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Historic Topographic Sheets to Satellite Imagery: A Methodology for Evaluating Coastal Change in Florida's Big Bend Tidal Marsh

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ABSTRACT

This open-file report details the methodology used to rectify, digitize, and mosaic nineteen 19th century topographic sheets on the marsh-dominated Big Bend Gulf coast of Florida. Historic charts of tidal marshes in Florida's Big Bend were prepared in a digital grid-based format for comparison with modern features derived from 1995 satellite imagery. The chart-by-chart rectification process produced a map accuracy of ±8 m. An effort was made to evaluate secondary map features, such as tree islands, but changes during the intervening years exceed standard surveying errors and rendered the analysis ineffective. A map, at 1:300,000 comparing historic and modern features, is provided to illustrate major changes along the coastline. Shoreline erosion is exceeded by the inland migration of the intertidal zone onto adjoining coastal forest lands. While statements of mapping accuracy are provided in the text, graphic representation of changes in the intertidal zone may be inexact at any given location. Thus caution is advised for site-specific applications. Maps and digital files provided should be used to visualize overall trends and regional anomalies, and not used to critically assess features at a particular location. Final product includes mosaic of historic coastal features and comparison to modern features.

INTRODUCTION

Current trends in sea level rise and a burgeoning coastal population have intensified concern regarding coastal stability, erosion, and risk (IPCC, 1995; Stumpf and Haines, 1998). Hazards in coastal areas can be monitored in real time, but evaluation of long-term trends is more difficult. Records are often spotty and comparing older maps with modern features can pose problems in datum shifts, transformations, and adjustments. Even greater difficulties arise when no stable features remain between the historic and modern landscape. On the Gulf Coast of Florida, a near surface limestone shelf conveys consistently stable features over time, facilitating the conversion of an extensive historic data set to a modern datum and coordinate system.

This report is part of the US Geological Survey Gulf of Mexico Tidal Wetlands Project. It documents the techniques used to scan, rectify, and digitize 19 nineteenth-century historic topographic surveys, and provides evaluations on accuracy and implications for change analysis. The digitized data is used to determine long-term change between historic topographic sheets (T-sheets) and coastal features derived from 1995 Landsat Thematic Mapper (TM) satellite imagery (Raabe and Stumpf, 1997a).

Background

Numerous scientists have analyzed the techniques for quantifying shoreline movement and rates of change, such as end point rate (EPR), average of rates (AOR), linear regression (LR), and jackknife (JK) (Crowell and others, 1997; Dolan and others, 1991). Other authors have attempted to reduce shoreline and mapping errors and to improve the accuracy of shoreline change studies (Anders and Byrnes, 1991; Crowell and others, 1991; Morton, 1991; Dolan and others, 1992). Traditionally, long-term change has been determined through the comparison of historic T-sheets to aerial photography using linear transects (Benoit, 1989; Dolan and others, 1990; Leatherman, 1983).

Researchers agree that as the time frame lengthens, short-term shoreline fluctuations are more likely to be filtered out of the long-term trend (Crowell and others, 1993; Dolan and others, 1991; Leatherman, 1983). Even when net long-term shoreline change is minimal, an extended time lapse between measurements can help identify "long-term trends, establish relative rates of change, and perhaps predict future rates of change" (Morton, 1978). Morton (1991) suggests that the application of GIS software and satellite imagery to long-term shoreline change studies will aid the effort to improve shoreline change assessments. A recent study conducted along the coastline of South Carolina utilizes these advances to determine coastal change along a sandy shore over 150 years, (Chasteen, 2000).

The identification of shoreline has been the subject of discussion relative to Mean High Water (MHW), the High Water Line (HWL), and geomorphic or vegetation characteristics (Swainson, 1928; Shalowitz, 1964; Morton, 1991). In this study, vegetation characteristics were used to define the intertidal zone. The full extent of the intertidal zone, as derived from satellite imagery and T-sheets, served as the foundation for shoreline change in this study. Several aspects of approach and data preparation differed from previous work.

1. Shoreline change research usually focused on cliff or sandy shorelines. This project focused on a marsh-dominated shore.

2. The traditional notion of shoreline was replaced in this project with the concept of the intertidal zone as a viable region for documentation and monitoring.

3. Short-term, <20 years, was replaced with a long term, 130-year time frame.

4. Estimates of shore and MHW line positions were replaced with the extent of emergent intertidal vegetation.

The use of a grid-based GIS resulted in a product useful in different types of analyses, disciplines and policies.

Study Area

The study area is located on the Gulf coast of Florida, in a region known as the Big Bend (Figure 1). The Big Bend is a marsh-dominated coast extending from the vicinity of Panacea in Wakulla County to Anclote Keys in Pasco County. The US Coast and Geodetic Survey (USCGS) surveyors mapped this coast between 1852-1886 in 23 separate surveys. Nineteen surveys were used in this data set (Table 1).

The Big Bend's intertidal zone is comprised of approximately 65,000 hectares of tidal wetlands dominated by black needlerush (*Juncus romerianus*), a high marsh grass (Raabe and Stumpf, 1997a; Montague and Wiegert, 1990). Thin sediments overlie a karst limestone shelf of the St. Marks Formation, the Suwannee Limestone, and the Ocala Limestone (White, 1958; Raabe and Stumpf, 1996). Coastal forest thrives inland of the tidal marsh and scattered tree islands, or hammocks, dot the intertidal zone at elevated locations. In some places, the adjacent upland consists of land development, pine plantation, or hydric hammock. Records of sea level at Cedar Key show a mean annual increase of 0.15 cm since 1939 (Stumpf and Haines, 1998).

Although commonly divided into multiple estuaries according to the influence of local rivers, there are no barriers separating the collective estuarine conditions dominating this coast. The entire Big Bend region is recognized as a distinctive, tide-dominated, open marsh coast (Fretwell and others, 1996; Davis, 1997), and may be considered a single estuary. Common characteristics in the Big Bend include a broad low-gradient offshore shelf, an open coast, low sediment supply, a one-meter tide range, low wave energy, near-surface limestone, and spring-fed rivers and flow from the Floridan aquifer (Fretwell and others, 1996; Davis, 1997; Montague and Odum, 1997).

