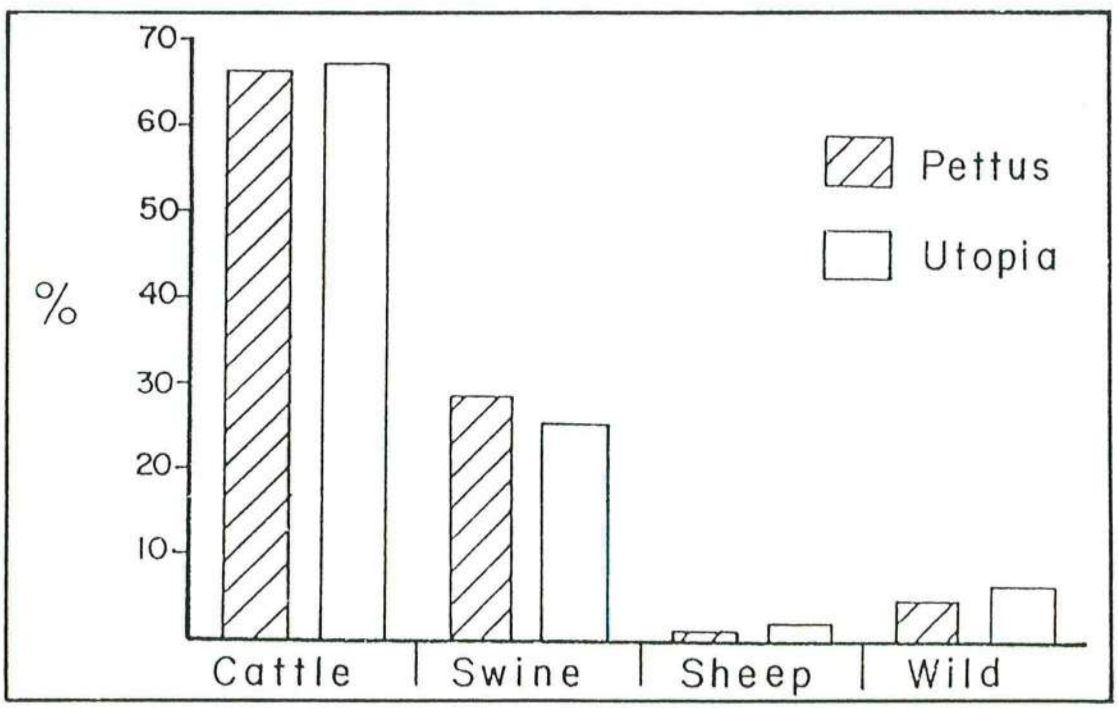

Figure 34: Comparison of Meat Frequencies from Pettus and Utopia

percentages are surprisingly close to the 6.08% wild contribution found at the nearby Drummond site.

The similarity between these sites in bone and meat frequencies is notable and unexpected. The possibility remains, however, that there were significant differences in the quality of the meats consumed. Perhaps the Utopia residents ate the poorer cuts and sold the higher quality portions in nearby Jamestown. To determine whether there were any notable differences, the bones of cattle and swine were divided into three categories:

1) skull and neck elements;

2) meat-rich bones from the main body; and

3) lower leg and hoof elements.

This division allows a rough comparison of the high quality versus low quality cuts present. The results for cattle are presented in Figures 35 and 36. Clearly, high quality elements make up the majority of the bones at both sites with little difference between them. A higher proportion of hoof elements was present at Utopia, but the proportions of skull/neck bones were identical. Incidentally, the cattle age structures at these sites were also nearly identical, suggesting similar husbandry practices (see Chapter 8). Swine bones (Figures 37 and 38) also provide evidence of the two sites" similarity. In terms of the meat-rich bones from the body, there is only a 6% difference between the two.

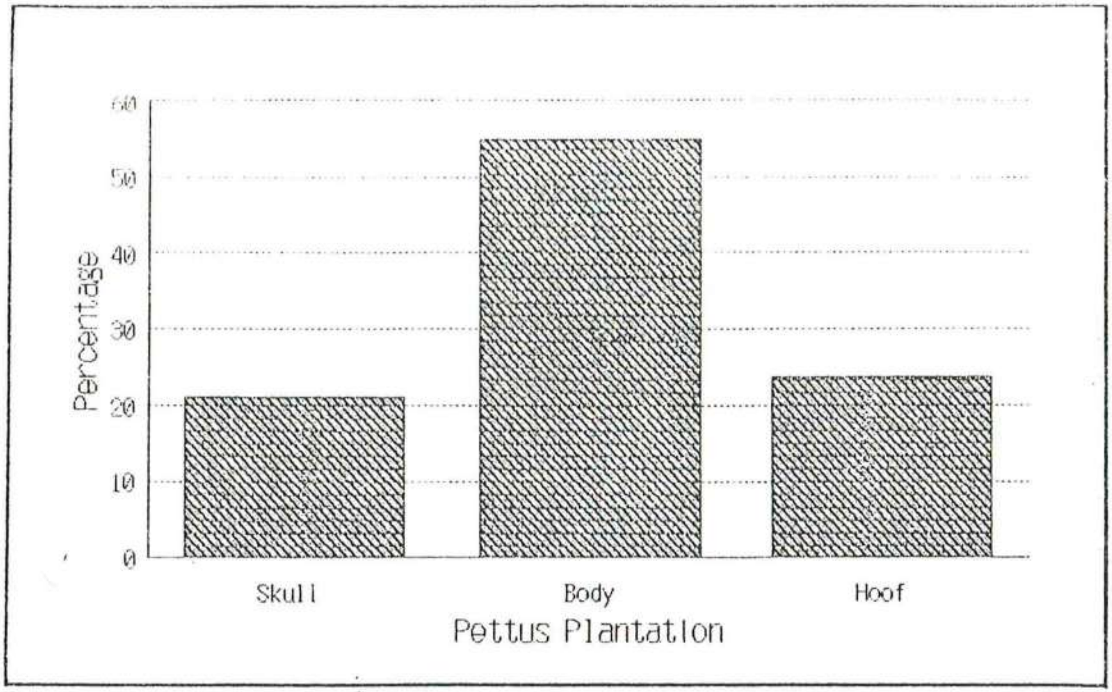

Figure 35: Cattle Bones By Body Section: Pettus Plantation

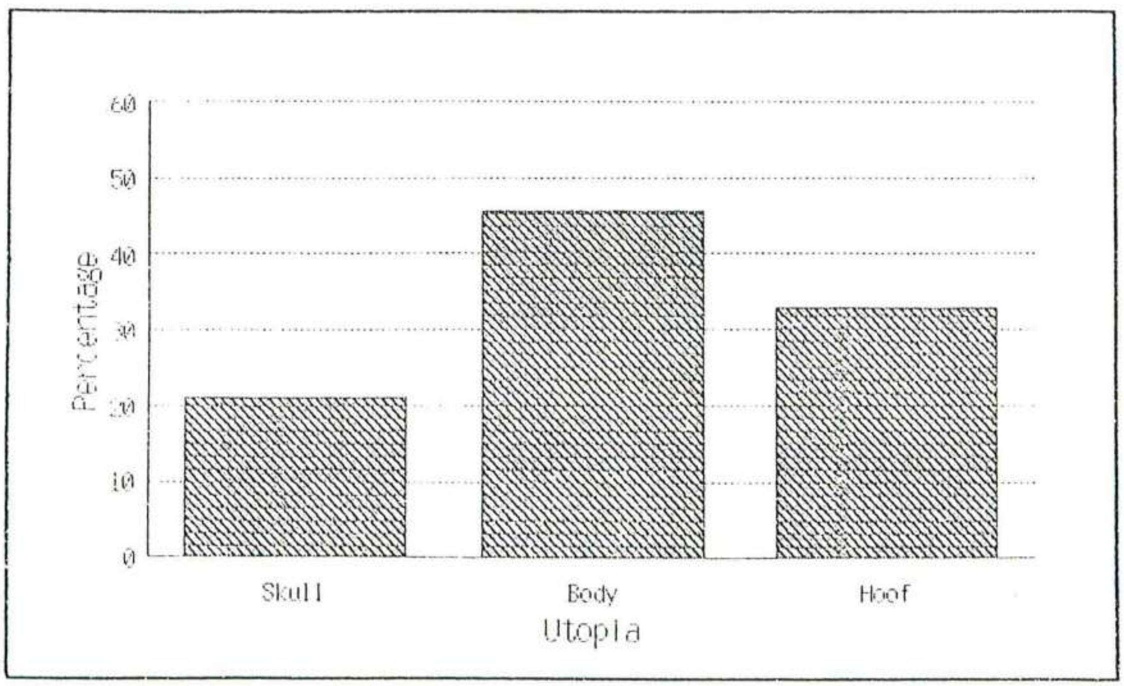

Figure 36: Cattle Bones By Body Section: Utopia

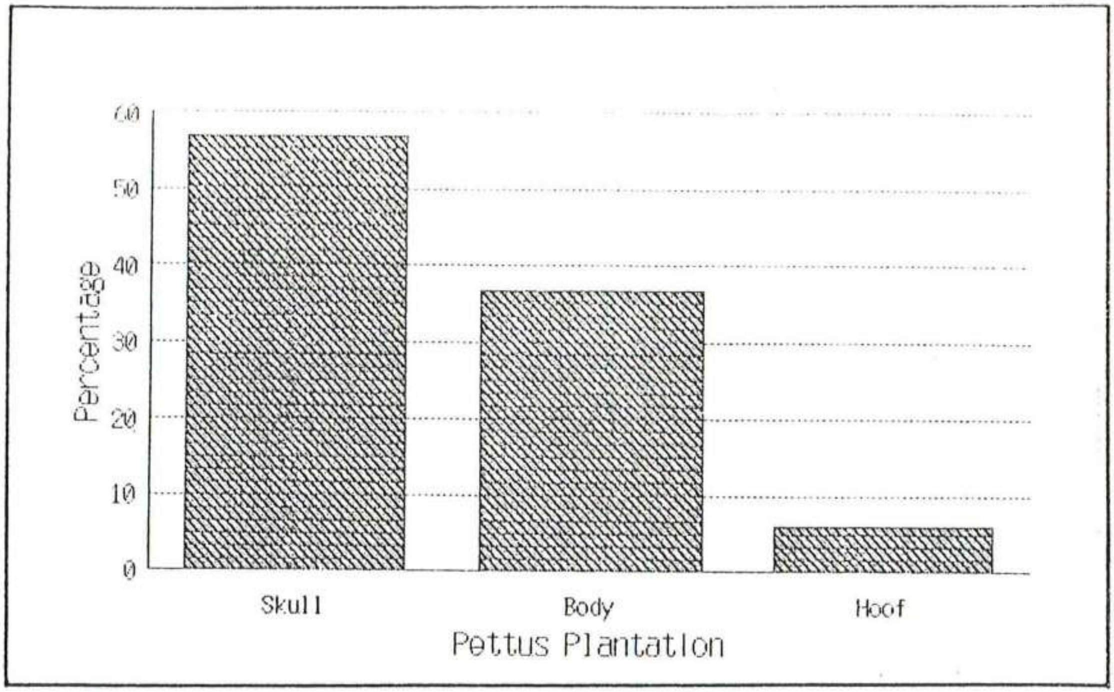

Figure 37: Swine Bones By Body Section: Pettus Plantation

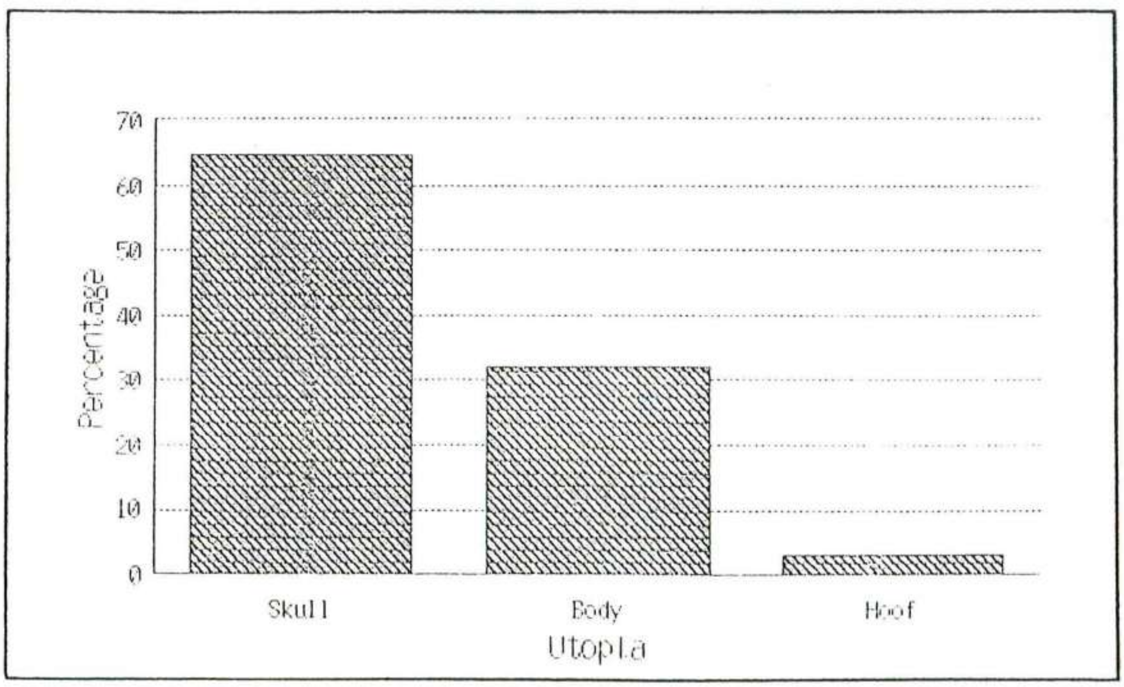

Figure 38: Swine Bones By Body Section: Utopia

Pettus and Utopia share a remarkable degree of similarity in meat consumption patterns that is surprising, given the prominent differences between them in architecture and ceramics. This finding suggests that reduced, instead of increasing, differentiation between the meat diets of wealthy and poorer planters occurred during the late 1600s. To further clarify this, data from Period 3 must be addressed.

From the post-1700 period, samples are available from two tenant households (Clifts III and IV, and Drummond III), a middling planter's house (St. John's II), a prosperous inn-keeper's home (Van Sweringen's), and a major James River plantation (Bray). The bone and meat frequencies of cattle, swine and total wild animals from these sites are presented in Table 36, which shows only a small degree of variation among them. Although bone frequencies show greater variation, the proportions of estimated meat display a high degree of similarity. Cattle meat estimates vary by only

Table 36: Period 3 Bones and Meat Frequencies of Cattle, Swine, and Combined Wild Animals

	Cattle		Swine		Wild	
	Bone%	Meat%	Bone%	Meat%	Bone%	Meat%
Clifts III	37.67	59.95	40.18	24.98	12.14	11.18
Clifts IV	47.78	67.99	38.63	26.06	9.66	4.18
Drummond III	39.64	60.99	39.25	28.89	13.63	7.80
St. John's	39.10	65.81	26.26	25.53	22.33	5.48
Van Sweringen	38.46	60.83	23.07	22.81	8.64	8.93
Bray	40.62	60.15	37.50	24.51	7.41	9.76

8%, swine by 6%, and wild animal by 7%. Differences between a major planter and a tenant in these samples are minimal, and hence the Period 3 data support the findings from Pettus and Utopia.

All investigated site data from the late 17th and early 18th centuries indicate that differences in subsistence between households were minor. Overall utilization of domestic and natural resources appears to have been nearly the same at middling and wealthy plantations, as well as in ordinaries. Independent planters, regardless of their wealth level, seem to have had sufficient resources to maintain comparable meat diets.

Nevertheless, important documented differences in status existed between individuals within the colonial society, and it seems improbable that these would not be at least suggested by archaeological findings. Review of the historical record indicates that the most clearly demarcated status distinctions were between masters and their servants and/or slaves. For much of the 17th Century, these differences were not expressed in a rigid manner. The boundary between servants and masters was real, but not always emphasized, partially because they often came from the same social background, and on smaller plantations, they worked side by side in the fields and lived in the same house. Additionally, servants could expect one day to be planters themselves, and the masters could later anticipate dealing with their freed servants as peers. Toward the end of the 17th Century, however, the social distance between master and servant increased. This shift was partially due to a change in the character of the servants. The more recent immigrants tended to be from poor, rather than middling backgrounds and included convicts and the Irish. By the 1690s, African slaves were also increasingly common. At the same time, the children of planters were inheriting estates. These native born individuals had less in common with the servants and nothing in common with the slaves. This widening gap has been archaeologically identified at the Clifts Plantation through a study of architectural change (Neiman 1978,1980), and it seems equally likely that these changes should be reflected in subsistence. The recognition of these status differences, however, requires a finer focus than an entire site.

Unfortunately, no faunal data are available from isolated servant or slave quarters to compare with other sites. There is one means by which this data might be obtained - by comparing feature materials associated with different structures at the same site. The central assumption is that pits directly related to the main house at a plantation will contain materials originating from within, while features associated with outbuildings will contain materials deposited by the occupants of those structures, perhaps servants or slaves. Although such an assumption is not always warranted with archaeological materials, it is possible for meaningful insights to be obtained regarding status differences if the features are carefully selected.

