

Biological and Physical Aspects of Dredging On Cumberland Island National Seashore

By Stephen V. Cofer-Shabica

Cumberland Island National Seashore (CINS), established by Congress on Oct. 23, 1972, is well known for its marine turtles, abundant shorebirds, dune fields, maritime forests, fishing, marshes and tidal creeks and flats, and historic structures. CINS is 25.7 km long and totals 13,342 ha. of which 6,821 ha are marsh, mudflats and tidal creeks. It was established to preserve the scenic, scientific, and historical values of the largest and most southerly island off the coast of Georgia (PL 92-536, 92nd Cong. S.2411.)

The Kings Bay Environmental Research Program was conceived in 1986 by the U.S. Departments of Interior and Navy to evaluate the relationships between submarines and their shipping channels, marshes, barrier island shorelines and dunes, notably those of CINS, Georgia and Amelia Islands (Florida), and tide-flats. The Program focuses on the potential effects of the deepening, from 12.7 m to 15.5 m, of the Kings Bay Trident Submarine Base ship channel. The channel is almost 35.2 km long, extending from Kings Bay, through Cumberland Sound, out the St. Marys Entrance to the 15.5 m contour, 19.2 km offshore. The removal of approximately 26.8 million cubic meters of dredged material was required.

Coastal Monitoring Plan

A 5-year study (1988-1992) was set up to perform environmental monitoring in the area of Cumberland and Amelia Islands and Cumberland Sound. This Program, currently in its third year, is funded at \$900,000 per year. The ecological aspects and overall synthesis of the monitoring program are the responsibilities of Interior, with the National Park Service as the implementing agency, Stephen Cofer-Shabica the Program director. Navy is responsible for monitoring the physical aspects of the study area with the Naval Facilities Engineering Command as the implementing command. The physical monitoring program includes both coastal and estuarine studies and is performed for the Navy by the U.S. Army Engineers.

The primary purpose of coastal monitoring is identification and quantification of any cause and effect relationships between the entrance channel modification and the ocean shoreline. A 3-fold study plan includes review of the historical setting and pre-project data to document the long-term evolution of the project area, data collection during the 5-year program to identify changes, and numerical modeling studies to extrapolate the measured process-response to scenarios beyond the measurement period of resolution.

Monitoring Activities

An intensive historical study gathered survey, sediment, geologic, aerial photography, map, dredging, wave, and process measurement data from numerous sources including the National Ocean Service, the States of Florida and Georgia, both area Corps of Engineers Districts, and the professional literature. The bulk of this study concentrated on evaluating the historic bathymetric surveys and shoreline change history in order to identify regional and local trends and anomalies. The historic sediment transport patterns, rates, and processes were conceptualized and a first order sediment budget developed.

Monitoring activities include (1) funding the 4.5 year operation of a 3-meter National Data Buoy Center off-



Trident submarines are almost 600 feet long, have a complement of 110 sailors, and carry 12 missiles each, armed with 10 independently targeted nuclear warheads. The U.S. has 30 Trident submarines, 10 of which are based at Kings Bay, GA, adjacent to Cumberland Island National Seashore.

shore directional wave gage in 65 ft (20 m) of water at Wave Information Study station #57, (2) installation of nearshore directional wave gages off Cumberland and Amelia Islands, (3) annual surveys of beach profile and offshore lines on Cumberland and Amelia Islands, (4) winter or half-year surveys of about 15% of these lines, (5) annual surveys of the wetlands, shore and near shore on the soundside of Cumberland Island, (6) beginning and end of the 5-year period surveys of St. Marys ebb tidal delta, (7) aerial photography (joint activity with the NPS), (8) sediment sampling, and (9) annual data analysis and interim report preparation.

Estuarine Monitoring Plan

The estuarine studies consist of six main elements, but unlike the coastal studies these elements are

planned as independent activities. Extensive physical and numerical model studies were performed and field data collected in support of the Trident channel design program. The scope of the estuarine studies was influenced by this existing study base and the interrelationship of the physical processes with the ecological studies which Interior had planned in the same area.

