

New Hanover Banks: Then and Now

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By William J. Cleary and Paul E. Hosier

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NEW HANOVER BANKS: THEN AND NOW
A GUIDE TO THE NEW HANOVER COUNTY BEACHES

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A number of historically oriented books, including Sprunt (1916), Lee (1965 & 1971) and Hall (1976), provided background information necessary for tracing the development of this region of New Hanover County. Some of the information contained herein has been obtained through personal communication with many knowledgeable, life-long residents of this area. We would like to single out a few who have been the most helpful: Mr. Dan Holt, Mr. Bill Robertson, Mrs. D. H. Barnett and Mr. E. C. Helms. Gratitude is extended particularly to Mr. Lim Vallianos, whose knowledge of coastal processes has been immensely helpful. Miss Pamela Johnson and Mr. Glenn Wells wrote term papers which provided information concerning the recent geologic history of the islands. We thank Ms. Anita Boney who typed the original draft and the many revisions since the manuscript took form. Her patience is appreciated.

Lastly much of the guide could not have been written without the help of Mr. Lewis P. Hall, whose knowledge of the development of this area has provided another dimension to understanding the problems confronting the shoreline.

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INTRODUCTION

A series of barrier islands forms the eastern margin of North Carolina. This chain plays the crucial role of protecting the mainland from hurricane surge. The islands are a home for many North Carolinians and the playground for thousands of visitors each year. And like many other coastal areas, they have been subjected to intense development pressures. Because of the fragility of the islands, this pressure is keenly felt. Development here often causes more damage than on adjacent mainland sites.

The life of a barrier island is governed by certain predictable natural processes. When man begins to live and build there, his actions affect the natural life of the island -- sometimes dramatically, sometimes more subtly. New value is placed on the real estate. Words like erosion and accretion take on a special meaning. The land often becomes a battleground between people determined to develop it along traditional building lines and those who oppose development.

This book is designed to help you understand how man and nature have interacted on the New Hanover County outer banks. It outlines the history of development in this area. These islands offer a wide spectrum of developed and undeveloped beaches. Wrightsville, Carolina and Kure Beaches and Figure 8 Island have each undergone different types of development. At the same time, Masonboro and Shell Islands remain virtually in their natural states.

BEFORE YOU BEGIN

There are 43.5 km (27 miles) of beaches in New Hanover County, extending from Rich Inlet at the north end of Figure 8 Island to New Inlet near Fort Fisher. Mason, Masonboro and Carolina Beach Inlets bring the total of the county's inlets to five. The coastline can be divided into four major segments: Figure 8 Island; Wrightsville Beach; Masonboro Island; and the Carolina, Kure and Fort Fisher Beach area (Figure 1).

Eighteen miles of beach in the county are severely eroding. In some developed areas, such as Wrightsville and Carolina Beaches, the natural dunes have eroded and artificial dune lines have been constructed in their place.

Exclusive, private shoreline development is occurring on Figure 8 Island. The southern section is more advanced in development, while the northern part is still pristine. Wrightsville Beach is highly developed, with both permanent and seasonal dwellings. The beach itself is made accessible

by walkways stretching across the artificial berm. The Shell Island Development Company has built permanent residences on its northern end. Masonboro Island, on the other hand, is bare of construction and is accessible only by boat.

Carolina and Kure Beaches are more highly developed and commercialized than Wrightsville Beach. They boast an amusement park, numerous hotels and motels and a public beach which fronts private development. South of Kure Beach is Fort Fisher, a state historic site. Its museum trails and picnic areas are open to the public.

The book is written as a guide to a field trip of the county's barrier islands. But it can easily be used alone as an educational text as accompanying photographs illustrate sites of particular interest in the field trip. The guide covers a 40-mile field trip which begins at the University of North Carolina at Wilmington campus, goes east to Wrightsville Beach and southwest along the barrier island beaches as far as The Rocks, just south of Fort Fisher. Appendix A outlines a tour of the private development, Figure 8 Island. You must have prior permission of the developer or a landowner to tour that island. Appendix B is a description of each of the major ecosystems which comprise the barrier islands: beach, dunes, shrub thicket, maritime forest, grasslands and tidal marsh. The discussion is an educational aid for the field trip or reading of the text.

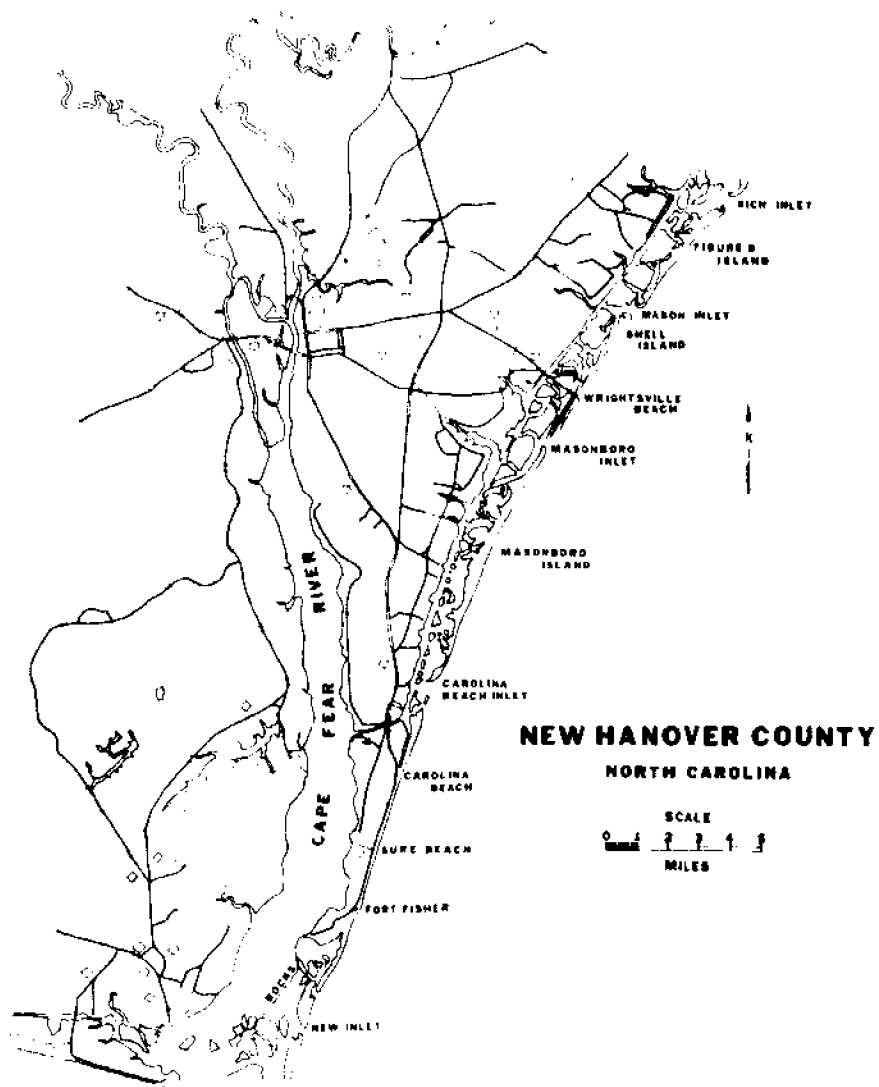


FIGURE 1. Map of New Hanover County shoreline showing major barrier island beaches, spits, mainland areas and tidal inlets.

THE FIELD TRIP

The field trip upon which you are about to embark will provide you with information and explanations of historic changes, the past experiences and the future trends in coastal development in the New Hanover County area. It is hoped that you will develop a better comprehension of both the problems and the potential for the coastal area of New Hanover County. Mileage indicators are provided to aid in following the Field Trip.

Mileage

- 0.0 *Assemble at Kenan Auditorium on the University of North Carolina at Wilmington campus at the corner of Randall Dr. and Street B. Proceed to light (Randall Dr. and South College Rd.). Turn right on N. C. 132; proceed north for 1 mile. Bear right onto U. S. 17-74 toward Wrightsville Beach.*
- 1.4 *Bear right at junction of U. S. 17-74 (East) and follow U. S. 74 to Wrightsville Beach.*
- 4.0 *Stoplight. Junction U. S. 74 and Truck Route U. S. 17. Proceed East on U. S. 74.*
- 5.0 *Junction U. S. 74-76. UNC-Wilmington Institute of Marine Biomedical Research (IMBR) on left. This marks the general location where early seaside development (Wrightsville) first occurred, in the late 1870's and early 1880's. The soundside resort areas sprang up following the completion of the Old Shell Road or Wilmington Turnpike in 1876. This early toll road provided easy access to the sounds as well as a jumping off spot for more hardy individuals, who ventured across the marshlands by boat and on foot to the hammocks (Harbor Island) and beach to the east. The Waterway Motor Lodge on the right now stands on the location of one of the earliest establishments, the Pine Grove House (1884), complete with baths, rooms and seafood dinners.*
- 5.2 *Atlantic Intracoastal Waterway (AIWW). Dredging operations on this section of the Beaufort to Cape Fear Inland Waterway segment began in 1930. The original cut was 27.45 m (90 feet) wide, 3.65 m (12 feet) deep and was positioned as close to the mainland as possible. During the summer months the waterway is crowded with boats, significantly increasing the pollution in the area.*

- 5.5 Bear left following U. S. 74. Saline Water Plant on right.
- 5.6 This section of U. S. 74 opened in 1957. The Channel Walk development, located on the left (north) of the road, marks the location of once flourishing tidal marsh that was bulkheaded and filled with dredged material from nearby channels in 1966 (Figure 2).
- 6.3 Tidal Creek. Notice the extensive bulkheading along this section.
- 6.7 Stoplight. Turn left, follow U. S. 74. Moores Inlet (also called Barren or Wrightsville) once flowed through this area in 1905-1915. You are now riding on the flood tidal delta of the former inlet (Figure 2).