Two features from the Drummond site seem well qualified for this type of comparison. Both are the same type of feature (wood lined wells later used as trash receptacles), yielded similar faunal sample sizes, and yet they differ in artifact content and location. The first well (Unit 347) dates about 1700 and was situated near the main house. The well yielded a dazzling collection of high quality artifacts including Venetian-style glass and a delftware plate decorated with the images of Willam and Mary (Alain Outlaw: Personal Communication 1982). Well 326, on the other hand, was near an outbuilding and only yielded such ordinary artifacts as locally made earthenware. The latter well was built in 1690, according to a dendrochronological analysis of the wood lining, and was filled by about 1710. Although preservation in Well 347 was not good for fragile materials, the bones of mammals survived in good condition, and hence these remains can be compared. Identified species and bone counts are provided in Table 37.

Differences between these features are apparent. The main house well (Unit 347) yielded the remains of cattle, swine, sheep/goat, and deer. Well 326 produced bones from cattle and swine, but lacked sheep or deer. The well associated with the outbuilding also contained several additional species, but some of this difference may have been produced by preservation factors. Bones of at least two opossums were found in Well 326 and this is noteworthy because these are the only elements from this species

Table 37: Faunal Materials From Drummond Wells 326 and 347

	326		347	
Species	Bones	%	Bones	%
Cattle	36	36.73	53	68.83
Swine	34	34.69	12	15.58
Sheep/Goat	-	-	11	14.28
Chicken	3	3.06	-	-
Deer	-	-	1	1.29
Opossum	6	6.12	-	-
Rat	1	1.02	-	-
Catfish	12	12.24	-	-
Crab	2	2.04	-	-
Cooter Turtle	4	4.08	-	-

identified in the Drummond II assemblage. Cellar 224 contained a bone sample over 25 times larger than the collection from Well 326 and yet not a single opossum bone was found in it.

Variation in the quantity of bone from cattle and swine is also visible between these two units. In the main house well, cattle bones make up 68% of the assemblage and swine comprise 15%, while in the outbuilding well, both accounted for approximately 35% of the bone. To aid in determining whether there differences are significant, a chi square test was performed, which indicates that these differences are significant at the .01 level. This finding suggests that beef was of greater importance in the diet of the main house residents.

The quality of meat cuts consumed is another aspect of subsistence that might differ between status groups. To evaluate this, the cattle bones were divided into two categories: 1) high meat value elements (thoracic and lumbar vertebrae, the scapulae, humeri, radii, ulnae, pelvic bones, femurs, and tibias) and 2) low meat value elements (skull bones, mandibles, cervical vertebrae, metapodials, astragali, calcanei and the phalanges). This comparison also shows considerable differences between the two features, with well 347 containing 31 high quality and 22 low quality elements and the outbuilding well yielding 10 high quality and 26 low quality bones. A chi square test reveals that these differences are also significant at the .01 level.

Thus, important differences exist between these faunal assemblages in species content, bone frequency, and the types of meat cuts present. Since the two wells are spatially separated and yielded quite different artifact assemblages, it is probable that these samples represent the diets of distinct social groups at the Drummond site. Materials from Well 347 suggest that the more wealthy residents of the main structure had a diet primarily composed of beef, especially the higher quality cuts, supplemented with pork, mutton and venison. The outbuilding assemblage, probably deposited by servants or slaves, indicates a meat diet composed of beef and pork in more equal ratios, with beef cuts of lower quality than in the main house assemblage. Small mammals such as opossums, it is implied, were added to the diet of this group. This diet bears a close resemblance to that of the Chesapeake slaves, as suggested by the documentary record

(Miller 1979:160-161). If this interpretation is correct, these faunal materials constitute the first archaeological evidence for status distinctions in 17th Century subsistence. Importantly, these samples also date from the end of the century when the documents indicate that social distance between master and servant was increasing. References to servants and slaves being housed in separate quarters and being fed differently from the planters' family, while by no means unknown throughout most of the 17th Century, become increasingly common during the late 1600s and early 1700s (cf. Danckaerts 1913:111; Durand 1934:116; Michel 1916:114; Jones 1956:78). These contemporary observations correlate well with the data from the Drummond site.

Therefore, while the archaeological data are limited, there is some evidence that the diets of different social groups living on plantations were different and may have become increasingly so through time. Certainly by the 18th Century, when slaves comprised much of the labor force, the differences in subsistence between planters and their slaves were pronounced (cf. Noel Hume 1978: 15-19).

Discussion

For the most part, the findings discussed above contradict the expectations of Hypothesis 6. While there is some archaeological evidence for differences in subsistence between status groups on plantations, little variation is apparent between wealthy and the middling to poor households. In resource usage, most of the late 17th and all of the early

18th Century assemblages investigated are remarkably alike. One problem in this investigation is that these samples tend to be from the larger and richer sites in the region. Data from the poorest households are notably lacking for every period because these sites have not been located or excavated. There are, however, samples available from small to middling scale plantations, and since the gap between these and the extremely wealthy estates was large and growing larger by the late 1600s, the lack of differentiation in subsistence between them is significant.

Subsistence, rather than becoming more differentiated through time, became less so. During the first period the most pronounced differences between households occurred. Most prominent of these is the usage of large mammals. Cattle appear to have been an important source of meat in all households while the contribution of swine was more variable. During the early decades, wealthy households seem to have invested labor in the exploitation of deer. In areas where the natural resources had been heavily utilized, however, the wealthy apparently placed greater reliance upon cattle and used what wild animals could be found.

Land and natural resources were abundant and readily available on the early Chesapeake frontier but two culturally controlled resources were not -- domestic cattle and human labor. The more wealthy households could afford to purchase breeding stock soon after the colonist' arrival in the colony, probably in some quantity, while a newly released servant just beginning his plantation would probably not be able to purchase livestock as soon or in as large a number. In a study of the first decades of the Maryland colony, Stone (1982) found that cattle were very difficult to obtain and only the most wealthy owned herds of any size. Throughout the 17th century, cattle were worth much more than other livestock and, for many planters, cattle accounted for a major portion of their personal wealth, as revealed through the study of inventories. The emphasis upon swine at tenant sites is probably related as much to the original cost and the slow growth rate of cattle as to the rapid growth and high reproductive potential of swine. Hence, economic factors probably had to be carefully weighed before a cow or steer could be slaughtered.

Equally important to a householder was the labor supply available. The wealthy controlled more labor and could apparently afford to expend some of it on exploitation of specific natural resources, such as deer. Poorer households with limited labor appear to have exploited natural resources in a less intensive and less labor consuming manner. They appear to have merely taken animals as the opportunity arose rather than concentrating upon specific resources, unless these resources were unusually abundant or easily obtained. Thus, wealth differences in the early period did have a notable impact upon the types of subsistence strategies employed.

Later, as livestock herds grew, cattle comprised a much greater proportion of the meat diet, while the input of swine rose only moderately. Usage of wild resources continued but at a greatly reduced level when compared to the early sites. By the end of the 17th Century, no evidence for significant variations in subsistence between households is apparent in the archaeological record. Of course, there certainly were differences in the quality of foods served between rich and poor households. The wealthy could afford a wider range of spices, sugar, specialized cooking equipment, baking ovens, imported wines, and spirits, as well as the labor and facilities with which to prepare elegant dishes. As Robert Beverley (1947:291) wrote in 1705:

> The Gentry pretend to have their Victuals drest, and serv'd up as Nicely as at the best Tables in London.

The Swiss traveler Michel (1916:140), however, apparently found the more elegantly prepared foods of the wealthy not always good, for he made the curious comment that:

> One must, however, be surprized when lodging with poor people, for better food is frequently met with there than among the rich.

Regardless of the means of food preparation, overall meat subsistence patterns appear to have differed minimally between the rich and poorer planters. Documentary support for this comes from the writings of Durand (1934:123), who observed in 1686 that:

> As to cattle raised for food, however rapidly they may multiply, their number is kept down, for there is not a house so poor that they do not salt an ox, a cow and five or six large hogs.

Using the meat figures employed in this study, the number of slaughtered livestock Durand gives for a poor household yields an estimated 61% beef and 38% pork. Although difficult to give these percentages much credence, it is curious that the only sites in the archaeological sample for which similar frequencies can be calculated are Kingsmill Tenement, Clifts I, and Bennett Farm I and II, the poorest occupations.

The evidence indicates that Hypothesis 6 should be rejected. Archaeological evidence indicates that by the late 1600s, there was little difference in subsistence activities among the colonists who managed their own households. Only in the non-free households, where subsistence strategies and food consumption was controlled by others, do indications of the stratified Chesapeake society appear.

CHAPTER 10

SUMMARY AND CONCLUSIONS

In this study, many different aspects of subsistence in the colonial Chesapeake have been addressed. Evidence for extensive and rapid changes in subsistence patterns has been presented. In the following sections, the overall study is briefly summarized and some aspects of Chesapeake subsistence that warrant further attention are discussed.

Summary

This study has been concerned with the process by which new lands are settled with specific attention given to the expansion of a European society into North America. In the first chapter, the characteristics of this process were identified and a model of colonization was presented. Since subsistence is one of the most crucial aspects in adaptation, it is expected to undergo change on frontiers in a manner commensurate with the process. For this reason, human subsistence is discussed and the criteria used in selecting appropriate adaptive strategies are considered. Hypotheses regarding subsistence change during colonization, derived from the model, are presented for testing with data from the 17th Century Chesapeake.

In the second chapter, the nature of subsistence in the colonists' British homeland during the late 16th and early 17th Centuries is investigated, and two major subsistence patterns identified: 1) the lowland pattern, with intensive grain agriculture and some livestock husbandry, especially of sheep and cattle, and 2) the upland pattern with an emphasis upon livestock husbandry, and agriculture of only secondary importance. Overall, British subsistence was highly focused upon a few types of grains and livestock. Wild species were of minor importance except for some fish. Cattle, sheep and swine were the principal animals and husbandry practices, complex in both the Upland and Lowland regions, required careful livestock management. In terms of late 16th and early 17th Century British dietary preferences, meat was regarded as a high status food and the standard of living was judged to a large extent by the amount consumed.

The study area of the Chesapeake Bay is next discussed and compared to Britain in Chapter 3. The two regions had generally comparable climates and vegetation although the Chesapeake was notably warmer in the summer than Britain and the ecological cycles were different. The primary difference between the two lands, however, was in the natural resources. Unlike Britain, the Chesapeake was covered with a mature decidious forest, and wild food resources were tremendously more abundant and diverse. The Chesapeake was also inhabited by a native people whose culture was radically different from that of the colonists.

In the fourth chapter, the history of settlement in the Chesapeake is reviewed and the chief characteristics of this frontier society are delineated. Historical documents reveal that the major features of this society were in keeping with the predictions of the colonization model. Key among these during the early decades of settlement are abundant opportunity, a fluid social structure, biased sex and age structures, reduced cultural complexity and a severe labor shortage. Also detected are temporal trends toward demographic maturity, cultural stability, increasing complexity, reduced opportunity and a more rigidly stratified social structure, as predicted by the model.

The data sources used to test the hypotheses are presented in the fifth chapter. Although historical documents are integrated into the study, the primary data base is archaeological. Animal remains from 15 sites and 21 separate occupations, dating from circa 1620 to about 1740, are utilized in the investigation. Only faunal materials from well dated, sealed contexts were selected for inclusion. Recovery methods, analytic procedures and the units of analysis are all discussed in detail to provide a basis for comparison with other studies.

Testing of the hypotheses begins in Chapter 6. The first hypothesis, supported by the findings of this study, predicts that evidence for cultural impoverishment should be found. Animal husbandry practices in the colonies were greatly simplified to a woodland pasture method that required minimal labor. Agriculture was greatly simplified as well, with the near abandonment of grain crops which required plows. Instead, native American crops were grown using slash and burn methods in a long term fallow system, an approach the colonists may have learned from the Indians.

The prediction that the early adaptive strategy would be of the diffuse type is verified in Chapter 7. Early colonial subsistence practices emphasized a much wider range of animals than in Britain and utilized them in a distinctive, seaonally variable pattern. Differences in resource usage due to ecological and wealth variables are detected in the early samples. A trend toward increased utilization of a few, select resources is also apparent in the data with a more focal subsistence pattern emerging by the late 1600s which emphasized two domestic species - cattle and swine. Fewer wild resources were exploited through time, and seasonal variation in subsistence was greatly reduced by the early 1700s.

Evidence is presented in Chapter 8 regarding increasing stability, uniformity and complexity in colonial subsistence. More uniform subsistence patterns are found at later sites , with the assemblages dating from c. 1680-1740 being very similar in the utilization of cattle, swine and wild resources. Increased uniformity and complexity are also indicated by changing cattle husbandry practices. Quite similar patterns are found at late 17th Century Virginia sites, and the age structure of the slaughtered animals suggests that cattle began to be used for purposes other than meat. Historical data support this observation and provide evidence that plow agriculture was more widely practiced toward the end of the 17th Century. Finally, indications of increased complexity are present in the form of the earliest oyster marketing in the Chesapeake, which apparently began along the James River in the late 1600s.

Evaluation of the faunal materials from different portions of the Chesapeake in Chapter 9 reveals that the same trends of change in subsistence occurred throughout the region, as predicted by the fifth hypothesis. However, the data also indicate that through time, variability between households at different wealth levels declined, rather than increased, as predicted in Hypothesis 6.

Overall, the findings in this study of subsistence confirm the predictions of the colonization model. The findings also demonstrate that this cultural process can be recognized in the archaeological record. Three remaining subjects deserve more discussion: 1) the factors underlying the move to the extremely focal adaptive strategy; 2) the lack of status/ wealth related subsistence variation; and 3) the timing and explanation of various frontier related changes in the cultural system.

Discussion

Chesapeake subsistence clearly underwent rapid change from a more generalized strategy to one which increasingly emphasized only a few domestic resources. The emergence of a more focal subsistence pattern is predicted, but what is surprising is the degree to which specific resources were focused upon. Domestic animal bone frequencies increased dramatically from 38% of the identified elements in early assemblages to 88% in the post-1700 samples. At the same time, the domestic contribution of estimated meat rose from 69% to 92%, most of which is attributable to just two animals -- cattle and swine.

The move to a more focal economy was not propelled by the general depletion of natural resources alone. Some resources such as deer and turkeys were probably over-harvested, but others were almost certainly not, especially the migratory fish and waterfowl. Even at Bennett Farm, where the fish resources were apparently readily available throughout the period under study, there is evidence for a major decline in utilization. Why was exploitation of these abundant and dependable natural resources nearly abandoned?

Cattle and swine were generally dependable resources in the Chesapeake environment. The shift to near total reliance upon them, however, occurred in the face of major plague outbreaks and a series of severe winters that claimed the lives of several hundred thousand animals in the region. Obviously, reliance upon a domestic resource base did not completely remove the potential for subsistence failure.

One factor likely to be involved is cost. In Chapter 1, this subject was discussed and the assumption was made that selection of subsistence strategies usually involved the least cost principle. The Chesapeake strategy which developed supports this assumption. From the historical documents pertaining to husbandry practices in the early 18th Century (Beverley 1947; Gray 1958), it is apparent that there was little change from the 17th Century. Animals were given slightly more care but overall, they were permitted to roam freely and forage for their food. Little investment was made in facilities such as barns or in fodder cutting. In essence, allowing animals to roam freely was one of the least costly means of livestock management possible, and it produced a large and dependable meat supply.

Factors other than food acquisition possibly were involved in the development of this focal strategy because cattle and swine also served other cultural needs. Livestock provided subsistence security, but also served as a form of economic security in colonial society. On the self-sufficient plantations, wild resources such as fish had little value except as food. Livestock, on the other hand, possessed an economic value in addition to their food value. In Maryland, a cow and calf during the late 1600s were worth over 2 pounds sterling (Menard 1975: 486-488); the equivalant of 600 to 700 lbs. of tobacco, or over one-third the amount of tobacco a man was expected to grow in a year. Consequently, in most inventories from the period livestock made up a major portion of a household's assets (Menard 1975; Kelly 1972). For example, in Surry County, Virginia during the late 1600s, livestock accounted on the average for half of the total personal property owned by planters (Kelly 1972: 166). Unlike tobacco production, livestock production required very little labor. A great deal of land for grazing was needed, though. Livestock were, in effect, a land extensive rather than a labor intesive resource, and land was far more available than labor in the early Chesapeake. In effect, livestock served as a sort of economic buffer against the unpredictable tobacco market, and the difficulties of acquiring and keeping labor. Although very poorly documented, there is evidence that a trade in beef and pork was developing by the early 18th Century with the West Indies, along with the sale of some salt beef and pork as ship provisions (Carrier 1957:30). Cattle and swine could also be sold to other planters within the small but growing local economy (Menard, Carr and Walsh 1983).

Probably of equal importance was the ability of livestock to serve as a means of providing children with an inheritance. Given the high death rate, it was unlikely that a planter would live to see his children grown. Housing was generally of an impermanent nature, lasting for perhaps one generation before replacement was necessary, and hence, it was an ineffective means of transferring wealth to one's children. Tobacco would not store for any period of time, bound labor was an unreliable inheritance because of the high mortality rate and there were limitations on the length of indentured servants' terms. Only land could be transferred with certainty to the following generation. Livestock, while perhaps not as certain, were of considerable value and had the advantage over land of returning a high rate of interest through reproduction. Given minimal care, cattle and swine could increase quickly, so that the gift of a cow and calf to a child could become a sizable herd by the time that child reached adulthood. An animal still might die, but the chances of an entire herd dying were probably small. Hence, livestock offered an important alternative to reliance on tobacco and helped provide economic as well as subsistence security, both to the planter and his heirs.

