# A Cultural Resource Survey of the Continental Shelf from Cape Hatteras to Key West

## Final Report

Volume III:
Shipwreck Archaeology and Remote Sensing Technology

June 1981



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Shipwreck Archeology
Remote Sensing Technology

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# 4.3 HISTORICAL CULTURAL RESOURCES

## 4.3.1 Introduction

### 4.3.1.1 Purpose of Study

Volume III provides an assessment of historic archeological sites of the South Atlantic Coast from mean high water to the 200-metre isobath within the area between Key West, Florida, and Cape Hatteras, North Carolina. The final section of this volume discusses underwater remote-sensing technology and its application to both prehistoric and historic archeological surveys. The historic archeology portion of the study specifically addresses management problems on the Outer Continental Shelf (OCS) involving the protection of historic shipwreck sites as finite, nonrenewable cultural resources. The primary objective of the study is the evaluation of the potential impact offshore natural resource exploitation will have on the archeological data base associated with shipwreck sites situated off the coasts of North Carolina, South Carolina, Georgia, and Florida.

The archeological assessment has involved the following main tasks:

1. The review and analysis of all available published and unpublished literature and data concerning the distribution of shipwreck sites from 1500 to the present.

2. The determination of the discoverability and recoverability of shipwrecks.

3. The assessment of present day remote-sensing technology for the location and identification of submerged cultural resources.

4. The identification of data gaps and future pilot studies.

5. The formulation of recommendations for the mitigation of adverse impacts on the archeological resource base.

6. The development of management zones for the preservation and protection of archeological resources on the Continental Shelf.

4.3.1.2 Survey Scope

The spatial and temporal distribution of shipwreck sites and other cultural material has been assessed within a regional framework defined as the Southern Gulf Stream. The shipwreck population has been generally interpreted in relation to known terrestrial historic sites within coastal counties along the littoral zone of the study area. Patterns within the shipwreck distribution are related to changing patterns of urban development reflected by the growth and decline of seaports and coastal settlements. In addition to shipwreck sites, modern obstructions have been identified and located. These obstructions include modern debris, artificial reefs, and military ordnance.

The shipwreck population is reviewed within the environmental framework outlined in Volume I. This involves the consideration of sites within four different marine environmental zones defined as: 1) Carolina Cuspate Forelands; 2) Georgia Sea Islands; 3) Florida Barrier Coast; and 4) Florida Keys (Figure 4.3.1). Within these environmental zones all shipwreck sites will be assessed in terms of three localities:

- o Coastal Waters. This includes the Intracoastal Waterway, harbor anchorages, river estuaries, and shallow water channels within the 10-metre isobath.
- o Inshore Waters. This includes all navigable water between the 10- and 20-metre isobaths.
- o Offshore Waters. This includes all the deepwater area between the 20-metre isobath and the edge of the Continental Shelf.

The shipwreck population has been assessed in terms of relative archeological significance which is determined by the physical integrity and research potential of the site clusters. Sensitivity on the base map is defined by the density and preservation potential of the shipwreck sites in any given area. The preservation potential is dependent upon depositional marine environments and the extent to which they affect submerged archeologic sites.

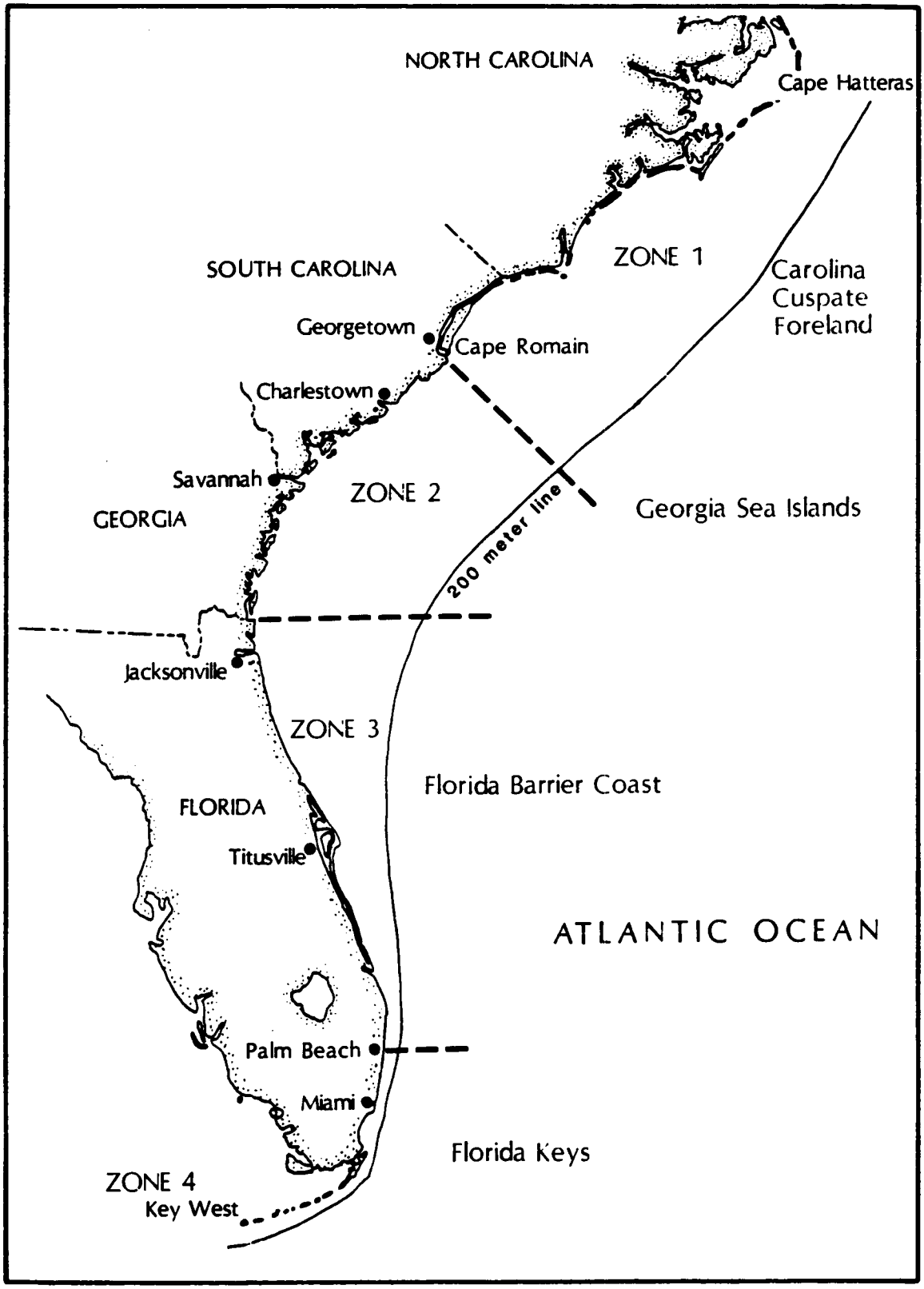


Figure 4.3.1 Coastal Geomorphological Zones

Management zones have been delineated on the basis of relative archeological sensitivity of submerged cultural resources. Three different management zones characterizing varying levels of archeological sensitivity have been delineated on the shipwreck resource management map in Volume V (Maps 1-6, Plate 6).

The scope of work required archival research to compile an inventory of shipwreck distribution and density from secondary sources. In order to accomplish this objective the research effort concentrated on synthesizing major compilations of shipwreck data. It must be recognized therefore that the locational data provided in support of the management zone delineations are based upon a very large, but incomplete, sample. Shipwreck data was missing in each state for different time periods. Therefore there is a certain bias to the sample that has been plotted.

4.3.1.3 Rationale for Periodization

The occurrence of shipwrecks on the Continental Shelf within the study area has been analyzed within a temporal framework. All known shipwreck sites from the early 16th century to present times are considered within six discrete periods (Table 4.3.1). Each chronological period is represented on a map which includes the location of all known wrecks. Each period was established on the basis of a regional overview of the thematic cultural trends in light of specific significant historical events. The complex nature of cultural development and change in the study area allows a broad range of chronological interpretive systems; however, the one selected for this study is felt to best describe and delineate the cultural phenomena taking place in southeastern North America.

Period I, defined as that era from 1500 to 1700, covers the time of exploratory voyages into the study area, from the initial

Table 4.3.1 Shipwreck Periods

| PERIODS | | CHARACTERIZATION |
|---|---|---|
| I. | 1500 - 1700 | Early maritime exploration and littoral settlement; development of the Spanish *flota* system. |
| II. | 1701 - 1820 | Expansion of English maritime domestic and overseas commerce; privateering and the War of Jenkins Ear; consolidation of the Southeast colonies into states; Revolutionary War and the War of 1812 naval action; development of American shipbuilding; growth of maritime provinces and coastal towns. |
| III. | 1821 - 1865 | Development of ocean industries by antebellum maritime entrepreneurs; clipper ship era and increased domestic and transatlantic commerce; development of oceangoing steamboats and ironclad warships; Civil War naval action. |
| IV. | 1866 - 1916 | Emergence of modern Navy; coastal urbanization; maritime mercantile development. |
| V. | 1917 - 1945 | Development of the merchant marine and present day maritime mercantile system; World War I and II naval action. |
| VI. | 1946 - 1979 | Expansion of merchant maritime traffic; exploitation of natural resources on the Outer Continental Shelf. |

discovery of the mainland of Florida in 1513 until the English explorations of the South Carolina coast prior to the establishment of a colony there. This period also encompasses the time during which the Spanish Flota system engaged in the New World treasure trade and during which permanent colonial settlements took place along the southeastern North American coastline.

The chronological boundaries of Period II are set at 1701 and 1820. During this time the English colonies of North and South Carolina, and later Georgia, developed a firm economic base and underwent a major increase in population. While the Spanish colony in Florida stagnated, the English colonies to the north matured into prospering mercantile communities. This period is also marked by three major armed conflicts: the War of Jenkins Ear, the Revolutionary War, and the War of 1812. These wars resulted in the expansion of English influence at the expense of the Spanish, and later the defeat of the British by American colonists. It is, therefore, an era in which the colonial system both matured and rapidly declined. In maritime affairs, the period is marked by a tremendous increase in the volume of shipping over the previous period, as both maritime technology and overseas trade underwent a rapid evolution. In its later decades the outstanding cultural phenomena of Period II was the rapid development of American maritime dominance in the area, as both political control and an increasing share of the maritime commerce passed to the United States. In 1820 the ownership of Florida passed from Spain to the United States and this event marks the closing date of the period.

The years 1821 to 1865 serve as the boundaries of Period III. It was a time of unprecedented economic expansion and national development, but an era which ultimately led to war. During this time commercial sailing vessels reached their highest stage of evolution with the appearance of the great Clipper Ships. It was also the period during which steampower began to be widely utilized in maritime commerce, a development which foretold the end of the great sailing ships. Maritime commerce during this period expanded rapidly, providing the major link between the western and eastern coasts of the United States, and with

Asian markets. Near the end of Period III, sectional disputes erupted into the American Civil War. The war accounted for large tonnage losses to the shipping trade. The end of the Civil War in 1865 is chosen as the concluding date of Period III.

In the aftermath of the Civil War, the coastal zone of the study area underwent an era of reconstruction. The disruption wrought from that conflict took decades to overcome. During Period IV (1866 to 1916) the dominance of steamship technology made the sailing vessel obsolete in maritime commerce, and the American Merchant Marine and Navy emerged in their modern form.

With the disappearance of the antebellum plantation economy, a more diversified and moderized one was developed. During this period the United States became more politically involved with the rest of the world commercially than in the previous period. This involvement inexorably drew the United States into World War I. It is on the eve of American entry into World War I that Period IV concludes.

Period V begins with the year 1917, when the United States entered World War I. Both ship losses and ship production increased significantly. Following the war came Prohibition, with its rumrunners and the coastal blockade established to intercept them. During these years steamships underwent further technological improvements, as oil began to replace coal as the major energy source. With the outbreak of World War II in 1939, the United States once again began construction of a merchant marine and naval fleet at an unprecedented rate. Beginning with the formal declaration of war by the United States in 1941, many ships were lost along the eastern North American seaboard. The losses to American merchant vessels caused by German submarines were extensive, and exact details are not readily available. Period V ends in 1945, with the end of the war.

Period VI (the modern era) begins in 1946, and is generally characterized by the development of cargo containers and supertankers; the expansion of the industrialized economy; and exploration for natural resources on the Outer Continental Shelf.

4.3.1.4 Survey Limitations

There were many difficulties associated with the survey of shipwreck data for the southeastern coast of the United States. Gagliano et al. (1977) in their study of the shipwrecks in the Gulf of Mexico reported similar difficulties. A brief review of some of these problems, and how they were dealt with in the present study, are summarized as follows:

1. Vague Shipwreck Location: This is caused by a number of factors. Although early mariners soon became proficient at determining latitude, it was not until the late 18th century that reliable chronometers became available for the recording of longitude. The inability to determine positions east and west along a known latitude made it impossible to make an accurate determination of a ship's location at any given time. Even with the use of a chronometer, it was not normal practice for captains on commercial vessels to maintain accurate positions at all times. The recorded positions of ships lost as late as World War II are often inaccurate. In cases where the position of a sunken ship is not verified by sonar, the recorded position is likely to be the last fix the navigator made prior to the sinking of the vessel, and not the actual position of the ship on the seabed. In some cases the discrepancy could represent a considerable distance. It is only with the use of Loran and other electronic navigation systems that the locations of vessels at sea could be accurately determined.

   Ships listed as lost near a prominent geographical feature, such as "off Tybee Island", have been plotted as near to the feature as the map scale would allow (Volume V Plates 2-5). Insets of major harbors are included on the charts to provide more clarity in mapping dense shipwreck-site clusters. However, no attempt has been made to plot specific site localities within these areas. Ships, noted simply as lost in the Savannah River or in Charleston Harbor, are plotted without making any further geographical distinctions. As far as possible, an attempt was made to distinguish between vessels lost in the harbors as opposed to those which sank while trying to enter the harbors. Those shipwrecks listed as simply being "lost off South Carolina" or "in the Florida Straits" have been identified but not specifically plotted on the charts.

2. Secondary Source Reliability: The primary concern is that this study, like others of its type, must be dependent upon site compendiums drawn up for popular publications focusing on the search for sunken "treasure." The credibility of this data therefore cannot be relied upon by the scientific researcher, as Gagliano (Gagliano et al., 1977) and others have already pointed out. Brief annotations on the use of these compendiums and other research materials appear later in this section as a general guide as to how they were utilized in the study.

4.3.1.5 Methodology

Very little attention has been directed towards adapting a regional approach for constructing locational models to predict shipwreck populations in the New World. The methodology predicting the location of historic shipwreck sites is similar to the methodology of predicting the location of terrestrial prehistoric sites. The shipwreck locations, like other archeological sites, are dependent upon cultural and environmental variables. As a result of the interplay between these variables, a nonrandom site distribution should be recognized in both time and space. The major cultural variables would include the following:

1. Vessel Type: Determined by hull design and construction; standing and running rigging; and date of construction.

2. Vessel Function: Determined by size and capacity. This implies a distinction between different types of ships used in deepwater offshore maritime commerce as opposed to those involved in inshore and coastal trade.

3. Maritime Technology: Determined by the development of ship navigation, bathymetric charting, and marking of navigational hazards.

The essential environmental variables would include:

1. Hurricane Frequency: The higher the storm frequency, the greater probability there will be wreck sites in any given time period.

2. Hydrographic Condition: The greater the influence of sea state, tides, currents, and prevailing winds, the greater the probability of wreck sites in any given time period.

3. Bathymetry: The closer dangerous shoals are to sea-lanes, the greater the probability of wreck sites in any given time period.

On the basis of these variables, the following general suppositions can be made to explain a nonrandom distribution pattern within a shipwreck population.

1. The number of sunken vessels in a coastal area is directly related to the extent of maritime commerce associated with the development of seaports and settlements along part of the coast.

2. During periods of simple maritime technology, there is a greater probability that the loss of ships is directly related to environmental variables.

3. The shipwreck population in any geographical area will decrease through time, as maritime technology improves.

4. Shipwrecks of all periods will tend to cluster in the vicinity of projecting headlands, shifting shoals, and shallow reef tracts.

These suppositions are based upon normal maritime activity during peacetime. Naval action during wartime often alters commercial sealanes, and may result in the blockading of seaports.

The validity of this hypothetical model was tested by comparing the preliminary predictions with the data plotted for the actual shipwreck population of the southeastern Continential Shelf available from literature sources. Patterns discerned within this population were analyzed and interpreted. On the basis of these interpretations, the final predictive statements were made concerning

the probable location of shipwreck clusters throughout the study area which are not specifically identified in archival records.

The shipwreck population has been plotted with as much accuracy as possible given the data limitations already noted. The site inventory has been compiled chronologically by state, which has facilitated areal syntheses of particular clusters of shipwreck sites within the total population. This greatly facilitated data management during compilation. Each known site is indicated on a chart by an inventory number. Basic data for each site are listed under the inventory number in the site compendium contained in Volume V. Whenever possible, the inventory data includes the following: vessel name; ship information, including ship type, flag, date built, and tonnage; and loss information, including state, location, date lost, and cause of sinking.

While plotting the shipwreck population, several distinctions were made through the use of different symbols. Wreck sites with specific locations were differentiated from those sites recorded only by a general location. In addition, an effort was made to distinguish those wreck sites which have been examined on the seabed by divers or remote-sensing equipment from the wrecks cited in the literature but still remain unconfirmed. Where a number of ships are known to have sunk at the same time and at the same place, they have been plotted as one cluster. The four shipwreck sites listed on the National Register of Historic Places occurring within the study area have been specifically indicated on the charts.

Sealanes are defined as maritime corridors along which the majority of shipping moves during any given period. They have been plotted on the charts. Originally, sealanes were determined largely by sailing directions which guided vessels around navigational hazards, while trying to make the most of the prevailing winds and currents. To some extent sailing routes were also determined by vessel type, and the nature of the cargo.

This study recognizes three major types of sealanes which reflect different maritime commercial patterns. The maritime trade along these different types of sealanes may be generally characterized as follows:

1. Local Commerce: This trade occurred in small, shallow draft boats of not much more than 100 tons; these vessels sailed along what is now the Intracoastal Waterway and up the major rivers. This coastal trade consisted of short hauls involving the exchange of food stuffs for raw materials and manufactured goods. Many of the boats were probably built locally, and were operated and owned by local captains.

2. Interstate Commerce: This maritime traffic was involved in sailing beyond the littoral zone. It was more complex than local trade, involving bigger ships, many built and owned by merchants in major seaports. The cargo was more diversified, involving the shipping of bulk cargo to seaports along the Atlantic Seaboard. Much of this commercial traffic occurred within inshore waters, not far off the coast.

3. Foreign Commerce: This was comprised of offshore maritime traffic involving large deepwater vessels. Such ships carried agricultural produce and raw materials bound for foreign ports in Europe, Africa, and the Caribbean. Much of this transatlantic export trade was controlled by large trading firms in England.

Throughout the last 400 years there has been considerable variation in the sealanes, largely the result of improved maritime technology. With the advent of steamships, vessels became less dependent upon prevailing winds. Consequently, sealanes during the 19th century became far more direct as ships sailed to their destination without as much consideration for wind direction. Naval warfare has also affected sealanes within the study area. This was particularly the case during the Civil War when the Confederate commercial vessels had to use other than conventional routes along the coast in order to avoid the Union blockade of the ports of Charleston, Wilmington, and Savannah. Similarly, commercial sealanes had to be shifted somewhat during World War II in order to avoid German submarines laying in wait for coastal convoys.

Currents have continually affected ships, even those that sail under their own power. In general, all maritime traffic heading north along the coast takes advantage of the strong northward flow of the Gulf Stream. Ships sailing south sail closer to shore to avoid the Gulf Stream. Along certain stretches of the coast such as the Georgia Bight and the Florida Keys, vessels took advantage of the strong countercurrent which flowed southward, a short distance off the coast. Because of these currents, sealanes have not shifted significantly, even with the transition from sail to steam. The sealanes have been plotted on Plate 6 (Volume V) to show their general configuration.

In addition, safe anchorages are also plotted when there is enough supportive data available. Anchorages along the coast were particularly important to early mariners as they explored the South Atlantic coast. Similarly, they played an important role in the growth and development of the coastal maritime trade during the late 17th and 18th century. Anchorages not only provided a safe place to avoid a storm, but also a place where fresh water and food could be secured to replenish depleted stores, and perhaps where the ship's hull could be careened.

The data compiled for this study should provide a basis for future research; the data presented should be verified through more intensive investigations within pilot study areas. Localities for future pilot studies have been recommended on the following basis:

1. High probability of historic site occurrence determined by the predictive model and/or the compiled inventory

2. High degree of archeological site sensitivity determined by physical integrity, recoverability, and research potential

3. The availability of logistic support and acceptable diving conditions which would allow the recording of archeological data within acceptable standards.

Pilot studies focused on resource management should be conducted with two main objectives: first, to test the predictive model in areas where the shipwreck population should be different from what the available archival records indicate; and second, to conduct site surveys of particular submerged historic sites to ascertain the artifact configuration pattern for a detailed management study which would identify procedures for mitigating adverse site impacts.

4.3.1.6 Research Materials

The research effort focused on locating relevant background information and archival data necessary to compile an inventory of the shipwreck population. A number of different sources were utilized in accomplishing this goal. These have been listed in Appendix III-F.

A literature search for secondary sources was conducted at a number of different libraries and research institutions. Time was spent in viewing particular artifact assemblages in museums and private collections. All data and site descriptions available for review in the various state archeological files were studied. Personal contact was made with state archeologists and a number of professional colleagues and government personnel concerning ongoing research, unpublished material, and pertinent information not normally accessible. Several local informants and information sources in the "waterfront community" provided information concerning their own research on shipwreck sites along different parts of the coast. Such interviews were invaluable as they provided research leads and access to unpublished information not available in the state files.

Source materials dealing with shipwrecks are often widely dispersed, out of print or available only in some remotely located library or archive. (An unfortunate number of marine records have been destroyed.) The literature of the field abounds with dubious and even fabricated shipwreck accounts; some of these survive to this day and continue to be revived by writers unable or unwilling to check upon their authenticity or origin.

The problem of researching old marine records is particularly compounded when data is required on shipwrecks of foreign registry, as the primary records and background data dealing with such vessels are usually located in institutions outside of the United States. In some cases the documentary material has never been organized, indexed, or catalogued, and the review of such records poses a formidable problem not readily solved without a substantial expenditure of time and money. No attempt was made in this study to cite foreign primary sources dealing with the specialized subject of the Galleon "Treasure" fleets. With some exceptions, serious documentary research on the Spanish Flota system can only be conducted in the Archives of the Indies, Seville, Spain.

In the early stages of the literature search an attempt was made to evaluate the backfile newspapers as a primary resource for compiling the shipwreck inventory. The most widely available newspaper on file is the New York Times which is well indexed to 1851. The London Times is also indexed for an extensive span of time. The Library of Congress has an extensive collection of backfile papers which consists of about 150,000 bound volumes, and includes some 1,600 newspapers printed before 1801. A considerable amount of primary information can be gleaned from newspapers published in major seaports within the study area, as well as more distant maritime centers such as New Orleans, Norfolk, New York, and Boston. Newspapers in the major northern ports very often covered shipping losses even though they took place off the South Atlantic coast.

Past experience has shown that working with newspapers is very time-consuming and not always the most productive way to spend limited research time; however, there is no question that they can provide information not available elsewhere. This would be particularly so in the case of recording the loss of small coastal vessels not usually covered anywhere but in local newspaper accounts. While the coverage would be uneven, it would complement late 18th and 19th century listings of shipwreck losses collected elsewhere.

Researchers experienced in compiling shipwreck inventories from newspaper accounts in South Carolina (E.L. Spence, personal communication, March 1979), and Georgia (E.G. Garrison, personal commmunication, March 1979) estimate that not more than 10 percent of the ship losses listed prior to the 20th century provide locational data sufficient for precise plotting. Most of the listings provide only a very general geographical location, and many simply mention the ship as sinking off a certain part of the coast.

A random survey of the following newspapers was made to assess the feasibility of using them as a primary data source:

VIRGINIA

Norfolk

American Beacon 1815-1855
Gazetter and Public Ledger 1804 - 1816
Norfolk and Portsmouth Herald 1802 - 1859
Daily Southern & Argus 1848 - 1860
Journal of Commerce 1888 - 1897

Williamsburg

Virginia Gazetter 1853 - 1926

Many earlier papers can be found in the Library of Congress going back as far as 1750. Fragmentary coverage exists for even earlier dates.

NORTH CAROLINA

Wilmington Advertiser 1837 -1841
Wilmington Daily Journal 1851 - 1877
Cape Fear Recorder 1829 - 1832
Chronicle 1820 - 1851
Peoples Press 1833 - 1836

SOUTH CAROLINA

Charleston

Charleston Courier 1803 - 1857

Charleston Daily Courier 1852 - 1873

Charleston Mercury 1822 - 1868

Various earlier issues of South Carolina papers go back as far as 1732.

BAHAMA ISLANDS

Backfiles of the following Bahamas newspapers can be obtained on microfilm:

Bahama Argus 1831 - 1835

Bahama Gazette 1784 - 1819

Bahamas Herald 1849 - 1863

Nassau Daily Tribune 1911 - 1961

Royal Gazette & Bahama Advertiser 1804 - 1837

The time required to assemble newspaper data was not considered to be cost-effective and therefore was not included in the scope of this study. The newspaper data which has been used in the study has been incorporated from shipwreck compendiums. Much of the compiled information contained in Spence's (1976) list of over 600 18th and early 19th century shipwrecks off the South Carolina coast comes from newspaper accounts. Similarly newspaper accounts have assisted in verifying over 650 19th century and early 20th century shipwrecks known to be scattered along the Outer Banks of North Carolina (Stick, 1958).

The pattern and geographical distribution of shipwrecks has been determined by many factors including coastal geomorphology, the location of sealanes, the frequency and courses of hurricanes, and the events of economic, political, and military history. Vessel losses off the southeastern coast of the United States from Cape Hatteras to Key West have resulted from a combination of these and others over a time span of almost 500 years. The three capes, comprising the North Carolina coastline of Cape Hatteras, Cape Lookout, and Cape Fear, together with the vast outlying reef areas bordering the Florida Keys have long been recognized as the sites for numerous shipwrecks.

Over 2,000 shipwrecks have been documented for Cape Hatteras, Cape Lookout, and Cape Fear (Watts, personal communication, September 1978). A review of reports on more than 1,200 shipwrecks has produced a list of 501 wrecks in the study area, which could be verified by location (Newton et al., 1971); this population in the study area is broken down in the following way:

Cape Fear - 111
Cape Lookout - 213
Cape Hatteras (South) - 177

The extensive offshore shoals off Cape Canaveral and reefs bordering the entire length of the Florida Keys is another area of high shipwreck density. So extensive was the loss of shipping along the Keys that marine salvage became the principal business of the area during the early years after 1800. By the 1830's a substantial portion of the population of the city of Key West was engaged in the practice of wrecking. The wrecking industry was an established business which was recognized legally, and encouraged under both Admiralty law and the large marine insurance companies as a means of saving lives and property. The area retains immense interest today for the commercial salvor and archeologist interested in the Spanish Plate fleets which sailed along this coastline for almost 300 years. Records of salvage go back as far as the mid 16th century when local Indians retrieved fittings and cargo from foundering ships which were driven towards shore.

### 4.3.2 Regional Overview of the Maritime Cultural History of the Southeastern United States

This overview of the maritime cultural history of the Southeastern United States is discussed in the context of the six chronological periods previously presented in Table 4.3.1. Their beginning and ending dates have been arbitarily set according to important regional events. Each period is described in terms of significant singular events that took place as well as the general thematic cultural processes making up the historical development of the region.

The first recorded shipwreck in the Western Hemisphere was the Santa Maria which went aground and broke up during the first year of the voyage of Columbus in 1492. Since that time, many thousands of vessels have been lost in North American waters. Estimates of the total number of shipwrecks lying off the Atlantic Coast vary considerably, but most commonly range from 15,000 to as high as 20,000. These estimates of the wreck-totals may appear high but are probably not too excessive in view of the fact that nearly half of the world's shipping involves transatlantic commerce.

Estimates of shipwreck totals vary with the criteria employed, and are dependent upon the use of data which is often fragmented and widely distributed. Marine records covering the first 300 years of American history are particularly incomplete, and the first marine register to be compiled anywhere did not make its appearance until 1764. Little formal recordkeeping was done during the early colonial years. Even later, when the Lifesaving Service was organized, such records were primarily concerned with wrecks in the immediate vicinity of the Lifesaving stations. Numerous vessels that foundered offshore freqently went unrecorded. Even today there is no single reasonably complete tabulation of all vessels which sink off the United States.

The 50-ton minimum size used in the compilation of some wreck maps and lists excludes a great many small craft. Small ships such as barks and pinnaces of not much more than 30 tons regularly made Transatlantic crossings to the South Atlantic coast. During earlier days of exploration, discovery, and colonial development many of these small ships had an important role. The explorer John Cabot is thought to have employed a vessel of less than 10 tons. Sir Francis Drake used a small vessel in 1585 during his raids on Spanish shipping and coastal settlements along the South Atlantic seaboard. As late as the American Civil War, the Confederacy utilized numerous small light-draft vessels in order to run the blockade and enter the shallower coastal waters too dangerous for the larger Union war vessels to navigate. The Confederate submarine CSS Hunley was only 4.5 tons in size but made

naval history when it became the first submarine to sink a major war vessel under combat conditions. Cargo carried by vessels of less than 50 tons was of vital importance to the survival and continued existence of numerous isolated colonial communities, as well as planters and farmers whose only link to the outside world was the river and waterway system.

Period I: 1500-1700

The major themes of this period are exploration and early colonial development. The temporal bounds for this period encompass the period between the known discovery of the mainland of North America and the beginning of permanent colonial settlement in coastal North and South Carolina, Georgia, and Florida. During this period the first European voyages of discovery were made in this region. These voyages were subsequently followed by efforts at establishing settlements, which eventually led to the development of agriculturally-based colonies tied economically to their mother country.

Transatlantic commerce between the Old and New Worlds was heavily influenced by natural environmental factors. Most notably, these were the prevailing wind patterns and ocean currents, most importantly, the Gulf Stream. The prevailing winds from Europe to America were the Northeast Trade Winds, which blew from east to west. These winds carried sailing vessels from Europe to a New World landfall in the West Indies. However, they also prevented these sailing vessels from returning by the same route. Winds blowing in a direction favorable for a return voyage to Europe were farther north, which dictated that vessels set their courses accordingly. By the middle of the 16th century, the other major natural environmental factor, the Gulf Stream, was widely recognized. This great ocean current swept out of the Gulf of Mexico, around the southern end of the Florida peninsula, and northeastward out into the Atlantic. Its velocity provided a significant aid to sailing vessels making a west-to-east crossing. By the mid 16th century, the advantages of using the Gulf Stream for an Atlantic crossing were so widely known that it developed into one of

the principal routes for shipping from the Spanish New World colonies back to Europe. It soon became the single most important route.

It appears that the first recorded European discovery of the mainland of North America took place in 1513. History credits this discovery to Juan Ponce de Leon, a Spaniard who had formerly been the Governor of the Island of Puerto Rico. There is some evidence that Amerigo Vespucci sailed along the Florida coast during his voyage of 1497-1498, but this is not certain. In any case, following Ponce de Leon's discovery and abortive explorations in 1521, the Florida Coast became more widely-known to navigators. Further explorations of the coastline zones to the north took place under the direction of Francisco de Gordillo (1521), Giovanni de Verrazzano (1524) (Figure 4.3.2), Esteban Gomez (1524-1525), and Pedro de Quexos (1525).

Don Lucas Vasquez de Ayllon led a program of exploration and attempted colonization along the present Georgia Carolina coast (Figure 4.3.3). In 1520 one of his vessels was lost at Cape Romain and another wrecked near Cape St. Helen in 1525 (Marx, 1971). Even his expedition flagship became a total loss on a sandbar at the mouth of a Carolina river. A site on the Carolina coast was ultimately selected for a Spanish colony, which was founded in 1526. It was short-lived, however, and soon after the death of Vasquez de Ayllon it was abandoned.

The vessels carrying the first North Carolina colonists to Roanoke Island in 1585 made their initial landing at Ocracoke Inlet where the Flagship grounded on a shoal. The vessels remained here at anchor for 3 weeks while the waters of Palmico Sound and the coast to the west were explored. On subsequent voyages, ships frequently anchored at Ocracoke Inlet before sailing up the coast to Roanoke Island and Fort Raleigh.