During the entire 5-year period there will be continuous monitoring of the tides, conductivity, temperature, salinity, and suspended sediments at six stations throughout the estuarine system. In addition, an intensive hydrodynamic sampling activity was conducted in 1990 over a 13-hour cycle. This study duplicates concentrated sampling studies conducted in 1982 and

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1985. The Sediment Sources and Redistribution task modified the previously archived numerical model study of the estuary to include all elements of the "as-built" project and compare the base-to-plan condition to identify any sedimentation redistribution effects. In 1989 a preliminary statistical analysis of the Long-term Fernandina Tide Gage record was conducted to determine if there is any evidence over the 50-year tide record to relate changes in the tidal prism to historical channel expansion.

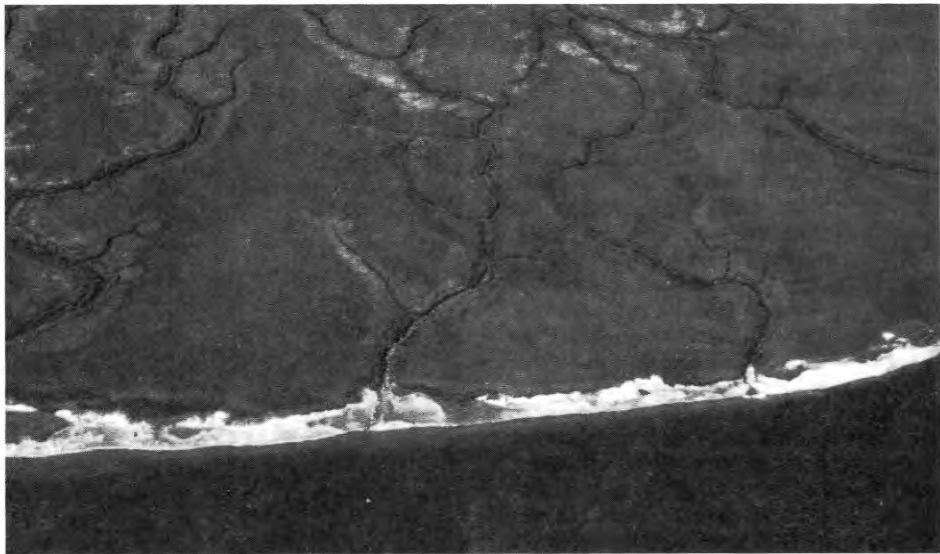
Biological Monitoring Program

Marsh, Mudflats and Tidal Creeks: The mudflats and tidal marshes and creeks are highly important to the Cumberland Sound ecosystem, providing habitat and foraging and shelter areas for numerous vertebrate and invertebrate species, including the endangered wood stork and manatee. These areas also are important in nutrient recycling. Interference with sediment deposition, both in terms of quantity and quality, could result in drowning of the marshes as sea level rises, and increase shoreline recession. The purpose of this study is to determine whether backbarrier dredging for the Kings Bay Submarine Base is affecting marsh habitat stability on Cumberland Island. Research was predicated on the hypothesis that if this operation is indeed exerting an influence on Cumberland Island, it will most likely be first perceived in the effect it has on the rates of supply and delivery of sediments to marches and tideflats.

Population Dynamics of the Hard Clam, Mercenaria mercenaria: It is possible that the construction and subsequent deepening of the entrance channel to the U.S. Navy's East Coast Trident Submarine base at King's Bay, GA, may have altered environmental conditions in Cumberland Sound sufficiently to affect native marine invertebrate populations. Possible changes could come from alterations in water quality, in sedimentation rates and types of sediments on the eastern and southern shores of Cumberland Island, erosion and steepening of the banks on the western shore, and changes in suspended sediment loadings. The hard clam, *Mercenaria mercenaria*, is being used in this study to compare historical and current growth rates, physiological stress, and reproductive effort between clams in "impact" (tideflats in close proximity to the ship channel) and "non-impact" control sites (tideflats far removed from the ship channel, but of similar physical and geomorphological characteristics).