Discussion of inheritance raises another subject of relevance for understanding the domestic animal focus in subsistence. As previously noted, it was only during the closing decades of the 17th Century that a native born majority was established in the Chesapeake colonies. The effect of this demographic transition on subsistence was that most later households did not begin at the minimal level necessary for the first generation. Instead, most of these households probably started with cooking equipment and animal herds inherited from their parents. In addition, these individuals had the advantage of knowing the natural environment and benefitting from the experiences of their parents or guardians regarding subsistence. The native borns' greater knowledge is an expected corollary of the development of a stable population. Attention must be given to this generational effect in the evaluation of subsistence patterns, which occurs not only in frontier settings, although it may be most clearly expressed in that setting. When studying relatively short temporal periods, as in Historical Archaeology, the phases of household development can potentially have an important effect upon the composition of archaeological assemblages and are worthy of serious study.

Finally, the development of this focal strategy can also be viewed as the successful reestablishment of traditional British subsistence practices. As Thompson (1973) has noted, one of the goals of colonists is to reestablish familiar cultural practices to the extent possible. Tradition is obviously a powerful force in subsistence behavior and it certainly had an important role in shaping the colonial Chesapeake subsistence pattern. The basic reliance upon domestic animals is apparent in the earliest archaeological samples and becomes more pronounced through time. Tradition was not the only factor, however, for many differences are apparent between British and Chesapeake subsistence. Certainly, husbandry practices were quite different from those employed in Britain, with livestock in the colonies essentially allowed to run free. Cattle and swine were apparently much more common in the Chesapeake while sheep were extremely rare in comparison to the huge flocks found in England. One of the major dietary staples in Britain, cheese, was nearly absent in Chesapeake subsistence. Real differences, probably attributable to both environmental and cultural factors, existed.

The focal adaptation that emerged in the late 1600s was a product of many forces. Certainly the dependability of domestic animals and the low cost of keeping them in the Chesapeake is at the heart of their acceptance as the subsistence base. Other factors, however, probably served to intensify and focus reliance upon cattle and swine. In In addition to meat, dairy products, and cooking fats, cattle and swine also provided a secondary source of income, a buffer against economic difficulty, and a means of improving the lives of one's children through inheritance. The British heritage of the colonists was also relevant in shaping the adaptive strategy because cattle and swine were central elements in British subsistence. That the evaluation of colonial subsistence must include other factors than just food acquisition is abundantly clear. Cattle and swine were of major significance for subsistence but they also functioned in other contexts. In complex societies, to evaluate an adaptive pattern only in terms of food acquisition likely will lead to erroneous conclusions. The explanation offered here for the emergence of a very focal adaptation is thus multi-dimensional, reflecting the complexity of variables involved in the process by which an adaptive strategy is selected.

Perhaps the most unexpected discovery of this study is the lack of evidence for status/wealth related differences in subsistence during the late 17th and early 18th Centuries. While some indication of subsistence variation between social groups was found at the Drummond site, comparison of faunal samples from other households dating to that period reveals little variation. The greatest evidence for variation is found in the early period, just the reverse of the prediction, and these differences were at least partially related to wealth. The more wealthy could afford to put labor toward the exploitation of high return, but high risk resources (i.e. deer), while the poorer households took them only occasionally. Another factor was the high cost of cattle, which could be more readily acquired and in greater numbers by wealthy rather than poor individuals. Thus, subsistence variation in the early period was produced in part by limited resources, but these were not natural resources, they were those under cultural control.

The rationale for the prediction that increased variation should occur through time was related to resource scarcity. As the population increased (which it did, and at a rapid rate), food requirements would rise (which they obviously did), and pressure on subsistence resources would lead to depletion or reduced availability of many of them. Some evidence suggests that this phenomenon also occurred. The next step in this line of reasoning, and the crucial one for Hypothesis 6, was that in the stratified Chesapeake society, differences in subsistence would occur due to the differing access of various wealth groups to the means (largely labor and equipment) for exploiting the increasingly scarce resources. Other studies of faunal materials from stratified colonial societies (Cumba 1975; Reitz 1979) have found evidence for significant status related differences in the exploitation of both wild and domestic resources. Why in the Chesapeake, where there is abundant evidence for increasing social stratification, are indications of subsistence variation minimal?

The answer lies in the fact that households, whether rich or poor, were highly self-sufficient in the Chesapeake. The focal adaptive strategy that emerged in the late 1600s seems to have been based upon key resources that were not depleted. Livestock husbandry practices were not labor intensive but they were land extensive, requiring large amounts of woodland pasture to support cattle and swine. Little equipment, facilities, or labor investment was necessary, so that the subsistence strategy did not necessitate the expenditure of much capital or labor. These key factors are normally expected to produce socio-economic differentiation in subsistence. Although land was not as available as it had been in the early 17th Century, land could still be obtained and plantations were generally large to include abundant woodland pasture. In early 18th Century Maryland, the median plantation size ranged from 200 to 300 acres with few plantations below 100 acres in size (Menard 1975:423). Since one laborer could tend only two or three acres of tobacco and two acres of corn a year, much of a planter's land was either in forest or "old fields" undergoing revegetation. Even on small plantations, there would have been abundant land for livestock to graze. Furthermore, since property boundaries were not fenced, the land available for grazing was in reality even larger. Thus, the critical resources for successfully employing this focal strategy were two - livestock and land - and neither was limited. All but the poorest individual could expect to raise livestock in quantity. Therefore, while the colonial society became increasingly stratified socially and economically, the key subsistence resources did not become unequally distributed, at least not during the time period under study.

The implication of this is important because differential access to resources, especially food, is a central element in the definition of status. The late 17th and early 18th Century Chesapeake provides a clear example of a stratified society where the archaeological remains relating to subsistence fail to show any differences. Since it is typically assumed when investigating a highly stratified society that these differences will be present, this discovery points out that such an assumption may not necessarily be valid.

The situation evidenced here may be a feature of frontier settings where there is an unusual abundance of available land. A much longer period of time may be necessary for access to land to become sufficiently restricted that status/wealth differences in the meat diet appear. Clearly, faunal materials from later 18th and 19th Century sites in the Chesapeake must be employed to fully investigate this subject. This finding, nevertheless, is significant because it refutes the commonly held assumption that differential access to foods, espcially meat, is an inevitable feature of social stratification.

Still another important subject is the timing of various changes in the colonial society. The rise of the more focal adaptive strategy and reduced seasonal variability in the diet became pronounced during the last decades of the 17th Century. This shift correlates well with many other changes in the colonial society discussed in Chapter 4 and which are predicted to occur as the colonization process ends. Among these indices are population growth through natural reproduction, economic diversification, establishment of a native born majority, rising population densities and declining opportunity. All of these factors are important elements in the establishment of a stable and viable society.

The colonization process took from 60 to 80 years from the date of original settlement to the establishment of a viable, stable society. This seemingly lengthy process was hindered and prolonged by exceptionally high mortality rates and the virtually continuous immigration of new colonists into the region. Particularilу surprising is the fact that both Virginia and Maryland experienced the same changes at approximately the same time, even though both colonies were founded 27 years apart. Certainly some regional variation, which only recently has become a topic of research, existed but the onset of natural population increase, the development of native elites and the stabilization of cultural processes in aspects as varied as subsistence and politics appear to have occurred only slightly earlier in Virginia. Among the several factors probably responsible for this situation is the conflict ridden early years of Virginia settlement. During the first years, there was little effort to establish a reliable subsistence base and several disasters destroyed many of the domestic animals. Colonization efforts were not really successful in any prominent way until after the demise of the Virginia Company in 1624, just a decade before Maryland's founding. The Maryland colonists also had the benefit of obtaining livestock from Virginia instead of having to transport them from England. More importantly, the Marylanders apparently learned from the experiences, and benefitted from the mistakes of the Virginia settlers, and hence they were able to adapt more rapidly to the Chesapeake. Thus, the temporal difference in development between the two colonies was not as great as might be surmised from a consideration of founding dates alone.

Colonial Chesapeake society seems to have gone through a major transition during the final decades of the 17th Century and, as noted above, the timing of this transition seems to have been similar in both colonies. Many changes appear to have been nearly contemporaneous. Explanation of them, however, has taken two courses. The first, and the one advanced here, is that the cultural process associated with colonization is the key factor in these many changes. The second approach has been to study each change in detail and produce specific historical explanations for them. For example, declining opportunity and economic diversification have been attributed to the over production of tobacco and a major depression in the tobacco economy beginning in the 1680s (Menard 1975). Such a specific historical explanation is correct and appropriate in the sense that every event is the product of a unique set of circumstances, and clearly, economic factors are of central importance. An emphasis upon the specific explanation for each phenomenon, however, can obscure perception of commonality and the operation of broader cultural processes.

The operation of such a process is not only suggested by the presence of features predicted by the colonization model but by the timing of their appearance. For example, decline in economic opportunity and the achievement of a naturally reproducing population are separate events, but according to the model, they should be contemporaneous because they mark the termination of the colonization process. The actual date of their appearance, however, is expected to vary geographically because the process should be most advanced in the longest settled area. On the other hand, if economic factors associated with the tobacco economy were solely responsible for these changes, then they should occur throughout the frontier at the same time. All planters participated in essentially the same marketing system.

Historical evidence suggests that these events occurred at varying times in the Chesapeake. Opportunity can be demonstrated to have declined earliest in the first settled areas of the Maryland colony (Carr and Meanrd 1979:233). Opportunity also declined first in the longest settled area of Virginia, where limits to land acquisition existed by the last third of the century (Morgan 1975:225-230). Even during the depths of the 1680s depression, however, a freedman could apparently still find opportunity to obtain land, establish a household and build a modest estate in the unsettled frontier areas such as the interior of Surry County (Kelly 1979: 197-199). Thus, there is a relationship between the date of settlement and the decline of opportunity which implies an association with the frontier process. Economic depression undeniably had an impact and probably intensified the speed and depth of the decline, but it is incorrect to say that market conditions were the sole or even major cause.

The appearance of a naturally increasing population also seems closely related to the date of settlement. In Maryland, which has been more thoroughly studied in this regard, this achievement occurred earliest in the first settled area of southern Maryland, and later on the Eastern Shore. Menard (1975:200) found that natural population increase occurred some ten to twenty years earlier in the counties of southern Maryland, settled in the 1640s and 1650s, than it did in those areas of the Eastern Shore first occupied in the 1660s and 1670s.

This variability in timing strongly suggests that these changes are related to the process of frontier settlement. The decline in opportunity is characteristic of frontiers. As the choisest resources and lands are claimed, the chances of success for newcomers decline proportionately. Achievement of natural population increase is an indication of demographic maturity and a demonstration that a viable population has been established. The economic depression certainly intensified but was not necessarily the cause of the decline in opportunity or economic diversification. The correspondence of multiple changes and their similarity to the predictions of the colonization model argue otherwise. These changes were part of a cultural process that had been set in motion with the founding of the colonies.

Specific historical explanations for each change are both important and necessary. Economic conditions, immigration rates and demographic factors all help explain various aspects of change. A single crop economy certainly had a profound impact upon the character of the Chesapeake society. Only by taking a broader perspective, however, can the relationship of features and patterns of change to a major cultural process become apparent. When men and women arrived, determined to settle the Chesapeake frontier, they unleashed an adaptive process with a dynamic of its own. Any attempt to understand a colonizing situation without reference to this process can never be successful.

Conclusions

The goal of this study has been to test a model of colonization with archaeological data. focusing upon the expression of this process in subsistence patterns on frontiers. Colonization is one process by which humans adapt to new environmental situations. Study of colonization can yield insights regarding how human adaptive strategies change in response to new conditions as well as the processual patterns associated with these changes.

This investigation has revealed that subsistence strategies on frontiers undergo rapid and pronounced change, and the direction and nature of this change can be predicted from the colonization model and a knowledge of human subsistence behavior. Subsistence on a newly settled frontier will tend to be generalized, with a diffuse adaptive strategy that utilizes many different resources in a scheduled manner. Variability in the use of food resources was due to ecology and the human resources available to a household. The heritage of the colonists also influences subsistence behavior. In the Chesapeake, domestic cattle and swine were emphasized from the beginning of settlement, indicating a continuation of British practice.

The model predicts that through time, the colonizing society, and its subsistence system, will become more stable and uniform. Subsistence theory permits the prediction that the adaptive strategy will become more focal in nature. Both archaeological and historical evidence support these predictions and demonstrate that they occurred in the Chesapeake. Indeed, subsistence became so highly focused upon two species of domestic animals that other equally dependable and efficiently exploited resources were relegated to a very minor position in the overall adaptive strategy. Clarke (1968) has suggested that the development of a stable adaptive strategy would be evidenced in the archaeological record by the appearance of uniform subsistence patterns within a region. To this should be added the criteria of persistence of the uniform subsistence pattern through time.

Analysis of data from the Chesapeake can be considered a test of this proposition and a demonstration of its correctness. There is an unmistakable trend in the data toward greater uniformity and this uniformity appears to last for a considerable period of time, suggesting that the measurement of uniformity can be an important tool by which to assess the stability of a cultural adaptation in the past.

Analysis of the historical data also reveals that the strategy selected by the colonists at the termination of colonization required minimal costs. The least-cost principle is a commonly assumed factor in resource selection but it is seldom possible to verify it. The focus upon two domestic species that could survive with extremely simple husbandry practices seems to reflect the operation of this principle. The Chesapeake colonists focused upon two high yield but <u>very</u> low cost resources that not only provided ample food but which had other economic and cultural values.

Significantly, the same trends of change are apparent in all of the archaeological samples. All households were participating in the same cultural process. Differences in the degree to which these trends are expressed at sites, however, vary according to differences in the wealth of households, as well as the time of household establishment on a frontier.

Unexpectedly, wealth related subsistence variation became less pronounced through time in the Chesapeake sample. Indeed, there are few if any significant differences in the samples dating to the post-1680 period. Given the fact that the colonial society became increasingly stratified during this period, the lack of wealth-related variability is noteworthy. Access to the key resources for subsistence was not limited in this otherwise stratified society. Differential access to subsistence resources is not necessarily an attribute of stratified societies. Assuming that there must have been subsistence differences when any evidence for status or wealth differentiation is found in material culture is not necessarily valid. If valid, this must be demonstrated with faunal and floral evidence rather than being an assumed, inevitable attribute of all stratified societies.

This seemingly rare situation may be an attribute of colonization where population densities and population-to-resource ratios are lower than found in most other settings. In the Chesapeake example, a focal adaptive strategy was selected that relied upon unusually abundant resources - land and livestock - and required few costs, which may not be possible in many situations. Still, the minimal evidence for wealth variation in these samples is an unexpected discovery, and stands as one of the only such examples reported in archaeology.

In this study, it has been possible to elucidate the regularities displayed during the operation of a major cultural process, and to demonstrate conclusively that this process is recognizable in the archaeological record. A model of this process has been developed and the predictive ability of the model in one aspect of culture has been successfully tested. This research is a first step, however, for only through the study of colonization in other settings and the recognition of variation can the predictive ability of the model be improved and, more importantly, a greater understanding of human adaptive behavior emerge. The possibilities for such studies can be found in diverse settings ranging from grasslands to jungles, for the process is worldwide. Study of colonization possesses great potential for elucidating human behavior and cultural processes, but it remains a largely unexplored research frontier.