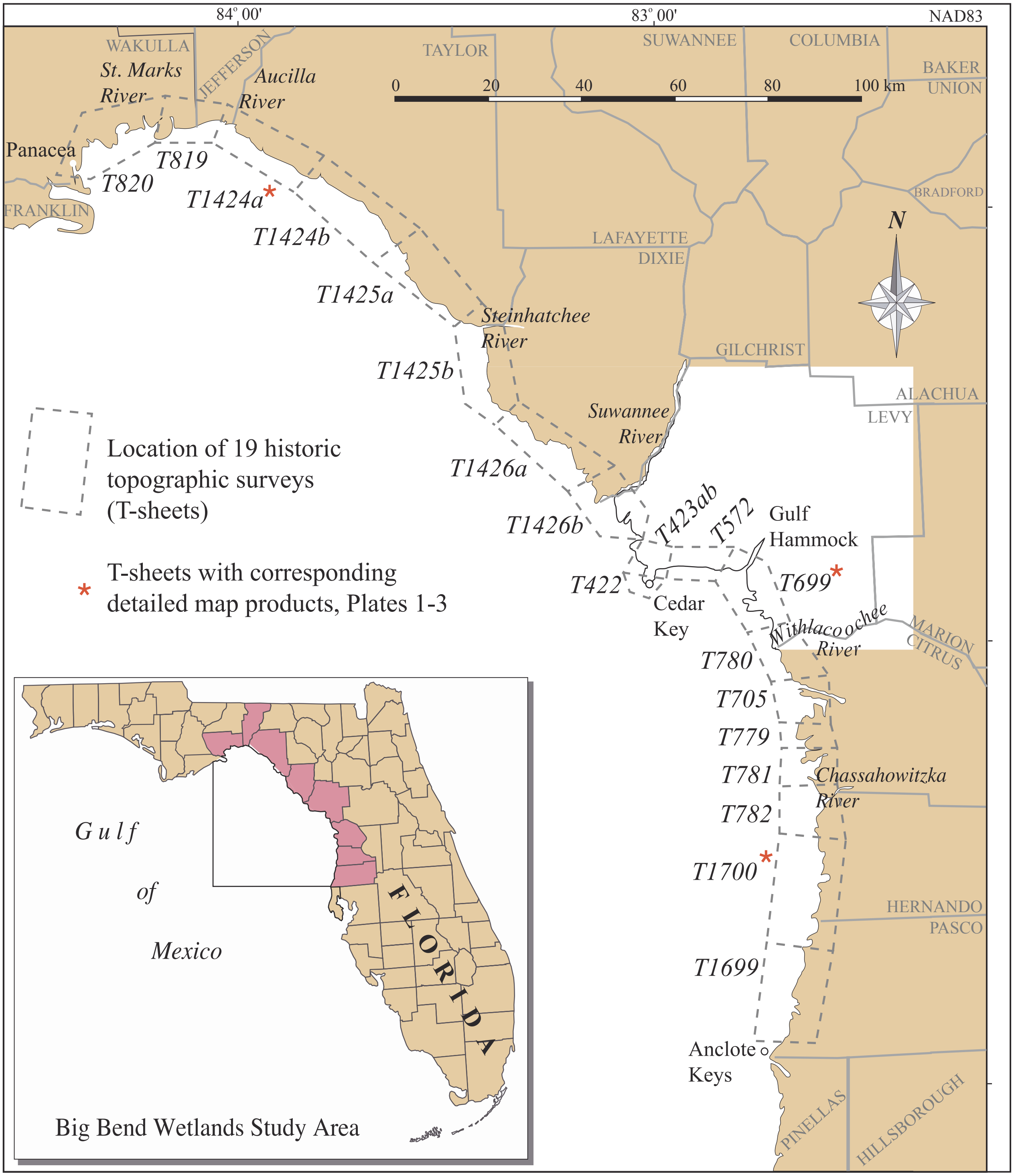


Figure 1. Location of historic topographic surveys on Florida's Big Bend coast

Table 1. T-sheets and survey dates from north to south

Chart #	Location	Date
T820	St. Marks West	1860
T819	St. Marks East	1860
T1424a	Aucilla	1875
T1424b	Fenholloway	1875
T1425a	Keaton Beach	1875
T1425b	Steinhatchee	1875
T1426a	Horseshoe	1876
T1426b	Suwannee	1877
T422	Atsena Otie	1852
T423ab	Cedar Key	1854
T572	Waccasassa North	1856
T699	Waccasassa South	1858
T780	Withlacoochee*	1859
T705	Crystal River*	1858
T779	Ozello*	1859
T781	Homosassa*	1860
T782	Chassahowitzka*	1859
T1700	Bayport	1886
T1699	Port Richie	1886

*Historic T-sheet of the coast is incomplete due to a complex shoreline

METHODS

Historic Topographic Surveys

The coastal topographic surveys of the last century were constructed with a polyconic projection on single sheets over small areas to preserve shapes, areas and distances (Snyder, 1987). Shalowitz (1964) explained how the topographic surveys were conducted and the potential problems associated with analyzing these maps, such as shrinkage, antiquated coordinate systems, lack of documentation, lack of conformity among survey feature representations, and mapping accuracy.

The projection of the historic topographic surveys was polyconic with true origin at each map's center based on the 1841 Bessel spheroid (Shalowitz, 1964). Ferdinand Hassler, first director of the Survey of the Coast (later the U.S. Coast and Geodetic Survey), developed the polyconic projection used in the coast surveys (Snyder and Voxland, 1989). This projection is distortion-free and true to scale at the large map scales and is similar to the Bonne projection. Table 2 lists the spheroids, datums and projections employed by the early USCGS.

A standardized datum did not exist at the time of the coast surveys in the study and therefore a local datum was employed (Shalowitz, 1964). The local longitude/latitude grid was drawn on most of the

Table 2. Early spheroids, datums, and projections

Spheroids (Years in use)	Datums	Projections
Clarke 1866 (1880-current)	NAD27	Polyconic
Clarke 1866 (1880-current	N.A. Datum (1913)	Polyconic
Bessel 1841 (1844-1880)	Local/unknown	Polyconic (Coast Survey, Simple, Ordinary, American, Bonne)
Walbeck 1819 (pre-1844)	Local/unknown	N/A

historic maps. The first standardized datum was not established until 1901. This datum was called the United States Standard Datum and was renamed the North American Datum (N.A. Datum) when accepted by the Dominion of Canada and the Republic of Mexico in 1913 (Shalowitz, 1964). In many cases, grid corrections from the original 'local' grid datum to either the N. A. Datum of 1913 or the North American Datum of 1927 (NAD27) were drawn by CGS on the sheet many years after the survey was completed.

Acquiring and scanning CGS charts

Mylar copies of nineteenth century T-sheets completed by the USCGS were ordered from NOAA's (National Oceanic and Atmospheric Administration) National Ocean Service (NOS), Hydrographic Surveys division. The topographic sheets for this region were surveyed between the years 1852 and 1886 and drawn at scales of 1:20,000 and 1:10,000 (Table 1). A list of each T-sheet, number, name, superintendent, topographer, dates and scale are provided in Appendix I.

Prior to scanning, registration marks were applied to the mylar sheets to identify intersecting lines of the coordinate system grid on the map. These intersections were used as registration tie-down points. Due to multiple datum corrections on the T-sheets, care was taken to consistently choose intersection points from the same datum. The original survey grid was used as tie-down points for registration due to an insufficient number of corrected intersecting grid points on the maps. The mylar T-sheets were scanned at 200 dpi (dots per inch), as grayscale TIFF (Tagged Image File Format) images, with a digital resolution of 2.5 m.

Rectification Methods

Three registration methods were tested to rectify the T-sheets to the current datum and coordinate system, Universal Transverse Mercator (UTM) WGS84. WGS84 is employed because this project relied on GPS survey data for ground control. The difference between NAD83 and WGS84 is insignificant, on the order of millimeters (Shrestha and others, 1993). The three registration methods are discussed below.

Rectification Method I

Method I attempted to convert the coordinates of the T-sheet grid from local longitude and latitude to UTM, WGS84, using a coordinate conversion program to rectify each T-sheet to a modern datum (WGS 84) and directly register to a modern coordinate system (UTM Zone 17, Row R). Selected intersections of the original longitude/latitude grid drawn on the maps were assigned UTM coordinates by converting the coordinates on the map from degrees, minutes, seconds (dms) in an historical datum to dms NAD27, to dms NAD83, and then to UTM NAD83 with a conversion program. The UTM coordinates were entered into a first order model as control points, and the image was rectified.

This method produced both an offset and unacceptable distortions of the coastal features. These distortions were attributed to insufficient corrections for the local datum.

Rectification Method II

A second attempt to rectify the images was performed using triangulation points located on the maps. These points appear on each topographic survey as either small triangles or small circles. Each point has an accompanying name written next to it (e.g. Cormorant Rock). Previous work of this type has concluded that the most accurate method to register each map is to use the first and second order triangulation points that were used by the original surveyors (Crowell and others, 1991).

An attempt was made to obtain the points transformed to the North American Datum of 1927 (NAD27) from NGS. However, it was discovered that an insufficient number of points were transformed to register the images; there were only14 transformed triangulation stations in the entire Big Bend region. While too few points were available in a single area to rectify a T-sheet, these points were useful later for cross-checking.

A sufficient number of original triangulation points were obtainable for T-699, only. These triangulation points were obtained from the National Geodetic Survey (NGS). NGS provided several reports compiled by the Coast Survey that contained both the original longitude and latitude coordinates as well as the transformed coordinates to the NAD27 datum (USCGS, 1855; 1857; 1859; 1865; Swick, 1913).

The 1913 N.A. Datum triangulation stations from Swick (1913) were used for T-699 because the majority of the triangulation stations for this T-sheet were not transformed to the NAD27 datum by the NGS. These triangulation stations consisted of longitude and latitude coordinates based on the 1913 N.A. Datum and the Clarke 1866 spheroid (Table 2), now obsolete. Because the GIS software does not support the 1913 N.A. Datum, it was necessary to transform the positions to either NAD27/Clarke 1866 or NAD83/GRS80.

An approximation of the datum shift between the 1913 N.A. Datum and the NAD27 datum was obtained from NGS and applied to the 1913 N.A. Datum triangulation stations (Table 3). The corrected coordinates for each 1913 N.A. Datum triangulation station were used for registration. For this method, two registration attempts were tested. The first involved applying the datum shift for 1913 N.A. Datum to NAD27 to each control point. The second involved applying the datum shift from 1913 N.A. Datum directly to NAD83. The geo-referencing units were labeled LON/LAT D-01 (NAD27), and LON/LAT D-02 (NAD83), respectively for the two tests. Table 3 lists the datum shifts provided by NGS for the region between the Waccasassa and the Withlacoochee Rivers. After rectifying the test image with each datum shift, it was determined that applying the NAD27 shift to the control points, rectifying the imagery to LON/LAT D-01 (NAD27), and then re-projecting to NAD83 was more accurate than applying the NAD83 shift to the control points and rectifying directly to NAD83. However, both approaches produced distortions that required an additional correction with Method III.

Table 3. Datum corrections for historic survey T-699*

Datum	Latitude	Longitude
Bessel to 1913 N.A. Datum	3.63"	-53.55"
1913 N.A. Datum to NAD27	0.19"	+0.13"
NAD27 to NAD83	+0.88"	-0.59"

* Between the Waccasassa and Withlacoochee Rivers

Rectification Method III

The lack of a standardized datum at the time of the historic surveys compromised our ability to use a simple coordinate shift or triangulation points for rectification. Methods I and II produced images that required further adjustments after the initial registration. Method III produced the most accurate registration without the introduction of intermediate distortions.

Method III required the identification of stable features in the historic survey, UTM coordinates for each position, and the rectification of the T-sheet with a first-order model. UTM coordinates were collected from geo-rectified satellite imagery (Raabe and Stumpf, 1997b). Ground control for the imagery was collected with GPS equipment. The image-to-image method was successful because a significant characteristic of the Big Bend coast is the near-surface limestone shelf that appears to control the location of features such as tidal creeks, islands, and points of land. This type of approach relies on a sufficient number of coastal features remaining unchanged during the intervening years (Morton, 1991). This method may not be suitable for other regions.

