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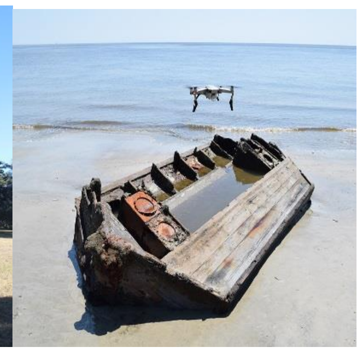


Submission date:

September 30, 2018

Abstract

The intention of the proposed project is student training in rapid *in situ* state of the art documentation on diverse case studies of coastal cultural heritage that are unstable, eroding or deteriorating situated both on land and underwater. To facilitate a national need in cultural resource management, researchers from different disciplines will work together to adapt and develop several technologies and techniques both low and high cost. Each case study site has state or national historic significance, conservation management challenges and serves as an intellectual platform to segue between preservation of an historic icon and research questions that will be utilized to develop student theses and dissertation topics

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INTRODUCTION

The intention of the proposed project, funded by a National Park Service Preservation Training and Technology (PTT) Grant, is student training in rapid *in situ* state of the art documentation on diverse case studies of coastal cultural heritage that are unstable, eroding or deteriorating situated both on land and underwater. To facilitate a national need in cultural resource management, researchers from different disciplines will work together to utilize, adapt, teach and develop several technologies and techniques, both low and high cost. Each case study site has state or national historic significance, conservation management challenges and serves as an intellectual platform to segue between preservation of an historic icon and research questions that will be utilized in a variety of formats.

The grant has facilitated outstanding educational opportunities for classes and fieldwork training of students across disciplines in maritime studies, history, geography, and geology. The data generated as the grant research progressed included student MA theses and PhD Dissertations, professional and public presentations, and social media such as a dedicated website and face book page. A series of journal articles are planned for this year. Students played an integral role in site visitation, data collection and technology testing, utilization and data post- processing.

This report will outline 1. The technologies used to record historic sites utilized including Laser Scanning, 3-D Photogrammetry, and 3D printing, Remotely Operated Underwater Vehicle (ROV), Wave Seismometer, Unmanned Aerial Vehicles (UAVs), Global Positioning System (GPS), Side Scan Sonar, and Ground Penetrating Radar (GPR) 2. Geological Processes on Costal areas impacting or likely to impact sites 3. Condition of the Cultural Resources 4. Identify preservation challenges for cultural resources managers.5. Compile diverse case study projects.

CHAPTER 1. TECHNOLOGY

Laser Scanning

The Terrain Analysis Laboratory in the Department of Geography, Planning, and Environment used a Leica HDS terrestrial laser scanners to record and preserve the current condition of features at the Bald Head Island, Fort Fisher, Ocracoke and Portsmouth historic structures sites. A terrestrial laser scanner is a tripod mounted instrument and emits laser light at a specified vertical and horizontal spacing. For example, we recorded the interior of the Bald Head Island Lighthouse at a point spacing of 6.3 mm. Any surface in the lighthouse reflecting the laser light back to the scanner will be recorded as a point at every 6.3 mm across the entire surface. Each point records the location of the surface, its height, the surface intensity (amount of energy reflected from each object), and an rgb value (from a photo taken with the laser scanner). This information can be used to: measure features; assess structural changes over time, assist in restoration of the sites by identifying features that are decaying, preserve the current condition of the site, develop educational and research-educational experiences, and visualize the features by a variety of media including 3D models printed from 3d printers.

Figure 1. Geography Student Laser Scanning Baldhead island lighthouse
(Photo by Lynn Harris, ECU)

3-D Photogrammetry

The Maritime Heritage at Risk team utilizes photogrammetry to collect rapid, 3-dimensional data from 2-dimensional photographs. The benefit of photogrammetry is that any camera can be used to collect the images, from a professional SLR to a cell phone. Images can even be extracted from high-resolution video taken with common video cameras, such as GoPros. This flexibility has made photogrammetry a popular low-cost solution for archaeological documentation with minimal technical knowledge required to utilize the methodology. In the field, the team follows a pre-determined flight plan over a site to collect enough overlapping images to import into the photogrammetry software. Depending on the size of the site, hundreds or thousands of photos may be taken.

Once the data set of images is collected, the photos are imported into the commercial software package PhotoScan, by Agisoft LLC, to post-process the images and render the 3D reconstruction. The software utilizes a Computer Vision (CV) algorithm to reconstruct the 3D structures of a site by finding common features or points among the set of images, taken from different vantage points of the given subject, and processes these images to derive virtual depths and geometry of the structures photographed. The CV algorithm automatically calculates the interior and exterior camera parameters, or camera locations and settings in virtual space, using the corresponding features of each consecutive photo in the dataset to orient the images, which generates a sparse point cloud of the object. This allows for further dense point cloud generation, surface or mesh reconstruction, and texture mapping. Using PhotoScan, the site can then be scaled appropriately, an orthomosaic plan view of a site or artifact can be delineated, or the 3D file can be imported into a digital animation program for further analysis and interpretation. The versatility and practicality of PhotoScan has made it one of the most widely used programs in archaeological or historic preservation studies.

Remotely Operated Underwater Vehicle (ROV)

Recently, the Program in Maritime Studies purchased a low-cost Open ROV 2.8. This ROV has been equipped with three GoPros, capable of shooting multiple video resolutions. The customized ROV was successfully used to record and create a 3D model of the schooner *Portland*, located in NOAA's Thunder Bay National Marine Sanctuary. If conditions allow, the ROV will be deployed on *Lawrence*; however, a handcrafted camera mount, capable of holding the three GoPros at the necessary angles, will be used if conditions do not allow for the use of the small ROV.

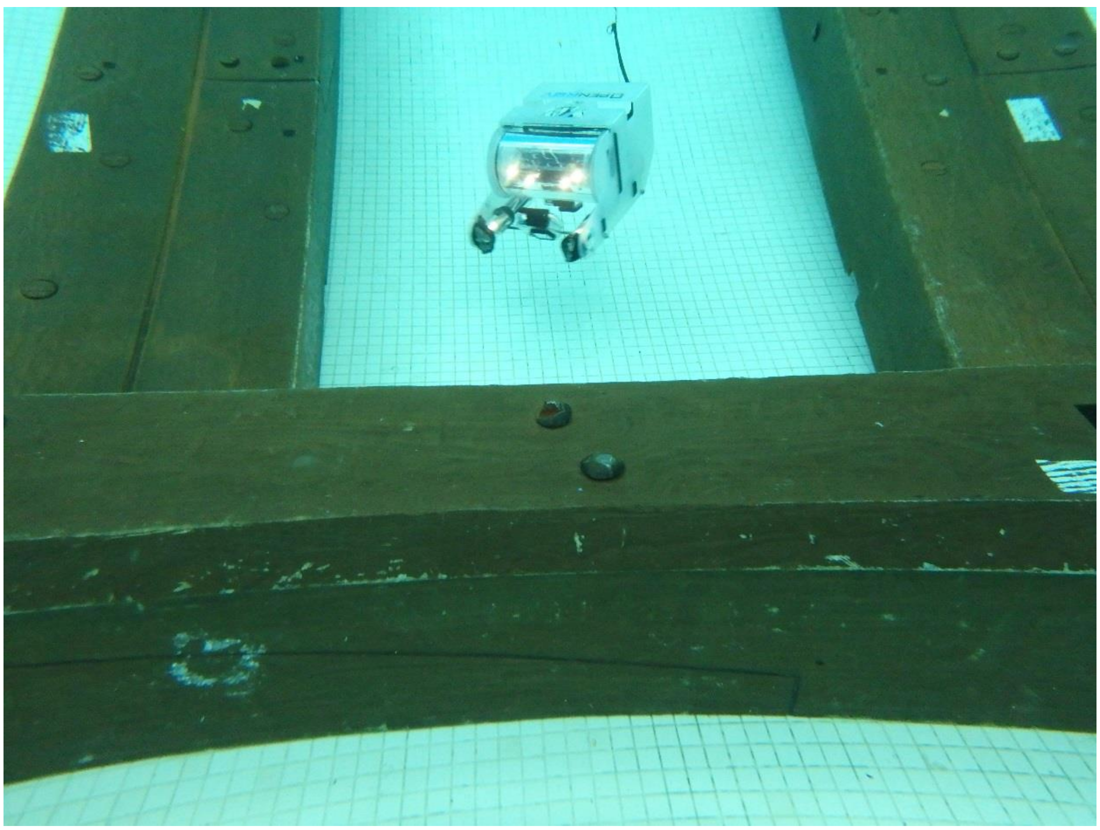

Figure 2. Testing the ROV in the ECU pool on a replica shipwreck (Photo by Lynn Harris).

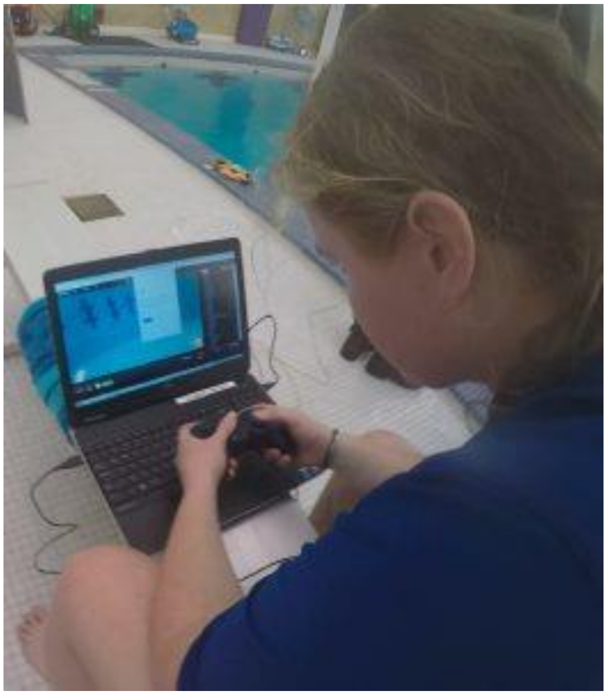

Figure 3. ROV control station (Photo by Lynn Harris).

Figure 4. Katie practicing photogrammetry sweeps on the replica shipwreck in ECU pool. The handcrafted camera mount is a backup plan if sea conditions are too rough on *Lawrence* shipwreck site for the small ROV (Photo by Lynn Harris).

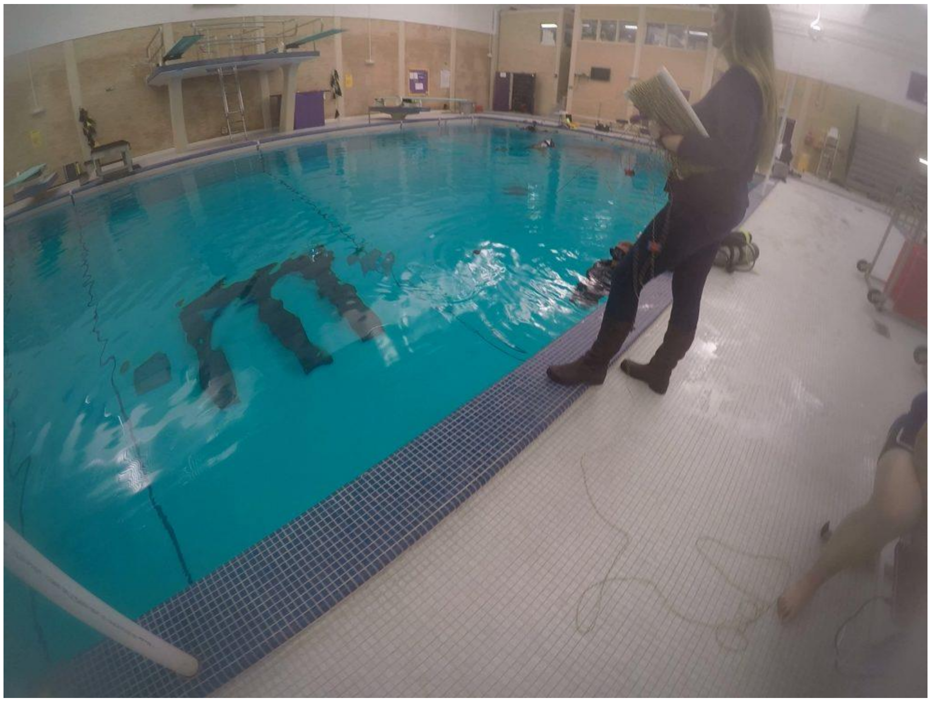

Figure 5. Managing the ROV tether cable from the pool deck (Photo by Lynn Harris).

Photogrammetry and 3D printing

Figure 6. A 3D Printed anchor created by student Annie Wright using underwater photogrammetry (Photo by Lynn Harris).

The use of photogrammetry and 3D printed allows for rapid prototyping and recording of archaeological sites and artifacts. This is particularly useful for sites at risk, as photogrammetry allows archaeologists to quickly record data in great detail. 3D printing allows the public to access sites that may not otherwise be possible, including sites that are too fragile for large numbers of visitor and sites in inaccessible places such as deep or dirty water, or remote locations.

Ground Penetrating Radar (GPR)

The Department of Geological Sciences is assisting the North Carolina Coastal Heritage at Risk Project by using ground penetrating radar (GPR) to find buried cultural sites and to assess the geological framework which partially controls the vulnerability of a site to erosion processes. A GPR images the subsurface by projecting radio waves into the ground using an antenna (the big orange box in the photographs). These reflect off of subsurface layers or objects where there i…s a change in electrical properties. Reflected energy is received by the antenna and recorded and displayed. Data can be processed to understand the depth scale. Here we are using a 200MHz antenna with a GSSI SIR-3000 system.

Figure 7. David Mallinson (left) and Barry Bleichner (right) deploying the ground penetrating radar unit at Fort Fisher historic battle field (Photo by Lynn Harris).

Wave Seisometer

The Department of Geological Sciences installed a seismometer at Fort Fisher. The unit measures ground vibrations and can record the energy of the breaking waves. The objective here is to assess the possibility of using an array to monitor wave breaking, which can enhance an understanding of sediment transport and erosion processes along the coast. A seismic refraction survey was also performed to provide information on the geological framework, which partially controls the vulnerability of a site to erosion processes.

Figure 8. Installing a Seismometer at Fort Fisher (Photo by Lynn Harris).

Figure 9. Checking the data recordation on a computer during a test trial run (Photo by Lynn Harris).

Unmanned Aerial Vehicles (UAVs)

Unmanned Aerial Vehicles (UAVs), or drones, are becoming commonplace items in many countries around the world. The newest versions are affordable, easily controlled, and provide a very useful platform for aerial imagery, videography, and photogrammetry at archaeological sites. The Maritime Heritage at Risk team utilizes two different drones to collect aerial data: the DJI Phantom 2 and the DJI Mavic Pro Platinum. Both drones are piloted using a separate hand-held controller, with the Mavic Pro operated from an app that is downloadable on Apple or Android cell phones. The Phantom 2 uses a separate GoPro camera to collect imagery, while the Mavic Pro has a built-in 4K camera mounted on a two-axis gimble. The flight time of each drone ranges from 25-30 minutes, making them useful for quick site assessments. The aerial imagery provided by these drones also gives archaeologists the opportunity to generate detailed plan, profile or photomosaic views of a site and the surrounding landscape. This imagery is often more precise than simply using satellite images found on GoogleEarth or ArcGIS. Further data collected from drones can be used for educational and outreach presentations or for the generation of 3D models.

Figure 10. Nick Delong pilots the DJI Phantom 2 drone over Bald Head Island (Photo by Lynn Harris).

Figure 11. Michelle Damian of Monmouth College practices with the DJI Mavic Pro controls on Jekyll Island (Photo by Lynn Harris).

Global Positioning System (GPS)

The Program in Maritime Studies has several hand-held GPS units that can be used for position-fixing and recording the spatial location of artifacts or sites. The primary unit used in our fieldwork is the Garmin Rino 655t. This GPS uses pre-loaded topographic maps along with a high-sensitivity receiver to connect to the network of satellites and determine the position of the user in various geographical projections. The Maritime Heritage at Risk team uses the GPS to plot the spatial coordinates of the site itself, artifacts around a site, and to determine the extent of a site in conjunction with remote sensing methods like metal detection or GPR.

Figure 12. The DJI Mavic Pro flies over the wrecked Liberty Ship Life Float on Jekyll Island (Photo by Jeremy Borrelli).

Side Scan Sonar

The Geology Department team conducted a side scan sonar survey of a river shipwreck at Rose Hill Plantation on the Cape Fear River showing the bathymetry and signature of the hull. Side-scan uses a sonar device that emits conical or fan-shaped pulses down toward the seafloor across a wide angle perpendicular to the path of the sensor through the water, which may be towed from a surface vessel or mounted on the ship' hull. The intensity of acoustic reflections from the seafloor of this fan-shaped beam is recorded in a series of cross-track slices. When stitched together along the direction of motion, these slices form an image of the sea bottom within the swath (coverage width).

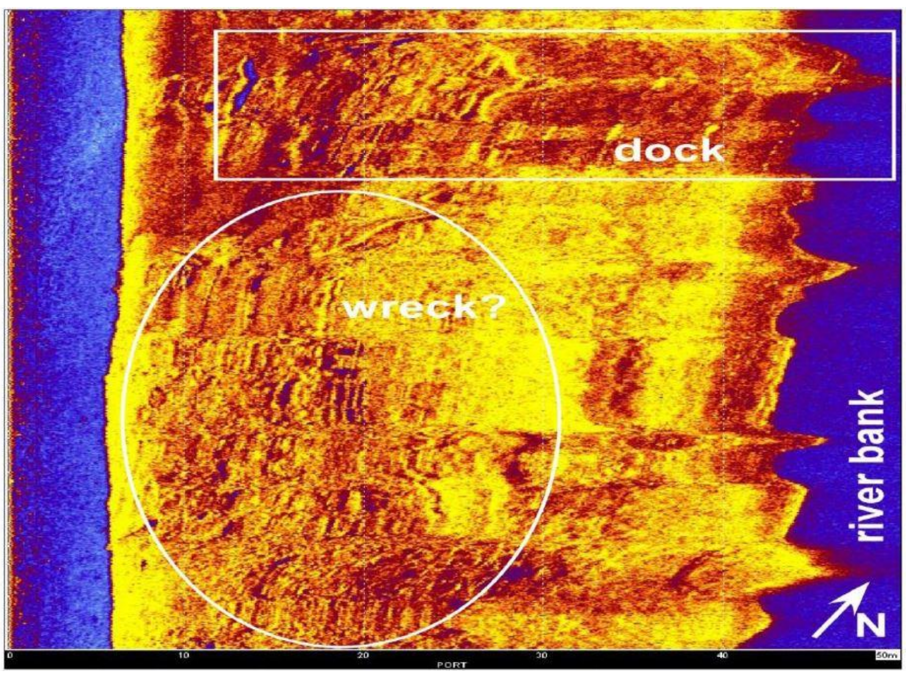

Figure 13. Side Scan image of the wreck and dock (Image by David Mallinson).

CHAPTER 2. GEOLOGICAL PROCESSES

The East Coast of the United States is a passive continental margin lying within the North American plate which is slowing moving away from Europe at a rate of ~2.5 cm/y due to seafloor spreading. The stratigraphy of the margin is complex and is related to a variety of factors including the initial geology and morphology of the margin during initial rifting and onset of seafloor spreading some 180 million years ago (Sheridan, 1976; Gohn, 1988; Klitgord et al., 1988). The build-up of sediments on this margin is a function of sea-level changes, changes in elevation of the land surface (uplift and subsidence), and the response of riverine and coastal systems, including the biology (i.e., carbonate production), to these processes.

Characterizing current environmental and erosion threats using qualitative and quantitative geomorphology and subsurface data

The NC coastal plain exhibits two major geomorphic/geologic provinces, with Cape Lookout demarcating the boundary along the coast (Fig. 1; Pilkey et al., 1998). These two provinces are distinguished by differences in the geomorphology and processes (e.g. degree of tidal versus wave energy). The Northern Province has large estuaries and long barrier islands with few inlets, while the Southern Province has narrow lagoons and shorter barrier islands with many inlets), which is controlled by the underlying geology. The differing geology is related to the long-term basin evolution impacted by tectonics, sea-level changes and sediment supply. The Northern Province is underlain by a filled basin beneath northern Pamlico Sound. A wedge of young Quaternary (<2.6 million years old) sediments has filled this basin to a depth of ca. 90 m (300 feet) and continues to undergo compaction, resulting in a very wide, very low gradient subsiding coastal system (Mallinson et al., 2005, 2010; Thieler et al., 2015). The estuaries occupy drowned river valleys that were incised during the last glacial maximum ca. 20,000 years ago (Riggs et al., 1995; Mallinson et al., 2005; 2010). The Southern Province is characterized by much older rock units exposed along much of the seafloor and adjacent upland areas (ca. 3 to 110 million years old, i.e., Pliocene to Cretaceous; Sheridan, 1976; Klitgord et al., 1988; Gohn, 1988; Grow and Sheridan, 1988). These occur above a crystalline basement high (the Carolina Platform High, or the Cape Fear Arch; Figure 1B). As a consequence, the Southern Province exhibits a steeper coastal gradient, but lesser amounts of sand to maintain beaches. Additionally, the Northern Province has a low tidal range (ca. 0.5 m) and experiences. In Figure 14 note the difference between the northern and southern coastal zones, which influences factors such as sediment availability, slope, and erosion rates. high wave energy, whereas the Southern Province has a tidal range of ca. 0.75 to 1 m, and lower wave energy. The combination of these geological and oceanographic factors is responsible for the narrow lagoons that occur behind the barrier islands, and the greater number of inlets in the SCZ (necessary to accommodate the greater tidal exchange).

Regional Sea-level Rise – An Overview

Sea-level studies in eastern North Carolina have been performed at numerous scales using various types of data (Fig. 2). On geologic time-scales (millennia) sea-level studies utilize proxy data such as salt marsh peat, marine fossils, or terrestrial indicators (e.g. roots, fresh water peats, etc.). Some data only provide limiting points (e.g. the maximum or minimum sea-level elevation), whereas other proxies, sea-level indicators, provide precise measurements of sea-level elevation, or index points. The best method of producing sea-level index points is using either basal salt-marsh peats, or foraminifera within salt marsh peats and transfer functions relating the foraminiferal assemblage to the elevation of the marsh surface. These types of data have yielded accurate sea-level elevations to approximately 4000 calendar years before present (Fig. 2a; Kemp et al., 2017).

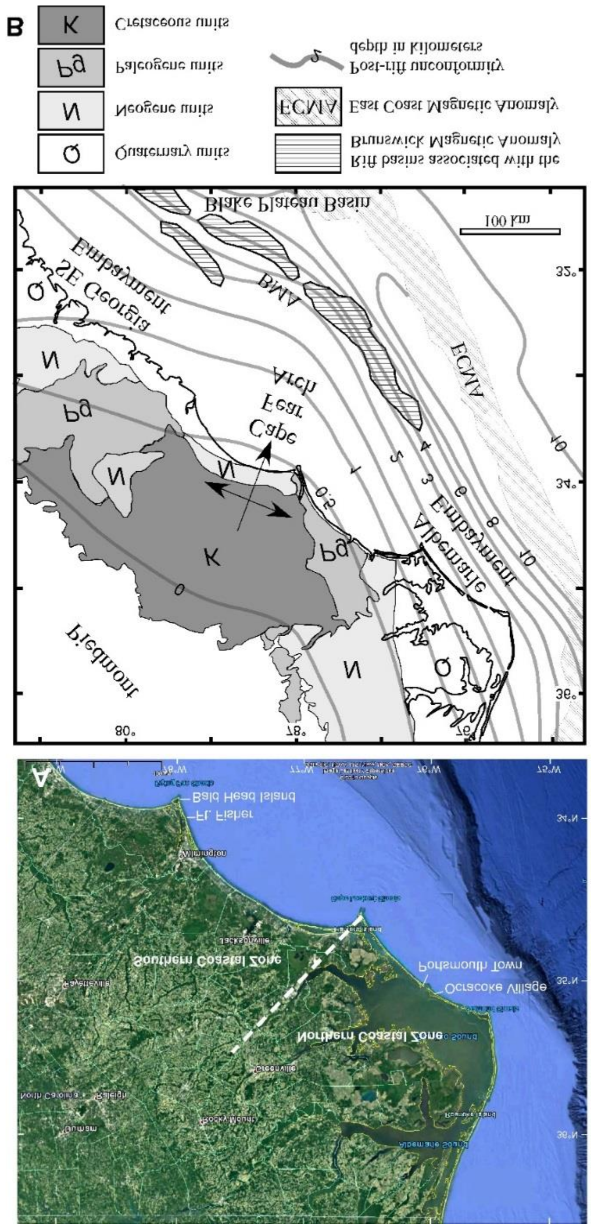

Figure 14. A) Satellite imagery and bathymetric model showing eastern North Carolina and the areas of investigation. B) Geological map of North Carolina illustrating the ages of surface units and deeper structural elements (modified from van de Plaasche et al., 2015).

Factors affecting sea-level change in the region (i.e., relative sea-level change) include global sea-level rise due to melting glaciers and ice sheets, thermal expansion of seawater as a result of increasing ocean temperatures, changes in ocean circulation patterns affecting currents such as the Gulf Stream, meteorological conditions affecting wind patterns and atmospheric pressure, land subsidence due to sediment compaction, and the vertical change in land elevation resulting from movement of mass in the deep earth (the asthenosphere) (Horton et al., Kemp et al., Kopp et al.). The current rate of global sea-level rise, as measured by satellite altimetry, is approximately 3.2 to 3.4 mm/y, which is twice the average rate of sea-level rise for the twentieth century. Thus it is clear that the rate of sea-level rise has recently accelerated. An acceleration of 0.084 mmy^{-2}, since 1993, can now be seen in satellite altimetry data (Fig. 2b; Nerem et al., 2018). Semi-empirical models of sea-level rise may be used to understand future rates. These models relate the rate of rise to temperature increases based on observations and correlations of past conditions. These are then used to project sea-level rise forward in time by estimating temperature increase associated with different carbon emission scenarios (Rahmstorf, 2007). Numerous models have been produced, using slight variations in assumptions and emission scenarios. These various models forecast sea-level elevations of ca. 0.26 to 1.5 m above present sea level by 2100 A.D (Fig. 2c; Horton et al., 2014).

In North Carolina, for example, future sea-level elevation will be greater than the global average because of the process of glacio-isostasy (Peltier, 1984; Mallinson et al., 2008; Dejong et al., 2016). This process affects the vertical motion of the land surface relative to sea level, and is the result of the expansion and contraction of the northern hemisphere ice sheet. Approximately 20,000 years ago, during the Last Glacial Maximum (LGM) the Laurentide Ice Sheet expanded southward from the Hudson Bay region, to as far as Ohio, Pennsylvania, and

New York. The mass of this ice sheet depressed the surface of the earth beneath it, and forced peripheral areas, such as NC, to rise in response, forming a *glacial forebulge*. By ca. 8000 years ago, the ice sheet was virtually gone, and mass redistribution within the Earth's mantle is causing the glacial forebulge to subside. This subsidence is most rapid in the Northern Coastal Zone (ca. 0.7 to 1 mm/yr), whereas in the SCZ, there appears to be some degree of uplift (ca. 0.23 mm/yr; van de Plaasche et al., 2014). As a result the rate of relative sea-level rise in northern NC is ca. 4.5 mmy^{-1}, whereas in the Wilmington region it is ca. 2.3 mmy^{-1}. Between these two regions, near Beaufort and Cape Lookout, the rate of rise is ca. 3.0 mmy^{-1} (Figs. 2d, e).

Other factors affecting SLR along the NC coast include basin-scale ocean circulation conditions in the Atlantic (the Atlantic Meridional Overturning Circulation – AMOC). Changes in the strength of AMOC may affect multi-decadal sea-level variability along the NC coast of 10 to 20 cm on 20 to 30 year time-scales (Cronin et al., 2014). AMOC conditions affect the speed and position of the Gulf Stream. A deceleration of the Gulf Stream will create an additional sea-level rise effect along the adjacent coast as surface water is redistributed (Levermann et al., 2005).

Storms

The threat of coastal erosion is driven by long-term chronic sea-level rise, which constantly shifts the profile of equilibrium upward and landward, effecting erosion (Komar, 1984), and very rapid erosion caused by storm events. Most significant are tropical cyclones (tropical storms and hurricanes) and extratropical cyclones (nor'easters). The National Oceanic and Atmospheric Administration (NOAA) has a record of 171 tropical and extratropical storms passing within 100 nautical miles of the Bald Head region (including Fort Fisher) since 1853

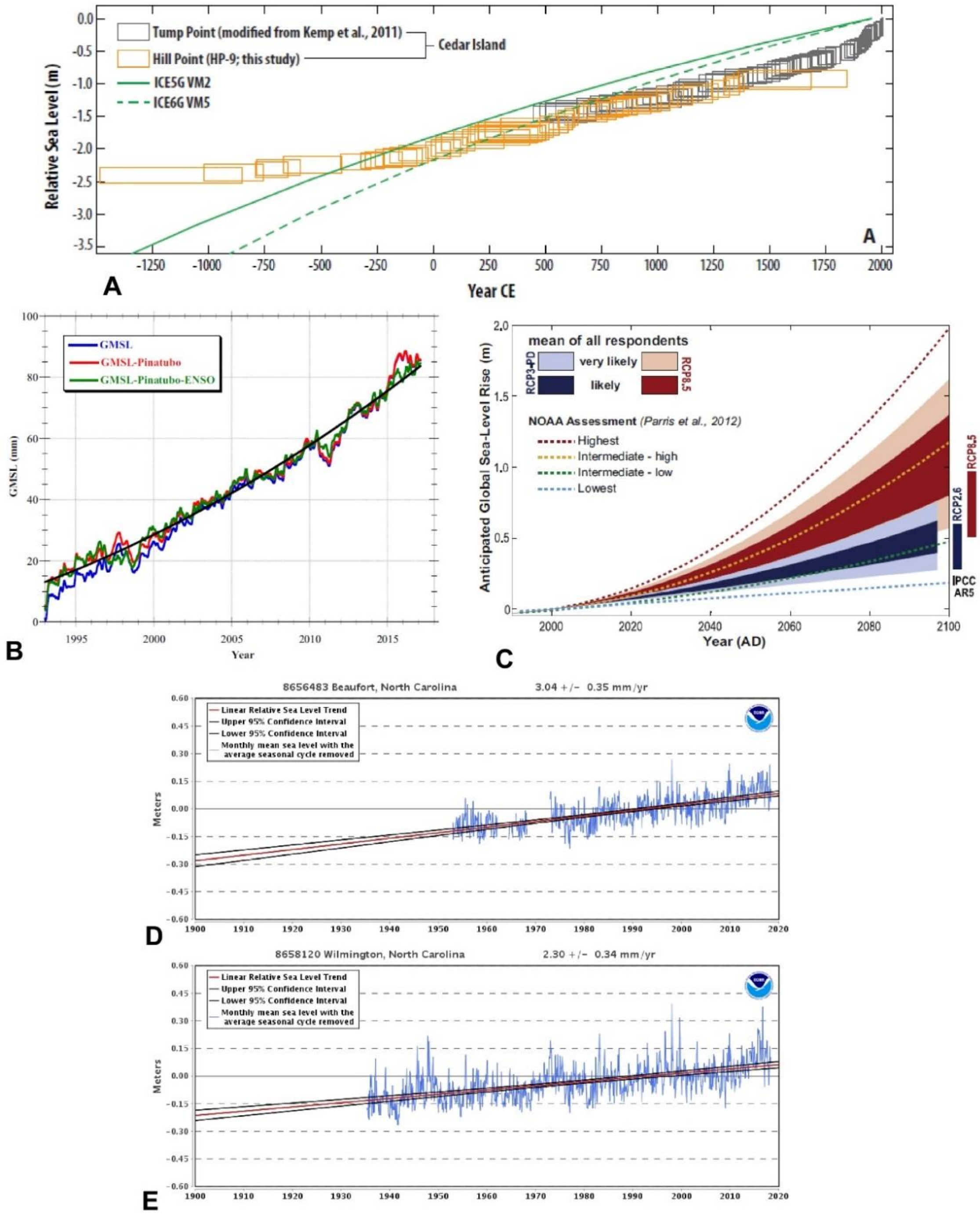

Figure 15. A) Long-term (ca. 3500 years) sea level data based on salt marsh peats and microfossil analyses from the Cedar Island area, 30 km southwest of Porstmouth Town (from Kemp et al., 2017). B) Global mean sea level (GMSL) based on satellite altimetry (Nemen et al., 2018). C) Sea-level rise projections using lowest and highest emission scenarios (RCPs – representative concentration pathways); from Horton et al. (2014) and Parris et al. (2012). D) Tide gauge data from Beaufort, NC, 65 km southwest of Portsmouth Town, showing a trend of 3.04 ± 0.35 mmy-1 since 1953. E) Tide gauge data from Wilmington, NC, 20 km north of Fort Fisher, showing a trend of 2.3 ± 0.34 mmy-1 since 1935.

Of those storms, 58 were hurricanes. In the Ocracoke Inlet region, 188 storms are recorded, including 62 hurricanes (Fig. 3). Thus, the tropical storm history of these two coastal regions is very similar. The impact of major hurricanes (wind speeds >96 knots) is particularly significant. The study area exhibits the lowest average return period (recurrence interval) for major hurricanes along the entire eastern seaboard, north of Cape Canaveral, FL (Fig. 4; NOAA 2013).