APPENDICES

Appendix I

Table 38: Faunal Remains From the Maine Site
(Data From Barber 1978)

Species	No. Bone	%	M.N.I.	Lbs. Meat	%
Cattle *Bos taurus*	22	11.22	1	400	25.95
Swine *Sus scrofa*	68	34.69	6	600	38.93
Sheep/Goat *Ovis aries* or *Capra hirca*	1	0.51	1	35	2.27
Cat *Felis domesticus*	4	2.04	1	-	-
Chicken *Gallus gallus*	4	2.04	1	2.5	0.16
Deer *Odocoileus virginianus*	31	15.81	3	300	19.47
Raccoon *Procyon lotor*	4	2.04	2	30	1.94
Woodchuck *Marmota monax*	1	0.51	1	5	0.32
Gray Fox *Urocyon cinereoargenteus*	1	0.51	1	-	-
Fox Squirrel *Sciurus niger*	1	0.51	1	1	0.06
Turkey *Meleagris gallopavo*	5	2.55	2	15	0.97
Canada Goose *Branta canadensis*	7	3.57	2	12	0.78
Goose *Chen* sp.	1	0.51	1	6	0.39
Mallard/Black Duck *Anas* sp.	1	0.51	1	2	0.13
Duck *Anas* sp.	7	3.57	2	4	0.26
Teal *Anas* sp.	1	0.51	1	1	0.06
Bald Eagle *Halioetus leucocephaalus*	1	0.51	1	-	-
Catfish *Ictalurus* sp.	3	1.53	2	4	0.26
Longnosed Gar *Lepisosteus osseus*	5	2.55	2	10	0.65
Sturgeon *Acipenser sturio*	8	4.08	1	100	6.49
Box Turtle *Terrapene carolina*	9	4.59	2	0.5	0.03
Snapping Turtle *Chelydra serpentina*	3	1.53	1	10	0.65
Cooter Turtle Chrysemys sp.	8	4.08	1	3	0.19
	196	99.97	37	1541	99.97

Table 39: Faunal Remains From the Kingsmill Tenement Site

Species	No. Bone	%	M.N.I.	Lbs. Meat	%
Cattle Bos taurus	262	30.36	8	2700	48.26
Swine Sus scrofa	235	27.23	22	2050	36.64
Sheep/Goat Ovis aries or Capra hirca	4	0.46	1	35	0.62
Chicken Gallus gallus	12	1.39	3	7.5	0.13
Deer Odocoileus virginianus	54	6.25	4	400	7.15
Beaver Castor canadensis	15	1.74	3	75	1.34
Raccoon Procyon lotor	26	3.01	5	75	1.34
Opossum Didelphis marsupialis	12	1.39	3	24	0.43
Rabbit Sylvilagus floridanus	2	0.23	1	2	0.03
Gray Squirrel Sciurus carolinensis	3	0.34	1	0.8	0.01
Turkey Meleagris gallopavo	4	0.46	1	7.5	0.13
Canada Goose Branta canadensis	2	0.23	1	6	0.10
Red Shouldered Hawk Buteo lineatus	12	1.39	2	–	–
Duck Anas sp.	4	0.46	2	4	0.07
Duck Aythya sp.	1	0.11	1	1.5	0.02
Cormorant Phalacrocorax auritus	6	0.69	1	5	0.09
Sturgeon Acipenser sturio	5	0.58	1	100	1.78
Longnosed Gar Lepisosteus osseus	35	4.05	1	5	0.09
White Perch Morone americana	16	1.85	5	5	0.09
Brown Bullhead Catfish Ictalurus nebulosus	14	1.62	4	8	0.14
Catfish Ictalurus sp.	7	0.81	1	2	0.03
Striped Bass Morone saxatilis	36	4.17	2	15	0.26
Black Drum Pogonias cromis	5	0.58	1	25	0.45
Sea Trout Cynoscion sp.	1	0.11	1	5	0.09
Box Turtle Terrapene carolina	31	3.59	5	1.25	0.02
Snapping Turtle Chelydra serpentina	20	2.32	3	30	0.53
Cooter Turtle Chrysemys sp.	3	0.34	1	3	0.05

Table 39: Continued

Species	No. Bone	%	M.N.I.	Lbs. Meat	%
Painted Turtle Chrysemys picta	1	0.11	1	0.25	0.004
Musk Turtle Sternotherus sp.	11	1.27	1	-	-
Blue Crab Callinectes sapidus	24	2.78	6	1.2	0.02
	863	99.92	92	5594	99.91

Table 40: Faunal Materials From St. John's I

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle *Bos taurus*	93	15.55	3	950	42.55
Swine *Sus scrofa*	79	13.20	6	400	17.91
Sheep/Goat *Ovis aries* or *Capra hirca*	5	0.83	1	35	1.57
Chicken *Gallus gallus*	4	0.68	1	2.5	0.11
Deer *Odocoileus virginianus*	145	24.26	7	700	31.35
Raccoon *Procyon lotor*	1	0.16	1	15	0.67
Goose *Chen* sp.	1	0.16	1	6	0.27
Mallard/Black Duck *Anas* sp.	1	0.16	1	2	0.09
Canvasback Duck *Aythya valisineria*	1	0.16	1	2	0.09
Scaup *Anas marila* or *affinis*	1	0.16	1	1.5	0.06
Duck *Anas* sp.	3	0.50	-	-	-
Mourning Dove *Zenaidura macroura*	1	0.16	1	0.4	0.01
Passenger Pigeon *Ectopistes migratorius*	1	0.16	1	0.5	0.01
Red Tailed Hawk *Buteo jamaicensis*	3	0.50	1	-	-
Sheepshead *Archosargus probatocephalus*	215	35.96	13	97.5	4.36
Red Drum *Scianops ocellata*	2	0.33	1	18	0.80
White Perch *Morone americana*	5	0.83	2	2	0.09
Box Turtle *Terrapene carolina*	37	6.18	2	0.5	0.02
	598	99.94	44	2232.9	99.96

Table 41: Faunal Remains From Pope's Fort

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle Bos taurus	131	17.01	4	1100	49.36
Swine Sus scrofa	68	8.83	3	250	11.22
Horse Equis caballus	9	1.17	1	-	-
Chicken Gallus gallus	21	2.72	4	10	0.45
Deer Odocoileus virginianus	116	15.06	5	500	22.43
Raccoon Procyon lotor	7	0.91	2	30	1.34
Gray Squirrel Sciurus carolinensis	6	0.78	3	2.4	0.11
Dog or Wolf Canis sp.	12	1.55	2	-	-
Turkey Meleagris gallopavo	9	1.17	2	15	0.67
Canada Goose Branta canadensis	4	0.52	1	6	0.27
Mallard/Black Duck Anas sp.	47	6.10	5	10	0.45
Redhead Duck Aythya americana	7	0.91	1	2	0.09
Blue Wing Teal Anas rubripes	9	1.17	2	2	0.09
Shoveler Duck Spatula clypeata	2	0.26	1	1	0.04
Scaup Aythya sp.	3	0.39	1	1.5	0.06
Pintail Anas acuta	2	0.26	1	1.5	0.06
Ringneck Duck Aythya collaris	1	0.13	1	1	0.04
Duck Anas sp.	16	2.08	1	2	0.09
Longnosed Gar Lepisosteus osseus	20	2.59	1	5	0.22
Sheepshead Archosargus probatocephalus	222	28.83	17	127.5	5.72
Sturgeon Acipenser sturio	4	0.52	1	100	4.48
Striped Bass Morone saxatilis	2	0.26	1	7.5	0.33
Black Drum Pogonias cromis	15	1.94	2	50	2.24
White Perch Morone americana	5	0.65	2	2	0.09
Toadfish Opsanus tau	1	0.13	1	0.5	0.02
Box Turtle Terrapene carolina	10	1.29	1	0.25	0.01
Painted Turtle Chrysemys picta	1	0.13	1	0.25	0.01
Crab Callinectes sapidus	20	2.59	5	1	0.04
	770	99.95	72	2228.4	99.93

Table 42: Faunal Remains From Chancellor's Point

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle *Bos taurus*	35	24.47	2	800	57.96
Swine *Sus Scrofa*	25	17.48	3	300	21.73
Chicken *Gallus gallus*	3	2.09	1	2.5	0.18
Deer *Odocoileus virginianus*	13	9.09	2	200	14.49
Sheepshead *Archosargus probatocephalus*	65	45.45	7	52.5	3.80
Black Drum *Pogonias cromis*	1	0.69	1	25	1.81
Box Turtle Terrapene carolina	1	0.69	1	0.25	0.02
	143	99.96	17	1380.25	99.98

Table 43: Faunal Remains From Bennett Farm I

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle *Bos taurus*	106	8.56	4	1350	41.49
Swine *Sus scrofa*	92	7.43	7	700	21.51
Chicken *Gallus gallus*	2	0.16	1	2.5	0.07
Deer *Odocoileus virginianus*	24	1.94	2	200	6.14
Raccoon *Procyon lotor*	1	0.08	1	15	0.46
Opossum *Didelphis marsupialis*	4	0.32	1	8	0.24
Gray Fox *Urocyon cinereoargenteus*	5	0.40	1	-	-
Goose *Chen* sp.	2	0.16	1	6	0.18
Duck *Anas* sp.	2	0.16	1	2	0.06
Brant *Branta bernicla*	1	0.08	1	3	0.09
Sheepshead *Archosargus probatocephalus*	843	68.14	69	517.5	15.90
Black Drum *Pogonias cromis*	35	2.82	5	125	3.84
Red Drum *Scianops ocellata*	111	8.97	18	324	9.95
Box Turtle *Terrapene carolina*	5	0.40	1	0.25	0.007
Blue Crab *Callinectes sapidus*	5	0.40	2	0.4	0.01
	1237	99.94	115	3253.65	99.94

Table 44: Faunal Remains From Drummond, Phase I

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle *Bos taurus*	205	38.32	7	2300	67.73
Swine *Sus scrofa*	114	21.30	7	650	19.14
Sheep/Goat *Ovis aries* or *Capra hirca*	18	3.36	2	70	2.06
Horse *Equis caballus*	4	0.74	2	-	-
Cat *Felis domesticus*	2	0.37	1	-	-
Chicken *Gallus gallus*	8	1.49	2	5	0.15
Deer *Odocoileus virginianus*	14	2.62	2	200	5.89
Gray Squirrel *Sciurus carolinensis*	2	0.37	1	0.8	0.02
Gray Fox *Urocyon cinereoargenteus*	2	0.37	1	-	-
Rat *Rattus* sp.	1	0.18	1	-	-
Turkey *Meleagris gallopavo*	7	1.30	1	7.5	0.22
Mallard/Black Duck *Anas* sp.	4	0.74	1	2	0.06
Duck *Anas* sp.	7	1.30	2	4	0.12
Duck *Aythya* sp.	1	0.18	1	2	0.06
Canada Goose *Branta canadensis*	10	1.86	2	12	0.35
Bobwhite *Colinus virginianus*	1	0.18	1	0.5	0.01
Teal *Anas* sp.	1	0.18	1	1	0.02
Coot *Fulica americana*	8	1.49	2	2	0.06
Grackle *Quiscalus quiscula*	3	0.56	1	0.4	0.01
Loon *Gavia immer*	1	0.18	1	4	0.12
Sturgeon *Acipenser sturio*	1	0.18	1	100	2.94
Striped Bass *Morone saxatilis*	7	1.30	1	7.5	0.22
White Perch *Morone americana*	3	0.56	2	2	0.06
White Sucker *Catostomus commersoni*	1	0.18	1	1	0.02
Catfish *Ictalurus* sp.	21	3.92	4	8	0.23
Box Turtle *Terrapene carolina*	22	4.12	2	0.5	0.01
D.B. Terrapin *Malaclemys terrapin*	49	9.15	1	0.6	0.01
Toad *Bufo* sp.	2	0.37	1	-	-
Spadefoot Toad *Scaphiopus holbrooki*	2	0.37	1	-	-
	535	99.93	55	3395.8	99.94

Table 45: Faunal Remains From Drummond, Phase II

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle *Bos taurus*	636	22.45	23	8200	72.16
Swine *Sus scrofa*	324	11.44	24	2200	19.36
Sheep/Goat *Ovis aries* or *Capra hirca*	73	2.57	9	235	2.07
Horse *Equis caballus*	13	0.45	1	-	-
Cat *Felis domesticus*	36	1.27	3	-	-
Chicken *Gallus gallus*	119	4.20	12	30	0.26
Goose *Anser domesticus*	5	0.17	1	7	0.06
Duck *Anas* sp.	1	0.03	1	2	0.01
Deer *Odocoileus virginianus*	15	0.52	2	200	1.76
Raccoon *Procyon lotor*	3	0.10	1	15	0.13
Opossum *Didelphis marsupialis*	6	0.21	1	8	0.07
Rabbit *Sylvilagus floridanus*	14	0.50	2	4	0.03
Gray Squirrel *Sciurus carolinensis*	6	0.21	2	1.6	0.01
Fox Squirrel *Sciurus niger*	1	0.03	1	1	0.008
Rat *Rattus* sp.	3	0.10	1	-	-
Turkey *Meleagris gallopavo*	5	0.17	1	7.5	0.06
Mallard/Black Duck *Anas* sp.	18	0.64	4	8	0.07
Blue Wing Teal *Anas rubripes*	14	0.50	3	3	0.02
Green Wing Teal *Anas carolinensis*	2	0.07	1	1	0.008
Baldpate *Mareca americana*	2	0.07	1	1.5	0.01
Bobwhite *Colinus virginianus*	2	0.07	1	0.5	0.004
Songbirds Turdidae	5	0.17	2	-	-
Sturgeon *Acipenser sturio*	1	0.03	1	100	0.88
Longnosed Gar *Lepisosteus osseus*	54	1.91	3	15	0.13
Sheepshead *Archosargus probatocephalus*	1	0.03	1	7.5	0.06
Striped Bass *Morone saxatilis*	97	3.43	9	67.5	0.59
White Perch *Morone americana*	183	6.45	13	13	0.11
Catfish *Ictalurus* sp.	905	31.93	100	200	1.76
White Sucker *Catostomus commersoni*	1	0.03	1	1	0.008

Table 45: Continued

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Blue Crab *Callinectes sapidus*	186	6.56	42	8.4	0.07
Box Turtle *Terrapene carolina*	3	0.10	1	0.25	0.002
Snapping Turtle *Chelydra serpentina*	60	2.11	2	20	0.17
Cooter Turtle *Chrysemys* sp.	40	1.41	2	6	0.05
	2834	99.94	272	11,363.75	99.93

Table 46: Faunal Remains From the Wills Cove Site

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle *Bos taurus*	163	39.28	5	1750	66.14
Swine *Sus scrofa*	65	15.66	6	550	20.78
Sheep/Goat *Ovis aries* or *Capra hirca*	14	3.37	2	50	1.89
Cat *Felis domesticus*	6	1.44	1	-	-
Chicken *Gallus gallus*	10	2.41	2	5	0.19
Deer *Odocoileus virginianus*	22	5.30	2	200	7.56
Raccoon *Procyon lotor*	2	0.48	1	15	0.57
Gray Squirrel *Sciurus carolinensis*	17	4.10	3	2.4	0.09
Fox Squirrel *Sciurus niger*	1	0.24	1	1	0.04
Wolf *Canis lupus*	2	0.48	1	-	-
Duck *Anas* sp.	1	0.24	1	2	0.07
Turkey Vulture *Cathartes aura*	1	0.24	1	-	-
Catfish *Ictalurus* sp.	5	1.20	2	4	0.15
White Perch *Morone americana*	20	4.82	6	6	0.22
Black Drum *Pogonias cromis*	6	1.44	2	50	1.89
Box Turtle *Terrapene carolina*	36	8.67	2	0.25	0.01
Snapping Turtle *Chelydra serpentina*	43	10.36	1	10	0.38
Water Snake *Natrix* sp.	1	0.24	1	-	-
	415	99.97	40	2645.9	99.98

Table 47: Faunal Remains From Bennett Farm II

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle *Bos taurus*	713	42.21	13	4950	63.78
Swine *Sus scrofa*	340	20.13	19	1750	22.54
Sheep/Goat *Ovis aries* or *Capra hirca*	48	2.84	5	155	1.99
Horse *Equis caballus*	5	0.30	1	-	-
Cat *Felis domesticus*	1	0.06	1	-	-
Chicken *Gallus gallus*	12	0.71	3	7.5	0.09
Goose *Anser domesticus*	3	0.17	1	7	0.09
Deer *Odocoileus virginianus*	20	1.18	2	200	2.58
Raccoon *Procyon lotor*	6	0.35	2	30	0.38
Opossum *Didelphis marsupialis*	4	0.24	1	8	0.10
Gray Squirrel *Sciurus carolinesis*	2	0.12	1	0.8	0.01
Blackfish *Globicephala macrorhyncha*	1	0.06	1	-	-
Turkey *Meleagris gallopavo*	4	0.24	1	7.5	0.09
Mallard/Black Duck *Anas* sp.	3	0.17	1	2	0.02
Sheepshead *Archosargus probatocephalus*	341	20.19	23	172.5	2.23
Black Drum *Pogonias cromis*	92	5.44	9	225	2.89
Red Drum *Scianops ocellata*	82	4.85	9	162	2.08
Blue Crab *Callinectes sapidus*	2	0.12	1	0.2	0.002
Box Turtle *Terrapene carolina*	5	0.30	1	0.25	0.003
Diamondback Terrapin *Malaclemys terrapin*	1	0.06	1	0.6	0.007
Cooter Turtle *Chrysemys* sp.	2	0.12	1	3	0.03
Atlantic Loggerhead *Caretta caretta*	2	0.12	1	80	1.03
	1689	99.98	98	7761.35	99.94

Table 48: Faunal Remains From Smith's Tavern Cellar

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle *Bos taurus*	98	32.45	4	1350	69.91
Swine *Sus scrofa*	82	27.15	4	350	18.12
Sheep/Goat *Ovis aries* or *Capra hirca*	15	4.96	2	50	2.59
Chicken *Gallus gallus*	26	8.61	4	10	0.52
Deer *Odocoileus virginianus*	5	1.65	1	100	5.18
Rat *Rattus* sp.	1	0.33	1	-	-
Turkey *Meleagris gallopavo*	5	1.65	2	15	0.77
Sheepshead *Archosargus probatocephalus*	68	22.51	6	45	2.33
White Perch *Morone americana*	1	0.33	1	1	0.5
Snapping Turtle *Chelydra serpentina*	1	0.33	1	10	0.52
	302	99.97	26	1931	99.99

Table 49: Faunal Remains From Baker's Tavern

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle *Bos taurus*	53	44.91	2	800	69.68
Swine *Sus scrofa*	29	24.57	2	200	17.42
Sheep/Goat *Ovis aries* or *Capra hirca*	5	4.24	1	35	3.05
Chicken *Gallus gallus*	6	5.08	2	5	0.43
Deer *Odocoileus virginianus*	1	0.85	1	100	8.71
Sheepshead *Archosargus probatocephalus*	11	9.32	1	7.5	0.65
Blue Crab *Callinectes sapidus*	12	10.17	3	0.6	0.05
Ray or Skate *Rajidae* or *Myliobatidae*	1	0.85	1	-	-
	118	99.99	13	1148.1	99.99