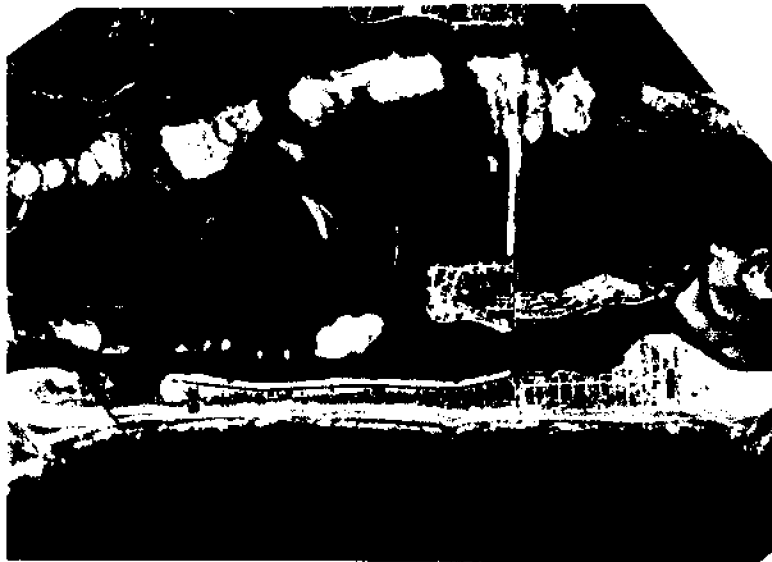


FIGURE 2. Aerial photograph of Wrightsville Beach (1938) shows the recent dredging of Banks Channel and construction of Waynick Blvd. (arrow). Note the narrowness of the island south of the causeway. The large structure on the southern end of beach is Lumina. Even at this early date, the dune line is almost nonexistent. Recurved dune ridges are evidence that Masonboro Inlet has migrated south.

7.0 Surf Club on right. Immediately north of this social club is one of the areas on the beach where natural dunes occur on the back barrier surface. A sewage treatment plant is on the left. In 1976, local residents sued the beach community because of raw sewage discharges from the treatment plant. The residents contended that the capacity of the plant had been exceeded on numerous occasions, leading to the closure of shell-fishing areas in the vicinity. The area to the left is a dredge and fill site on the northern extension of Wrightsville Beach in the 1950's. In the early 1950's Moore's Inlet was located just north of the Surf Club. Prior to 1940, Moore's Inlet was the major inlet in the area (Figure 2).

7.2 STOP 1. HOLIDAY INN/ISLANDER/SHELL ISLAND DEVELOPMENT
*Park cars wherever possible and walk out onto the beach
in front of the Holiday Inn.*

This section of Wrightsville Beach once was Moores Inlet, which has had a complex history of migration. In the early 1920's, it was located 0.5 km (.3 miles) south of your position. The inlet was closed in 1965 by the Corps of Engineers as part of the hurricane protection project for Wrightsville Beach. Notice the blackened shell material representing lagoonal deposits used as fill (Figure 3).

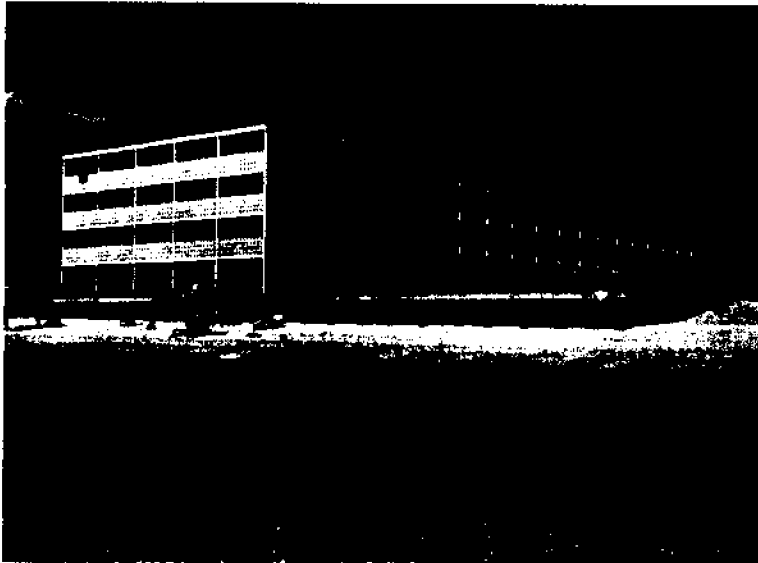


FIGURE 3. View of Holiday Inn. Built in 1966, the motel rests on sand and shell material that once comprised the flood tidal delta of Moores Inlet. The inlet was closed in 1965 by the U. S. Army Corps of Engineers. Over a period of time, wave reflection from the bulkhead will lead to increased erosion at the toe of the structure and on the adjacent beach.

Usually when an inlet closes and dunes redevelop, that section of the island becomes very stable due to the development of extensive vegetated sand flats landward

of the former inlet. In the vicinity of Moore's Inlet, however, sand was pumped to the beach to make elevated land for development and to provide homeowners in the area access to the Intracoastal Waterway. The natural intertidal sand bodies landward of the former inlet were the source of this dredge material.

As a result of the pumping, no salt marsh areas were created behind the closed inlet. A potentially stable section of the island was then rendered less stable. If a major hurricane were to approach Wrightsville Beach, ocean water pushed into the deep unvegetated sound behind the former inlet, would likely be released as the hurricane passes, forcing water over the low section in the vicinity of the Shell Island development. This places the development in a highly vulnerable position with respect to inlet formation. The highest elevations on this section are 3.65 m (12 feet) (MLW); the surge accompanying Hurricane Hazel (1954) was nearly 3.65 m (12 feet) above mean low water.

A hurricane approaching at high tide with 1.21 m (4 feet) waves will produce waves breaking on the second story of the Holiday Inn and the homes to the north. Construction of the dwellings on wooden pilings affords some protection during mild storms, but is no guarantee of survival in a strong hurricane. In addition, structures are located further seaward than the high tide swash level. Some houses constructed at this elevation are protected from normal wave action only by a seawall (Figure 4).

North of the present Shell Island development is an undeveloped area. If development occurs here, building on or just in front of the large rear dune would prove most satisfactory. Development further seaward would place structures in hurricane vulnerable positions. Stop by here in a few years and see what has happened.

Federal officials squashed a permit request to fill in the marsh from the high dune ridge to the dredge islands on the Atlantic Intracoastal Waterway. Grandiose plans had been made to carve finger canals, boat basins, etc., from the newly made land.

Compare the vegetation of the Shell Island development with that on the undeveloped section to the north. Note that the plant cover which has colonized the fill material is much more sparse than the plant cover on natural dunes. Dunes and vegetation generally grow in

concert; the plants act as a brake in causing sand to accumulate while the sand stimulates the plants to grow more rapidly. The coarse, sandy, shelly fill material is not nearly as conducive to the establishment and growth of sea oats and other beach plants as natural windblown sand. The lack of vegetation in these fill areas further compounds the effects of beach erosion.



FIGURE 4. View of beach houses on the northern end of Wrightsville Beach. The houses are north of the Holiday Inn (arrow), and are positioned seaward of the primary dune line. Notice orientation of swash lines and bulkhead. The highest swash line occurs landward of the bulkhead.

Under natural conditions, a dense vegetation mantle retards erosion of the dune system. Here, the vegetation is lush only where sand has moved up from the beach after the berm was constructed. Although the berm has been nourished since its construction by the Corps of Engineers in 1965 (See Stop 6), scarped areas have developed along this section of the beach. It gets worse further south. Walk north along the berm beyond the developed section. This section of Shell Island as

well as the remaining 5 km (3 miles) to the north are characterized by multiple dune rows.

Walk over to the back side of the island to the area where the grasslands border a shallow tidal creek. As you cross the dunes look south from the foredune ridge. Note that the imaginary line formed by the foredune ridge cuts through the center of the Holiday Inn, placing it, and several dwellings between you and the Holiday Inn, in an extremely vulnerable position.

In the early 1920's this general area on Shell Island was the location of the First National Negro Seaside Resort complete with pavillion, cottages and pier. After several fires caused damage, the development was abandoned and engulfed by the migrating inlet.

- 7.4 STOP 2. SHELL ISLAND. Looking westward from atop the rear dune on Shell Island, you can see the edge of a washover terrace. It can be traced over a significant distance along the back barrier. These same sediments can be found in the tidal creek, suggesting that the creek is eroding the terrace material. Washover sediment on Shell Island is quite similar to that on Masonboro Island to the south, but unlike that further north. Coring and shallow trenches at this site reveal that the upper 2 m (6.5 feet) of sediment are composed of multiple graded washover sedimentation units.

Aerial photo data show the event or events that resulted in the formation of the majority of this terrace occurred prior to 1938. Recovery of the dunes occurred during storm-free periods beginning with small discontinuous dunes formed on the washover terrace. With time, fronting dunes formed; by 1938 the island was characterized by a seaward building beach system. Hurricane Hazel (1954), the third most intense hurricane in the past 300 years, removed the fronting dune rows.

The north section of the island shows evidence of more recent (1955-1962) washover fans that extend into the marsh. Washover sediments are composed of coarse sands overlain by windblown fine quartz sands. These fans are found at the terminus of small channels that closely follow previous overwash areas or low spots in the grassland (Figure 5).

The small elongated islands seen in the marsh are probably features associated with inlet formation and migration. These likely indicate the location of the main channel of former inlets. Sands are deposited on the marshes behind the inlet channel as overwashing waves from the inlet move across the marsh. The marsh is buried, and as a result elongated sandy areas are elevated. Higher marsh, shrub thicket, or even dune vegetation develops.

As the inlet migrates, the ribbon of sand continues to form on the landward side of the main channel. These features remain when the migration cycle is complete and the inlet closes. Eventually old tidal channels are infilled and vegetation succession occurs, ultimately producing the observed pattern. This takes about 100 years. Evidence in support of this origin is the thick peaty/organic-rich sediment landward of the ridge (the site of the overwash-buried smooth cordgrass marsh). Seaward of the island thin marsh peat over-

lies fine quartz sand.



Figure 5. Multiple dune rows on Shell Island and marsh islands in lagoon. The grassland and dune ridges overlie a washover terrace that pre-dates 1938. The presence of multiple dune rows suggests a recent history of progradation. The elongated islands in the marsh (arrows) formed during the migration of Moores Inlet in the 19th century.