Model Methods

The scanned historic charts were brought into a grid-based, or raster image processing environment. Each grid cell on the historic image represents a five-by-five meter square. While more detail is depicted on the charts, accuracy for the charts has been evaluated at 2 – 8 m (Daiber, 1986; Dolan and others, 1990). The 5 m pixel size accurately represents the transferable information.

Control points for the model were located on the historic chart and the satellite image. Features protected from or resistant to wave energy and along large tributaries were selected, as well as points such as rocks and oyster reefs. Vegetation such as upland hammocks and mangroves were not used for ground control due to their sensitivity to alteration from storm surge and freezing. Fifteen horizontal control positions were collected for each chart. Collected points were distributed across the geographic extent of the chart to prevent distortion of the image. Out of each set of selected positions, five or more were used as control points in a first order model. Another five or more positions were retained as checkpoints, and the remaining positions were deleted based on performance of the first order model. The checkpoints for each model were evaluated, and if any checkpoint exceeded a 10 m error, the control points were recollected, and a new model created. A first order polynomial model was applied to each T-sheet to rectify and re-project the image into UTM WGS84 coordinate space at a 5-meter resolution.

Rectification and Model Results

Map boundaries were set for each chart in UTM coordinates. An image-to-image geo-rectification program was used to create a first order polynomial model for each T-sheet. Table 4 presents the number of control points, checkpoints, range of RMS error in meters, and plot residuals for each chart. Plot residuals are less than 10 m for control and checkpoints for all T-sheets (Table 4). The mean plot residual for all charts is 4.57 m for control points and 7.33 m for checkpoints. The residual distance is less than 10 m for each of 121 individual checkpoints. An evaluation of all checkpoint residuals established that 90% or more of all map features are within 8 m of their known location for all 19 T-sheets.

The checkpoints offer a reliable measure of accuracy of ±10 m or better for all charts. The accuracy of some individual charts was ±4 m or better. While this modeling method may not be applicable in regions with extreme shoreline change, the nature of the Big Bend coastline lent itself well to the identification and modeling of stable control points.

A quality check was conducted by overlaying the historic survey on the satellite image for each area. Linear north/south and east/west features were evaluated to identify potential distortion or shifts

Table 4. Control and check point RMS range and model residual

T-sheet #	# Control Points & RMS Range (m)	Residual Plot RMS (m)	# Check Points & RMS Range (m)	Residual Plot RMS (m)
T-1424a	6/0.55-4.0	3.25	8/1.45-5.10	3.80
T-1424b	5/0.25-1.25	1.40	12/2.65-8.50	5.45
T-1425a	5/0.85-2.60	2.80	9/1.90-9.15	6.55
T-1425b	7/0.20-2.25	2.15	7/2.25-4.55	4.65
T-1426a	5/1.10-3.55	4.20	5/3.70-7.90	9.35
T-1426b	5/2.00-3.45	4.85	5/2.35-5.90	7.30
T-1699	5/0.50-1.85	1.90	5/0.35-8.35	8.10
T-1700	6/1.75-4.50	3.95	7/1.15-5.95	4.80
T-422b	5/1.10-3.25	3.05	5/1.50-4.90	5.45
T-423ab	5/0.40-6.55	6.80	5/0.55-7.80	8.80
T-572	5/1.35-8.70	8.80	5/1.90-8.10	8.75
T-699	5/0.75-9.10	8.65	5/5.45-6.60	9.65
T-705	5/1.60-3.55	4.40	5/3.80-7.80	8.85
T-779	6/0.20-4.40	4.20	10/1.75-9.30	7.50
T-780	5/2.10-5.50	6.10	5/2.63-7.20	8.85
T-781	5/0.25-2.70	2.95	5/3.65-6.70	8.40
T-782	5/1.65-3.95	4.80	6/2.65-8.70	9.40
T-819	6/0.90-4.15	3.90	7/1.35-6.70	5.35
T-820	5/3.35-6.35	8.70	5/2.35-7.90	8.30
Total #/Range (m); Mean (m)	101/0.20-9.10	4.57	121/0.35-9.30	7.33

along parallel or perpendicular elements. Overlays were also examined for local distortion. When necessary, the control points were re-collected and the model re-created two and three times to ensure best fit between the model and the coastal features.

Digitizing Methods

Historic survey features were digitized on-screen with heads-up digitizing for each geo-rectified T-sheet image. Each feature on the historic maps was digitized as a separate category (Table 5). The back, inland edge of the upland boundary was extended inland to the edge(s) of the map. In addition, individual features were combined to represent the aggregated categories of submerged, intertidal, and upland zones (Table 5). Mapped features and feature symbols varied from one T-sheet to another, depending on the surveyor, the year of the survey, and the type of features in the immediate area (Appendix I).

Conformity between survey sheets is not reliable, because the surveys were completed between 1852-1886, before the Coast Survey began to standardize the representation of features on maps in 1891. Documentation indicates that the 1840 survey parties used approximately a dozen conventional map symbols for prevalent coastal features. These symbols were revised in 1860 and 1865 (Shalowitz, 1964; Swainson, 1928). Descriptive field reports, written while conducting the surveys, were available for only two T-sheets, T-1700 and T-1699, obtained from NGS (Appendix II). The descriptive field notes and notes on the T-sheets themselves provide documentation on the nature of the environment, weather conditions, the amount of human development, and catastrophic events such as storms (Vinal, 1888; see Appendix II). Notes written by the survey team on the features themselves were also used to identify the meaning of map symbols.

Table 5. Historical features and merged categories

Historic Feature	Assigned Digital Value (0-255)
Submerged Features	5-40
Gulf water	5
Low water	10
Sand Bars	20
Boat Channels	30
Salt water ponds	40
Intertidal Features (between low water and high water lines)	50-110
Mud/tidal flats	50
Shoreline	60
Sand	70
Reefs	80
Oyster bars	82
Oyster reefs	84
Oyster rock	86
Rocks	90
Low Marsh	95
Marsh	100
Mangroves	110
Upland Features (beyond high water line)	150-195
Sedge	150
Sedge hammocks	155
Upland hammocks	160
Upland boundary	170
Grass	175
Roads and development	180
Freshwater ponds	190
Freshwater marsh	195

Despite differences in map symbols, first-hand familiarity with regional characteristics and coastal conditions eased interpretation and facilitated the identification of surveyed features. Field experience, team consensus, and a set of contingency rules assured reliable map interpretation and consistency in digitization. A set of guidelines was developed to standardize feature recognition (Table 6).

The individual digitized features were assigned to one of three categories: submerged features, intertidal features, and upland features. Submerged classes included features below the low-water line: low water, submerged sand bodies, boat channels, open water, and salt-water ponds. Intertidal classes included features above the low-water line and below the uplands: shoreline, sand above the low-water line, mud/tidal flats, oyster bars, oyster reefs and rocks, other reefs, rocks, low marsh, marsh, and mangrove. Upland classes included features intolerant of saltwater flooding: sedge, sedge hammocks, upland hammocks, upland boundary, grass, roads and development, freshwater ponds, and freshwater marsh.

Categories that were included in the creation of the shoreline varied from survey to survey but in each case included any feature that was bounded by Gulf water. In a similar manner, a line was created to represent the upland boundary including the following classes: upland boundary, upland hammock, sedge, sedge hammock, roads, and development (Table 5).

A mosaic of the 19 T-sheets was prepared in a 10-m resolution file. Decreased resolution was necessary because of increased file size to cover the whole region. Where features from different surveys joined or overlapped, the features of the more accurately surveyed map were used to map the

Table 6. Guidelines for historic feature recognition

Interpretation of historic symbols:

1. First use the symbols on the map and the surveyor s notations within the features to determine the meaning of symbols and to differentiate between vegetation types. Maintain consistent interpretation of symbols on each T-sheet.
2. Use T-sheets within the same time frame and by the same survey crews as a reference (Appendix I).
3. Use modern field photos and team member knowledge of regional characteristics on difficult sections of a T-sheet.
4. When the distinction between surveyed hammocks and surveyed mangrove symbols is difficult to visually discern:
    a. Place features with open-ended curls and crosses in the upland category. Place features with closed rounded curls in mangrove category. Use magnification on original mylar if necessary.
    b. If questionable tree symbols are on the shoreward edge of the Gulf, on a southern chart (Cedar Key and south), and at low elevations (characterized by low water line, shallowness in the nearshore), place in mangrove category.
    c. If tree symbols border interior tidal creeks and rivers where levee formations occur, place in upland hammock category. Check modern topographic charts and aerial photographs to validate elevated features in the intertidal zone.
5. If the meaning of a symbol is still uncertain, consult a topographic chart or aerial photograph to determine the local topography, modern features, development and other characteristics to aid in interpretation.
6. When all else fails, a feature is characterized as “the same as” the current feature.

While final uncertainty was a rare occurrence, the map interpretations err on the side of no change, rather than change, when symbols or surveying was questionable.

area. Accuracy was based on chart rectification (Table 4), year of survey, and the detail with which historic features were drawn. Features at chart overlap were edited to properly connect tidal creeks and upland boundaries. Polygons of the three main categories were created for the mosaic. Area in hectares was quantified for each feature on individual charts and the full mosaic.