When the permanent settlement of North Carolina began in the early 1660's, practically all of the ocean-going vessels serving the colony entered through Roanoke Inlet. Until the early 18th century this Inlet was the most important cut-through to the Outer Banks (Stick, 1958).

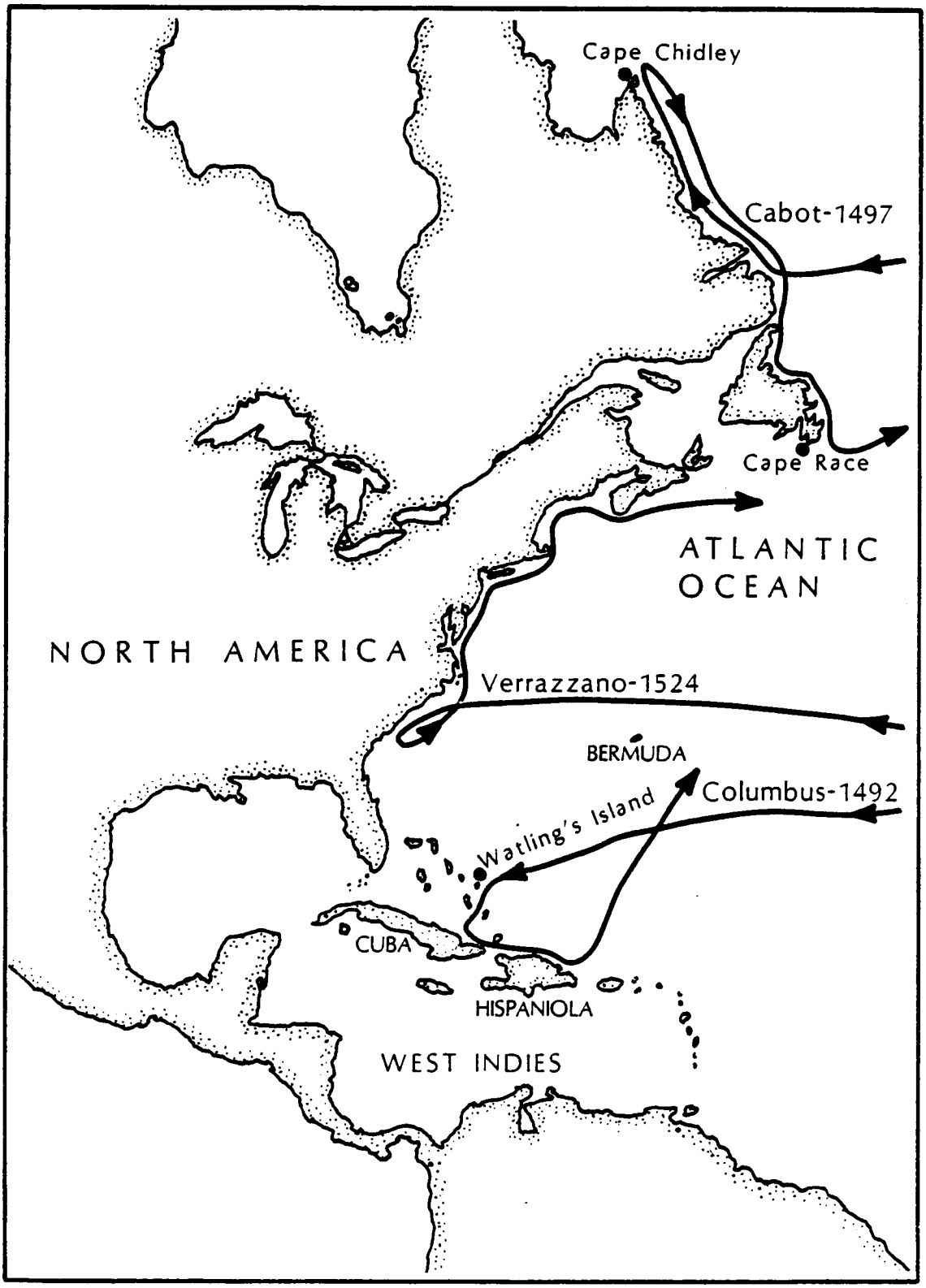


Figure 4.3.2 Discovery of the Atlantic Seaboard
(After Kogan, 1966)

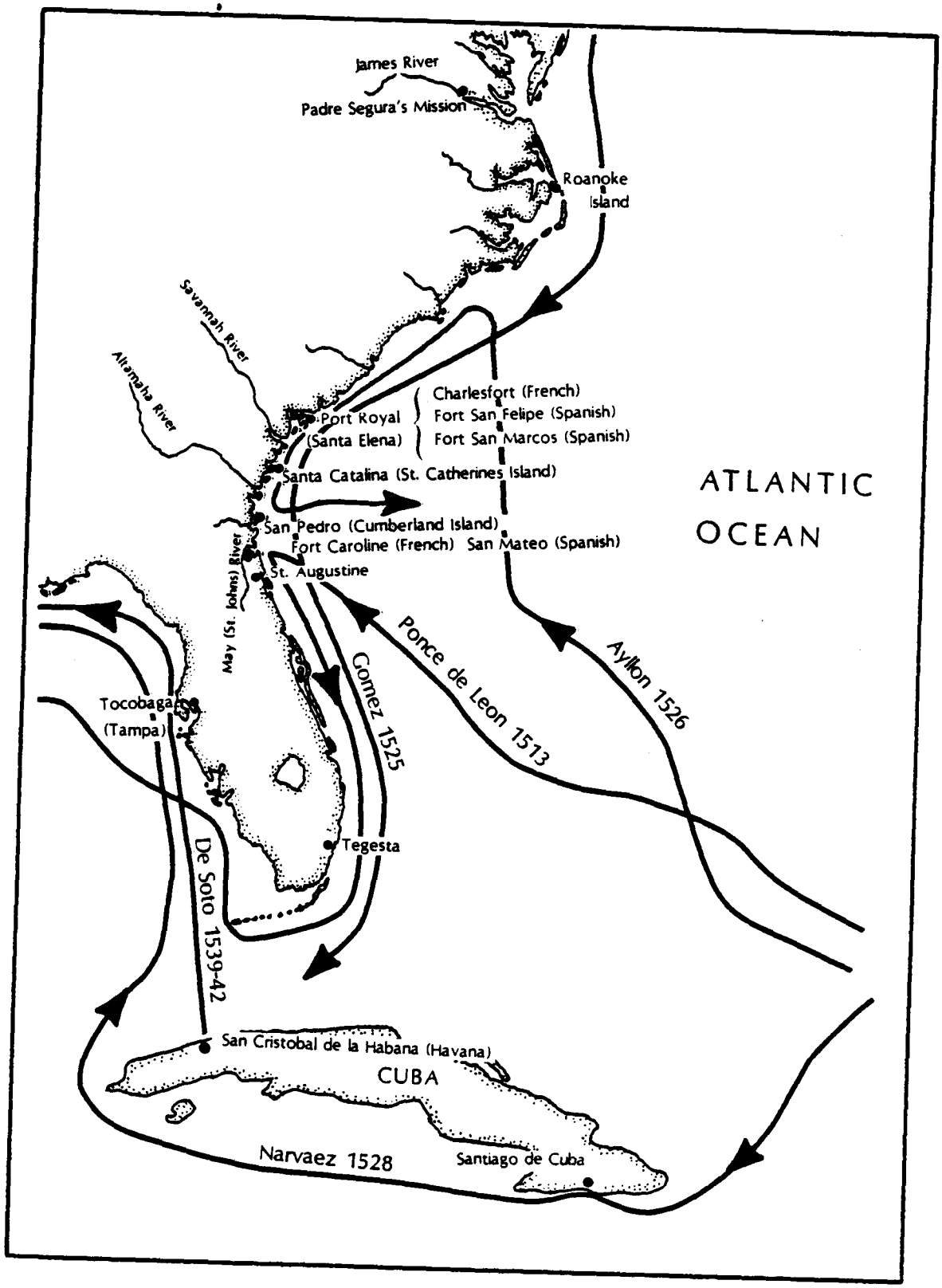


Figure 4.3.3 Exploration and Settlement Along the South Atlantic Coast (After Kogan, 1966)

Factors in the cultural environment also influenced development and emerging patterns in transatlantic shipping. One such factor was the great value placed upon the products of the New World colonies. The Spanish colonies were so immensely productive that the economy of the mother country grew dangerously dependent upon them. Dangerous to Spain as well, was the avarice that the wealth of these colonies elicited among the other peoples of Europe, notably the French, Dutch, and English.

By the mid 16th century, French sea-raiders sailed to the New World to prey upon Spanish commerce. They were ultimately joined by the Dutch and English, and Spanish shipping began to suffer great losses. In addition to raiding, many of these northern Europeans turned to smuggling. Surreptitious trade with the closed markets of the Spanish colonies became a certain way to earn a profit.

In response to these assualts upon their commerce, the Spanish developed a system of convoys to protect their shipping. These convoys were called flotas (fleets). Each consisted of several heavily-armed warships escorting more vulnerable merchant ships. In addition, there was a special fleet, the Armada de Guerdia, armed separately to protect the convoy. Under this system, the flotas left Spain every year. One fleet, the Nueva Espana Flota, was assigned to the Meso-american economic zone, and sailed to the port of Vera Cruz, Mexico. Another, known as the Tierra Firma Flota, was assigned to the South American economic zone, and called at the ports of Porto Bello, in Panama, and Cartagena, Columbia. After completing their trading missions, both flotas tried to rendezvous at the port of Havana, Cuba, and sail in company back to Spain. The route these flotas regularly sailed was known as the Carrera de Indias (Figure 4.3.4). The route from Havana back to Spain followed the path of the Gulf Stream along the Florida Keys northward off the Florida coast. After reaching Cape Canaveral, the ships followed the northward flowing currents until they began to veer eastward toward Bermuda on their transatlantic course (Figure 4.3.4).

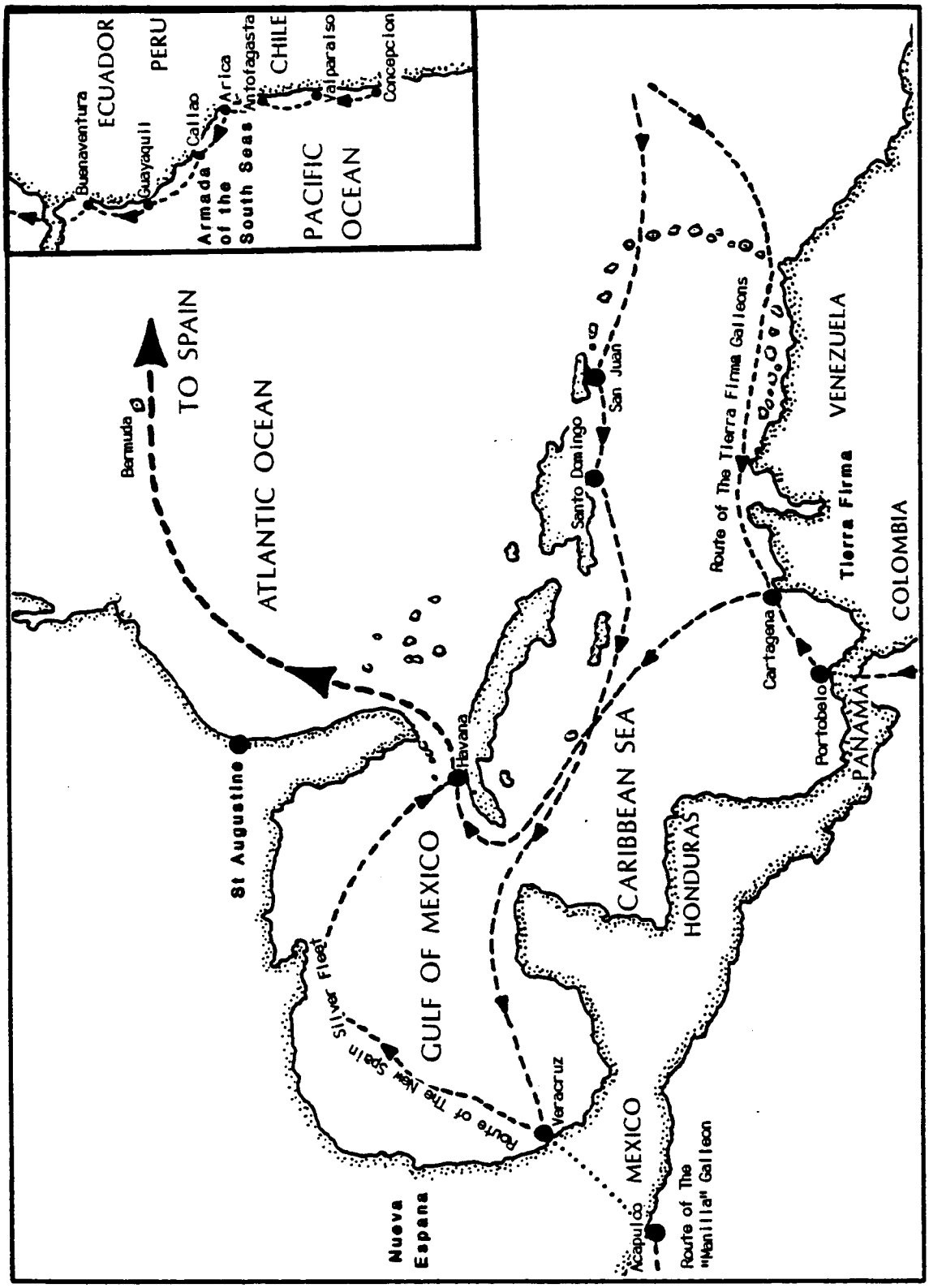


Figure 4.3.4 Maritime Commercial Routes of the Caribbean Basin 1550-1750 (After Peterson, 1975)

The cargoes carried by the Spanish flotas played a major role in European economy. Due to the large scale mining of gold and silver in Central America, South America, Spain became a major economic and military power for several hundred years. Spanish silver, gold, and numerous other products of the New World greatly influenced the economy of Europe. The annual movement of these fleets through the Straits of Florida continued for nearly 300 years; this flow of commodities was constantly monitored and frequently attacked by Spain's rivals France, Holland, and England (Peterson, 1977). Shipping losses were considerable as a result of these attacks and as a result of hurricanes. While normally these vessels veered off to the northeast towards Bermuda, lack of water, mechanical damage, or strong persistent winds and fall hurricanes sometimes carried them onto the coasts of the Carolinas. Bad weather and navigation miscalculations could bring individual vessels and sometimes whole fleets northwards along the coast where they skirted such dangerous shoal areas as Cape Fear, Cape Lookout, or Diamond Shoals off Cape Hatteras.

Vessel losses to the Spanish during this period were about 5 percent but sometimes went as high as 12 percent a year. Wreck losses were especially high off the Florida Keys, Cape Canaveral, Cape Fear, and Cape Hatteras.

The next major effort at colonizing the coast in the study area took place in the Sea Islands along the Georgia coast. The people behind this were the French, who were familiar with the importance of the Gulf Stream route to Spanish commerce. Jean Ribaut attempted to establish a settlement (Santa Elena) at Port Royal, South Carolina, in 1562, but failed (Figure 4.3.5). Excavation under the direction of Stanley are now being conducted to recover archeological data from successive settlements at Santa Elena. .In 1564, another French expedition under Laudonniere founded Fort Caroline on the St. Johns River in Florida. This fortified settlement was recognized by the Spanish as a major threat to their Gulf Stream shipping route, and an expedition was sent to attack it. This force was led by Pedro Menendez de Aviles, who arrived in the area in 1565. At the same time, a French squadron under Ribaut was being sent to reinforce Fort Caroline. However, a hurricane wrecked two of the French vessels on the Florida coast between Mosquito

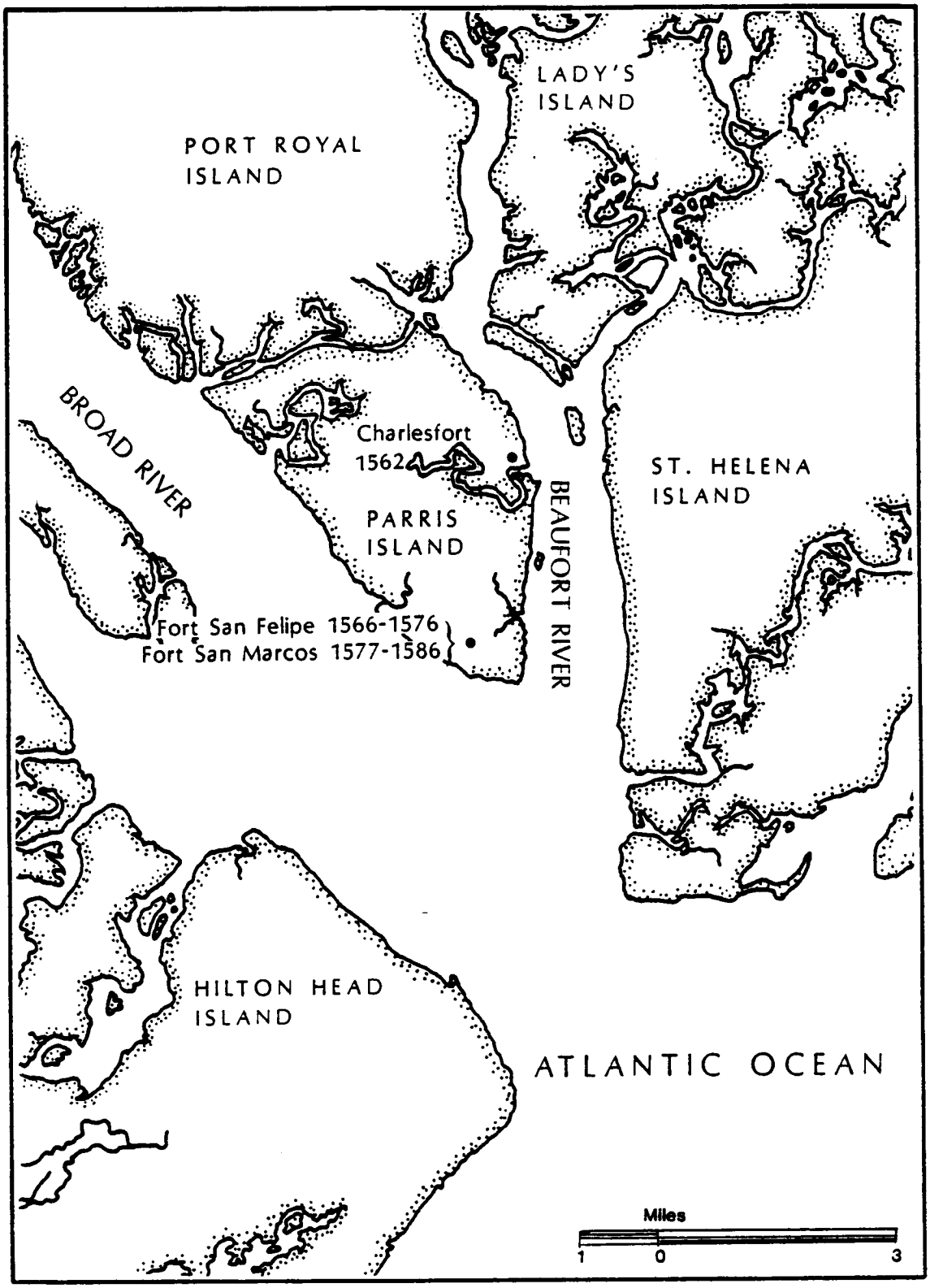


Figure 4.3.5 Early Settlements in Port Royal, South Carolina (After Kogan, 1966)

Inlet (present Ponce de Leon Inlet) and Matanzas Inlet. Menendez captured and executed nearly all the survivors. He also wiped out the settlement at Fort Caroline, and established the town of St. Augustine to secure this strategic area of the coastline for Spain (Figure 4.3.6).

The Spanish had many shipwrecks during this period, as the amount of traffic northward through the Straits of Florida increased yearly. As time went by, the loss of shipping also mounted. The majority of these wrecks in present-day United States waters occurred along the Florida east coast and in the Keys. The earliest documented vessel off the east coast of Florida was the Tierra Firma ship which went down off Cape Canaveral in 1549. Several ships of the 1554 Tierra Firma Flota were lost in storms and one or more may have have wrecked near Cape Canaveral. In 1563 one or possibly two ships of the Nueva Espana Flota sank off Canaveral. Many others foundered along this coast for the next 200 years (Lyon, personal communication, Feb. 1979).

Since the Florida coast was so remote from outposts of civilization, and inhabited by frequently-hostile Ais and Calusa Indians, many of the wrecked vessels simply vanished without record. Without survivors to return to civilization to report a loss there would be no salvage attempt, and no documentation of the wreck's location.

The Spanish ultimately established additional outposts, settlements and missions, both in Florida and along the coast to the north. There was even a mission established as far north as the Chesapeake Bay. South of St. Augustine a fortified watchtower was erected at Matanzas Inlet. To the south of this last outpost stretched hundreds of miles of inhospitable coastline, all the way to the mouth of the Miami river where a small mission was established (Figure 4.3.7).

During this period, the southern Gulf Stream became firmly established as the major route for the vessels from the West Indies, and Central and South America to Europe. This great volume of maritime traffic attracted many of the sea-raiders to the area also. The Bahamas Archipelago, with its thousands of islands and inlets, came to be a popular staging area for these raiders.

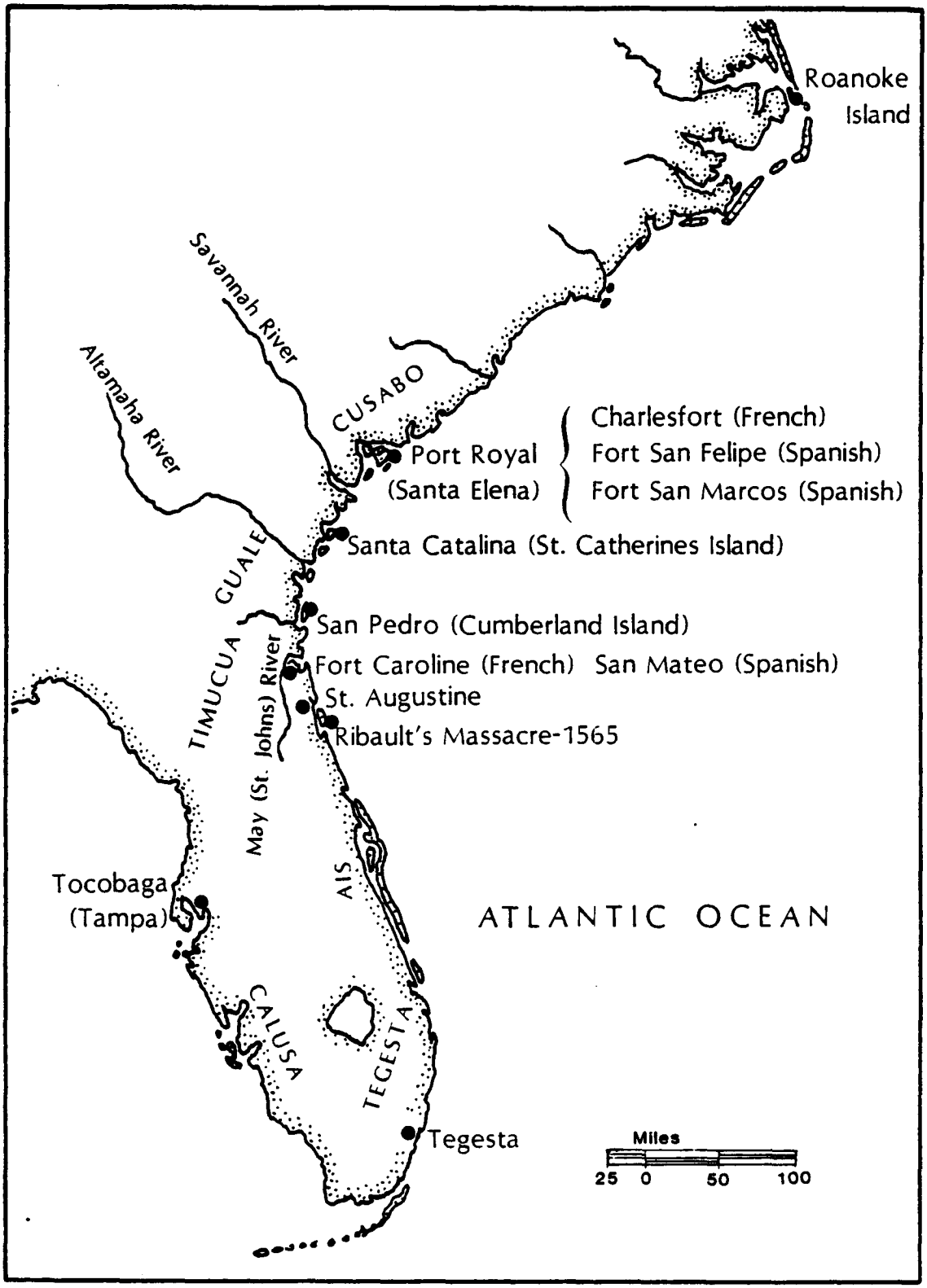


Figure 4.3.6 Florida French and Spanish Settlements 1562-1588
(After Kogan, 1966)

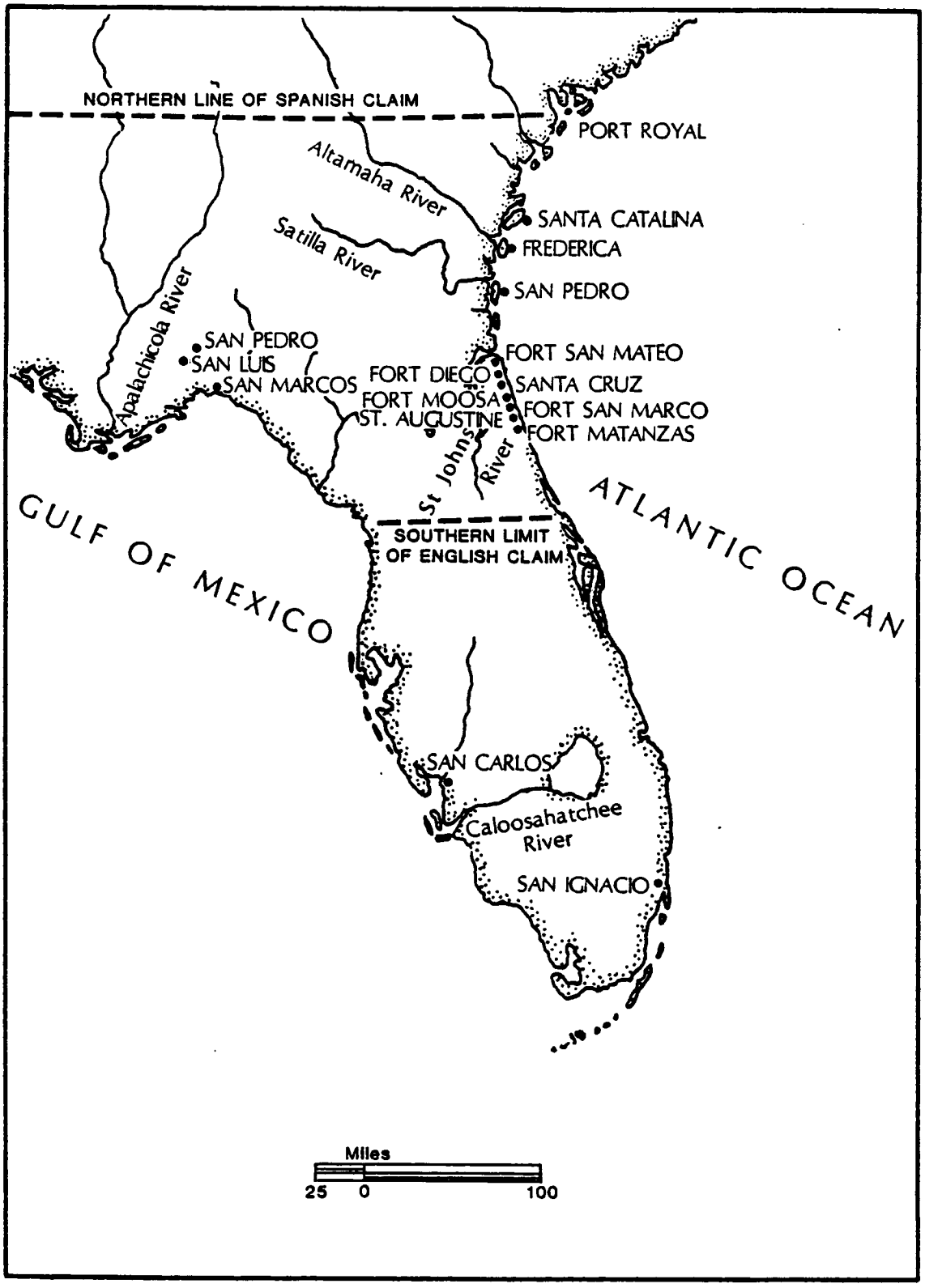


Figure 4.3.7 Spanish Florida 1670-1763
(After Adams, 1943)

As the 16th century ended, the English began their efforts to colonize the eastern coast of North America. While their initial effort at Roanoke Island in North Carolina failed, a permanent settlement was soon established at Jamestown, Virginia. During the first half of the 17th century, the English colonies in the Chesapeake Bay area grew in economic strength and population. The expanding English sphere of influence, which encountered no serious resistance, spread southward. Settlers soon were migrating into the Carolinas. This coastal strip was first settled by these colonists during the middle of the 17th century. Settlement along the Georgia coast soon followed (Figure 4.3.8).

Settlement in the Carolinas and Georgia was concentrated along the coast because of the preeminence of maritime communication routes over those on land. Roads were virtually nonexistent, and the several navigable rivers of the area became the primary means for transporting both goods and people. The Carolina colony was chartered by the English King in 1663-1665, and the rate of settlement soon accelerated. In 1670, a town was established in present-day South Carolina on the Ashley River. This was shortly relocated to the confluence of the Ashley and the Cooper Rivers and the community began to grow. This marked the founding of the city of Charleston. Immigrants and slaves increased the population of the Carolina colony, which expanded westward and southward. To the south, this expansion encroached upon the Spanish sphere of influence, resulting in some border-area warfare.

The vigorous expansion of the English into the Sea Islands along the Georgia coast coincided with weakening Spanish influence in the area. In 1686, the Spanish evacuated all of their settlements and missions north of the St. Marys River, leaving the southern portion of the Georgia coast without European settlements for the next 35 years.