Return to your vehicles and proceed to the stoplight (North Lumina Ave. and U. S. 74). Along the way you will notice landscaped areas containing a variety of vegetation including the Palmetto (Sabal palmetto). Man has extended the range of the Palmetto 25 miles to the north from Bald Head Island, its natural northern limit.

7.7 STOP 3. MERCER'S PIER. *Stoplight. Turn left if parking spots are available or park along one of the side streets.*

Parking meters and the median are located where the gorge of Moore's Inlet existed in 1920 (Figure 6). After the inlet migrated to the north, Mercer's Pier was built during the early 1940's. It has been rebuilt several times following destruction by coastal storms.



FIGURE 6. Northern section of Wrightsville Beach in the early 1920's. This photograph shows the island is already developed with many rows of cottages across the dune and grassland surface. Moores Inlet is visible in center of photograph. Moores Inlet, a major inlet at this time, has had a complex history of migration and closure. In the 1920's the inlet was as far south as Salisbury Street and Mercer's Pier. Shell Island is seen in the upper portion of the photo. (D. H. Barnett collection)

From atop the pier at low tide you can see some of the early groins that were built (1923) at regular intervals down the beach as a measure to impound the eroding sand.

The sloping section of the upper beach immediately in front of the lifeguard stand is the result of the recent grading (1976) of the artificial dune and berm. Note that the pilings in the fill material directly in front of the steps of Mercer's Pier are being undermined. You can see that the supports are exposed and abundant blackened oyster shells are strewn about the toe of the dune. Again note the relatively poor vegetation development on the berm and foredune (Figure 7 and 8).



FIGURE 7. Artificial dune line south of Mercer's Pier, Wrightsville Beach. Note scarping and undercutting of artificial dune. Material comprising the "dune" consists of coarse shells and fine sand. Only the upper berm remains from the original 1965 Corp of Engineers Hurricane Protection Project. Station One Condominium is in the background.

Return to cars and proceed south along Lumina Blvd. Development of this section of the beach began in the late 1920's when the sound side of the island was bulkheaded, dredged, drained, and sold as lots. To the left are streets that provide access to the beach

(Figure 9). While beach access presents few problems, parking in the area during peak times is a major undertaking. To control this problem, Wrightsville Beach officials have proposed a non-resident users fee. This has met with resistance from a variety of people.



FIGURE 8. Artificial dune line north of Mercer's Pier, Wrightsville Beach. Note the position of the Holiday Inn and houses further north with respect to the scarped dune line. Coarse material on the beach face is derived from winnowing of fill material.



FIGURE 9. Typical side street, Wrightsville Beach, perpendicular to North Lumina Avenue. The artificial dune is seen in the background. Streets such as these will in time of a hurricane act as conduits for water and washover sediment.

- 8.7 STOP 4. STATION ONE. *Park your vehicle south of Newell's or close to Station One. Again parking may be a problem. Directly west of here on the sound was the original footbridge that connected the Banks with the Hammocks (Harbor Island). The original bathhouses were located on the footbridge. Station One in the days of early beach development was the northern limit of Ocean View Beach, the first stop of the electric trolley on the Ocean View Railroad (Figure 10). It is now one of the newest condominiums.*



FIGURE 10. View looking south of Station #1 (Newells), Wrightsville Beach (ca 1920). Note the narrowness of the southern section of Wrightsville Beach. Cottages and hotels line the island from sound to ocean side. Tracks of the early trolley were laid within the dune swales. The old road bed of the early railroad underlies south Lumina Avenue. Banks Channel is seen on the right in the photo. Dredge spoil from this channel provided the material for construction of Waynick Blvd. and the artificial berm and dune (1965). (D. H. Barnett collection)

Wrightsville Beach has been billed as a "Family Beach", but the influx of the condominiums is likely to alter this long-standing tradition. Continued pressure to build these structures may cause "family dwellings" to be a thing of the past.

The condominium is located behind the berm constructed in 1965 and is relatively safe from mild hurricane surge -- for a while. Note, however, the condition of the artificial berm. Renourishment of the berm is a chronic problem.

- 8.9 *Return to your cars and proceed south on South Lumina Avenue (the old trolley line railbed) for one block and turn right, then left onto Waynick Blvd. The land was once a swale area between large dunes similar to those on Shell Island that was disturbed when the Ocean View Railroad bed was laid in 1889. The intent of the railroad company was to develop the banks into the Atlantic City of the south (Figure 11). The road paralleling the sound is built partly on dredge material derived from the adjacent Banks Channel.*



Figure 11. Early Banks Channel trestle, Wrightsville Beach. Trolley cars carried summer visitors to Wrightsville Beach (ca. 1920). The large hotel at right of photo is the Oceanic. The original timbers of the trestle were driven in 1889. The structure connected the Hammocks (Harbor Island) and Wrightsville Beach. (D. H. Barnett collection)

STOP 5. BLOCKADE RUNNER.

This hotel opened in 1964 and occupies the location of several earlier famous structures (Figure 12). One of the first structures built on Wrightsville Beach was a bathhouse constructed in 1888. In 1898 the Seashore Hotel was constructed. Later a steel pier was built which survived a fire and several storms but finally was destroyed in January, 1921, by a nor'easter during which time the dune line retreated over 15.25 m (50 feet). Later, in 1954 Hurricane Hazel destroyed the Ocean Terrace Hotel on this site. The foundation of Station #3 of the Wilmington and Sea Coast Railroad underlies the parking lot.

The Blockade Runner provides an example of good beach development. A large volume of sand has been maintained between it and the sea (Figure 12). Note, however, that the newer section has been built closer to the beach than the original section. People apparently were beginning to forget Hurricane Hazel when this section was added.

Another excellent development feature of the Blockade Runner is the location of the expendable structures such as the patio and swimming pool nearest the ocean. Not only is the placement of these structures esthetically pleasing, but if a storm takes out part of the beach, the motel structure is likely to remain intact with only a minimal loss of property.

- 9.6 *Return to cars and proceed south on Waynick Blvd.* The large building on the ocean side (left) of the parking lot is the Carolina Yacht Club, the second oldest Yacht Club in the United States, founded in 1854. This was the first structure on the beach and the only one for more than twenty years. The club was the major stop on the old steam railroad. The original structure was destroyed in 1899 and again in 1954 (Figure 13). Banks Channel was the source of some of the sand used in the construction of the U. S. Army Corps of Engineers Hurricane Protection Project in 1965. The channel has been deepened considerably and the sides steepened. Erosion is occurring along this section of the channel due to the constant wave activity generated by boat wakes. No stabilizing marsh grass is present along the banks; the wave activity would unearth grass which was started.

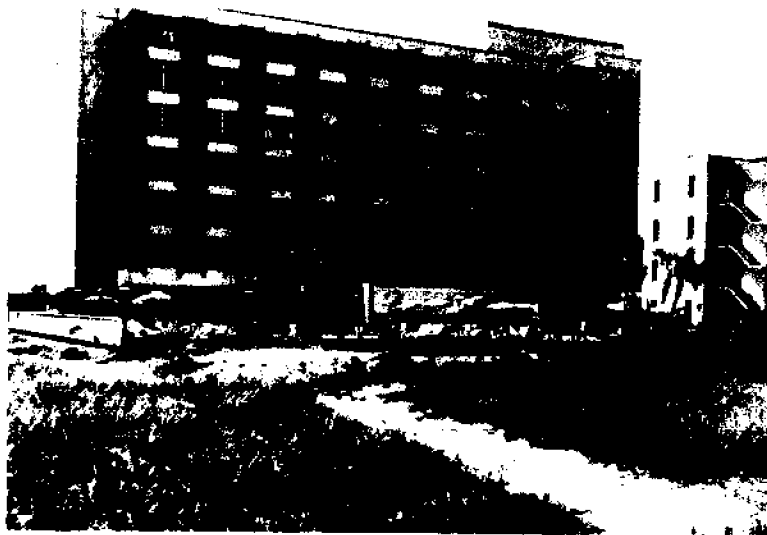


FIGURE 12. Blockade Runner Motel, Wrightsville Beach. Built (1964) with hurricanes in mind, this motel is positioned well back of the dune line. The spot marks the location of an earlier famous hotel, originally the Sea Shore and later the Ocean Terrace. In the 1900's this location (Station 3) was a major stop on the trolley line that served the beach community.

9.8 *Stopsign. Turn right onto Sunset Avenue and right onto South Lumina Avenue.*

To the left is the Crystal Pier and Motel built over the remains of one of the early famous hotels. Seaward of the pier lies the blockade runner "Fannie and Jenny" which sank off Wrightsville Beach. The open area north of the Crystal Motel marks the spot where the massive three-decked Lumina, the most famous landmark on the beach, stood for over 68 years. It was demolished in 1973. The original cost of this land, from the old dune line to the Tidewater Power Co. Railway, was ten dollars.

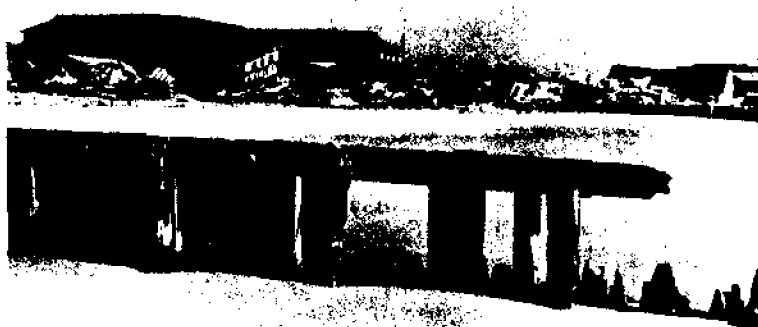


FIGURE 13. Carolina Yacht Club after Hurricane Hazel (1954). Note the groins that represent earlier attempts at impounding the migrating sand. The Yacht Club, the second oldest in the nation, has been rebuilt several times. Fifty-five years earlier the memorable north-easter of November 1899 also severely damaged the structure. (E. Helms collection).