While the early spheroid and projection may present difficulties in mosaicking in all directions over a large area, most distortions will appear across an extended east/west component. The coast in question is dominated by a north/south trend. No distortion or difficulties were encountered in combining the 19 charts.

PRESENTATION OF MAPS

Overlay of historic and modern

Historic features are compared to features derived from satellite imagery to evaluate the character and extent of change between historic surveys and the present day. The 10-m mosaic of surveyed historic features was overlaid on modern features mapped by Raabe and Stumpf (1997a). Categorical accuracy of mapped modern features is 92% or better in the estuarine zone (Raabe and Stumpf, 1997a). The 1995 satellite image pixels are 28.5 x 28.5 m with a horizontal map accuracy of ±20 m, having been processed as described in Raabe and Stumpf (1997b). Mapping between the two data sets utilized three categories: submerged features, intertidal zone, and upland features. The upland boundary line identifies expansion or contraction of the intertidal zone and the shoreline documents shoreline erosion or accretion.

The satellite image classification distinguishes two additional categories in the intertidal zone, estuarine scrub and salt barren. Estuarine scrub in the intertidal zone may be either mangrove on the shore edge in the southern counties, or it may be transitional vegetation between the tidal marsh and coastal forest. Transitional scrub consists of salt marsh species with salt scrub and thin tree cover on levees, in tree hammocks, and along the upland boundary. As part of the intertidal zone, these areas are exposed to tidal flooding. Also included in the intertidal zone are the salt barrens. These areas are just above the MHHW line, have high levels of accumulated salts, and support salt tolerant vegetation (Hoffman and Dawes, 1997; Raabe and others, 1996).

Interpretation and discussion

Maps were prepared from the 10-m resolution mosaic to present the major changes along the Florida Big Bend coast. Change is depicted for the following features: water to marsh, marsh to water, upland to marsh, upland to water, and marsh to upland. Other change categories are too small to display. Plates for select areas are presented as Plates 1-3. A map for the whole Big Bend coast (1: 300,000) is displayed in Plate 4 (map pocket). The Big Bend coastline shows both loss and gain of marsh at the shoreline and advancement of intertidal marsh over the adjoining uplands. Die-back of the coastal forest is a common sight along the interior boundary of Florida's Big Bend marsh coast (Figure 2). Black needlerush and sabal palm trunks occupy an area previously mapped as forested uplands.

Three maps of individual charts were produced as examples of the types of change that occur along the Big Bend coast (Figure 1 for locations). Plate 1 illustrates the changes that are most commonly seen along the Big Bend coast, showing small incremental changes along the shore and moderate, 0-0.5 km, coastal forest retreat. Tidal marsh loss occurred at the shoreline and along widened and extended tidal creeks. Increased tidal flooding has led to the loss of scattered hammocks within the tidal marsh and widespread forest retreat along the upland boundary. The Hickory Mound Impoundment near the Econfina River is a man-made feature constructed to support migratory birds. Small pockets of shoreline accretion occur along the coast. These areas typically appear to be the slumped material of a high marsh bank, subsequently colonized by low marsh species within a few meters of the shore. While the feature is still intertidal, the functional character of a frequently flooded low marsh differs from that of an infrequently flooded high marsh.

Figure 2. Photograph of area mapped as forest on early topographic sheet (T-1424b), Taylor County, Florida.

Plate 2 shows expansion of tidal marsh inland into the coastal forest in the Gulf Hammock region between Cedar Key and Withlacoochee Bay, where, the marsh migrated 1km or more inland over a broad exposed limestone platform, previously occupied by coastal forest. Shoreline erosion occurs at the river mouth and in the extension and widening of tidal creeks. Evidence of the loss of mangroves and submergence of oyster bars and small islands is also visible on Plate 2. The extension of tidal marsh up the Waccasassa River and across the coastal forest is pronounced in this area. Several factors may contribute to the marked loss of coastal forest in this region.

1. Cedar Key was the site of shipbuilding, and pencil and brush factories prior to the turn of the 19th century. The source of materials lay primarily in Gulf Hammock, which were rafted to Cedar Key. Wood was also required for salt works in the area during the Civil War (Fishburne, 1997).

2. The aquifer-bearing Ocala limestone is at or near the surface throughout this region. Large numbers of sinkholes and dissolution channels are evidence of weakened limestone and wasting by solution (White, 1958).

3. Discharge from the Waccasassa River may have been reduced in the intervening years, allowing tidal flow to reach further up river. Records are available only from 1964-present (http://waterdata.usgs.gov/fl/nwis).

4. Due to the configuration of this embayment, storm surges would be concentrated into this cove east of Cedar Key, giving rise to higher surge levels, focusing marine energy and flooding further into the adjoining low-lying forests.

A combination of soil damage during tree harvest, the dissolution of the limestone, a change in freshwater flow from the river, and concentrated storm impacts may have exacerbated the effect of rising sea level in this embayment.

Plate 3 illustrates the intertidal zone near Weeki Wachee River and Indian Bay between Pasco and Hernando Counties. The area north of Weeki Wachee River exhibits a disproportionate loss of tidal marsh to the open Gulf. Field reconnaissance confirmed the presence of open water where salt marsh was previously mapped. While limestone exposures are present in this area, another common feature of this deteriorating marsh are expanses of open mud flats with remnants of salt marsh rhizomes on the surface. South of Weeki Wachee River, Hernando Beach serves as an example of coastal wetland loss to development. Additional changes can be seen in the form of coastal forest retreat and the submergence of oyster bars. Modern extraction and dredging activities, resulting in ponds within the boundaries of the early T-sheets, are depicted as upland to water.

The major changes along the coast, composed of a T-sheet mosaic, are presented in Plate 4 (map pocket). This plate depicts the full extent of change at 1:300,000 throughout Florida's Big Bend coastal marsh region. Areas of concentrated shoreline erosion occur near St. Marks River, east of Cedar Key, and south of the Chassahowitzka River. The greatest gain in tidal marsh occurs near the Waccasassa River. The transition zone, or scrub/salt marsh, that was historically mapped as forest is shown in a lighter shade. While some trees are still present in these areas, the transition to tidal flooding and salt marsh has already begun. This map represents the long-term changes that are occurring along this coastline. The short-term cycles of loss and recovery caused by fire, freezing temperatures, storm deposits, and drought were presented by Raabe and Stumpf (1997a). Long-term trends, as depicted in this report, may be the result of a combination of sea level rise, changes in freshwater supply, sediment movement, antecedent topography, logging, and development pressures.

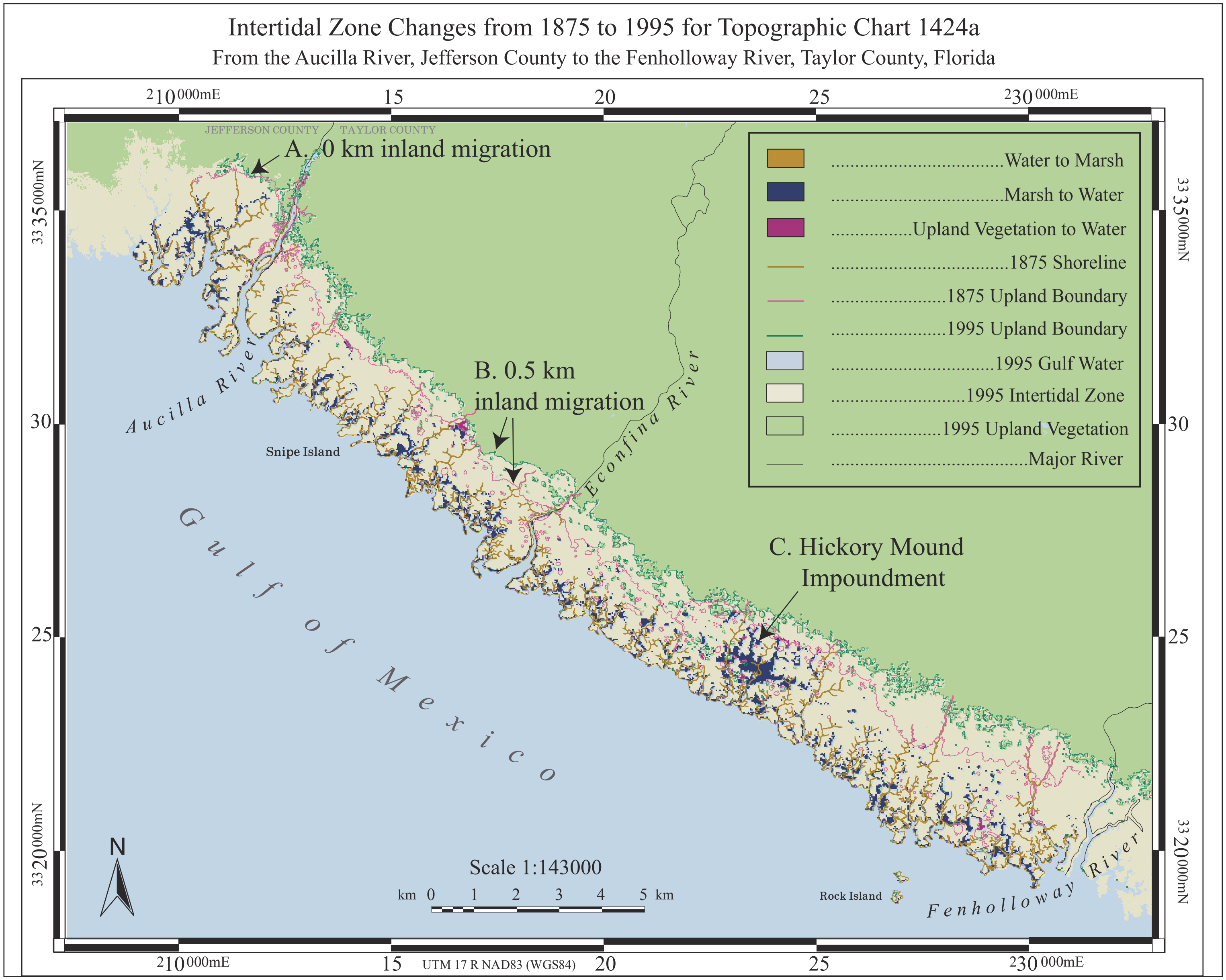


Plate 1. Intertidal zone changes for T-1424a along the Aucilla River.

