# SCATTERED TO THE WIND: AN EVALUATION OF THE DISASTER LANDSCAPE OF COASTAL NORTH CAROLINA

By

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Coastal North Carolina has had a long and intimate relationship with severe weather events, the outcome of which has affected the physical, economical, and social structures of the State. The primary objective of this thesis is to investigate historical storm occurrences in coastal North Carolina in order to determine a correlation between weather disasters and the initial settlement, sustained occupation, or abandonment of occupied lands. Utilizing geographic information systems (GIS) to explore historical hurricane tracks and shipwreck and land site loss, spatial and temporal analysis can provide insight into how the disaster landscape is reflected in settlement patterns and loss versus survivability, as well as the social, economic, or environmental factors that have shaped continued and subsequent settlement and trade in coastal North Carolina.

# SCATTERED TO THE WIND: AN EVALUATION OF THE DISASTER LANDSCAPE OF COASTAL NORTH CAROLINA

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DEDICATION

This thesis is dedicated to the most supportive family
Who always make sure I can keep up with The Jones'.

And the incoming Class of 2008—you have been the best crew with which I have ever "sailed."

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## INTRODUCTION

North Carolina's history, both early and recent, is littered with accounts of severe weather events. Hurricanes and tropical storms are frequent for the state and have physically altered the landscape of the coastal region. The severe weather that occurs in North Carolina adds a dimension to the disaster landscape that is endemic to the coastal region of the state. This changing landscape has been observed since the first explorers happened across the Atlantic coast of North America; since that time, growing populations and sophistication of monitoring have led to the observance of numerous severe tropical storms and hurricanes, with patterns and trends across time and space. Recent headlining severe storms and research in climate change have pushed for a better understanding of the effect of these events on the cultural and archaeological record, especially for areas prone to the reoccurrence of natural disasters.

The effects of severe weather events such as hurricanes are social, environmental, and economic; they are seen in a variety of cultural attributes such as shipwrecks, economic patterns, and community shifts. Physical alterations are often accompanied by social and economic changes which are usually fine-scale, local trends but have the potential for broad-scale, regional change. Trends in hurricane tracks vary across time and space, producing varying reactions across the physical and cultural landscape affected. These reactions produce patterns of deposition, movement of people, and trends in social and economic response through a variety of industries and characteristics.

This thesis is an attempt to not only correlate severe weather events with their archaeological, social, environmental, and economic impacts, but provide a better understanding of how these impacts are manifested, and how they have shaped reactions and responses to hurricanes and tropical storms over time and across the North Carolina coastal region. Building on previous research and utilizing specific theoretical components, historical records, and computer visualization, this thesis provides a general, encompassing view of North Carolina's coastal disaster landscape and its reaction to a major component such as severe weather events.

### *Previous Research*

Research investigating the impacts of severe weather events has begun to gain popularity in the field of archaeology. With the rise of the number of natural disasters making headlines in recent times, the interest in understanding their impacts and signatures has become important for protecting and/or studying resources before they are lost. Research has focused primarily on the effects of documented events or the potential of these effects to destroy previously documented structures or shipwrecks. Ongoing research is focusing on both submerged and terrestrial sites, many attempting to provide a broader view of the effects of natural disasters on the regions they impact. Specific studies concerning site formation processes and storm events, such as paleotempestology, compare the historical record with sediment features, like overwash deposits, to expose historical storm activity, variable climate patterns, and coinciding cycles (Kam-Bui 2004; Mitchell and Thomas 2001). Along similar lines, the development of models to study storm effects on site formation processes highlights hydrodynamic and physical deterioration from high energy storms caused by waves, currents and abrasion (Nash and Petraglia 1987; Schiffer 1987; Murphy 1990; Ward and Veth 1999). Not only can individual components be affected by the changes in site formation but whole regions and coastlines have to the potential to be inundated by the effects of severe weather, often rapidly changing the formation of both terrestrial and underwater sites (Stewart 1999). These processes, often highly variable, may be general in nature or local in character (O'Shea 2002). Changes in site formation can lead to the preservation or deterioration of underwater and terrestrial sites; thus an understanding of variable, and often rapid, effects such as storm events on site formation processes and cultural features, provides an insight into the changing nature of a dynamic disaster landscape such as coastal North Carolina.

Current and ongoing research in the Gulf of Mexico is seeking to determine the impacts caused by recent hurricane activity on known historic shipwrecks. The study utilizes remote sensing surveys and diver investigations of known and previously documented shipwrecks in order to make comparisons of the sites pre- and post-hurricane activity (Ball 2009). The nature of this study may provide valuable insight into the impacts of severe weather events on a broad and comparative scale. Similar studies are being conducted within Irish maritime archaeology in looking at a broad survey of Irish shipwrecks that correlate with historic storms in an attempt to quantify the extent of these incidents, and relate the weather observations of the distressed vessels to those at meteorological stations (Forsythe et al. 2002:247).

Research on terrestrial sites, such as archaeological surveys in Australia undertaken by Przywolnik (2002:137), have taken the opportunity to study in detail the effects of recent extreme storm conditions on coastal sites; the study has aimed to quantify and characterize the consequences of a single, extreme, documented event on a coastal archaeological site and the implications of studying such events in the archaeological record. These studies attempt to go beyond the simple acknowledgement that climatic events have potential to impact archaeological sites. A post-cyclone survey aimed to assess and quantify the effects of tropical cyclones on midden sites; it looked at the implications of severe storm processes “for understanding the complex archaeological site formation processes of coastal sites” (Przywolnik 2002:137). Their analysis showed that severe storms are potentially destructive to archaeological sites and coastal landforms. As all middens present in the study showed evidence of wind and water erosion, the study has been able to “quantify the effects of a single extreme weather event on archaeological sites located on a high-energy exposed coastline [as well as] quantify the less visible effects of extreme weather on coastal archaeological sites in the movement of midden material within archaeological sites during cyclonic activity” (Przywolnik 2002:150).

Along a similar methodology, previous terrestrial research undertaken by Beaman (2009) in North Carolina has focused on specific counties within the State that have been affected by natural phenomena. Brunswick Town and New Bern have been the focus of a recent archaeological study that has sought to express the link between written historical records and the archaeological evidence of unnamed hurricanes. The study has shown the presence of hurricanes in the archaeological record through examination of stratigraphy and material culture; it presents the possibility of identifying weather signatures in the archaeological record and their link to long-term social and economic processes. In studying the stratigraphy, archaeologists at these sites have discovered that the artifacts found at these sites place their associated stratum within the time frame of a 1769 documented hurricane; they argued that no other single event documented could have produced a uniform, homogeneous deposition of white sand across so many lots. This layer of white sand is associated with storm surge or flooding at different sea level occupations from a severe storm such as hurricane or nor’easter (Beaman 2009). The research approach for this project is useful in recognizing the signatures and site formation processes that severe weather events produce in the archaeological record; however, some argue that while coastal cultural deposits can be impacted by storms, storm impact is “an all too convenient explanation for stratigraphic anomalies [and] these impacts need to be demonstrated through detailed geoarchaeological analysis” (Craib and Mangold 1999:305).

Additional archaeological investigations within the State of North Carolina were conducted at Diamond City, focusing on evidence of the former whaling activities once prominent on the island of Shackleford Banks. Research included visual inspection surveys and limited underwater surveys focused on identifying evidence of occupation and associated whaling materials. Several mounds and structures were identified on the eastern shore of Shackleford Banks, as well as an artifact assemblage that contained historic ceramics, brick, and fasteners (Jateff 2006). Despite the cultural assemblages found, their occupation period and their association with Diamond City was inconclusive. Parts of Diamond City may in fact now be underwater. Examination of the area through survey and further examination of the stratigraphy and site formation processes of the area are a promising avenue for understanding the effects of severe weather on village communities such as Diamond City, where the occupants chose to abandon the area after the continual threat of hurricanes took its toll.

In the same vein, hurricanes have been a major altering event for areas such as Galveston and Indianola in Texas, producing massive flooding resulting in loss of lives, property, and shipping (Arnold 1987:20). Indianola barely escaped a hurricane in 1875, only to be completely destroyed and abandoned in 1886 when a second storm wiped out the last remaining buildings of the port city (Franz 2010). In the deadliest disasters in United States history, Galveston, Texas, was also destroyed (Arnold 1987:20). Archaeological work on the coast of Texas has often been aimed at examining the remains of jetties, piers, and camps, either terrestrially or under water, that represented former ports before destruction; these studies provide comparative analysis for the effects of hurricanes on the economy and environment of coastal communities that have migrated or altogether disappeared (Arnold and Oertling 1995).

Previous studies of severe weather events have also focused on certain regions, such as Cuba, in a specific time period, such as the nineteenth century to characterize the long-term effects of hurricanes and severe storms on socioeconomic changes of a specific community (Perez 2001). Like nineteenth century Cuba, nineteenth century North Carolina saw a varying array of severe storms that occasionally led to patterns of permanent abandonment and resource and environmental change. Perez (2001:10) argues that "virtually every facet of Cuban life was affected by the great nineteenth century hurricanes. The storms rearranged the terms" of social class and colonial order, which transformed relationships elsewhere. Perez's study inserts the phenomenon of nineteenth century hurricanes into the larger circumstances of the Cuban condition as an additional variable in the formation of a nation. This approach, although limited to only a certain time period, provides the basis for this thesis and examines the ways that catastrophic storms of a specific century or decade shaped social, economic, and environmental development and in which human agency was "defined even as the circumstances of human choice were refashioned" (Perez 2001:10). In this regard, hurricanes can be viewed as factors, often decisive, in shaping the "options and outcomes to which huge numbers of people were obliged to respond and to which they were often required to reconcile themselves" (Perez 2001:10).

It has long been recognized by coastal scientists that high-energy storms can cause change to the shoreline which can encompass overwashing or "breaking of barrier islands to create new inlets" (Zhang et al. 2005:123). Previous studies have attempted to quantitatively estimate sediment loss for sandy beaches (Birkemeier 1979; Savage and Birkemeier 1987; Stauble et al. 1990); morphological responses to storm activity occur in multiple dimensions, varying along a shoreline during the same event. Advances in Light Detection and Ranging

(LIDAR) technology has enabled the large-scale quantitative mapping of beach erosion, dune scarping, and overwash deposition in detail (Zhang et al. 2005:123). As an active remote sensing technology, one of the principal applications of LIDAR is topographic surveying through contour mapping or airborne laser surveys. Airborne LIDAR technology enabled three dimensional quantification of beach changes caused by Hurricane Floyd along Florida's Atlantic coast at both small and large scales. The study determined that storm-generated beach erosion was dictated by "storm tide, wave energy, storm duration, and local coastal geomorphic and geological conditions," and all of these factors varied along the coastline during Hurricane Floyd (Zhang et al. 2005:133-134). Airborne LIDAR measures the magnitude of beach erosion and the technology has the ability to facilitate the study of beach response to storm impact by making discernible, inlets, beach and dune ridges, and overwash (Zhang et al. 2005:133).

With all of this previous research concerning historical timelines, spatial mapping of hurricane tracks and shoreline movement, shipwreck deposition, and site formation processes, little has been examined along the lines of the effects of severe weather events on the social and economic histories of coastal areas over time, such as coastal North Carolina, especially in relation to settlement patterns and changes in occupation. The issue of correlation (an extreme event happened about the time as observed culture change) versus causation (the cultural change was dependent on the environmental event) is rarely satisfactorily addressed, and Torrence and Grattan (2002:2) suggest that too often "archaeologists and earth scientists have simply assumed that the occurrence of extreme natural events means that they were the prime movers in cultural change without demonstrating that the latter was solely or largely dependent on the former." Being able to document the fact that disastrous "perturbations occurred and had some effect on the culture-historical trajectory is a crucial first step" and working within a theoretical framework allows us to gain understanding of the role of such events on cultural change (Kornbacher 2002:206). Thus this thesis will explore to what extent historical severe weather events such as hurricanes and tropical storms have had an effect on coastal North Carolina's cultural history.

### *Purpose/Research Questions*

Since European settlement and development in North America, documentation of historic disaster events became more extensive and reliable. Later historical records, especially into the seventeenth century, provide an increase in detail, accounting for seasons, paths, damage, and recovery of the physical land and their communities at large (Ludlum 1963; Schwartz 2007; Hairr 2008). The advent of the National Weather Service and observing systems has aided in the collection of statistics relating to all aspects of weather events. The continual impact of natural disasters on the coast of North Carolina, and the recent destructive force of several notorious weather events, has prompted a discussion of the effects of the events on the land and the community. Various effects contribute to a collective disaster landscape for coastal North Carolina and reactions to these effects vary temporally and spatially. With this in mind, several research questions are posed for this thesis utilizing historical and archaeological research:

- Primary question:
    - Is there a correlation between weather disasters and the initial settlement, sustained occupation, seasonal or transient occupation, or abandonment of occupied lands in eastern North Carolina?
- Secondary questions:
    - How is a "disaster landscape" reflected in the distribution of settled, recurrently occupied, and abandoned settlements and shipwreck locations?

- What are the factors (social, economic, environmental) that have determined site loss or survival and influenced human decision-making to continue land occupation and maritime trade in disaster-impacted areas of eastern North Carolina?
- Using the historical and archaeological records, what have been the major impacts of natural disasters on North Carolina’s coastal communities since the seventeenth century?
- How does analysis of the effects of major weather events on site formation processes facilitate an understanding of the dynamics of coastal environments and their associated communities?

This thesis will attempt to answer these questions through a combination of theoretical approaches and a systematic methodology that examines temporal and spatial data from a wide variety of sources. In examining the research questions, more questions may in turn be prompted, given the nature of the data. Each chapter details a specific step or component in the process of completing this thesis with the ultimate goal of attempting an analysis and interpretation of the relationship between severe weather events and patterns of coastal settlement.

### *Thesis Outline*

Chapter Two presents the theoretical models used for the interpretation of data and research questions presented in this thesis. The theoretical approaches include Behavioral Archaeology, the interaction of the land-sea interface in the creation of a maritime cultural landscape, and catastrophism as it relates to natural disasters and maritime archaeology. This combination of theories aids in analyzing the temporal and spatial data related to severe weather events in coastal North Carolina. Behavioral Archaeology presents the premise that cultural and natural forces act upon and create archaeological sites, creating the context for human behavior and natural action in specific situations or over time. The concept of the land-sea interface focuses on preventing the divide between the water and the mainland when analyzing the social, economic, and environmental aspects of a maritime culture, which can occur across a landscape, not just at sea. It also emphasizes viewing sites in connection with one another, rather than in isolation. Additionally, catastrophism details the effects of natural disasters on cultural and environmental change, often in relation to settlement patterns and climate change. These theoretical approaches provide the framework for viewing the historical and archaeological data and interpreting the patterns they present, which are discussed in Chapters Five and Six.

Chapter Three is an examination of the severe weather events that have historically occurred along North Carolina's coast. This summary of historic events spans from the sixteenth century to the present-day, detailing social, economic, and environmental changes that have occurred directly and indirectly from these events. This chapter relies heavily on newspaper accounts and historic compilations of events to provide a chronological list of hurricanes and tropical storms that have affected coastal North Carolina since the first expeditions to the New World. The historical compilation of severe weather events provides the basis for viewing the coastal region of North Carolina as a disaster landscape and an understanding of the frequency and severity of events to occur in the area and their associated effects on the communities they cross.

Chapter Four details the methodological approaches that are used in the analysis and interpretation of data in relation to the research questions. The methodology includes historical research, looking at historical accounts of severe weather events, as well as the examination and manipulation of geospatial data to expose and interpret patterns. The methodology not only utilizes historical and statistical data but also relies on geospatial data and ERSI ArcGIS software to visualize storm tracks over coastal North Carolina and through time. In preparing graphs, charts, and maps of the historic storms and their associated effects (i.e., shipwrecks, lives lost, monetary damage, and environmental change) we gain a better understanding of patterns and changes in specific areas and time periods as well as regionally and across time.

Chapter Five takes a generalized look at the effects of North Carolina’s historic hurricanes on the socioeconomic characteristics of the coastal region, as well as environmental trends in coastline erosion and storm surge inundation. In examining population trends, economic statistics, and environmental change we may glean the broad effects of severe weather events on the various arenas of the coastal economy such as agriculture, tourism, forestry, fishing, and property as well as any correlations that may exist between severe weather events and noticeable changes in coastal population.

Chapter Six continues the analytical chapters by examining the temporal and statistical data for signatures of North Carolina’s severe weather events. This chapter looks at the ways in which severe weather events have left their mark on coastal North Carolina by defining the cultural attributes affected, as well as the other social and economic impacts of these natural disasters. In viewing hurricane patterns, shipwreck patterns, population change, economic consequences, and social implications, we glean patterns in the overall signatures of severe weather events for coastal North Carolina which have led to changes in the cultural and social characteristics of the region.

Chapter Seven analyzes the spatial correlations between the patterns seen in the severe weather events and the cultural and environmental changes in the coastal communities of North Carolina, especially in relation to settlement patterns and the occupation or abandonment of the region and specific areas within this region. This chapter also looks at the factors (social, economic, and environmental) that affect human-decision making in terms of the settlement of the disaster landscape of North Carolina's coast. The combination of Chapters Five and Six attempts to examine the relationship between the effects of historic severe weather events and the changes over time in the initial settlement, sustained occupation, seasonal or transient occupation, or abandonment of occupied lands in eastern North Carolina.

Chapter Eight offers observations concerning the research questions posed in this thesis and the ability of the data and subsequent analysis in answering the questions. Chapter Seven also provides conclusions about any patterns presented in the previous chapters and the signatures and effects of severe weather events over time across coastal North Carolina.
This chapter also poses additional questions and directions for further investigation for future historical and archaeological researchers.

*Conclusion*

As outlined above, the culmination of research and analyses will provide a broad overview of the role of severe weather events in the disaster landscape of coastal North Carolina. Through the examination of the historical record and utilization of spatial data, this thesis will investigate not only the historical occurrences of hurricanes and tropical storms in the region, but also their correlations to effects on social and economic changes and movements. Patterns may or may not correlate to historic events, thus prompting an exploration of the various reactions to these events, whether human, geographical, economic, or otherwise. Trends may emerge that increase our understanding of local and regional reaction to severe weather events over time, providing insight into the cultural interactions of the North Carolina coastal region and severe weather.

# CHAPTER 2: AN ATMOSPHERIC DEMONSTRATION…

## THEORY

This thesis utilizes several theoretical approaches, combined to assess and interpret the disaster landscape in coastal North Carolina. Each component provides a unique angle for approaching the research questions and in conjunction with the other theories provides insight into research questions concerning catastrophic weather events in North Carolina's history. This chapter will include assessment of the three theoretical components of this thesis. These theoretical concepts include the study of site formation processes within the realm of behavioral archaeology as well as the concept of a land-sea interface that is manipulated by human behavior and events which are distinguishable in the archaeological record. Additionally the premise put forth by catastrophism that natural hazards can invoke transformations on various levels is considered. Each of these approaches will be supplemented with various literature that relate the theoretical concepts to the investigation of historical storm occurrences in coastal North Carolina and their correlation to settlement, occupation, and abandonment of this region.

### *Behavioral Archaeology*

Behavioral Archaeology is associated with the theoretical study of site formation processes of the archaeological record. This conceptual system attempts to reconstruct the cultural past through behavioral inferences based on those formation processes (LaMotta and Schiffer 2001:14). Formation processes interact with and affect sites. The site is an important unit for recording and analyzing data, and an understanding of the cultural and environmental formation processes that have effected a site is a prerequisite for inferring anything about the cultural or behavioral past (Schiffer 1987:199). An appreciation for large scale effects of site-level processes is present in the theory of Behavioral Archaeology; distinctions between primary, culturally-formed deposits at a site, and secondary deposits, which contain materials redeposited by environmental processes, are essential in making inferences about past cultural systems (Schiffer 1987:199).

Both cultural and non-cultural components interact with and affect sites and settlements. Cultural processes, labeled c-transforms, describe related variables of on-going cultural systems through cultural depositions or even lack of depositions (Schiffer 1995:38). Processes of the natural environment, or non-cultural "n-transforms", concern the archaeological data and post-depositional changes of processes such as wind, water, or chemical action. Non-cultural deposits may contribute to or modify deposits and behaviors at a particular site, and thus an understanding of n-transforms allow archaeologists to predict the interaction between variables of cultural materials and the non-cultural environment in which they are deposited or moved (Schiffer 1995:38; LaMotta and Schiffer 2001:199).

N-transformations pertain usually to post-depositional phenomena, especially the modification or destruction of artifacts and ecofacts by chemical and physical agents; these post-depositional n-transforms are what most archaeologists are concerned with in regard to the changes in sites and artifact movement. Within this domain are geological processes, such as erosion, that alter site morphology and may result in secondary deposits or the dispersal of remains (Schiffer 1975:840-841). The powerful winds, torrential rains, and storm surges that accompany tropical storm systems make them particularly destructive to low-lying coastal areas where populations are concentrated, and which are extremely susceptible to such environmental processes as flooding. These processes have various effects, ranging from erosion of cultural remains to complete site obliteration (Fitzpatrick 2010:4). For the most part, effects of storms are brought about by wind and water, agents that work similarly, in that their potential to damage and move materials is a function of their velocity (Schiffer 1987:233).

In this thesis, n-transforms will additionally be viewed as the cause of transformation of sites, rather than changes following deposition. The archaeological record is a static structure that is a reflection of a dynamic system and therefore has undergone successive transformations from past behavioral systems to present observations. Many of the transformations and processes occur on a regional scale such as sand deposition by wind or water, and also have site-level impacts; when these processes effect occupied settlements, they are referred to as "natural disasters" (Schiffer 1987:234). Treacherous storms such as hurricanes or tornadoes have drastic impacts on communities and are recurrent phenomenon in particular regions. The effects of these storms can be swift and dramatic or slow and subtle, and their effects may be predictable, such as those that typically involve wind or water deposits causing damage or erosion, or more uncommon events may occur, such as abandonment. The effects of environmental processes are evident on activities and settlement systems and the interaction of the archaeological remains with the regional environment poses challenges and research opportunities for archaeologists. Sites or portions of them may be destroyed or become less visible, but the processes may also reveal buried sites and present evidence for past processes crucial for understanding cultural or economic adaptations (Schiffer 1987:233-235).

Ongoing research is focusing on both submerged sites and terrestrial sites, many attempting to provide a broader view of the effects of natural disasters on the regions they impact. Paleotempestology studies examine past storm activity through sediment proxies such as overwash deposits along with historical records, to expose climate and storm patterns which are highly variable and may coincide with certain cycles (e.g. El Niño Southern Oscillation--ENSO) that affect regions differently at different times (Mitchell and Thomas 2001:103-104; Kam-biu 2004:13). The study of effects of severe weather on site formation processes has begun to develop models for both hydrodynamic and physical deterioration of sites. In high energy environments, such as those during hurricanes, tsunami, or cyclones, physical deterioration processes are the most significant and highly variable (Nash and Petraglia 1987). Processes may be progressive, cyclic, chaotic, ordered, or random and may operate dependently or independently of other components of the coastal system. Coastlines may become inundated as sea levels change, often quite suddenly, affecting the formation processes of both underwater and terrestrial sites (Stewart 1999:571-572).

Environmental site formation processes affecting submerged archaeological sites or shipwrecks operate on the artifact, site, or regional level (Stewart 1999:578). The processes encountered, such as waves, tides, and currents, whether by the natural cycle or exaggerated by severe intermittent events, subject sites to the destructive effects of erosion and abrasion, and can "operate according to time scales ranging from less than a second to those measured in millennia or more," and in spatial terms, they can operate over a wide range of scales, from millimeters to hundreds of kilometers (Bartlett 1995:7). Wave action varies spatially and temporally and depends on the size of the wave and wind strength, whose patterns may vary over time (Stewart 1999:582). In high energy environments, physical processes such as those aforementioned will be more significant than chemical or biological processes that may bring about deterioration. The nature of the hydrodynamic environment may be variable in time, and physical processes such as hydraulic forces, may be applied to a wreck or inundated site as part of the ambient climate, through episodic storms such as hurricanes, or by currents (Ward and Veth 1999:565). Episodic events like hurricanes or cyclones, can increase deterioration or induce erosion and accumulation (Ward and Veth 1999:568).

Storm surges associated with high tides and large waves from hurricanes or northeasters can be very destructive to coastal areas. These conditions create longshore currents that erode sand bars and dunes, and breach barrier islands in a matter of hours. Wave impact is seen as an overwhelming destructive force, suspending bottom sediments and transporting sand to cause erosion and littoral drift. The implication of these processes for coastal, inundated, or submerged archaeological sites is either the displacement of materials or burial beneath the wave base (Murphy 1990:14-15).

While cultural and behavioral aspects affect the material nature of a site, natural or environmental forces operate simultaneously, independently acting upon the "physical structure of the vessel [or site] and its contents, and consequently influencing the responses of the humans involved" (Gibbs 2006a: 8). The distribution or pattern of historic shipwrecks is the product of historical and natural factors (Garrison 1989: 12). A shipwreck presents a unique event on a specific historical trajectory "of individual action and local circumstances, which results in a particular deposition of material remains within a specific spatial matrix" (O'Shea 2002: 211). Site formation theory is intended to deal with two related archaeological problems:

> (1) how do materials pass from a systematic context, where they are part of an ongoing behavioral system, into a static archaeological context; and (2) what happens to these material remains and their spatial relationships between the time they are deposited and the time they are recovered by the archaeologist (O'Shea 2002:212).

Environmental conditions at the time and place of a wreck represent a relevant set of depositional processes. If local weather and/or water conditions are known, or can be determined, a great deal can be predicted regarding the condition and distribution of a wreck.

Approaches to this concept have employed cluster analysis to identify artifacts with similar distributional properties, which may be a result of their being acted upon by similar environmental forces. These forces may be extremely local in the character of effects and significance, and may also contrast between normal conditions and those that occur during a storm. Within this concept wrecked vessels and associated wreckage within an area are not viewed in isolation, but instead as an aspect of the regional environment (O'Shea 2002:213-215).

In viewing sites as part of a local or regional environment, the act of abandonment is often studied in relation to behavioral archaeology and may be an effect of natural site formation processes such as storms. Abandonment invokes images of

> Catastrophe, mass migration, and environmental crisis…Most archaeological studies of abandonment have focused on either regional exodus…or spectacular cases of repaid abandonment. Since about 1970, abandonment has been increasingly recognized as a normal process of settlement, and, more importantly, identified as a key process in the formation of the archaeological record (Cameron 1993: 3).

Abandonment of settlements is usually a gradual process, although rapid, catastrophic abandonment does occur (Cameron 1993:3-4). This process can occur at the level of activity area, structure, settlement, or an entire region. There are various forms of abandonment that include punctuated abandonment with anticipated return, and permanent abandonment, both of which present distinctive processes and assemblages in the archaeological record (Graham 1993:25; Tomka 1993:11).

With regard to shipwrecks, there are also various forms of abandonment that can be distinguished in the physical act, whether from conscious or unconscious decisions. At the center of the definition of a shipwreck is the concept of the act being the result of a catastrophic event, causing the loss of a ship by sinking, breaking, striking, or stranding. According to Richards

(2008:7) all watercraft have come to be abandoned whether accidentally or intentionally. Catastrophic abandonment occurs when the "desertion of a ship becomes a prerequisite in the preservation of life," and in other instances crew may feel there is a perception of impending disaster and allow the vessel to go abandoned without consideration for value (Richards 2008:8-9). The extent of the catastrophic aspect of the event may vary widely, from the vessel breaking apart in a hurricane to a slow and unintended settling in shallow waters, but "the unintentional nature is perhaps the defining characteristic" (Gibbs 2006a:7). Consequential abandonment is seen where the loss of a ship is the consequence of a catastrophe, but with "some thought concerning value and its potential losses and gains that would culminate with the act of abandonment" (Richards 2008:9).

Studying abandonment may aid in the understanding of local adaptations and long-term settlement processes (Horne 1993: 52). The most significant cultural and ecological factors in settlement abandonments of small scales (i.e. local) may differ in kind and frequency from those factors that shape abandonment phenomenon of a more encompassing extent, such as regional abandonment or total obliteration. The factors that influence small-scale abandonments cumulatively account for larger-scale phenomenon only if there are sufficient elements for causal interrelationships and locational and temporal synchronicity (Fisk and Fisk 1993:99). Even when abandonments are widespread as to create regional patterns,

> Different scales of archaeological analysis result in emphasis on different aspects of the overall phenomenon. Studies focused at the levels of sites, locales, or regions experiencing abandonment are informative on environmental and cultural factors affecting the endurance and success of populations in these respective categories (Fisk and Fisk 1993:99).

Decisions to abandon can be seen as solutions to certain problems. The perceived outcome of the act of abandonment must have been considered the more acceptable action under given circumstances, than remaining in the same place. These conditions would have affected the timing and manner of departure, and even the thought of return (Fisk and Fisk 1993:100). Lillios (1993:110) argues that unicausal explanations, such as environmental catastrophe, cannot account for the archaeological data associated with most regional abandonments. Tomka and Stevenson (1993:192) demonstrate that the "rapid, single-event, permanent abandonment of features or sites without future re-use or reoccupation appears to occur only under relatively unique conditions (i.e. catastrophic abandonment)," thus concluding that site and regional abandonments are cultural, adaptive responses to sociocultural, technological, or environmental circumstances. It is necessary to ask what are the relationships between the conditions of abandonment and the causes, and how do we proceed from the detailed material correlates reflecting the abandonment process and circumstances, to the socio-cultural level (Tomka and Stevenson 1993:192-193)?

### *Land-Sea Interface*

For populations that live on or near the shore, the relationship between the people and the sea is "one that transcends purely objective, rational description" (Bartlett 1995:4). Firth (1995:3-4) defines the maritime landscape as "consisting of material and immaterial aspects of networks…and other human activity on land and underwater, mirroring the entire range of maritime economies." However one defines the coastal zone, it is a region of extreme significance for human affairs; many social, political, economic, and cultural activities depend on, or are driven by the characteristics of the coast. The coast may facilitate or restrict the workings of a society, and the dynamic nature of the coastal environment provides the setting for complex flows of matter and information that flow in all directions at a variety of temporal and spatial scales (Bartlett 1995:4-7; Rönnby 2007:66). These forces or the effects of natural disasters on sites and settlements are linked to a wider concept of the land-sea interface which makes distinct the connection between the marine and terrestrial site, and the linked events and behaviors that are easily traceable within the historical and archaeological data (Gibbs 2006b:70).

The enduring problem with the land-sea interface in maritime archaeology has been the tendency to view sites as individual events, rather than interrelated phenomena that expose broader processes of behavior and activity; historical and archaeological data both reveal patterns and themes, identifying areas of commonality in processes, and by exploring well-documented and archaeological visible situations, "generalized understandings and frameworks could be developed to assist in interpreting undocumented and/or archaeologically less coherent sites" (Gibbs 2006a:4, 2006b:74-75). In viewing individual sites or events in a broader context we may find shared "intentions and rationales, relationships with wider economic and settlement processes, [and] the nature of local and regional variations in response to differing environmental, social and economic conditions, as well as change over time" (Gibbs 2006b:79). For example, the hulls of shipwrecks, along with their fragments and contents are representative of a particular national maritime heritage, but waterfronts, shipyards, and coastal communities are also significant parts of the maritime cultural landscape, as examples of the land-sea interface (Claesson 2009:698).

Connected to the land-sea divide is the concept of a maritime cultural landscape composed of interacting elements that should be studied in conjunction with one another rather than in isolation (Martin 2000:39). A particular landscape should be understood with reference to its neighbors whether by political, cultural, climatic, or physical criteria. Landscapes studies focus on the duality of interaction between human activities and landscapes, where human action creates a landscape, and a landscape shapes human actions/culture (Duncan 2006: 7). The most dynamic form of landscape interactions are encountered along the boundaries of distinctly different landscapes,

> Where mechanisms of cause, effect, and interdependence may often be observed with unusual clarity. An extreme example of such a boundary is the coastline, which separates the sea and its shifting perils from its essentially static terrestrial hinterland (Martin 2000:39).

The use of cultural landscapes has been integrated into archaeological interpretation and

> explores the complex interrelationships that exist between human cultural activity and the physical environment…It adopts a holistic approach to the interpretation of past cultures" and for thematic surveys can draw correlations between submerged databases, such as shipwrecks, and terrestrial events and patterns (Duncan 2000:7, 10).

A seascape may exist where "correlative relationships between terrestrial and maritime activities occur" (Duncan 2000:33). Ties between the land and sea may be seen through the comparison of spatial and temporal patterning of sites, terrestrial and maritime, known from historical records or archaeological sites that display trends, trades, and cultural factors. For example, relict landscapes, whose natural processes have ended, may be regarded as archaeological in nature but also include historical evidence in the material culture, such as newspapers. Relict landscapes include "shipwrecks, disused lighthouses, jetties, buoys, harbor facilities, disused ports, and even debris trails all represent relict remains of past seascapes" (Duncan 2000:47). Seascapes exist on a number of levels, from small-scale areas to large stretches of coastline, and are a product of cultural and physical factors. Seascape studies should recognize and investigate environmental factors when considering the structure of the seascape as the sea is a "dynamic and often boisterous setting, which is often more prone to the effects of environmental conditions than its terrestrial counterpart;" sources such as these might include prevailing weather patterns (Duncan 2000:54).

It has been noted that initially maritime archaeology tended to focus more on the technical aspects of working underwater and failed to utilize the theoretical framework of terrestrial archaeology (Nash 1987:26-27; Duncan 2000:5-6). Although research was undertaken in the marine environment, it was largely restricted to shipwreck and maritime routes studies, where the sea was examined as a separate entity to the land. It has thus been prompted that further studies within maritime archaeology investigate the "relationship between terrestrial, submerged and maritime structures," and recognize that the division of landscapes by environmental parameters is a shortcoming because culture and utilization do not stop at the shoreline (Duncan 2000:6; 2006:7-8).

The maritime cultural landscape was first applied to the "unity between the terrestrial and underwater material culture" by Westerdahl in 1979, and signified human utilization of maritime space by "boat, settlement, fishing, hunting, shipping, and its attendant subcultures, such as pilotage, lighthouse and seamark maintenance" (Westerdahl 1992:5; Duncan 2000:21). Studies of maritime landscapes and/or seascapes have begun with the examination of shipwrecks, terrestrial artifacts, traditions of usage, natural topography, and toponomy (Duncan 2000:21-22). Specifically, maritime cultural landscape studies have progressed in multiple directions and approaches to examining regions, and themes of maritime culture, specialization, geomorphological processes within archaeological landscapes, riverine and estuarine sites, cultural and environmental heritage management, computer visualization of landscape, and ethnography have come to "illuminate the cultural and social relationships between communities and the environment" through a combination of archaeology and history (Duncan 2006:11).

A growing trend in maritime archaeology and management of cultural resources attempts to see "the shipwreck as but one integral part of a continuum of maritime heritage sites, on, in, around and under our waters" (McCarthy 2003:25). While each wreck site or terrestrial site "may be regarded as a discrete archaeological entity, having its own specific cultural attributes and fixed place in time, its relative value in the understanding of a particular sequence of events increases considerably when linked to a broader archaeological or historical context" (Stanbury 1983:261). Maritime archaeological sites do not consist solely of shipwrecks, which also do not alone signify the presence of a seascape. Maritime sites also include other relict archaeological evidence, and seemingly isolated sites and finds may delineate and elucidate a seascape for a particular area (Duncan 2000:141-142). These maritime components are "no more than extension or reflections of the broader culture to which they belong and are integral rather than isolated economic or social elements" (Hunter 1994:262). The relationships between wreck sites and archaeological land sites can enhance knowledge of man's activities and relationship with the sea and the coast (Stanbury 1983:261).

### *Catastrophism*

The wider economic, social, and environmental relationships that are influenced by abrupt geological or atmospheric events may be represented in immediate short-term threats such as flooding that can eventually lead to site abandonment, or long-term threats such as ecological devastation and resource depletion. Models used to study abrupt atmospheric events require an account of variability in the event's role in cultural and environmental change (Losey 2005:102-103). The concept of catastrophism as it relates to maritime archaeology, enforces the idea that abrupt atmospheric events such as hurricanes or tsunamis advance hazards that invoke social transformations such as changes in settlement patterns and subsistence regions (Losey 2005:101, 105). Hazards related to extreme weather conditions are the most frequently occurring hazardous events and are often the events that affect the largest areas (Leroy 2006:4). Local catastrophism may play a role in actual continuity and account for gaps in regional cultural sequences (Maxwell 1980:165, 168).

With an increase in reported natural hazards, archaeology has begun to focus on "the theme of rapid and catastrophic environmental changes and human and ecosystem responses" (Leroy 2006:4). The amplitude of disasters are contributed to by time, area, and societal characteristics, which converge to cumulatively affect an area or community (Leroy 2006:5). The extreme effects of hazardous weather conditions have been in constant interplay with both environmental and human elements for centuries, leading to short-term damage and long-term change (Feiman and Fisher 2005). The catastrophic events "happen in periodical or chaotic patterns, varying in frequency, magnitude, and functional structure," presenting various risks to maritime cultural resources through changing formation processes (Laoupi 2008:1). Catastrophic sequences, which can be visible in the archaeological record, can highlight the temporal and spatial distribution of past events. Periodic changes with moderate character, or sudden, violent events can transform the natural ecosystems, rebuild the landscape, and forge new dynamics in societies by influencing stability, trends, and the archaeological record. Databases with this type of information can enrich the categorization of potential affected targets such as ecosystem equilibrium, economic losses, artifacts, demographical stability, and cultural identity (Laoupi 2008). The effects of natural hazards, such as severe storms, can be hidden in the archaeological record as they transform the natural and cultural landscape, intensifying degradation processes, and promoting a broad spectrum of changes and losses (Laoupi 2008:3). These physical changes may lead to adaptive adjustments, modifications, or transformations within a community or culture. The archaeological layers preserve evidence of physical damage as well as respective changes in occupation, management and trade, structures, and even technology. Major environmental events have transformed whole areas, while other periodically expressed events have had long- to short-term impacts on socioeconomic structures, all of which are held in the archaeological record whether as shipwrecks, inundated sites, or vanished maritime communities (Laoupi 2008:3).

The nature and intensity of the physical impact of storms on the archaeological record is a matter of debate. Craib and Mangold (1999:299) argue the overestimation of storm effects and the difficulty in assessing remnant storm deposits and their use in the interpretation of stratigraphy and archaeological evidence. However, "storm surges, or temporary rises in sea-level concomitant with tropical cyclones, can be a major factor in influencing the development and modification of the coast. Under cyclone conditions, coastal changes which would normally take many years, may take place in just a matter of hours" (Bird 1992:75). The impact of each event is seen in changes on coastal geomorphology and thus, the archaeological record. Often times, storms succeed one another rapidly, as is often the case during some hurricane seasons, giving the environment, and their associated communities, little time to recover. Specifically, major erosion problems occur, which could result in inlet closure or opening when hurricanes are in close proximity to one another, as there is "limited opportunity for foredune accretion along the coast," making erosion cumulative and amplified (Bird 1992:82). Along these lines, erosion or storm surge may not only cover up preexisting archaeological sites, but may also expose previously unknown sites (Bird 1992:82).

Many archaeologists have acknowledged the effects of storms, but research in investigating and assessing severe weather effects on archaeological sites, and thus on the larger cultural landscape, has been limited (Przywolnik 2002:137). The impact of tropical cyclones, or hurricanes, on coastal geomorphology and the archaeological record has been noted (Bird 1992:77). The potentially destructive forces that include high winds, violent gusts, scouring by waves, wind-borne debris, rain and flooding, and storm surge, cause stress and pressure not only on the physical environment, but also on the cultural, social, and economic landscape of coastal areas (Przywolnik 2002:137-138). Some studies have been able to identify and quantify "the effects of a single extreme weather event on archaeological sites located on a high-energy exposed coastline," as well as the less visible effects of extreme weather events on coastal sites by the movement of materials during storm activity (Przywolnik 200l:150). In coastal areas, storm surge is a major factor in site change as it may be erosive or depositional. Due to high energy, storm surge may cause beach erosion and coastal land formations, such as dune systems, suddenly with long-lasting consequences, but "archaeologically it is probably the superimposed effect of many surges over centuries that make sites uninhabitable, even though mean sea level remains unchanged…As yet stratigraphical evidence of storm surge has not been clearly defined" (Everard 1980:15; Przywolnik 2002:138).

Historical records may be incomplete or lost at sea, but "longer storm record[s] can be obtained from the sedimentary record, especially from hurricane-deposited sand layers in coastal lakes, marshes, and swamps" (McCloskey and Keller 2009:53). Larger, more intense hurricanes generate larger storm surges and imbed sand layers within normally deposited coastal sediment, permitting the establishment of multi-hurricane strike records (McCloskey and Keller 2009:54). Storm sediment may contrast to normal coastal stratigraphy, but differentiating between varying natural 'marine invasion phenomena' can be difficult (Costa et al. 2003:157). Although ENSO events have been evidenced in ice cores, tree rings, and paleolandforms, their buried signatures may be similar to those of annual or seasonal storms, floods, and droughts (Stahl 1996:111-112). In viewing evidence of past environmental catastrophes, Craib and Mangold (1999:299-301) argue the model for storm deposition in terms of archaeological site formation fails to outline the diagnostic features by which storm deposits may be recognized; storm deposits are indistinguishable from beach sand, and on the whole, storm activities are not destructive to certain features. In accepting that storms can impact cultural deposits, Craib and Mangold (1999:305) deny the convenient explanation of storm impact as the source of stratigraphic anomalies and the process as rare compared to erosion and scouring. Finding traces of hurricane deposits in sedimentological records from coastal deposits does have inherent problems. The composition is based on energy levels, and the record can vary greatly from where a storm made landfall; in the historical study of hurricanes, this is less of a problem "since we know where the storm made landfall," but in other circumstances, where we do not have an exact record, it becomes important to "recognize records both close to and far away from the direct landfall of a particular storm to obtain a true picture of periodicity. However, to recognize the record we must examine deposits that we know relate to specific" storms (Collins et al. 1999:16). Unfortunately, geomorphic evidence of storm-related erosion and deposition patterns may be modified or obliterated by natural processes such as subsequent storm erosion or human-induced changes (Buynevich et al. 2004:135-136).

Although natural phenomena may often be quantified, the impacts of disasters or catastrophes are usually immeasurable except for determining the number of deaths, price of a commodity, insured losses, or economic losses. A full scale of "possible rapid environmental change has not been recorded in the short period covered by the instrumental record. Therefore it is essential to turn to historical and even geological and archaeological archives, which span a much longer timescale" (Leroy 2006:6). The signatures of environmental catastrophes can be visible in the archaeological record, as well as apparent in the historical documentation. In looking for evidence of such events and processes in both the archaeological and historical record, there are recognizable, discernible, and accepted signatures.

Shipwreck patterns may be the product of complex natural phenomenon such as equinoctial storms, currents, winds, shoals and reefs. Shipwreck patterns may be discernible through newspaper accounts, official insurance reports, ships' logs or direct observations observed in lifesaving records (Garrison 1989:12). In studying shipwreck patterns, a single wreck may be seen as a "unique phenomenon and of interest primarily for its intrinsic characteristics, including the information that it may offer about more general issues, or a general problem may require seeking out one or more particular wrecks in specific places dating from specific periods" (Watson 1983:27). Shipwrecks have been described as time capsules in representing specific time period, or a 'Pompeii' where information can be gleaned from a single moment in time. Although they may be seen as the representation of the "full spectrum of the group's activities at the location, represented by the material culture in use at the time" deposited as a discrete unit, frozen in time, they are rarely the result of human intent, unlike a time capsule (Murphy 1983:66). Shipwrecks parallel terrestrial archaeological sites in that they can produce a great deal of information even in scattered or absent circumstances; what a wreck site may lack in comparison to terrestrial archaeological sites is stratigraphical sequencing (Murphy 1983:76). Transformational factors are apparent on shipwrecks, and the "nature of dispatch and deposition are important in the formulation of the wreck site" (Murphy 1983: 76). The complex issue of the extent of natural, environmental impacts on site formation processes has been raised by various disciplines, but to date Muckleroy (1977, 1978) has been able to classify wrecks by "isolating environmental attributes relevant to wreck preservation" (Murphy 1983:77).

Additionally, historic hurricanes have been well-documented, especially in the last few centuries with technological developments increasing sound observations; but even before satellites and computer modeling, ships' logs, newspapers, and lighthouse stations kept weather records as evidence of catastrophic and disastrous events. Historical data, such as ships' logs, have been used to reconstruct weather patterns during the nineteenth century and even earlier (Wheeler 1988:122). These logs, usually obtained from Captains', Masters', or Lieutenants' books, "have been used to provide a quantitative framework for the preparation of a long record which is designed to demonstrate the general nature of the climatic history and to enable the analysis of trends, extremes and other statistical meteorological attributes of the location to which they relate" (Oliver and Kington 1970:520).

Archaeologically, the remnants of structures such as buildings or piers, present evidence of past environmental catastrophes. However, lack of such evidence may also be indicative of these disastrous events as well; considering the dynamic coastline of North Carolina and the potential of strong storms to transport materials, surface evidence may be unlikely, even in areas with historic documentation of occupation for economic, domestic, or periodic purposes. Taphonomy, the process through which the archaeological record is created, produces a slow-moving stratigraphic structure (Dawdy 2006:719). Disasters occur at the intersection of culture and nature, each in turn affecting the constitution of the other over several different time registers. Grand-scale environmental studies have been cautious in identifying the taphonomic evidence of natural disasters and their link to cultural context, some even suggesting that disasters are taphonomically invisible. However, sudden event studies have been successful and detailed in their taphonomic identifications, typically due to the type of disaster and the impacts they leave. Short term disasters, or those of a more contingent than chronic nature, "should also be visible taphonomically within particular sites. Floods (whether caused by high rainfall, tsunamis, or hurricanes) usually leave clear depositional signatures on archaeological sites, yet rarely are these interpreted as anything more than chronological aids" (Dawdy 2006:727). Coastal zones are extremely "susceptible to erosion from a variety of natural and human-induced processes, including…tropical storms…Individually, or in concert, these processes can cause extensive damage to both terrestrial and submerged sites and in some cases, completely destroy evidence for past human occupation" (Fitzpatrick et al. 2006:251).

*Conclusion*

Ascher (1961: 324) argued that it is impossible for archaeologists to conceive of the true remains of a once living community stopped at a specific moment in time, and the 'Pompeii premise' was an erroneous notion in archaeological literature. It is seen as a matter of fact by many that the rate of deposition for an archaeological site is much slower than the rapid sequence of events for the lives of the peoples associated with a given site, and at best, the archaeological record

> Represents a massive palimpsest of derivatives from many separate episodes. Any structure and repetitive pattern of association and co-variation must derive from the operation of 'systemic events,' or dynamics, with a much longer term, more rigidly determined organization than is true of the observed (Binford 1981:197).

Schiffer (1976) proposed that to face the inferential challenges of the archaeological record, we need to understand the source or causes for the remaining properties in the archaeological record, and keep in mind the difference between dynamic context and the archaeological, or static, context. It has been argued that although it would be nice if sites were like Pompeii, they do not have to be in order to yield important, unique, behavioral information. Many cultural and non-cultural formation processes contribute to the makeup of archaeological sites, and "until the effects of the processes are systematically investigated and methods are found for taking them into account, one cannot readily evaluate, much less accept, the previous behavioral and organizational influences" (Schiffer 1985:19). Non-cultural formation processes, such as hurricanes, can create and manipulate archaeological sites, whether shipwrecks or settlement sites. These sites, when examined as a whole rather than individual components, can provide information on expression of and changes in the social, economic, and cultural use of a maritime landscape that emphasizes the land-sea interface. In turn, these wider relationships are influenced by catastrophic phenomena that cause short- and long-term transformations that are visible in the archaeological and historical record.

# CHAPTER 3: TALE OF A GALE…

## HISTORY OF SEVERE WEATHER EVENTS

North Carolina has had a long and intimate relationship with severe weather events. These events have been historically documented for the state since approximately the fifteenth century, and explorers have witnessed these events along North America's coasts since the time of Columbus' first expedition (Ludlum 1963:1-10). Subsequent centuries have seen regularity in the occurrence of severe weather impacts along the coast and Outer Banks of North Carolina, and with European settlement and development in North America, documentation of historic disastrous weather events becomes more extensive and reliable. Later historical records, especially starting in the seventeenth century, provide an increase in detail, accounting for seasonal patterns, paths, damage, and recovery for the physical land and the communities at large (Ludlum 1963; Schwartz 2007; Hairr 2008). The continual impact of natural disasters on the coast of North Carolina, and the recent destructive force of several notorious weather events, has prompted a discussion of the effects of the events on the land and the community. With this in mind, the history of severe weather events in North Carolina is detailed in this chapter with respect to research questions that  relate to the correlation between weather disasters and the settlement, occupation, and abandonment of lands in eastern North Carolina. This also requires looking at the major impacts of natural disasters on North Carolina's coastal communities since the seventeenth century and the reflection of the disaster landscape in the distribution of occupation and shipwreck locations. Additionally, the factors (social, economic, environmental) that have determined site loss or survival and influenced human decision-making to continue land occupation and maritime trade in disaster-impacted areas of eastern North Carolina are taken into account along with the effects of major weather events on site formation processes in order to facilitate an understanding of the dynamics of coastal environments and their associated communities. Events are represented in chronological order; as such, some occurrences may not be detailed here as there was not enough information to understand the event's effect or the event was recorded as having no effect on North Carolina's coastal communities.

### *Early North Carolina Hurricanes*

Hurricanes have long been considered a fact of life in the Carolinas. The formation of North Carolina includes a 175-mile long chain of barrier islands, a vast estuary of sounds fed by river systems and creeks, navigable inlets, and three capes with associated shoals. North Carolina has a unique geomorphology and is predominated by specific and distinctive ocean currents and storm patterns. The Gulf Stream is the predominant current of the Atlantic Coast, following northbound along the Straits of Florida to Cape Hatteras, at which point these warm waters turn eastward. Additionally, a southern extension of the Labrador Current approaches North Carolina with colder water from Greenland. The interaction of these two currents creates unstable weather conditions and the Atlantic Storm Track. Hurricanes and tropical storms, which typically occur from July to October, are the most powerful of the storm systems for North Carolina, resulting in numerous lost vessels, lives, and communities. These storm patterns have physically shaped the coast and have also had a "direct impact on settlement patterns, coastal navigation, and the occurrence of shipwrecks" (Lawrence 2008:2-6). Natural event systems such as these appear to make some places or areas more vulnerable to disaster and natural hazards than others (Cutter 2001:13). With the lengthy, exposed coastline protruding into the Atlantic Ocean and reaching to the Gulf Stream, "there is little wonder that these tempests have visited the land since before there was a North or South Carolina. Hurricanes have literally shaped the land along [the] coast, and in a sense, the people as well" (Hairr 2008:7).

Records of severe storms and hurricanes "are widely scattered throughout the history of colonial North Carolina" (Barnes 2001:34). The first European explorers to the North Carolina coast often encountered violent hurricanes. Giovanni da Verrazano sailed to the coast in 1524, and "on the XXIIII day of February…went through a storm as violent as ever [a] sailing man encountered", afterward charting the first shoal of North Carolina, naming it Cape Fear (da Verrazano 1524; Barnes 2001:34, 2003:68). When these Europeans first attempted to found settlements along the coast, they quickly learned about the frequency and intensity of these storms. For Sir Francis Drake, in returning to England to garner aid for the dwindling colony, "a great storm arose, and drove the most of their fleet from their anchors to sea" on the Outer Banks in June of 1586 (Cayley 1806:77; Hairr 2008:9-10). Throughout the next two centuries, settlements developed along the Carolina coast as did the records of hurricanes affecting colonial settlements. As these centuries passed and settlers learned more about their new homeland, they experienced these storms on such a regular basis that they became accustomed to them, eventually calling them equinoctial storms (Hairr 2008:10).

Only three recorded hurricanes are known to have affected North Carolina during the seventeenth century, all occurring within a four year period (Barnes 2001:35; Hudgins 2007:3). On September 6, 1667 a great storm passed directly over the Outer Banks, destroying tobacco and corn crops as it passed into Virginia. Rain is said to have lasted for twelve days (Barnes 2001:35; Hudgins 2007:3) Again in 1669 and 1670, the northern Outer Banks felt the fury of severe hurricanes (Hudgins 2007:3). The high colonial period of North Carolina saw numerous and increasingly devastating hurricane activity. Several early storms were chronicled in June, "the earliest striking in June 2, 1825. Only a handful of late-season storms have hit in November and December. The latest recorded storm moved out of the Caribbean and struck the North

Carolina coast on December 2, 1925” (Hairr 2008:10). Many records account for shipwreck losses, property damage, and geographic changes. With the eighteenth century there comes a greater frequency of recorded hurricane activity along the North Carolina coast, striking Cape Fear and the Outer Banks in varying intensity. Some years see gaps in hurricane activity while other seasons see devastating continual blows to the coastal regions of the State. Many rose up from South Carolina where they caused massive damage and numerous deaths, only to peter out in North Carolina, causing only a shift in tides; however, others targeted North Carolina’s capes and barrier islands, directly aimed at coastal communities causing wind damage and flooding.

With the aforementioned information in mind, the following is a chronological list of the severe weather events, excluding nor’easters, that affected North Carolina during the colonial period, or the eighteenth century. These early storms are rarely named, but state records and personal accounts often provide details about the type and severity of destruction and the response to these hazardous events.

*September 1713*

This storm affected Charleston, South Carolina with its greatest violence while striking the Cape Fear region of North Carolina, driving ships from their anchors and pushed far inland such as a sloop that was driven three miles over marshes into the woods (Catesby 1731: ii; Hudgins 2007:3).

*August 1728*

August brought a storm damaging Charleston and bringing destruction as far north as Ocracoke, where many ships were lost (Hudgins 2007:3).

*October 1749*

A "severe hurricane moved through the middle Atlantic coastal waters, and caused damage as far south as Ocracoke [i.e. it could have hit at Hatteras or been an extratropical storm from the north], where nine ships are said to have been lost. Very high tides were reported on the Outer Banks" (Hudgins 2007:3). The *Pennsylvania Gazette* (1749:2) reported the loss of sloop of Captain Kellog, where each person on board was drowned and "great damage has also been done…otherwise, by drowning of cattle, hogs, &c." Not only were vessels lost at sea but two ships were driven over the bar, sinking five miles northward when the tide rose (Ludlum 1963:23).

*August 18, 1750*

Referred to in colonial accounts as the "Great Storm of August 18, 1750," this hurricane was responsible for wrecking or driving five ships of the Spanish Flota on the North Carolina coast, resulting in the loss of millions of dollars in silver (*Pennsylvania Gazette* 1750; Saunders 1968a [5]:1031). This storm was also responsible for cutting new inlets through the barrier islands (Barnes 2001:35; Hudgins 2007:4).

*September 1752*

September saw the first of several storms in 1752; at the end of the month into early October, an infamous hurricane destroyed many ships, such as a schooner out of Virginia and a sloop out of North Carolina, but the storm was remembered for its flooding and destruction of the Onslow County seat, Johnston, when its full fury hit the New River, destroying the courthouse, and forcing the residents to abandon the town to a new location farther inland (*Pennsylvania Gazette* 1752; Hairr 1996: 36; Barnes 2001: 35; Hudgins 2007: 4). Several other houses were destroyed, many trees torn up, corn destroyed, and seven or eight people killed

(*Boston Evening Post* 1752). In addition to the destruction at Johnston, Beacon Island, a two mile stretch of sand was said to have completely disappeared under the intense waves, while heavy rains fell throughout the Cape Fear region causing flooding (*Virginia Gazette* 1752; Saunders 1968a [5]:596). Five additional storms were recorded to have caused some minor damage in September 1753, October 1757, August 1758, May 1761, and June 1761 (Hudgins 2007: 4).

*September 23, 1761*

A hurricane of great intensity raked the southern coast of North Carolina, causing much damage at sea and on shore. Numerous ships were wrecked and property destroyed, but most recounted was where the "sea forced a passage through a neck of land called Bald Head," forming new inlet at a place called the "Haul Over", between Cedar House and Bald Head, which was eighteen feet deep at high water and nearly a mile wide. This inlet remained open for more than 100 years (*Pennsylvania Gazette* 1761; Barnes 2001:36; Hudgins 2007:4).

*September 6-7, 1769*

Reports of this devastating hurricane spoke of the unprecedented tides and winds in the region of Smithville (now known as Southport) to New Bern, where the colonial towns of Brunswick, New Bern, and Edenton, all on estuaries, "appear to have been very close to the path of the great storm and suffered immense damage" (Ludlum 1963:48). Newspapers also displayed accounts of extreme damage done along the North Carolina coast to agriculture, structures, and vessels:

> The corn is laid level with the ground, and much of it destroyed; the fodder is entirely gone. What tobacco was in the fields is quite spoiled, and that in houses by their falling, and the deluges of rain which poured into them, greatly damaged, which may likewise be said of the wheat…many old houses were blown down, and a number of trees…All the wharfs [sic] in that Town (Edenton) are demolished, many small craft

> drove ashore, and several houses thrown down (*Pennsylvania Gazette* 1769).

Information comes primarily from New Bern, the colonial state capital, where the storm destroyed the banks of their two rivers, and many of the buildings and residences (Barnes 2001: 36; Hudgins 2007: 5). An extract of a letter from New Bern appeared in the *Pennsylvania Gazette* (1769) detailing the "horrors of the hurricane" befalling the crops, ships, warehouses, and dwellings. Additional letters from Governor Tryon, the state proceedings, and parish priests particularize the fury of the storm which caused damage to commodities (i.e. rum, sugar, wine, Indian corn, and rice), destroyed warehouses, wharves, homes, and took the lives of several women, children, and slaves at New Bern (Saunders 1968b [8]:71, 73-75, 89, 92, 159-160). The Brunswick County Court House was also destroyed (Schwartz 2007:41).

*September 1772*

The *South Carolina Gazette* (1772) reported a violent hurricane in eastern North Carolina in September of 1772 bringing a high tide and damage to shipping. At Ocracoke Bar 14 of 15 vessels were driven ashore and perhaps 50 people perished.

*September 1775*

The Independence Hurricane of 1775 is considered one of North Carolina's most lethal historic storms, claiming at least 170 lives, wrecking numerous ships, and devastating the land as it passed to the east and came ashore toward Cape Lookout or Cape Hatteras (Hairr 2008:21-30). The effects of this storm were particularly lethal at Ocracoke Inlet, where "upwards of 100 dead bodies had drifted ashore," and Pasquotank County required government funding to replace damaged corn crops (*Edinburgh Evening Courant* 1775; Ludlum 1963: 26; Hudgins 2007:5).

*August 11, 1778*

New Bern again suffered a violent gale with high winds and heavy rains; many vessels were damaged at Ocracoke Bar and feed supplies were ruined (Clark 1968[13]:456; Hudgins 2007:5). The effects of damage to corn, tobacco, and fodder were felt later in the fall season when "corn advanced to an inflationary price of 50 shillings a bushel" due to the hurricane (State Records of North Carolina 13:490; Ludlum 1963:50).

*October 1783*

Reports indicate a hurricane center passed northward through eastern North Carolina, with extreme damage near the Wilmington-Cape Fear region, damaging buildings and trees (Hudgins 2007:6). In this area, valuable stores of salt were damaged due to storm tides (Ludlum 1963:51).

*September 1785*

A hurricane passed over Ocracoke Bar at the entrance to the Pamlico Sound (Hudgins 2007:6). The major breach in the dunes allowed flood tides to drive water far inland, drowning cattle and forcing people to seek shelter in the trees (*South Carolina Gazette* 1785; Ludlum 1963: 30).

*July 1788*

Widespread damage was caused to North Carolina's central coast as a hurricane eye passed over Cape Hatteras. Newspaper reports indicated six vessels destroyed, eleven driven ashore, and two dismasted at Ocracoke Inlet. Other reports listed 22 out of 30 ships dismasted, while many vessels were stranded in the Pamlico Sound as the northeasterly gale forced the waters out of the sound (*Pennsylvania Journal* 1788; Ludlum 963: 30; Hudgins 2007:6). A list of vessels lost at sea, driven ashore, or dismasted by this hurricane was given to Captain Caleb

Green by Captain Coffin and published in the *Pennsylvania Gazette* (1788). High winds tore up trees and removed houses, chimneys, and fences. The cotton crop suffered little, but tobacco did not meet a favorable end; many plantations along the coast were inundated (*Wilmington Centinel* 1788).

*August 2, 1795*

A hurricane, whose effects were severe in the Cape Hatteras-Ocracoke area, drove eighteen vessels of the Spanish fleet on the Cape Hatteras shoals (Hudgins 2007:6). Vessels were driven ashore at Ocracoke Bar and the ports of New Bern and Washington experienced damaging high tides (*North Carolina Journal* 1795). Corn was leveled and due to heavy rains, the Roanoke River experienced flooding (Ludlum 1963:34).

*September 5, 1797*

This hurricane caused damage along the entire North Carolina coast, and caused the loss of a sloop as far north as Currituck Inlet (Hudgins 2007:6).

### *Nineteenth Century Hurricanes*

The nineteenth century saw numerous severe weather events that caused devastating destruction to ships and land sites alike. Much of the information is centered on a select few storms that caused the most severe damage. Many other accounts come from the records of ships lost, driven ashore, or damaged due to hurricane activity. Many storms that were reported to have caused major damage at Charleston, South Carolina were assumed to have caused damage to the North Carolina coast as well; however, detailed reports of these storms in relation to North Carolina are lacking. At this point, we must take into account more complete records and dramatic changes in the settlement and society of North Carolina during this time period.

*September 1804*

The gale of September 1804 was first felt severely in South Carolina, but moved north toward Wilmington where the extent of the hurricane's path and damage becomes unclear except for a few accounts. As far as 100 miles from the coast, trees were blown down from the gale's winds, while near the "entrance to Cape Fear river a brig, the Wilmington Packet, was cast away on Bald Point during the height of the blow after striking Frying Pan Shoals" (Ludlum 1963: 55).

*Twin Hurricanes of 1806*

The first storm of this year made its landfall on the North Carolina coast on August 22, 1806, near the mouth of the Cape Fear River. As Wilmington and Smithville stand exposed where storms recurve to the north/northeast, they were at risk for this storm. At Smithville several ships were damaged, property destroyed, and riverbank wharves ruined. Additionally, strong winds and high tides broke through New Inlet near Smithville (Ludlum 1963: 56). Upriver at Wilmington where the center passed, the storm caused widespread destruction to good stores and buildings. The United States Revenue Service Cutter *Governor Williams* was dismasted and driven ashore near Bald Head Island. The center of the storm passed over New Bern, but damage was not extensive (Hairr 2008:32-34).

Many vessels were wrecked on North Carolina's shores due to this storm; many were unidentified due to the severity of the wreckage. However, *Adolphus* and *Atlantic* were identified on the Bogue Banks (Hairr 2008:36). A month later, 1806's second hurricane hit near Ocracoke Inlet, causing damage and destruction to much of the Outer Banks. Destruction was extensive to the buildings and ships at Shell Castle, including the previously dismasted *Governor Williams*, and the U.S. Revenue Service Cutter, *Diligence*. Hatteras experienced the full extent of this

August storm, with damage to the lighthouses at Beacon Island and Cape Hatteras (Hairr 2008:36).

*September 3-4, 1815*

The Great North Carolina Hurricane is often confused with another devastating storm that struck New England in the same month, but this hurricane moved northward to the east of Wilmington, causing only a glancing blow to Brunswick and New Hanover counties, passing close to New Bern and Elizabeth City (Hudgins 2007:7). It ravaged the coasts of South and North Carolina, "blowing down fences, crops, and moveables in the country and sweeping vessels, ware-houses and wharves into ruin" (*Scioto Gazette and Fredonian Chronicle* 1815). The storm caused great damage to Onslow. Additionally, "shipwrecks littered the sandy shores from Cape Fear to Currituck [,] inland crops were drowned, forests flattened, grist mills carried away and roads washed out from Wilmington to Washington" (Hairr 2008:41).

The saltworks on Masonboro Sound, which had only been in operation for two weeks, was destroyed, losing three hundred bushels of salt (*Star* 1815:3). Adjacent barrier islands suffered extensive damage, as well as land in the vicinity of Topsail Island and Swansboro, where damage was estimated at $60,000. Numerous wrecks were reported, such as a schooner near the mouth of New River, wrecks at Beaufort, along Shackleford and Bogue Banks, upon the beaches in the vicinity of Ocracoke (more than 30 vessels were wrecked near Ocracoke, including *Julia*), and near Cape Hatteras (Hairr 2008:44-46).

The Neuse River rose into the city of New Bern, pounding parts of it to rubble as it rose about 12 feet above normal water mark (*Scioto Gazette and Fredonian Chronicle* 1815). The streets were impassable by trees, and buildings were carried by the high tides (Ludlum 1963:112-113). Parts of Fort Hampton, on the eastern end of Bogue Banks were inundated (Hairr 2005:26).

At Beaufort the tide rose four feet higher than any previous known level, and every vessel at Ocraocke Inlet, some 20 in total, were driven ashore (Ludlum 1963: 113).

*September 2-3, 1821*

This fast-moving hurricane came up from Puerto Rico, crossing North Carolina near Cape Lookout, causing considerable damage at Morehead City (Hudgins 2007:8). Winds from this storm raged across the Pamlico and Albemarle Sounds. The center passed over the bay and swamps of eastern North Carolina just inside Cape Hatteras, exposing island settlement to severe winds and tides. At Currituck Island, all but six houses were blown down and several people killed. On Lake Mattamuskeet, 70 houses were destroyed from the winds (*Edenton Gazette* 1821; Ludlum 1963:82-82).

*June 3-4, 1825*

This early, widespread hurricane caused high tides at New Bern and Adams Creek. The high tides at Adams Creek caused heavy losses to crops and drowned cattle, as well as engulfing fields and barns (*Saturday Evening Post* 1825). Along with considerable damage at New Bern's waterfront and inundation of coastal plantations near the South River, more than twenty vessels were driven ashore at Ocraocke, twenty-seven near Washington, and dozens more from Wilmington to Cape Lookout (Barnes 2001:36; Hudgins 2007:8). The heavy gale blew over Elizabeth City, uprooting trees and causing severe damage to the commercial center (*Star and Intelligencer* 1825).

*November 17-18, 1825*

In this late season hurricane, five or more persons were lost, and the schooner *Harvest* was wrecked on the North Carolina coast near Nags Head (Hudgins 2007:8).

*August 24-25, 1827*

The Great North Carolina Hurricane of 1827 struck the coast at Cape Hatteras from the Windward Islands. In the Wilmington area, damage was extensive; winds and storm surge widened the inlet at Masonboro Sound by half a mile and dozens of vessels were driven ashore along the Cape Fear River. At New Bern and Washington, the effects were severe, especially to waterfront shipping when the town's port facilities and docks were destroyed. Losses to shipping at Ocracoke were not as extensive, although some vessels were grounded there, and at least twenty washed ashore near Portsmouth. Ships from all over the world were scattered along the North Carolina coast from Cape Fear to Currituck, such as *Amphibious* and the famous Diamond Shoals Lightship (Ludlum 1963:120; Hairr 2008:50-53).

The high water at Wilmington rolled over garden fences as far as 600 feet from the beachfront and was estimated to be ten feet above normal high water mark (*Wilmington Recorder* 1827). Near Cape Hatteras two packets were driven ashore and completely destroyed in the breakers, while the inlet at Masonboro Sound was widened by a half-mile (Ludlum 1963:120).

*August 15-17, 1830*

This storm damaged many vessels and blew others from their moorings at New Bern. High tides rose in the Wilmington area, and many vessels were driven ashore on the south coast of Smithville as well as two houses blown down. Additionally new jetties were swept away in this area by high tides. In the Albemarle Sound Region, the storm wreaked havoc on shipping in the bays and rivers, and spreading destruction to buildings and crops, such as were damaged at Edenton (*New York Mercury* 1830; Ludlum 1963:88; Hudgins 2007:9).

*September 4, 1834*

A small hurricane came inland near the North Carolina-South Caroling line, where Wilmington received the full brunt of the storm's impact. There numerous ships were seen to be in distress while others were beached in the vicinity (Ludlum 1963:122). Heavy rains produced flooding in the Cape Fear and Neuse Rivers (Hudgins 2007:9).

*1837*

Three significant storms hit North Carolina between August and November of this year. In August, a hurricane inundated the coastal region, coming ashore near Wilmington, bringing "tremendous rains to the region," cresting rivers to record levels (Barnes 2001:37). In additional to uprooting trees and overwashing streets and bridges, the storm effects created "two new inlets opposite M'Rae's on Peden Sound" (Ludlum 1963:127). All bridges between Wilmington and Waynesboro (now Goldsboro) were destroyed, and a brig was driven ashore at Smithville. In October, a hurricane dubbed "Racer's Storm" moved across the Gulf states into the Atlantic. As it covered the Outer Banks, it sank numerous ships, including the passenger steamboat *Home* near Ocracoke, *Cumberland* at Core Banks, and *Enterprise* at Bodie Island (Barnes 2001:37; Hudgins 2007:9). Near Wilmington and north of the storm track, the cotton crop suffered severe devastation (Ludlum 1963:146). Two weeks later, another storm fell at Hatteras.

*August 28-30, 1839*

This hurricane passed just offshore of Cape Hatteras, bringing flooding to Elizabeth City, and damage to twelve of the fifteen vessels anchored at Ocracoke (Hudgins 2007:10). When the wind shifted on the 29$^{th}$, the piled-up waters of the Albemarle Sound were driven back over the low-lying islands of the Outer Banks. Also on this day the height of the storm passed over

Elizabeth City, downing trees and putting out bridges that closed the operating stages into Norfolk (*Phoenix* 1839; Ludlum 1963:90).

*1842*

This was another year that saw multiple destructive hurricanes. In July, a devastating hurricane swept the entire coast with the most force in the Portsmouth-Ocracoke area, where crops were ruined and numerous unnamed vessels were lost. Many livestock were drowned and houses swept away on the Outer Banks. The entire village of Portsmouth Island was wrecked with the exception of one building. Fourteen vessels were stranded near Ocracoke Inlet, while two other unknown vessels were broken to pieces upon the Diamond Shoals (Stick 1952:45; Barnes 2001:37; Hudgins 2007:10). On the Pamlico River at Washington, high tides flooded the streets while rough winds felled trees (*Republican* 1842). On an arm of the Albemarle Sound near Edenton, "the floating bridge at Hertford was carried away, the mail packet washed high and dry, and severe crop damage inflicted on farm areas. All vessels at the Edenton anchorage except one were driven from their moorings and piled up on shore" (Ludlum 1963:129). The railroad from Wilmington to Raleigh was also washed out disrupting the flow of mail for five days (*New York Tribune* 1842).

In August, a similarly severe hurricane struck the same area causing the loss of eight persons and the brig *Kilgore* at Currituck, *Pioneer* at Ocracoke, and *Congress* at Cape Hatteras (Barnes 2001:37; Hudgins 2007:10).

*1846*

This year saw an equally devastating hurricane as in previous seasons. In September, a slow-moving and intense storm caused a pile up of an unusual amount of water in the sounds, flooding rivers and creeks inland. The winds then shifted piling water onto the Outer Banks and back over into the ocean. Furthermore, the schooner *Mary Anne* was lost off Hatteras as well as driving 20 ships driven ashore or out to sea at Ocracoke Inlet (*Newbernian* 1846; Barnes 2001:37; Hudgins 2001:10). Additionally, the small community of Hatteras south of the Cape was exposed to the full force of the hurricane, where all but six houses were destroyed (Ludlum 1963: 131). Throughout the Outer Banks, tides rose to destroy homes, hotels, and warehouses, while in other places such as the Perquimans River, waters became too low (*Edenton Sentinel* 1846).

The severe hurricane of 1846 is particularly well known for the creation of two new inlets that became important major commercial inlets for the Outer Banks. To the south of Cape Hatteras, a new Hatteras Inlet between Ocracoke and Hatteras Islands "provided a new entrance into Pamlico Sound, while to the north, Oregon Inlet, so named for the first ship to pass through, split Bodie Island below Nags Head for a more direct route to Albemarle Sound ports" (Ludlum 1963:131).

*1850*

In July and August of this year gales from hurricanes caused tremendous damage; the railroad bridge over Quankey Creek was blown down, as were many corn crops. The schooner *H. Wescott* was driven ashore at the entrance to Cape Fear, and a pilot boat sank after colliding with a storm near Southport (Hudgins 2007:11).

*September 7, 1853*

A hurricane passed off Cape Hatteras, causing heavy rains in the southern coastal section of North Carolina, and the loss of a brig off Cape Hatteras (Hudgins 2007: 11).

*1856*

On August 19, a tropical storm developed southeast of Cape Fear and moved inland across Carteret County and the southern Outer Banks. The storm was accompanied by heavy rains (Hudgins 2007:11). In late August, early September, a "perfect tempest" accompanied a hurricane to the Wilmington area, "packing destructive winds, heavy rains, and an unprecedented storm surge" (Hairr 2008:55). Crops were destroyed by flooding, and the live oak coverage on Wrightsville Beach was washed away (Barnes 2001:38; Hudgins 2007:11-12).

*September 9-12, 1857*

One of the most violent storms of the time period, this hurricane was most severely felt near Cape Hatteras on the 9-10, and elsewhere by the 11-12. The storm was violent at Wilmington, and the tides rose above wharves into the streets at New Bern (Hudgins 2007:12). This storm was especially disastrous for steamers plying the coast between northern and southern ports; "two of them, the *Central America* and the *Norfolk*, were totally lost; and three others, the *Columbia*, the *Empire City*, and the *Southerner* were barely to have escaped a like fate" (*Virginia Free Press* 1857; *New York Times* 1857:1). Additionally, the bark *John Parker*, bound for Rotterdam from New Orleans, went down with a cargo of hides, tobacco, and staves worth $60,000 (*Virginia Free Press* 1857).

*September 27, 1861*

A fast-moving category one hurricane came ashore near Wilmington. Little information is available (NHC 2010).

*November 1861*

Just after the battle at Fort Sumter and the beginning of the American Civil War, a "terrific gale" off Cape Hatteras scattered seventy-five vessels of the Union Navy, sinking at least two and wrecking one or more on the coast to be salvaged by the Confederates (Stick 1952:51; Ludlum 1963:101; Barnes 2001: 38; Hudgins 2007:12).

*August 18-22, 1871*

This prolonged storm brought high tides and heavy rains and winds to the Wilmington area. The effects were most severe at Smithville, where houses were rocked, trees downed, and two schooners capsized and sank (Hudgins 2007:12).

*September 19-20, 23-24, 1873*

Although these two storms of similar paths passed in succession through North Carolina's coastal waters, neither seemed to have direct effect on the state with the exception of a severe squall and tornadoes at Cape Fear and near Wilmington (Hudgins 2007:12-13).

*September 28, 1874*

The center of this hurricane passed to the west of Wilmington, where destruction was great; at places the waves of the Cape Fear River were above the wharf. The storm was reported to be disastrous at Smithville, with several houses blown down, warehouses destroyed, and the Oceanhouse demolished. Telegraph lines, railroad bridges, and thirty-three percent of the rice crops were damage. The Spanish barque *Arrina* was blown over in ten fathoms of water (Hudgins 2007:13).

*September 17, 1876*

A severe hurricane struck near the North Carolina-South Carolina border. The full fury of the "Centennial" storm struck Wilmington, uprooting trees, moving buildings, and washing away bridges (Schwartz 2007: 68). Water rose high in the sounds. There was also great damage at Masonboro Sound, Wrightsville, Smithville, and Brunswick, but the impact went beyond the Cape Fear region. The military camp at New River in Onslow County was destroyed by high tides, and two men drowned. The British bark *Excelsior* was driven ashore two miles below Wilmington, where many ships were lost and a Captain C.C. Morse lost 1,400 terrapins at Wrightsville (Barnes 2001:40-42; Hudgins 2007:13). Intelligence continued to reach other countries into the next few months of the extreme damage done by this hurricane; reports of dismasted ships, foundered vessels, and floating cargo off Cape Lookout and Cape Hatteras were brought to the northern states by ships that barely escaped (*The Belfast News-Letter* 1877).

*September 29, 1877*

This slow-moving storm was severely felt from Cape Lookout to Cape Henry, Virginia. In Wilmington, heavy rains caused flooding and swollen streams (Hudgins 2007:13). In October of the same year a long-lived and violent hurricane moved northeast of the North Carolina mountains "causing a terrific storm in the vicinity of the Albemarle Sound" (Hudgins 2007:14). Floods carried away bridges and wharves and destroyed crops. The steamship *Magnolia* foundered off Hatteras (Hudgins 2007:14).

*1878*

An early hurricane struck North Carolina in January of this year; (this storm is most likely a nor'easter given the time of year). The steamer *Metropolis* was driven ashore off Currituck Beach near the Kitty Hawk signal station, with nearly two hundred lives thought to be lost (*New York Times* 1878:1). An additional two hurricanes moved through North Carolina in September and October of this year. In the former, many ships were wrecked or disabled. The "Great October Gale" moved inland between Wilmington and Morehead City, and struck the Outer Banks with full force, likely as a Category Three (Schwartz 2007:73). The steamer *City of Houston* was lost on Frying Pan Shoals, as many other vessels were damaged or lost along the entire coast (Hudgins 2007:14).

*August 18, 1879*

Dubbed the "Great Beaufort Hurricane of 1879", or the storm that ruined Carteret County, this storm left a seldom unequaled path of destruction along the Carolina coast (Arthur 1992). The storm brought heavy rains and catastrophic winds, when it made landfall in the region of Topsail Island and Swansboro. Shipwrecks were reported along the coast that included *North Carolina*, *Marion Gage*, *Arietta*, and *Lorenzo* (Hairr 2008:70-71). The storm was particularly damaging in the Morehead City-Beaufort area from where the State's vacationing Governor was forced to flee and two hotels were destroyed, 1,000 feet of railroad torn up, and windmills, wharves, churches, shops, and homes destroyed (Barnes 2003:70; Schwartz 2007:80). The Atlantic Hotel,

> The largest hotel in that part of the country, was entirely demolished, not a vestige being left. There were 150 guests in it, and there was not a particle of clothing saved by any of them. The people did not begin to leave until the waves were literally breaking the hotel to pieces, and then there was a stampede. The young men saved all the ladies and children at great danger to their own lives. All the baggage, furniture, etc., went to destruction. John Hughes, a son of Mayor Hughes, of Newbern, lost his life in the wreck of the Atlantic [Hotel]. The front of Beaufort is strewn with lumber, trunks and goods, and crowds of people…The Ocean View house, the only other hotel in Beaufort, is damaged badly. Many private houses are ruined. There is not a wharf left in Beaufort, and only two or three of the hundreds of sail boats are fit to sail in (*Rocky Mountain News* 1879).

On the Outer Banks, the storm caused great destruction to Diamond City and Portsmouth (Barnes 2001:43; Hudgins 2007:14). The hurricane's "storm surge opened at least two inlets on Bogue Banks, just west of Fort Macon…Beaufort Inlet was reshaped, as almost eight hundred yards of sand were washed way on the western end of Shackleford Banks (Barnes 2001:45).