Models of future hurricane activity under different scenarios of climate change have high degrees of uncertainty. However, the general consensus is for an increase in the number and intensity of major hurricanes, with no increase or a decrease in hurricane frequency (Bender et al., 2010). An increase in intensity of tropical cyclones over the last 40 years has been noted (Elsner et al., 2008). An increase in the impacts of intense hurricanes on regions south of Cape Hatteras is anticipated as a result of the orientation of this coastal zone (NCSLRIS, 2014). This region includes the study areas in this report.

Although much attention is given to hurricanes and tropical storms, nor'easter impacts to the coast are also quite significant. These are the result of extratropical storms related to low pressure systems tracking across the region, and northward along the coast (Davis and Dolan, 1993). The most infamous nor'easter was the Ash Wednesday storm of March 7, 1962, which caused waves in excess of 10 m and $300 million in damages along 1000 km of the Atlantic coast (Davis and Dolan, 1993), including study areas in this investigation. Nor'easters of varying intensities typically impact the NC coastal system multiple times each year. Although winds may not be as extreme as hurricanes, the constant wind direction and slower speed of the storm provide the potential for extensive erosion.

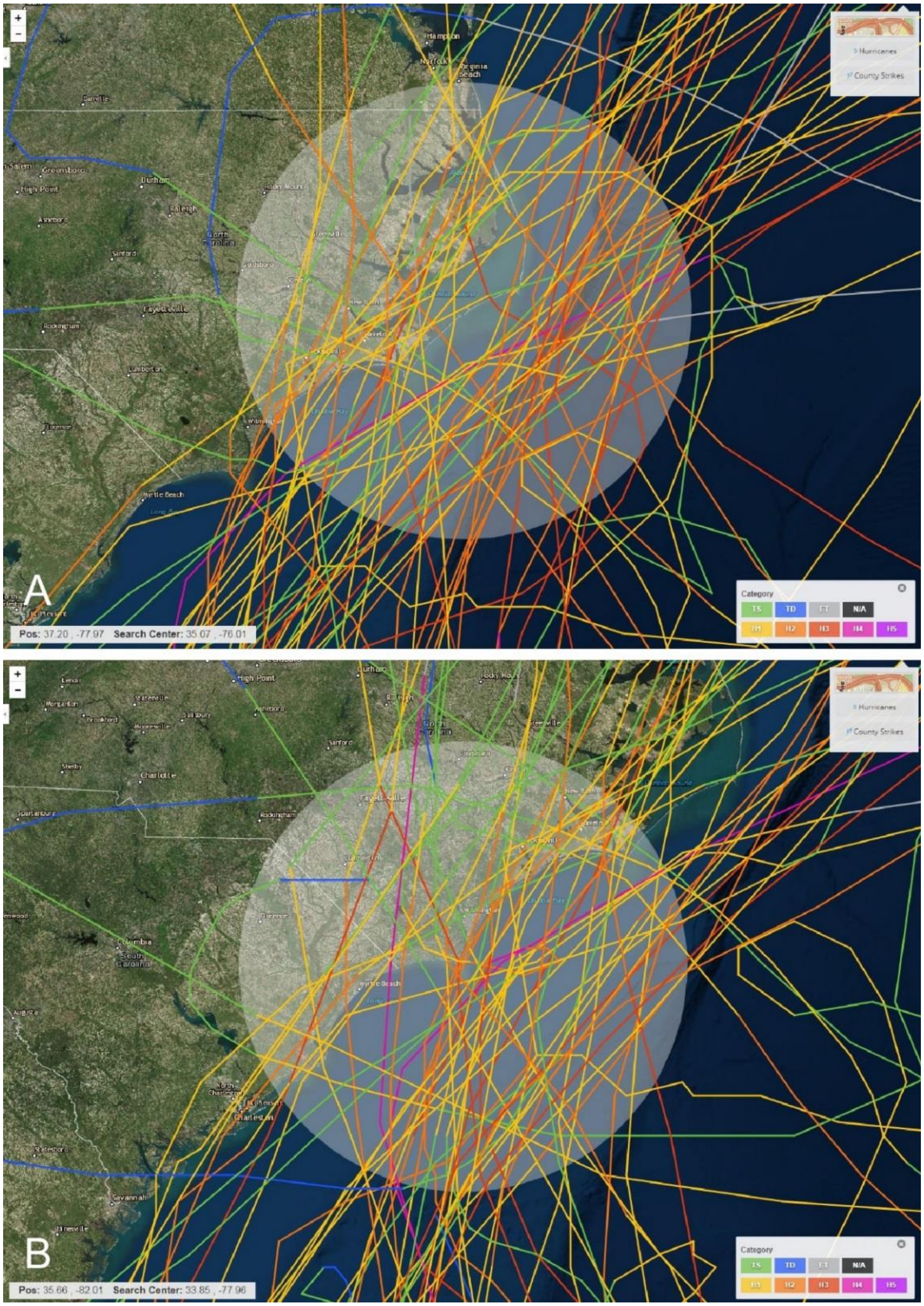

Figure 16. Hurricane tracks since 1850 within 100 nautical miles of Ocracoke Inlet (A) and Cape Fear (B).

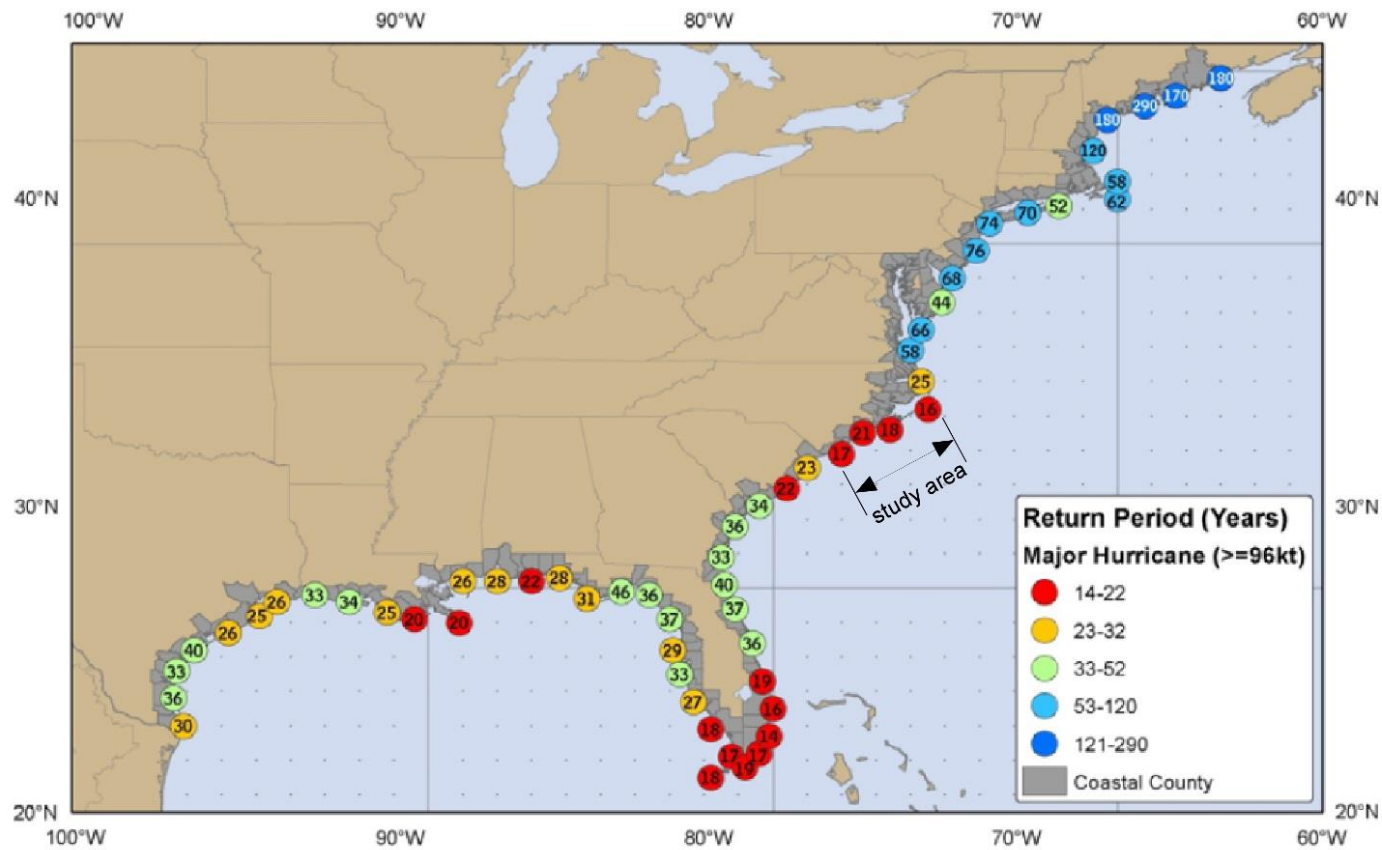

Figure 17. Major hurricane recurrence interval. Note that our study area has the shortest recurrence interval north of south Florida.

Regional Coastal Vulnerability Assessment

Thieler and Hammer-Klose (1999) determined the vulnerability of coastal regions to sea-level rise, as a function of geomorphology, shoreline erosion rates, coastal slope, tidal energy, wave energy, and rates of relative sea-level rise. Data from coastal regions were combined to produce a coastal vulnerability index (CVI), with the intent of providing useful predictions of coastal change with a degree of certainty, necessary for coastal management. The CVI is shown for the study areas in Figure 5. Based on their assessment, the southernmost study areas, Fort Fisher and Bald Head Island, are in a region of moderate to high risk, whereas the Ocracoke and Portsmouth area is in a region of high to very high risk. This is largely a function of the higher rate of relative sea-level rise, and higher wave energy in the Ocracoke-Portsmouth region.

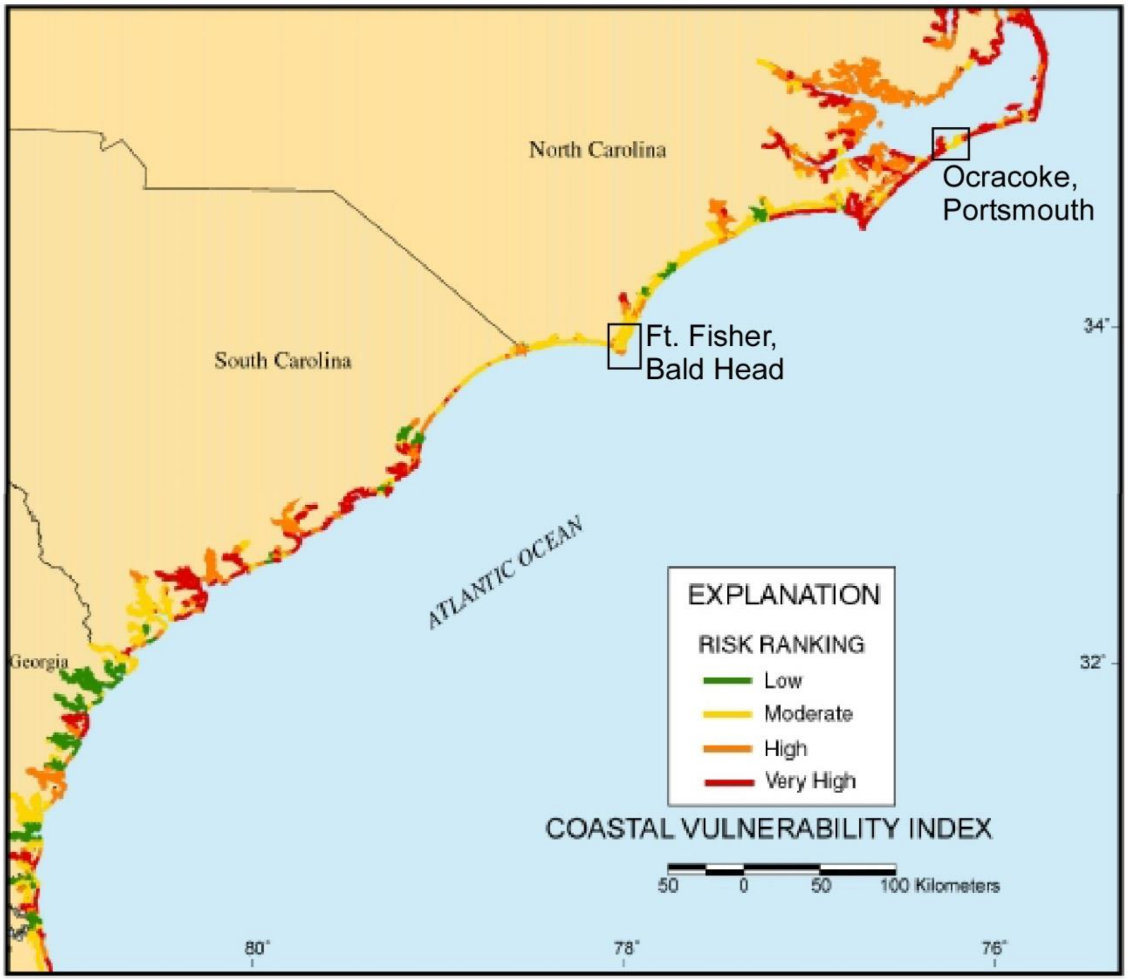

Figure 18. Coastal vulnerability of study areas based on the work of Thieler and Hammer-Klose (1999).

Case Study: Portsmouth Historic Town – Portsmouth Island

Geology

Portsmouth Town is situated on the northern end of North Core Banks (also known as Portsmouth Banks or Portsmouth Island). Core Banks is a narrow barrier island with low elevation, dominated by inlet and washover processes (Heron et al., 1984). Highest dunes (ca. 7 m) occur in the Portsmouth Town area. The upland regions, consisting of dunes, are separated by tidal creeks which drain a tidal flat (algal flat) region situated between the highest areas (where the town resides) and the ocean shoreline (Fig. 18). The island is situated on the downdrift side of Ocracoke Inlet, thus the shoreline is highly dynamic, with erosion or accretion rates sometimes exceeding tens of meters during a single storm event. The position of Ocracoke Inlet has remained relatively stable during historical times, likely as a result of the control exerted by a relict river channel (paleo-Pamlico Creek) situated beneath the inlet (Mallinson et al., 2010).

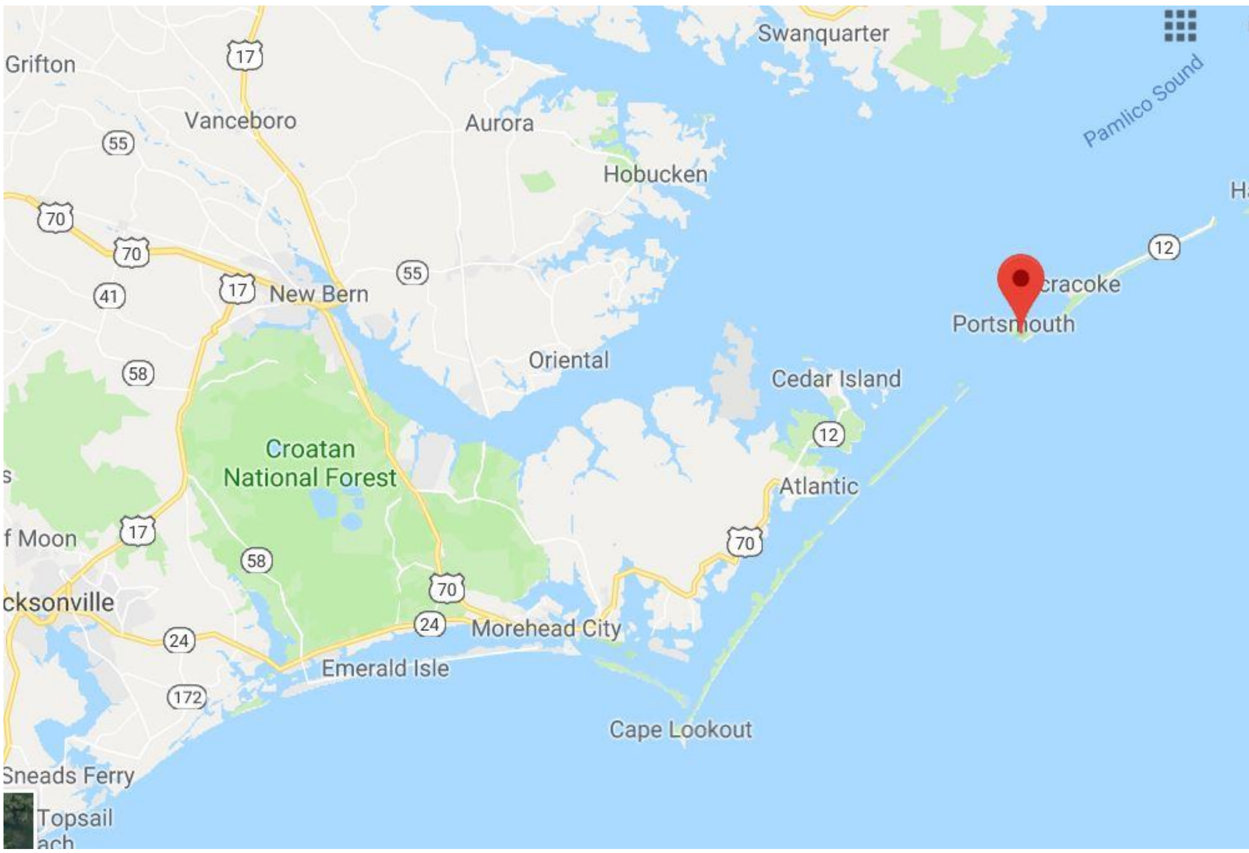

Figure 19. Location map of Portsmouth

Sea-level Rise and Shoreline Erosion

Long-term rates of sea-level rise in this area were measured using peat records from near Cedar Island (Kemp et al., 2017), ca. 10 km southwest of Portsmouth Town. The tide gauge at

Beaufort, NC approximately 60 km to the southwest, provides data since 1953. Both methods indicate a rate of rise of ca. 3 mmy^{-1}. Shoreline erosion rates vary considerably seasonally and annually as a result of the position adjacent to Ocracoke Inlet. Portsmouth Town is situated on low land, on a dynamic barrier island. However, the adjacent inlet shoreline has remained somewhat stable over the last 25 years. Furthermore, the tidal flat region, and the seaward side of the uplands are actually accreting sand, and marsh vegetation has replaced open algal flats in the backshore on the eastern extent of the island. This suggests that sedimentation may help to maintain this island even in the face of rising sea level.

Vulnerability Assessment

The historic sites at Portsmouth Island occur at low elevations on a dynamic barrier island. Many of the sites occur within 0 to 1.5 m above sea level, meaning they are likely to be inundated by rising seas over the next century (Fig. 20). Thieler and Hammer-Klose (1999) place it in their high to very high risk category. Sediment erosion, transport and deposition in the form of inlet and spit migration, and shoreline erosion and overwash will likely shift the present ocean shoreline to the north, likely further filling the algal flats (Fig. 18), but eroding the sand hills. It is unclear what may happen to the inlet shoreline as it depends on unpredictable storm energy and sediment transport around the inlet, affecting the channel position. If the trend of the last 30 years continues,

Figure 20. Historical shoreline positions since 1848 for the Portsmouth Town to Ocracoke

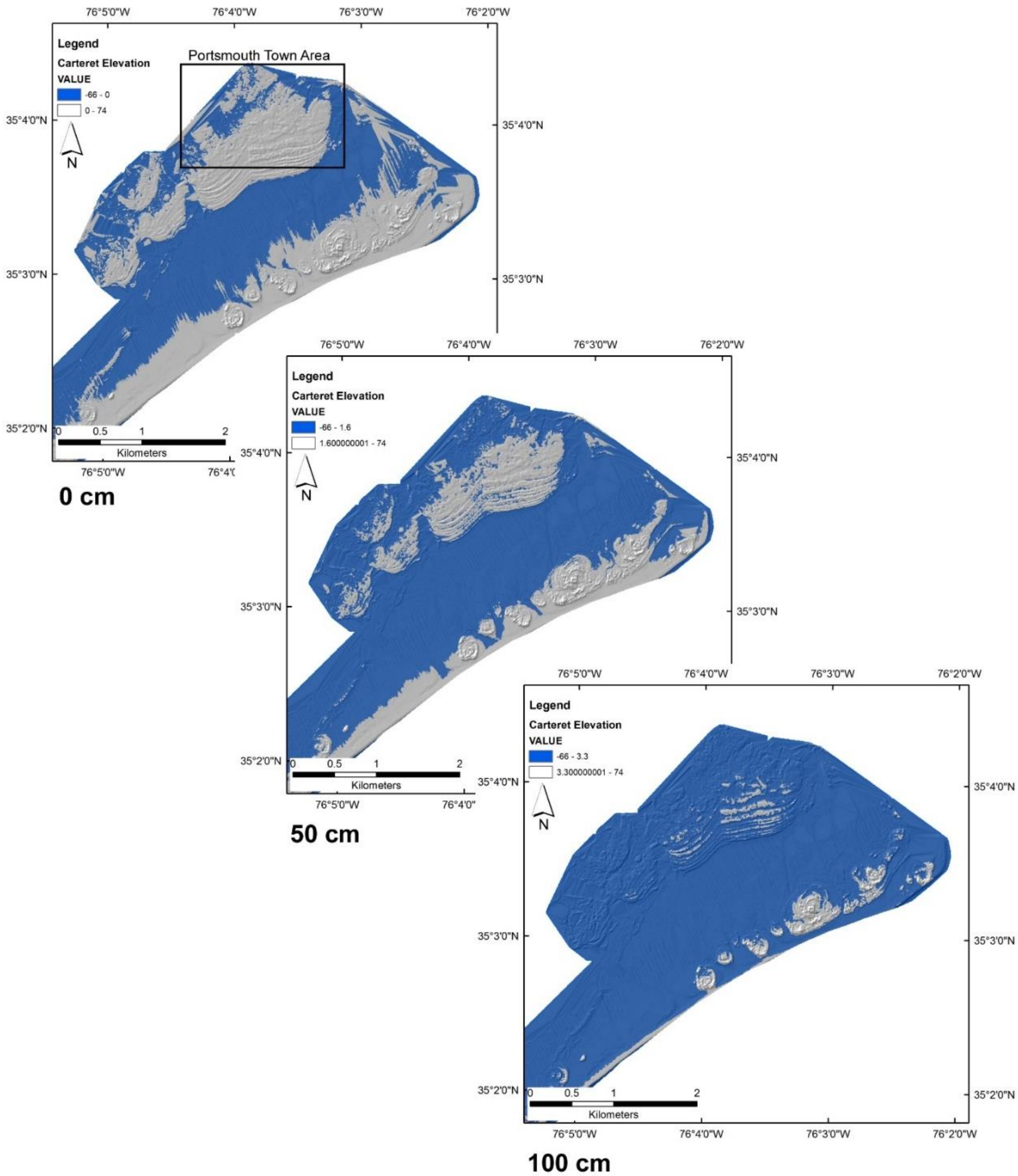

Figure 21. Inundation of Portsmouth Banks (LiDAR data).

Summary

The various historical structures and potential archaeological sites investigated are all within regions that are or will be directly impacted by sea-level rise and coastal erosion in the near future (<100 years).

CHAPTER 2. BEACH WRECKS

Introduction

The archaeological remains of ships in the beach zone are part of a complex and dynamic natural system. This portion of the study reports on several beach sites documented on the southeastern seaboard including a colonial sailing vessel, plantation boat, a Civil War wreck and World War II life craft. These sites are periodically exposed and reburied, and vary between being both visible and frequently forgotten features of the physical and cultural coastal landscape. Beached wreck sites have research potential to expand clarification about larger historical pictures and cultural landscapes. Their value demands equal consideration although, up until now, few have acknowledged their potential informational, symbolic, and even economic values. These cultural resources are often thought of as unimportant, even ephemeral, because of the transitory nature of the resource. These limited and nonrenewable resources play an important informational role as tangible pieces of maritime heritage that also document dynamic coastal process (Russell 2004, Jones 2017, Nickens 1991, Delgado 1985). Maritime Archaeologist James Delgado (1985: 11) argues,

> The study of these sites is hence important and should be part of any archaeological survey conducted in coastal localities, particularly when those areas are managed by public agencies whose responsibilities include cultural resource management concerns. [They] should survey [these] areas because 1) due to shoreline changes the placement of a boundary at mean high tide becomes arbitrary, and 2) because sites can exist above the mean high tide mark.

Corolla Wreck, Outer Banks NC

In 2008, a Corolla homeowner discovered and reported the possibility of a wreck in 2008. Coastal storms washed up a lot more of the wreck in 2009, and beach comers started finding coins from the early 1600's washing up. At this point, investigators began the process of recovering, identifying, and trying to determine the origins of the ship. Former ECU student Dan Brown, who conducted thesis research on the wreck, believes that the wreck is a 28 gun British naval vessel named the "HMS John" which went down in 1652.

Figure 22. Corolla Shipwreck on the beach
(https://www.outerbanksvacations.com/blog/2015/11/shipwreck-found-in-corolla-could-be-from-the-1600s)
CNN Report: http://www.cnn.com/2010/US/06/05/oldest.shipwreck/index.html

The ship, qualifies as the oldest shipwreck ever found on the Outer Banks coast, and is currently exhibited on a concrete pad behind the Graveyard of the Atlantic Museum. On two occasions ECU students groups visited the shipwreck and compiled site condition reports, sketched, photographed and created 3-D imaging of the wreck. The thesis of ECU student Dan Brown (2013) was used as a baseline for comparison of change due to deterioration.

For this portion of the report the student's voices, photos and conclusions are part of the narrative.

Fieldtrip 1. Tyler Ball and Stephanie Soder

Objectives: Our goal was collect photos of the shipwreck remains for up to date assessment. We took basic measurements of the perimeter of the wreck site for planning a future photogrammetry trip. Primarily we reported changes to structure since last report (Dan Brown's Thesis-2013).

- Ship dimensions
    - Largest Width is 17.6 Feet
    - Tallest Height is 4.7 Feet
    - Cement slab is 30 by 30 Feet
    - Support frame (holding timbers up from cement slab) 10 by 30 feet
- Model
    - Recommend a minimum of 25 by 35 Feet for frame base. Recommend height of model 10 to 15 Feet.

Observations:

- Termite damage noted o some of the timbers
- All timbers have some level of degradation (bleached, rotting, burnt marks, rust stains).
- Rust stains located in streak along the center of the timbers.
- Several other planks, timbers located near or on the Corolla timbers-unknown if associated with Corolla.

Photos for Condition Assessment:

- Poor condition


Figure 23. Eroding wood (Photo credit: by Tyler Ball, ECU)


Figure 24. Frames showing bleaching, drying and severe degradation (Photo credit: Tyler Ball, ECU)

Figure 25. Wreckage elevated on a wooden platform (Photo Credit: Tyler Ball, ECU)

Figure 26. Burning on ship timbers (Photo Credit: Tyler Ball, ECU)

Figure 27. Shrinkage indicated by treenails protruding from frames (Photo Credit: Tyler Ball, ECU)

Figure 28. Rust stains on timber (Photographer Tyler Ball, ECU)

Figure 29. Rusty concretion on a timber (Photographer Tyler Ball, ECU)

Figure 30. Students from the ECU Maritime Studies Program measuring the Corrolla Wreck, August 27, 2018. (Photo by Ryan Miranda, ECU)

Figure 31. Close up of the Keel notch located on the aft frame. (Photo by Ryan Miranda, ECU)

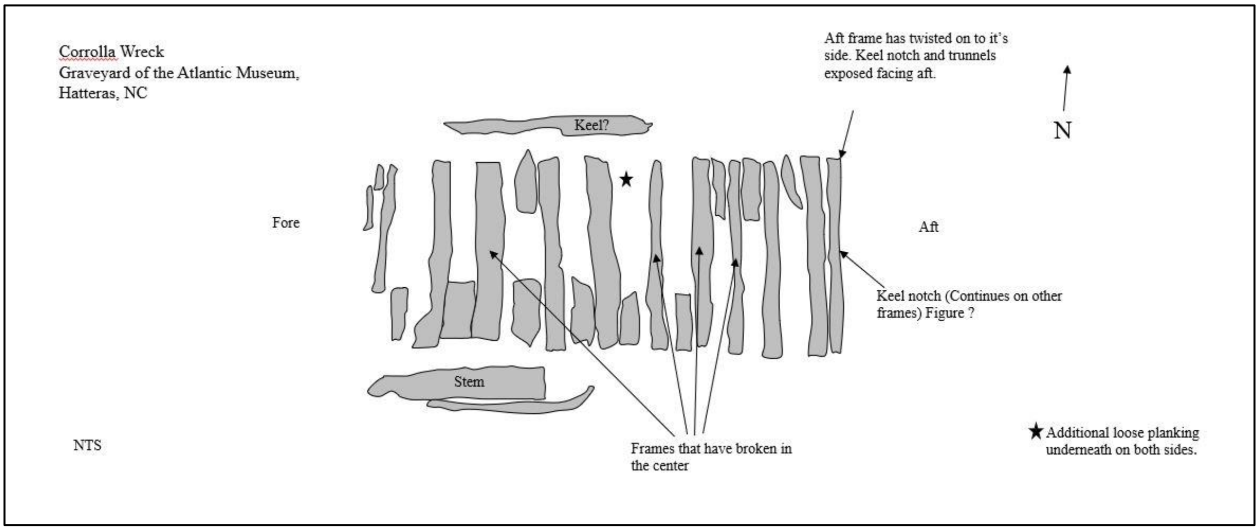

Figure 32. Sketch Map of Corrolla wreck, August 27 2018 (Created by Ryan Miranda, ECU).

Field Trip 2 (Jason Raupp, Jeremy Borrelli, Molly Trivelpiece, Ryan Miranda, Aleck Tan, Gus Adamson, Josh Vestal,

The Corolla Wreck is in a severe state of deterioration. Many of the timbers on the back half of the wreck are sagging, some to the point of caving in and breaking, and the wood is in extremely poor condition with splits in many of the frame ends. The stem and a long-curved plank lay to the left of the main wreck, with scattered pieces likely from a separate wreck sitting slightly over the curved frame. They consist of one long plank with a nail through its center and four broken planking pieces. Several other shipwreck pieces sit to the back right of the shipwreck's stern section and cannot be confirmed as associated with the wreck or not. Overall, it is clear that the Corolla Wreck has been poorly managed. To allow such an important piece of maritime history to quite literally crumble to dust is a disgrace to the profession of maritime archaeology. Documentation of the wreck via photogrammetry was conducted during this assessment period, and it will undoubtedly be changed for the worst by the time the next archaeological work is conducted on it. Fortunately, the Corolla Wreck has taught the profession a valuable lesson about the proper management of shipwrecks, but served as a martyr to fuel the effort.

-Joel Cook, ECU

The Corolla Wreck has greatly worsened in the ten years since discovery. The once pristine wreck has been sitting outside, with no protection from the elements. The frames, which were once straight and nearly flat, are now warped, cracked, and have broken in the center where iron bolts deteriorated. None of the floors and frames are flush together anymore, and the trunnels are sticking out precariously. There also seem to be several pieces around the wreck that do not belong to it. There are several pieces (two futtocks and part of hull planking) housed in the upstairs portion of the collections department that, due to being housed inside in a temperature-controlled room, are relatively well preserved. There is no point in trying to start conserving the wreck, as the body of it is too far gone.

-Molly Trivelpiece, ECU

On August 27, 2018 a group of students traveled to the Graveyard of the Atlantic Museum in Hatteras, NC to record and assess the condition of the Corolla wreck. The remains represent ten floor timbers, a partial keel, bow apron, and the lower ends of several futtocks of what is believe to be the oldest wreck in North Carolina (Brown, 2013). The wreck has spent the last eight years on a concrete slab behind the museum without any conservation treatment or even a covering to protect it from the elements. Upon arrival at the site, the severe degradation of the wreck was immediately obvious. Many of the large floor timbers are now deformed and sagging in the middle, seeming to have cracked under their own weight. The aft most floor timber is broken almost entirely in half. One portion of the timber has been rotated onto its side, so the treenails point aft and the timber itself is twisted, while another portion is supported by a small stack of cinder blocks. Shrinkage of the timbers is evident because nearly all of the treenail fasters extend up to ten centimeters from the timbers, where, according to Brown and other researchers, the fasteners had originally been flush with the rest of the surfaces. Many futtocks have sagged out of their original position, while the aft most starboard futtock has almost disintegrated entirely. Hull planking is also exhibiting cracks and breakage, the outermost port plank is cracked longitudinally along its entire length with one side pinned between the wreck and its support frame and the other half laying on the ground beside it. The keel and apron section are no longer attached to the main structure and lay disarticulated on the ground beside the wreck.

In short, the condition of the wreck at present is extremely poor. Eight years of exposure to sun, wind, rain, and freezing temperatures has deformed the structure profoundly and eroded any fine details that may have originally been present. Immediate conservation intervention would be the best course of action, but with such advanced decay and neglect, it is difficult to predict what other damage may result from even the most careful conservation treatments. If anything more is to be learned from this wreck immediate action must be taken to arrest it's decay, and fulfill the museum's ethical obligation to preserve items in their care.

-Kendra Lawrence, ECU

The Corolla Shipwreck was originally discovered in 2008 on Corolla Beach, North Carolina and was removed from the shoreline in 2010. It is currently located at the Graveyard of the Atlantic Museum in Hatteras, North Carolina. It is behind the museum on two stands to keep the shipwreck off the ground.

The condition of the wreck as of the last assessment (August 28, 2018) was not good. The wood that makes up the remains is dried and warped, showing no effort by the museum to impede the deterioration of wood. Several frames have broken in the middle and show iron corrosion from bolts inside the frames. Based on descriptions and pictures taken from previous surveys, the Corolla Wreck has deteriorated significantly.