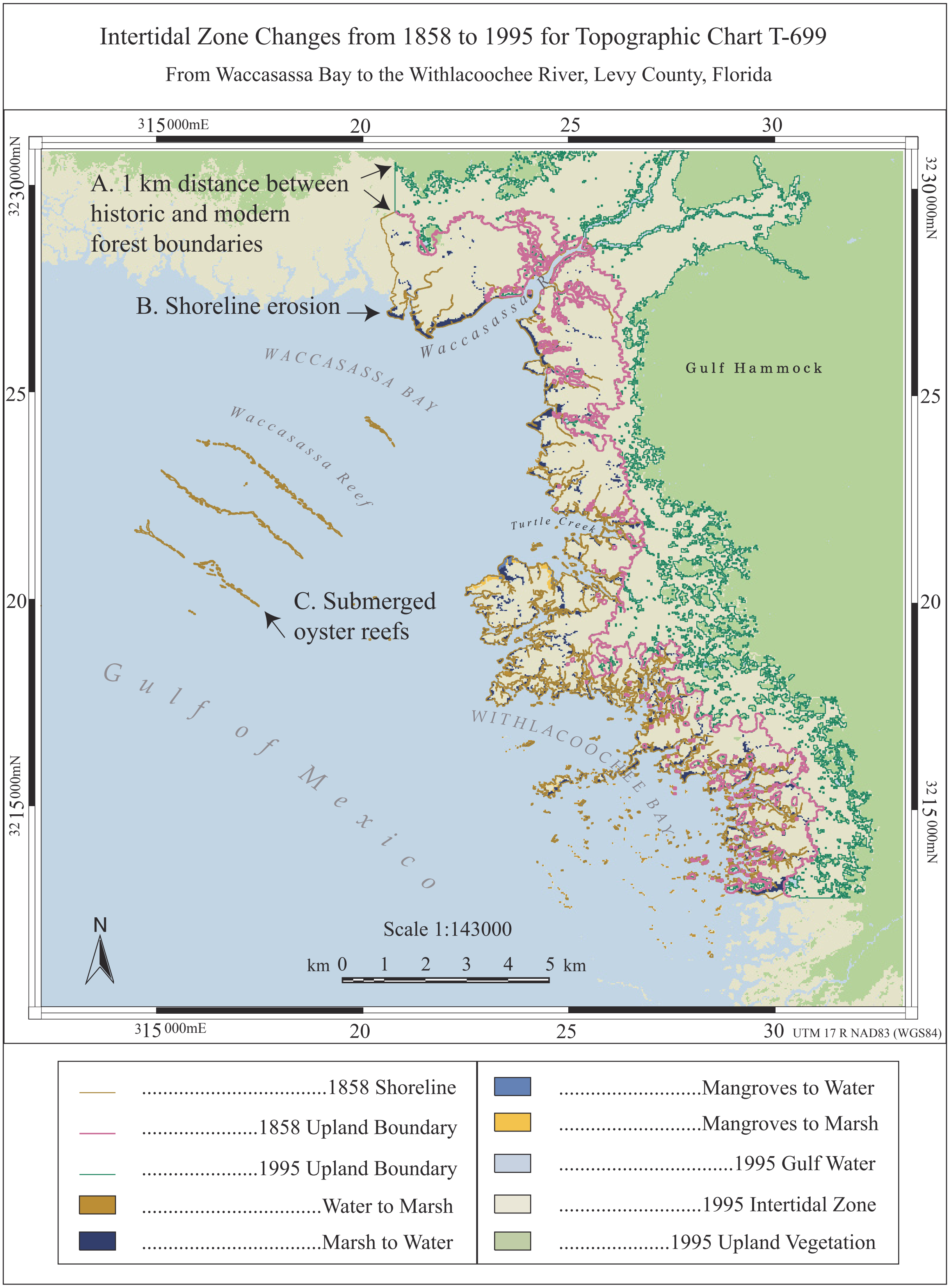


Plate 2. Intertidal zone changes for T-699 in Waccasassa Bay, Levy County, Florida.

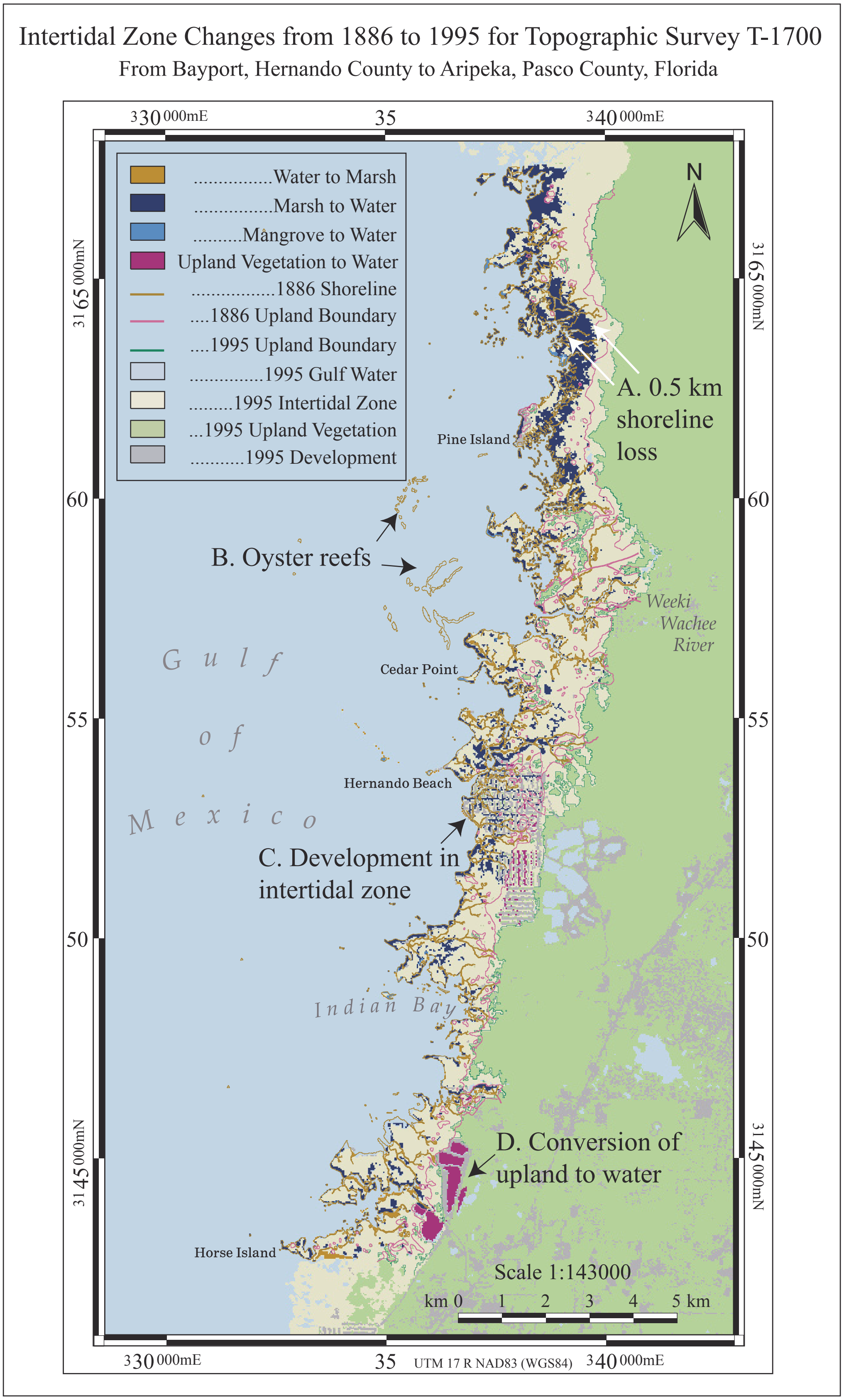


Plate 3. Intertidal zone changes for T-1700, Hernando County, Florida.