*September 9, 1881*

The center of this hurricane struck near Smithville and curved across the Wilmington-Wrightsville Beach area. At Smithville damage was done to trees and buildings, and "all pilot boats in the harbor were sunk, and loaded vessels driven ashore" (Barnes 2001:46; Hudgins 2007:15). At Wrightsville, the tide washed over the turnpike, and at Wilmington, damage was estimated at $100,000 (Hudgins 2007:15).

*1882*

This year's season was active all across North Carolina. In early September a gale blew at Wrightsville Beach and Masonboro Sound, causing heavy rains and high tides. A possible tornado destroyed crops and house at Topsail Beach (Barnes 2001:46; Hudgins 2007:15-16). In late September, a tropical storm moved near Cape Lookout, causing extensive damage to crops and bridges. The Wilmington and Weldon Railroads suffered damage, and a train was smashed when it ran into a washout (Barnes 2001:46; Hudgins 2007:16). In a few hours, rainfall accumulated to near eight inches, especially near Tarboro in the northern coastal plain. In October, a tropical storm paralleled the North Carolina coast. Rainfall accumulated at Wilmington with high winds (Hudgins 2007:16).

*September 11, 1883*

A major hurricane, first identified at Martinique, made landfall near Smithville bringing punishing winds to the Cape Fear region. Trees, fences, and telegraph lines were downed, crops were damaged, and wind-driven water caused flooding up the Cape Fear River. This storm was "reported very disastrous to vessels between Hatteras and Wilmington;" among the losses were several pilot boats and the Frying Pan Shoals Lightship which was torn from its anchor and came ashore near Myrtle Grove Sound (Barnes 2001:47). Many houses were unroofed, wharves washed away, fisheries damaged, and only two vessels kept anchorage at Smithville during the gale (*The North American* 1883).

*1885*

The 1885 hurricane season saw several extreme hurricane events beginning in August. The storm crossed just west of Wilmington and made an arc toward Cape Hatteras. Winds were high and extensive damage was done at Smithville, Wilmington, and Morehead City; crop destruction was severe and ships were grounded (Barnes 2001:47; Hudgins 2007:17). October brought a northeasterly to southeasterly gale along the North Carolina coast. High tides submerged the entire waterfront of Smithville. Flooding also occurred at Wilmington and New Bern, and a schooner was wrecked at Hatteras Inlet (Hudgins 2007:17).

*1886*

The 1886 season had several intense storms whose heavy rains and dangerous winds effected various regions of the State (Hudgins 2007:17-18).

*1887*

Three storms of varying strength and levels of damaged occurred in this season. In August, a rapidly moving hurricane passed east of Hatteras, being severe in the Pamlico Sound area “where many vessels were lost and houses blown down,” as were the Outer Banks telegraph lines. An early October storm did little damage to North Carolina, but its late October predecessor brought heavy winds and rain (Hudgins 2007:18).

*1888*

There were similar varying storms in October and November of this year. The former produced itinerant heavy winds. The late November hurricane passed close to shore but winds came and went rapidly (Hudgins 2007:18-19).

*1889*

September of this year saw two consecutive storms, the forces of which caused destructive gales and high tides, cutting a new (or re-opening) an old inlet at Nags Head. The latter storm brought rough winds (Hudgins 2007:19).

*1893*

During 1893, residents experienced two "great" hurricanes along the coast. The Great Hurricane of 1893 came in August, causing horrible flooding and a massive storm surge that reshaped the coastal islands. Sometimes referred to as the Sea Islands Hurricane, this storm caused evacuation from Wrightsville Beach, severe flooding at Wilmington, and tornadoes at Kernesville and Oxford. Numerous ships were lost at sea or wrecked on the coast, causing great distress to shipping; lifesaving crews helped disabled ships at Corn Cake Inlet, Southport, and Caswell Beach (*News-Observer-Chronicle* 1893; *Manchester Times* 1893). Rainfall accumulated to nearly eight inches (Barnes 2001:48; Hudgins 2007:19). The hurricane "caused much damage to the [cotton] crop in North Carolina," forcing the lowest crop yields since 1881 (*New York Times* 1893:8).

In October, another great hurricane forced itself on the southern coast of North Carolina, causing high winds and extensive crop and shipping damage. High tides and overflow in Wilmington's waterfront caused an estimated $150,000 of damage (Barnes 2001:48; Hudgins 2007:19-20).

*1894*

Two successive hurricanes in September and October caused high winds, and "schooners were reported wrecked in the Ocracoke and Cape Fear areas" (Hudgins 2007:20).

*1897*

Through September and October of this year, several small storms hit North Carolina with high winds and heavy rains (Hudgins 2007:21).

*1898*

This was a particularly uneventful hurricane season, although in October, a hurricane over Georgia's coast "caused heavy surf far enough north to wash across Carolina Beach, destroying some property there" (Hudgins 2007:21).

*1899*

The 1899 season was one of North Carolina's most destructive hurricane seasons, and saw a Category Four storm in August, dubbed the "San Ciriaco Hurricane" due to its landfall and devastation in Puerto Rico on Saint Ciriaco's Day earlier in the month (Hairr 2008:81). The storm moved northward off the south Atlantic's coast, and from Cape Lookout north along the Outer Banks, destruction was widespread (Schwartz 2007:113). Observers at Hatteras reported the entire island under ten feet of water, with piers and bridges swept away and vessels wrecked. Lieutenant C.E. Johnston of the revenue cutter service witnessed the hurricane's "frightful velocity in the vicinity of Cape Hatteras…The ocean swept over a strip of land separating Pamlico Sound from the Atlantic. Sheep, cattle, and horses…were drowned, and many houses were wrecked" (*Bangor Daily Whig & Courier* 1899). There was much destruction at Shackleford Banks and Diamond City, where "waves rolled over the sandy barrier islands, inundating the entire island and even washing away some prominent landmarks, dealing the local villages a lethal blow. After riding out the latest in a procession of fierce storms that had taken aim at their barrier island, many of the inhabitants decided to move" (Hairr 2008:90-91).

Flooding occurred throughout the coastal region, including Core Banks and Portsmouth (Hudgins 2007: 21-22).

Several ships were wrecked including the *Fred Walton* on Hog Island Shoal near Ocraocke Inlet, and *Lydia A. Willis* on Dry Point Shoals (Hairr 2008: 92). Over fifty ships were wrecked along the North Carolina coast between Cape Fear and Currituck which included the schooners *Goodwin* and *Aurora* in the Pamlico Sound, and also *Minnie Bergen*, *Aaron Reppard*, *Priscilla*, *Florence Randall,* and *Robert W. Dosey* (*Morning Oregonian* 1899; Hairr 2008:99). The Diamond Shoals Lightship was driven ashore after its mooring lines were broken by the storm's mountainous seas. Six other ships were reported lost at sea without a trace: *Beswick*, *John C. Haynes*, *M.B. Millen*, *Albert Schultz*, *Elwood H. Smith*, *Henry B. Cleares,* and *Charles M. Patterson* (*Morning Oregonian* 1899; Barnes 2001:55). *Aaron Reppard* was struck so far from shore the life savers could not reach the crew as the vessel went to pieces and crew were swept overboard; eight were rescued as they were swept toward land (*Bangor Daily Whig & Courier* 1899). Only ten mariners survived the wreck of the Baltimore barkentine *Priscilla*, and many other vessels had yet to arrive their final destinations at the time of print on August 24, 1899 (*The Washington Post* 1899:3).

The rising waters of the Atlantic met the wind-driven waters of the Albemarle Sound at Nags Head, flooding the entire area, even where the beach was over a mile wide (Barnes 2001:54). At Ocracoke Island, small craft were destroyed, horses and cattle drowned, 30 houses and two churches demolished, and the Norfolk & Southern railway piers washed away (*Morning Oregonian* 1899). Reports showed that a large number of lives were lost—as many as 60 lost their lives in the storm including 14 fisherman drowned trying to cross the Pamlico Sound in skiffs and 20 fisherman off Ocraocke Island (*Morning Oregonian* 1899). The greatest loss of property was said to be of the crops on the mainland which amounted to a half million dollars (*Labor Advocate* 1899). At Durant's Station, 300 bales of cotton and 200 cords of oak staves washed ashore along with the bow of a vessel believed to be the steamship *Agnes* and two bodies (*Bangor Daily Whig & Courier* 1899).

October of the same year brought a category two storm battering the Cape Fear coast on Halloween Day. The hurricane struck the Brunswick beaches causing massive damage and destruction, especially in the vicinity of Southport, Wilmington, and Wrightsville Beach (Barnes 2001:57). Ocean waves broke over into the Banks Channel. At Wrightsville Beach, water was eight feet above normal tide. Cape Fear was flooded, overcoming wharves in Wilmington, and also in New Bern, Morehead City, and Beaufort. Destruction at Carolina Beach was equal to that at Wrightsville, and near Southport several vessels were wrecked (e.g. *Johannah*, *Southport*) (Barnes 2001:58-61; Hudgins 2007:22). Additionally, "Old Stump Inlet, said to have been closed for more than a generation, was reopened by this storm and was reported to have had twelve feet of water on its bar" (Barnes 2001:61).

### *Twentieth Century Hurricanes*

The twentieth century was a period of transition and development in multiple arenas, including weather tracking and understanding of how hurricanes move and develop; this included the Saffir-Simpson scale and a naming scheme that continues today. Storms continued to hit North Carolina with varying intensity, and during this century the State was dubbed "Hurricane Alley." Some of the most intense and devastating storm events in North Carolina, and even in North American history, occurred in this era. In the early twentieth century, several storms repeatedly brought strong winds or heavy rains; however, details regarding some occurrences are still scant as communication methods, such as along the Outer Banks, frequently failed during storms (Hudgins 2007:23). The bulk of the recent hurricane activity in North Carolina comes from the 1950s, which offers an example of an intense and devastating season with six storms making landfall on one year (Yocum 1998:45). But for the following 40 years, North Carolina lazed through a period of almost no significant hurricane activity, until a "double-barreled impact of hurricanes Bertha and Fran in 1996 changed that," and continued a trend through the end of the twentieth century (Yocum 1998:45).

*1904*

The first major hurricane to have hit North Carolina in the twentieth century, it brought high tides and heavy rains to the entire coast. Tornadoes were reported and high water stopped trains across the Neuse River. Extensive damage occurred at Fort Caswell and two schooners were wrecked at Cape Fear. Storm surge swept away the Life-Saving station at New Inlet, and lives were lost in the wreck *Missouri*, a schooner downed near Washington, North Carolina. Additional lives were lost at a fishing lodge on Hatteras Island and when a yacht sank in the Pamlico Sound (Barnes 2001:64; Hudgins 2007:23).

*1906*

This hurricane, making landfall near Myrtle Beach, South Carolina (producing several famous shipwrecks in this area), did considerable damage to shipping up the coast to Wilmington; Thomas Hock, the only remaining crew member of the three-masted schooner *Oliver S. Barrett*, was rescued off the North Carolina coast after the vessel turned turtle in the gale with a cargo of lumber (*The Washington Post* 1906:5). Tides were high and cottages, a hotel, and other property, including a trolley trestle, were damaged as breakers swept across Wrightsville Beach. There was also damage done at Carolina Beach and Southport (Barnes 2001:64: Hudgins 2007:23).

*1908*

In late July a storm skirted the Carolinas plying up considerable water on the North Carolina coast, south of Hatteras. This, with torrential downpours, caused flooding in the eastern counties. Wind-driven waters covered Wrightsville Beach and destroyed property there. In late August another storm caused flooding in the Cape Fear area due to high tides and heavy rainfall (Hudgins 2007:24).

*1910*

A storm of sufficient force passed northeastward off the North Carolina coast, causing high tides in the Wilmington area. There was some damage on the beaches, such as the partial destruction of a steel pier (Hudgins 2007:24).

*1913*

This severe hurricane moved inland between Hatteras and Beaufort, crossing over Core Banks into the Pamlico Sound. Due to high waters, the most severe at New Bern and Washington, great damage was done to property and crops. Railroad bridges and communication lines were downed. Several ships were wrecked or lost, including *Dewey* at Cape Lookout, schooners *Manteo* and *Grace G. Bennett* near Portsmouth, and schooner *George W. Wells* offshore Ocracoke (Barnes 2001:64-65; Hudgins 2001:24).

*1920*

This small storm passed inland near Wilmington with high winds at the Cape Fear River mouth, carrying the lightship several miles west of its anchorage. Additionally, a house was demolished when blown from its foundations in Wilmington (Hudgins 2007:25).

*1924*

Fringe effects of this hurricane brought high winds to Hatteras, and Ocracoke was partially inundated by high tides (*The Washington Post* 1924:1; Hudgins 2007:25).

*1925*

This rare late season hurricane moved inland between Wilmington and Hatteras December 2, causing high winds but only slight damage (Hudgins 2007:26).

*1928*

A severe hurricane in Florida, this September storm still brought heavy rains causing high record flooding in portions of the upper Cape Fear River (Barnes 2001:66; Hudgins 2007:26).

*1929*

Another Florida hurricane weakened as it moved across North Carolina from the southwest, causing flooding from heavy rains (Barnes 2001:66-67; Hudgins 2001:26).

*1930*

The Santo Domingo Hurricane again caused rough winds in September, and “scattered minor wind damage was reported from Atlantic Beach to Hatteras” (Hudgins 2007:26). The full force of the hurricane buffeted Cape Lookout “demolishing a dozen buildings and damaging the Coast Guard headquarters slightly” (*New York Times* 1930:11).

*1933*

This Category Three storm originated east of the Windward Islands passing almost directly over Cape Hatteras in August. High tides, severe gales, and beach erosion were reported all along the coast (Barnes 2001:67-68; Hudgins 2007:26-27). September brought a Category Three hurricane, considered one of the century’s most intense, west of Hatteras with 125 mile per hour winds at New Bern and Beaufort (Schwartz 2007:140). High winds and waves caused flooding of the Neuse and Pamlico River basins, while along the banks of the Albemarle Sound, water was blown away to the lowest level recorded. Core Banks was overwashed from east to west, opening Drum Inlet. Many small tornadoes were produced from this storm and over half of Carteret County was underwater (Carraway 2003:3). At least 21 lives were lost including Captain Jones Hamilton and his sons, the daughters of Elijah Nixon and Herb Carraway, and several other unidentified sailors and fishermen (*The Washington Post* 1933:3; *New York Times* 1933:3). There was estimated $3 million in damage done; " it was reported that in several coastal towns hardly a building was standing" (Hudgins 2007:27).

*1934*

This storm passed slightly over Cape Hatteras causing mild winds, slight physical damage, and ten inches in rainfall in the Beaufort area (Hudgins 2007:27).

*1935*

The Great Labor Day Hurricane had minimal effect on North Carolina, but little or no additional information is available (Hudgins 2007:27).

*1936*

This Category Two September storm is one of the most severe hurricanes on record at Hatteras. Damage was confined principally to the northern half of the coast, especially to crops, roads, bridges, buildings, and piers. Tides were high at Hatteras and Manteo, and some damage occurred at Elizabeth City (Hudgins 2007: 27-28). High winds "brought significant beach erosion to the coast [where] about thirty-five feet of beach was lost at Nags Head" (Barnes 2001:73).

*1938*

Although most severe in New England, this September storm brought heavy rains, gales, rough seas, and high tides to the northern coast of North Carolina (Hudgins 2007:28).

*1940*

An August hurricane drove inland from Georgia, dissipating over eastern North Carolina. Although wind damage was negligible, torrential rainfall caused “one of the most serious general river flood situations in the history of the State” (Hudgins 2007:28).

*1944*

This season saw devastating storms back to back, beginning in August 1, when a hurricane formed in the Bahamas stuck the North Carolina coast in the vicinity of Southport, whose waterfront suffered severely. The greatest reports of damage were reported at Carolina Beach, “due mainly to the unusually high tide and heavy seas which washed upon the beach and battered to pieces or undermined many dwellings and business places. Two fishing piers were demolished” (Hudgins 2007: 28). Two piers were also partially wrecked at Wrightsville Beach. Damage to corn, tobacco, and cotton was high in Brunswick, New Hanover, Pender, and Onslow counties, and total damage was estimated at $2,000,000 (Barnes 2001: 75; Hudgins 2007: 28).

Again in September a Category Three/Four “Great Atlantic” hurricane caused 900 miles of destruction along the Atlantic coast (Schwartz 2007:180). This hurricane passed slightly east of Hatteras, therefore damage to the southern coast of North Carolina was slight, while the central and northern coastal areas suffered major property and crop losses (Hudgins 2007: 28-29). The strong winds “filled the sounds with ocean water, backing up all the rivers, creeks, and marshes on the mainland side” of the Banks (Barnes 2001: 77). Heavy flooding and wind damage was reported in Avon, Elizabeth City, and Nags Head. Although numerous ships were wrecked in the hurricane's path, and even more forgotten shipwrecks uncovered, a particular set of ships has remained in memory. The Coast Guard Cutters *Jackson* and *Bedloe* both capsized and sank "approximately fifteen miles off the Outer Banks, near Oregon Inlet and the Bodie Island Lighthouse" while guarding a torpedoed liberty ship (Barnes 2001: 77; Hudgins 2007: 29; Hairr 2008: 113). In October, a tropical storm of minor intensity passed west of Wilmington (Hudgins 2007: 29).

*1945*

This season brought two Category One storms, the first late in June, with high wind gusts and substantial rain in Wilmington. A severe September hurricane produced torrential rains, causing high level flooding along the Cape Fear River and at Moncure, Fayetteville, and Elizabethtown. Economic losses were great when large areas of crop lands were flooded (Hudgins 2007:29).

*1946*

Two tropical storms moved over North Carolina in July and October of this year. The former reported high winds and heavy rains at Elizabeth City, Carolina and Wrightsville Beaches, and Manteo. The latter had minimal effects on the State (Hudgins 2007:30). A hurricane in September of 1946 caused the destruction of a Norwegian motor tanker, *Marit II*, 148 miles off the North Carolina coast, foundering the vessel and causing the loss of 14 lives (*The Washington Post* 1946:1).

*1947*

Although this hurricane remained well to the south of North Carolina, the southern portion of the coast was hit relatively hard. Lowlands were flooded and seven inches of rain fell in the three days at Hatteras (Hudgins 2007:30).

*1949*

This hurricane passed directly over the Diamond Shoals Lightship off Hatteras in late August, resulting in high winds and heavy rains on the Outer Banks; an estimated $50,000 in damages resulted, mostly near Buxton (Hudgins 2007:30).

*1950-1951*

Tropical storms passed the State in these years with little effect, but the modern era of named hurricanes began in this period, and “seven hurricanes blasted the Tar Heel State in roughly two years,” earning it the name Hurricane Alley (Barnes 2001:80; Hudgins 2007:31).

*Hurricane Barbara, 1953*

Hurricane Barbara struck the coast between Morehead City and Ocracoke in August of 1953. The highest winds were reported at Hatteras and Nags Head, with torrential rain all along the coast. Trees were blow down and signs and roofs torn off. Power and communication lines were out in many places. Eight to ten stores were flooded in New Bern, where the Trent and Neuse Rivers meet (*New York Times* 1953:20). Coastal property damage was estimated at $100,000 and crop damage at $1,000,000. One man was drowned after being swept from the pier at Wrightsville Beach (Barnes 2001:80; Hudgins 2007:31).

*Hurricane Carol, 1954*

Hurricane Carol, a Category Two storm, passed just east of Hatteras in late August 1954. The coastal areas were on the weaker side of the storm but high winds did significant damage to corn and soybean crops as well as an estimated $250,000 damage along the entire coast (Barnes 2001:80-81; Hudgins 2007:31-32).

*Hurricane Edna, 1954*

Hurricane Edna followed in September 1954 with minor but widespread damage. Beach erosion was severe and "total property damage was estimated at $75,000 and crop damage at $40,000 (Barnes 2001: 82; Hudgins 2007: 32).

*Hurricane Hazel, 1954*

Hurricane Hazel continued the trend for 1954, but this Category Four hurricane wreaked unprecedented havoc on North Carolina, considered the most intense hurricane to make landfall in North Carolina during the twentieth century thus far (Schwartz 2007:197). Taking dead aim on Brunswick County, "wind-driven tides devastated the immediate oceanfront from the South Carolina line to Cape Lookout," practically annihilating all traces of civilization on that waterfront (Hudgins 2007:32). Severe damage was done at Long Beach, Holden Beach, Ocean Isle, Robinson, and Colonial Beach. The storm surge, which coincided with the highest lunar tide, was the greatest in North Carolina history, with 17-18 feet at Calabash and Long Beach; at Long Beach 352 of the 357 buildings were washed away (Barnes 2001:83; Barnes 2003:71). The storm tide forced ocean water through the mouth of the Cape Fear River, flooding Southport's waterfront. The Pamlico and Albemarle Sound regions were also flooded. Carolina Beach was hit hard with $17,000,000 in property damage (Barnes 2001:92, 95, 106).

*Hurricane Connie, 1955*

Hurricane Connie hit in August 1955 close to Cape Lookout and passing east of Oriental, Plymouth, and Elizabeth City. This sluggish Category Three hurricane piled high water along the coast, flooding farm land and causing beach erosion (Hudgins 2007:109). Torrential rainfall was reported at Morehead City (Barnes 2001:110).

*Hurricane Diane, 1955*

Following close on the heels of Connie, only five days later, Diane caused record-breaking flooding (Barnes 2001:110). Diane entered the coast near Carolina Beach, bringing high winds and even higher tides. Beach erosion was severe along many southern beaches as far north as Cape Hatteras. Prolonged winds pushed salt water into farms and fields, destroying crops (Barnes 2001:112; Hudgins 2007:35).

*Hurricane Ione, 1955*

This storm hit North Carolina a month after Connie and Diane in late September 1955, a few miles west of Atlantic Beach. This Category Three hurricane “eventually inundated record portions of the coastal plain and established new high-water makes in numerous locations” (Barnes 2001:114). New Bern took a terrible “drubbing” from winds and flood waters and extreme damage from wind and water occurred at Morehead City and Beaufort (*Los Angeles Times* 1955:1). Principal damage was due to water. A total of seven deaths were attributed to Ione, and $88 million in property damage (Hudgins 2007: 36). Drum Inlet became un-navigable after Ione when “new sand shoals formed and choked the channel” (Barnes 2001:116). Protective dunes were carved away by beach erosion at Ocracoke and Hatteras (Barnes 2001:116-117). The Diamond Shoals lightship was snapped from its moorings and the Coast Guard station at Nags Head was evacuated (*Los Angeles Times* 1955:1, 6).

*Hurricane Helene, 1958*

Hurricane Helene brought Category Three wrath in September 1958, with high winds recorded at Wilmington. Its approach coincided with the astronomical low tide which prevented much flooding but caused some beach erosion. Wind damage was significant to property and crops (Barnes 2001:119; Hudgins 2007:37). As Helene moved back into the Atlantic, it left behind" tangled communication lines, felled power circuits, blocked highways, chopped-up beaches and smashed dwellings" (*Los Angeles Times* 1958:1). Although there was no reported loss of life, damage was considerable; at Wilmington alone damage was estimated at $1,000,000 and at Southport between $500,000 and 750,000 (*Los Angeles Times* 1958:8).

*Hurricane Cindy, 1959*

This tropical depression made a looped track as it became a tropical storm in July, 1959. Overall structural damage from Cindy was minimal but the storm brought tornados which caused minor damage in North Carolina. Tides at Wilmington were two feet above normal (*The Miami News* 1959).

*Hurricane Donna, 1960*

Considered one of the most destructive storms in United States history, this storm passed inland between Wilmington and Morehead City September 11, 1960. Donna passed over Carteret, Pamlico, Hyde, and Tyrrell counties before crossing Albemarle Sound through Elizabeth City (Barnes 2001:126). From Carolina Beach to Nags Head, coastal communities suffered heavy structural damage and considerable beach erosion. The hurricane resulted in several deaths, numerous injuries, and an estimated $1,000,000 in damage to crops and property (Hudgins 2007:38).

*Hurricane Ella, 1962*

In October 1962, this stalled storm brought mainly beach erosion to the North Carolina coast (Hudgins 2007:39).

*Hurricane Ginny, 1963*

October 1963 brought rough seas which caused beach erosion. Little structural or crop damage was done, and the heavy rains were confined to the coast (Hudgins 2007:39).

*Hurricane Cleo, 1964*

Heavy rains, especially in the northeast, caused flash flooding and crop damage from this August-September 1964 storm (Hudgins 2007:39).

*Hurricane Dora, 1964*

In September 1964 this hurricane brought sufficient seas and tides to cause some beach erosion, and heavy rains caused flooding to the northern coast beach highways (Hudgins 2007:40).

*Hurricane Isbell, 1964*

Hurricane Isbell developed as a weak tropical depression in early October, 1964. Although most damaging in Cuba, Isbell brought widespread rains and high winds (reported in Elizabeth City), but no significant damage was reported. Beach erosion was also minimal. Associated tornados unroofed homes and buildings throughout several North Carolina communities (*The Daily Times News* 1964).

*Hurricane Abby, 1968*

Hurricane Abby made landfall in Florida and weakened to a tropical depression as it crossed Georgia into North Carolina in June, 1968. Rain was minimal and associated tornados caused the most damage. There were no fatalities associated with Hurricane Abby in North Carolina (National Hurricane Center 1968).

*Hurricane Doris, 1971*

This tropical storm made landfall near Atlantic Beach in August 1971, bringing flood waters and minimal wind damage (Hudgins 2007:42-42).

*Hurricane Ginger, 1971*

A long-lived hurricane tracked out of the Bahamas, made landfall near Atlantic Beach, late September 1971. Rainfall was heavy because of the slow movement of the storm, especially in the Pamlico Sound (Barnes 2001:134). Corn and soybean damage was approximately $10 million (Hudgins 2007:44).

*Hurricane Agnes, 1972*

The remnants of this hurricane fell as a tropical storm on the northeastern portion of North Carolina. Agnes brought heavy rains (10.6 inches) which caused flooding and crop damage (Hudgins 2000:43-44 ). Two deaths were attributed to Agnes.

*Hurricane Gilda, 1973*

Gilda caused minor beach erosion in 1973 (Hudgins 2007:45).

*Hurricane Amy, 1975*

In 1975 this storm cased beach erosion and temporary flooding (Hudgins 2007:45).

*Hurricane David, 1979*

Originating near the Cape Verde Islands, this tropical storm hit North Carolina September 5, 1979 causing mainly beach erosion and flooding in the coastal sections, despite remaining well inland. Tides were three to five feet above normal and rainfall in the coastal areas was seven to ten inches (Hudgins 2007:47).

*Hurricane Diana, 1984*

Hurricane Diana developed in the Bahamas and became a Category Three hurricane as it moved close to Cape Fear, making landfall near Bald Head Island September 9, 1984 as a Category Two storm. Total damage over southeast North Carolina was estimated around $80,000,000, a third from agricultural damage. New Hanover and Brunswick counties were considered hardest hit, although Pender, Sampson, Bladen, and Columbus counties also suffered (Barnes 2001:141; Hudgins 2007:49). Beach erosion occurred from Pender County south along New Hanover beaches. High tides and heavy rains caused flooding and dam failures at Boiling Springs, Roseboro, and Faison (Hudgins 2007:49). Strong winds "struck from Cape Fear north to Wrightsville Beach, destroying the water tower at Carolina Beach and leaving the town without drinking water. Most of the coast…was without electrical power" (*Los Angeles Times* 1984:B1).

*Hurricane Josephine, 1984*

A depression formed out of the Bahamas, Josephine gained tropical storm strength as it moved north, hitting North Carolina between October 12-15, 1984. The combination of this storm and a high-pressure system "created strong winds over an extensive area. The winds combined with abnormally high astronomical ties and large waves produced damage to marine installations and caused severe beach erosion along the Outer Banks (Hudgins 2007:49-50).

*Hurricane Gloria, 1985*

Gloria originated as a tropical depression off the west coast of Africa, Gloria drifted across the Atlantic to cross the Outer Banks near Cape Hatters September 26-27, 1985 (Barnes 2001:143; Hudgins 2007:50). Although Gloria's sweep over North Carolina was considered moderate, it still amounted to around $8 million in damage with beach erosion and flooding. Dare County is said to have suffered the greatest damage (Barnes 2001:145; Hudgins 2007:50).

*Hurricane Charley, 1986*

Originating in the Gulf of Mexico, this depression increased to hurricane force as it drifted across Ocracoke, Pamlico Sound, Hyde and Dare counties, and the Currituck area August 17-18, 1986 (Barnes 2001:148). Charley's impact was overall minimal with light damage occurring primarily from tidal flooding and downed trees. One death was attributed to Charley (Hudgins 2007:51-52).

*Hurricane Hugo, 1989*

Hugo was an intense Cape Verde storm originating off the western coast of Africa. Hugo made landfall at Sullivan Island, South Carolina as a Category Four hurricane. As it moved rapidly up the coast it decreased to a Category Three storm when it reached Brunswick County, North Carolina, September 21-22, 1989. Hugo had a severe impact, primarily in Brunswick County, where $70 million in damages were reported (Hudgins 2007:52). Over 120 homes at Long and Ocean Isle Beaches were destroyed. Severe beach erosion occurred in Brunswick County as well, “with many sections of the barrier island beaches dune system cut or eliminated,” and oceanfront piers damaged in Brunswick, New Hanover, Pender, and Onslow counties (Hudgins 2007:53). Seven deaths were associated with Hugo in North Carolina.

*Hurricane Bob, 1991*

Bob accelerated to a position 30 miles east of Cape Hatteras on August 18-19, 1991. With sustained high winds, tornadoes, and heavy rains (between 5.3 to 8 inches), damage was around $4,000,000 in North Carolina with one associated death (Hudgins 2007:54).

*Hurricane Emily, 1993*

Emily developed out of the Cape Verde Islands and veered toward the Outer Banks August 30-31, 1993. The 30-mile-wide eye maintained 115 mph winds and battered the villages of Hatteras, Frisco, Buxton, and Avon (Barnes 2001:157). 160,000 people were evacuated from the barrier islands, and $35,000,000 in damages to homes was recorded. Extensive sound-side flooding was observed in the Pamlico Sound (Hudgins 2007:55).

*Hurricane Felix, 1995*

Although this Category One hurricane never made landfall in North Carolina, "large swells generated by the storm caused rough surf and severe beach erosion along the Outer Banks" from August 18-20, 1995 (Hudgins 2007:56). Property damage was low, but three people died from drowning.

*Hurricane Luis, 1995*

Although a large and powerful Category Four storm, Luis produced residual effects for North Carolina during the period September 9-10, 1995. Thirty foot swells and twelve foot waves caused severe beach erosion and pier damage in Carteret and Onslow counties (Hudgins 2007:56-57).

*Hurricane Allison, 1995*

Although only an extratropical storm when it crossed North Carolina, Allison produced heavy rainfall causing extreme flooding leading to $5,000,000 in crop damages. (Hudgins 2000:54).

*Hurricane Bertha, 1996*

Reaching Category Two status just before slamming into the North Carolina coast between Wrightsville Beach and Topsail Island in 1996, Bertha "was the first July hurricane to strike [the State] since 1908" (Barnes 2001:163). Although winds and rain were significant, storm surge was the most destructive, especially along south-facing beaches between Cape Fear and Cape Lookout. Storm surge engulfed the waterfront at Swansboro and an estimated five thousand homes were damaged to this effect. Flooding from the Pamlico Sound was reported in Belhaven, Washington, and New Bern. Additionally, "severe beach erosion, roof damage, destroyed piers, fallen trees, and damage to crops [led] to federal disaster declaration across coastal North Carolina. Total figures put damage across North Carolina at $270 million" (Hudgins 2007:58).

*Hurricane Fran, 1996*

Another Cape Verde hurricane, Fran made landfall over southeast North Carolina just west of Cape Fear as a category 3 storm September 5-6, 1996 (Hudgins 2007:59). Maximum sustained winds were 115 miles per hour (mph). The hurricane's greatest power was concentrated on the eastern side, battering the beaches of New Hanover, Pender, Onslow, and Carteret (Barnes 2001:175). Due to storm's strength and course, "extensive storm surge flooding of eight to 13 feet damaged or completely destroyed many beachfront homes southwest of Cape Lookout and caused destruction to piers and boars along much of the coastal community" (Hudgins 2007:59). High water levels were compared with those of Hazel of 1954, some even exceeding those levels in areas (Barnes 2001:177; Hudgins 2007:59). Beach erosion was especially severe from Emerald Isle and Topsail Beach south. Minor flooding was reported in the Pamlico Sound, but extensive fresh water flooding created record crest levels in the Neuse and Cape Fear rivers, with up to 12 inches of rainfall in Pender and Brunswick counties.

In North Carolina alone, economic damage was over $2,000,000,000, Fran being the first multibillion dollar disaster in North Carolina's history (Barnes 2003:72; Hudgins 2007:59).

*Hurricane Josephine, 1996*

On October 7-8, 1996, this originally extratropical storm crossed the Florida panhandle into the Carolinas. Rainfall produced significant small stream flooding across Brunswick, Bladen, Columbus, New Hanover, Pender, and Onslow counties, all still recovering from Hurricane Fran. High storm tides were observed on south and east-facing beaches from Cape Lookout to Cape Fear, and beach erosion along the south facing Brunswick County beaches was severe. Josephine also produced tornadoes, which added another level of damage to trees and homes (Hudgins 2007:60).

*Hurricane Bonnie, 1998*

Hurricane Bonnie developed over the tropical Atlantic, gradually strengthening to a Category Three hurricane by the time it drifted across southeast Brunswick County and eastern New Hanover County, making landfall August 26, 1998 near Wilmington (Hudgins 2007:61). Rainfall totals of 8 to 11 inches were recorded causing localized flooding and high storm tides caused beach erosion along the Brunswick and New Hanover beaches (Barnes 2001:207; Hudgins 2007: 61). Pasquotank and Camden counties were hit by a six foot storm surge along the Albemarle Sound. Significant tree, roof and structural damage, and power outages were widespread in eastern North Carolina, in places like Calabash, Shallotte, and Carolina Beach, with total damage estimated at $240,000,000 (Barnes 2001:207-208; Hudgins 2007:61-62). At least seven piers in North Carolina were trimmed or destroyed including Freddy Phelp's pier on Carolina Beach, the Iron Steamer Pier in Pine Knoll Shores, and the Indian Beach Pier (Barnes 2001: 209). Isolated tornadoes associated with Bonnie caused significant destruction, and one fatality occurred in Currituck County from a falling tree (Barnes 2001:210-211; Hudgins 2007:62).

*Hurricane Dennis, 1999*

Hurricane Dennis, which stalled off the North Carolina coast September 4-5, 1999, "was a larger-than-average western Atlantic hurricane that was erratic in both track and intensity. Although it never made landfall as a hurricane, it affected the North Carolina coast with hurricane force winds, heavy rains, prolonged high surf, and beach erosion" (Hudgins 2007:63). The first pass of Dennis near the coast sustained high winds and heavy rains and produced “heavy surf, severe erosion, and coastal flooding from Brunswick County to eastern Virginia” (Barnes 2001:216). Dennis stalled offshore on its second pass between Cape Lookout and Ocracoke, bringing widespread flooding of sounds and eastern rivers, heavy surf, and severe erosion. On Carteret County’s Core Banks, a new inlet was created, three hundred yards wide and 12 feet deep. Further north, an inlet was cut across Hatteras Island north of Buxton, washing away 3,000 feet of highway 12 (Barnes 2001:217).

*Hurricane Floyd, 1999*

Just over one week after Dennis moved along the coast, a tropical wave emerged from western Africa, intensifying to a Category Two hurricane as it came ashore near Cape Fear, September 16, 1999. High winds were recorded at 122 mph (the highest at 138) and storm surge was as high as 10 feet along the coast, but much of Floyd’s impact came from the extreme rainfall. Although a fast moving hurricane, its large circulation interacted with a frontal zone proving “the catalyst for Floyd’s most disastrous legacy” (Barnes 2001:227). Rain lasted in some areas over sixty hours and totals were between 4 to 12 inches across eastern North Carolina, with totals as high as 15 to 20 inches in portions of the State (i.e. Wilmington’s total was 19.06 inches with 15.06 in 24 hours) (Hudgins 2007:64). The heavy rains caused a magnitude of flooding and flash flooding never seen in North Carolina’s history (Barnes 2001:228; Hudgins 2007:64). With no place for the water to drain, floodwaters overfilled rivers, and backed up “into streets, homes, farms, businesses, and interstate highways” (Barnes 2001:228). Eleven USGS monitoring stations exceeded their 500 year flood levels, and the Neuse, Tar, and northeast Cape Fear rivers established all-time flood records (Barnes 2001:228, 230). Unfortunately, river flooding was not the only destructive power Floyd brought. Tidal surges along the coast caused heavy damages, especially on Oak Island (Barnes 2001:245-246). Homes and piers were demolished along the beaches. Erosion cut Mason Inlet to within 10 feet of Shell Island Resort, and Floyd's overwash cut three new inlets across Topsail Island (Barnes 2001:246-247). In all

> damage was over $3 billion; there were 35 deaths; 7,000 homes destroyed; 17,000 homes inhabitable; 56,000 homes damages; most roads east of I-95 flooded; the Tar River crested over 24 feet above flood stage; over 1500 people were rescued from flooded areas; over 500,000 customers without electricity at some point; 10,000 people housed in temporary shelters; much of Duplin and Greene counties under water; [and] severe agricultural damage throughout eastern NC (Hudgins 2007: 64).

### *Twenty-first century Hurricanes*

The twenty-first century has continued North Carolina's timeline of severe weather events, with varying intensity and paths. Tropical depressions, tropical storms, and several intense hurricanes have struck North Carolina from 2000 to the present. Tracking these storms and measuring their speeds, velocities, paths, and damage has become highly specialized, and North Carolina's coastal storms continue to fascinate and frustrate professionals and communities throughout the State.

#### *Hurricane Gustav, 2002*

Tropical storm Gustav passed between Cape Hatteras and Diamond Shoals Light Tower September 10, 2002. Storm surged flooding occurred on the inland side of the Outer Banks, in Hyde and Dare counties. A weak tornado occurred near Ocracoke and property damage was estimated at $100,000 (Hudgins 2007:66-67).

#### *Hurricane Isabel, 2003*

This tropical wave moved westward from the coast of Africa, strengthening to a Category Five storm, and making landfall as a Category Two hurricane near Drum Inlet on September 18, 2003. High wind gusts were reported throughout the Outer Banks, and heavy rainfall occurred in

Craven, Carteret, Pamlico, Hyde, Washington, Pitt, Edgecombe, Halifax, and Northampton counties with flooding in low-lying areas. Storm tides were highest across the lower reaches of the Neuse and Pamlico rivers and flooding was reported in Craven County (at Hatteras) and eastern Pamlico County (at Oriental). Flooding at Ocracoke and Washington was also significant. Overwash and beach erosion occurred in Dare and Hyde counties; piers were destroyed or damaged at Nags Head, Rodanthe, and Frisco. Buildings were shaken off foundations, and a new inlet was carved along Highway 12 between Frisco and Hatteras Village (Hudgins 2007:69-70).

*Hurricane Alex, 2004*

Alex moved slowly northeastward after forming as a low pressure system off the coast of Florida, becoming a hurricane August 3, 2004, centering itself 65 miles south-southeast of Cape Fear. Alex made its closest approach to landfall near Cape Hatteras with its eyewall raking the Outer Banks. Although the center of Alex remained offshore, the Outer Banks endured wind gusts of over 100 mph, and 4 to 8 inches of rainfall accumulation throughout the coast. The highest surge values from soundside flooding in Pamlico Sound were recorded at Buxton, Hatteras Village, and Ocracoke Island. Water levels between 2 to 4 feet above normal rose across Craven, Carteret, and Pamlico counties, as well as in the lower reaches of the Neuse and Pamlico rivers, and in the western sections of the Albemarle Sound. Significant erosion due to soundside flooding occurred on Core Banks, Ocracoke Island, and on the Outer Banks from Buxton to Hatteras Inlet (Hudgins 2007:70-71).

*Hurricane Charley, 2004*

Although this hurricane re-strengthened to hurricane force as it moved into the Atlantic, when Charley passed over southeastern North Carolina August 14, 2004 it was a tropical storm that began to interact with a frontal zone. Flooding, tornadoes, and wind caused the most damage across eastern North Carolina, especially in the coastal plain counties and Outer Banks, Dare County. The highest wind speeds were recorded across Brunswick, New Hanover, and Pender counties, and moderate wind damage to homes occurred in Onslow County. There were five tornadoes in throughout eastern North Carolina associated with Charley, resulting in building damage in areas like Kitty Hawk. Storm surge and rising water levels were minimal, as was beach erosion; however, "overall damage totaled 25 million dollars in North Carolina," including crop damage (Hudgins 2007:74).

*Hurricane Ophelia, 2005*

Ophelia moved slowly northward, becoming a hurricane as a portion of its 50 mile wide eye moved over the coast of North Carolina near Cape Fear on September 14, 2005. Strong winds raked the southeastern coast from Cape Fear to the Outer Banks, the large eyewall causing "significant damage in coastal areas such as Morehead City, Beaufort, Atlantic Beach, Emerald Isle, including the rest of Bogue Banks and downeast Carteret County" (Hudgins 2007:81). Wind damage to structures across Carteret and Onslow counties amounted to over $20,000,000. Additionally, flooding from excessive rainfall occurred throughout most of the coastal region, being especially heavy over Brunswick County. Storm surge flooding inundated many areas of the western side of the Pamlico Sound and along the Neuse, Pamlico and Newport rivers, with high water levels near Washington, New Bern, Morehead City, and Beaufort. From Cape Fear to Bogue Banks severe beach erosion resulted from high ocean water and surf, resulting in millions in damages alone (Hudgins 2007:80-81).

*Hurricane Ernesto, 2006*

As a strengthened tropical storm, Ernesto made landfall in Brunswick County near Long Beach, North Carolina August 31, 2006. Strong winds damaged homes and businesses, and three tornadoes occurred along the coast in Onslow and Carteret counties. Heavy rain and storm surge caused some flooding in coastal regions and in bays and rivers, as well as beach erosion on the immediate coastline (Hudgins 2007:83).

## *Conclusion*

The list of severe climatic events throughout North Carolina's history is extensive and there have been many powerful and deadly storms along the coast throughout time. Levels of destruction and effects have been varied by era and by location, but regardless of variation, each storm has left an impact on its associated areas and communities. This timeline of severe weather events places them within their historical context for the North Carolina coast. The series of information provides not only a chronological framework for the severe weather events, but also provides historical evidence of the effects of severe weather events on economic trends, social patterns, and environmental change. The signatures produced by hurricanes and tropical storms are not only evident in the historical record, but are present in the archaeological and environmental record as well. The succeeding chapters will examine the statistical and spatial signatures of North Carolina's severe weather events and the correlations between these signatures and patterns of change in social, economic, and environmental attributes. These patterns may be related to trends in the settlement and movement of communities along the North Carolina coastal region.

# CHAPTER FOUR: WEATHERING THE STORM…

## METHODOLOGY

The methodology for this thesis requires a series of structured steps that permit a systematic examination and analysis of previously collected data. In approaching the research process toward examination of the research questions for this project, the methodology combines historical research and archaeological investigations into the historic weather events and their physical and cultural impacts on the coastal communities of North Carolina. In order to appropriately analyze the research questions, some parameters have first been set. The seventeenth century starting at 1667 has been chosen as the earliest time limit for historical analysis due to the lack of appropriate or detailed sources in the fifteenth and sixteenth centuries for the North Carolina coast. Secondly, in gathering cartography of North Carolina for a geographical information system (GIS), it was determined the database encompass only the coastal region of North Carolina. Although the interior of the state has experienced the effects of coastal weather events, to include this region within the data set would present too large a scale for this thesis. Thus, the geographical area has been limited to the portion of North Carolina that includes the counties which have had, and continue to have, the greatest threat from historic and contemporary severe coastal weather events. This area includes the prominent Outer Banks, sounds, bays and major eastern river basins which flow into the coastal sounds and bays. The counties include: Brunswick, New Hanover, Pender, Onslow, Carteret, Pamlico, Craven, Beaufort, Hyde, Dare, Currituck, Chowan, Bertie, Washington, Tyrell, Perquimans, Pasquotank, Jones, Martin, Hertford, Gates, and Camden (Figure 4.1). Similarly, weather events compiled into Excel (Appendix A) have been restricted to hurricane activity rather than the inclusion of nor'easters; (although there is some data for nor'easters, both historically and spatially, the limit has been set in order to limit the size of the research set). The definition of a gale as it relates to actual hurricane activity versus a strong wind has also been used for this thesis, to better gauge which storms to include within the database.


FIGURE 4.1 Map of study area (North Carolina Department of Environment and Natural Resources 2005).

In addition to geographical data, subsets of catastrophically lost sites and ships have been extracted from pre-existing databases such as newspapers, insurance and shipping lists, and existing shipwreck datasets; these sites have been researched in detail and their attributes, i.e. latitude and longitude, wrecking date, or other identification information if available, integrated into other Microsoft Excel spreadsheets and GIS databases. In Excel, the shipwrecks are arranged by name, date of wrecking, general area in which the wreck lies, latitude and longitude coordinates, source information, and any additional notes about position or changes (Appendix B). The records have been ranked according to the accuracy of the information that is available for them, such as longitude and latitude information. The records are ranked 1 to 5, where 5 is considered to have the highest accuracy of information, where multiple sources verify the information such as longitude and latitude, ship name, type, and any associated owners or captains (Table 4.1).

| |
|---|
| Accuracy of Shipwreck Record Account:<br>1= Only a passing mention of vessel loss—no name, type, etc.<br><br>2= Information may include vessel type but does not have a ship name with which to reference information; information comes from mainly one source<br><br>3= Information usually includes ship name and date of wrecking, rarely has some locational coordinates and is only available from one source<br><br>4= Information is almost complete with ship name and type, but mostly no locational coordinates; information is verifiable through multiple sources<br><br>5= Information is complete with ship name, type, and locational coordinates; information is verifiable through multiple sources |

TABLE 4.1. Accuracy of Shipwreck Accounts

A ranking of 1 implies there is only a passing reference to a shipwreck associated with a severe weather event, as in a newspaper article or insurance listing, with little information beyond general location or date. Additionally, the accuracy of the latitude and longitude provided for specific wrecks is also ranked on a scale of 1 to 3, where 3 is considered to have the highest accuracy such that locations have been verified from multiple sources, particularly current locations from diving guides (Table 4.2).

| |
|---|
| Accuracy of Latitude/Longitude:<br>1= Information may be given by a newspaper or ship log<br><br>2=The location can only be verified through diving guides which may give the current location only, not necessarily location of sinking<br><br>3=The location has been verified through multiple sources such as diving guides and archaeological investigations |

TABLE 4.2. Accuracy of Longitude and latitude

For the wrecks with latitude and longitude available, their coordinates were placed into an additional Microsoft Excel sheet as x,y data. Those with other coordinate systems such as Universal Transverse Mercator (UTM) or other units were converted to geographic latitude and longitude coordinates using an online coordinate convertor to ease manipulation of the data (Geoscience Australia 2011). Their coordinates were placed into a Microsoft Excel spreadsheet along with the other data. The x,y data was then entered in ArcGIS using the "Add XY Data" function, which automatically placed points in the locations for each coordinate. This methodology has allowed for the visualization of patterns in the shipwrecks.

Weather events have been reconstructed using existing GIS data from such projects as Storms to Life (Walsh and Seibert 2010), the International Best Tracks dataset (National Climatic Data Center 2011), and the National Atlas (National Atlas 2011) raw data services, which all provide data for weather events in tracks or point files. Specific dates or storms can be extracted by name or attribute for single or multiple storm analysis in ArcGIS, which also allows for the examination of temporal and spatial correlations between weather events and other phenomenon such as lost ships or sites. The combination of these steps determines the selection strategy for case studies of site presence or absence from data correlations. Specific sites and events are thus examined contextually to look at aftermath in terms of social and economic consequence in order to explain continued occupation or abandonment. It must be noted that the calculations for the number of categories used in the analyses chapters does not account for the same category for different sections of the same storm, but does make a note/addition when a portion of a storm track changes intensity (Figure 4.2). For example, as the storms are recorded in sections of varying time periods, if the storm does not change category, i.e. stays a tropical storm for each portion, the record of one tropical storm is used; however, if a storm changes from Category One to tropical storm, a record of Category One and tropical storm was counted as two.

| FID | Shape * | FNODE_ | TNODE_ | LPOLY_ | RPOLY_ | LENGTH | HURALLL020 | YEAR | MONTH | DAY | BTID | NAME | LONG | LAT | WIND_KTS | PRESSURE | WIND_MPH | CATEGORY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 168 | Polyline | 0 | 0 | 0 | 0 | 0.538517 | 26820 | 1971 | 9 | 30 | 972 | GINGER | -76.5 | 34.5 | 65 | 984 | 75 | H1 |
| 169 | Polyline | 0 | 0 | 0 | 0 | 0.509902 | 26821 | 1971 | 10 | 1 | 972 | GINGER | -77 | 34.7 | 60 | 991 | 70 | TS |
| 170 | Polyline | 0 | 0 | 0 | 0 | 0.509902 | 26822 | 1971 | 10 | 1 | 972 | GINGER | -77.5 | 34.8 | 55 | 997 | 65 | TS |

FIGURE 4.2. Example of Data from ArcGIS IBTrACS dataset (World Data Center for Meteorology 2010).

*Historical Methodology*

Historical research encompasses the use of local and regional newspapers that have documented weather occurrences in North Carolina and detailed their coastal paths and the damage inflicted on the communities impacted. These newspapers include *Raleigh Observer*, *Newbernian*, *North Carolinian*, *Wilmington Daily Herald*, and *Elizabeth City Star & North Carolina Eastern Intelligencer*. Information gathered from lifesaving stations (Chenery 2000), lighthouse information systems (Rowlett 2011), and several diarists (Washington 1788) from the eighteenth century also provide insight into the weather systems that regularly occurred during the seventeenth through twentieth centuries. These sources have been compiled into books that focus on the Middle Atlantic states in general (Schwartz 2007), and North Carolina specifically (Barnes 2001; Hairr 2008). Additionally, some of the records from newspapers, such as *Elizabeth City Star & North Carolina Eastern Intelligencer*, *Raleigh Observer*, and *Wilmington Daily Herald* are available in the internet database for the Library of Congress Newspaper and Current Periodical Reading Room or are present physically in the Library of Congress Reading Room in Washington D.C. The database divides the newspapers for each century by state, and then by county. Many of the North Carolina newspapers are also available on microfilm in the

Joyner Library North Carolina Collection, East Carolina University, but only for select years. There are also several newspaper databases, ProQuest Historical Newspapers and Early American Newspapers, available through the Joyner Library that provides access to newspapers from historic periods that are searchable by time period, area, or subject/keyword. The combination of newspaper and personal accounts, as well as collective histories from various entities have resulted in a database of historic storms to have occurred throughout North Carolina's written history (Appendix A). This database includes dates, names of storms (if applicable), area of landfall, lives lost, damage incurred, and sources of information about these severe storms.

Historical maps are also an also invaluable resource for comparing change in landscapes along the North Carolina coast. Comparative cartography may express shoreline change by using nautical charts or historic maps, showing any major changes including historic inlets that have opened or closed due to hurricane activity. Maps may be overlayed and compared with one another or entered into a GIS program to analyze changes in relation to storm paths and destruction by utilizing functions such as transparency or vectorization into shapefiles (Stephenson 1990). Historic maps, which are available from a myriad of sources such as the North Carolina State Archives, NOAA Office of the Coast, UNC Davis Library, Outer Banks History Center, and East Carolina Joyner Library North Carolina Collections have been georeferenced to a contemporary topographic map, provided from ESRI's mapping services, and rectified in a projected coordinate system such as the North Carolina State Plane; once the maps are georeferenced to a coordinate system they can be accurately analyzed for changes in landscape from one time period to another. Shapefiles of the historic coastlines of North Carolina have been made to glean shoreline changes through overlays or animations that may show shifts in relation to specific time periods or even specific events, such as severe weather systems. From these shapefiles, or new maps, further analysis can be performed in relation to storm patterns and their effect on the coastal geomorphology of North Carolina or economic patterns associated with inlet openings and closings and coastal shift. Furthermore, historic inlets of North Carolina have been mapped from the referenced historic maps to provide a point file of their locations and their attributes to analyze changes that may affect economic and social changes.

In order to gather appropriate data sets, or historical maps of North Carolina, research began with the North Carolina Historic Maps Project, a combined collection of digitized maps viewable on the internet from sources such as the North Carolina State Archives, the Outer Banks History Center, and the North Carolina Collection at the Davis Library at the University of North Carolina-Chapel Hill. The maps are available for viewing and interactively overlaying but are not available for download. In contacting the individual repositories, most maps were not available for high resolution digitization. Luckily, the National Oceanic and Atmospheric Administration's (NOAA) Office of Coast Survey houses a website that features a historical map and chart collection with both viewable and accessible maps available for a myriad of United States areas. Maps from this collection were chosen based on time period, resolution, quality of original map, and area charted. Additionally, a United States topographic map was obtained from ERSI's ArcGIS online map service; this map provides the base map for control points and a reference comparison for the historical maps.

The first step in manipulating the historic maps required georeferencing the scanned map so they may be edited and compared with other layers in ArcGIS. This step required finding points on both the contemporary topographic man and the historical maps that would correspond to features stable in both data sets to act as reference points between the maps. Afterward, the raster of the historic map needs to be vectorized in order to manipulate it as a layer. This required creating a new shapefile in ArcCatalog into which the raster's data could be transferred. Using ArcScan, the map was first cleaned to eliminate any unwanted visuals on the map such as labels or soundings and then using batch vectorization, the clean map was vectorized into a new shapefile of both lines and polygons. These new shapefiles are used in analysis with other existing datasets.

In tracking the weather events, the National Climatic Data Center in Asheville, North Carolina monitors and records regional climate change, as well as hurricane, tornadoes, tropical storms, draught, and precipitation. The National Climatic Data Center is the world's largest active archive of weather data, working with NOAA Satellite and Information System to provide lists and searches of weather/climate events within certain parameters (National Climatic Data Center 2010). Such joint ventures have led to the compilation of databases such as the "Historical Hurricane Tracks" that provide GIS tracking of historical hurricane paths (NOAA 2010). The International Best Tracks contains the most complete global set of historical tropical cyclones available through easily accessible formats for the Atlantic Basin, with information on position, maximum sustained winds, minimum central pressure, storm name, radius of maximum winds, and more as provided by specific regional agencies (World Data Center 2010). National Atlas also provides raw data for Atlantic Coast hurricanes in two forms: major landfall and all Atlantic hurricanes. These sources have tracked severe weather events from the 1850s, and keep track of changes in climate that have caused these occurrences in the past. Apart from the modern digitized data that these sources provide, several early books (Ludlum 1963; Carney and Hardy 1967) have looked not only at the points of impact for these severe weather events on the North Carolina coast, but have also tracked their paths from initial contact to dissipation, and the damage associated with them. These datasets provide the foundation for GIS work dealing with hurricane tracks and patterns used in conjunction with other environmental and archaeological data.

In relation to population changes potentially associated with historic severe weather in coastal North Carolina, census data was gathered by county from 1790-2010 using the Historical Census Browser from the University of Virginia Geospatial and Statistical Data Center (2004). Data was collected based on each coastal North Carolina county for each census year, paying particular attention to total population as well as any information related to agriculture, maritime activity, and dwellings. This data is used in comparison to hurricane tracks and historic records in order to glean any pattern in population change in relation to the occurrence of severe weather.

### *Archaeological Methodology*

In conjunction with historical records, this thesis examines archaeological sites in relation to the research questions, whether their attributes are congruent with the historical records or not. This has involved the creation of a geo-database tracking known weather events as well as the locations of suspected shipwreck sites associated with damage from severe weather events. The compilation of shipwrecks into a database has been accomplished by consulting shipwreck references from newspapers of the eighteenth, nineteenth, and twentieth centuries, as well as shipping and commerce lists and logs, which are available in compilation form (Angley 1991; 1995), individual newspaper records, Underwater Archaeology Branch (UAB) reports, and surveys, such as the Roanoke River/Albemarle Sound Survey (Price 2006; Friedman 2008; Leuchtmann 2011). These sources, as well as diving guides by known coastal historians and divers (Stick 1952; Gentile 1993), have aided in locating suspected wrecks sites and/or identifying sites that are known to have been impacted by severe weather events, as they offer

Earth coordinates and historical references to their cause of wrecking. Once a list of suspected and known sites was compiled, their known latitude and longitude coordinates, if available, were input into a GIS database as a point layer, usable for interaction with other datasets and features for analysis.

Many terrestrial archaeological sites that have had known interactions with a documented severe weather event are also included in this thesis as a subset of data. For example, deserted sites such as Diamond City, North Carolina, on Shackleford Banks are documented as abandoned due to weather impacts and should display evidence of a signature of the event in the site formation processes. Areas of Shackleford Banks contain large mounds that need to be more thoroughly examined. As the exact location of Diamond City is not known after its abandonment, finding evidence of the weather event in the archaeological record may help to pinpoint the site, and therefore aid in studying the impacts of the event and the way it effected the economy and social nature of a the community. Additionally, an examination of the coastal environment of the Outer Banks in general may also provide evidence of the changing dynamics associated with drastic, weather-related changes. In examining such a site archaeologically, it may be easier to determine the signatures of a documented severe weather event because it is known to have existed. According to Gibbs (2006), by exploring well-documented and archaeologically visible processes to “examine the processes of transformation…generalized understandings and frameworks could be developed to assist in interpreting undocumented and/or archaeologically less coherent sites” (Gibbs 2006: 4).

A potential case study lies in contrasting Diamond City with Portsmouth Island, North Carolina and Ocracoke Island, North Carolina. Portsmouth Island has suffered gradual “economic death” since adjacent Ocracoke Inlet has decreased in importance as a North Carolina port of entry, owing to changes in coastal dunes and erosion, often the result of severe weather events (Pilkey 1998: 13). Ocracoke Island is prone to flooding and erosion, but due to the surrounding forest lands, the island has escaped significant risks. The Island managed to survive for hundreds of years despite its precarious location (Pilkey 1998: 161). In contrasting the areas, it may be possible to glean why certain areas are more prone to devastation than others, and what prompts some communities, such as those of Ocracoke Island, to survive, while others relocate or disappear. These cases may be compared through economies, geography, social character, and the movement of the communities over time and space in order to understand the differences in survival and loss.

Several existing cultural datasets are utilized that pertain to terrestrial, maritime, and geoarchaeological material. Previous studies from students in East Carolina University's Program in Maritime Studies have focused on wrecks within the Albemarle Sound that have resulted in the Albemarle Sound Cultural Landscape Database (ASCLD). Franklin Price's (2006) thesis culminated in the initial Roanoke River Database that documented spatial patterns of shipwrecks and abandoned vessels. Adam Friedman's (2008) thesis and Amy Leuchtmann's (2011) research have added considerably to this database and drawn on the role of industrial legality and the evolution of maritime trade. Their contributions to the database include remote sensing surveys, visual inspections, and historical research. Jeanette Hayman (2011) has assessed the interaction of wrecks by comparing intertidal terrestrial site distribution in the Albemarle Sound with the geological data to determine any geophysical changes that affect the cultural landscape of the Sound. Additional wreck datasets include the Ocracoke Survey which examined all available shipwreck sources, utilizing historical research and data compilation to identify and locate shipwrecks (Runyan et al. 2005). Researchers examined and documented the environmental, historic, and cartographic history of a three mile zone on ocean and sound sides of the Outer banks from Cape Lookout to Cape Hatteras, and an additional zone with a 10 mile radius surrounding the Ocracoke lighthouse. The survey employed geographical information systems to provide overlays of data by location, date, ship type, and other criteria, which was then used to create survey blocks in areas identified as most likely to contain shipwrecks or vessel clusters (NOAA 2006). The *Automated Wreck and Obstruction Information System* (*AWOIS*) similarly contains spatial and historical information for a myriad of submerged wrecks and obstructions along the coastal waters of the United States, and the Underwater Archaeology Branch (UAB) at Fort Fisher, North Carolina houses the Beached Shipwreck Database. Land sites have been placed into datasets by the North Carolina Office of State Archaeology (OSA). Additionally, a dataset of North Carolina storms post-1890s exists within the Renaissance Computing Institute's (RENCI at East Carolina University) set of ongoing projects (Walsh and Siepert 2010). *Storms to Life* is a project that aims to improve public awareness of living in hurricane-prone areas like coastal North Carolina by providing documentation of these severe events with digital maps of storm paths, overwashing, and storm surge, as well as displaying the economic and social effects of the storms.

### *Environmental Datasets*

Environmental data are utilized in a two-dimensional (2-D) form to allow for simple analysis of overlying patterns. These datasets are prioritized to include only those that are directly influenced or are within the area of the weather event path. The US Geological Survey (USGS) in conjunction with the National Aeronautics and Space Administration (NASA) and U.S. Army Corps of Engineers (USACE) investigates the effects of extreme storms along the coasts of the United States using airborne Light Detection and Ranging (LiDAR) as a primary tool. They maintain airborne LiDAR surveys of coastal areas to serve as pre-storm baselines with the objective of improving the capabilities “to predict the nature and magnitude of storm-induced coastal change (Sallenger et al. 2006: 881). The North Carolina Department of Transportation (NCDOT) provides LiDAR contour elevation data and flood maps for each county that may assist in evaluating the geological conditions of the North Carolina coast, especially in regard to changes over time; however, LiDAR data is only available for more contemporary years and thus does not provide comparison for historic shorelines changes and trends (North Carolina Department of Transportation 2007). The Division of Coastal Management within the North Carolina Department of Environment and Natural Resources houses erosion maps and oceanfront shoreline changes for North Carolina counties with information often dating back to the nineteenth century (2010). NC One Map, through the North Carolina Center for Geographic Information and Analysis (NCCGIA), provides inundations layers which provide 2-D generalized data sets comparable to 3-D LiDAR, utilizing storm surge shape file and polygons representing various categories of storm intensity (NCCGIA 2010).

An additional database that works on the same principle is the Sea, Lake and Overland Surges from Hurricanes (SLOSH), which is a computerized model run by the National Hurricane Center (NHC) that can estimate storm surge heights and winds resulting from historical, hypothetical, or predicted hurricanes, taking into account pressure, size, forward speed, track, and winds to predict or evaluate (National Hurricane Center 2010). The graphical output from the model provides a color coded display of storm surge heights for a particular area in feet above the model's reference level, the National Geodetic Vertical Datum (NGVD). Calculations are applied to a specific shoreline, incorporating the unique land configurations, water depths, and other physical features such as roads or bridges (National Hurricane Center 2010). These various databases provide a starting point for analysis of the dynamic geophysical changes that occur during severe weather events, which in turn may be related to the archaeological and historical evidence to provide an understanding of the processes and risks present in the maritime cultural landscape.

*Analysis*

Combining historical and archaeological records, along with environmental and cultural datasets will permit a detailed analysis of North Carolina's weather events. Shipwreck data and weather paths will be placed into a GIS that can develop maps and informational layers, allowing for the spatial and temporal analysis of existing patterns. This analysis, in conjunction with historical references to weather damage, may aid in recognizing the major impacts of severe weather events regionally in terms of economic viability and social change. An additional approach that is applied in this study is the use of GIS for marine and coastal areas. As the coast is an interface between the land and sea, it becomes necessary to understand the link between two very distinct environments (Wright and Bartlett 2000: 11). By manipulating the datasets, ( i.e. shipwrecks, storm tracks, and shoreline changes), through ArcGIS data exploration, we can examine the general trends in the data, take a closer look at specific data subsets (their attributes and values), and focus on possible relationships between the data sets. Interactive and dynamically linked tools in ArcGIS involves spatial and attribute data to formulate and analyze relationships and hypotheses. By exploring general patterns, querying data, and descriptive statistics, geovisualization integrates cartography, GIS, image analysis, and exploratory data analysis that can discern associations between events, changes, and their associated effects on settlement and economics. Additionally, through data classification of descriptive statistics generated from data attributes and values, data can be linked with tables and graphics, and through attribute data inquiry, subsets of data can be examined and displayed in charts and linked to other features to show associations and patterns. With ArcGIS we can also work directly with spatial data and specific features. All of these functions allows for an examination of data sets in relation to the research questions posed in this thesis, and an evaluation of the data in relation to North Carolina's disaster landscape.

Placing known shipwrecks that are retrieved from the shipwreck datasets found in the ASCLD, OAS, UAB, AWOIS, historic newspapers and diving logs, severe weather paths obtained from NOAA and the International Best Tracks database, and documented changes in coastal geographical features available from LIDAR, storm surge, and comparative cartography into a GIS database permits the creation of overlying data sets that provide an analysis of spatial and temporal patterns, which may be accomplished by examining the interaction of the data layers (Runyan et al. 2005: 75). These spatial patterns may relate to changes in settlement patterns, resource availability, and social systems. Additionally, viewing sites archaeologically will aid in recognizing and understanding the site formation processes that have been affected by major weather events, as well as the physical signatures that are left in the archaeological record. Comprehending the signatures of these events may lead to identifying unnamed weather events that have affected past communities, therefore leading to a better understanding of changes in economic and social systems. The layering of data will provide the opportunity to assess a region or site before, during, or after a certain event. In doing so, we can compare case studies in relation to one another or compare case studies over time which will allow for an analysis of the changes in cultural resources, which may be defined as the loss of lives, vessel types, or resources lost. The interaction of data may account for correlations that constitute a disaster landscape for coastal North Carolina and its environmental and cultural dynamics.

# CHAPTER FIVE: THE FOUNDATION WAS ROCKED…

## SOCIAL AND ECONOMICS EFFECTS

The impact of hurricanes on the North Carolina coast can "cost lives and dollars, and disrupt communities. Category 3, 4, and 5 storms—intense hurricanes—are responsible for a majority of hurricane-related damage," but damage and loss of life can occur at any storm intensity (Pielke and Pielke 1997:131). While loss of life has decreased over the centuries owing largely to more advanced weather tracking and better warning systems, social and economic costs of hurricanes are seen to be rising. However, a hurricane can affect many aspects of society that do not explicitly or easily associate with any measure of economics. Therefore, any comprehensive "measurement of a hurricane's impact will necessarily include the quantification of costs associated with subjective losses" (Pielke and Pielke 1997:135). Pielke and Landsea (1998:621) argue that in order to "best capture the year to year variability in tropical storm damage, consideration must…be given toward two additional factors: coastal population change and changes in wealth." These changes are usually viewed as gradual processes from years of atmospheric extremes, but the history of tropical storms and hurricanes "reveals many instances of cities and towns overwhelmed and thousands of lives lost in inundation, which is evidence that such [changes] are not always gradual" (Tannehill 1952:30). Estimates from early studies placed the annual average of losses from hurricanes between $2,200,000,000 and $6,100,000,000. These large losses are attributed to an increasing coastal population and thus the increasing vulnerability to hurricane impacts (Changnon 2003:278).

Although open-water and coastal ship losses have decreased from the past century and a half, the rapid and continual growth of North Carolina's coastal communities over the past 500 years "has meant an ever-increasing population at risk to tropical cyclones" from coastal ship losses and storm surge inundation, including flooding, causing loss of life and property, forcing citizens and communities for centuries to mold their social and economic patterns to the changing winds (Rappaport and Fernandez-Partagás 1995:8). Using statistical analysis, we are able to garner certain patterns from the historical records related to population, economic impact, and effects of severe weather on the regional environment and specific locations, in turn utilizing this information to answer with the research questions concerning settlement, social, and economic patterns for the coastal region of North Carolina. This chapter examines population trends and economic sectors (i.e. agriculture, tourism, forestry, fishing, and property) central to North Carolina's coastal region in order to better understand the effects of historic severe weather events on the socioeconomic changes of coastal North Carolina. In addition to cultural trends, this chapter will also look at regional environmental trends associated with severe weather events. Chapter Seven will further examine population and community change spatially to visualize any patterns or trends that may or may not correlate to the statistical data.

### *Population*

> Where waves once broke on uninhabited North Carolina shores, they now break in the front yards of cottages, hotels, and apartment buildings. The use of land on the barrier islands has changed since old timers shunned the beach for wooded, sheltered spots. But the patterns of the legendary storms which strike the coast remain the same (Baker 1978:i).

North Carolina coastal communities have seen a steady and continual growth in population since the first census was performed in the United States in 1790 (Historical Census Browser 2004). Although each census year varies in the statistics gathered, each census provides an examination of total population by county with the later addition of urban versus rural populations, dwellings, and households.

It is necessary to utilize the historical record and the census records to observe any patterns or trends in the population data before the development of the modern weather systems, which allow an examination of the spatial data only after 1850; however, the first United States census record did not occur until 1790 which makes it difficult to determine the number of people affected by the earliest historic hurricanes merely from the historical data. Early accounts from newspapers refer to hurricanes by the ships or crops lost or damaged, with only general mention to overall areas of loss. Historic letters or diaries often account of specific people affected by historic storms and can provide evidence of destruction and cultural effects but may be difficult to obtain or reference to a specific storm.

River and coastal towns like Edenton, Bath, Portsmouth, New Bern, and Wilmington boasted growing populations and early economies for the fledgling American nation as well as communities vulnerable to intense, continually occurring early storms and hurricanes. More complete records and newspaper accounts of the colonial period dictate the losses to towns such as these. For example, in September 1752, Johnston, the county seat of Onslow, was flooded and destroyed, forcing residents to abandon the town (Hairr 1996:36). New Bern was hit in 1769, where practically everything from residences and warehouses to crops and commodities were destroyed, as well as several lives lost (Saunders 1968b [8]:71, 73-75, 89, 92, 159-160). In fact, New Bern is seen frequently in the pre-1790 hurricane record, with major destruction in 1775's Independence Hurricane, and again in 1778, suffering from heavy rains and high winds (Ludlum 1963: 26; Clarke 1968 [13]: 456). For the post-1790 period, we utilize census records in comparison with hurricanes by decade to visualize correlations between weather patterns and population change over time (Figure 5.1).

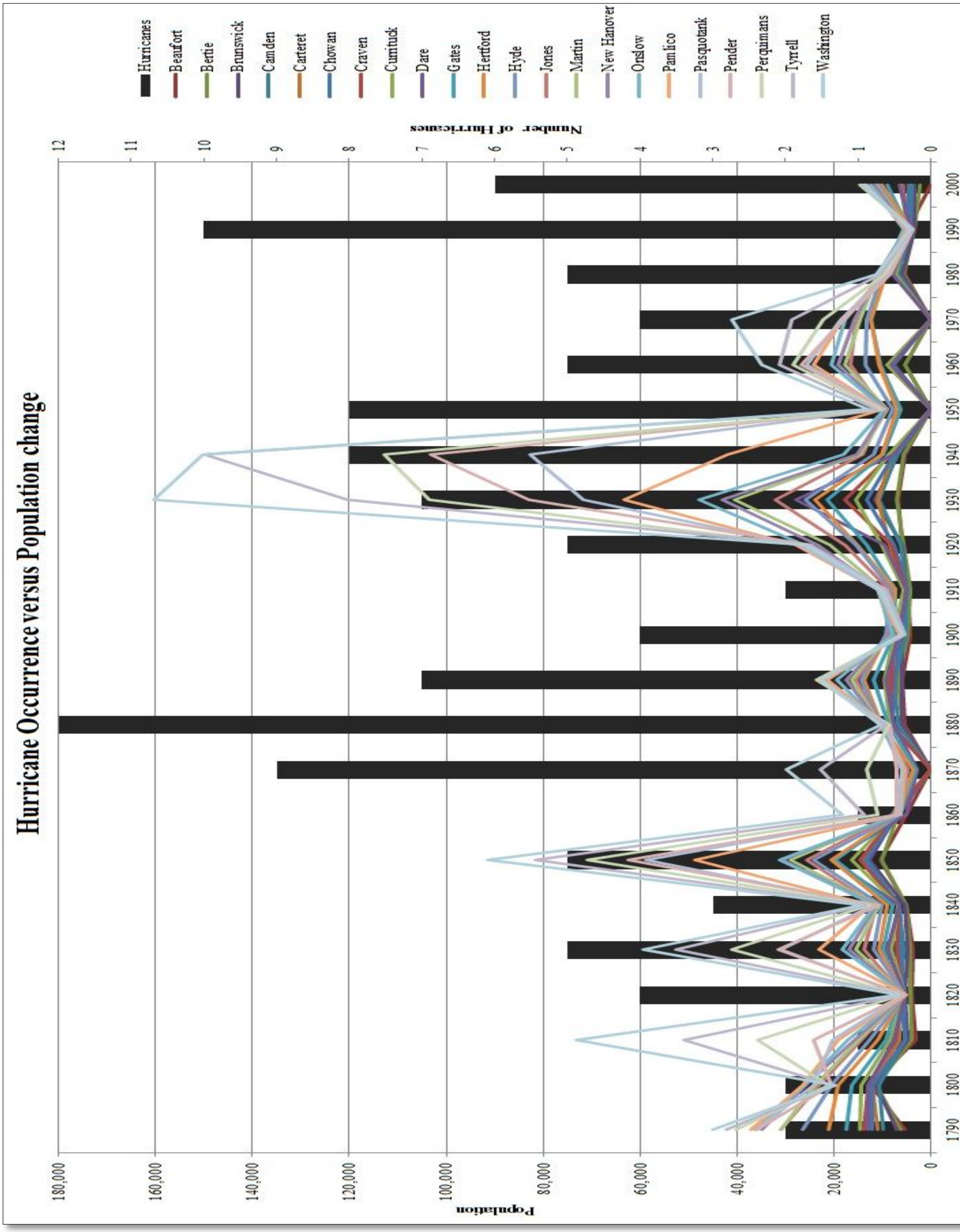



FIGURE 5.1 Population change over time versus hurricanes over time (Historical Census Browser 2004).

When examining the statistical data comparing the occurrence of hurricanes over time with population changes over time, there are several interesting patterns that emerge, some that correlate to severe weather events and some that do not. The 1830s and 1850s were periods of substantial storm activity but little evidence of population increase or decline with the exception of a few small areas. The 1860s saw little hurricane activity and slight increases in population. Around the 1870s there are substantial losses in population for several counties such as Beaufort, Bertie, Hyde, and Jones. The severe weather events during this time period were substantial enough to warrant some population changes as intensity would reach Category Three; however in several counties that experienced the brunt of this decade's storms, New Hanover and Craven, saw population increases.

After the storms of the 1870s, the 1880s again produced a decade of intense severe weather. Previously increasing populations in counties such as New Hanover and Craven took a hit, while a general trend in population growth occurred for the majority of other coastal North Carolina counties. This steady increase and/or leveling of population characteristics continued through the beginning of the twentieth century despite severe hurricane seasons in the 1890s and 1920s. With the increased hurricane activity in the 1930s and 1940s, we actually see an increase in population growth for several counties such as Onslow, Craven, Dare, and Hyde. We begin to see some decline in populations during the 1950s when North Carolina became known as "Hurricane Alley," but the decline is not widespread across coastal North Carolina, as counties like New Hanover, Onslow, and Craven saw sharp increases in population during this time period. With relatively widespread level populations through the 1960s, despite nine storms in that decade, the 1970s and 1980s mark a considerable increase in population for coastal North

Carolina again especially in counties such as Carteret, Brunswick, Perquimans, and Pender. These decades saw relatively few but destructive storm seasons, while the 1990s saw frequent and intense storms—ten in five years making frequent landfall in the Cape Fear Region as well as Carteret County. After the 1990s, the 2000 Census for coastal North Carolina shows some sharp declines and sharp inclines in population change. Onslow, Craven, Hertford, Dare, Perquimans, and Pender counties see a sharp decrease in their populations with the beginning of the twenty-first century, while Martin, Chowan, Pasquotank, and Jones see sharp increases in population growth. Hyde and Tyrrell counties also see small increases in population growth during this time.

Despite the continual presence of severe storms and hurricanes in the coastal area of North Carolina, there is a continual population growth in the coastal counties, especially in the twentieth and early twenty-first centuries. There is at least one severe storm or hurricane in every decade that creates enough damage and destruction to warrant some form of social change, but this is rarely seen in the theme of coastal population change. There are several instances where there are slight decreases in population in some counties after a severe storm, but it is impossible to determine with any certainty from the statistical data that the severe weather event is the sole cause of any population change; in fact, often after a particularly devastating season, such as in 1899, one would expect to see a population decrease, when in fact there is an increase in population. Without population statistics for each year, it may be difficult to ascertain what affect specific hurricanes have had on the overall coastal North Carolina population. There are changes in specific areas between hurricane seasons.

The areas most affected by historic hurricanes are seen to be the counties of the Cape Fear region—Brunswick, New Hanover, Pender, and Onslow—and the counties of the central

Outer Banks—Carteret, Dare, Hyde, and Currituck. But these counties exhibit different reactions from their populations after severe weather events. The southern counties tend to continually exhibit population growth despite severe and continual storm experiences, while the other counties tend to exhibit occasional fluctuations between decrease and increase in population change.

Within the theme of population change it is also necessary to recognize the division of population by permanent occupant versus tourist or seasonal occupant when speaking of population changes in coastal North Carolina. This characteristic may be a large influence on the correlations between weather events and population changes. Although data is not available for every county and for every time period, there are some areas that provide contemporary estimates of the permanent versus temporary occupancy of townships or counties. Firstly,

> The permanent population refers to those persons who reside year-round [while] the seasonal population includes persons who temporarily reside… such as tourists and vacationers, but who normally reside in another location. The peak population would be the permanent plus the seasonal population that is an approximation of the study area's population on a "typical" day (Town of Southern Shores 2010:12).

Areas like Dare County see substantial seasonal occupancy that may account for a large percentage of the peak population in the summer months; the tourist season is seeing an extension into the fall months as well. It is also noted that some of the more severe reductions in visitations to tourist areas such as these may be associated with adverse weather conditions (Conley 1975:65). Unfortunately, resident type is not examined in the census record and would need to be assumed without further data. Seasonal occupants for example, may say they permanently live in another county from the one they occupy seasonally, or even another state. Therefore, an examination of such occupation would need to go beyond the census data to personal statements and accounts.

According to the statistical data, population change and the occurrence of severe weather events have mixed correlations. Where we see decreases in population with increases in hurricane activity, a direct correlation between population change and severe weather events may be implied, but where we see increases in population and increases in hurricane activity, the relationship is inverse. Population change is thus due to multiple factors rather than the severe climatic events themselves. This suggests that the theoretical approaches that emphasize multi-causal explanations for change to be correct. For example, Tomka and Stevenson (1993) argue that population and community shifts are the product of a combination of social, economic, and environmental factors, not just the catastrophic event itself. Thus, it is necessary to consider additional cultural factors such as war, migration of certain populations (i.e. African Americans out of the South), baby booms and their echoes, and even recreational and tourist populations.