Table 50: Faunal Remains From Clifts, Phase I *

Species	Bones	%	M.N.I.	Meat	%
Cattle *Bos taurus*	43	10.26	2	800	48.35
Swine *Sus scrofa*	124	29.59	6	600	36.26
Horse *Equis caballus*	1	0.24	1	-	-
Chicken *Gallus gallus*	5	1.19	2	5	0.30
Deer *Odocoileus virginianus*	3	0.72	1	100	6.04
Raccoon *Procyon lotor*	1	0.24	1	12	0.72
Turkey *Meleagris gallopavo*	1	0.24	1	7.5	0.45
Goose *Chen* sp.	1	0.24	1	6	0.36
Sheepshead *Archosargus probatocephalus*	229	54.65	13	97.5	5.89
Black Drum *Pogonias cromis*	6	1.43	1	25	1.51
White Perch *Morone americana*	1	0.24	1	1	0.06
Crab *Callinectes sapidus*	3	0.71	1	0.2	0.01
Box Turtle *Terrapene carolina*	1	0.24	1	0.25	0.01
	419	99.99	32	1654.45	99.96

* Data From Bowen 1979

Table 51: Faunal Remains From Pettus Plantation

Species	Bones	%	M.N.I.	Meat	%
Cattle *Bos taurus*	405	57.28	13	4700	65.87
Swine *Sus scrofa*	226	31.97	21	2000	28.02
Sheep/Goat *Ovis aries* or *Capra hirca*	25	3.54	3	85	1.18
Horse *Equis caballus*	4	0.56	1	-	-
Cat *Felis domesticus*	2	0.28	1	-	-
Chicken *Gallus gallus*	2	0.28	1	2.5	0.03
Deer *Odocoileus virginianus*	21	2.97	3	300	4.19
Raccoon *Procyon lotor*	6	0.84	1	15	0.21
Opossum *Didelphis marsupialis*	3	0.42	1	8	0.11
Rabbit *Sylvilagus floridanus*	6	0.84	1	2	0.02
Turkey *Meleagris gallopavo*	2	0.28	1	7.5	0.10
Catfish *Ictalurus* sp.	1	0.14	1	2	0.02
Snapping Turtle *Chelydra serpentina*	1	0.14	1	10	0.14
Cooter *Chrysemys* sp.	3	0.14	1	3	0.04
	707	99.96	50	7135	99.98

Table 52: Faunal Remains From Utopia

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle *Bos taurus*	556	55.93	16	5350	67.06
Swine *Sus scrofa*	232	23.34	22	1950	24.45
Sheep/Goat *Ovis aries* or *Capra hirca*	45	4.53	6	160	2.01
Horse *Equis caballus*	35	3.52	3	-	-
Dog *Canis familiaris*	4	0.40	1	-	-
Cat *Felis domesticus*	39	3.92	2	-	-
Chicken *Gallus gallus*	8	0.80	2	5	0.06
Deer *Odocoileus virginianus*	22	2.21	3	300	3.76
Raccoon *Procyon lotor*	9	0.90	2	30	0.37
Opossum *Didelphis marsupialis*	3	0.30	1	8	0.10
Gray Squirrel *Sciurus carolinensis*	3	0.30	1	0.8	0.01
Duck *Anas* sp.	1	0.10	1	2	0.02
Turkey *Meleagris gallopavo*	7	0.70	1	7.5	0.09
Goose *Chen* sp.	1	0.10	1	7	0.08
Sturgeon *Acipenser sturio*	4	0.40	1	100	1.25
Longnosed Gar *Lepisosteus osseus*	5	0.50	2	10	0.12
Striped Bass *Morone saxatilis*	9	0.90	1	7.5	0.09
Red Drum *Scianops ocellata*	5	0.50	2	36	0.45
Box Turtle *Terrapene carolina*	5	0.50	2	0.5	0.006
Cooter *Chrysemys* sp.	1	0.10	1	3	0.03
	994	99.95	71	7977.3	99.95

Table 53: Faunal Remains From Van Sweringen's

Species	Bones	%	M.N.I.	Meat	%
Cattle *Bos taurus*	40	38.46	2	800	60.83
Swine *Sus scrofa*	24	23.07	3	300	22.81
Sheep/Goat *Ovis aries* or *Capra hirca*	13	12.50	3	90	6.84
Chicken *Gallus gallus*	18	17.31	3	7.5	0.57
Deer *Odocoileus virginianus*	3	2.88	1	100	7.60
Sheepshead *Archosargus probatocephalus*	3	2.88	1	7.5	0.57
Snapping Turtle *Chelydra serpentina*	1	0.96	1	10	0.76
Toad *Bufo* sp.	2	1.92	1	-	-
	104	99.98	15	1315	99.98

Table 54: Faunal Remains From St. John's II

Species	Bones	%	M.N.I.	Meat	%
Cattle *Bos taurus*	289	39.10	8	3350	65.81
Swine *Sus scrofa*	194	26.26	15	1300	25.53
Sheep/Goat *Ovis aries* or *Capra hirca*	45	6.09	4	140	2.75
Dog *Canis familiaris*	1	0.13	1	-	-
Horse *Equis caballus*	1	0.13	1	-	-
Chicken *Gallus gallus*	43	5.83	6	15	0.29
Goose *Anser domesticus*	1	0.13	1	7	0.14
Deer *Odocoileus virginianus*	25	3.39	3	200	3.93
Raccoon *Procyon lotor*	2	0.27	1	15	0.29
Rabbit *Sylvilagus floridanus*	3	0.40	1	2	0.04
Opossum	2	0.27	1	8	0.15
Gray Squirrel *Sciurus carolinensis*	5	0.68	2	1.4	0.03
Rat *Rattus* sp.	26	3.52	5	-	-
Rodentiea	6	0.81	1	-	-
Turkey *Meleagris gallopavo*	20	2.70	2	15	0.29
Goose *Chen* sp.	4	0.54	1	6	0.12
Mallard or Black Duck *Anas* sp.	4	0.54	2	4	0.08
Woodpecker *Picidae*	1	0.13	1	-	-
Sheepshead *Archosargus probatocephalus*	3	0.40	2	15	0.29
White Perch *Morone americana*	3	0.40	1	1	0.02
Blue Crab *Callinectes sapidus*	3	0.40	1	0.2	0.003
Box Turtle *Terrapene carolina*	50	6.76	4	1	0.02
Snapping Turtle *Chelydra serpentina*	8	1.08	1	10	0.19
	739	99.96	64	5090.6	99.97

Table 55: Faunal Remains From the Clifts, Phase III *

Species	Bones	%	M.N.I.	Meat	%
Cattle *Bos taurus*	211	37.67	6	2400	59.95
Swine *Sus scrofa*	225	40.18	10	1000	24.98
Sheep/Goat *Ovis aries* or *Capra hirca*	16	2.85	4	140	3.50
Horse *Equis caballus*	3	0.53	2	-	-
Cat *Felis domesticus*	24	4.28	2	-	-
Chicken *Gallus gallus*	11	1.96	3	7.5	0.18
Deer *Odocoileus virginianus*	54	9.65	4	400	9.99
Raccoon *Procyon lotor*	1	0.18	1	12	0.30
Goose	2	0.36	1	7	0.17
Longnosed Gar *Lepisosteus osseus*	11	1.96	1	5	0.09
Sheepshead *Archosargus probatocephalus*	1	0.18	1	7.5	0.18
Black Drum *Pogonias cromis*	1	0.18	1	25	0.62
	560	99.98	36	4003	99.96

* Data From Bowen 1979

Table 56: Faunal Remains From the Clifts, Phase IV *

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle Bos taurus	679	47.78	15	6000	67.99
Swine Sus scrofa	549	38.63	23	2300	26.06
Sheep/Goat Ovis aries or Capra hirca	18	1.26	3	105	1.19
Horse Equis caballus	6	0.42	2	-	-
Chicken Gallus gallus	24	1.69	3	7.5	0.08
Deer Odocoileus virginianus	44	3.09	3	300	3.40
Raccoon Procyon lotor	3	0.21	2	30	0.31
Opossum Didelphis marsupialis	2	0.14	1	8	0.09
Gray Squirrel Sciurus carolinensis	7	0.49	2	1.6	0.01
Fox Squirrel Sciurus niger	1	0.07	1	1	0.01
Turkey Meleagris gallopavo	8	0.56	3	22.5	0.25
Goose Chen ?	2	0.14	2	12	0.13
Duck Anas sp.?	6	0.42	2	4	0.04
Bobwhite Colinus virginianus	5	0.35	5	2.5	0.02
Passenger Pigeon Ectopistes migratorius	1	0.07	1	0.5	0.005
Corvidae	1	0.07	1	-	-
Sheepshead Archosargus probatocephalus	13	0.91	2	15	0.17
White Perch Morone americana	13	0.91	2	2	0.02
Yellow Perch Perca flavescens	1	0.07	1	1	0.01
Striped Bass Morone saxatilis	2	0.14	1	7.5	0.08
Sciaenidae	1	0.07	1	9.6	0.11
Blue Crab Callinectes sapidus	34	2.39	7	1.4	0.01
Box Turtle Terrapene carolina	1	0.07	1	0.25	0.002
	1421	99.95	84	8831.35	99.99

* Data From Bowen 1979

Table 57: Faunal Remains From Drummond, Phase III

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle Bos taurus	201	39.64	6	1900	60.99
Swine Sus scrofa	199	39.25	9	900	28.89
Sheep/Goat Ovis aries or Capra hirca	23	4.54	3	105	2.07
Horse Equis caballus	3	0.59	2	-	-
Chicken Gallus gallus	12	2.37	3	7.5	0.24
Deer Odocoileus virginianus	2	0.39	1	100	3.21
Opossum Didelphis marsupialis	1	0.19	1	8	0.25
Rabbit Sylvilagus floridanus	2	0.39	1	2	0.06
Turkey Meleagris gallopavo	14	2.76	2	15	0.48
Duck Anas sp.	4	0.79	1	2	0.06
Canada Goose Branta canadensis	5	0.99	2	12	0.38
Teal Anas sp.	2	0.39	1	1	0.03
Owl Strix varia	1	0.19	1	-	-
Sturgeon Acipenser sturio	3	0.59	1	100	3.21
Catfish Ictalurus sp.	4	0.79	1	2	0.06
Box Turtle Terrapene carolina	29	5.72	2	0.25	0.008
Mud Turtle Kinosternon sp.	2	0.39	1	-	-
	507	99.97	38	3154.75	99.94

Table 58: Faunal Remains From Bray Plantation

Species	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle *Bos taurus*	104	40.62	4	1350	60.15
Swine *Sus scrofa*	96	37.50	6	550	24.51
Sheep/Goat *Ovis aries* or *Capra hirca*	22	8.60	3	105	4.67
Horse *Equis caballus*	1	0.39	1	-	-
Cat *Felis domesticus*	1	0.39	1	-	-
Chicken *Gallus gallus*	6	2.34	2	5	0.22
Goose *Anser domesticus*	6	2.34	2	14	0.62
Dove *Columbidae*	1	0.39	1	0.4	0.01
Deer *Odocoileus virginianus*	6	2.34	2	200	8.91
Turkey *Meleagris gallopavo*	1	0.39	1	7.5	0.33
Gray Fox *Uroycon cinereoargenteus*	1	0.39	1	-	-
Gray Squirrel *Sciurus carolinensis*	3	1.17	2	1.6	0.07
Hawk *Buteo* sp.	1	0.39	1	-	-
Box Turtle *Terrapene carolina*	4	1.56	1	0.25	0.01
Snapping Turtle *Chelydra serpentina*	3	1.17	1	10	0.44
	256	99.98	29	2244.15	99.94

APPENDIX II

Estimated Meat Weights of Species

Estimating the amount of meat provided by animals is an integral component of the analytic process in faunal studies. In the following section, the weights of animals used in this study are presented. These weights were arrived at through consultation of a wide variety of information sources with many pertaining specifically to the Chesapeake region. The average meat weights contributed by wild animals were compiled from the following sources:

Mammals

Bailey 1946; Cleland 1966; Hamilton 1963; Handley and Patton 1947; Llewellyn and Handley 1945; Paradiso 1969; Taylor 1965.

Birds

Cleland 1966; Kortright 1943; Mosby 1943; Schorger 1973.

Fish

Goode 1903; Hildebrand and Schroeder 1928; McClane 1965; Menzel 1943; Richards 1973; Schwartz 1961, 1962a, 1964; Simmons and Brewer 1962; Truitt, Bean and Fowler 1929.

Turtles

Babcock 1971; Cleland 1966; Schwartz 1962b.

In addition to these published references, information regarding fish and waterfowl was also obtained from hunters and commercial fishermen in the Chesapeake area.

For domestic animals, determining the average weights is a more difficult task because data regarding 17th Century livestock is not readily available. Modern livestock weights are inappropriate because these animals are significantly improved when compared to 17th Century livestock. The larger size of modern animals is due to several centuries of controlled breeding and maintenance on a diet nutritionally superior to that of colonial livestock. Because of this problem, it is necessary to review the limited historical information regarding livestock sizes and meat yields.

One of the most well known early statements regarding the average weights of slaughtered animals is Gregory King's estimate for London in 1710. King wrote that cattle averaged 370 pounds, calves 50 pounds, sheep 28 pounds, and lambs 18 pounds (Rice 1942:21); he was apparently referring to dressed weights. A late 17th Century Irish account gives a live weight of 700 to 800 pounds for a fully grown ox (Trow-Smith 1957: 240), which would yield a dressed weight of 400 to 500 pounds. Utilizing 16th and 17th Century cattle weights from various locations in Western Europe, an average dressed weight of 400 pounds can be calculated (Lois Carr: Personal Communication 1982). This is supported by data from New England where Bidwell and Falconer (1925:108) estimate that the average dressed weight of old cows and oxen was 400 to 500 pounds during the 18th Century. From Pennsylvania in the 1730s, the average dressed weight of 9 slaughtered steers and cows was 412 pounds and they ranged in size from 337 to 507 pounds (Lemon 1967:63). Based upon this and other 18th Century Pennsylvania data, Lemon (1972:153) estimates that 450 pounds of meat was an average for cattle. Hence, 400 pounds seems to be a reasonable average for the free ranging, poorly tended cattle in the 17th Century Chesapeake.

While such a weight is probably a good approximation for mature animals, it is obviously much too high for calves or inmature beasts. Therefore, a weight of 50 pounds is employed for very young calves (with unfused bones and only slightly worn decidious teeth). A weight of 150 pounds is used for inmature cattle less than two years old (Animals with worn decidious teeth and partially fused bones). By distinguishing where possible between calves, inmature cattle, and mature cattle, consumption of younger animals can be recognized and a more accurate estimate of the total amount of beef available can be achieved. Since livestock slaughter is controlled by human action, this permits the selection and usage of veal or young beef to be accounted for in the overall evaluation of an assemblage.

Information regarding sheep weights is more difficult to obtain. For 18th Century New England, a dressed weight of 10 to 15 pounds per quarter is estimated by Bidwell and Falconer (1925:110). Lemon (1972:153) gives an estimate of 50 pounds as an average live weight for sheep in 18th Century Pennsylvania, which would convert to about 30 pounds dressed. Given this range, an average of 35 pounds is used for calculations in this study. Information regarding lambs is even more scarce but an estimate of 15 pounds may be a good approximation.

Information on swine weights is somewhat more available.

An early reference to swine weights is found in a 1612 English farm account book (Trow-Smith 1957:251) in which the effects of fattening the animals on beans and peas is discussed. In this experiment, the animals weights increased significantly with the best hog finishing off at 140 pounds dressed carcass weight. This permits the inference that the average British hog weighed substantially less. Swine weight figures from the 17th Century Chesapeake are found in a number of documents and these references give an average of 109 pounds per animal (Lois Carr: Personal Communication 1982). Two farm accounts from 18th Century Virginia have also been located and they provide comparable data. In February of 1760, George Washington slaughtered 15 hogs. The dressed weights of these animals indicate an average weight of 107 pounds with a range between 70 and 142 pounds (Washington 1925:123). From the plantation of Garrett inor, the weights of 41 swine slaughtered between 1771 and 1774 are available. The mean dressed weight of these animals was 96.29 pounds with a range from 65 to 140 pounds (True 1976). These figures suggest that a weight of 100 pounds is a reasonable estimate for swine. Since some of these animals may have been selected for slaughter while young, however, an effort has been made to account for this. Where it was possible to determine that a swine was less than one year of age, usually on the basis of dentition, a weight of 50 pounds was utilized.

