



Modern and Historical Bathymetry of Florida Bay

Sea-Floor Mapping in Florida Bay



Figure 1. Florida Bay.

Land development and alterations of the ecosystem in South Florida have decreased freshwater and increased nutrient flows into Florida Bay (fig. 1). As a result, there has been a decrease in the water quality of the bay; the decline in water quality has prompted sea grass die-offs and has led to reduced fish populations. Restoration of water quality in Florida Bay will depend partly upon using numerical-circulation and sediment-transport models to establish water-quality targets and to assess progress toward reaching restoration targets. Application of these models is complicated, however, because of complex sea-floor topography (basin/mudbank morphology). Consequently, an accurate and modern sea-floor or bathymetric map of the bay is critical for numerical-modeling research.

A modern bathymetric data set will also permit comparison with historical data to determine sedimentation rates within the bay. Previous research suggests that the mudbanks in Florida Bay are dynamic features that migrate, accrete, and erode. Less is known about the basin sedimentation rates in the bay. Some experts suggest that the basins are filling, in association with sea-level rise, whereas others suggest that the basins are deepening relative to sea level. This study will produce a detailed bathymetric data set of Florida Bay to help assess sedimentation rates and to provide numerical modelers with an accurate bathymetric map.

The bathymetry of Florida Bay has not been systematically mapped since the 1890's, and some shallow areas have never been mapped. Maps of areas near Key Largo were updated in the 1930's; the updates focused primarily on the intercoastal channel just north of the Florida Keys. More recently, spot soundings have been collected in the bay primarily to update the location of cuts and other navigational hazards. Therefore, one can assume that most of the bathymetry presented on modern hydrographic charts of Florida Bay originates from data that are between 60 and 100 years old.

The U.S. Geological Survey (USGS) is conducting a mapping project in Florida Bay to collect new bathymetric data for all of the bay, to digitize the historical shoreline and bathymetric data, to compare previous data to modern data, and to produce maps and digital grids of historical and modern bathymetries. This information will be provided to other researchers involved in the South Florida Ecosystem Restoration Program so they can better address the water-quality issues of Florida Bay.

Study Design

The bay will be mapped by using a shallow-draft boat equipped with a high-precision global positioning system (GPS) coupled with a high-precision depth sounder. Data will be collected on a USGS 7.5-minute quadrangle-by-quadrangle basis, proceeding westward from Blackwater Sound. Sounding trackline spacing will vary depending upon the relief of the sea floor; that is, closer spacing adjacent to mudbanks and wider spacing in the basins. Digital sea-floor grids will be produced from the trackline data.

The parts of the bay that are accessible by a shallow-draft boat will be mapped by using the System for Accurate Nearshore Depth Surveying (SANDS). This system, developed by the USGS, utilizes differential GPS receivers, a digital fathometer, a heave-roll-pitch sensor, and a shallow-draft boat (fig. 2). The system is accurate to approximately 10 cm vertically and 4 cm horizontally and can collect data in water depths as shallow as 50 cm. To achieve this accuracy, the boat must not rove more than 10 km from any one GPS reference receiver. Therefore, approximately 10 new ground control points (with 1- to 2-cm accuracy) will be established throughout the bay for use as reference receiver sites. Soundings will be referenced to the North American horizontal datum of 1983 and to the North American vertical datum of 1988.

For areas not accessible by boat (mudbank tops and sensitive sea grass areas), nonintrusive (remote-sensing-based) methods must be employed to map the bathymetry of the bay fully. The preferred method will utilize vertical photography or imagery in combination with water-stage data to determine elevations of the mudbanks. This method determines the land-water interface for various water stages, thus producing several isocontours. The elevation of an isocontour is derived from the water stage at the time that the image was collected. Utilizing nonintrusive methods in conjunction with the SANDS system will provide basin and mudbank elevations for the entire bay.

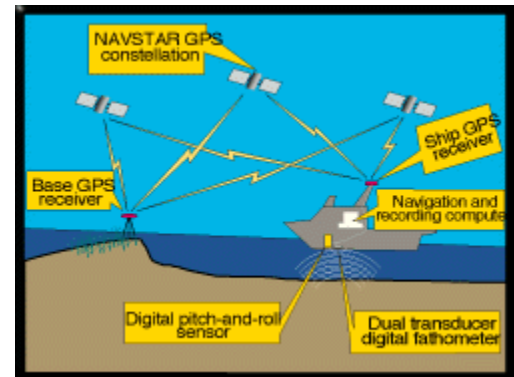


Figure 2. Components of the System for Accurate Nearshore Depth Surveying (SANDS). The base GPS (global positioning system) and the ship's GPS simultaneously collect signals from the NAVSTAR GPS constellation. The data are used to navigate the ship's survey course and properly time tag the incoming data from the fathometer and pitch-and-roll sensor.

Historical Data

An example of the digitized historical data for the Blackwater Sound area is shown in figure 3. Historical topographic and hydrographic smooth sheets from the 1850's and the 1890's have been obtained from National Ocean Service archives for all of Florida Bay. The shorelines and soundings shown on the sheets will be digitized by using ARC/INFO, a common graphical information system. The data will be projected into a modern horizontal datum so that it can be compared to modern surveys.