Based on the current condition of the wreck, there is not much that can be done to save the remains of the vessel. The wood frames have experienced too much deterioration to got through normal conservation methods. A suggestion was made to put the remains in a mixture of water and Elmer's glue to stabilize it. The only problem with this procedure is that it is not reversible which an important tenant in the conservation ethic is.

The Corolla Wreck is well known as being the oldest shipwreck found in North Carolina. While it is not known when or where the wreck was originally deposited, it has since become a cautionary tale in the conservation of recovered beach wrecks. Based on the survey conducted on the remains on August 28, 2018, the wreck has gone beyond the point of no return in terms of conservation. The only way to halt the deterioration of the wreck would be to use a non-reversible procedure and use the ship as both and educational tool for prospective archaeology students and an example of what not to do with a recovered maritime heritage.

-Ryan Miranda, ECU

On Monday, August 27, 2018, Dr. Lynn Harris, Dr. Jason Raupp, and a small group of students from ECU revisited the remains of *Corolla* (CKB0022) to reevaluate its structure as part of the Program in Maritime Studies 2018 fall field school. While it was understood that the remains were not properly conserved after their recovery and relocation to Graveyard of the Atlantic Museum (GOAM) in 2010, the level of degradation was significantly more than the survey team anticipated. *Corolla*'s articulated structure rests on pressure-treated frames over a large concrete slab at GOAM, although it seems some pieces have been lost (notably, the keelson referenced in Dan Brown's 2013 MA thesis) and additional timbers from unassociated wrecks have been introduced. The following is a summary of the state of *Corolla's* extant remains as of August 2018.

The most obvious damage resulting from *Corolla's* lack of conservation involves the collapse of four frames (from the aft, F1, F4, F5, and F9), significant sagging of frames F3 and F6, and "pivoting" of first futtocks away from their original locations. Early photographs of the wreck show these frames were unbroken and tightly fastened together as of June 2010. Significant shrinkage of *Corolla*'s timbers was also observed, as treenails were recorded protruding approximately 3.5 inches from the face of frame F1, and treenails observed elsewhere on the wreck were observed protruding a similar distance from their respective faces. Further evidence of shrinkage is observed at the framing sections where floor timbers fasten to first futtocks, as the gaps between these timbers has increased significantly since ECU's 2010 field school.

-Luke LeBras

Ship wrecks are a key asset to studying and understanding cultural heritage. The best course of action to take when preserving a ship wreck is a topic that has been discussed heavily by archaeologists. Beach ship wrecks are a category of wrecks that preservation is a highly time sensitive issue. They provide a great deal of information and should be recorded properly if given the opportunity, but how best to preserve them is a major issue.

People often see beach ship wrecks and decided to pull them farther up on shore to be explored or seen by other people. This is often done with no plan for preserving the wreck, and this can lead to disastrous results for the wreck. One example of this is the Corolla Wreck, which is currently located near the Graveyard of the Atlantic Museum in the Outer Banks. The ship has been left unprotected in the sun after being dragged off the beach and transported to the museum where it was set on a concrete pad. The exposure to the elements has led to significant degrading of the remains of the wreck. Several of the frames are cracked and splitting at the end, and most are chipping. Trunnels that were originally flush when the wreck was brought up have now slid out of the holes they were in. The hull planking that was previously attached to the wreck is now detached from the frames. The Corolla wreck, which is a significant historical wreck for the state of North Carolina, is an excellent case study for what can happen when proper preservation plans are not in place before removing a shipwreck from its environment. Seeing what can happen to wrecks that are not properly preserved should caution everyone when it comes to what actions to take with beach wrecks.

-Joshua Vestal, ECU.

Hilton Head Wreck, Calibogue Sound, South Carolina

The wreck is located on an oyster shell beach on Calibogue Sound, Hilton Head. It was part of a South Carolina Underwater Archaeology Division training stewardship course in 2011 and is managed by the South Carolina Institute of Archaeology and Anthropology. At this time, the team sandbagged the timbers to stabilize the shipwreck and prevent it eroding out of the beach. During the 2018 visit, the team observed that the sandbags were scattered and shredded by the wave action.

The shipwreck, with an overall length of 13.80m and maximum beam of 4.50m, comprises wood fragments, primarily short sections of 17 framing members around 21cm in width and spaced 31 cm apart. The fastenings included both treenails (wooden dowels) and metal spikes. Other timbers were outer and inner hull planking on the wreckage situated higher up on the beach. The site is orientated diagonally to the water's edge. The team observed teredo worm (*Teredo navalis*, the naval shipworm, is a species of saltwater clam, a marine bivalve mollusc in the family Teredinidae, the shipworms). This species is the type species of the genus ***Teredo***. Like other species in this family, this bivalve is called a shipworm, because it resembles a ***worm*** in general appearance) on a few of timbers, especially the frames.

Figure 33. Plan View of the Hilton Head wreck (Captured by Jeremy Borrelli).

Figure 34. Aerial view of the wreck showing the beach environment (Captured by Jeremy Borrelli)

Figure 35. View of wreck looking towards ocean (Photo by Lynn Harris)

Figure 36. Kelsey Dwyer, Lynn Harris and Jennifer Jones documenting ship timber (Photo by Jeremy Borrelli)

Figure 37. Jennifer Jones recording timber degradation (Photo by Lynn Harris)

Figure 38. Jeremy Borrelli flying the drone to capture an aerial plane view and coastal characterization (Photo by Lynn Harris)

Figure 39. Stoneware pottery shard near the shipwreck (Photo by Lynn Harris).

One diagnostic artifact type in vicinity of the shipwreck were stoneware sherds.. Plantations used these utilitarian wares for a variety of daily functions. Sometimes these shards also erode out of river banks near plantation sites. Maritime landscapes throughout the South yield a wide array of pottery that reflect both time period and location of these finds. Specifically in South Carolina, the most common type of pottery found is described as Southern Alkaline Glazed Stoneware, which was developed in the early 19th century. Described as "durable, shiny transparent glazes made from a combination of wood ash or lime, clay and a silica source like sand, crushed glass or flint" (Baldwin 1993:1), Southern Alkaline Glazes can be found in a wide array of colors and textures dependent on the mineral makeup, specifically iron, and the kiln conditions that produced them. Continuing until the 20th century, the production of these glazes was centered around Edgefield, South Carolina, spreading south all the way through Texas in the 1840s, and are marked by a rough texture with a smooth drip glaze on the exterior or interior, depending on design specifications (Greer 1970: 161).

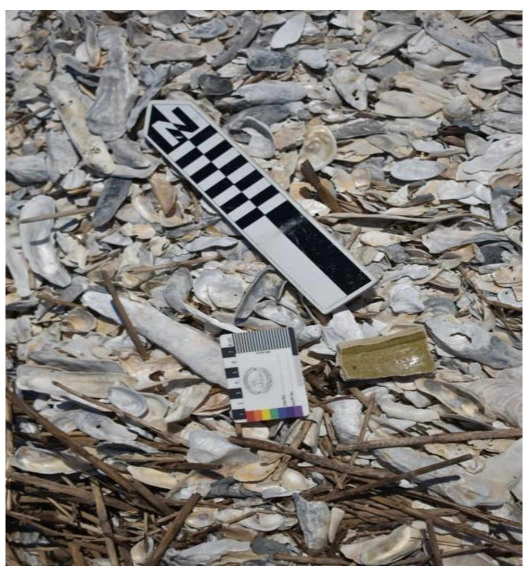

Figure 40. Alkaline glazed stoneware (Photo by Lynn Harris).

Figure 41. Teredo worm concreted casements in timber (Photo by Jeremy Borrelli).

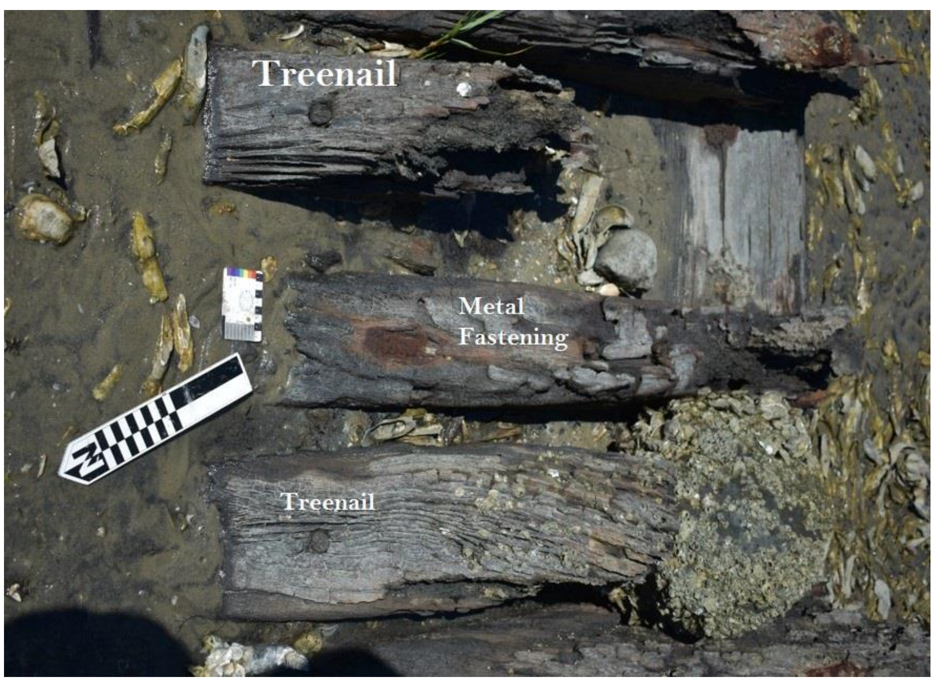

Figure 42. Combination of treenails and metal fastenings (Photo by Jeremy Borelli).

Table 1. Tables of Shipwreck Measurements (Collected and Complied by J.E. Jones and Kelsey Dwyer).

Frame #	Height	Description
0	34 cm	
1	1 m	
2	1 m, 15 cm	
3	1 m, 27 cm	
4	1 m, 22 cm	
5	1 m, 15 cm	
6	1 m, 10 cm	
7	1 m, 5 cm	
8	1 m, 15 cm	ballast present, represented with curve
9	85 cm	
10	81 cm	
11	71 cm	
12	64 cm	
13	29 cm	to middle point
	57 cm	with curve
14	51 cm	
15	30 cm	to middle point
	55 cm	with curve
16	41 cm	

Timber Height

Location Description	Length
Inner hull plank (waterside extremity)	2m 9cm
Exposed timber, upright opposite hull section	3.95 m
Vertical (highest to lowest point):	
3rd grouping opposite hull	47cm
2nd grouping "	50cm
1st grouping "	23cm

Miscellaneous measurements

Table 2. Widths of Frames and degradation on the timbers (Collected and Complied by J.E. Jones and Kelsey Dwyer).

Frame Space	Measurement (cm)	Feature Description
0 to 1	34	-
1 to 2	30	-
2 to 3	30	-
3 to 4	34	-
4 to 5	36	-
5 to 6	34	-
6 to 7	33	location of ballast 1
7 to 8	33	location of ballast 2
8 to 9	33	-
9 to 10	44	degradation
10 to 11	42	degradation; location of ballast 3
11 to 12	36	degradation
12 to 13	40	degradation
13 to 14	37	degradation
14 to 15	43	-
15 to 16	39	spike

Figure 43. Stabilizing sandbags on the site shredding and eroding (Photo by Jeremy Borrelli).

Figure 44. Location of shipwreck on Hilton Head Island and proximity to Stony Baynard Plantation (Map by J.E. Jones).

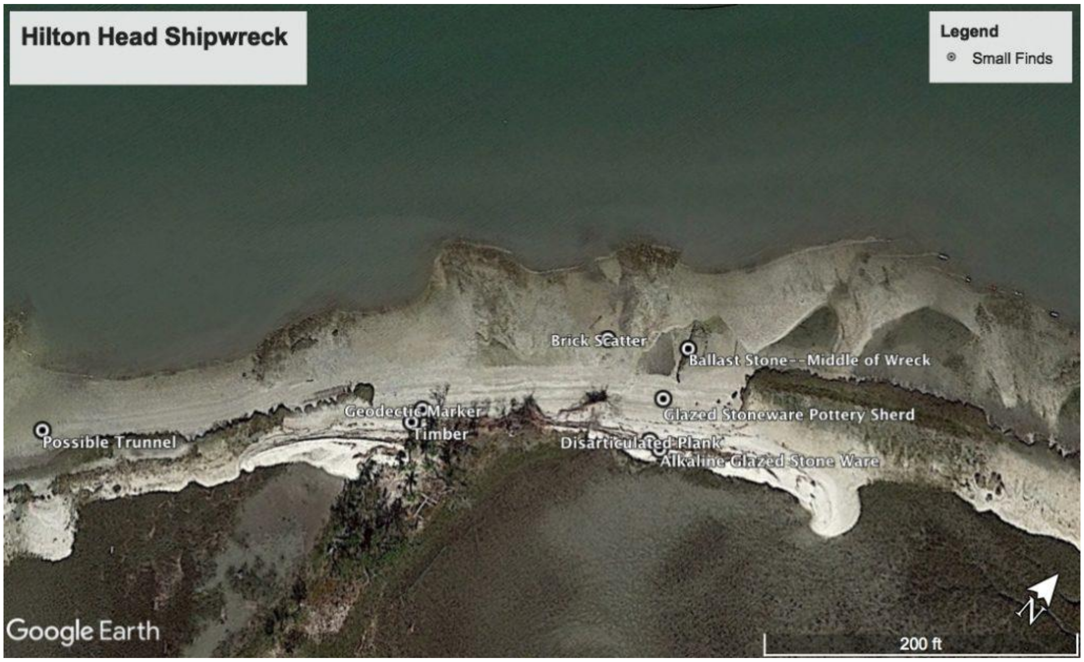

Figure 45. Location of small finds across Hilton Head shipwreck site (Map by J.E. Jones).

Figure 46. Timeline of Hilton Head shipwreck exposure from 2011 to present (Map by J.E. Jones).

Possible Historical Context of the Wreck

Dating to the early 18th or 19th century, the Stoney Baynard Ruins are hidden away in the Sea Pines division of Hilton Head Island, South Carolina, remain the only existing structures of a plantation that once allowed the island to thrive. Originally constructed between 1790 and 1810, Captain John Stoney ran the plantation alongside his two sons, John and James. John specialized in mercantilism out of Charleston, while James worked as a planter. Together, they ran the plantations' primary crop of sea cotton. Named after Captain Dave Cutler Braddock, owner of the "Beaufort", the plantation was labored by 129 African slaves during its height of production; Braddock's Point Plantation was the largest producer of cotton for the area. They owned two schooners named *John and Mary* and *Pick Pockett.*

The site today is comprised of the main plantation house side structure, two slave houses, and the kitchen chimney at the furthest end of the plantation grid. Of the 129 slaves on Braddock's Point Plantation, more than one hundred of them were field hands working to harvest the sea cotton crop day in and day out. The slave dwellings reflect the communal sentiment of the plantation, as it is laid out in almost a street canal, or row, along which other dwelling might have stood. Each dwelling housed two families of slaves, but whose dimensions depicted less than tolerable conditions. Only the tabby style concrete blocks that once supported the wooden structure of the home mark the structure today and give definition to the current conditions of these slave houses. It is interesting to note the overall tabby style used to create these dwellings. Thousands of oyster shells are mixed together to create a concreted block that has stood the test of time, and remain an aesthetic marker for the overall site.

The plantation fell into financial ruin in the early 1830s, and when John Baynard passed away in 1838, the area was sold off to the bank of Charleston to pay outstanding debts. In 1845, William E. Baynard who owned the site until the Civil War purchased the plantation. While not much is known about the involvement of the structures in the Civil War, it is documented that the site housed Union Troops, during which portions of the site were burnt in 1869. Following the Civil War, the structure fell to ruin due to the lack of continued labor previously provided by the slave population of the plantation. Today, the structure lies abandoned and deteriorated amongst an upscale suburban neighborhood at the far end of Hilton Head Island. The overall structures appear deteriorated, but lack evidence of erosion, as each individual oyster shell from the tabby construction can still be observed- a true testament to the history and influence of this structure to the local area.

Figure 47. Braddock Point Tabby Plantation ruins (Photo by Lynn Harris)

Figure 48. Tabby ruins of the Main House (Photo by Jeremy Borrelli).

Figure 49. Aerial view of slave cabin tabby foundations (Photo by Jeremy Borrelli).

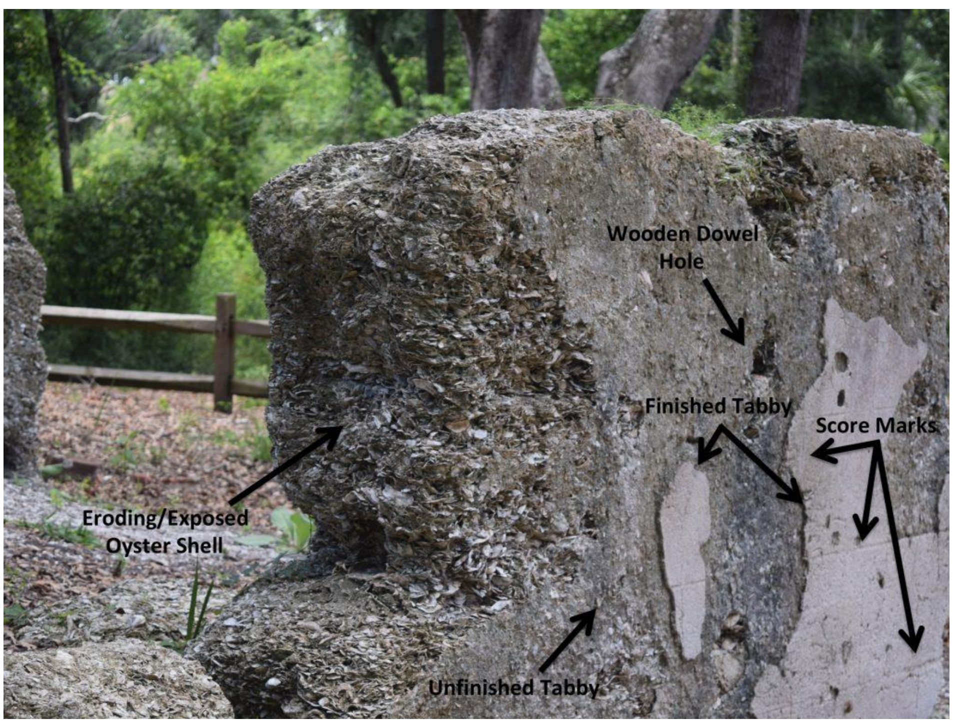

Figure 50. Tabby wall features (Photo and captions by Jeremy Borrelli).

Jekyll Island Lifeboat

Jekyll Island is the southernmost island of the Golden Isles in Georgia. The island spans 5,500 acres across 10 miles of shoreline with more than 1000 acres of maritime forest. Governor James Oglethorpe named it after Sir Joseph Jekyll (1663 – 19 August 1738) a British barrister, politician and judge with British colonization in 1733. In 1886, the island was purchased by the Jekyll Island Club, a turn-of-the century vacation resort patronized by the nation's leading families. Club Members included such prominent figures as J.P. Morgan, Joseph Pulitzer, William K. Vanderbilt, Marshall Field, and William Rockefeller. In 1904, Munsey's Magazine called the Jekyll Island Club "the richest, the most exclusive, the most inaccessible club in the world." Today, it hosts a variety of vacation homes, a sea turtle nature reserve, thriving restaurants, as well as many other activities along its distant shorelines.

In May 2018 Dr. Kurt Knoerl from Georgia Southern University collaborated with Mr. Bruce Piatek, Director of Historic Resources for Jekyll Island authority, to document and research a boat stranded on Driftwood beach. They determined that it was most likely a WWII Liberty ship life float. In July the ECU team joined them to conduct a rapid site assessment. The site is at risk due to natural factors and beach goers who attempted to remove portions of the hull and fittings using a bladed tool. In addition, the shoreline has changed dramatically since 2011 when the shoreline was much further out at least 31 meters. The site also supports local biological life within its structure and surrounds. Crabs, shrimp, barnacles, limpets, algae, and even a small fish all inhabit the life float. It is a living museum and an unusual ecosystem on a beautiful beach! Sea birds utilize the structure and leave droppings. Deer tracks are clearly evident in the vicinity and rattlesnakes are reported in the maritime forests higher up the beach.

Figure 51. Documenting the wreck (Photo by Lynn Harris).

Figure 52. Wreckage on Jekyll Island beach (Photo courtesy of Kurt Knoerl).

After a short drive along the sandy Driftwood Beach of Jekyll Island, Georgia, we observed piles of driftwood from trees damaged by hurricanes. The life raft float is located on a desolate beach, adjacent to the marsh and mature maritime forest, and completely exposed at low tide. The structure measures 5.50m in length and 4.44cm in width. It appears to be constructed of a variety of woods, some with a red tint while others are likely pine. The outer hull on the northern side has planking missing (believed removed by beach visitors), and underneath the original military grey paint is apparent. Most notably, are pairs of metal air tanks at the front and back of the structure. The “lids” are sealed with rubber gasket. There is evidence of intentional hatchet or machete damage on one exterior of the float. Equally notable, are two large concretions, measuring 38cm high, encrusting the shore-most point of the wreck. This could be possibly be the remnants of a metal chain.

Figure 53. Kurt Knoerl documenting the wreckage (Photo courtesy of Kurt Knoerl).

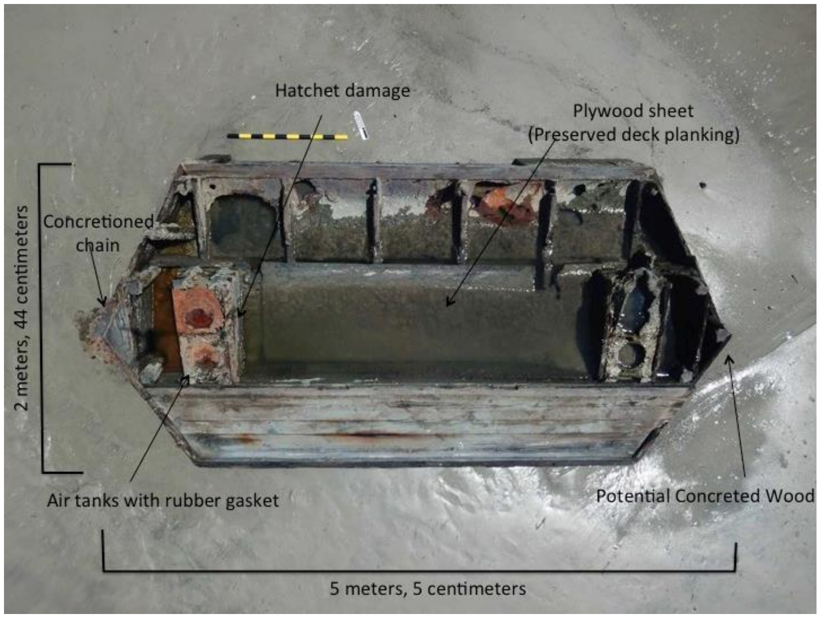

Figure 54. Labeled view of life boat (Photo by Kelsey Dwyer and Jeremy Borrelli).

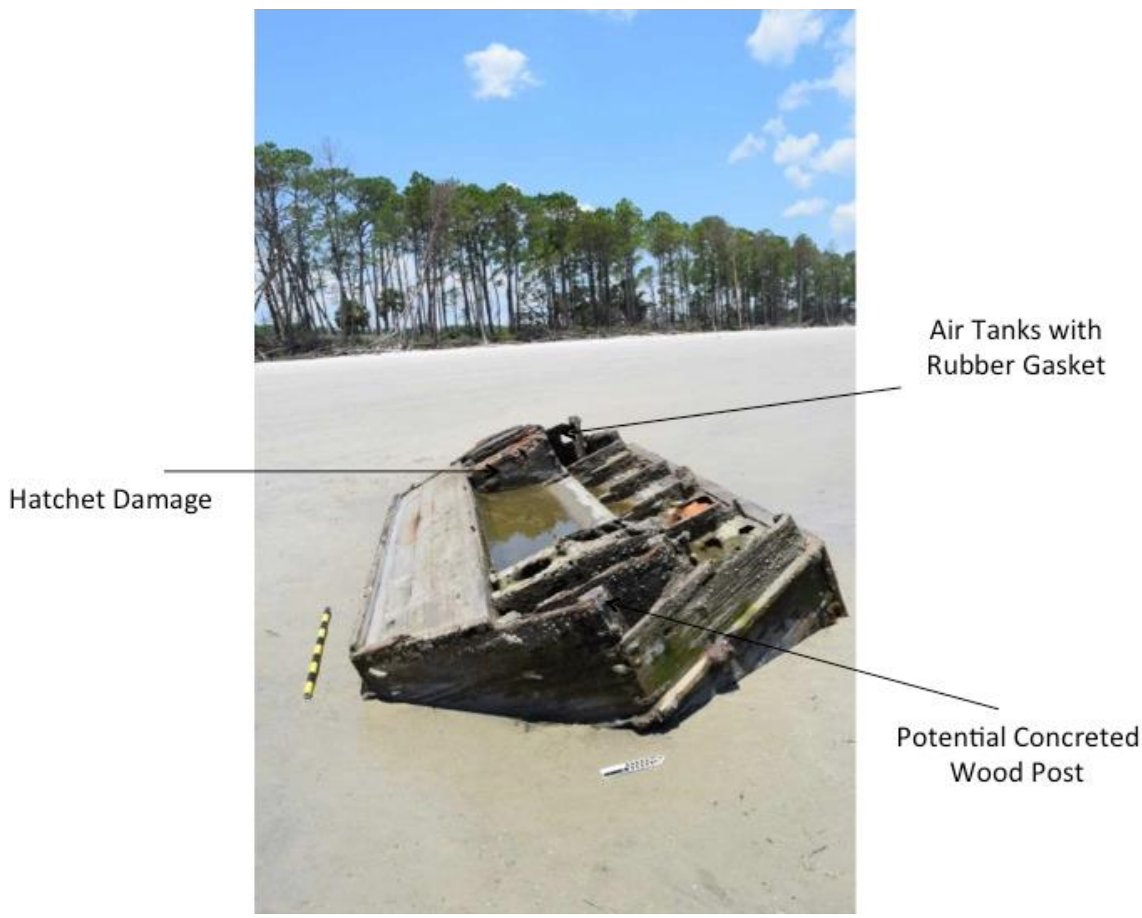

Figure 55. Labeled view of life boat (Photo by Kelsey Dwyer and Jeremy Borrelli).

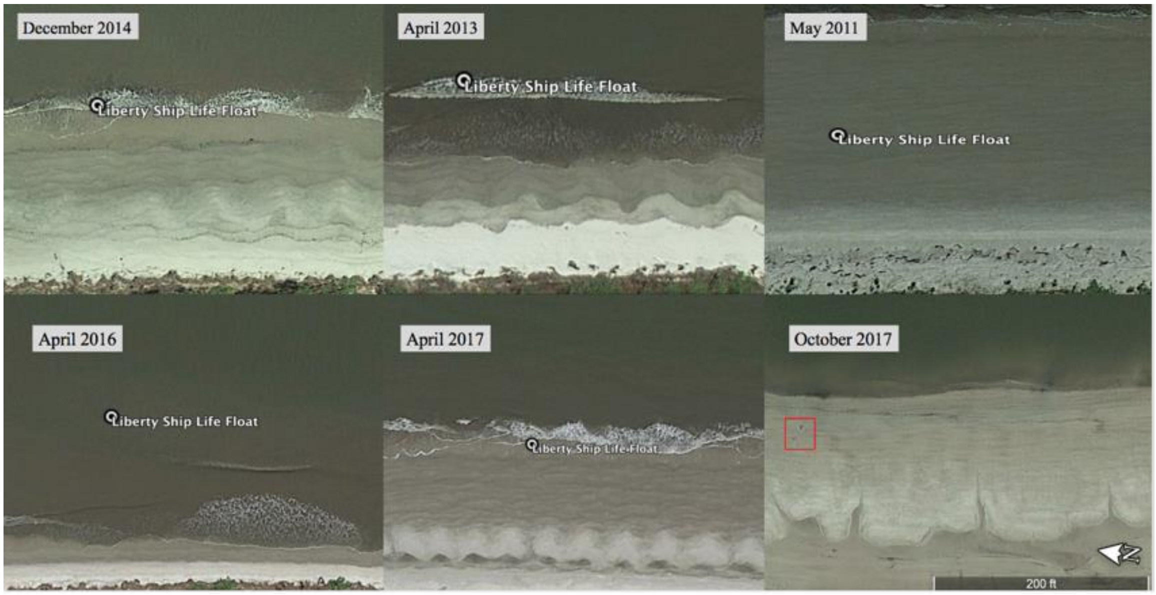

Figure 56. Shoreline changes the site since 2011 (Compiled by J.E. Jones)

Figure 57. Metal Detecting Targets in Proximity to the boat indicated by the red line (Compiled by J.E. Jones).

Georgia's barrier islands are part of the Georgia Bight, the longest development of barrier islands in the world including the nearly continuous chain from Cape Hatteras, North Carolina to Cape Canaveral, Florida (Hayes 1979). The Georgia Sea Islands, also popularly known as the Golden Isles, are composed of dune and beach ridges created by a complex interaction between waves, winds, current, and sea level rise. The area consists of low, sandy islands, separated from the mainland by tidal marshes. A majority of these islands are made up of a core of Pleistocene marine terrace rimmed on the outer edges by present sea level beach ridges.

Jekyll Island is a semi-developed, drumstick island, with narrow back barrier areas and dominant regressive mixed-energy beach ridges (Hayes 1979). It is the smallest of Georgia's barrier islands at 5700 acres. It is located southeast of the city of Brunswick, south of St. Simons Island, and just north of the Florida barrier Cumberland Island. The landward side of the island is edged by Jekyll Creek and an extensive salt marsh (Hunter 2017). Jekyll Island is a magnolia, live-oak forest canopy dominated by palmetto and scrub oak; wildlife includes white-tailed deer, rabbit, squirrel, bald eagle (Hunter 2017).

Jekyll Island consists of a core of marine terrace fronted by a rim of modern beach ridges. These ridges have a complex history of accretion and erosion, creating continuously changing island shapes. Typically, the islands are also experiencing southward growth, with northward erosion (USGS 1962). Additionally, severe storms such as Hurricanes Matthew and Irma have created massive loss of elevation. As erosion continues to increase on the north end of the island, there growing concern for beach change management. As such, a rock revetment is being built along the shoreline to combat further erosion.

Figure 58. Rock Revetment under Construction on Driftwood beach (Photo by Jeremy Borrelli).

Figure 59. Driftwood caused by shoreline changes and sea encroaching on tree line (Photo by Jeremy Borrelli).

Figure 60. Deer tracks on beach near the site. Over population on the Island is currently a problem (Photo by Jeremy Borrelli).

Wando River Wrecks

The two Wando River wrecks were reported to South Carolina Institute of Archaeology and Anthropology by a local Julian Weston of Mount Pleasant in 2002. In July our ECU team visited the wreck with Nate Fulmer of the Maritime Resources Division, Charleston office. Both wrecks are located on the shoreline at Remley Point, Mount Pleasant where rapid sub division development is occurring, and new docks abound.

River Reach at Remleys Point is a small, highly exclusive, luxury, subdivision located along the Wando River and Molasses Creek with ancient oak trees, beautiful vistas and spectacular marsh views. The wreckage is situated in the marsh between docks and only visible at low tide.

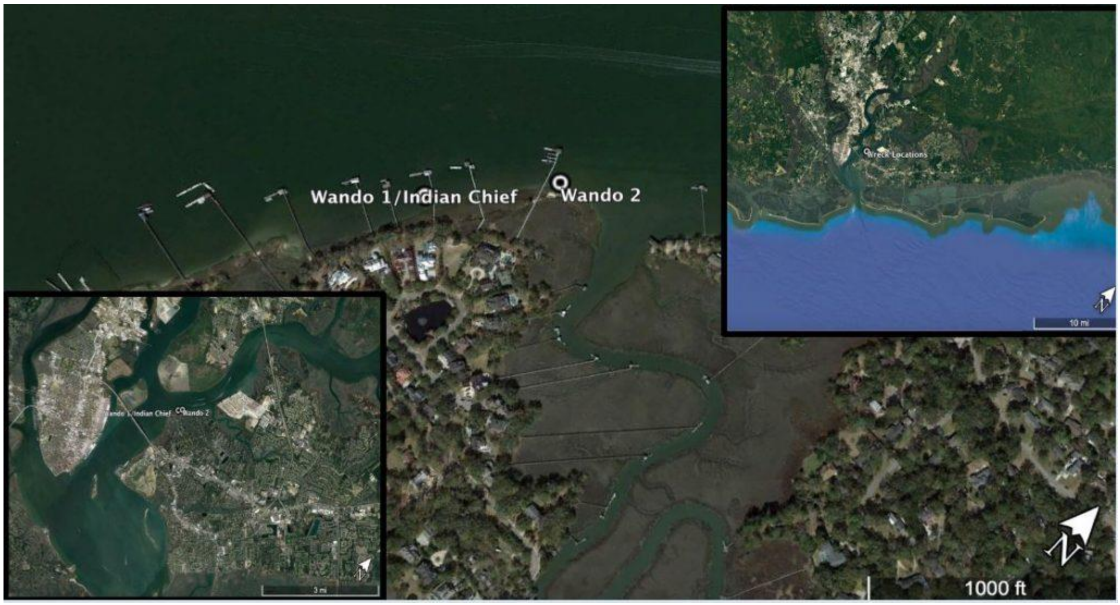

Figure 61. Location of Wando 1 and Wando 2 (Map created by J.E, Jones).