The withdrawal of the Spanish from Georgia reflected the general decline of Spanish power and influence in other areas of the New World as well. This was particularly true in the West Indies, where the appearance

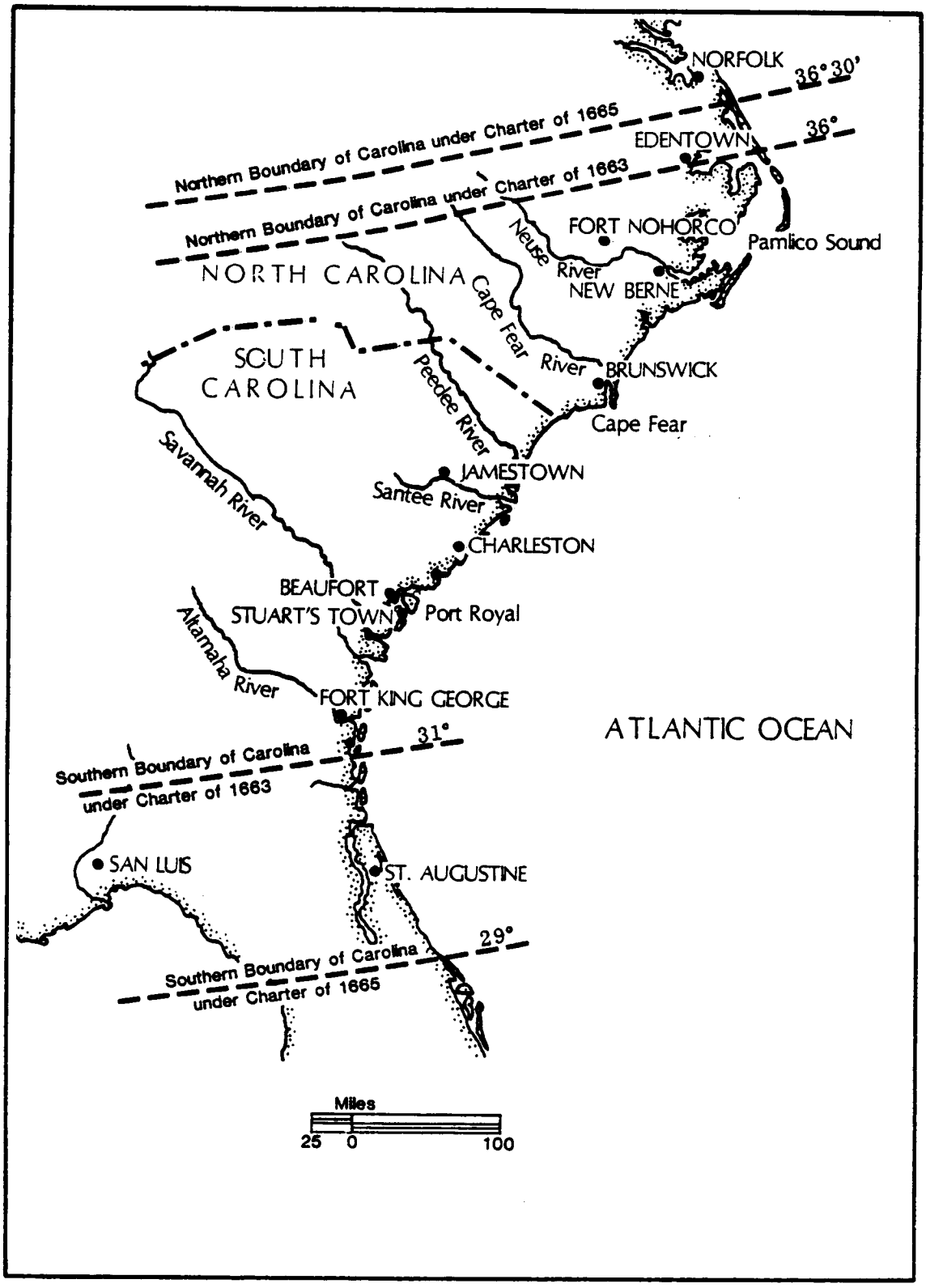


Figure 4.3.8 Coastal Settlements in the Carolinas 1663-1729 (After Adams, 1943)

of the buccaneers intensified the maritime predatory activities begun by the French in the previous century. The buccaneers, operating from bases in the Caribbean and the Bahamas, crippled Spanish maritime commerce. The flota system provided some protection from these sea-rovers but there was no protection at all from hurricanes.

During Period I, a large number of vessels, including entire flotas, were lost to hurricanes. Spanish efforts to salvage the cargo off these sunken vessels were often very successful. Examples of these major disasters were the losses inflicted on the flotas of 1622, 1623, and 1632. In the first of these, the Spanish Galleons Nuestra Senora de Atocha and Santa Margarita were sunk. Historical research and archeological efforts relating to these two wreck sites have been successful in determining the location of both sunken vessels and other lost ships of the 1622 flota as being off the Outer Florida Keys between Marquesas Keys and the Dry Tortugas and not in the Middle Keys as first thought (Lyon, 1976, 1979; Lyon & Mathewson, 1975; Mathewson, 1977a).

For the most part, the Florida east coast and the Florida Keys were the scene of very limited European activity; only the area immediately adjacent to the outpost settlement at St. Augustine was permanently occupied (Figure 4.3.9). The coastline to the south was, for the most part, left to the coastal Indians.

Throughout the first 200 years of the colonial period there were frequent shipping losses throughout the southern Gulf Stream region due to storms, warfare, or navigational errors. During this time there was an extensive utilization of small watercraft in both coastal and inshore waters (Manucy, 1965). Good roads in early America were almost nonexistent. The Coastal Plain of the southeastern states from North Carolina to Florida had many rivers, swamps, and tidal estuaries which made road building, bridge construction, and land travel expensive and difficult. Such formidable terrain virtually dictated the movement of heavy freight by water.

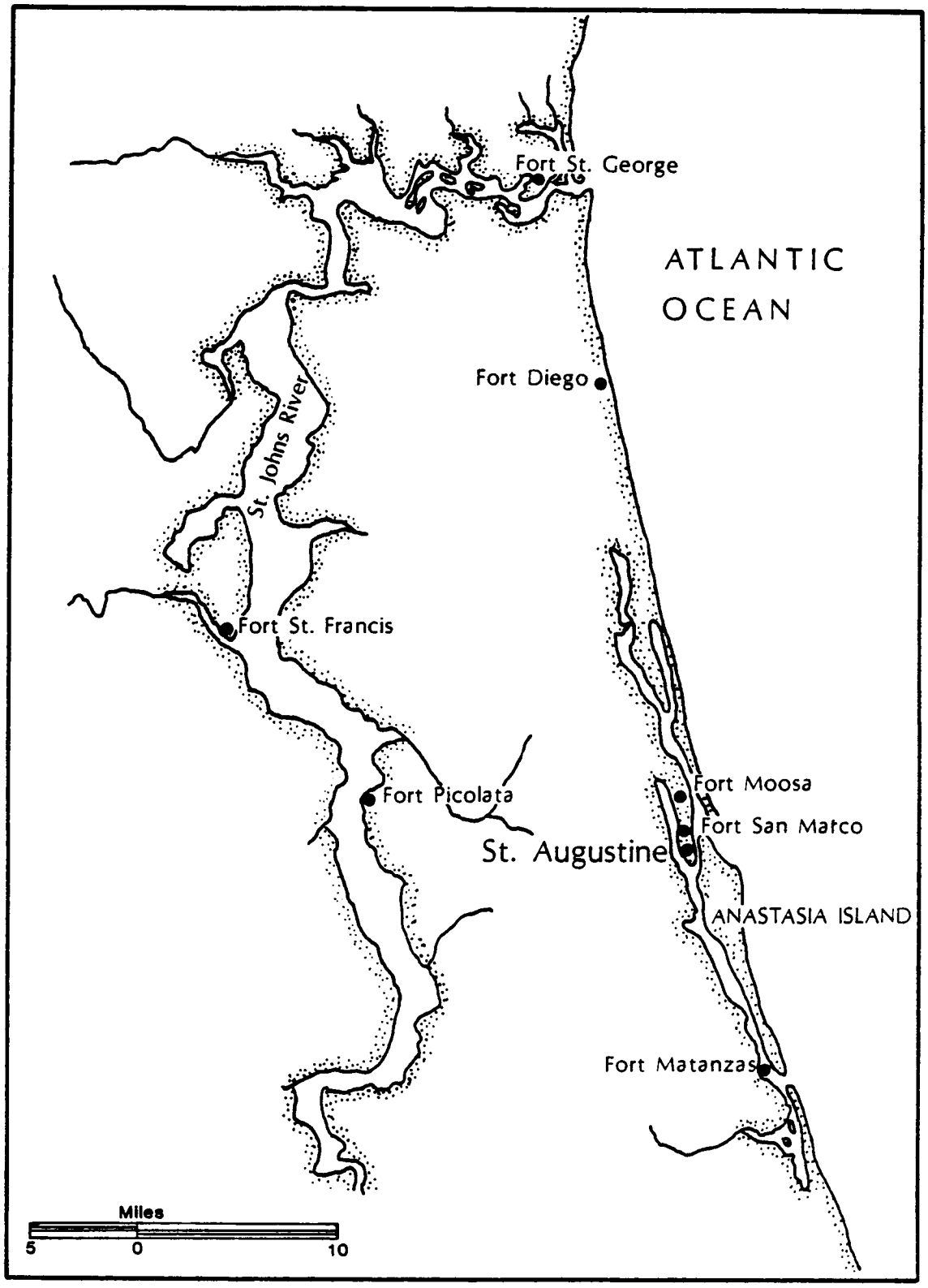


Figure 4.3.9 Coastal Settlements in the Vicinity of St. Augustine from 1700-1764 (After Kogan, 1966)

It was necessary to rely upon numerous small craft to provide a link from farms, factories, plantations, and mills to the larger towns and deepwater ports. To accomplish this the early colonists built numerous small vessels such as ketches, pinnaces, shallops and sloops. The most widely used single type of vessel was the sloop which was sometimes even used in offshore maritime trade and deepwater voyages (Baker, 1966).

Period II: 1701-1820

Throughout Period II, the Spanish presence in the study area continued to decline, while the population of the English colonies (and later the United States) vigorously expanded. The total volume of shipping during Period II steadily increased as trade between eastern North America and the West Indies became more developed and interdependent. In addition, large-scale wars occurred during this period, including wars between Spain and England, England and its colonies, and ultimately between the United States and England. Frontier development, population expansion, and economic growth resulted in considerable cultural change in the region's coastal zone (Fairbanks, 1976). In this era, before railroads and canals, when overland transport was both primitive and costly, use of coastal waterways remained the principal means of transportation.

The Spanish flota system continued to be the mainstay of maritime commerce between Spain's New World empire and the mother country. The major disasters in which entire flotas were virtually destroyed by hurricanes also continued. Two of the most prominent of these were the convoys of 1715 and 1733. The former was wrecked along the Florida east coast near Fort Pierce and the latter in the Florida Keys. The Galleon as a ship type was largely superseded by vessels which were larger, faster and easier to sail. Some of these vessels were well over 1,000 tons.

In the early decades of Period II, English territorial expansion into the Georgia coastal areas provoked considerable concern

among the Spanish in Florida. In 1721, the first English settlement in present-day Georgia, Fort King George, was established. The lack of Spanish opposition and the potential wealth of the area led to the founding of the Colony of Georgia in 1733. Its first major settlement was at Savannah, which became an active port. Three years later, fortifications were erected on St. Simons and Cumberland Islands to the south (Figure 4.3.10). In addition, the Carolina colonies, founded in the later years of Period I, prospered, and grew in wealth and population at a steady rate (Figure 4.3.11).

Conflict between Spain and England in Europe erupted into war in the New World. In southeastern North America this became known as the War of Jenkins Ear, which lasted from 1739-1748. The major battleground in this region was the southern Georgia coast. In a series of raids and battles the English defeated the Spanish, and secured a firm hold upon the territory south, to the St. Marys River. With peace restored, settlement continued to expand and maritime commerce flourished.

Pirates were active all along the southeast coast during the 18th century. As the cultural descendants of the buccaneers, the pirates continued the practice of attacking merchant shipping. From ports in the Bahamas, the Carolina Outer Banks and Virginia, the pirates managed to capture many vessels before being suppressed.

Although privateering was another act of piracy, it was legally sanctioned. By definition, privateering only took place during wartime, when government officials granted privateering commissions to privately-owned armed vessels to capture merchant ships sailing under the flag of an enemy country. Privateering began during Period I, but became most common during Period II, when it was extensively practiced during all wars. Because of the great volume of shipping that was concentrated in the southern Gulf Stream region, a large number of vessels were taken by privateers.

Shipbuilding in the southern colonies never developed as extensively as it did in New England. Despite the presence of ample

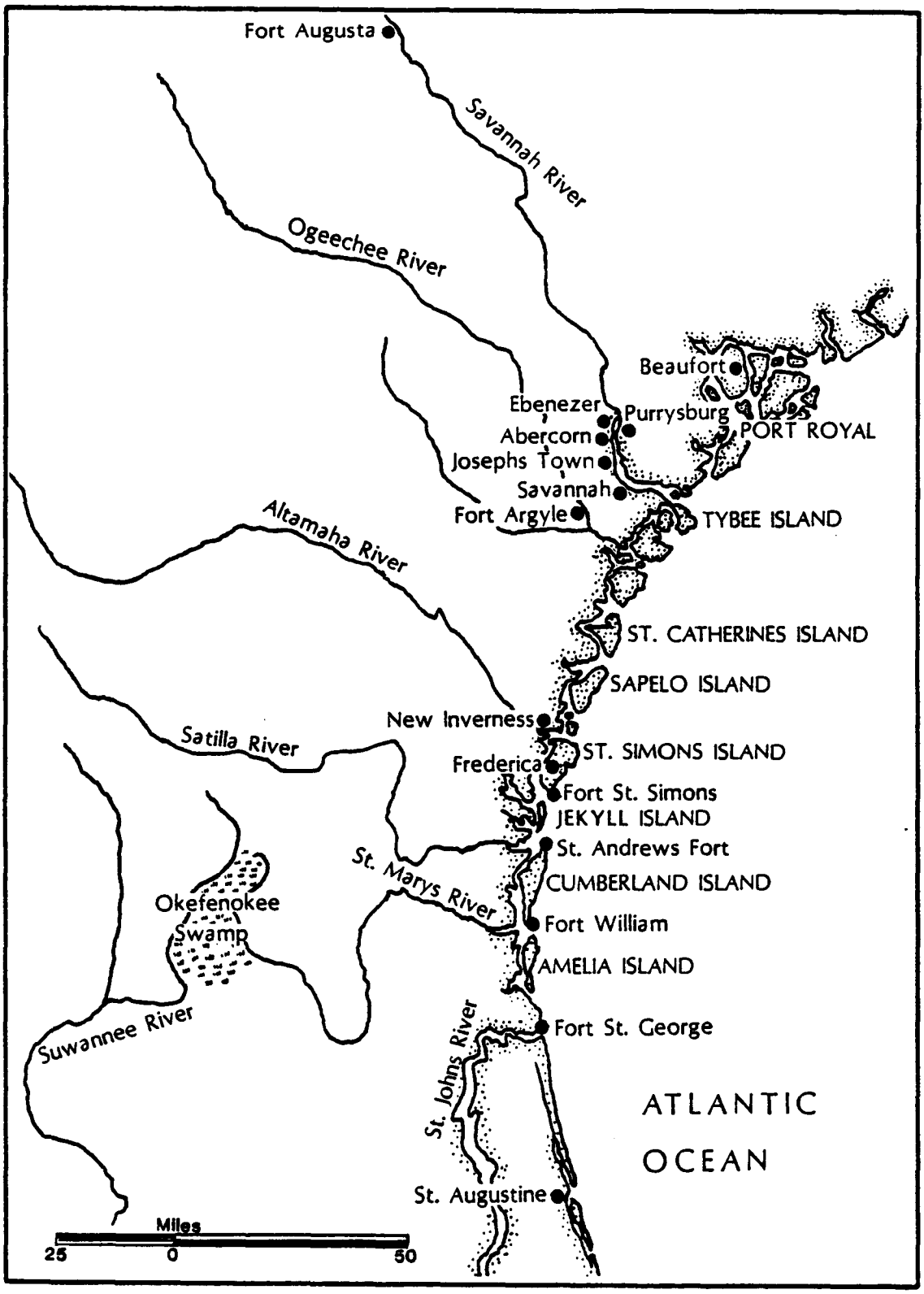


Figure 4.3.10 Settlements Along the Georgia Coast 1732-1755 (After Kogan, 1966)

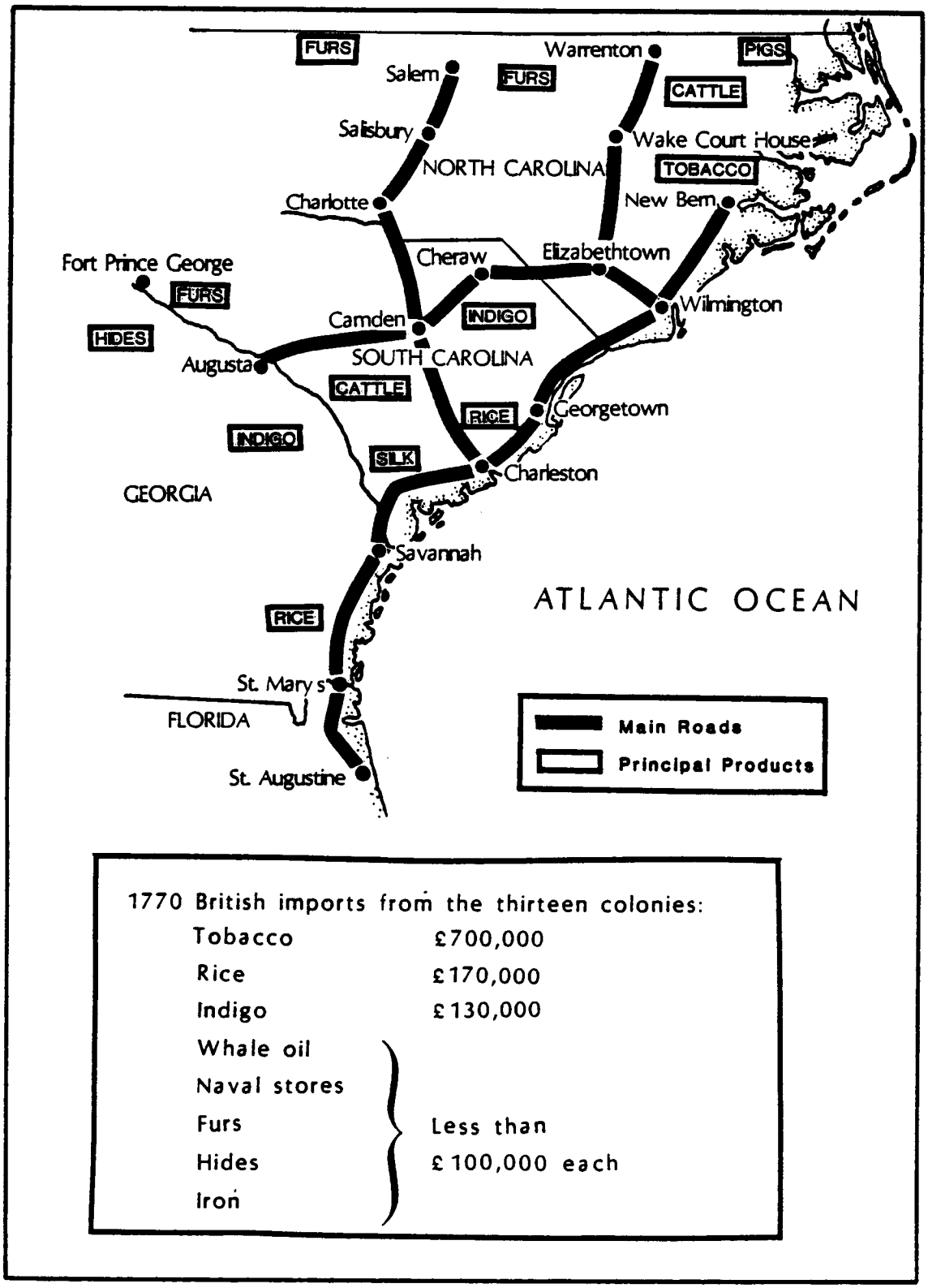


Figure 4.3.11 The Development of 18th Century Trade in the Carolinas (After Adams, 1943)

natural resources and skillful shipwrights, shipbuilding in the Carolinas did not develop to any great extent until the mid 18th century. Time spent on agriculture and the plentiful supply of ships from British merchants did not create an immediate demand for a local shipbuilding industry. Available documentary evidence suggests that shipwrights in the southern colonies concentrated on ship repairs rather than on organized building programs until sometime after 1730 (Goldenberg, 1976).

In 1720 most of North Carolina's maritime trade was conducted along coastal waters by New England sloops. Of the 229 vessels built between 1710 and 1739 which were trading with North Carolina, only 38 were built within the colony. Out of these 38 vessels, 33 were small sloops and schooners. There was a similar situation in South Carolina where shipping was generally ignored in favor of agriculture. British ships maintained a monopoly of the overseas commerce in the profitable cargoes of rice and deerskins bound for English ports. All 20 of the small vessels owned by South Carolinians in 1720 were involved in coastal trading (Goldenberg, 1976).

Economic conditions and political events in England during the early years of the 18th century caused a decline in the construction of merchant ships. This situation encouraged shipwrights to travel to other countries where work might be found more easily. In the early 1720's the English Board of Trade viewed shipbuilding in the American colonies as a desirable industry. Consequently, shipbuilding was encouraged throughout the colonies, both by government officials and English merchants. By 1730 one-sixth of the English merchant fleet was built in the American colonies (Goldenberg, 1976).

The most significant sailing vessel to appear during this period in American waters was the schooner, which could sail closer to the wind, and hence was more maneuverable than the older square-rigged ships. The schooner was fairly fast, and could be operated with a smaller crew than other square-rigged vessels (Baker, 1962).

Colonial craftsmanship developed rapidly in the major seaports where a large proportion of the urban population consisted of artisans. The construction of a 300- or 400-ton sailing vessel was the most elaborate product of colonial craftsmanship (Bridenbaugh, 1961). Two general classes of vessels were built in colonial shipyards. These were topsail ships of various types and rigs, ranging from 100- to over 400-tons used for the transatlantic deepwater trade; and sloops of various types for fishermen and coastal traders, and schooners. Twice as many sloops and schooners as topsail vessels were built (Bridenbaugh, 1961).

Vessel size grew rapidly and navigation aids such as lighthouses were constructed along the coastline. Of special significance was the establishment of the first marine register in the early 1760's by Lloyds of London, an insurance firm. Here, for the first time, was a roster of shipping with pertinent rating and ownership data. The earliest register listed over 3,000 sailing vessels along with their classification ratings, name of the master, tonnage, and short description of the vessel's construction features, number of crew, and place and year of construction. Officially called Lloyds Register of Shipping, it was the beginning of classification society register books and today provides a vital tool to the marine historian. American Marine Insurance had its beginning in Boston in 1724, and by the 1740's officials dealing with marine insurance were to be found in a number of east coast port cities.

The first American ship classification register was compiled in the year 1857 and provided much essential data on American shipbuilding. Much of the construction and cargo data for each vessel was included as well as ownership. Vessels generally were classed as ships, barks, brigs, schooners, and steamers.

Charleston, South Carolina soon developed into the single most important port in the English colonies south of Virginia (Figure 4.3.12). As shipping traffic increased, so did the number of vessels lost to the natural hazards of the Charleston area. Hurricanes in 1713 and 1728, two in 1752, and others in 1761 and 1781 sent a large number of ships to the bottom. The sandbars guarding the entrance to the harbor also

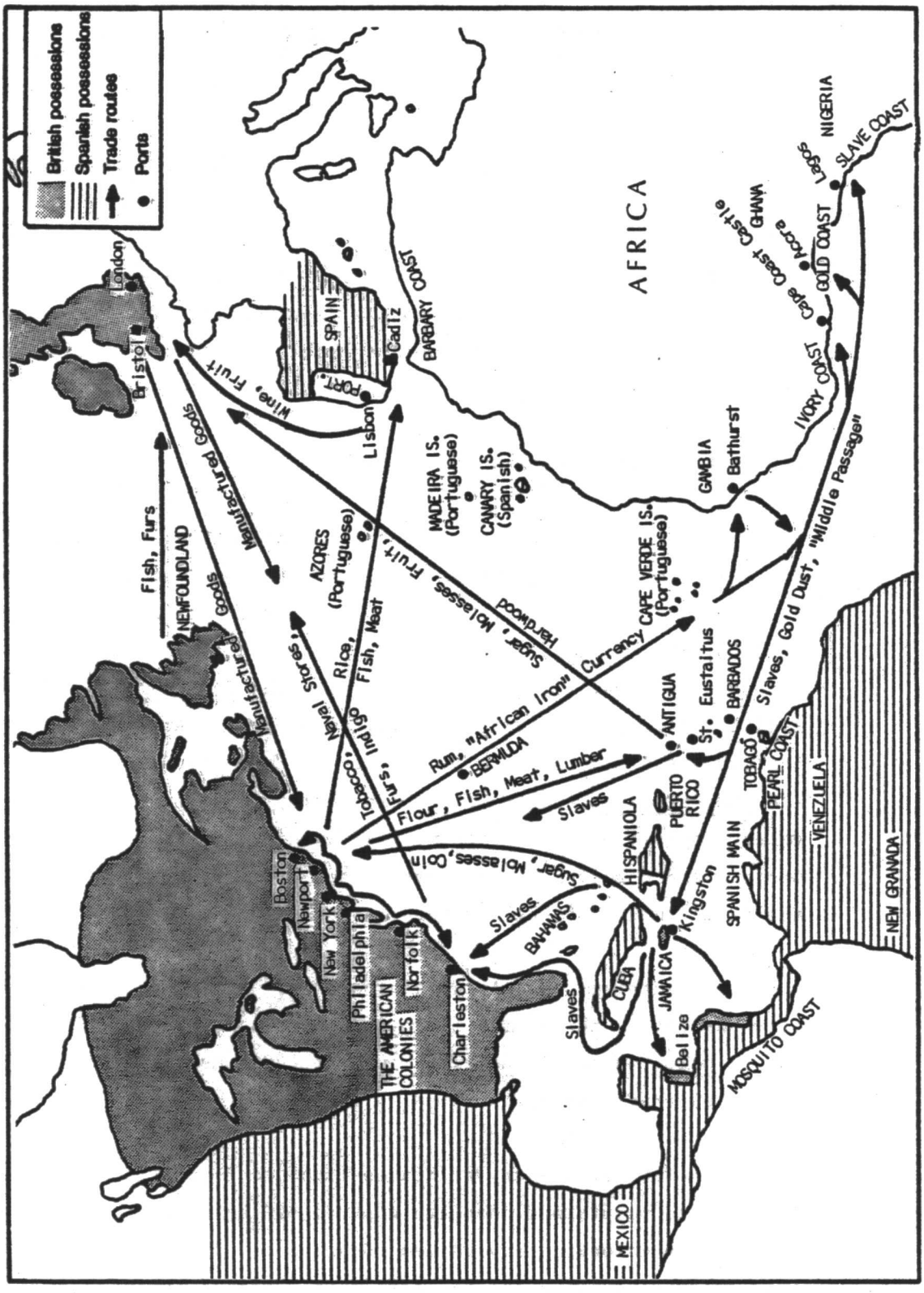


Figure 4.3.12 The Transatlantic Triangular Trade of the Late 18th Century (After Adams, 1943)

caused the loss of many others, such as the Scottish merchantman Rising Sun in 1700, the English merchantmen Caesar in 1750, and Speedwell in 1766.

By the mid 1770's, tensions between England and its colonies in eastern North America had become so divisive that broad sentiment had developed in the colonies for revolt. Inevitably, war broke out in 1776. The strategic and economic importance of the colonies of North Caronina, South Carolina and Georgia resulted in several campaigns and battles between the English and the American revolutionaries, who were aided by the French. In addition, the effectiveness of the English naval blockade of ports in the northern colonies served as an impetus to use the southern ports along the Carolina Coast.

The war in the southern colonies was fought both on land and sea. The two major seaports, Charleston and Savannah, soon became focal points of conflict. At the beginning of the American rebellion in 1776, HMS Jacteon, an English 28-gun warship, was burned in Charleston harbor (Figure 4.3.13). A smaller ship, the HMS Cruizer, suffered a similar fate off Charleston the following year. At Savannah, other British vessels were lost, including the HMS Rose, a ship of 20 cannon, and HMS Defiance, a ship of the line carrying 64 guns. American privateers operating out of the more isolated inlets and ports along the Georgia and Carolina coasts preyed upon British shipping. As a result, a sizable number of English vessels were captured or sunk.

American vessels were also lost. During a 1780 sea battle off Charleston, three American naval vessels were sunk. These were the Bricole (44 guns), General Moultrie (20 guns), and the Notre Dame (16 guns) (Marx, 1971).

Until the entry of France into the Revolutionary War, the British had maintained complete control of the waters off the Atlantic coast. The Colonial Navy varied considerably in size and effectiveness from state to state. For the most part, American ships were used for local defense and consisted mostly of small shallow-draft vessels such

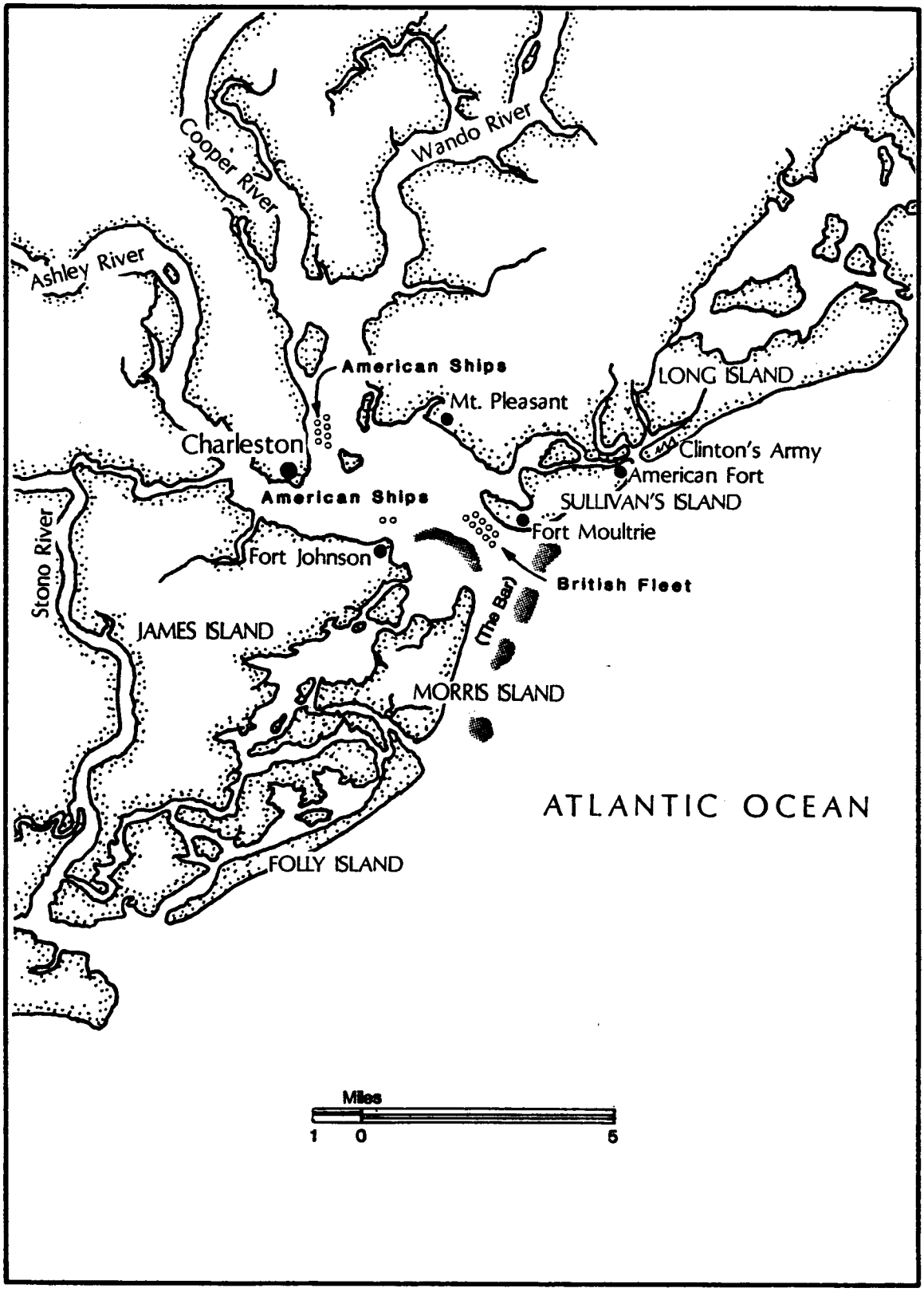


Figure 4.3.13 Charleston Harbor at the time of General Clinton's Invasion in 1776 (After Adams, 1943)

as galleys, gunboats, and barges capable of operating along shallow coastal waterways and river systems. They were ideal craft for protecting coastal waters, conveying troops, and transporting supplies. The galleys were generally about 50 feet long with a beam of about 13 feet with 10-15 oars on a side. Each galley was manned by not less than 30 men but no more than 50 men. They were armed with at least one 32-pound or 24-pound cannon. The gunboats and barges were a great deal smaller and were usually armed with a smaller 4-pound cannon (Coggins, 1969).

Although the South Carolina Navy was considerably smaller than that of some of the other northern states, it was very active throughout most of the war, despite a shortage of seamen (Table 4.3.2). Between 1776 and 1779, South Carolina vessels captured approximately 35 vessels in the waters of Carolina, Florida, and the West Indies. The following three vessels classified as ships were bought from France in 1780-81: Bricole (44 guns), Truite (26 guns), and South Carolina (40 guns). The Bricole and Truite were two of the four major state vessels which were lost to British ships when they attacked Charleston in 1780. The South Carolina had an armament of twenty-eight 32-pounders and twelve 12-pounders, but was captured by the British in 1782. Two years earlier, three Continental frigates, Boston, Providence, and Ranger, were taken off the Carolina coast by the British fleet prior to its assault on Charleston. The frigate Queen of France, which was purchased from France in 1777, was one of the ships American forces sank in 1780 as a navigation obstruction during the British attack on Charleston (Coggins, 1969).