Meat Weight Estimates for Individuals by Species

Domestics

Cattle = mature- 400 pounds, inmature- 150 pounds, calf- 50 pounds
Swine = mature- 100 pounds, young- 50 pounds
Sheep = mature- 35 pounds, young- 15 pounds
Chicken = 2.5 pounds
Goose = 7 pounds

Wild Mammals

Deer = 100 pounds
Beaver = 25 pounds
Raccoon = 15 pounds
Opossum = 8 pounds
Woodchuck = 5 pounds
Rabbit = 2 pounds
Fox Squirrel = 1 pound
Gray Squirrel = 0.8 pound

Wild Fowl

Turkey = 7.5 pounds
Canada Goose = 6 pounds
Double Crested Cormorant = 5 pounds
Loons = 4 pounds
Brant = 3 pounds
Canvasback Duck = 2 pounds
Mallard/Black Duck = 2 pounds
Baldpate = 1.5 pounds
Pintail Duck = 1.5 pounds
Scaup Duck = 1.5 pounds
Ringneck Duck = 1 pound
Coot = 1 pound
Green Winged Teal = 1 pound
Blue Winged Teal = 1 pound
Bobwhite = .5 pound
Mourning Dove = .5 pound
Passenger Pigeon = .5 pound

Fish

Sturgeon = 100 pounds
Black Drum = 25 pounds
Red Drum = 18 pounds
Striped Bass = 7.5 pounds
Sheepshead = 7.5 pounds
Sea Trout = 5 pounds
Gar = 5 pounds
Catfish = 2 pounds

Sucker = 1 pound
White Perch = 1 pound
Yellow Perch = 1 pound
Toadfish = .5 pound
Crab = .2 pound

<u>Turtles</u>

Atlantic Loggerhead = 80 pounds
Snapping Turtle = 10 pounds
Cooter = 3 pounds
Diamond Back Terrapene = .6 pound
Box Turtle = .25 pound
Painted Turtle = .25 pound.

Appendix III

Seasonal Indicators in the Chesapeake Region

The temperate climate of the Chesapeake region displays marked seasonal variation and, consequently, the availability of animal species also varies. This fact is of significance to the archaeologist because it provides a means of evaluating seasonal changes in human subsistence activities. Through the use of various indicator species, it is often possible to determine the season of site occupation and/or the periods during which features were filled. In this section, data will be presented regarding the chief seasonal indicators found to be of utility in the Tidewater Chesapeake region. The principle animal groups are migratory fowl, fish, and reptiles along with crab and deer.

The migratory fowl commonly found in colonial sites tend to be water oriented. The location of the Chesapeake on the Atlantic Flyway means that a huge variety of birds migrate through the region in the spring and fall periods. A few fowl begin to appear in the region during late February and the peak time of spring migration is from early March to mid-April. Nearly all of the birds depart by the middle of May. Fall migrants begin to appear in early September (the Pintail, Gadwall and Teals), but most start arriving in early October. Peak migration occurs from late October to the end of November. During the winter, water fowl leave the Chesapeake, with the exception of Loons, Teals, and a few

Coots, Canada Geese, and Mallard Ducks.

Of the terrestrially based birds, the Passenger Pigeon is one of the best indicators because their migration was primarily during the October-November period. On their northward migration in the spring, most of the Passenger Pigeons apparently took a more westerly route, beyond the Chesapeake region (Schorger 1973:268).

To summarize the data regarding the major bird species, their availability periods are graphically presented in Figure 39. Information used in constructing this figure derives from the following sources: Lippson, et al 1979; Robbins and Van Velzen 1968; Rives 1890; Schorger 1973; and Stewart 1962. It should be noted that these availability dates are averages. The exact period of availability tends to vary slightly from year to year and may differ by as much as one month between the southern and northern ends of the Chesapeake.

The seasonal availability of fish in the Chesapeake is directly related to water temperature. Many of the species exploited by the colonists are migrants that enter the Bay during April, when the water warms, and remain until October or early November, when they depart for the Atlantic. Among these species are the Black Drum, Herring, Red Drum, Shad, Sheepshead, Sea Trout, and Sturgeon. Estuarine species such as White Perch, and Striped Bass remain in the Chesapeake during the winter but they move to deeper, warmer water where they are difficult to obtain. Some fresh to brackish water

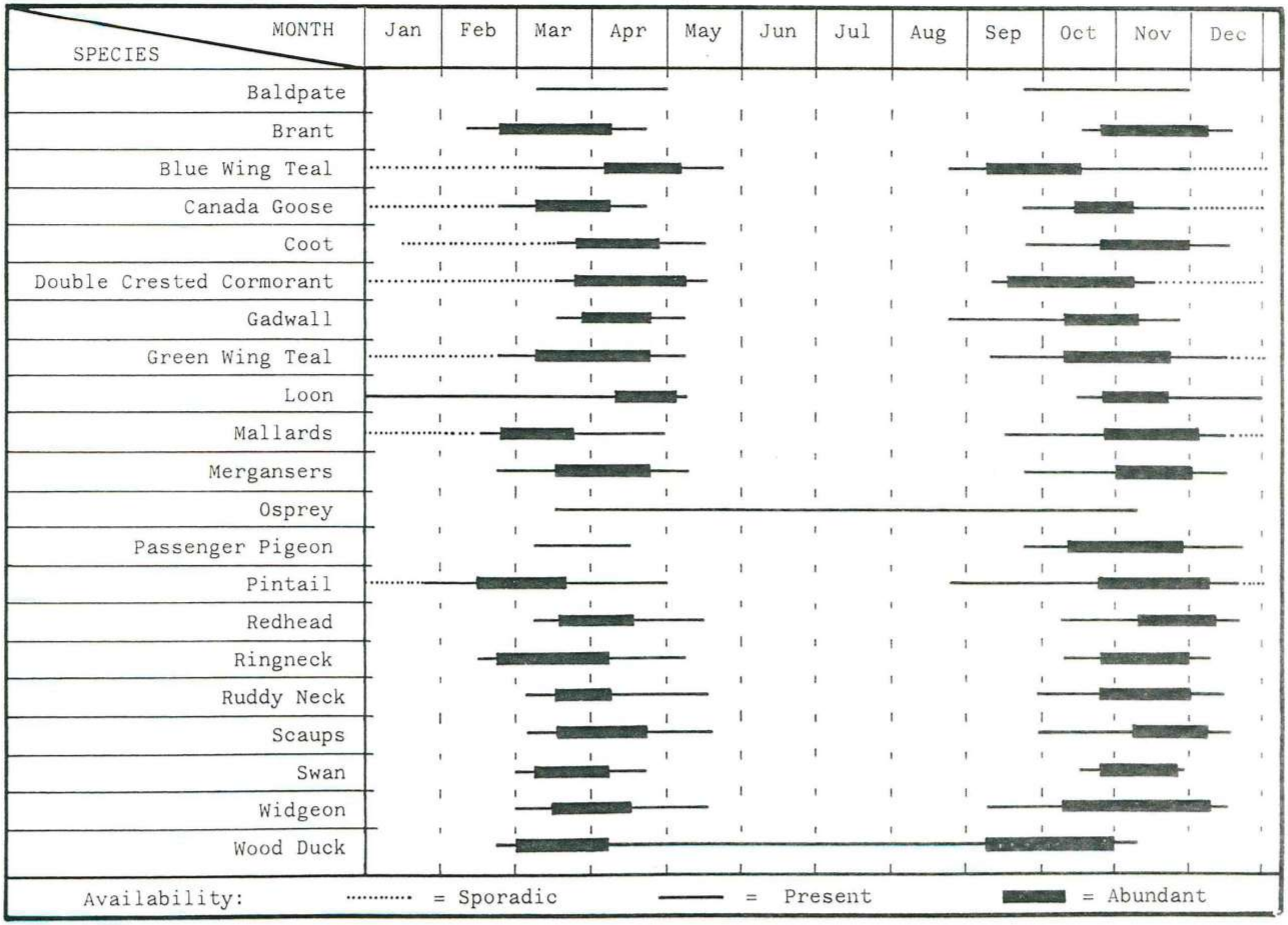

Figure 39: Availability Periods of Common Wildfowl in the Chesapeake.

species, such as suckers can be obtained throughout most of the year. Catfish can be taken from March to mid-November but during the coldest months, they eat very little and apparently enter a state of semi-hibernation (Menzel 1943:22). Still another aquatic animal of importance is the Blue Crab. Crabs become active in late April or early May and can be obtained till the end of October, when they hibernate.

Information regarding the availability of some major fish species in the Chesapeake is graphically summarized in Figure 40. The data used to construct this comes from the following sources: Hildebrand and Schroeder 1928; Hoagman, et al 1974; Lippson, et al 1979; Mansueti 1961; Menzel 1943; Quittmeyer and Andrews 1966; Richards 1973; Schwartz 1961, 1962a; and Truitt 1939.

Snakes and turtles are also of importance in seasonal determination because they hibernate during the winter period. Most emerge in late March and April and remain active until the end of October (Hardy 1972; Hardy and Mansueti 1962; McCauley 1945; Mitchell 1974; Schwartz 1962b). Hence, they hibernate for approximately five months of the year and should be excellent seasonal indicators. Unfortunately, human activities can invalidate the use of turtles for seasonal determination. This is because it is possible to obtain snapping turtles, cooters and other species during the winter by locating them in the mud by probing and collecting the hibernating animals by hand or with tongs. This was common in Maryland until recently

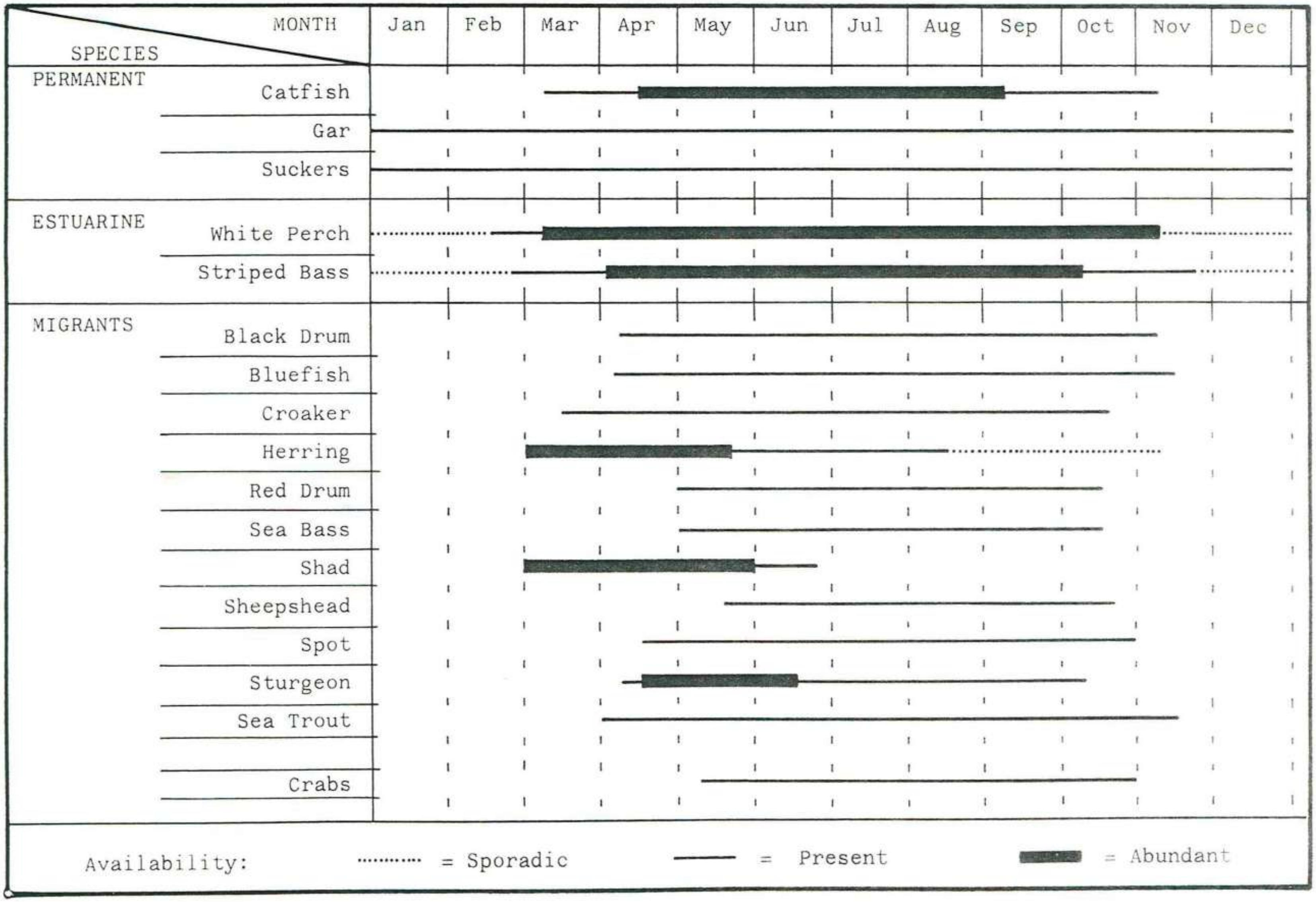

Table 40. Seasonal Availability of Fish in the Chesapeake.

(McCauley 1945:50; Silas Hurry: Personal Communication 1978), and it may be a colonial or perhaps even a pre-colonial practice. Thus, while turtles may indicate a warm weather deposition period, this cannot be automatically assumed and turtle remains are best considered supporting data rather than a primary indicator of seasonality.

Another valuable species is the White Tailed Deer. The antlers of the male undergo an annual sequence of growth and loss and thus, the condition of antlers found in archaeological sites can provide an important clue to the season in which the deer was killed. This sequence has been studied by Wislocki (1942) who found that growth of the antler begins in late May or early June. In early July, the base of the antler begins to calcify and full growth and calcification is achieved by late September. Data from Virginia (Mirarchi, et al 1973) indicates that most deer shed their antlers between late December and late January. Hence, the recovery of a deer skull or antlers can permit some assessment of the period during which the animal was killed.

By carefully utilizing these indicator species along with other data, it is possible to estimate the season in which bone deposits were created. In the following section, faunal assemblages from features utilized in this study are presented along with the estimated fill periods and evidence for this. Common names are utilized to reduce the space required and permit the seasonal estimate to appear on the same page with the data.

Table 59: Kingsmill Tenement : Feature 154

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	2	1.54	1	400	45.67
Swine	16	12.30	2	150	17.13
Chicken	5	3.84	1	2.5	0.28
Deer	5	3.84	2	200	22.84
Raccoon	14	10.77	4	60	6.85
Opossum	7	5.38	2	16	1.83
Rabbit	2	1.54	1	2	0.23
Gray Squirrel	1	0.77	1	0.8	0.09
Turkey	1	0.77	1	7.5	0.85
Bullhead Catfish	14	10.77	3	6	0.68
Catfish	6	4.61	1	2	0.23
White Perch	12	9.23	3	3	0.34
Sea Trout	1	0.77	1	5	0.57
Box Turtle	9	6.92	2	0.5	0.05
Snapping Turtle	16	12.30	2	20	2.28
Musk Turtle	11	8.46	1	–	–
Crab	8	6.15	2	0.04	0.04
Total	130	99.96	30	875.7	99.96

Estimated Deposition Period: Summer

Evidence: Crabs are present which indicates a May to November fill period. The sea trout is a marine species that would not be found far up the James River until the summer when water salinity had risen well above the low springtime levels. Catfish and Perch are well represented. Finally, three species of turtles are present and multiple individuals have been identified of two of these.

Table 60: Kingsmill Tenement: Feature 369

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	13	16.45	1	400	40.60
Swine	32	40.50	2	200	20.30
Sheep/Goat	1	1.26	1	35	3.55
Chicken	4	5.06	1	2.5	0.25
Deer	5	6.33	2	200	20.30
Raccoon	4	5.06	2	30	3.04
Opossum	2	2.53	1	8	0.81
Branta	1	1.26	1	3	0.30
Duck	2	2.53	1	2	0.20
Sturgeon	5	6.33	1	100	10.15
White Perch	1	1.26	1	1	0.10
Crab	2	2.53	1	0.2	0.02
Box Turtle	5	6.33	1	0.25	0.025
Cooter	1	1.26	1	3	0.30
Painted Turtle	1	1.26	1	0.25	0.02
Total	79	99.95	18	985.2	99.96

Estimated Deposition Period: Spring to Summer

Evidence: Migratory water fowl are present. Brants are available from late February to Mid-April and late October to early December. A few crab claws are also present and they indicate a May to November deposition. Remains of sturgeon were recovered, a species which appears in April and remains until September. From the accounts of John Smith, the sturgeons were most abundant in April and May along the James.

Table 61: Kingsmill Tenement: Feature 393

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	174	41.72	5	1500	42.62
Swine	169	40.52	17	1600	45.46
Deer	36	8.63	3	300	8.52
Beaver	15	3.60	3	75	2.13
Raccoon	7	1.68	2	30	0.85
Gray Squirrel	1	0.24	1	0.8	0.02
Hawk	9	2.15	1	-	-
Box Turtle	2	0.48	1	0.25	0.007
Cooter	2	0.48	1	3	0.08
Snapping Turtle	2	0.28	1	10	0.28
Total	417	99.98	35	3519.05	99.97

Estimated Deposition Period: Fall to Winter

Evidence: There is an almost total absence of fish and migratory bird remains. Only turtles are present but their value as a seasonal indicator has been questioned. The recovery of a minimum of three beaver in the pit is suggestive of a late fall or winter deposit. It is likely that they were trapped for their fur and the pelt is of best quality during the late fall and winter.