Severe weather events, as theorized by catastrophists, cause pressure and stress on the social landscape of coastal areas (Pryzwolnik 2002:138). But as is evident from the data presented here, the stresses and pressures of hurricanes do not always transform regions or patterns of settlement (Losey 2005:105). The correlations between hurricanes and population change, if at all connected, are short-term, implying any changes or responses to natural events such as severe storms is variable by time and area on the small scale rather than on the regional scale.

*Lives Lost*

It is difficult to quantify the number of lives lost in severe storms for several reasons, the first being the lack of records for earlier storms or their lack of specific details. Additionally, the count of lives lost for a given storm may extend weeks or even months after a storm has occurred, making it difficult to relate specific factors or causes to that specific storm. Deaths from severe storms are often associated with the flooding that occurs alongside the storm as well. Many deaths from historic hurricanes are associated with the vessels lost along the North Carolina coast and contribute to quite large numbers such as 170 lives lost in the Independence Hurricane of 1775. Although it is argued that the number of lives lost seems to have decreased over time with each storm, deaths are still attributed to structural damages and collapse, casualties at sea, and severe inundation and flooding (Figure 5.2).

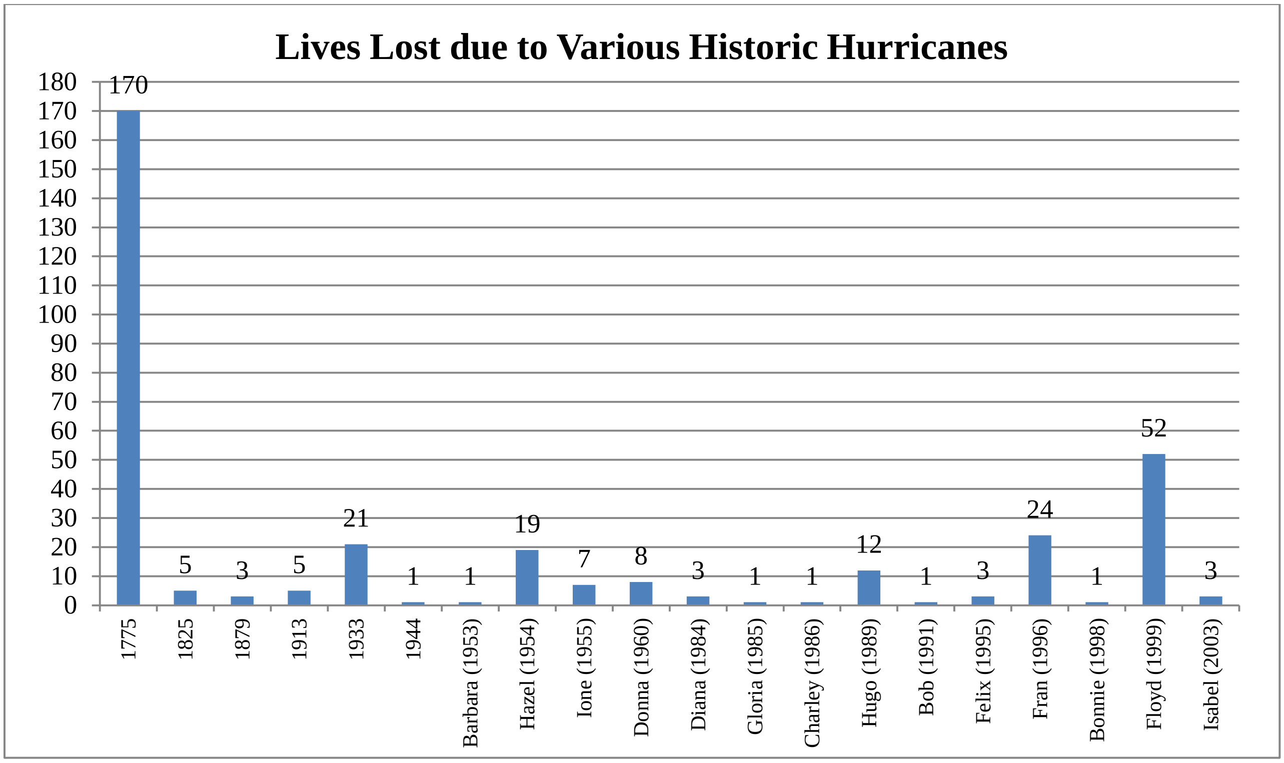


FIGURE 5.2 Lives lost from hurricanes and severe storms (Figure by Author).

The record of lives lost to severe weather events over time in North Carolina is incomplete at best, and one can see that the numbers of lives lost fluctuates depending on the specific characteristics of a storm. The course of time has not completely prevented the loss of lives during hurricanes, as can be seen from the substantial amount of lives lost during Hurricane Floyd (1999). Related to the number of lives lost is typically the type of effect that a hurricane brings; flooding has been a major cause of loss of life over time, but especially in modern occurrences of hurricane-related loss. Further examination of the historic record can provide insight into the amount of lives loss due to historic hurricanes, providing a more complete picture of change in this occurrence over time. Additionally, examining the nature of the deaths, such as due to immediate cause or later from peripheral effects would provide a better analysis of the correlation between severe weather events and the associated loss of life.

### *Economic Effects*

The need to define and analyze the economic impacts from climate and weather extremes has been long recognized as the United States experiences extremes of one type or another almost every year, but it may be difficult to assess the level of economic change brought on by severe weather events as the "economic impacts of hurricanes during a year depend upon several factors: total output, the capital-intensity of output, the location of economic activity, the number of storms, the intensity of storms, and the geographical features of the affected areas" (Chagnon 2003:273). The challenging task of assessing losses from severe weather events is compromised partly from the lack of any systematic collection of data (Chagnon 2003:273-274; Nordhaus 2006:5). Economic patterns in the historic record make mention of damaged crops, drowned livestock, wrecked ships, structural damage, lost commodities, and changes in shipping. In assessing these cultural factors and various industries we can see how over time, severe weather events have affected the economic vitality of the coastal area through these arenas. Trends in the economics of agriculture, tourism, forestry, and fishing have in turn altered the social character of the coastal residents. Additionally, changes in these industries can affect the changes in population of the coastal area, especially with regard to tourism and seasonal occupation.

Hurricanes have had various effects on economics and the cost of damages from severe weather events varies due to time, frequency, intensity, area affected, and resources affected.

Although monetary costs of losses over time may be relative, especially considering factors such as inflation, statistical analysis of the cost of damages from North Carolina's historic storms provides insight into trends over time and the possible nature of correlations between hurricanes and changes and/or trends in wreckage (discussed in Chapters Six and Seven), population, and thus occupation of the North Carolina coast.

*Agriculture*

The agricultural sector is one of the industries most affected by severe weather events. The large portion of rural farmland in coastal North Carolina experiences variations in agricultural damage across counties for a given storm, and damage varies due to crop type and the intensity of crops and livestock raised, distance to the coast, storm landfall, and the storm track. Variations in damages are dependent on the intensity of the agricultural sector of a given county, the timing of the landfall when crops may be more vulnerable to high winds and flooding, and commodity prices from year to year (Bin et al. 2007:78). Despite variations, some patterns do emerge, where higher intensity storms produce greater damage in the short term, while the frequency of lower intensity storms produces greater economic losses in the long-term.

Decimated crops, lost feed supplies, and dead livestock are ubiquitous with hurricane occurrences, and beginning with the 1820 census, information about the number of people engaged in agriculture, the value of produce, livestock, and farms, the value of real estate, crops planted versus crops produced, and the value of buildings, repairs, and the number of dwellings becomes available for analysis. In 1820, 27% of the population engaged in agriculture, and 25% in 1840, as opposed to only 0.3% that were engaged in navigation of the ocean or canals. In 1850, the cash value of just coastal North Carolina farms exceeded $13,000,000 and the value of livestock for the 22 coastal counties was $2,778,530 (Figure 5.3 and 5.4).

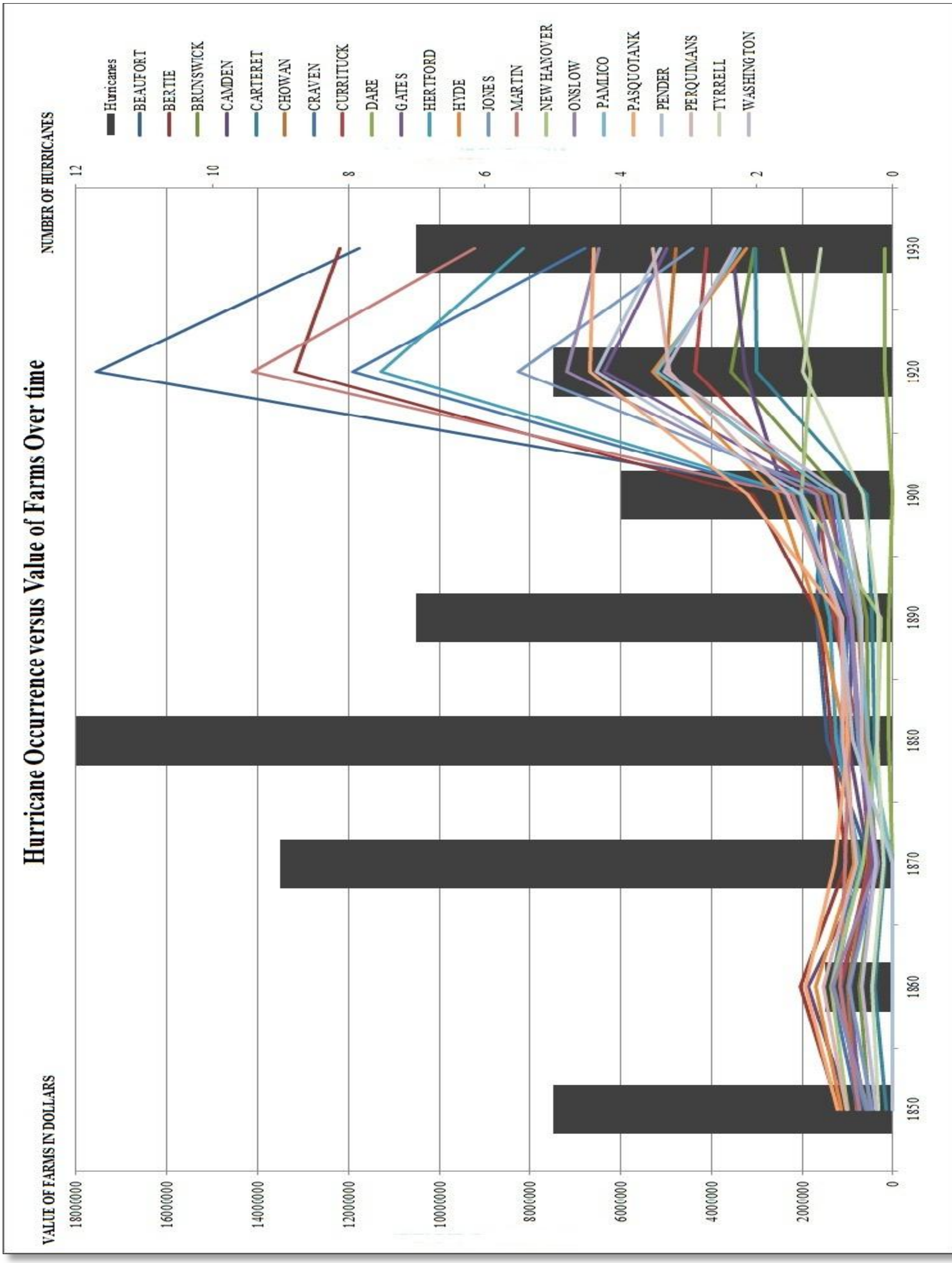



FIGURE 5.3 Value of Farms over time (Historical Census Browser 2004).

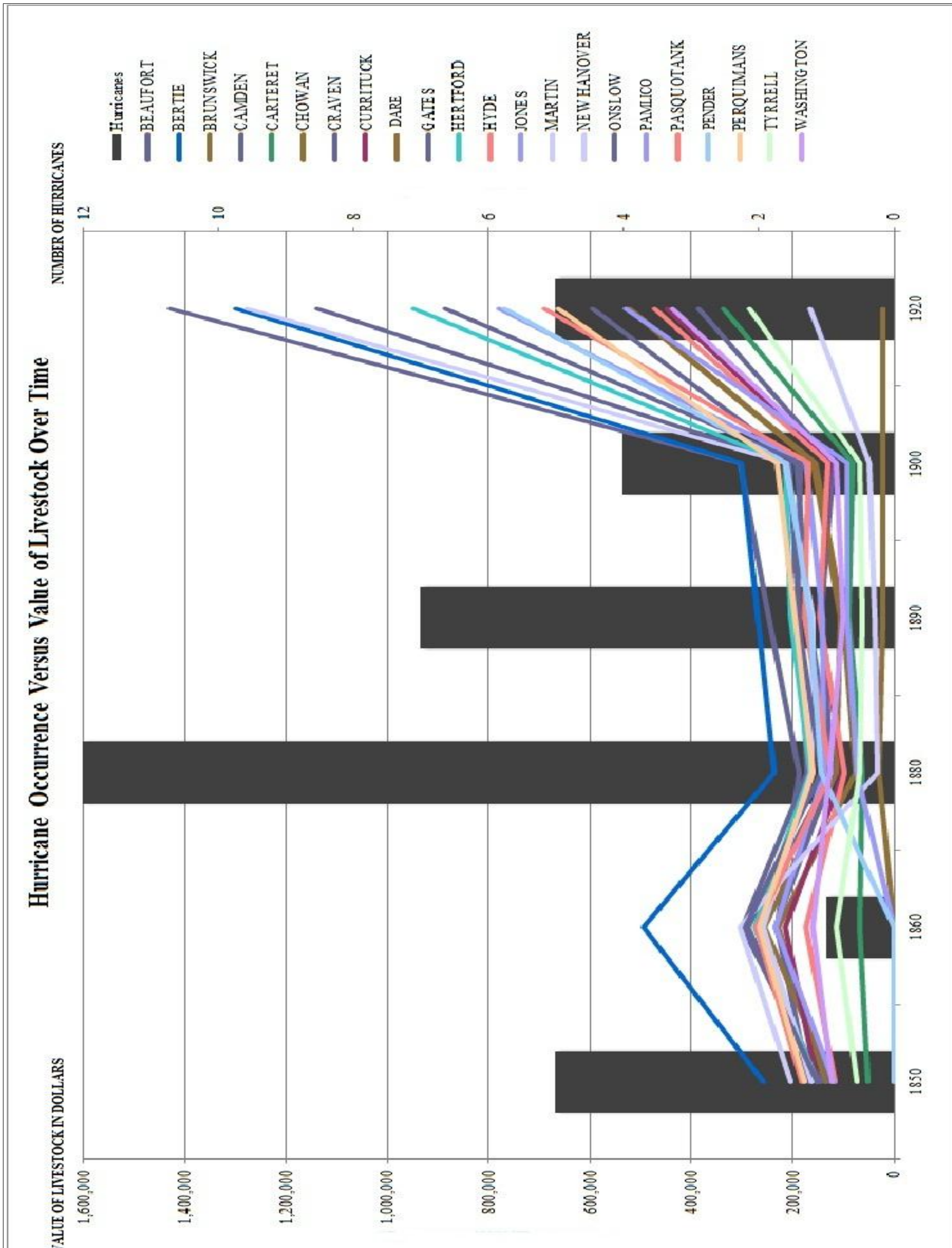



FIGURE 5.4 Value of livestock over time (Historical Census Browser 2004).

These values increased as the population of coastal North Carolina steadily increased over time, producing more farms at greater value. In 1860, the total value of farms, livestock, and orchard products was $27,897,548, but in 1870 this value had dropped to only $20,732,390. The 1860s were not a particularly devastating decade for severe storms, and the counties that were affected by a Category One storm in 1861 were small and did not encompass the greatest wealth in the value of farm products.  Two tropical storms in 1861 and 1863 passed through 12 of the 22 coastal counties, which would have produced a great enough effect to correlate with a $7,000,000 decrease in agricultural output; however, other decades, such as the 1870s, that saw an increase in the number of storms for the coastal area, would also be expected to produce residual effects such as loss in agricultural output and therefore value. But the 1880 census saw a rise in the value of farm products, livestock, and farm buildings back to $27,315,418, although there was a substantial cost of rebuilding and repairs in 1879 at $310,168, which may correspond with the frequent and intense storms of 1878 and 1879. These storms saw the greatest damage in Onslow, Beaufort, Carteret, and Bertie counties.

The number of farms and the value of all crops continued to grow into the early twentieth century, with the exception of the 1910 census record that saw a drop from $34,995,085 in 1900 to only $18,081,197; however, this total did not include the value of any livestock or farm land. The 1920 census shows an extreme increase in the value of all crops to $69,397,745 and the value of all farm property to $146,820,621, despite a severe Category One storm in 1913 that did severe damage from high water to crops and property. The lack of frequent or intense storms in the latter part of the 1910s as well as in the 1920s may account for the ability to quickly and substantially recover, presenting a decrease in property and promoting an increase in farm production and worth. The value of all farm property and the total value of crops decreased in the

1930s census overall; this is interesting considering the 1920s saw frequent but less intense storms, and areas such as Hatteras and Wilmington that experienced the brunt of these low-intensity storms, still saw an increase in output and value. These values are steady and consistent until the 1950s. Adjustment for inflation of agricultural output over time (Figure 5.5) shows that the 1920s as a period of extreme increase in agricultural output.

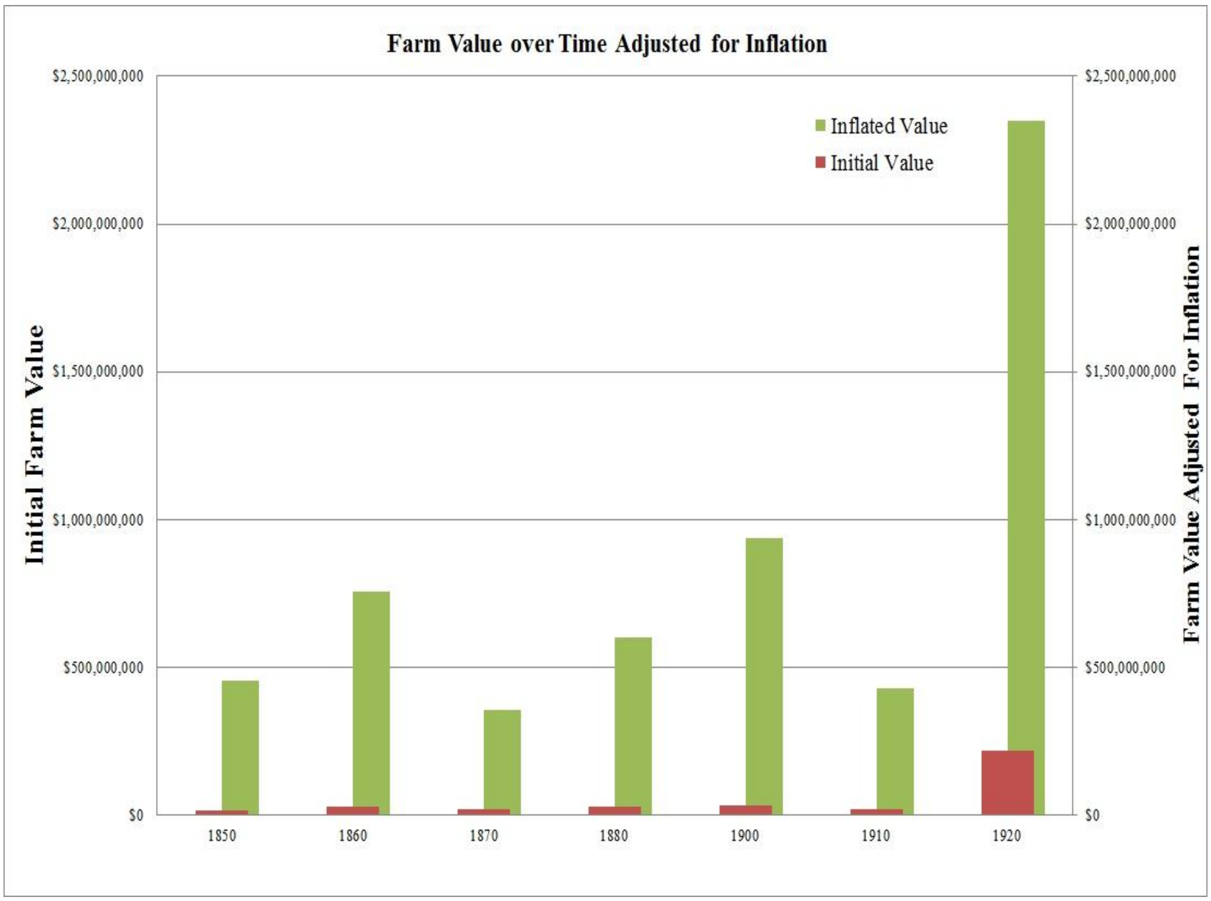



FIGURE 5.5 Value of Agriculture over time, adjusted for inflation 2010 (Historical Census Browser 2004; Williamson 2011).

Again, this correlates to a period of few and/or less intense severe storms; however, this was also a period of intense production, recovery, and rebuilding during and after the First World War. In this case, a lack of severe storm activity cannot be seen as the sole perpetrator behind extreme increases in agricultural output. There is a pattern of increase and decrease for every other decade of the census from 1850 to 1920. Census years, such as 1870, where there is a decrease in the value of agricultural output do not correspond with hurricane seasons that were particularly extreme, so the cause of these changes may relate more to non-environmental causes, such as the American Civil War in the 1860s for decreases in the value of agricultural output. Further analysis of individual trends would provide a better understanding of the effects of severe weather events on agricultural trends and the nature of any relationships.

Beginning with the 1930s, we see more mention in the historical record of the total costs of damage done by hurricanes and severe storms for coastal North Carolina (Figure 5.6-5.8), often with agricultural damage as a major contributor to the total cost. Damage to corn crops in New Hanover, Brunswick, Pender and Onslow counties contributed to $2,000,000 damage estimates in August of 1944. Barbara in 1953 caused crop damage that added to the $50,000 cost of damages. Carol in 1954 damaged corn and soybean crops resulting in $250,000 worth of damages. Flooding of farm lands and the destruction of crops from salt water inundation continued throughout the 1950s, and in 1960 with Donna, crop damage added to $1,000,000 in overall hurricane damage. Ginger caused corn and soybean damage again in 1971, contributing to the $10,000,000 bill for storm damage, and agricultural damage accounted for a portion of the $80,000,000 worth of damage done by Diana in 1984. Crop damage from Bertha in 1996 also attributed to a considerable portion of the damage that amounted to $270,000,000 in damages. The flooding from Floyd caused record high levels for coastal rivers prompting damage to agricultural products, a part of the $3,000,000,000 in storm damage.

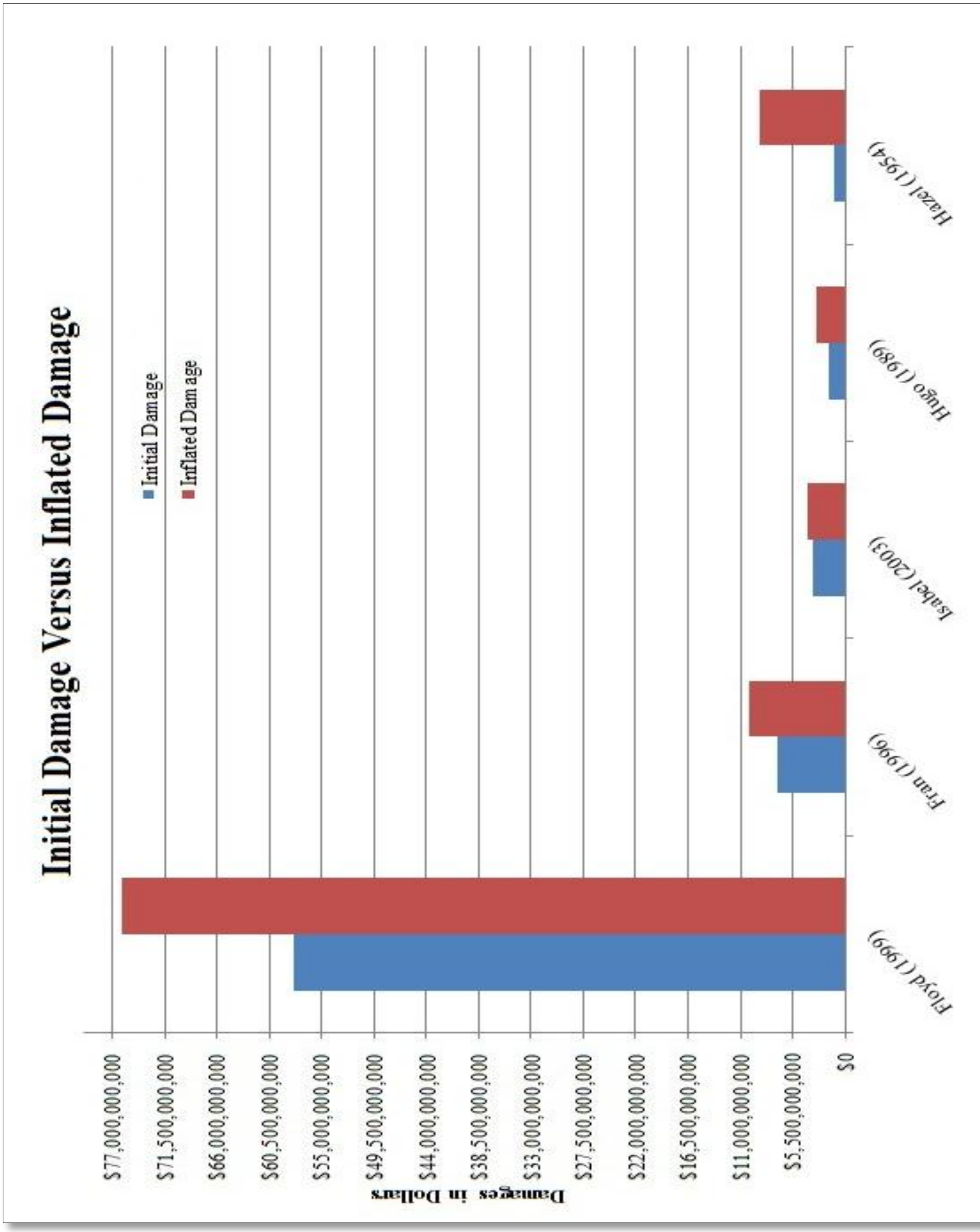



FIGURE 5.6  Damage amounts from storms through North Carolina's history over one billion dollars (Historical Census Browser 2004; Williamson 2011).

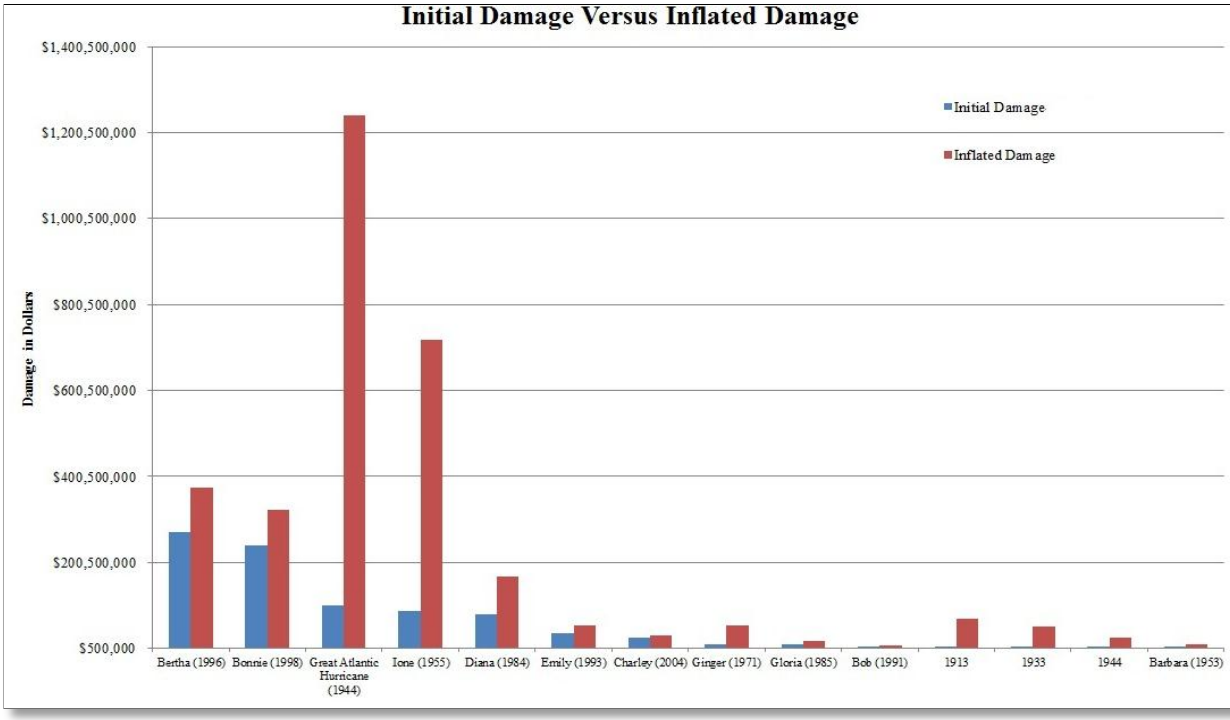



FIGURE 5.7 Damage amounts from historic storms over one million dollars (Historical Census Browser 2004; Williamson 2011).

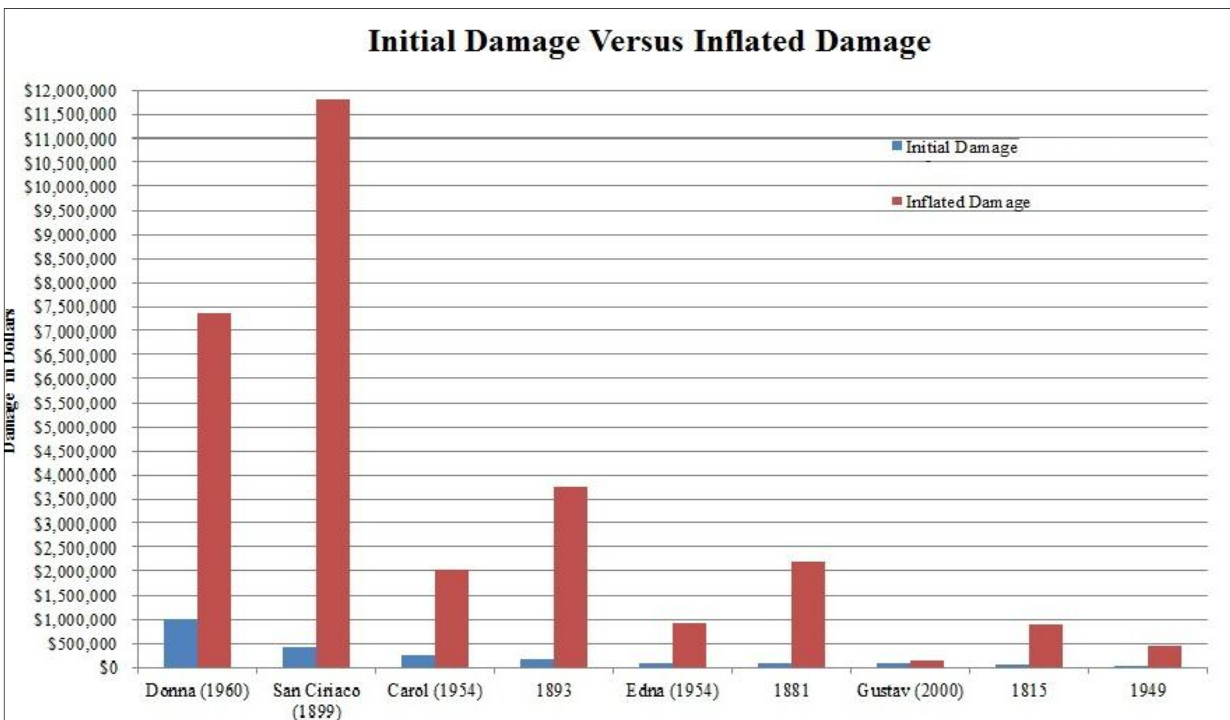



FIGURE 5.8 Damage amounts from historical hurricanes, one million dollars or less (Historical Census Browser 2004; Williamson 2011).

This happened again in 2004 with Charley, adding to the $25,000,000 tab. Between 1996 and 2006, "14 storms or hurricanes caused agricultural damage, including crop damage and impacts on livestock, totaling $2.4 billion throughout the state" (Karetinov et al. 2008:11). The graphs show raw figures for initial and inflated costs of damage done by historic hurricanes (i.e. no adjustment on the y-axis); they are divided into three separate graphs in order to better display the range of figures associated with damage done in dollars. Figure 5.6 shows damage amounts that were initially totaled to over one billion dollars, while Figure 5.7 shows damage amounts that accumulated between one million and one billion dollars initially. Figure 5.8 then shows hurricane damage amounts that were initially under one million dollars total. As is evident, after inflation even the smallest amount of monetary damage from historic hurricanes may be considered devastating.

Trends in agricultural damage are sporadic at best due to the lack of a complete record, at least provided by the census. Almost every recorded hurricane exhibits crop, livestock, or farm damage of some kind, but often the value of damage is unavailable. Further examination of state records and personal accounts may provide damage totals for agriculture, especially for the historic period where we lack complete information. Patterns from the census records do not include agricultural information for every census year, but do show some correlation between severe weather and changes in the value of agricultural products and associated infrastructure for coastal North Carolina over time, although not widespread across the region. In the mid-twentieth century we begin to see greater loss in terms of dollars, which is consistent with the higher monetary value being placed on crops, especially corn, in this time period. The severity of damage is dependent on the timing of hurricanes with the planting and harvesting seasons; the harvesting season for crops such as corn coinciding with the height of hurricane season for North Carolina—August through November (USDA 1997:6).

Not only must the damage to the product be considered, but also infrastructure needed to grow and process crops and livestock (Mulcahy 2004:642). Equipment and buildings associated with agriculture are vulnerable to storm processes but when viewing the little statistical data concerning these implements, the value associated with agricultural equipment and buildings remain strong and even increases in the early twentieth century. There is little on the effect of hurricanes on the agricultural laborer, with the exception of studies pertaining to plantation slaves in the British Caribbean and colonial South Carolina (Mulcahy 2004). Although we can see from the data presented here how someone involved in agriculture may fair economically, it is difficult to ascertain from this data any other information about the effects of severe weather on the individual laborer.

The long-term and short-term effects of severe weather on agriculture must also be taken into account to fully analyze said effects. Occasionally hurricane damage is severe enough to warrant production and product value to decline. As is seen from the statistical data, not all hurricanes result in major declines in agricultural production over time, and often output, despite damages, falls only slightly. The loss of crops seems to have short-term consequences to supply and cost, and often replanting and reproduction begin immediately after severe weather. The long term consequences to agriculture lie in changes in practice or the effects of environmental change. After Hurricane Floyd and its severe flooding, livestock farmers reevaluated the way the animals were to be handled, housed, and disposed of during and after severe storm events (Schmidt 2000:74-77). Also, as will be further discussed in Chapter Seven, environmental changes like inlet opening/closing after a hurricane can promote salt water inundation which would harm most crops. Despite all of this, it is difficult to propose that North Carolina's historic hurricanes have in any way transformed the fundamental structure of the agricultural economy of the coastal region; we can go so far as to say it can and sometimes does shape and change aspects of North Carolina coastal agriculture mainly in the short-term, but further analysis and examination of aspects such as human decision-making and choices about areas to plant or decisions to rebuild would need to be consulted. The concept of catastrophism argues that a severe climatic event such a hurricane or tropical storm has a role in cultural or environmental change that may lead to adaptive adjustments, modifications, or transformations within a community or culture (Tomka and Stevenson 1993; Laoupi 2003). If we relate this to the arena of agriculture, we see that in some aspects, severe weather events promote modification or adaptation of components within the larger framework of agriculture, but long-term, regional transformations are not seen in the data at this time.

*Tourism and Lodging*

A large portion of the collective economy for coastal North Carolina is due to the tourism and lodging industry. Seasonal occupants and beach-goers have flocked to the North Carolina coast in growing numbers, especially since the 1960s. The key to economic growth in coastal states such as North Carolina "has been the strength of the travel and tourist industry [and] coastal communities have shifted from traditional maritime activities such as fishing and boating, to a more service-oriented, and tourism-dependent economy"—especially since the 1970s (Klein and Viola 2004:1080).

Although the height of the tourist season and the height of hurricane season do not completely coincide, the tourism industry has seen the effects of North Carolina's severe weather events. An analysis of the lodging and tourism industry before September 1999 found that North

Carolina's tourism industry was economically sound, but with the hurricanes of September and October of 1999, seasonal and temporary occupancy halted for the coastal plain of North Carolina. The decrease in occupancy in relation to tourism caused nearly three quarters of a million dollars in losses from flood-related damages. In the long term, the amount of damages totaled to $3,800,000 from physical damages and lost resources (Chandler 2004:317-318). Physical costs to tourism came not only from property damage but also from losses to beach area from erosion and inundation, leading to less tourism, causing additional beach area economic and business losses (Karetinov et al. 2008:9). The short- and long-term effects of hurricanes on the tourism industry in coastal North Carolina relate to rebuilding of structures as well as business interruptions that include disruption to services, supplies, and access (Burrus et al. 2002:119). Environmental processes such as overwash can extend the long-term effects of severe storms on tourism and lodging if roads are cut and access to beaches closed. These effects may last as long as several weeks or months after the storm event, but these disruptions have not prevented tourists from returning to coastal areas and beaches, within weeks, months, or years.

The correlations between severe weather events and changes in the tourism and lodging industry are short-term and vary depending upon the characteristics of a community. Just as hurricanes are sporadic events, the impacts of said events on the socioeconomic structures of the economic landscape, including the substantial tourism industry, are sporadic in effect. Despite the large losses and large potential losses faced by the tourism industry, tourism and lodging often recovers from the short-term impacts quickly enough to prevent long-term change in the regional patterns of coastal seasonal and temporary occupation. The interrelation of such phenomena as severe weather events and the quick recovery of the tourism and lodging industry may be representative of a broader process of behavior and activity that link the communities of the North Carolina coastal region to their landscape.

*Forestry*

Apart from the agricultural sector, the forestry industry has also been affected by severe storms and hurricanes over time. The forestry industry has always had a substantial impact on the economy of North Carolina. According to the Natural Resources Conservation Service (NRCS 2000), North Carolina currently contains 15,958,800 acres of forestland, a substantial amount which lies in the coastal zone of the State (Figure 5.9). Forestry-related industries, such as construction and furniture contributed $3,100,000,000 to North Carolina's economy in 2005, and are equally as impacted by hurricane effects as the forestland itself (NRCS 2000). Physical damage to forestland from hurricanes comes from the high winds, storm surge, and rain. The species of the tree influences reaction to wind abrasion and energy transfer, while topography can influence exposure to winds and soils influence anchorage (Stanturf et al. 2007:123).

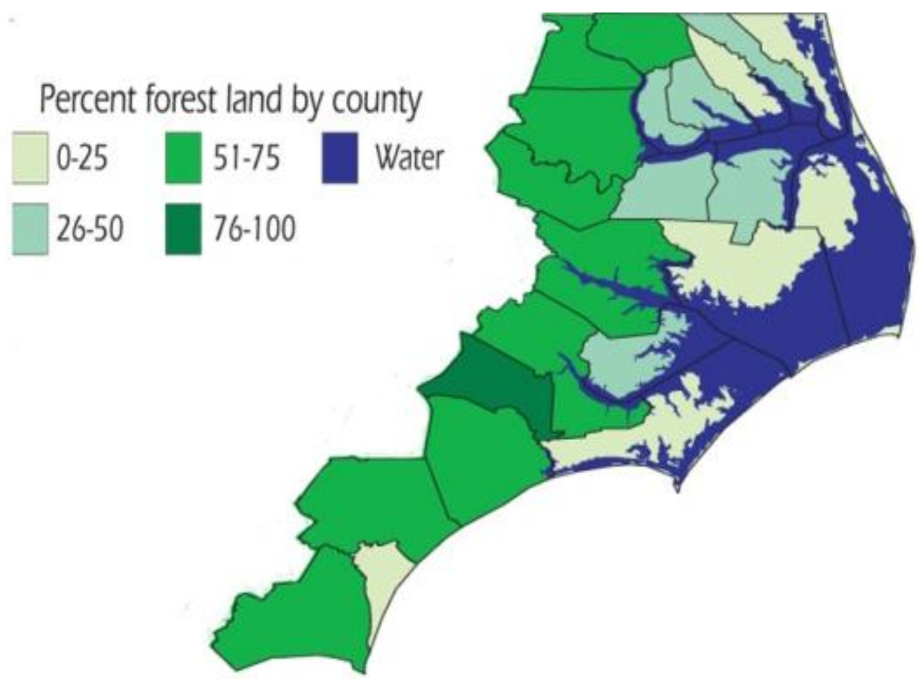



FIGURE 5.9 Percentage of Forestland by county, North Carolina (Brown 2011).

Damages from Hurricane Hugo in 1989 included a large portion of the lumber industry. Although Hugo was a Category Four storm, it did not make landfall in North Carolina; however, approximately 68,000 acres of North Carolina's forests were destroyed, and another 2,700,000 acres were damaged. In total, North Carolina lost $435,000,000 worth of lumber (RENCI 2010). Hurricane Fran, a Category Three storm, damaged 8,300,000 acres of forest throughout North Carolina, resulting in $1,700,000,000 in damages (Karetinov et al. 2007:11).

The geographic distribution and level of forest damage are heavily dependent on the relationship between storm track and the distribution of forest land and tree maturity. Due to variations in timber and pulp prices, and the distribution of timber, it is difficult to "estimate the average impact of a hurricane of given severity, much less the incremental impact of increased severity" (Bin et al. 2007:79). However, a study estimates that forest damage in North Carolina rises by $500,000 for every increase in level of category or intensity (Karetinov et al. 2007:11). If we use this estimate as a guide, the damages to coastal forestland in North Carolina due to hurricanes is potentially devastating, especially when considering the peripheral effects to forest-based industries, which would add substantially to the economic losses. If we consider that Hurricane Fran, a Category Three resulted in $1,700,000,000 in damages (adjusted for inflation to $2,360,000,000), and each category of storm would increase or decrease by $500,000, even tropical storms and Category One storms would be extremely costly.

According to Leroy (2006) the amplitude of a disaster is added to by area, time, and local characteristics that converge to dictate how an area, community, or in this case, an industry react to a phenomenon; in the case of the forestry industry, this is seen to be true. The effects of hurricanes on the forestry industry are amplified by time, environment, and the local characteristics of the land and species. The effects of severe weather events on the forestry industry for coastal North Carolina differ from the effects on other industries due to the nature of the industry; the effects of hurricanes and tropical storms are more long-term due to the time it would take to recuperate from any damage or destruction. As it could take years to regain harvestable wood products, forestry and forestry-related industries would need a longer recovery time than industries that could recuperate within a few weeks, months, or just a few years.

*Commercial and Recreational Fishing*

Although little research to date exists on the relationship between hurricanes, commercial and recreational fishing, and the socioeconomic characteristics of North Carolina's coastal communities, hurricanes may present long- or short-term effects to fishing and coastal communities (Cheuvront 2005:10; Burgess et al. 2007: xvii). The hurricane that struck the North Carolina coast in 1846 and opened both the Hatteras and Oregon Inlets, brought saltwater, and consequently saltwater creatures into the sounds (Whisnant and Whisnant 2010:165). According to Burgess et al. (2007: xvii): "Hurricanes do not appear to have long-term consequences on fish stocks themselves most of the time; however, hurricanes can affect fisheries by causing damage to gear, vessels, and personal property which keep people from actively fishing." Hurricanes can also result in damage to docks and channel markers and present hazards to navigation that lead to an increase in vessel loss. Although rare, "occasionally, environmental conditions could be right for a hurricane to cause a lasting impact on a particular fishery" by decimating a population or forcing a particular species out of an area when conditions, such as warmer waters, change over time (Burgess et al. 2007: xviii). But these conditions may not be attributable to a series of hurricanes or tropical storms but a combination of storms and other effects. Burgess et al. (2007: xviii) provide evidence that hurricanes may actually produce a greater impact on estuaries and nearshore fisheries than offshore, and sectors of the economy most affected by any decline are actually dwellings (mortgages rates), wholesale trade, food services, medical services, and the real estate industry.

All fisheries do not feel the impacts of hurricanes and severe storms to the same degree. The impact varies depending on the fisheries involved, gear used, and bodies of water fished (Cheuvront 2005:10). North Carolina's fishing industry suffered extensive damage from hurricanes Dennis, Floyd and Irene and their accompanying floods. Vessels, fishing gear, and shoreside structures, or the infrastructure supporting the commercial and recreational fishing of North Carolina were damaged or destroyed more than the species concerned (Cheuvront 2005:2). Fisherman have often described the movement of species from their normal habitats and a result of water quality changes after hurricanes causing habitat destruction; some argued that their targeted species were pushed out of sounds and inland waterways by the large volumes of water dropped by hurricanes such as Floyd, while some said their species had not recovered in numbers in specific areas to their pre-hurricane levels (Chevuront 2005:10). However, from the surveys presented in Cheuvront (2005), most fishermen did not feel that hurricanes caused direct and long-term damages to their industry that would force them to relocate or even cease fishing as an occupation. Thus, the correlation between severe weather events and the fishing industry is mainly short-term and related more to the infrastructure of the industry rather than any overall, long-term connections. A study of specific species and geographical locations within the North Carolina coastal region would provide a better understanding of the specific components of the industry in relation to reaction to severe weather events. However, for the analysis of this thesis, the correlations between hurricanes and fishing is seen as mostly negative given the short-term effects and general lack of change associated with the effects of severe weather events. In the case of the fishing industry, despite the potential for losses to equipment and facilities, the severe weather events are not seen to evoke any major human response in the face of the storms. The industry can be seen to adapt to the environmental circumstances if needed, but it may not always be necessary to do so.

*Property*

The estimates of property damage, which includes damage done to crops (previously detailed), roads and highways, and power and communication lines, are never considered more than rough estimates or approximations of the damage actually done  and can be exaggerated, but we can gain some semblance of the impact of hurricanes on the coastal area by examining the property damage done over time (Tannehill 1952: 133). In the early historic period of North Carolina's, property damage, apart from vessel loss and agricultural damage, was perpetuated in residential and commercial buildings, piers, and wharves. In the eighteenth century, courthouses in Onslow and Brunswick counties were destroyed from severe storms, and towns such as New Bern were constantly trying to rebuild from flooding and wind damage to trees, roads, and houses. Along rivers and in port towns such as Smithville, Wilmington, Edenton, and New Bern, wharves and warehouses located near the water were often destroyed. The Great Hurricane of North Carolina in 1815 destroyed grist mills and saltworks, as well as washing out roads, costing approximately $60,000 at Swansboro. In 1879, a severe hurricane decimated the Atlantic Hotel in Beaufort. Lighthouses were also vulnerable to the destructive forces of severe storms, often requiring extensive repairs. Besides specific buildings and roads, whole cities and village communities were damaged or inundated from flooding, requiring residents to move, as with Diamond City, or rebuild, sometimes continuously as with New Bern. Bridges, railroads, and jetties were often crippled from storms, blocking the movement of people, commodities, and aid.

San Ciriaco was particularly devastating on various levels and its economic impact was no exception. Ocracoke and Hatteras Islands were partially destroyed with "practically every house on the island (Ocracoke)…damaged to some extent" (*Washington Gazette* 1899). For Hatteras Island the property damage estimates were around $436,000. Hurricane Hazel's economic impact varies, but Brunswick County was hardest hit with only five of 357 buildings remaining afterward. New Hanover sustained $8,000,000 in damages adding to the $1,100,000,000 estimated for North Carolina. Buildings such as the Old Pier House Restaurant (Figure 5.10) on Kure Beach and the general area of Carolina Beach (Figure 5.11) were destroyed during Hurricane Hazel.

FIGURE 5.10 The Old Pier House Restaurant remains perched on its stilts among the wreckage next to the Kure Beach Pier (Photo courtesy: Hugh Morton, Storms to Life 2010) .

FIGURE 5.11 October 1954: Carolina Beach, N.C. Boats stranded by the side of the road (Photo courtesy: Hugh Morton, Storms to Life 2010).

Although Hurricane Hugo made landfall in South Carolina, North Carolina suffered $1,700,000,000 in damages. The lumber industry suffered greatly, as did the beaches of Brunswick County, where damage to homes, businesses, and structures amounted to $131,000,000. Fran surpassed Hugo with a cost of $7,200,000,000, hitting Topsail Island and the Wilmington areas the hardest, where homes, churches, boats, and agriculture were ruined. Hurricane Fran tore apart homes (Figure 5.12) and overwashed islands to the point of inaccessibility (Figure 5.13).

FIGURE 5.12 Fran tore this house in coastal North Carolina in half (Gatley 1996).

FIGURE 5.13 An aerial view of overwash at North Topsail Beach (USGS 1996).

Floyd’s economic impact varies from $5,800,000,000 to $7,800,000,000, but especially hit was agriculture, totaling $1,290,000,000 in damages. Flooding was a particularly devastating effect of Hurricane Floyd (Figures 5.14) as well as substantial storm surges along the coast (Figure 5.15).

FIGURE 5.14 Aerial photograph of inland flooding caused by Hurricane Floyd (Jordan 1999).

FIGURE 5.15 Floyd's 15-foot storm surge destroyed this house in Long Beach (Gatley 1999).

Piers have been a constant reminder of the ability of severe storms and hurricanes to quickly wipe out existing structures. There were once as many as 39 fishing piers along North Carolina’s coast; now there are approximately 20, many destroyed by hurricanes, leaving nothing but pieces of post in the surf as a reminder of their existence. Frisco Pier, a historic pier at Hatteras was cut in half by Hurricane Earl (Figure 5.16). Because of the cost of repairing piers, whether wooden or steel, often they are not rebuilt and their cost adds to large damage estimates such as in 1996 and 2003.

FIGURE 5.16 Bridge damage at Frisco Pier, Hatteras, NC during Hurricane Earl (Adkins 2010).

Since the early twentieth century, estimates for property damage have skyrocketed due to the increasing values of oceanfront property and the money and technology put into transportation and technology systems. A Category Three hurricane in 1933 left hardly a building standing in many coastal towns, with damage estimates beginning in the millions. This trend continued into the 1950s and 1960s with the first billion dollar loss in 1996 with Hurricane Fran. Although it is difficult to compare earlier losses with modern expenses, it is likely that the damages could have been just as costly, especially considering inflation. The value of beach front property has increased more in value over time than property in other parts of coastal North Carolina. This is interesting considering that storm damage is more pronounced on the beach side of the coastal counties, especially along the Outer Banks. One study thus concludes that "since such property has shown a great increase in value, one must conclude that neither weather conditions nor any related factor has had an adverse effect on the value of property" in most coastal counties (Conley 1975:38). This is very telling of the current situation in coastal North Carolina about the relationship between property value and the settlement of such a disaster landscape. If the property values were not as high, would people still flock to the coast in the face of such great risks? Given other periods of time, this relationship seems different, although not starkly so. Property values of course were not as high in previous periods of North Carolina's history, yet residents continually over time have sought to settle along the coast despite the risk of inclement weather, leading one to assume that although destruction to property proves to be a great and costly disruption, it is not a hindrance to settlement patterns, at least as seen from the data presented here.

*Environmental Trends*

Severe storms and hurricanes often have a dramatic effect on the physical configuration of an area, especially a coastline. North Carolina is no exception and severe storms have altered various environmental elements throughout the State's history. These environmental factors have in turn shaped changes in terms of coastal society and economics and how and where people have occupied the coastal zone. This section will examine the environmental patterns created and manipulated by the occurrence of hurricanes through inlet change, coastal erosion, and storm surge inundation. Inundation maps based on various levels of hurricane intensity and shoreline maps demonstrate changes over time. These maps are used to analyze any possible correlations between severe weather events and environmental change as well as the correlation between hurricane-related changes and socioeconomic trends that may have influenced settlement and occupational patterns on the North Carolina coast.

If we assume that the relationships or correlations between severe weather events and environmental change are positive, the questions remains how do these correlations affect other transformations—i.e. settlement? For example, if we know that certain hurricanes in history have hit an area and caused a physical change—shoreline erosion or inland flooding—or if we can hypothesize that certain physical changes are possible with a certain type of storm (i.e. Category Four produces extreme inundation, 115 mile per hour wind abrasion, or 0.5 meter shoreline erosion), then how do these known or possible reactions and responses affect and manifest themselves in modifications and transformations of other cultural attributes and resources? Environmental changes evoked by severe weather events, such as inlet change, storm surge, or coastal erosion can be seen as examples of n-tranforms that create and manipulate coastal sites, and thus potentially prompt the human decision making that creates or perpetuates the occupation of North Carolina’s disaster landscape.

*Coastal Erosion*

Hurricanes have been a significant factor in the erosion of North Carolina’s coast over previous centuries. They can cause significant shoreline damage leading to loss of property and life. Often, erosion from hurricanes to beaches and barrier islands prevents their ability to function as effective buffers. Some coastal areas experience infrequent hurricanes causing “periods of rapid beach erosion and widespread damage followed by calm periods when the beach is relatively stable. This sporadic loss promotes a false sense of beach stability and safety that has led to high density development” (Morton 2004:7). Some debate if hurricane action causes long-term erosion to coastal regions such as the entire southern United States, many arguing the shoreline data expresses that although in a few hours or days large amounts of beach width can be lost due to a severe storm, beaches actually recover after a storm to a consistent long-term position. Large storms can cause drastic erosion during a short period including overwashing and the creation of inlets, but this deviation is considered only temporary in the long-term evolution of a barrier island or shoreline (Zhang et al. 2002:493). Underdeveloped beaches and barrier islands revert quickly to their original state after extreme events, but with mass development, the risk of living on the coast has changed, making property once thought to be safely located inland, more exposed to storm-related hazards (Dolan et al. 1988:418; Dolan and Davis 1994:103). In examining the shoreline data from various time periods, we can see that the trend for the North Carolina coast follows these rules, with little change over the long-term periods, except in areas such as inlets and capes, and drastic changes following extreme storm conditions (Figures 5.17).

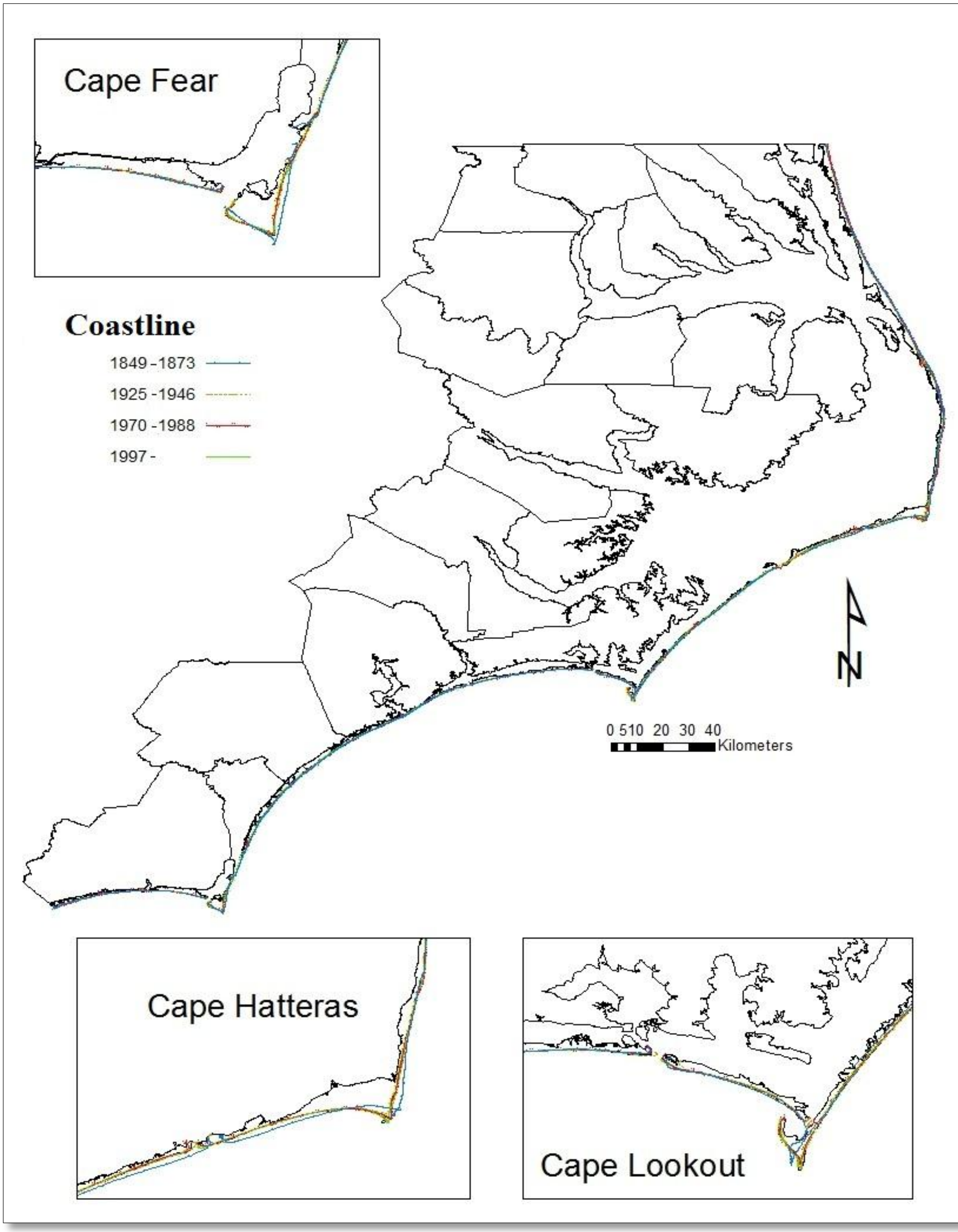



FIGURE 5.17 Evidence of shoreline erosion over time at various North Carolina capes (North Carolina Department of Environment and Natural Resources 2005).

Although the central map of the entire coastline is makes it difficult to discern shoreline change, there are changes over time that are visible in areas such as Cape Fear, Cape Lookout, and Cape Hatteras. Storm activity is one of the two major processes, apart from sea level rise, that drive barrier island migration and coastal erosion. Storm processes erode, transport, and deposit sand, and in areas with minimal human interference, sand is transported across an island as overwash or funneled through inlets to accumulate during storms. Both of these processes allow barrier islands to accumulate width and elevation. However, human modification interferes with the natural processes and "accentuates erosion on the ocean and estuarine side of the islands" (Culver 2008:16).

There are various examples of areas along the North Carolina that exhibit reactions to coastal erosion and shoreline change. Either through the natural processes afforded over time or through human-made corrections, the trend leans toward survival rather than abandonment or movement. Ocracoke village, on the widest stretch of Ocracoke Island, an area notorious for hurricane records, has managed to survive for hundreds of years. In its remote location and small size, Ocracoke Village has resisted mass development, which may be what has saved it from storm destruction. Although the land is low enough to experience floodwaters from storm surge, the marine forest reduces this risk to storm devastation and prevents its complete demise (Pilkey et al. 1998: 161). Wrightsville Beach in New Hanover County, located between Mason and Masonboro Inlets, has been raked by numerous historic hurricanes but has managed to maintain a growing seasonal occupation. Despite destruction from Hazel and Diane in the 1950s, various replenishment techniques have prevented complete island erosion. The fact that Wrightsville Beach sees mainly seasonal occupation, apart from a handful of permanent residents, may also be a factor in the area's survival. Connection to the mainland and the reoccupation of the island sets Wrightsville Beach apart from other areas such as Shackleford Banks (Pilkey et al. 1998:186).

Carolina Beach, also in New Hanover, between Carolina Beach Inlet and Cape Fear, is another island community that has maintained a steady seasonal occupation despite continual devastation from storms as early as the 1880s. The 1950s were particularly intense for Carolina Beach, as Hazel, Connie, Diane, and Grace each caused severe damage for the area, followed by Bertha and Fran. However, despite flooding and structural damage, Carolina Beach's recovery can be attributed to its geologic setting and beach nourishment. Carolina Beach is located on an area of spit that is low and prone to overwashing but the mainland is high enough to withstand all but the highest-intensity storms (Pilkey et al. 1998:189). In spite of the high risk of the spit area, development of this portion of the island continues as does the seasonal population. On the very southern spit of the island, Kure Beach has fared even better from storms such as Fran and Hazel. Although the Kure Beach Fishing Pier has been destroyed 12 times and erosion is a constant concern, the dense forest and high elevated bluffs have buffered Kure Beach from the intense storms that have historically targeted this area, preventing total devastation and abandonment. Again, Kure Beach experiences seasonal occupation and is often reoccupied after storms have occurred. Additionally, Sunset Beach, the southernmost North Carolina island, has been battered by several hurricanes, especially Hazel which annihilated Cape Fear. But due to the accretionary dunes on Sunset Beach, the island has been able to bear the brunt of these severe storms (Pilkey et al. 1998:200-201).

Various areas along the North Carolina coast react differently to the effects of storm-driven coastal erosion; these reactions invariably dictate how a community reacts to changes whether it be through some form of movement or through maintaining a level of permanence.

Despite changes in the shoreline along the North Carolina coast, especially seen in areas such as Cape Fear and Cape Lookout, population continually grows, even despite periods of intense erosion seen in the 1970s to 1980s. Considering the aforementioned debate concerning the level of long-term erosion capable of severe storm events and the generalized spatial examples of shoreline movement over time, we see that in general, the effects of severe weather events on coastal erosion and shoreline change do not correlate to regional changes in coastal occupation for North Carolina. Coastal erosion and shoreline change associated with severe weather events can disrupt some economic factors; tourism, especially of the beaches in North Carolina, can be affected by changes to the coastline when beach areas are shortened or roads are overwashed. But as expressed earlier in this chapter, these disruptions are often short-term and area-specific rather than long-term or regional.

*Storm Surge*

Storm surge and the associated inundation are two major causes of destruction and concern for coastal communities in North Carolina. The rising water level causes flooding, especially in the rivers and coastal areas, many of which are less than ten feet above sea level. Therefore, storm surge along the coast "is often the greatest threat to life and property from a hurricane" (NHC 2011). Using shapefiles for fast-moving storms that combines categories 3, 4/5, we can see how much of the coastal region of North Carolina is affected by storm surge and hurricane flooding (Figure 5.18). The notorious Hurricane Hazel of 1954 arrived around lunar high tide, when sea level was already above normal. With strong winds and high water levels, beaches from Topsail to Southport experienced surges up to 15 feet, with a record-breaking surge level of 18 feet at Holden Beach and Calabash.

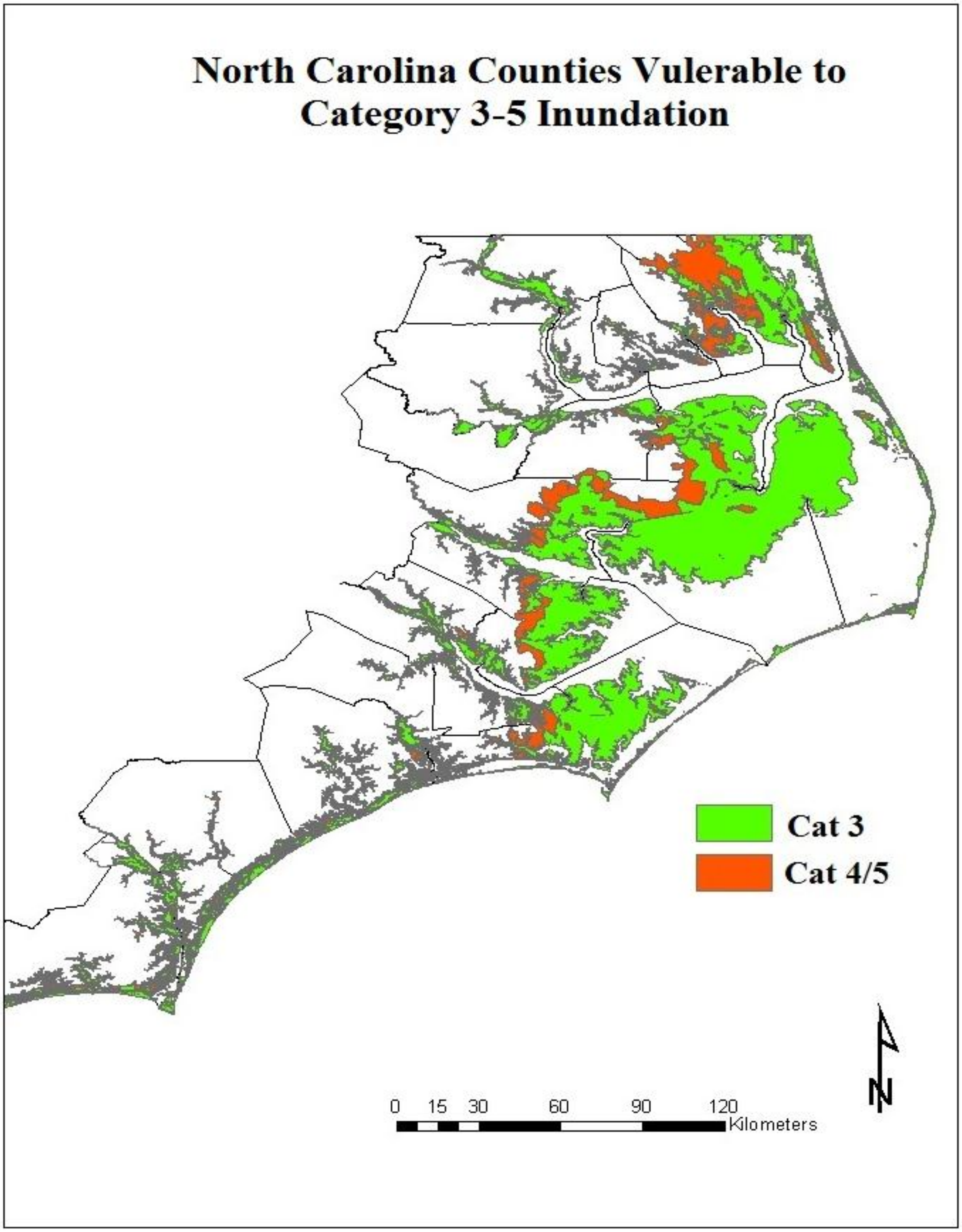



FIGURE 5.18 Storm surge inundation—Category 3-5 (National Hurricane Program 2002).

The storm surge was so powerful, areas removed from the landfall at the North Carolina/South Carolina border experience severe flooding. The storm surge also altered the coastal landscape, reopening Mary's Inlet (RENCI 2010). With Category Four/Five storm surge inundation, the entirety of the Outer Banks from Currituck to Cape Fear is inundated as well as Dare and Currituck counties. The inundation continues inland with levels covering most of Carteret, Pamlico, Hyde, Tyrrell, and Camden counties. Additionally, due to New Hanover County's location, riverine flooding increases its vulnerability to Category Three-Five storm surge inundation. It is interesting to note that the largest levels of inundation occur in the least populated areas such as Dare and Hyde counties, with the exception of Carteret and New Hanover counties. Not only does inundation affect the coastal populations themselves, but can cause interruptions and disruption to various industries; agriculture is at risk to saltwater inundation when Atlantic waters breach the Outer Banks or winds push waters into the estuaries, while livestock are at risk to drowning. Additionally, the majority of lives lost to hurricane events are caused by severe flooding.

*Conclusion*

When examining the relationship between population statistics from the historical data and hurricane data, the trend for the coastal population shows a continual increase until the twenty-first century, even for those counties that experience the most severe hurricanes. The modern era has seen an explosion of occupation on the coast, especially since 1960, when there was a lull in the frequency and intensity of severe weather events for North Carolina. But even with the harsh hurricane seasons of the 1980s and 1990s, coastal North Carolina continued to grow in population. In the long term, especially with regard to the modern period, severe weather events and their created disaster landscape have not correlated to patterns of settlement in terms of abandonment, for North Carolina as a whole; however, this can only be said with any certainty for the recent past or at least the 1960s to the present. Before this time period, various regions and short-term periods saw correlations between the coastal disaster landscape and occupational patterns.

Hurricanes have brought various levels of devastation to industries such as agriculture, forestry, fishing, and tourism, but it is not always clear if the changes in these industries prompt changes in occupation of the coastal area. With the exception of the forest industry, North Carolina’s coastal industries experience short-term effects, and rarely suffer from long-term change. Additional examinations of the economic factors are necessary to understand if certain areas of farmland, areas of fishing, or changes in seasonal occupation are results of human decisions that take into account the severe weather events that are habitual to the coastal North Carolina region.

Chapters Six will further examine the statistical correlations of severe weather events and cultural resources such as shipwrecks. That Chapter will provide a more detailed examination of such correlations, rather than a general assessment of regional effects. Chapter Seven will also examine population data spatially in order to visualize any patterns in the data as is positively or negatively correlates to hurricane activity over time.

# CHAPTER SIX: A CHANGE IN THE WIND…

## STATISTICAL CORRELATIONS

The spatial and temporal signatures of severe weather events in North Carolina are varied and present a unique opportunity to approach the identification of such events in the archaeological record. Because there is debate, presented in Chapter Two, as to the legitimacy of viewing weather events in the traditional sense of archaeological investigation, e.g. patterns in sediment layers or wear on artifacts, there is a need to seek and analyze evidence of severe weather events elsewhere. The signatures of such events may be more readily visible through patterns of shipwreck deposition, changes in shoreline configuration such as inlet opening or closing, the destruction of permanent structures such as piers, wharves, warehouses, or residential buildings, or the obliteration of entire communities. These signatures are mentioned in historical records, but the examination of their presence in the archaeological record allows for the analysis of site formation processes carried out by severe weather events and the precipitation of site formation and change, and ultimately the understanding of correlations between severe weather events, the patterns of sites, and patterns of occupation in North Carolina's disaster landscape.

This chapter utilizes statistical analyses to express patterns seen in the archaeological, spatial, and temporal data in relation to hurricanes and shipwrecks. Chapter Seven will discuss the geospatial correlations between severe weather events and shipwrecks, population change, and environmental factors. Together these analytical techniques provide a complete picture of the themes of settlement, abandonment, and socioeconomic change and may refute or reflect the generalizations of archaeological and cultural theorists where catastrophe is concerned.

## *Hurricane Patterns*

The numerous storms and hurricanes to hit coastal North Carolina present statistical patterns in general events such as intensity and general location, as well as chronological patterns such as frequency by year. In viewing the data statistically, we can better understand the patterns that emerge, such as periods of time that received the most impact from historic and contemporary hurricanes or areas of the coast that have endured more intense weather events than others. This section will examine the hurricanes that have intersected the North Carolina coast through time, as well as the intensity of the storms. In looking at the individual components of the storms in relation to the coast as a whole, we may better understand the specific and general effects of North Carolina's historic hurricanes on its various coastal communities, and any behavioral changes associated with severe weather events as natural transformations.

### *Chronological Statistics*

Chronologically charting storms of the historical record provides a better idea about which periods experienced the greatest threat from these severe storms. In viewing the trends in hurricanes chronologically we can also correlate the statistical data to economic, social, and environmental patterns that were discussed previously. The statistical data, gained from the historical record, presents patterns by year and by month for coastal North Carolina.

There is evidence of hurricanes hitting North Carolina's coast since the sixteenth century when these storms most likely occurred with "the same regularity as they have in subsequent centuries, though in the sixteenth century there were no permanent settlers to keep tabs on them" (Ludlum 1963:9). But in the late-seventeenth century, a more permanent and cohesive storm record began to manifest.

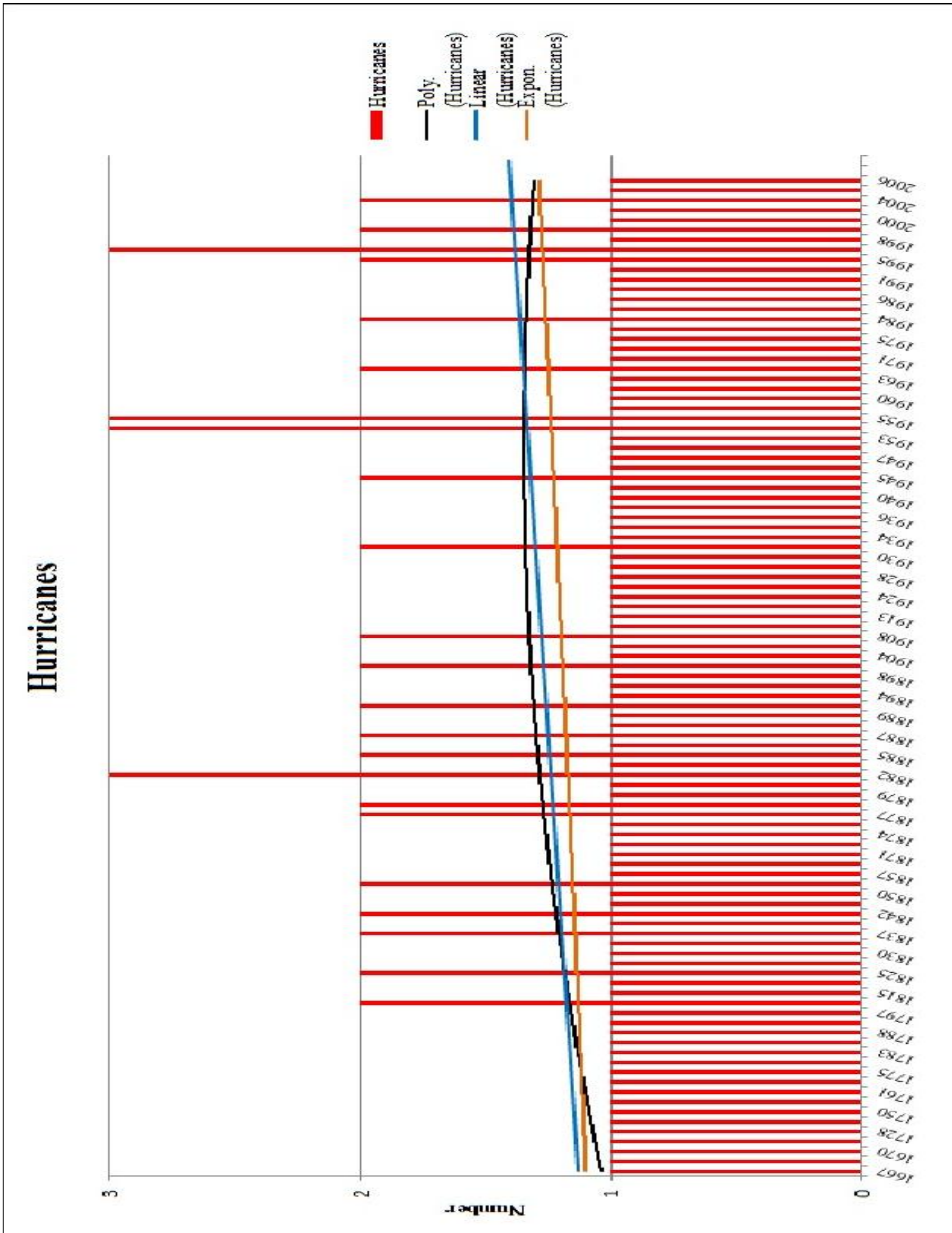



FIGURE 6.1 Number of hurricanes by year, 1667-2004, n=141 (Graph by Author).

From 1667-2006, 141 hurricanes (given the historical record) of varying intensities struck the North Carolina coast. Considering the lack of early records, this number may actually be larger, but from 1850, when hurricanes were more sophisticatedly recorded and a record of each storm was kept spatially, the number of hurricanes has been 96. There has been an average of one hurricane per year since 1667, while within the dataset 19 years have witnessed two hurricanes, and four years have experienced three hurricanes (Figure 6.1).

Beginning with the nineteenth century, there is a general trend in an increasing number of hurricanes per year, which continues into the twenty-first century. The number of hurricanes per year increases to two storms per year, and reaches three hurricanes per year in the 1880s, 1950s, and 1990s, according to the historical record. Various trend lines reflect this rise in hurricane activity over time. It is difficult to determine if this is an actual environmental trend or an effect of the lack of early historical records.

Historic storms also vary by month. Fifty-six storms occurred in the month of September, followed in number by the month of August and October as the months with the most frequent storms (Figure 6.2). This is considered the height of hurricane season for coastal North Carolina. These chronological trends are important in examining and analyzing the correlations of severe weather events to levels of damage and changes in socioeconomic trends. Patterns in chronological statistics provide a foundation for viewing subsequent trends in hurricane-related statistics. For example, as will be seen in a later section of this chapter, chronological trends correspond with the time frame for the majority of shipwrecks occurring due to severe weather along the North Carolina coast.

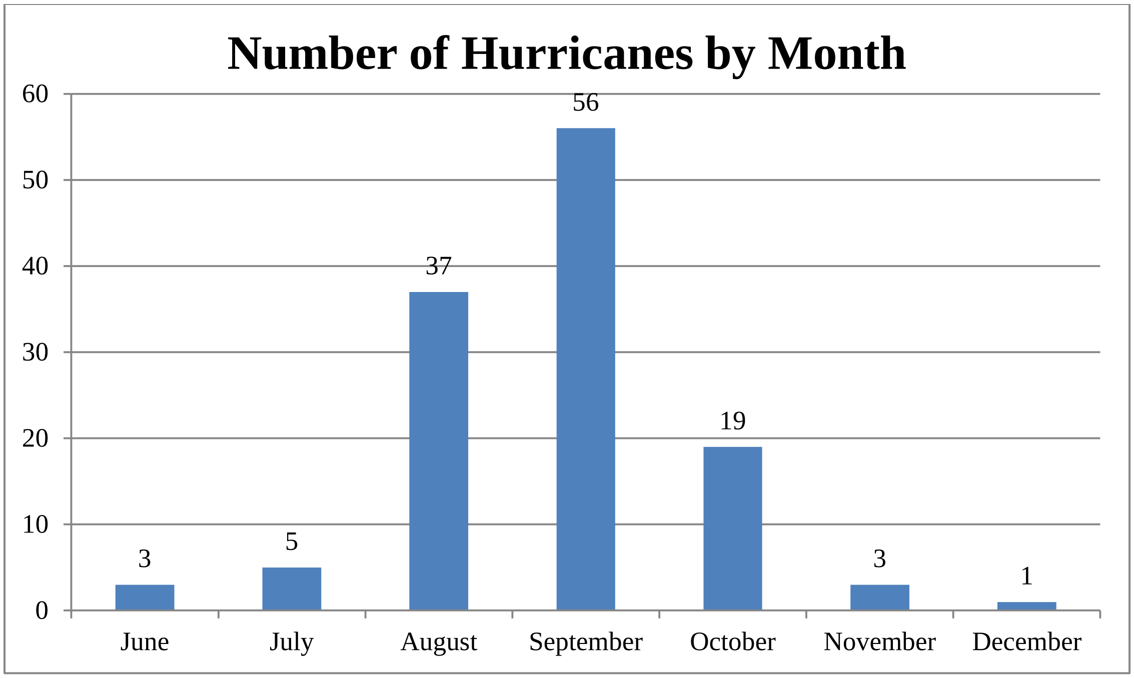



FIGURE 6.2 Hurricanes Occurring by Month, 1667-2004, n=141 (Graph by Author).