During the Revolutionary War North Carolina was primarily concerned with providing protection to commercial ships trying to enter the Ocracoke Inlet. Three brigantines -- Washington, Pennsylvania Farmer, and King Tammany -- were obtained for this purpose. In 1778 the ship Caswell was bought from Virginia to assist in the protection of the Inlet, but sank in 1779. The previous year the sloop Independence, purchased from France, was also wrecked while protecting the Inlet (Coggins, 1969).

Georgia contributed very little to the Continental Navy. A 10-gun schooner was used briefly in 1775. In 1777 four galleys were

Table 4.3.2

The Navy of South Carolina

Acquired 1775

| | | | |
|---|---|---|---|
| Commerce | sloop | Defence | schooner |
| Comet | schooner | Prosper | ship |

Acquired 1776

| | | | |
|---|---|---|---|
| Peggy | schooner | Rattlesnake | schooner |
| Notre Dame | brigantine | | |

A number of galleys were built. Among these were:

| | | | |
|---|---|---|---|
| Congress | South Edisto | Revenge | Beaufort |
| Lee | Marques de Bretigny | Carolina | Rutledge |

Other vessels commissioned included:

| | | | |
|---|---|---|---|
| Beaufort | brigantine | Hornet | brig |
| General Lincoln | brigantine | Wasp | brig |
| Ballony | brigantine | Polly | schooner |
| Sally | schooner | Eshe | schooner |
| Anthony | schooner | Nancy | schooner |
| Three Friends | schooner | General Moultrie | schooner |
| Lovely Julia | schooner | Count de Kersaint | sloop |

After Coggins, 1969.

built: two of these, Washington and Bullock, were stranded and set on fire, while the other two, Lee and Congress, were captured in 1779 (Coggins, 1969).

In the aftermath of the American Revolution the economy of the United States adjusted to the newly-won independence. The invention of the cotton gin, and the successful cultivation of a special strain of cotton, led to the rapid development of a plantation economy based upon that product (Figure 4.3.14). The political freedom and economic opportunities of the new nation attracted a steadily increasing number of immigrants. The products of the interior were transported to the coasts, where they were shipped to other ports of the new country or to destinations overseas. In return, the products of other nations and their colonies entered the new country through its coastal ports.

The politics of Europe, with its cycle of wars, was never far away. With the United States favoring free trade as a means to prosperity, its ubiquitous vessels could not avoid European conflicts. In particular, the practice of the British navy in stopping American ships and seizing seamen for service on British vessels caused widespread resentment. For a time during the late 18th century, there was also an undeclared naval war with France. Ultimately, the United States came to declare war against Britain in the conflict known as the War of 1812. That war led to a resurgence in American privateering, which caused extensive losses to the British shipping which used the Gulf Stream route from the West Indies to England.

With the outbreak of the War of 1812, the British set up a blockade from New York to Savannah which became increasingly effective during 1813. In 1814 the blockade was extended to the New England coast. During this time a total of 15 ships of the line (74 guns), 27 frigates (20 to 50 guns) and numerous sloops (18 - 20 guns) and gunboats were employed in the Atlantic Blockade. The strength of this blockade was focused on cutting off maritime trade out of New England ports. In 1814 the blockade south of Chesapeake Bay consisted only of two frigates, one sloop, and a brig stationed off Charleston and Savannah.

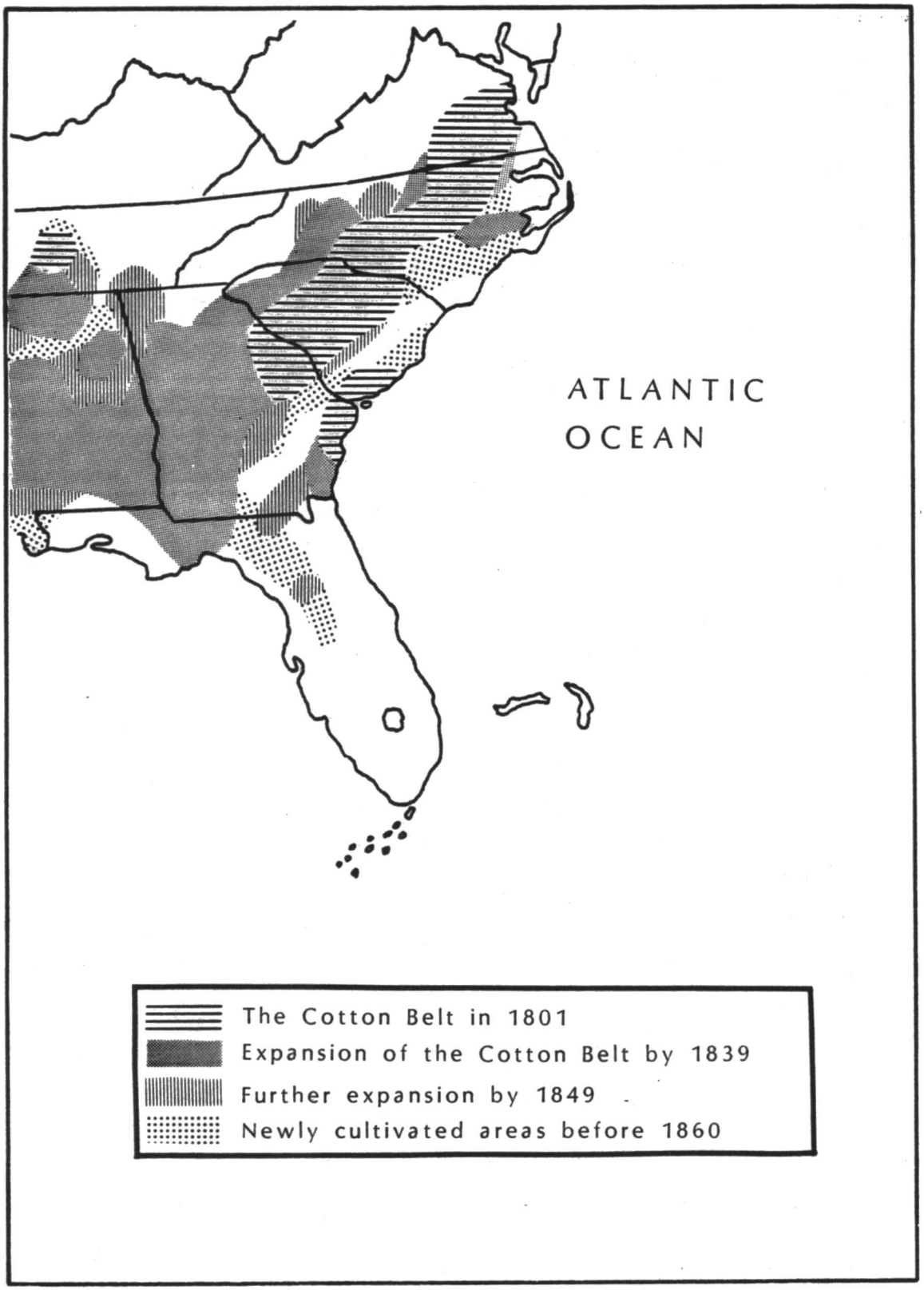


Figure 4.3.14 The Expansion of the Cotton Belt Along the Southeast Coast Prior to the Civil War (After Adams, 1943)

At the conclusion of the war, Britain agreed to stop interfering with American maritime commerce. By this time, economic development along the Carolina and Georgia coasts had accelerated. Commerce had been hindered by the war, but now with the war ended, new coastal mercantile enterprises began to flourish. One result of the rapidly-developing economic prosperity was the great expansion in shipbuilding in the United States. This industry, which had developed apace with other sectors of the economy during colonial times, was now to undergo a major expansion to provide the transport for America's growing overseas commerce.

Since the early colonial period, the Outer Banks have played an important role in the maritime commercial development of North Carolina. The continous stretch of underwater sand bars and high coastal dunes from the Core Banks to the Virginia boundary have formed a barrier blocking the passage of large transatlantic vessels from entering Polmico Sound (Stick, 1958). At different periods inlets would open and close as the result of wave action during hurricanes. Old Hatteras Inlet is believed to have been closed after an English vessel sank in the channel and sandy shoals began to buildup around the hull.

Between the Core Banks and Cape Hatteras there have been ten different inlets which remained open for significant periods. Of these only Ocracoke Inlet has been open continuously throughout the historical period. The summary below provides a guide as to the different time periods small coastal vessels and shallow draft Transatlantic ships were able to pass through the major inlets in the study area (Stick, 1958).

| Common Name | Other Names | Location | Opened | Closed |
|---|---|---|---|---|
| Hatteras | — | W. of Hatteras | 1846 | still open |
| Wells Creek | West | Ocracoke Island | 1840's | 1850's |
| Old Hatteras | Hattaras<br>Passage<br>de Hattarxis | Ocracoke Island | pre-1657 | 1750's to<br>1760's |
| Ocracoke | Wokokon<br>Wosoton<br>Okok<br>Ocacock<br>Octacock | W. of Ocracoke<br>Island | pre-1585 | still open |
| Whalebone | — | Portsmouth Island | 1860's | early 1900's |
| Swash | — | Portsmouth Island | 1930's | still open |
| Drum | — | Core Banks | 1930's | still open |
| Cedar | Porters | Core Banks | 1808 | 1830's |
| Normans | Hunting<br>Quarter | Core B anks | 1730's | 1730's |
| Old Drum | — | Core Banks | 1730's | late 1700's |

The Florida coastal areas during the latter part of this period were still sparsely inhabited, except for settlements at St. Augustine and New Smyrna. From there south, European influence was minimal. The Florida Keys were also unsettled by Europeans throughout most of Period II. Near its conclusion, however, seafaring people from the Bahamas and New England became interested in the area for the many wrecks that were occurring there. This interest was to result in immigration, about which more will be discussed in the following section. The Florida Coastal areas were frequented by salvors and pirates, who either sought to recover material from wrecked ships or to plunder suitable vessels that passed through the area.

The major event that brought Period II to an end was the sale of Florida by Spain to the United States. This transfer brought the entire coastline from Key West northward under United States dominion, and accelerated its settlement and development. Toward the end of the period 1701-1820, various steampowered vessels were constructed and tested but did not supersede the sailing vessel until well into the 19th century.

Period III: 1821-1865

During this time the coastal zones of the Carolinas underwent development that had begun a century earlier. Shipping activity increased all along North Carolina. In 1836-37 figures show that more than 1,400 ships passed through Ocracoke Inlet in a 12 month period. With the opening of Hatteras and Oregon Inlets in 1846 more and more ships began to use these ship channels. By the Civil War almost all ship traffic through the Outer Banks had switched from Ocracoke Inlet to Hatteras Inlet.

The Georgia coast to the north during this period was undergoing intensive agricultural development, as cotton, sugar, and rice plantations prospered. With its economy based upon slave labor, and its products commanding high prices, both in the United States and abroad, the Georgia Sea Islands became a major center of maritime activity. The ports of Charleston and Savannah grew rapidly, bringing

wealth to the maritime businessmen headquartered there. The area to the south of Georgia still remained unsettled. Migrating Amerindians known as Seminoles, driven from Georgia in the early 18th century, sought refuge in Florida. Runaway slaves mixing with these indigenous peoples resulted in the ethnic amalgamation known as the "Spanish" Indians. For the most part, in 1820, the Florida coast still remained outside the effective control of the United States government.

In the Florida Keys an interesting cultural phenomena was taking place. It came about as a result of the naval campaign to suppress the last bands of pirates operating in this area and along the coast of Florida. Once Key West was occupied by the U.S. Navy and a base established there in 1821, a settlement of immigrants from the Bahamas soon developed. These people were cultural and perhaps lineal descendants of the English pirates of New Providence. Their way of life involved the salvage of goods and the rescue of people from vessels wrecked on the reefs of the area. While ethnically they came to be known as "Conchs," the name associated with their livelihood was "wreckers" (Shepard, 1961). They were the first pioneers of south Florida, and from anchorages at Key West, Indian Key, Vaca Key (Marathon), Tavernier Key, Rock Harbor and Cape Florida, they ranged throughout the area. The Seminoles of the Florida territory during these years resisted the expansion of the authority of the United States government. Warfare soon resulted, and the series of wars known as the Seminole Wars took place from 1839-1842. The military activities associated with the Seminole Wars led to an intensification of American control of the Florida coastal zone. A chain of fortifications were built, several of them along the coast. Locations such as Fort Pierce, Fort Lauderdale, and Fort Dallas (Miami) became centers of military activity, and eventually pioneer settlements were established nearby.

It was during this period that the highest development of the American sailing merchant vessel was attained. Based upon a long tradition of naval architecture, the clipper ship was perfected, and became a mainstay of American overseas trade. The building of the

first oceangoing steamship, the Savannah, heralded the dawn of a new age in international commerce. Within only 44 years, steampowered vessels evolved from an experimental concept to practical, reliable, working vessels. By 1835 at least three steam vessels had crossed the Atlantic, but none of these did so exclusively under steampower alone; all three were aided by sail. It was not until 1838 that a ship made this trip powered exclusively by steam. Even after the demonstrated feasibility of steampower for ocean crossing, many vessels still carried sail to supplement their engines. It is interesting to note that the original building specifications of the famed USS Monitor called for the inclusion of masting and sails by a doubting Navy Department.

In 1835 some 700 steampowered vessels were operating in American waters, many of which were employed in coastal or inshore commercial traffic. By 1836, inventor John Ericsson had successfully developed the screw propellor, a major milestone in the development of marine transportation. The shipping industry of the United States underwent a tremendous technological development and expansion during Period III, securely establishing the United States as a major maritime mercantile power.

With the tremendous expansion of the American shipping industry there came an increase in the number of vessels lost as well. The development of steamship technology led to the construction of many small fast vessels, several of which entered the lucrative Atlantic coastal packet trade. As years passed, storms and accidents caused the loss of many ships such as the Home 1837 and the Pulaski in 1838 off the North Carolina coast, with the loss of hundreds of people. While the majority of vessels afloat during this period were powered by sail, the great steamships were the ocean liners of the era. One of the most famous of these was the Central America, which foundered off the Carolina coast in 1857.

In 1861, the first shots of the Civil War were fired at Fort Sumter in Charleston Harbor. A major element of the strategy of the Union side was to blockade the coastline of the Confederacy. The

purpose was to stifle its commerce and cut off the importation of military supplies. Beginning in 1861, the blockade was to become steadily tighter and more effective as more Union naval vessels were added to increase the strength of the blockading squadrons. Confederate strongholds in the coastal zone were steadily captured, neutralized, and occupied (Figure 4.3.15).

The Carolina and Georgia coast was a major theater of action from very early in the Civil War. In August, 1861, Hatteras Inlet in North Carolina was captured through naval bombardment and amphibious attack by Union soldiers. Port Royal, South Carolina, was occupied in November 1861, and became an important base for the blockading squadrons. Fort Pulaski, at the entrance to the Savannah River, fell to the Union in 1862, as did St. Augustine. Throughout the war, the military activity off the Carolina and Georgia coast was intense, with the United States forces steadily tightening their hold, strangling the Confederacy.

With its economy so dependent on overseas trade, the Confederacy relied heavily on the cargoes brought in by blockade-running vessels. While in the early months of the war most blockade runners completed their voyages safely, losses mounted as the blockade became more effective. A sizable number of these blockade runners were captured, and dozens more were sunk or wrecked while trying to elude the Union Navy (Shomette, 1973).

Attempts at blockade running during the Civil War resulted in numerous wrecks along the coastline of the Carolinas, some of which can be seen today in North Carolina along the beach and a short distance off shore. The physical survival of these vessels over a span of over 100 years has been attributed to various factors, one of which was the use of a special grade of charcoal iron in the hull. These dated wrecks, along with their cargoes, are of great interest to marine archeologists (Table 4.3.3). Among these important Civil War wrecks off the North Carolina coast is the Modern Greece which is one of the few blockade runners studied by state archeologists (Bright, 1973). Another interesting vessel is the USS Peterhoff sunk off Smith Island while blockading the Cape Fear River, this shipwreck site has been listed on the National Register of Historic Places.

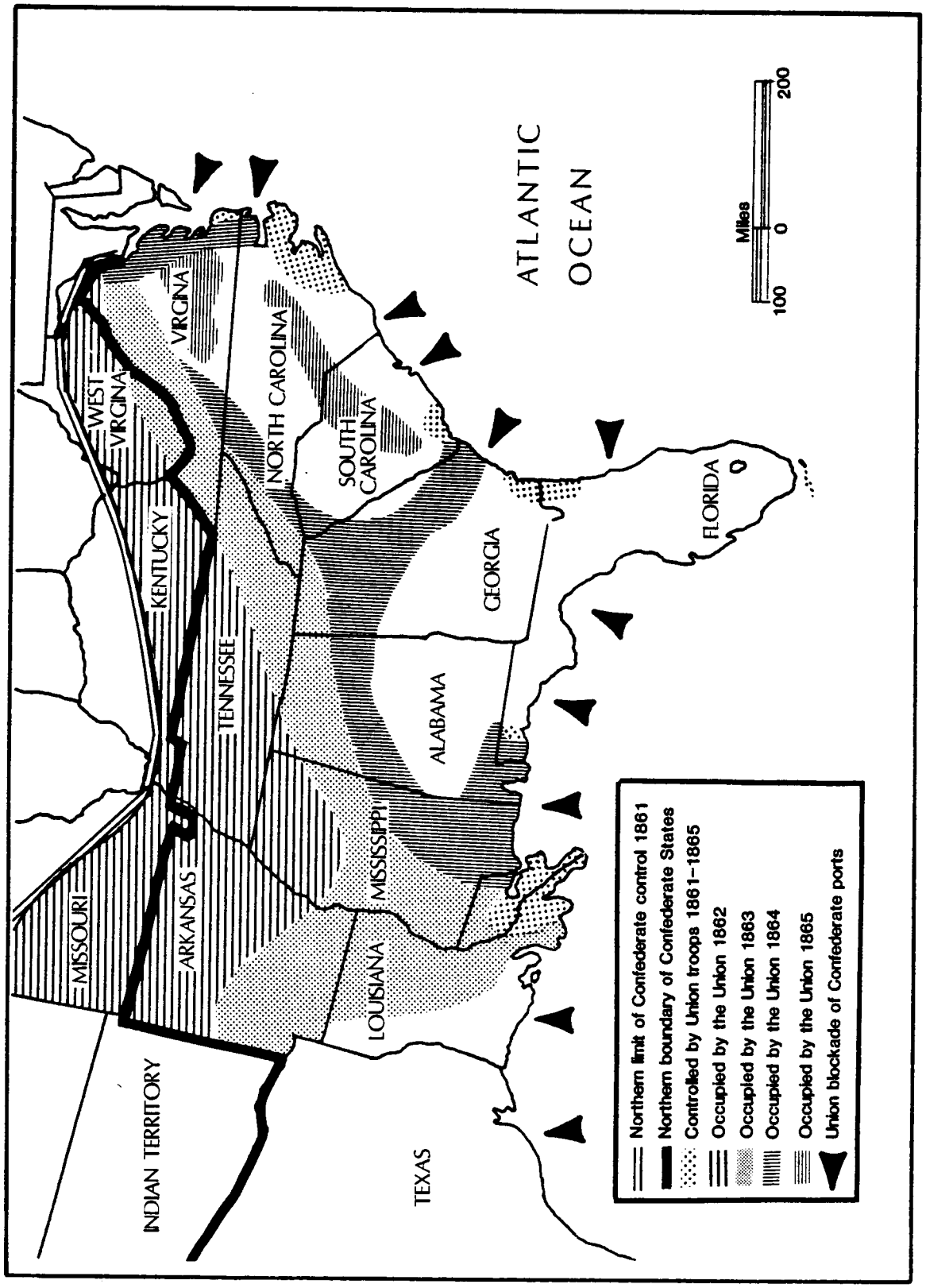


Figure 4.3.15 The Union Advance 1861-1865
(After Adams, 1943)

Table 4.3.3

Summary of The Types of Vessels Lost in The Study Areas From Naval Action During the Civil War
(Donald Shomette, personal files obtained March 1979)

| State | Union Navy | Union Commerce | Conferate Navy | Conf. Commerce | Total |
|---|---|---|---|---|---|
| Florida (includes Gulf Coast) | 9 | 1 | 8 | 28 | 46 |
| Georgia | 8 | - | 11 | 5 | 24 |
| South Carolina | 32 | - | 11 | 29 | 72 |
| North Carolina (includes North of Cape Hatteras) | 23 | 1 | 28 | 62 | 120 |
| Total | 72 | 2 | 58 | 124 | 262 |

Another major development in maritime affairs was the development of ironclad warships on a significant scale. The most radical new warship design to emerge was the Monitor-class of vessel. This was ultimately to revolutionize naval warfare. Several monitors were lost during the course of the war, as were several Confederate ironclad warships such as the CSS Georgia in the Savannah River.

The USS Monitor itself foundered at sea southeast of Cape Hatteras in 1862. The location of this was confirmed in 1973 (Watts, 1975), and since then has been listed on the National Register of Historic Places. In 1977 a maritime sanctuary was established to further protect this site as plans were formulated for the possible recovery of the vessel remains (Childress, 1977; 1978; NOAA, 1979c).

A relatively minor, but none the less significant development was the use of semi-submersible "torpedo boats" by the Confederacy. On February 17, 1864, the USS Housatonic was sunk while on blockade duty by the CSS Hunley. In so doing, the Hunley became the first submarine to sink a major war vessel under combat conditions. The CSS Hunley is located somewhere on the Charleston Bar. Although its exact location is uncertain, it has been placed on the National Register of Historic Places in an effort to protect it.

A great number of steampowered and sailing vessels were casualties of the war, but storms and accidents accounted for others as well. Examples of such losses were the USS Patapsco, a monitor sunk in 1865 by a Confederate torpedo, and the USS Weehawken, another monitor, which was lost due to accidental capsizing. Both of these vessels, as well as many others, were lost while on blockade duty at Charleston, South Carolina.

Many ships were scuttled during the blockade of southern ports. Perhaps the most famous of these were the vessels of the two "Stone Fleets." (See Appendix III A & B.) The first "Stone Fleet" consisted of a large number of old sailing vessels that were purchased by the Union Navy to be used in the effort to blockade Charleston.

These vessels were loaded with cargoes of rock, and scuttled in 1861. The second "Stone Fleet" was sunk in 1862 in another attempt to block the shipping channels. The effort was less than a success, as the vessels quickly settled in the mud and did not prevent the passage of ships through the channels.

## Period IV: 1866-1916

In the period following the Civil War, a great deal of effort was devoted to rebuilding the shattered economy of the South. The plantation system was dead, and a more diversified one developed in its place. Shipping facilities and channels had to be repaired and cleared of obstructions so that maritime commerce could again operate freely.

To replace the agricultural products which formerly were the area's major export, other goods and services were marketed. Notable among these was lumber, which became a major export from the Georgia coast. Another aspect of the area's economy which began to grow during this period was tourism and resort development. By the 1870's the Sea Islands had begun to be visited by people attracted to its pleasant climate and natural beauty. The construction of the Florida East Coast Railroad opened up the Florida coastal zone to agricultural, industrial, and resort development. Before long, Palm Beach became the first major Florida resort community along the east coast.

The Carolina coastal zone was undergoing major changes as well during Period IV. Fin and shellfishing, turtling and even whaling, were all significant activities in the economy of this part of the coast. The concern of the United States government over the large number of vessels that were being wrecked along its coasts led to the establishment of the United States Lifesaving Service. Lifesaving stations were constructed and manned at strategic and hazardous locations along the coast from Cape Hatteras to southern Florida. Existing lighthouses were improved and new ones built at a number of points along the coast.

The improvement and expansion of the inland transportation network in the southeastern United States served as an impetus to increased urbanization in the coastal zone. The expense of transporting goods to the coastal ports became less burdensome, further stimulating economic growth. Industrial facilities were established in coastal[ areas, where the raw materials of the interior could be manufactured into finished goods ready for shipment.

Marine technology was undergoing a rapid evolution, as steampower steadily demonstrated its superiority to sail in maritime commerce. In the early decades of Period IV, this change was relatively slow, as the high cost of the new steampower technology meant that sailing vessels could still be economically competitive. This was particularly true in the coastal and overseas transport of low-cost bulk cargoes such as coal, timber, and building materials. While coastal trading schooners were in widespread use during this period, they would become increasingly rare in the period to follow.

Despite the rapid development of steampowered vessels and the improvements in marine engines in the period just after the Civil War, the total number of steampowered vessels did not exceed sail-powered ships until 1893. By the year 1899 however, there were still approximately 14,000 sailing vessels registered with the U.S. Commissioner of Navigation.

The importance of maritime affairs to the United States continued to expand. This resulted in the United States Navy's becoming a leader in the development of ship design and technology. It was during this period that the complete transition from sail to steam was made for the Navy's warships. Besides the system for powering vessels, these changes involved major improvements in ship design, armament, and support facilities. Merchant shipping also took on its modern form during Period IV, as steel-hulled steampowered freighters and passenger liners came into common use.

Period V: 1917-1945

In 1917, after 3 years of official neutrality, the United States entered World War I on the side of the Allies. In the southern Gulf Stream region, the major impact of the war was to stimulate industrial production and the volume of shipping in response to the needs arising from the conflict. Therefore shipping losses in the area were due to the normal peacetime causes.

Due to the late entry of the United States into the First World War, German submarines never presented a real threat to shipping along the coast; only two sinkings attributed to submarine attacks have been noted in the study area. One of the most notable of these was the sinking of the Hatteras Lightship and the other was the Diamond Shoals Lightship in 1918. Two enemy submarines were also sunk off Cape Hatteras.

In the period after the World War I, the use of sailing craft in the area's maritime trade entered its last phase. The vulnerability of such vessels to adverse weather conditions had always contributed to their substantial loss rate.

Along the North Carolina coast shipwrecks were becoming a rarity by the 1920's. Maritime traffic through the Outer Banks was confined largely to small fishing vessels. By this time steamboat lines had ceased operating in Polmico Sound (Stick, 1958).

After the war, another decrease in American shipbuilding occurred. From 1922-1938 very few shipbuilding companies remained in business. During this period there were no Class I shipyards along the South Atlantic coast capable of building oceangoing vessels over 400 feet in length (Lane, 1951). As an initial response to the increased shipping needs, which occurred at the outbreak of World War II, shipbuilding expanded. In 1941, Wilmington was selected among other cities to help launch the emergency shipbuilding program to develop more ships for the lend-lease program. After the Japanese attacked Pearl Harbor, new shipyards were developed in several waves of expansion along the

southeast coast. In 1942 shipyards in Savannah, Brunswick, and Jacksonville began to construct Liberty ships, freighters, tankers, and Victory ships (Lane, 1951).

In 1919 the Prohibition Era began, as the sale and consumption of alcohol was made illegal. Demand for liquor continued, however, and soon an illicit industry in manufacturing and importing alcoholic beverages was developed. In the Southern Gulf Stream region the smuggling of liquor became a major business, particularly along the south Florida coast. With the distilleries of the West Indies processing much of that area's sugar production into rum, the illicit importing of that drink soon became widespread. "Rumrunners" loaded their vessels with liquor in safe ports in Cuba and the Bahamas and sought to elude the blockading vessels of the United States Coast Guard. They were often successful, despite frequent losses due to capture or shipwreck.

The era of prosperity following the end of World War I was short-lived, and America passed into the years of the Great Depression. Economic expansion and development were severely curtailed throughout the southeastern coastal area. One aspect that did expand, however, was the tourism industry. During this period Miami began to attract a substantial number of visitors. The completion of the railroad line between Miami and Key West in 1912 initiated a major change in the Florida Keys. While the railroad in the Keys was destroyed by a hurricane in 1938 and ceased to function, its roadbed and bridges were soon adapted for use by automobiles.

In the late 1930's the aggressive policies of the Axis powers finally erupted into war. Once again, the cultural and economic ties of the United States drew it closer to the side of the Allies. In 1941, Pearl Harbor, Hawaii, was attacked by the Japanese, and the United States formally entered World War II. Within a short period, shipping in the southern Gulf Stream area came under heavy attack from German submarines, resulting in major losses to the merchant marine of America and its allies. The development of aggressive defensive measures by the United States Navy soon resulted in a substantial reduction in sinkings, and the destruction of several of the attacking U-boats.

The First and Second World wars were responsible for shipping losses off the coasts of North and South Carolina, Georgia, and Florida. The activity of German submarines during World War II was significantly greater along the east coast of the United States. By taking advantage of constricted shipping lanes along the shallow shoals of Cape Hatteras, Cape Fear, Cape Canaveral, and the Florida Keys, the U-boats were able to concentrate their attack on a great number of ships within relatively small areas. During the first year of the War, American shipping along the east coast lost over 1,000 ships (6.4 million deadweight tons) before strong escorts were employed to protect the convoys (Lane, 1951).

In the first half of 1942, German submarines sank 71 Allied merchant ships off the Carolina coast and 24 off the Florida coast (Lloyd, 1975). During the early part of the war there were no anti-submarine defenses; coastal communities did not institute blackouts until July 1942. Submarines were therefore able to surface at night, only a few miles offshore, and wait until ships were silhouetted against the glowing horizon. For this reason many of the ships sunk during this period lie offshore of such coastal cities as Morehead City, Wilmington, and Jacksonville.

By the end of 1942 the U-boat threat to shipping along the South Atlantic coast had diminished. From August 1942 to May 1943,only one merchant ship is known to have been sunk off the Carolina coast; during the same time period no sinkings were reported off Florida (Lloyd, 1975).

As anti-submarine technology improved during 1942 and 1943 along the South Atlantic coast, German submarines encountered more difficulty in attacking the convoys which stayed close to the coast. Improved tactics by the United States Navy resulted in the sinking of four U-boats off the North Carolina coast; among the German submarines sunk off American shores was the U-352. It attacked a United States Coast Guard cutter, which sank the U-boat offshore of Cape Lookout. Many ships were sunk off the Carolina Capes by German submarines during the early part of the year. In 1942 this area saw the sinking of several freighters and tankers, including Naeco, and John D. Gill off Cape Fear, and Atlas, Ashkabad, and Ario off Cape Lookout.

Period VI: 1946-1979

Period VI is best characterized by several technological developments, such as improved navigation systems, cargo containers for the transshipment of goods, and the development of supertankers. With the expansion of the industrialized economy, the exploration for natural resources intensified on the Outer Continental Shelf.

The discovery of gold and silver coins from the sunken Spanish galleons of the 1715 fleet off the coast of Florida in the early 1960's created widespread interest in shipwrecks. From that time onward, both sport divers and commercial salvage groups began to spend increasingly more time in locating and salvaging these wrecks. Archeologists were slow to expand their interest from land sites to shipwrecks just off the coast. Continued work by salvors on early galleon sites, long famed for exceedingly valuable cargoes of precious metals made archeologists soon realize that important archeological data was being destroyed. By the early 1970's it had become clear that archeologists and salvors had to cooperate with one another if shipwreck data was to be preserved. Interest now is growing in protecting these cultural resources.

Techniques for shipwreck location and identification improved after the Second World War. The development of Loran systems and the more widespread use of improved sonar systems made the search for sunken vessels easier. Wreck charts and lists published at the end of World War II were inaccurate. This point was well-illustrated by the United States Coast Guard when they searched the New Jersey Coast for three oil tankers sunk during the second World War. The tanker RP Resor was found 1/2 mile south of its charted position, while the tanker Varanger was located 1-1/2 miles Northwest of its charted position (United States Coast Guard, 1968).

### 4.3.3 Shipwreck Archeology

Modern archeological research on shipwreck sites began in the Old World in 1960 with the work of George Bass and Peter Throckmorton on

the Bronze Age wreck at Cape Gelidonya off the southwest coast of Turkey (Bass, 1961, 1962; Throckmorton, 1960, 1962). This joint research effort demonstrated for the first time the clear distinction between a rigorous scientific approach to the study of shipwreck sites and the unsystematic and oftentimes destructive recovery techniques which were to characterize much of the work conducted by commercial salvors, marine antiquarians, and non-diving archeologists throughout the 1960's.

From 1960 Bass, Throckmorton and their associates became the focus of a whole new approach to shipwreck archeology through their continuing work in the eastern Mediterranean (Bass, 1965, 1966; Throckmorton, 1964; Dumas, 1962; Ryan and Bass, 1962). Their work motivated both marine scholars and laymen by revealing for the first time the full potential of future archeological and historical shipwreck research. Through numerous popular accounts and professional reports, the beginnings of a conceptual framework were laid for the scientific study of shipwreck sites throughout the Mediterranean (Bass, 1967, 1968, 1972, 1975; Throckmorton, 1966; Van Doorninck, 1972; Katzev, 1970).