Table 62: Kingsmill Tenement: Feature 425

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Swine	1	0.78	1	100	33.95
Chicken	2	1.57	1	2.5	0.85
Deer	5	3.93	1	100	33.95
Opossum	3	2.36	2	16	5.43
Turkey	2	1.57	1	7.5	2.54
Hawk	3	2.36	1	–	–
Cormorant	6	4.72	1	5	1.70
Mallard/Black Duck	1	0.78	1	2	0.68
Duck	1	0.78	1	1.5	0.51
Longnosed Gar	35	27.56	1	5	1.70
Catfish	1	0.78	1	2	0.68
Striped Bass	31	24.41	2	15	5.09
Black Drum	5	3.93	1	25	8.49
White Perch	2	1.57	2	2	0.68
Crab	12	9.45	4	0.8	0.27
Box Turtle	15	11.81	1	0.25	0.08
Snapping Turtle	2	1.57	1	10	3.39
Total	127	99.93	23	294.55	99.99

Estimated Deposition Period: Late Summer, Fall

Evidence: The presence of crab remains and a variety of fish suggests a May-November fill period. Bones from a Double-Crested Cormorant and ducks indicate a late March to May or early Spetember to November deposition. The Cormorant is not present in the summer. Late summer is suggested by the bones of a Black Drum. This is a marine fish and probably could not be taken on the upper James until late July when the water salinity levels were high.

Table 63: Kingsmill Tenement: Feature 430

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	44	95.66	3	1200	92.30
Swine	2	4.34	1	100	7.70
Total	46	100.00	4	1300	100.00

Estimated Depostion Period: Winter?

Evidence: The total absence of bird, fish and turtle bone is notable. Examination of the bones does not suggest preservation is a problem here.

Table 64: St. John's: Feature 50M/50P

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	81	20.56	3	950	53.00
Swine	56	14.21	3	300	16.74
Sheep/Goat	3	0.76	1	35	1.95
Chicken	1	0.25	1	2.5	0.14
Deer	86	21.82	4	400	22.31
Raccoon	1	0.25	1	15	0.83
Canvasback Duck	1	0.25	1	2	0.11
Duck	1	0.25	1	–	–
Mourning Dove	1	0.25	1	0.5	0.02
Passenger Pigeon	1	0.25	1	0.4	0.02
Red Tailed Hawk	2	0.51	1	–	–
Sheepshead	121	30.71	9	67.5	3.76
Red Drum	1	0.25	1	18	1.00
Box Turtle	37	9.39	1	0.25	0.01
Total	394	99.96	29	1792.65	99.97

Estimated Deposition Period: Late Summer to Early Winter

Evidence: The large quantity of Sheepshead bones along with the remains of a Red Drum indicate a May to October deposition. Three types of ducks were also found and they are generally available in March-April and October to December of the year. Of particular importance is the fact that the Canvasback duck does not appear in the Chesapeake area until late October and is only common from mid-November to mid-December. One bone from a Passenger Pigeon was recovered and this species was generally only available during the fall period. Analysis of oyster shell growth lines indicates that most of oysters in this pit were collected during the fall. Finally, a deer skull in the feature had a fully developed antler, still firmly attached to the cranium. This indicates that the animal was killed between September and late January.

Table 65: St. John's: Feature 55C,55G

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	2	2.08	1	400	47.73
Deer	10	10.42	4	400	47.73
Snow Goose?	2	2.08	1	6	0.72
Sheepshead	78	81.25	4	30	3.58
White Perch	4	4.16	2	2	0.24
Total	96	99.99	12	838	100.00

Estimated Deposition Date: Spring, early Summer

Evidence: An abundance of sheepshead bones were recovered from this feature. Analysis of fish scales by David A. Singer indicates that they were taken during the Spring, probably May-June. The bones of a wild goose suggests a Spring or Fall deposit. Finally, analysis of the oyster shell growth lines by Bretton Kent reveals that the oysters were mostly collected during the spring.

Table 66: Pope's Fort: Strata 1222 P and N

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	96	18.46	3	950	48.91
Swine	42	8.07	3	200	10.29
Horse	9	1.73	1	–	–
Chicken	14	2.69	2	5	0.25
Deer	88	16.92	5	500	25.74
Raccoon	5	0.96	1	15	0.77
Gray Squirrel	4	0.77	2	1.6	0.08
Turkey	9	1.73	2	15	0.77
Canada Goose	3	0.58	1	6	0.31
Redhead Duck	7	1.34	1	2	0.10
Blue Wing Teal	7	1.34	2	2	0.10
Mallard/Black Duck	10	1.92	2	4	0.20
Scaup Duck	3	0.58	1	1.5	0.07
Pintail Duck	2	0.38	1	1.5	0.07
Duck	10	1.92	–	–	–
Sturgeon	1	0.19	1	100	5.15
Sheepshead	159	30.58	13	97.5	5.02
Striped Bass	2	0.38	1	7.5	0.38
Black Drum	11	2.11	1	25	1.28
Longnosed Gar	13	2.50	1	5	0.25
White Perch	2	0.38	2	2	0.10
Toadfish	1	0.19	1	0.5	0.02
Crab	16	3.07	4	0.8	0.04
Box Turtle	6	1.15	1	0.25	0.01
Total	520	99.94	51	1942.15	99.91

Estimated Deposition Period: Summer, early Fall

Evidence: The abundant Sheepshead remains, bones of Black Drum, and crab claws all suggest a May to October period of deposition. Six types of migratory waterfowl are also present, indicating a spring or fall period. Two of these, the Blue Wing Teal and the Pintail are the earliest appearing waterfowl, arriving in late August, a full month before most of the others. Study of the oyster shell growth lines suggests that most were harvested in the fall period.

Table 67: Bennett Farm I: Feature 28A

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	30	5.05	2	550	37.15
Swine	54	9.09	4	400	27.02
Chicken	1	0.17	1	2.5	0.17
Goose	1	0.17	1	7	0.47
Deer	12	2.02	1	100	6.75
Gray Fox	5	0.84	1	–	–
Opossum	1	0.17	1	8	0.54
Sheepshead	412	69.36	34	255	17.22
Black Drum	13	2.18	2	50	3.38
Red Drum	65	10.94	6	108	7.29
Total	594	99.99	52	1480.5	99.99

Estimated Deposition Period: Summer

Evidence: The predominance of migratory fish in the assemblage and the absence of any spring or fall indicator species.

Table 68: Drummond Site: Feature 265

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	48	22.01	3	700	50.50
Swine	36	16.51	5	300	21.64
Sheep/Goat	4	1.83	1	35	2.52
Chicken	3	1.37	2	5	0.36
Deer	8	3.66	2	200	14.43
Rat	1	0.45	1	-	-
Turkey	4	1.83	1	7.5	0.54
Duck	2	0.91	2	4	0.29
Sturgeon	1	0.45	1	100	7.21
Striped Bass	7	3.21	1	7.5	0.54
Longnosed Gar	14	6.42	3	15	1.08
White Perch	3	1.37	2	2	0.14
Catfish	21	9.63	4	8	0.58
White Sucker	1	0.45	1	1	0.07
Box Turtle	12	5.50	2	0.25	0.01
D. B. Terrapene	49	22.48	1	0.6	0.03
Toad	2	0.91	1	-	-
Spadefoot Toad	2	0.91	1	-	-
Total	218	99.99	34	1386.1	99.94

Estimated Deposition Period: Summer

Evidence: Fish remains are abundant in the feature. These include the migratory sturgeon, and the seasonally available striped bass and white perch. Finally, bones of two types of toads were found. They are most active during the summer months and hibernate during the cooler months of the year.

Table 69: Drummond Site: Feature 255

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	56	46.66	2	800	68.27
Swine	19	15.83	2	200	17.06
Sheep/Goat	1	0.83	1	35	2.98
Chicken	5	4.16	2	5	0.42
Deer	3	2.50	1	100	8.53
Gray Squirrel	2	1.66	1	0.8	0.06
Gray Fox	2	1.66	1	–	–
Turkey	2	1.66	1	7.5	0.64
Canada Goose	10	8.33	2	12	1.02
Duck (Aythya sp.)	1	0.83	1	2	0.17
Mallard/Black Duck	4	3.33	1	2	0.17
Duck (Anas sp.)	3	2.50	2	4	0.34
Teal	1	0.83	1	1	0.08
Coot	8	6.66	2	2	0.17
Grackle	3	2.50	1	0.5	0.04
Total	120	99.94	20	1171.8	99.95

Estimated Deposition Period: Winter to Spring

Evidence: This feature lacks the remains of fish and reptiles but yielded a diversity of bones from migratory waterfowl. These include three types of ducks, teal, coot, and canada geese. The birds suggest a September to December or March to May deposition. The latter is more probable because there is stratigraphic evidence that the bird remains become more common in the upper levels of the feature.

Table 70: Drummond Site: Feature 332

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	101	51.79	6	2150	74.15
Swine	57	29.23	7	600	20.69
Sheep/Goat	13	6.66	1	35	1.20
Horse	4	2.05	1	–	–
Cat	2	1.02	2	–	–
Deer	3	1.53	1	100	3.45
Turkey	1	0.51	1	7.5	0.26
Bobwhite	1	0.51	1	0.5	0.01
Duck	2	1.02	1	2	0.06
Loon	1	0.51	1	4	0.13
Box Turtle	10	5.12	1	0.25	0.008
Total	195	99.95	23	2899.25	99.95

Estimated Deposition Period: Winter?

Evidence: No identifiable fish remains were recovered from this feature. Migratory birds consist of duck and a loon. The loon is of interest because it is one of the few birds that winters in the Chesapeake. There is also a predominance of domestic bones.

Table 71: Wills Cove Site: Feature 5

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	29	19.86	2	800	56.92
Swine	37	25.34	3	250	17.79
Sheep/Goat	11	7.53	2	70	4.98
Chicken	10	6.84	2	5	0.35
Deer	5	3.42	2	200	14.23
Raccoon	2	1.36	1	15	1.07
Gray Squirrel	17	11.63	3	2.4	0.17
Fox Squirrel	1	0.68	1	1	0.07
Duck	1	0.68	1	2	0.14
Turkey Vulture	1	0.68	1	-	-
Black Drum	6	4.11	2	50	3.55
White Perch	20	13.43	6	6	0.43
White Catfish	5	3.42	2	4	0.28
Water Snake	1	0.68	1	-	-
Total	146	99.94	29	1405.4	99.98

Estimated Deposition Period: Spring/Summer or Summer/Fall

Evidence: The presence of three species of fish represented by multiple individuals is a strong summer indicator. In the total bone sample, fish account for over 30% of the fragments. In addition, the water snake could only be found during the warmer months of the year. The single duck may indicate that deposition began during the late spring or extended into the early fall.

Table 72: Wills Cove Site: Feature 6

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	134	49.81	4	1600	71.25
Swine	28	10.41	4	400	17.81
Sheep/Goat	3	1.11	1	35	1.56
Cat	6	2.23	1	–	–
Deer	17	6.31	2	200	8.91
Wolf	2	0.74	1	–	–
Box Turtle	36	13.38	2	0.25	0.01
Snapping Turtle	43	15.98	1	10	0.44
Total	269	99.97	16	2245.25	99.98

Estimated Deposition Period: Winter

Evidence: Absence of migratory and warm weather indicators. Turtles would seem to be evidence of a warm month deposition but as previously noted, there are problems using turtles as seasonal indicators. Deer antlers recovered from the pit are fully mature and the single skull section found still had an antler firmly attached, demonstrating a kill prior to February. Also, many of the cattle bones are of prime meat cuts, such as would have been preserved for winter use and these derived from multiple animals and were cut in precisely the same manner.

Table 73: Bennett Farm II: Feature 6

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	52	45.21	3	1200	72.00
Swine	29	25.21	3	300	18.00
Sheep/Goat	5	4.34	1	35	2.10
Horse	1	0.87	1	-	-
Mallard/Black Duck	3	2.60	1	2	0.12
Sheepshead	5	4.34	1	7.5	0.45
Black Drum	14	12.17	2	50	3.00
Red Drum	6	5.21	4	72	4.32
Total	115	99.95	16	1666.5	99.99

Estimated Deposition Period: Spring/Summer or Summer/Fall

Evidence: Migratory fish comprise a very significant portion of this assemblage and indicate a late April through October deposition period. The presence of a duck implies that filling also occured in the spring or fall.

Table 74: Bennett Farm II: Feature 8

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	203	47.99	7	2550	69.08
Swine	133	31.44	8	700	18.96
Sheep/Goat	30	7.09	4	80	2.16
Horse	2	0.47	1	-	-
Chicken	5	1.18	2	5	0.13
Goose	3	0.71	1	7	0.17
Deer	2	0.47	1	100	2.70
Raccoon	1	0.24	1	15	0.40
Opossum	1	0.24	1	8	0.21
Turkey	4	0.94	1	7.5	0.20
Sheepshead	13	3.07	3	22.5	0.60
Black Drum	16	3.78	5	125	3.38
Red Drum	9	2.12	4	72	1.95
Box Turtle	1	0.24	1	0.25	0.006
Total	423	99.98	40	3692.25	99.96

Estimated Deposition Period: Summer

Evidence: Presence of migratory fish and the absence of migratory waterfowl.

Table 75: Bennett Farm II: Feature 16

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	183	42.26	6	2150	61.98
Swine	56	12.93	8	750	21.62
Sheep/Goat	4	0.92	1	35	1.00
Deer	6	1.38	1	100	2.88
Raccoon	2	0.46	1	15	0.43
Sheepshead	69	15.93	4	30	0.86
Black Drum	46	10.62	5	125	3.60
Red Drum	57	13.16	10	180	5.18
Box Turtle	4	0.92	1	0.25	0.007
D.B. Terrapene	1	0.23	1	0.6	0.01
Cooter	2	0.46	1	3	0.08
Atlantic Loggerhead	2	0.46	1	80	2.30
Atlantic Blackfish	1	0.23	1	-	-
Total	433	99.96	41	3468.85	99.94

Estimated Deposition Period: Summer

Evidence: The large quantities of migratory fish in this assemblage strongly suggest a summer deposit. The recovery of remains of four species of turtles, especially the Atlantic Loggerhead, also supports a summer deposit.

Table 76: Bennett Farm II: Feature 30

Animals	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	155	58.49	6	2150	69.68
Swine	64	24.15	7	600	19.44
Sheep/Goat	1	0.37	1	35	1.13
Horse	1	0.37	1	-	-
Cat	1	0.37	1	-	-
Chicken	1	0.37	1	2.5	0.08
Deer	10	3.77	2	200	6.48
Raccoon	2	0.75	1	15	0.48
Sheepshead	17	6.41	2	15	0.48
Black Drum	12	4.52	2	50	1.62
Red Drum	1	0.37	1	18	0.58
Total	265	99.94	25	3085.5	99.97

Estimated Deposition Period: Summer

Evidence: The presence of migratory fish represented by multiple individuals and the absence of migratory waterfowl.

Table 77: Smith's Ordinary Cellar

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	98	32.45	4	1350	69.91
Swine	82	27.15	4	350	18.12
Sheep/Goat	15	4.96	2	50	2.59
Chicken	26	8.61	4	10	0.52
Deer	5	1.65	1	100	5.18
Rat	1	0.33	1	-	-
Turkey	5	1.65	2	15	0.77
Sheepshead	68	22.51	6	45	2.33
White Perch	1	0.33	1	1	0.05
Snapping Turtle	1	0.33	1	10	0.52
Total	302	99.97	26	1931	99.99

Estimated Deposition Period: Summer

Evidence: The presence of many bones and multiple identified individuals of Sheepshead, a migrant, suggests a deposition in the summer. This is supported by recovery of White Perch and Snapping Turtle bones.

Table 78: Baker's Tavern Feature

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	53	44.91	2	800	69.68
Swine	29	24.57	2	200	17.42
Sheep/Goat	5	4.24	1	35	3.05
Chicken	6	5.08	2	5	0.43
Deer	1	0.85	1	100	8.71
Sheepshead	11	9.32	1	7.5	0.65
Crab	12	10.17	3	0.6	0.05
Ray or Skate	1	0.85	1	–	–
Total	118	99.99	13	1148.1	99.99

Estimated Deposition Period: Summer

Evidence: Sheepshead bones and crab claws are strong indicators of a warm weather deposition period. This is supported by the recovery of a ray or skate element since these animals migrate from the Chesapeake during the fall.

Table 79: St. John's II: Large Circular Pit

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	161	57.29	5	2000	73.03
Swine	64	22.77	5	450	16.43
Sheep/Goat	21	7.47	2	70	2.56
Chicken	13	4.63	4	10	0.36
Deer	16	5.70	2	200	7.30
Gray Squirrel	1	0.36	1	0.8	0.03
Turkey	3	1.07	1	7.5	0.27
Box Turtle	2	0.71	1	0.25	0.009
Total	281	100.00	21	2738.55	99.98

Estimated Deposition Period: Winter?

Evidence: Total absence of fish remains and the predominance of prime meat portions from several cattle implies that they were preserved sections. Both facts suggest a cold weather deposit. However, the evidence is not as conclusive as in some other features.

Table 80: Van Sweringen Feature

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	40	38.46	2	800	60.83
Swine	24	23.07	3	300	22.81
Sheep/Goat	13	12.50	3	90	6.84
Chicken	18	17.31	3	7.5	0.57
Deer	3	2.88	1	100	7.60
Sheepshead	3	2.88	1	7.5	0.57
Snapping Turtle	1	0.96	1	10	0.76
Toad	2	1.92	1	–	–
Total	104	99.98	15	1315	99.98

Estimated Deposition Period: Summer?