Complications in use and interpretation of data

It is important to be aware of the complications in using and interpreting these data. For some areas the early surveys were incomplete, in other areas the results may be misleading and are discussed below. This section presents the most salient problems related to mapping techniques, natural processes, and human activities in the region. Application of the maps should be limited to use as a general guide to regional trends rather than for site-specific interpretation.

1. Incomplete surveys in Citrus County

Map comparison was not possible for five charts that were incompletely surveyed (Table 1; Plate 4). Small islands dominate the coast and navigation was nearly impossible between the Withlacoochee River and the Chassahowitzka River (see Appendix 2). The task of surveying this complex archipelago shoreline proved to be time-consuming and difficult for early surveyors. This portion of the coast does exhibit the dying coastal hammocks symptomatic of the inland migration of the intertidal zone seen elsewhere along the coast (Figure 2). If it is desirable to evaluate this area further, a potential solution exists for an interested agency. The majority of the unmapped area is in Citrus County, and early plat maps may be available from the state of Florida. While slightly more recent, and surveyed for land use rather than navigation, the early upland boundaries could be digitized from turn of the century plat maps. Subsequent plots of the early upland features could then be used to help determine the relative movement of the intertidal zone in this region.

2. Interpreting marsh to upland

The category, marsh to upland, is a potentially confusing concept and requires some discussion and illustration. Essentially, no documentation exists for previous areas of salt marsh having converted to uplands during the last 100-200 years on this coast. However, several large areas of this category result from the comparison of historic and modern features. In nearly every case, the category occurs near the location of early settlements at St. Marks, Keaton Beach, Steinhatchee, Suwannee, and Cedar Key. Burning, logging and other land clearing operations were common at settlement sites for cultivation, grazing, and other activities (Ewel, 1990). It is likely that early surveyors looking out across an expanse of marsh would see a recently logged area as an extension of the intertidal zone. The visible tree line that was surveyed may define a line of human activity rather than the actual upland boundary as determined by tidal influence. Re-growth of the forest in subsequent years would be mapped as forest overtaking marsh, while in reality it represented the recovery of a previously existing condition.

Near the Steinhatchee, the area historically mapped as marsh is presently a curious combination of hummocky scrub and freshwater habitats, as determined from field reconnaissance. It is possible that the ‘swampy’ nature of the area led surveyors to map it as marsh regardless of marine or freshwater dominance. This confusion may have also played a role in mapping such features at the Suwannee River.

Another common feature in the tidal marsh are the salt barrens. Due to their relatively non-vegetated appearance, these features resemble development in satellite imagery. Where development and salt barrens both occur near the coast, there may be some confusion. To remedy this situation, all features within the historical intertidal zone that now appear in satellite imagery as bright, thinly vegetated land surface are excluded from this category of change. Only areas with relatively full tree canopy are mapped as the potentially erroneous marsh to upland category.

The category was further divided into two classes: areas near settlements with modern road access and areas at a distance from settlements with no modern road access. Areas in this category that are accessible by road may represent artifacts of human settlement activities. The remaining areas depicted on the maps may represent survey errors. While these errors may be used to balance opposite survey errors (Figure 3), such extreme errors were not common in early surveys, nor was a change from marsh to upland likely during an era of sea level rise on a low gradient coast. Only extensive field and historical investigation into this topic can clarify the discrepancies.

3. Atsena Otie

The area covered by T-sheet 422b consists of several small islands including Atsena Otie, with tree hammocks but no interior uplands. The total acreage for this chart is relatively small and no opportunity for inland migration of the marsh exists. A comparison between this chart and the others is not recommended.

4. Development in the intertidal zone

Another exception to the widespread expansion of tidal marsh includes the Bayport and Port Richie charts, where the impact of development prevented inland migration of the intertidal zone into upland areas. In the southern counties, mapping natural change was superceded by the impacts of human-induced change. Users are cautioned against interpreting this as a stable area. Stability exists presently in the form of built structures and fixed coastal defenses. The long-term interactions between natural processes and human activities such as dredge and fill are presently unknown on this coast.

5. Interpretation of mapped change

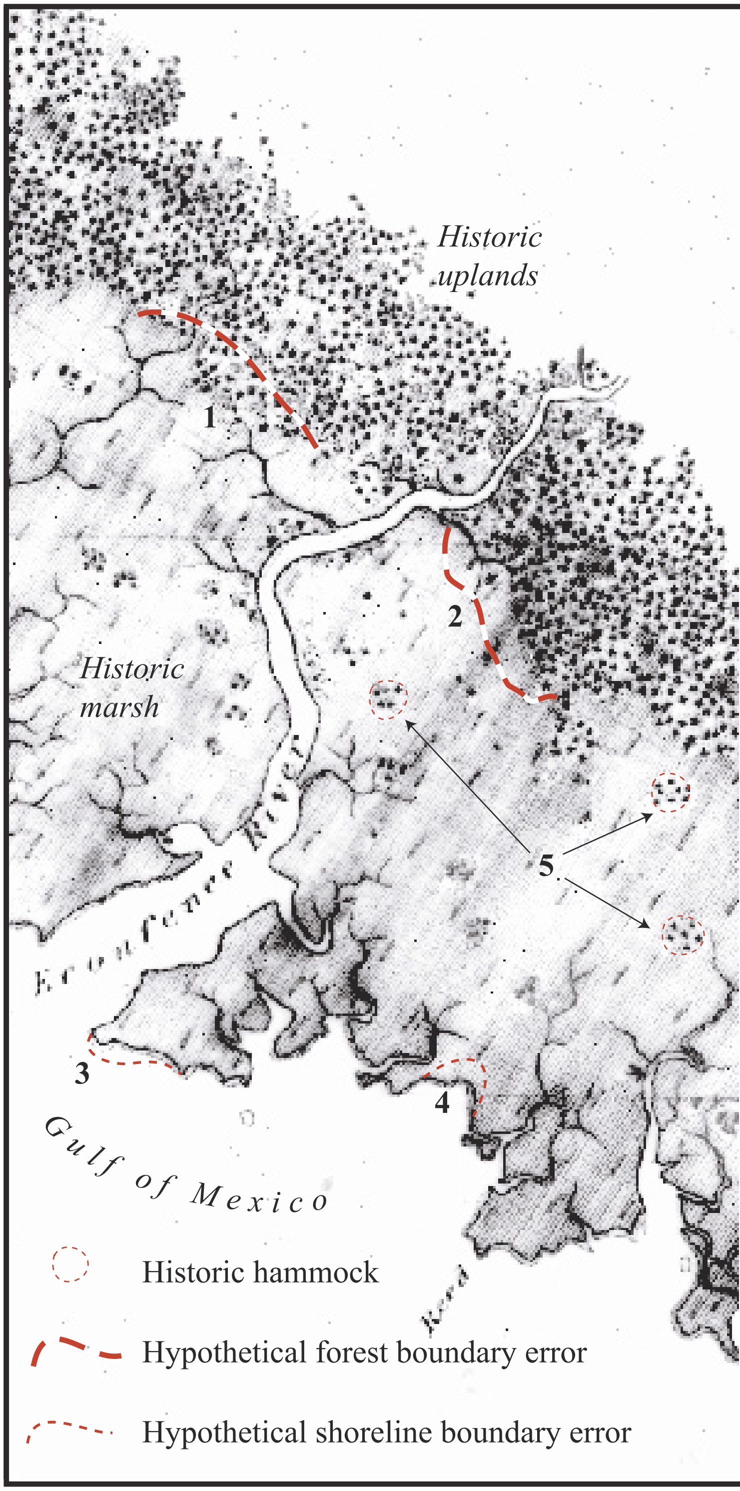
Change between the two data sets was prepared as a map covering a large area rather than single feature differences. As such, interpretation of change can avoid the pitfalls of inadvertently measuring to uncharacteristic features, anomalies, survey errors, and temporary fluctuations. Irregularities are presumed to cancel each other over a large area (Figure 3). The likelihood of 8 m more tidal marsh or 8 m less tidal marsh was equally probable at any given location, and is assumed to be balanced.

Based on the errors stated for each data set, the maps may display locally inaccurate features. With this consideration in mind, the maps should be used to gain a broad perspective of the processes at work, and the relative stability and vulnerability of different sections of the coast. The full benefit of mapping change by area is realized only if users understand that mapped change at any given location is approximate.

6. Secondary features

Since historic topographic surveys were completed as navigational aids, the accuracy of secondary features, such as coastal forest, depended on their level of importance for navigation as determined by the surveyor (Swainson, 1928). The shoreline was almost always accessible and of immediate concern for navigation. Navigable waters were delineated by the edge of "low water" features and the shoreward extent of emergent intertidal vegetation. The distant upland tree line was considered a visual aid to navigation, owing to the lack of local topography, and the nearly flat, vast expanse of salt marsh. Much of the interior coastal forest boundary was surveyed at a distance with triangulation methods. Hammocks, or tree islands, occur within the intertidal zone where the elevation is sufficient to prevent tidal flooding (Kurz and Wagner, 1957; Williams and others, 1999). These features were also considered important to navigation and were included in the early surveys.