*Event Statistics*

Severe weather events that have continually crossed North Carolina's coast often vary in intensity and general location of landfall. Statistical data for event characteristics provide an examination and analysis of any trends or patterns in hurricanes over time and in the specific character of each coastal storm and their impact regionally or locally.

*Category.* Storms that have ravaged the North Carolina coast often vary by intensity. Unfortunately, since the implementation of the Simpson-Saffir scale did not occur until the 1960s, historic storms do not have the same categorical designations as those as early as the 1930s, when modern categorical labels were being subscribed to these early twentieth century storms; it is therefore difficult to judge the severity of early historic storms based on uncategorized criteria and different labels and terms. Category Four storms are rare in the historical record but two are visible in North Carolina's record; the first occurred in 1954 with Hurricane Hazel, one of North Carolina's most notorious storms, and again in 1995 with

Hurricane Luis (Figure 6.3). There are 12 Category Three storms recorded in North Carolina's historic record beginning in 1933. Four Category Three storms occurred between 1955 and 1960. These storms were some of the most lethal and damaging hurricanes of the twentieth century, prompting the nickname "Hurricane Alley" for North Carolina. Additional Category Three storms occurred in 1985, 1989, 1991, 1993, and 1998. Category Three storms are the most common, followed by Category One hurricanes and tropical storms (Figure 6.4).

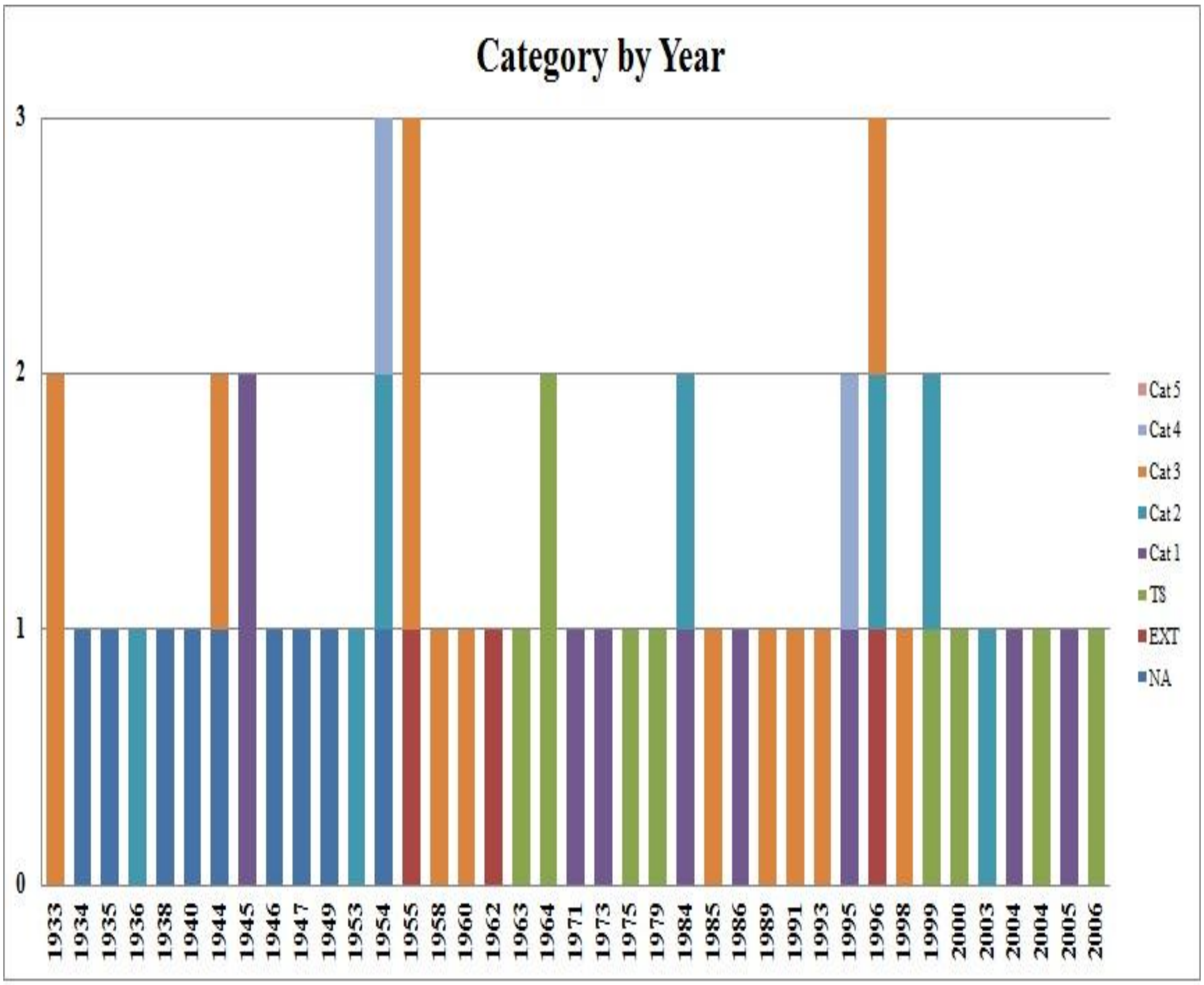



FIGURE 6.3 Hurricane Categories by Year, 1933-2006, n= 52; TS=Tropical Storm, EXT=Extratropical, NA=Unknown (IBTrACS 2010).

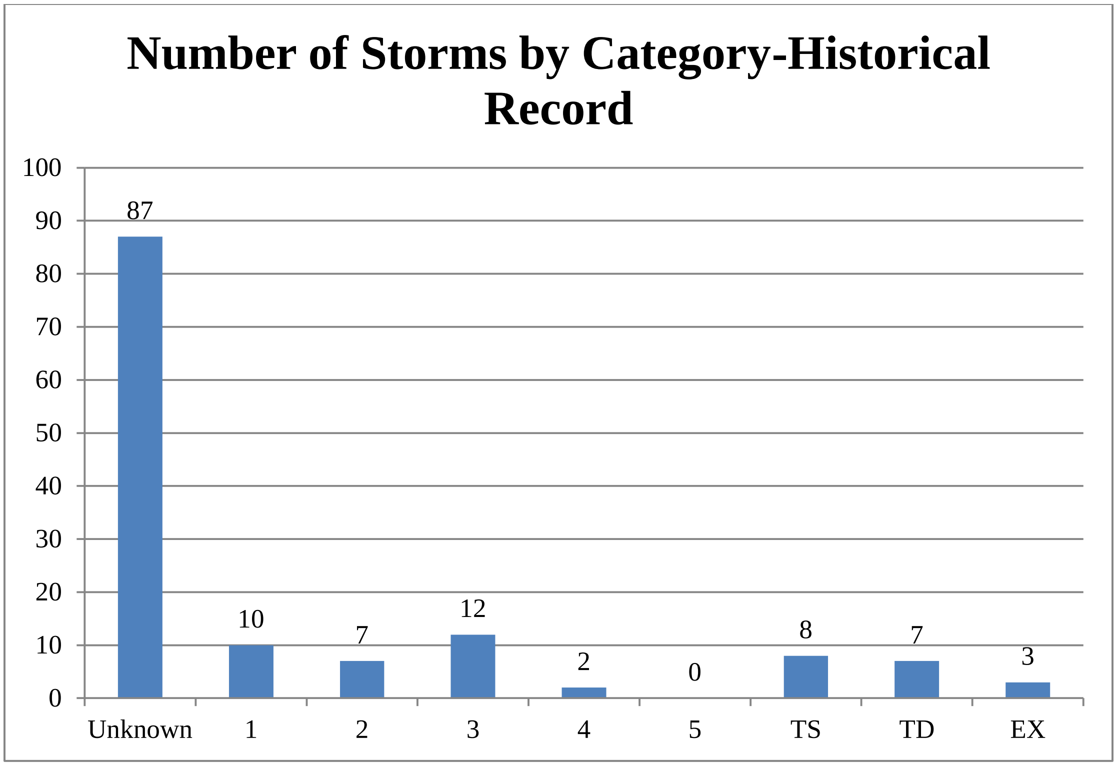


FIGURE 6.4 Hurricanes by Category, 1667-2004, n=141; TS= Tropical Storm, TD= Tropical Depression, EX= Extratropical, SS=Subtropical (Graph by Author).

Trends in the International Best Tracks Dataset (IBTrACS) do not always follow the data compiled for this thesis from the historical record; according to IBTrACS tropical storms are the most frequent intensity of severe storms encountered by coastal North Carolina with 108 of the total 232 tracks recorded by the dataset. This is followed by Category One hurricanes with 35 and extratropical storms with 33 (Figure 6.5). Although IBTrACS does not record any Category Four or Five storms for coastal North Carolina, the historical record presents a Category Four storm making landfall in North Carolina, and from historical accounts, possibly several early additional Category Four and Five storms. IBTrACS data is only available from 1850 so it is possible that the number of storms of a given intensity would be higher if this database housed data for the period before 1850.

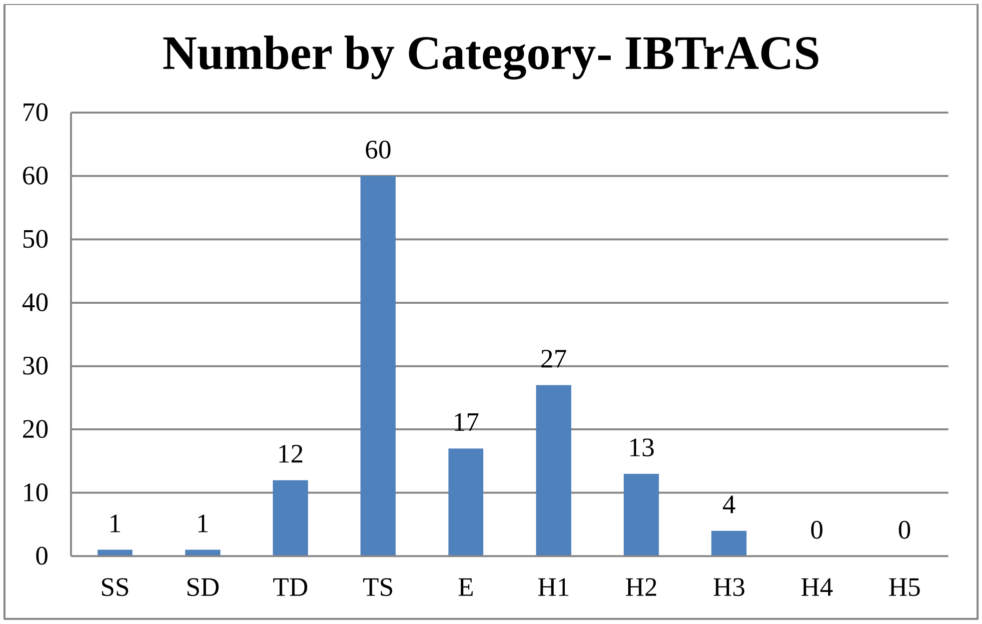



FIGURE 6.5 Number of Storms by Category, n=232 (IBTrACS 2010).

Not only do the hurricanes and severe storms vary in intensity across the coastal region, but intensity varies by county as well. Each coastal county has experienced various levels of severe storms during their existence which is detailed by the IBTrACS since 1850 (Figure 6.6).

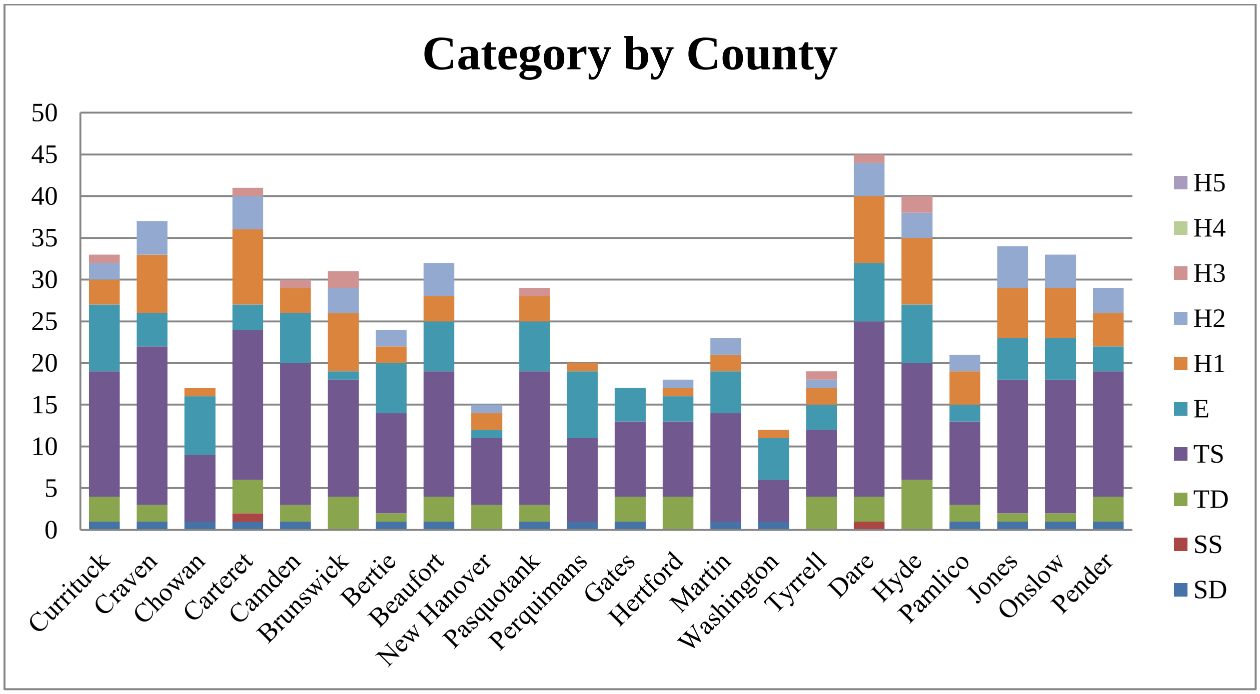



FIGURE 6.6 Category of storms by county, n=232 TS= Tropical Storm, TD= Tropical Depression, EX= Extratropical, SS=Subtropical, SD=Sub-Depression (IBTrACS 2010).

The IBTrACS Dataset shows that Hyde and Brunswick counties have experienced the most Category Three storms. All coastal counties have experienced an average of two Category Two storms and an average of 3.7 Category One storms per county; Hyde, Dare, and Carteret counties have had eight and nine Category One storms respectively. Tropical storms, which are the most common in the IBTrACS Dataset reach a high of 21 for Dare County, with an average of 13 for every other county.

An analysis of storm categories reveals discrepancies between datasets. Variations between the historical record and the IBTrACS database may be due to the difference and/or sophistication of data collection and maintenance, in that the historical record, to a certain level, either does not designate a storm intensity or uses different categorical standards. However, statistical data shows that the 1950s and 1990s were particularly intense years for storm activity on the North Carolina coast with higher levels of storms occurring in these periods. Also, certain counties tend to receive higher levels of storm intensity than others, such as Hyde and Brunswick. The nature of the correlation between storm intensity and location for these specific counties may be related to the location of these counties in the geography of the North Carolina and the natural paths most often taken by storms that approach the region.

*General Location.* According to the statistical data presented from the historical record, 32 hurricanes have affected the general North Carolina coast causing damage from the Cape Fear Region to Currituck and the Virginia line. The southern portion of the North Carolina coast and the Cape Fear Region both have experienced 21 storms, followed by the Hatteras area with 18 hurricanes (Figure 6.7).

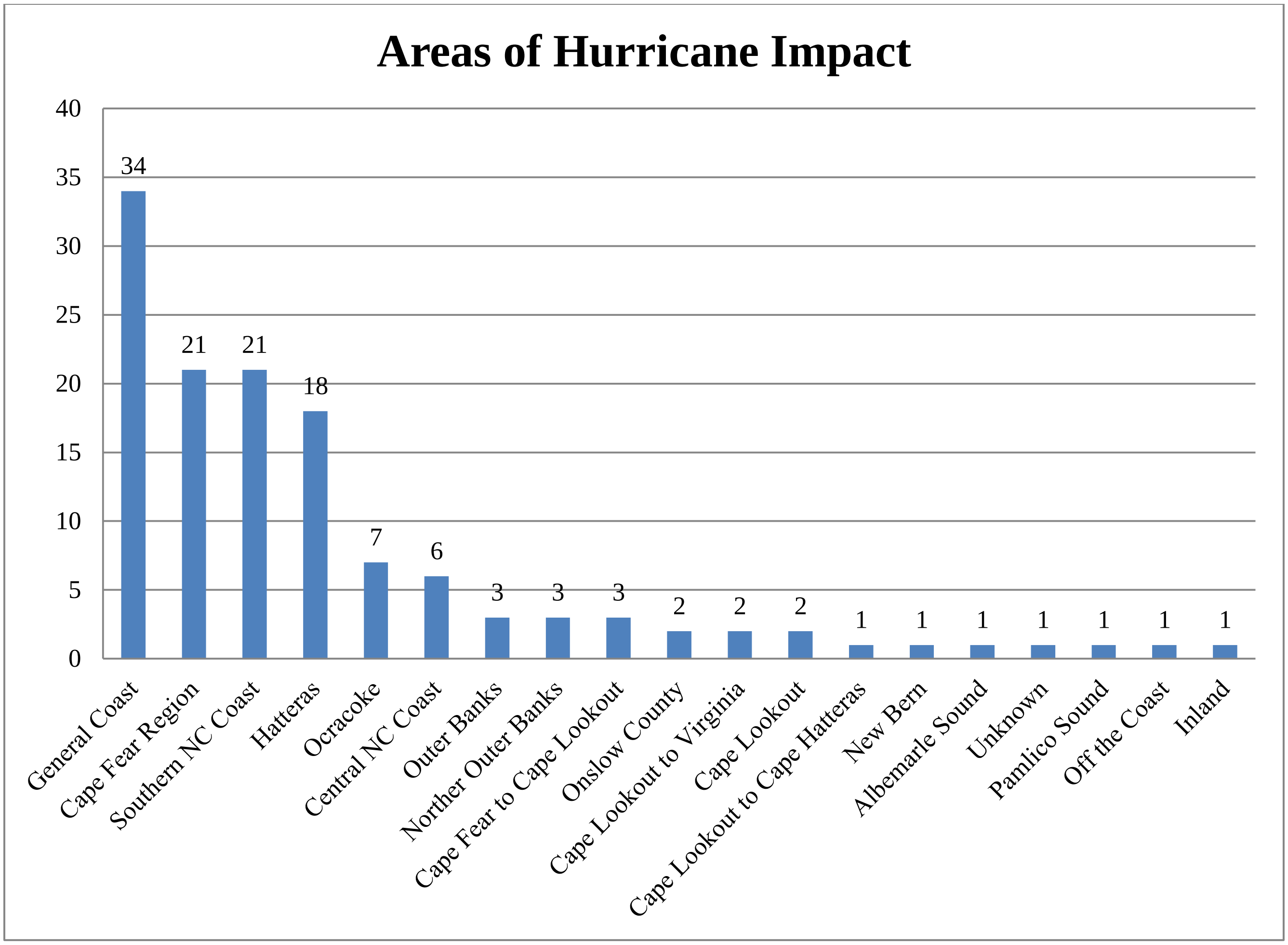



FIGURE 6.7 Number of hurricanes by area of impact, n=141 (Graph by Author).

When the statistical data from the historical record is compared with the data compiled from the IBTrACS Dataset's attribute tables, we see a substantial difference in the number of hurricanes to intersect coastal North Carolina since only 1851.

According to IBTrACS, there were 232 tracks to intersect the 22 coastal counties. Many of these storms are unnamed and are ranked usually as tropical storms, tropical depressions, or extratropical storms. Dare County represents the county with the most hurricane hits with 45 intersecting tracks, followed by Craven and Carteret with 38 (Figure 6.8).

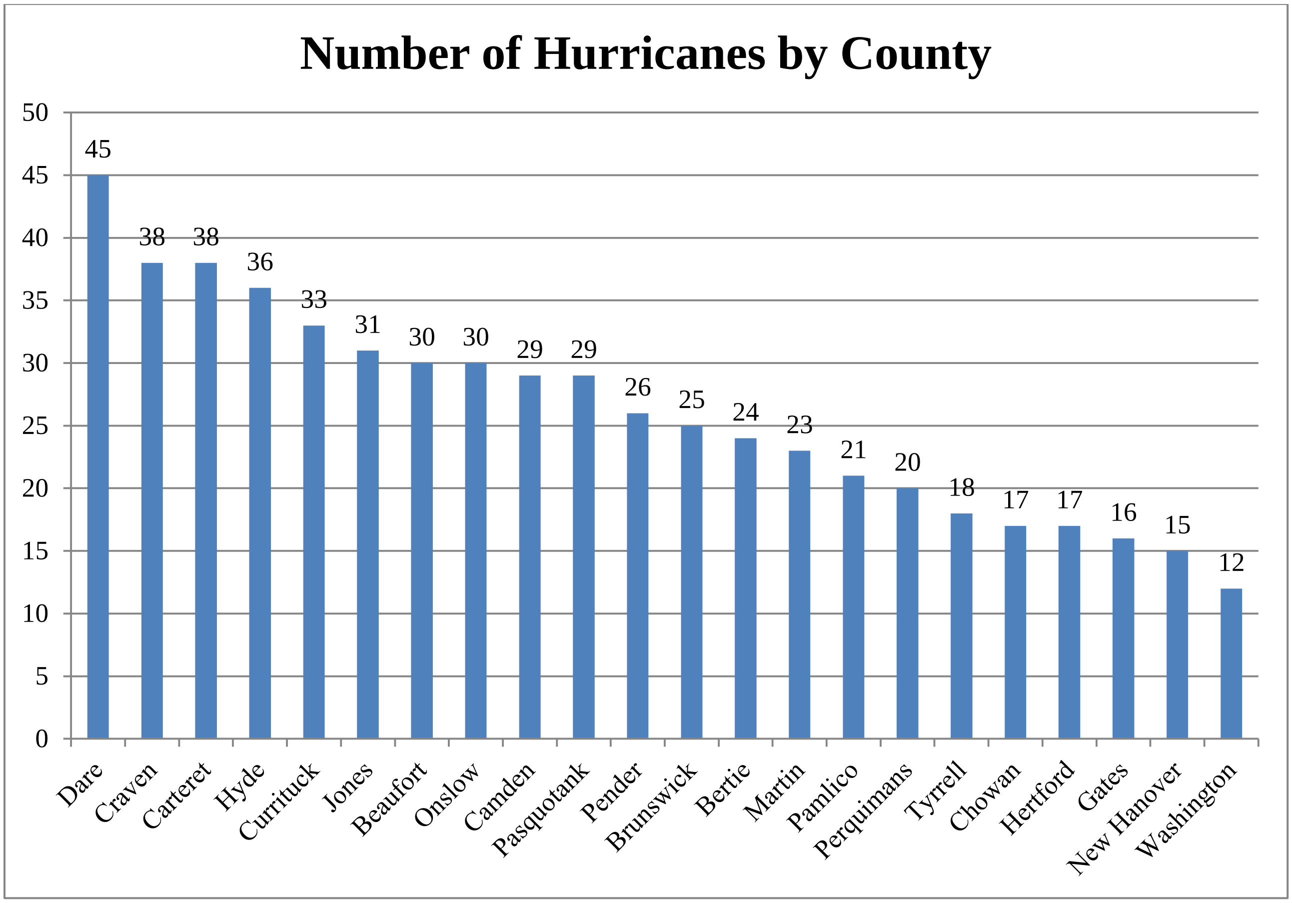


FIGURE 6.8 Number of hurricanes by County, n=232 (IBTrACS 2010).

The following table (Table 6.1) details the characteristics of hurricanes and severe storms for each coastal North Carolina county, specifically looking at the range of intensities of storms for each county, the periods of the most activity, and the areas of each county that are most affected by severe climatic events. In assessing the data presented in Table 6.1, using data from the historical record and the IBTrACS dataset, Dare County sees the greatest number of hurricanes as compared with other coastal counties in North Carolina. The 1960s through the early twenty-first century are the most common periods of hurricane activity for all coastal North Carolina counties with the exception of the mid-nineteenth to early twentieth century and the late 1940s.

| County | Hurricanes 1850- (Tracks) | Lowest Intensity | Highest Intensity | Years of Majority Occurrence | Notorious Storms | Area of Greatest Affect in County |
|---|---|---|---|---|---|---|
| Beaufort | 30 | EXT | 2 | 1973-2004 | Great Beaufort of 1815 | |
| Bertie | 24 | EXT | 2 | 1862-1894, 1966-2004 | | Southern course of Chowan River |
| Brunswick | 25 | TD | 3 | 1969-2004 | Great Beaufort of 1815; 1899; 1944; Hazel, Diane, Hugo, Fran, Bonnie, Charley, Ophelia, Ernesto | Beaches |
| Camden | 29 | EXT | 3 | 1864-1907, 1948, 1979 | Bonnie | |
| Carteret | 38 | TS | 3 | 1961-1982 | Great Beaufort of 1815; 1933; Fran; Dennis, Ophelia, Ernesto; San Ciriaco | |
| Chowan | 17 | TS | 1 | 1974-2004 | 1769; 1828; 1830 | Historic Edenton |
| Craven | 38 | TS | 2 | 1864-1894, 1973-2004 | 1769; 1778; 1806; 1815; 1825; Barbara; Ione; Bertha; Isabel; Alex | New Bern; Neuse River |
| Currituck | 33 | TD | 3 | | Bonnie; Charley | Outer Banks |
| Dare | 45 | TD | 3 | 1930s, 1985-1986 | Gustav; Isabel; Charley | Cape Hatteras; Outer Banks |
| Gates | 16 | EXT | TS | 1943-1971 | Floyd | Chowan River |
| Hertford | 17 | TS | 2 | 1882-1944, 1945-1970 | Floyd; Allison; Isabel | Chowan River |
| Hyde | 36 | TD | 3 | 1947-2006 | San Ciriaco | Ocracoke |
| Jones | 31 | TD | 2 | 1873-1894, 1973-2004 | Barbara | Trent River meets Neuse River |
| Martin | 23 | TS | 2 | 1966-2004 | Earl; Isabel | Roanoke River |
| New Hanover | 15 | TD | 2 | | Great Beaufort of 1815; Hazel; Connie; Diane; Ione; Donna; Diana; Hugo; Fran; Josephine; Bonnie; Charley; Dennis; Floyd | Wilmington; Beaches |
| Onslow | 30 | TD | 2 | | 1752; Great North Carolina of 1815; 1876; 1944; Hugo; Luis; Fran; Josephine; Charley; Ophelia; Ernesto | New River; Beaches |
| Pamlico | 21 | TS | 2 | 1972-2004 | Connie; Isabel | Neuse River; Oriental |
| Pasquotank | 29 | TS | 3 | 1864-1907, 1948-1979 | 1775; 1839; 1936; 1944; 1946; Bonnie | Elizabeth City |
| Pender | 26 | TS | 2 | 1857-1894, 1965-2004 | 1944; Diana; Hugo; Fran; Josephine | Cape Fear River; Beaches |
| Perquimans | 20 | TS | 1 | 1972-2004 | Hazel; Gloria; Bertha; Fran; Bonnie; Dennis; Floyd; Irene; Isabel | |
| Tyrrell | 18 | TD | 3 | | Hazel; Connie; Diane, Ione; Donna; Fran; Bonnie; Dennis; Floyd | |
| Washington | 12 | TS | 1 | | Connie; Isabel | Plymouth |

TABLE 6.1 Hurricane characteristics by county (Alphabetical Order).

The most notoriously widespread storms are the Great Beaufort Hurricane of 1815, San Ciriaco, Hazel, Floyd, Isabel, and Fran. Although each county feels the effects of severe weather events differently the areas most affected within a specific county, such as the beaches, are actually commonly affected features regionally; the beaches and areas along the rivers, especially port cities, are impacted most frequently from hurricanes in the coastal counties of North Carolina. It should also be noted that when comparing the post-1850s IBTrACS data with the statistical data compiled from the historical record (1667-2006), we see that the most hurricane hits both pre- and post-1850 have occurred at Cape Fear instead of Dare County.

Although the historical record and IBTrACS data do not always coincide, there are specific areas of the North Carolina coast that have received more hurricane activity than others, certain time periods that are more storm-laden, and certain levels of intensity more common than others. By the time most hurricanes have crossed the North Carolina coast, they are technically tropical storms; this however, does not make them any less severe or destructive, and there have been a substantial number of Category One, Two, Three, and Four storms to make landfall across the State. The counties that have received the greatest threat from severe weather events according to the IBTrACS dataset are Dare, Hyde, and Carteret; those counties also seeing an increased number of higher intensity storms are Brunswick, Onslow, and Craven counties. However, according to historical records, counties such as New Hanover would have historically seen as many, if not more hurricanes than presented in the IBTrACS dataset. In viewing the hurricane data in isolation, it is difficult to visualize any certain chronological or characteristic trends. Although there is an increase in the number of hurricanes per year after 1800 this trend in not consistent for all years. Analyzing hurricane trends as n-transforms in relation to other cultural resources such as shipwrecks, population change, and economic trends we can gain a better understanding of hurricane-related patterns and thus any patterns within the weather events themselves, as well as helping predict the interaction between variables of coastal materials and the environment in which they move. Additionally, the geospatial data presented in Chapter Seven will further examine some of the storm characteristics of severe weather events and compare them to physical locations and datasets through mapping to find spatial correlations that may corroborate or discord with trends presented in this chapter.

### *Shipwreck Patterns*

Shipwrecks have long been a presence off the coast of North Carolina, and in the sounds, bays, and interior rivers, shipwrecks are littered across the landscape. Shipwreck patterns provide insight into the associated patterns of weather events and their effect on a coastal landscape. By examining shipwrecks and site formation processes acted there upon, we can garner better understanding of the formation of North Carolina's disaster landscape by severe weather events.

Previously, studies of shipping associated with severe climatic events have concentrated on individual incidents, and there has been limited consideration of the wider synoptic and historical picture, particularly with regard to shipwrecks (Forsythe et al. 2000:247). But using weather patterns and known shipwrecks associated with climatic events, maritime archaeologists can better understand the processes of wreckage and site formation, as well as the consequences that produce changes in the socio-economic environment of the North Carolina coast. Weather patterns and associated wrecking events can also indicate potential hurricane readiness. Shipwreck patterns provide different observations from the terrestrial signatures of weather events. The patterns of deposition may reflect not only the limited options facing shipowners and operators during a severe weather event, but also allows for a better understanding of how these owners/operators understood the waters and coastline of North Carolina.

As the waters of the North Carolina coast have been frequented by storms systems, numerous vessels have been lost along the State’s coast and sounds (Lawrence 2008:5). Environmental factors, such as currents and storm patterns have not only physically shaped the North Carolina coast, but had a direct impact on settlement patterns, navigation, and shipwreck occurrences. For example, the eastward projection of the Outer Banks “meant that vessels travelling up and down the east coast passed near Cape Hatteras and its treacherous Diamond Shoals” (Lawrence 2008:6). Of the 5,000 shipwrecks lost in North Carolina waters (files of which are housed by the UAB), approximately 429 are known to have been wrecked due to environmental factors, specifically severe climatic events; although this shows only 10% of the wrecks being due to severe weather events, many of the shipwrecks have unknown causes and thus provides a skewed view of the data (Lawrence 2008:11). It has been considered that the “location of sailing routes and ports may determine the principal location of shipwrecks, but these historical factors do not, in themselves cause shipwrecks. The interaction of these factors with another category of natural factors, hurricanes, is responsible for numerous maritime losses” (Lawrence 2008:15). The product of historical and natural factors has led to a unique pattern of shipwrecks for North Carolina; and in turn the pattern of maritime losses may relate to social and economic patterns for the State.

This section utilizes statistical analyses in examining ships wrecked due to severe weather events, which present patterns related to time, space, and typology. The statistical analyses examine shipwrecks by year of wreck, vessel type, and general location of loss. In searching historic newspapers, local histories, diver’s guides, and existing shipwreck datasets, a total of 489 shipwrecks wrecked due to hurricanes have been compiled into the dataset for this thesis. The number of hurricane-related shipwrecks may in reality be larger, but due to the lack of historical evidence or through the exclusion of certain terms (i.e. the use of “heavy winds” versus “hurricane” or “gale”), some vessels were not included in the dataset.

*Date Wrecked*

Vessels wrecked by severe weather events have occurred since the beginning of North Carolina’s written history, wrecks occurring for each year in varying quantities. In several instances, wrecking events may occur that do not correspond to a recorded hurricane event, but this discrepancy may be due to variations in early historical records or loss of corresponding records aboard ships or from weather tracking systems. The storm season for the North Carolina coast is typically in the winter and early spring, while hurricane season specifically for North Carolina begins in June and lasts through November, although hurricanes have occurred as late as December and as early as late May. According to Lawrence (2008:6) March is the month with the greatest number of storms (although he does not classify what category of storms to which he is referring) and in tabulating shipwrecks by month from the UAB records, the data reflects a correlation between shipwreck loss and the aforementioned storm seasons. When examining the shipwreck data compiled for this thesis, the greatest number of shipwrecks occur between July and October with 116 in August, the height of the hurricane season on the coast of North Carolina (Figure 6.9). Although shipwrecks have been chosen based on their wreckage due to severe weather events, this correlation at least provides statistical authority to the data.

Hurricane-related shipwrecks also show a pattern that revolves around the year of wrecking. While the trend line for hurricanes shows an increase over time, the trend lines for hurricane-related shipwrecks presents a height of activity around the mid- to late-nineteenth century, which corresponds to a high in hurricane activity.

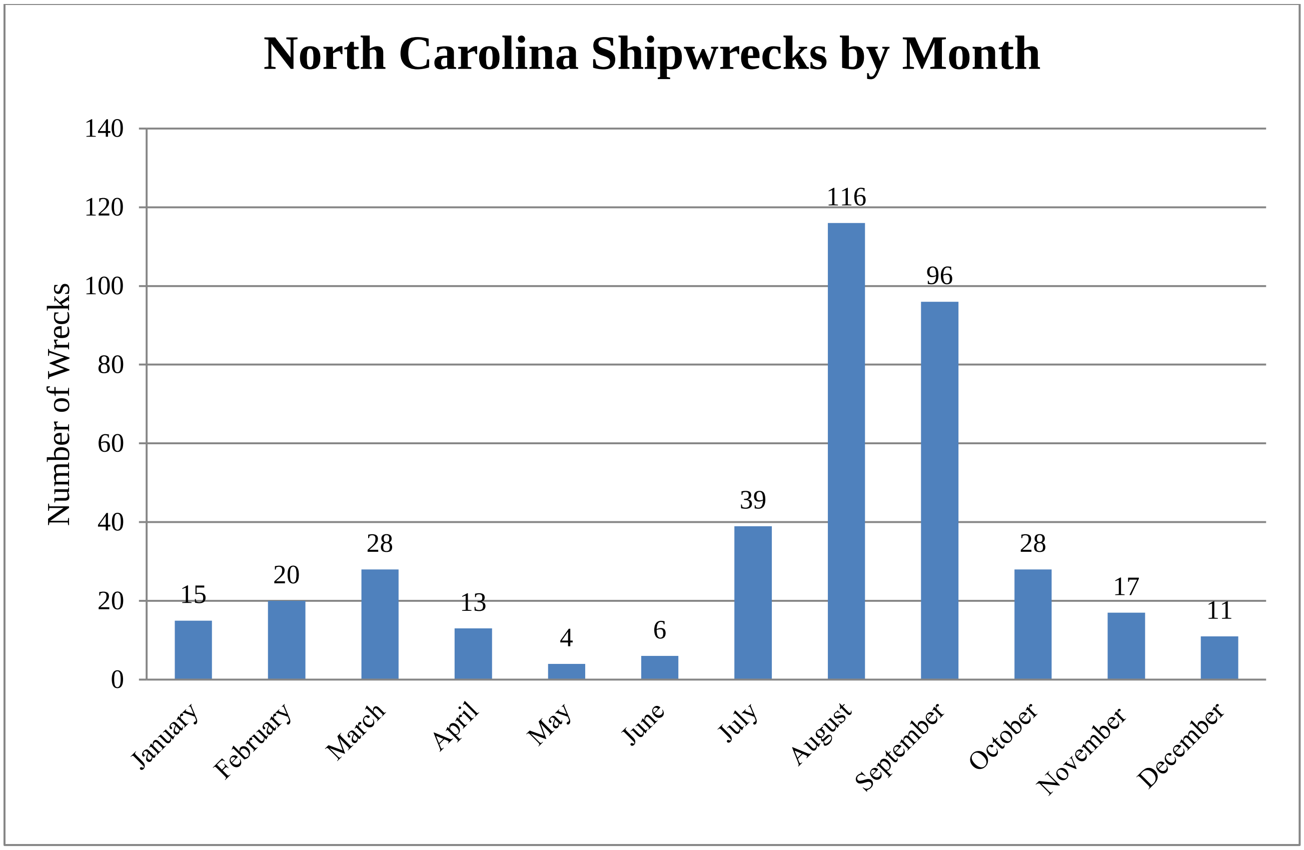



FIGURE 6.9 Shipwrecks off North Carolina by Month, n=489 (Graph by Author).

The trend line for shipwrecks after this time shows a decrease into the twentieth century. Apart from overall trends, there are several years where the number of shipwrecks are clustered in greater numbers than other years, the most being in the years 1839 and 1899, both with 27 wrecks due to hurricanes (Figure 6.10). The high number of vessels wrecked in 1839 corresponds to a hurricane that passed off Cape Hatteras in August that did damage to vessels mainly at Ocracoke (Hudgins 2007:10). This data also corresponds with the historical hurricane record, as the 1899 season was particularly destructive for the Atlantic Basin. In particular, the San Ciriaco Hurricane in August, 1899 was one of the most destructive hurricanes of the nineteenth century for Puerto Rico and North Carolina. The shipwrecks associated with the 1899 hurricane season were scattered from Cape Fear to Currituck.

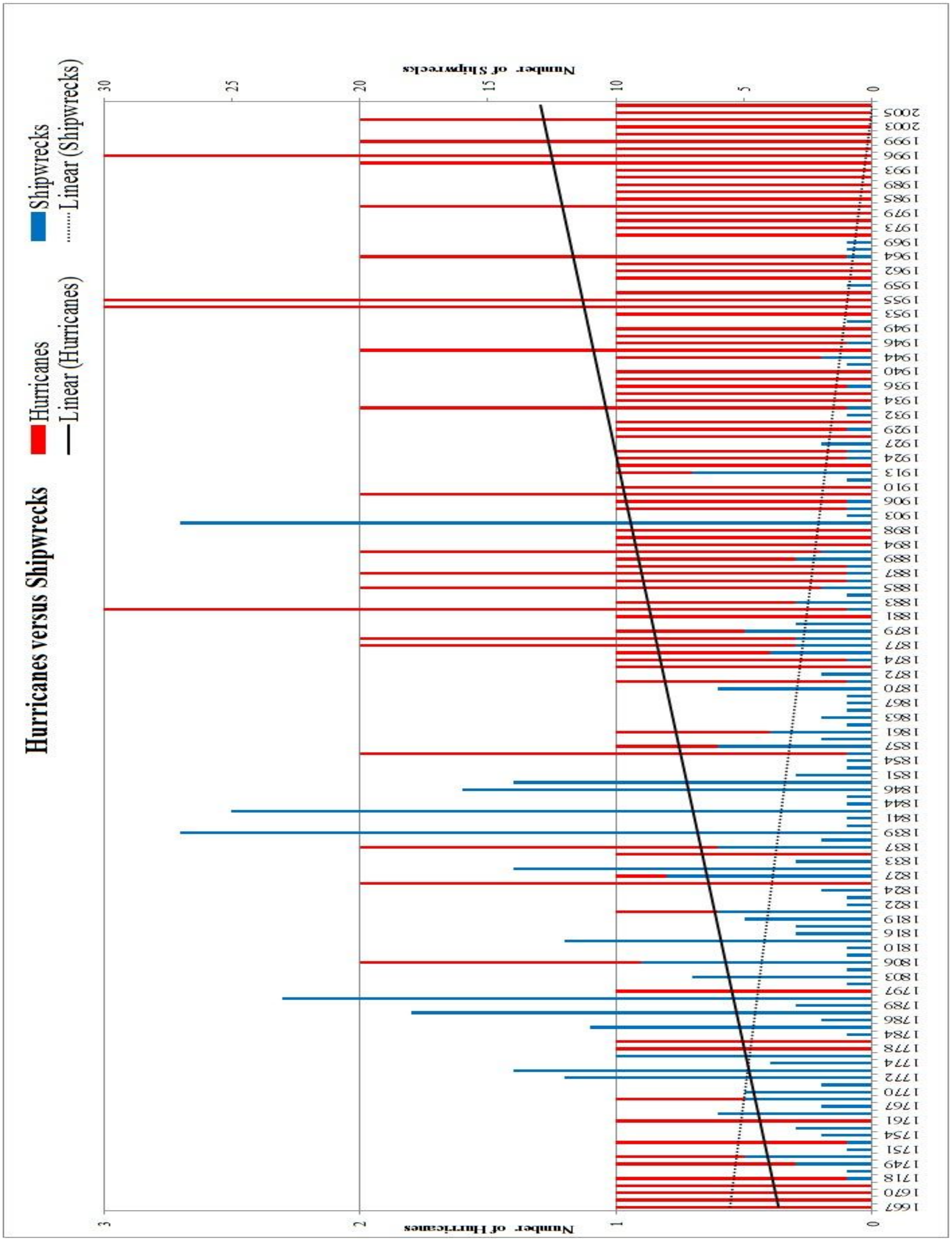



FIGURE 6.10 Shipwrecks due to hurricanes by year, n=489 (Graph by Author).

After 1839 and 1899 as the most destructive years for vessels wrecked due to inclement weather, 1795 and 1842 are also years with significant numbers of wrecked vessels. The large amount of vessels wrecked in 1795 corresponds to a particularly destructive hurricane in the Ocracoke-Hatteras area where vessels of the Spanish fleet were driven upon the Cape Hatteras Shoals, and possibly other vessels as well. The 1842 hurricane season brought multiple storms which did vessel damage in the Portsmouth-Ocracoke areas as well as at Currituck and Cape Hatteras.

There are historical records of extremely devastating storms or storm seasons along the North Carolina coast that do not register a significant number of wrecked vessels. For example, the Independence Hurricane of 1775 was one of North Carolina's most lethal and destructive historic storms, but for the 1775 season, only 10 vessels are accounted for in the historical records as having wrecked due to the severe weather. Additionally, a hurricane in July of 1788 caused widespread damage to vessels along the entire North Carolina coast, but only 18 vessels were discernible in the historical record (which does not account for the large number of dismasted vessels). Additional destructive hurricane seasons whose number of wrecked vessels does not correspond to the amount of damage expressed in the historical record includes:

- *1806.* Twin Hurricanes caused vast damages, especially to many unidentified vessels due to the severity of wind and water damage.
- *1815.* The Great North Carolina/Great Beaufort Hurricane ravaged North Carolina and littered the northern Bank with shipwrecks.
- *1830.* A large number of vessels were blown from moorings at New Bern and driven ashore at Smithville, but the historical record does not account for actual loss or destruction of vessels beyond repair.

- *1857*. The storm of 1857 was one of the most violent nineteenth century storms, but there is little historical evidence of vessels wrecked.
- *1876.* Numerous vessels were reported lost at Wilmington, Cape Lookout, and Cape Hatteras but details beyond this are negligible.
- *1887*. Many of the vessels were lost in the area of the Pamlico Sound, but numbers and details do not go beyond a general account of damages. The discrepancies between the statistical data and the historical records may be due to a lack of completeness of the historical records as well as the large amount of unidentified vessels that are reported in historical accounts, which skews the dataset.

The largest number of vessels wrecked by severe weather events are clustered between the mid-eighteenth to the mid-nineteenth centuries, with the exception of the 1899 season. This corresponds with the height of the Age of Sail, especially the heyday for coasting trade for North Carolina. This does not imply that steam propulsion reduced the chance of wrecking due to hurricane activity (something addressed later in this chapter), but the peak of wrecked vessels during this time period may be a product of less sophistication in navigation, mapping, technology, and/or an understanding of weather systems, as they occur before the development of modern weather records and warning systems. If certain shipwrecks do not correlate to a certain severe weather event, various factors can account for the loss of the vessel such as human error or geography. This can imply that advances in meteorology, such as weather tracking, and maritime safety, such as GPS and markers, have been aids to navigation and safety that would account for an inverse correlation between weather events and shipwrecks.

The reasons for inverse correlations between shipwreck patterns and hurricane seasons are many, and may expose past cultural and behavioral practices. For example, the degree of completeness of the historical records, may account for the lack of shipwreck accounts in years where the hurricanes are intense and/or frequent. But there are other indices which may also account for the patterns of shipwrecks, or in some cases, lack of expected wrecks. Patterns of trade may largely account for patterns of hurricane-related shipwrecks during a given time period or event. The state of the economy and the importance of certain ports or inlets at the time of a hurricane may account for an abundance or lack of shipwrecks during a particular event or time frame. Along similar lines, shipping arrivals and departures would have had a substantial effect on the number of ships in a port or area at the time of a hurricane (i.e. more ships equals potentially more wrecks). For example, during the early stages of North Carolina's economic development, the dangerous coastline, scarcity of currency, lack of marketable goods, and a limited population base inhibited maritime trade and commercial growth for the colony (Combs 2003:1). This can be a cause for the lack of a substantial amount of hurricane-related shipwrecks prior to 1750 despite the occurrence of severe weather events in the historical record for this period. The large amount of shipwrecks compared to relatively small hurricane seasons, as seen in Figure 6.10, could also be attributed to various factors; the level of storm intensity could have produced larger amounts of shipwrecks despite a smaller number of hurricanes for the years 1750 to 1850. Additionally, increases in North Carolina's coastal trade and economic development could account for the increased number of hurricane-related shipwrecks during this time period. Growing populations along the North Carolina coast and the substantial importance of areas such as Cape Fear would have produced more maritime traffic during this period. Subsequent sections of this chapter will look at additional attributes that contribute to the wrecking of vessels along North Carolina's coast in relation to area, type, and cost in order to glean a more complete idea of the relationship between hurricanes and shipwreck deposition patterns along the coast. Additionally, Chapter Seven will look at the spatial characteristics of these relationships.

Arrivals and departures information may also contribute to the correlation between the number of hurricane-related vessels in a given area and the occurrence of a specific event. The number of vessels in a given area along North Carolina's coast for a given period of time has been difficult to determine, with the exception of the early period of North Carolina's maritime history. Some records provide data concerning the amount of tonnage to enter a specific port for a specific year; however, the majority of North Carolina's maritime traffic in the early colonial period can be considered incidental, as vessels had to round North Carolina's capes to reach other ports such as Charleston (John Lawrence 2011, pers. comm.). Early in North Carolina's maritime history, the seaports were extremely small compared with the neighbors of Charleston and Norfolk (Logan 1956:28). After 1760, "all ships entering the Cape Fear River were recorded" at Port Brunswick. Between April 1767 and April 1768, 122 vessels cleared Port Brunswick with nearly 8,000 combined tons (Logan 1956:50). Port Roanoke, the second largest North Carolina colonial port, cleared 160 vessels in 1771 and 168 vessels in 1772. In the 1760s, the smaller ports of Beaufort, Bath, and Currituck cleared around 127 vessels with varying levels of tonnage still shy of the larger ports of Brunswick and Roanoke (Logan 1956:53-59). The larger ports may have cleared more tonnage during the colonial period but the considerable number of vessels clearing at ports such as Bath may correspond to the larger number of hurricane-related shipwrecks occurring around Cape Hatteras and Ocracoke Inlet during this time (Appendix B). This shows a potentially positive correlation between the number of shipwrecks in a given area and a specific weather event. However, given the treacherous nature of the geography of this area, the nature of any correlation between the number of ships in an area during a given weather event and the number of associated shipwrecks could be geographical/environmental or even human error. Furthermore, without more data to compare, it is difficult to consider this a trend.

For other periods of North Carolina's maritime history, records are scarce or non-existent due to certain circumstances such as the American Revolution that took precedence over the records of North Carolina's small seaports. This presents difficulties in comparing the number of vessels in a seaport at a given period of time, preventing the determination of any correlation between the occurrence of a specific storm and the number of shipwrecks at a specific location during this time. Additionally, more contemporary records for North Carolina's prominent ports, such as Wilmington, are housed in the southern National Archives in Atlanta, Georgia, but are not available for every decade or era of North Carolina's maritime history. It would be best to view these records as a starting point to developing a picture of the number of vessels entering and departing North Carolina's ports over time and could present an additional avenue of research for examining the relationship between the movement of people and goods via vessel along North Carolina's coast; however, these records do not detail the traffic around the inlets or capes where the majority of hurricane-related shipwrecks occurred. At this time it is not possible to determine a direct correlation between the number of shipwrecks in a given area and the occurrence of a specific severe weather event; however, given the colonial data, we can hypothesize that there may be a correlation between the two.

*General Location*

There are 489 wrecks associated with hurricanes in this dataset; all of these have general locational information available but of the total, only 107 vessels have coordinates to mark their locations, which will be discussed in further detail in the spatial analyses of Chapter Seven. The lack of exact locations for many of the vessels is a product of the sources in which references to shipwrecks were found; newspaper accounts or insurance lists often provide a general location of wrecking but often do not provide any coordinates for exact marking. However, despite lack of specific locations, marking the general locations for all wrecks provides information for better understanding of which areas contain hurricane-related wreckage, and any other patterns that may be present. Statistically examining the general location of all the wrecks in the dataset provides a broad view of patterns of deposition related to broad regions of the North Carolina coast. There are a large number of wrecks with unidentified locations (39), where the source merely mentions a wreck due to inclement weather and nothing more. Despite the unidentified wrecks, the statistical data presents a clustering of 136 vessels around Ocracoke, Ocracoke Bar, and Ocracoke Inlet (Figure 6.11).

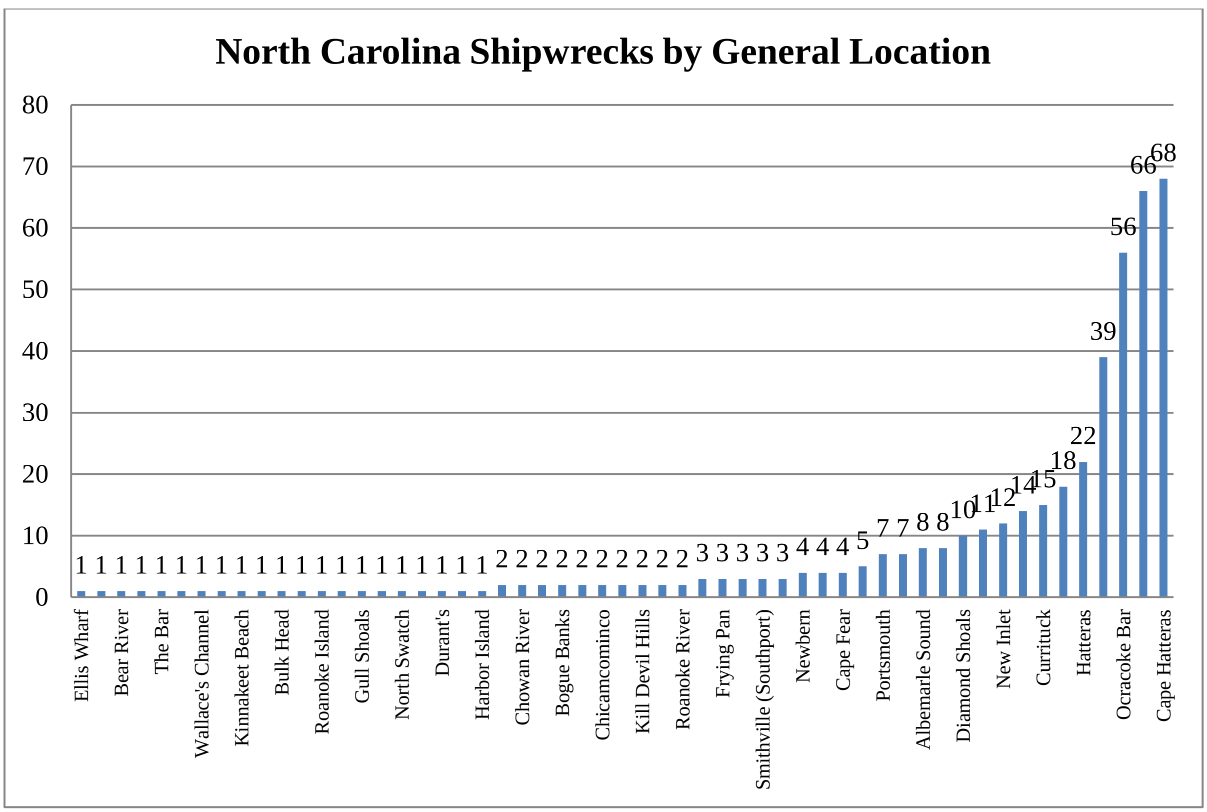


FIGURE 6.11 Shipwrecks by general location, n=489 (Graph by Author).

There are also 90 wrecks clustered around Cape Hatteras (including Hatteras Island and Hatteras Inlet) with 10 additional wrecks at Diamond Shoals. There are particularly low numbers of shipwrecks at Cape Fear and Cape Lookout with only 10 and 11 respectively; this is interesting considering these areas can be hazardous passages along the North Carolina coast. There are also a substantial clustering of wrecks not associated with the more infamous Outer Banks, but wrecked behind the barrier islands in the Pamlico and Albemarle Sounds, Roanoke, New, and Pasquotank Rivers, and near the port cities of Edenton, New Bern, and Elizabeth City. Additionally, several inlets contain clusters of hurricane-related shipwrecks such as Ocracoke, Hatteras, Beaufort, Bogue, New and Topsail Inlets.

In examining historical records for hurricanes in the pre-1850 era of North Carolina's history, the largest number of hurricane encounters occurred at Cape Fear, Ocracoke, Cape Hatteras, and New Bern. The number of hurricane tracks versus the number of shipwrecks corresponds to the wreckage seen at Ocracoke and Hatteras, but one would expect to find a larger number of hurricane-related wrecks in the Cape Fear Region due to the number of hurricane impacts in that area during the pre-1850 time period (Figures 6.12 and 6.13). From 1850 to 2004, which are the available weather tracks for spatial analysis, there is a large amount of wreckage documented around Cape Hatteras and Diamond Shoals (Figures 6.14 and 6.15). The large number of wrecks at Hatteras corresponds with the frequency of hurricanes for this region during this time period. However, for the time period, again we should be seeing more wrecks associated with severe weather events in locations such as the Northern Outer Banks and the Albemarle Sound, as well as along the region from Cape Lookout to Cape Fear.

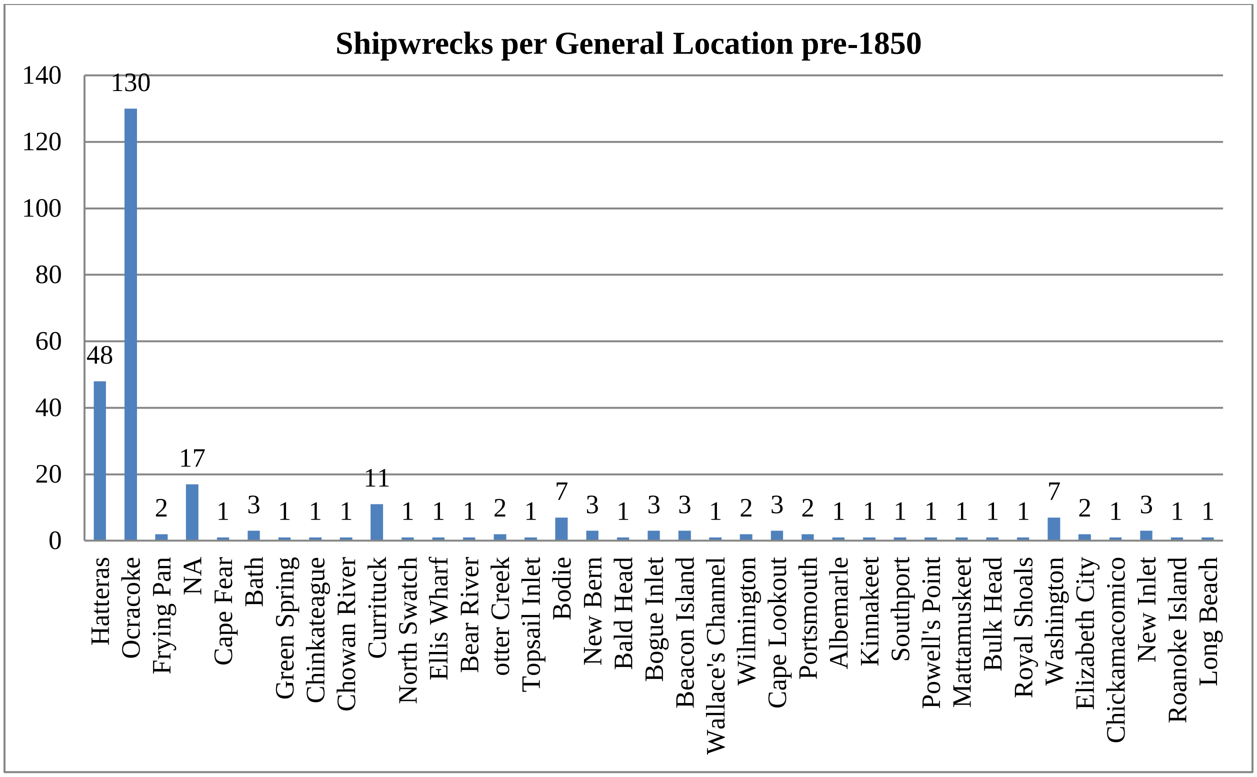



FIGURE 6.12 Hurricane-related shipwrecks by general location, pre-1850 (Graph by Author).

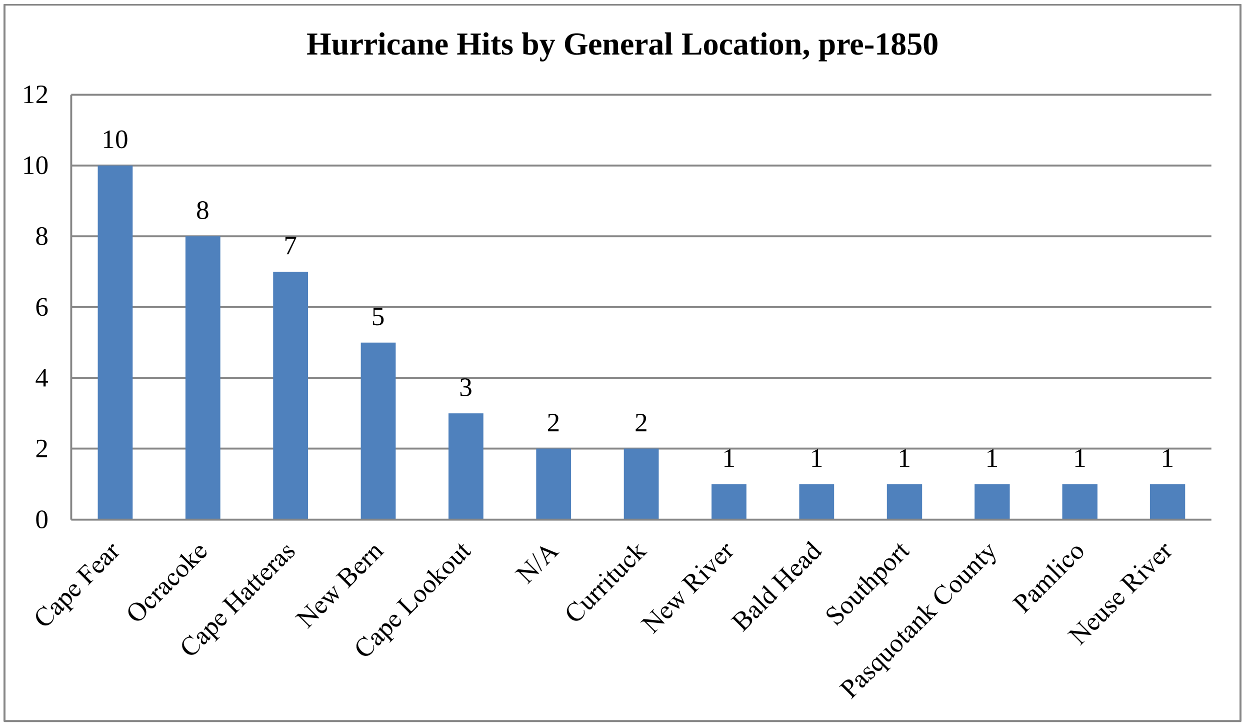



FIGURE 6.13 Hurricane occurrences by general location, pre-1850 (Graph by Author).

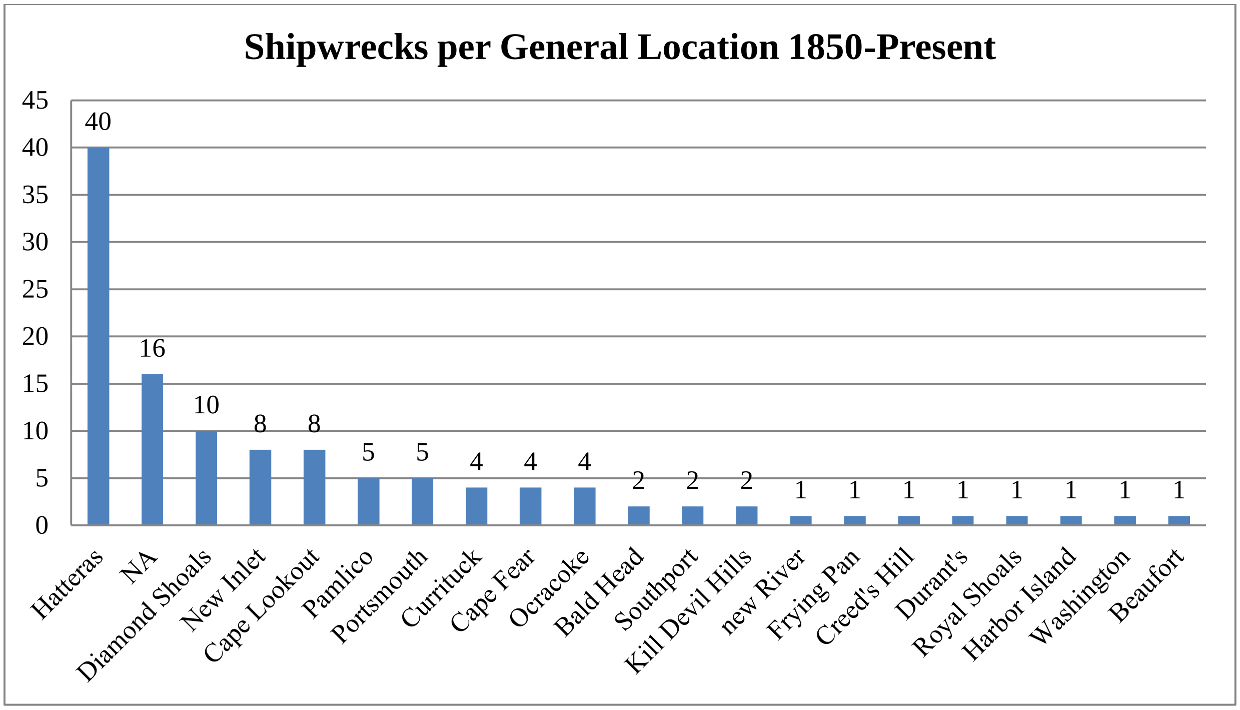



FIGURE 6.14 Hurricane-related shipwrecks by general location, 1850 to the present (Graph by Author).

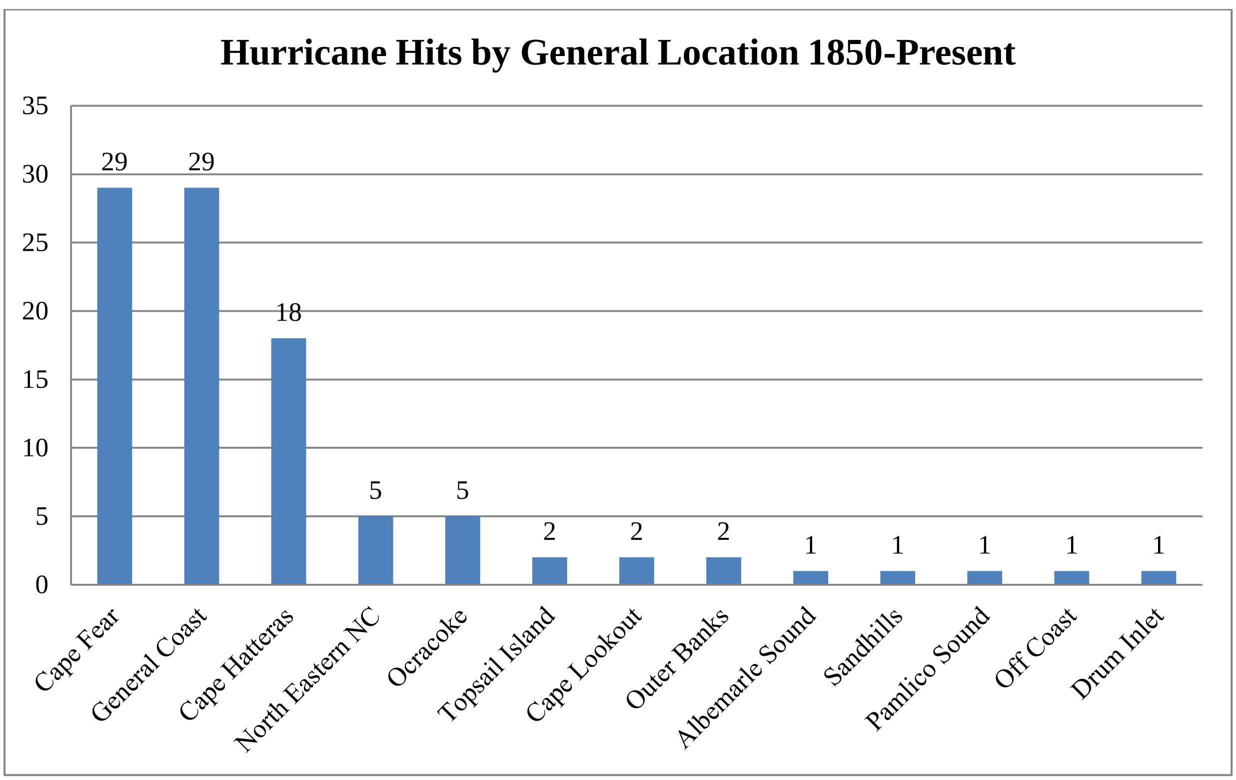



FIGURE 6.15 Hurricane occurrences by general location, 1850-present (Graph by Author).

As previously mentioned, during the colonial period Brunswick was North Carolina's busiest port (Figure 6.16). The use of the Cape Fear River made this area easier to access, especially to vessels of larger tonnage; so one would perhaps expect a increased amount of shipwrecks given the larger amount of hurricanes to hit this area prior to 1850 along with the increased maritime traffic in this region.

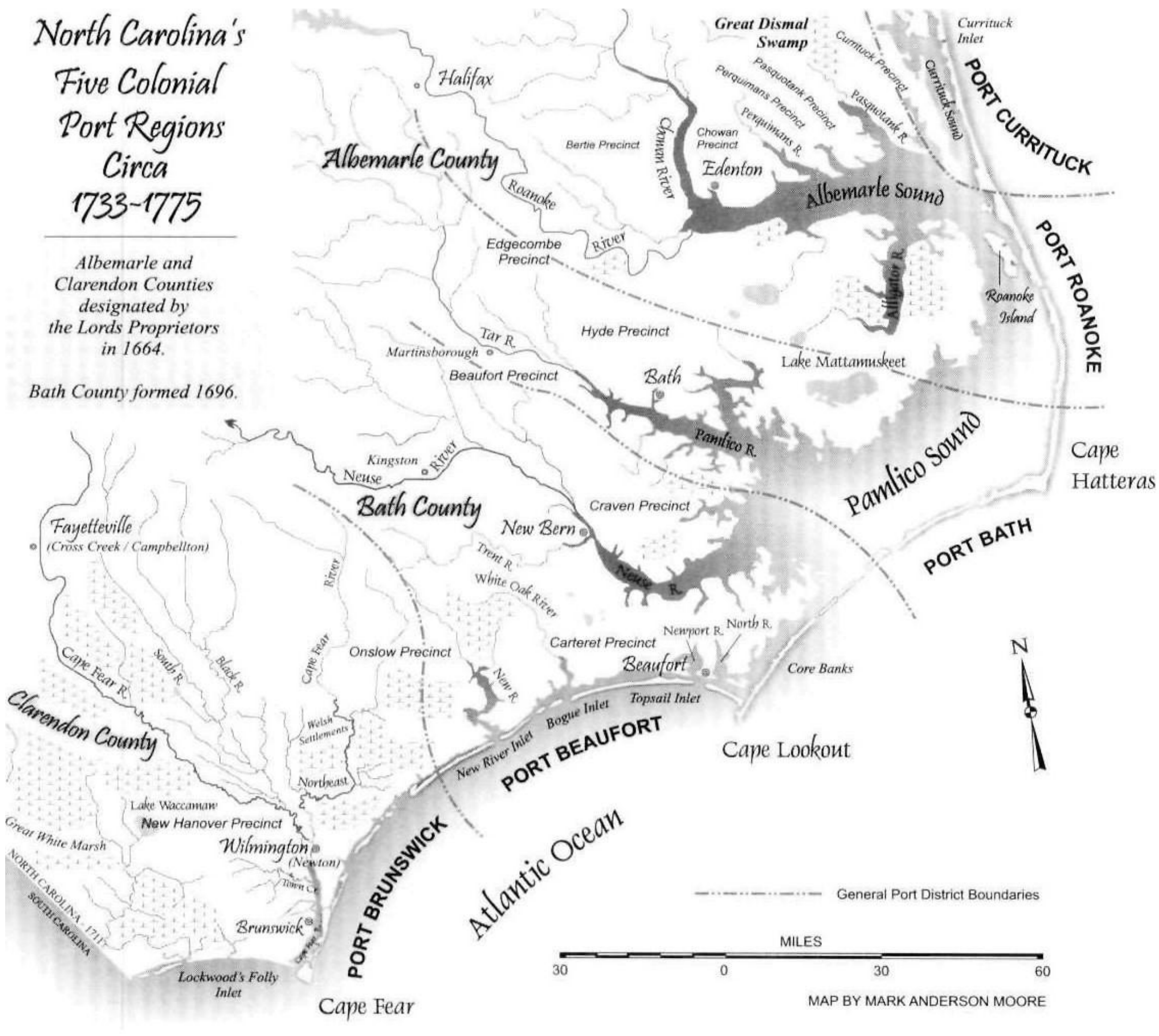



FIGURE 6.16 North Carolina's Colonial Port Regions (Combs 2003:3).

However, despite the implications of the name Cape Fear, this area was the least hazardous in relation to navigation along the Outer Banks. As is confirmed from the statistical data, more ships succumbed to the treachery of the Hatteras area than the Cape Fear Region, despite the larger number of hurricanes at Cape Fear during the colonial period. This trend is continued from the 1850s to the present with a greater number of shipwrecks around the Hatteras and Ocracoke area rather than the Cape Fear area, suggesting that the geography of the coast may have had a larger role in the deposition of hurricane-related shipwrecks than the hurricanes themselves. The lack of shipwrecks in the Cape Fear area may be due to the ease of maneuverability for ships, the stability of the shoals and sand bars, the deeper channel of the Cape Fear River that provides more direct and safer access to the interior, or a better knowledge of or preparation for sailing this area. Additionally, the constantly shifting shoals and convergence of currents at the Hatteras/Ocracoke area may be considered a reason for an increased number of shipwrecks there.

Historians have stressed the importance of geography in North Carolina's economic development and to some degree geographic conditions have dictated trade patterns around North Carolina's shores. Shoals and sand bars in areas such as Ocracoke Inlet shaped the commerce at ports such as Beaufort, Bath, and Roanoke; larger vessels were limited once inside the Inlet and commerce often relied on the extra expense of lightering. Currituck was severely limited due to the size of vessel that could travel there. Coastline traffic was encouraged at these areas due to geographical limitations, whereas at Brunswick ocean-going vessels could travel with relative ease, promoting large scale movement of goods and people in the this area. Population distribution was also a factor in commercial patterns (and could in turn be affected by patterns of trade). Heavy immigration, especially in the colonial period, to the Cape Fear Valley contributed to a higher volume of maritime trade in the Brunswick area (Combs 2003: 13). Additionally, profitable markets and goods influenced the shipping patterns along North Carolina's coast. Chapter Seven will further analyze the locations of hurricane-related wreckage spatially by examining locations through density mapping and tracking hurricanes versus wreck locations. Any correlations between the statistical and spatial data may be examined there for more concrete correlations between weather events and deposition of wrecks and the nature of the correlations.

*Vessel Type*

Various vessel types have plied the waters of North Carolina's coast, capes, and sounds. Vessel types vary from small vernacular craft to coasting schooners, liberty ships, and tankers. Unfortunately, in examining the vessels wrecked by hurricanes-related events, there are a large number of unidentified vessel types (132 of 489 or approximately 27%) (Figure 6.17).

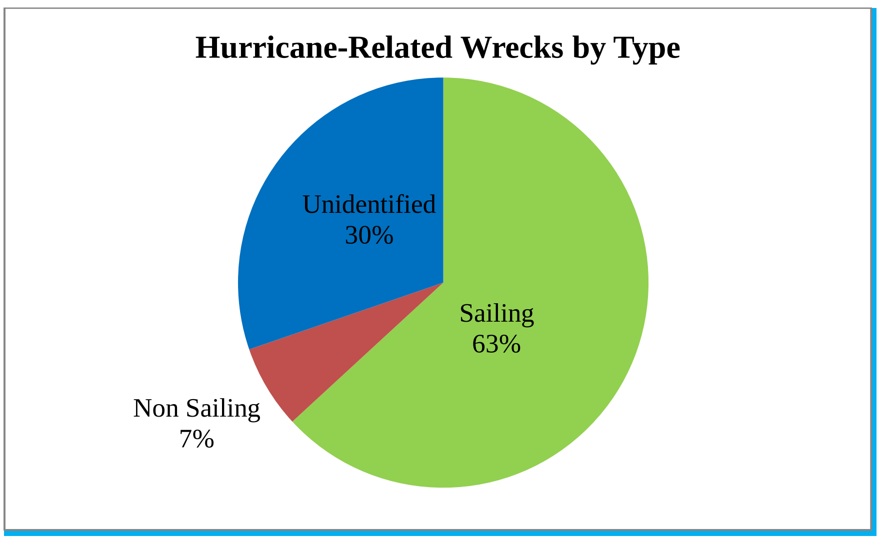



FIGURE 6.17 Hurricane-related shipwrecks by type (excluding unknown types), n=489 (Graph by Author).

This essentially skews the number of certain vessels types considered for analysis, and therefore affects how the data is viewed. However, the remaining identified vessel types are categorized as general types such as sailing versus non-sailing, and are also categorized as specific vessels types such as schooner, sloop, steamer, yacht, and liberty ship. There were also a wide range of vessels that utilized both systems of movement/propulsion, depending on the era in which they worked and existed. Without further details from owner or operators, most vessels are generally characterized as either a sailing or non-sailing vessel if identified. Examining the shipwreck data by vessel type potentially allows us to understand the relationship between the occurrence of hurricanes and the patterns of trade that are associated with vessel type.

In examining the dataset by vessel type, sailing vessels are the most affected by hurricane events regardless of location of the wrecks or any specific time frame. Vessel types that are non-sailing make up a very small percentage of the ships wrecked from hurricanes, but there are again a large number of unidentified vessels present in the dataset that may otherwise be identified as sailing or non-sailing (Figure 6.18). With that in mind, schooners represent the vessel type most often wrecked due to hurricanes on the North Carolina coast and in the sounds, with 157 of the 489 total vessels, or 32% of the total.

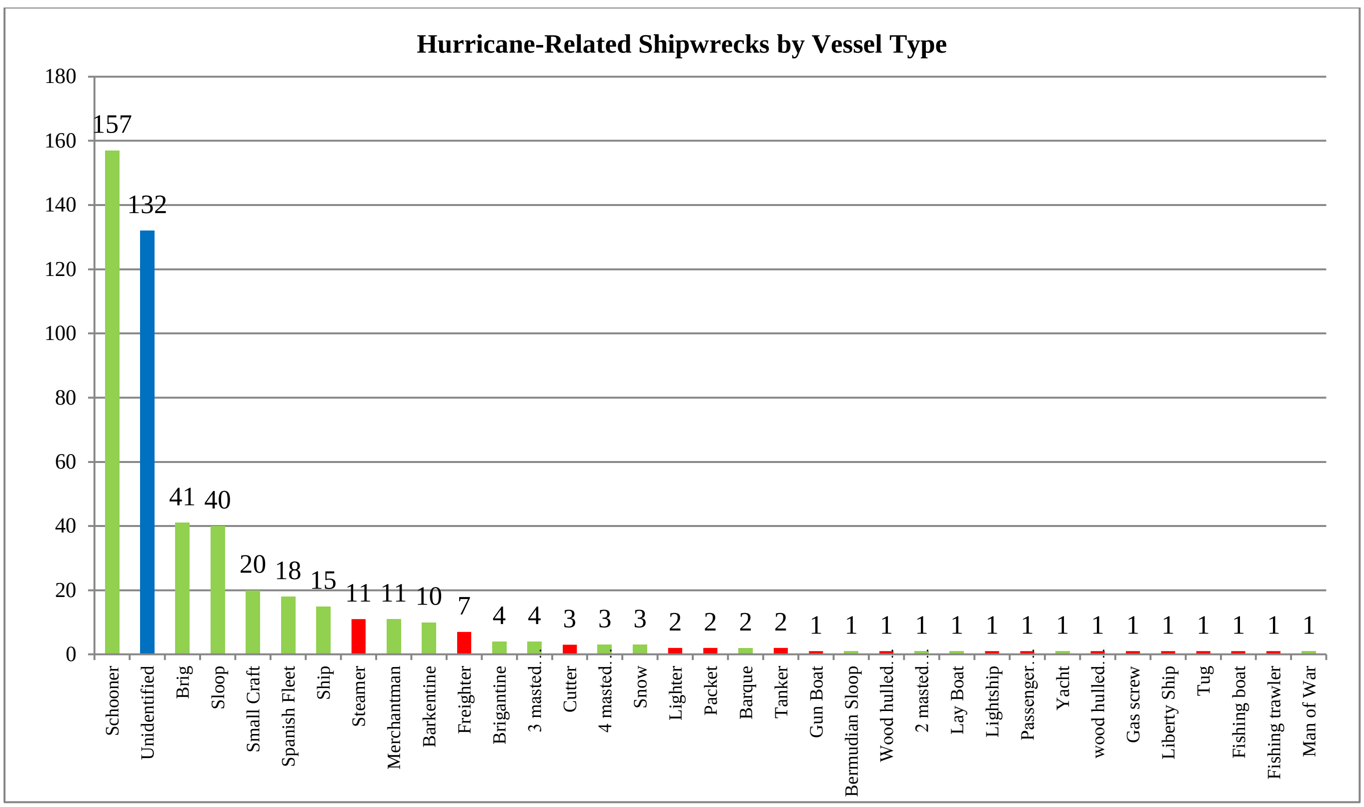


FIGURE 6.18 Hurricane Related Shipwrecks by Vessel Type, n=489 (Color-coding follows Figure 6.17) (Graph by Author).