While this underwater research was being carried out in the Mediterranean, new underwater methodological procedures and theoretical models were being developed in Britain to deal more effectively with the shallow-water historic wreck sites lying off the British coast. Much of this research concentrated on the Spanish Armada ships which sank off the Irish and Scottish coasts in 1588 (Martin, 1972, 1975; Stenuit, 1973, 1974a, 1974b). Others turned their attention to investigating English 16th century wrecks of ships constructed during the reign of Henry VIII (McKee, 1968), and 17th and 18th century wrecks in the Scilly Isles (Morris, 1969).

An awareness of the need for improved underwater scientific methodology soon became apparent in Britain (Frost, 1963; Taylor, 1966; Throckmorton et al., 1969; Wilkes, 1971; Marsden, 1972a). In addition, considerable interest was directed toward investigating the archeology of Dutch East Indian Merchant ships off the coast of England (Marsden, 1972b), Scotland (Martin, 1972), the Verde Islands (Stenuit, 1975),

Ceylon (Clark, 1966), and Australia (Green, 1973; 1975). In Scandinavia new conservation and excavation techniques were being developed through the work being carried out on Vasa (Franzen, 1966) and the Viking ships in the Roskilde Fjord on the Danish coast (Crumlin-Pedersen, 1972). Technological advances were made in developing more efficient digging procedures, magnetometry, and remote-sensing devices to deal more effectively with shipwreck sites (Potter, 1958).

Archeologists have been relatively slow in directing their attention to historic shipwreck sites in the New World. Although the archeological work carried out in the Mediterranean by Bass and his associates became well known, there was relatively little effort on the part of American archeologists to develop a similar scientific approach to dealing with historic shipwreck sites off their own coasts.

In the New World, historic shipwreck archeology followed a different line of development. Apart from the work conducted in the 1930's involving the raising from Lake Champlain of two American Revolutionary war vessels, Royal Savage (Skerrett, 1935), and Philadelphia (Hagglund, 1936), little interest was shown in historic wreck sites in the United States prior to World War II. Although there were intermittent attempts to recover historic relics off sunken ships, these were nothing more than crude salvage operations. One such attempt was made in 1934; this involved dredging for Revolutionary War artifacts from several British warships which sank in 1781 in the York River during the Battle of Yorktown (Ferguson, 1939).

With the growing involvement in World War II, there was an increased demand, in the United States, for scrap iron; this motivated Florida hard-hat divers to search for iron cannon on wreck sites within the shallow offshore areas along the east coast. During this search for iron cannon, a number of historic shipwreck sites were located for the first time. Although not much is known about the commercial salvage activities on the majority of these wrecks, one wreck off Key Largo was briefly described and identified as HMS Winchester, an English warship which sank on Carysfort Reef in 1694 (Brookfield, 1941).

To most commercial divers these wreck sites were of little significance. Once the iron cannon were removed from the ballast piles, the sites were considered of little further value and were soon forgotten. However, by 1948, one of the more successful hard-hat divers, Art McKee, developed an interest in these shipwreck sites. By this time, he had explored numerous ballast piles all along the southeast coast of Florida. After recovering a number of commercially valuable artifacts, he expanded his salvage efforts to hunt for "treasure" on a full-time basis along the Middle Florida Keys (Peterson, 1974). He concentrated his efforts on a wreck soon to be identified as Capitana el Rui, one of the major galleons known to have sunk in the loss of the 1733 Spanish Flota (Potter, 1972; Peterson, 1975; Haskins, 1976).

By the middle 1950's, the increasing popularity of the aqualung coupled with the glowing accounts of sunken "treasure," began to stimulate SCUBA divers in ever-increasing numbers to search for ballast piles in the waters of the Florida Keys. Florida was rapidly becoming the center for wreck diving in the country. Both weekend hobbyists and commercial salvors began to systematically probe known ballast piles along the Keys in search of marketable artifacts.

In 1960 the discovery of gold coins washed up on the beach from the breakup of sunken wrecks off Sebastian Inlet was widely publicized throughout Florida and many parts of the country (Wagner and Taylor, 1966). This discovery led to the commercial exploitation throughout the 1960's of a number of shipwreck sites from Sebastian Inlet to Stuart, Florida, including some of the 12 vessels known to have gone down in the loss of the 1715 Spanish Flota (Potter, 1972; Peterson, 1975; Burgess and Clausen, 1976). During this same period, salvors in the Middle Florida Keys renewed their efforts to locate and salvage the 21 vessels thought to have sunk in the loss of the 1733 Spanish Flota (Burgess, 1977). Thus began the widespread and irreparable destruction of archeological data by commercial salvors on numerous historic wreck sites all along the southeast coast of Florida.

Throughout the 1950's and 1960's, a wide range of popular accounts appeared concerning the archeology of shipwreck sites in the

New World. For the most part, these early descriptive accounts were written by maritime historians, marine antiquarians, and SCUBA divers involved with shipwreck salvage efforts along the South Atlantic Coast and Caribbean Basin. Although this material dealt with some of the progress being made by avocational archeologists in developing methodological procedures for the recovery of artifacts from historic wreck sites, it attracted little, if any, attention from professional archeologists. New techniques were being developed, largely on a trial-and-error basis with minimal input and guidance from the academic archeological and scientific community.

The first published reports by a professional archeologist concerning exploration and the collection of underwater data in the New World dealt with underwater research in Lake Amatitlan in the Mayan Highlands of Guatemala (Borhegyi, 1958, 1959). The full potential for underwater archeological research in the Americas was clearly laid out for the first time by Goggin (1960). This was followed a year later by a description of how SCUBA could be utilized for conducting archeological research under water (Olsen, 1961), and an account of one such application in California (Jewell, 1961). For the first time non-diving archeologists dealing with historic materials began to see the potential for utilizing underwater data in the clarification of archeological problems they were dealing with on terrestrial sites (Fairbanks, 1962, 1964). Underwater archeological surveys were conducted for the first time to locate historic shipwreck sites by Gluckman (1962). Conservation and recovery techniques were developed for the raising of timber hull structures (Seaborg and Inverarity, 1962) and the preservation of wood artifacts (Albright, 1966). An increased awareness of the need to develop a more structured approach to underwater research led to an archeological symposium (Holmquist and Wheeler, 1964) and a theoretical study of shipwreck archeology dealing with basic cultural concepts and methodological concerns (Gluckman, 1967). More recently, archeological work has largely concentrated on surveys such as those designed to locate shipwreck sites in the Dry Tortugas (Fischer, 1973; Cockrell et al., n.d.) and along the Florida Gulf Coast (Fischer, 1974a; Lenihan, 1974).

The most important advances in the early development of historic shipwreck archeology were derived from the work centered in Florida and neighboring Caribbean waters. In 1951, salvage work on a shipwreck on Looe Key off the Lower Florida Keys led to archival research which confirmed the identification of this wreck as HMS Looe, known from the documentation to have sunk in 1744. This was a landmark development as it was the first time in the New World that an artifact assemblage from an unknown shipwreck was successfully identified with a particular ship from extant documentation (Peterson, 1955). This salvage effort also demonstrated, as did later work at Port Royal, Jamaica, the technical application and effectiveness of airlifts and water jets in uncovering artifacts from shallow water shipwreck sites (Link, 1959, 1960; Marx, 1967).

The salvage work proceeding in Florida on the 1715 and 1733 Spanish shipwreck sites stimulated the publication of descriptive accounts dealing with the convoy flota system (Marx, 1968; Horner, 1971); guides for locating and identifying shipwreck sites (Potter, 1972; Marx, 1969, 1971); ordnance materials (Peterson, 1961a, 1963, 1966, 1967); numismatic studies (Peterson, 1961b, 1964); artifact identification and preservation (Peterson, 1965a); magnetometry and exploratory surveys (Harnett, 1962, 1965; Peterson, 1965b, 1968); and legal problems concerning shipwrecks (Slack, 1968). Since the early 1970's the archival research carried out by Eugene Lyon on Nuestra Senora de Atocha, Santa Margarita and the other ships of the 1622 Spanish Plate Fleet has provided new insights to Spanish maritime culture and has set the standard for shipwreck identification in the New World (Lyon, 1975, 1976, 1979).

Within the last 5 years, offshore archeological surveys of shipwreck sites have been directed in the study area by state underwater archeologists in the lower Cape Fear region (Watts, 1973; Bright, 1977), off the Florida Keys (Dunbar and Smith, 1977), and the Florida East Coast (Cockrell and Murphy, 1978). In Georgia, initial archeological work on shipwrecks has centered on surveys carried out in the Savannah River and Brunswick area by the Savannah District U.S. Army Corps of

Engineers (Anuskiewicz, 1979; Garrison, forthcoming). In South Carolina, recent underwater archeological work has been focused on the shipwreck at Brown's Ferry in the Black River (Steffy, 1978; Albright and Steffy, 1979). During this time, archeological work proceeded on several shipwreck sites outside the study area which have provided invaluable inferences to sites within the scope of this study. This work includes the survey and data recovery started in 1972 by Carl Clausen and continued by Borto Arnold on behalf of the Texas Antiquities Department on the three Spanish ships lost in 1554 off Padre Island, Texas (Arnold and Weddle, 1978). New information on the anatomy of shipwreck sites was recovered from the 1622 wreck site of the Nuestra Senora de Atocha being salvaged by Treasure Salvors Inc. off the outer Florida Keys (Mathewson, 1977c) and the ongoing excavation of the Revolutionary War privateer, Defence begun in Penobscot Bay, Maine by the Maine State Museum in 1975 (Switzer, 1978; Brooke and Morris, 1978).

## State Programs

### North Carolina

State archeologists in North Carolina first became interested in shipwreck archeology in 1962 when a storm uncovered the wreck of the British steamer Modern Greece, a Civil War blockade runner which sank near Fort Fisher in 1862 (Watts, 1973). Its discovery by Navy divers stimulated the Office of Archives and History to organize salvage operations to recover artifacts exposed by the storm.

The salvage effort on Modern Greece resulted in the recovery of considerable archeological information, including some 11,500 artifacts, which shed new light on Confederfate blockade running activities during the Civil War (Bright, 1977). While work was being carried out on this shipwreck site, Navy divers explored 10 other Civil War wreck sites within the Lower Cape Fear area. These sites included: Phantom, Hebe, Venus, General Beauregard, Iron Age, Ella, Bendigo, and two other unidentified sites (Bright, 1977). One of these sites was later identified as the USS Peterhoff, a captured blockade runner which had been fitted-out

by the Federal Navy for duty on the blockade station off Wilmington (Watts, 1973). This shipwreck has since been placed on the National Register of Historic Places.

During 1962, a second salvage effort was carried out by a private group on another Civil War vessel, the Confederate ram CSS Neuse, which was scuttled and burned in the Neuse River near Kinston, North Carolina in 1865. Following the recovery of the hull in three sections in 1964, it was reassembled and mounted in a permanent display as State historic property in Kinston. The success of these salvage operations paved the way in 1963 for the establishment of a permanent preservation laboratory administered by the Office of Archives and History and housed at the Fort Fisher State Historic Site at Kure Beach.

In 1967, the North Carolina General Assembly designated the Office of Archives and History as custodian of underwater archeological sites. An underwater archeology law was passed which declared State ownership of all historical and archeological material lying unclaimed in State waters for 10 years or more. This act also gave authority to establish a professional staff and to issue and supervise permits and licenses for exploration, recovery, and salvage operations. Under this salvage program, a contract was issued to a commercial company to recover artifacts from the wreck sites of two blockade runners, Ella and Ranger (Watts, 1973). This salvage work has been described by Horner (1968).

The underwater archeological program became firmly established in 1972 when further funds were appropriated for the development of a professional staff and educational programs to train sport divers and college students in underwater survey methodology. Within the last few years, there has been an ongoing effort to further develop artifact preservation laboratory facilities and to conduct a survey of the Lower Cape Fear area from Tubbs Inlet to Masonboro Inlet. The primary objective of this survey was to gather sufficient background information in order to nominate this area as an historic district on the National Register of Historic Places. This was an attempt to provide better protection to the numerous blockade runners situated within a short

distance from the beach all along this part of the coast. Background research is still proceeding in support of this nomination.

Further survey efforts include magnetometer surveys carried out in the Roanoke River (Watts, 1978), Summer field schools designed to inventory shipwreck sites were also conducted in the Lower Cape Fear River. This work included surveys off Brunswick Town, Fort Fisher, and the Old Topsail Inlet (R. Lawrence, personal communication; July 1979). A summer field school and magnetometer survey was conducted in Bath Harbor, during 1979 under the direction of Gordon P. Watts, the State Underwater Archeologist. A similar shipwreck inventory project has just been completed in Edenton Harbor (Watts, 1981).

Since the USS Monitor was located in 1973 (Newton, 1978), the North Carolina Underwater Archeological program has been largely focused on the development of alternate strategies involving the recovery and preservation of the site as a national monument (Watts, 1975,NOAA, 1979c). In 1977 the site was placed on the National Register of Historic Places, and in January, 1975, the National Oceanic Atmospheric Administration (NOAA) designated the USS Monitor as the first marine sanctuary in the country (Brennan, 1975; Childress, 1977, 1978; NTHP, 1978). Over the last several years, management procedures have been under review within a master plan incorporating state of the art technical capability for the salvage of the hull remains (NCDAH, 1978). Recent excavations directed by Gordon Watts have provided new data for management decisions concerning the future of this site and the preservation of deepwater wrecks as a whole (Watts, in preparation).

South Carolina

The underwater archeological program in South Carolina is administered by the Institute of Archeology and Anthropology at the University of South Carolina (Stephenson, 1971; South, 1971). In 1972, the General Assembly appropriated funds with which to administer the State's law governing commercial salvage activities. Although the funds were not sufficient for a large research project, they were adequate to administer the law, and for necessary research in emergency situations.

Since the 1960's, most of the interest in shipwreck sites off the South Carolina coast focused on the blockade runners at the entrance to Charleston Harbor. For several years, two commercial licenses were granted for the salvage of the three Civil War ships Mary Bowers, Georgiana, and Constance (Spence, 1971a, 1971b, 1974). However, since 1973, salvage licenses were no longer issued for work on off-shore wreck sites as more and more attention was given to administering "hobby permits" issued to recreational sport divers interested in recovering artifacts from shipwreck sites in the 9,000 miles of rivers throughout the state. Since the beginning of this program, over 600 "hobby permits" have been issued. As a result of this program the number of archeological sites jumped from 6 to over 150 (Alan Albright, personal communication, Feb. 1979).

In 1977, SCUBA divers reported a shipwreck in the Black River, near Brown's Ferry. The site was inspected by Alan Albright, Underwater Archeologist with the Institute of Archeology and Anthropology. The hull was found to be nearly intact to above the turn of the bilge. The cargo consisted of some 25 tons of brick and associated artifacts dating the site to about 1740. The hull portion was lifted from the riverbed with a crane (Figure 4.3.16) and sent to Columbia, South Carolina for conservation and reconstruction (Albright and Steffy, 1979).

Research on this structure and the ship reconstruction is being directed by J. Richard Steffy (1978) at the Institute of Nautical Archeology, Texas A&M University. Although there are still a number of unanswered questions concerning this hull structure, considerable information is available which sheds new light on local shipbuilding techniques along the Carolina coast (Figure 4.3.17). Steffy's analysis suggests that it was probably a small "coaster" with a shallow draft for sailing along the inland waterways and for loading cargo from beaches and river banks. It appears that the ship had two masts as well as sweeps and poles. The hull was probably designed to carry specific cargos along specific routes. The design of the hull has not been previously recorded and is, therefore, making a substantial contribution to maritime cultural history (Albright and Steffy, 1979).

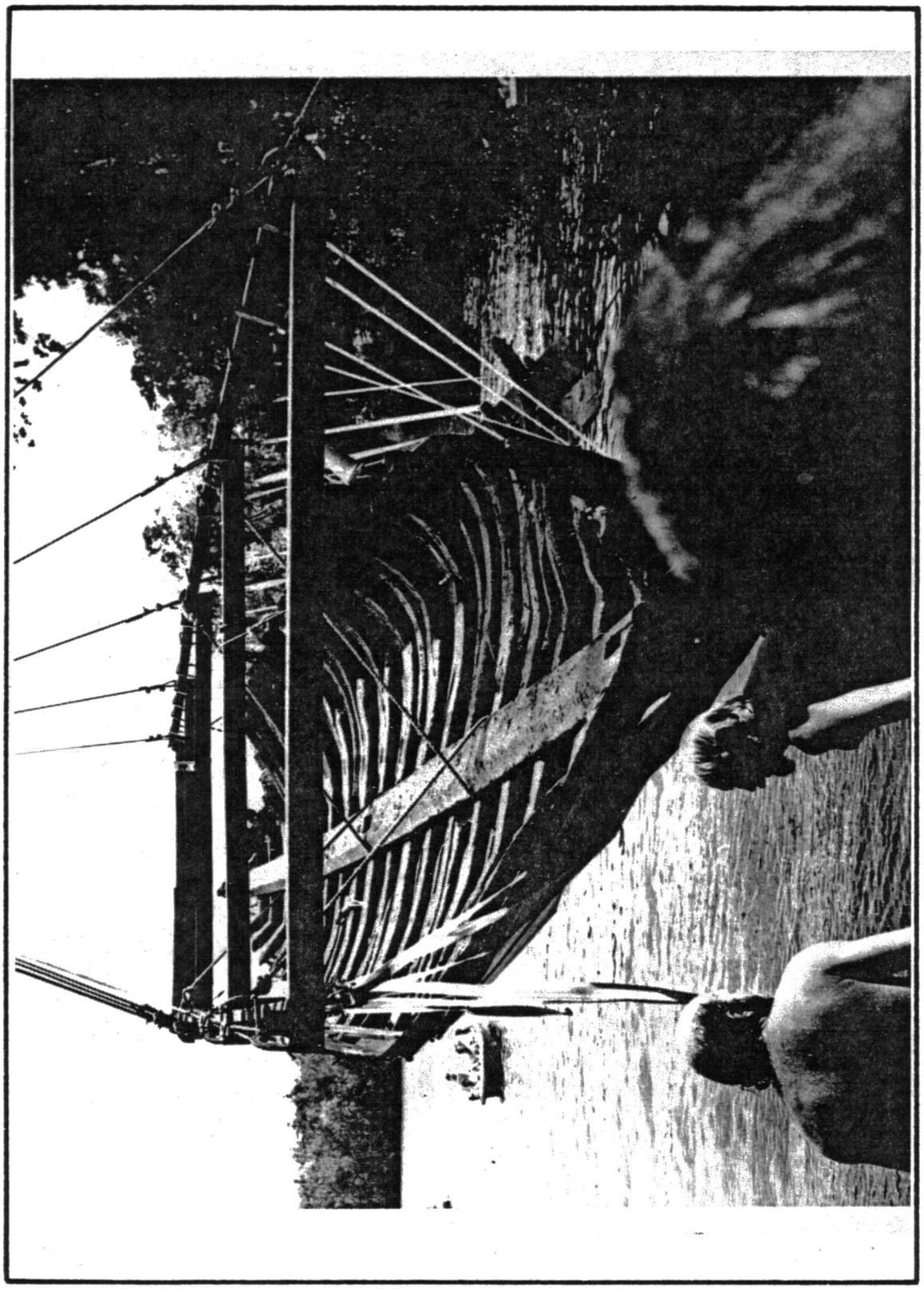

Figure 4.3.16 The Brown's Ferry Site Hull Structure in its Cradle being lifted out of the Black River
(Photo Courtesy: Alan Albright)

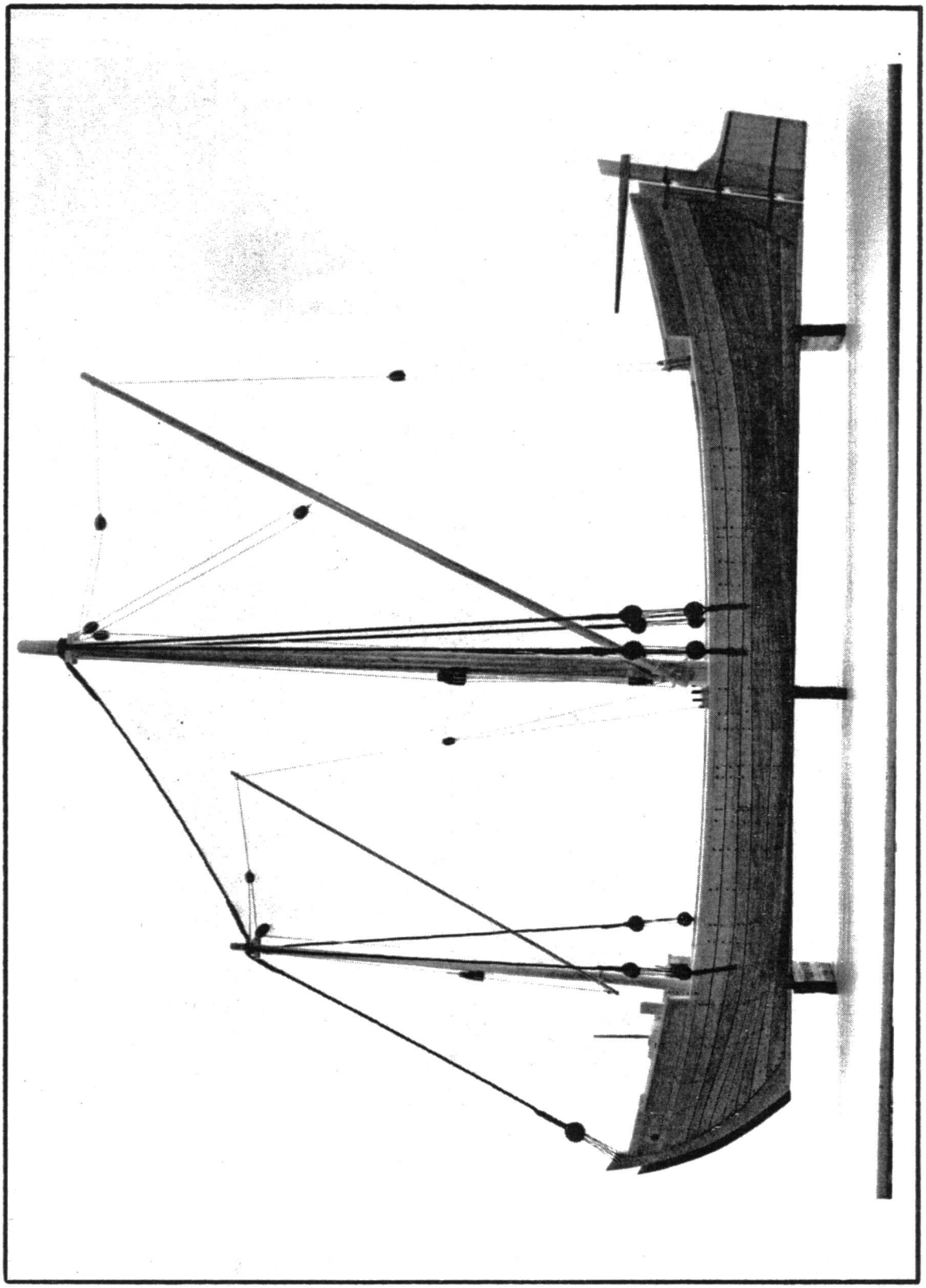

Figure 4.3.17 Reconstructed Ship Model of the Brown's Ferry Site
(Photo Courtesy: Alan Albright and Richard Steffy)

## Georgia

A formal research program in underwater archeology has never been instituted in Georgia. There have been no licenses issued for commercial salvage operations on shipwreck sites. Although a preliminary draft for the management of submerged cultural resources within the jurisdiction of the State has been prepared (Larson, 1975), no further comprehensive planning for this part of the Outer Continental Shelf has occurred. At the present time the Savannah District, U.S. Army Corps of Engineers is drawing up management plans to survey stretches of the Intracoastal Waterway in an attempt to locate shallow water shipwreck sites in navigable channels south of Savannah (R.J. Anuskiewicz, personal communication, Feb. 1979). Due to bad visibility and strong currents which generally characterize much of the Georgia coast, sport divers do not normally represent a serious threat to historic shipwrecks. However, some late 18th century and 19th century wrecks have increasingly become favorite sites for "relic hunting". Perhaps one of the most popular sites for sport divers is the Civil War wreck of Nashville or Rattlesnake which blew up in 1863 in the Ogeechee River near Fort McAllister.

## Florida

The underwater archeological program in Florida had its beginning in 1959 when State officials began to take an interest in the salvage operations being carried out on shipwrecks off the east coast. This initial involvement resulted from Real Eight Corporation's requesting a permit from the Board of Trustees of the Internal Improvement Fund for an exploration and salvage lease to recover artifacts off 1715 Spanish shipwrecks within an offshore area on the east coast stretching from Sebastian Inlet to Stuart.

In 1963, the Real Eight Corporation entered into a partnership with Treasure Salvors Inc. which accelerated the salvage efforts on the 1715 flota wreck sites. This increased commercial activity created the need for more regulatory control and onsite supervision. Florida's first marine archeologist, Carl Clausen, was appointed by the Trustees

to monitor the activities on the ongoing salvage operation. In 1965, the State legislature passed the "Board of Antiquities Act" that established an Antiquities Commission consisting of archeologists and historians whose responsibility it was to advise and assist the governor and the cabinet in matters concerning the handling of all historic and archeological objects under Florida's antiquities law, including material recovered from historic shipwrecks. This regulatory program involved the hiring of field agents by the State to monitor the commerical operations and to inhibit salvage activities by unlicensed treasure hunters. As time went on an attempt was made to replace these field agents by personnel with some training in archeological techniques so they would become more responsible for recording artifact provenience as the material was recovered.

In 1967, the Florida legislature passed the "Archives and History Act" which included the responsibilities to oversee and protect historic wreck sites formerly under the Antiquities Act, and which created the Board of Archives and History to administer the law.

Under Clausen's direction, archeological studies were conducted in 1964 during the ongoing salvage operations being carried out by Treasure Salvors, Inc., on the 1715 flota shipwreck known as the "Colored Beach site" or "Goldwreck," and now referred to as "Douglas Beach." These archeological investigations were an important milestone in the development of historic wreck archeology in the New World (Burgess, 1980). Clausen's report of this work (1965) was the first published account of a shipwreck by a professional archeologist in the New World. Later Clausen turned his attention to describing magnetometer survey procedures (1966) and the prop-wash digging technique (1968) developed by Treasure Salvors, Inc. in their salvage operations on wreck sites of the 1715 flota. Soon after the Board of Archives and History was formed, Clausen was instrumental in setting aside four archeological preserves in order to protect shipwreck sites for future scientific investigations. In addition to the John Pennekamp Coral Reef State Park, two other preserves are situated in the study area; these are located between St. Augustine and Matanzas Inlet and between St. Lucie

Inlet and North Lake Worth Inlet. Both preserves extend out to 3 nautical miles which is believed by the State of Florida to be its territorial limit of control over submerged bottom lands.

The regulatory procedures and policies formulated under Clausen's supervision established the operational framework and philosophical basis upon which the underwater salvage and exploration contract program was administered by the State. In 1972, Clausen resigned as the State Underwater Archeologist and was succeeded by W. A. Cockrell (1973, 1974, 1979), who has been responsible for administering the commercial salvage program until 1980 when he resigned. From 1973 to 1978 over 50 exploration and salvage permits have been issued to commercial salvors in Florida waters (Cockrell, 1978).

## Intrasite Variability

The concept of shipwrecks as time capsules is well known. By their nature, shipwrecks represent a specifically dated assemblage of artifacts which are directly associated with one another (Fischer, 1974b). One of the problems in shipwreck archeology has been to reconcile this concept with the apparent way in which artifacts were widely scattered during the sinking and disintegration of a wooden vessel in shallow water.

The deposition of shipwreck material raises an important archeological question concerning the nature of contextual relationships in shallow-water situations. Commercial salvors have often argued that ships driven up onto shallow shoals impact with such force that any contextual relationships between artifacts are destroyed. Support for this argument has in the past come from Gluckman (1967) and Clausen (1965) who believed on the basis of his work on the "Colored Beach" wreck that the scattered condition of the deposits result in "little if any discernible spatial relationships between the recovered items." This is somewhat hard to reconcile, however, with the artifact scatter pattern shown on his site plan of the wreck (Figure 4.3.18). Definite clusters of gold and silver artifacts are apparent, seeming to suggest a rudimentary patterning of artifacts within the overall scatter of material (Mathewson, 1975a; 1975b; 1975c; 1976a).

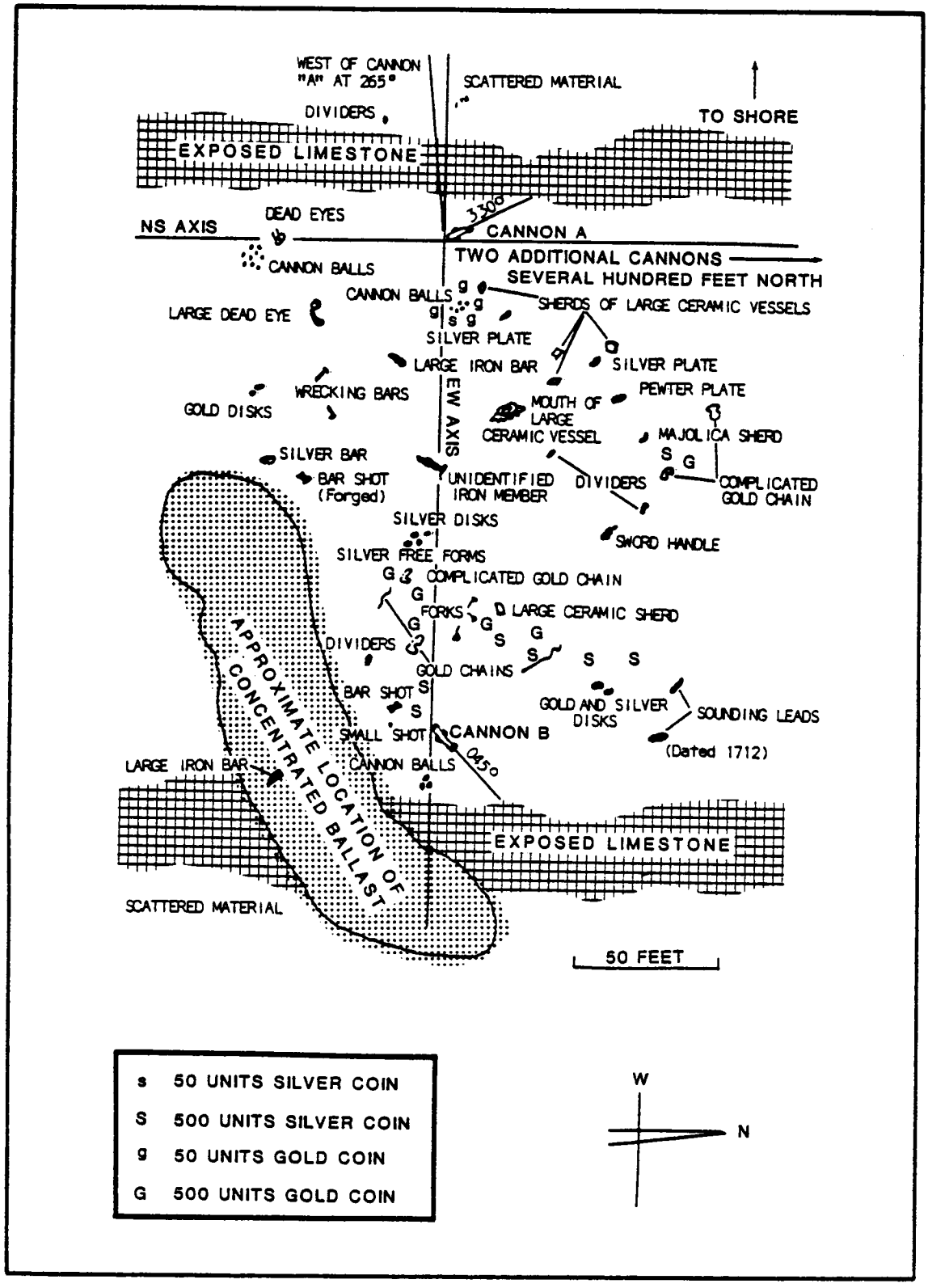


Figure 4.3.18 Site Plan of the "Colored Beach" Wreck (Clausen, 1965)

The shifting of material during the sinking and disintegration of wooden vessels would of course preclude the reconstruction of precise spatial relationships of shipboard artifacts. However, the overall structural content of the archeological record, consisting of objects and features within a spatial framework, can provide useful contextual insights. Artifact clusters and associations can define particular activities performed by different members of the ship community within different parts of the vessel. Different activities reflect different behavior patterns common to prescribed locations on board the vessel (Mathewson, 1977a; 1977c).