The original Ocean View Railbed extended the length of South Lumina Blvd. from Station #1 (Newells) to Station #7 (the Lumina) (Figure 14). Just south of the Crystal Pier the first groin was installed on the Beach in 1923. Since the late 1800's the beach and dune line had eroded enough to warrant attention. The section south of the Lumina to the present location of Masonboro Inlet developed at a later date as the railbed was extended.



FIGURE 14. Station #7 (Lumina), Wrightsville Beach.
View is looking north along old electric trolley line.
Note the close spacing of the beach cottages, hotels
and bath houses even at this early date.
(D. H. Barnett collection, ca 1925)

10.4 STOP 6. MASONBORO INLET JETTY AND THE ARTIFICIAL BERM.
Turn around at the end of island and park.

Recently houses have been constructed in this general vicinity. Normally, building this close to the inlet would not be a good investment, but considering the proximity of the jetty, the chances of a significant loss are minimal. Notice sand fencing and the relatively large amount of sand that has collected in the past several years.

In 1965 a cooperative federal, state and local hurricane protection project was completed on Wrightsville Beach. Major hurricanes of the 1950's had devastated the beach, destroying many homes and causing massive erosion along the beachfront (Figures 13 and 15). As a result, the strand line which was left had no fronting dunes for protection from hurricanes. Structures were exposed to possible storm surge (Figure 16).

The U. S. Army Corps of Engineers constructed a berm along the entire length of the island from just south of the Holiday Inn to Masonboro Inlet, a distance of 4.3 km (2.7 miles). The project design called for a 15' high, 25' wide artificial dune fronted by a 50' wide 12' high berm. The structure was designed to protect the beach from storms nearly as destructive as Hazel in 1954 (Figure 17).

The dredge spoil came primarily from Banks Channel. The material contained large quantities of very coarse materials (shells and sand) which appear blackened as a result of the oxygen deficient conditions present in the channel environment. You will notice that the material is rather unpleasant to walk on, but it has done the job of protecting structures. During the initial construction of the berm system by the Corps of Engineers, nearly 3,000,000 yd³ (2,295,000 m³) of fill material were pumped onto the beach. In 1966, 360,000 yd³ (275,400 m³) of material were added. Again in 1970, nearly 1,500,000 yd³ (1,147,500 m³) of fill were used to renourish the beach. The artificial berm at present (1978) is severely scarped along nearly the entire length of the island. Erosion is still occurring; the beach nourishment program will have to continue.



FIGURE 15. Aftermath of Hurricane Hazel (1954), Wrightsville Beach. Wreckage and pilings are remnants of the first two rows of beach cottages. The photograph was taken near the foot of Fayetteville Street. Hazel piled up water on the streets 8 feet above normal high tide. (E. Helms collection)

Masonboro Inlet, separating Wrightsville Beach from Masonboro Island has been a fickle inlet during the past 40 years. On occasion the inlet has been extremely wide and shallow, at other times narrow and deep. It has migrated back and forth across a 2.42 km (1.5 miles) stretch from just north of its present location to approximately 1.61 km (1 mile) south on Masonboro Island. The Corps of Engineers has attempted to stabilize it by constructing a jetty seaward from Wrightsville Beach along the north (updrift) side of the inlet (Figure 18). The Corps also dredged a permanent channel to accommodate boat traffic to and from the ocean. The spoil from this dredging was placed on the southern end of Wrightsville Beach and the northern end of Masonboro Island.



FIGURE 16. Hurricane Protection Project, Wrightsville Beach. This view is south from the Blockade Runner Motel. The swale (arrow) in front of the houses on the right was the beach before the project was undertaken. The houses are those left standing after Hurricane Hazel in 1954. A row further seaward was obliterated by the storm.

Note the jetty construction. The portion of the jetty nearest the shore is low and narrow. It was constructed in this manner to act as a weir. Sediments moving along shore were to be carried across the jetty into a previously dredged depositional basin on the Masonboro Island side of the jetty. From here, the trapped sand was to be pumped periodically to Masonboro Island to nourish the downdrift side of the jetty (Figure 18). This unique system has not worked. The inlet gorge has shifted northward (jettyward) from its original position to a point where it now threatens to undermine both the sheet metal weir and the outer rock jetty.

The Corps of Engineers has armored the bottom of the channel with large stones, but a major storm is capable of removing this armor and undermining the jetty. Boats

now must pass close to the jetty in order to navigate the inlet. The numerous temporary buoys in the vicinity of the inlet attest to the rapid and unpredictable shoaling of the inner portions of the inlet. Marsh islands are visible within the salt marsh, landward of the inlet. These islands were discussed previously (Stop 2).

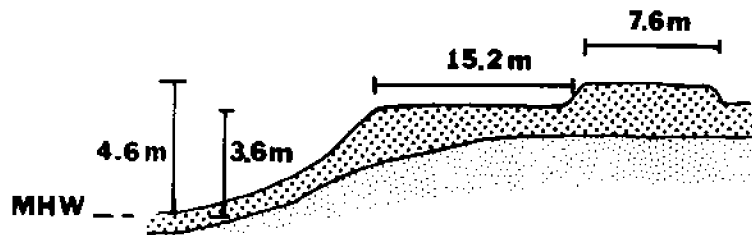


FIGURE 17. A diagrammatic representation of the beach-berm Project for Wrightsville and Carolina Beaches. The plan called for 2 large berms with fill material added seaward to approximate the natural slope of the beach.

A positive feature of the jetty system is that the southern end of Wrightsville Beach has been building seaward as sand in the littoral drift has been impounded by the jetty. As you face the ocean, note the greater deposition on the left side (updrift) of the jetty. A jetty has been planned for the south side of Masonboro Inlet. A model of the inlet has been constructed and data are being analyzed in order to assess the impact of a second jetty on the dynamics of the inlet. If you are going to Masonboro, embark on the sound side of island or from the vicinity of the Coast Guard dock. Appendix B includes a discussion of the physiography, environment

and organisms which you may encounter on the island.



FIGURE 18. The Wier Jetty at Masonboro Inlet. The jetty built as part of the Masonboro Inlet stabilization project has served to impound sand on the updrift side (left). As a result of this impoundment the southern end of Wrightsville Beach is slowly prograding. The inlet channel has shifted and is generally migrating toward the rock wall. Plans call for a second jetty to be constructed on Masonboro Island in an effort to stabilize the channel.

STOP 7. MASONBORO ISLAND. Masonboro Inlet migrated to cover the northern 1.61 km (1 mile) of Masonboro Island during several periods in the last 40 years. This part was finally stabilized by the Corps of Engineers in 1958 . . when material dredged from the inlet was deposited on the island. Since that time natural dunes have developed along the ocean side and highly productive salt marsh has begun to develop along the sound side.

Spoil material was dumped in high mounds along the center of the old inlet area. The spoil material was piled so high that the native vegetation has not developed well on this surface. The Corps of Engineers, however, created an area favorable for nesting birds. Several species of birds, including least terns, oystercatchers, and black skimmers, prefer poorly vegetated sites for their nests. All three of these species nest on this section of Masonboro Island.

Note that a portion of the old inlet area was not fully filled in by the dredge spoil. Here, the island is low and chronically overtopped by wave activity. It is a likely spot for a new inlet to develop.

From the high dune along the southern limit of Masonboro Inlet, the view to the south shows an alternating pattern of intact and flattened sections of the beach. Where the dunes have been destroyed by the changing pattern of beach sediment transport, storm waves have overtopped the berm crest and caused sand and water to spill across the island. For thirty years prior to 1954, such breaches of the dune ridges were not very important. Since Hurricane Hazel, however, these washover areas have expanded, breaching more and more dune lines. Washover is now a dominant environmental factor on Masonboro Island.

The State of North Carolina is currently considering Masonboro Island for a state park, since much of the New Hanover County shoreline is already developed. Due to the width and storm protection afforded on the island, as well as the processes which now dominate, development would be severely restricted. Thus, a park would be a natural use for the island. In addition, the extensive salt marshes occurring behind Masonboro Island are much too valuable to destroy for the sake of private development.

Leave parking area and return by the same route to Crystal Pier; turn left and then right onto Waynick Blvd. About .48 km (0.3 mi.) north on the ocean side is the Sand Peddler Inn. This motel rests on marsh that was dredged and subsequently filled with material from Banks Channel in 1914. Early records show the sub-aerial portion of the island prior to development was relatively narrow. The year 1899 marks the date of the incorporation of Wrightsville Beach and also the occurrence of a devastating nor'easter. The developed section of the beach at this time consisted of about 60 cottages and several hotels, most of which were completely leveled. After the storm, many of the cottages, along with boats and large oaks, were found strewn along the soundside shell road. Less than 40 years later (1934), after much of the beach had been rebuilt, a major fire destroyed a large portion of the area north of Station One.

11.2 Turn left on U. S. 76 (Causway Bridge). International Nickel Corrosion Laboratory is on your left.

11.4 HARBOR ISLAND. Turn left at the first street off bridge at Wrightsville Methodist Church.

This area was called at one time the "Hammocks" (1890) and later "Shore Acres" (1925). The gnarled oaks and junipers are relics of a once major maritime forest. Prior to 1890, when development began, the forest canopy provided a nesting area for cranes and other birds. The feather industry provided plumage for the fashions of the day by the wholesale killing of these birds. The ten acres of the original hammocks consisted of sand dunes and adjacent marshlands. Vegetation patterns of the time of development indicate that Harbor Island is several hundred years old. Presumably its origin is related to early inlet migration and marsh island formation.

By 1888 population pressures in New Hanover County provided the impetus for the construction of a 1.6 km (1 mile) railroad trestle across the marsh to the Hammocks. At the same time the Wilmington and Sea Coast Railroad opened the Island Beach Hotel on Harbor Island, the terminus of its railroad, which originated at Wrightsville Station on the mainland. A foot bridge across Banks Channel was also added for the convenience of the public.