We attempted to evaluate the positional accuracy of hammocks scattered across the intertidal zone (Figure 3). The hammocks were evaluated for differences between the original survey position and their current known location by identifying the same hammock in satellite imagery or aerial



T-sheet 1424a showing hammocks in the marsh and hypothetical irregularities at the shoreline and forest boundary. Such errors are presumed to cancel each other.

1. Marsh/forest boundary further inland than depicted on T-sheet.

2. Marsh/forest boundary closer to Gulf of Mexico than depicted on T-sheet.

3. Marsh shoreline further into the Gulf than depicted on T-sheet.

4. Marsh shoreline further inland than depicted on T-sheet.

5. Tree islands, or hammocks, were included on the early surveys. The trees served as secondary navigational features on an otherwise featureless stretch of coast.

See Plate 1 for location of Econfina River.

Figure 3. A portion of historic chart, T-1424a, at the Econfina River, Taylor County, Florida depicting scattered tree hammocks and hypothetical survey errors.

photography. The imagery was examined to determine the present location of the hammocks, but tree morbidity in the intervening years often resulted in shrinking or entire loss of tree islands.

Trees near the coast have been stressed and dying because of increased tidal flooding for many years (Kurz and Wagner, 1957; Williams and others, 1999). Sometimes a scar was visible in the imagery where a hammock had been mapped 100 years ago. A scar appeared in the imagery as a bare, or thinly vegetated patch having a similar shape and approximate size as the historic hammock. Alternately, a light-colored ring-like feature surrounded a hammock that had decreased in size because of tree loss. If the corresponding modern hammock was successfully located, the question remained whether or not trees had died in the interim and if a measurement would reflect survey accuracy or changes to the feature.

The resolution of the satellite imagery at 28.5 m reduced the capacity to identify small features or thin tree cover. Whereas the surveyors could see single and small clumps of trees, these features were lost in the coarseness of imagery, giving the appearance of salt marsh. Aerial photographs were consulted, but the same problems with tree morbidity and scars were encountered.

The uncertainty of hammock location is a reflection of several interrelated factors including change from natural events and processes, the resolution of features, and human impacts. A combination of the following issues rendered a secondary features evaluation ineffective:

- Up to 10 m horizontal error in rectification of the historic charts
- Possible inaccuracies in historic surveying of secondary features
- Tree morbidity from increased tidal flooding
- Image horizontal map accuracy (20 m)
- Imagery resolution (28.5 m) compounded the problem of positive hammock identification
- Trees may have been removed from hammocks by logging

SUMMARY

Historic topographic surveys were rectified with a map accuracy of $\pm$8 m and digitized in a 5 m resolution grid. A 10 m resolution mosaic of historic features was overlaid on a 28.5 m image of modern coastal conditions in the intertidal zone to evaluate response to sea level rise. The Florida Big Bend region is considered to be a relatively stable, low energy shoreline compared to other Gulf coast shorelines. Stability at the shore is in part related to the near-surface position of the underlying limestone. This regional characteristic proved to be useful in the rectification of historic charts to a modern datum. The persistence of local features, such as limestone pinnacles, right angle creek mouths and intersections, and limestone peninsulas are controlled by underlying geology. These features facilitated the collection of control points from the modern imagery as reference for the historic surveys. While not applicable in all coastal environments, the opportunity to consider features from an otherwise obsolete datum extended regional change analysis 100+ years into the past. Based on the RMS error for all check points, final registration of each chart assures that 90% or more of all map features are within 8 m of their known location.

Despite the underlying stability, shoreline loss appeared to exceed shoreline accretion along most of this coastline. Pockets of shoreline accretion are observable, but erosion clearly dominates shoreline change. Kurz and Wagner documented loss of marsh at the shore in 1957. Dramatic loss of tidal marsh to the Gulf of Mexico occurred at specific locations near St. Marks River, east of Cedar Key and south of the Chassahowitzka River. The location of these losses generates questions regarding characteristics that promote marsh development, and the characteristics that would increase susceptibility to loss. Sea level rise, increased tidal flooding, and storm surge are some of the driving forces. Other factors include freshwater input, topography, offshore bathymetry, and sediment supply. Additional analyses will focus on local characteristics, mechanisms and implications to regional vulnerability.

Loss of marsh to open water is exceeded by gains of the intertidal zone migrating inland. The inland migration of the marsh is reflected in coastal forest retreat along the Big Bend of Florida. Increased sea level, increased tidal flooding, and extension of tidal creeks inland contribute to the movement of marine waters onto low elevation forest soils. Over time, trees are stressed and killed by the increases in tidal flooding (Williams and others, 1999). Eventually the area is colonized by salt marsh vegetation (Kurz and Wagner, 1957). Kurz and Wagner (1957) provided hard evidence of tidal marsh overtaking forest almost 50 years ago near St. Marks River. This report shows an inland movement of the intertidal/forest boundary along the entire open marsh coast with variations in degree from site to site. Little or no inland movement of the tidal marsh is observable at the mouth of the St. Marks River, Aucilla River, Suwannee River, and Weeki Wachee River. However, the marsh has migrated a kilometer or more over historical coastal forest in the Gulf Hammock region between Cedar Key and the Withlacoochee River (Plates 2 and 4).

These coastal marshes present a unique environment for the evaluation of change in response to sea level rise and coastal development. Overall, the gain of tidal marsh over upland habitat is greater than shoreline loss of tidal marsh. Based on these maps, we suggest that a simple measurement of shoreline movement cannot fully represent the impact of gradual sea level rise in a low gradient coastal environment.

Products

These data are archived and presented in a mosaic of the coast on an accompanying CD-ROM. The open-file report and a CD-ROM are produced for information distribution. The CD-ROM contains: viewing software, a complete coast survey from Wakulla to Pasco County with polygons of change, and this Open File Report in PDF format. A hardcopy map and .rtl file for the historic to present is provided to visually illustrate some of the common as well as some of the more dramatic types of change that have occurred along the Big Bend coast (Plate 4). Individual plates were created for the following surveys: T-699, T-1700, and T-1424a showing examples of historic, current features, and areas of change (Plates 1, 2, 3).

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APPENDIX I

T-sheet Inventory

This is an inventory of the historic maps of the west coast of Florida in the Florida Big Bend project. The T-sheets were surveyed between 1852 and 1886 by the U.S. Coast and Geodetic Survey. The inventory includes T-sheet number, title, superintendent, surveyor, assistant surveyor, topographer, section, date, scale and presence of notes on the map where applicable. T-sheets are listed in chronological order starting with the earliest map T-422 (The Cedar Key) created in January, 1852 and extending through several T-sheets completed in 1886. The purpose of the inventory is to identify similarities in workmanship, potential errors, and style between the various T-sheets in this analysis. The inventory lists a total of 23 maps covering the Florida Big Bend study area. Only 19 were used in this project. Unused surveys show details of river entrance.

1. A. MAP T-422.

    B. THE CEDAR KEYS, FLORIDA.

    C. DATE: 1852.

    D. SUPERINTENDENT: A.D.BACHE.

    E. TOPOGRAPHER: F.H.GERDES.

    F. SECTION: 7.

    G. SCALE: 1/10,000.

    H. NOTE: THERE IS ALSO A TRACING TO THIS MAP.

2. A. MAP T-423. (In two parts, a & b, combined in this project)

    B. CEDAR KEYS, FLORIDA.

    C. DATE: 1852-1854.

    D. SUPERINTENDENT: A.D.BACHE.

    E. TOPOGRAPHER: F.H.GERDES.

    F. SECTION: 7.

    G. SCALE: 1/10,000.

    H. NOTES: NONE.

3. A. MAP: T-575. (Small area, not used in this project)

    B. RIVER ST MARKS ON THE WESTERN COAST OF FLORIDA.

    C. DATE: 1856.

    D. SUPERINTENDENT: A.D.BACHE.

    E. TOPOGRAPHER: D.WISE.

    F. SECTION: NONE GIVEN.

    G. SCALE: 1/20,000.

    H. NOTES: TRIANGLATION DONE BY S.C.McCORKLE.

4. A. MAP: T-570. (Small area, not used in this project)

   B. THE RECONNAISSANCE OF THE MOUTH OF THE WITHLACOOCHEE RIVER FLORIDA.

   C. DATE: 1856.

   D. SUPERINTENDENT: A.D.BACHE.

   E. SURVEY CHIEF: A.M.HAMFON AIDED BY P.R.HARVLEY.

   F. SECTION: NONE GIVEN.

   G. SCALE: 1/10,000.

   H. NOTES: NONE.

5. A. MAP: T-572.

   B. MAP OF PART OF THE COAST OF FLORIDA FROM CEDAR KEYS EASTWARD.

   C. DATE: 1856.

   D. SUPERINTENDENT: A.D.BACHE.

   E. SURVEY CHIEF: A.M.HAMFON AIDED BY P.R.HARVLEY.

   F. SECTION: NONE GIVEN.

   G. SCALE: 1/10,000.

   H. NOTES: NONE GIVEN.

6. A. MAP: T-705.

   B. SURVEY OF THE WESTERN COAST OF FLORIDA SOUTHWARD FROM CRYSTAL RIVER.

   C. DATE: JANUARY AND FEBUARY 1858.

   D. SUPERINTENDENT: A.D.BACHE.

   E. SURVEYER: N.S.FINNEY AIDED BY J.L.FILGHMAN.

   F. SECTION: 7.

   G. SCALE: 1/20,000.

   H. NOTES: NONE GIVEN.

7. A. MAP: T-691. (Small area, not used in this project)

   B. SURVEY OF THE HOMOSASSA RIVER.

   C. DATE: MARCH 1858.

   D. SUPERINTENDENT: A.D.BACHE.

   E. SURVEYER: N.S.FINNEY AIDED BY N.L.FILGHMAN.

   F. SECTION: 7.

   G. SCALE: 1/10,000.

   H. NOTES: NONE GIVEN.

8. A. MAP: T-699.

B.SURVEY OF THE WESTERN COAST OF FLORIDA FROM THE WACCASASSA TO THE MOUTH OF THE WITHLACOOCHEE.