The repetitive performance of any activity within a specified unit of space has been termed a "locus" (Binford, 1964), or an "activity area" (Struever, 1968). Five main activity areas on a capital vessel should be identifiable by mapping clusters of different types of artifacts. These foci of different activities for the shipboard community would include the weather deck, the gun deck, the orlop cargo compartments (lowest deck on a ship), the bow section (forecastle) and the stern castle.

Archeological work on the wreck site of Nuestra Senora de Atocha focused on the development of a number of adaptive field strategies and methodological techniques for recovering contextual data to better understand the anatomy of shallow water shipwreck sites (Mathewson, 1977c). This involved implementing a variety of procedures for the recovery of horizontal and stratigraphic data for onsite interpretation of the intra-site variability of the cultural and geological deposits. The use of standardized data forms helped to record the spatial relationships between artifact cluster assemblages and the stratigraphic provenince of major artifacts; thus, it was possible to discern a nonrandom patterning in the derived deposits which reflected a stern castle shipboard provenince (Figure 4.3.19). Photogrammetric mapping of the cannon, in situ, (Figure 4.3.20) provided locational data which helped to formulate a predictive model concerning the nature and location of the primary cultural deposit.

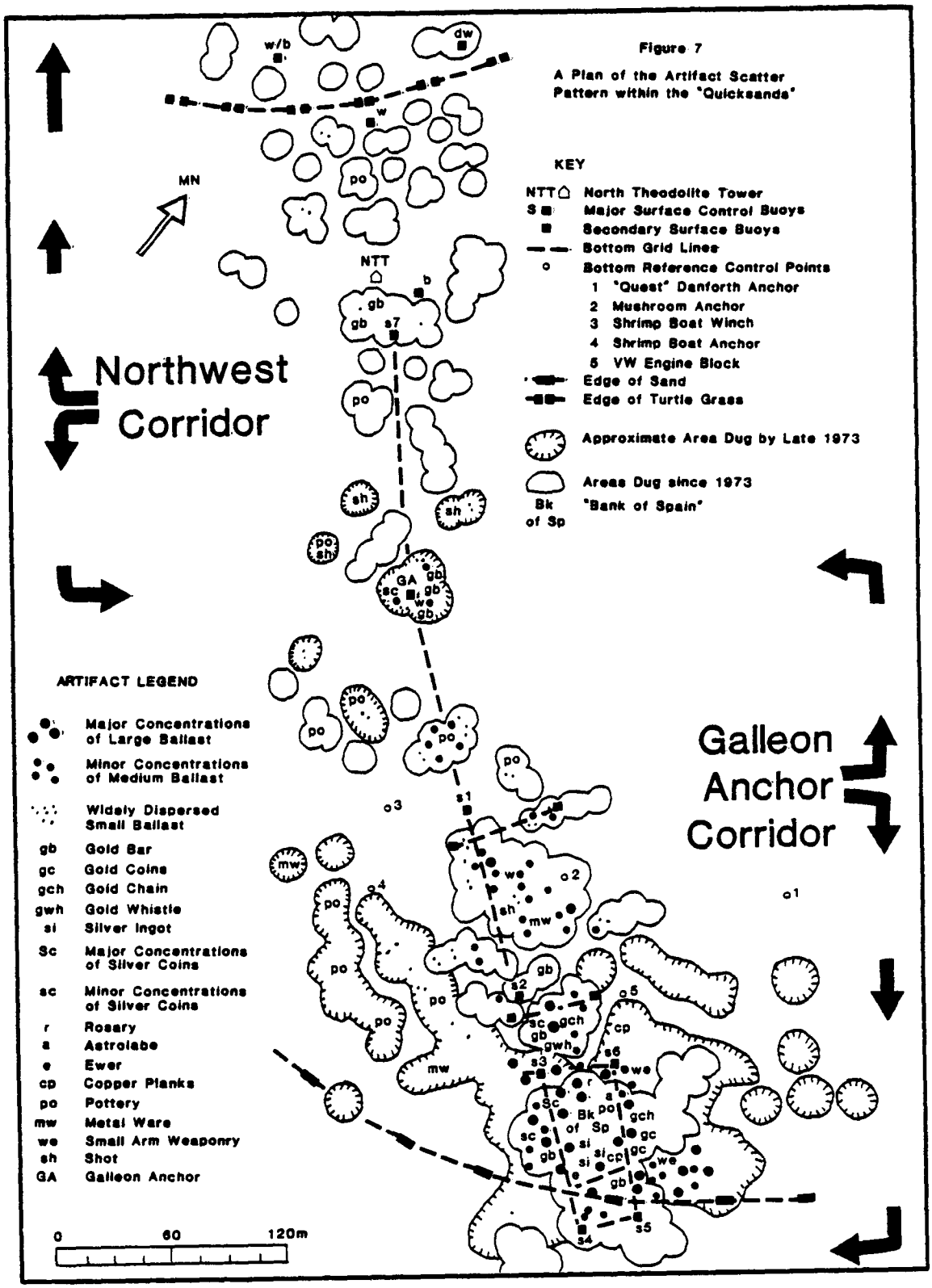


Figure 4.3.19 Site Plan of the Secondary Impact Zone on the Site of Nuestra Senora De Atocha (Mathewson, 1977c)

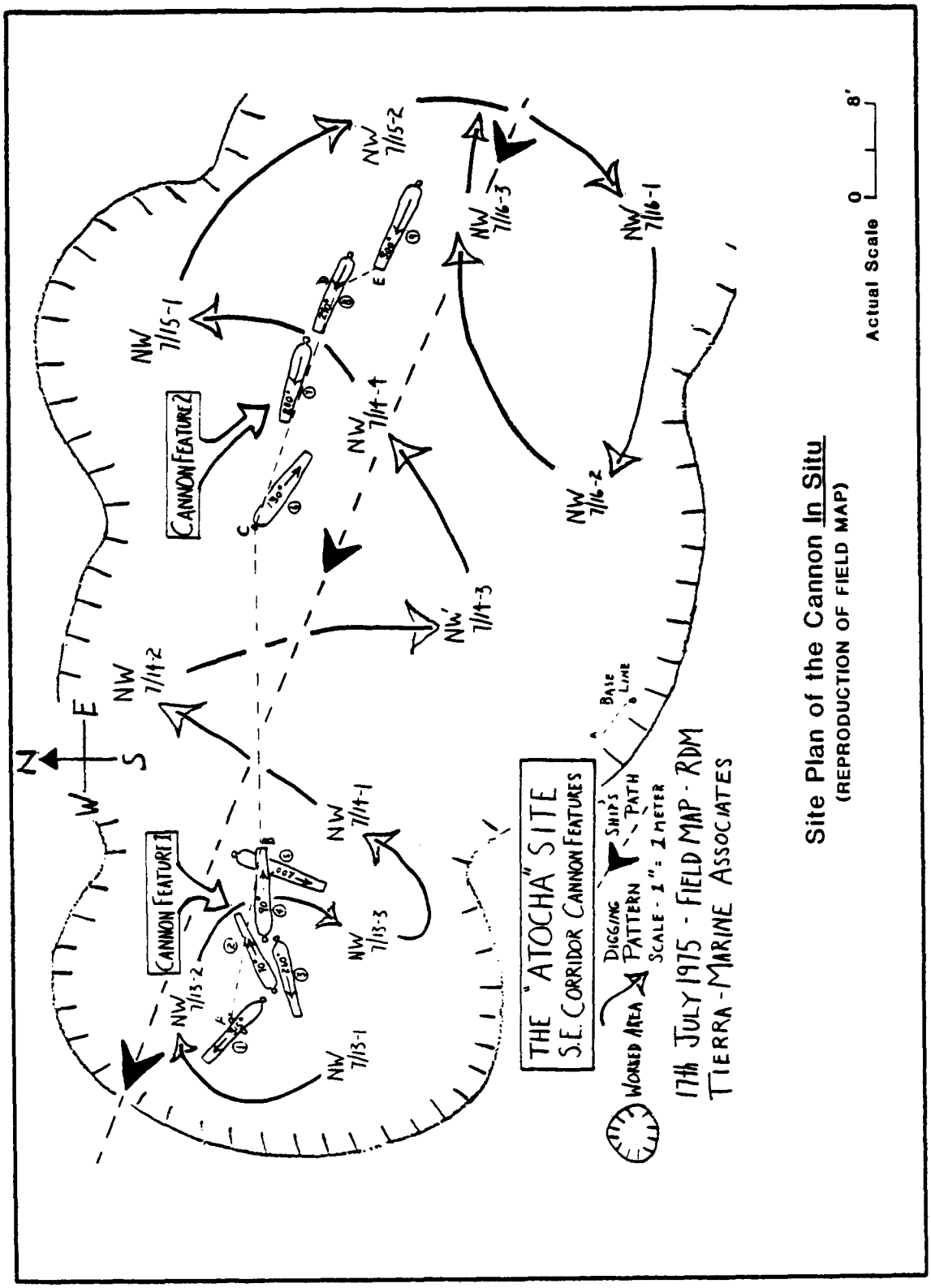


Figure 4.3.20 Site Plan of the Nine Bronze Cannon found on the Atocha Site (Mathewson, 1977c)

An effort was made on the Atocha site not only to record horizontal relationships between major artifact clusters but also to determine the extent to which stratigraphic relationships could be used for site interpretations. By recording artifact clusters recovered in each hole, and the general depth at which individual artifacts and ballast were occurring, a stratigraphic picture slowly began to emerge (Table 4.3.4). The stratigraphy of the overburden was found to consist essentially of two depositional zones. This consisted of an upper depositional zone of fine bio-clastic sand, underlain by a lower zone composed of coarser sand. The lower part of this zone was interspersed with dark silty-clay lenses. These lenses appeared to vary considerably in thickness and occasionally occurred as a distinct clay layer filling irregular pockets on the surface of the limestone bedrock (Figure 4.3.21).

On the one hand, the sand in the upper depositional zone, particularly in the upper metre or so was slowly shifting due to the tidal current moving across the site in a northeastern-southwesterly direction. On the other hand, the sand in the lower zone appeared to be more stable with very little lateral movement. This differentiated overburden had affected both the stratigraphic and horizontal configuration pattern of the cultural material.

Stratigraphic data from the Atocha site indicated that there was a vertical sorting throughout the overburden of the cultural material and ballast according to density. This resulted in a downward movement of the heavier objects which had a tendency to accumulate in the lower part of the overburden, near the bedrock. Observations suggested that heavier artifacts such as coin clumps, ingots and ballast had moved downward through the sand while lighter objects had not. These heavy materials most probably became stabilized relatively quickly after the initial scattering of material during the break-up of the ship structure. This has resulted in a minimum amount of secondary lateral displacement within the overburden.

Lighter artifacts, particularly the ceramics, barrel hoops and individual coins were generally found concentrated within the upper

Table 4.3.4 Stratigraphic Data from the Atocha Site (Mathewson, 1977c)

| Recorders: Chuck Hirst, R. Duncan Mathewson — Hole: SW 7/11/74 2 — Area: Galleon Anchor Corridor | | | |
|---|---|---|---|
| Digging Interval | Recovered Finds | Size & Quantity of Ballast | Depth & Nature of Burden |
| 2 min.[2]<br>2 min.<br>2 min.<br>2 min.<br>2 min.<br>2 min.<br>2 min.<br>2 min.<br>Bed Rock | 4 E.O.s (encrusted objects)<br>1 coin | Estimated at C.150 wheel barrows; ranging C. 20-30 cm. dia. Extension of ballast concentrations uncovered in SW 7/1-1,2, 3; part of main area of "Bank of Spain." | Sand overburden measured at 5'. Bed rock area uncovered 35' long by 25' wide; Back berm of hole was C.2' high while side berms were C. 1-1/2' high. |
| **Remarks:** Bottom 2 m grid was laid on bare bedrock for photographic tests, but visibility was not very good. Modifications to the grid have to be made. With minor modifications, the grid should prove successful in photomosaic mapping | | | |

| Recorders: Chuck Hirst, R. Duncan Mathewson — Hole: SW 7/2/74 3 & 4 — Area: Galleon Anchor Corridor | | | |
|---|---|---|---|
| Digging Interval | Recovered Finds | Size & Quantity of Ballast | Depth & Nature of Burden |
| 3 min.[3]<br>2 min.<br>30 sec.<br>1 min.<br>Bed Rock | 5 coins<br>6 silver "tapers" | Estimated at C. 50 wheel barrows: ranging from 10 to 50 lbs. in weight. | 4-5 ft. deep sand; water depth 28 ft. |
| 3 min.[4]<br>2 min.<br>3 min.<br>3 min.<br>Bed Rock | Nothing | No more than 2 wheel barrows of small "fist" size rock | Same as in previous hole. |
| **Remarks:** Hole SW 7/2- 3 lies on the S III-S IV cable line some 20 meters from S III on 135° bearing. Position is on the edge of the "Bank of Spain." Ballast concentrations ran out as the SW swung over the cable to dig SW 7/2- 4 hole 5 meters to the southwest. Defines ballast line on western edge of corridor. | | | |

| Recorders: Spencer Wickens, R. Duncan Mathewson — Hole: VIR 5/20/75 1 & 2 — Area: NW Corridor | | | |
|---|---|---|---|
| Digging Interval | Recovered Finds | Size & Quantity of Ballast | Depth & Nature of Burden |
| 10 min.[1]<br>10 min.<br>10 min.<br>10 min.<br>10 min.<br>10 min.<br>10 min.<br>Bed Rock | Nothing | Nothing | Tough digging through deep sand; overburden about 12' and more compacted here than in area SE of anchor. Only some 9 sq.' of Bed Rock was exposed. Sides are slumping in. |
| 10 min.[2]<br>10 min.<br>10 min.<br>10 min.<br>10 min.<br>10 min.<br>Bed Rock | Nothing | 3rd and 4th "dig" produced 3 small ballast stones | Same as in previous hole. Bed rock measured 30' to water surface. |
| **Remarks:** Ballast includes Quartz Graywacke weighting C. 10 lbs., sub-rectangular, measuring 36 cm. long, 25 cm wide, 24 cm high; Quartzite weighing C. 3 lbs., sub-rounded, measuring 10 cm long axis; Epidiorite weighing C. 5 lbs., angular, measuring 14 cm long, 12 cm wide, 8 cm high. | | | |

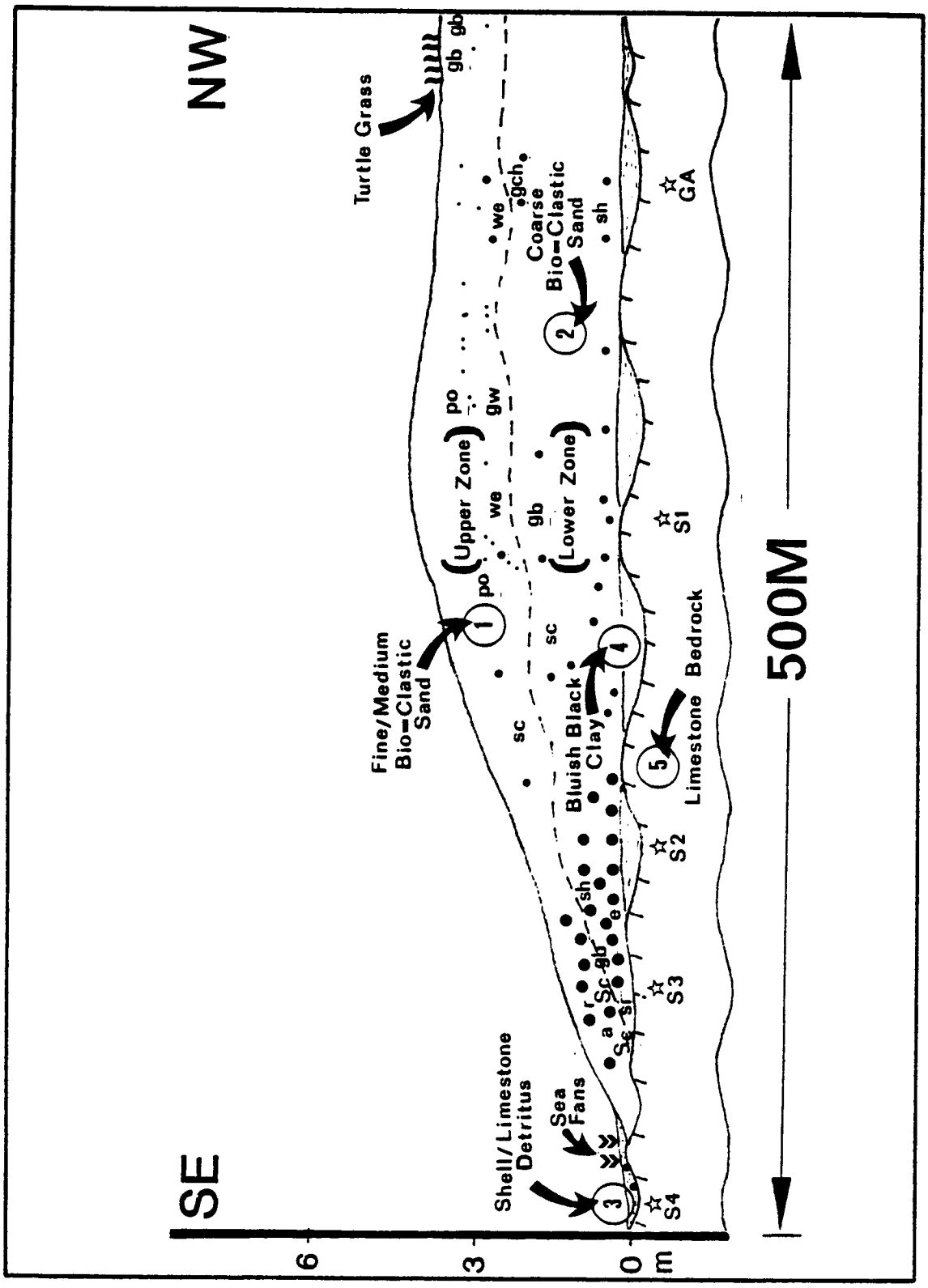


Figure 4.3.21 A Generalized Stratigraphic Section of the Secondary Scatter Pattern on the Atocha Site (Mathewson, 1977c)

depositional zone. The horizontal position of this material had been subjected to the lateral movement of the shifting sand. Consequently, the configuration pattern of the cultural material in this upper zone was seen to be displaced off the central axis of the main scatter of heavy material in the lower zone. The slight lateral movement of lighter materials to the southwest of the corridor was generally defined by the relative abundance of sherds in the uppper zone, as opposed to little, if any, ballast in the lower parts of the overburden. This became the main archeological criterion used in distinguishing the general perimeters of these two superimposed scatter patterns within the derived material.

The configuration of ballast deposits in the lower depositional zone provided the best archeological evidence to define the point of impact on the edge of the shoals and the general scatter pattern of the bulk of shipwreck material. The ballast varied considerably according to main variables defined by size, weight, volume, rock type, sphericity, and surface texture. An attempt was made to determine relationships between variables but it was impossible to obtain data of sufficient reliability within a commercial operation for such a study.

The intrasite variability of the artifact scatter pattern defined on the Atocha site clearly indicates that shallow water wreck sites should no longer be conceptualized as just a meaningless scatter of artifacts devoid of substantive anthropological and of historical value. The problem is not whether or not such shallow water archeological deposits contain meaningful contextual relationships but rather that appropriate methodological tools have not yet been rigorously and consistently applied to discern stratigraphic and horizontal spatial patterning (Mathewson, 1977c). Muckelroy (1978) has had good success in conducting statistical studies for defining site variables on historic shipwrecks in English waters. These types of studies need to be done before historic shipwrecks in the study area can be adequately assessed as finite cultural resources. More surveys similar to the work carried out in Biscayne National Monument (Fischer, 1975) and along the Georgia coast (Garrison and Evans, forthcoming) should be carried out in the future.

Depositional Environments

There are not sufficient geological data to determine depositional conditions under which hull deposits might be visible on the sea floor. Archeological data, however, are available from several wreck sites which can be used in considering this problem. Examinations of a wreck site in the Dry Tortugas believed to be one of the ships of the 1622 flota clearly demonstrated that lower hull structures together with their ballast piles can, in some circumstances, remain intact and clearly visible on the sea-bottom in water as shallow as 3 metres (Mathewson, 1975b). Other wreck sites consist of wooden hull structures and ballast piles visible on the surface in waters no deeper than 10 metres in the Bahamas (Mathewson, 1976b), Roatan, Belize (J. Rudawski, personal communication, 1975), the Virgin Islands (Albright, 1974), and Bermuda (Dethlefsen et al., 1978). This suggests that this type of archeological phenomenon is not nearly as uncommon in shallow water as some writers have suggested (Marx, 1971b; Bascom, 1976). Further support comes from the visual detection of several 17th and 18th century ballast piles by aerial reconnaissance in Bermuda (Tucker, 1966) and in the middle Florida Keys (Meylach, 1971). When hull structures and associated ballast are completely covered with overburden, this is generally considered to be the result of the mass movement of sand within a high-energy coastal region. This has been the case with the 1715 flota wreck sites (Figure 4.3.22) along the east coast of Florida (Burgess and Clausen, 1976). Even along a high-energy coastline, ship hull structures should remain partially intact if protected by overlying ballast and shifting sand overburden (Figure 4.3.23).

Of the 17 sites believed to be ships lost in the sinking of the 1733 Spanish Flota off the Middle Keys, very few were completely covered with bottom deposits. Many of these wreck sites were visible on the bottom of Hawk Channel. Four of these wrecks, identified as the Chaves, Tres, Puentes, and Herrera, were located by aerial reconnaisance (Meylach, 1971). The intact ballast pile of the Herrera site was spotted from the air lying in the center of a sand pocket in solid grass on the inner edge of Hawk Channel in about 6 metres of water (Meylach, 1971). The San Jose, the only Florida shipwreck on the National Register

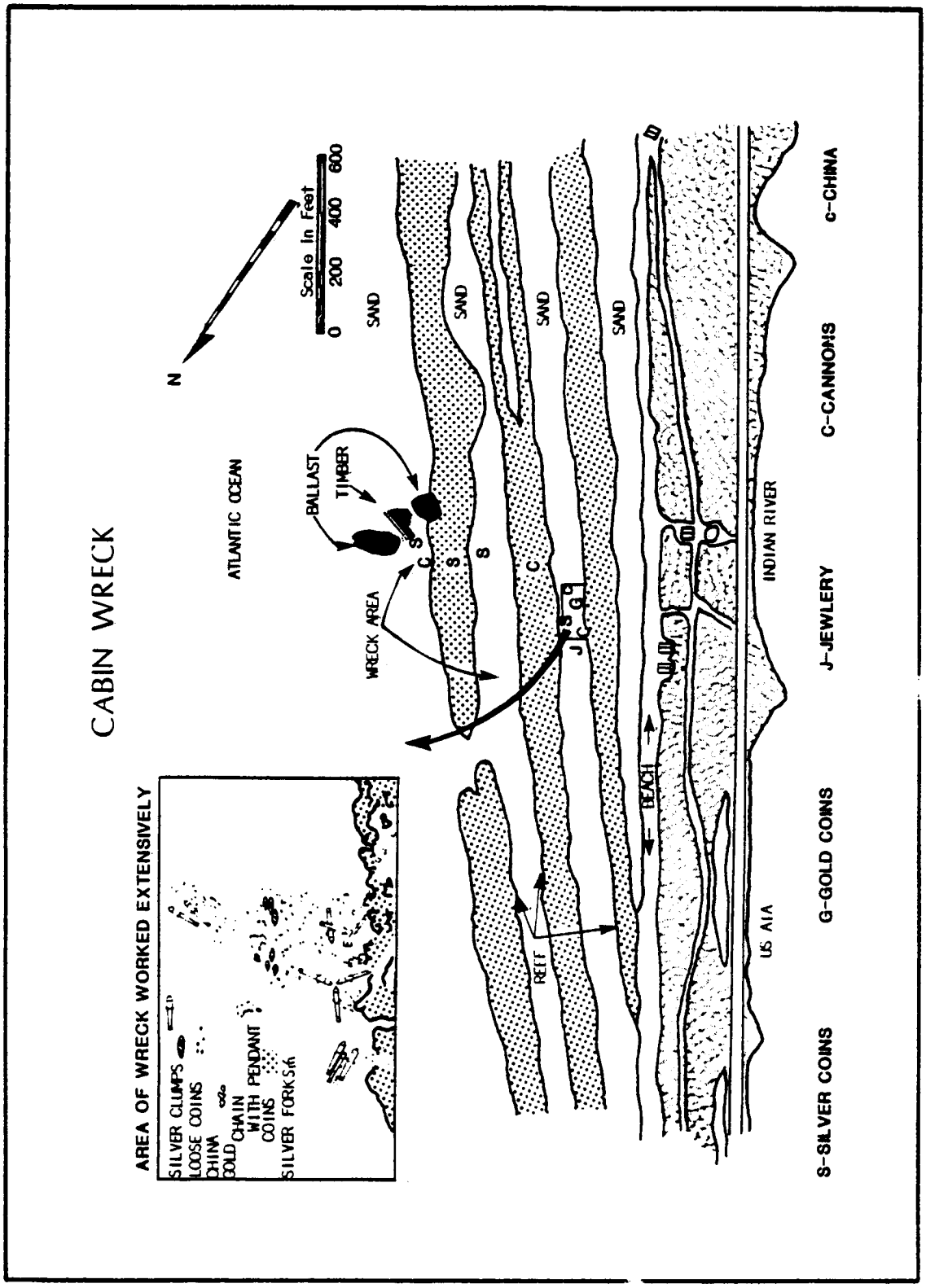


Figure 4.3.22 General Site Plan of the "Cabin Wreck"
(Burgess & Clausen, 1976)

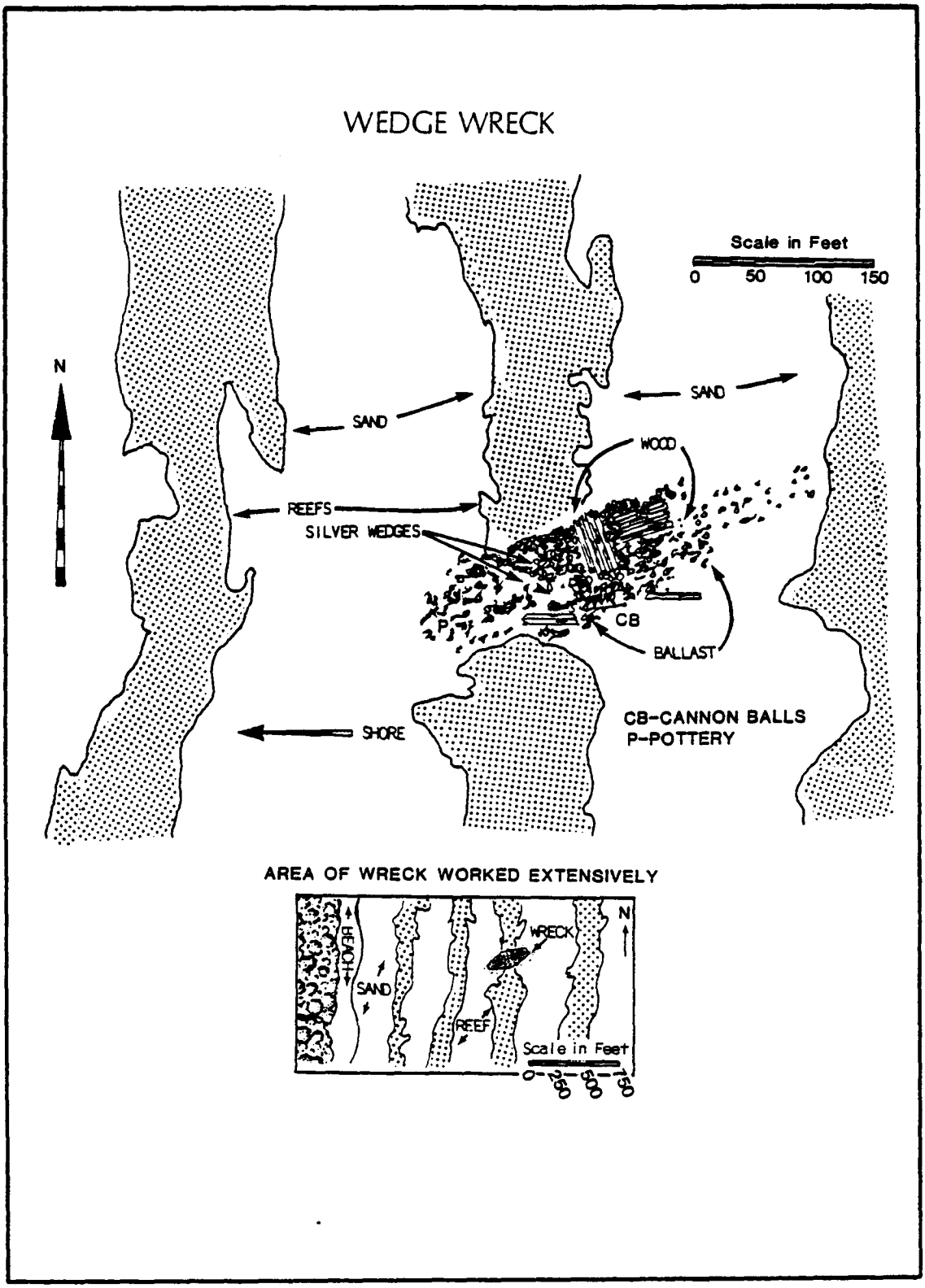


Figure 4.3.23 General Plan of the "Wedge Wreck" (Burgess & Clausen, 1976)

of Historic Places, was one of the few 1733 sites which were completely covered by overburden.

Whether or not intact ballast piles are eventually covered with bottom deposits is determined by how the ship sank and a number of interrelated environmental variables which are not completely understood. It is not surprising, however, that the lower hull structures of the 1715 Flota wreck sites lying in about 5 metres of water within the high-energy east coast environment have been more completely covered by drifting sand deposits than the 1733 flota hull structures which lie in some 7 to 10 metres of water within the lower energy depositional environment of Hawk Channel. The depositional character of Hawk Channel is typical of a low-energy depositional environment. There appears to be limited bottom circulation and a slow rate of sedimentation in most parts of the main channel along the inside of the outer reef tract.

There is, at the moment, an immediate need along the South Atlantic Coast to develop a coordinated regional approach for the coastal management of shallow water historic wreck sites as nonrenewable cultural resources. Relatively little is known about the potential data base which these underwater sites represent. More must be learned about the location and archeological data base of shipwreck sites before proper management procedures can be applied to mitigate adverse impact. Underwater technical capability and scientific archeological methodology must be developed for the identification and assessment of shipwreck sites in order to generate multidisciplinary problem-oriented research priorities and to evaluate their relative significance within the Southern Gulf Stream.

Archeologists in the southeast should not neglect shallow water shipwreck sites as important data banks for anthropological and/or historical research. Many more shallow wrecks lie within the 20-metre isobath on the Outer Continental Shelf than further out in deeper water. The close proximity to shore of many of these shallow water wrecks places them in a much greater danger of being irreparably impacted by sport divers, salvage activities, and commercial development than

deepwater wrecks. Consequently, objective criteria and procedural guidelines should be set as a high-order of priority for the assessment of the relative significance of shallow shipwrecks within coastal waters. Future work should be directed at determining their respective data bases and examining what measures should be taken to properly mitigate potential adverse impact.

The application of a multidisciplinary approach provides the technical expertise from several related scientific fields necessary for proper understanding of a number of complex problems concerning the shipwreck archeology (Mathewson et al., 1975). The complexity of historic shipwrecks and their potential data base requires such an approach for proper management. Recently, archeologists have become increasingly aware of the need to conserve archeological sites rather than to exploit them (Lipe, 1974; Schiffer and House, 1977; McGimsey and Davis, 1977). This basic philosophical shift in archeological thought has not yet been rigorously applied to dealing with the management of historic wreck sites. Nowhere is this need more apparent than with the shallow water wreck sites along the South Atlantic seaboard.

### 4.3.4. Modern Obstructions

Artifact distribution on the seabed records human maritime activity within recent times just as it does in the more distant past. Although shipwreck sites are by far the most common archeological phenomena on the Outer Continental Shelf, there is a wide assortment of other types of cultural material which should be mentioned. Much of this material is of relatively recent date.

