An Experiment in Archeological Site Stabilization

Cumberland Island National Seashore

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Changes in the natural and cultural environment on and around Cumberland Island National Seashore are accelerating shoreline erosion; the rate of loss of unprotected cultural deposits has increased accordingly. Surprisingly, along the northwest shore between Terrapin Point and Cumberland Wharf, the tidal marsh zones are stabilizing thanks to an increase of naturally deposited oyster shell rakes (dikes). Construction of an experimental, artificial rake emulating this natural phenomenon was undertaken to expedite the revegetation of a static marsh zone, and thus help stabilize the bankline and its cultural deposits.

Numerous significant archeological sites and cultural resources are being severely degraded through cutbank shoreline erosion on the western side of Cumberland Island National Seashore, Georgia (see map). Wind- and boat-generated waves, daily tidal fluctuations, and the deepening of the inland waterway are taking their toll.

Concern over accelerating shoreline loss led to a program in 1987 to determine the rate of bank-loss at two sites, Brickhill Bluff (CUIS-24) and Dungeness Wharf (CUIS-6). During the first year of the monitoring program, average losses of six inches at Dungeness and four feet at Brickhill Bluff were recorded; it was imperative that some stabilization measure be implemented.

An October 1988 inspection of the western shore however, indicated that while some portions of the shoreline were eroding, others were rebuilding and stabilizing. Several areas near the northwest end of the island between Terrapin Point and Cumberland Wharf were developing stable tidal marsh zones. This evolution was attributed to the formation of naturally deposited oyster shell rakes.

The rakes, rising to a uniform height of about two feet, varied in basal width according to the wave force factors that caused the shell deposition. This tightly compacted shell is resistant to low tide wave action and further stabilized by submersion during high tide. Rather than forming parallel to the island's shoreline, the orientation of the natural shell deposition runs parallel to the dominant wave alignment.

Contiguous rake formation occurs in such a manner that enclosures develop along the low tide line. These miniature stilling ponds act as settling basins for silts and sands carried by the Cumberland River (Photo 1).

Tidal incursion fills the ponds, allowing sediment to accumulate as the tide goes out. The tightly compacted shell (Photo 2) provides an erosion resistant armor on the active wave side while allowing water trapped behind the rakes to filter through. Once sufficient silt is deposited in these small basins, colonies of grasses begin to develop. Notable among these are three salt and submersion tolerant species: *Spartina alterniflora, Spartina patens,* and *Distichlis spicata.* As the grass colonies expand, additional silts are trapped reducing the force of incoming waves.

The buffering action of a well-established, submerged plant colony at the lower marsh levels allows the subsequent evolution of herbaceous species, such as *Juncus roemarinus* and *Salicornia virginica*, at slightly higher elevations. These species provide high marsh soil protection as a result of the damping action of the leaves and the binding action of the root system. Above this band of marsh grasses and in areas less frequently inundated by high tides, woody species, such as the prolific false-willow (Photo 3) and high-tide bush, serve to hold the base of the cutbank in place.

Imitation of this marsh development and land building process, with its natural healing mechanism, was determined the best plan to follow for protecting the shoreline.

The Experiment

The Brickhill Bluff site (CUIS-24) along the Brickhill River was the chosen location for the experiment. This site represents prehistoric and historic Indian occupations, and is the probable setting of the 16th-century Spanish Mission known as San Pedro y San Pablo de Puturiba. It has also been recommended for nomination to the National Register of Historic Places.

At CUIS-24, the river measures about 0.3 miles wide and provides a relatively long (1.5 mile wave fetch) course for northwesterly winds resulting in shoreline exposure of approximately 2,000 linear feet of midden materials. These cultural deposits vary in thickness and range in depth from 6 to 24" in an almost vertical bankline that reaches a maximum height of 4' (Photo 4).

The soil of the 50' wide "beach zone" between the bankline and the river consists of a very sandy loam. This sandy deposit lies on a tightly compacted Pleistocene salt marsh deposit that is marl-like in composition. Prone to the effects of storm driven tides and the higher tidal levels associated with the lunar cycle, the soil has eroded to the Pleistocene deposit. Vegetation is virtually absent unless a sand/soil covering is present to support root growth. Where the marl is covered, several species of grass have re-established. In the past 15 months, approximately one-third of the "beach zone" has begun a natural revegetation.