WANDO 1

Wando 1 wreckage located at N 32 degrees 49′ 05.7″ W 79 degrees 54′ 14.0″ comprises three substantive timbers, either outer hull or lower hull planks, running approximately parallel to the shoreline at a 312 degrees NW. The center plank extends 14.85 meters, the shore line plank 5.92 meters and the water side 5.88 meters. Top surfaces of the planks are very eroded. The edge of the shore most plank was 10 cm thick but an eroded wood casing around a fastening suggest it was originally between 18 to 20cm thick.

Figure 62. Julian Weston on the wreck in 2002 (Photo courtesy of SCIAA).

Figure 63. East Carolina University, Clemson University and University of South Carolina team 2018 (Left to right: Lynn Harris, Emily Schwalbe, Nate Fulmer, Kelsey Dwyer and Jen Jones, missing Jeremy Borrelli taking photograph).

Most distinctive features on this wreck are the fastenings. Forty-three long Muntz alloy spikes protrude from the planks ranging from 10 to 50cm in height. Some are bent over or clinched. The planks are joined edge to edge with a 10cm vertical fastening. This is evident from smoothly drilled, but empty, fastening grooves. From the outer edges of the planks, 10 cm of still attached muntz sheathing is evident.

Muntz's was a 60:40 alloy of copper and zinc, also called 'yellow metal', The bolts were durable and easier to drive through heavier woods like oak. It also replaced copper as the preferred sheathing and fastening medium. Sometimes (as with the copper form) heads of Muntz or Yellow Metal bolts were 'clinched', 'upset' or 'peened' over circular clinch rings to become 'clinch bolts', or were clinched at both head and end, to become double-clenched rivets. Large circular section copper alloy nails—or short bolts called 'dumps'.On December 17, 1832, George Frederick Muntz submitted patent No.6347 promoting Muntz as a favorable and durable fastenings for ships. The invention consists in making such fastenings of "an alloy of zinc and copper, in such proportions and of such qualities as while it enables the manufacturer to roll and work the said compound metal into bolts and other the like ships' fastenings at a red heat, and thus makes" such "fastenings less difficult to work, and consequently cheaper to manufacture, renders" them also "less liable to oxydation, and consequently more durable than the ordinary bolts and other the like ships' fastenings now in use." "I take that quality of copper known in the trade by the appellation of 'best selected copper,' and that quality of zinc known in England as 'foreign zinc,' and melt them together in the usual manner in any proportions between fifty per cent. of copper to fifty per cent. of zinc, and sixty-three per cent. of copper to thirty-seven per cent. of zinc. both of which extremes and all intermediate proportions will roll and work at a red heat," but "I prefer the allow to consist of about sixty per cent. of copper to forty per cent. of zinc." [Printed, 3*d*. No Drawings. See Repertory of Arts, vol. 16 (*third series*), p. 12; and London Journal (*Newton's*), vol. 3 (*conjoined series*), p. 83.]

Figure 64. Wando 1 wreck fully exposed in the muddy bottom.
(Photo by Jeremy Borrelli).

Figure 65. Copper alloy fasteners protruding from the deteriorated planking. Note the bent fastener and channel forming where the copper meets the wood (Photo by Jeremy Borrelli).

Figure 66. Evidence of edge to edge fastening of the hull planks. This fastener would have likely been near the center of the plank, suggesting the wood has degraded significantly (Photo by Jeremy Borrelli).

Figure 67. Sheathing and tacks embedded in the marsh (Photo by Jeremy Borrelli).

Figure 68. Kelsey Dwyer and Lynn Harris collecting GPS data (Photo by Jeremy Borrelli).

Table 3. WANDO 1 TIMBER MEASUREMENTS (Compiled by Kelsey Dwyer)

Description	Measurement
Total length	14.84 m
Inner Sided plank	27 cm
Center sided plank	27 cm
Outer sided plank	27 cm
Planks molded	10 cm
Planks sided	27 cm

WANDO 2

The wreckage (4.80m in length) located at N 32 49' 05.9" w 79 54' 14.6" lies orientated parallel to Wando River crushed onto the starboard side with port side exposed. Essentially it is a flattened profile port view. The stern and stern post is located on the NW extremity. The wreckage comprises 2 strakes of the outer hull port side planks and the inner faces of five frames exposed where planks are missing. Fastenings are abundant, especially in the stern area and include copper sheathing tacks and holes for trunnels. The best preserved portion is the stern area (1.32m in width) becoming, with timbers increasingly eroded towards the bow (91cm in width). Evidence of burning is evident in the stern area.

Figure 69. Setting up for fieldwork on Wando wreck 2 with drone aerial photos and GPS coordinates (Photo by Lynn Harris).

Figure 70. Wando wreck 2 (Photo by Jeremy Borrelli).

Figure 71. Sheathing tacks and burning on Wando wreck 2 in the stern area (Photo by Lynn Harris).

Figure 72. Emily Schwalbe of Warren Lasch Conservation Lab. Clemson University documenting Wando 2 wreckage (Photo by Jeremy Borrelli).

Table 4. WANDO 2 TIMBER MEASUREMENTS (Compiled by Kelsey Dwyer)

Description	Measurement	
Total length	4.38 meters	
Width at stern	1.32 m	
Width at bow portion	.91m	
Stern post:		
length	88cm	
width	7cm	
Frames: (1-5) Length		
1	57 cm	
2	46 cm	
3	67 cm	
4	28 cm	
5	39 cm	
Frames (1-5) Room and Space		
1 to 2	67 cm	
2 to 3	67 cm	
3 to 4	70 cm	
4 to 5	67 cm	
Frames (1-7) Molded and Sided	Molded	Sided
1	28 cm	19 cm
2	17 cm	19 cm
3	19cm	2cm
4	16 cm	N/A
5	18 cm	19 cm
6	18 cm	N/A
7	18 cm	6 cm
Stern Post Length		
Shore most plank	19cm	
Middle plank	17 cm	
Water most plank	34 cm	
Disarticualted Wood length		
Shore most piece	34 cm	
Middle piece	1 m 9cm	

Historical Context

There is a possibility that this wreckage represents remnants of Civil War wrecks dumped on the river banks in the 1920s during dredging operations recorded in the logbook of Associate Engineer, H.F. Rivers. Amongst these vessels that matches the description is that of *CSS Indian Chief. He* wrote a description of the discovery in his logbook. “It’s ribs were 12' X 12' mahogany timbers, butting each other on the keel. They were solid but as usual when sunken timbers are exposed they dry rot in a short time...Beautiful handmade brass spikes & long copper drift bolts hold the hull together." Rivers concluded that these were the remains of a ship dating back to the Civil War the Confederate receiving ship—CSS *Indian Chief*. "The *Indian Chief* was a 3-mast schooner of heavy timber construction sheathed with Muntz metal. Appearances indicated it to be 150' long. Removal completed July 7, 1929,"Rivers noted in his logbook. While this wreckage may not be remains of the CSS *Indian Chief*, but it has some similar construction details. There is a possibility that it is of the same vintage and may be associated Civil War activity in the general area.

Between July and August of 1929, the U.S. Corps of Engineers found three more wrecks. These were identified as former Confederate navy vessels CSS *Palmetto State*, CSS *Chicora*, and CSS *Charleston*. Rivers describes the CSS *Chicora* as 150 feet long, 35 feet in beam and a 12 foot depth of hold. Armor: two layers of iron plating laid upon a 22 inch backing of oak and pine. Plating was continued below the waterline and also covered the ram that was a strong elongation of the bow. 500 tons of iron used in her armor and she was propelled by an engine with a 30-inch diameter cylinder and 26 stroke driving three-bladed screw eight feet in diameter. Battery: 2-9-inch smooth bore guns and 4 rifles, 32-pounders each.

Historians believe there were probably more trained seamen in the *Charleston* squadron than any other. Many were enlisted foreigners. In contrast to the other Confederate squadrons, three African Americans served aboard the ironclad CSS *Chicora*. The crews of the *Charleston* squadron had a reputation of being well trained, very disciplined and having a respect for their officers. The vessels were known as the cleanest and of great credit to the Confederate navy. There are several associations between these vessels and the *H.L. Hunley*. In October 1863, the *H.L. Hunley* practiced numerous dives under CSS *Indian Chief* for training purposes. The *H.L. Hunley* sank, resulting in the death of the crew and inventor Horace Hunley, although the submarine itself was recovered. In November of the same year, Lieutenant George Dixon, commander of the *H.L. Hunley*'s last mission, obtained permission from General Beauregard to ask for volunteers for the submarine from the crew of CSS *Indian Chief*. Despite the fact that only a month before these sailors had witnessed the fatal sinking of the *H.L. Hunley*, there were volunteers. Two other confederate vessels, CSS *Chicora* and CSS *Palmetto State* also supplied volunteers for the earlier crews of the *H.L. Hunley*.

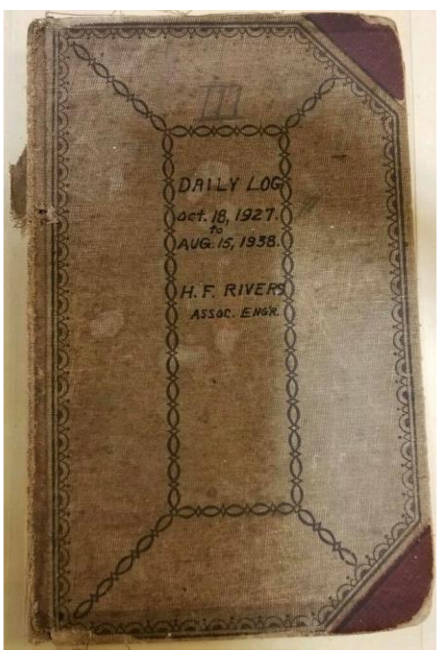

Figure 73. The cover of the logbook for the dredger *Hallendale* that originally discovered the wreck site in 1929. The logs suggest that the remains may be that of *CSS Indian Chief*, scuttled in 1865. Further research is needed to confirm this identification (Photo by Lynn Harris).

Environment

Nearly two thirds of the state of South Carolina lies in the coastal plain, which stretches 80-90 miles from the Atlantic Ocean to the piedmont province. The Charleston area lies in a marine coastal terrace region, or low country, less than 270 feet abound sea level. Drained by large rivers and numerous tributaries, the area is part of the Pamlico coastal terrace, a nearly level plain subject to inundation (Cooke 1937).

The site/s lies on the Wando River, a tidewater river that empties into the Cooper river at Charleston harbor. This tidal flat, based on Pleistocene sand, shell, and clay, is attached to substantial marsh land which is subject to scraping and erosion (Smith 2016).

Typical marsh wildlife, particularly small crab, accompany dolphin and alligators, as well as land-based animals such as white-tailed deer. Residential development has been rapid since 2005, and large homes with accompanying extended docks are continuously appearing along the shoreline.

Figure 74. Map showing the location of Wando 1 wreckage and the changing marsh shoreline between 2013 and 2018 (Created by J.E. Jones).

Figure 75. Map showing the location of Wando 2 (Created by J.E. Jones).

CHAPTER . OCRACOKE ISLAND HISTORIC DISTRICT

Ocracoke Lighthouse

The original Ocracoke Light Station, built in 1823, consisted of the lighthouse tower, as well as a small, one and a half story lighthouse keeper's house. Additional buildings have been added over the years, including an oil house, coal shed, and storage shed. A kitchen and dining room were added to the lighthouse keeper's quarters. The light station is located in the middle of modern day Ocracoke. The lighthouse, constructed of brick with a mortar surface, is whitewashed. Originally, a wooden spiral staircase led from the base of the tower to the lens room. However, in 1950 the wooden staircase was torn out and replaced with a steel spiral staircase. The lens room contains twelve glass trapezoidal lens panes, as well as a dome and finial of cast iron. The lantern originally consisted of a valve lamp with reflectors.In 1938, the oil lamp was replaced with an electric bulb. This power light was visible for fourteen miles out to sea. Except for the changes to the light, as well as minor repairs and additions, the lighthouse itself appears as it did in 1823.

Figure 76. Lens room of The Ocracoke lighthouse (Image Courtesy of the National Park Service)

In the late 18th and early 19th centuries, Ocracoke Inlet was the primary port for ocean-going ships that were headed to the northern parts of coastal North Carolina, creating the need for a functioning light station. The Ocracoke Light Station has a long and rich history. Throughout its life, townspeople would take shelter from bad storms on the high ground of the lighthouse quarters. During World War II, the U.S. Coast Guard conducted round-the-clock watches from the lighthouse. The lighthouse is still in use by the U.S. Coast Guard, although the property is currently under the jurisdiction of the National Park Service and in contrast to other lighthouses in North Carolina, the interior is not open to the public due to the deteriorated condition of the structure. Public viewing is facilitated from a deck that is situated a meters away from the structure. The ECU team could conduct two-day 3-D laser imaging of the exterior.


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Figure . Deck constructed for public viewing of the lighthouse.

Island Inn, Ocracoke

The Island Inn, now located at 25 Lighthouse Road in Ocracoke, was built in 1901 by the Independent Order of Odd Fellows. While the top floor was used as a meeting room, the bottom floor was used as a school house. In 1917, another schoolhouse was built and the Lodge was disbanded, leaving the property to be sold and used as a private residence. It was later converted to an inn in the 1930's by Stanley Wahab, and served as an Officer's Club and coffee shop during World War II. "The Island Inn" officially became the name in the 1950's under the care of Doward Brugh. In 1978, Foy Shaw and Larry Williams (of the Wahab family) procured the Inn, and added an extra wing and swimming pool (National Park Service, Ocracoke Navigator 2017).

Since the beginning, the Island Inn had been a hub of social activities for the island, acting as a dance hall, restaurant, and meeting place. In the 1980s the Inn featured a popular dining room serving locally caught seafood, clam fritters, chicken in Cajun sauce, orange cake, chocolate rum cake and fig cake - a local favorite. An additional attraction was an aviary next to the dining room with displaying parrots, cockatiels and parakeets. The lobby was decorated with hundreds of frogs made from a variety of materials including wood, shells, glass and fabrics. Since the beginning, the Island Inn had been a hub of social activities for the island, acting as a dance hall, restaurant, and meeting place. The inn boasted great atmosphere, three homemade meals daily, and private porches to sit back and relax. The Island Inn was put up for sale in 2017, but as of December 7, the Ocracoke Island Preservation Society has made arrangements to procure and renovate the inn under their Island Inn Preservation Committee. The inn boasted great atmosphere, three homemade meals daily, and private porches to sit back and relax (Ocracoke Navigator 2017). The Island Inn was included on the Ocracoke Village nomination for the National Register of Historic Places in 1990. The Island Inn was put up for sale in 2017, but as of December 7, the Ocracoke Island Preservation Society has made arrangements to procure and renovate the inn under their Island Inn Preservation Committee (Ocracoke Current 2017).

Figure 77. Odd Fellows Lodge 1930(Bill and Ruth Cochran Collection – Courtesy of Ocracoke Preservation Society Collection)

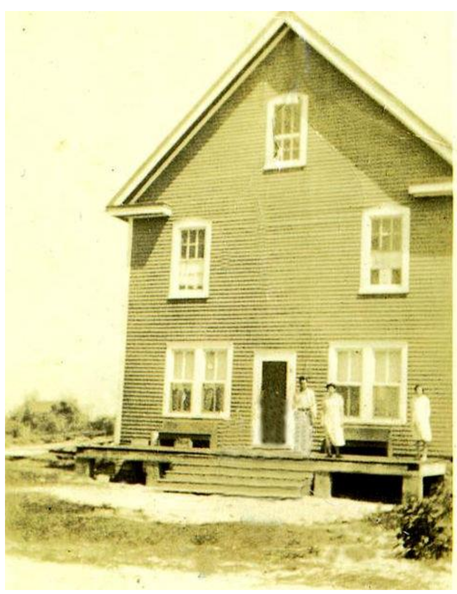


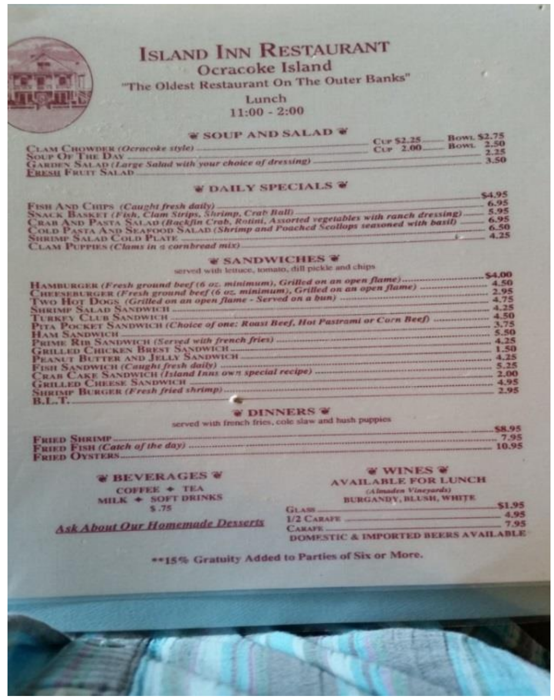
Figure 78. Island Inn as a private residence in 1930s (Bill and Ruth Cochran Collection – Courtesy of Ocracoke Preservation Society Collection)

Figure 79. Island Inn Dance, circa 1940s (Courtesy of Chester Lynn)

Figure 80. Island Inn circa 1940s (Bill and Ruth Cochran Collection – Courtesy of Ocracoke Preservation Society Collection)

Figure 81. Island Inn circa 1950s (Bill and Ruth Cochran Collection – Courtesy of Ocracoke Preservation Society Collection)

Figure 82. Island Inn 1960s (Bill and Ruth Cochran Collection – Courtesy of Ocracoke Preservation Society Collection)



ISLAND INN RESTAURANT
Ocracoke Island
"The Oldest Restaurant On The Outer Banks"
Lunch
11:00 - 2:00

SOUP AND SALAD

Cup $2.25 — Bowl $2.75
Clam Chowder (Ocracoke style) — Cup 2.00 — Bowl 2.50
Soup Of The Day — 2.25
Garden Salad (Large Salad with your choice of dressing) — 3.50
Fresh Fruit Salad

DAILY SPECIALS

$4.95
Fish And Chips (Caught fresh daily) — 6.95
Snack Basket (Fish, Clam Strips, Shrimp, Crab Ball) — 5.95
Crab And Pasta Salad (Backfin Crab, Rotini, Assorted vegetables with ranch dressing) — 6.95
Cold Pasta And Seafood Salad (Shrimp and Poached Scollops seasoned with basil) — 6.50
Shrimp Salad Cold Plate — 4.25
Clam Puppies (Clams in a cornbread mix)

SANDWICHES
served with lettuce, tomato, dill pickle and chips

$4.00
Hamburger (Fresh ground beef (6 oz. minimum), Grilled on an open flame) — 4.50
Cheeseburger (Fresh ground beef (6 oz. minimum), Grilled on an open flame) — 2.95
Two Hot Dogs (Grilled on an open flame - Served on a bun) — 4.75
Shrimp Salad Sandwich — 4.25
Turkey Club Sandwich — 4.50
Pita Pocket Sandwich (Choice of one: Roast Beef, Hot Pastrami or Corn Beef) — 3.75
Ham Sandwich — 5.50
Prime Rib Sandwich (Served with french fries) — 4.25
Grilled Chicken Brest Sandwich — 1.50
Peanut Butter and Jelly Sandwich — 4.25
Fish Sandwich (Caught fresh daily) — 5.25
Crab Cake Sandwich (Island Inns own special recipe) — 2.00
Grilled Cheese Sandwich — 4.95
Shrimp Burger (Fresh fried shrimp) — 2.95
B.L.T.

DINNERS
served with french fries, cole slaw and hush puppies

$8.95
Fried Shrimp — 7.95
Fried Fish (Catch of the day) — 10.95
Fried Oysters

BEVERAGES
COFFEE ✦ TEA
MILK ✦ SOFT DRINKS
$ .75

Ask About Our Homemade Desserts

WINES
AVAILABLE FOR LUNCH
(Almaden Vineyards)
BURGANDY, BLUSH, WHITE
Glass — $1.95
1/2 Carafe — 4.95
Carafe — 7.95
DOMESTIC & IMPORTED BEERS AVAILABLE

**15% Gratuity Added to Parties of Six or More.

Figure 83. Menu at Island Inn (Courtesy of Chester Lynn)

To view 3-Models of the Island Inn in 2017:

http://blog.ecu.edu/sites/maritimeheritageatrisk/sites/ocracoke-island/island-inn-ocracoke-island/island-inn-3-d-model/

Figure 84. East Side Façade showing stairway to top rooms (Photograph by Lynn Harris, 2017)

Figure 85. West Side Facade View (Photograph by Lynn Harris, 2017)

Figure 86. Front North façade showing room balconies (Photograph by Lynn Harris, 2017)

Figure 87. East Side Façade showing stairway to top rooms (Photograph by Lynn Harris, 2017)

The main block of the building is a three story gable front with a steeply pitched roof with crowned eaves and two adjoined ells. A full three story balcony with square support posts and railing. The western ell is two stories tall with a moderately pitched sill fronted roof. The first floor has framed blue cloth canopies covering the tops of the windows and doors. The eastern ell is a one story, flat roofed extension with an overhanging roof supported by cylindrical columns. The roof is clad in asphalt shingles while the walls are covered with white painted horizontal clapboards. The thickness of the clapboards varies on the main block and the ells. Figures in this report include photographs of the exterior northern facade and southern elevation of the building and associated out buildings.

The exterior was assessed with a general rated condition label of fair and poor. The front facade of the building is in fair condition. General weathering has deteriorated the paint on the exterior and removed some of the asphalt shingles from the roof. Some organic staining is present on the exterior as well by the base of the building. While the rest of the front doesn't appear to have any other visible signs of deterioration, the rear southern facade and out buildings have extensive damage and is in poor condition. Figures below depict extensive damage where much if the paint is flaking off down to the wooden substrate. This is most prevalent on the two ells. There is heavy damage to the eastern ell rear where the wall is missing and exposed. It is covered by a blue tarp. Evidence of massive water damage too as there is rot in the wooden walls with heavy organic staining. The various out buildings are in poor to fair shape with many similar issues as explained above. Due to the extensive amount of visible damage, it seems plausible that there is a significant amount of interior damage as well but cannot be determined unless an interior conditions assessment is done.

Figure 88. Southeastern elevation of out building and early twentieth century beach resort (Photo by Paul Willard Gates, ECU).

Figure 89. Rear: Southern elevation of out building and early twentieth century beach resort (photo by Paul Willard Gates, ECU).

Figure 90. Rear: eastern elevation of out building and early twentieth century beach resort (Photo by Paul Willard Gates, ECU)

Figure 91. Rear: southern elevation of early twentieth century beach resort (Photo by Paul Willard Gates, ECU)

CHAPTER .PORTSMOUTH ISLAND HISTORIC DISTRICT

Portsmouth Island Historic District, or Portsmouth Village, is located on the northern end of the island in the Outer Banks of North Carolina. The village was originally settled prior to the Revolutionary War and served as an important point of contact for shipping vessels through the 19th century. With the rise in use of the Hatteras Inlet, Portsmouth Village began to be used less and less. The population declined rapidly, even with the establishment of the Lifesaving Station in 1895. Between storm damage, declining population, and economic downfall, Portsmouth Village was left with only three residents by the 1960's. Portsmouth Village was nominated for the National Register of Historic Places in 1978; since then, revitalization and conservation efforts have been increased by local historic groups (National Park Service 1978).

Table 5. Historical Structures on Portsmouth Island.

NPS Building #	Building Name	GPS Coordinates (Google Earth)
1	Life-Saving Station	35° 4'6.69″N 76° 3'27.19″W
2		35° 4'5.46″N 76° 3'29.70″W
3		35° 4'8.02″N 76° 3'38.18″W
4		35° 4'9.39″N 76° 3'37.15″W
5		35° 4'10.24″N 76° 3'38.67″W
6		35° 4'12.25″N 76° 3'36.86″W
7		35° 4'11.12″N 76° 3'38.90″W
8	Portsmouth Methodist Church	35° 4'10.78″N 76° 3'40.50″W
9	Washington Roberts House	35° 4'7.71″N 76° 3'41.70″W
10		35° 4'9.53″N 76° 3'46.57″W
11	Post Office and General Store	35° 4'11.22″N 76° 3'50.12″W
12		35° 4'12.88″N 76° 3'48.56″W
13	Theodore and Annie Salter House	35° 4'12.75″N 76° 3'51.34″W
14		35° 4'14.55″N 76° 3'45.21″W
15	Pigott House	35° 4'15.62″N 76° 3'41.92″W
16		35° 4'18.41″N 76° 3'46.64″W
17		35° 4'19.66″N 76° 3'46.53″W
18		35° 4'12.59″N 76° 3'56.76″W
19		35° 4'11.52″N 76° 4'5.15″W
20	School	35° 4'2.04″N 76° 3'50.03″W

21		35° 4’4.45″N 76° 3’48.68″W
22	Sea Captains’ Graves	35° 4’7.24″N 76° 3’21.13″W
23	Cemetery	35° 4’12.83″N 76° 3’37.75″W
24	Cemetery	35° 4’5.40″N 76° 4’2.77″W
25	Cemetery	35° 4’11.42″N 76° 3’48.81″W
26	Cemetery	35° 4’14.25″N 76° 3’54.94″W

Portsmouth Island Cemeteries

There are ten cemeteries on Portsmouth Island that have been recorded. The conditions of the cemeteries vary depending on age and location to the village. The cemeteries owned by families and near town have been very well taken care of by the island caretakers. On the opposing side, however, one of the smaller outlying cemeteries has been overtaken by a creek towards the southern end of the island. Below are the locations, conditions, and graves of the ten known as cemeteries. The Babb Cemetery, Grace Cemetery, and the Community Cemetery are the only cemeteries listed on the nomination for the National Register of Historic Places in 1978.

Life Saving Station

Please note that the entirety of the interior of the building could not be fully assessed as the Life Saving Station Boat Shed, first floor foyer with staircase leading to the second floor, second floor, and observation tower was not examined. The floors, ceiling, and walls were assessed with a general rated condition label of either excellent, good, fair, or poor. Examples of deterioration and related mechanical processes are explained with supporting photographic documentation for evidence of the various types of deterioration. Overall, the general rated conditions of the interior ranges from good, fair and poor with a majority of the rated assessments falling under fair and poor.

Figure 92. Ceiling example in the 1st floor entrance way of the Life Saving Station (Photo by Paul Willard Gates, ECU).

Figure 93. East wall example in the 1st floor entrance way of the Life Saving Station. (Photo by Paul Willard Gates, ECU).

Figure 94. Floor example in the 1st floor pantry of the Life Saving Station. (Photo by Paul Willard Gates, ECU).

Methodist Church

Built in AD 1915, the Methodist Church is built atop of brick foundation piers from its predecessors and measure 40 ½’ x 25’ (Figure 1). A working bell tower extends outward from the front of the church and measures 10’ x 10’. Between the brick foundation piers under the bell tower is a brick lattice. Only one is still intact while the other three have collapsed and lay where they fell. A storm in AD 1944 resulted in foundational shifting and is the reason for the structure tilts to the right. Overall, the paint on the exterior and interior has been chipping and flaking off. The corrosive window furnishings are minimally damaging the wood. Minimal water damage is observable on the interior. With very minimal work and funds, the structure can be improved by stopping the water damage. In turn this should slow the deterioration of the rest of the structure while retaining the current furnishings, paint, and wooden planks for the foreseeable future.

Figure 95. Overview of the Western exterior façade, entrance, and bell tower of the church (Photograph by Lynn Harris, ECU)

Figure 96. Example of window fixture corrosion, wasp infestation, and paint chipping on the interior (Photography by Lynn Harris).

Figure 97. The current extent of damage to the backrest of a pew (Photography by Lynn Harris).

Post Office and General Store

A conditions assessment was conducted of the exterior and the interior of the Post Office on Portsmouth Island. The exterior, interior, floors, ceiling were assessed with a general rated condition label of either good, fair, or poor. Examples of deterioration and related mechanical processes are explained with supporting photographic documentation for evidence of the various types of deterioration. Overall, the general rated conditions of the interior range from good, fair and poor with a majority of the rated assessments falling under good and fair.

<u>Southern Exterior Façade:</u> Good. Some minimal paint damage and loose / missing putty from the muntins holding in the window panes. Further loss of putty will lead to window panes falling out. Some iron staining underneath of paint. Exterior door is offset at a slight angle making it hard to fully close. Similar issues with the interior door. Rust present on the door hinges and handle hardware. General wear and tear on the exterior door and steps. General overall weathering, wear, and tear

Figure 98. Front of the post office on Portsmouth Island.

Cemeteries

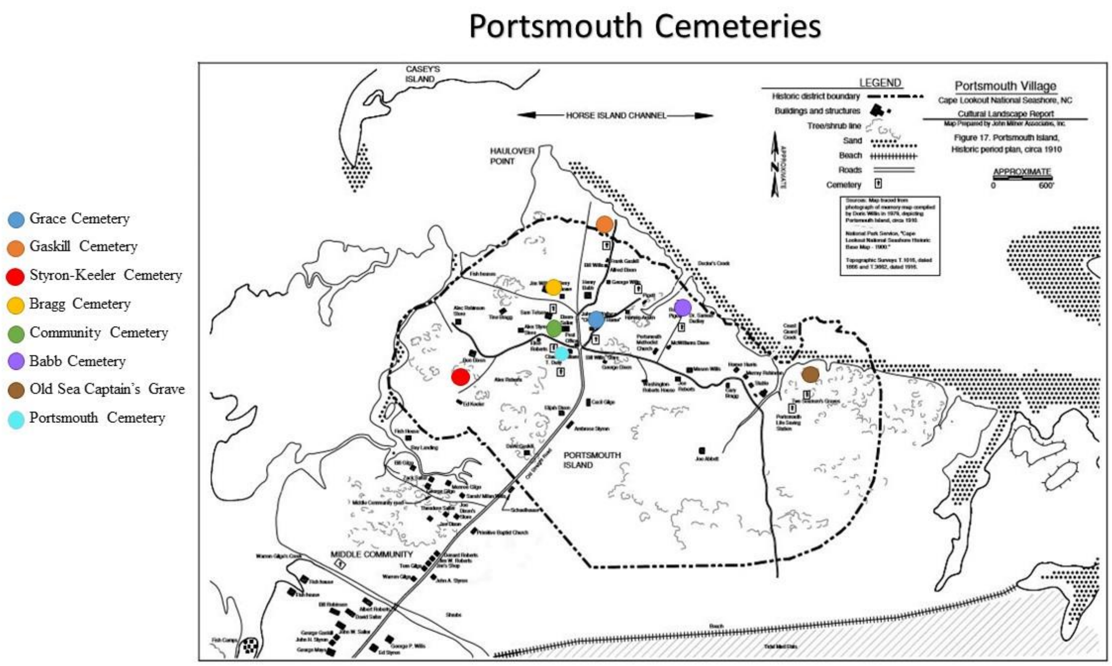


Figure 99. Map of cemeteries on Portsmouth Island

Using data bases such those created by Friends of Portsmouth (http://www.friendsofportsmouthisland.org/cemetery.htm) the ECU team created documented gravestones and gave condition.