Brigs and sloops follow with 41 and 40 vessels. Apart from the unidentified vessels, schooners, sloops, and brigs are the largest number of vessels wrecked pre-1850, with a schooner wrecked in almost every year in which there is a storm recorded (Figure 6.19). In the colonial era of North Carolina's maritime commerce, ports like Brunswick and Roanoke (Figure 6.16) saw an abundance of ships, brigs, and snows carrying exports and imports in and out of the area. Early on, sloops and schooners carried a smaller percentage of goods to and from North Carolina's shores for the larger ports along the coast. But when the maritime trade began to emphasize coastwise and coastline trade in certain treacherous areas of North Carolina, sloops and schooners became more prominent. These trends are reflected in the statistical data that emphasis these various vessel types in various time frames.

According to Dobbs (2009:61),

> The sloop was the most popular vessel built in North Carolina from 1693…to the 1750s. In the 1740s, 49 percent of all vessels built in that decade were sloops…In the 1750s, the schooner became the most popular type of rig built in North Carolina.

Although this does not take into account vessels built outside of North Carolina, the statistical analysis of the wrecked vessel types is indicative of this trend, with sloops being a larger percentage of the wrecked vessels until 1750, although continually appearing in the record into the early twentieth century. Schooners were crucial vessel types in the nineteenth century, engaged in an estimated "90 percent of all foreign trade of the United States" and were considered the most seaworthy hull type for the difficult configuration of the North Carolina coast (Dobbs 2009:61).

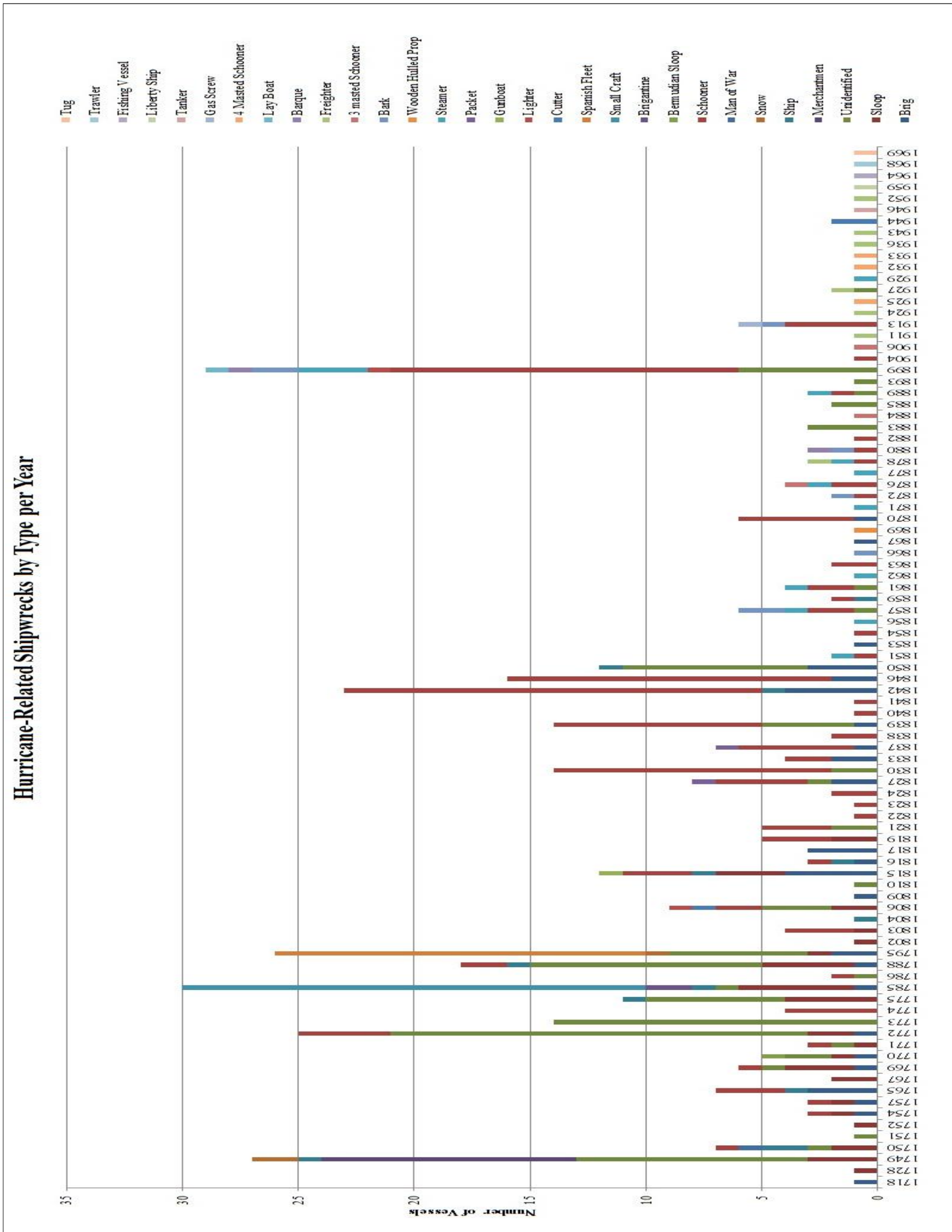



FIGURE 6.19 Vessel type by year, 1718-1969, n=489 (Graph by Author).

The statistical data reflects the trend of increased use of the schooner through the 1750s; however, the schooner is continually seen in the statistical data although the historical record implies a dwindling of its use for economic and shipping purposes after the beginning of the twentieth century.

The ubiquitous nature of the schooner and sloop was a result of their versatility for "being used as cargo carriers, fishing vessels, commerce raiders, slavers, and warships….They were cheaply and easily built, given the abundance of timber, and their construction was relatively simple and straightforward" (Jarvis 2010:124). These qualities and their ability to move freely in reefs, sand bars, and shallow-river channels, such as were the obstacles that limited the access to North Carolina ports, made sloops and schooners the most popular and abundant vessel in the colonial period through to the early twentieth century, which can be considered a factor in the correlation of this vessel type in the hurricane-related shipwreck statistical data.

Although the historical record tells us the popularity of the schooner passed by 1850, we continue to see its presence in the statistical record after that year. It is difficult to ascertain if these schooners are commercial vessels, or if they are recreational schooners; (given the previous data on trade, we may assume commercial vessels to be more likely). It must also be noted that although schooners in particular, and sailing vessels in general, are the most common hurricane-related vessel in the statistical data, "steamship voyages contributed increasingly to the number of lost ships during the latter half of the nineteenth century" (Rappaport and Fernandez-Partagas 1995:15). In 1875-76, 'heavy weather' was blamed for the loss of 176 steamships" (Rappaport and Fernandez-Partagás 1995:7). Some particularly famous hurricane-related wrecks off the North Carolina coast have been steamers, such as *Central America* (1852-1857). Although steamships could succumb to the nature of severe weather events, they generally are lacking in the dataset as related to hurricane destruction. Despite the intensity of storms at sea, "vessels, especially steamships, sometimes overtake hurricanes because their speed is greater than the progression of the storm center" (International Correspondence Schools 1906:289). This can account for the general lack of non-sailing vessels in the record of hurricane-related shipwrecks. Additionally, early losses to severe weather events, whether sailing or non-sailing vessels, may be owed in part to the unseaworthiness of the ships and their equipment, begging the question does the event account solely for the damage or does a combination of the boisterous nature of the weather and the physical nature, or type of vessel, lead to patterns of deposition?

In analyzing the statistical data associated with vessel type, it is difficult to ascertain if there is any certain correlation between hurricane-related shipwrecks and vessel type. Although sailing vessels in general, and schooners specifically, are the most commonly wrecked vessels due to severe weather events, there is no clear correlation between vessel types and periods of hurricane activity. There are stages in North Carolina's maritime commerce that emphasized certain vessel types over others, but the statistical data does not necessarily correlate to this. Chapter Seven will analyze the location of hurricane-related shipwrecks by type to glean any trends that correlate ship type with hurricane events spatially. Throughout the discussion of shipwrecks and hurricanes we continually see a trend where cultural factors are predominating as underlying causes of wrecking. In other words, there are better correlations between wrecking events and cultural factors (such as trade) than with natural factors (such as hurricanes). This has ramification for viewing human agency in the archaeological record; depositional trends, such as hurricane-related shipwrecks are not determined solely by catastrophe, but by human decisions regarding economic (trade and shipping routes) and social circumstances. Considering a lack of correlation between natural factors, i.e. hurricanes, and ship wrecks, we must consider the cultural factors, i.e. trade, involved with vessel loss by type. Thus, economic circumstances determine what vessels, i.e. sloop versus steamship, will be stricken by severe weather events. In other words, it is not a particular design flaw or characteristic which causes a sailing vessel to be lost but rather the fact that trade and shipping attracted these vessels to a certain port or area. This again follows the notion that multi-causal factors are at play in the relationship between hurricanes and wrecking events, and again the predominance of cultural factors and human agency in the deposition patterns of vessels.

*Vessel Cost*

There is meager data regarding the cost of the hurricane-related shipwrecks in this dataset, mainly owing to the nature of the data sources regarding ownership and construction details, as well as the large number of unidentified vessels presented in the historical records. Vessels with names and/or associated owners, masters, or captains were searched using registers such as *Lloyd's Register of Shipping* (Blake 1960); however, this proved difficult for gaining any further information about many of the costs to manufacture vessels, even if identified. Therefore data relating to ownership and cost is incomplete. We may assume that prior to 1850 most unidentified vessels would be sailing craft, but after this time, vessels may be sailing, mechanically propelled, non-propelled, or even a combination of several. In examining general accounts of the various vessel types, we gain a general understanding of the cost of vessels lost to severe weather events. One of the difficulties in examining the cost of vessels lost due to hurricanes lies in finding specific information related to the value of vessels and any cargo or equipment lost with the vessel. For certain storms, many nameless or unidentified vessels were lost, providing no information regarding any comprehensive economic loss related to the vessels;

however, for some storms such as the infamous San Ciriaco, more detailed information is available concerning the value of vessels lost to this storm including any cargo or equipment. The Graveyard of the Atlantic Museum houses information concerning the loss of vessels due to the 1899 San Ciriaco Hurricane which destroyed numerous ships along the entire North Carolina coast. Several vessels are specifically detailed due to the efforts of the United States Lifesaving Service, while many others went unidentified. Northeast of the Portsmouth Island Lifesaving Station, *Fred Walton*, estimated at $1,100 value wrecked in the vicinity of Ocracoke Inlet. The vessel was being used as a lay boat for the Norfolk and Southern Railroad when it broke loose from its moorings. The master survived the disaster but the vessel was a total loss. The crew of *Florence Randall* also endured this mighty hurricane; sailing from New York to South Carolina, *Florence Randall* was valued at $15,000 and was carrying $4,000 worth of fish scrap. South of the Little Kinnakeet Lifesaving Station, *Robert W. Dasey*, a three-masted schooner came ashore enroute from Philadelphia to Jacksonville carrying coal; the vessel was valued at $8,000 with the coal valued at $1,000. Near the Chicamocomico Station, *Minnie Bergen*, a three masted schooner of Cuba carrying railroad iron, coal, and oil was discovered run ashore. Although the crew was saved, the vessel valued at $15,000 and cargo valued at $13,000, was a total loss.

Vessels constructed for the government, such as lightships or liberty ships, have associated information about the cost of construction or repair, providing a generalized value for comparison with other vessel types. The Diamond Shoals Lightship, built in 1897 at a cost of $70,700 as a screw steamer, was often hammered by severe weather events, causing extensive damage when the lightship was removed from its moorings or driven ashore (Graveyard of the Atlantic 2009). World War II liberty ships were the backbone of the supply line for Allied forces and the building program that produced approximately 2,700 liberty ships were one of the most productive in history. However, these vessels were not immune to the effects of severe weather, especially if traveling along the North Carolina coast, such as *Antonin Dvorak* (1943-1959). At an average cost between $1,600,000 and $2,000,000, the loss or destruction of one of these vessels was extremely costly not just as a piece of property but also to supply lines (Skylights 2007; Graveyard of the Atlantic 2009).

For each era of shipbuilding development, vessel cost could prove to be quite expensive before any returns were made. Although the figures presented here are generalized, they provide an idea of the average cost of a certain vessel type lost during a hurricane, a cost which could run even higher than the vessel's worth depending on crew, cargo, machinery, and industry served. For the colonial period, estimates for shipbuilding costs vary but range between £3 and £9 per ton, depending on the source and the vessel and rigging type. Shepard and Walton (1972:243-244) suggest "average prices of about £4 14s. per measured ton in New England and £7 4s. per measured ton in the middle colonies. The same higher quality oak ships were being built in the southern colonies as were built in the middle colonies, so the higher price would have also applied to both these regions." The majority of vessels entering North Carolina ports were small, usually not exceeding 300 tons; however, ships as large as 300 tons could enter the Cape Fear River, and those as large as 250 tons could sail through Ocracoke Inlet (Crittenden 1936:9). Commercial vessels entering North Carolina during this time were schooners, sloops, brigantines, snows, and ships. The average size of sloops and schooners were under 50 tons and as small as six to eight tons. The brigantine averaged 100 tons, while the largest vessels, the snow and ship, averaged 150 tons (Crittenden 1936: 10-11). Given the estimate of vessel cost being between £3 and £9 per ton, and the size and type of vessels wrecked during this period, the average cost of colonial vessels would cost between £36 to £300 for smaller vessels (sloops and schooners), and between £600 and £900 for larger vessels (brigantines, snows, and ships). Considering inflation (which some argue is impossible to determine for currencies before 1776 due to the unique nature of colonial currency) and the frequency of hurricane-related shipwrecks during the colonial period—approximately 133 vessels—the cost of vessels lost due to severe weather events would potentially eclipse the cost of vessels wrecked at a later period (Officer and Williamson 2006). Before conversion or adjustment for inflation, total colonial era vessel loss could be between £4,788 and £119,700. Using conversion calculators (Donne 2008) for the conversion of colonial pounds to colonial dollars, and an inflation calculator (Officer and Williamson 2011) for 2010 (the latest year to comparison) the value of colonial vessels lost along North Carolina's coast is between $1,280,000 and $31,400,000 for the colonial period. Although these estimates are relative, it provides a glimpse of the total value of loss accrued during the early period of North Carolina's hurricane history in relation to ships.

Nineteenth- to early twentieth-century costs of construction could range from £8-25 per ton for a schooner or sloop depending on the number of masts, but in 1917 it cost C.C. Paul $75,261.02 to build and outfit the four-masted schooner *Albert F. Paul* (Figure 6.20) (Burgess 1978:236-237; MacGregor 1982). According to Graham (1956:80) in 1850 "a ship built largely of softwood, e.g. larch, might cost £17-18 a ton…[and] the best iron ships cost £25-30" but could drop as low as £15 in a depression. Henry Hall (1884:87) stated in 1825 "a 300-ton ship cost $75-80 a ton in the U.S." Sloops and single-masted schooners "ranged in size from 5 to more than 140 tons, but typically were between 25 and 100 tons burden (Jarvis 2010:122). In Henry Halls' *Report on Shipbuilding* (1884:15) a fishing schooner built in that census year could cost $55 to $65 per ton with the cost of a 75 ton vessel at about $5,000 with labor at an extra $1,900 not including the value of any cargo carried or the value of insurance or additional machinery. Steam frigates built in the 1840s cost $550,000 to $600,000 (Hall 1884:156).

## Figures and Facts

Statement of Cost of Schooner *Albert F. Paul*

Baltimore, Maryland
October 23, 1917

| | |
|---|---|
| Contract with W. G. Abbott for hull | $40,000.00 |
| Allowance to Mr. Abbott | 750.00 |
| Bonus money | 2,000.00 |
| George Taulane Sons, sails | 1,900.00 |
| William F. Wilson, rigger | 1,142,70 |
| C. M. Struven & Co., a/c outfit | 13,304.01 |
| J. S. Beacham & Bro., spars, painting and extra carpentry work | 3,778.42 |
| Redman-Vane Shipbuilding Co., painting etc. | 56.26 |
| Wm. E. Woodall & Co., hauling | 121.59 |
| Geo. W. Ilgenfritz, blacksmith | 113.62 |
| Captain Southard, wages, railroad fare, hotel bills, incidentals | 1,094.71 |
| W. S. Biggs, ironwork | 3,157.60 |
| W. S. Bier, tank and freight | 276.93 |
| W. D. Hollhes, loading bowsprit | 5.00 |
| Fare to Washington, Shipping Board, a/c masts | 1.50 |
| J. L. Gilbert & Bro., screens, table and wood work | 120.57 |
| J. F. Corcoran & Co., galvanizing iron work | 294.34 |
| Mullen, towing in harbor | 26.00 |
| Mianus Motor Works, engine for yawl | 204.90 |
| W. G. Abbott, for cartage and freight on outfit and extras | 969.47 |
| Carving trailboards | 26.00 |
| H. D. McCollough & Son, plumber | 700.00 |
| Watchman at Baltimore | 64.00 |
| Hughes & Sons Transp. & Towing Co., towing to Baltimore | 1,400.00 |
| J. W. Neilly, galvanizing link and chain | 21.73 |
| Rohde & Sons Co., building boats and cutting numbers | 277.28 |
| Otto Schmidt, medicines | 54.60 |
| E. J. Codd Co., rudder supporter | 165.00 |
| Maury, Donnelly, Williams Co., trip and harbor ins. | 481.25 |
| Duffer, Baggott & Co., copper wire and rods | 15.69 |
| John J. Nigl, plumbing and supplies | 58.12 |
| R. H. Dougherty, making davits | 226.85 |
| Geo. D. Summers, furniture for the cabin | 179.70 |
| I. Franklin & Son, blacksmith work | 264.37 |
| The Gibson & Kirk Co., furnishing and putting up hand rails, etc. | 94.21 |
| Duer, brass screws, knobs, and buttons | 4.06 |
| Chronometer | 200.00 |
| Mianus Motor Works, engine for forward house | 1,502.87 |
| J. F. Fisher, surveyor | 195.37 |
| Ten certificates of ownership | 2.00 |
| John E. Hand & Sons Co., nautical supplies | 10.30 |
| | $75,261.02 |

| | |
|---|---|
| Paid in full for hull | $40,000.00 |
| Paid bonus to carpenters | 2,000.00 |
| Paid account outfit | 15,300.00 |
| Paid account outfit | 9,000.00 |

C. C. Paul, Managing owners

FIGURE 6.20 Cost of building and outfitting *Albert F. Paul* (Burgess 1978:236-237).

To analyze vessel cost over time, inflated vessels costs were obtained using a relative value calculator based on the Gross Domestic Product (GDP), with input years based on the vessel's construction and an output of 2010 (Officer and Williamson). Cost estimates based on the previous examples and presented in Figure 6.21 are utilized for the entire dataset in order to gain a better understanding of the cost of vessel loss due to hurricanes over time. Although it is impossible to provide a precise evaluation of vessel costs without specific tonnage for each ship, we can use the average tonnage of each vessel type and the average costs from specific time periods to estimate the value of the loss of ships to severe weather events.

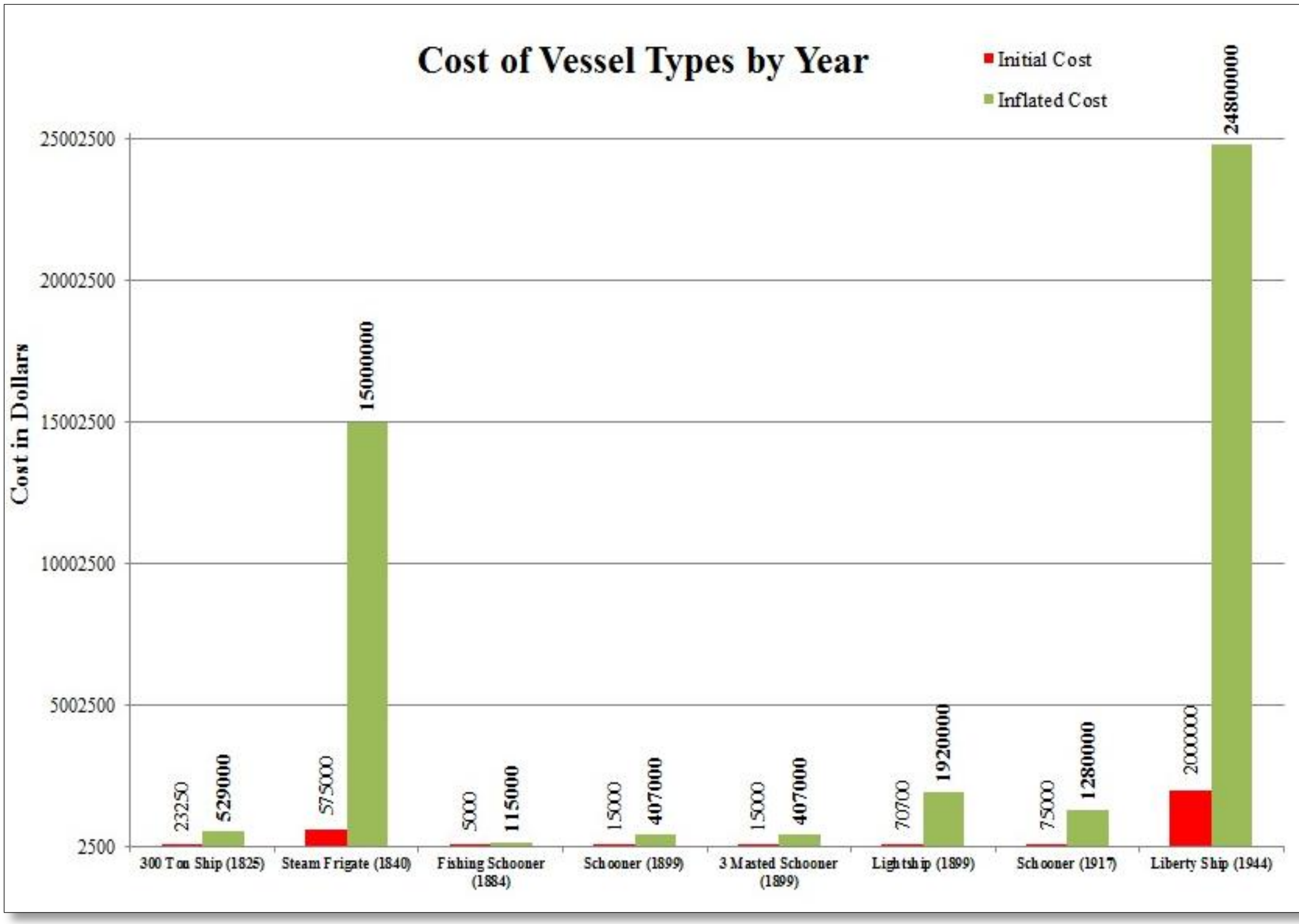



FIGURE 6.21 Average cost of a vessel by type and year, n=8 (Hall 1884; Burgess 1978; Skylights 2007; Graveyard of the Atlantic 2009).

It would be assumed that the largest monetary loss would have occurred during times when steam and mechanically-driven vessels were prominent in the historical/archaeological records. Due to the size of these vessels and the addition of machinery such as engines and turbines, and the use of iron or steel materials, the cost of such vessels would be greater than any smaller, wooden sailing vessel. If we consider though, the cargo carried, the addition of armaments (e.g. on the Spanish fleet), and the use of rigging and sails, sailing vessels had the potential to cost as much if not more than mechanically-driven ships. Furthermore, given the large number of sailing vessels wrecked over time—321—the greatest total cost would actually come from sailing vessels rather than mechanically-propelled ships.

Inflated prices for sailing vessels could range between $11,500 and $1,280,000 per vessel, depending on tonnage. In calculating for the lowest and highest average tonnage for each vessel, the total value of sailing vessels loss from hurricanes would be between $3,691,500 and $410,800,000 from 1718 to 1969. Additionally, despite the expense of twentieth-century vessels (e.g. liberty ships or tankers), due to the amount of vessels wrecked before 1900—332—this era would have been more expensive for vessel loss.

### *Conclusion*

The statistical signatures of hurricanes in North Carolina are various and abundant. These signatures, or correlations, are seen in the relationships between patterns or trends in hurricanes tracks and shipwreck deposition. The correlations, whether positive or negative, between severe weather events and these cultural resources reflect the nature of the disaster landscape of coastal North Carolina. Patterns and changes in the nature of the maritime disaster landscape may affect patterns and promote changes in the occupation of coastal lands for this region as well.

As seen from the statistical data, hurricanes vary by time, area, and intensity. The statistical data shows that on a temporal scale, hurricanes follow a pattern by month for coastal North Carolina, but not necessarily by year. There are periods of time when hurricanes are negligible in the historical record and other times when they are frequent and intense. Additionally, there are various levels of storm intensities that have affected coastal North Carolina, but the storms that have dominated the coast have been considered low-intensity; however,

> Although low-intensity strikes typically cause less physical damage than high-intensity storm strikes, the frequency of low-intensity hurricane strikes is much greater. As a result, low-intensity hurricanes may have significant cumulative impacts on regional economics (Burres et al. 2002:118).

Every county of North Carolina has dealt at some point with adverse climatic effects. While some areas of the entire region are more prone to the occurrence of these events than others, Dare County, for example, has had the most hurricane strikes since 1850. Severe weather events are seen as n-transforms that produce effects causing cultural and behavioral reactions in cultural resources, allowing us to extrapolate about past actions and behaviors unique to the coastal region of North Carolina.

Several factors may account for the existence of certain distributions of shipwrecks across North Carolina's coast. Correlations between historic hurricane events and date of wreckage or general location of shipwrecks are visible in the statistical data. There are specific time periods that correlate seasons of severe weather events with higher numbers of shipwrecks, while there are time periods in which the number of shipwrecks does not correspond to times of intense and/or frequent storm occurrences. The same can be said of the general place of hurricane-related shipwrecks that see an emphasis on places like Hatteras or Ocracoke instead of Cape Fear even though this area was more prone to severe weather events over time. This suggests the nature of the correlations between shipwrecks and weather patterns is not always solely due to the event itself. For example, deposition patterns of shipwrecks that do not correlate with any natural event, such as the lack of patterns related to vessel type, may be more related to human or cultural response, rather than natural forces. The cultural reaction may be seen as the result of local and/or individual actions and circumstances rather than the specific severe climatic event. As explained in Chapter Two, O'Shea (2002) postulates that knowing the local weather, including the occurrence of severe climatic events, allows us to predict the distribution of a wreck or pattern of associated wreckage; in some instances this is true, while in others, the correlation is not so strong or evident.

Severe weather events and their relation to ship losses have been a constant reminder in the historical and archaeological records of the destructive power of these storms throughout time. Beginning in the fifteenth century and continuing for the next four centuries, hurricanes and tropical storms have caused a great magnitude of ship losses, with each era contributing new levels of loss for various vessel types, no matter the development of or changes in technology. According to Rappaport and Fernandez Partagás (1995:7), "the large number of ship losses was partially a consequence of the great number of ships that inadvertently encountered storms." This may be the cause of so many storm-related ship losses on the North Carolina coast, where a combination of intense climatic events and hazardous geography, human error, or faulty equipment, spelled the end for centuries of vessels. Additionally, in viewing a wreck individually, we can glean if the wreck's relationship to a severe weather event is direct or indirect relationships (i.e. human agency), but in order to better understand the process of wrecking regionally, we must view the wreck as a part of a whole series and as a reflection of a cultural behavior/reaction to these events. We are beginning to see that shipwrecks and their relationship to severe weather events are often direct but also contingent on other cultural factors such as trade patterns and human decision-making.

Chapter Seven will examine these factors spatially in order to glean a better and more complete understanding of their correlations and relationships to severe weather events in coastal North Carolina over time. Together such an analysis can expose the nature of such relationships, assuming they exist, and their effect on the settlement of North Carolina's disaster landscape.

# CHAPTER SEVEN: A WEATHERED LANDSCAPE…

## GEOSPATIAL CORRELATIONS

The previous two chapters discussed the various statistical correlations of North Carolina hurricanes that were extracted from the historical records of severe weather events. This Chapter examines the geospatial correlations of North Carolina hurricanes. By merging spatial and statistical data into charts and maps, this chapter analyzes correlations between North Carolina hurricanes and population change, areas affected, inlet change, and shipwreck deposition. The analysis of these components exposes patterns within the spatial data in order to visualize and interpret the trends and changes that ultimately correspond to chronological or regional settlement patterns for coastal North Carolina. Through the identification of correlations between severe weather events and social and environmental changes, we may also gain a better understanding of the factors that affect the various stages of occupation of a region over time and transitions in coastal North Carolina's disaster landscape. Various communities throughout the region (Figure 7.1) exhibit a range of reactions to severe weather events which are potentially visible in patterns of settlement, occupation, and abandonment, and the subsequent spatial analysis may aid in displaying these reactions.

### *Population Change and Communities*

North Carolina's coastal communities have seen fluctuations in population over time. The statistical analyses from Chapter Six showed that hurricane activity and population change rarely correlate, or do so inconsistently. In other words, despite the occurrence of often frequent or intense weather events, populations continued to grow, influenced more by other factors (cultural, social, or environmental) than merely the climatic events themselves.

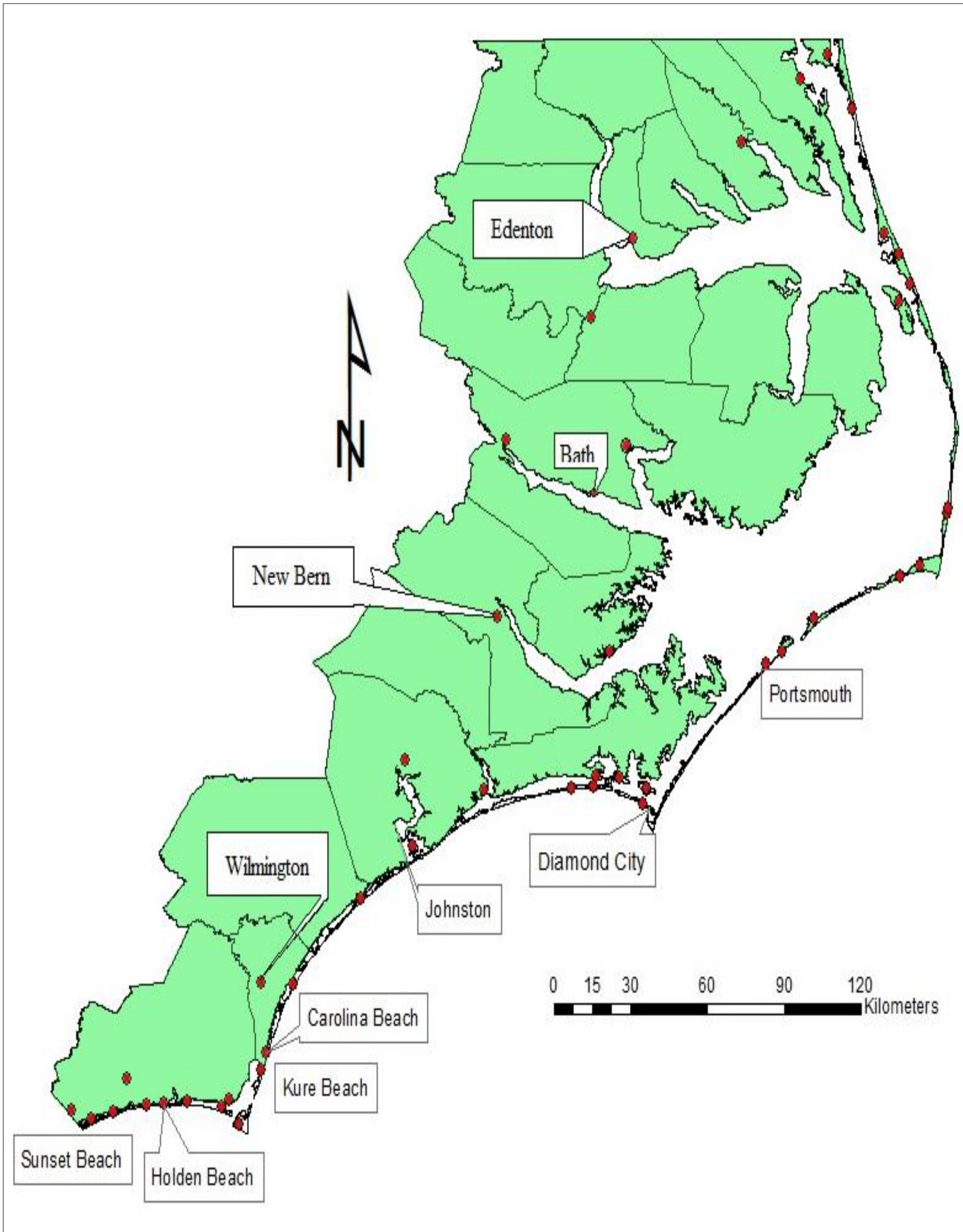



FIGURE 7.1 North Carolina's coastal communities (Map by Author).

This section examines population data spatially to visualize potential correlations between storm tracks and population change, and explores shifts or trends in population and community movement precipitated by severe weather events. This includes an analysis of the patterns of movement and decision-making of abandoning communities in their experiences with severe weather events. Exploration of the spatial data compares hurricane tracks with census figures for interpretation of change over time. Examination of specific community abandonment versus surviving communities also allows for the comparison of sites over time and an appraisal of their place in North Carolina's disaster landscape. Through these spatial patterns we can understand how hurricane activity affects the settlement patterns of coastal North Carolina.

*Hurricane Tracks Versus Population Change*

Although census records for coastal North Carolina counties are available from 1790, accurate spatial data for hurricanes begins only in 1851; therefore, the spatial comparison between hurricane tracks and population change can only be visualized from 1851 to 2004 (Figure 7.2-Figure 7.17). The mid-nineteenth century began with modest populations throughout the region, with the exception of several counties that exhibited larger populations (New Hanover, Craven, Beaufort, and Bertie). Into the 1870s there was an overall steady, level population with slight increases for the some counties. But after the storms of 1878 and 1879, the census maps show counties undergoing population change. After an 1878 storm, the counties within the storm's path experienced fluctuations in population with a decrease in population for New Hanover and Craven, but increase in population for Bertie, Martin, Beaufort, and Hertford. Additionally, in 1879 there are increases in population for the counties in the direct path of the storms of this year—Hyde, Carteret, and Tyrrell.

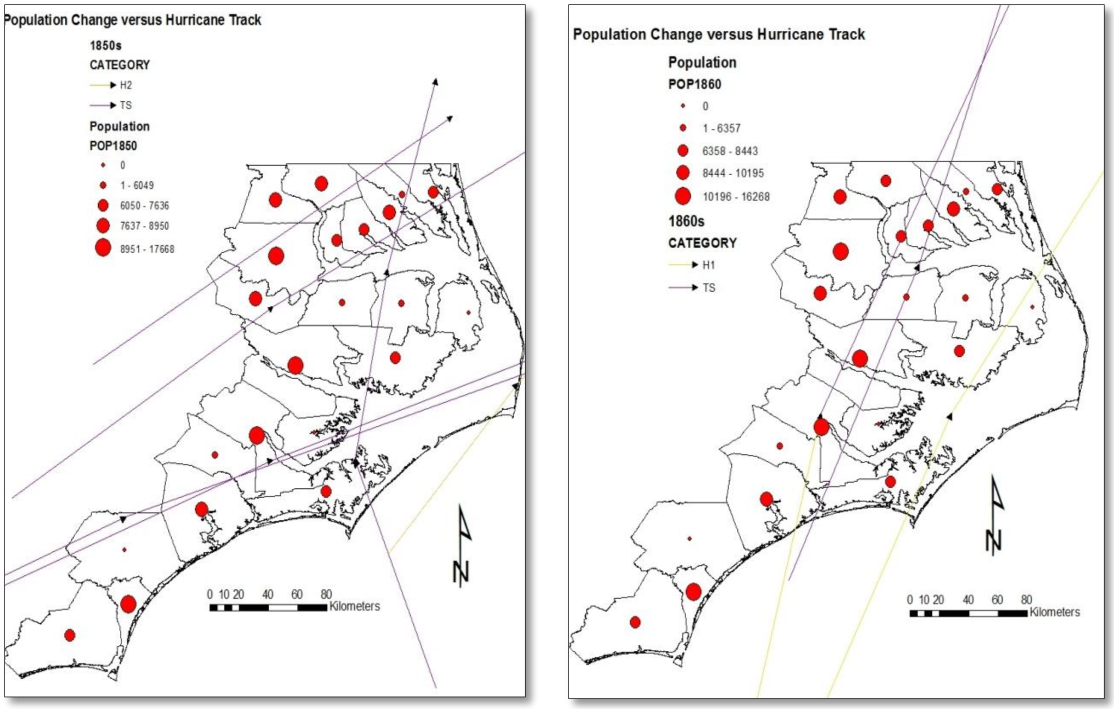



FIGURE 7.2 and 7.3 Population changes and hurricane tracks 1850 and 1860 (IBTrACS 2010; Historical Census Finder 2004).

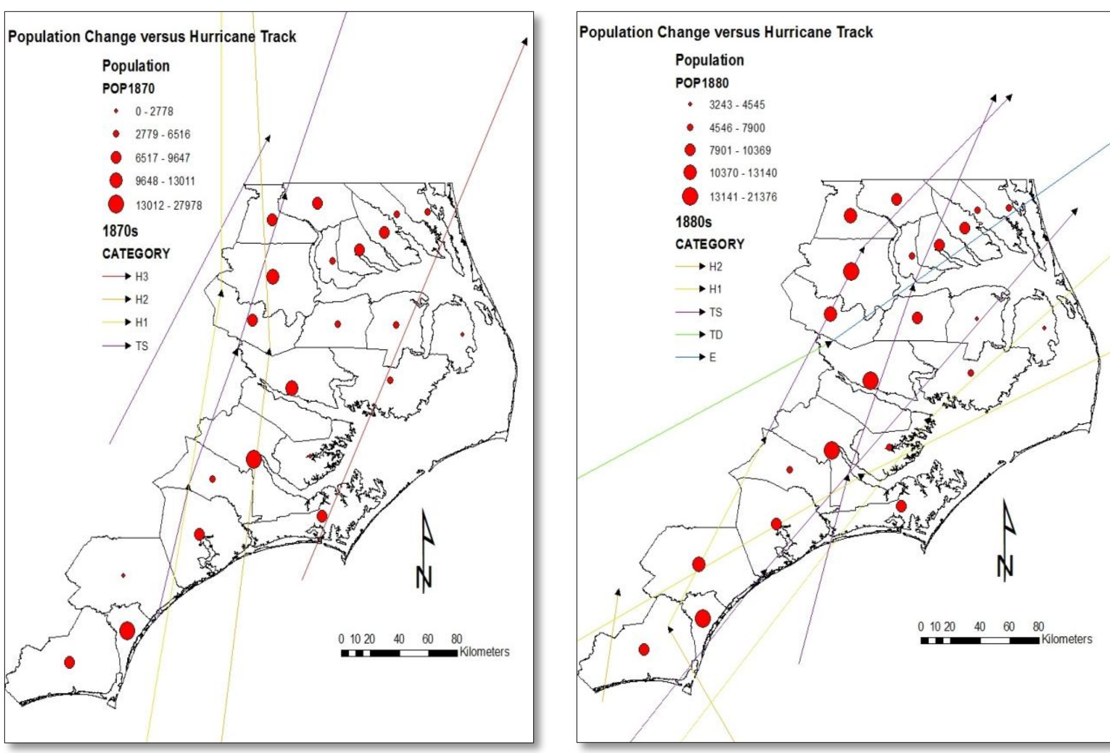
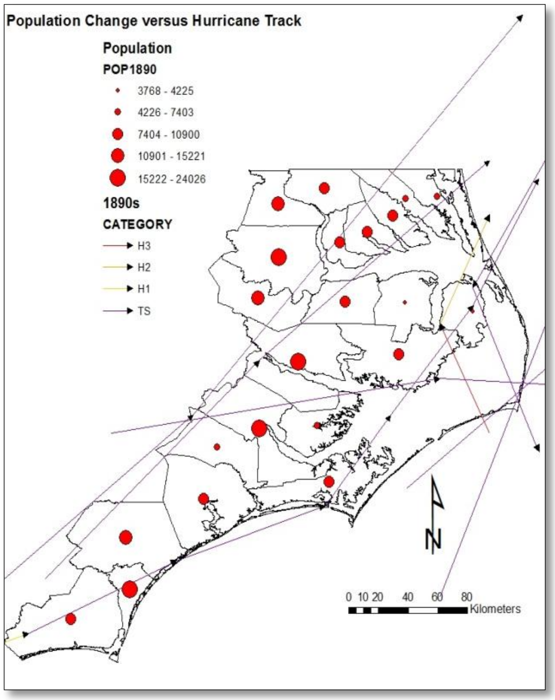



FIGURE 7.4 and 7.5 Population changes and hurricane tracks 1870 and 1880 (IBTrACS 2010; Historical Census Browser 2004).



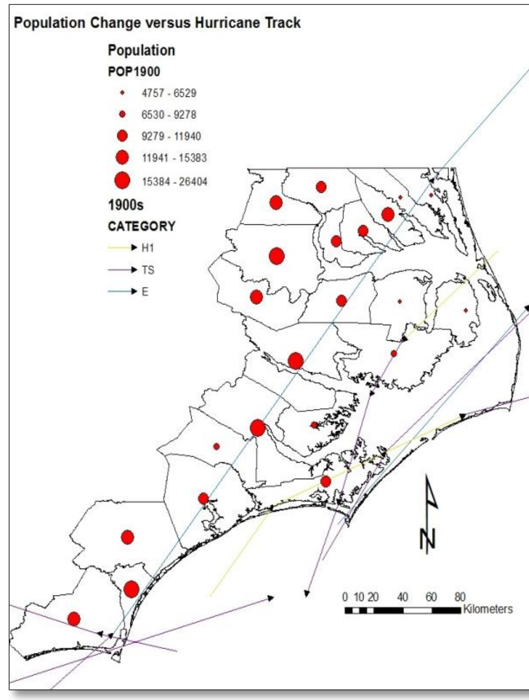
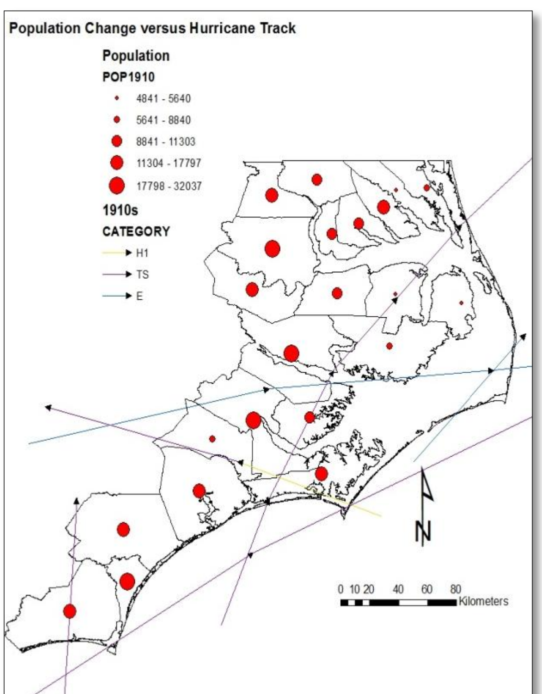




FIGURE 7.6 and 7.7 Population changes and hurricane tracks 1890 and 1900 (IBTrACS 2010; Historical Census Browser 2004).



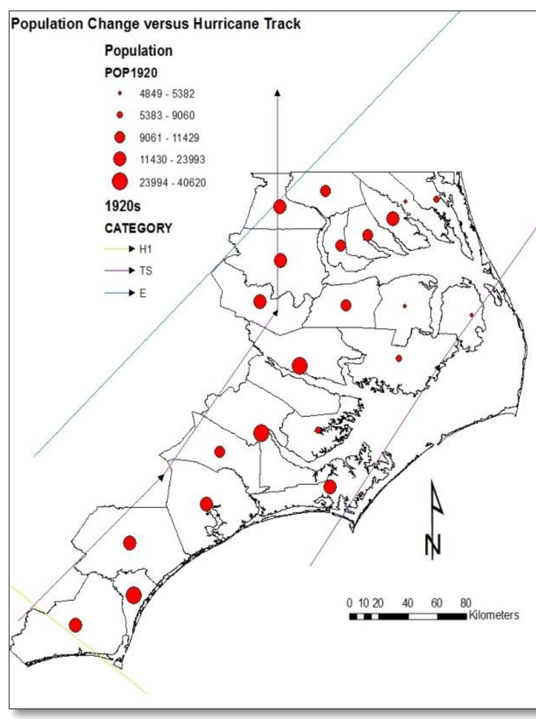




FIGURE 7.8 and 7.9 Population changes and hurricane tracks 1910 and 1920 (IBTrACS 2010; Historical Census Browser 2004).

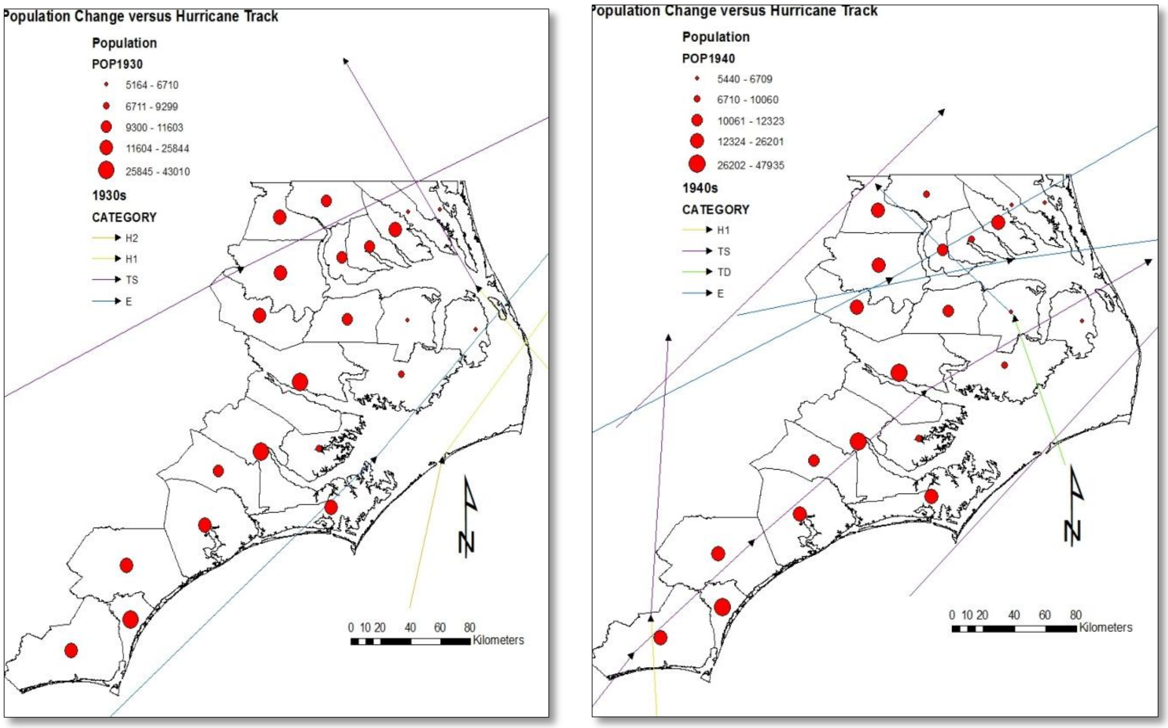



FIGURE 7.10 and 7.11 Population changes and hurricane tracks 1930 and 1940 (IBTrACS 2010; Historical Census Browser 2004).

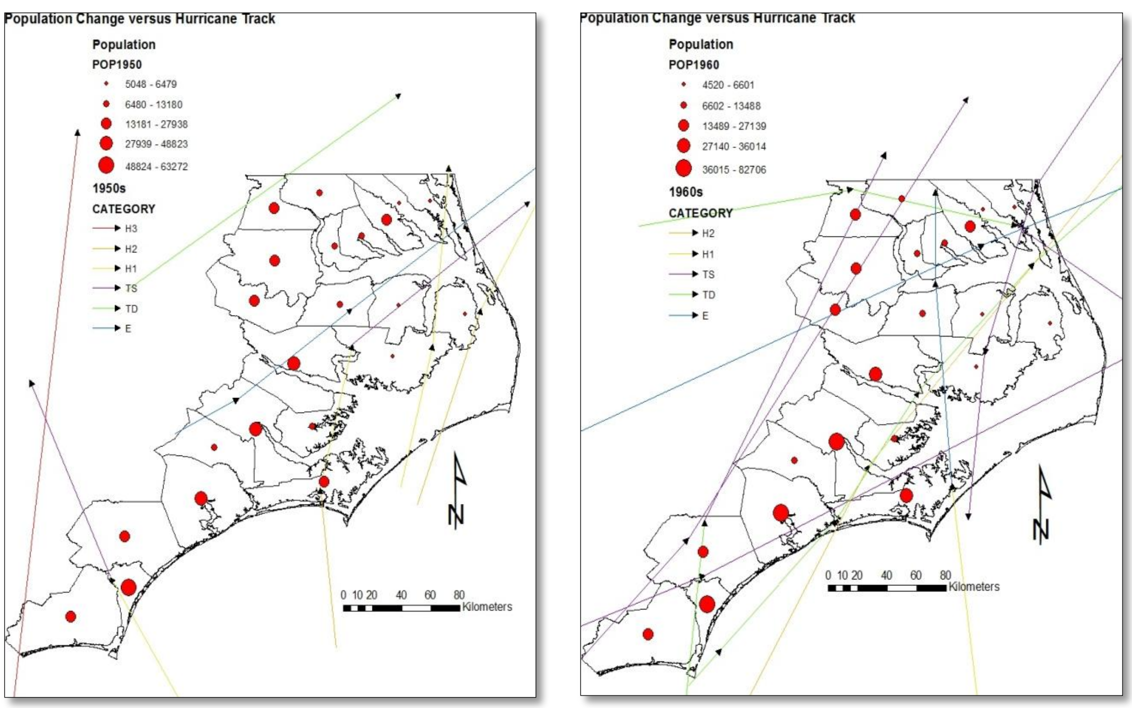



FIGURE 7.12 and 7.13 Population changes and hurricane tracks 1950 and 1960 (IBTrACS 2010; Historical Census Browser 2004).

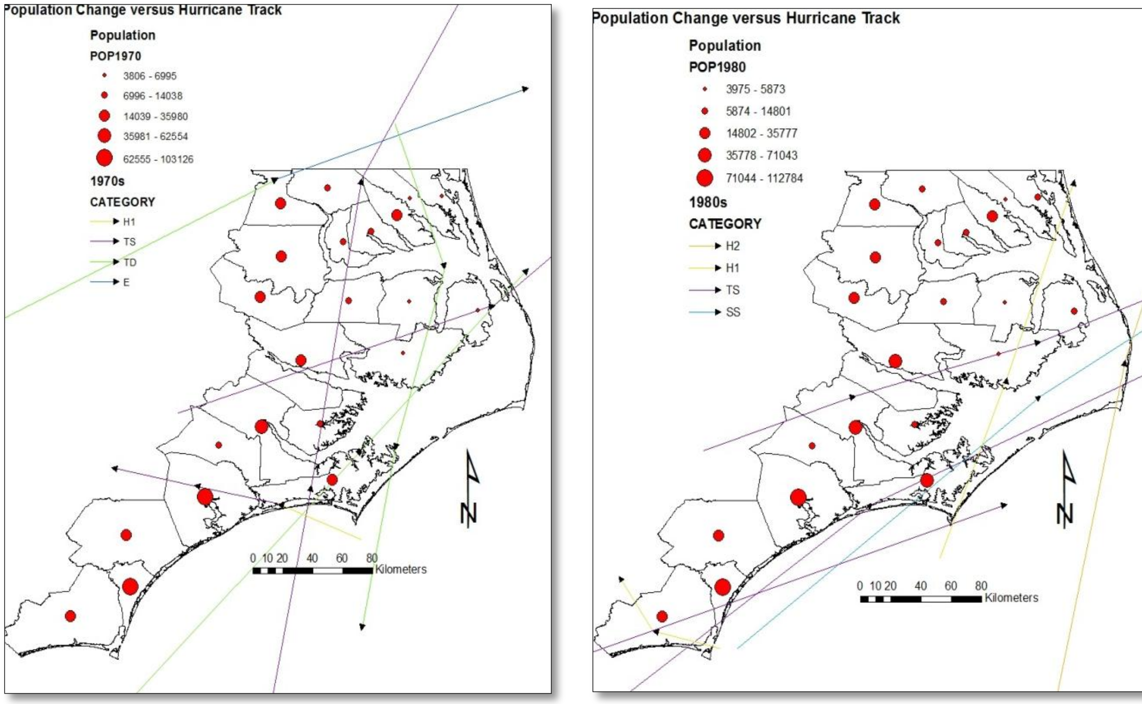



FIGURE 7.14 and 7.15 Population changes and hurricane tracks 1970 and 1980 (IBTrACs 2010; Historical Census Browser 2004).

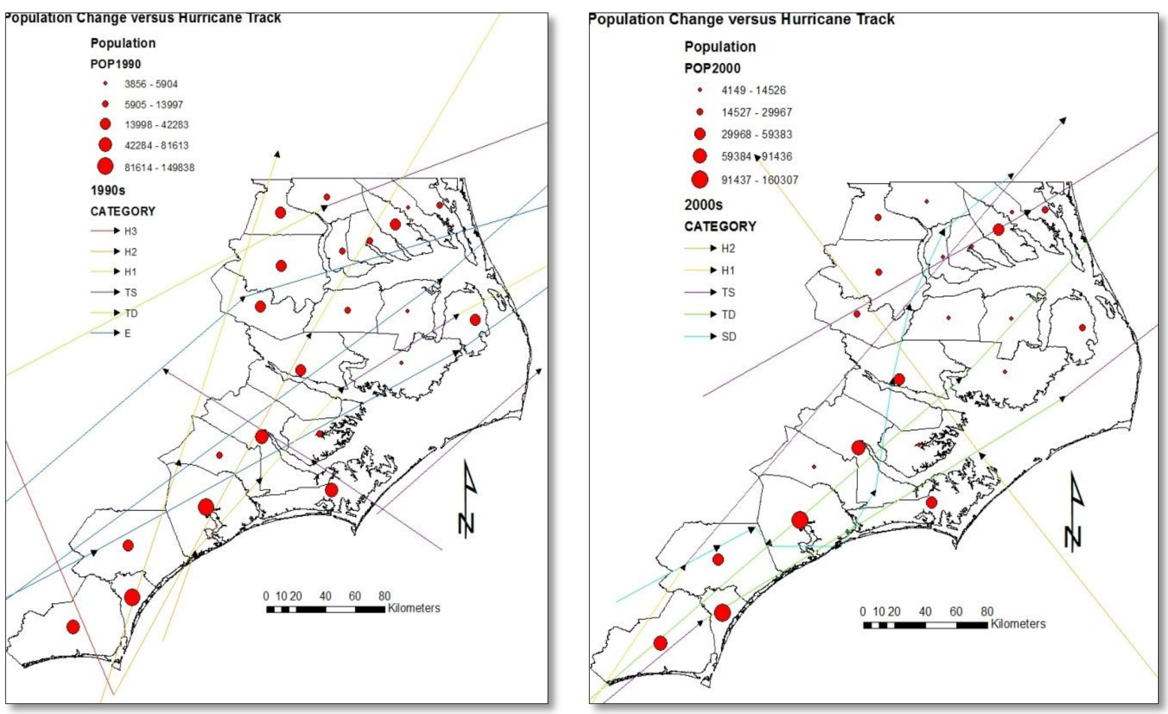



FIGURE 7.16 and 7.17 Population changes and hurricane tracks 1990 and 2000 (IBTrACS 2010; Historical Census Browser 2004).

It must be noted that there is a strong correlation between the effects of hurricanes and population change for Craven County during the 1870s when this county would have felt the direct and indirect effects of at least four severe storms. These severe storms could be considered responsible for the changes to the 1880 census, which shows a slight 3.836% decrease in population.

In looking at changes from the 1890s to the 1900s, we see several counties lose population while other counties continue to grow. Camden and Currituck counties lose population in the 1900 census. Camden and Currituck counties directly received the hits of at least three severe storms, and indirectly at least two more, while Hyde directly received three and at least the peripheral effects of another but saw an 4.21% increase in population. This suggests there can be a positive correlation between multiple storm hits per decade and population decrease for some counties. However, there are other instances where the correlation is negative implying other factors may be at play in relation to population fluctuation. For example, Dare county endured six severe storms but saw a 2.62% increase in population. The spatial maps show a 7.68% decrease in the Currituck county population despite no severe weather events between 1920 and 1930. There is a possible positive correlation between a decrease in populations in Gates and Perquimans counties between 1930 and 1940 with a directly falling hurricane in those counties in 1935, although the population changes were small (4.65% and 8.39% respectively).

After the 1940s, we see an overall change in population across the coastal area in the spatial data. Counties either leveled out in population or experienced decreases, which may be positively correlated to the seven severe storms experienced throughout the 1940s, especially in Hyde county. However, despite the intense storms of the 1950s, populations gradually increased and recuperated into the 1960s in areas like the southern coastal region and Onslow, Craven, and

Carteret counties. After the 1980s and 1990s there is a sharp decrease in population in several counties.

Again we see the inconsistency of the relationship between severe weather and population changes. Overall there seems to be no clear correlation between county population change and catastrophic weather. If there is a connection, it must only exist on the fine-scale, individual town level, which we cannot see from the county data presented here. In all probability, people reacting to severe weather events to the point of relocation may have moved within their county or to a nearby area, which would not necessarily represent any significant or visible change in the census data. In the examination of coastal communities marked by abandonment we may better see such trends in the adaptation of coastal peoples to severe weather events and what factors are influencing trends if the weather event is not the major cause of change.

*Coastal Communities Marked by Abandonment*

Horne (1993) suggests that studying abandonment aids in our understanding of local and regional adaptations and long-term processes of settlement and occupation. Considering that in the course of North Carolina's hurricane history, numerous cities, villages, and communities have had varied experiences with and reactions to historic weather events, looking at North Carolina coastal communities for evidence of settlement practices that include abandonment can expose any correlations between these practices and severe weather activity. For certain places along North Carolina's coastal area, hurricanes have left signatures in the disaster landscape that have caused changes in social and economic patterns as well as modified settlement. Several communities in the coastal region present opportunities to contrast settlement patterns through community reaction to severe weather events. The region of the North Carolina coast that experiences the greatest threat over time—the Cape Fear region and the central Outer Banks—have had very different occupational histories and reactions to severe weather events. Both may be considered hazardous geographical areas, but underlying social, economic, and environmental factors have made reactions to severe weather events vary.

Whole communities which once thrived on the North Carolina coast, have been completely engulfed and destroyed by the sands and winds of severe weather events. Wash Woods which 100 years ago lay on the narrow strip of land between Currituck Sound and the Atlantic Ocean is now only occupied by buried, deserted houses (Conley 1975:2). The August Storm of 1899, referred to as “San Ciriaco”, was one of the most deadly and powerful storms to hit the western Atlantic in the nineteenth century. Although losses were not comparable to the destruction in Puerto Rico, the storm left a path of heavy destruction throughout the Outer Banks. On the southern portion of the Outer Banks at Portsmouth and Diamond City, shifting winds converged to flood the entirety of Shackleford Banks, washing away dunes, killing wild and domesticated animals, and destroying homes (Barnes 2007:40). Marine forest covered nearly all of Shackleford Banks in the early nineteenth century, given the protection of Cape Lookout, but with the 1899 hurricane most of the forest was submerged and killed, leaving the bar unprotected to subsequent storms (Schoenbaum 1982:205).

In the early 1880s, Diamond City, on the island of Shackleford Banks, was a thriving whaling and fishing community of hundreds who made their homes there living off the marine life abundant to the area (Barnes 2007:36). Through the years, the residents of Diamond City endured all forms of punishing weather and during the 1893 hurricane season, they most likely “felt the effects of at least 5 major tropical storms or hurricanes, including one that caused 18 deaths in North Carolina in August and another that caused 22 deaths across the State in

October" (Barnes 2007:38). The 1896 season brought two major hurricanes with high winds and flooding, prompting some residents of Diamond City and other communities along the Outer Banks, to begin relocating. This set off "a decline that would continue for years. Those who remained were forced to leave after the great hurricane of August 17, 1899 struck a final blow and became the singular event that ended life as they knew it on Shackleford Banks" (Barnes 2007:38). By 1902, Diamond City itself was a ghost town, with only a handful of building foundations and gravestones as the reminders of any former residency (Jateff 2006:56; Barnes 2007:36). Residents migrated out of Diamond City to portions of the Carteret County mainland such as Beaufort and Morehead City as well as Masrhallberg and Broad Creek; but they also moved to other locations on the Banks down Bogue Island and near Salter Path (Figure 7.18).

Portsmouth Village is yet another Outer Banks community virtually destroyed by nineteenth century hurricanes, although it took considerably more time to force its complete desolation. Established in 1753, by 1770 Portsmouth Village grew to be one of the largest settlements on the Outer Banks. Ocracoke Inlet being a major trade route through the Banks, made Portsmouth, adjacent to the inlet, a lightering village with a growing shipping industry. But before the outbreak of the American Civil War, a hurricane opened the deeper Hatteras Inlet in 1846, causing shifts in shipping lanes away from Portsmouth. With the decline in usage, fishing replaced shipping at Portsmouth. The United States Lifesaving Station opened in 1894 at Portsmouth, but the population steadily declined (NPS 2011:1). The final abandonment of Portsmouth village in 1971 was the result of gradual isolation and economic depression, initiated by a constant threat to life and property from storms (Friends of Portsmouth 2011).

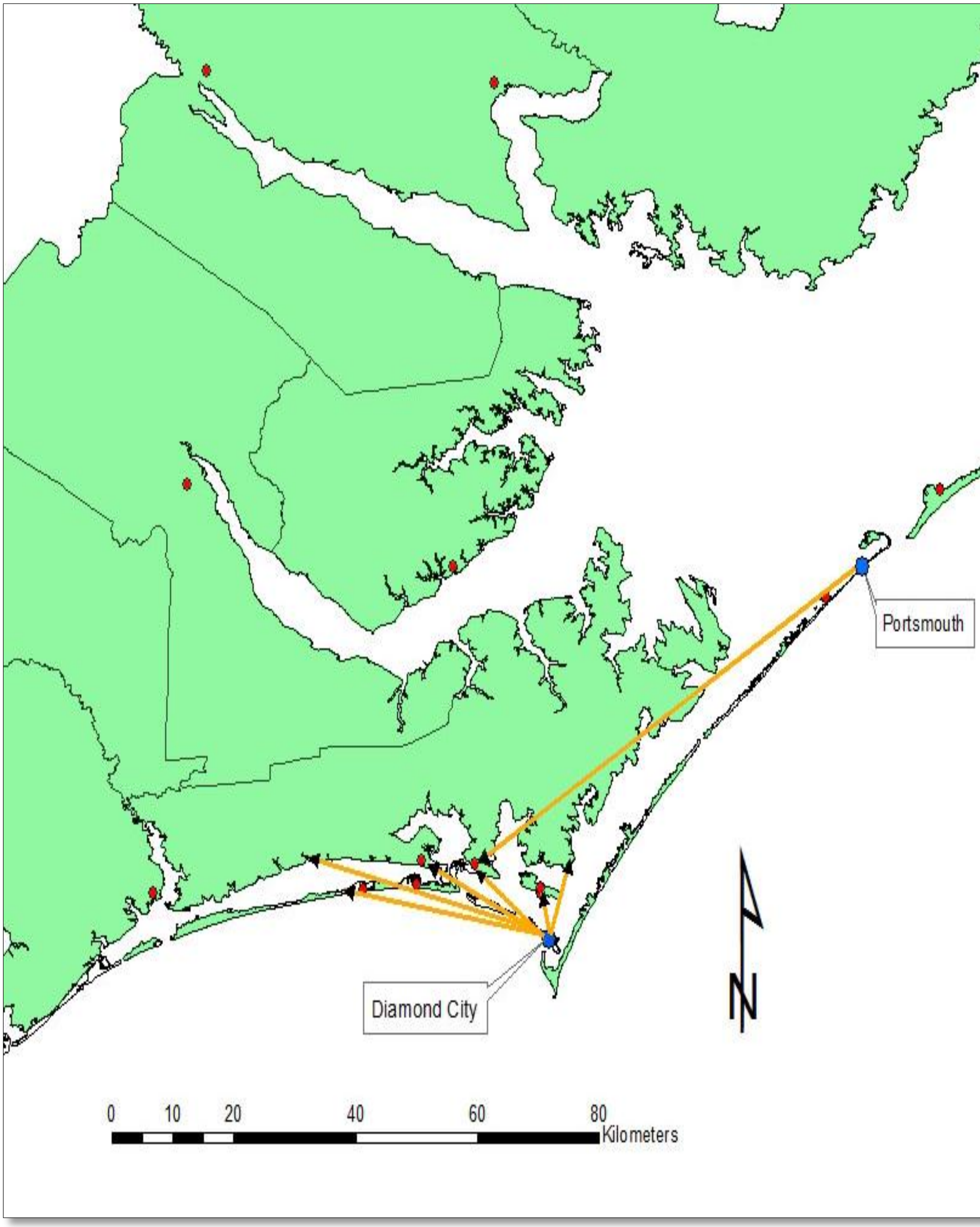



FIGURE 7.18 Map of movement of the Diamond City and Portsmouth communities (Map by Author).

The Outer Banks is not the only area of the North Carolina coast that has experienced the damaging repercussions of historic hurricanes, causing changes in occupational patterns. Between 1744 and 1753, court in Onslow County was held at Johnston, the county seat located on the New River, but a lethal hurricane destroyed Johnston in 1752, forcing the county courthouse, and local residents to be relocated to Jacksonville. Furthermore, the previous centuries are not the only periods of history where coastal North Carolina towns were devastated by severe storms and forced to relocate or reoccupy. Hurricane Hazel in 1954, one of the most devastating storms of the twentieth century, wiped out Holden Beach in Brunswick County. Although Brunswick County was no stranger to destructive storms “hardly a vestige of human habitation [remained] on the Brunswick County shore following Hurricane Hazel” (Pilkey et al. 1998:13). What makes Holden Beach and Brunswick County different from areas such as Shackleford Banks is that despite devastation in the 1950s, “the development at Holden Beach and other coastal communities in Brunswick County is presently much more extensive than it was before Hazel,” while Diamond City and Portsmouth remain isolated and uninhabited (Pilkey et al. 1998:13).

The areas of abandoned coastal communities are interesting in that they are uncommon features among North Carolina’s coastal region. A landscape such as coastal North Carolina, one that can be considered a disaster landscape, would be expected to see more regional abandonment, especially in periods where inclement weather is frequent and intense; however, coastal North Carolina as a whole has refused to ever completely falter in the face of a typically constant and devastating threat. Here we only have a handful of communities that have had to eventually abandon their towns and villages; cities and towns often lose economic or spatial importance over time due to the effects of severe weather events, but rarely do we see complete abandonment due to these effects. A major question within the study of abandonment concerns the nature of the processes of abandonment. Scholars have suggested that abandonment is usually a gradual process and rapid permanent abandonment is rare (Cameron 1993; Tomka and Stevenson 1993). The data presented here suggests that there is evidence of both processes within the record of abandoned communities, and presents a certain level of threshold. In the example of Diamond City, the process was rapid, often blamed on a single event that caused the decision to abandonment this small community for other grounds. The decision to abandon was finally seen as a solution to a recurring problem, in this case inundation from severe weather events. In the case of Portsmouth Village, the process was gradual, taking years for the final occupants of the community to permanently abandon the area under a set of given circumstances.

It is also interesting to note the movement of these communities when abandonment actually does occur. For the residents of Diamond City and Portsmouth, inland areas such as Beaufort, Morehead City, Marshallberg, and Broad Creek would have been the safest and easiest alternatives, but choices to continue living on the Banks along Bogue Sound or on Harker's Island seem unusual choices for the residents of a storm-battered village (unless they sought to emulate their trades). However, if we consider the relatively safer geographical conditions for areas beyond the turn of Cape Hatteras, it could be assumed that despite the presence of severe storms in the area of the Carteret mainland and Bogue Banks, former residents of abandoned villages would find these new places similar enough in culture and economy and just different enough in storm intensity and frequency to warrant moving so close to their former residences.

Despite fluctuations in the census records of coastal North Carolina in the temporal vicinity of severe weather events, it is difficult to say with certainty that these changes are the result of any one event or series of events. We can say with certainty that coastal counties and communities react differently to the occurrence of severe weather events in relation to population change and settlement patterns. Various reactions can be positively correlated to hurricanes, the result of intense or frequent storms, while reactions can also be negatively correlated presuming any change may be the result of other factors (or processes) such as geography, economy, war, or the like.

Considering the cases of abandonment and survival along North Carolina's coastal region, it may be fair to say that the abandoned communities have had economic, or cultural, problems before any hurricane event occurs. Lack of viable trade options or changes in fish populations (e.g. Diamond City and whaling populations) often contributed to the decline of coastal communities. In lieu of the data thus far, this study has demonstrated some key points. Cultural factors are pre-conditions for the presence of change. We see this in the distribution of sites along the coast and trends related to social and economic factors. Furthermore, people adapt; they may abandon their towns, but they do not abandon their region. Both points highlight the concept of multi-causality, or multiple underlying factors, in archaeological site formation processes and reinforce the importance of human agency and behavior in dictating change. Subsequent examination of the relationship between hurricanes and cultural and environmental resources can shed light on the influences behind such correlations.

### *Additional Hurricanes Effects*

As seen in Chapter Six, hurricanes can affect generalized locations along the North Carolina coast (such as the Cape Fear or Cape Hatteras regions), and certain areas have been more affected than others to the passing of severe storms. When viewing the data spatially, we can better visualize the specific areas affected by hurricanes through the trends in the weather tracks. Although spatial data is only available from 1851, mapping of hurricane tracks provides details about the movement of severe storms across the region over time, displaying patterns related to area and trends in the hurricanes themselves. This data can then be examined in relation to the statistical data from Chapter Six and an understanding of the counties, areas, or communities most affected and their reaction to severe weather events.

*Areas Affected*

The areas affected by severe weather events vary with each storm and storm season. Widespread hurricane activity is often the norm when we view hurricanes by decade. Each county has also had varying degrees of hurricane activity (Figure 7.19), although Dare County has endured the most storm activity, followed by the counties that border the Pamlico Sound.

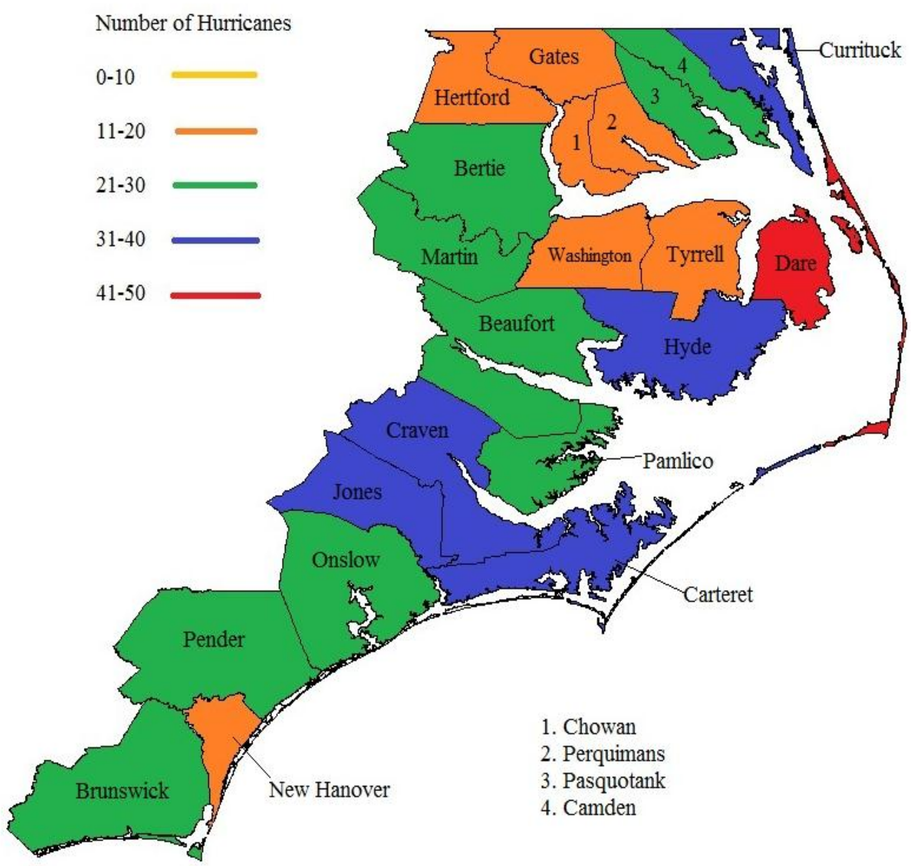



FIGURE 7.19 North Carolina coastal counties coded by the number of hurricane hits (IBTrACS 2010)

Those counties to the western border of the Albemarle Sound in the north, see the least amount of hurricane activity. Although this is a visual representation of statistical data, it better shows any visible patterns, such as the greater amount of hurricane activity in the counties that contain portions of the Outer Banks, such as Dare, Currituck, and Carteret. Using spatial data from IBTrACS (2010), Figures 7.20-7.36 detail the areas affected by hurricane tracks utilizing a line density technique. Line density mapping and kernel point densities are functions used in computer mapping programs such as ESRI's ArcGIS that "calculate the magnitude per unit area from a point or line" using a mathematical function, or equation (ArcGIS Resource Center 2011). In the examples used in this chapter, cell size (or the environmental values) and the search radius (the area in which density is calculated) are kept small (0.1-0.3 km) in order to produce figures with more detail for analyses.

Figure 7.20 displays all hurricane track data for the years 1851 to 2004 (the years available from the IBTraCS dataset). Using the line density function, the application took the hurricane tracks and calculated the areas of most activity, using square map units, in this case kilometers. As we can see from this map, a substantial concentration of hurricane activity occurs along the Pamlico Sound Region, concentrated around Hyde, Dare, and Carteret counties. This intensity of activity is also found in the Albemarle Sound Region around the tip of Currituck and Pasquotank counties. Figure 7.21 utilizes a line density with the intersection of hurricane landfalling tracks and coastal counties, similar to the line density function of hurricane tracks. This map details the points throughout coastal North Carolina where hurricanes have made the most frequent landfall, which are seen in areas such as Brunswick and Carteret counties as well as Cape Hatteras.

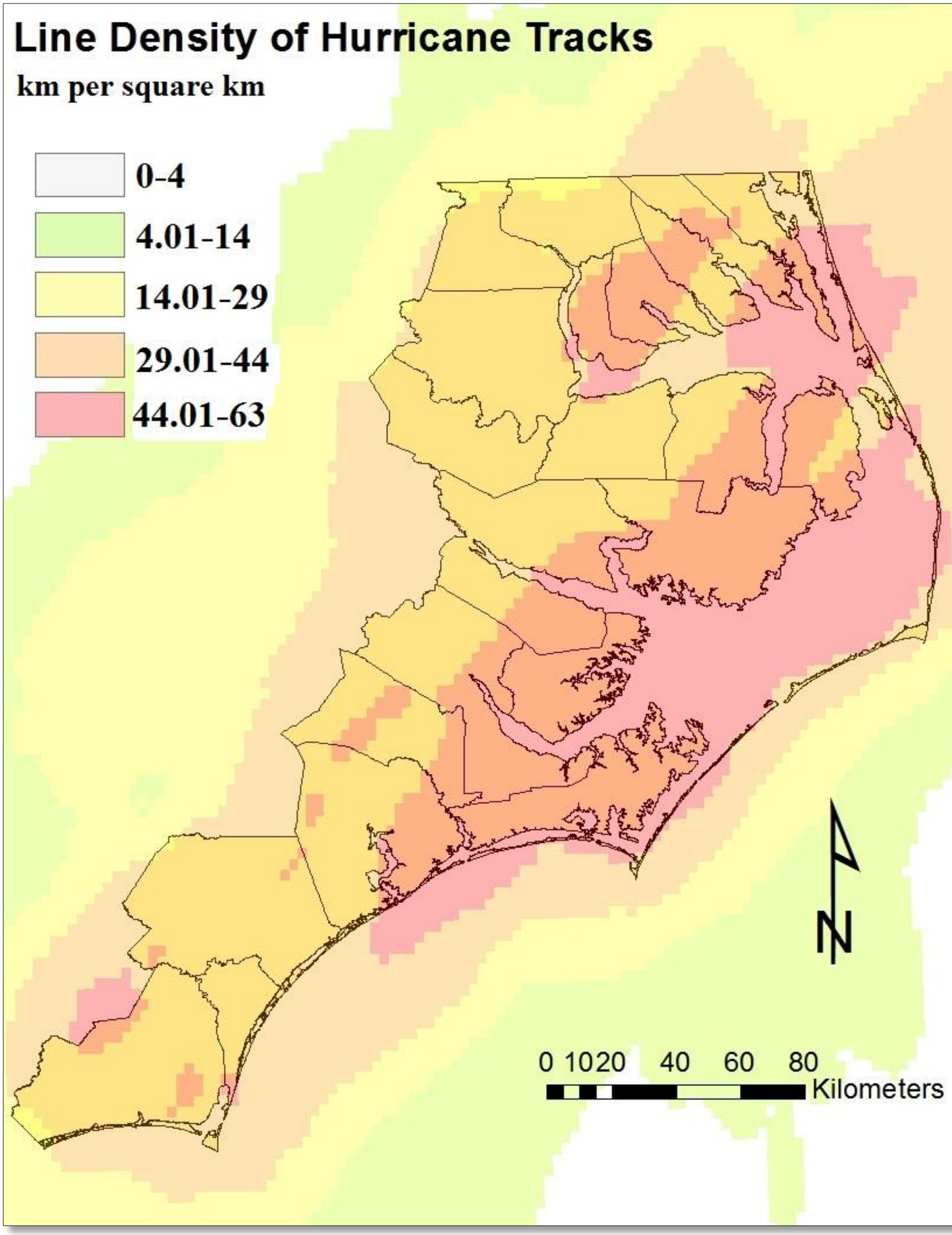



FIGURE 7.20 Density mapping of hurricane tracks, 1850-2004 (IBTrACS 2010).