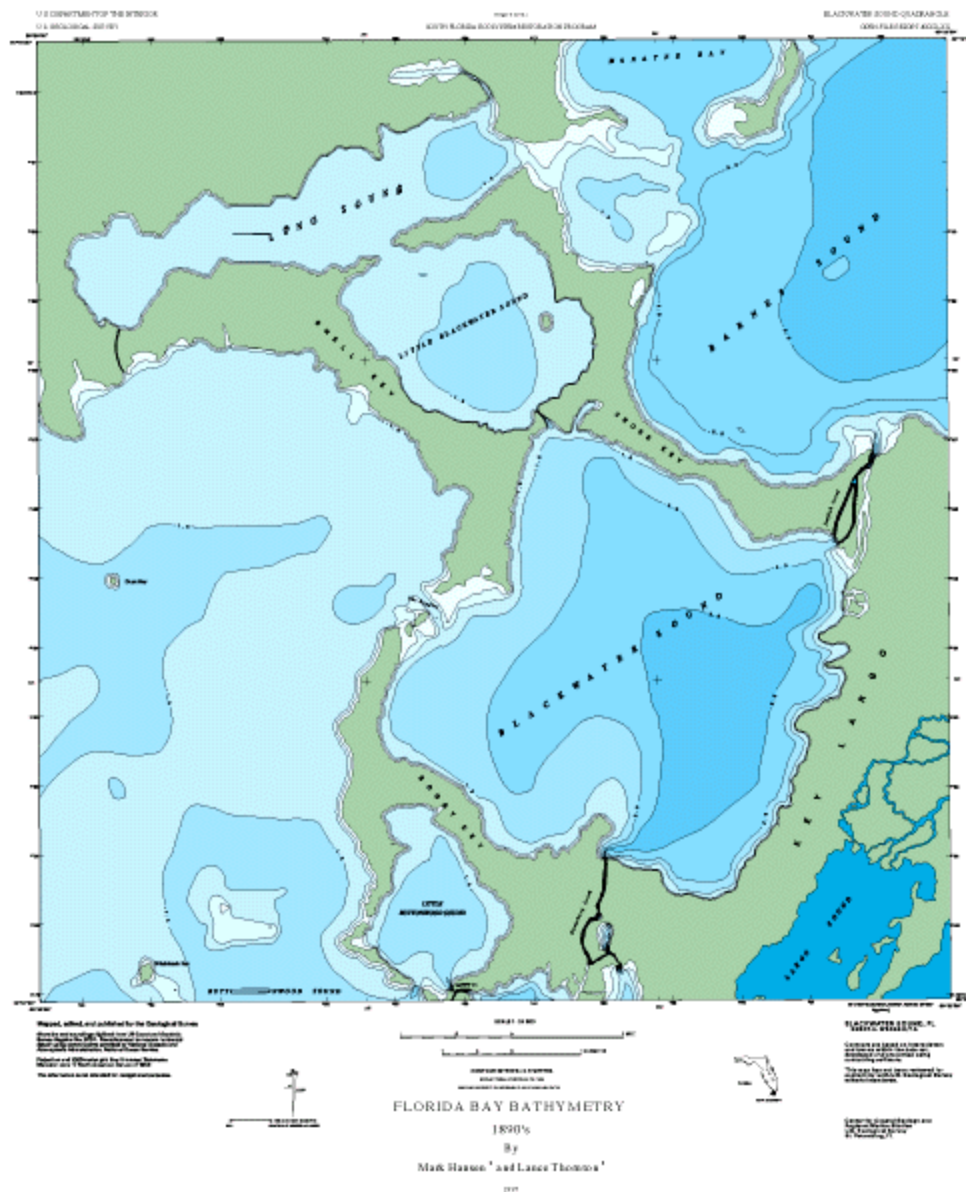


Figure 3. Example of historical hydrographic smooth sheet, showing Florida Bay bathymetry in the 1890's (Mark Hansen and Lance Thornton, 1998, unpub. data).

Bathymetric Change

Bathymetric-change maps are the final product of the project. This part of the project uses a common method of determining sedimentation rates and sea-floor change by digitally comparing historical bathymetric surveys with modern surveys. Maps of bathymetric change will be created by digitally subtracting the historical digital surface from the modern surface. The quantity of accretion or erosion in the mudbanks and basins will then be computed for the entire bay. Subsequently, sedimentation rates and transport direction can be inferred from the patterns of historical change.

Research Status

Data collection with the SANDS system began in the summer of 1995 in the northeast quadrant of the

bay, Blackwater Sound. Data collection will take 4 years to complete. It is anticipated that data collection will be completed in the summer of 1998 and that analyses and finalization of maps and CD-ROM products will be completed in 1999.

All bathymetric data will be referenced to modern datums, and processed x,y,z data points will be archived in the ARC/INFO data base. Digitizing the historical data began in 1995 and is near completion. These data will also be archived in the ARC/INFO data base.

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Planned Products

- Historical and modern sea-floor maps of Florida Bay
- Maps identifying patterns of historical accretion and erosion
- Digital grids of the bathymetry of Florida Bay
- Maps on CD-ROM
- Presentations at meetings
- Summary reports of findings

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