Table 6. Location and condition of cemeteries on Portsmouth Island

NAME	LOCATION	# OF Graves	CONDITION	ON MAP
Grace Cemetery	In front of Wallace-Grace-Styron House	4	Good, well-kept	Y
Gaskill Cemetery	100 yds behind Frank Gaskill house	1 tomb +evidence of 2 graves	Unknown	Y
Styron-Keeler Cemetery	next to Keeler House	9	Unknown	Y (?)
Bragg Cemetery	Between Tolson and Willis' house	13	Unknown	Y
Community Cemetery	Store/Post office, adjacent to Daly house	25	Good, well-kept	Y
Babb Cemetery	Near church and behind the Babb House	5	Good, well-kept	Y (?)
Old Sea Captain's Cemetery	Behind Life Saving Station	2	Gravestones are in good condition	Y
Capt. Dixon Site	1 mile south on "Straight Road"	1	Unknown, likely overgrown	N
Portsmouth Cemetery	Behind Visitor's Center/adjacent to Tolson house	13	Good, well-kept	Y
Lost Cemetery	In Warren Gilgo's Creek	2-50 (2 found, 50 possible)		

Table 7. Residents of Portsmouth Island buried in cemeteries

NAME	DOB	DOD	CEMETERY
Dixon, Arthur Edward	1/14/1888	10/31/1945	Babb Cemetery
Dixon, Nora Elizabeth	3/5/1892	9/12/1956	Babb Cemetery
Babb, Lillian M.	7/30/1896	1/8/1996	Babb Cemetery
Pigott, Elizabeth	8/28/1889	9/12/1960	Babb Cemetery
Pigott, Henry	5/10/1896	1/5/1971	Babb Cemetery
Capt. Thomas W.	32y	1/17/1810	Old Sea Captain's Cemetery
Hilzey, Capt. William D.	36y2m27d	10/4/1821	Old Sea Captain's Cemetery

Dixon, Harry Needham	9/10/1889	9/27/1931	Community Cemetery
Dixon, Lida	9/19/1889	9/27/1931	Community Cemetery
Roberts, John B.	3/22/1830	3/19/1894	Community Cemetery
Dixon, George B.	3/19/1857	11/24/1919	Community Cemetery
Dixon, Martha	3/13/1859	3/4/1914	Community Cemetery
Dixon, Mary Helen	12/22/1876	8/22/1927	Community Cemetery
Dixon, Wilford B.	11/30/1909	11/23/1922	Community Cemetery
Dixon, Alfred B.	2/16/1870	3/16/1931	Community Cemetery
Babb, George Rodnal	10/16/1924	10/18/1924	Community Cemetery
Styron, James	NA	NA	Community Cemetery
Williams, Bettie	7/6/1847	9/11/1929	Community Cemetery
Williams, Carolina	11/4/1856	7/30/1891	Community Cemetery
Parsons, Mary H.	7/31/1859	6/8/1934	Community Cemetery
Dixon, Eugene	3/2/1868	9/23/1888	Community Cemetery
Daly, Claudia	3/19/1857	9/7/1914	Community Cemetery
Daly, William T.	6/2/1844	2/6/1893	Community Cemetery
Daly, William T.	6/15/1887	6/29/1948	Community Cemetery
Daly, Blanch E.	5/10/1897	7/21/1927	Community Cemetery

Gaskins, Elizabeth Daly "Dasiy"	10/23/1883	2/22/1926	Community Cemetery
Gilgo, Monroe	3/26/1882	1/20/1927	Community Cemetery
Gilgo, Rita Johnson	8/18/1909	10/15/1911	Community Cemetery
Babb, Hugh Linwood	8/19/1912	10/28/1912	Community Cemetery
Willis, Ronald C.	4/25/1904	6/22/1904	Community Cemetery
Roberts, Elsie T.	10/15/1859	9/10/1914	Community Cemetery
Roberts, Mary E.	8/24/1878	1/29/1908	Community Cemetery
Roberts, William	5/18/1907	5/18/1907	Community Cemetery
Gaskill, Elijah	5/15/1878	11/11/1906	Gaskill Cemetery
Dixon, Capt. William W.	6/4/1800	9/14/1840	Capt. Dixon Site
Bragg, Thomas	2/17/1878	3/21/1960	The Portsmouth Cemetery
Bragg, John V.	61y	11/23/1887	The Portsmouth Cemetery
Bragg, Jane L.	6/22/1839	1/4/1893	The Portsmouth Cemetery
Mayo, Nancy	12/29/1833	1/26/1906	The Portsmouth Cemetery
Mayo, James	6/5/1830	4/18/1900	The Portsmouth Cemetery
Pigott, Rachel	8/15/1895	3/4/1960	The Portsmouth Cemetery
Dixon, George M.	1867	3/16/1905	The Portsmouth Cemetery
Dixon, Benjamin R.	1840	4/7/1905	The Portsmouth Cemetery

Styron, Maria	11/14/1816	9/1/1894	The Portsmouth Cemetery
Gaskill, Thomas	12/11/1840	2/1/1881	The Portsmouth Cemetery
Robinson, Alexandra	6/5/1843	8/21/1919	The Portsmouth Cemetery
Robinson, Jane Ann	12/24/1864	6/11/1928	The Portsmouth Cemetery
Robinson, James	5/21/1899	2/20/1919	The Portsmouth Cemetery
Styron, Benjamin G.	6/1/1815	9/21/1866	Keeler Cemetery
Styron, Ambrose J.	1/1/1839	6/12/1910	Keeler Cemetery
Styron, Mrs. J.D. Styron	2/21/1851	4/10/1932	Keeler Cemetery
Lawrence, Hannah	11/11/1811	3/23/1876	Keeler Cemetery
Pigott, Leah	6/1867	3/19/1922	Keeler Cemetery
Pickett, Rose (mispelled?)	12/1836	Mar-09	Keeler Cemetery
Pigott, Isaac	NA	NA	Keeler Cemetery
Tolson, Sam	11/7/1840	11/30/1929	Keeler Cemetery
Grace, John K.	3/29/1881	9/8/1892	Grace Cemetery
Grace, Theresa	4/27/1842	1/14/1912	Grace Cemetery
Grace, John B.	4/2/1861	7/3/1883	Grace Cemetery
Grace, William	11/11/1867	9/9/1872	Grace Cemetery
Gilgo, Rita	NA	12y	Lost Cemetery
Austin, William	41y	8/4/1832	Lost Cemetery

Shell Castle

Early commercial success of Portsmouth Island is attributed to an early opportunistic land reclamation and construction endeavor situated on an oyster shell bed to the west of Portsmouth Island in Ocracoke inlet. The operation was financed by two prominent business partners John Wallace and John Blount and their domestic, artisan and maritime slaves. The permanent pollution was 25. It took place in successive stages in 1790, 1792, 1793 and 1797. The operation consisted of adding ballast stones, shells and turf to the bed and stabilizing with crib style wharf construction typical of the colonial period. It was one mile long and twenty feet wide. The village comprised a warehouse, several dwellings, a chandlery store, rope works, sail lofts, a warehouse, a tavern, a pier and other docking facilities (McGuinn 2000:46-49; NRHP Inventory).

Shell Castle became a successful maritime enterprise serving the southeaster seaboard and Atlantic trade networks. It was convenient for North Carolina trade because ships did not have to enter the Pamlico Sound or the less accessible ports up the Neuse River. Captains could more efficiently undertake repairs, unload cargo and resupply. The slave population on Portsmouth played a crucial role in shipwreck salvage operations, lightering cargoes and piloting ships over the sand ships. Other maritime industries also emerged such as seine netting mullet and a porpoise fishery as an alternative to whale oil (McGuinn 2000:39-115; NRHP Inventory). Hurricanes and closing of the channel that served the Castle ended activities in 1812. Thus, when Ocracoke Inlet shifted and shoaled Shell Castle Island, eroded away and so did the role of the island as a vibrant maritime center. The death knell to the island was the 1846 storm sliced new inlets and new trade routes through Hatteras Island to the north.

In 1999 a collaborative underwater archaeology project was undertaken on the site involving the NC Underwater Archaeology Branch and East Carolina University, Program in Maritime Studies. The National Park Service, US Coast Guard, and Ocracoke Historical Society provided further logistical and financial. The team conducted remote sensing operations, mapped the remaining submerged structure and recovered historic ceramics. The data all formed the basis for Philip Horne McGuinn's excellent MA thesis *Shell Castle, A North Carolina Entrepot, 1789-1820: A Historical and Archaeological Investigation* written under the direction of Professor Gordon Watts.

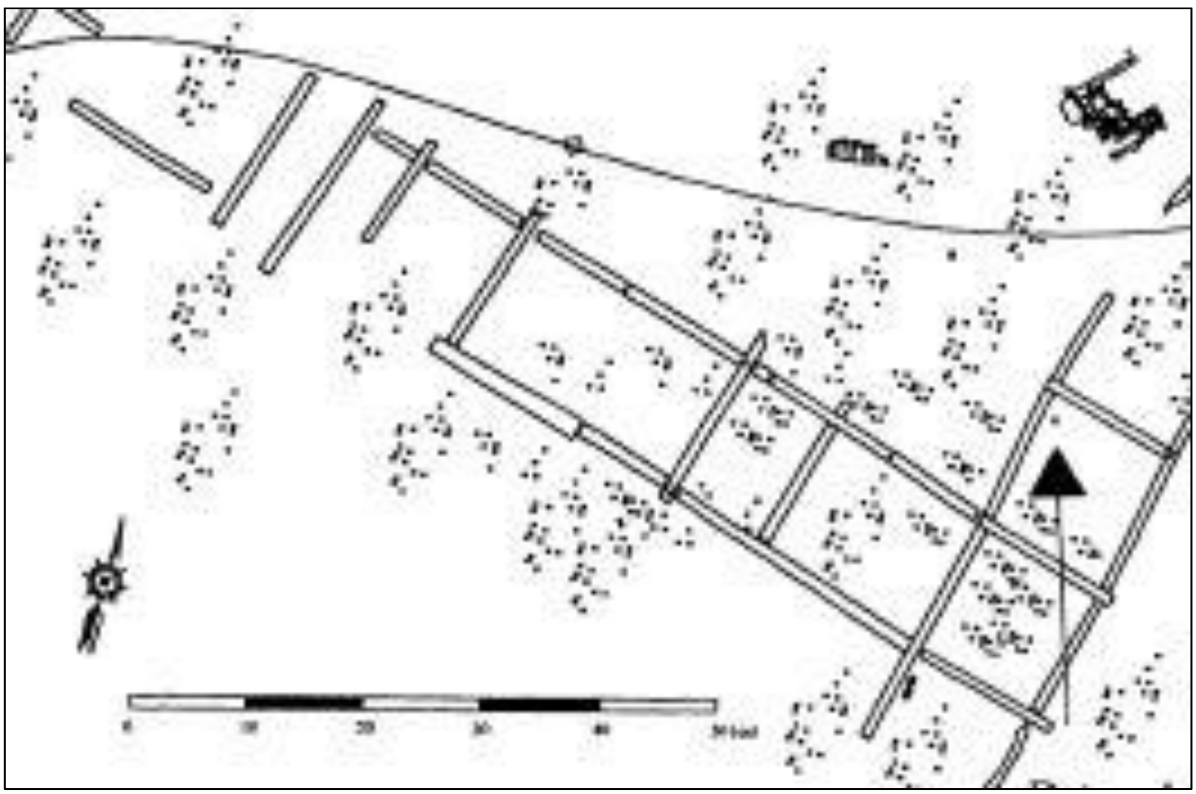


Figure 100. Cribb Wharf: South Eastern Feature (McGuire 2000:366)

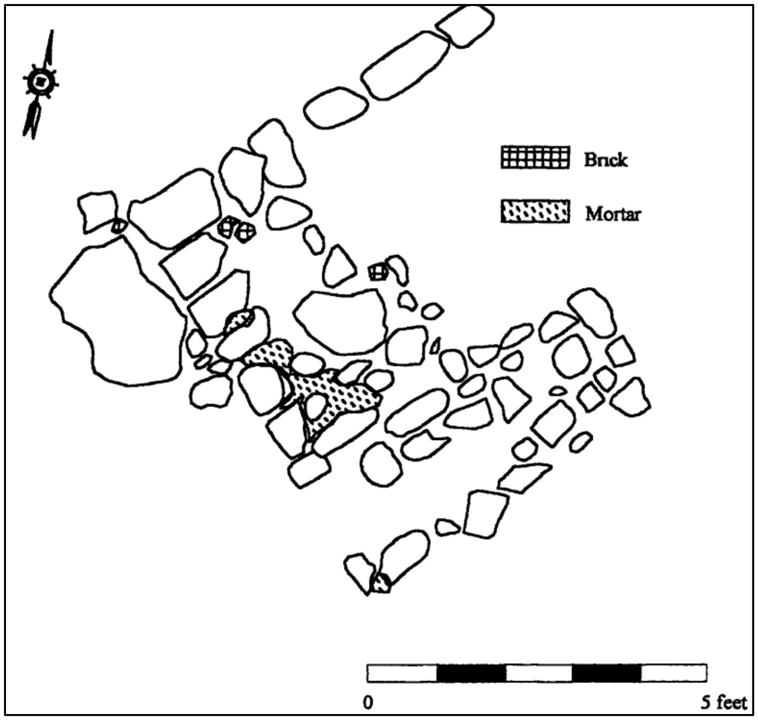


Figure 101. South eastern Stone and Mortar feature (Chris Kirby and Mark Wilde-Ramsing)

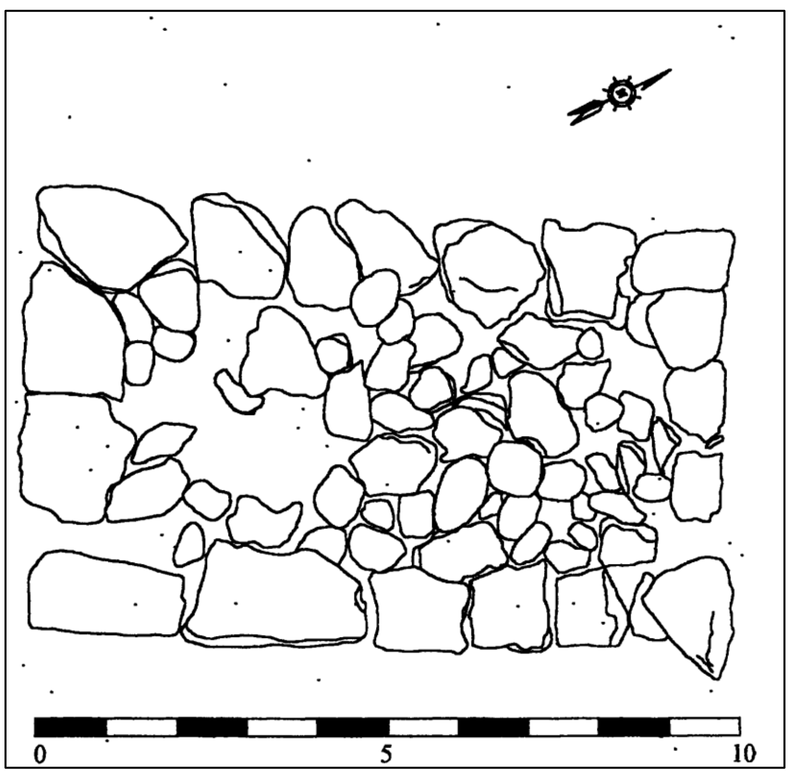


Figure 102. Western End Stone and Mortar feature (Mark Wilde Ramsing)

Shell Castle Ceramic Sherd Types by Section Location

Grid Section	Section A-1		Section A-2		Section B-2		Section C-1		Section C-2		Section Z-1		Section Z-2		Total	
Ceramic Type	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Porcelain		-		-		-		-		-	1	4 8		-	1	1 0
Creamware		-	4	18 2		-		-	2	25 0	6	28 6	1	6 3	13	13 4
Pearlware	7	36 8		-	2	28 6	2	50 0	2	25 0	4	19 0	4	25 0	21	21 6
Stoneware	7	36 8	1	4 5		-		-		-		-		-	8	8 2
White Salt Glazed		-	1	4 5	1	14 3		-		-		-		-	2	2 1
Brown		-	1	4 5		-		-		-	1	4 8	1	6 3	3	3 1
merican Blue & Gray		-	1	4 5		-		-		-	1	4 8		-	2	2 1
Fulham		-	2	9 1		-		-		-		-		-	2	2 1
Nottingham		-	1	4 5		-		-		-		-		-	1	1 0
Grey Albany		-		-		-		-		-		-	1	6 3	1	1 0
Red bodied		-	1	4 5		-		-		-		-		-	1	1 0
Barley Pattern		-		-	1	14 3		-		-		-		-	1	1 0
Redware	3	15 8	3	13 6		-	1	25 0	1	12 5	4	19 0	7	43 8	19	19 6
Copper Redware			1	4 5		-		-		-		-		-	1	1 0
Astbury	2	10 5	2	9 1		-		-	1	12 5	1	4 8		-	6	6 2
Annular ware		-	1	4 5	2	28 6	1	25 0	1	12 5	1	4 8	1	6 3	7	7 2
Whiteware		-	3	13 6		-		-	1	12 5	2	9 5	1	6 3	7	7 2
Delft/Majolica		-		-	1	14 3		-		-		-		-	1	1 0
Total	19	100 0	22	100 0	7	100 0	4	100 0	8	100 0	21	100 0	16	100 0	97	100 0
% of Total	19 6%		22 7%		7 2%		4 1%		8 2%		21 6%		16 5%			

Note No artifacts were located in Section B-1 which covered the north side of Shell Castle and extended into the shoal area with deep sediment and little wave action to uncover artifacts

Table 8. Shell Castle Ceramic Types by Section Location

Table 9. Ceramic sherds by type found on Shell Island

Ceramic Sherd Types By Pattern

Pattern		Ceramic Type: Creamware N	%	Pearlware N	%	Stoneware N	%	Total N	%
Shell Edge									
Handpainted	Blue			1	5.9			1	4.3
	Green			1	5.9			1	4.3
Transfer Print	Blue			4	23.5			4	17.4
	Green	2	40.0	1	5.9			3	13.0
Feather Edge									
Transfer Print	Blue			2	11.8			2	8 7
	Green								
Royal		1	20.0					1	4.3
Barley						1	100	1	4.3
Feather & Floral				1	5.9			1	4.3
Chinese				2	11.8			2	8.7
Annular		2	40.0	5	29.4			7	30.4
Total		5	100	17	100	1	100	23	100
% of Total Types		21.74		73.91		4.35			

Source: Appendix B Shell Castle Artifact Catalog

Table 10. Shell Castle Transfer Print Pitchers

Tablc 8

SHELL CASTLE TRANSFER PRINT PITCHERS

PITCHER	HEIGHT (IN.)	WIDTH (IN)	DIAMETER (IN.)	RIGHT ILLUS	LEFT ILLUS
WALLACE 77.193.1	11.2	10	8.5	Shıp undcr sail	Peace & Independencc
BLOUNT 33.12.51	13	12.9	10.3	Ship undcr sail	Pcacc & Indcpendence
WINTERTHUR 67.0024	13.25			Washington in Glory	Emblem of Amcrica
TELFAIR ACADEMY*	11.125				

Source: N.C D.A.H., Winterthur Muscum, Rauschenberg, "Success to the Tuley,"
* No additional information was availablc on this artifact.

In June 2018 researchers visited the site to see the status of the remaining island steadily washing away and compared it to images 18 years ago.

Figure 103. Research team in 2000 (Photo courtesy of Nathan Henry UAB, NCDCR)

Figure 104. Gulls inhabiting Shell Castle ruins (Photo courtesy of Nathan Henry UAB, NCDCR)

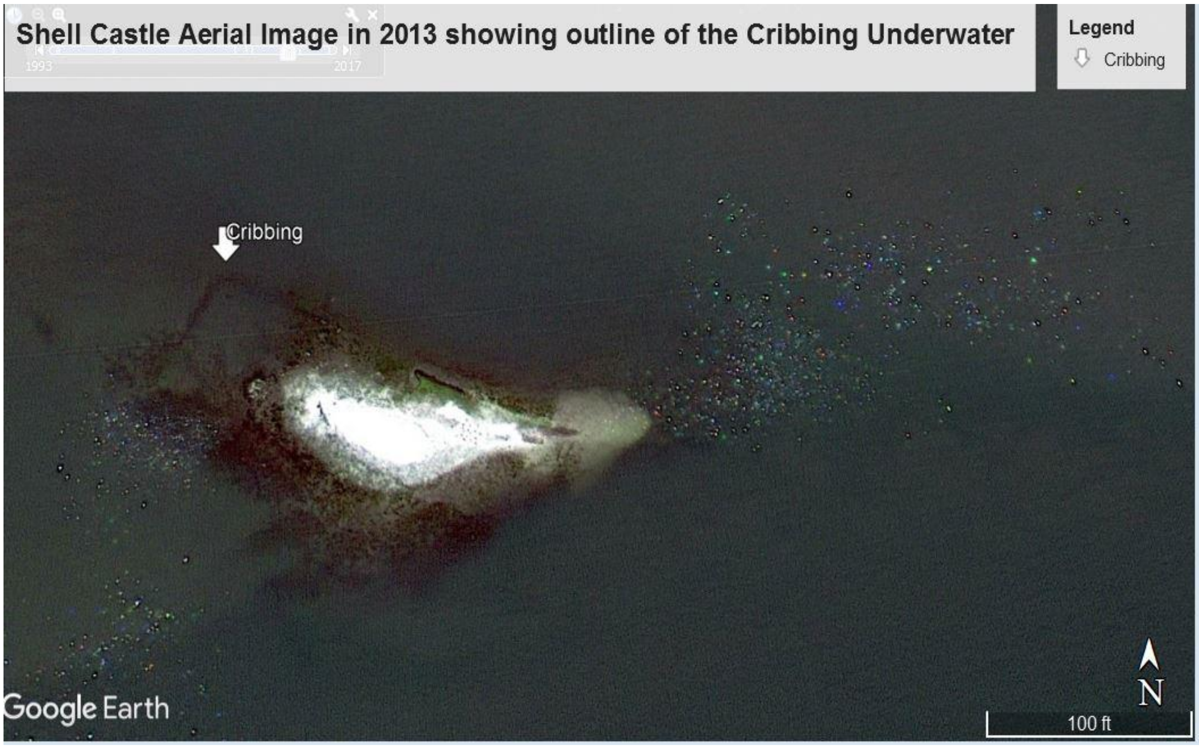


Figure 105. Google Earth image in 2013 (adapted by Lynn Harris)

Figure 106. Google Earth image in 2018 (adapted by Lynn Harris)

Figure 107. View of remains of the island in 2018 (Photo by Lynn Harris)

Beacon Island is another similar small island in Ocracoke inlet used both as part of a trading port developed in the late 1700s. During the Civil War it was the site of the Confederate Army Fort Okrakoke. Erosion steadily degraded the island, which measured about twenty acres in size in the 18th century but, like Shell Castle, had shrunk to about 7.5 acres by 2014. Since 2016, Beacon Island was owned by Audubon North Carolina as a bird refuge—it was home to a large population of pelicans until Hurricane Arthur struck in 2014 and damaged the island to an extent that the pelicans left, leaving a population of herons, egrets, gulls, and terns.

Figure 108. Beacon Island now a sea bird breeding habitat (Photo by Lynn Harris 2018)

CHAPTER . BALD HEAD ISLAND

Geology

Bald Head Island is a barrier island defining the cape associated with a cape shoal massif (Cape Fear) with crescentic coastal embayments to the northeast (Onslow Bay) and the southwest. The barrier island consists of a spit platform and beach ridges with eolian sand cover and maritime forest.

Figure 109. A) Satellite image of Bald Head Island to Fort Fisher area, with survey waypoints shown. B) Close-up of the lighthouse area on Bald Head Island.

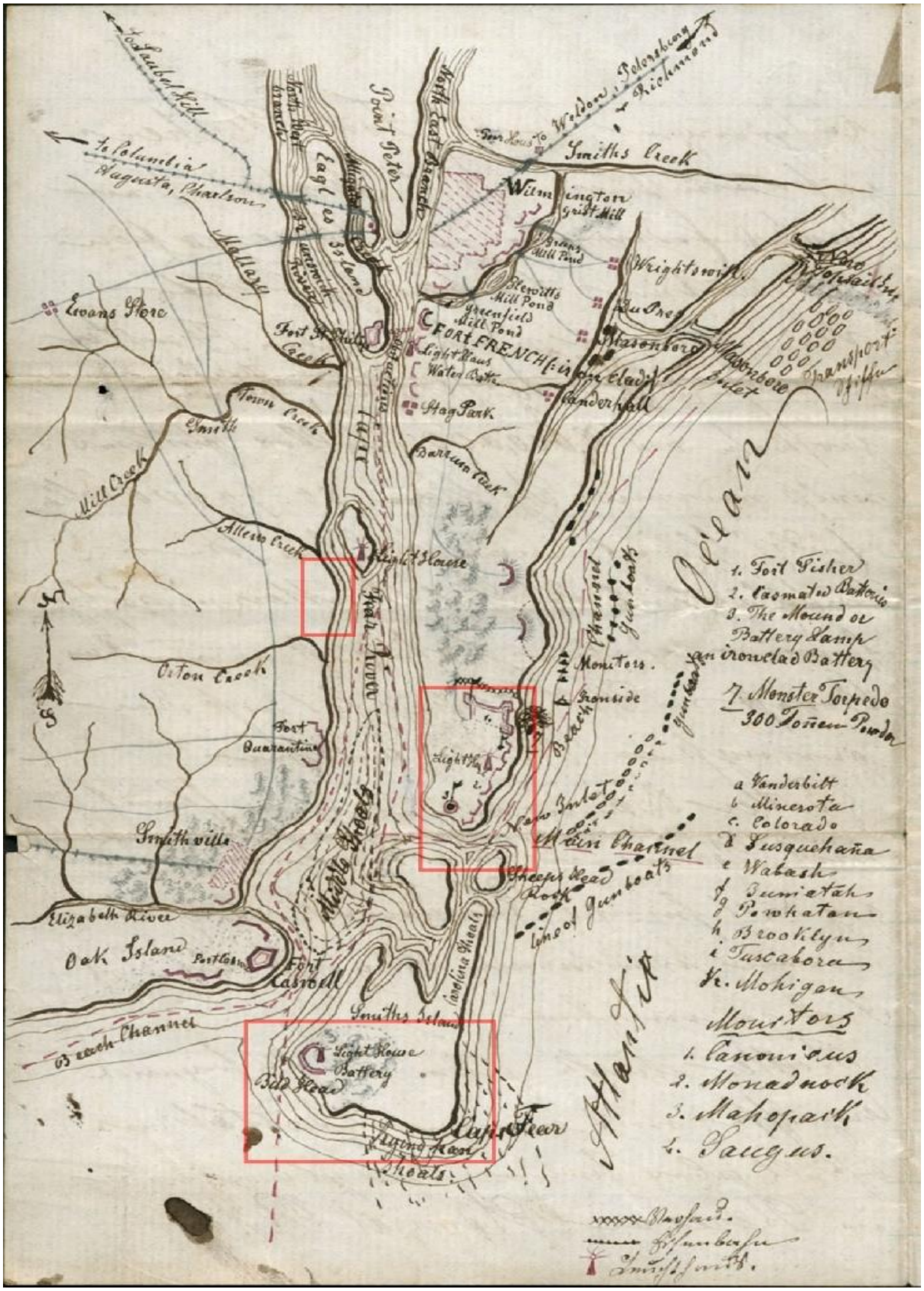


Figure 110. Map (circa 1865) showing the locations (red boxes, from south to north) of Bald Head Island (with Lighthouse and Battery labeled), Fort Fisher and New Inlet, and the wharfs at Brunswick Town.

Sea-level Rise and Shoreline Erosion

Sea-level rise in this region was evaluated by Kopp et al. (2013) and Van de Plassche et al. (2015) using salt marsh peats from Oak Island (just west of Bald Head Island). Data indicate that the rate of relative sea-level rise near Cape Fear is slower than areas to the north. A recent (1900-2012 CE) RSL rise rate of 1.9 ± 0.6 mmy^{-1} is indicated, which is in line with the tide gauge data at Wilmington showing 2.3 ± 0.34 mmy^{-1} (Fig. 2d). As a result, shoreline erosion, although significant, is occurring at a lower average rate than to the north.

Erosion rates along Bald Head Island vary greatly according to location, with the island shoreline showing a general counterclockwise rotation since 1850 (Fig. 16). Long-term erosion rates are greatest at the western and eastern ends of the island, on the south-facing shoreline. The shoreline near the lighthouse has remained somewhat stable. No data are available for erosion rates on the marsh shoreline north of the lighthouse. A 1300 m long leaky terminal groin structure was recently constructed on the west end of the island to address shoreline erosion where structures were being threatened, and the Village of Bald Head Island (VBHI) regularly receives beach nourishment sand from U.S. Army Corps of Engineer dredging of Wilmington Harbor channel. However, shoreline erosion and loss of sand from the island continues at an estimated 371,700 cubic yards per year (Walsh et al., 2017). The impacts on the shoreline to the east and north of the lighthouse have not been determined.

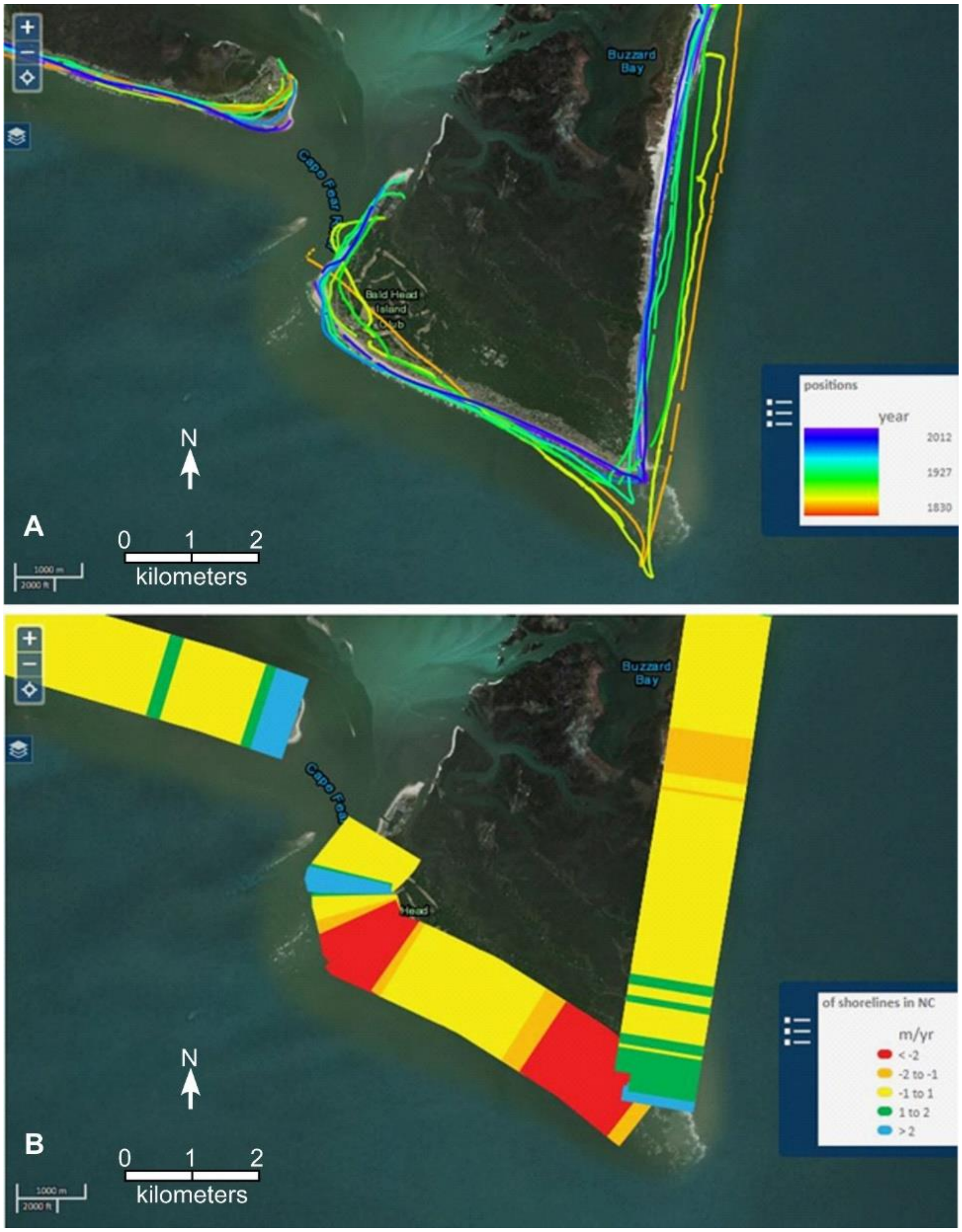


Figure 111. Shoreline positions since 1830. B) Average erosion rates.

Ground Penetrating Radar Survey

A ground penetrating radar (GPR) survey of the area surrounding Old Baldy was performed 2017 to evaluate the subsurface geology and to evaluate potential archaeological targets. The survey utilized a GSSI SIR-3000 GPR system with a 400 MHz antenna on push-cart. Twenty transects were scanned to create at 3D grid of 19 m x 26.5 m (transects were spaced at 1 m intervals). Survey corners were recorded using a Garmin WAAS enabled GPS. Data were processed using Radan v.8 software, and included a time adjustment, background removal, migration, deconvolution, gain enhancement, and gridding (Figure 2).

The data revealed the presence of numerous potential archeological targets. A buried structure was located that may be the cistern. Other targets may correspond with foundation remnants.

Vulnerability Assessment

The Baldhead Island Lighthouse is positioned on the highest ridge on Baldhead Island, at an elevation of ca. 3 to 4 m. A rise of 1.5 m will not inundate the ridge, however, given the proximity to the back-barrier shoreline, the erosion rates here are critical. The lighthouse is positioned only 30 m from the marsh/upland boundary. The marsh will have a buffering effect on shoreline erosion, helping to protect the lighthouse. Given the rates of shoreline change on the marsh edges in this area, it is expected that it may take XX years to erode the back-barrier shoreline and undermine the lighthouse.

Figure 112. GPR gridded survey near Bald Head Island Lighthouse.

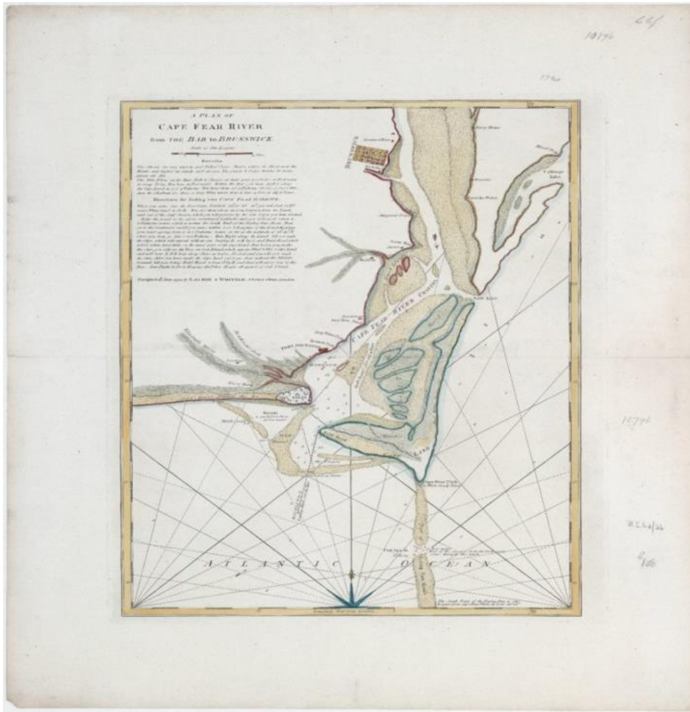


Figure 113. A plan of Cape Fear River from the bar to Brunswick. Date Published 1794. Date Depicted 1794 Place of Publication London Publisher Laurie & Whittle, Digital Collection North Carolina Maps, Call Number Cm912m C23 1794L, Institution University of North Carolina at Chapel Hill.