Evidence: Presence of Sheepshead, Snapping Turtle and a Toad.

Table 81: St. John's II: Cellar

Analysis	No. Bone	%	M.N.I.	Lbs. Meat	%
Cattle	114	34.34	4	1600	61.43
Swine	75	22.60	8	750	28.79
Sheep/Goat	19	5.72	2	70	2.69
Dog	1	0.30	1	–	–
Chicken	19	5.72	3	7.5	0.29
Goose	1	0.30	1	7	0.27
Deer	9	2.71	1	100	3.84
Raccoon	1	0.30	1	15	0.58
Opossum	3	0.90	1	8	0.31
Gray Fox	1	0.30	1	–	–
Gray Squirrel	3	0.90	2	1.6	0.06
Rabbit	1	0.30	1	2	0.07
Rat	18	5.42	4	–	–
Turkey	3	0.90	1	7.5	0.29
Duck	3	0.90	2	4	0.15
Goose	4	1.20	1	6	0.23
Sheepshead	3	0.90	2	15	0.58
Crab	1	0.30	1	0.2	0.007
Box Turtle	45	13.55	3	0.75	0.03
Snapping Turtle	8	2.41	1	10	0.38
Total	332	99.97	41	2604.55	99.99

Estimated Deposition Period: Summer-Fall?

Evidence: The fish, turtles and crab suggest a summer fill period while the migratory waterfowl indicate a spring or fall deposit. The recovery of one fully mature deer antler with a portion of the skull still attached suggests that fall is likely.

Table 82: Drummond III: Feature 277

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	201	39.64	6	1900	60.99
Swine	199	39.25	9	900	28.89
Sheep/Goat	23	4.54	3	65	2.08
Horse	3	0.59	2	–	–
Chicken	12	2.37	3	7.5	0.24
Deer	2	0.39	1	100	3.21
Opossum	1	0.19	1	8	0.25
Rabbit	2	0.39	1	2	0.06
Turkey	14	2.76	2	15	0.48
Duck	4	0.79	1	2	0.06
Canada Goose	5	0.99	2	12	0.38
Teal	2	0.39	1	1	0.03
Owl	1	0.19	1	–	–
Sturgeon	3	0.59	1	100	3.21
Catfish	4	0.79	1	1	0.06
Box Turtle	29	5.72	2	0.5	0.01
Mud Turtle	2	0.39	1	–	–
Total	507	99.97	38	3115	99.95

Estimated Deposition Period: Spring or Fall

Evidence: Presence of migratory fowl along with some fish turtle. Study of the stratigraphic distribution of the faunal materials does not reveal whether a spring or fall deposition is more likely.

Table 83: Bray Plantation: Feature 10

Animal	No. Bones	%	M.N.I.	Lbs. Meat	%
Cattle	61	43.26	3	1200	65.48
Swine	58	41.13	5	450	24.55
Sheep/Goat	14	9.93	2	70	3.82
Chicken	2	1.42	1	2.5	0.13
Deer	4	2.84	1	100	5.45
Gray Fox	1	0.71	1	-	-
Snapping Turtle	1	0.71	1	10	0.54
Total	141	100.00	14	1832.5	99.97

Estimated Deposition Period: ? Winter?

Evidence: There is little evidence for seasonal evaluation. The absence of fish and migratory fowl might be indicative of a winter period.

Appendix IV

Bone Fusion Data For Cattle

Table 84: Cattle Bone Fusion Data From Kingsmill Tenement

	Fused	Unfused
<u>0-18 Months</u>		
First Phalange	15	2
Second Phalange	15	-
Humerus - distal	3	-
Radius - proximal	1	-
Total Bone	34	2
Percentage of Age Range	94.4%	5.5%
<u>24-36 Months</u>		
Metacarpal - distal	1	4
Metatarsal - distal	-	1
Tibia - distal	-	1
Total Bone	1	6
Percentage of Age Range	14.2%	85.7%
<u>36-48 Months</u>		
Femur - proximal	-	1
Radius - distal	1	2
Ulna - proximal	1	1
Femur - distal	1	1
Tibia - proximal	1	-
Total Bone	4	5
Percentage of Age Range	44.4%	55.5%

Table 85: Cattle Bone Fusion Data From Pope's Fort

	Fused	Unfused
0-18 Months		
Humerus - distal	1	-
First Phalange	11	-
Second Phalange	5	-
Radius - proximal	4	1
Total Bone	21	1
Percentage of Age Range	95.45	4.55
24-36 Months		
Metacarpal - distal	1	-
Metatarsal - distal	1	-
Tibia - distal	2	1
Calcaneus	1	1
Total Bone	5	2
Percentage of Age Range	71.5	28.5
36-48 Months		
Femur - proximal	1	1
Radius - distal	-	3
Ulna - proximal	-	3
Femur - distal	2	-
Tibia - proximal	-	2
Total Bone	3	9
Percentage of Age Range	25%	75%

Table 86: Cattle Bone Fusion Data From Drummond I

	Fused	Unfused
0-18 Months		
First Phalange	15	-
Second Phalange	7	-
Humerus - distal	1	-
Radius - proximal	7	-
Total Bone	30	0
Percentage of Age Range	100%	
24-36 Months		
Metacarpal - distal	2	2
Metatarsal - distal	3	-
Tibia - distal	4	-
Total Bone	9	2
Percentage of Age Range	81.81%	18.18%
36-48 Months		
Femur - proximal	1	1
Radius - distal	1	1
Ulna - proximal	1	1
Femur - distal	1	-
Tibia - proximal	3	3
Humerus - proximal	1	2
Total Bone	8	8
Percentage of Age Range	50%	50%

Table 87: Cattle Bone Fusion Data From Drummond II

	Fused	Unfused
0-18 Months		
First Phalange	31	-
Second Phalange	16	-
Humerus - distal	25	-
Radius - proximal	26	-
Total Bone	98	0
Percentage of Age Range	100%	
24-36 Months		
Metacarpal - distal	14	4
Metatarsal - distal	8	5
Tidia - distal	11	3
Total Bone	33	12
Percentage of Age Range	73.33%	26.66%
36-48 Months		
Femur - proximal	10	5
Radius - distal	10	2
Ulna - proximal	11	6
Femur - distal	7	4
Tibia - proximal	9	3
Total Bone	47	20
Percentage of Age Range	70.14%	29.85%

Table 88: Cattle Bone Fusion Data From Pettus Plantation

	Fused	Unfused
0-18 Months		
First Phalange	23	-
Second Phalange	7	-
Humerus - distal	14	-
Radius - proximal	7	-
Total Bone	51	0
Percentage of Age Range	100%	
24-36 Months		
Metacarpal - distal	10	2
Metatarsal - distal	11	1
Tibia - distal	10	-
Total Bone	31	3
Percentage of Age Range	91.10%	8.90%
36-48 Months		
Femur - proximal	8	3
Radius - distal	5	1
Ulna - proximal	6	-
Femur - distal	5	2
Tibia - proximal	6	3
Total Bone	30	9
Percentage of Age Range	76.9%	23.0%

Table 89: Cattle Bone Fusion Data From Utopia

	Fused	Unfused
0-18 Months		
First Phalange	29	2
Second Phalange	17	-
Humerus - distal	5	-
Radius - proximal	5	-
Total Bone	53	2
Percentage of Age Range	96.00%	4.00%
24-36 Months		
Metacarpal - distal	20	2
Metatarsal - distal	22	1
Tibia - distal	2	-
Total Bone	44	3
Percentage of Age Range	93.00%	7.00%
36-48 Months		
Femur - proximal	3	1
Radius - distal	6	3
Ulna - proximal	1	1
Femur - distal	1	-
Tibia - proximal	3	-
Humerus - proximal	2	-
Total Bone	16	5
Percentage of Age Range	76.00%	24.00%

Table 90: Cattle Bone Fusion Data From Bennett Farm II

	Fused	Unfused
0-18 Months		
First Phalange	25	-
Second Phalange	25	-
Humerus - distal	22	-
Radius - proximal	26	-
Total Bone	98	0
Percentage of Age Range	100.00%	0.0%
24-36 Months		
Metacarpal - distal	26	4
Metatarsal - distal	25	5
Tibia - distal	24	2
Total Bone	75	11
Percentage of Age Range	87.20%	17.79%
36-48 Months		
Femur - proximal	1	1
Radius - distal	14	5
Ulna - proximal	5	-
Femur - distal	4	2
Tibia - proximal	4	3
Humerus - proximal	2	-
Total Bone	30	11
Percentage of Age Range	73.16%	26.82%

Table 91: Cattle Bone Fusion Data From St. John's II

	Fused	Unfused
0-18 Months		
First Phalange	14	-
Second Phalange	8	-
Humerus - distal	1	1
Radius - proximal	2	-
Scapula	4	-
Total Bone	29	1
Percentage of Age Range	96.66%	3.33%
24-36 Months		
Metacarpal - distal	6	-
Metatarsal - distal	4	2
Tibia - distal	1	2
Calcaneus	1	-
Total Bone	12	4
Percentage of Age Range	75.00%	25.00%
36-48 Months		
Femur - proximal	-	1
Radius - distal	1	1
Ulna - proximal	1	1
Femur - distal	-	1
Tibia - proximal	2	-
Humerus - proximal	2	1
Total Bone	6	5
Percentage of Age Range	54.50%	45.50%

Table 92: Cattle Bone Fusion Data From Drummond III

	Fused	Unfused
0-18 Months		
First Phalange	10	-
Second Phalange	7	-
Radius - proximal	4	-
Total Bone	22	0
Percentage of Age Range	100.00%	0.0%
24-36 Months		
Metacarpal - distal	5	1
Metatarsal - distal	4	1
Tibia - distal	3	1
Total Bone	12	3
Percentage of Age Range	80.00%	20.00%
36-48 Months		
Femur - proximal	1	1
Radius - proximal	2	-
Ulna - proximal	1	1
Femur - distal	1	1
Tibia - proximal	-	2
Total Bone	5	5
Percentage of Age Range	50.00%	50.00%

Table 93: Cattle Bone Fusion Data From Clifts III*

	Fused	Unfused
0-18 Months		
First Phalange	13	-
Second Phalange	16	-
Humerus - distal	6	-
Radius - proximal	2	-
Scapula	1	-
Total Bone	38	0
Percentage of Age Range	100.00%	0.0%
24-36 Months		
Metacarpal - distal	1	-
Metatarsal - distal	1	-
Tibia - distal	5	1
Calcaneus	1	2
Total Bone	8	3
Percentage of Age Range	72.70%	27.30%
36-48 Months		
Radius -distal	1	1
Ulna - proximal and distal	1	-
Femur - distal	0	2
Tibia - proximal	2	2
Total Bone	4	5
Percentage of Age Range	44.40%	55.60%

* Taken from Bowen 1979

Table 94: Cattle Bone Fusion Data From Clifts IV*

	Fused	Unfused
0-18 Months		
First Phalange	92	8
Humerus - distal	4	1
Radius - proximal	4	-
Scapula	8	-
Total Bone	108	9
Percentage of Age Range	92.30%	7.70%
24-36 Months		
Metacarpal - distal	15	6
Metatarsal - distal	14	15
Tibia - distal	9	7
Calcaneus	1	19
Total Bone	39	47
Percentage of Age Range	45.30%	54.70%
36-48 Months		
Femur - proximal and distal	2	5
Radius - distal	4	3
Ulna - proximal and distal	1	2
Tibia - proximal	-	2
Total Bone	7	12
Percentage of Age Range	36.80%	63.20%

* Taken From Bowen 1979

APPENDIX V

Statistical Data

Spearman R Correlation

Significance of Sample Size Effect on Evenness and Richness with sample size the number of identified elements.

	Evenness	Richness
R Value	-0.785	0.759
Significance	0.0001	0.0002

Least Squares Regression Analysis

Sample Size and Richness: (Using MNI Counts)	R-Square= 0.446, Intercept= 11.156, Slope= 0.0071, Significance= 0.0018
Sample Size and Evenness: (Using MNI Counts)	R-Square= 0.158, Intercept= 0.924, Slope= -0.0001, Significance= 0.0005.

Spearman R Correlation

Significance of sample size effect on Relative Bone Frequency when divided by animal groups.

	Cow	Swine	Sheep	Dom. Fowl	Deer
R Value	-0.022	-0.228	-0.370	-0.440	-0.070
Significance	0.926	0.347	0.117	0.059	0.775

	Small Mamm.	Water Fowl	Terr. Fowl	Turtle	Fish
R Value	0.428	0.315	0.165	0.016	0.252
Significance	0.067	0.188	0.497	0.946	0.296

One-Way Analysis of Variance and Kruskal-Wallis Tests

Test of the mean relative frequencies of bone across time for each animal group. This used the transformed frequence data.

Test for Periods 1, 2 and 3:

	ANOVA		KRUSKAL-WALLIS*	
	F-Value	Sign.	Chi-Square	Sign.
Cattle	8.69	0.0002	9.13	0.010
Swine	5.96	0.0117	7.61	0.022
Sheep/Goat	11.53	0.0008	10.36	0.005
Dom. Fowl	1.93	0.177	3.04	0.218
Deer	8.66	0.002	8.29	0.015
Small Mamm.	0.52	0.605	0.67	0.715
Water Fowl	1.31	0.298	2.12	0.346
Terr. Fowl	0.33	0.725	0.67	0.071
Turtle	0.20	0.824	0.80	0.669
Fish	9.75	0.001	11.94	0.002

* Degrees of Freedom = 2

T-Test

Test for the significance of the difference between means of transformed relative bone frequencies through time.

All Domestic Bone Frequencies:

	Mean	T	DF	Sign.
Period 1	0.666	-2.675	10.8	0.022
Period 2	0.928	-2.670	11.0	0.021
Period 2	0.928	-4.130	7.8	0.003
Period 3	1.228	-3.874	11.0	0.002

T-Test for Cattle Frequencies:

	Mean	T	DF	Sign.
Period 1	0.434	-2.494	10.7	0.030
Period 2	0.616	-2.428	11.0	0.033
Period 2	0.616	-1.425	6.8	0.198
Period 3	0.702	-1.324	11.0	0.212

T-Test for Swine Frequencies:

	Mean	T	DF	Sign.
Period 1	0.432	-0.830	7.6	0.431
Period 2	0.486	-0.868	11.0	0.403
Period 2	0.486	-3.231	10.6	0.008
Period 3	0.632	-3.237	11.0	0.007

T-Test for Sheep/Goat Frequencies:

	Mean	T	DF	Sign.
Period 1	0.038	-3.737	9.7	0.004
Period 2	0.165	-3.581	11.0	0.004
Period 2	0.165	-1.550	9.9	0.152
Period 3	0.237	-1.571	11.0	0.144

T-Test for Deer Frequencies:

	Mean	T	DF	Sign.
Period 1	0.341	3.638	6.5	0.009
Period 2	0.128	3.861	11.0	0.002
Period 2	0.128	-1.303	8.5	0.227
Period 3	0.180	-1.346	11.0	0.205

T-Test for Fish Frequencies:

	Mean	T	DF	Sign.
Period 1	0.642	0.854	9.5	0.414
Period 2	0.517	0.870	11.0	0.402
Period 2	0.517	4.448	7.0	0.002
Period 3	0.114	4.140	11.0	0.001

<u>Least Squares Regression Analysis</u>

Sample Size and Richness: (Using Meat Weights)	R value= .653, R-Squared= .427, Intercept= 11.181, Slope= .0068, Significance= .0012.
Sample Size and Evenness: (Using Meat Weights)	R value= -.506, R-Squared= .256, Intercept= .507, Slope= -.007, Significance= .0133

Kruskal-Wallis Test (Chi-Square Approximation)

This test was used to test the significance of variation in the mean frequencies of estimated meat of each animal group through time.

	Chi-Square	Significance
Total Domestic Meat:		
Period 1 to Period 2	8.163	0.004
Period 2 to Period 3	2.040	0.153
Period 1 to Period 3	8.307	0.003
Cattle Meat:		
Period 1 to Period 2	7.367	0.006
Period 2 to Period 3	2.469	0.116
Period 1 to Period 3	8.307	0.003
Swine Meat:		
Period 1 to Period 2	0.326	0.567
Period 2 to Period 3	4.591	0.032
Period 1 to Period 3	0.923	0.336
Sheep/Goat Meat:		
Period 1 to Period 2	3.180	0.074
Period 2 to Period 3	2.931	0.086
Period 1 to Period 3	5.769	0.016
Domestic Fowl Meat:		
Period 1 to Period 2	1.000	0.310
Period 2 to Period 3	0.183	0.668
Period 1 to Period 3	0.641	0.423
Deer Meat:		
Period 1 to Period 2	5.898	0.015
Period 2 to Period 3	0.510	0.475
Period 1 to Period 3	3.692	0.054
Small Mammal Meat:		
Period 1 to Period 2	1.653	0.198
Period 2 to Period 3	0.326	0.567
Period 1 to Period 3	4.006	0.045
Water Fowl Meat:		
Period 1 to Period 2	2.040	0.153
Period 2 to Period 3	0.081	0.775
Period 1 to Period 3	3.102	0.078
Fish:		
Period 1 to Period 2	2.938	0.086
Period 2 to Period 3	5.898	0.015
Period 1 to Period 3	7.410	0.0065

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