The general location of this modern material is important for several reasons. Although late 19th and 20th century material may not be particularly significant to archeologists today, this may not always be the case. It is important to know the distribution of modern material as it helps to discriminate areas of recent disturbance from suspected archeological sites of importance which are identified in remote-sensing surveys. In a magnetometer survey modern ferrous

material can often mask the presence of earlier sites. By knowing the distribution of modern material, remote-sensing surveys can be made more cost-effective by avoiding these areas so that more time can be spent in areas where masking does not occur.

Modern culture material has either been intentionally or accidentally placed on the seabed. In both cases a nonrandom distribution pattern would be expected. Plotting the location of this material is not easily accomplished. Much of the recent maritime activity on the OCS has never been compiled into reports for publication. What documentation exists is contained in government files and is not readily accessible. A survey of the extant literature suggests that the modern material in the study area can be summarized into four categories: modern debris, artificial reefs, military ordnance, and cables.

## Modern Debris

Modern debris has been deposited on the seabed primarily through the activities of maritime industries, commercial shipping, and the military. At present there are no functioning oil production wells in the study area. Therefore, there are no pipelines which are similar to that found throughout the oil fields in the Gulf of Mexico (Gagliano et al., 1977). Industrial waste and urban sewage have for years been dumped off the coast. For the most part dumping grounds are situated in the vicinity of Charleston Harbor and waters south of Charleston and Key West. Waste dumped in these areas consists of dense materials which are not easily transported by currents. Dumped debris and dredged material in these areas may have buried undetected shipwreck sites; this might be particularly true in Charleston Harbor, where dumping has been concentrated along the east shore of the Cooper River and along the James Island shore of the Ashley River. Accumulated debris within dumping grounds is likely to interfere with remote-sensing surveys.

## Artificial Reefs

An artificial reef may be defined as almost any object or objects not naturally occurring in the ocean, which have been placed

on the seabed by man. Artificial reefs are constructed by sinking a wide variety of material at easily located sites along the coast. These reefs serve dual roles in that they create habitats for sport fish, and are an effective way of disposing of materials which are unsightly litter on land (Myatt, 1978).

Artificial reef construction in the United States extends back to the 1800s, when settlers in South Carolina began to fell trees along the Barrier Islands to plant cotton. The trees provided marine sanctuaries for local species along the coast; as the trees disappeared, the settlers resorted to building wooden structures to replace this vanishing artificial habitat (Stone, 1978).

Artificial reef sites are largely selected on the basis of local public demand; many small artificial reefs have been constructed all along the South Atlantic by local fishing clubs and municipal organizations. Oftentimes sites are chosen based on surveys which have identified areas of good fishing, and are located outside shipping lanes. Any government body or private organization wishing to place an artificial reef in the ocean must have a permit from the Corps of Engineers. The sinking of derelict vessels usually occurs beyond the 12-mile limit in at least 100 metres of water. However, they could be more effectively used as resources if they were to be disposed of in water shallow enough for diving and fishing (Rogers 1978).

These reefs have often been made from concrete rubble, and simulate low natural reef formations. For the most part these are marked with buoys, and are recorded on local charts. Some commercial fishermen have constructed small reefs and have kept their location a highly guarded secret. This practice was more widespread before construction of artificial reefs became regulated by the states (Moe, 1970).

Increased user pressure on natural fishing reefs has led to the construction of additional artificial reefs of varied substance and positioning within inshore waters along the southeast coast (Aska, 1978).

## 4.4 REMOTE-SENSING SURVEY TECHNOLOGY

### 4.4.1 Magnetometry

The use of magnetometry for locating buried archaeological features on upland sites is well known (i.e., Aitken, 1961; Breiner and Coe, 1972; and Breiner, 1973). Since the early 1960's magnetometers have proven to be of special importance in marine archelogy. During the search for sunken ships of the 1715 flota off the coast of Florida commercial salvors quickly confirmed that properly adapted magnetometers could be effectively employed at sea to locate submerged shipwreck remains, often more quickly and efficiently than by conducting visual searches with divers (Harnett, 1962; Clausen, 1965, 1966; and Wagner, 1966) (Figure 4.4.1). As magnetometers began to be used more frequently in underwater archeological surveys, more sophisticated procedures became available and new technical developments in sensing instrumentation, positioning systems, and data processing hardware greatly advanced the state of the art (i.e., Green, 1970; Arnold, 1974, 1975, 1976; Clausen and Arnold, 1975; and Watts, 1975) (Figure 4.4.2).

The general application and problems concerning the use of magnetometers as an underwater survey tool to locate shipwreck remains on the Outer Continental Shelf has previously been reviewed in some detail for offshore areas of Alaska (Dixon, 1976), the Gulf of Mexico (Gagliano et al., 1977) and the southern California Bight (BLM, 1978). The standard magnetometer survey procedures employed in the offshore areas along the south Atlantic coast would not be substantially any different from the types of surveys previously described for other areas of the Outer Continental Shelf. Although varying environmental factors within different hydrographic regimes may produce different sets of variables resulting in slight alterations in survey procedures from area to area, as a general rule, uniform magnetometer procedures for locating historic shipwreck sites can be applied on most parts of the Outer Continental Shelf.

The magnetometer is the most versatile and useful remote-sensing instrument for locating shipwreck sites. Within the present

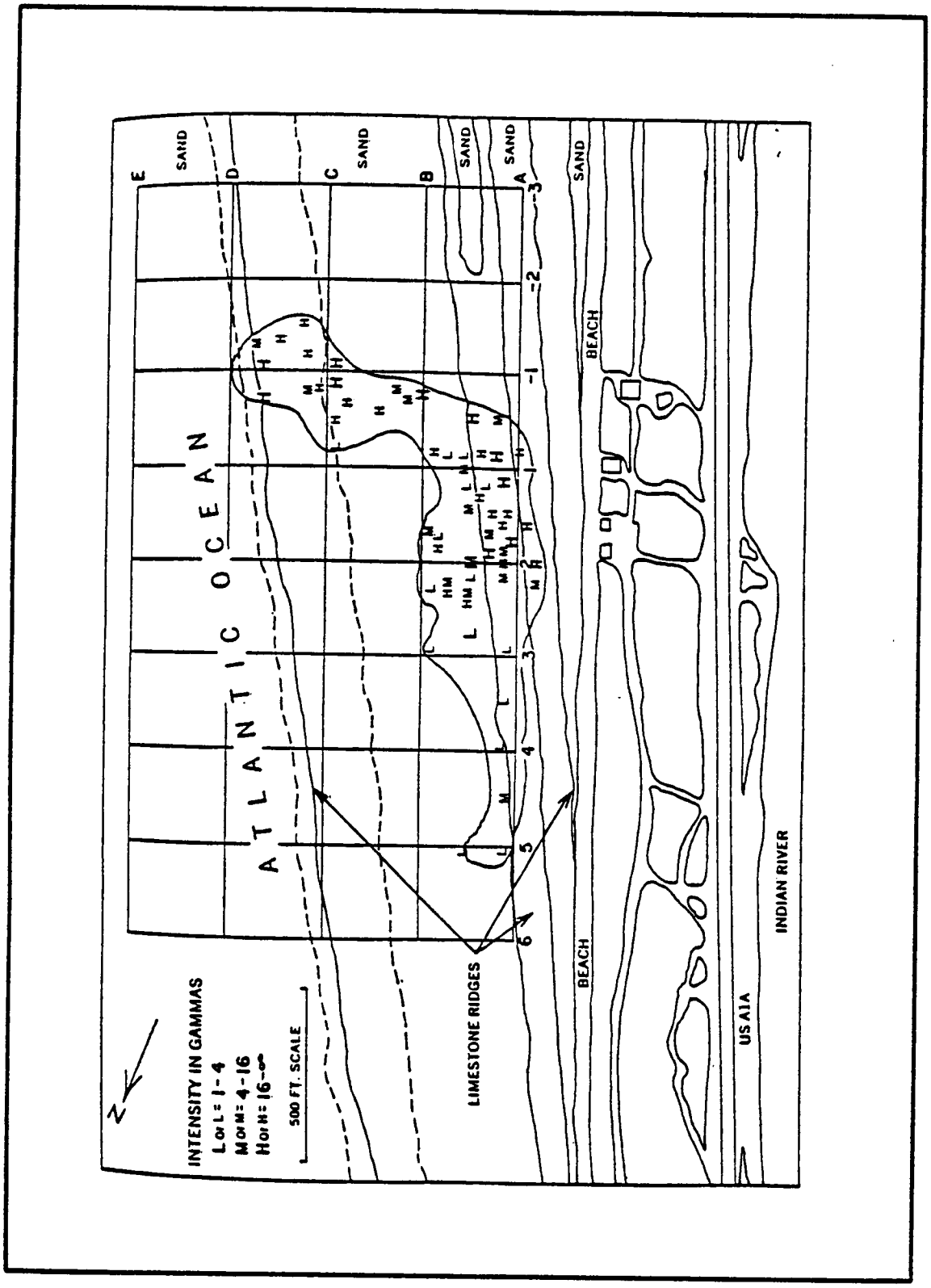


Figure 4.4.1 Distribution of Ferrous Artifacts on the "Colored Beach" Shipwreck Site off Ft. Pierce, Florida as mapped in 1963 (Clausen, 1965)

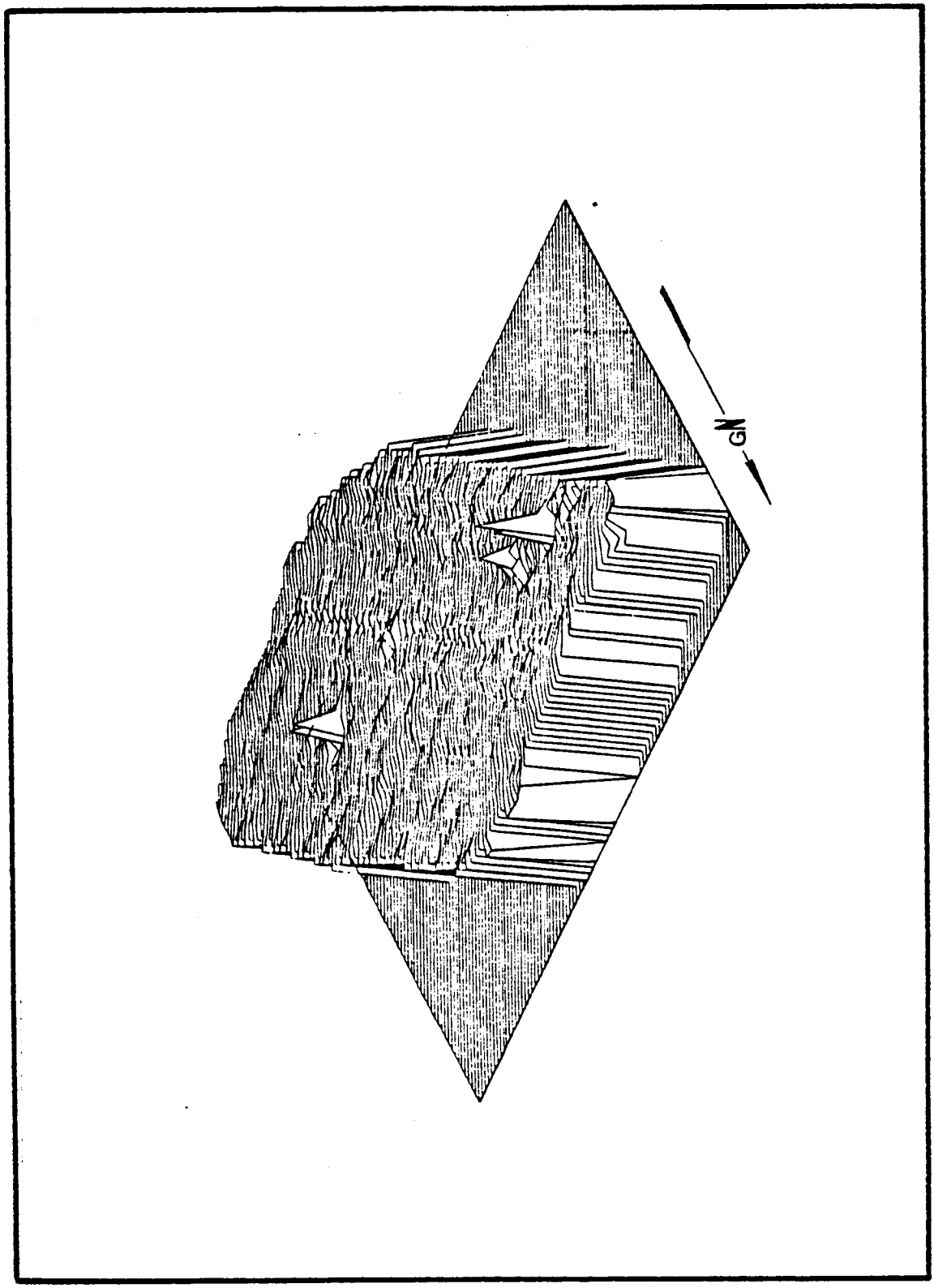


Figure 4.4.2 Three-Dimensional Rendition of Magnetic Signatures of Shipwreck Material off Padre Island, Texas (Arnold, 1976)
Courtesy: Texas Antiquities Committee

state of the art, a number of different types of magnetometers are available which are adaptable to deep and shallow water remote-sensing survey operations. Different magnetometers display some variation in their relative sensing capabilities under certain conditions; however, the instrument packages presently available on the market should be assessed in terms of their own inherent strengths and limitations prior to conducting survey operations.

An appraisal of a magnetometer's capability must be made in accordance with the known environmental conditions of the survey area and the archeological questions which need to be answered. It is important that the instrument operator be fully acquainted with the operation of the instrument to insure accurate interpretation of the anomalies. It is impossible to get reliable magnetometry data with an inexperienced instrument operator.

The effectiveness of a magnetometer in detecting archeological features on the seabed stems from the fact that certain types of cultural remains slightly affect the intensity of the earth's magnetic field. Different types of objects and features will create varying localized changes in the intensity of the natural magnetic field in the immediate area surrounding the target. It is the relative change in the earth's magnetic field that is evidence of possible cultural material. Magnetic anomalies are recorded only when objects, which are more magnetic than the surrounding overburden or when buried features displace uniformly magnetic deposits covering them (Breiner, 1973).

The interpretation of anomalies in the earth's magnetic field as indications of underwater cultural material presents a number of problems. Magnetometers cannot produce visual images; they provide magnetic signatures which may be subject to several different interpretations. With few exceptions no comparative sets of signature types exist which would facilitate the identification of magnetic anomaly sources associated with submerged archeological deposits (Arnold, 1976, 1978; Arnold & Hudson, 1981). More often than not, reliable interpretation of magnetic signatures can be viewed as a direct function of the

archelogical knowledge, technical training, and underwater experience of the observer. Precisely recorded data sets are worthless if they are interpreted by people inexperienced people with historic shipwreck phenomena and/or the technological capabilities of the remote-sensing hardware.

The interpretation of magnetic data signatures usually tends to be highly subjective and without any general scientific support. For this reason magnetometer survey results are often considered unsatisfactory and even controversial when archeological interpretations run counter to what contractors would favor. Many factors affect the shape and amplitude of magnetometer signatures. The signature is dependent upon the distance from the sensor head to the object and the mass of the target object (Table 4.4.1). The anomaly wave length or width is a function of depth; distance between the sensor and the object; the greater the distance, broader the signature.

Table 4.4.1 Typical Maximum Anomalies of Common Objects (Breiner, 1973)

| Object | Near Distance | Far Distance |
|---|---|---|
| Automobile (1 ton) | 30 feet (40 gammas) | 100 feet (1 gamma) |
| Ship (1000 tons) | 100 feet (300 to 700 gammas) | 1000 feet (0.3 to 0.7 gammas) |
| Light Aircraft | 20 feet (10 to 30 gammas) | 50 feet (0.5 to 2 gammas) |
| File (10 inch) | 5 feet (50 to 100 gammas) | 10 feet (5 to 10 gammas) |
| Screwdriver (5 inch) | 5 feet (5 to 10 gammas) | 10 feet (0.5 to 1 gamma) |

The magnetometer is most sensitive to detecting iron objects. The presence of iron anchors and cannon is usually the first indication of the presence of an historic shipwreck. Although magnetometers do not react to nonferrous metals, experimentation off the Florida Keys has indicated that ballast piles containing stones with a high content of ferromagnesium minerals (i.e., pryoxene and amphiboles) are detectable in a fine-grained survey (Mathewson, 1974). Similarly it may be found on further testing that under certain conditons, bronze cannon may be detected depending upon their oientation and the content of the iron impurities in the gun metal.

The reliability of magnetic data is directly dependent upon the known survey variables at the time of data acquisition and signature interpretation. Accurate data interpretation is only possible when the survey variables are clearly understood. There are a number of important variables which will affect the data quality in any magnetometer survey. In order to recognize a magnetic anomaly, it must be significantly larger than the resolution of the magnetometer and the instrument's "background noise level." For example, if a magnetometer is set for 0.25 sensitivity with "background noise" of 0.5 gamma, only objects producing an anomaly of 1 gamma or more will be readily identified (Breiner, 1973).

The sensitivity of magnetometers must be adjusted according to the type of survey being conducted. Quite obviously finer resolution will be required to locate archeological materials than what is necessary when searching for geological phenomena. Accordingly, instrument adjustments must be made when remote-sensing engineers are employed to locate submerged cultural material rather than geophysical features. Observations made over several years, during magnetometer surveys of shipwreck remains on the Atocha site, indicate that instruments set to detect ship's anchor and cannon will not be able to sense smaller objects at the same setting. If ballast trails are to be detected by the scatter of small ferrous material such as rigging, fasteners, cannon balls and side arms, magnetometers must be finely adjusted so that high resolution can detect an artifact scatter pattern to provide a reliable record of existing intrasite variability (Mathewson, 1974).

Other variables affecting the outcome of magnetometer surveys include the sea state, boat speed, length of tow cable, height of sensor head above the seabed, and lane spacing. The last two variables mentioned require some further comment. It is imperative to know the height of the sensor head above the seabed if anomaly signatures are to be accurately interpreted. As anomaly width is largely dependent upon the depth of objects buried in the overburden, signature interpretation is facilitated if sensor heads are towed at a constant known height above the overburden.

There has been considerable discussion between archeologists and contractors about the minimal requirements concerning the width of

lane spacing between survey tracks covered in a magnetometer survey. Survey strategy involves designing a search pattern which would provide complete coverage of a target area pinpointing all the shipwreck sites with spacing between the tracks as wide as possible to minimize operational costs. Recent archeological work off the Texas coast involved magnetometer surveys with 45 metre spacing to assure that all shipwreck sites would be located (Arnold, 1976). Twenty-five metre lane spacing was used on the Atocha site in an intrasite survey designed to provide data for a magnetic contour map of ferrous materials during the search for the primary cultural deposit (Mathewson, 1974). Experience on the Atocha site has shown that it is impossible to magnetically map a ballast trail stemming from the breakup of a 17th century wooden vessel with lane spacing any wider than 25 metres. Lane spacing recommendations to the study area will be considered in Volume IV.

Magnetic anomalies on submerged prehistoric sites have never been registered and little effort has been made to examine the potential for this type of archeological exploration on the Outer Continental Shelf. Since anomalies exist at archeological sites due to a contrast in magnetic properties between cultural deposits and the surrounding overburden, it should theoretically be possible to locate submerged prehistoric habitation sites by detecting old land surfaces containing buried features such as fire pits, burial mounds, earthworks, and organic refuse middens. These archeological features are commonly associated with Upland Archaic and Early Woodland habitation sites and there seems to be little doubt that these features can be associated with submerged sites of the same period on the Outer Continental Shelf.

Anomalies registered by such nonmetallic features for the most part are caused by thermo-remnant magnetism commonly present in materials which have undergone heating (Breiner, 1973). Surveys on upland sites have indicated that subsurface archeological features can be readily detected on upland prehistoric sites without the presence of iron (Gramly, 1970, and Arnold and Kegley, 1974). Therefore it is erroneous to believe that magnetometry does not have the potential capability to detect submerged prehistoric sites just because they predate the use of iron objects.

While it is theoretically possible to detect direct evidence of prehistoric habitation on the Outer Continental Shelf, there are significant differences in the approach to conducting this type of survey. The magnetic anomalies are comparatively weak. Therefore, it is critical that the magnetometer be close to the target if an anomaly is to be registered. Similarly, in the ocean a magnetometer would necessarily have to be moved very slowly and close to the bottom. The range of the magnetometer for this type of survey is very limited, and therefore it would not be practicable to use it for wide area survey for prehistoric cultural material.

Little effort has been made to develop a research design to evaluate remote-sensing capability to detect submerged prehistoric sites anywhere on the Outer Continental Shelf. In order to initiate such a study, suitable sites must first be located so that the performance of various sensing systems might be evaluated against known calibrated targets. Since 1973, Reynold J. Rupee has attempted to test remote-sensing systems on a partially submerged habitation site near Venice on the Florida Gulf coast (Rupee, 1978, 1979); however, a number of logistic problems have made it impossible for him to conduct magnetometry and sub-bottom profile surveys (R.J. Rupee, personal communication, June 1979). Although the submerged prehistoric archeological deposits mapped under the direction of W.A. Cockrell off Fort Pierce (Cockrell and Murphy, 1978) do not lend itself to this type of remote-sensing study, continuing efforts should be made in the study area to locate prehistoric sites so that a technical evaluation can be made of existing remote-sensing capability.

### 4.4.2 Side-Scan Sonar

Side-scan sonar as a remote-sensing instrument is still comparatively new to resource managers responsible for submerged cultural material. A relatively recent guide has outlined for the first time some practical information and major operational difficulties concerning the use of this system (Flemming, 1976). Essentially, side-scan sonar has been used in the study area, as in other parts of the Outer Continental Shelf, for conducting cultural resource inventories as a backup to the magnetometer.

A side-scan sonar unit provides a visual negative image of the underwater topography and can give direct confirmation of magnetic anomalies on the surface of the seabed. Similar to the magnetometer, side-scan sonar cannot provide data concerning the depths of targets beneath the seabed. This sonar system is only effective in detecting objects on, or projecting above, the bottom surface.

The side-scan sonar system is capable of mapping the topography of the sea floor with coverage of hundreds of metres on both sides of the moving survey vessel. The sensor head projects high intensity, high frequency bursts of acoustic energy. These acoustical bursts project along the sea floor until they intercept objects or topographic features which produce a return pulse of echo. These echos are amplified and received by the shipboard recorder which processes the incoming echos and records them on a dual channel print out. This creates a permanent and continuous visual record of a side path along the surface of the seabed (Klein Associates, 1978). Computer-corrected bottom mapping systems are also being developed and applied now.

The configuration of the side-scan sonar image is highly dependent upon the angle at which the acoustical energy approaches and is reflected back. Side-scan sonar "views" of the same object taken from different directions, and with the sonar fish at different depths, can be substantially different and difficult to interpret.

Although the capabilities of side-scan sonar have been known for some time (Yules and Edgerton, 1964; Klein, 1967), it has not been used on a regular basis in cultural resource surveys on the Outer Continental Shelf until fairly recently. One of the earliest successful applications of a side-scan sonar survey within the study area occurred in 1973 when it was used to locate the wreck site of U.S.S. Monitor (Watts, 1975). Over the last couple of years shipwrecks near Fort Pierce along Florida's east coast have been identified by side-scan sonar (Klein Associates, 1978). In March 1979 side-scan sonar located five targets believed to be shipwreck sites in the NOAA survey of the deepwater (30-50 metres) reefs within the Key Largo Reef Marine Sanctuary (NOAA, 1979a; 1979b).

Side-scan sonar is probably the most cost-effective remote-sensing instrument for detecting shipwreck sites in the deeper off-shore waters of the Outer Continental Shelf (Jameson, 1979). Recent survey work with a side-scan sonar in South Carolina rivers has met with considerable success in demonstrating the versatility of this remote-sensing system in shallow water environments (Alan Albright, personal communication, February 1979). More experimentation on known calibrated targets in both shallow and deepwater environments needs to be carried out to determine the full potential of this system for detecting historic shipwrecks.

Gagliano (1977) has previously summarized the available technology and inherent problems of using side-scan sonar to detect probable areas of prehistoric habitation on the Outer Continental Shelf. Since then there has been considerable improvement in the resolution quality of newly developed instrument packages. There appears, however, to have been little effort made to utilize these new technical developments to better define benthic environments for predicting likely areas for prehistoric sites on the Outer Continental Shelf. Recent underwater archeological surveys off the California coast have shown that side-scan sonar units are now available which produce sonograms capable of distinguishing individual artifacts as small as metates (Gary Stickle, personal communication, Feb. 1979). In light of these improvements in the state of the art, new efforts should be made in the study area to use side-scan sonar to delineate bottom configurations which may provide clues to identifying prehistoric habitation sites on the Outer Continental Shelf.

### 4.4.3 Sub-Bottom Profiler

The sub-bottom profiler is a system which provides information on the depth of objects below the seabed by emitting and receiving sound signals. Designed for geological purposes, it transmits a low-frequency acoustical signal downwards towards the sea floor. This signal is partially reflected at the surface of the sea floor, and partially continues on to penetrate the underlying material. Under ideal conditions, this acoustical signal may produce acoustical echoes at interfaces between one type of substratum and another (such as a

boundary between silt and sand). In reality, such interfaces are often indistinguishable on the data record, for one reason or another.

Good results depend on a number of variables: selection of frequencies, pulse length, and acoustical strength of the signal are important. Transducer characteristics and the quality of the recorder will also greatly affect data resolution. Other factors not influenced by instrumentation or operator experience include acoustical characteristics of the sea floor, water depth, and the sea state.

The sub-bottom profiler has been little used for archeological research in the study area or other parts of the Outer Continental Shelf. Descriptive literature on this remote-sensing system is scattered throughout a number of underwater acoustics handbooks, engineering journals, and manufacturer's manuals. Although sonar for sub-bottom penetration was pioneered by Dr. Harold E. Edgerton (1963; 1968) in the middle 1960's, a practical field manual summarizing the current state of the art is not yet available.

There has been little effort to assess the capability of sub-bottom profile units to locate and evaluate submerged cultural resources. The potential usefulness of this system in cultural resource assessment is considerable as it is the only remote-sensing instrument presently available which can detect objects within the overburden and measure their depth below the sea floor and detect relict shelf geomorphology. The variety of different types of bottom sediments encountered along some coastal areas may require adjustments in instrument configurations. Many bottom environments such as highly organic sediments, sandy deposits, and coarse-grained calcareous overburden often adversely affect the recording of sub-bottom data. The profiler was originally designed for survey work in deepwater and has not been known to be reliable in shallow water of not much less than 10 metres. However recent experimentation on a new profiler unit in the York River, Virginia, suggests that sub-bottom sonar can be successfully adapted to detect buried archeological resources in riverine and estuarine environments in approximately three metres of water (M. Klein, personal communication, 1979).

Few if any historic cultural materials anywhere in the world have been positively identified by sub-bottom prolifing. The Mary Rose (McKee, 1968) is the only site which has been positively identified with a sub-bottom profiler. Other sites have been claimed to have been located by sub-bottom sonar (i.e., Columbus' ship in St. Anns Bay, Jamaica) (Marx & Muckelroy, 1980) but these sites are unconfirmed. One of the first dramatic uses of the technique occurred in 1968 when Dr. Harold E. Edgerton detected buried features which were believed to be buildings which slid into the sea during the 1692 earthquake at Port Royal, Jamaica (Marx, 1975). Since that time, very few if any historic shipwreck sites have been positively identified in the New World by sub-bottom prolifing. One of the problems has been that people who have enough technical experience to reliably interpret sub-bottom profile data do not have the experience to equate historic shipwreck signatures with archeological interpretations. Another problem is that very little experimental work has been done to build up a comparative set of signatures from calibrated targets with known technical and environmental variables. A relatively recent sub-bottom profile survey of the Atocha site produced a signature which strongly suggests concentrated ballast deposits in over 5 metres of mud deposits (Figure 4.4.3). Upon examination this recorded feature was found to be large fragmented coral heads which had accumulated within the overburden (Mathewson, 1977c).

Much work needs to be done to develop sub-bottom profiling into an effective cultural resource inventory tool. Its greatest potential for detecting historic shipwrecks has yet to be developed. Further technical improvements should produce greater capability for evaluating historic material within anchorages and intracoastal waterways throughout the study area. With continued development, some progress hopefully will be made to utilize this remote-sensing system to detect shell middens and old land surfaces associated with prehistoric habitation sites on the Outer Continental Shelf. At the moment the present state of the art is only sufficient for sub-bottom profiler to detect possible paleo-environmental features which may be associated with early habitation sites.

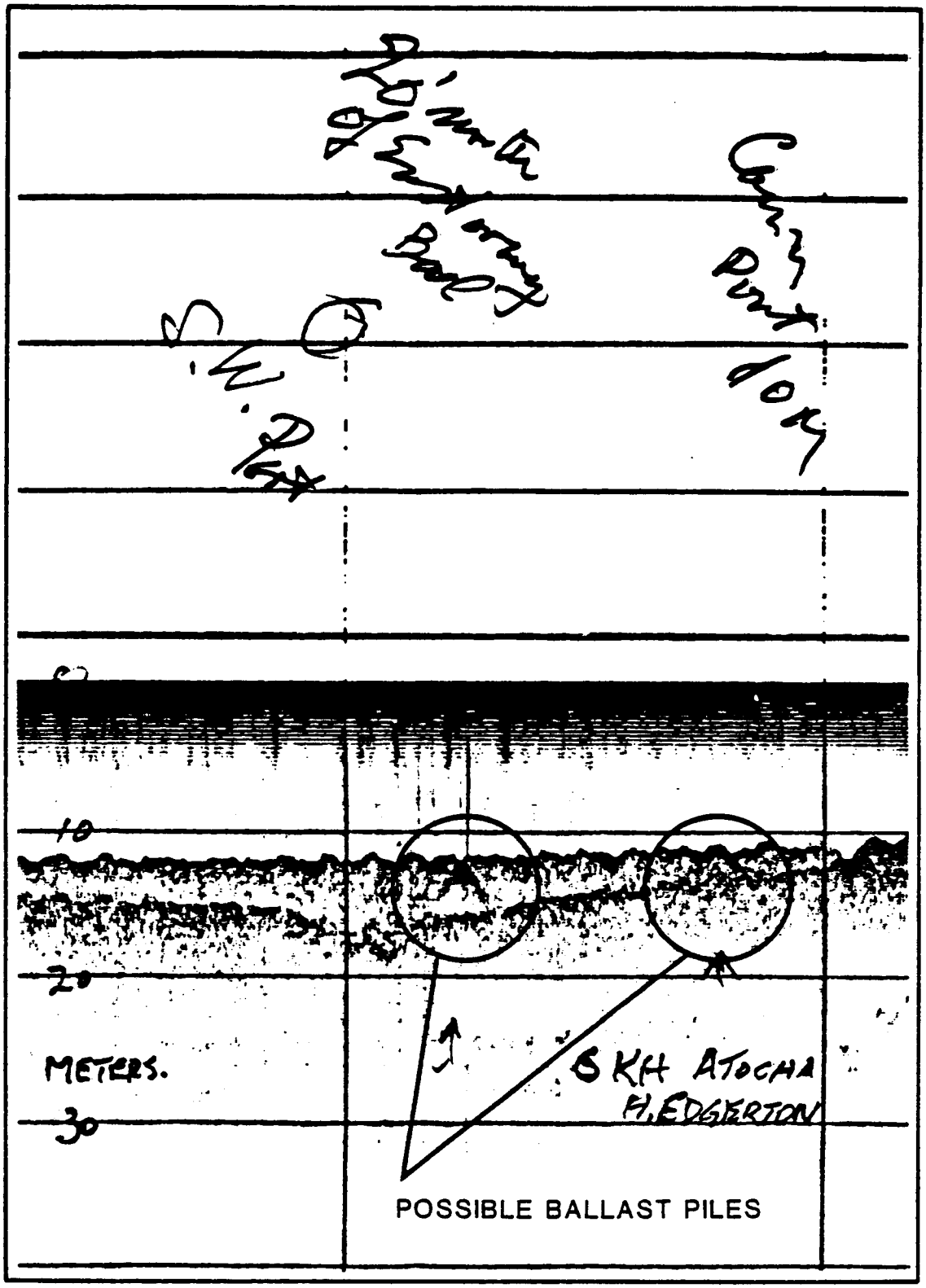


Figure 4.4.3 Sub-Bottom Profile Survey of the Atocha Site
(Photo Courtesy: Mel Fisher)

### 4.4.4 Underwater Vehicles

The use of underwater vehicles in remote-sensing work is not new but has generally not been applied to many archeological surveys due to the high cost or to the classified nature of much of the deepwater instrumentation. Within recent years the manned Pegasus vehicles developed by Dimitri Rebikoff have presented a growing potential for cost-effective photogrammetric surveys of shallow coastal areas. The photomosaic of the 1733 shipwreck site of the San Jose off the middle Florida Keys was compiled from photographs taken from a Pegasus (Rebikoff and Cherney, 1975). The photogrammetric techniques being used to record the hull remains of Santa Margarita recently located by Treasure Salvors Inc., is a good example of the type of arecheological detail which can be recovered from shallow water structures (Mathewson, forthcoming). Rebikoff has developed an unmanned vehicle similar to the Pegasus for work in the deeper areas of the Outer Continental Shelf. Other remote-sensing vehicles such as TVSS (Television Search and Salvage System) have been built to operate at great depths. This system was designed to be lowered from a stationary vessel and includes closed circuit television, cameras, sonar and a grab bucket capable of lifting 5 tons (Bascom, 1976). The unit was tested off California in 1972 but has never been involved in any extensive shipwreck survey work. At the moment there are a number of Deep-Tow systems being developed by the Navy which should provide greater future potential in remote-sensing capability in the deeper areas of the Outer Continental Shelf (Tyce and Boegeman, 1977).