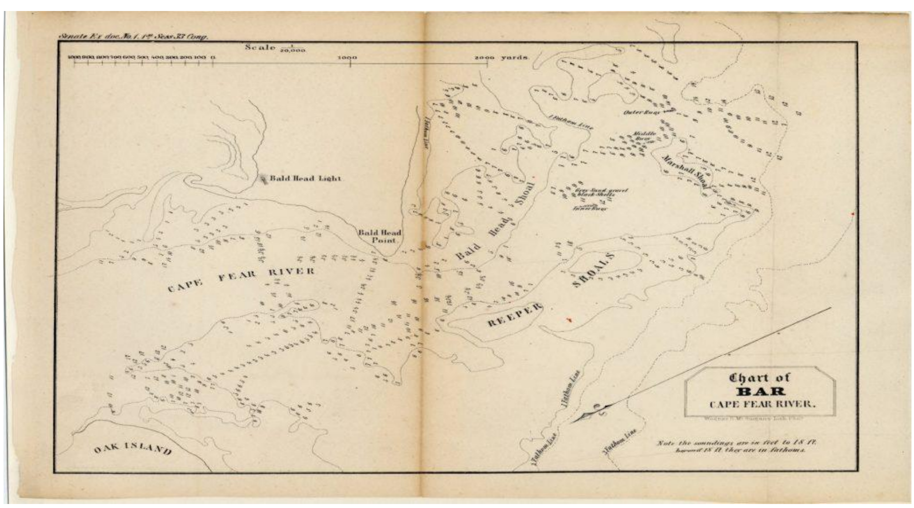


Figure 114. Chart of Bar Cape Fear River Date Published 1853-1854 Date Depicted 1853-1854 Creator - Organization U.S. Coast and Geodetic Survey. Place of Publication Philadelphia Publisher Wagner & McGuigan's Lith. State Library of North Carolina.; Call Number MC.167.C237.1853uh, copy 2;MARS Id 3.10.4.57 Additional Copies North Carolina Collection Call number, additional copies NCC Cm912m U58cf21.

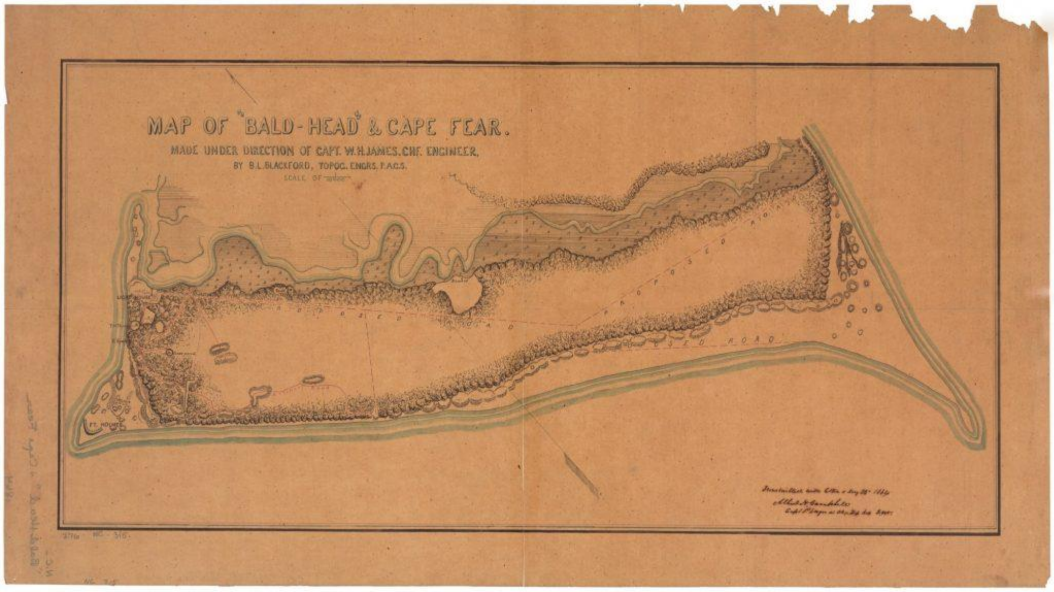


Figure 115. Map of "Bald Head" & Cape Fear. Date Published 26 January 1864 Date Depicted 26 January 1864. Creator - Individual Gilmer, Jeremy Francis, 1818-1883. State Library of North Carolina. Call Number 276/240; Gilmer Map Number 315 Copyright The University Library at the University of North Carolina at Chapel Hill

Bald Head Creek Boathouse

The Bald Head Creek Boathouse, located at the mouth of the Cape Fear River on Smith Island, was built ca. 1915 in the salt marshes. This lone dwelling is believed to have been built by the U.S. Lighthouse Service as a supply station for the Coast Guard and the lighthouse keepers of Bald Head. The structure was nominated for the National Register of Historic Places in August 1997 (National Park Service 1997). The weathered, one-story, side-gabled structure is a lonely sentinel in the surrounding salt marshes that recalls the isolated lives of lighthouse keepers and coast guard personnel in the early decades of the twentieth century. Believed to have been built about 1915 for the United States Lighthouse Service, years of exposure to the harsh coastal atmosphere has scoured the building to a faded, weathered gray, making it seem a part of its natural surroundings. Smith Island is actually a complex of small islands with forested dune and beach ridges, salt marshes, and tidal bays and creeks. From north to south, the three named islands of the Smith Island complex are Bluff, Middle, and Bald Head. Bald Head Creek is the southernmost tidal waterway on Smith Island and is located between Bald Head and Middle islands. It begins near the coastal beach above Cape Fear and flows in a northwestern direction into the Cape Fear River. Built as a landing and transfer point for supplies which needed to be hauled from this point to the east end of the island, a distance of approximately 1.5 miles, the boathouse was constructed as far along the creek as possible while still allowing boat passage. It is presently located approximately mid-point along the northwest to southeast length of Bald Head Creek, but some eighty-four years ago, it was situated adjacent to the creek's south bank. Due to a southwardly migration of the creek, a common natural phenomenon in a salt marsh environment, the boathouse now rests slightly north of the meandering creek. A simple single-craft, rectangular, frame, gable-roofed structure, the Bald Head Creek Boathouse rests on wooden pilings. The gable end boat entrance of the boathouse faces west, looking toward the Cape Fear River. The entrance is a simply framed opening, designed to allow broad-beamed, masted sloops to dock inside.

Rapid reconnaissance survey of the heritage-at-risk site Bald Head Creek Boathouse on Bald Head Island, North Carolina. Surveys included detailing the condition and degradation of the Bald Head Creek boathouse, taking photographs and videos of the interior and exterior, and mapping the shoreline of the marsh land that the boathouse is situated upon.

Figure 116. Diagram of Boat house from an aerial view
(Adapted from Google Earth by Tyler Ball, ECU).


Figure 117. South and west face of boat house (Photo by Aleck Tan, ECU)

Figure 118. North face view of the boat house (Photo by Tyler Ball, ECU).

Figure 119. East face of boat house (Photo by Ryan Marr, ECU)

Figure 120. West face of boat house (Photo by Tyler Ball, ECU).

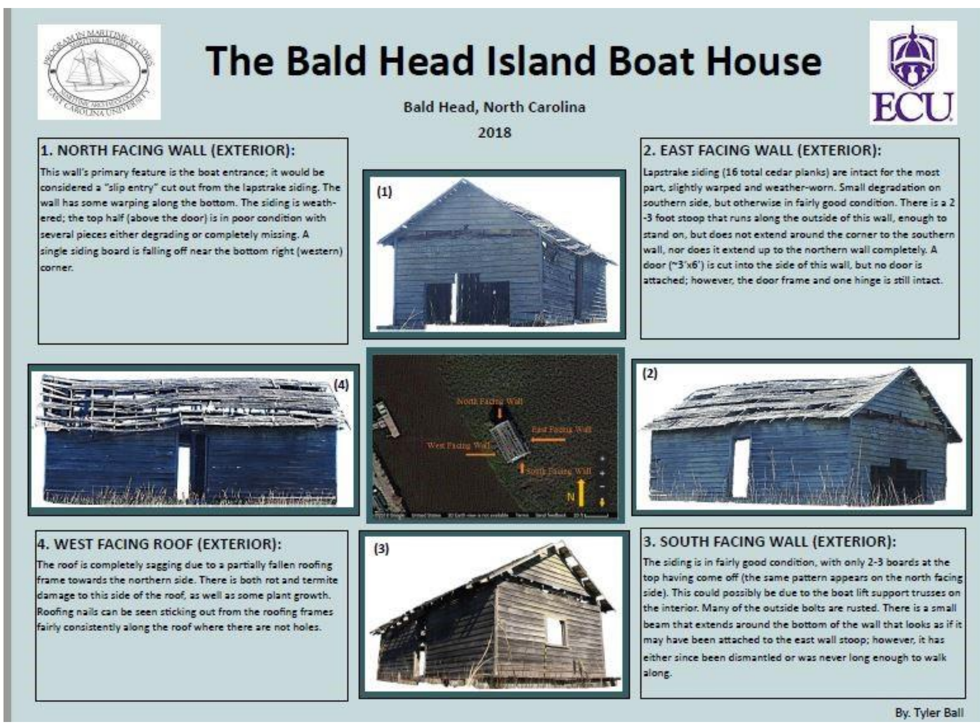


Figure 121. Poster of bald head boat house (Created by Tyler Ball, ECU)

East Facing Wall (Exterior):

Lapstrake siding (16 total cedar planks) are intact for the most part, slightly warped and weather-worn. Small degradation on southern side, but otherwise in fairly good condition. There is a 2-3 foot stoop that runs along the outside of this wall, enough to stand on, but does not extend around the corner to the southern wall, nor does it extend up to the northern wall completely. A door (~3'x6') is cut into the side of this wall, but no door is attached; however, the door frame and one hinge is still intact.

North Facing Wall (Exterior):

This wall's primary feature is the boat entrance; it would be considered a "slip entry" cut out from the lapstrake siding. The wall has some warping along the bottom. The siding is weathered; the top half (above the door) is in poor condition with several pieces either degrading or completely missing. A single siding board is falling off near the bottom right (western) corner.

South Facing Wall (Exterior):

The siding is in fairly good condition, with only 2-3 boards at the top having come off (the same pattern appears on the north facing side). This could possibly be due to the boat lift support trusses on the interior. Many of the outside bolts are rusted. There is a small beam that extends around the bottom of the wall that looks as if it may have been attached to the east wall stoop; however, it has either since been dismantled or was never long enough to walk along.

West Facing Wall (Exterior):

There are 16 total cedar planks on this wall. The wall is in great condition; the siding is weathered but intact. The door frame is intact, and there is an old placard hanging next to the door on the left (north). There are two hinges still on the doorframe.

West Facing Roof (Exterior):

The roof is completely sagging due to a partially fallen roofing frame towards the northern side. There is both rot and termite damage to this side of the roof, as well as some plant growth. Roofing nails can be seen sticking out from the roofing frames fairly consistently along the roof where there are not holes.

East Facing Roof (Exterior):

The roof is falling apart, 35-40% of planking is gone. Remaining planks are weathered and the trusses are warped. Roofing nails can be seen sticking out from the roofing frames fairly consistently along the roof where there are not holes.

Foundation Pylons:

The structure is stable enough to allow 2-3 people to walk around on the inside, however, the foundation pylons are slightly tilted towards the northern wall. These pylons are approximately 1 meter long from floor to water (though slightly changes with the rise of the tides). Mussels (unidentified species) are growing on each of the pylons, though the amount of damage they are actually inflicting on the pylons is unknown at this time. One of the pylons is completely missing from under the western facing wall (see photograph above). These pylons are further supported by 45° beams attached to the underside of the boathouse.

Interior

Inside the boathouse, there is planking that can be walked on. 11 floor beams attach the structure to the pylons, and are likely 2”x4” or 6”x6”. It covers the west, south, and east sides; the west side walkway does not extend all the way to the north wall. In the middle, the area is open for the boat slip and is open to the marsh (no flooring). The flooring creates a triangular cut out towards the south wall. Along the north-side on the east walkway, there appears to have been a table in the corner approximately 3 feet tall.

Roof Interior

There are 15 extension of beam, and approximately 50 centimeters in length. Along the rafters, a large axel spans the length of the building and still has the semblance of a lift mechanism and two gears. There is one large gear hanging from a rope from the rafters into the boat slip area.

Other Features

Graffiti

There are several areas where names, initials, and symbols have been carved into the boathouse walls. The western facing doorframe has several names carved into the side, as well as dates. Along the eastern wall there appears to be a waterline carved into the side along with names and years carved or scratched into the side.

Bullet Holes

There are bullet holes on the east and west facing walls. It looks as if the boathouse was used for target practice. The size of the holes has led investigators to believe that they are from .22 or .223 caliber bullets. There were approximately 55 total bullet holes. Based off of the bullet hole sizes and trajectory, investigators believe that the shooters were in the marsh, shooting towards the direction of the houses (possibly before the houses were built).

CHAPTER . FISH HOUSES

Fish houses are fishing boat marinas are iconic symbols of heritage at risk on the south eastern seaboard. In addition, the livelihood of fishing is an example of intangible heritage at risk. North Carolina commercial fishermen, like fisheries-dependent workers across United States, face wrenching economic, political, and environmental changes that directly impact their local livelihood. The combined impact of these factors has reduced the economic viability of the commercial fishing industry in the last decade; declines in numbers of fishermen, fish houses, and seafood landings have accelerated in just the past five years. Changing conditions are compelling remaining participants to reassess their markets, fishing methods, and even commitment to the state's fishing industry (Garrity–Blake and Nash 2007:3). In this report the team conducts a photo inventory of the existing structures.

Varnamtown

Varnamtown has three fish houses still operating, with fish markets adjacent to them, in addition to a boat rail (the only boat rail in southeastern North Carolina). Furthermore, there is one fish house that has closed, but the building and its dock are still in place. The area around Varnamtown fishing community has not yet been gentrified with new development. Most residents are local people, engaged in fishing related businesses, if not fishing then other services, such as boat repair, providing fuel for fishing boats, packing seafood, and making nets and TEDs for shrimpers. The area is in closer to the inlet and to the ocean, and therefore, more and bigger fishing boats can reach these fish houses. These fish houses are very close to each other and have a good connection with each other. Additionally, they enjoy a well-managed distribution of seafood, including imported and locally caught shrimp, not only through wholesale, but also through direct contact with individual customers. Fishermen and fish house owners have a common social-cultural memory from the past and value their fishing tradition.

Figure 122. Google earth image of the fish houses in Varnamtown (Sorna Khakzad, ECU).

Harker's Island fish house

Figure 123. Harker's Island Seafood Warehouse now a commercial boat ramp with a convenience store (Photo by Lynn Harris, ECU).

Figure 124. Front entrance of the dilapidated Old Fulcher fish house in Harker's Island built in 1940s (Photo by Lynn Harris, ECU).

Figure 125. Roof damage of the dilapidated Old Fulcher fish house in Harker's Island built in 1940s (Photo by Lynn Harris, ECU).

Figure 126. Interior damage of the dilapidated Old Fulcher fish house in Harker's Island built in 1940s (Photo by Lynn Harris, ECU).

Shalotte fish houses

Shallotte is the furthest south commercial fishing community in Brunswick County before Calabash. This area also is the closest of the four communities to the Gordon Net Shop. Although there are several other locations such as S&S Marine that sell nets and provide services for net repair, Gordon net Shop is the only shop in the area whose only activity is net making and repair. The two fish houses in Shallotte are very different in their way of operating and success. The northern one (Holden Seafood and its adjacent seafood market) is to some extent isolated. The area is dominated by new urban development.

According to the fishermen, big boats cannot get there anymore, due to the fact that the channel is not being dredged and is not deep enough anymore, and therefore the business have gone down. However, two kilometers down along the same channel, the Lloyd's Oyster House is operating well. The houses around this oyster house are mostly local residents and fewer outsiders live in the surrounded area. Still large untouched natural landscape exists close to this fish house. In addition, the fish house is near a local seafood restaurant and a boat yard. In fact, the fish for the restaurant is partly provided by Lloyd's. The concentrations of the activities of the oyster house, boat yard and the restaurant, in addition to more local people living in this area and involved in fishing related activities, have provided a stronger sense of place and maritime landscape in this area than in the area around Holden's Seafood. Lloyd's Oyster House has a good networking between the suppliers (fishermen) and the buyers. The good contact between fishermen and the oyster house, and the distribution of the fish/oyster to the local restaurants, as well as its vicinity to other fishing related activities are the strong points of Lloyd's Oyster House. On the contrary, although Holden Seafood has a market as a point of connection with public, its location and lack of networking among fishermen, and difficulties of navigation of big boats in the river, along with growing urban development, have caused its isolation, and reduced its strong sense of place regarding the physical aspects of maritime cultural landscape.

Figure 127. Google Earth image of Shalotte fish houses (Sorna Khakzad, ECU).

1. Lloyd’s Oyster House – visited and talked with owner Lloyd Milliken
    1. Located at 33°55’12” N, 78°22’23”W, 50 ft elevation

Lloyd’s Oyster House – Shallotte, North Carolina

Notes from interview with Lloyd Milliken:

1. Located off the Intracoastal Waterway
2. Building was started by his father, after he came back from WWII
    1. A 3 generation family business; Lloyds children run the restaurants
3. Has been in business about 50 years
4. The building sits on land that used to be marshes, but was purposefully filled in

5. It is a store, distribution center, and oyster sterilization factory
    1. Each oyster is sterilized by heating them up to a certain point
    2. This process was developed by Lloyd, and this business is the only one to do it
6. The inside of the building was remodeled to be lined with stainless steel 37 years ago
    1. Steel is easier to clean and more sanitary
    2. Prior to remodeling, the inside had to be repainted every two years
7. Collects oysters from the Intracoastal area by the building, Texas, and Louisiana
    1. Each oyster must be at least 3 inches long
8. Distributes to grocery stores and restaurants
9. Oysters are stored in bushels in a cold room until ready for distribution
    1. Sent out in 6lb buckets, 5lbs of oysters, then filled with water
10. Has several restaurants in Florida, South Carolina, and North Carolina:
    1. Fishlips, Cape Canaveral, Florida
    2. Pelican Dreams (**unsure of name)**, South Carolina
    3. Sunset Grille, Cocoa Beach, Florida
11. Currently has one custom shrimping troller
    1. Used to have up to three, most recently *Tina Rae* sank 8 miles off the coast of Cape Hatteras, about 8 years ago (no lives lost)

Other:

1. Lloyd, aged 60, was born and raised in the area
    1. Not planning on retiring anytime soon
2. Lloyd’s office has photographs of his various businesses and boats
    1. One picture had two seashells taped to it
3. Donates to various charities
4. Lloyd is the owner of a Steak n’ Shake franchise in parts of North and South Carolina

PHOTO LOG

Aleck Tan's photo log using iPhone 7 (Photos available).

IMG_9262, IMG_9263	Outside of Lloyd's Oyster House	Facing towards the water, oyster shells and trash are on the ground
IMG_9265	Where they pack oysters	Inside of Lloyd's Oyster House
IMG_9266	Oysters go heat shock treatment in the tubs	Inside of Lloyd's Oyster House
IMG_9267	Packaged oysters	Inside of Lloyd's Oyster House
IMG_9268	Mud rinsed out from oysters end up in wheelbarrows to haul out	Inside of Lloyd's Oyster House
IMG_9269	Where they process the oysters for export	Inside of Lloyd's Oyster House
IMG_9270	Where they process the oysters for export	Inside of Lloyd's Oyster House
IMG_9271	Man prepares oyster boxes	Inside of Lloyd's Oyster House
IMG_9272	One of the containers in the oyster house	Inside of Lloyd's Oyster House
IMG_9273	Notes on Heat Shock treatment	Inside of Lloyd's Oyster House
IMG_9374	Area where oysters are rinsed and packaged	Inside of Lloyd's Oyster House
IMG_9275	Area where oysters are rinsed and packaged	Inside of Lloyd's Oyster House
IMG_9276	Oysters that have been brought in	Inside of Lloyd's Oyster House
IMG_9277	Where oysters go through a rinse?	Inside of Lloyd's Oyster House

Holden Beach

Holden Beach is located about a kilometer from each other along the northern shoreline of the Intracoastal Waterway. They have a strong connection with the public through the fish markets adjacent to them. The owners remember the past fondly. There are a couple of boat yards and docks close by and a famous fish market on the other side of the waterway. They have established a good connection to public through sharing historic pictures, selling shells from the fishing trips, and sharing stories. Fishermen have a good network and most of them are connected to each other. The area around these fish houses are mostly wetlands and marshes.

Summer 2018 Update

Fish Market #1 (FM1)

1. Located west of the bridge, before crossing the intercoastal waterway
2. Torn down and rebuilt a new fish market called Fish Headz, which has not opened yet
    1. Looks new, haven't written down the hours of operation yet
3. Developed around a place that rents out boats and jet skis
4. West of the Fish Headz is the shipwreck. The dock where the wreck is located is crumbling down into the water = not safe to walk on dock

2. Fish Market #2 (FM2)
    1. Located east of the bridge, after crossing the intercoastal waterway
    2. Torn down and replaced with a pavilion
3. Fish Market #3 (FM3)
    1. Located east of the bridge, along the intercoastal waterway
    2. Named Old Ferry Seafood – looks like it is still in operation

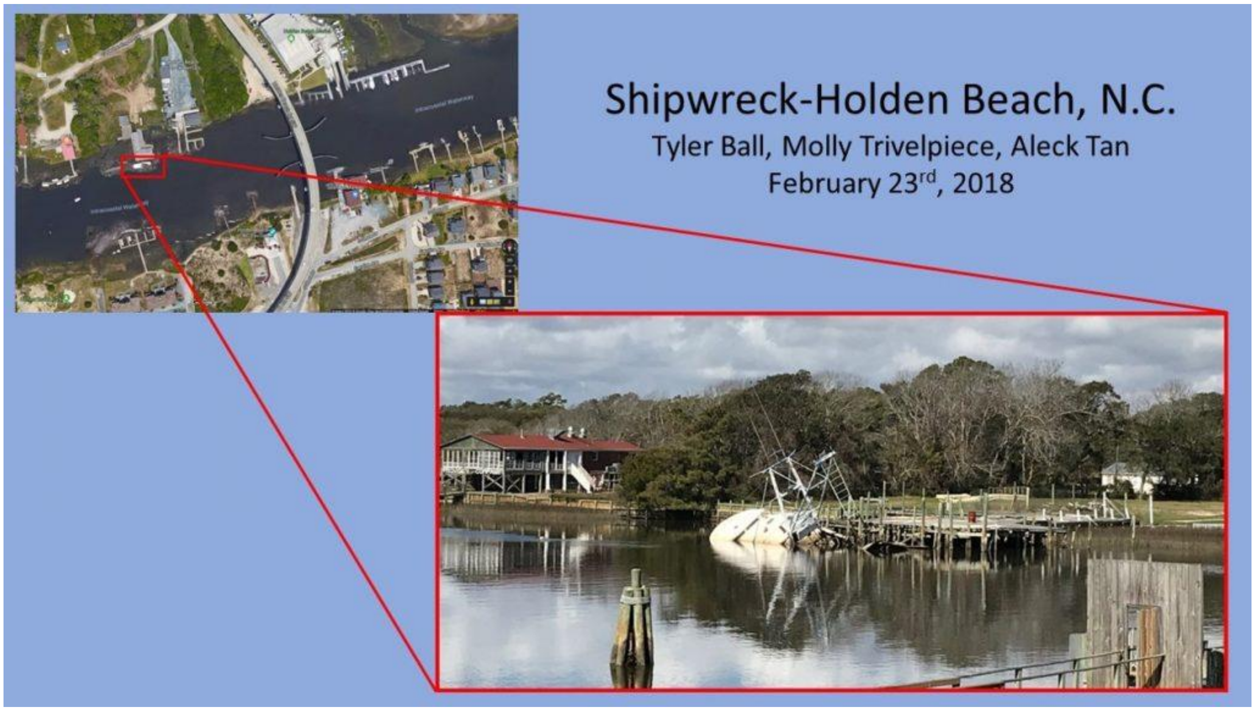
.

Fish Headz (FM1) at Holden Beach opening this summer to replace the old building (Photo by Aleck Tan, ECU).

Interior of the new fish house (Photo by Aleck Tan, ECU).

Pavilion at Holden Beach replacing old fish house (FM2) torn down (Photo by Aleck Tan, ECU).

Picnic bench at Fish Market, Holden Beach. Plaque on the bench: “This area is dedicated to Barbara and Jim Lowell for their service to the town of Holden Beach and the Greater Holden Beach Merchants Association May 7, 2011” (Photo by Aleck Tan, ECU).



Shrimp boat hulk at FM 1 Holden Beach (Photos by Tyler Ball, Aleck Tan and Molly Trivelpiece, ECU).

Old Ferry Seafood (FM 3) front façade (Photo by Aleck Tan, ECU).

Back façade of Old Ferry Seafood (FM3) facing the intercoastal waterway. Head of shark decorative treatment (Photo by Aleck Tan, ECU).

East side of the Old Ferry Seafood (FM3) at Holden Beach. Photo by Aleck Tan, ECU).

West side of the Old Ferry Seafood (FM3) at Holden Beach showing ice generators
(Photo by Aleck Tan, ECU).

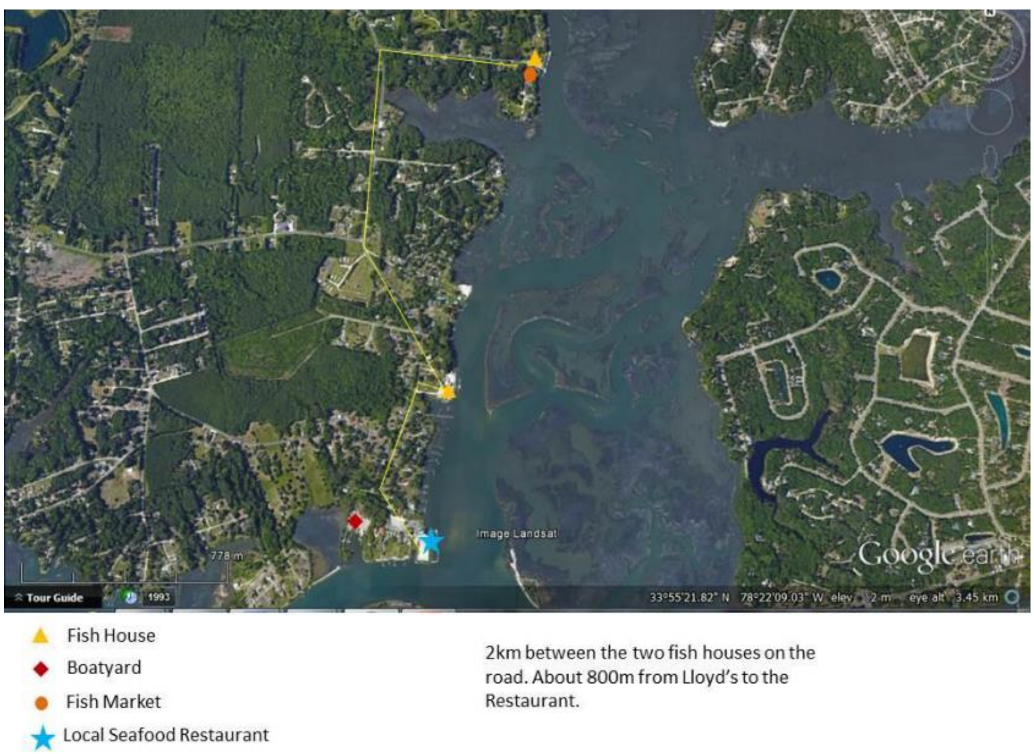


Figure 128. Google Earth image of the Holden Beach fish houses. (Sorna Khakzad, ECU).

Beaufort fish house

The Beaufort fish house belonged to the Styron family since the 1940s. Celia Faye Styron was born here and has renovated it as a tourist venue.
https://www.wral.com/lifestyles/travel/video/14734156/.

Figure 129. Styron fish house (1942-2018) in Beaufort NC (Photo by Lynn Harris, ECU).

Figure 130. View of side porch from the water showing shingle construction (Photo by Lynn Harris, ECU)

Figure 131. Old Tram Tracks for loading boats (Photo by Lynn Harris, ECU)

Figure 132. Interior of fish house filled with fishing paraphernalia (Photo by Lynn Harris, ECU)

Figure 133. Interior façade showcasing a framed picture of the young fisherwoman, old locks, keys and a shelf holding the family bible (Photo by Lynn Harris, ECU)

Figure 134. Fish net mending needles (Photo by Lynn Harris, ECU).

Figure 135. Homemade lead weights for fishing net (Photo by Lynn Harris, ECU).

Figure 136. Scale for weighing catches (Photo by Lynn Harris, ECU, 2018)

Figure 137. Shelf with bible on display (Photo by Lynn Harris, ECU).

Figure 138. Woodworking tool box for boat building and house repairs (Photo by Lynn Harris, ECU).

Figure 139. Shoulder clam rake (Photo by Lynn Harris, ECU).

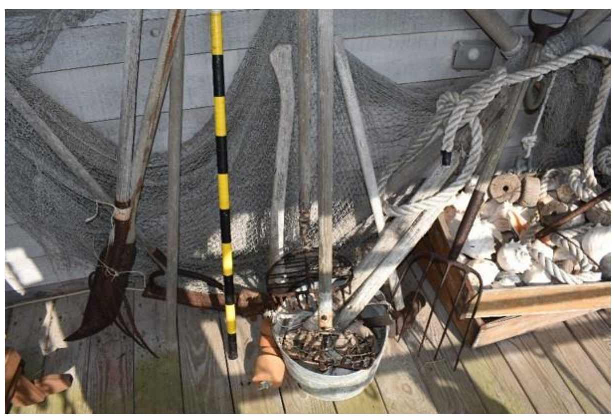


Figure 140. Assorted rakes and ice block chopper (Photo by Lynn Harris, ECU)

Figure 141. Sales and purchase accounting notebook held open with an old oarlock (Photo by Lynn Harris, ECU).

Figure 142. Irons (Photo by Lynn Harris, ECU)

Figure 143. Bilge Pump and Fish Tongs (Photo by Lynn Harris, ECU)

Menhaden Fishing

Menhaden processing started in North Carolina shortly after the Civil War. The1890s was the start of an economic boom for menhaden fisheries. Local companies in

Carteret County provided generations of workers — boat captains, boat pilots, engine runners, ring setters, fish bailers, factory foremen, shore engineers. The last factory, Beaufort Fisheries on Front Street, closed in 2005 and was razed a few years later. Although nothing remains of the structure, a old net reel is on display."The Fish that built Beaufort" *Our State*, April 30, 2014.https://www.ourstate.com/fish-built-beaufort/. Listen to recordings from "Raising the Story of Menhaden Fishing" at carolinacoastalvoices.com. James "Poppy" Frazier of Harlowe, was interviewed as part of the Raising the Story of Menhaden Fishing project undertaken in 2009—2010 in Beaufort and Harkers Island, NC. He talks about his history as a menhaden fisherman. He describes pulling the purse seine net by hand before the mechanized hydraulic power block was introduced in the early 1960s. He describes the jobs of a captain, a bunt puller and a fish bailer. He discusses singing chanteys.