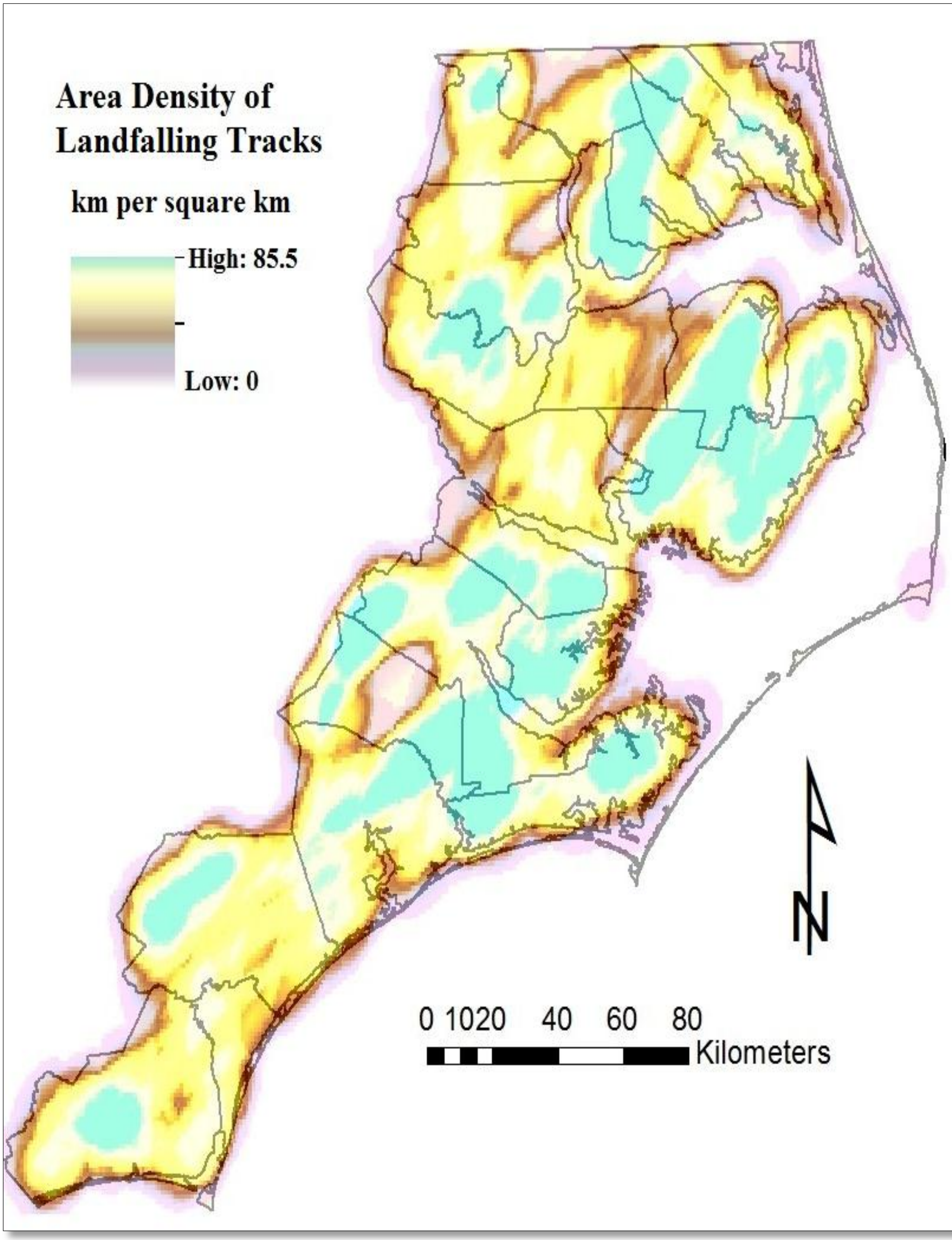
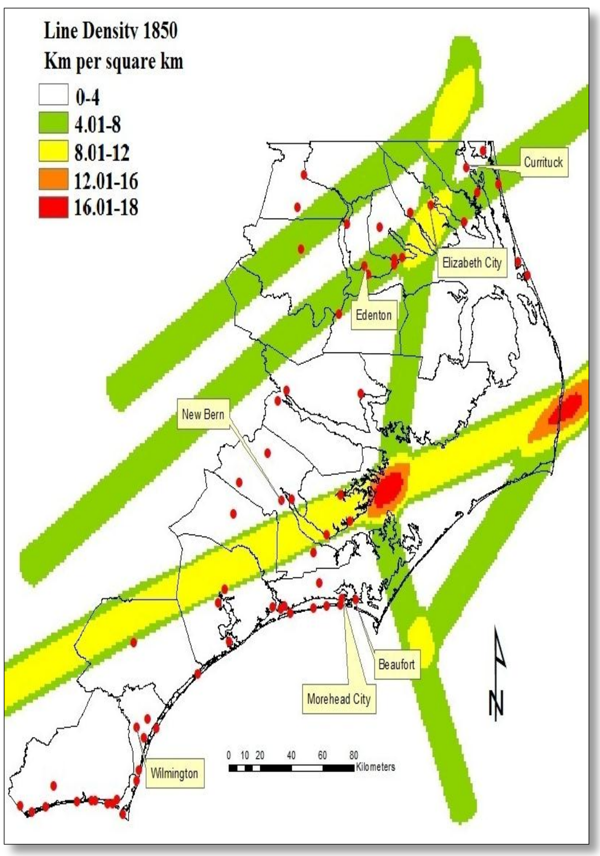



FIGURE 7.21 Kernel density of point of hurricane landfall (Map by Author).

Figures 7.22-7.37 detail the density of hurricane paths for each decade in order to gain better understanding of any changes over time. The region as a whole has endured widespread hurricane activity in the 1850s, 1880s, 1890s, 1940s, 1960s, 1970s, 1990s, and 2000s. Multiple hurricanes in these decades struck various locations throughout the coastal region causing extensive damage in the general coastal region rather than a single area within the region. This corresponds with the statistical data that sees a dominance of hurricane activity characterized by a general location of landfall and path.



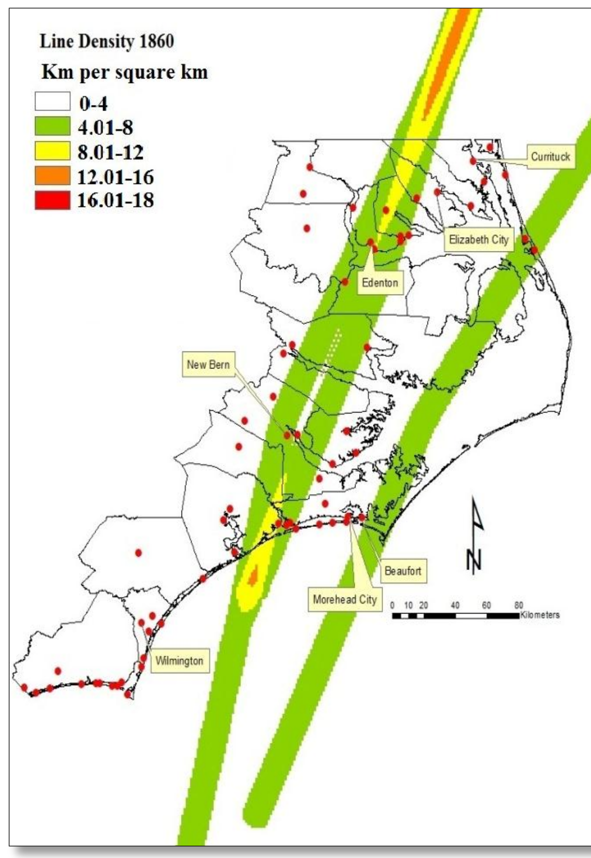




FIGURE 7.22 and 7.23 Line density mapping 1850 and 1860 (IBTrACS 2010).

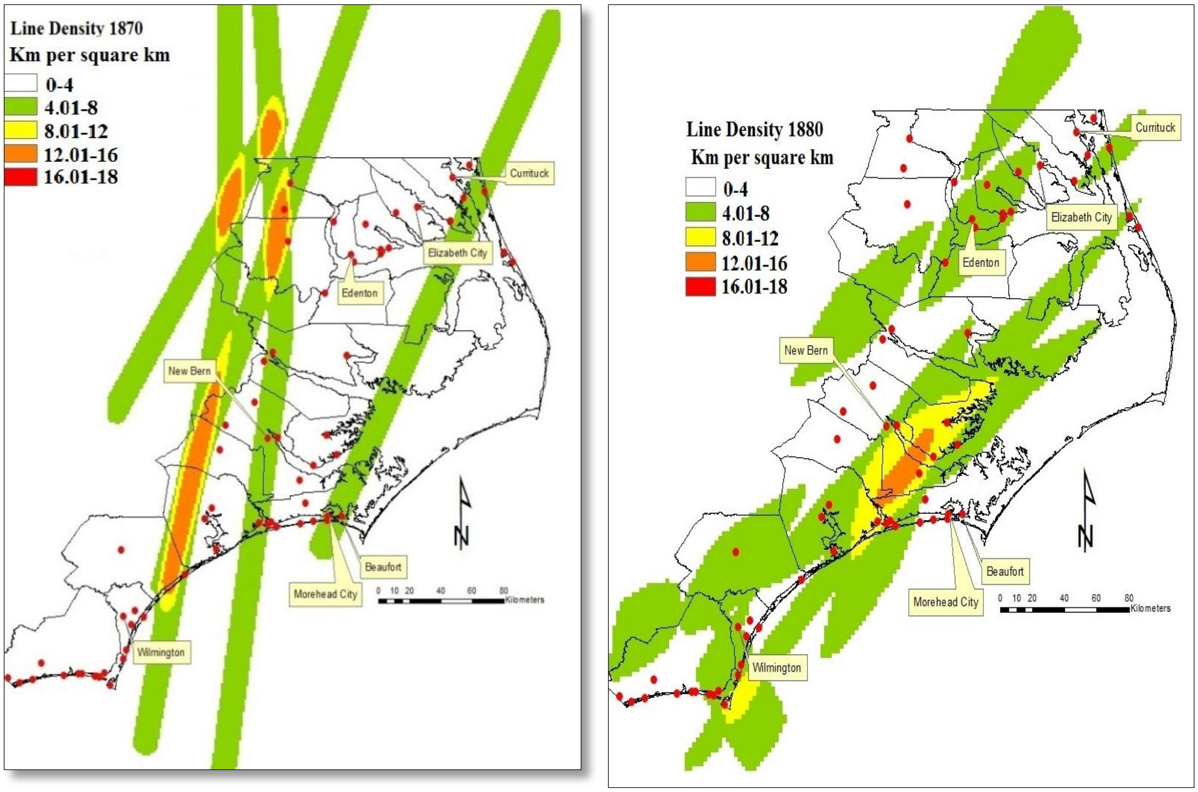



FIGURE 7.24and 7.25 Line density mapping 1870 and 1880 (IBTrACS 2010).

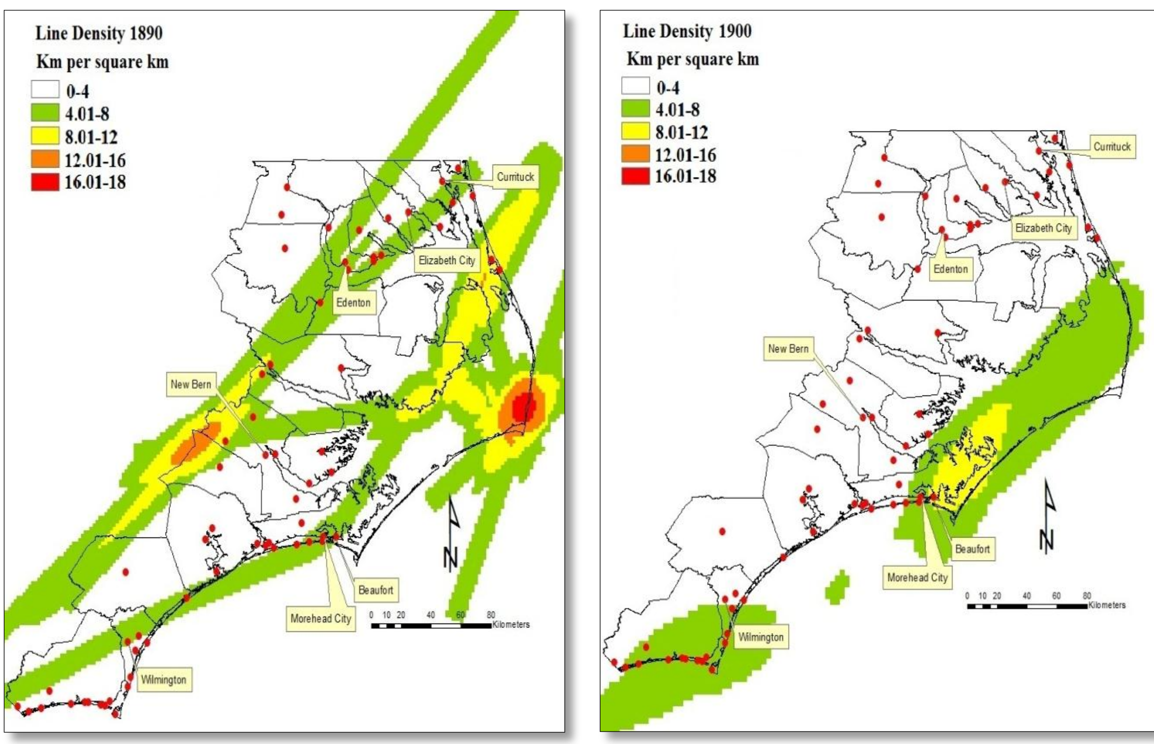



FIGURE 7.26 and 7.27 Line density mapping 1890 and 1900 (IBTrACS 2010).

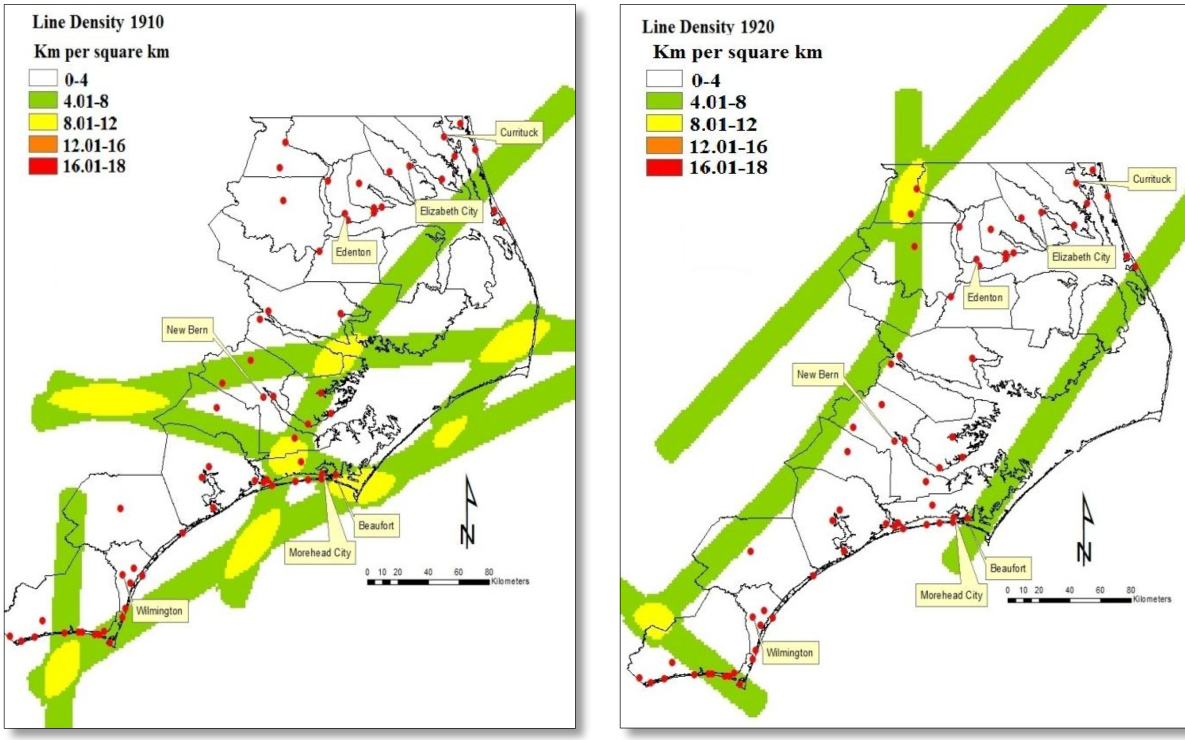



FIGURE 7.28 and 7.29 Line density mapping 1910 and 1920 (IBTrACS 2010).

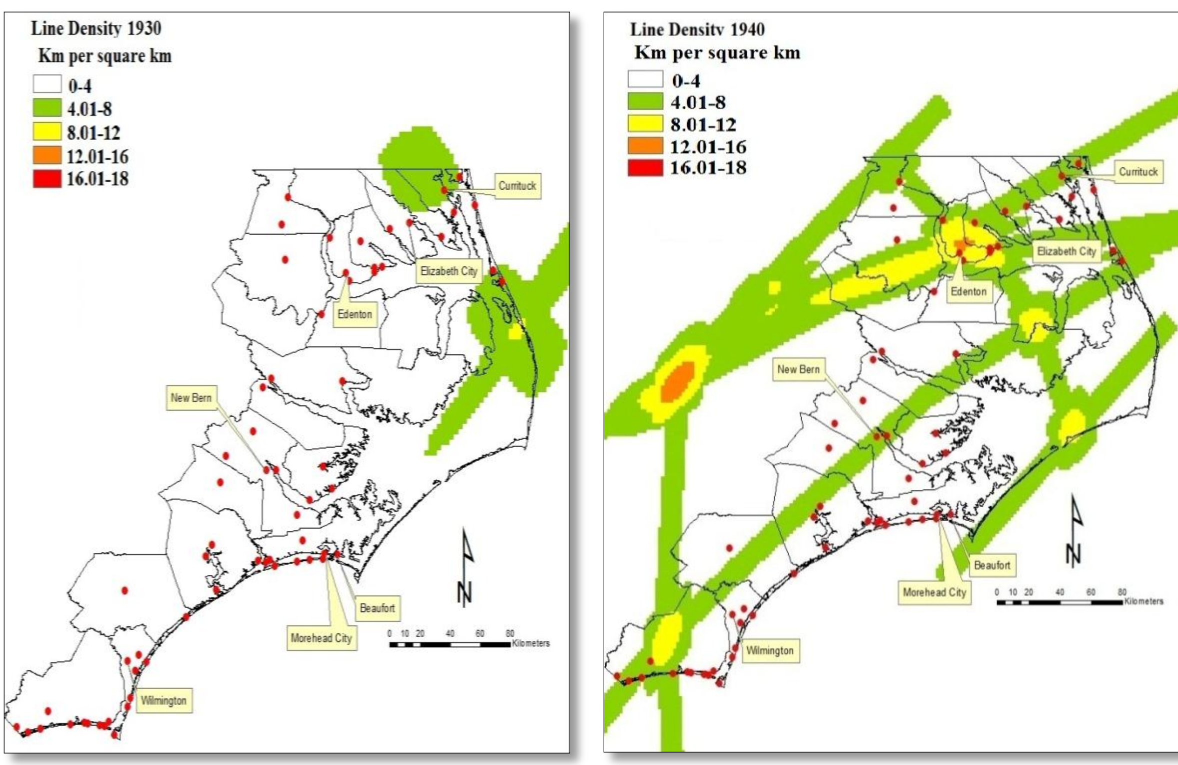



FIGURE 7.30 and 7.31 Line density mapping 1930 and 1940 (IBTrACS 2010).

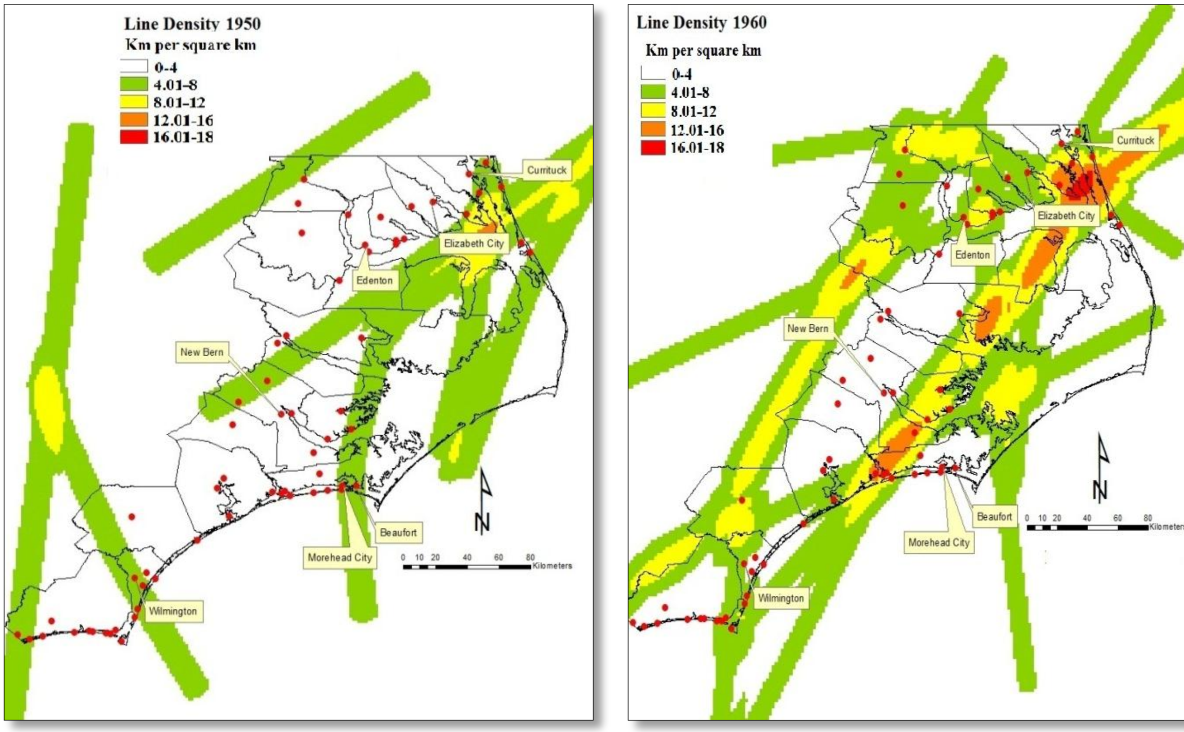



FIGURE 7.32 and 7.33 Line density mapping 1950 and 1960 (IBTrACS 2010).

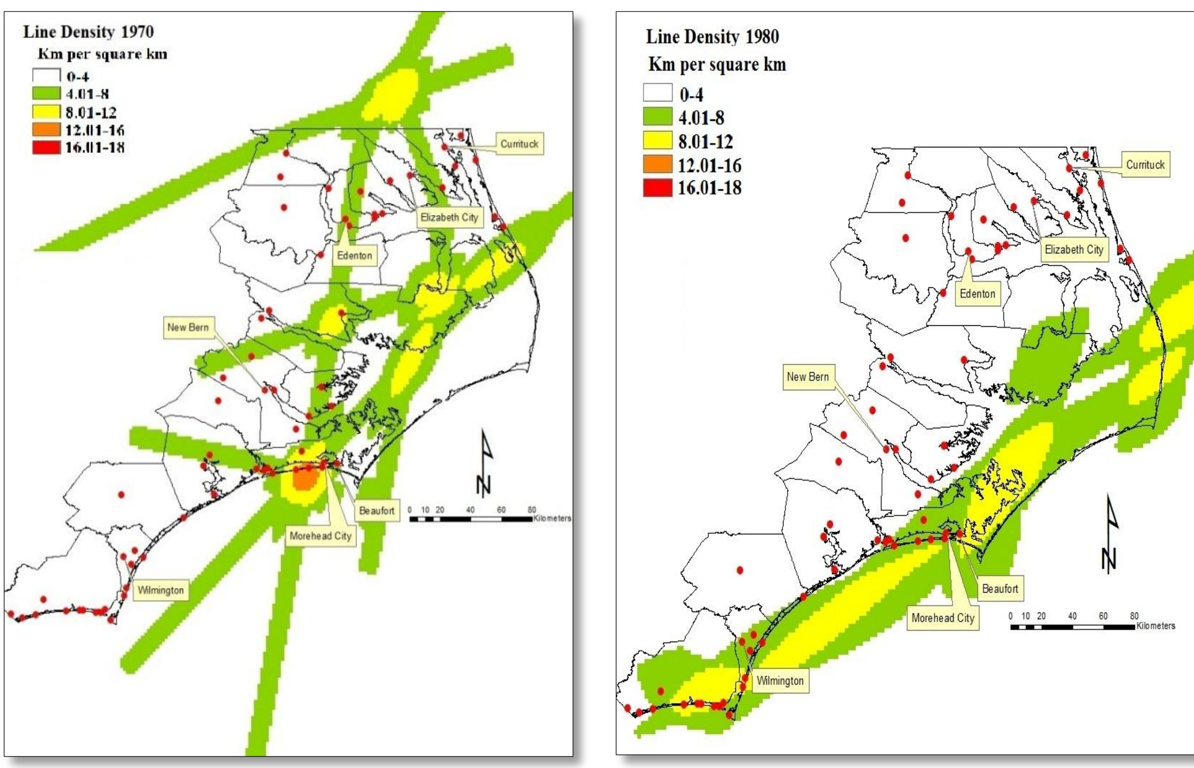



FIGURE 7.34 and 7.35 Line density mapping 1970 and 1980 (IBTrACS 2010).

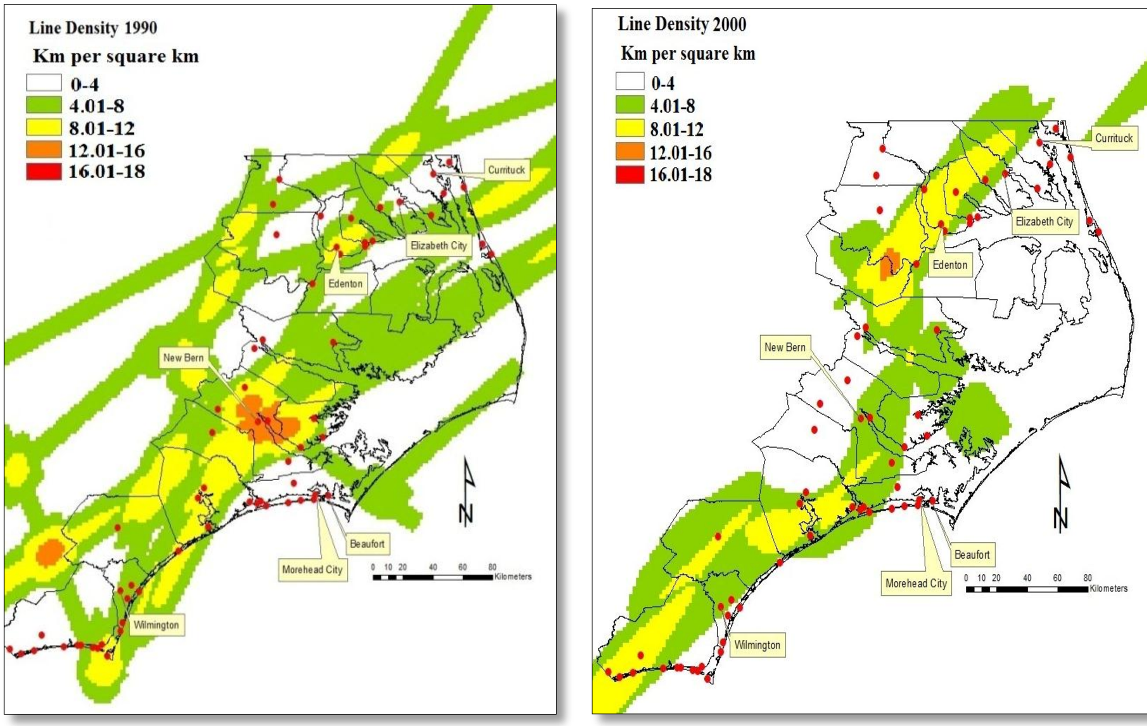



FIGURE 7.36 and 7.37 Line density mapping 1990 and 2000 (IBTrACS 2010).

There are also decades where specific areas within the whole coastal region are the bearers of the brunt of hurricane activity during that time period. For example, in the 1870s the western portion of the coastal region experienced four of the five storms that decade. Similarly, in the 1900s the stretch of the Outer Banks from South Carolina to the upper Albemarle Sound received the effects of six of the seven hurricanes for that decade, especially through Carteret County. The 1950s saw a concentration of storm activity on the eastern portion of the coastal region around Hyde and Dare counties and the upper Outer Banks. In the 1980s, the stretch of the Outer Banks is again the location for a majority of the storms to occur along coastal North Carolina. There are also other decades where at least one storm is tracked up through the middle of the coastal region from Brunswick County to the northern Outer Banks through Currituck (e.g. Figures 7.25, 7.27, 7.31, 7.33, and 7.36).

The line densities show a concentration of activity that varies by decade. Although hurricanes vary by category, strength, and wind speed, by viewing the data this way, we see that some areas indeed receive more frequent bouts of hurricane activity than others; areas like Hatteras, Carteret, and Cape Fear are continually at the center of frequent storms. Characteristically, the effects of the severe storms can be viewed as widespread or regional with the exception of 1900, 1930, and 1980 that show more local activity along the Outer Banks than the remaining decades It must also be kept in mind that the line density data is only for 1851 to the 2004; thus, any patterns related to time or space before 18501 can only be gleaned from the statistical record, and therefore may not be as apparent as the patterns exposed through visualization. Additionally, we must keep in mind that the density maps may project the density of hurricane activity for an area it does not express the area of most damage. Furthermore, as examined in others sections of this chapter, areas of more intense activity may be related to other environmental and cultural factors on more explicit temporal and spatial scales.

*Trends in Tracks*

The hurricanes that frequent North Carolina see variation in the tracks of these storms either by frequency, category, or area affected (Figures 7.38-7.53). Maps of the 1880s through 1910s exhibit an explosion of North Carolina hurricanes compared with previous years, and this is seen again from the 1960s to the present. Tracks vary by year and decade, but multiple storms within a single year rarely, if ever follow the same path. If they do form similar tracks, the paths typically affect different areas of the region; for example, in 1861 two hurricanes followed a track from the southern banks just south of Cape Lookout, across the central coastal region, and out along the northern Outer Banks. However, one hurricane kept more toward the central portion of the region, while the other veered toward the Atlantic.

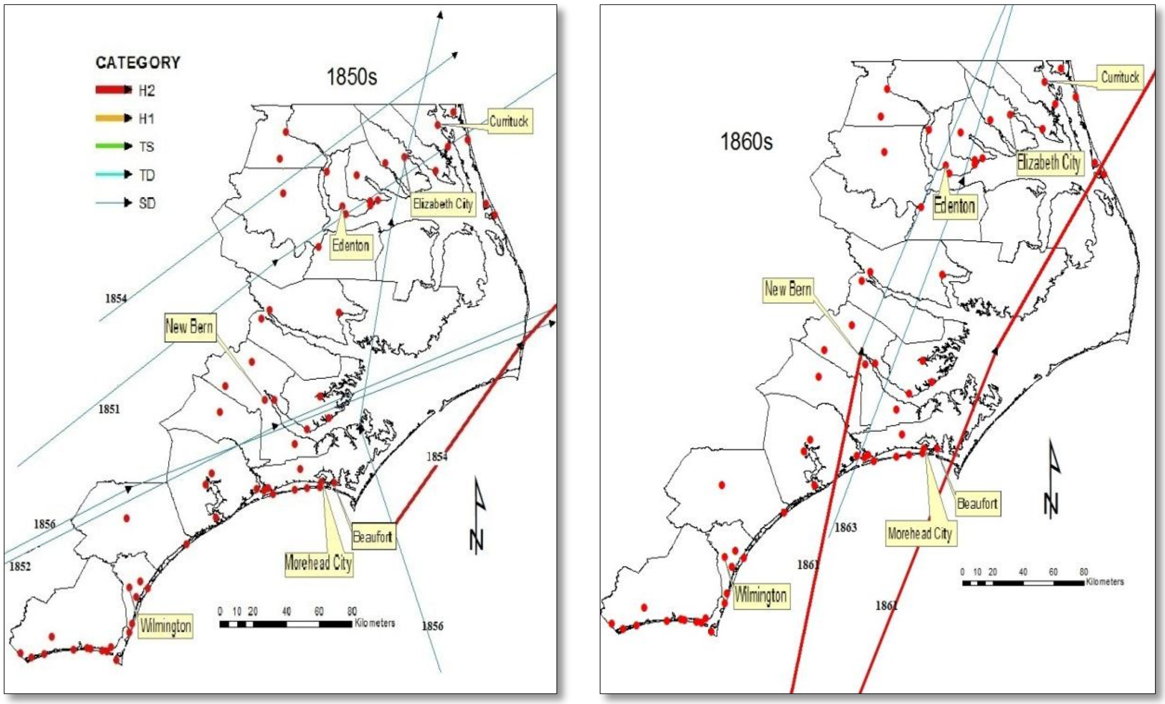



FIGURE 7.38 and 7.39 Trends in hurricane tracks 1850 and 1860s (IBTrACS 2010).

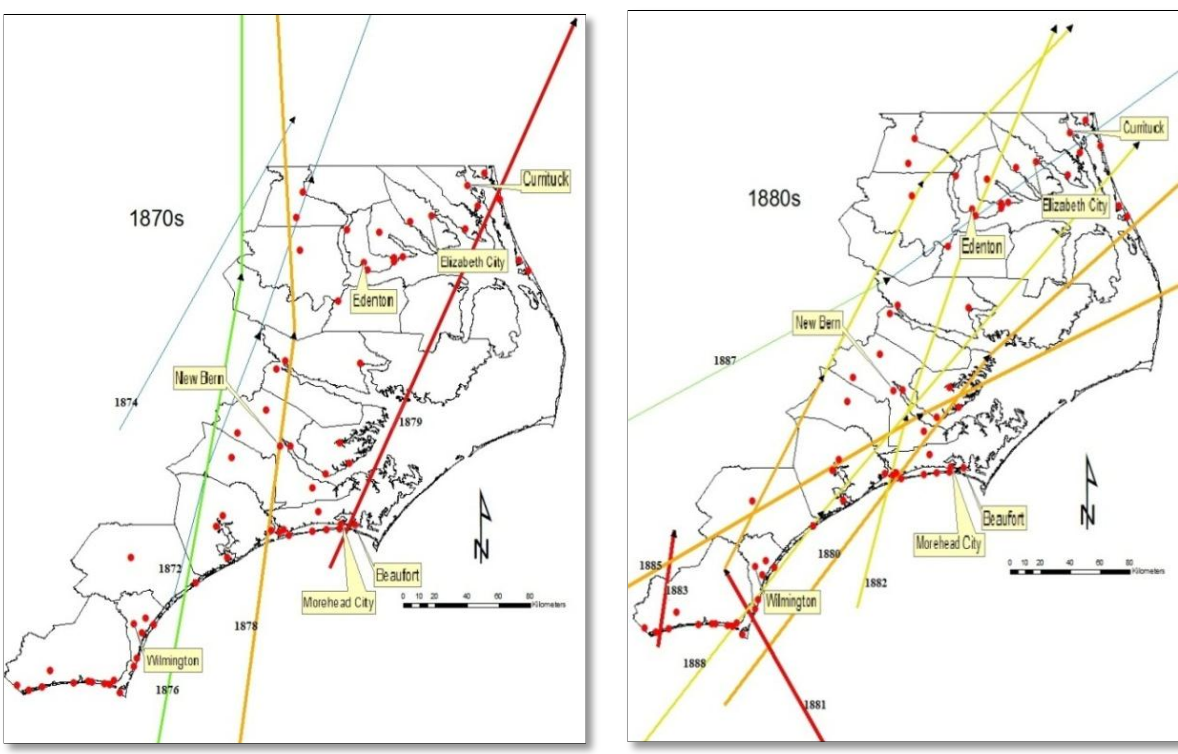



FIGURE 7.40and 7.41 Trends in hurricane tracks 1870 and 1880 (IBTrACS 2010).

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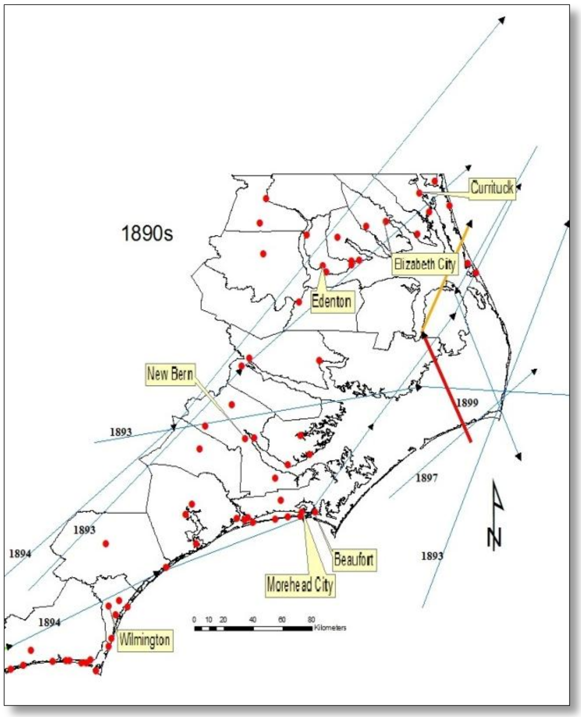


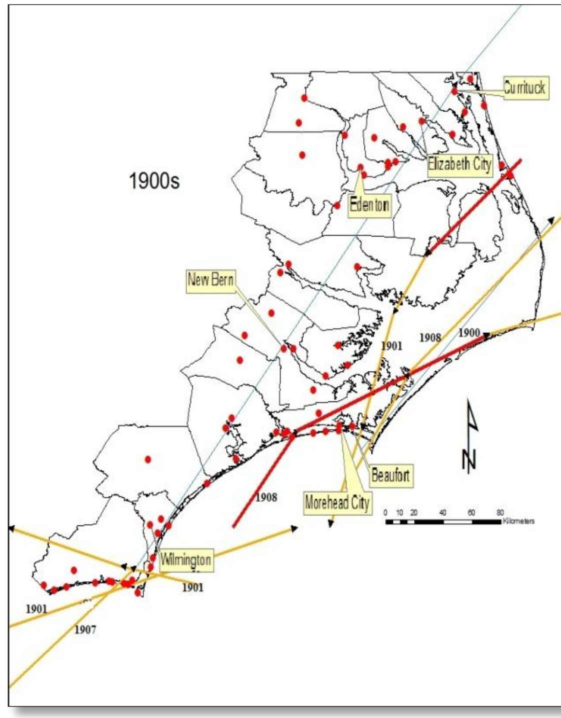
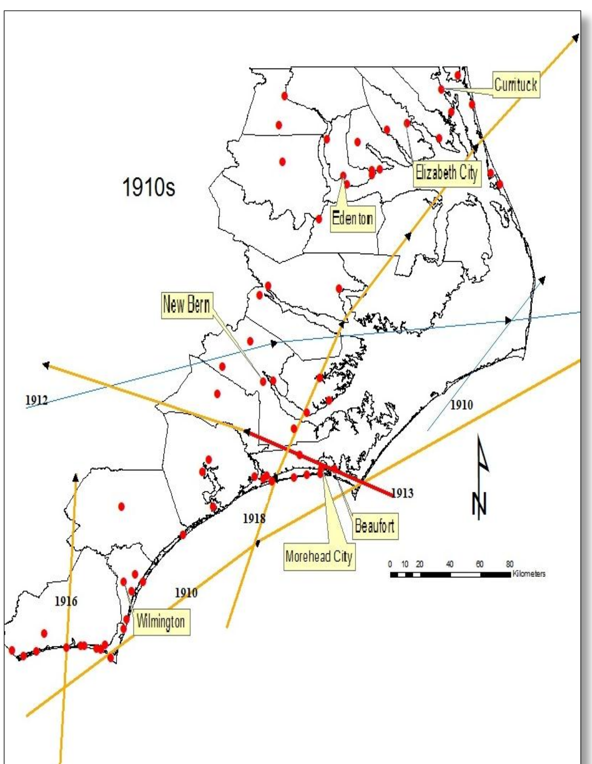




FIGURE 7.42 and 7.43 Trends in hurricane tracks 1890 and 1900 (IBTrACS 2010).



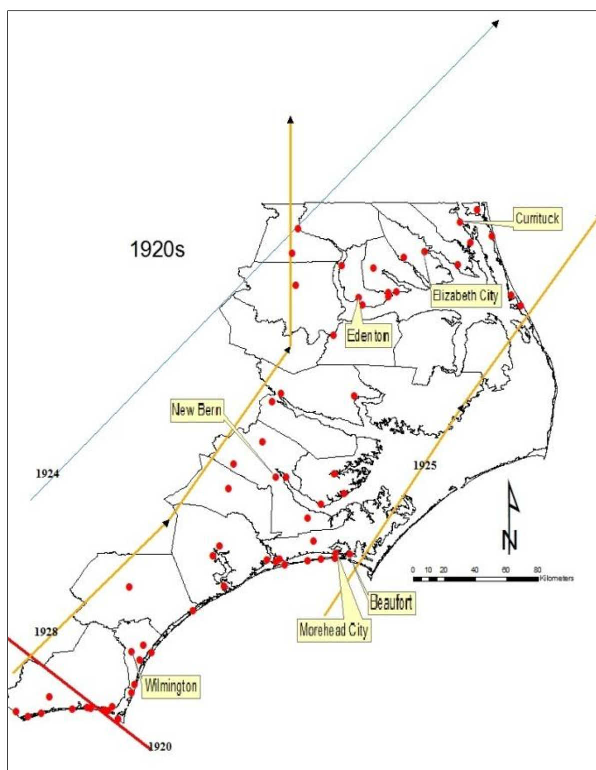
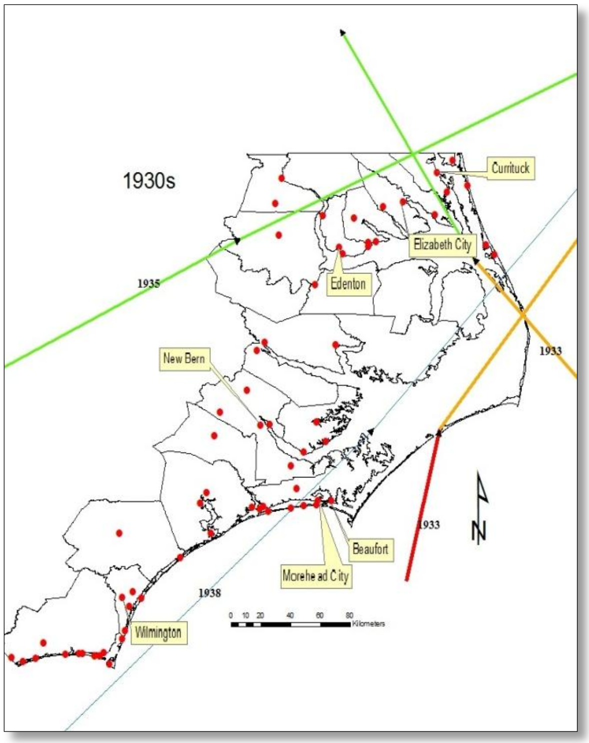




FIGURE 7.44 and 7.45 Trends in hurricane tracks 1910 and 1920 (IBTrACS 2010).



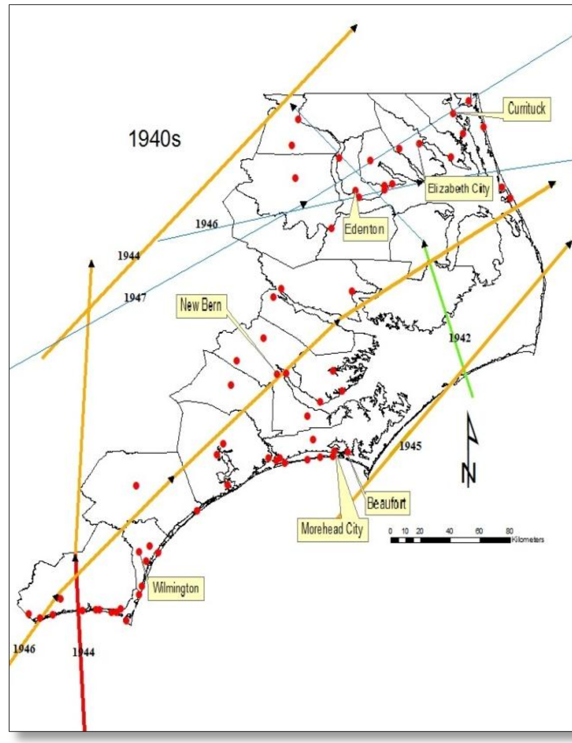
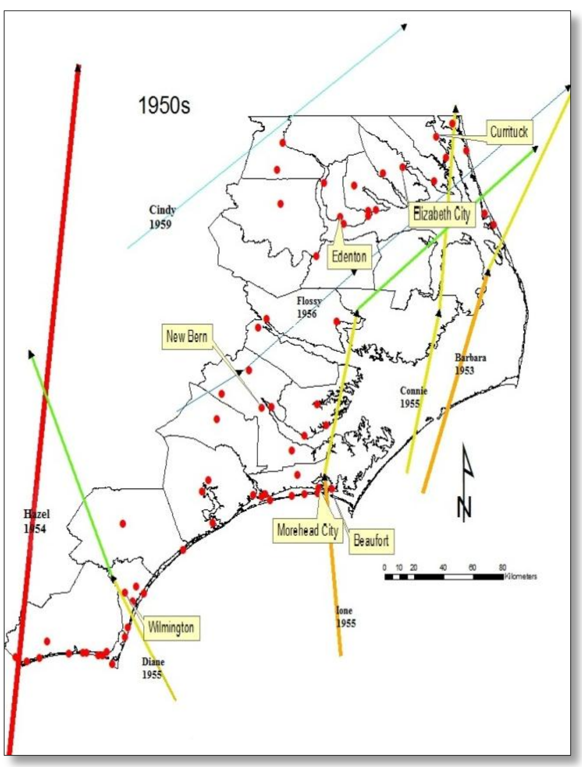




FIGURE 7.46 and 7.47 Trends in hurricane tracks 1930 and 1940 (IBTrACS 2010).



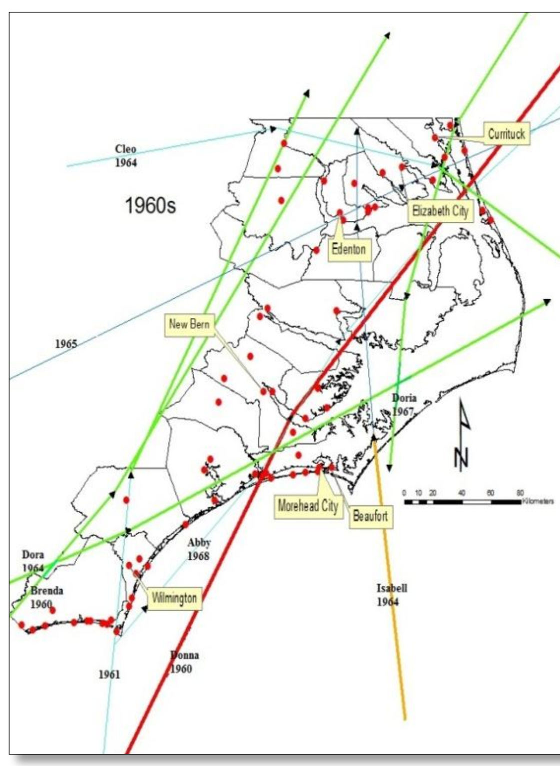
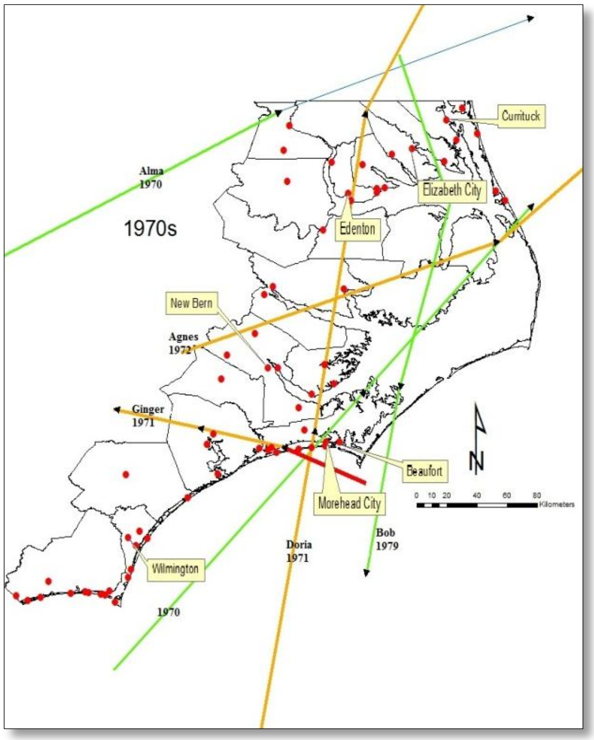




FIGURE 7.48 and 7.49 Trends in hurricane tracks 1950 and 1960 (IBTrACS 2010).



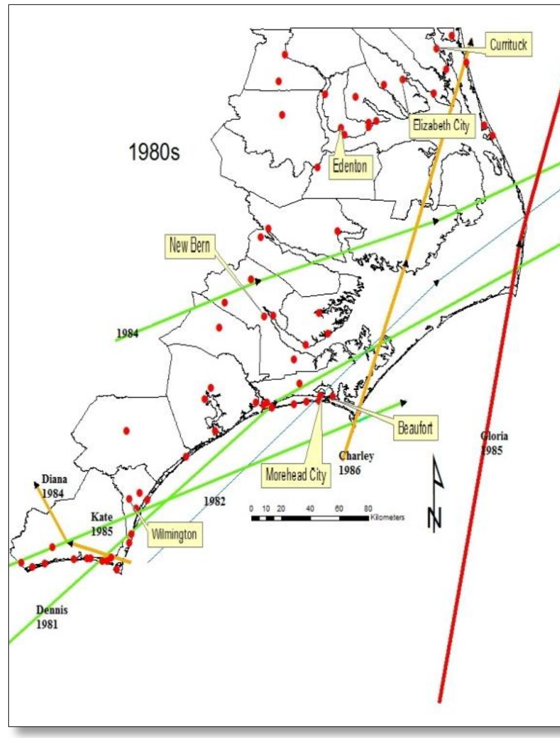
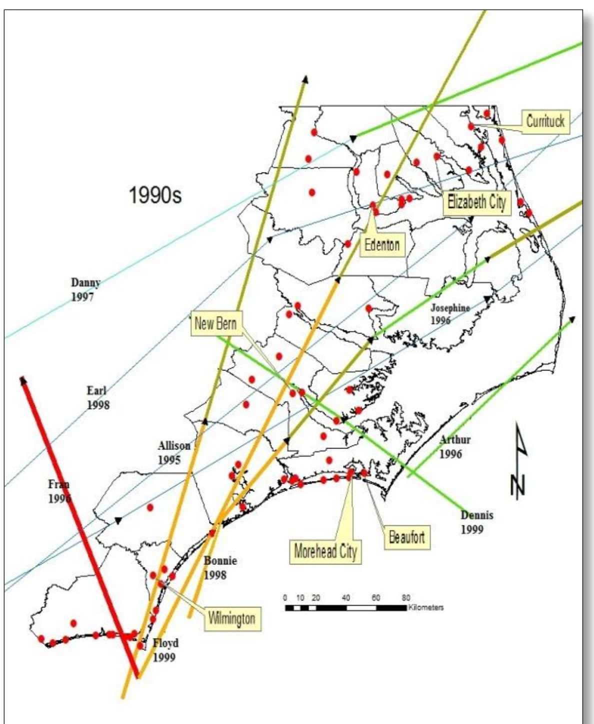




FIGURE 7.50 and 7.51 Trends in hurricane tracks 1970 and 1980 (IBTrACS 2010).



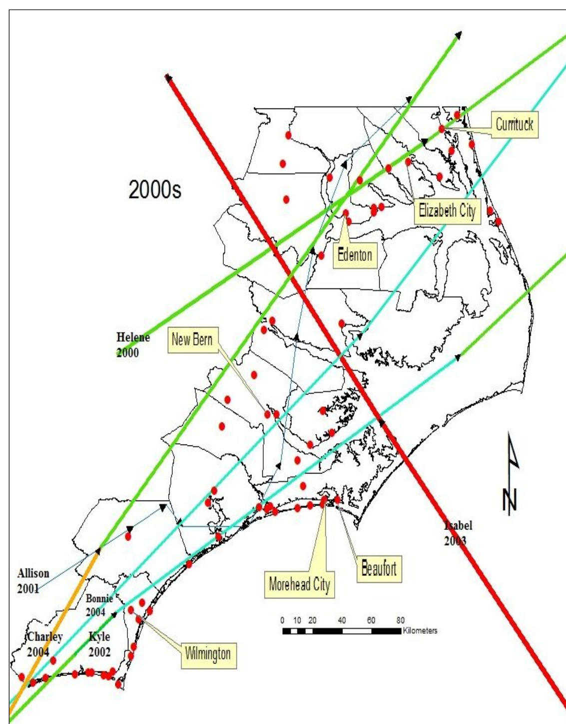




FIGURE 7.52 and 7.53 Trends in hurricane tracks 1990 and 2000 (IBTrACS 2010).

Spatial trends in the hurricane tracks are inconsistent at best although there are periods of high frequency and intensity. There may be widespread landfall for the coastal region or storms concentrated in a particular area, such as the Outer Banks/Cape Hatteras area. The 1870s-1890s were a period of frequent, high intensity storms, affecting the region as a whole. In contrast, tracks in the 1900s and 1910s were concentrated in the southern region and along the Outer Banks. Storm activity in the 1920s was less frequent and intense. The 1950s-1970s again saw widespread activity across the coastal region, while the 1980s again experienced a concentration of events along the Outer Banks. From the 1990s to 2004, tracks are again intense, frequent, and regionally widespread. The spatial representations of North Carolina hurricanes represent both positive and negative relationships that expose the extent of hurricane activity for a given time period or area, as well as how people and places react to severe storms. The large amount of hurricanes deemed general location in the statistical analysis concurs with the amount of regional activity that is seen from the spatial tracks of the hurricanes. There are areas that tend to see more concentration of activity in certain time periods, such as the Cape Hatteras area, the Outer Banks, or the southern coast. This also correlates with statistical data that places landfall and activity at these areas most often.

The statistical and spatial data have shown that hurricane tracks vary across time and space, with intensities of varying degrees also occurring on a temporal and spatial scale. Although some areas are more prone to activity and some time periods see more frequent and intense storm seasons, there are no clear or definitive patterns in the hurricane tracks. With this in mind, we are interested in trends not to imply that there is reason to the orientation, strength, or track of a hurricane, but to understand which counties were most affected by severe weather events. The data additionally demonstrates that hurricane tracks are random (as would be expected) therefore any patterns seen in the data are more likely expressions of cultural factors at play. The characteristics of hurricane tracks over time and across space can be related to other cultural and environmental resources in order to expose the seemingly invisible patterns of hurricane tracks in relation to changes in those resources. Using inlet configuration and shipwreck deposition as they correlate to severe weather events provides a better understanding of how the character of hurricanes over time have affected and potentially transformed the North Carolina coastal region, as well as the reactions to these severe weather events.

### *Inlet Change*

The Outer Banks, North Carolina's long strip of barrier islands separate the sounds and interior coastline from the Atlantic Ocean and studded throughout these barrier islands are inlets that provide channels of separation between islands. Numerous historic inlets have opened and/or closed throughout North Carolina's history, often associated with the passing of severe weather events. As hurricanes approach the barrier islands, strong winds may drive storm surge waters against the island and through inlets into estuaries and sounds. As a storm passes, the wind stops or shifts seaward, pushing water back to the ocean; if existing inlets do not permit water to escape, new inlets can be cut (Pilkey et al. 1998: 121). Several inlets have been opened in this manner, such as Hatteras and Oregon Inlets, and others can be closed by these same physical actions. Identification of these historic inlets may be difficult considering the sometimes rapid physical changes which may lead to little documentation. Inlets may only be open for a short time or for decades or centuries before being manipulated or closed.

Presently there are roughly 22 active, open inlets through the North Carolina barrier island system and there have been 48 (or more) historic inlets (Figure 7.54). The barrier island system in general and inlets particularly "are subject to a variety of natural forces.

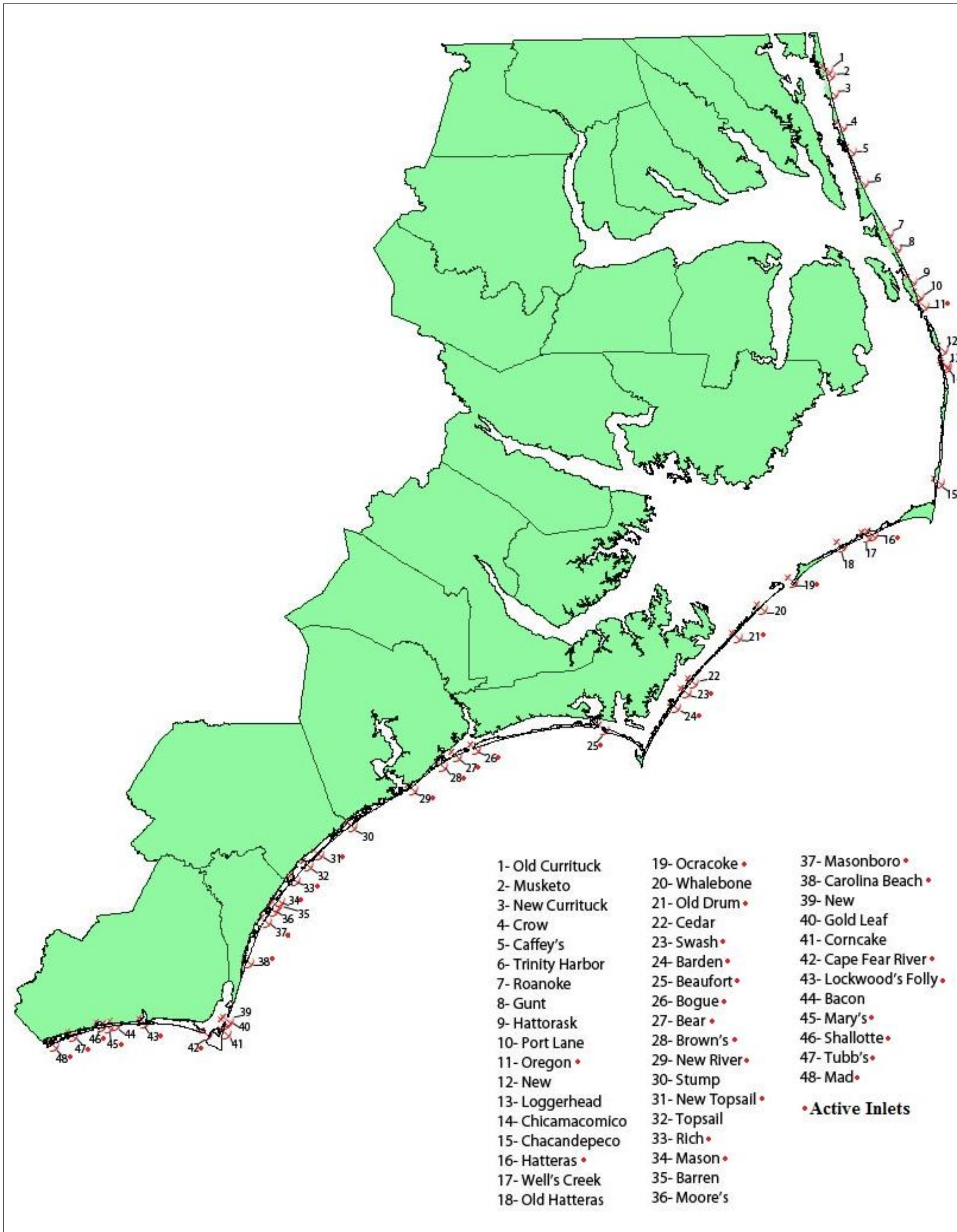



FIGURE 7.54 Location of historic and active inlets along North Carolina's coast (Map by Author).

Winds, waves, currents, and periodic high energy storms move the sands of barrier islands to change their shapes and to open and close inlets" (Baker 1977: 3). Hurricanes have been acknowledged as significant events that can affect the form of barrier islands (White and Wang 2003: 39).

*Inlet Change Related to Hurricane Activity*

Oregon Inlet separates Hatteras Island from the northern Outer Banks and is one of the most dynamic inlets on the eastern coast. Oregon Inlet was opened with a hurricane in 1846, allowing waters from the Albemarle and Pamlico Sounds to flow into the ocean. New Inlet divided Pea Island from Hatteras Island. New Inlet shoaled up with the opening of Oregon Inlet in 1846 to its north, but has periodically reopened at various times. The last occurrence of New Inlet's opening was from 1933, with a hurricane, to 1945 when wooden bridges were built across the gap, which are still visible today (Schoenbaum 1998: 145). South of present-day Avon where the island narrows, historic maps show an inlet called Chacandepeco, which existed there until the middle of the seventeenth century. This area was convenient for transport of goods from ocean to sound, even though this inlet was closed around 1657. The area became known as the "Haul Over," between Cedar House and Bald Head, where a new inlet was cut during a hurricane in 1761. Again in 1962 during the Ash Wednesday Storm, another inlet was cut at Chacandepeco Inlet's exact location, Buxton Inlet, but was later filled in (Schoenbaum 1998: 149; Barnes 2001: 36). Old Hatteras Inlet closed in the 1750s and Ocracoke Island was attached to Cape Hatteras until the new Hatteras Inlet was opened in 1846 by a storm. Hatteras Inlet was one of North Carolina's major shipping channels during the American Civil War (Schoenbaum 1998: 153-154). On the south side of Ocracoke Island, Ocracoke Inlet has existed continuously since at least 1585. Ocracoke Inlet separates Ocracoke Island and Portsmouth Island and connects the

Atlantic Ocean to the Pamlico Sound. At one time, Portsmouth Island was the most densely populated place on the whole of the Outer Banks, but after the hurricane of 1846 that opened Hatteras Inlet and Oregon Inlet, Ocracoke Inlet lost its prominence. Separating Core Banks from Shackleford Banks is Barden Inlet, sometimes referred to as the "Drain." Historic maps show that Barden Inlet existed during the first half of the nineteenth century, was closed around the time of the American Civil War, and reopened by a hurricane in 1933 (Schoenbaum 1998: 202). Hazel's Inlet was opened in 1954 with the passing of Hurricane Hazel across North Carolina, but has since closed.

*Inlets and Economic Patterns*

Continuous changes in inlet configuration (often hurricane-related) are closely tied to economic factors leading to changes in occupational patterns along the North Carolina coast. Inlets have historically played an important role in the shipping and commercial history of coastal North Carolina. Inlet change, either opening or closing, can drastically alter some of the economic patterns that help maintain a certain community. Areas that were once intertwined with the economic, political, or social world of North Carolina's coast, may have become isolated or desolate places due to inlet change. The impact of storms and hurricanes on the location and configuration of inlets, as well as the nature of the sounds and inland waterways after openings or closings has impacted the economic and social development associated with them and their related populations, communities, and occupations (Whisnant and Whisnant 2010: 24).

Associated with the shipping of goods and the movement of people, for centuries inlets have provided coastal access as a means of navigation between the ocean and the protected coastal waters of the barriers islands. North Carolina's barrier island inlets afforded access to the New World settlers during the sixteenth century, enabling exploration of the Sounds, and have continued since to provide passage for recreational and commercial vessels. Despite the passage to shelter waters, "the dynamic, shifting sands of the inlet shoals have led to the grounding and destruction of numerous vessels, contributing to the famous label 'Graveyard of the Atlantic' for the North Carolina coast" (Mallinson et al. 2008: 1). Throughout the history of North Carolina's coast, some inlets have also provided access to the development of port towns "which became locations for trade, and which would provide a local pilot to help navigate ships through the shifting channels. Thus, inlets became an important economic asset" (Mallinson et al. 2008: 1). Although today inlets are still a vital resource to navigation, commerce, trade, and fishing, they have been altered over time, many by severe climatic events, leading to changes in the importance of certain vessel types that can navigate the channels, as well as the importance of certain inlets or port towns over time, subsequently altering shipwreck deposition and economic and settlement patterns. Economic changes may also be linked to commercial and recreational fishing patterns through inlet change. For example, the opening or closing of inlets by a hurricane can affect water salinity of sounds and thus the type of fish species available for catching.

The hurricanes on the Outer Banks have been numerous and constant in creating new configurations that in turn affect the economic vitality of an area. A hurricane in 1828 "closed New Currituck Inlet turned Currituck Sound from salt water to fresh, and doomed Knott's Island as a maritime port" (Whisnant and Whisnant 2010:164). Founded in 1712, the town of Edenton was a prosperous inland port for the Albemarle Sound. But in 1828 Currituck Inlet, vital to Edenton's shipping, closed during a severe storm reducing Edenton's viability in terms of maritime trade. Similarly, Ocracoke Inlet was a major commercial access point for the Cape Lookout area, becoming increasingly important after Currituck, Roanoke, and Old Hatteras closed in the early eighteenth century (Whisnant and Whisnant 2010:183). But after an 1846 hurricane opened Oregon and Hatteras inlets, Ocracoke declined in importance, and the decline led to a decrease in population for areas like the previously mentioned Portsmouth.

Inlets are at the junction of the relationship between severe weather events and cultural changes. Modifications to shipping patterns and shifts in economic emphasis from port to port have resulted from the interplay between hurricanes and inlet change, even leading to community transformation in some cases. The interaction of environmental and human elements is visible here more than any other component. We also need to consider that although economic needs and changes (for example) may lead to shifts in the importance of one inlet or port over another, the severe weather event was the catalyst in many cases.

The changes seen in inlet configuration along the North Carolina coast are often tied to the presence of severe storm events throughout the State's history. The processes of the storm events are responsible for the shifts in sand and the movement of water that have the possibility to alter an inlet. The nature of these changes is also tied to change in cultural and economic resources that can ultimately affect the movement of people in the North Carolina coastal region. Economic shifts have come when inlets open or close, forcing trade and shipping into new areas of the coast. Changes in the prominence of an area to trade, economics, and resource viability may also be related to the deposition patterns of shipwrecks along North Carolina as well. If we look at wreckage location in relation to dates of wreckage there may be patterns that emerge, especially in relation to shipping routes and areas of economic prominence.

### *Shipwrecks*

While Chapter Six examined the chronological and general characteristic patterns of hurricane-related shipwrecks, this chapter examines the spatial characteristics of hurricane-related shipwrecks, analyzing vessel location through such techniques as density mapping and the comparison of wreck locations versus hurricane tracks. An analysis of the spatial data provides a view of the patterns of hurricane-related wreckage and any correlation they may have to changes in other cultural resources such as economic patterns, and in turn their relationship to occupational patterns of coastal North Carolina. This prompts the questions: how do ships find themselves in the situation of becoming shipwrecks? Is it at best a severe weather event acting upon a helpless craft, or does human agency play a role in the wrecking? The combination of statistical and spatial analyses will help in examining these questions and allow better understanding of the factors at play behind any correlations between severe weather events and wreckage.

*Wreckage Location*

Due to the configuration of the North Carolina coast, the combination of geography and proximity to the mixing of the Gulf and Labrador Currents has made North Carolina infamous for shipwrecks, especially those associated with severe weather events. There are particular areas of this dangerous coast that present exaggerated paths of treachery where one would expect to find a greater number of shipwrecks. The shifting Outer Banks, for example, have presented continual problems for shipping and recreational vessels especially with inlets that migrate or alternately open and close. Alternatively, there are inlets or stretches of the coast that may have been the only available or appropriate access points to major port towns or inner waterways of the sounds and rivers. For example, Ocracoke Inlet was an important but "dangerous point of entry for shipping" (Howren 1962:163). Additionally, due to the geography of the coast, ships had no alternative but to navigate the capes and shoals, such as the Frying Pan Shoals near Cape Fear or the Diamond Shoals near Cape Hatteras, which are two potentially dangerous areas along the North Carolina coast (Division of Coastal Management, 2010). The stretch of land from Currituck to Cape Hatteras also presents a precarious place for ships that come too close to the coast or veer to far westward in order to avoid the Gulf Stream (Carolina Lights 2011). This treacherous geography, combined with the varying hurricane seasons, has created a disaster landscape littered with shipwrecks, and the distribution of wrecks may expose a certain level of human agency involved.

When examining the geospatial data of the paths of historic hurricanes for the North Carolina coast some patterns emerge. The largest number of shipwrecks actually occurs before 1850 and therefore cannot be compared with the geospatial record of hurricane paths. In order to glean any patterns from these shipwrecks, they must be compared with the historical record only. After 1850, shipwrecks can be compared with spatial records of hurricane paths provided from datasets such as IBTrACS. In addition to comparing shipwrecks to the paths of hurricanes, it is possible to spatially visualize the locations of shipwrecks by general area, as not all shipwrecks provide specific coordinates. When examining the location of hurricane-related shipwrecks, it is important to take notice of the density of wreckage in certain locations (Figure 7.55). Density analysis allows the visualization of areas where noticeable amounts of wreckage occur using calculations performed by ArcGIS. This analysis is also used to see if the spatial data corresponds with the statistical data that places emphasis on certain areas as containing denser wreckage than others.

Results of density analyses may also be related to economic and social changes that were examined in Chapters Five and Six to glean if wreckage densities correlate to patterns of change in relation to hurricanes, or if other factors are responsible for vessel loss.

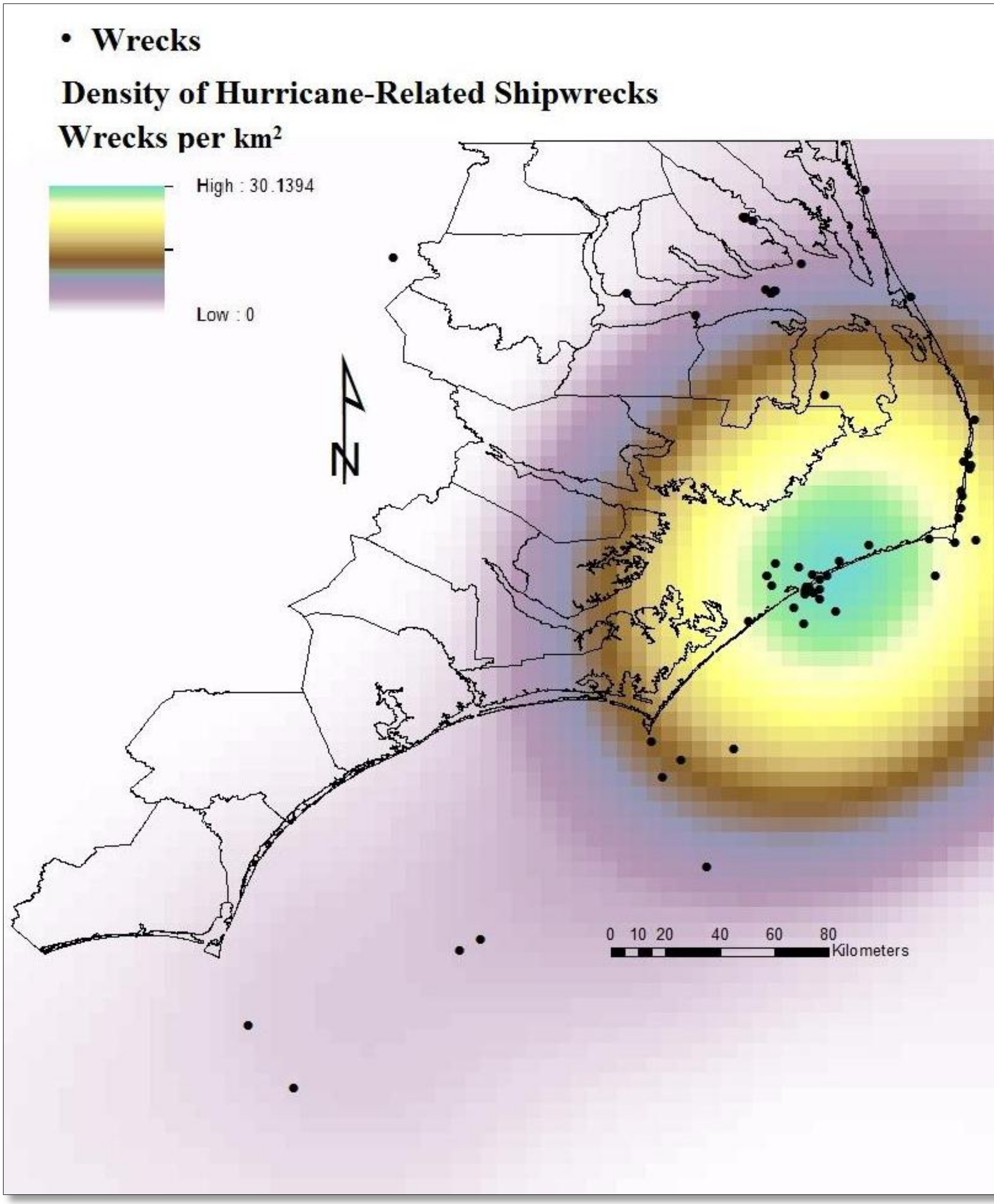



FIGURE 7.55 Density map of hurricane-related shipwrecks around the North Carolina coast, 1728-1969 (Map by Author).

In viewing the density map, we see that there is a higher density of hurricane-related wreckage occurring around Ocracoke, Ocracoke Bar and Ocracoke Inlet. The next level of activity is centered around Cape Hatteras, Hatteras Island, Hatteras Inlet, and Diamond Shoals. The density of hurricane-related wreckage is small for Cape Lookout and insignificant for Cape Fear despite the fact that these areas are dangerous passages on the North Carolina coast. The density of wreckage associated with the back of the barrier islands in the Pamlico and Albemarle Sounds, Roanoke, New, and Pasquotank Rivers, and near the port cities of Edenton, New Bern, and Elizabeth City is substantial.

A comparison of density mapping features in Figure 7.56 that include the density of hurricane-related shipwrecks and the line density of hurricane tracks from 1850 to 2004 add another level of exposition on the relationship between hurricane events, areas of impact, and shipwreck deposition. We have seen that there are areas of overlapping concentration of the features (Figure 7.56); for example, the area of the largest overlapping concentration of hurricane tracks and hurricane-related shipwrecks lies around Ocracoke Inlet, showing an area of intense impact. The Pamlico Sound as a whole is also an area of intense hurricane activity, major landfall points at inlets and capes, and a substantial concentration of hurricane-related shipwrecks. Subsequent portions of this section will expose the nature of these correlations, which may be environmental, economic, social, or a combination of several.

It was suggested in Chapter Two that the spatial patterning of shipwrecks could expose trends in cultural factors such as trade and shipping. If we compare the locations of hurricane-related shipwrecks to other factors such as inlet location and historic patterns of shipping and trade, we can better extrapolate the relationships between severe weather events and shipwreck deposition.

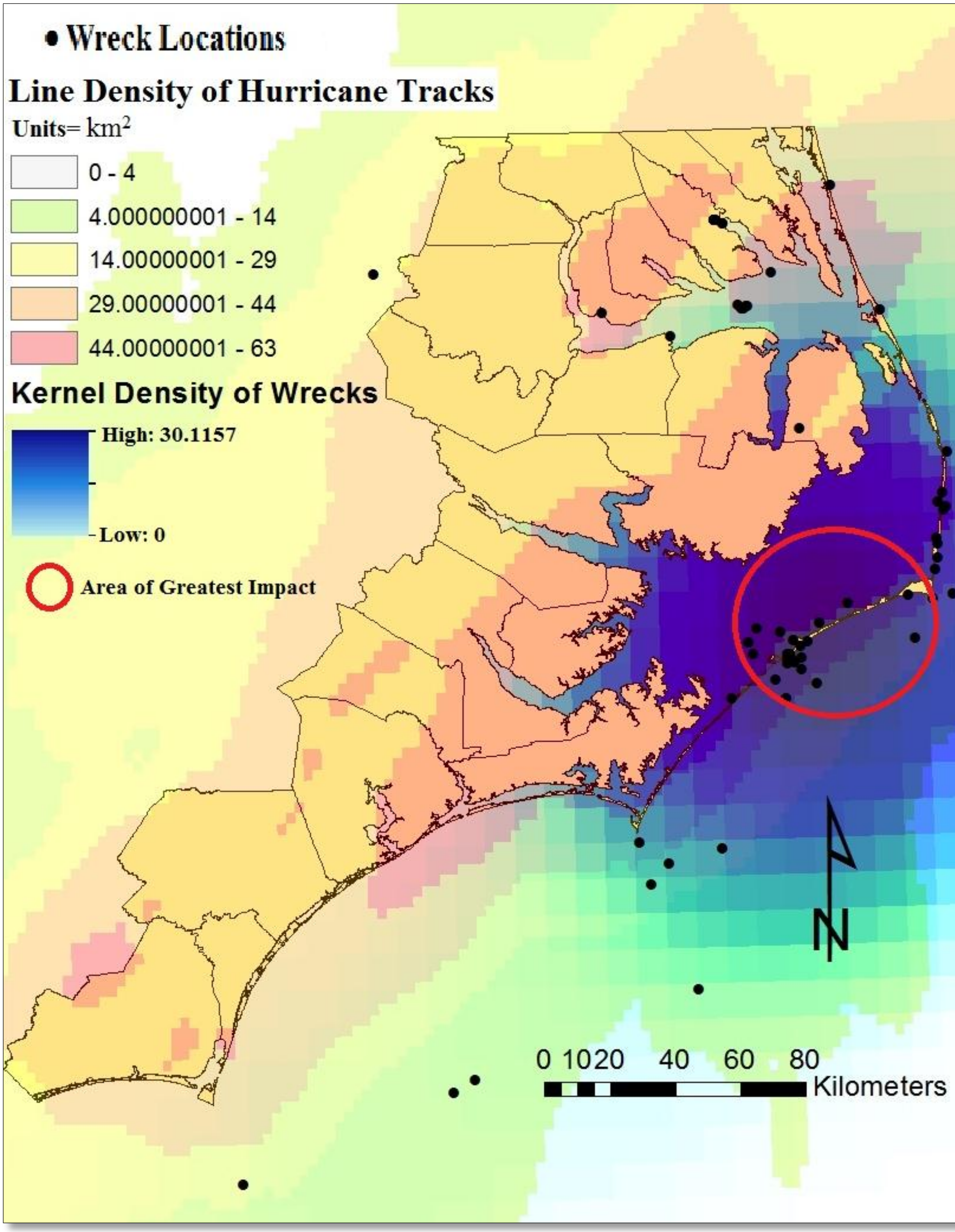



FIGURE 7.56 Area of greatest combined impact (IBTrACS 2010).