### 4.4.5 Aerial Photography

Progress in the development of remote-sensing technology during the last few years has stimulated a new awareness among archeologists of the practicality of gathering data through the use of air imagery (Gumerman and Lyons, 1971). Increasingly, it is becoming obvious to archeologists that aerial photographs can provide a synoptic view for archeological prediction and hypothesis testing within problem-oriented research (Harp, 1975; Lyons, 1976). Aerial photography can also be applied as a remote-sensing procedure for compiling locational data in an inventory survey of shallow water shipwreck sites.

The application of low altitude photographic technology for the location and definition of submerged archeological deposits has received little attention in the past. Although aerial photography has been successfully applied in the mapping of underwater features within submerged harbor sites in the Mediterranean (Whittlsey, 1974), there has been little effort there to utilize this same technological capability for the location of shipwreck sites. Within the New World however, commercial salvors in Bermuda (Tucker, 1966) and Florida (Meylach, 1971) have given considerable attention to the detection of shipwreck sites from the air since the late 1950's. Most of these efforts have focused on the visual spotting of suspected underwater features rather than on interpretation of anamolous "signatures" on photographs.

The first attempt to utilize aerial photographic technology for determining the location of historic wreck sites in the New World was made by the National Park Service in a survey conducted in the Fort Jefferson National Monument in the Dry Tortugas (Marmelstein, 1972). A multiband system composed of four different film/filter combinations demonstrated for the first time that archeological potential exists in low altitude aerial photography for the location and explication of wreck site phenomena. Additional assessments of remote-sensing capability have since been carried out by the National Park Service on other possible shipwreck sites in the Gulf Islands National Seashore along the Florida panhandle (Fischer, 1974a) and near the suspected site of the underwater remains of Fort Poinsett on Cape Sable (Wood and Stapor, 1974) in the Florida Gulf Coast. Although the results of these surveys were disappointing from an archeological standpoint, they nevertheless defined several problem areas concerning image resolution and the acquisition of underwater bathymetric data.

Recently there has been a growing emphasis on the development and evaluation of aerial photographic systems designed for maximum water penetration. Through the experimental work of Eastman Kodak (Boller and McBride, 1974; Specht et al., 1973), and the National Aeronautics and Space Administration (NASA) (Lockwood et al., 1974) considerable progress has been made in developing camera systems which utilize film-filter combinations capable of detecting bathymetric detail in water depths

unrealized in the past. The new high-speed aerial color films such as Aerocolor (2445) and Ektachrome EF Aerographic (SO-397) developed by Eastman Kodak have the potential for maximum water penetration to depths of over 20 metres. It should be recognized, however, that water clarity is, of course, a controlling factor in light penetration and therefore photo interpretability.

The current availability of camera systems capable of recording bathymetric detail in water depths of over 20 metres presents an excellent opportunity to utilize existing remote-sensing technology for inventory survey work on shipwreck sites within shallow coastal and inshore waters. If archeological features relating to hull structures are visible on the seabed, the technological potential exists for detecting them through low altitude photographs.

The application of aerial photography for locating and assessing a shipwreck site population can serve several different survey functions (Mathewson, 1977b). Aerial photographs can be used to construct a planimetric chart recording the location of major hydrographic features. A scale of 1:12,000 can first be utilized to gain a synoptic view of particular areas containing suspected shipwreck site clusters. Once this preliminary chart has been compiled, a larger scale and more detailed bathymetric chart can be constructed as a base chart upon which all subsequent survey data can be plotted. If reasonable resolution of bottom detail can be obtained, it might be possible to correlate the distribution pattern of major coral heads recorded on the photographs with similar patterns recorded on side-scan sonar read-outs. Although such correlations might not always provide a precise location for some bottom features, they might provide the means for differentiating coral heads from anomalies recorded along particular compass headings. Through the use of such multisensor data correlation, bathymetric features can be more easily and quickly interpreted as a means of identifying suspected archeological features (Mathewson, 1977c).

The identification of hull structures from aerial photography in some cases would involve deductive inferences arising from the

association of several different patterns rather than from the actual visual perception of shipwreck material itself. The following are predominant criteria which should be considered (Mathewson, 1977b):

1. Size: It is important to consider both relative and absolute size of a wreck against a known standard when comparisons are made. At a photographic scale of 1:3000, the length of a 25-metre long hull structure recorded on the imagery will be a little over 6 mm.

2. Shape: When viewed from the air, intact sunken hulls oftentimes have an oval shape which can produce a "halo" feature. Discrimination between coral heads and a suspected feature solely on the basis of shape will not always be possible because coral formations often assume similar oval shapes. Shipwreck material, particularly an exposed ballast pile, may often provide the necessary firm substrate required for coral growth. In areas predominantly overlain with unconsolidated soft sand and mud deposits each individual coral patch should be closely examined through onsite "sea truth" inspection for shipwreck material beneath the coral.

3. Pattern: Any configuration anomalous to the orientation and distribution of the natural sea bottom phenomena should be investigated. All linear features should be examined both for possible shipwreck structures and reef scars caused by ships being driven across coral tracts. Successful pattern recognition of shipwreck phenomena is based primarily upon two principles: (a) the detection of a marginal border between the observed cultural feature and its predominant surrounding natural background, and (b) the identification of different internal components within a specific area, as opposed to immediate surroundings. The recognition of these pattern characteristics is not necessarily interdependent. One type of pattern may be easier to detect in a particular marine depositional environment than the other. Therefore, scanning photos for these two pattern characteristics should be undertaken independent of one another.

4. Photographic tone: Different phenomena all have varying qualities of light reflectance which is registered on an image in different color values or hues. The light reflectant quality of an object is essentially determined by its composition, surface texture and color.

5. Bathymetric location: The association of bio-geological features within specific known isobaths may provide important clues concerning prevailing environmental variables and how they might affect archeological material.

Photo interpretation of hull structures must be based upon the ability to define the natural marine environment through the recognition of their respective image signatures (Mathewson, 1977b). It is first necessary to be able to interpret the images representing bio-geological phenomena before images suggesting anomalous features appearing at variance with this environment can be pinpointed. Signatures in the imagery which seem to be out of place or generally do not fit into the normal ecological setting can then be examined more closely as possible archeological phenomena relating to sunken ships.

If lower hull structures are visible on the sea bottom in shallow areas having good water clarity, there is a good probability that they can be detectable with proper acquisitioning and interpretation of low-altitude photography.

Low-altitude photographs can often provide bathymetric data more quickly and at relatively low cost as compared to sea-surface surveys. Aerial surveys in clear coastal waters can offer a cost-effective solution to the management problem of compiling shipwreck inventories for a large area. Evaluation of this remote-sensing capability is being conducted along the Lower Florida Keys as an inventory procedure which might meet cultural resource management needs along other parts of the South Atlantic seaboard (Mathewson, 1978). This study involves the evaluation of photographic signatures of documented and calibrated shipwreck phenomena at different water depths and within varying depositional environments as an effort towards generating a comparative series of images. The study of these photographic images hopefully will provide a better understanding of the relationships between particular marine archeological features and their corresponding signatures. Once baseline parameters have been established on known archeological targets, they can be applied in the identification of similar features in an inventory survey of shipwreck sites elsewhere along the coast.

### 4.4.6 Underwater Video System

The use of closed circuit television in underwater archeology is not a new technique. In 1969 archeologists in Britain were experimenting with an underwater televison system to assist in the mapping of shipwreck sites (McDonald, 1970). These efforts proved that archeological work could be directed from the surface through the use of television systems when low visibility would have made such work otherwise impracticable. Claims that the camera could see over twice as far as the divers clearly demonstrated that a television camera was more sensitive than the human eye at low-light levels underwater.

During a shipwreck survey conducted by George Bass in the Mediterranean, an underwater television camera was lowered from a survey boat for a visual inspection of buoyed targets and to provide a permanent record of suspected shipwrecks for future reference (Gifford, 1974). However, the full potential of a video system as an underwater archeological tool was not realized until W.A. Cockrell employed a diver-held video system (Figure 4.4.4) for the recording of contextual data at the Prehistoric Man site in Warm Mineral Springs, Florida (Murphy, 1978).

The use of a video system to maximize data retrieval from underwater archeological sites has been fully demonstrated elsewhere (Cockrell, 1975a, 1975b, 1975c). The advantages of this system for conducting archeological investigations underwater can be summarized as follows:

1. It provides close range remote-sensing capability for the acquisition of synoptic and locational contextual data not otherwise obtainable.
2. Non-diving scientists can observe and help to supervise specific operations from the surface as bottom deposits are being investigated. The instant playback function of the video recorder (VTR), performing in normal, slow motion, or stop action modes, provides real-time review of archeological material in situ.
3. Data recording becomes more objective through acquisition of permanent visual documentation of contextual relationships. The camera records not only what the diver visually perceives,

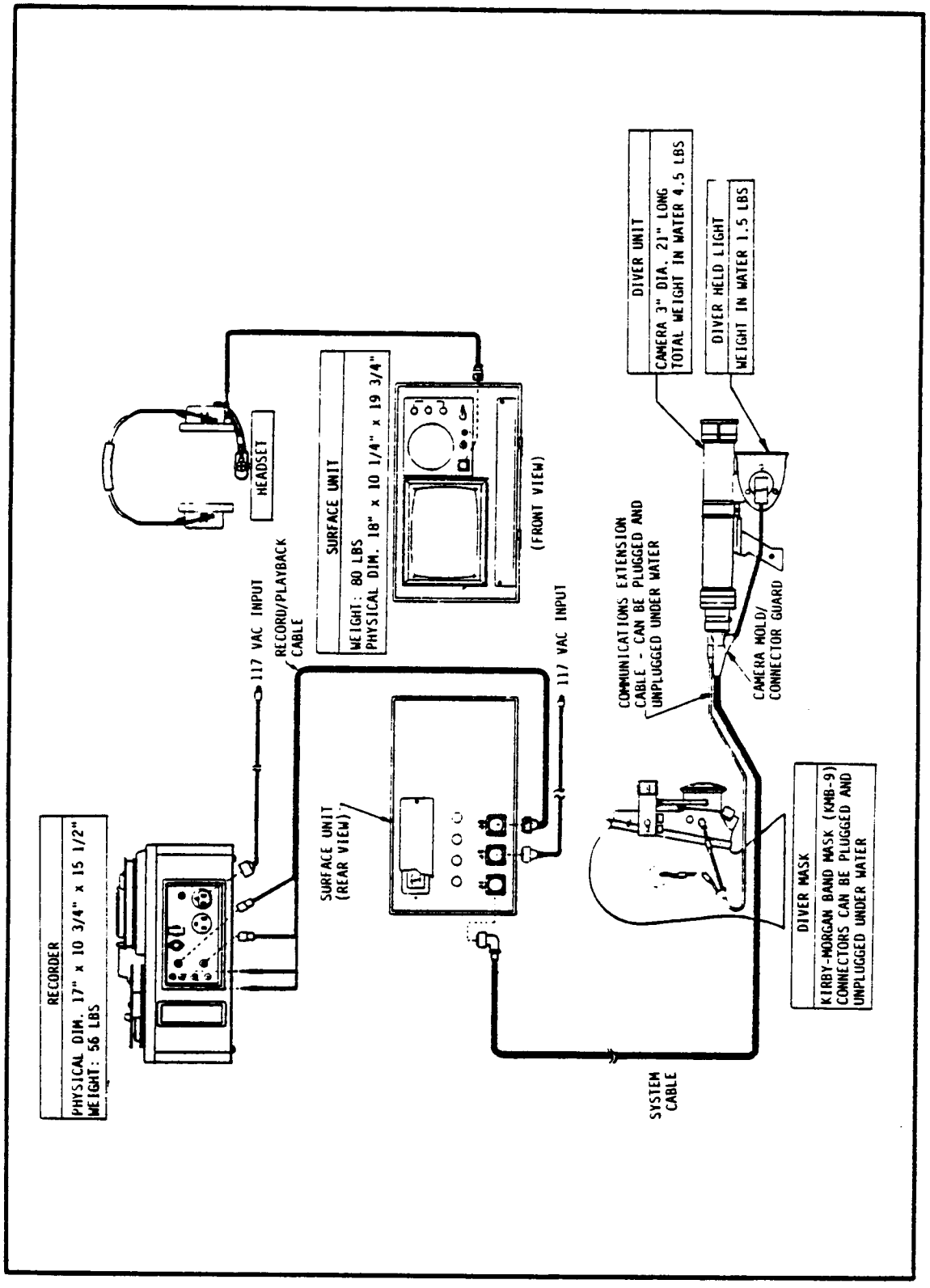


Figure 4.4.4 Underwater Video System Equipment
(Photo Courtesy: Hydro Products)

but also spatial relationships of the bottom sediments which may not be initially recognized by the human eye; the distinguishing characteristics of the archeological deposits not readily apparent to the cameraman can be interpreted off the monitor later through video playback. Oftentimes, top-side viewers get a clearer view off the monitor than the divers do; this is particularly true in low-light level conditions. With a Thallium iodine light, excellent topside viewing and recording can be made in underwater visibility of one foot.

4. Locational information from video tapes can be cataloged into a computerized data bank to facilitate storage and retrieval; such a data bank would enhance rapid reviewing of different data sets for the interpretive analysis of archeological phenomena. Locational information might also be digitized for computer drawn maps and perspective drawings.

Since the successful application of the video system at Warm Mineral Springs, several efforts have since been made to adopt this data recording technique during the National Reservoir Inundation Study (Lenihan, 1974; 1977), and in riverine remote-sensing surveys such as those carried out in the White River, Arkansas (Garrison et al., 1978), and Roanoke River, North Carolina (Watts, 1978). Although underwater video systems have been used for some time in deepwater salvage efforts carried out on modern shipwrecks such as the Andrea Doria, archeologists have only recently begun to realize its full potential for the scientific documentation of submerged sites on the Outer Continental Shelf.

The use of a video system to investigate the archeology of a shipwreck site within a marine environment presents a number of different variables from those in a freshwater or riverine environment. Tidal action, strong currents, and the need for a steady power source are some of the factors which have to be considered in any attempt to use video from an off shore boat. In 1977 evaluation tests were conducted in Key West to assess the practicality of operating a video system to document the archeology of shipwreck sites off the Florida Keys (Mathewson and Irick, 1976). Bad weather did not permit evaluation dives to be made from a boat; however two video tapes were made under simulated open-water conditions. These tests suggested a number of potential mapping applications for using video to document archeological recovery techniques, artifact contextual relationships and the content and physical integrity of shallow-water shipwreck sites on shallow areas of the Outer Continental Shelf.

The use of underwater video in the archeological study of deepwater shipwreck sites has been demonstrated by Watts (1975) during the preliminary underwater exploration of USS Monitor in over 70 metres of water off the North Carolina coast. By lowering a televison camera over the wreck site, the hull was carefully scanned from the surface in order to assess the physical integrity of the structure. Through this means a photomosaic was compiled of the site. More recent work carried out on the Monitor site by Watts in August, 1979 resulted in 30 hours of video tape documenting the test excavations carried out in the port bow section (Watts, personal communication, Oct. 1979). The use of video on the Monitor site has proven it to be an invaluable remote-sensing tool not only for locating and identifying offshore shipwrecks, but also for documenting excavations during the recovery of archeological material from deepwater shipwrecks (Watts, personal communication, Oct. 1979).

Another evaluation of closed circuit underwater television with surface-to-diver communication has been recently carried out on a shipwreck in 60 metres of water off the coast of Italy (Keith, 1978). This was focused on assessing a number of technological problems for the future planning of archeological work on deep water shipwreck sites.

Over the last 2 years archeological survey work on CSS Georgia has been carried out in the Savannah River by the Savannah District, U.S. Army Corps of Engineers (R.G. Anuskiewicz, personal communication, May 1979, and Garrison, Anuskiewicz, and Henry, 1979). Recent work carried out in August, 1979 has provided a good opportunity to develop new techniques in underwater video and low-level light photographic systems for conducting archeological assessments on shallow water shipwrecks in riverine environments under conditions of bad visibility (R.J. Anuskiewicz, personal communication, May 1979).

There is good archeological potential in the further development of video systems for assessing historic shipwreck sites under "blackwater" conditions in harbors and riverine environments along the Intracoastal

Waterways within the study area. Recent developments in sonar imaging have resulted in underwater sonar television cameras. These produce a television image based upon a sonar signal in zero-light conditions. While this image lacks the resolution of a visible light image, it would provide visual capabilities in turbid coastal waters where there is no visible light and a diver must otherwise work only by touch.

### 4.4.7 Future Systems

The remote-sensing systems presently available vary greatly in cost-effectiveness and technical complexity (Anusklewicz, 1978). Future systems must be developed which will provide increased capability to inventory and assess submerged cultural resources as efficiently and accurately as possible. Table 4.4.2 describes four improved systems currently in development which could make cultural resource surveys on the Outer Continental Shelf more cost-effective. In the immediate future, attention might also be given to further develop airborne magnetometer systems (Arnold, 1981) and low-altitude photographic imagery as cost-effective techniques for acquiring inventory data on shipwreck populations within the study area.

### 4.4.8 General Recommendations

If submerged cultural resources in the study area are to be properly protected from adverse impact from commercial activities on the Outer Continental Shelf, more effective remote-sensing procedures must be developed. A greater effort must be made to evaluate the effectiveness of the survey process used to identify potentially significant cultural resources. Minimal survey guidelines and archeological procedures should be outlined in more detail in the Notice to Lessees. Higher archeological standards should be set for Marine Archeological Surveyors to improve the scientific content and interpretative quality of lease block survey reports. As a general procedure, all lease block surveys should have the input of a professional archeologist during the planning stages and all final archeological reports should be subjected to external peer review. A close working relationship should be established between the remote-sensing engineer who records the data and the

Table 4.4.2 Near Future Survey Devices

| Device | Performance | Advantages/Disadvantages |
|---|---|---|
| o Magnetometer Arrays | o Range < 100M for a cannon | o Gives location of objects |
| o Airborne laser depth finders | o 4m x 4m spot<br>o depths to 20m | o Permits quick air surveys for sunken ships and major objects |
| o Synthetic Aperture Sonars | o Range 100m at 200 kH | o Permits object definition and recognition in a three-dimensional field of view |
| o Spectrum expanded low-level television | o Probably 260 line pairs | o Expands blue-green spectrum into red to violet for better object recognition<br>o Two dimensional picture |

archeologist responsible for interpreting them. Whenever possible archeologists should participate in the data gathering process on the survey boat.

Research should be conducted to develop interpretive keys for each type of remote-sensing system used and each type of cultural remains anticipated. Knowing the variation of the signature of a given object under different environmental conditions would result in a significant improvement in survey effectiveness. With this increase in effectiveness, more precise survey procedures could be developed involving sampling techniques for predictive modeling. Remote-sensing surveys conducted in the selected geographic areas identified in Volume IV will be the only way in which the accuracy of the historic and prehistoric cultural resource predictive models can be verified. Any future remote-sensing archeological surveys conducted by government agencies or the private sector should be periodically reviewed to determine what value this data may be in refining the predictive model or redrawing the sensitivity zones.

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## 4.4.11 ANNOTATED BIBLIOGRAPHY OF MAJOR SOURCES

Bearss, Edwin C. Shipwreck Study: The Dry Tortugas. National Park Service, U. S. Department of the Interior, Washington, D. C.; 1971.

An excellent inventory of shipwreck sites on the Dry Tortugas, west of the study area. It provides useful background information on the seafaring enterprise of the Southern Gulf Stream.

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This consists of a massive listing of some 13,000 ships of more than 50 tons which were lost in American waters. It is arranged alphabetically by region, and gives the name of each vessel, type of rigging, tonnage, year built, date of loss, cause, place of loss, and brief comments. This is a comprehensive work, and a most useful research tool for inventory work on shipwrecks from the early 19th century through present times.

Blanton, J. O., Newton, J. G. and Pilkey, O. H. An Oceanographic Atlas of the Carolina Continental Margin. Beaufort, NC: Duke University Marine Laboratory; 1971.

This publication is of special interest to researchers of shipwrecks on the coastline of North Carolina. In addition to other information on this area, the Atlas contains three excellent charts portraying the locations of wrecked vessels off Cape Fear, Cape Lookout and Cape Hatteras. Each chart is accompanied by an extensive wreck list which cites the location of the wreck, nature of the vessel lost, type, date of loss, tonnage or length, and additional comments on such matters as depths, etc.

These charts portray wrecks stranded, partially submerged, totally submerged, and those of doubtful position. By comparison to most shipwreck charts, these are of superior quality, and are fairly comprehensive, listing many hundreds of the vessels lost off the marine graveyard adjoining the North Carolina capes.

Burgess, Robert F. and Clausen, Carl J. Gold Galleons and Archaeology. New York: Bobbs Merrill Co., Inc.; 1976

A good account of the salvage and archeological work conducted on the Spanish Flota which foundered off the East Coast of Florida in 1715.

Clark, William Bell (ed.) Naval Documents of the American Revolution, Government Printing Office, 1966.

A basic source for the Revolutionary War period. This work contains numerous old maps and prints and is a comprehensive study of over 1,463 pages. Two Volumes.

Clausen, Carl J. "A 1715 Spanish Treasure Ship." Contributions of the Florida State Museum Social Sciences No. 12. Gainesville, FL: University of Florida; 1965.

A descriptive account of the first scientific effort in the United States to investigate and record the archeology of a shipwreck. This pioneering effort to conduct archeological research within a commercial salvage operation is a landmark in the development of underwater archeology in the New World. The study provided new insights to the Spanish Plate fleet which sank in 1715 off the east coast of Florida.

Coast and Geodetic Survey. Coast and Geodetic Wreck Chart Series.

These charts were compiled primarily for wartime use, and show the locations of those shipwrecks which were considered to be a potential menace to navigation during and just after the Second World War. A number of these shipwrecks were incorrectly plotted or misnamed, but probably constituted the best information available at the time.

CAPE HATTERAS TO CHARLESTON LIGHT - Chart No. 1106, Scale 1:449,600

CHARLESTON LIGHT TO CAPE CANAVERAL - Chart No. 111-A, Scale 1:449,600

CAPE CANAVERAL TO KEY WEST - Chart 1112-A, Scale 1:400,000

While these charts are long out-of-date for navigational purposes, they can provide baseline data in the absence of better or more complete information. This series can be found in the Library of Congress Map Division, Washington, D.C.

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This is a successor to the famous Lytle List of 1931. The book is a basic document for the researcher in this field. It is compiled from primary source materials, such as registers, licenses, enrollments,and other vessel documents. The loss list in the revised edition is over 70 pages long and highly useful. The loss list gives name of vessel, tonnage, year, nature of loss (stranded, burnt, etc.), date, place, and number of lives lost. This is probably the best single listing of steamship losses assembled in one volume for the period during and prior to the Civil War. This list cites several thousand vessels lost prior to 1868.

Mathewson, R. Duncan. Method and Theory in New World Historic Wreck Archeology: Hypothesis Testing on the Site of Nuestra Senora de Atocha, Marquesas Keys, Florida. MA Thesis. Florida Atlantic University: Anthropology Department; 1977.

An account of archeological data recovery to define the anatomy of a 1622 Spanish Galleon wrecksite off the Florida Keys. This study demonstrates the possibilities and inherent problems of collecting archeological data within a commercial salvage operation when there are no other alternative options to mitigate adverse impact.

Mathewson, R. Duncan. An Introduction to Historic Shipwreck Archeology of the Southern Gulf Stream: An Annotated Bibliography. Unpublished manuscript; 1978.

A review of relevant literature pertaining to the archeology of shipwreck sites of the pre-1750 period along the South Atlantic seaboard.

Marx, Robert F. Treasure Fleets of the Spanish Main. Cleveland, OH: World Publishing Co.; 1968

A good general introduction to the Spanish Flota system of the 16th and 17th century.

Marx, Robert F. Shipwrecks in Florida Waters. Eau Gallie, FL: Scott Publishing Company; 1969.
This contains brief references to some 357 shipwrecks off Florida from 1525 to 1825. There are some valuable comments on source materials.

Marx, Robert F. Shipwrecks of the Western Hemisphere. New York: World Publishing Company; 1971.
Gives wreck losses for the United States on a state-by-state basis, and includes much loss data on adjacent areas, including the Bahamas and the West Indies. Covers the period 1492-1825, and is fairly comprehensive.

Marx, Robert F. Spanish Treasure in Florida Waters: A Billion Dollar Graveyard. Boston: Mariners Press; 1979.
The author's most recent guide to historic wrecksites off the Florida Coast. Like similar books of this type, it has a heavy emphasis on treasure hunting.

Meylack, M. (as told to C. Whited). Diving to a Flash of Gold. Garden City, NY: Doubleday & Co., Inc.; 1971.
A popular account of salvage efforts to recover "treasure" from the sites of the 1733 Spanish Flota wrecked off the Florida Keys. Although a non-scientific study, it pulls together a lot of information on shipwrecks situated between Fowey Rocks and Sombrero Key. Meylach's locational data where checked have been found to be reasonably accurate; both Florida Divisions of Archives, History and Records Management, and National Park Service have utilized Meylach's shipwreck knowledge for their survey work.

Official Records of the Union and Confederate Navies in the War of the Rebellion - 1894-1922. Washington, D.C.
This is the official and basic source of information on many Civil War shipwrecks. It contains considerable blockade runner loss data, and can usually be found in the larger libraries. This is an essential source to any researcher working on the Civil War period. The set contains 30 volumes, and is well indexed.

"Sunken Time Bombs." Popular Mechanics; November, 1976
A brief description of some 78 oil tankers sunk off the Atlantic coast, which notes their damage potential from oil pollution. Gives name, date, location, tonnage of each tanker.

Peterson, Mendel L. The Funnel of Gold. Boston: Little, Brown & Co.; 1975.
An authoritative historical description of the Spanish Plate fleets and maritime commercial activity along the southern Gulf Stream from 1492 to 1750.

Potter, John S. The Treasure Diver's Guide. New York: Bonanza Books; 1972.
A popularized description and guide to historic shipwrecks around the world. Strong emphasis is placed on "treasure" wrecks off the Florida Coast.

Price, Marcus W. Ships that Tested the Blockade. American Neptune; 1965.
A series of excellent articles in Volumes VIII through XI. They contain much detailed material on the Civil War blockade runners sunk off the coasts of North and South Carolina.

Shepard, B. Lore of the Wreckers. Boston: Beacon Press; 1961.
Contains an interesting discussion of East Coast wrecking and salvage practices, ranging from New England to the Florida Keys.

Ships of the Esso Fleet in World War II. Standard Oil Company of New Jersey; 1946.
An excellent ship-by-ship description of Esso tanker losses during the Second World War. Good photographic coverage of tanker structure and damage.

Shomette, Donald G. Shipwrecks of the Civil War: The Encyclopedia of Union and Confederate Naval Losses. Washington, D.C. 1973.
This is an excellent compendium of Civil War ship losses and a valuable reference aid. The lack of a table of contents and index makes it difficult to cross-check sites for comparative studies.

Spence, E. Lee. Spence's Guide to South Carolina. Charleston, SC: Nelson's Southern Printing Co.; 1976.
Contains a list of over 600 shipwrecks lost on the South Carolina Coast from 1520 to 1813. Much of the list has been compiled from colonial newspapers and Lloyds' lists.

Spence, E. Lee. Spence's Shipwrecks of South Carolina: 1520-1979. Sullivans Island, SC: Shipwreck Press; (Forthcoming).
An updated comprehensive listing of over 2,000 shipwrecks off the South Carolina coast. Many of the listings have come from newspaper accounts.

Sprunt, James W. Tales of the Cape Fear Blockade. Charlestowne, NC: Charlestowne Preservation Trust; 1965.
Deals with the wrecks of numerous Civil War blockade runners. Many of these old wrecks still exist off the North Carolina coast.

Stick, David. Graveyard of the Atlantic. Chapel Hill, NC.; 1952.
Devoted to marine losses off the coast of North Carolina. It contains an extensive listing of vessels totally lost off North Carolina. Vessel losses are arranged chronologically from 1526 to 1945, and cite name of vessel, date, type, lives lost, and approximate place.

Stick, David. The Outer Banks of North Carolina 1584-1958. Chapel Hill, NC: University of North Carolina Press; 1958.
An authoritative historical account of the settling and development of the Outer Banks.

U. S. Army Corps of Engineers. Annual Report of the Chief of Engineers on Civil Work Activities. Washington, D.C.: Department of the Army, Office of the Chief of Engineers; 1976.
This is one of a series of annual reports which are a basic source dealing with many varied aspects of harbor and waterway work. These reports are of special interest to shipwreck researchers, for they deal with many government shipwreck removal operations in South Atlantic waters. These voluminous reports go back before the Civil War, and often contain large scale charts showing a vast wealth of harbor and waterway detail, as it existed a century ago. Researchers should not ignore this source, because a number of old shipwrecks currently being described by modern writers as still extant, were removed by the Corps of Engineers long ago during harbor or waterway improvement operations. These volumes are well indexed and usually accompanied by extensive fold out maps and charts, but are difficult to locate in complete sets containing the older out-of-print volumes needed by the historical researcher. A few sets still exist in Washington, D.C. in the Library of Congress and the National Archives.

This source of information is particularly useful to the researcher seeking data on historical or modern waterway or channel alignments, engineering or harbor features, dredging activities or data on the demolition or salvage of old wrecks.

U. S. Coast Guard. Coast Guard Annual Reports 1915 to 1931. U. S. Treasury Department. Washington, D. C.: Government Printing Office; 1915-1931.

This series picks up where the old Life Saving Reports left off, and includes much additional data from U.S. Coast Guard vessels, as well as land situations. The series is in hard cover, and located in the National Archives in Washington, D.C.

U. S. Department of Commerce. United States Coastal Pilot No. 4, Atlantic Coast: Cape Henry to Key West. NOAA, 16th Ed. Washington, D. C.: U. S. Department of Commerce; 1978.
This basic source of navigational information provides a supplement to earlier nautical charts and notices to mariners concerning the South Atlantic seaboard.

United States Navy. Dictionary of American Naval Fighting Ships. Washington, D. C.: Naval Division, Office Chief of Naval Operations; 1959.

Volume I was compiled in 1959, and subsequent volumes have been completed, or are currently being compiled. This monumental work is a continuing series, and constitutes a basic source of data on American Naval vessels. It lists nearly all naval vessels built or operated by the Navy from its earliest beginning, and contains thumbnail sketches of nearly all major units and some loss data where pertinent. This is an extremely useful basic source, and sets of this work can be found in many major libraries.

All the volumes of this series can be purchased from the Government Printing Office, Washington, D.C. Of special interest to historical researchers is Volume II, which contains an extensive section on Confederate vessels and privateers, as well as the Confederate Stone Fleet.

U. S. Treasury Department. Life Saving Service Reports -- 1876-1914. U. S. Treasury Department, Washington, D.C.

These are basic sources for reports of vessels wrecked on the coast after 1875. Reports were published for each fiscal year. Coverage is extensive and far more accurate than most of the shipwreck data in this field. This series was discontinued after the Life Saving Service merged with the U.S. Coast Guard, so after 1914 the researcher must consult U.S. Coast Guard reports for this type of data.

Watts, Gordon P. "The Location and Identification of the Iron Clad USS Monitor." Journal of Nautical Archaeology. London. Vol. 4:301-330; 1975.

An authoritative account of the state of the art remote sensing technology and research methodology for locating and assessing deepwater shipwrecks on the OCS.