In July 1888, yellow coaches of the Wilmington and Sea Coast Railroad began shuttling passengers from the mainland to the island edge, eliminating all but a short walk to the beach. By 1889, several bathhouses were constructed on the foot bridge. Modern Harbor Island was created in 1925 by dredging and bulldozing the original island at cost of \$400,000. A total of 350,000 yd³ (267,750 m³) of dredged material were used in the construction project. Live Oak Drive is but a vestige of this unique area.

- 11.7 *Continue on Live Oak Drive. Bear left around the circle and then right. Turn right on Shore Drive and continue to U. S. 76.*
- 12.1 *Stopsign. Zip Mart on right, turn left, follow U. S. 76.*
- 12.4 *Sea Path condominium built on filled marsh (left).*
- 12.5 *Water Research and Technology Desalination Plant (right).*
- 12.8 *To the left is the Old Causeway. The 1926 beach season opened with automobiles traveling to Harbor Island across the newly constructed causeway, which included a 167.6 m (550 feet) bridge adjacent to the mainland. Total cost was \$138,000. Beach officials in 1935 replaced the foot bridge with a wooden bridge over Banks Channel. Wrightsville Beach was no longer isolated and in time the trolley railbeds were covered with asphalt. Today they underlie parking lots and major streets.*
- 12.8 *Atlantic Intracoastal Waterway.*
- 12.9 *Babies Hospital. During Hurricane Hazel in 1954, water stood in the parking lot of the hospital.*
- 13.2 *Follow U. S. 76 West. Bear left, inside lane.*
- 13.5 *Shopping center on right.*
- 14.5 *Bradley Creek. East of the bridge on the north side, close to the point where the creek enters the sound, is the location of the first hotel constructed at the seaside in 1879.*
- 14.9 *Stoplight. Turn left onto Greenville Loop Road. To the right in the wooded area was the Salt Works.*

During the Civil War, local people collected salt, a prized commodity, by evaporating sea water.

- 17.4 Tidal Creek - White Oak Drive. Black needlerush is the most common species in this section of the creek.
- 17.8 Fish Camp Restaurant. *Turn left onto Masonboro Loop Road.*
- 18.6 Hewlett's Creek. *Bear right following Masonboro Loop Road.*
- 20.9 Whiskey Creek. It's not too difficult to ascertain the occupation of the early inhabitants of this area. *Stay on Masonboro Loop Road.*
- 22.9 Sea Skiff Boat Builders on left.
- 26.5 *Junction Masonboro Loop Road and U. S. 421. Proceed across median and turn left onto U. S. 421 south. Head toward Carolina Beach.*
- 28.9 SNOW'S CUT.

You are now passing over Snow's Cut, a land cut across the narrow peninsular section of New Hanover County. The cut is named after a major with the U. S. Army Corps of Engineers who was stationed in Wilmington and headed the dredging operation at Federal Point in the early 1930's. The earlier highway was located to the west. It was completed in 1929. During the late 1950's, the low swing bridge over U. S. 421 was replaced by the existing high rise bridge. To the left is Carolina Beach extension and the ocean. To the right is the Cape Fear River (Figure 19).

Note the exposure of coquina (loosely cemented limestone) on the right. The remnants of Sedgeley Abbey lie off to the right near the river. The mansion was supposed to have been constructed of this rock in 1726. Snow's Cut is approximately 2.9 km (1.8 miles) long, 27.4 m (90 feet) wide and 3.66 m (12 feet) in depth. On a falling tide, Cape Fear River water (recognized by its chocolate brown color) moves through Snow's Cut into Myrtle Grove Sound. From there it moves out to the ocean through Carolina Beach Inlet. The mixing of ocean and river water is retarded by the density differences, thus a distinct brown cloud can be seen to spill out of the inlet and migrate along the shore. A Corps of Engineers spokesman has indicated that due to the

environmental problems created by the cut, such a project would probably not have been approved today.

- 29.5 Carolina Beach State Park is located just off of U. S. 421. Camping, fishing, boating and nature trails are available in the park.
- 30.4 Turn left at first traffic light onto King St. (City Hall is on right).
- 30.5 Turn left and proceed north on Canal Drive.



FIGURE 19. Snow's Cut and the Cape Fear River. This view is from atop the Inland Waterway Bridge. Coquina limestone outcrops in this cut along both banks. This late Pleistocene deposit was used in the early development of Carolina and Kure Beaches as a building material.

32.1 STOP 8. CAROLINA BEACH PIER. *Stop and park your car.*

The ramp to the pier provides an excellent view of an area which has been undergoing severe erosion. To the north is Carolina Beach Inlet and to the south is the town of Carolina Beach. Prior to 1952, the section of Carolina Beach to the north was attached to Masonboro Island. In January 1952, a public hearing was held in order to act on a permit request to open a tidal inlet 2285 m (7500 feet) north of Carolina Beach. Although the Beach Erosion Board advised that erosion to the south would likely result, support for the inlet project was overwhelming. The Corps of Engineers granted the permit. In September, the inlet was created and the trouble began (Figure 20).

Erosion at Carolina Beach before the opening of the inlet was approximately 18.3 cm (0.6 feet) per year. Following the opening of the inlet, erosion increased dramatically to 3.96 m (13 feet) per year (1952-1955). The hurricanes of 1954 and 1955 were devastating on Carolina Beach Extension. Overall, since 1952, the erosion rate along the northern portion of Carolina Beach has averaged 12.24 m (40.2 feet) per year.

Indicative of the effects of the inlet is the fact that the greatest measured erosion rate has occurred along the segment closest to the inlet. The sediment trapped by the inlet has caused Carolina Beach Extension to become a feeder beach for the southern section of Carolina Beach.

So, a dilemma exists. Carolina Beach Inlet is largely responsible for the erosion experienced by the town of Carolina Beach; however, the same people who are asking for erosion control measures on the beach also oppose closure of the inlet which is now a well established outlet for fishing interests in the area. Further, lack of maintenance has now produced a hazardous, nearly unnavigable inlet.

South of the inlet, beach erosion has carved into the shoreline which terminates against the north end of a rip-rap seawall. Remnants of the earlier wall plus a groin portray the history of several attempts to stabilize the coast. The engineering was carried out to save beach property at a long term cost that is certain to ultimately exceed the value of the protected property (Figure 21).



FIGURE 20. Northern extension of Carolina Beach. This view is looking north from Carolina Beach pier. Subsequent to the artificial opening of Carolina Beach Inlet (1952), erosion along this section became very severe. Increased erosion is caused by the retention of beach materials in the tidal sand bodies associated with the inlet. Recession is often accompanied by oceanic overwash. People walking on the beach (left of photo) are standing atop a thick outcrop of salt marsh peat (arrow) which has been exposed from underneath washover sediments.

The mainland area of Carolina Beach and Kure Beach also has a long, interesting, and expensive record of beach stabilization attempts. These beaches have long been adversely influenced by hurricanes and nor'easters. Their history is one of extensive loss of property and beach due to severe storms (Figure 22). From 1857 to 1934, Carolina Beach was experiencing an average recession rate of 70 cm (2.3 feet) a year. During this time erosion and accretion have been experienced, although, erosion has been predominant. Between 1940 and 1955 average recession along the beach was 4.47 m (14.7 feet) a year.



FIGURE 21. Beach stabilization project, Carolina Beach. This view is looking south from the pier on the northern extension of Carolina Beach. The beach has had an expensive record of beach stabilization projects (see text). The granite boulders that comprise the 2050' long seawall were emplaced between 1970 and 1973.

The Corps of Engineers report on erosion at Carolina Beach relates the damage due to hurricanes:

"Cottages nearest the ocean were smashed to pieces or lifted intact from their foundations and hurled against nearby cottages. The ocean face only was ripped from many cottages, while others had both front and rear ripped off, leaving only the shell. Boardwalks and piers were torn apart, with piles being twisted off. Sand, washed inland, was deposited 3 and 4 feet deep in the streets."



FIGURE 22. Damage caused by Hurricane Hazel (1954) at Carolina Beach. Damage by Hurricane Hazel was estimated at 17 million dollars. Note houses, sand, and rubble deposited by storm surges accompanying the hurricane. (A. Newton collection)

The first effort to protect the dwindling beach was made in 1955 when a dune ridge was constructed from Carolina Beach Inlet to Fort Fisher. It was not continuous, but broken by several drainage canals, a building, and the boardwalk. A total of 252,000 yd³ (192,780 m³) of beach fill was pumped from Myrtle Grove Sound to the beach. Sand fences were constructed and a rock rubble groin was built at the foot of Hamlet Street. This project lasted approximately 7 months. The hurricanes of the season of 1955 scattered the rubble groin and removed the fill material.

In 1956, 200,000 yd³ (153,000 m³) of fill were pumped to the beach and 12 low short groins were spaced along the beach within the Carolina Beach corporate limits. They were composed of concrete and granite rubble. But money ran out and they were never completed.

In 1962, the Corps of Engineers authorized a project of 7860 m (25,800 feet) of shoreline protection from Carolina Beach to Kure Beach. Kure Beach could not come up with the matching money and only approximately 4265 m (14,000 feet) of beach berm were actually constructed. The project was similar in design to that at Wrightsville Beach (Figure 17). It called for the construction of an artificial dune with a berm placed seaward of the dune. A naturally sloping beach was to be constructed seaward of the berm. A feeder beach north of Carolina Beach was also proposed and periodic nourishment was provided for in the plan.

In 1965, the plan was implemented: 3,500,000 yd³ (2,677,500 m³) of fill from Myrtle Grove Sound, Carolina Beach Inlet and the Intracoastal Waterway were pumped to the beach along 4268 m (14,000 feet) of Carolina Beach. Erosion in 1966 led to the pumping of more sand in 1967 (370,000 yd³) (283,050 m³), 1970 (346,000 yd³) (264,690 m³) and 1971 (760,000 yd³) (581,400 m³). Then, in 1970, a 335.1 m (1100 feet) granite boulder seawall was built. In 1973, the seawall was extended both north and south for a total distance of 624.6 m (2050 feet) (Figure 21).

Proceed south along Canal Drive, retracing your path toward City Hall.