As examined in an earlier section of this chapter, inlets played an important role in shaping the economic vitality of coastal North Carolina, allowing ships to reach the inner rivers and sounds of the coastal. When analyzing hurricane-related shipwrecks, there is often a strong correlation between the weather event and the location of deposition, but if the location of a hurricane-related shipwreck does not correlate to a specific track of a weather event, it may be assumed there are additional factors that have led to the deposition of a vessel. These factors may be environmental or cultural in nature.

One such environmental factor that is associated with shipwrecks on the North Carolina coast, is the often-changing location of inlets along the coast. Historically, inlets have provided mariners with difficulties in this region of the Atlantic because of their shifting nature, which makes mapping them difficult. In spatially visualizing hurricane-related shipwrecks in relation to the various inlet locations along the coast, we may glean patterns of shipwreck deposition related to occurrences of weather events and the geography of the coastline as well (Figure 7.57).

We see from this map that there are some clusters of hurricane-related shipwrecks around several inlet locations, especially Ocracoke and Buxton Inlets. Ocracoke, which was discussed previously, was the main passage through the Outer Banks well into the nineteenth century to ports and communities along the Pamlico and Albemarle Sound (Lawrence 2008:9). The prominence of hurricane-related shipwrecks deposited around this inlet suggests a relationship between the geography and the severe weather event. This idea will be subsequently examined in this chapter by looking at changes of inlets as compared to the movement of hurricane-related shipwrecks clusters over time. These patterns can be correlated to trends in shipping and trade along the North Carolina coast over time as well.

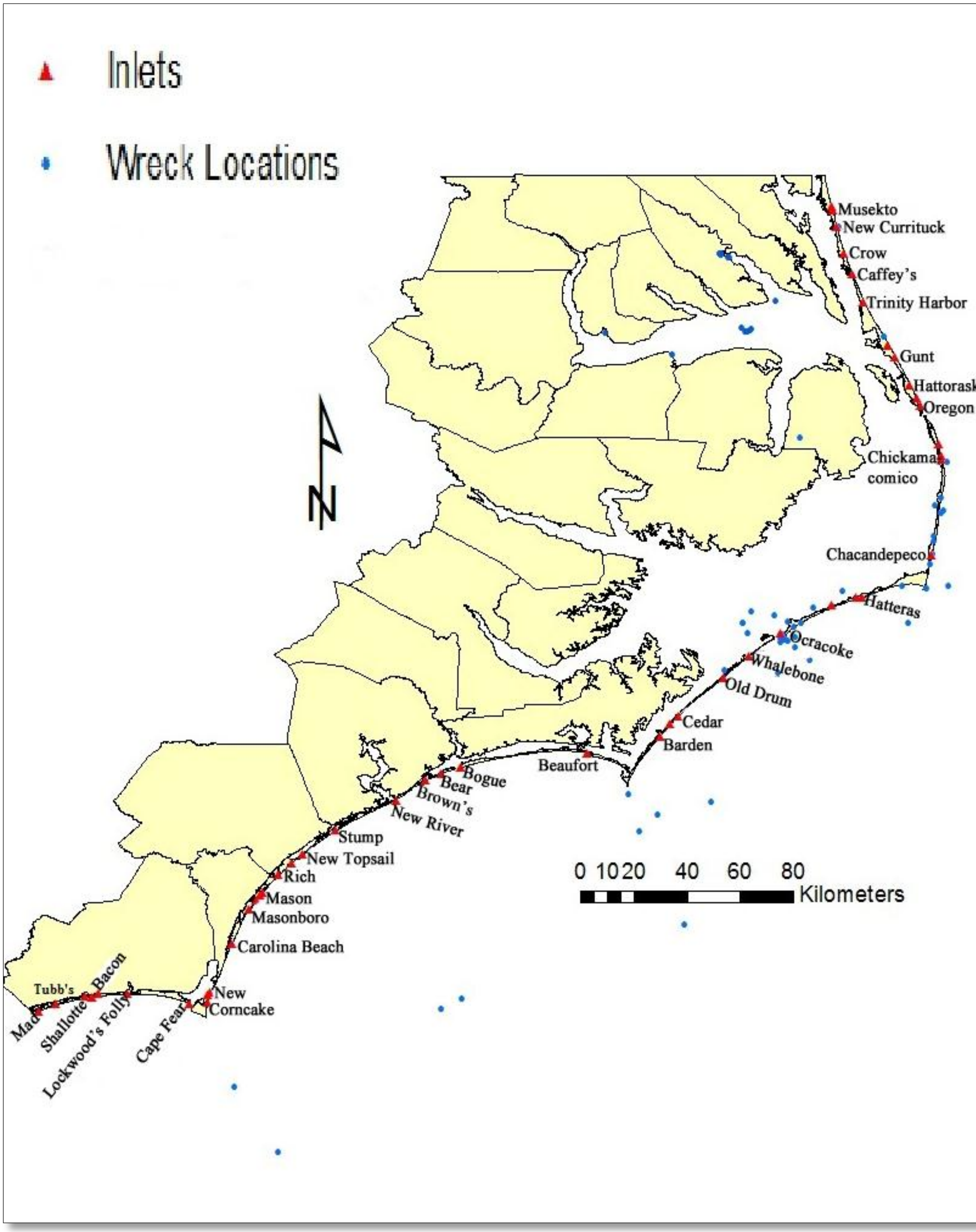



FIGURE 7.57 Hurricane-related shipwrecks in relation to inlet points, pre-1585 to the present (Map by Author).

Inlets also played a role in the nature of the relationship between shipwreck deposition and severe weather events though patterns of shipping and trade along the North Carolina coast, often a factor in the location of hurricane-related shipwrecks. The proximity of the North Carolina coast to the Gulf Stream made navigation difficult for vessels traveling northbound (Figure 7.58).


FIGURE 7.58 Proximity of shipping lanes to the Gulf Stream (Lawrence 2008).

Vessels traveling southward could travel farther offshore against the Gulf Stream, or pass between the Gulf Stream close to the treacherous Outer Banks, Cape Hatteras, and Diamond Shoals (Lawrence 2008:6). This area, even apart from any added pressures from inclement weather, often led to disaster for ships.  Other areas such as Ocracoke Inlet, and later Hatteras and Oregon Inlets served as important access points along this dangerous portion of the southbound shipping route. For example, the biography of Captain Leonard Tawes (1967) mentions perilous passage around Cape Hatteras, but never mentions hazardous travel past this point toward Cape Lookout or Cape Fear. Considering this, it is interesting to note the large amount of wrecks located along the passage near Cape Hatteras and Ocracoke Inlet, and the lack of hurricane-related shipwrecks near Cape Lookout and Cape Fear, an example of the possible geographical and economic nature of correlations between severe weather events and the deposition of shipwrecks along the North Carolina coast. Along these lines, one would expect to see more deposition near Cape Fear, not because of any dangerous geography, which could be bypassed to the east, but due to the prominence of the area as an economic maritime center of the southern coast. It may be that the nature of this correlation between shipwreck deposition and severe weather events is more geographical than economical. The nature of the relationship may also indicate a higher level of geographical knowledge, preparation, or navigational care. Considering the larger amount of traffic entering the Cape Fear region, mariners may have been more prepared or careful approaching any geographical or human hazards.

As mentioned in Chapter Three the year 1846 was a year of considerable environmental change when a major hurricane altered the structure of a portion of the Outer Banks. Utilizing the convex hull polygon method of the minimum bounding geometry functions in ArcGIS for Figures 7.59-7.74 allows us to see the definition of the extent of the input features, i.e. shipwrecks. In other words, the convex hull polygon shows where the clusters of hurricane-related shipwrecks lie and the extent of their location. Figures 7.59-7.60 present clusters of hurricane-related shipwrecks along the North Carolina coast and their relationship to the specific inlet changes associated with the hurricane of 1846.

Before 1846, Ocracoke Inlet was a major place of passage for trade and shipping into the Sounds. In viewing the spatial data (Figure 7.59), we see that data reflects a clustering of shipwrecks around Ocracoke Inlet.

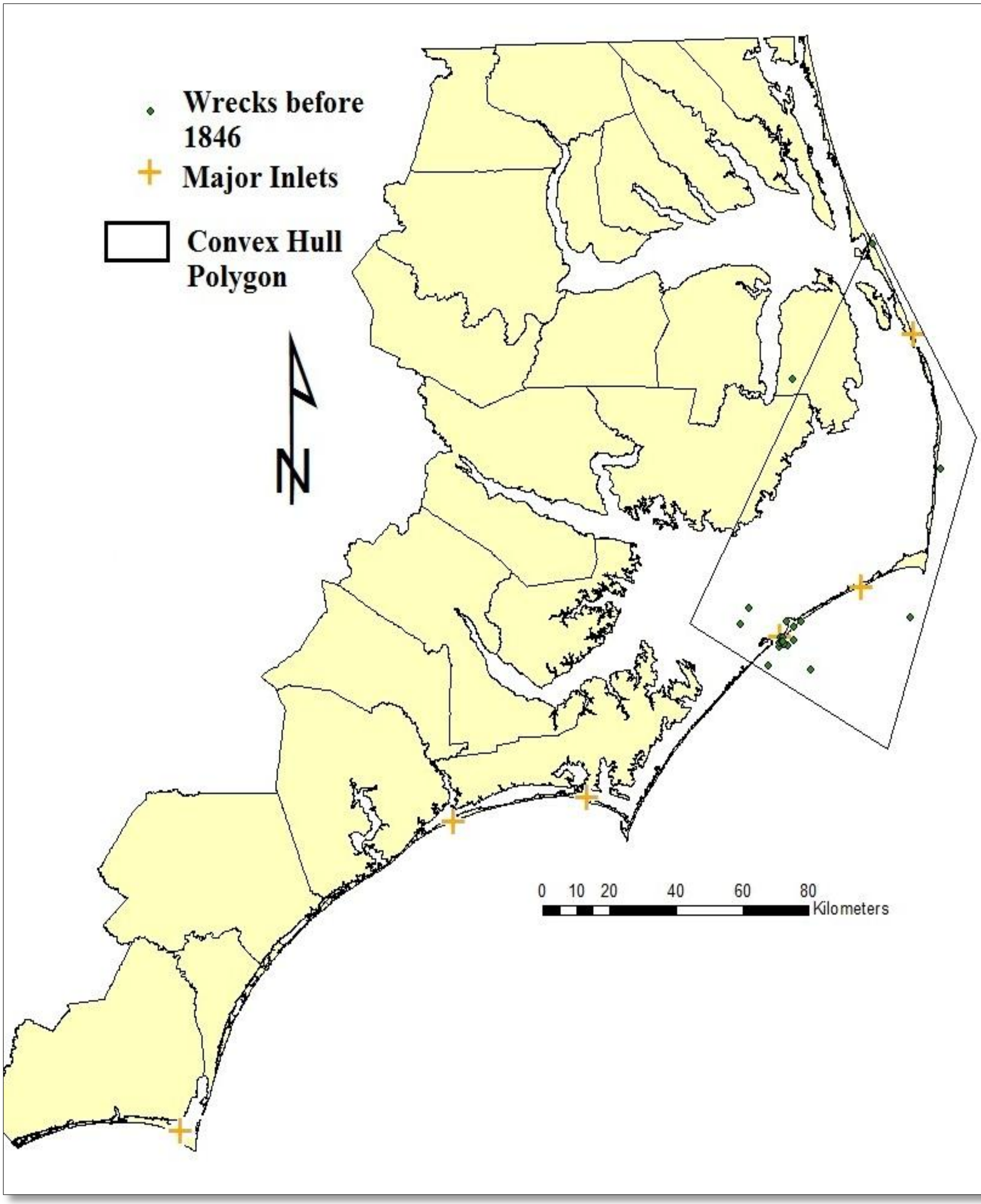



FIGURE 7.59 Cluster of hurricane-related shipwrecks before 1846 (1728-1846) (Map by Author).

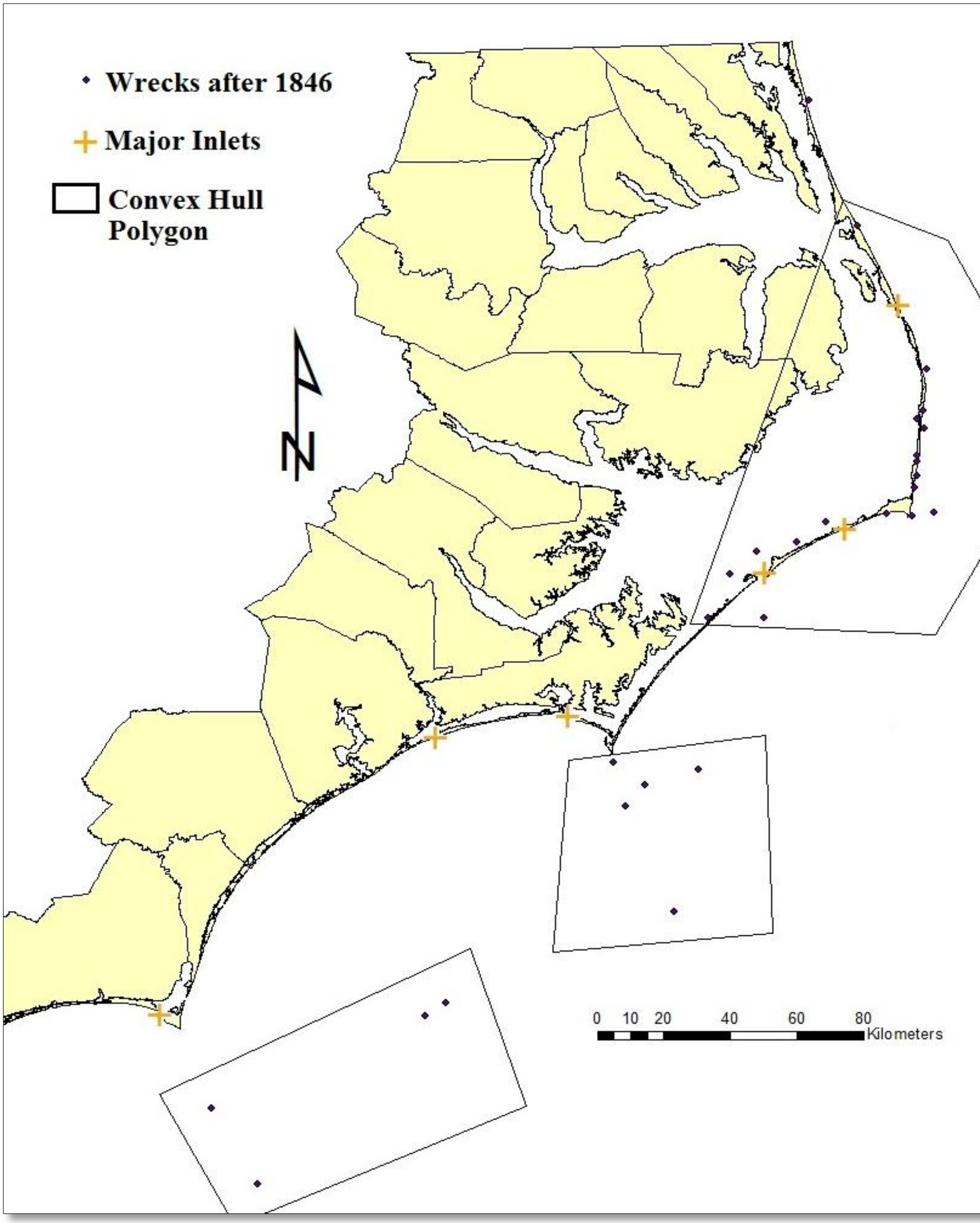



FIGURE 7.60 Hurricane-related shipwrecks after 1846 (1847-1969) (Map by Author).

After 1846 the distribution of shipwrecks changes, we see some movement away from Ocracoke (Figure 7.60). This is interesting considering with the 1846 hurricane came the opening of new inlets at Hatteras and Oregon, and thus subsequent changes in patterns of shipping and trade.

In these cases, the spatial data exposes the idea that physical changes such as inlet transformation, can be seen as catalysts for adaptive adjustments in social and economic resources—a scenario that is evident in the archaeological record. Ultimately, the hurricane acted as a mechanism for transformation to shipping and trade through physical alterations to the landscape. Hurricane activity occurred at the intersection of nature and culture, providing evidence of the link (taphonomically) between a natural disaster and its cultural context, suggesting a certain level of human agency in the visible changes.

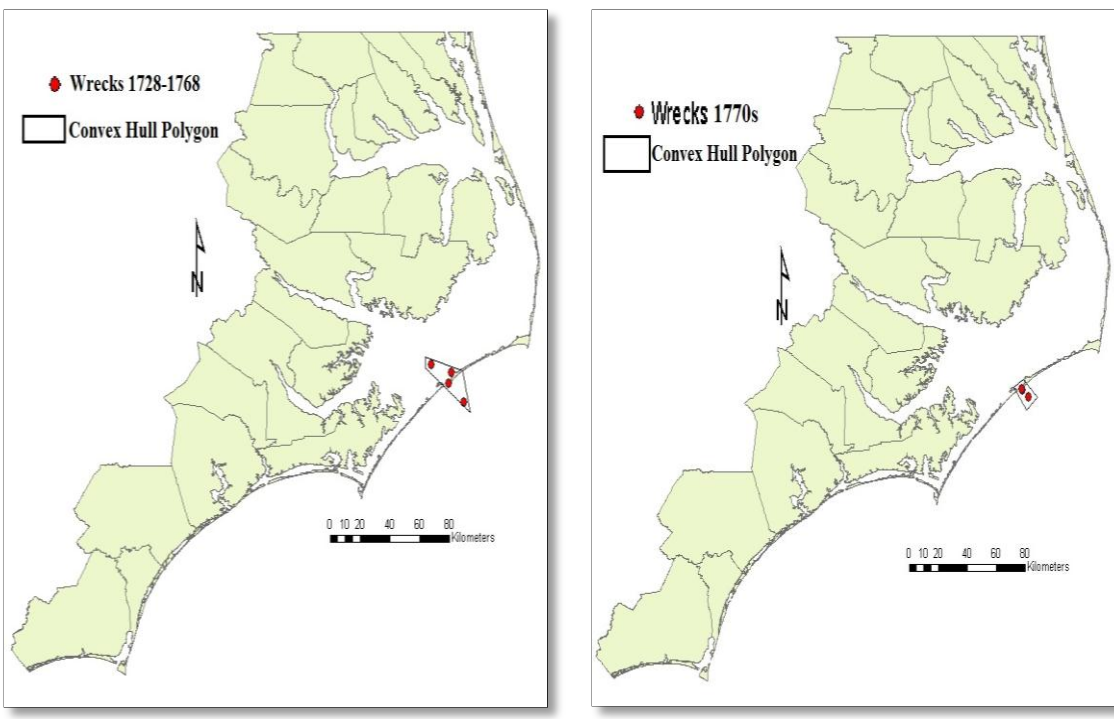



FIGURE 7.61 and 7.62 Convex Hull Polygons of hurricane-related shipwrecks by decade, 1720s to 1770s (Maps by Author).

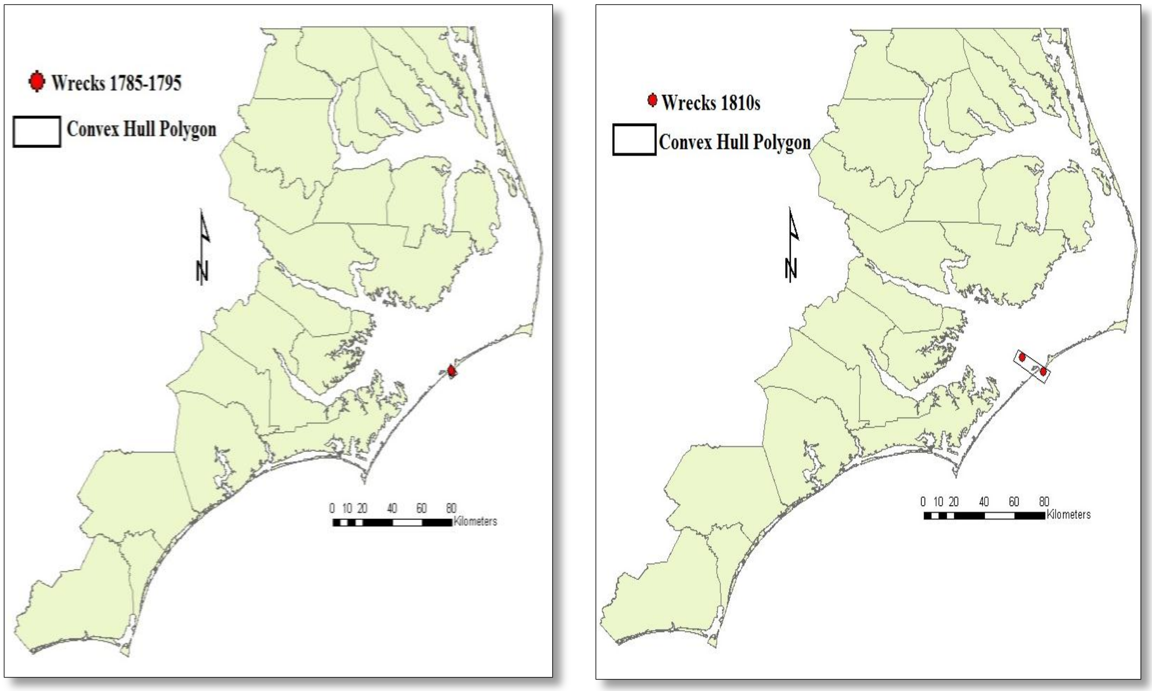



FIGURE 7.63 and 7.64 Convex Hull Polygons of hurricane-related shipwrecks by decade, 1780s to 1810s (Maps by Author).

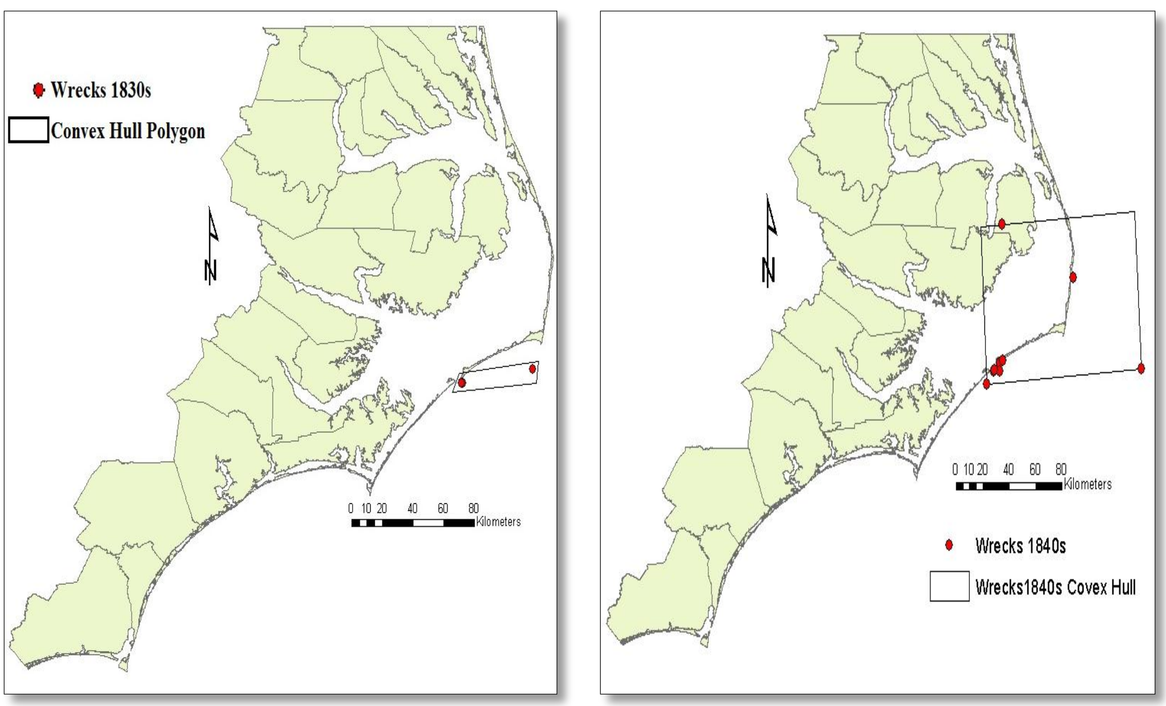
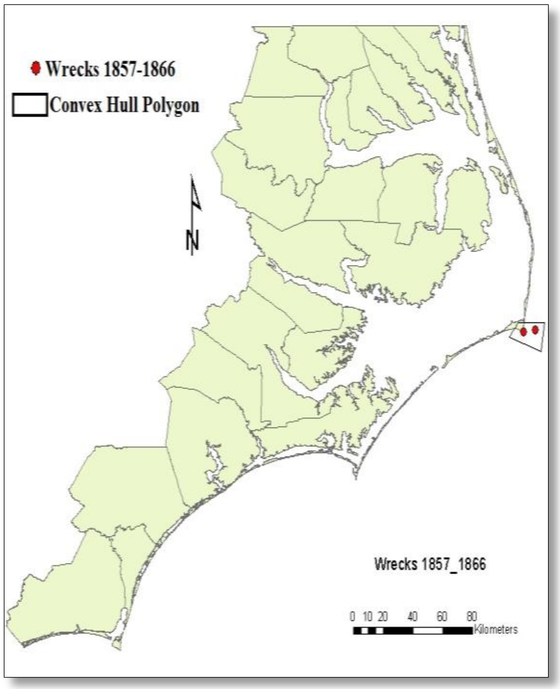



FIGURE 7.65 and 7.66 Convex Hull Polygons of hurricane-related shipwrecks by decade, 1830s and 1840s (Maps by Author).



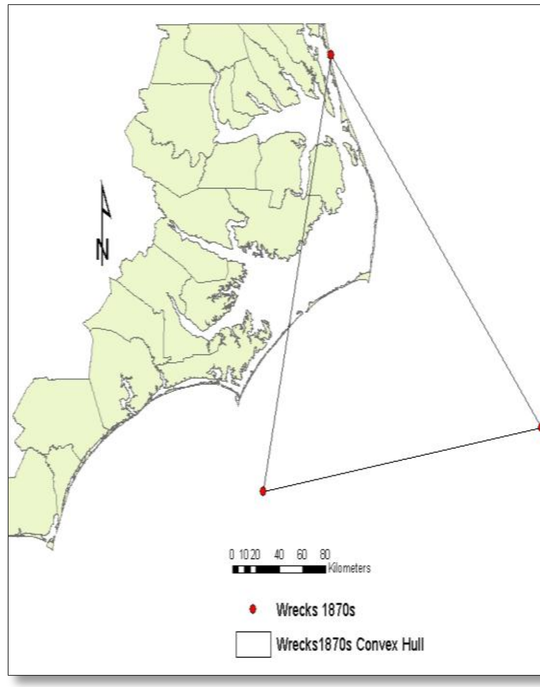
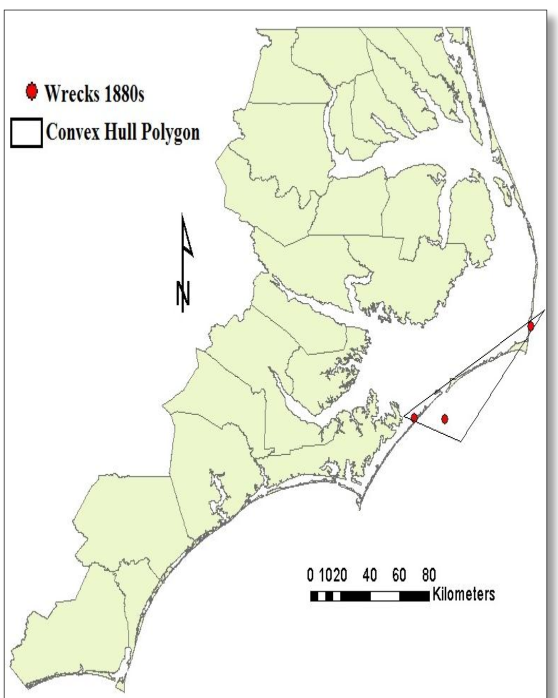




FIGURE 7.67 and 7.68 Convex Hull Polygons of hurricane-related shipwrecks by decade, 1850s through 1870s (Maps by Author).



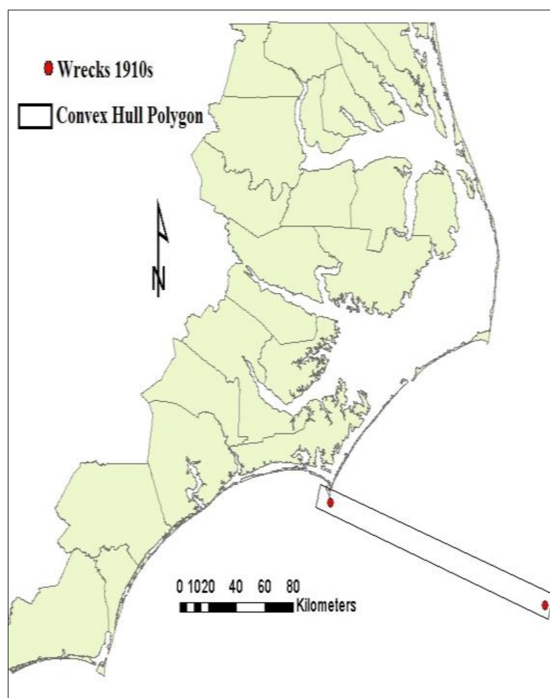
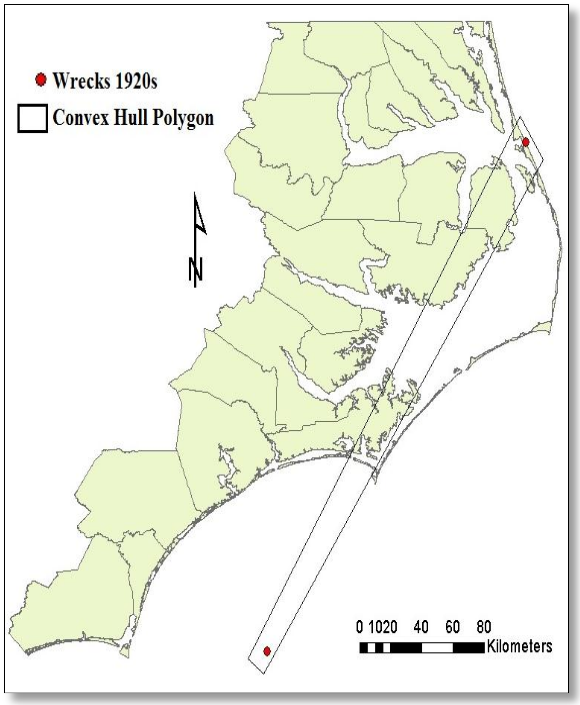




FIGURE 7.69 and 7.70 Convex Hull Polygons of hurricane-related shipwrecks by decade, 1880s and 1910s (Maps by Author).



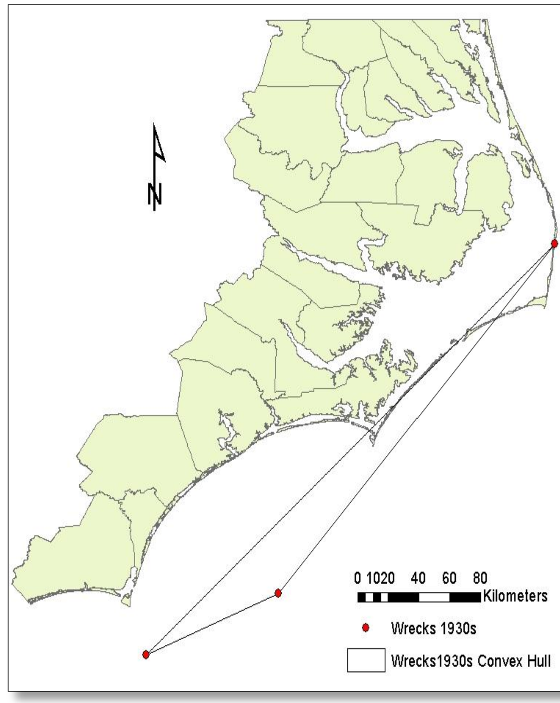
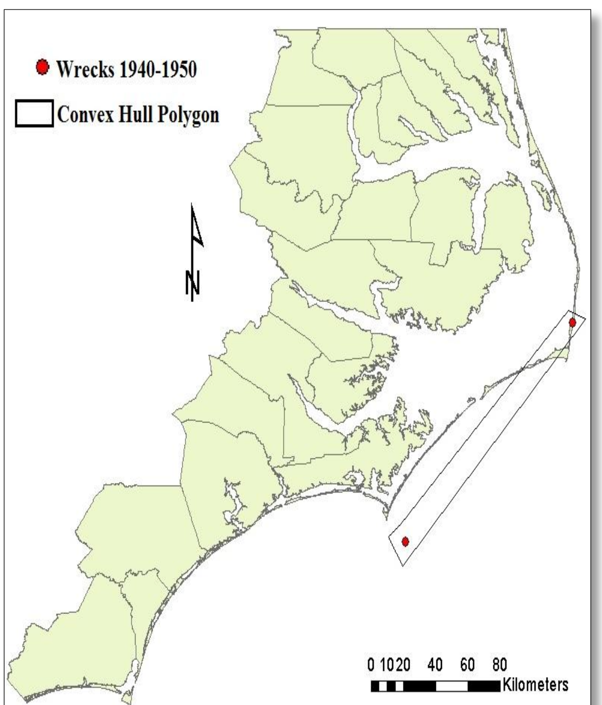




FIGURE 7.71 and 7.72 Convex Hull Polygons of hurricane-related shipwrecks by decade, 1920s and 1930s (Maps by Authors).



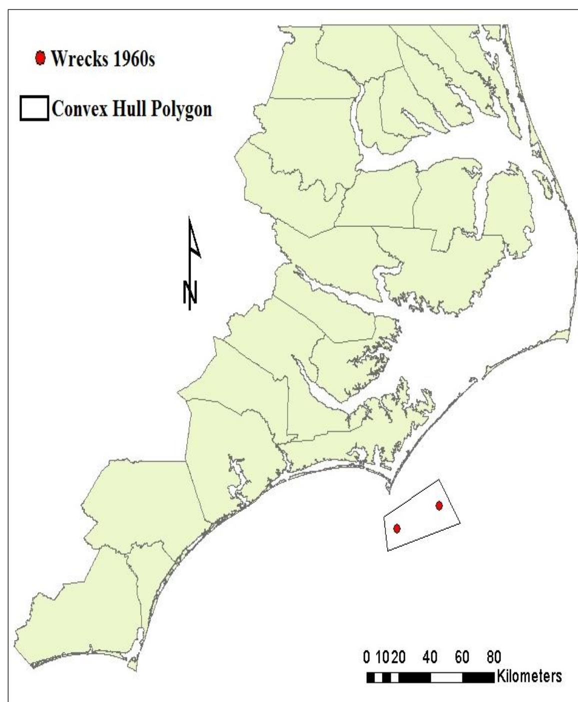




FIGURE 7.73 and 7.74 Convex Hull Polygons of hurricane-related shipwrecks by decade, 1940s through 1960s (Maps by Authors).

But this leads to the question: do transformations in trade and shipping through such physical alterations lead to changes in settlement? In some cases, yes (i.e. Portsmouth Village); in others, the correlation is not as visible. From the 1720s to the 1840s, shipwrecks are clustered around Ocracoke Inlet. After the 1840s, the wrecks become more scattered and removed from the Ocracoke area. Some of the wrecks are still located around other inlets and Capes Hatteras and Lookout. Therefore, although the importance of Ocracoke Inlet changed over time affecting the clustering of hurricane-related shipwrecks, later ships were also affected by the geography and trade patterns along other areas of the North Carolina coast.

*Hurricane Tracks Versus Vessel Location*

Viewing spatial data in relation to hurricane track versus wreckage may expose any correlations between wreck location and the event itself, allowing us to interpret if the event is the sole cause of deposition of a shipwreck. Within the historical and spatial data, only certain years contain hurricane track and shipwreck data in which to map correlations. Years with such data are 1857, 1933, 1959, and 1964 and 1968 (Figures 7.75-7.78). These are the only years in which spatial data is available for both a hurricane and a shipwreck (either through historical sources or IBTrACS).

Most of the maps show that there can be positive correlations between weather events and wreckage location (Figures 7.75, 7.76, 7.78), leading us to assume the weather event was the major factor in the deposition of the vessel. If we see there is an inverse correlation between a weather track and the location of a shipwreck there must be other factors behind the relationship rather than the weather event itself. For example, the map of Hurricane Cindy (1959) versus the deposition of *Antonin Dvorak* (1943-1959) (Figure 7.7) exposes that the two factors do not always positively correlate; in this case, the wreck is nowhere in relation to the storm track.

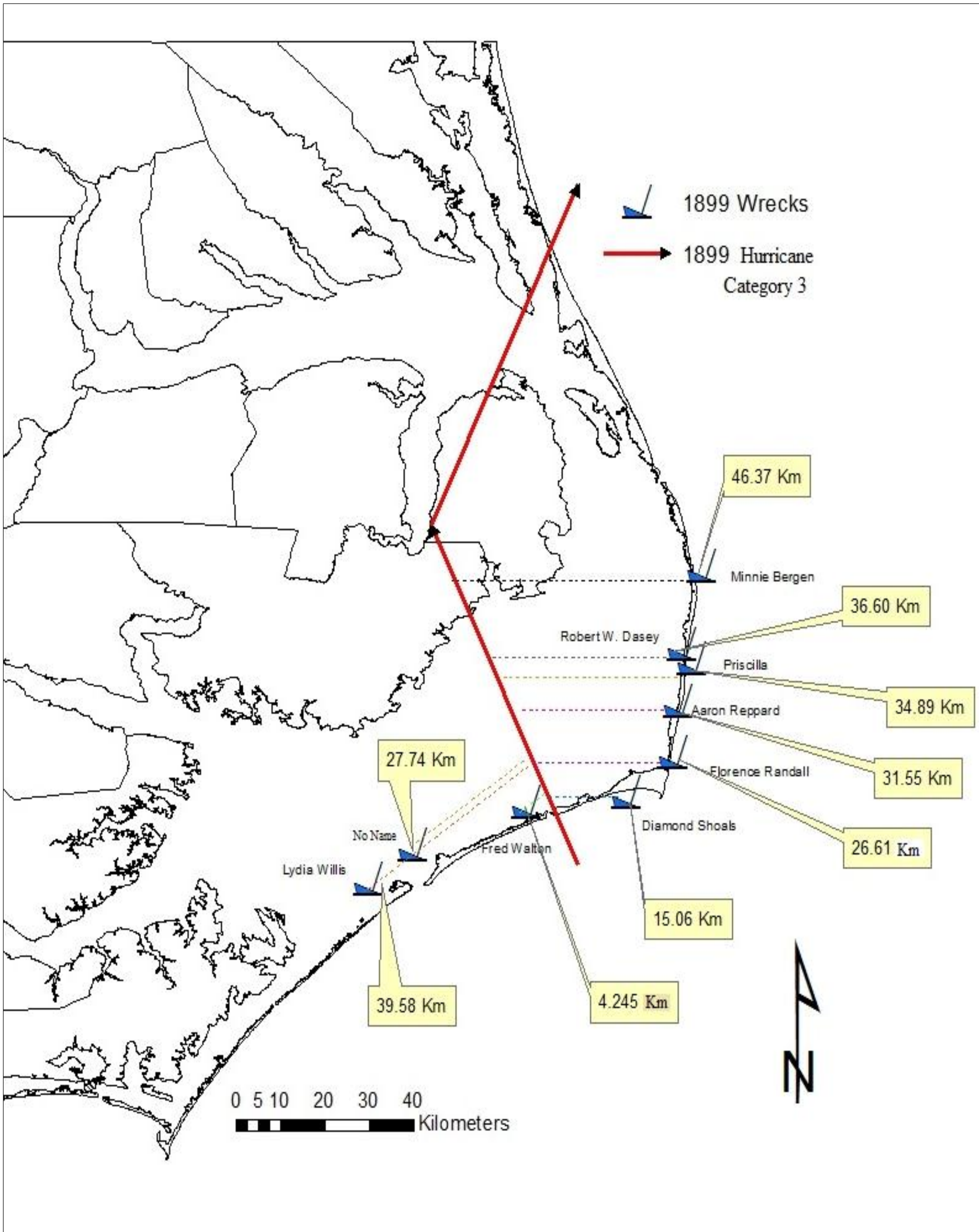



FIGURE 7.75 Relationship between hurricane track and wreck deposition, 1899 (IBTrACS 2010).

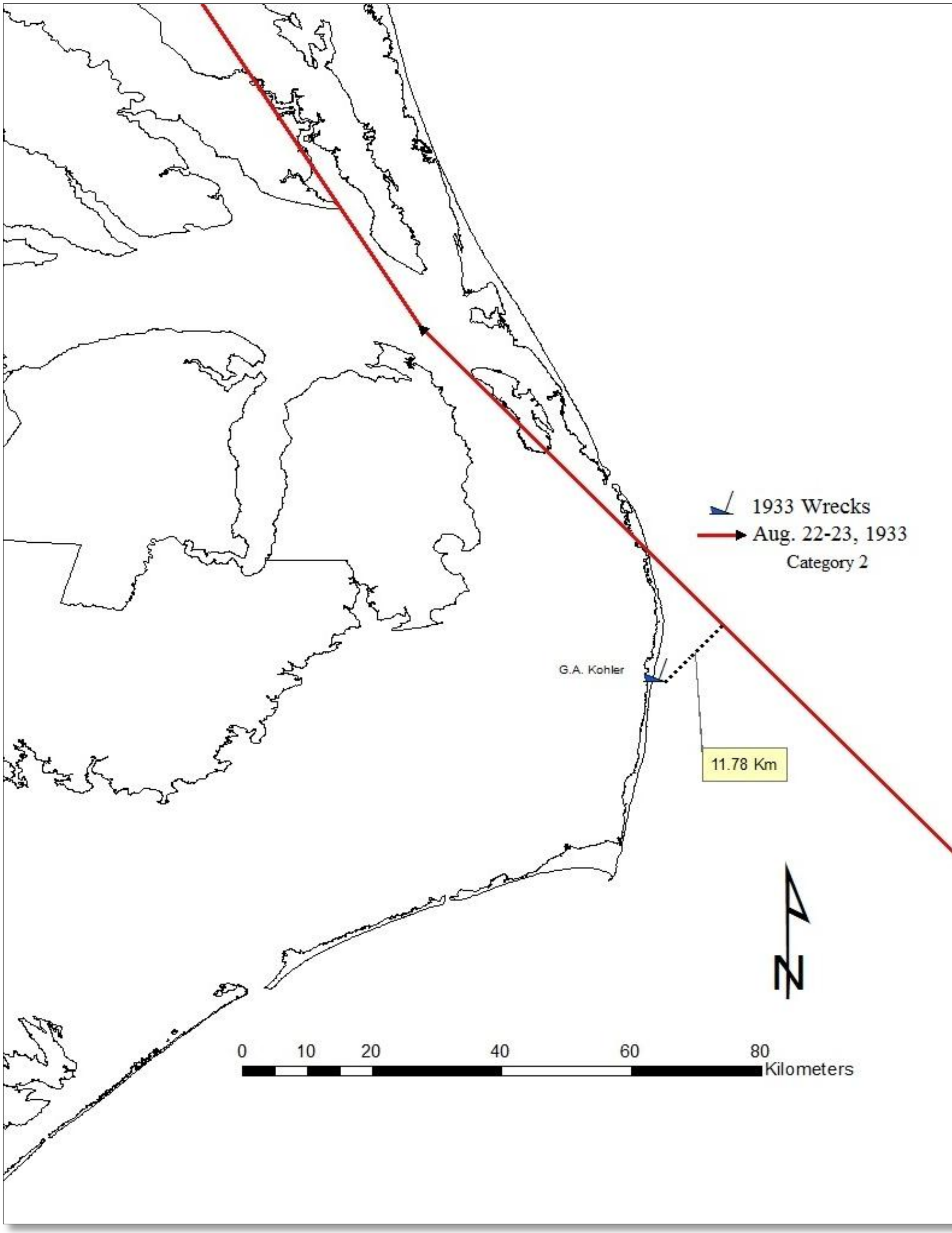



FIGURE 7.76 Relationship between hurricane track and wreck deposition, 1933 (IBTrACS 2010).

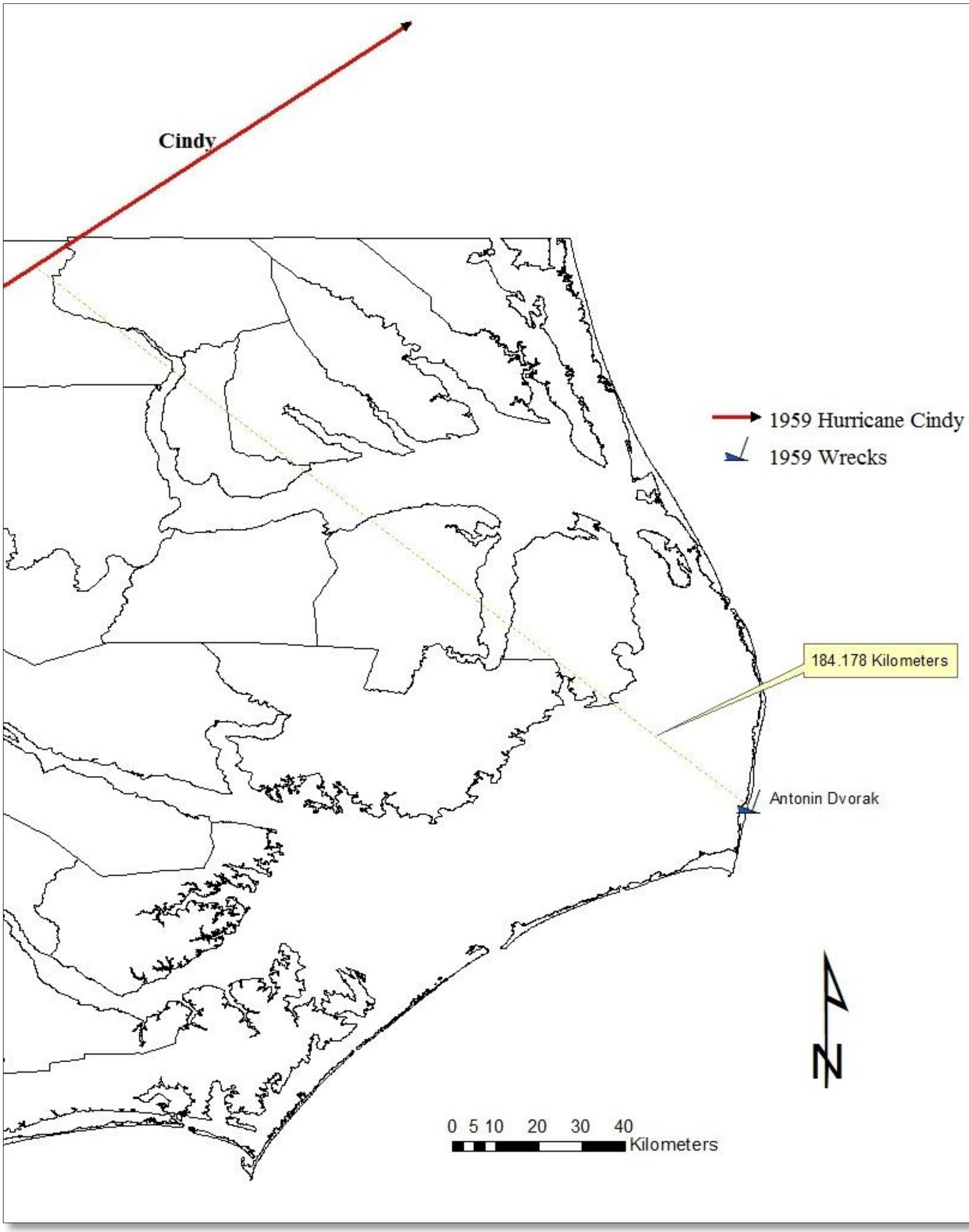



FIGURE 7.77 Relationship between hurricane track and wreck deposition, 1959 (IBTrACS 2010).

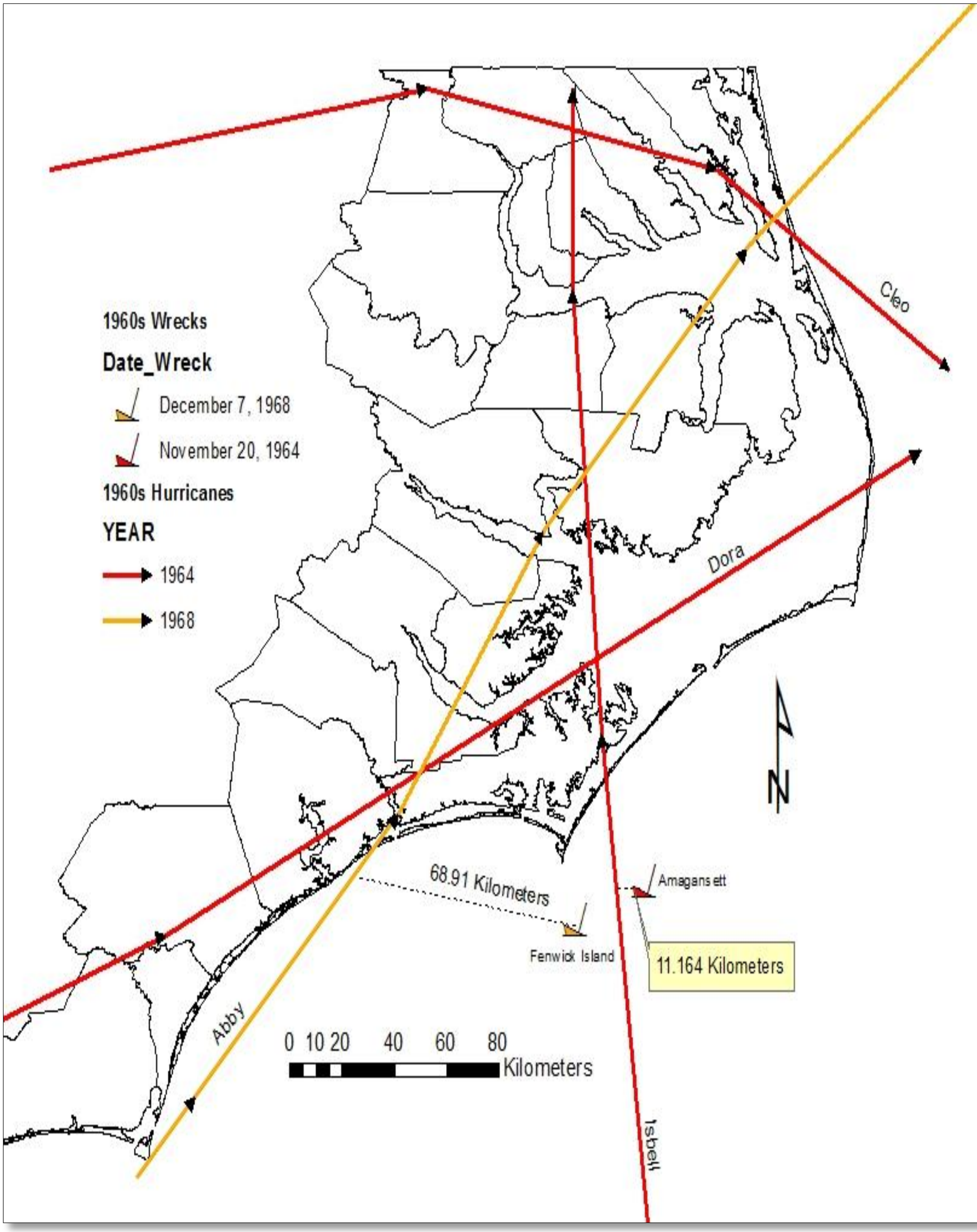



FIGURE 7.78 Relationship between hurricane track and wreck deposition, 1964 and 1968 (Map by Author).

Depending on the intensity of a storm and its associated effects, a large area of damage could include wreckage at a substantial distance from the track; however, it is unlikely given the location and direction of this particular storm that the wreckage could be directly correlated to the event itself. Thus we must look at other factors involved in the deposition of the wreck. These factors could be related to human error, geography, trade patterns, or a combination of these. Given the location of *Antonin Dvorak* near Cape Hatteras and Buxton Inlet, geography may have played a large role in the wreck's location, as well as being the result of human error such as choosing to ride out a storm that would eventually lead to vessel loss. However, it is difficult to determine the level of human error without ship's logs or personal accounts. Furthermore, inverse correlations may also illustrate that the track (or eye) of the storm is not the best indication of the area of most damage.

*Vessel Type*

Varying vessel types are visible at various locations along the North Carolina coast, but in analyzing the geospatial data, no one vessel type is prominent in a single location than another with the exception of the cluster of schooners located in the Albemarle Sound. The clusters of wrecked vessels at Cape Hatteras and Ocracoke Inlet contain various vessels types that include sailing vessels such as schooners, brigs, and sloops, as well as steamers and freighters (Figure 7.79). Previously, there seemed to be no correlation between deposition a hurricane-related shipwreck and its type, and it was difficult to conclude that certain vessel characteristics have a bearing on the nature of the relationship between inclement weather and shipwrecks. However, in viewing the data spatially by type, we see that there are a large amount of schooners clustered around inlets, most prominently Ocracoke Inlet and the Albemarle Sound.

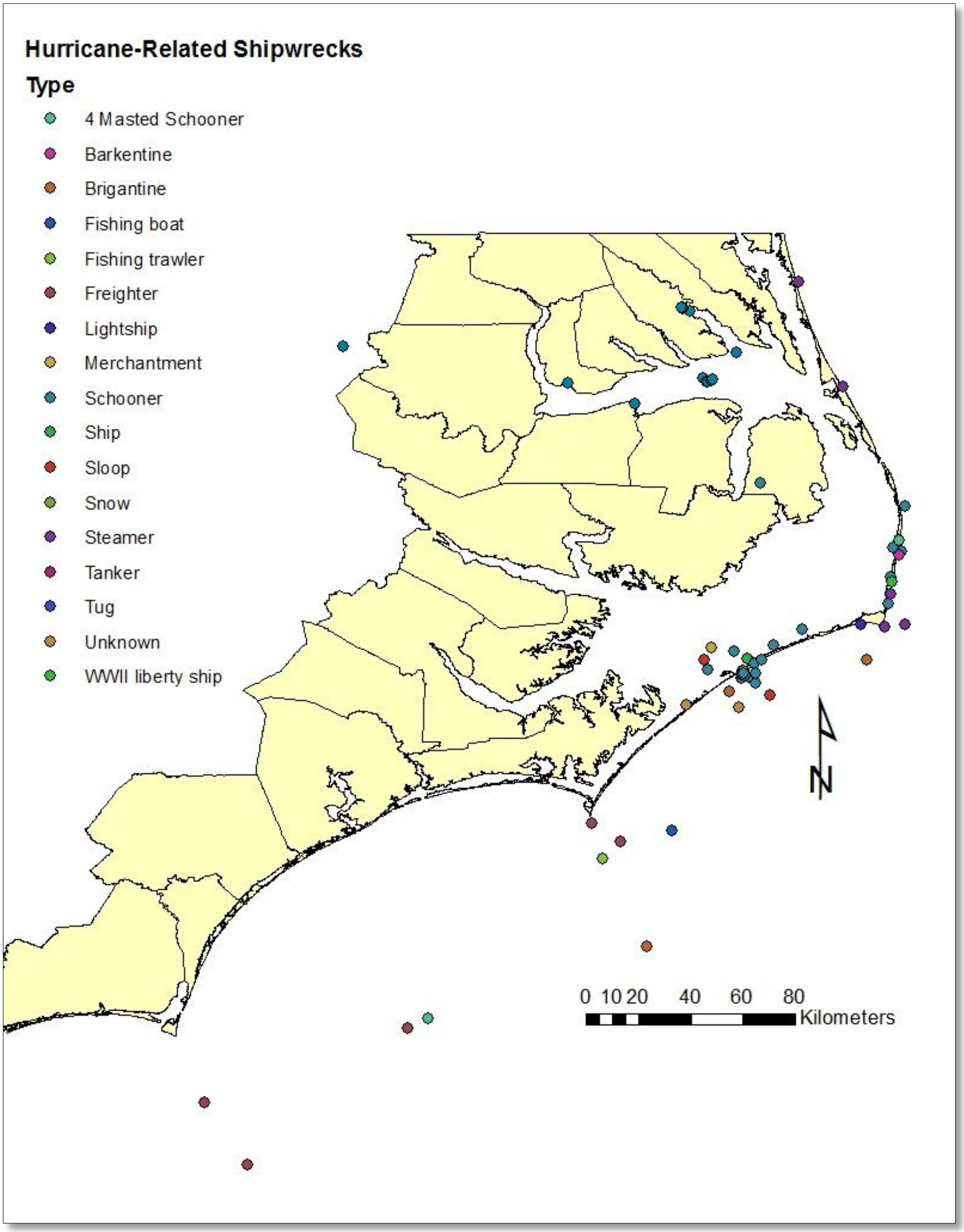



FIGURE 7.79 Hurricane-related shipwrecks by type, 1728-1969 (Map by Author).

This correlation may be related the geography of the inlets, the characteristics of the vessels, and the geographical/economic importance of certain inlets and waterways at certain times. Additionally, from Cape Lookout to Cape Fear the majority of hurricane-related shipwrecks are in the non-sailing class of vessels that include freighters and lightships. As this was seen as the less treacherous portion of the coast (according to seamen like Tawes), this correlation may be accounted for by human error or poor preparation.

There are still a large number of unidentified wrecks that need to be taken into account; if it were possible to characterize these vessels, a clearer pattern could come to light that may or may not corroborate the data displayed here. Shipwreck deposition is one of the only avenues thus far, where we can see some clear and definitive correlations between severe weather events and cultural transformation across time and space. Shipwrecks are often correlated to physical alterations to the landscape (i.e. inlet change) sometimes brought about by hurricane activity, and patterns of trade and shipping. But what do these correlations show us about the preparedness of shipowners and operators when dealing with severe weather events? With a decrease in hurricane-related shipwrecks over time, this can imply a higher-level of preparedness when dealing with hurricane activity and/or a greater knowledge of the North Carolina coast, accompanied by a greater sophistication in vessels, navigation, and weather-tracking systems.

In the historic period, we see prolonged usage of dangerous areas such as Ocracoke and Cape Hatteras because these areas constitute the prime lanes of shipping and the most important access points for trade and resource exploitation (especially fishing) along the North Carolina coast. We see concentrations of shipwrecks in these areas because there are no alternative choices in bypassing these regions in certain time periods in terms of access to the inland waterways and sounds. Ocracoke and Hatteras Inlets were prominent access areas where we consequently see more wrecks. The combination of the social and economic primacy of the area and the hazards of severe weather events may account for patterns in the data. The same is true for the prominence of sailing vessels (especially schooners and sloops), which were better able to navigate the shallows and shoals. Due to geographical and environmental constraints in pursuing social and economic means along the North Carolina coast, vessel owners and operators had no choice but to endure the harsh weather.

There was an increase in the number of hurricanes to occur on the North Carolina coast in the twentieth century, but a decrease in the number of shipwrecks that occurred from these intense weather events. An increase in recorded hurricanes is most likely due to the development of the modern weather tracking systems and not an actual environmental increase in the number of events. A decrease in hurricane-related shipwrecks may also correspond to changes in technology that prevented such wreckage, or this decrease may again be attributed to lack available records, especially in the early part of the century.

There are often clear correlations between hurricane tracks and shipwreck locations as seen from the spatial representations, implying the hurricane's effects are sometimes responsible for the location of historic shipwrecks along North Carolina's coast. In other respects, the relationship between shipwrecks and hurricanes are negative on the basis of track and wreck location, illustrating that the track of a storm may not serve as the best indicator of the path of damage. Although the severe weather event may be a catalyst for reaction, other factors are responsible for wreck deposition. The data also shows a certain level of cultural, or human, involvement in the patterns of shipwreck deposition. This is important for how we view human agency in the archaeological record. Clearly, despite the occurrence of catastrophic weather events, human manipulation and decision-making are driving factors in site formation processes.

*Conclusion*

The spatial data has provided more depth of analyses to the examination of the relationships between North Carolina hurricanes and the cultural and environmental resources of North Carolina's disaster landscape. Patterns in the spatial data emerge for hurricane characteristics themselves, shipwreck deposition, and physical/environmental alterations. Certain areas of the North Carolina coast are more prone to higher levels of hurricane activity, just as certain decades see more activity than others.

North Carolina's coastal populations have endured numerous hurricanes throughout the State's history. As such, coastal populations have fluctuated through time, at times correlating with the occurrence of severe storms or intense storm seasons. There are certain areas or specific counties of the coastal region whose population fluctuations can be more strongly correlated to the occurrence of severe weather events. Although there are periods of time where there are decreases in population after a storm or storm season, without population data for each, individual year to compare to the hurricane record, it is impossible to state with any certainty that severe climatic events are positively correlated to coastal population change regionally. Population change cannot always be correlated to the occurrence of severe weather events over time, although there are some instances where hurricane activity could be viewed as a contributor to changes seen in population fluctuations. But this is inconsistent and fluctuations in population are better related to cultural factors than solely the event itself.

Environmental alterations, which are a given for severe weather events such as hurricanes, have the potential to modify or transform responses and reactions to said events in relation to occupational patterns over time. Inlets are important components of North Carolina's dynamic coastline. Inlet change also shows some of the most visible effects of severe storms that also prompt social and economic reactions in other cultural resources such as shipwreck deposition and community change. Inlet opening or closing, often the result of transformation brought about by severe weather events can stimulate change in shipping patterns and the economic vitality of certain areas over others. This can be seen in shipwreck deposition and the abandonment of small coastal communities on North Carolina's Outer Banks.

Shipwrecks can be seen as aspects of the regional or local environment due to the correlation between the location of wreck sites and weather events, which constitute a component of the disaster landscape. Carrying a relationship with such components allows us to use shipwreck deposition to detail economic and cultural activities and any long- or short-term impacts on these structures from major environmental events such as hurricanes. There is a substantial correlation between shipwreck deposition and severe weather activity along North Carolina's coast, but the nature of this correlation is often related to physical changes in the landscape and/or the patterns of shipping and trade that are often transformed by the physical alterations.

Within the relationships between severe weather activity and these resources is the nature of patterns of settlement and occupation in the disaster landscape created in coastal North Carolina. As can be seen from a majority of the spatial data, many of the reactions to the existing relationships between cultural resources and severe weather events are a matter of individual action and local circumstances (i.e. the role of human agency in acting on a given set of conditions), especially in relation to patterns of settlement and occupation in coastal North Carolina. Spatial and temporal synchronicity provides the basis for the correlations between severe weather events and any small-scale abandonment or change. At this point, we can mostly reject Feiman and Fisher's (2005) idea about long-term change from the effects of severe weather events on environmental and human elements of a cultural, or maritime landscape; there are some exceptions to this rejection where some hurricanes have been catalysts for physical alterations that led to shipping, trade, or economic shifts which contributed to other social changes. However, the effects of most severe weather events have been short-term rather than any long-term transformations, and the dynamic nature of North Carolina's coastal environment, or disaster landscape, can be seen to facilitate or restrict the workings of its associated society in specific instances, in specific times.

# CHAPTER 8: A STORMY PAST, PRESENT, AND FUTURE…

## CONCLUSION

Catastrophic weather events have long been a common occurrence in the historical records of North Carolina. As seen from the previous chapters, the events have been widespread and varied both in occurrence and effect, intensity and frequency. It is also evident that storm events have had different effects on the various coastal communities prompting different cultural, social, and economic reactions. There are instances where a clear, positive connection between severe weather events and change (e.g. total abandonment or shipwreck deposition) may be assumed, while in other cases the relationship is dominated more by underlying cultural factors. Either way, severe climatic events such as hurricanes are at least catalysts for change.

### *Observations*

In lieu of the research questions posed and the data presented, there are several observations that can be made. Numerous instances of severe weather events have been documented throughout North Carolina's history (as seen in Chapter Three), and the major impacts of climatic disasters on the State's coastal communities have varied by time and space, acting on the people, places, and cultural resources in different degrees. Major impacts have included not only loss of life and loss of money and resources, but have also included changes to social and economic patterns over time. There is regional evidence of the effects of severe weather events on economic and environmental resources such as coastal industry and environmental change (e.g. storm surge and coastline erosion), while the major impacts of climatic events on a local scale are seen more in population change, i.e. settlement and occupation. Patterns of shipwreck deposition may be viewed as local circumstances affecting regional trends.

In examining whether severe weather events have affected the settlement and occupation of coastal North Carolina, we see that the correlations are rare and inconsistent, existing on the small-scale and short term, if existing at all. Although there are some well-documented examples of positive relationships between climatic disasters and abandonment (e.g., Diamond City and Portsmouth Village), instances of population change associated with severe weather events are more strongly linked to cultural factors such as trade opportunities, shipping patterns, resource viability, or personal attachment—all attributable to human agency (behavior and decision-making). This is reflected in the distribution of settlements and shipwrecks in areas linked to navigable waterways (e.g., inlets), trade opportunities, and culturally similar communities. Sites within the disaster landscape are distributed not only around areas of particular geographical hazards, (e.g., Cape Hatteras, shifting shoals, or moving inlets), but also around areas of economic importance (e.g., trade and shipping lanes). It can be viewed as a double-edged sword: the area may be treacherous given the geography and constant threat of severe weather, but the most treacherous areas are necessary for access to social and economic survival.

The substantial cultural component and the dominance of human agency on the distribution of hurricane-related sites (i.e. site formation processes) facilitates an understanding of how the people and communities of North Carolina's disaster landscape experience and react to the dynamics of their coastal environment. This has been important for how we view human agency in the archaeological record.  Not only has the study of site formation processes shown us that despite the threat of often severe and intense severe weather events cultural factors override the threat, but also how to possibly identify human agency in the archaeological record. This also reinforces the concept that uni-causal explanations, i.e. the severe weather event as the sole cause of change, are too simplistic; severe weather events may be a catalyst for change, but there are multiple underlying causes for the outcome of change.

Certain counties, such as Dare and New Hanover, have seen the most storms. Cape Hatteras and Cape Fear have experienced the most hurricane land falls. But do the cultural resources as seen in population change, shipwreck deposition, economic activity—reflect this? Yes and no. Population change rarely draws a direct relationship with severe weather events—at least regionally—suggesting that population change is dictated more by cultural factors (e.g., war, economics, personal attachment, reconstruction, trade opportunities, and trade routes) than strictly environmental forces. Even when the relationship can be assumed to be direct, it cannot be considered the sole cause of change given the data used here. Certain areas such as Portsmouth and Ocracoke have clearly been manipulated to the point of change by severe weather events, while for others, the link is not as obvious. Some time periods, such as the mid- to late-nineteenth century, have seen more adjustments in settlement patterns due to hurricanes than other eras. The only general trend that encompasses the whole of coastal North Carolina has been the recent explosion of development and occupation to the region despite the threat of hurricanes and severe storms, and even then certain areas within this region experience different levels of development and population increase. Unfortunately, this is difficult to expose with any certainty for the historic period without more detailed personal accounts and specific reasons behind choices to settle, remain, or abandon.

Shipwreck deposition draws the most conclusive and direct relationships with severe weather events. But even where patterns emerge, such as clusters of wreckage around Ocracoke, they can be seen as reactions to not just the event itself but other factors like geography and shipping or the result of human agency. Inlet change, shipping lanes, commercial importance, treacherous shoals, and vessel traffic can all be considered factors at play in the direct relationship between shipwreck deposition and severe weather events. Even inverse correlations show us the extent of these other factors, although it is difficult to determine the extent of certain factors like human error without some additional source of information (i.e. ship logs, personal accounts). Hurricane-related shipwreck deposition can be related to numerous factors but the most visible have been the inter-relation of geography and economics. This also involves a certain level of human agency as in deciding or choosing to travel to a certain area given economic or safety reasons, prompting the idea that to some degree, in some situations, human agency overrides natural events/transformations, while in others, the severe weather prompts change in social, environmental, and economic arenas that can also dictate human behavior. Each situation is unique in its reaction to the severe weather event but as a whole the combination of wrecks reflects a level of human agency not dominated by the climatic arena of the disaster landscape.

Severe weather events are seen as n-transforms, or non-cultural transformations that can create sites and act upon them, dictating changes in human behavior. Given the data used here, there are times when this is seen to be true, while in others it is contradicted. Through shipwrecks, we can see how the severe weather events are part of the process of wrecking. As theorized in Chapter Two, shipwrecks present the opportunity to study a specific event in the course of North Carolina’s history related to human reaction and cultural, social, and economic circumstances as seen through the deposition and location of a vessel as well as its characteristics. Shipwrecks and their relationship to severe weather events serve as inferences about the cultural and behavioral past. Hurricanes present a specific set of environmental conditions at a certain time and place that effect the position of a given wreck site; however, the environmental conditions alone do not work alone in influencing the deposition of vessels. Severe weather forces combined with factors that are economic or social, work on ship as it moves along the North Carolina coast. These forces may be local or regional, which allows us to view each wreck as a single event and to view all of the hurricane-related wreckage as a regional phenomenon—part of North Carolina's disaster landscape.

Environmental changes brought about by severe weather events are n-transforms and can affect patterns of movement and abandonment throughout the coastal region. Additionally, as with some coastal communities, severe weather events have acted as stimuli for behavioral changes leading to community movement. Catastrophism states that severe climatic events such as hurricanes and tropical storms can prompt cultural change on small and large scales. Given the data, hurricanes are seen to affect some cultural change on small-scales but not necessarily regionally. There are specific instances, such as extreme storms like the storm of 1846 or Hurricane Floyd in 1999 that prompt changes in economic and social patterns in areas of the coastal region, but like coastal communities that see permanent abandonment, these are exceptions to the rule. Furthermore, it is evident that viewing the cultural resources on land and at sea that we gain a better understanding of the full effect of severe weather events on the coastal region of North Carolina and the extent of the disaster landscape.

We have seen the effects of hurricanes on various socio-economic and environmental aspects such as population trends, changes in coastal industry, property loss, lives lost, and vessels wrecked, but how do these components factor into human decision-making with regard to settlement and occupation of coastal North Carolina? Certain factors brought about by severe weather events can be considered the cause of death of some areas while others recuperate and redevelop. Often areas resist devastation due to their environmental and geological characteristics, despite continual thrashing from severe storms and hurricanes, or the "right" combination of factors may lead to abandonment. Additionally, in certain time periods, specific areas or regions may be the only option for social or economic survival of coastal North Carolina and thus remain occupied despite problems with continual storms. The rapid and dramatic coastal development of North Carolina in the periods between 1940 to 1962 and 1991 to 2005 has also dramatically increased the social impacts and costs of current and future natural disasters (Culver 2008:18). But despite the increase in social and economic costs the disaster landscape created by the impacts of severe weather events and hurricanes has not prevented the settlement, whether small groups of permanent communities or large groups of seasonal occupants, of coastal North Carolina, at least in the twentieth century to the present. Complete abandonment of any area of coastal North Carolina due to hurricanes or severe weather is only seen in a minority of areas where a combination of factors, such as economic deterioration and environmental change has led to demise and abandonment. Individually, smaller villages may be affected in the long-term, but as a whole, hurricanes have not affected the long-term occupation of the North Carolina coast whole prompting the idea that there are other motivations for continual occupation.

*Limitations*

Considering the data and analyses presented in this thesis, some limitations became clear throughout the research and analysis stages. There are limitations in compiling shipwreck occurrences from newspaper accounts. Historic accounts often use terms for the severity and type of weather events that ships encountered that are different from what is characterized today; therefore, it is highly likely that there were many shipwrecks that were not included in this dataset for this reason, while others may in reality not need to be included for the same reasons. Also, the lack of spatial data (latitude and longitude) for a majority of the hurricane-related shipwrecks prevents the visualization of a complete picture of the distribution of wreckage around coastal North Carolina. Along these lines, the number of unidentified wrecks skews any complete statistical analysis of characteristics.

Although not necessarily a limitation, there were difficulties in learning new mediums of analyses and computer software such as ArcGIS, especially learning the software as it changed. Additionally, the constant addition of new data such as hurricane tracks, makes providing a complete overview of the disaster landscape difficult. Furthermore, it is difficult to provide evidence of any patterns seen from the hurricane record for the long-term, as comprehensive economic and social records for the historic and early modern periods are not readily available. Therefore, long-term patterns, may be considered conjectural. According to Pielke and Pielke (1997:135), a

> Hurricane is a shock to a community that leaves various impacts which reverberate through the system for short or long periods. As the impact becomes further removed in time and in causation from the hurricane's direct impacts, pulling the signal of the reverberation from the noise of ongoing social processes becomes increasingly difficult.

In reinforcing Chapters Five and Six on population,

> Communities that are vulnerable to hurricanes are undergoing constant change…Thus, comparing hurricanes impacts across time and space is problematic. Storms that make landfall in relatively sparsely populated areas would have certainly left a greater legacy of damage had they made landfall over a major metropolitan area. Yet, damage statistics often go into the historical record noting only the storm event and economic damage. Such statistics can lead to mistaken conclusions about the significance of trends in historical damage (Pielke and Pielke 1997:137).

Thus, the analyses of certain types of data (i.e. value) can be considered hypothetical. However, a combination of social, economic, and environmental factors considered together can account for trends both temporally and spatially.

### *Further Questions/Research*

The research questions answered here (even if the answer is negative) are preliminary and foundational, and thus there are places where additional questions may be raised, thus prompting further research. In this thesis we have seen that hurricanes have produced varying reactions from shipping patterns and routes, erosion of the coastline, changes in coastal industry such as agriculture, forestry, tourism, and fishing, and development of the coastal region over time. But how does this fit into the archaeological context of coastal North Carolina? Given the statistical, historical, and spatial data, one would expect to find certain areas with traditional archaeological evidence of severe storms, such as New Bern, Edenton, Wilmington, or Southport, but can we determine site formation processes in the physical archaeological record from evidence presented in this thesis? Traditional archaeological research involving field surveys would be beneficial in examining these areas to look for signs of formation processes within the archaeological record that could relate to the severe weather events that have been habitual in the historical record.

There are also several avenues of future research that can be done toward the understanding of severe weather events and their interaction with the communities of coastal North Carolina. For example, there are long- and short-term effects of severe weather events on coastal North Carolina. We have seen that various factors have affected community reactions to hurricanes and severe storms; these factors also vary in their long-term and short-term effects of the associated communities. Often the long- and short-term factors overlap, and sometimes the long- and short-term factors may be different, or reversed, for different communities. For the coastal region of North Carolina as a whole, hurricanes and their residual long-term effects have been difficult to express except for specific instances in the historic period; after the 1940s when the coastal population began to expand, any long-term effects of severe weather events are difficult to ascertain except for storms like Hazel and Floyd, whose extensive studies have shown lasting effects to the economy and social character of the communities affected by these storms. The short-term effects are more easily visible after a severe storm, such as lives lost, buildings damaged, or crops destroyed. The farther removed from an event, the more difficult it becomes to view effects, except for effects considered secondary, but with extensive investigation of a specific community within the region over time, we may glean long-term effects that can be generalized to encompass the whole coastal zone of North Carolina. More intensive study of individual community reactions over time and the comparison of several communities over time may expose which factors act upon settlement patterns at one time and which may continually alter a community after an event has passed. Along the same lines as short- and long-term effects of hurricanes which generally focus on the negative effects of these severe storms, little attention has been paid to the benefits or positive effects of hurricanes to a community. It has been proposed that the immediate or short-term effects of a severe storm are negative, while the long-term effects are actually positive for a community in terms of economic reconstruction and increase in income (Guimaraes et al. 1992:1). This claim requires more investigation into the social and economic characteristics of communities over time and the possible relationships to community change.

Additionally, more detail needs to be examined along the lines of the occupational configuration of coastal communities in North Carolina. Although this may be difficult for historic communities, contemporary settlement characteristics will help in determining if population configuration and storm patterns are truly correlated. Historically, looking at population composition changes of well-documented historic towns such as Wilmington or New Bern that have been continually occupied in some form throughout North Carolina's history, can expose changes in the composition of coastal populations and if any changes correspond to severe weather events and their associated effects. Specifically, looking at communities known to have larger seasonal populations versus those that contain larger permanent populations will aid in understanding how types of communities react to severe storms and hurricanes; certain types of communities may be more resilient to storm effects as was presumed in Chapters Five and Six.

Much research has been done on the social and economic factors involved in evacuation processes in relation to hurricanes and severe storms; however, little has been examined in regard to the social, economic, or environmental factors involved in the initial settlement of an area, especially areas such as coastal North Carolina which are prone to hurricanes, or the abandonment and resettlement of an area after a hurricane event. For contemporary coastal communities, this would involve the use of surveys and the analysis of the social characteristics of a community as well as individual incomes and community types. Historically, looking at the composition of certain communities by age, race, gender, income, and occupation aids in understanding why certain groups chose an area for settlement and chose to stay, leave, or return after a severe weather event.

At this time it is difficult to ascertain which factors have the most influence over settlement patterns without further detail specific industries or coastal villages. But prior to the twentieth century, smaller, more rural communities were easily dispersed, scattered, and abandoned, especially if certain resources were destroyed. Near the turn of the twentieth century, rebuilding and recuperating after severe hurricanes became quicker, with larger communities. Often the difference between these earlier and later communities is the pattern of their occupation—permanent versus seasonal—or their trade, which may affect how a community responds to severe weather events. Such characteristics may be major factors in the occupational life of a community, although in some instances certain areas of the southern coastal region have sustained continual reoccupation despite continual severe storms, the data suggesting this factor may be quite influential in a community's vitality over time. These generalizations are broad in the sense that they may be utilized to view the coastal region as a whole but may not fit for certain areas within the region.

In the late-twentieth to early twenty-first centuries, despite the occurrence of continual severe storms, there was and has been an explosion of occupation—although mainly seasonal or temporary. But as a whole the natural hazards that batter eastern North Carolina cause substantially more damage than in the past because of

> Extensive development and increasing population density in the coastal zone…The heightened vulnerability of eastern North Carolina to severe weather events reflects the gradual transformation of the region from one of sparsely populated rural and coastal communities to a region with a higher population density (Wilson et al. 2001:81).

Although hurricanes and severe storms do not always present the same intense threat as in previous eras when multiple storms hit in rapid succession, they are still a hazard that is inherently linked to the coastal region of North Carolina, but for a variety of reasons, the growing population of this area seems to disregard this fact. Previous periods of the historic era were seemingly more affected by the historic storms of the region than populations today despite the claim that currently the area is at more risk to storm fury. Small communities and less technological development may be accountable for more varied settlement of the region and less resilience to past storm effects. Looking more intensely at the industrial components of these coastal communities may also aid in understanding the patterns of change associated with North Carolina's disaster landscape.

### *Conclusion*

We can say with some certainty that certain time periods and small sections within the larger coastal region of North Carolina have been more affected by North Carolina's disaster landscape than others. It has taken the specific combination of factors at specific times to promote any change in settlement patterns, especially abandonment which is rare and often only temporary. A combination of storm frequency and intensity, geographical characteristics, population, economic vitality, and social characteristics are seen to determine the patterns of settlement along the coastal zone of North Carolina, at least in relation to the survival of certain communities over others. Cultural factors and human agency dominate the relationships between severe weather events (the catalyst) and cultural change.