The specific area selected for the stabilization experiment was a section eroded down to the Pleistocene marsh surface and covered with only a thin sand deposit. The terrain was essentially barren of invading marsh grasses (Photo 5). Tidal transport of sand was no longer effective.

Once the location and alignment of the artificial rake was determined and its length approximated, the collection of dead oyster shell began. * Numerous natural rakes are located along Cumberland Sound and on the Cumberland River; one location on each waterway served as the primary sources of shell acquisition. At low tide, the rakes were some six feet above the water line, exposing a slope of Pleistocene marsh deposit and making it impossible to fill the bags and load them for transport to the site by boat. At high tide, the base of the rakes on Cumberland Sound was covered with about two feet of water, leaving the shell more easily accessible. A similar situation existed at the Cumberland River rake. Shell had to be loaded on the boat and transported during periods of high tide.

It was concluded that a shell rake could not be imitated by simply piling shell on the beach; tidal activity would quickly spread the shell into a thin sheet. The solution was to fill burlap bags with the shells. The bags are strong, porous enough to permit the passage of both water and silt, and they are biodegradable.

Shell was shoveled into the bags; when about three-fourths full, the bags were closed with twisted wires. The estimated weight of each bag was forty pounds; when laid flat, each sack spanned about 30". Two hundred eighty bags were filled from the two locations and transported to the area to be tested. The bags were laid out in a semicircle in two parallel adjacent courses with a third course resting on top. The rake thus measured about 2.5' high, 4' wide, and covered a semicircular distance of about 178'. The bankline protected by this arc spans a distance of 155'. It took about three days to fill, transport, stock pile the bags at the site, and lay them in place (Photos 6 and 7).

Once the bags were situated, only one high tide was observed before the team's departure from the Island. At the lowest point, tidal water flowed over the bags and into the artificial stilling basin. Inside the enclosure, silt particles could be seen settling out of the water. Marine life, particularly blue crabs, quickly found the nicks and crevices between the bags. As the tide receded, crabs moved back and forth across the tops of the bags, inspecting and apparently preferring their new environment.

The original intent was to transplant marsh grass in the area enclosed by the artificial rake. The rate of natural revegetation adjacent to the experiment suggested that it might be best to let nature take its own course. Furthermore, an appropriate growth medium (sand and silt) to support the revegetation had yet to form. If the projected accumulation of fill material occurs as predicted and vegetation does not result, a transplanting effort will then be undertaken.

Final Protection Step and Monitoring

Cumberland Island has a sizable population of wild pigs and horses that forage and graze along newly established marsh grass communities. To protect the rake and revegetation experiment from predation, strips of GEOWEB were installed on paths leading down to the rake. This material opens into squares and acts similar to a cattle guard; neither pigs nor horses will cross it.

The rake will be inspected on a regular basis to insure that mechanical failure does not occur. Stakes rising three feet above the original ground surface inside the enclosure will be used to chronicle the rate of sand/silt accumulation and the hoped for natural invasion of marsh vegetation.

For additional information, contact John Ehrenhard at the National Park Service Southeast Regional Office, 75 Spring Street, SW, Atlanta, GA 30303. Future articles about this project will report on results and costs associated with this experiment.

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NPS has a cooperative agreement with the University of Mississippi to be involved with site stabilization in the U.S.

*Regulatory responsibility for the Intercoastal Waterway that lies to the west of the Island, and for the tidal marshes that are a part of the National Seashore is vested in the Corps of Engineers and Georgia's Department of Natural Resources. It was necessary to obtain permit authority from the Corps to initiate the project. Permission from the state was required to recover a sufficient quantity of dead oyster shell from storm deposited rakes to complete the actual installation of the imitation rake.

Further scheduling problems arose when Hurricane Hugo struck the Carolina coast. While Cumberland Island was not directly affected, destruction in other National Park Service facilities drew manpower and equipment away from the stabilization project. Fieldwork was finally completed between June 7 and June 10, 1990.