- 33.8 *Stoplight. Turn right onto King St. and then left onto Lake Park Blvd. This section is typical of the highly commercialized section of the beach. Very little planning has gone into the development in this area. In this portion of New Hanover County much of the beach area has been altered. Those things which make the beach attractive to some visitors have nearly vanished (Figure 23). The area through which you are now passing is not a barrier island; it is a mainland beach. Note the lack of a lagoon or sound side marsh in this environment on the right.*

Carolina Beach began to develop toward the end of the nineteenth century. In the early 1880's, the only means of transportation to the beach was by way of poorly paved shell roads. In 1886, several enterprising citizens organized the New Hanover Transit Corporation which erected a pier just south of Snow's Cut on the Cape Fear River. From this dock, passengers arriving by steamer from Wilmington were transported to the beach by a narrow gauge railroad.



FIGURE 23. Carolina Beach business district. Unlike Wrightsville Beach, Carolina Beach is characterized by tightly congested midway and carnival attractions.

Because there were no inlets to contend with, because it was easy to get to the beach, and because there was no undertow, Carolina Beach was considered to be the Atlantic City of the South. By 1890, several large hotels and numerous make-shift cottages dotted the beach. Development prior to 1925 was relatively slow compared to Wrightsville Beach because of the poor transportation routes.

- 33.9 *Bear left at fork in road.* This section of U. S. 421 has frequently been closed due to water ponding in this natural depression. The lake to the right may represent a drowned creek now dammed by the beach.

Hurricane Hazel destroyed the first brick hotel, the Breakers, built on the shoreline in 1924. It was located at the corner of Ocean Blvd. and South Carolina Ave. (Figure 24). The debris and piles of rubble from

the Breakers Hotel were hauled to Fort Fisher to help curb the erosion there.



FIGURE 24. Breakers Hotel, Wilmington Beach. This portion of the mainland beach suffered severe damage. Red brick rubble from the Breakers now lines the shoreline at Fort Fisher. (A. Newton collection)

34.9 Wilmington Beach.

36.0 International Nickel and U. S. Government Cooperative Metal Corrosion Testing Site is on the left.

Salt spray corrosion of materials in the coastal zone is a significant problem. Metal plumbing and fixtures exposed beneath older stilt houses along the North Carolina coast often show extensive corrosion damage. Newer cottages are using the less expensive and corrosion-resistant PVC piping.

Plants also are strikingly influenced by salt in the coastal air. Shrub and tree species are often 'wind pruned' by the salt-laden air which passes over the vegetation from the beach. As a result, the vegetation

takes on a smooth, clipped appearance. Twigs, leaves and buds which receive the most intense salt spray are killed back, thus only the more protected parts of the plant grow normally. The dominant wind directions can be determined from observing the pattern of wind pruning.

36.4 Kure Beach corporate limits.

36.8 STOP 9. KURE BEACH. *Stoplight, turn left.*

Kure Beach is a mainland beach. Notice the difference in local relief from the main road to the high tide line. Compare this with Wrightsville Beach. The local relief is approximately 7.31 m (24 feet). About 1890, an enterprising young Danish sea captain, Hans Kure, began to develop this area in much the same manner as Carolina Beach.

The road to Kure Beach, 3.22 km (2 miles) south of Carolina Beach, was in all likelihood very poor at the turn of the century. In order to attract more summer residents, a pier on the river and a narrow gauge railroad were constructed in the spring of 1904 similar to that constructed at Carolina Beach in 1889. The new construction helped to lure visitors to the Kure Beach but a hard paved road was essential to the development of this and other sections. A joint venture between the local development companies and New Hanover County extended the paved road to Federal Point. Hans Kure extended it 3.62 km (2 1/4 miles) by building a plank road to Fort Fisher. Some of the road metal and support stones were derived from the coquina that outcrops at Fort Fisher.

The pier directly in front of you is the second-oldest fishing pier on the East coast, built in 1927. One of its claims to fame is the fact that it has been rebuilt twelve times, the most recent rebuilding occurring after Hazel (1954). To the left (north) of the pier the town has recently constructed an additional 15.23 m (50 feet) of bulkhead (Figure 25). Look around and notice the concrete strewn about in front of this section. This rubble is the remains of earlier sea walls - a common American beach scene.

Hurricane Hazel, cut away the first two streets of Kure Beach. The present beach road was the third street west of the high tide line prior to 1954. This storm, the third or fourth most intense ever to hit this section of North Carolina, exhumed stumps of a forest of cypress and cedar that are possibly hundreds of years old. Similar "forests" are now exposed on Oak Island in Brunswick County.

North of the bulkhead the remnants of the intake pipe of the Dow Chemical Co. Ethylene Dibromide Plant can be seen. The pipe was used for pumping ocean water to a canal 309.7 m (1000 feet) west of the Fort Fisher Road.

The plant, constructed in 1931, was built for manufacturing gasoline additives.

Return to your cars and proceed south on U. S. 421.

37.7 Entrance to Fort Fisher.

38.1 Fort Fisher Air Force Station.



FIGURE 25. Groins and bulkhead, Kure Beach. Note bulkhead, remnants of groins and condition of berm. Hurricane Hazel (Oct. 1954) removed one row of houses from this section of the mainland and unearthed a relict stump forest.

39.2 STOP 10. FORT FISHER HISTORICAL SITE. *Park in the lot on right.*

This historic fort area is of significant interest. The Fort Fisher area became in times of war a crucial area in defense of the important commercial navigation route on the Cape Fear River. New Inlet, 12.88 km (8 miles) north of Cape Fear, was opened by a hurricane in 1761. Fearing an influx of privateers, residents of the area kept secret the fact that New Inlet could accommodate vessels of up to 1.83 m (6 feet) of draft.

New Inlet, while providing an alternate entrance to the Cape Fear, and thereby the Port of Wilmington, was valuable to the Confederacy during the Civil War as a channel for running the Federal blockade of the Cape Fear River. Fort Fisher was constructed to guard New Inlet and as the last link in a series of defenses of the lower Cape Fear.

When completed, Fort Fisher was shaped like an L, with the angle pointing northeast to the sea (Figure 26). The land face, located about a mile and a half north of New Inlet, was a massive rampart of sand and sod which stretched across the peninsula from the riverside almost to the sea where it ended in a bastion at the point of the angle. From there, the sea face extended south for approximately a mile (1.6 km). The first hundred yards was similar to the land face, but the remainder was a series of mound batteries connected by infantry fences.

At a distance of a half mile (.8 km) or so from the terminus of the sea face, Battery Buchanan stood detached and isolated at the edge of New Inlet. It was a massive earthen mound with guns that guarded the inlet. It was also a potential stronghold to which a hard-pressed garrison might retreat and be transported away from a nearby wharf. At the time Fort Fisher was one of the strongest fortifications in the world. By some it was called the "Malakoff of the South" and by others, the "Gibraltar of America."

A coquina rock outcrop occurs just north of the picnic area. This is part of the same coquina which is also outcropping at Snow's Cut. Note the extensive erosion of the beach area near the picnic area. Historic records show that the erosion at this point has been approximately 366 m (1200 feet) since 1862. A portion of the fort has been removed by the erosion. Early excavation of the coquina by Kure for the Shell Road

probably contributed to the accelerated erosion (Figure 27).

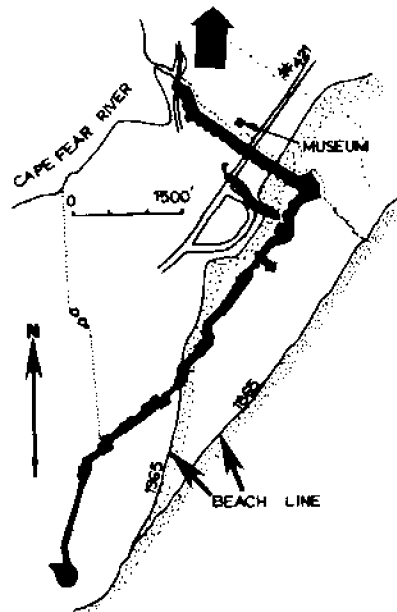


FIGURE 26. Map of Fort Fisher showing the location of the 1865 and 1965 shorelines. (Modified from Division of Archives and History Pamphlet 90M-6/75).

The live oak trees which are standing in the picnic area have been opened up to the full force of salt-laden air. Even these resistant trees are gradually dying because of the lack of dunes protecting their leaves from salt spray.

A worthwhile side trip is a visit to the museum (closed on Mondays). Take the short trail to the large mounds along the Cape Fear River. This vantage point provides a spectacular view of the river and the extensive marshes which border it.

- 39.2 Return to U. S. 421 south. Make a loop around the Fort Fisher Monument. To the south is the area of historic inlets which the fort was designed to protect. Further south is Cape Fear (Bald Head Island).



FIGURE 27. Mainland beach, Fort Fisher. This section of New Hanover County has one of the highest erosion rates in the state. Large boulders have been placed here to ease erosion. Erosion has continued despite these efforts. A coquina outcrop is seen in the background (arrow). This is the only natural, intertidal hard surface outcrop in North Carolina.

40.5 N. C. MARINE RESOURCES CENTER.

Return to U. S. 421 and drive south, to end of the road past the Ferry entrance on right.

41.2 STOP 11. "THE ROCKS".

A nineteenth century major engineering feat, "The Rocks" is located off to the right (west). In 1971, a storm, probably the most intense to hit North Carolina, opened an inlet between Bald Head Island and Fort Fisher. The opening became known as New Inlet. Early charts (prior to 1760) of this section indicate this general area was called the "Haulover" - most likely because it was the narrowest section of the shoreline where early fishermen could haul their small boats over to the river. No major inlet deep enough for large craft existed along this section prior to 1761 for at least 250 years. Early records show that only one pirate ship ventured up the river. Seeking refuge in harbors with only one outlet was considered risky business. Stede Bonnet who did sail into the Cape Fear River was captured and later hung.

The inlet that opened in 1761 remained open until 1881 when it was closed artificially by a dam. This dam has come to be known as the "Rocks" (Figure 28). An engineering feat of its day the dam was composed of siltstone, granite and basalt. These rocks were used to cap the upper sections of the mile long, 100 feet wide (at its base) and 30 feet high wall that separates the waters of the Cape Fear River and the open Atlantic Ocean. The Army Corps of Engineers contended that closure of the 120 year-old inlet would reduce the amount of shoaling in the river and help maintain the channel.