(http://www.carolinacoastalvoices.com/exhibits/vex1/C2E02B23-51D5-415C-911B-661337564890.htm)

Figure 144. Menhaden Netting Operation (NC State Archives)

Figure 145. Menhaden Netting Operation (NC State Archives)

Other images and resources on Menhaden Fishery in NC Archives

	Menhaden Plant, Beaufort	1986, n.d.	Folder	N.86.1.32	0
4.1.13.37	NT	Drying Menhaden, Beaufort	1986, [ca. 1900]	Folder	N.86.1.37
4.1.15.101	NT	Boat at dock unloading fish	1988, [n.d.]	Folder	N.88.8.8
4.1.27.406	NT	Hunting party return from hunt on menhaden boat with game, New Bern, North Carolina, ca. 1925-1930.	2000; 1925-1930	Item	N.2000.4.86
4.1.28.166	NT	Net reel and Menhaden Boat, Morehead City, N.C., c. 1920	2001; c. 1920	Item	N.2001.2.66A-B
4.1.29.402	NT	Menhaden Boats off Cape Lookout, c. early 1950s	2002; c. early 1950s	Item	N.2002.12.32
4.1.29.403	NT	THE SOUTHLAND, a menhaden boat, Morehead City, N.C., c. 1950	2002; c. 1950	Item	N.2002.12.33
4.1.29.406	NT	The KING FISHER laden with menhaden, Beaufort, N.C., c. early 1950s	2002; c. early 1950s	Item	N.2002.12.36
68.1.2.5	NT	Albemarle Sound Fishing	1889	Item	OP-6
68.1.2.6	NT	A Big Menhaden Catch	1889	Item	OP-6.1

5000.1.1.15	HICATS	"Won't you Help me to Raise 'em"?	1990	Item	33AUD-0-15
5000.2.3.1213	HICATS	The Men All Singing : The Story of Menhaden Fishing	1978	Item	33BOK-0-1213
5000.2.3.5005	HICATS	Menhaden : Natural Resource from the Pastures of the Sea	UNK	Item	33BOK-0-5005
5000.2.3.9019	HICATS	The Fish Factory:Work and Meaning for Black and White Fishermen of the American Menhaden Industry	1994	Item	33BOK-0-9019
5000.2.3.9584	HICATS	Chanties as Sung by the Menhaden Chanteymen of Beaufort, NC	10/1989	Item	33BOK-0-9584
5000.4.569.44	HICATS	Crewmen with Deckload of Menhaden	1941	Item	33GRF-0-44
5000.4.569.81	HICATS	A Big Menhaden Catch	08/10/1889	Item	33GRF-0-81
5000.4.570.274	HICATS	Atlantic menhaden : Brevoortia tyrannus	UNK	Item	33GRF-1-274
5000.8.2468.30	HICATS	No. 85-02:Medhaden:Soybean of the Sea	01/1985	Item	33SER-139-30
5000.8.2468.119	HICATS	No. 72-12:The Menhaden Fishing Industry in NC	01/1973	Item	33SER-139-119
5000.8.2469.17	HICATS	No. 83:Estimated Socio-Economic Impacts in NC of a Shortened Menhaden Season	06/1983	Item	33SER-140-17
5000.8.2952.36	HICATS	No. 45:Socioeconomic Impacts of a Shortened NC Menhaden Season	10/1985	Item	33SER-623-36
5000.8.3069.107	HICATS	NC's Atlantic Menhaden Fishery, 1984-85	04/1985	Item	33SER-740-107
5000.8.3197.1	HICATS	No. 2:Atlantic Menhaden:A Most Abundant Fish	08/1979	Item	33SER-868-1
5004.1.1.352	HICATS	The 177-Foot-Long Atlantic Mist, a Menhaden Purse Seine Netting Vessel, Lists About 200 Yards off the Beach	11/27/1990	Item	301GRF-0-352
5004.1.1.540	HICATS	A Young Woman Plants Beach Grass on Dunes in Nags Head With an old Menhaden Boat in Background	1988	Item	301GRF-0-540

5004.1.1.2371	HICATS	Four Anglers on the end of the Outer Banks Fishing Pier Watch as a Giant Commercial Menhaden Boat Passes	1992	Item	301GRF-0-2371
5004.1.1.2892	HICATS	Thousands of seagulls take flight as an angler four whells down the beach	ND	Item	301GRF-0-2892
5004.1.1.2925	HICATS	The 177-foot-long Atlantic Mist lists Tuesday morning as crewmen pump water from its bilges	1990	Item	301GRF-0-2925
5004.1.1.2962	HICATS	Larry Lamborne walks through thousands of pounds of menhaden and other fish that were dumped by the fishing vessel Atlantic Mist			

Portsmouth fish houses

During the Civil War most inhabitants evacuated Portsmouth. Historians speculate that the island never fully recovered its population or its economic viability. In 1867, the customs house was abolished. The population declined, and the number of residences in the town dwindled to fifty-nine in 1870 and forty-four by 1880. The shifting sands of the Outer Banks had closed Ocracoke Inlet to shipping by the late 1800s, forcing the decimated population to turn to fishing for its livelihood (Milner 2016:2). Currently there are 5 fish houses on the island and location of a fish factory know as Greys Factory shown on a historic map near Haulover point in 1866. The factory was an attempt to develop a menhaden processing industry on the island. It was built by a stock company from Rhode Island known as the Excelsior Oil and Guano Company. It was supplied with modern apparatus for cooking and processing the fish. It proved to be not very profitable and was abandoned (Milner 2016:32). While shifting sand often prevented boats from reaching Greys factory, these environmental features were useful for techniques used to fish for mullet. Fishers worked together in two or three skiffs hauling nets and landing or "pounding" the fish on an exposed shoal. In order to prevent the mullet from escaping they immediately broke their necks, and later removing their backbones and intestinal cavities. The Portsmouth fishermen developed a reputation in the fisheries markets for these local traditions (North Carolina. Geological survey, 1891-1925.M. Uzzell & Company, 1907:408)

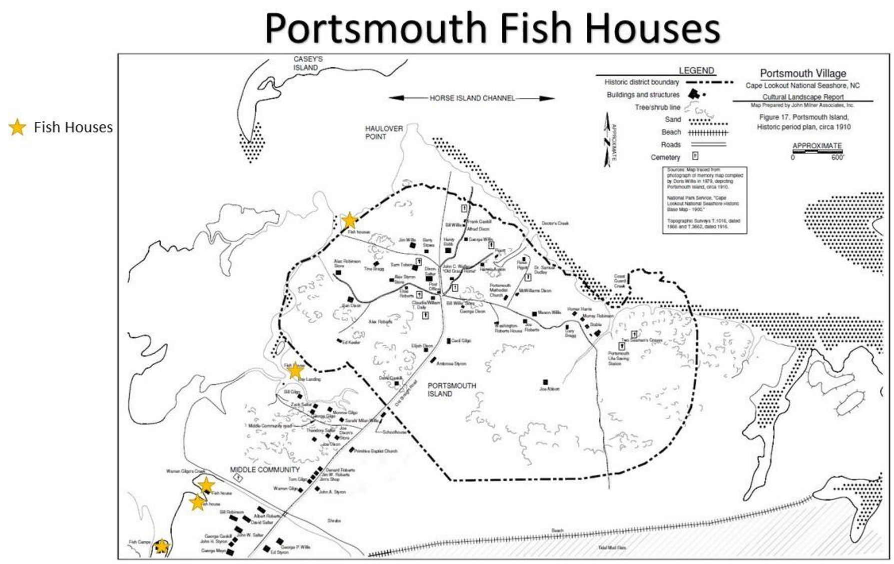


Figure 147. Location of Greys Menhaden Processing Factory on Portsmouth Island (Map adapted from Milner Report showing Grey's Menhaden factory)

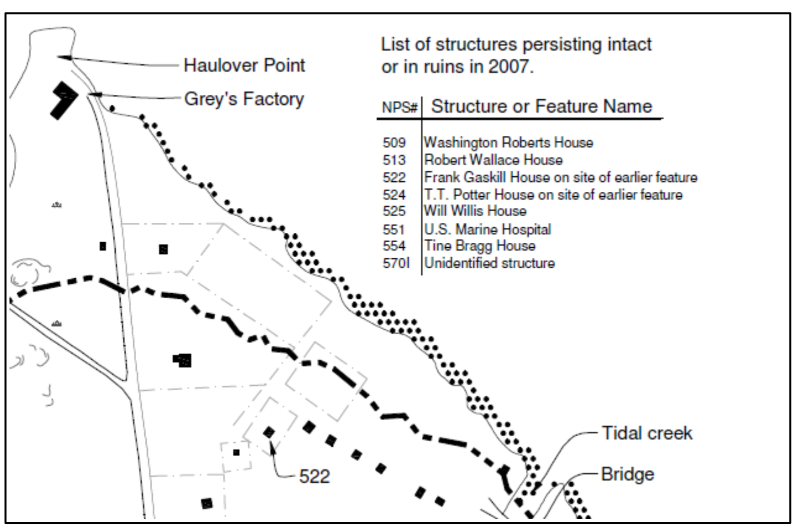


Figure 148. Locations of structures on Portsmouth island.

Marshallberg fishing boat yard

Marshallberg is located in Carteret County, North Carolina at the end of Marshallberg Road, approximately 3 miles south of the village of Smyrna. Marshallberg and Smyrna are both hamlets along with Davis, Sea Level, Atlantic and Cedar Island that are collectively referred to as Down East Carteret County. Marshallberg is a quaint, unincorporated town with approximately 400 residents. The primary economy of Marshallberg has always been that of a water based industry including fishing and boat building. Landowners surrounding Marshallberg have contested rights to use the water as a result of the ownership of property that abuts a water body known as “Riparian Rights”. This water right is said to be "part and parcel" of the land, unless expressly and legally excluded from the land title.

Like Harker’s island, the small town is known for local boat building and repairs, especially small and large fishing vessels (http://articles.latimes.com/1985-07-28/news/vw-5705_1_harkers-island-boat). Marshallberg boasts craftsmen like Mr. Mildon and his two sons, Grayer and Kenneth, Ray Davis and his grandson Gary, Gerald Davis, Myron and Buddy Harris, and Keith Willis. These talented men built boats for many purposes including Core Sound skiffs, Core Sound work boats, offshore party boats, pleasure yachts, and small electric powered lake boats by Budsin Wood Craft. Three sea food business operated here during the period of the late 30’s and mid 40’s, buying and selling soft crabs, hard crabs, shrimp, clams and oysters.

During the late 1950s, engineers dredged a harbor of refuge Deep Hole Point and the sand spoil pumped into creeks along the south waterfront of the community, drastically changing the shoreline. Where there were once sandbars along the shore with creeks between there and the mainland, now the waters of the Straits wash on the mainland (http://www.downeasttour.com/marshallberg/history.htm). *Lady Barbara* previously docked in the small town of Oriental, where the boat sank and spilled oil, before it was towed to Marshallberg (https://towndock.net/news/the-lady-vanishes?pg=1 and http://www.carolinacoastonline.com/news_times/article_653353e8-60eb-11e2-ac5e-0019bb2963f4.htm).

Another unique feature on the maritime landscape is the presence of a *Trumpy* boat converted into a marina pub. Iconic vessels built from the 1920s to 1970s, *Trumpy* yachts were considered a study in elegance. Their sleek profile, crisp white hulls and polished wood detailing exude luxury and leisure. Although more than 400 were built, each *Trumpy* was meticulously handcrafted to the owner's specifications. While every *Trumpy* is unique, the boats have a signature look and always the essential *Trumpy* embellishment: carved wood scrollwork on the bow that, on close inspection, incorporates a capital T. In their heyday, the boats were *de rigueur* for members of the US aristocracy. The most well-known was the presidential yacht *USS Sequoia.*

Figure 149. Hull portion of the *Trumpy* luxury boat converted into a bar next to the old paint shed (Photo by Lynn Harris, ECU).

Figure 150. View of the *Trumpy* boat bar interior (Photo by Lynn Harris, ECU).

Figure 151. Derelict locally–built 70-foot shrimp fishing boat *Lady Barbara* profile view (Photo by Lynn Harris, ECU).

Figure 152. Derelict 70-foot locally-built shrimp fishing boat *Lady Barbara* stern view (Photo by Lynn Harris, ECU).

Figure 153. Abandoned dry dock boat lift apparatus (Photo by Lynn Harris, ECU).

CHAPTER . SUBMERGED SHIPWRECKS

Rose Hill Plantation Wreck

The Rose Hill wreck is located on the bottom of the Northeast Cape Fear River, 6.4 miles from the river's mouth, in approximately 18 feet of water. The entire river basin is situated within the NC coastal plain. The Program in Maritime Studies dive team worked in collaboration with the NC coastal plain. Underwater Archaeology Branch to assess the Rose Hill Plantation shipwreck in the Cape Fear River 6 miles upriver from Wilmington. The shipwreck is located adjacent to the development River bluff near a planned boat ramp. The team assessed the condition of the shipwreck's structural integrity, stability and riverine site formation processes. It was also noted that the frames had transverse fastenings (not previously observed), a possible disarticulated saddle mast step, and apron in the bow area.

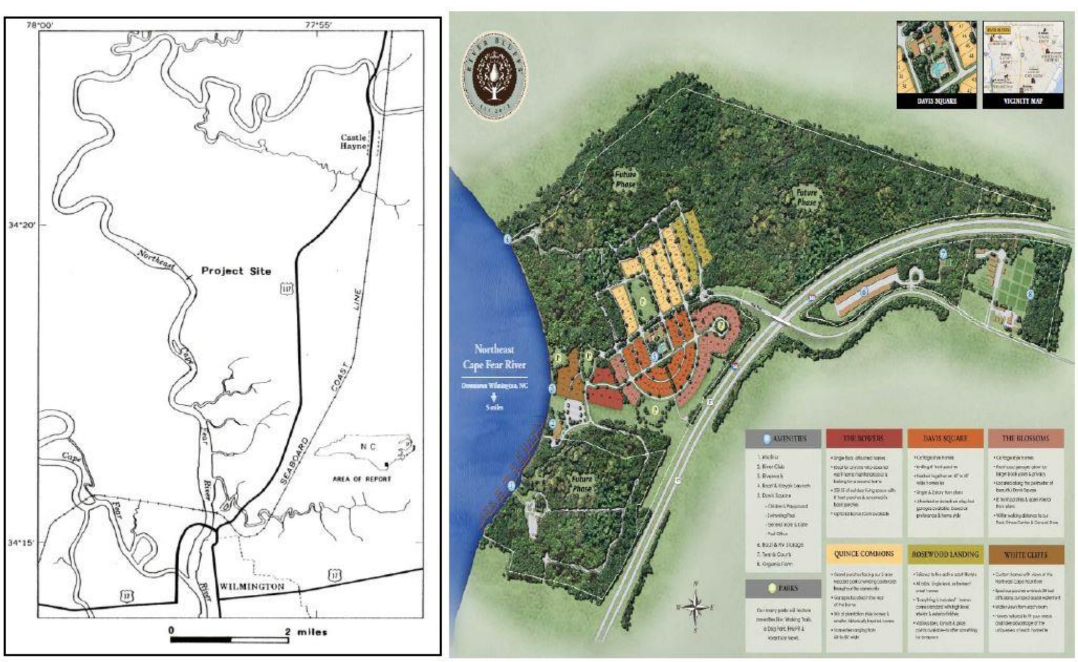


Figure 154. Location of Shipwreck and the River Bluff Development (NC UAB Report)

Figure 155. Boat Ramp in progress that may impact the shipwreck site with boat traffic and wake (Photo Lynn Harris)

The Geology Department team conducted a side scan sonar survey of the wreck area showing the bathymetry and signature of the hull. Side-scan uses a sonar device that emits conical or fan-shaped pulses down toward the seafloor across a wide angle perpendicular to the path of the sensor through the water, which may be towed from a surface vessel or mounted on the ship' hull.. The intensity of acoustic reflections from the seafloor of this fan-shaped beam is recorded in a series of cross-track slices. When stitched together along the direction of motion, these slices form an image of the sea bottom within the swath (coverage width) of the beam

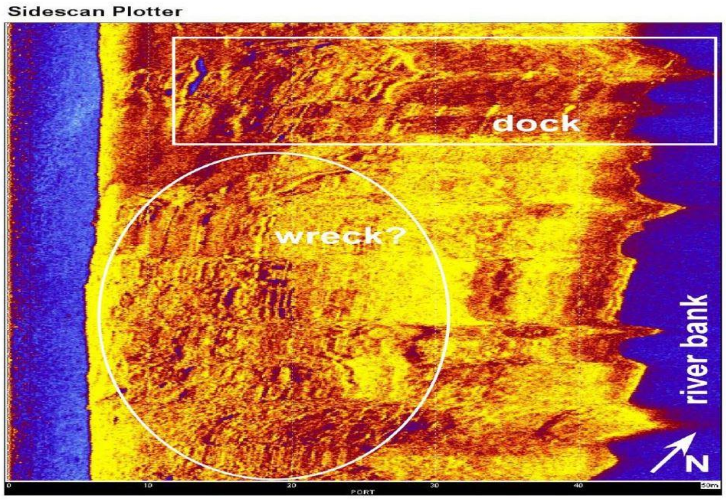


Figure 156. Side Scan image of the wreck and dock (Image by David Mallinson).

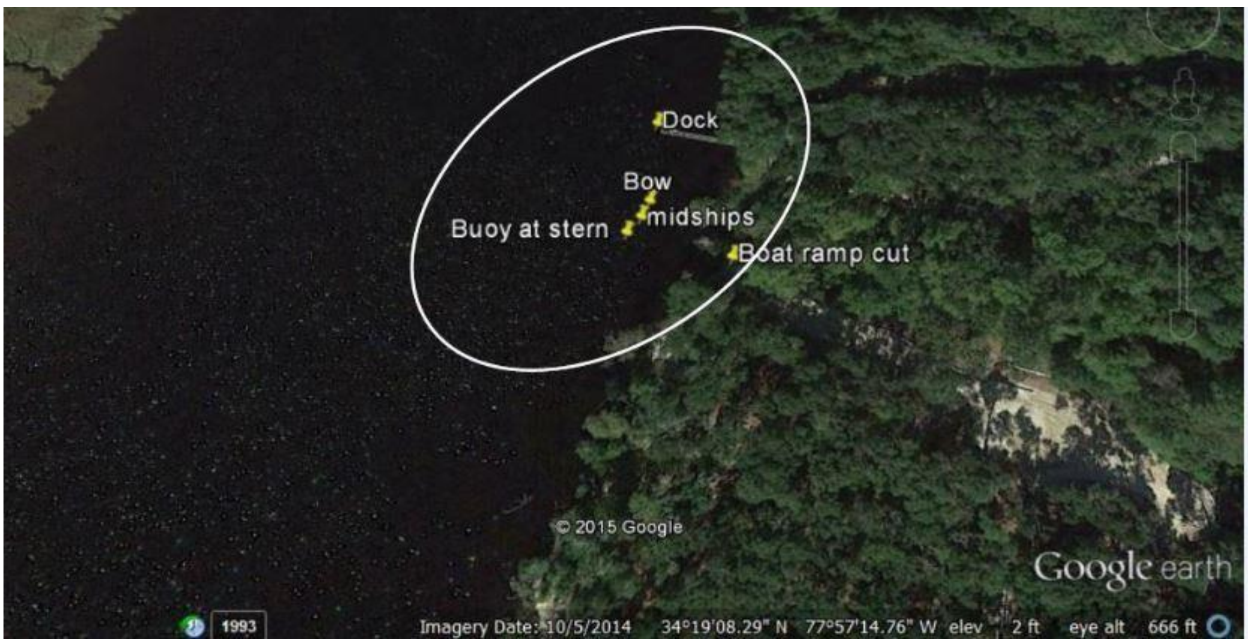


Figure 157. Map showing location of the shipwreck orientation plus the proposed boat ramp and nearby dock (Adapted from Google maps).

Table 11.

Co-ordinates are:
Buoy at stern 34°19'8.31"N 77°57'14.72"W
Bow 34°19'8.66"N 77°57'14.93"W
Modern Dock 34°19'9.26"N 77°57'15.77"W
Boat ramp cut 34°19'8.81"N 77°57'13.8"W

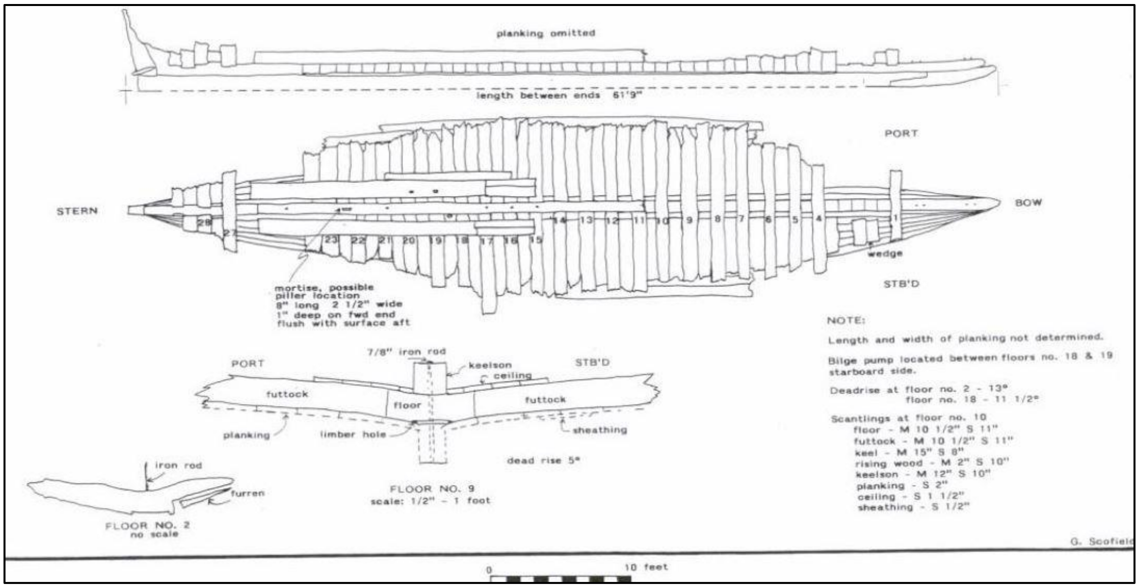


Figure 158. Rose Hill Shipwreck Plan at the River Bluff Development (NC UAB Report)

Figure 159. History Department Dive team works with NC UAB to relocate the Rosehill shipwreck and to give a status report on the condition of the hull structure (photo by Lynn Harris).

CHAPTER SS WILLIAM LAWRENCE (1869)

The shipwreck *SS William Lawrence* (1869) located in Hilton Head, South Carolina is of local, state, and national historical significance. The hull structure of the wreck and its well-preserved cargo contents yield information about nineteenth century technology, transportation, and commerce. The vessel incorporates milestone features of iron shipbuilding in the United States and Southern commercial consumption patterns. The ship was built by the Atlantic Ironworks in Boston in 1869. She was ordered by the Merchants and Miners Transportation Line, whose passenger and cargo steamers had been running up and down the East Coast since 1852. SS *William Lawrence* was the first to be equipped with a surface condenser and the company's first iron screw propeller steamer. The Merchants and Miners Transportation Company was involved primarily in shipping water hides from leather tanneries in Baltimore, mine products and various raw materials from the manufacturing plants of New England; and to bring back from Boston finished products, particularly shoes and clothing. Some cargo was recovered from the wreck in 1990 archaeological investigations and included: leather shoes; fabric; glassware and containers filled with medicine, pickles and preserves; toys; dolls; ornaments; artwork; and comic books. The ship wrecked during an ice storm in February 1899. Lynn Harris, then an employee of the University of South Carolina submitted a National Register eligibility nomination. It was listed in the National Register February 10, 1998 representing post bellum trade between northern and southern states as well as 19^{th} innovations in iron hull ship construction. The ECU team visited the site that has since been covered by inlet sand and compiled a photo inventory of the artifact collection.

Figure 160. Pickles and Preserves (Photo by Lynn Harris, Courtesy of SCIAA)

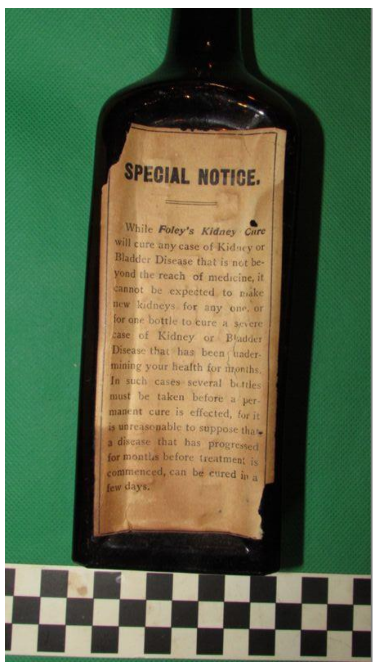


Figure 161. Foleys Kidney Cure (Photo by Lynn Harris, ECU).

Figure 162. Toilet paper (Photo by Lynn Harris, Courtesy of SCIAA).

Figure 163. Collection of dolls (Photo by Lynn Harris, ECU).

Figure 164. Collection of Thimbles (Photo by Lynn Harris, ECU).

Figure 165. Tea Cup (Photo by Lynn Harris, ECU)

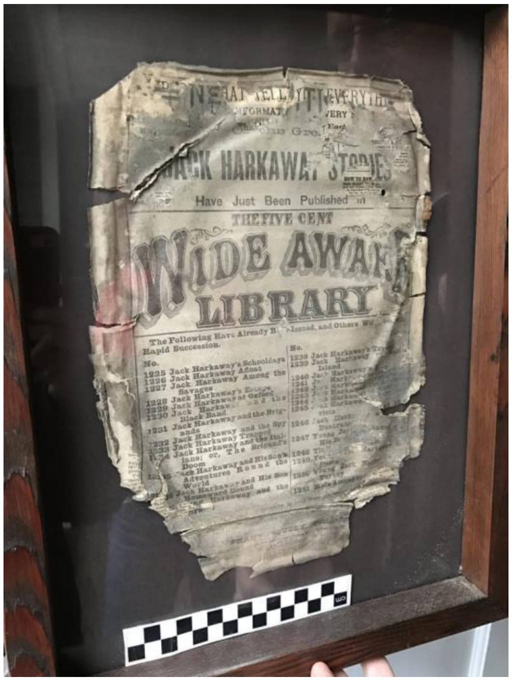


Figure 166. Newspaper fragment advertising the "Wide Awake Library," (Photo by Lynn Harris, ECU).

Figure 167. Crystal Punch Bowl and medicine bottles (Photo by Lynn Harris, ECU).

Figure 168. Baked Beans Wooden Crate Lid (Photo by Lynn Harris, ECU).

Figure 169. Collection of Wooden Toothbrushes (Photo by Lynn Harris, ECU).

Figure 170. South Carolina Dispensary Bottles (Photo by Lynn Harris, ECU).

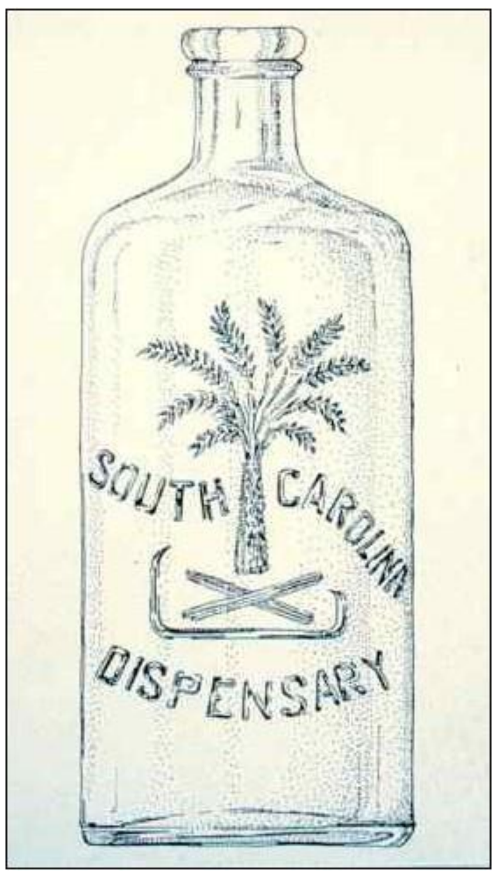


Figure 171. Drawing of South Carolina Dispensary bottles.

Figure 172. Bone doll (Photo by Lynn Harris, ECU).

Figure 173. Collection of Buttons (Photo by Lynn Harris, ECU).

Figure 174. Ceramic doll heads (Photo by Lynn Harris, ECU).

Figure 175. Decorative metal containers (Photo by Lynn Harris, ECU).

Figure 176. Baby Pacifier (Photo by Lynn Harris, ECU).

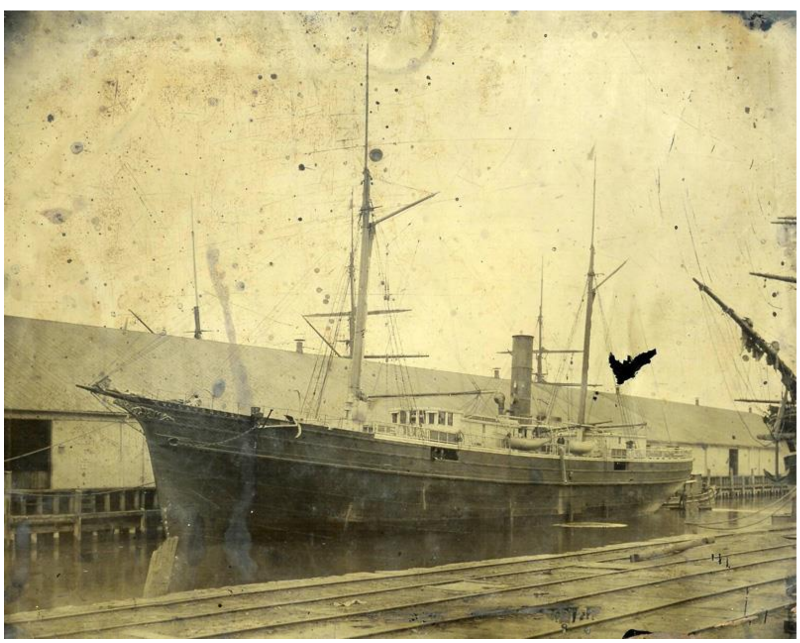


Figure 177. *SS William Lawrence* (Image Courtesy of Edward Mahlon Perry)

Figure 178. *SS William Lawrence* (Image Courtesy of SCIAA)

CHAPTER . FORT FISHER

The Fort Fisher Historic Civil War site is located 18 miles south of Wilmington on U.S. 421. It is National Register Number: 66000595 defense – fortification. It was classified as threatened in 2008. Current use is a state park. Today, its significance is as an earthen Confederate stronghold which created an impassable barrier for the blockading Union fleet. Its fall, in January 1865, helped spell the collapse of the Confederacy. Until its capture by the Union army in 1865, Fort Fisher was the largest earthwork fortification in the world. The "Gibraltar of the South" protected the port of Wilmington and ensured that the Confederacy had at least one "lifeline" until the last few months of the Civil War.

Figure . Geography team scanning the earthworks at Fort Fisher
(Photo by Lynn Harris, ECU).

The Department of Geological Sciences installed a seismometer at Fort Fisher. The unit measures ground vibrations and can record the energy of the breaking waves. The objective here is to assess the possibility of using an array to monitor wave breaking, which can enhance an understanding of sediment transport and erosion processes along the coast. A seismic refraction survey was also performed to provide information on the geological framework, which partially controls the vulnerability of a site to erosion processes.

The ECU Geologists with help of students set up a seisometer at Fort Fisher State Historic Park (Photo by Lynn Harris, ECU).

The earthen fortifications of Fort Fisher have suffered due proximity to the Atlantic shoreline. Beachfront erosion destroyed most of the fort by the 1950s. Fortunately, this tidal erosion was arrested in 1996 with installation of a stone revetment wall. However, the erosion caused by wind and rain continues to damage the remaining earthworks. The ground cover is inadequate for preservation, and past maintenance practices emphasizing curb appeal have been detrimental. Without appropriate ground cover and a proper maintenance plan, erosion will continue to adversely impact the remnants of the fort

Geology

Fort Fisher Earthworks are situated on a narrow rapidly eroding peninsula (a headland) bounded by the Cape Fear River to the west, and the Atlantic Ocean to the east (Fig. 5). The geology is characterized by a wave cut platform on Oligocene rocks, with Pleistocene units comprising the mainland peninsula, and a thin beach unit perched on top of the Pleistocene units (Snyder et al., 1994; Riggs et al., 1995). The position of the earthworks is just north of the position of a relict inlet (New Inlet) which was a conduit between the Neuse River and the Atlantic (Fig. 7). In the 1870s a dam (the Rocks) was built on the west side of the inlet (within the Cape Fear River) to close down the inlet, to prevent sand from washing into the Cape Fear channel, and allow the river channel to scour deeper to accommodate shipping. This allowed a continuous ocean shoreline with a low narrow barrier to develop south of Fort Fisher and connected it to Bald Head Island.

Seismic data from offshore indicate the occurrence of fluvial paleo-channels in the subsurface just to the north, which are buried by shoreface attached shoals and coquina rock (Fig. 8; Snyder et al., 1994). Cross-bedded coquina sandstone of uncertain age crops out on the shoreface, nearshore, and beach just north of Fort Fisher (Fig. 6). Pleistocene iron-cemented and friable sandstone forms that terrace on which the Fort lies. A paleo-fluvial channel was mapped just offshore of the New Inlet location, just south of Fort Fisher and likely exerted a control on the position of New Inlet (Fig. 8; Snyder et al., 1994). The location of the paleo-fluvial channel experiences the highest erosion rates of this study area (Figs 9 and 10; Riggs et al., 1985).