Severe weather events clearly add to the foundation of North Carolina's disaster landscape, and their signatures are well-defined in various cultural resources of the coastal region. But the correlations between these signatures and the settlement and movement of the region's people are not as clearly or easily portrayed. When there is a connection between the two factors, the nature of the relationship often varies spatially or temporally, and various factors affect specific areas differently. At this time, there does not appear to any be large-scale, or regional, correlations, but there are definite individual instances of relationships between the severe weather aspect of North Carolina's disaster landscape and its settlement.

Often in the history of North Carolina, hurricanes and their aftermath loomed large in the sequences of factors that influenced social and economic change and development in certain periods and have been implicated in the ways that coastal North Carolina has evolved over time. Whether directly or indirectly, long- or short-term, hurricanes have often acted as a catalyst for change, by rearranging circumstances for certain communities, and acting as a part of the larger context in which boundaries are reconfigured. Although the factors and characteristics are often difficult to define, "so much in the character of economic conditions, social relationships, and cultural forms bear the distinctive imprint of the hurricane" for coastal North Carolina (Perez 2001:155).

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# APPENDIX A: HURRICANES

| Name | Date | CAT | Area of Impact/Damage | Land Damage | Rain Acc. | Inlets | Building Damage | Damage in $ | Lives | Shipwreck Damage | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sep. 6, 1667 | | Outer Banks (OB) | Crops Destroyed | | | Building damage | | | | Carney and Hardy (C/H) |
| | Aug. 18, 1669 | | Northern Outer Banks (NOB) | | | | | | | | C/H |
| | Aug. 6, 1670 | | NOB | | | | | | | | C/H |
| | Sep. 16-17, 1713 | | Cape Fear Region (CFR) | | | | | | | Ships driven from anchor | C/H |
| | Aug. 13, 1728 | | Ocracoke | | | | | | | Many ships were lost | C/H |
| | Oct. 18-19, 1749 | | Ocracoke | High tides | | | | | | Nine ships | C/H |
| Great Storm of August 18 | Aug. 18, 1750 | | North Carolina Coast (general)(NCC) | | | new inlets | | | | Spanish Flota driven ashore | C/H |
| | Sep. 30-Oct. 1, 1752 | | Onslow County | Flooding | | | Destroyed courthouse at Johnston | | | Many ships lost | C/H |
| | Sep. 23, 1761 | | Southern North Carolina Coast | | | Haul-Over, | | | | Numerous ships | C/H |
| | Sep. 7, 1769 | | Between Cape Fear and Cape Lookout | | | | Brunswick County Courthouse and New Bern | | | | Hairr |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Independence Hurricane of 1775 | Sep. 2, 1775 | | Between Cape Lookout and Cape Hatteras | Crop damage at Pasquotank County | | | | | 170 | Several sloops and ships lost | Hairr |
| | Aug. 11, 1778 | | New Bern | Feed supplies ruined | | | | | | Ocracoke Bar | Hudgins |
| | Oct. 1783 | | CFR | Tree damage | | | building damage | | | | Hudgins |
| | Sep. 1785 | | Ocracoke Bar | Breaking sand dunes; drowned cattle | | | | | | | Hudgins |
| | July 1788 | | Central coast | | | | | | | Ocracoke Inlet; Pamlico Sound | Hudgins |
| The Great Freshet of 1795 | Aug. 2, 1795/Aug. 12, 1795 | | CFR | massive flooding | | | | | | Spanish fleet | Hairr |
| | Sep. 5, 1797 | | Cape Hatteras/Ocracoke | | | | | | | sloop at Currituck Inlet | Hudgins |
| Twin Hurricanes of 1806 | Aug. 22, 1806 | | Cape Fear River | | | | Smithville; Wilmington; wharves ruined | | | Governor Williams; Adolphu/Atl antic | Hairr |
| Twin Hurricanes of 1806 | Sep. 28, 1806 | | Ocracoke | | | | Shell Castle; Beacon Island and Cape Hatteras Lighthouses | | | Governor Williams, Diligence | C/H |
| The Great North Carolina Hurricane of 1815 | Sep. 3-4, 1815 | | Wilmington; Onslow County coast between Topsail Island and Swansboro | Many trees blown down, high tides; crops drowned; roads washed out; | | | New Bern inundated; damage to saltworks at Masonboro Sound; grist mills destroyed | 60000 | | New Bern, Beaufort, Shackleford, Bogue, Ocracoke, and Hatteras | C/H; Hairr |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sep. 2-3, 1821 | | Cape Lookout to Norfolk, VA | Damage at Morehead City | | | | | | | C/H |
| | June 3-4, 1825 | | NCC | Coastal plantations inundated near South River; loss of crops and livestock | | | High tide at New Bern and Adams Creek; | | | + 20 vessels at Ocracoke, 27 near Washington and at New Bern | C/H |
| | Nov. 17-18, 1825 | | NCC | | | | | | 5 | Nags Head | C/H; Barnes; Hudgins |
| Great North Carolina Hurricane of 1827 | Aug.24-25, 1827 | | Wilmington to Hatteras | | | Masonboro Sound | Waterfront destroyed at Washington | | | Diamond Shoals Lightship; +20 at Portsmouth | C/H; Hairr |
| | Aug. 15-17, 1830 | | NCC | damage to crops in Edenton areas | | | high water at Wilmington; new jetties swept away | | | at New Bern; vessels driven ashore at Smithville | C/H |
| | Sep. 4, 1834 | | Near North Carolina/South Carolina line | heavy rains and flooding | | | | | | N/A | C/H |
| | Aug. 18-20, 1837 | | Wilmington | Heavy winds and rain; high waters; | | 2 opposite M'Rae's on Peden Sound | Bridges swept away at Wilmington and Waynesboro | | | Smithville | C/H |
| Racer's Storm | Oct.. 9, 1837 | | North Carolina Coast (general) | | | | | | | Ocracoke; Core Bank; Bodie Island | C/H |
| | Aug. 28-30, 1839 | | Hatteras | Trees blown down; severe winds | | | bridges overwashed in Elizabeth City; | | | Ocracoke | C/H |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | July 12-15, 1842 | | Ocracoke-Portsmouth | crops ruined; livestock drowned | | | Houses swept away on Outer Banks | | | Many ships lost | C/H |
| | Aug. 24, 1842 | | NCC | | | | | | | Currituck; Ocracoke; Cape Hatteras | C/H |
| | Sep. 6-8, 1846 | | NCC | Flooding inland | | Hatteras/ Oregon | | | | Hatteras | C/H; Barnes |
| | July/Aug. 24, 1850 | | Wilmington/Cape Fear | corn crops blown down | | | Railroad bridge over Quankey Creek blown down | | | Cape Fear; Smithville | C/H; Hudgins |
| | Aug 25, 1851 | TS | | | | | | | | | IBTRaCS (*) |
| | Oct 10-11, 1852 | TS | | | | | | | | | * |
| | Sep. 7, 1853 | | Cape Hatteras | Heavy rains | | | | | | Cape Hatteras | C/H |
| | Sep 10, 1854 | TS | | | | | | | | | * |
| | Aug. 19, 1856 | | Cape Fear/Southern Outer Banks | Heavy rains | | | | | | | Hudgins/ * |
| | Sep. 4-5, 1856 | | Wilmington area | Damage to crops, esp. rice; oak trees swept away at Wrightsville | | | | | | | C/H; * |
| | Sep. 9-12, 1857 | 2 | Cape Hatteras | high tides | | | | | | Several ships lost | C/H; * |
| | Sep 27, 1861 | 1 | | | | | | | | | * |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nov.1, 1861 | 1 | Cape Hatteras | | | | | | | 75 vessels | C/H; * |
| | Sep 18, 1863 | TS | | | | | | | | | * |
| | Aug. 18-22, 1871 | | Wilmington area | high tides, heavy rains and winds; trees downed | | | Houses rocked at Smithville | | | Smithville | C/H; Hudgins |
| | Oct 25, 1872 | TS | | | | | | | | | * |
| | Sep.19-20, 23-24, 1873 | | NCC | tornadoes | | | | | | | Hudgins |
| | Sep. 28, 1874 | TS | Wilmington-Norfolk | High winds; trees uprooted; high waters; rice crop damaged | | | buildings destroyed; wharf destroyed at Smithville; telegraph lines and railroad bridges down | | | Spanish barque Arrina blown over | C/H; * |
| | Sep. 17, 1876 | 1 | Near North Carolina/South Carolina line; CFR | tree damage; high waters; 1400 terrapins lost at Wrightsville Beach | | | Military camp at New River destoryed; building damage at Masonboro Sound, Wrightsville, Smithville, and Brunswick | | | Wilmington ; many ships were lost | C/H; Barnes; Hudgins; * |
| | Sep. 29, 1877 | | North Carolina Coast (general) | flooding and swollen streams | | | | | | | C/H; Hudgins |
| | Oct. 3-4, 1877 | | Albemarle Sound | Crops destroyed from flooding | | | Bridges and wharves destroyed | | | Hatteras | C/H; Hudgins |
| | Sep.1878 | | | | | | | | | Many ships wrecked or destroyed | Hudgins |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct. 23, 1878 | 2 | Between Wilmington and Morehead City | | | | | | | Fyring Pan Shoals | C/H; * |
| Great Beaufort Hurricane of 1879 | Aug. 18, 1879 | 3 | region of Topsail Island and Swansboro | | | Beaufort Inlet reshaped; 2 new on Bogue Banks | Morehead City-Beaufort area; hotels, railroad, windmills, wharves, churches, shops, and homes destroyed | | 3 | Cape Hatteras; Beaufort; Smithville; | C/H; Barnes; Hudgins; * |
| | Sep 9, 1880 | 1 | | | | | | | | | * |
| | Sep. 9, 1881 | 2 | Wilmington area | Smithville covered with fallen trees/debris; high tide at Wrightsville Beach | | | tide washed over turnpike at Wrightsville | 100000 | | All pilot boats were sunk at Smithville | C/H; Barnes; Hudgins; * |
| | Early Sep., 1882 | | Cape Lookout | Heavy rains; crop damage | | | | | | | Barnes |
| | Late Sep., 1882 | TS | Cape Lookout | Damage to crops | | | Damage to bridges; Wilmington and Weldon Railroads | | | | Barnes; Hudgins; * |
| | Oct., 1882 | | NCC | High winds | | | | | | | Hudgins |
| | Sep. 11, 1883 | 2 | Smithville/Wilmingt on area | tree and crop damage; flooding | | | Fences, Buildings of light construction, telegraph lines down | | | Smithville, Hatteras and Wilmington; Frying Pan Shoals Lightship | C/H; Barnes; * |
| | Aug. 25, 1885 | 1 | Smithville/Wilmingt on area | Heavy crop damage | | | Extensive damage at Smithville, Wilmington, and Morehead City | | | ships were grounded | C/H; Barnes; Hudgins; * |
| | Oct.12, 1885 | | NCC | Flooding at | | | Smithville waterfront | | | Hatteras Inlet | C/H; Hudgins |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aug., 1887 | | Hatteras | | | | telegraph lines downed; houses in the Pamlico Sound | | | Pamlico Sound | Hudgins |
| | Oct., 1887 | TD | NCC | heavy rain, high winds | | | | | | | Hudgins; * |
| | Oct 11, 1888 | TS | | | | | | | | | * |
| | Oct./Nov., 1888 | | NCC | heavy winds | | | | | | | Hudgins |
| | Sep., 1889 | | NCC | high tides | | new inlet at Nags Head | | | | | Hudgins |
| | June 16, 1893 | TS | | | | | | | | | * |
| The Great Hurricane of 1893/Sea Islands Hurricane of 1893 | Aug. 27-29, 1893 | | NCC | Tornadoes | 8 inch | | Wrightsville Beach evacuated; buidlings wrecked at Kernersville and Oxford; high river tide at Wilmington | | | off the NC coast; the Cape Fear River | C/H; Barnes |
| | Oct 4, 1893 | TS | | | | | | | | | * |
| | Oct. 13, 1893 | | NCC | great destruction to forests, crops; high tides | | | Wilmington waterfront, property and shipping | 150000 | | N/A | C/H; Barnes; Hudgins |
| | Oct 23, 1893 | TS | | | | | | | | | * |
| | Sep. 27-28/Oct., 1894 | 1 | Southeastern North Carolina | | | | | | | Ocracoke and Cape Fear | C/H; Hudgins; * |
| | Oct 9-10, 1894 | TS | | | | | | | | | * |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sep./Oct. 1897 | TS | NCC | High winds, heavy rains | | | | | | | Hudgins; * |
| | Oct 25, 1897 | TS | | | | | | | | | * |
| | Oct. 2, 1898 | | Georgia | | | | Property damage at Carolina Beach | | | N/A | C/H |
| San Ciriaco | Aug. 16-18, 1899 | 3 | South Atlantic coast | High tide at Hatteras; flooding | | | Destruction of Shackleford Banks and Diamond City | | 30 | Hog Island Shoal, Dry Point Shoals, Cape Fear and Currituck | C/H; Barnes; * |
| | Oct. 30-31, 1899 | | Southern North Carolina Coast | Ocean waves over Banks Channel; high tide; flooding | | Old Stump Inlet opened | Destruction at Carolina Beach, Southport, Wilmington, and Wrightsville | | | on the coast vessels were driven ashore; Southport | C/H; Barnes; Hudgins |
| | Oct 13, 1900 | E | | | | | | | | | * |
| | July 11, 1901 | 1 | | | | | | | | | * |
| | Sep 18, 1901 | TS | | | | | | | | | * |
| | Nov. 13, 1904 | | NCC | high tides, heavy rains, tornadoes | | | Fort Caswell; storm surge swept away Life-Saving station at New Inlet | | | Washington; Cape Fear | C/H; Barnes; Hudgins |
| | Sep. 17, 1906 | | Southeastern North Carolina | | | | Property damage at southern beaches; shipping at Wilmington; damage to property Wrightsville Beach | | | | C/H; Barnes; Hudgins |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jun 29, 1907 | TS | | | | | | | | | * |
| | July 30, 1908 | 1 | NCC | Heavy flooding | | | | | | | C/H; * |
| | Aug. 31-Sep. 1, 1908 | TS | Hatteras | High tide at; flooding | | | destroyed property at Wrightsville Beach | | | | C/H; Hudgins; * |
| | Late, 1910 | | Northeastern North Carolina | Flooding from high tides and heavy rainfall | | | | | | | Hudgins |
| | Aug 28, 1910 | E | | | | | | | | | * |
| | Oct 20, 1910 | TS | | | | | | | | | * |
| | Jun 14-15, 1912 | E | | | | | | | | | * |
| | Sep. 3, 1913 | 1 | Inland between Hatteras and Beaufort | Crop damage | | | Property damage at New Bern and Washington; railroad bridges and communication lines downed | 3000000 | 5 | Cape Lookout; Portsmouth; offshore Ocracoke | C/H; Barnes; Hudgins; * |
| | Sep 6, 1916 | TS | | | | | | | | | * |
| | Sep 24, 1918 | TS | | | | | | | | | * |
| | Late 1920 | 1 | CFR | | | | House demolished in Wilmington | | | lightship carried from anchorage | Hudgins; * |
| | Late, 1924 | E | Hatteras | high winds | | | Ocracoke partially inundated | | | | Hudgins; * |

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| | Dec., 1925 | TS | Between Wilmington and Hatteras | high winds | | | | | | | Hudgins; * |
| | Sep. 18-19, 1928 | TS | Sandhills of North Carolina | Flooding of Cape Fear River | | | | | | | Barnes; Hudgins; * |
| | Oct. 1-2, 1929 | | South central North Carolina | Severe flooding; crop damage | | | | | | | Barnes; Hudgins |
| Santo Domingo Hurricane | Sep., 1930 | | Mid North Carolina coast | rough winds | | | Minor scattered damage | | | | Hudgins |
| | Aug. 22-23, 1933 | 3 | Outer Banks | High winds and tides; beach erosion; crop damage | | | | | | | Barnes; * |
| | Sept. 15-16, 1933 | 3 | Pamlico Sound | Flooding; lowest level of the Albemarle Sound; overwashing; | | opening of Drum Inlet | Hardly a building standing in many coastal towns | 3000000 | 21 | | Barnes; Hudgins; * |
| | Late, 1934 | | Cape Hatteras | mild winds | 10 inches | | Slight physical damage | | | | Hudgins |
| Great Labor Day Hurricane | Sep. , 1935 | TS | NCC | | | | | | | | Hudgins; * |
| | Sep. 18, 1936 | 2 | Northern North Carolina coast | damage to crops; high tides; 35 feet of beach was cut away at Nags Head; beach erosion | | | Damage at Hatteras; highways washed out; damage to Elizabeth City; bridges and piers damaged | | | | C/H; Barnes; Hudgins |
| | Sep., 1938 | | Northern North Carolina coast | heavy rains, gales, rough seas, high tides | | | | | | | Hudgins |
| | Oct 24, 1938 | E | | | | | | | | | * |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| | Aug, 1940 | | Georgia | torrential rainfall led to flooding | | | | | | | Hudgins |
| | Oct 12, 1942 | TD/E | | | | | | | | | * |
| | Aug. 1, 1944 | 1 | Southeastern North Carolina | damage to corn crops | | | Damage at Carolina Beach; piers wrecked at Wrightsville Beach; property damage in Wilmington | 2000000 | | | C/H; Barnes; Hudgins; * |
| Great Atlantic Hurricane | Sep. 14, 1944 | 3 | East of Hatteras and northward | Crop loss overall; strong winds filled sounds, backing up creeks, rivers, and marshes | | | Proptery damage overall; damage in Elizabeth City and Nags Head; heavy flooding and damage in Avon | 100000000 | 1 | Coast Guard cutters off the Outer Banks near Oregon Inlet | C/H; Hairr; Barnes; Hudgins |
| | Oct 20, 1944 | TS | | | | | | | | | * |
| | June, 1945 | 1 | Wilmington area | high wind gusts; substantial rain | | | | | | | Hudgins; * |
| | Sep. 17, 1945 | 1 | NCC | Flooding; large crop loss | | | Cape Fear River, Moncure, Fayetteville, and Elizabethtown | | | | C/H; Hudgins |
| | July, 1946 | TS | NCC | high winds and heavy rains | | | Elizabeth City; Carolina/Wrightsville Beaches, and Manteo | | | | Hudgins; * |
| | Oct 9, 1946 | E | | | | | | | | | * |
| | Late, 1947 | E | Southern North Carolina Coast | Lowlands flooded | 7 in. | | | | | | Hudgins; * |
| | Aug., 1949 | | Hatteras | high winds and heavy rains | | | Damage near Buxton | 50000 | | | Hudgins |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| Barbara | Aug. 13, 1953 | 2 | Between Morehead City and Ocracoke | crop damage | | | Property damage | 1100000 | 1 | | C/H; Barnes; Hudgins; * |
| Carol | Aug. 30, 1954 | 2 | East of Hatteras | Corn and soybean crops damaged | | | | 250000 | | | C/H; Barnes; Hudgins |
| Edna | Sep. 10, 1954 | | East of Hatteras | Beach erosion | | | Property damage | 115000 | | | C/H; Barnes; Hudgins |
| Hazel | Oct. 15, 1954 | 4 | Southeastern North Carolina | Dunes destroyed; extreme storm surge; flooding of Pamlico and Albemarle Sounds | | | damage at Long Beach, Holden Beach, Ocean Isle, Robinson, and Colonial Beach; waterfront at Southport; property damage at Carolina beach | 11000000 00 | 19 | | C/H; Barnes; * |
| Connie | Aug. 12, 1955 | 3 | Cape Lookout to Norfolk, VA | flooding farm lands; beach erosion; torrential rainfall | | | | | | | C/H; Barnes; Hudgins; * |
| Diane | Aug. 17, 1955 | EXT | Near Carolina Beach | high tides and high; beach erosion; salt water destroying crops | | | | | | | C/H; Barnes; Hudgins; * |
| Ione | Sep. 19, 1955 | 3 | West of Atlantic Beach | new high water marks; record inundation; beach erosion | | | Water damage to property | 88000000 | 7 | | C/H; Barnes; Hudgins; * |
| Flossy | Sep 27, 1956 | E | | | | | | | | | * |
| Helene | Sep 27, 1958 | 3 | Wilmington | high winds; flooding; beach erosion; wind damage to crops | | | wind damage to property | | | | C/H; Barnes; Hudgins |
| Cindy | July 10, 1959 | TD | | | | | | | | | * |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| Brenda | July 29, 1960 | TS | | | | | | | | | * |
| Donna | Sep 11, 1960 | 3 | Between Wilmington and Morehead City | High winds; beach erosion; crop damage | | | Heavy structural damage | 1000000 | 8 | | C/H; Barnes; Hudgins; * |
| N/A | Sep 14, 1961 | TD | | | | | | | | | * |
| Ella | Oct 18-19, 1962 | EXT | 200 miles off coast | high tides; beach erosion | | | | | | | C/H; Hudgins |
| Ginny | Oct 19-27, 1963 | TS/1 | NCC | Erosion; heavy rain | | | | | | | C/H; Hudgins |
| Cleo | Aug 29-Sep 1, 1964 | TD | Near Charlotte | tornadoes; flash flooding; crop damage | | | | | | | C/H; Hudgins; * |
| Dora | Sep 13, 1964 | TS | Near Atlantic Beach | tornadoes; beach erosion; flooding | | | | | | | C/H; Hudgins;* |
| Isbell | Oct 16, 1964 | 1 | | Heavy rainfall | | | | | | | * |
| N/A | June 16, 1965 | E | | | | | | | | | * |
| Doria | Sep 16-17, 1967 | TS | | High tides | | | | | | | * |
| Abby | June 12-13, 1968 | TD | | Heavy rain; tornadoes | | | | | | | * |
| Alma | May 26, 1970 | TD | | Heavy rain | | | | | | | * |
| N/A | Aug 18, 1970 | TD | | | | | | | | | * |
| Doria | Aug 27, 1971 | TS | | Mudslides | | | | | | | * |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| Ginger | Sep 30-Oct 3, 1971 | 1 | Near Atlantic Beach | heavy rain; corn and soybean damage | | | | 10000000 | | | Hudgins; * |
| Agnes | Jun 21, 1972 | TS | | Heavy rainfall | | | | 6560000 | 2 | | * |
| Gilda | Oct 25-26, 1973 | 1 | Cape Hatteras | Beach erosion | | | | | | | Hudgins |
| Amy | Jun 25, 1975 | TS | NCC | beach erosion; temporary flooding | | | | | | | Hudgins |
| Bob | July 15, 1979 | TD | | | | | | | | | * |
| David | Sep 5, 1979 | TS | NCC | beach erosion; flooding; high tides | 7-10 in | | | | | | Hudgins |
| Dennis | Aug 20, 1981 | TS | | | | | | | | | * |
| N/A | Jun 19, 1982 | TS | | | | | | | | | * |
| Diana | Sep 9-14, 1984 | 2 | Cape Fear/Bald Head Island | agricultural damage; beach erosion; flooding | | | New Hanover and Brunswick counties; dam failures at Boiling Springs, Roseboro, and Faison | 80000000 | 3 | | Barnes; Hudgins; * |
| Josephine | Oct 12-15, 1984 | 1 | NCC | severe beach erosion | | | | | | | Hudgins |
| Gloria | Sep 26-27, 1985 | 3 | Cape Hatteras | beach erosion; flooding | | | Dare suffered most damage | 8000000 | 1 | | Barnes; Hudgins; * |
| Kate | Nov 22, 1985 | TS | | | | | | | | | * |
| Charley | Aug 17-18, 1986 | 1 | Northern North Carolina coast | tidal flooding; downed trees | | | | | 1 | | Barnes; Hudgins; * |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| Hugo | Sep 21-22, 1989 | 3 | Brunswick County/Southern North Carolina coast | severe beach erosion; barrier island dune systems cut | | | 120 homes at Long and Ocean Isle Beaches destroyed; t piers damaged at Brunswick, New Hanover, Pender, and Onslow counties | 17000000 00 | 12 | | Hudgins |
| Bob | Aug 18-19, 1991 | 3 | Cape Hatteras | high winds, tornadoes, heavy rains | 5.3-8 inches | | | 4000000 | 1 | | Hudgins |
| Emily | Aug 30-31, 1993 | 3 | Outer Banks | high winds; extensive sound-side flooding in the Pamlico Sound | | | battered villages of Hatteras, Frisco, Buxton, and Avon | 35000000 | | | Barnes; Hudgins |
| Allison | June 6, 1995 | E | | | | | | | | | * |
| Felix | Aug 18-20, 1995 | 1 | NCC | rough surf; severe beach erosions | | | Property damage was low | | 3 | | Hudgins |
| Luis | Sep 9-10, 1995 | 4 | NCC | 30 foot swells, 12 foot waves; severe beach erosion | | | pier damage in Carteret and Onslow counties | | | | Hudgins |
| Arthur | June 20, 1996 | TS | | | | | | | | | * |
| Bertha | July 12, 1996 | 2 | Between Wrightsville Beach and Topsail Island | destructive storm surge; flooding in the Pamlico Sound; severe beach erosion; fallen trees; crop damage | | | Swansboro waterfront engulfed; roof damage; destroyed piers; five thousand homes damaged | 27000000 0 | | | Barnes; Hudgins; * |
| Fran | Sep 5-6, 1996 | 3 | Southeastern North Carolina | extensive storm surge flooding; beach erosion; record crest levels in the Neuse and Cape Fear Rivers | 12 inches | | Destruction of beach front homes due to flooding | 72000000 00 | 24 | | Barnes; Hudgins; * |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| Josephine | Oct 7-8, 1996 | EXT | Southeastern North Carolina | small stream flooding; high tides; beach erosion; tornadoes; tree damage | | | Property damage from associated tornadoes | | | | Hudgins; * |
| Danny | July 24, 1997 | TD | | | | | | | | | * |
| Bonnie | Aug 26, 1998 | 3 | Southeastern North Carolina | flooding; high storm tides; beach erosion; tree damage; tornadoes | 8-11 inches | | roof and structural damage; power outages; seven piers trimmed or destroyed | 240000000 | 1 | | Barnes; Hudgins; * |
| Earl | Sep 4, 1998 | E | | | | | | | | | * |
| Dennis | Sep 4-5, 1999 | TS | NCC | heavy rains, high surf, high winds, beach erosion; coastal flooding | | new inlet on Core Banks | 3,000 feet of highway 12 washed away | | | | Barnes; Hudgins; * |
| Floyd | Sep 16 1999 | 2 | Cape Fear Region | High winds, extreme storm surge; extreme rainfall; agricultural damage; record high river levels | 4-12, 15-20 in | Mason Inlet further cut | Streets, homes, farms, busineses, and highways flooded; homes and piers demolished from erosion; 7,000 homes destroyed | 58000000000 | 52 | | Barnes; Hudgins; * |
| Helene | Aug 23, 2000 | TS | | | | | | | | | * |
| Gustav | Sep 19, 2000 | TS | Between Cape Hatteras and Diamond Shoals Light Tower | storm surge; weak tornado | | | Property damage | 100000 | | | Hudgins |
| Allison | June 14-16, 2001 | SD | | | | | | | | | * |
| Kyle | Oct 11-12, 2002 | TS | | | | | | | | | * |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| Isabel | Sep 18, 2003 | 2 | Near Drum Inlet | high wind gusts; heavy rainfall; high storm tides and flooding; overwash and beach erosion | | New inlet between Frisco and Hatteras | Piers destroyed at Nags Head, Rodanthe, and Frisco; buildings off foundations | 3370000000 | 3 | | Hudgins; * |
| Alex | Sep 3, 2004 | 1 | Cape Hatteras | high wind gusts; heavy rainfall; flooding; erosion | 4-8 in | | | | | | Hudgins |
| Bonnie | Aug 13, 2004 | TD | | | | | | | | | * |
| Charley | Aug 14, 2004 | TS/1 | Southeastern North Carolina | flooding; tornadoes; wind damage; beach erosion; crop damage | | | Property damage from tornadoes | 25000000 | | | Hudgins;* |
| Ophelia | Sep 14, 2005 | 1 | Southeastern North Carolina | wind damage; flooding from excessive rainfall; storm surge flooding; beach erosion | | | Wind damage to property | | | | Hudgins |
| Ernesto | Aug 31, 2006 | TS | Brunswick County | strong winds; tornadoes; heavy rain and storm surge causing flooding; beach erosion | | | damage in Onslow and Carteret counties | | | | Hudgins |

# APPENDIX B: Shipwrecks

| Name of Vessel | Type | Any Associated Names | Nationality | Date Wrecking | General Location | Lat | Long | Cause of Wreck | Notes | Source | Other Relevant Details | Accuracy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N/A | Brig | Capt. John Parsons | Irish | Nov. 1718 | Cape Hatteras | | | Great storm | Boston Gazette (BG) | Angley | | 3 |
| N/A | sloop | | | Sept. 1728 | Ocracoke Inlet | 34.98949 | -75.91479 | Hurricane | New England Weekly Journal | Marx; Hairr; UAU | 6 miles Inlet | 3 |
| N/A | 9 vessels lost/11 merchantment | Capt. Kellog in a Sloop | | Oct. 1749 | Ocracoke Inlet | 35.14813 | -76.11451 | Hurricane | Pennsylvania Gazette; BG | Angley | | 3 |
| N/A | 2 sloops; 1 ship; 1 snow | | US | Oct. 1749 | Bath | | | Gale | BG | Angley | | 3 |
| N/A | snow | | US | Oct. 1749 | Bath | | | Gale | BG | Angley | | 4 |
| N/A | Sloop | | US | Oct. 1749 | Bath | | | Gale | BG | Angley | | 4 |
| Nuestra Senora de Solidad | Ship | | Spain | Aug. 1750 | Ocracoke | 35.11222 | -75.99084 | Gale | Virginia Colonial Records; Lloyd's List | Charles | | 3 |
| Galga | Man of War | | Spain | Aug. 1750 | Chinkateague Shoals | | | Gale | New York Gaz. (NYG) | Charles | | 3 |
| N/A | Ship | | British | Aug. 1750 | Hatteras | | | Gale | NYG | Charles | | 3 |
| N/A | Unknown | | | Aug. 1750 | Cape Hatteras | | | | NYG | Charles | | 3 |
| N/A | Schooner | | | Aug. 1750 | Ocracoke | | | | NYG | Charles | | 2 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Greyhound | Unknown | | US | Sep. 1751 | Chowan River | | | Bad Weather | Lloyd's List | Charles | Near Salmon Creek | 5 |
| St. Kitts Packet | sloop | | British | Sep. 1752 | Ocracoke | | | Violent Gale | Lloyd's List | | | 5 |
| Hester | Sloop | Master John McCaul | US | Jan. 1754/5? | Currituck | | | Snow storm | Pennsylvania Gazette (PG) | Angley | | 3 |
| N/A | Brig; Schooner | | | Jan. 1754/5? | Currituck | | | Snow storm | PG | Angley | | 3 |
| N/A | sloop | | | Oct. 1757 | Cape Hatteras | | | Storm | PG | Angley | | 4 |
| N/A | schooner | | US | Oct. 1757 | Cape Hatteras | | | Storm | PG | Angley | | 4 |
| N/A | brig | | | Oct. 1757 | Cape Hatteras | | | Storm | PG | Angley | | 4 |
| N/A | schooners; ship | Capts. Morton and Pindar | US | Apr. 1765 | Ocracoke Bar | | | Snow storm | PG | Angley | | 4 |
| N/A | brig | | | Apr. 1765 | Off Cape Hatteras | | | | PG | Angley | | 3 |
| N/A | brig | | | Apr. 1765 | Off Cape Hatteras | | | | PG | Angley | | 3 |
| N/A | brig | | | Late Mar. 1765 | Off Cape Hatteras | | | | PG | Angley | | 3 |
| N/A | schooner | | | Mar. 1765 | Near Ocracoke | | | | PG | Angley | | 3 |
| N/A | schooner | | | Mar. 1765 | Ocracoke Bar | 35.06709 | -76.00636 | | | UAU | | 3 |
| N/A | sloop | | | Jan. 1767 | | | | | Carolina Gaz. | | | 3 |
| N/A | sloops | | | Nov. 1767 | Ocraocke | | | Heavy gale | PG | Angley | | 3 |
| N/A | Un-ID vessels | | | Oct. 1769 | | | | Hurricane | PG | Angley | | 3 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N/A | sloop | | | Oct. 1769 | Ocracoke | | | | PG | Angley | | 4 |
| N/A | sloop | | | Oct. 1769 | Ocracoke | | | | PG | Angley | | 4 |
| St. Andrew | brigantine | | | Sep. 1769 | | | | storm | Virginia Gazette | Charles | | 3 |
| N/A | unidentified schooner and sloop | | | Nov. 1769 | Ocracoke | | | Late storm; gale | PG | Angley | | 3 |
| Ann and Dorothy | ship | Capt. Greenway | US | Mar. 1770 | Northward of Cape Hatteras | | | Gale | PG | Angley | North of Cape Hatteras | 4 |
| N/A | sloop; Bermudian sloop; 2 other unidentified | Captain Hibbs | US | Mar. 1770 | Northward of Cape Hatteras | | | Gale | PG | Angley | | 3 |
| N/A | schooner | | | Apr. 1770 | | 35.03034 | -75.96458 | | PG | | | 3 |
| N/A | brig | | US | June 1770 | | | | Gale | PG | Angley | | 3 |
| Friendship | schooner | Capt. Noys | US | Mar. 1771 | Frying Pan | | | Gale | PG | Angley | | 3 |
| N/A | Unknown | | | Apr. 1771 | Ocracoke Bar | | | | UAB | | | 2 |
| N/A | 14 vessels | | US | Oct. 1772 | Cape Fear | | | Gale | BG.;Virginia Gazette | Angley; Charles | | 3 |
| N/A | schooner | Master John Kerr | US | June 1772 | Currituck Inlet | | | Gale | PG.; Virginia Gaz. | Angley; Charles | | 4 |
| N/A | schooner | Capt. Clarke | US | Sep. 1772 | Ocraocke | | | Gale | PG | Angley | | 3 |
| N/A | brig | Capt. Pearse | US | Sep. 1772 | Ocracoke | | | Gale | PG | Angley | | 3 |
| N/A | schooner | Cpt.Towers | US | Sep. 1772 | Ocracoke | | | Gale | PG | Angley | | 3 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N/A | Unknown | Capt. Hill | | Sep. 1772 | Ocracoke | | | Gale | PG | Angley | | 3 |
| N/A | sloop | | | Sep. 1772 | Ocracoke | | | Gale | PG | Angley | | 3 |
| N/A | schooner | Capt. Dane | US | Sep. 1772 | Ocracoke | | | Gale | PG | Angley | | 3 |
| N/A | Unknown | Capt. Corter | US | Sep. 1772 | Ocracoke | | | Gale | PG | Angley | | 3 |
| N/A | sloop | Capt. Conway | US | Sep. 1772 | Ocracoke | | | Gale | PG | Angley | | 3 |
| N/A | Unknown | Capt. Thomas | US | Sep. 1772 | Ocracoke | | | Gale | PG | Angley | | 3 |
| Betsey | Unknown | | | Sep. 1772 | Ocracoke Inlet | | | | | | | 3 |
| N/A | ~ 14 Unknown craft | | | Sep. 1773 | Ocracoke Bar | | | | Virginia Gaz. | Charles | | 2 |
| N/A | ~ 3 schooners | | | March/Ap 1774 | Ocracoke Bar | 35.06209 | -76.00519 | | Virginia Gaz. | Charles | | 3 |
| N/A | schooner | | | Apr. 1774 | North Swatch | | | | Virginia Gaz. | Charles | | 3 |
| N/A | Sloop | Capt. Mulford | US | Aug. 1775 | Ellis' Wharf | 35.06476 | -76.00731 | Hurricane | From New York | Hairr | | 3 |
| N/A | Sloop | Capt. Mulford | US | Aug. 1775 | Green Spring | 35.06476 | -76.00731 | Hurricane | From St. Croix | Hairr | | 3 |
| Sukey | Sloop | Capt. Cohran | US | Aug. 1775 | Bear River | 35.06476 | -76.00731 | Hurricane | | Hairr | | 3 |
| Harmony Hall | Ship | Capt. Greenway | US | Aug. 1775 | Otter Creek | 35.06476 | -76.00731 | Hurricane | | Hairr | | 3 |
| N/A | ~ 2 Unknown | | | Aug. 1775 | Ocracoke Bar | 35.06476 | -76.00731 | Hurricane | | Hairr | | 3 |
| N/A | Sloop | Capt. Bell | US | Aug. 1775 | Otter Creek | 35.06476 | -76.00731 | Hurricane | | Hairr | | 4 |
| N/A | Unknown | | | Aug. 1775 | Ocracoke | | | | | | | 2 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N/A | Unknown | | | Aug. 1775 | Ocracoke Bar | | | | Maryland Gazette | | | 2 |
| N/A | Unknown | | | Sep. 1775 | The Bar | | | | | | | 2 |
| Hector | Unknown | | British | Sep. 1775 | Frying Pan | 32.996836 | -79.096433 | Gale | Lloyd's List | Charles | | 4 |
| N/A | sloop | | French | Sep. 1784 | Topsail Inlet | | | Gale | North Carolina Gazette | Charles | 12 miles from Old Topsail Inlet | 2 |
| N/A | ~ 3 sloops | | | Aug. 1785 | Ocracoke | | | | UAB file 295 | | | 2 |
| N/A | brigantine | | | Aug. 1785 | Ocracoke Bar | 35.0618 | -76.00676 | | | | | 4 |
| N/A | brigantine | | | Oct. 1785 | Ocracoke | | | Tempest | BG | Angley | | 2 |
| N/A | ship | Flemmish | | Oct. 1785 | Ocracoke Bar | | | Tempest | BG | Angley | | 2 |
| N/A | sloop | | | Oct. 1785 | Ocracoke Bar | | | Tempest | BG | Angley | | 2 |
| N/A | ~20 small craft | | | Oct. 1785 | Ocraocke Bar | | | Tempest | BG | Angley | | 2 |
| N/A | Sloop | Capt. Standford | US | Oct. 1785 | Ocracoke Bar | | | Tempest | BG | Angley | | 2 |
| N/A | brig | | | Nov. 11, 1785 | Hatteras | | | | | Angley | | 2 |
| N/A | Unknown | | | Nov. 1785 | Hatteras | | | | | Angley | | 2 |
| Mary | Schooner | | | Sep. 1786 | Currituck Inlet | | | Heavy gale | Norfolk and Portsmouth Journal; BG. | Angley | | 4 |
| N/A | Unknown | | | Sep.1786 | Ocracoke | | | | | Angley | | 4 |
| N/A | Schooner | | | July 23, 1788 | Ocracoke | | | | | Angley | | 3 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N/A | ~ 10 Unknown | | | July 23, 1788 | Ocracoke Inlet | 35.06425 | -76.00031 | severe gale | Lloyd's List | Charles | | 5 |
| Fanny | Sloop | Capt. Joseph Gardner | US | Aug. 1788 | Ocracoke | | | Hurricane | BG; PG | Angley | | 3 |
| N/A | ship | Capt. Ferguson | | Aug. 1788 | Ocracoke | | | Violent storm | PG | Angley | | 2 |
| N/A | brig | Capt. Thomas Cox | | Aug. 1788 | Ocracoke | | | Violent storm | PG | Angley | | 2 |
| N/A | Sloop | Capt. Smith | | Aug. 1788 | Ocracoke | | | Violent storm | PG | Angley | | 2 |
| N/A | sloop | Capt. Davis | | Aug. 1788 | Ocracoke | | | Violent storm | PG | Angley | | 2 |
| N/A | Sloop | | | Aug. 1788 | Ocracoke | | | Violent storm | PG | Angley | | 2 |
| Nancy | Schooner | | | Aug. 1788 | Bodie Island | | | Gale | PG | Angley | | 2 |
| N/A | Unknown | | | 1789 | Albemarle Sound | 36.053 | -76.1134 | Violent Gale | UAB | | | 4 |
| N/A | Unknown | | | 1789 | Albemarle Sound | 36.0579 | -76.1473 | Violent Gale | UAB | | | 4 |
| N/A | Unknown | | | 1789 | Albemarle Sound | 36.0528 | -76.116 | Violent Gale | UAB | | | 4 |
| Spanish Fleet | ~ 18 Unknown | | Spain | Aug. 2, 1795 | Cape Hatteras | | | Great Freshnet of 1795 | | Hairr | | 4 |
| Adventure | brig | | US | Aug. 1795 | Newbern | | | Gale | PG | Angley | | 4 |
| Betsey | snow | | US | Aug. 1795 | Newbern | 35.07293 | -76.01085 | Gale | PG | Angley | | 3 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N/A | brig | | US | Aug. 1795 | Newbern | | | Gale | PG | Angley | | 2 |
| N/A | Sloop | | US | Aug. 1795 | Newbern | | | Gale | PG | Angley | | 2 |
| N/A | ~ 6 unknown | | | Aug. 1795 | Ocracoke Inlet Bar | | | | UAB file 215 | | | 2 |
| Enterprise | sloop | | British | Oct. 1802 | | | | Gale | Norfolk Herald | Charles | | 3 |
| Hero | schooner | | US | Feb. 1803 | | | | Gale | Norfolk Herald | Charles | | 3 |
| N/A | 2 schooners and a sloop | | | Feb. 1803 | Ocracoke Bar | | | Gale | Norfolk Herald | Charles | | 2 |
| N/A | ~ 5 Unknown | | | 1803 | Edenton Harbor | 36.0467 | -76.6065 | Storm | UAB | | | 3 |
| Nancy | ship | | US | Nov. 1804 | Currituck Shoals | | | Gale | Norfolk Gaz. & Publick Ledger | Charles | | 3 |
| Earl of Lonsdale | sloop | | British | Jan. 1806 | Currituck | | | Gale | Norfolk Gaz. & Publick Ledger | Charles | northward of Currituck | 3 |
| Governor Williams | US Revenue Service Cutter | | US | Aug. 22, 1806 | Bald Head Island | | | Hurricanes | | Hairr | | 3 |
| Adolphus | Unknown | | | Aug. 22, 1806 | Bogue Banks | | | Hurricanes | | Hairr | | 3 |
| Atlantic | Unknown | | | Aug.22, 1806 | Bogue Banks | | | Hurricanes | | Hairr | | 3 |
| N/A | sloop | | | Aug.27, 1806 | Beacon Island | | | | Wilmington Gazette (WG) | Hairr | | 2 |
| N/A | schooner | | | Aug.28, 1806 | Wallace's Channel | | | | WG | Hairr | | 2 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N/A | schooner | | | Aug. 1806 | | | | | Lighthouse Corresp. | Hairr | | 2 |
| N/A | lighter | | | Aug. 1806 | Ocracoke | | | | WG | Hairr | | 2 |
| N/A | ~ 24 Unknown vessels | | | Aug. 1806 | Ocracoke beach | | | | WG | | US Weather Bureau Document | 2 |
| N/A | Brig | | | Nov. 1809 | Ocracoke | | | | Federal Republican/Commerical Gaz. | Charles | | 2 |
| N/A | Unknown | | | Oct. 25, 1810 | Hatteras | | | | Federal Republican and Commercial Gaz. (FR/CG) | Charles | | 2 |
| Industry | Ship; ~20 Unknown vessels | | US | Sep. 1815 | Ocracoke Bar | | | | FR/CG | Charles | UAB file 212 | 4 |
| Howard and Grimes | sloop | | US | Sep. 1815 | Ocracoke Bar | | | | FR/CG | Charles | | 4 |
| George Devereux | brig | | US | Sep. 1815 | Ocracoke Bar | | | | FR/CG | Charles | | 4 |
| Margaret | brig | | | Sep. 1815 | Ocracoke Bar | | | | FR/CG | Charles | | 4 |
| Arodondo | brig | | US | Sep. 1815 | Ocracoke Bar | | | | FR/CG | Charles | | 4 |
| Linnet | sloop | | US | Sep. 1815 | Ocracoke Bar | | | | FR/CG | Charles | Sunk | 4 |
| Julia | brig | | US | Sep. 1815 | Ocracoke Bar | | | | FR/CG | Charles | | 4 |
| N/A | gun boat | | US | Sep. 1815 | Ocracoke Bar | | | | FR/CG | Charles | | 4 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lively | schooner | | | Sep. 1815 | Ocracoke Bar | | | | FR/CG | Charles | | 4 |
| Jolly Sailor | schooner | | US | Sep. 1815 | Ocracoke Bar | 35.04715 | -76.01414 | Gale | New York Shipping and Commercial List (NYSCL) | Angley | | 5 |
| N/A | sloop | | | Sep. 1815 | Ocracoke Bar | | | | | Angley | | 4 |
| Amicus | schooner | | US | Sep. 1815 | Chickamacomico Beach | | | Storm | American Beacon | Charles | | 4 |
| Little Dick | ship | | British | Feb. 1816 | Wilmington Bar | | | Gale | NYSCL | Angley | | 4 |
| Mary | Brig | | US | Feb. 1816 | Wilmington Bar | | | Gale | NYSCL | Angley | | 4 |
| Bolina | schooner | | US | Sep. 1816 | Cape Hatteras | | | Gale | American Beacon & Commercial Diary | Charles | northward of Hatteras, and Roanoke Inlet | 3 |
| Chatham | brig | | US | Feb. 1817 | Cape Lookout | | | Snow storm | NYSCL | Angley | | 4 |
| N/A | brig | | | May 1817 | Portsmouth | | | | Maryland Gazette | | On Portsmouth Banks | 2 |
| General Swift | brig | | US | June 1817 | 60 miles to the northward of Cape Hatteras | | | Squall | NYSCL | Angley | | 4 |
| Milo | Schooner | | US | Jan. 1819 | Ocracoke Bar | 35.10781 | -76.14085 | Gale | NYSCL | Angley | 7 miles east of Ocracoke | 4 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Henry | sloop | | US | Jan. 1819 | Ocracoke Bar | 35.10781 | -76.14085 | Gale | Norfolk & Portsmouth Harold | Charles | | 4 |
| Commerce | schooner | | US | Mar. 1819 | Cape Hatteras | | | Squall | Federal Gaz. and Baltimore Daily Advertiser (FG/BDA) | Charles | | 3 |
| Rachel and Betsey | sloop | | | May 1819 | Currituck Beach | | | Gale | FG/BDA | Charles | | 3 |
| Constitution | schooner | | | May 1819 | Currituck Beach | | | Gale | FG/BDA | Charles | | 3 |
| Emeline | Schooner | | US | Sep. 1821 | Ocracoke Bar | 35.05809 | -76.01038 | Gale | NYSCL | Angley | | 4 |
| Olive Branch | Unknown | | US | Sep. 1821 | Ocracoke Bar | 35.07226 | -76.00424 | Gale | NYSCL | Angley | | 5 |
| Federalist | Unknown | | US | Sep. 1821 | Ocracoke Bar | 35.05959 | -76.01438 | Gale | NYSCL | Angley | | 5 |
| N/A | Schooner | | French | Sep. 1821 | Ocracoke Bar | | | Gale | NYSCL | Angley | | 2 |
| Milo | Schooner | | | Sep. 1821 | Ocracoke Bar | | | Gale | NYSCL | Angley | | 4 |
| N/A | ship | | British | Sep. 1821 | Cape Hatteras | | | | | | | 2 |
| Golden Pheasant | schooner | | US | June 1822 | Cape Hatteras | | | Squall | Norfolk & Portsmouth Herald | Charles | | 3 |
| Ann Maria | schooner | | US | Feb. 1823 | Cape Hatteras Shoals | | | Gale | American Beacon/Norfolk &Portsmouth Daily Advertiser | Charles | | 3 |
| Jane | Schooner | | US | Aug. 1824 | Albemarle Sound | | | Squall | NYSCL | Angley | | 4 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Patriot | Schooner | | US | Oct. 1824 | Kinnakeet Banks | | | Gale | NYSCL | Angley | | 4 |
| N/A | brig | | | Aug. 24, 1827 | Ocracoke | | | | Carolina Observer | | | 2 |
| N/A | Unknown | | | Aug. 25, 1827 | Portsmouth | | | | | Barrett | | 2 |
| N/A | schooner | | | Aug.26, 1827 | Cape Hatteras | | | | | | | 2 |
| Louisa Mailda | Packet ship | | US | Sep. 1827 | Bodie Island | | | Gale | NYSCL | Angley | | 4 |
| Cotton Plant | Schooner | | US | Sep. 1827 | Ocracoke | | | Gale | NYSCL | Angley | | 4 |
| George Washington | Schooner | | US | Sep. 1827 | Ocracoke | | | Gale | NYSCL | Angley | | 4 |
| Defiance | Schooner | | US | Sep. 1827 | Ocracoke | | | Gale | NYSCL | Angley | | 4 |
| Monarch | brig | | British | Sep. 1827 | Cape Hatteras | | | Gale | NYSCL | Angley | | 4 |
| Felicity | Schooner | | US | Aug. 1830 | Smithville, NC (Southport) | | | Gale | NYSCL | Angley | | 4 |
| Triton | schooner | | US | Aug. 1830 | Powell's Point | | | Gale | American Beacon/Virginia & North Carolina Gaz. (AB/VNCG) | Charles | | 4 |
| Abner P. Neal | Unknown | | | Aug. 1830 | Currituck Beach | | | Gale | AB/VNCG | Charles | | 4 |
| Francis D. Williams | Unknown | | | Aug. 1830 | Mattamuskeet | | | Gale | AB/VNCG | Charles | | 4 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Proxy | schooner | | | Aug. 1830 | Beacon Island | | | Gale | AB/VNCG | Charles | | 4 |
| Mary Ann | schooner | | | Aug. 1830 | Bulk Head | | | Gale | AB/VNCG | Charles | | 4 |
| James Monroe | schooner | | | Aug. 1830 | Beacon Island | | | Gale | AB/VNCG | Charles | | 4 |
| Emeline | schooner | | | Aug. 1830 | Royal Shoal | | | Gale | AB/VNCG | Charles | | 4 |
| Pigot | schooner | | | Aug. 1830 | | | | Gale | AB/VNCG | Charles | | 4 |
| L. Plandome | schooner | | | Aug. 1830 | Ocracoke | | | Gale | AB/VNCG | Charles | | 4 |
| Sarah Ann | schooner | | | Aug. 1830 | Ocraocke | | | Gale | AB/VNCG | Charles | | 4 |
| E.O | schooner | | US | Aug. 1830 | Cape Lookout | | | Gale | AB/VNCG | Charles | | 4 |
| Morse | Schooner | | US | Aug. 1830 | Cape Lookout | | | Gale | NYSCL | Angley | | 4 |
| Ariel | Schooner | | US | Dec. 1830 | Ocracoke Bar | 35.05062 | -75.98847 | Gale | NYSCL | Angley | In the breakers at Ocracoke and then floated out to Gulf Stream | 5 |
| Hercules | brig | | US | Nov. 1833 | Bodie Island | 35.10929 | -75.58103 | Gale | NYSCL | Angley | | 5 |
| William | Schooner | | US | Nov. 1833 | Cape Hatteras | | | Gale | NYSCL | Angley | | 4 |
| Concepcion | brig | | Spain | Nov. 1833 | Whales Head (Currituck Beach) | | | Gale | American Beacon | Charles | | 4 |
| Johannes | brig | | Danish | Mar. 1837 | Ocracoke Shoals | | | Gale | American and Commerical Daily | Charles | | 3 |
| Eugene | Schooner | | US | Aug. 1837 | Ocracoke | | | Gale | NYSCL | Angley | 20 miles S of Ocracoke | 4 |

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| Favourite | Schooner | | US | Sep. 1837 | Wash., NC | | | Gale | NYSCL | Angley | | 4 |
| Ann | Schooner | | US | Sep. 1837 | Washington, NC | | | Gale | NYSCL | Angley | | 4 |
| Nancy and Sally | schooner | | US | Sep. 1837 | Washington, NC | | | Gale | NYSCL | Angley | | 4 |
| Superior | Schooner | | US | Sep. 1837 | Washington, NC | | | Gale | NYSCL | Angley | | |
| Home | steam packet | | US | Sep. 1837 | Ocracoke | | | Gale | American Beacon | Charles | | 4 |
| Paul Pry | Schooner | | US | Sep. 1838 | Ocracoke Bar | 35.05432 | -75.99937 | Gale | NYSCL | Angley | | 5 |
| Henry | Schooner | | US | Sep. 1838 | Ocracoke Bar | | | Gale | NYSCL | Angley | | 3 |
| Mary and Little Joe | Schooner | | US | Apr. 1839 | Wash., NC | | | Gale | NYSCL | Angley | | 4 |
| New York | Schooner | | US | Apr. 1839 | Wash., NC | | | Gale | NYSCL | Angley | | 4 |
| Alabama | Schooner | | US | Sep. 1839 | Ocracoke | | | Gale | NYSCL | Angley | | 5 |
| Eli Hoyt | Schooner | | US | Sep. 1839 | Ocracoke | | | Gale | NYSCL | Angley | | 5 |
| Mary Ann | Schooner | | US | Sep. 1839 | Ocracoke | | | Gale | NYSCL | Angley | | 3 |
| Standard | Schooner | | US | Sep. 1839 | Ocracoke | | | Gale | NYSCL | Angley | | 3 |
| Franklin | Schooner | | US | Nov. 1839 | Bodie Island | | | Gale | NYSCL | Angley | | 3 |
| N/A | Schooner | | US | Nov. 1839 | Bodie Island | | | Gale | NYSCL | Angley | | 3 |
| N/A | 4 Unknown | | | Dec. 1839 | Elizabeth City | | | Gale | NYSCL | Angley | | 3 |
| William | brig | | US | Dec. 1839 | Ocracoke | | | Gale | NYSCL | Angley | | 3 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| William S. Pigot | Schooner | | US | Dec. 1839 | Ocracoke | | | Gale | NYSCL | Angley | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.297 | -76.2167 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2969 | -76.2164 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2976 | -76.2174 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.297 | -76.2174 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2967 | -76.2175 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2967 | -76.2175 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2966 | -76.2158 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.298 | -76.2176 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2977 | -76.2168 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2975 | -76.2162 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2964 | -76.2154 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2973 | -76.216 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2969 | -76.2153 | Storm | UAB | | | 3 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2976 | -76.2167 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2977 | -76.2171 | Storm | UAB | | | 3 |
| N/A | Unknown | | | 1839 | Pasquotank River | 36.2969 | -76.217 | Storm | UAB | | | 3 |
| Mail | Schooner | Master Fries; Mr. Armer Patton | US | Dec. 1840 | Cape Hatteras | | | Gale | The Sun | | | 3 |
| American Trader | Schooner | | US | Sep. 1841 | North Banks (Between Cape Henry and Cape Hatteras) | | | Gale | NYSCL | Angley | | 4 |
| D.W. Hall | brig | | US | June 1842 | Cape Hatteras | | | Gale | NYSCL | Charles | | 5 |
| Trident | Schooner | | US | June 1842 | Bodie Island | | | Gale | NYSCL | Angley | | 3 |
| Ann Stille | Schooner | | US | July 1842 | Ocracoke | 35.70741 | -75.94864 | Gale | NYSCL | Angley | Ocracoke Bar | 5 |
| Henry Camerden | Schooner | | US | July 1842 | Ocracoke | | | Gale | NYSCL | Angley | | 5 |
| Attalia | Schooner | | US | July 1842 | Ocracoke | 35.09574 | -75.96735 | Gale | NYSCL | Angley | | 5 |
| Brilliant | Schooner | | US | July 1842 | Ocracoke | | | Gale | NYSCL | Angley | | 4 |
| Orion | Schooner | | US | July 1842 | Ocracoke | | | Gale | NYSCL | Angley | | 5 |
| Maria | Schooner | | US | July 1842 | Ocracoke | | | Gale | NYSCL | Angley | | 3 |
| Samaritan | Schooner | | US | July 1842 | Chickamacomico | | | Gale | NYSCL | Angley | | 3 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Convoy | Schooner | | US | July 1842 | Ocracoke | | | Gale | NYSCL | Angley | | 5 |
| Sarah and Abigail | Schooner | | US | July 1842 | Ocracoke | 35.47327 | -75.46292 | Gale | NYSCL | Angley | | 5 |
| Mary Patten | Schooner | | US | July 1842 | North of Hatteras | | | Gale | NYSCL | Angley | | 3 |
| Pizarro | Schooner | | US | July 1842 | Ocracoke | | | Gale | NYSCL | Angley | 8 miles NE of Hatteras on Ocracoke | 5 |
| Dunmore | Schooner | | British | July 1842 | Ocracoke | | | Gale | NYSCL | Angley | | 3 |
| Venus | schooner | | US | July 1842 | New Inlet | | | Gale | NYSCL | Charles | | 5 |
| Eliza Maria | schooner | | US | July 1842 | | | | Gale | NYSCL | Charles | | 5 |
| Transport | lighter | | US | July 1842 | | | | Gale | NYSCL | Charles | ashore among the breakers | 5 |
| Granary | schooner | | US | July 1842 | Ocracoke | | | Gale | NYSCL | Charles | | 5 |
| John Hughes | schooner | | US | July 1842 | Ocracoke | | | Gale | NYSCL | Charles | | 5 |
| John L. Durand | brig | | | July 1842 | | | | Gale | NYSCL | Charles | | 5 |
| Congress | ship | | US | Aug. 1842 | Cape Hatteras | | | Gale | NYSCL | Barnes; Angley | Diamond Shoal | 4 |
| Pioneer | brig | | US | Aug. 1842 | Ocracoke; near Currituck Beach | 35.00204 | -76.0535 | Gale | NYSCL | Barnes; Angley | 30 miles south of Cape Hatteras | 5 |
| Kilgore | Unknown | | | Aug. 1842 | Currituck | | | | | Barnes | Wash Woods, Cape Henry | 5 |
| Francis Lord | Brigantine | | | Oct. 1842 | | | | Gale | | The Sun | | 4 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Leroy | Schooner | | US | Oct. 1842 | 7 miles north of Cape Hatteras | | | Gale | NYSCL | Angley | | 4 |
| Superior | Schooner | | US | Feb. 1844 | New Inlet | | | Gale | NYSCL | Angley | | 4 |
| Margaret Kemble | schooner | | US | Feb. 1846 | Elizabeth City | | | Gale | NYSCL | Angley | | 4 |
| Rochambeau | schooner | | US | Mar. 1845 | Cape Hatteras | | | Gale | NYSCL | Charles | | 3 |
| Avon | Schooner | | US | Mar. 1846 | Ocracoke Beach | 35.10897 | -75.94314 | Gale | NYSCL | Angley | | 5 |
| Two Brothers | Schooner | | US | Mar. 1846 | Ocracoke Beach | | | Gale | NYSCL | Angley | | 4 |
| Lewis Spicer | Schooner | | US | Mar. 1846 | Bodie Island | | | Gale | NYSCL | Angley | | 4 |
| Friendship | Schooner | | US | Mar. 1846 | Bogue Inlet | | | Gale | NYSCL | Angley | | 4 |
| Reaper | brig | | US | Mar. 1846 | Cape Hatteras Shoal | | | Gale | NYSCL | Angley; Charles | Diamond Shoals | 5 |
| L.L. Sturgess | schooner | | US | Mar. 1846 | Ocracoke Bar | | | Gale | Baltimore Sun | Charles | | 4 |
| Orleans | brig | | US | Mar. 1846 | New Inlet | | | Gale | NYSCL | Charles | | 4 |
| Charles Slover | Schooner | | US | Sep. 1846 | Ocracoke Bar | 35.06217 | -75.96532 | Gale | NYSCL | Angley | | 5 |
| Defiance | Schooner | | US | Sep. 1846 | Ocracoke Bar | 35.06815 | -75.00072 | Gale | NYSCL | Angley | | 4 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frances | Schooner | | US | Sep. 1846 | Ocracoke Bar | | | Gale | NYSCL | Angley | May be Francis Lord | 3 |
| Sophia D. | Schooner | | US | Sep. 1846 | Ocracoke Bar | 35.06021 | -76.00762 | Gale | NYSCL | Angley | | 5 |
| Patrick Henry | Schooner | | US | Sep. 1846 | Ocracoke Bar | 35.06239 | -76.00409 | Gale | NYSCL | Angley | | 5 |
| Palestine | schooner | | US | Sep. 1846 | Roanoke Island | | | | NYSCL | Charles | | 3 |
| Merry Gallant | schooner | | | Oct. 1846 | Washington | | | | NYSCL | Charles | | 4 |
| Judge Hitchcock | schooner | | | Oct. 1846 | Long Beach | | | | NYSCL | Charles | | 3 |
| N/A | ~ 8 Unknown vessels | | | July 1850 | Diamond Shoals | | | | | Angley | | 2 |
| N/A | ship | | | July 1850 | Diamond Shoals | | | | | Angley | | 2 |
| Margaret | brig | | US | Aug. 1850 | Cape Hatteras Shoal | | | Gale | NYSCL | Angley | | 4 |
| Belle | brig | | British | Aug. 1850 | Cape Hatteras | | | Gale | NYSCL | Angley | Hatteras Shoals | 4 |
| Ocean | brig | | British | Aug. 1850 | Cape Hatteras | | | Gale | NYSCL | Angley | | 4 |
| Racer | Schooner | | British | Aug. 1850 | Cape Hatteras | | | Gale | NYSCL | Angley | Diamond Shoals | 4 |
| Mary Ellen | brig | | US | Aug. 1850 | Cape Hatteras | | | Gale | NYSCL | Angley | Diamond Shoals | 4 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| William Penn | Schooner | | US | Jan. 1851 | Cape Hatteras | | | Gale | NYSCL | Angley | | 4 |
| America | steamer | | US | July 1851 | Cape Hatteras | | | Gale | NYSCL | Angley | Hatteras Lighthouse | 4 |
| Empire | Schooner | | | 1851 | Roanoke River | | | Squall | UAB | | | 4 |
| N/A | brig | | | Sep. 7, 1853 | Hatteras | | | | | Angley | | 3 |
| John Potts | schooner | | US | Sep. 1854 | Cape Fear | | | Gale | New York Daily Times (NYDT) | Charles | | 3 |
| City of Savannah | steamship | | US | Oct. 1856 | Cape Hatteras | | | Storm | NYDT | Charles | | 3 |
| Central America | steamer | | US | Sep. 12, 1857 | Cape Hatteras | 35.226844 | -75.447922 | Hurricane | | Farb | | |
| Colin McRae | barkentine | | Irish | Sep. 1857 | Wilmington Bar | | | Hurricane | NYDT | Charles | | 4 |
| J.W. Blodgett | bark | | US | Sep. 1857 | New Inlet Bar | | | Hurricane | NYDT | Charles | | 4 |
| Emily Ward | schooner | | US | Sep. 1857 | New Inlet Bar | | | Hurricane | NYDT | Charles | | 4 |
| Abdel Kader | Schooner | | US | Sep. 1857 | Rich Inlet | | | Hurricane | NYDT | Charles | | 4 |
| N/A | Unknown | | | Sep. 1857 | | | | | New Bern Union | | | 2 |
| Agamemnon | Ship | | British | Mar. 1859 | Currituck Beach | | | Gale | New York Times (NYT) | Charles | | 3 |
| Liberty | Schooner | | US | Mar. 1859 | Cape Lookout | | | Gale | NYT | Charles | | 3 |
| N/A | Schooner | | | Sep. 1861 | Hatteras Inlet | | | | | | | 3 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N/A | Unknown | | | Nov. 1861 | Cape Hatteras | | | | | Angley | | 3 |
| N/A | steamers | | US | Nov. 1861 | Hatteras | | | | | Angley | | 3 |
| N/A | schooner | | | Nov. 1861 | Ocracoke Inlet | | | | | Angley | | 3 |
| City of New York | Wooden-hulled screw steamer | | US | Jan. 15, 1862 | Hatteras Inlet | 35.21862 | -75.51914 | Gale | | Gentile | northeast of Ocracoke Inlet | 5 |
| S.B. Ashmead | schooner | | US | Apr. 1863 | Hatteras | | | Heavy Gale | NYT | Charles | | 3 |
| Madeline | schooner | | German | Apr. 1863 | Chincoteague | | | Heavy Gale | NYT | Charles | | 3 |
| Winthrop | bark | | Bermud a | May 1866 | | 36.12 | -73.3 | Gale | NYT | Charles | | 3 |
| George E. Maltby | brig | | US | Jan. 1867 | | 35.27 | -73.35 | Hurricane | NYT | Charles | | 4 |
| Alliance | Wooden-hulled propeller | | US | Mar.4, 1869 | Hatteras Inlet | | | Gale | | Gentile | | 3 |
| Samuel C. Eborn | schooner | Capt. James H. Farrow | US | Feb. 1870 | Four miles north of New Inlet | | | Gale | San Francisco Bulletin (SFB) | | | 3 |
| Racer | Schooner | Capt. Hatchell | US | Feb. 1870 | New Inlet | | | Gale | SFB | | | 3 |
| Ray | schooner | Capt. Nelson | US | Feb. 1870 | New Inlet | | | Gale | SFB | | Shallotte Bar | 3 |
| Eleanor T. | schooner | | US | Feb. 1870 | southward of the Eborn | | | Gale | SFB | | | 3 |

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| Gen. Marshall | brig | | US | Feb. 1870 | | 34.14 | -76.34 | Gale | Daily Journal | Charles | | 3 |
| Surpass | schooner | | US | Apr. 1870 | New Inlet | | | Heavy Gale | Daily Journal | Charles | | 3 |
| Republique | steamer | | Haiti | Feb. 25, 1871 | Cape Hatteras | | | Gale | NY Maritime Register (NYMR) | Charles | | 4 |
| Helena | bark | | US | Mar. 1872 | | 34.47 | -74.2 | Gale | NYT | Charles | | 3 |
| Hannah Little | schooner | | US | Dec. 1872 | Hatteras Shoals | | | Heavy Gale | NYT | Charles | | 3 |
| Wallkill | Unknown | | | 1874 | Albemarle Sound | 36.047 | -76.1303 | Gale | UAB | | Barge, cargo carrier valued at $6,000 | 4 |
| Shiloh | schooner | | | Mar. 1876 | Cape Hatteras | | | Gale | US Life Saving Service (USLSS) | Charles | six miles below US signal Station | 4 |
| Lottie Lee | 3 masted schooner | | | Mar. 1876 | Cape Hatteras | | | Gale | USLSS | Charles | six miles below US signal Station | 4 |
| N/A | schooner | | | Aug. 1876 | Portsmouth | | | | The Morning Star | | | 3 |
| Rebecca Clyde | steamship | | | Sep. 1876 | | | | | | | | |
| Magnolia | steamer | | | Sep. 1877 | Cape Hatteras | | | Hurricane | | Hairr | | 3 |
| Elizabeth | Schooner | | | 1877 | Albemarle Sound | 35.9742 | -76.379 | | UAB | | Drive 1.5 miles up a marsh | 3 |
| N/A | Schooner | | | 1877 | Albemarle Sound | 36.0546 | -76.1255 | | UAB | | Blown ashore | 3 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metropolis | steamer | | US | Jan. 31, 1878 | Currituck Beach | 36.386867 | -75.816745 | Gale | | Aberdeen Daily News | Beach Light and about 100 years offshore | 4 |
| City of Houston | Passenger freighter | | US | Oct. 23, 1878 | | 33.405189 | -77.711944 | Foundered in gale | | Gentile | | 3 |
| Altoona | two master schooner | | US | Oct. 24, 1878 | Hatteras | | | | Public Ledger | Charles | | 4 |
| North Carolina | bark | | British | Aug. 18, 1879 | Northern Outer Banks | | | | | | | |
| Arietta | yacht | | | Aug.18, 1879 | Cape Fear | | | | | | | |
| Marion Gage | 3 masted schooner | | | Aug. 18, 1879 | New Inlet | | | | | | | |
| Lorenzo | Schooner | | | Aug. 18, 1879 | New River | | | | | | | |
| Forest City | bark | | German | Aug. 18, 1879 | | | | | | | | |
| Randolph | schooner | | British | Feb. 1880 | Bald Head Bar | | | Gale | NYT | Charles | | 3 |
| N/A | barque | | | Feb. 1880 | Hatteras | | | | | | NNE of Hatteras | 2 |
| Resolute | barkentine | | British | Feb. 1880 | Bald Head Bar | | | Gale | NYT | Charles | | 3 |
| Stampede | Schooner | | US | Feb. 1882 | Frying Pan | | | Heavy Gale | USLSS | Charles | | 3 |
| N/A | Unknown | | | Sep. 1883 | Creed's Hill | | | | | | | 3 |
| N/A | Unknown | | | Sep. 1883 | Durant's LSS | | | | | | | 3 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N/A | Unknown | | | Nov. 1883 | Diamond Shoals | | | | | | | 3 |
| Emma C. Rommell | 3 masted schooner | | US | Jan. 1884 | Gull Shoal | | | Gale | USLSS | Charles | 20 miles N of Hatteras | 3 |
| N/A | Unknown | | | Sep. 1885 | Cape Hatteras | 34.94977 | -76.02039 | | | | 30 miles sse Hatteras | 4 |
| N/A | Unknown | | | Sep. 1885 | Cape Hatteras | 34.95547 | -76.20276 | | | | 30 miles sse Hatteras | |
| N/A | Sloop | | | 1886 | Pasquotank River | 36.1451 | -76.0273 | Storm | UAB | | 2 miles west of lighthouse | 3 |
| Ocean Bird | Schooner | | | 1887 | Pasquotank River | 36.2875 | -76.1897 | Storm | UAB | | Btw. Nags Head and Eliz.City | 4 |
| Manteo Mail Boat | Unknown | | | 1888 | Albemarle Sound | 36.2969 | -76.2155 | Heavy squall | UAB | | Off Carlington; | 4 |
| Susannah | Unknown | | | Apr. 1889 | Hatteras | | | Gale | NYMR | Charles | | 4 |
| John S. Moulton | schooner | | | Apr. 1889 | Hatteras | 35 | -74 | Gale | NYMR | Charles | | 4 |
| N/A | two masted steamer | | | Apr. 1889 | Cape Hatteras | 35.33032 | -75.49757 | Gale | The Morning Star | | 6 miles North Hatteras | 4 |
| N/A | Unknown | | | Oct. 1893 | Cape Lookout Lighthouse | | | Hurricane | Wilmington Messenger | | | 3 |
| L. and W. Showell | Schooner | | | 1893 | Roanoke River | | | Gale | UAB | | Caused vessel to fill and sink | 4 |
| N/A | schooner | | | Aug. 1899 | Pamlico Sound | | | | The Messenger | | Royal Shoals | 3 |
| N/A | lay boat | | | Aug. 1899 | Pamlico | | | | The Messenger | | Hog Island | |

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| | | | | | Sound | | | | | | | |
| N/A | Schooner | | | Aug. 1899 | Pamlico Sound | | | | The Messenger | | Harbor Island | 3 |
| N/A | schooner | | | Aug. 1899 | Pamlico Sound | | | | The Morning Star | | | 3 |
| N/A | steamship | | | Aug.16, 1899 | | | | | | | | 3 |
| N/A | schooner | | | Aug. 16, 1899 | Royal Shoals | 35.13618 | -76.03581 | | | | | 3 |
| Priscilla | barkentine | | US | Aug. 17, 1899 | Hatteras Island | | | San Ciriaco Hurricane | Wilkes Barre Weekly Times; Morning Star | Duffus; NC Shipwreck files | off Diamond Shoal, SE of Hattaras light | 3 |
| Robert W. Dasey | Schooner | | US | Aug.17, 1899 | Hatteras Island | 35.48855 | -75.48988 | San Ciriaco Hurricane | Wilkes Barre Weekly Times (WBT) | Duffus; Barnes; | | 5 |
| Aaron Reppard | schooner | | US | Aug. 17, 1899 | Kinnakeet and Hatteras | 35.38792 | -75.49709 | San Ciriaco Hurricane | WBT | Barnes | South of Gull Shoal Station 500 Yards from shore | 5 |
| Florence Randall | schooner | Captain Cavalier | US | Aug.17, 1899 | Kinnakeet and Hatteras | 35.29932 | -75.50673 | San Ciriaco Hurricane | WBT | Barnes | SE of station, 200 yards from shore north of Gull Island Light | 5 |
| Lydia Willis | Schooner | | | Aug.17, 1899 | Ocracoke | 35.075644 | -76.12685 | San Ciriaco Hurricane | | Barnes | east Portsmouth Station | 5 |
| Fred Walton | schooner | | | Aug.17, 1899 | | 35.210628 | -75.805031 | San Ciriaco Hurricane | | Barnes | Ocracoke Station on Hog Shoal | 4 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Minnie Bergen | schooner | | US | Aug. 17, 1899 | Kinnakeet and Hatteras | 35.62673 | -75.45092 | San Ciriaco Hurricane | WBT | Barnes | 1.5 miles NE of the station | 4 |
| John C. Hayes | Unknown | | | Aug. 17, 1899 | | | | San Ciriaco Hurricane | | Barnes | | 3 |
| M.B. Millen | Unknown | | | Aug. 17, 1899 | | | | San Ciriaco Hurricane | | Barnes | | 3 |
| Albert Schultz | Unknown | | | Aug.17, 1899 | | | | San Ciriaco Hurricane | | Barnes | | 3 |
| Elwood H. Smith | Unknown | | | Aug.17, 1899 | | | | San Ciriaco Hurricane | | Barnes | | 3 |
| Henry B. Cleaves | Unknown | | | Aug.17, 1899 | | | | San Ciriaco Hurricane | | Barnes | | 3 |
| Charles M. Patterson | Unknown | | | Aug. 17, 1899 | | | | San Ciriaco Hurricane | | | | 3 |
| Diamond Shoals | Lightship | | US | Aug. 17, 1899 | Kinnakeet and Hatteras | 35.2289 | -75.6019667 | San Ciriaco Hurricane | WBT | | | 5 |
| N/A | barque | | | Aug.17, 1899 | Between Kinnakeet and Hatteras | | | San Ciriaco Hurricane | WBT | | | 3 |
| N/A | steamship | | | Aug.17, 1899 | Between Kinnakeet and Hatteras | | | San Ciriaco Hurricane | WBT | | | 3 |
| N/A | Three schooners | | US | Aug.17, 1899 | Between Kinnakeet and Hatteras | | | San Ciriaco Hurricane | WBT | | | 3 |
| N/A | schooner | | | Aug. 22, 1899 | Harbor Island | | | San Ciriaco Hurricane | The Messenger | | | 3 |
| Henrietta Hill | schooner | | US | Aug. 24, 1899 | Portsmouth | | | San Ciriaco Hurricane | USLSS | Charles | 3 miles SE of Portmsouth | 4 |

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| | | | | | | | | | | | LSS | |
| Johannah | barkentine | | Norway | Oct. 31, 1899 | Southport | | | Hurricane | | Barnes | | 4 |
| Southport | steamer | | US | Oct. 31, 1899 | Southport | | | Hurricane | | Barnes | | 4 |
| Missouri | schooner | | US | 1899 | Washington | | | Hurricane | | Barnes | 1 mile from Durant's Station | 3 |
| Olive | Unknown | | | 1903 | Chowan River | | | Cyclone | | UAB | Sunk due to water intake | 3 |
| Oliver S. Barrett | 3 masted schooner | | US | Sept. 1906 | | | | Gale | Washington Post | | | |
| Thistleroy | freighter | | British | Dec. 28, 1911 | Cape Lookout | 34.557331 | -76.527144 | Violent storm | | Farb | | 4 |
| Future | schooner | | US | Jan. 3, 1913 | | 34.133522 | -75.166242 | Gale | Macon Daily Telegraph (MDT) | | | |
| Carrie Winslow | Barkentine | | US | Jan. 3, 1913 | | | | Gale | MDT | | | |
| N/A | | | | Jan. 3, 1913 | | | | Gale | MDT | | | |
| Dewey | Gas Screw | | | Sept. 3, 1913 | Cape Lookout | | | Hurricane | | Barnes | 1 mile NE of Cape Lookout | 5 |
| Manteo | schooner | | | Sept. 3, 1913 | Portsmouth | | | Hurricane | | Barnes | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Grace G. Bennett | schooner | | | Sept. 3, 1913 | Portsmouth | | | Hurricane | | Barnes | | |
| George W. Wells | schooner | | | Sept. 3, 1913 | Portsmouth | 35.15786 | -75.901553 | Hurricane | | Barnes | SW of Hatteras Inlet SW of Durants Station | 5 |
| Normannia | freighter | | Denmar k | Jan. 17, 1924 | | | | Gale | | Gentile; Farb | | 4 |
| Victoria S. | four masted schooner | | | Aug. 23, 1925 | Ocracoke Island | | | Hurricane | | Duffus | | 3 |
| Kyzikes | | | | Dec. 4, 1927 | Kill Devil Hills | 36.032536 | -75.664527 | Severe storm | | Duffus; Farb | | 5 |
| Cibao | freighter | | | Dec. 4, 1927 | Hatteras Island | | | Nor'easter | | Duffus | near Hatteras Inlet | 4 |
| Carl Gerhard | steamer/freighter | | | Sept. 13, 1929 | Kill Devil Hills | 36.03298 | -75.665081 | | | Duffus | | 5 |
| Ella Pierce Thurlow | four masted schooner | | US | Mar. 23, 1932 | Cape Lookout | 33.900175 | -77.091333 | Storm | | Farb | | 4 |
| G.A. Kohler | four-masted schooner | | US | Aug. 23, 1933 | Hatteras Island | 35.51216 | -75.47156 | Hurricane | | Duffus | | 5 |
| Mount Dirfys | freighter | | British | Dec. 26, 1936 | Cape Fear | 33.6164 | -77.861869 | Storm | | Farb | | 4 |
| Portland | freighter | | US | Feb. 11, 1943 | Cape Lookout | 34.49417 | -76.4275 | Violent storm | | Farb | | 4 |
| Bedloe | Cutter | | US | Sept. 11, 1944 | | | | | | | | |
| Jackson | Cutter | | US | Sept. 11, 1944 | | | | | | | | |

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| Marit II | tanker | | Norway | Aug. 13, 1946 | | 35.150.189 | -73.566181 | Hurricane | Washington Post | | off NC coast | |
| Miget | Freighter | | US | Feb. 4, 1952 | Ocracoke Inlet | | | Storm | | Gentile | | 4 |
| Antonin Dvorak | WWII liberty ship | | US | Mar. 28, 1959 | Hatteras Island | 35.37166667 | -75.495 | Storm | | Duffus | | 5 |
| Amagansett | Fishing boat | | US | Nov. 20, 1964 | Cape Lookout | 34.53333 | -76.25 | Storm | | Farb | Beaufort Inlet | 5 |
| Fenwick Island | Fishing trawler | | US | Dec. 7, 1968 | Cape Lookout | 34.437111 | -76.489919 | Violent storm | | Farb | | 4 |
| Marjorie McCalister | Tug | | US | Nov. 2, 1969 | Beaufort Inlet | | | Storm | | Regan | | 4 |