Closure was begun in 1881 when a log raft was extended across the river section and loaded with large limestone boulders until it sank, forming a foundation for future material.

Enough rock was used in this construction to build a wall one hundred miles long, eight feet high, four feet wide. It took 6 years and \$480,000. Later a dam twice as long was constructed. It stretched south from Zekes Island to Bald Head Island.

Since 1881, a number of inlets have opened, migrated and closed. As many as three inlets have existed at one time in this 8 km (5 mile) long section. Most openings are related to hurricane activity. Hazel's Inlet opened in 1954 and is now closed. New Inlet reopened in 1938 and is only a vestige of the earlier formed inlet. This inlet is relatively active and has

migrated over 3.2 km (2 miles) in the past 25 years.

You may walk out on the rocks to get a view of the river and the former inlet area. USE EXTREME CARE. The algal mat on the rocks is extremely slippery. A cut made by slipping on this surface heals slowly. Walk only on the dry surfaces.



FIGURE 28. Aerial photograph of the "Rocks" and the shoreline south of Fort Fisher. The dam was a major engineering feat of the nineteenth century. Upon completion in 1881, it stretched for one mile between the mainland and Zekes Island. The southern 2-mile section was completed in the mid-1880's. New Inlet which had opened in 1761 was used by the Blockade Runners during the Civil War and was one of the main reasons for the existence of Fort Fisher. Today this section of the shoreline is characterized by extensive narrow terraces and small fickle inlets.

FIGURE EIGHT ISLAND TOUR

Figure Eight Island is a private development with access via a private causeway. Permission is required to go onto the island which contains some of the most beautiful, well designed, and solidly constructed homes to be seen along the North Carolina coast. Large lots and some cottages designed to be in harmony with the landscape give the development an open, spacious look where the dune, maritime forest, and marsh have been preserved. On the other hand, portions of the development occupy areas of fairly frequent and severe washover as well as sites where inlets have previously been located.

- 0.0 *Drive onto bridge.* Bridge operator is guard. This interesting barge swing-style draw bridge provides the only land access route to the island. The island causeway leading from the bridge to the barrier island was constructed from sands dredged up from the original marsh to the left of the road. The dredged area was revegetated although unvegetated spoil piles remain along part of the causeway. Present laws probably would not permit such destruction of the salt marsh so that a much more expensive bridge would be necessary in place of a dredged causeway. Evacuation plans in case of an impending hurricane have been developed; however, the bridge remains a weak link in the plan. If it became inoperative, boats would be the only means of departing the island.
- 0.7 *Clubhouse on left. Ahead on the right, houses are* located on an artificial buildup of dredge fill with finger canals bisecting the flat. Much of the area is less than 3.2 m (10 feet) above mean sea level. Note that the causeway ends in an area of frequent washover; it is likely that the only access to the mainland would be the first area blocked by washover in a major storm. Figure Eight Island would not be a safe place to wait out a storm and early evacuation would be advisable. Full development of the island is planned. This would include more than 400 homes, providing a dwelling density equal to that of Wrightsville Beach today. The development is approximately 20% complete.
- 0.8 *Intersection. Continue left on Beach Road North.* This is an area of frequent washover as can be seen on air photos taken over the last 40 years. This site was the location chosen for constructing a large condominium complex by the Figure Eight developers. The Wilmington-New Hanover County Planning Board turned down the zoning

request on the basis of vulnerability of the site to washover.

To the right is a canal formed during dredging operations. This deep channel could possibly act like the dredged channel behind the Shell Island development on Wrightsville Beach (See Stop 2). This would mean that a storm could breach the beach connecting the channel with the ocean, thus forming an inlet. Homeowners on Beach Road South would then be on an island all their own.

- 1.0 Shrubs on flat to left mark the landward edge of a washover fan.
- 1.2 Cottage on right is built on a washover fan. Is it likely that it would survive a major storm?
- 1.3 Old vegetated dunes on right. *Take Salters Road to left.* Area to left is to be developed.
- 1.4 *Loop Cul-de-sac and retrace route along Salters Road.*
- 1.5 *Turn left onto Beach Road North.* From this point on the north the island is being "exclusively" developed. This northern portion of the island shows good evidence of stability. Note for example the vegetation on the right right which includes good sized trees, up to 60 cm (24 inches) in diameter, including juniper (Juniperus virginiana) and live oak (Quercus virginiana). Proceeding north, note that the road skirts the most mature island maritime forest in New Hanover County. In addition, air photo studies indicate that both the dune line and beach are accreting on this part of the island (Figure 29).
- 2.3 The house on left is good example of beauty, solid construction, and safe position - well behind the first dune and in the forested area - that typifies development in this area. The narrowness of the island plus the position atop the stable forested dune provide these island dwellers with a beautiful panorama of marsh, barrier island, and ocean. In addition to "stilts", there are main columns that extend from below ground through the second story.



FIGURE 29. View looking south from north end Figure Eight Island. The houses (right of photo) rest atop a forested dune with local relief in excess of 10.67 m (35 feet). Forest vegetation indicates the area has been stable for at least 50-75 years. This portion of Figure Eight Island is prograding.

2.4 STOP 1. PRE-1938 WASHOVER FAN.

A small breach or break in the forest on the left is the position of an old washover fan. Several such breaks occur through this area; however, all of these washover fans predate the 1938 air photos of this island, the oldest photographic coverage available. Currently, the beach is accreting so it seems unlikely that such washover would occur on this end of the island today. Contrast this condition to the area crossed at the end of the causeway.

Walk to the back of the island. The old cedar, live oak, yucca and shrubs suggest a long period of stability. You can see where the washover fan was deposited over the marsh.

2.6 STOP 2. CUL-DE-SAC.

Beach ridges and dunes extend north beyond the road's end and suggest stability. This area provides a good study of dune ridge development on accreting barrier as well as vegetation succession. Extensive development is proposed for this area.

- 2.8 The houses on the left have less protection than cottages in the forested area, but their location behind the dune is reasonable. If the trend of accretion is reversed, these houses certainly would be lost.
- 3.7 *Pass Salter Road Jct. and end of forest and washover fan.*
- 4.2 *Turn left onto Beach Road South.* To the right is a large area of filled-in marsh for development, and on the left are some old washover areas (pre-1938). Presence of occasional bushes and cedars on the primary dune show some stability.
- 4.7 The massive dunes on the left indicate an area which has been stable for a long time and rapid sand accretion.
- 5.5 Passing out of high dunes into lower, open, poorly vegetated area, note the black and white shell material on both sides of road. This material is pumped fill and is coarser grained than natural dune sand. As a result, revegetation has progressed slowly. Washover has occurred on this part of the island, primarily because Mason Inlet was further north than its present location. It has migrated south through this section since 1938 (Figure 30).

The developers of Figure 8 Island placed a large amount of fill on the beach berm to help stabilize the former inlet area. Houses placed here are now 4.3 m (14 feet) above mean sea level. In general, the combination of factors present on this end of the island make it a poor area for development. It is doubtful that the pumped-fill buildup will prevent washover. Perhaps it is appropriate that the less "exclusive" cottages are at this end of the island. Examples of good construction can be found, however, such as the cottage on the right at the corner of Beach Road and Jib which has external stilt posts that extend through the upper level. (Figure 31).



FIGURE 30. View looking south, Figure Eight Island. The large dunes (arrow) mark the location of Mason Inlet in 1938. Notice the sparse vegetation. The area shown in the photograph is primarily fill material pumped onto former low sandy flats. Emplacement of the fill provided elevated sites for home construction and created navigable waterways for homeowners.



FIGURE 31. The Bay house. The Bay house is an example of a well-constructed beach home. It is built so that the pilings are continuous from the ground through the second story. In more poorly constructed buildings, the upper story is attached to the tops of pilings, allowing strong winds and/or waves to literally 'rip the house from its foundation'.

- 6.1 STOP 3. CUL-DE-SAC: VIEW OF MASON INLET. The island is building by spit growth into Mason Inlet. A large amount of marsh area has been filled for development on the back side of the island, which is only a few feet above sea level. The beach on this end of the island is coarser, steeper, and undergoing some erosion in contrast to the northern section. Stabilization of the substrate around houses is an important consideration in development of a site.

Here, near the inlet, property owners have tried unsuccessfully to stabilize the dunes. The strong winds and shifting sands have prevented vegetation from being established. Beach sections near inlets are constantly shifting due to this lack of stabilization. As the inlet migrates under natural conditions, these unstable areas are removed from the influence of the abundant sand supply and gradually become stabilized by vegetation. There are, then, several reasons why coastal development should not take place in inlet areas.

THE BARRIER ISLAND ECOSYSTEM

BEACH

The beach ecosystem can be divided into 3 zones based upon physical environmental factors: a) the sublittoral, b) the intertidal, and c) the supratidal. In the sublittoral zone, the area never exposed by tidal fluctuation, burrowing organisms, scotch bonnets and other mollusks, sand dollars and other echinoderms and polychaete worms are found. Pelagic animals such as fish and crustaceans are abundant. They feed upon the rich populations of plankton characteristic of the nearshore areas. Blue crabs and brown shrimp are important crustaceans in the sublittoral zone. Many species of fish - puffers, pompano, flounder, bluefish, mullet and trout - are common in the troughs between offshore bars (Figure 32).



FIGURE 32. Beach ecosystem, Masonboro Island. This ecosystem is characterized by temperature and moisture extremes, as well as constantly pounding surf. The few organisms which colonize this environment are abundant due to the lack of competitors.

The intertidal zone, the area bounded by the high and low tides, is an extremely harsh environment. Only organisms adapted to the pounding surf and the shifting substrates are able to survive here. Coquina clams and mole crabs are very numerous in the sandy substrate. These organisms are filter feeders; they move in and out of the beach with the tides, feeding on plankton.