Groundwater Hydrology: Channel development which intercepts the edge of the surface-water lens and/or the Pliocene-Miocene aquifer could result in loss of water confinement causing alterations in the groundwater resources for the island. Such changes include lowering of the surface- and ground-water tables, and salt water intrusion. Since the plant and animal communities of the island are dependent on the quantity and quality of the surface- and ground-waters, adverse changes in this resource would have adverse consequences for the Island's ecology. The placement of a series of shallow 4.5 m to 39.4 m water monitoring wells in the surficial and Pliocene-Miocene aquifers of Cumberland Island and the determination of the island's water budget will permit an evaluation of changes in the freshwater resources of the Island as they might be related to the deepening of the Kings Bay ship channel.

Manatee Presence in Cumberland Sound: Five radio-tagged manatees, three tagged in Brevard County and two in Nassau County, moved into the



Waves break on the shoreline of a Cumberland Island marsh.

Cumberland Sound region during the summers of 1987 and 1988, and were tracked there. With Navy funding, tracking of manatees in Cumberland Sound was continued during the 1989 season. This is the first ecological study of the Florida manatee outside of Florida. Purpose of the study was to determine how long manatees stay in the Cumberland Sound region, and to determine if military activities, such as dredging or increased boat traffic, are likely to affect manatees or manatee habitat.

Geologic History of Cumberland Island Marshes: The mudflats and tidal marshes and creeks are highly important to the Cumberland Sound ecosystem. Interference with sediment deposition, both in terms of quantity and quality, could result in drowning the marshes as sea level rises, and increased shoreline recession. In question is whether the deepening of the channel will affect the marshes of the Cumberland Island ecosystem. To answer this question it is necessary to know how the marshes existed in the past, how they evolved, and what environmental factors affected this evolution and development. Purpose of this study is to investigate and document the historical evolution and development of the marshes, mudflats, and marsh tidal creeks of Cumberland Island and vicinity for the last 3,500 years.

Aerial Photographic Surveys: Using high resolution metric A0Aaerial photography to establish the current state of the beaches and barrier island seashores, future changes can be identified through additional aerial photographic surveys. This annual series of photography is also being used to evaluate marsh productivity. All photography conforms to pre-set flight lines and includes all of Cumberland Island and the shoreline of Amelia Island. Aerial photographic missions are flown by NASA using the high altitude ER-2 aircraft. The plane flies at 19,400 m and provides distortion-free stereo photographs. The aircraft is equipped with the RC-10, 9" x 9" format camera, the HR 732 Hi-con, 9" x 18" format camera with 24-in. lens, and the Daedalus Thematic Mapper Simulator. Products are color, color infrared, and black and white photographic transparencies, negatives, and prints.

Wading Bird Habitats and Populations: The breeding population of Wood Storks (*Mycteria americana*) in

the U.S. declined from an estimated 20,000 in 1930 to less than 5,000 just 50 years later. With the continued destruction of the Florida Everglades, Wood Storks have been reported breeding on the Georgia Coast since 1977. The habitats used by Wood Storks for foraging are subject to disturbance by island visitors and by the dredging activities in the vicinity. Of particular concern is the possibility that dredging induced changes in hydrology and/or erosion may reduce the availability of Wood Stork foraging habitat. The study's purpose is to determine the relative use of various habitats as foraging areas by Wood Storks, and to investigate the factors involved in foraging habitat choice.

Program Review and Oversight

A technical Review Committee composed of representatives from the Naval Facilities Engineering Command, the NPS, the States of Georgia and Florida, and university consultants meets twice yearly to review project and program progress and direction. Recommendations are made to an Interagency Steering Committee (from Interior and the Navy), which then makes final decisions.

In summary, the goal of this research is to document the potential for short- and long-term changes on the resources of Cumberland Island and Cumberland Sound estuary. The monitoring program has been in effect for approximately three years for the Navy (2 years for Interior), and immediate data sets and analyses can not be used at this time to summarize or identify any trends.

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