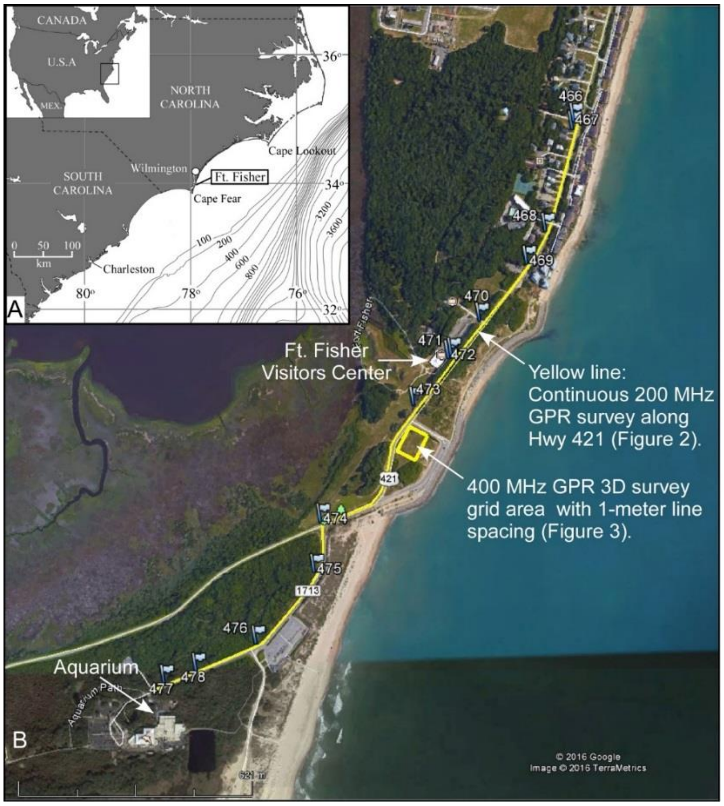
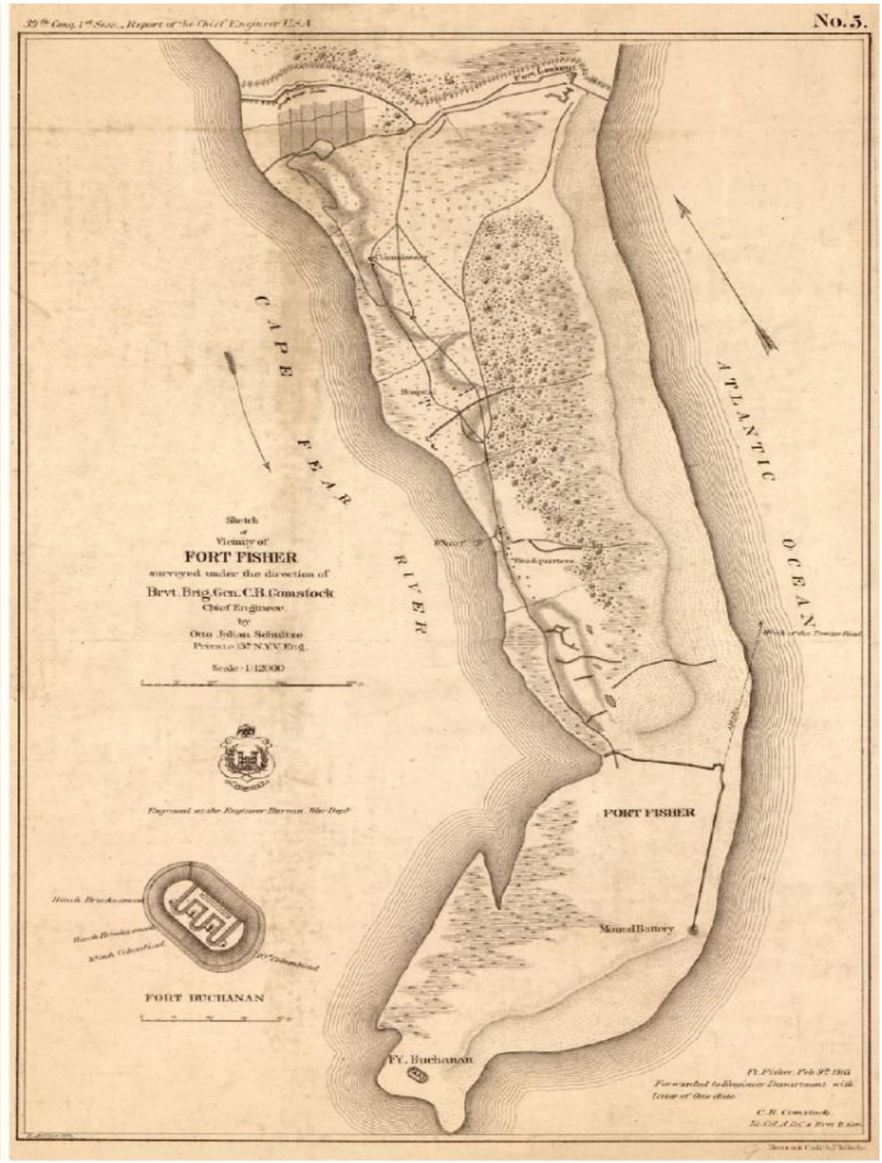


Figure 179. Location map for Fort Fisher, NC, showing the location of GPR surveys.

Figure 180. Oblique view of Fort Fisher showing the remaining earthworks, coquina cropping out on the shore face, and the extensive rock revetment emplaced to protect the historic site.

A



B

Figure 181. A) Map of the lower Cape Fear River region from 1865, showing the position of New Inlet, separating the Ft. Fisher region from Bald Head Island. B) Civil War era map of the Ft. Fisher earthworks also showing the coastal geomorphology.

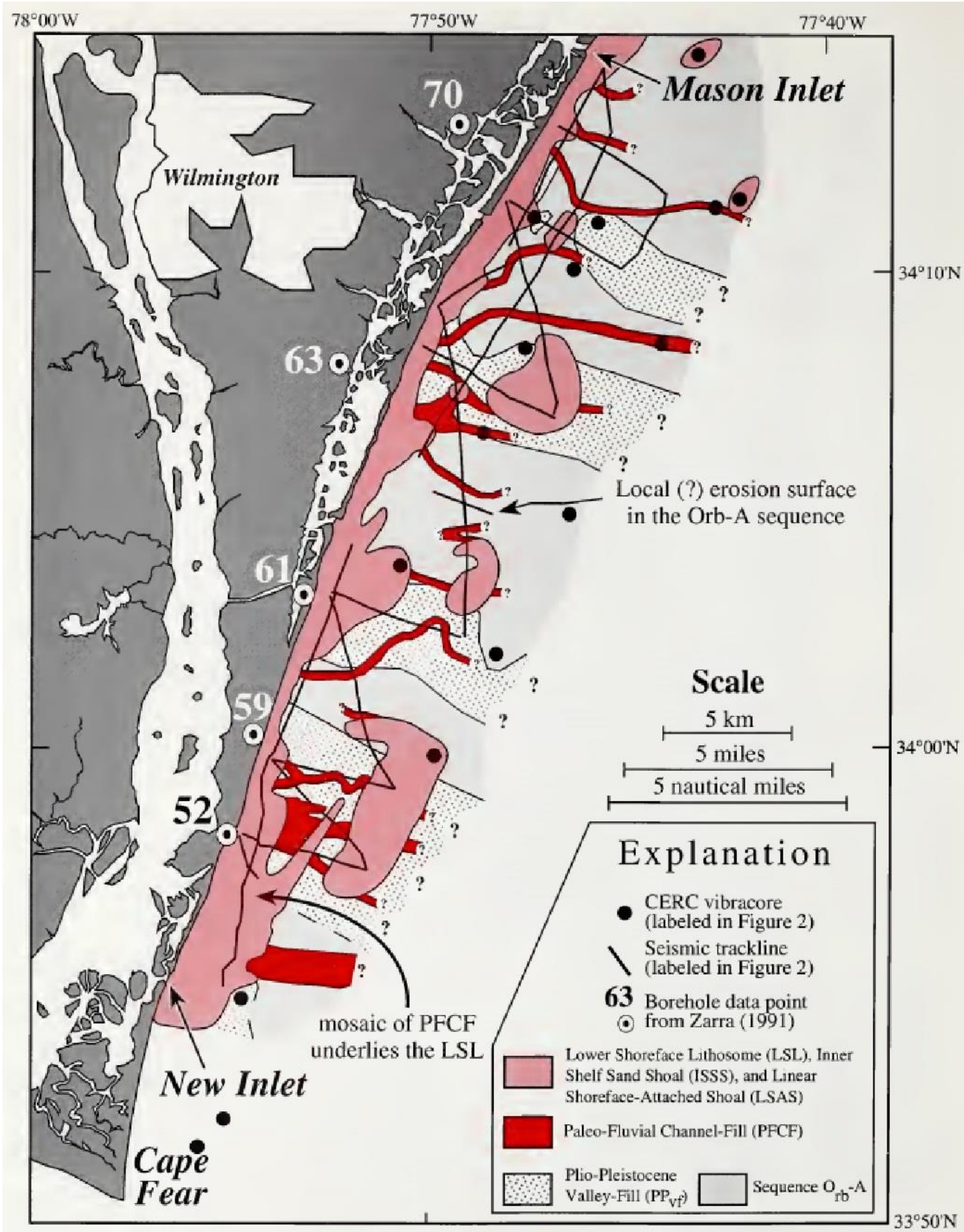


Figure 182. Map of the shallow geologic framework offshore of the Ft. Fisher area showing the location of fluvial channels and shoals (Snyder et al., 1994).

Sea-level Rise and Shoreline Erosion

Sea-level rise in the Fort Fisher region was evaluated by Kopp et al. (2013) and Van de Plassche et al. (2015) using salt marsh peats from Oak Island (just west of Bald Head Island). Data indicate that the rate of relative sea-level rise near Cape Fear is slower than areas to the north. A recent (1900-2012 CE) RSL rise rate of 1.9 ± 0.6 mm/y is indicated, which is in line with the tide gauge data at Wilmington showing 2.3 ± 0.34 mm/y (Fig. 2d).

Shoreline erosion in this area has been impacted by the various construction projects, and mining of coquina. Building the "The Rocks" to close down New Inlet resulted in the collapse of the ebb-tidal delta, which was protecting Fort Fisher from wave energy from the south. Also, mining of coquina for building and road construction in the early 1900s accelerated erosion. Several small-scale construction projects including groins and a small rock revetment were undertaken between 1959 and 1970, with boulders dumped continuously along the shoreline from 1970 to 1995. In 1996 a major rock revetment (3,040 feet in length by 70 feet wide) using 3-ton granite boulders and 5-ton interlocking pods was completed. This revetment has, for the time being, stabilized the portion of the coast in front of Fort Fisher, however adjacent areas continue to erode at rates of ca 2 m/y (Fig. 6B).

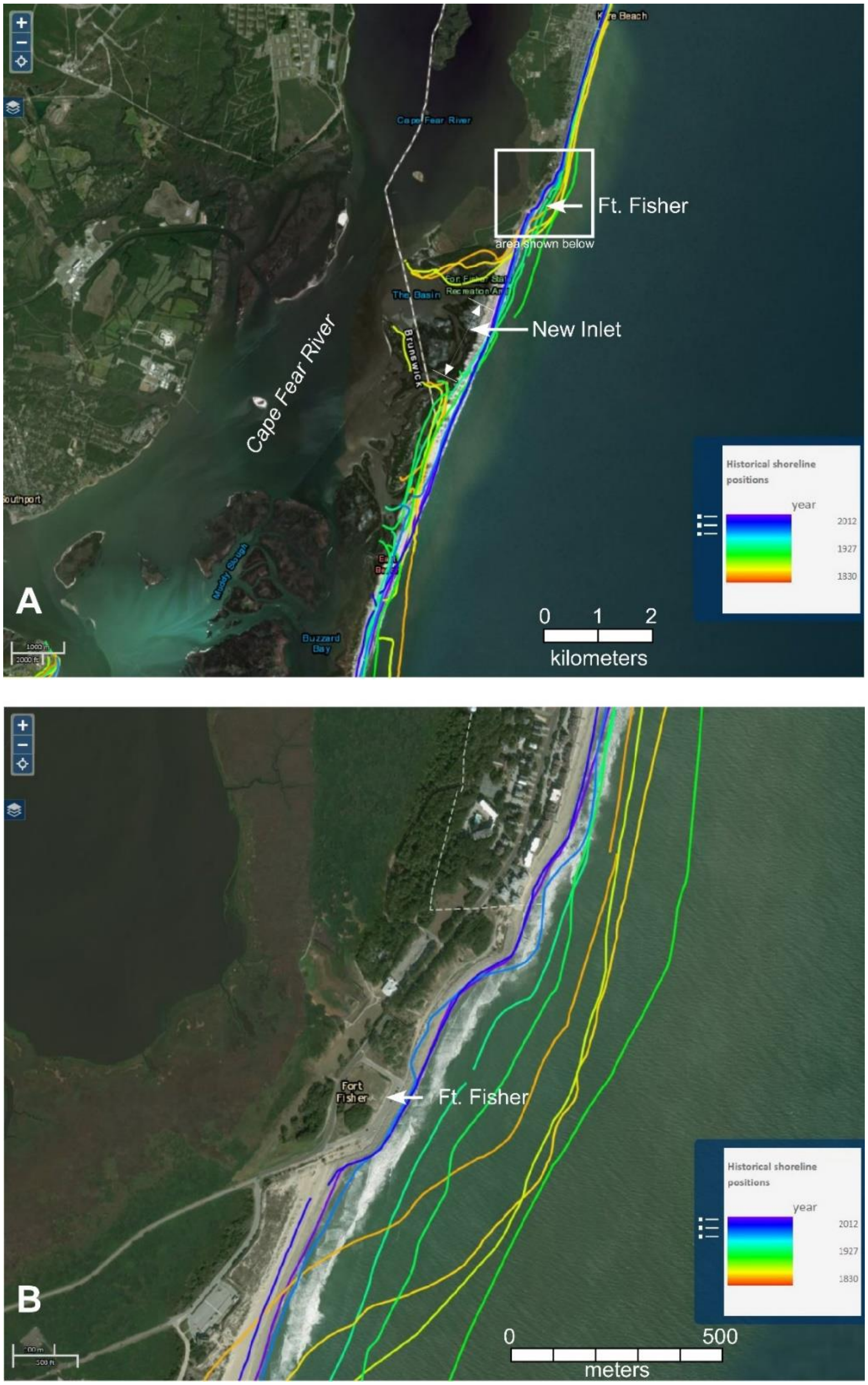


Figure 183. A). Historical shoreline positions (1850 to present). B). Historical shoreline positions from 1850 to present at Fort Fisher (https://marine.usgs.gov/coastalchangehazardsportal/).

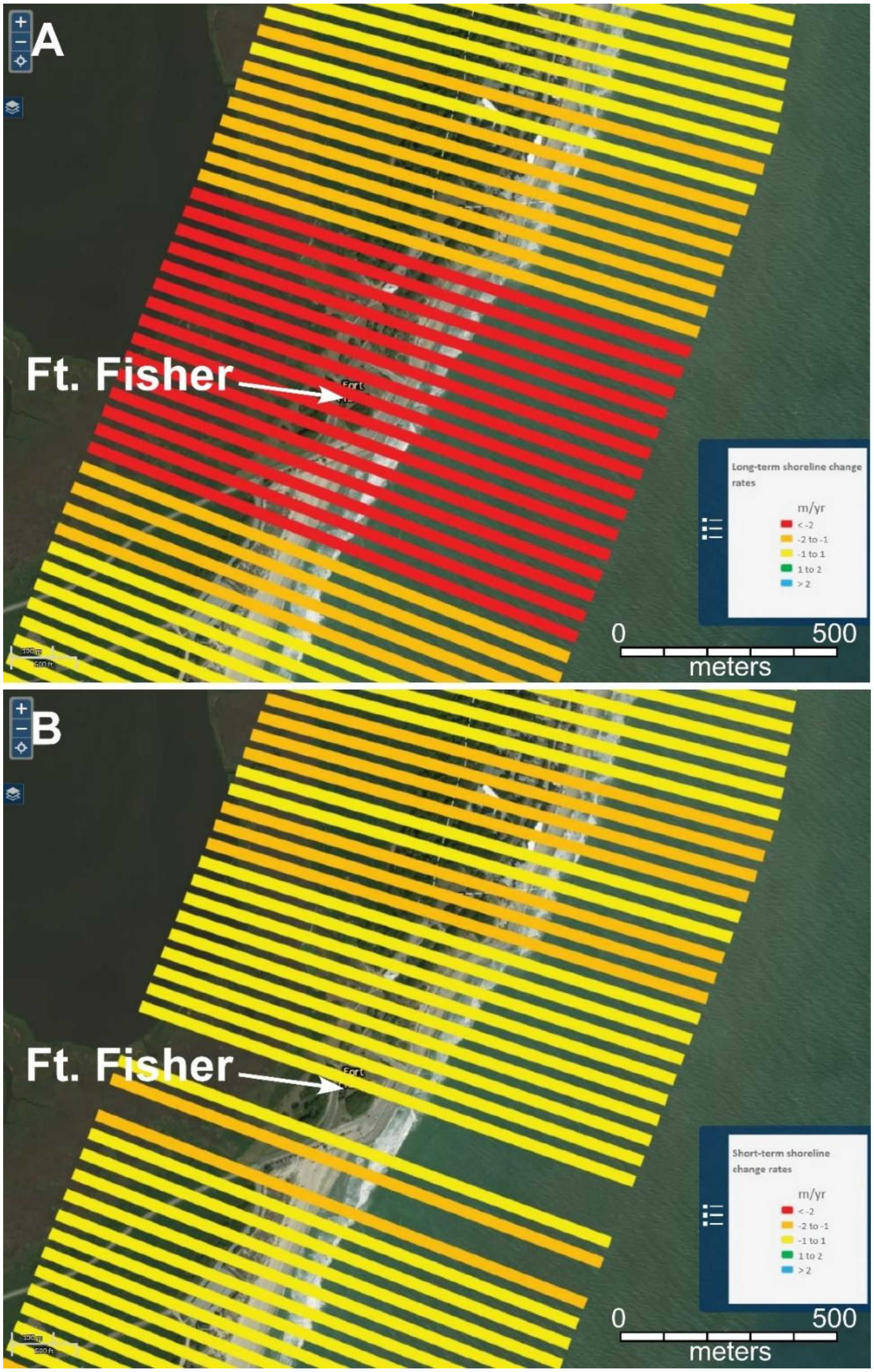


Figure 184. A) Long-term (~70-170 years) shoreline erosion rates based on linear regression analyses (USGS). B) Short-term (~30 years) shoreline erosion rates based on linear regression analyses (USGS) (https://marine.usgs.gov/coastalchangehazardsportal/).

Ground Penetrating Radar Survey

Ground penetrating radar (GPR) was utilized on two separate occasions (Feb. 7 and March 7, 2017) to evaluate the subsurface geology in the region. The first survey utilized a GSSI SIR-3000 GPR system with a 200 MHz antenna. The antenna was towed at ~3-5 mph from north to south along Highway 421, through Ft. Fisher State Park, to the Aquarium entrance (Figure 5). Waypoints were marked on the data, and recorded using a Garmin WAAS enabled GPS. Data were processed using Radan v.8 software, and included a time adjustment, background removal, migration, deconvolution, and gain enhancement. The purpose of this first survey was to characterize the subsurface stratigraphic framework and identify the extent of the Pleistocene coquina (which is exposed along the beach), and locate the position of the inlet which was active during the Civil War era. Figure 11 shows the extent of these geological features.

The second survey utilized a GSSI SIR-3000 GPR system with a 400 MHz antenna mounted on a push-cart. A survey grid, consisting of 55 NE-SW trending lines (shore parallel) spaced at 1 meter, was flagged and surveyed. Data were processed and gridded using Radan v.8 software (same processing steps as outlined above) to produce a 3D volume to allow for the analysis of depth slices (Figure 12).

The purpose of this second survey was to locate any potential culturally significant features. Most notably, it has been proposed that the Civil War era Federal Point Lighthouse and light-keepers cottage were in this area. The map in Figure 9 reveals several potential targets. A circular feature, and an adjacent rectangular distribution of reflections are outlined. In profile these appear to correspond with disturbed and possibly excavated surfaces. Two other small, but very high amplitude reflections are also outlined and correspond to some high density small buried objects.

Vulnerability Assessment

The average elevation of Fort Fisher State Park is approximately 4.3 m above mean sea level, with earthworks heights extending to ca. 11 m, thus inundation by sea-level rise is not an immediate concern, although nuisance flooding will certainly increase in response to rising water table. The historic site at Fort Fisher is well-protected on the ocean side by the massive rock revetment that was emplaced here in 1995-1996. The main concern may be rapid shoreline retreat to the north and south of the revetment. If rates of retreat continue at 1 to 2 m/y, then by AD 2100 it is expected that the shorelines would retreat enough to threaten or destroy the entrance road (Highway 421) as well as many of the structures north and south of the park.

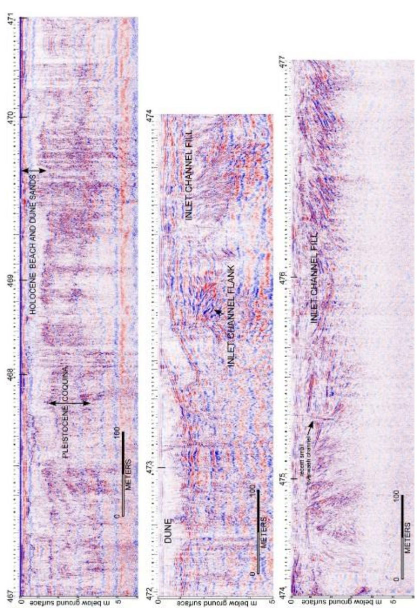


Figure 185. 200 MHz GPR data collected along Highway 421. Numbers along the top of the files are waypoints and correspond to waypoint positions on the map in Figure 1. Several radar

facies are apparent: the Pleistocene coquina (which crops out on the beach to the east), Holocene dune sands, and inlet channel fill sands.

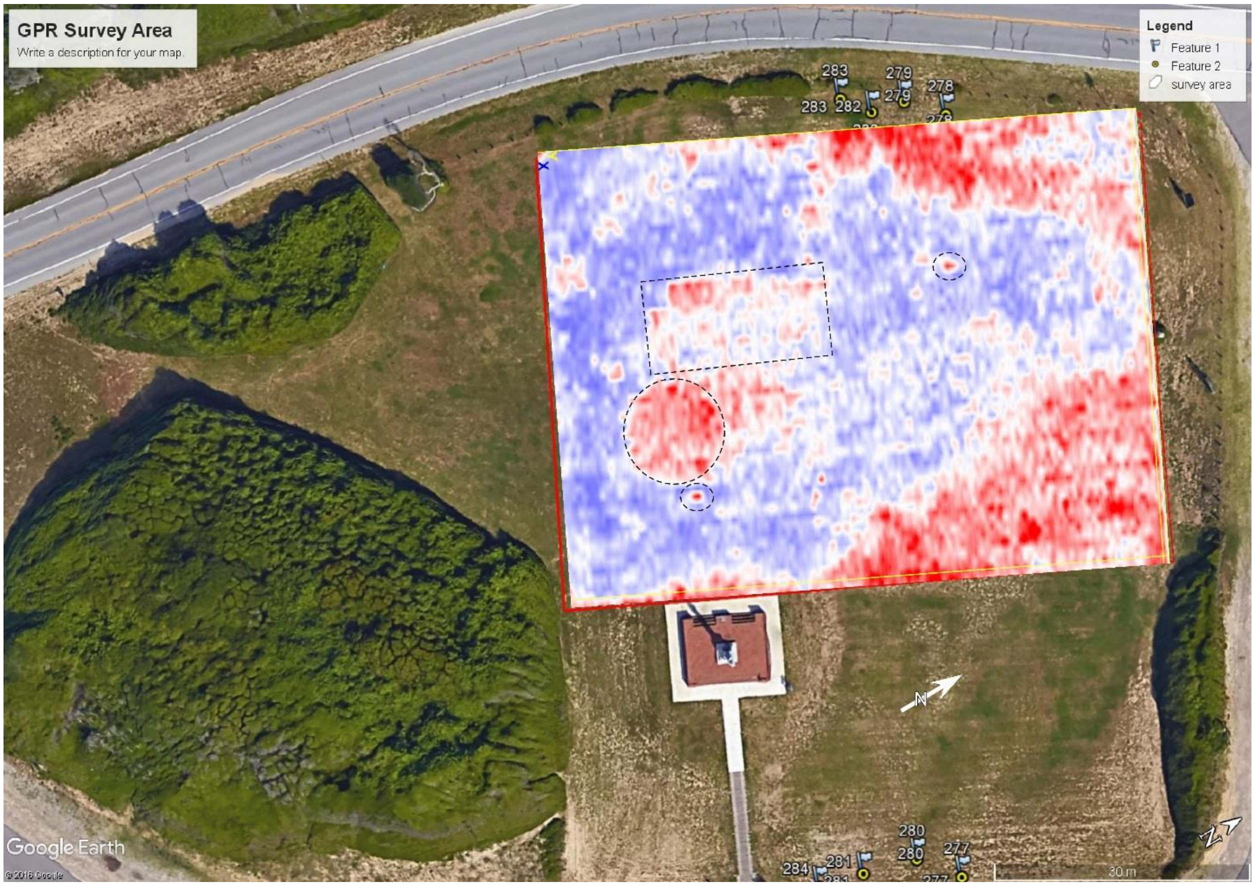


Figure 186. Depth slice (1 m) of 3D GPR data showing the low reflectivity (blue) associated with fine sand and high reflectivity (red) associated with course sand and shells, as well as possible human structures (dashed outlines).

Cape Fear Discontinguous Shipwreck District

In addition to fortifications the world's largest concentration of Civil War shipwrecks are submerged in the waters of Cape Fear. These vessels represent the evolution of ship architecture and construction during the revolutionary transition of ship propulsion from sail to steam, and wood to iron hulls. The material culture remains are evidence of the economic and social impacts to the South during this conflict and their deposition patterns closely reflects the naval boundaries established by Union blockade strategists. The shipwrecks contribute to the history of

Fort Fisher, deepening our understanding of the fort as a Confederate stronghold and highlighting the pivotal role it played in the Civil War. There are six wrecks in the New Inlet area of the Cape Fear Civil War Discontiguous Shipwreck District: *Arabian*, *Condor*, *Modern Greece*, *Stormy Petrel*, *USS Aster*, and USS *Peterhoff*. Others are located further offshore or on adjacent beaches like blockade runner *CSS Beauregard* scuttled in 1863 is still visible at low tide about 100 yards off shore. These wrecks were part of a thesis project for a student participating in the grant initiative (Wright 2013). The grant team attempted a reconnaissance snorkel on the site of the shipwreck.

Location of *CSS Beauregard* (Adapted from Google Earth).

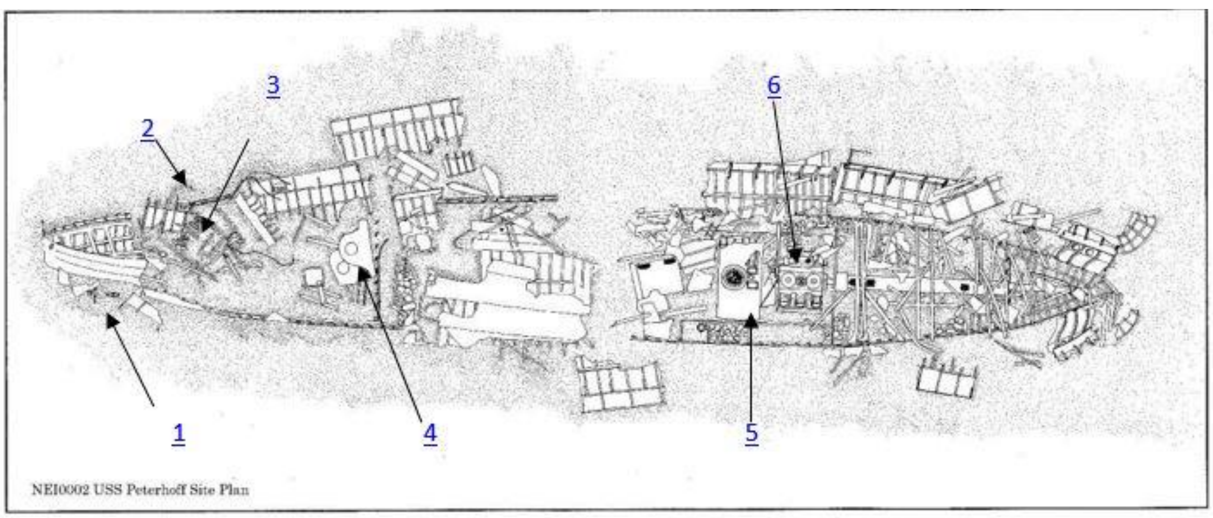
ECU conducted a rapid site assessment of *USS Petershoff*. The most evident change in the site since a video recorded visit in 2012 was a broken bow area. The wreck is a popular fishing site and it is likely that vessels anchoring on or near the wreck, could damage the structure. Alternatively it could represent structural deterioration, especially the bow area that presents the highest area of relief on the seabed and may lose integrity first. Students noted diagnostic hull features, the condition and marine life including fish and corals. Visibility over a two day period ranged from 1 to 10 feet.

Figure .Luke Lebras and Gus Adamson documenting the engine
(Photo by Josh Vestal, ECU)

Figure . Gus Adamson recording design features and marine life on the Engine

(Photo by Josh Vestal, ECU).

Currently, the wreck is situated within the Fort Fisher Contiguous underwater district and approximately 1.3 miles offshore. It is the wreck furthest out from the coast. The exposed remains of the vessel consist of part of one boiler and a concentration of machinery. The surviving structure has considerable profile and resides on a sand bottom in 34 feet of water. Much of the hull has collapsed, the bow and stern are readily identifiable. The bow lists slightly to starboard and the stern sits on an even keel. Amidships, the engineering space is well defined by the remains of watertight bulkheads fore and aft. Within those bulkheads the boilers and steam engine remain intact. The orientation of the hull is northwest to southeast with the bow to the southeast.



1. Trotman Patent Anchor 2. Davit 3. Windlass 4. Cheek plates 5. Boiler 6. Two inverted direct-acting cylinder steam engines. Image Courtesy of UAB (adapted by Ryan Miranda, ECU).

The location of the wreck of *Peterhoff* was well established at the time of its loss on 6 March 1864. Historical sources confirm that the ship was sunk approximately three miles off the beach three and one half miles southeast of Fort Fisher. Identification of *Peterhoff* is based on a combination of factors including the wreck location, the surviving hull structure and machinery,

U. S. Navy ordnance recovered from the site and the base of a bowl embossed "Peterhoff." Ordnance recovered from the site by the United States Navy in the 1960s and UAU personnel in 1974 consists of 32-pounder smoothbores, a 30-pounder Parrott rifle and elements of a small boat carriage for a 12-pounder Dahlgren howitzer. All of the ordnance matches the historical inventory of the *Peterhoff*'s battery. Several additional 32-pounder smoothbores, identified in 1997, remain at the site. The English ironstone bowl base with "Peterhoff" in the bottom provides confirmation of the vessel's identity.

The overall length of the wreck is sufficient to accommodate the 220 foot length, 29 foot beam and 16 foot 11 inch depth of hold of *Peterhoff* recorded on the Certificate of British Registry (CBR). The 28 foot beam and 31 foot length of the engine room recorded at the wreck site correspond exactly with those recorded on the CBR. *Peterhoff* has two engines listed on the CBR and two inverted direct-acting cylinder steam engines were identified in the remains of the vessel. *Peterhoff* was also known to have a donkey engine and steam powered capstans. The remains of a steam capstan were identified in the wreck aft of the bow adjacent to the anchor davits.

Trotman Patent Anchor (Photo by Jeremy Borrelli, ECU).

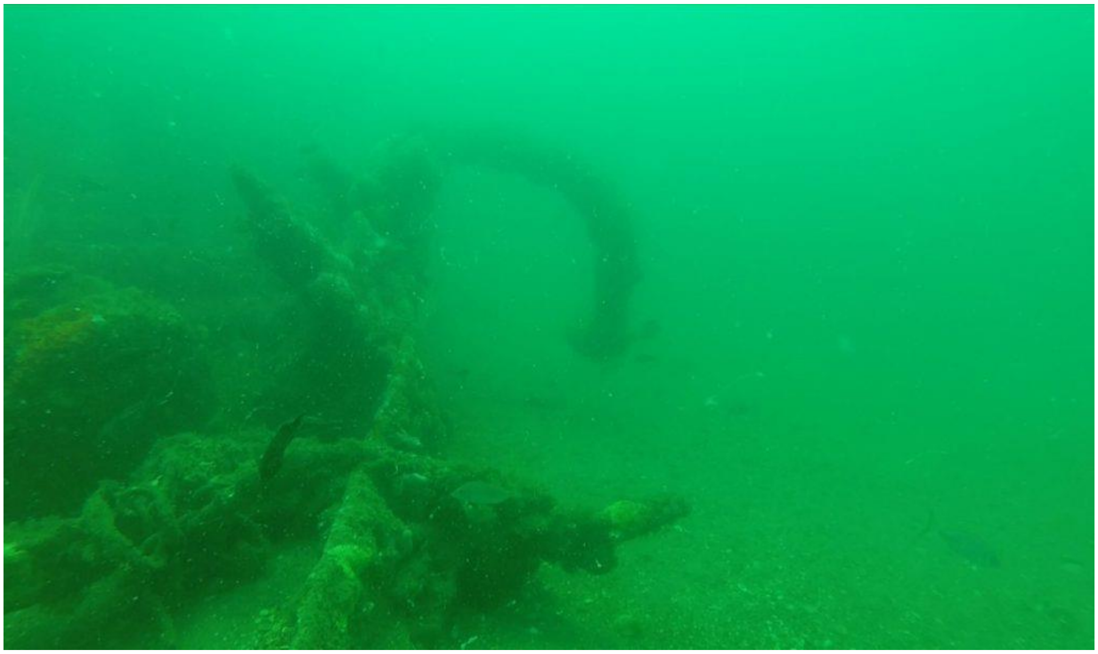


Figure   Davit to secure lifeboats (Photo by Jeremy Borrelli, ECU).

Figure   . Cheek Plates in the Bow Area (Photo by Jeremy Borrelli, ECU).

Figure . Steam Boiler (Photo by Jeremy Borrelli, ECU).

Figure . Two inverted direct-acting cylinder steam engines (Photo by Jeremy Borrelli, ECU).

The hull of *Peterhoff* has broken into two distinct elements. The bow, forward of the coal bunkers, and a stern section containing the engineering space amidships and stern. Most of the 120 foot long forward section of the hull has broken down to the turn of the bilge. A 22 foot section of the bow lies on the bottom listing to starboard and extends more than 10 feet into the water column. That section extends from the stem post to the forward hold bulkhead. A Trotman Patent anchor lies off the port bow and two anchor davits and a steam capstan lie within the surviving hull structure. Aft of the forward hold bulkhead, the hull has collapsed to the turn of the bilge and sections of plate and frames from the sides lie adjacent to the hull. Deck beams and small sections of the deck clamps lie on the sand within the confines of the surviving lower hull structure.

Peterhoff was originally built for the Baltic trade, but shifted to blockade running in anticipation of high profits. The Confederate vessel was captured February 25, 1862, in the West Indies. After condemnation on July 24, 1863, the United States Navy purchased it for $80,000 and re-fitted it as a blockader and re-commissioned it as USS *Peterhoff* in February 1864, sending it to the North Atlantic blockading squadron and stationed off of New Inlet. On February 20, 1864, *Peterhoff* was rammed and sunk by USS *Monticello*, who had mistaken it as a blockade runner.

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