The supratidal zone, the area above the high tide, is characterized by temperature extremes and low water availability. Beach fleas, insects and ghost crabs are important animals in this zone. Ghost crabs dig deep holes in the sand to escape the intense summer heat while beach fleas accomplish the same by hiding under beach debris. Birds are an important component in the beach ecosystem. Many species of birds feed in nearshore waters, the surf, or in the swash zone. Terns and gulls are found commonly on the nearshore waters feeding on fish and crustaceans, while black skimmers fly low over the surf seeking small fish and crustaceans. Numerous shore-birds, including sandpipers, sanderlings, and plovers probe the wet sand of the swash for crustaceans and worms.

DUNES AND GRASSLANDS

The zone directly behind the beach is the dune field. The dunes are mounds of sand which have been produced and shaped by winds which influence the island (Figure 33). On Masonboro Island, the dunes are sometimes high and continuous, low and flat, or non-existent, depending upon the past history of the beach area. The source of sand for dunes is the open beach. As the tide moves out, moist sand is exposed to the drying air. As it dries it is picked up by the wind and blown landward. Any object such as a beer can or beach debris will trap sand and form a mound.



FIGURE 33. View of undeveloped Masonboro Island. The low single foredune ridge fronting a poorly vegetated grassland is probably what Wrightsville Beach looked like before development began. Erosion has occurred on Masonboro Island similar in magnitude to that experienced on Wrightsville Beach but since there are no structures on Masonboro Island, it goes unnoticed.

Under natural conditions, tufts of vegetation such as sea oats or sea elder trap the sand as it blows from the beach. These plants grow larger as sand builds around them.

Gradually the dunes become large and well-vegetated, thus stabilizing the areas so that other life forms not adapted to salt spray and/or moving sand can survive.

Blowouts are initiated by the destruction of the stabilizing vegetation. Winds move dry sand, creating a depression which may expand to several hundred feet in diameter. The dune zone is visited by numerous animals and many are residents of the area. Several species of birds, including the nighthawk and the least tern, use the beach or dune zone for nesting sites. Laughing gulls, herring gulls, common terns, least terns, and black skimmers often rest either singly or in flocks on the beach. The dunes also serve as nesting sites for birds such as the seaside sparrow and mourning dove. Glass lizards and six-lined racerunners are found searching for food in and around the dunes. Once a year terrapins move out of the estuaries and into the dunes to lay their eggs. Ants, ant lions, crickets, grasshoppers, cicadas, dragonflies, spiders, and insect pests such as mosquitos are the most common species which occur there.

The grassland ecosystem is located behind the dune ecosystem. It occupies areas which are moister and lower than the dunes. The vegetation consists primarily of grasses, sedges and occasional shrubs. The grasslands are rarely flooded by tidal water. Either high spring tides or wind tides may flood from the sound side. Thus, most plant species which occur here are able to survive short periods of salt water flooding.

The dominant grass and sedge species in the grasslands are salt meadow cordgrass, little bluestem, muhly, bulrush, *Fimbristylis*, finger grass and love grass. Important broad-leaved species include pennywort, *Sabatia* and seaside goldenrod. Grasshoppers, birds and small mammals are the major herbivorous animals within the ecosystem. Sparrows and red-winged blackbirds eat the seeds of several grasses. Coachwhip snakes, six-lined racerunners and glass lizards are occasionally found in the grassland ecosystem, while Fowler's toads and tree frogs visit the area to feed upon the insects which occur there. A great variety of insects, including ants, dragonflies, greenheads, deerflies, and crickets are common here.

The grasslands are also important to birds for nesting. Meadowlarks, sparrows, and mourning doves often nest in the dense grasslands. Barn swallows, marsh hawks, and nighthawks obtain food in this ecosystem.

SHRUB THICKET

Where the vegetation has been established for a long time, shrub species usually invade. Eventually, these areas may form a dense thicket of shrubs or a maritime forest. The thickets may be impenetrable or scattered and park-like. Shrub thickets grow in locations such as on the edges of the maritime forest, old stabilized dunes and dune swales. The shrub's stage of development depends upon the age and relative stability of the area. In closed thickets, the ground is nearly barren of herbaceous vegetation due to the lack of light penetration through the dense canopy. Within the more open thickets, grassland vegetation or black needlerush marsh is interspersed among the shrub patches (Figure 34).



FIGURE 34. Dense shrub thickets are present in strips on Masonboro Island. Shrub thickets are most common on Masonboro Island in areas which have received only minor washover impacts.

On Masonboro Island the most common species of shrubs, wax myrtle and marsh elder, along with the small shrubby sea ox-eye, dominate. The vegetation occurring in the shrub thickets commonly exhibits the effects of salt spray pruning.

When viewed aerially the shrubs are uniformly pruned in the direction of the dominant, salt-laden winds.

Grackles and red-winged blackbirds nest in the shrub thicket and usually feed in and around the thicket on insects and seeds. Insects - such as butterflies, dragonflies and mosquitos are common.

MARITIME FOREST

On higher elevations where the substrates are unaffected by salt water flooding and heavy salt spray, maritime forest may occur. This forest is the climax of the successional process and is the stage following the shrub thicket. On Masonboro Island only two small patches of forest occur (Figure 35).



FIGURE 35. Maritime live oak ecosystem, Masonboro Island. The maritime forest is dominated by evergreen tree species including live oak, loblolly pine, red bay and red cedar. Only two small patches of maritime live oak forest are found on Masonboro Island.

From the air, the forest appears to be a uniform surface of leaves of different hues produced by the very dense, salt spray-pruned canopy and spreading vines. Occasionally dead branches project above the general level of the canopy and suggest the fate of trees which grow high into the salt-laden air. From inside the forest, gnarled and twisted trees with strong lateral branches show the results of salt spray on the growth of the trees. The undulating topography of the forest floor demonstrates that the forest is growing on what were

once dunes.

The maritime forest is composed of tree species which are relatively resistant to salt spray, but their contorted shapes indicate that they do suffer damage from the salt air. Live oak is the dominant tree and one of the most salt spray-resistant tree species on the seashore. Cedar, American holly, hercules' club, and loblolly pine are important overstory trees. Occasional spleenworts and cacti are found within the maritime forest. The bromeliad, spanish moss, and a variety of lichens cover the branches of the live oaks and other trees, creating an eerie and forbidding appearance. Vines are important components of the forest. Virginia creeper, grapes, cat briar and poison ivy occur throughout the canopy, sometimes in dense mats across the top branches of live oaks or other trees.

TIDAL MARSH

To the rear of Masonboro Island, broad expanses of tidal marsh are present (Figure 36). The dominant factor controlling the marsh ecosystem is the ebb and flow of the tides. The rigorous environmental conditions produced by tidal action has resulted in a relatively simple, but highly productive ecosystem. Plants and animals which are adapted to the alternating wet and dry environment, the heating and cooling, the low soil oxygen, and the varying salinities flourish in the tidal marsh.



FIGURE 36. Salt marsh and mudflat environments. Masonboro Island fronts an extensive area of mudflats, sandflats, saltmarsh and subtidal bays. Development of the island would likely sacrifice some of these environments and probably contaminate others with various pollutants.

Two types of tidal marsh are generally recognized: the regularly flooded salt marsh and the irregularly flooded salt marsh. Smooth cordgrass is the dominant plant of the regularly flooded marsh while black needlerush and sometimes salt-meadow cordgrass, dominate the irregularly flooded marsh. The needlerush marsh is usually on higher ground than the smooth

cordgrass marsh and as a result is flooded only by the higher tides; the spring tides produced by wind will also flood the needlerush marsh.

As the areas dominated by cordgrass accumulate sediments, they grow upward until the tidal flow does not provide sufficient new sediment to allow continued accretion. Barring changes in the level of the sea, erosion or compaction, the salt marsh then remains stable.

Large areas of irregularly flooded marsh are developed after needlerush seeds germinate and grow above the regularly flooded marsh. The rushes expand, soon dominating the occasionally flooded areas.

Within both ecosystems, the plant cover is so dense that little light penetrates to the surface and few other plant species occur. Where smooth cordgrass stems are smaller or more scattered, associated species such as glasswort, sea lavender and gerardia are present. In high sites of the needlerush marsh, sea ox-eye and pennywort are common. Occasional large shrubs of sea myrtle tower over the dense needlerush.

The substrates of the tidal marsh communities differ somewhat. In the vicinity of smooth cordgrass, peat accumulates from deposition of decaying salt marsh material and silt transported from inland by rivers flowing into the estuary. The black needlerush dominated areas usually contain less silt and organic matter and are characteristically a sandy peat.

Over a period of time, salt marshes become dissected by tidal creeks which are produced by the flow of tidal water from the marsh surface. Within and on the banks of these creeks, many estuarine animals seek food and shelter.

Numerous animals find food, shelter, and/or nesting sites within the tidal marsh ecosystem. Many of them burrow into the sandy or peaty substrates to avoid the environmental fluctuations which occur on the marsh surfaces throughout the year. Razor clams, lugworms, and quahogs burrow into the oxygen-poor substrates. Other animals living on the surface of the marsh include fiddler crabs, mud snails, and ribbed mussels. The marsh abounds with insects. Grasshoppers, plant hoppers and biting flies such as mosquitos and green-heads feed upon plants or other animals within the tidal marsh ecosystem.

Blue crabs, terrapins, salt marsh minnows, and shrimp are common animals of the tidal creeks and adjacent sound

waters. These organisms depend upon the marsh for their food. Birds are especially abundant here. Various shorebirds and marsh birds are found seeking food along the edges of the marsh. Other species, such as the seaside sparrow, nest within the salt marsh vegetation. Marsh periwinkles are found in large numbers moving up and down the stems of the smooth cordgrass with each ebb and flow of the tide.

Productivity in the tidal marsh ecosystem is higher than on most intensive agricultural land. With the exception of some material eaten by grasshoppers and other herbivores, the tidal marsh ecosystem has a detritus-based food web. Dead and decaying plant material is at the base of the food web. Mussels, clams, fiddler crabs, and insects feed upon the decaying material and are in turn fed upon by the salt marsh carnivores: mice, gulls, terns, rails, ducks, red-winged blackbirds, and marsh hawks.

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