C. DATE: 1858.

D. SUPERINTENDENT: A.D.BACHE.

E. SURVEYER: N.S.FINNEY AIDED BY J.L.FILGHMAN.

F. SECTION: 7.

G. SCALE: 1/20,000.

H. NOTES: NONE GIVEN.

9. A. MAP: T-779.

B. SURVEY OF THE WESTERN COAST OF FLORIDA FROM GREEN POINTsig, SOUTHWARD TO HOMOSASSA RIVER.

C. DATE: DECEMBER AND JANUARY 1858-1859.

D. SUPERINTENDENR: A.D.BACHE.

E. SURVEYER: N.S.FINNEY AIDED BY J.L.TILGHMAN.

F. SECTION: 7.

G. SCALE: 1/20,000.

H. NOTES: A BRIEF DESCRIPTION FOR SAILING AND ANCHORING AND HIGH TIDE IS INCLUDED ON MAP.

10. A. MAP: T-782.

B. SURVEY OF THE WESTERN COAST OF FLORIDA FROM THE NORTH SIDE OF THE MOUTH OF THE CHASSAHOWITZKA.

C. DATE: FEBUARY AND MARCH OF 1859.

D. SUPERINTENDENT: A.D.BACHE.

E. SURVEYER: N.S.FINNEY AIDED BY J.L.FILGHMAN.

F. SECTION: 7.

G. SCALE: 1/20,000.

H. NOTES: THERE IS A BRIEF DESCRIPTION ON THE MAP OF ANCHORING SITES AND HOW THE MARSH WAS VERY HARD TO MAP BECAUSE IT SEEMED TO EXTEND FOR MILES. ALSO MAP WAS HARD TO COMPLETE BECAUSE IT WAS AN AREA THAT WAS EXTREMELY HARD TO NAVIAGATE.

11. A. MAP: T- 780.

B. SURVEY OF THE WESTERN COAST OF FLORIDA FROM BASIN ROCK sig, WITHLA-COOCHEE BAY SOUTHWARD TO CRYSTAL RIVER.

C. DATE: 1859.

D. SUPERINTENDENT: A.D.BACHE.

E. SURVEYER: N.S.FINNEY AIDED BY THE U.S.C.S.

F. SECTION: 7.

G. SCALE: 1/20,000.

H. NOTES: ON THE MAP THERE IS A BRIEF DESCRIPTION OF THE AREA BEING SURVEYED.

12. A. MAP: T-820.

B. SEA COAST OF FLORIDA FROM OLOCKONEY BAY TO ST MARKS RIVER.

C. DATE: WINTER OF 1859-60.

D. SUPERINTENDENT: A.D.BACHE.

E. SURVEYER: TRIANGULATION BY S.C.McCORKLE AND TOPOGRAPHY BY D.WISE.

F. SECTION: 7.

G. SCALE: 1/10,000.

H. NOTES: NONE GIVEN.

13. A. MAP: T-819.

B. SEACOAST OF FLORIDA FROM THE STMARKS RIVER TO THE OCILLA RIVER.

C. DATE: JANUARY AND FEBUARY 1859-60.

D. SUPERINTENDENT: A.D.BACHE.

E. SURVEYER: TRIANGULATION BY S.C.McCORKLE AND TOPOGRAHPY BY D.WISE.

F. SECTION: 7.

G. SCALE: 1/20,000.

H. NOTES: NONE GIVEN.

14. A. MAP: T-781.

B. SURVEY OF THE WESTERN COASY OF FLORIDA FROM TUCKERS IDsig, MOUTH OF THE HOMOSSASA RIVER SOUTHWARD.

C. DATE: 1860.

D. SUPERINTENDENT: A.D.BACHE.

E. SURVEYER: N.S.FINNEY.

F. SECTION: 7.

G. SCALE: 1/20,000.

H. NOTES: NONE GIVEN.

15. A. MAP: T-962. (Small area, not used in this project)

B. BAY PORT FLORIDA, BAY PORT HARBOR AND THE KEYS.

C. DATE: DECEMBER 21ST, 1864.

D. SUPERINTENDENT: A.D.BACHE.

E. SURVEYER: N.S.FINNEY.

F. SECTION: NONE GIVEN.

G. SCALE: 1/20,000.

H. NOTES: THIS MYLAR IS A COPY OF THE ORIGINAL PLANE TABLE MAP.

16. A. MAP: T- 1424a.

B. WEST COAST OF FLORIDA FROM FENHOLLOWAY RIVER TO THE OCILLA RIVER.

C. DATE. 1875.

D. SUPERINTENDENT: CARLILE P. PATTERSON.

E SURVEYER: F.W.PERKINS AIDED BY J.F.PRATT.

F. SECTION: 7.

G. SCALE: 1/20,000.

H. NOTES: NONE GIVEN.

17. A. MAP: T-1424b.

B. WEST COAST OF FLORIDA FROM LIVE OAK POINT TO FENHOLLOWAY RIVER.

C. DATE: 1875.

D. SUPERINTENDENT: CARLILE P. PATTERSON.

E. SURVEYER: F.W.PERKINS AIDED BY J.F.PRATT.

F. SECTION: 7.

G. SCALE: 1/20,000.

H. NOTES: NONE GIVEN.

18. A. MAP: T-1425a.

B. WEST COAST OF FLORIDA FROM DALLASCREEK TO LIVEOAK POINT.

C. DATE: 1875.

D. SUPERINTENDENT: CARLILE P. PATTERSON.

E. SURVEYER: F.W.PERKINS AIDED BY J.F.PRATT.

F. SECTION: 7.

G. SCALE: 1/20,000.

H. NOTES: NONE GIVEN.

19. A. MAP: T-1425b.

B. WEST COAST OF FLORIDA FROM PEPPERFISH KEYS TO STEINHATCHEE RIVER.

C. DATE: 1875.

D. SUPERINTENDENT: CARLILE P.PATTERSON.

E. SURVEYER: F.W.PERKINS AIDED BY J.F.PRATT.

F. SECTION: 7

G. SCALE: 1/20,000.

H. NOTES: NONE GIVEN.

20. A. MAP: T-1426a.

B. WEST COAST OF FLORIDA NORTH OF CEDAR KEYS.

C. DATE: 1876.

D. SUPERINTENDENT: CARLILE P.PATTERSON.

E. SURVEYER: F.WALLEY PERKINS AIDED BY JOHN De WOLF.

F. SECTION: 7.

G. SCALE: 1/20,000.

H. NOTES: NONE GIVEN.

21. A. MAP: T-1426b.

B. WEST COAST OF FLORIDA BETWEEN HORSESHOE COVE AND CEDAR KEYS.

C. DATE: 1876-77.

D. SUPERINTENDENT: CARLILE P.PATTERSON .

E. SURVEYER: JOHN De WOLF AIDED BY F.W. PERKINS.

F. SECTION: 7.

G. SCALE: 1/20,000.

H. NOTES: NONE GIVEN.

22. A. MAP: T-1699.

B. WEST COAST OF FLORIDA FROM TROUBLE CREEK TO CEDAR POINT.

C. DATE: 1886.

D. SUPERINTENDENT: F.M.THORN.

E. SURVEYER: W.IRVING VINAL AND TOPOGRAPHY BY C.MAHON.

F. SECTION: NOT GIVEN.

G. SCALE: 1/20,000.

H. NOTES: NOT GIVEN.

23. A. MAP: T-1700.

B. WEST COAST OF FLORIDA FROM CEDAR POINT TO WALL CREEK.

C. DATE: 1886.

D. SUPERINTENDENT: F.M.THORN.

E. SURVEYER: W.IRVING VINAL AND TOPOGRAPHY BY C.MAHON.

F. SECTION: NOT GIVEN.

G. SCALE: 1/20,000.

H. NOTES: NOT GIVEN.

APPENDIX II

Field Notes from Topographic Surveys

U.S. Coast and Geodetic Survey
F.O.M. Thorn, Superintendent
State: Florida
Descriptive Report,
Topographic Sheets Nos. 1698,1699,1700.
Locality: West Coast of Florida, From Clearwater to Bayport.
1888
Chief of Party: W. Irving Vinal.
(faxed copy begins at page 2.)
...ing in the interior, particularly as we proceed northward.
The line dividing Hillsboro County from Hernando County runs eastward from the mouth of the Anclote River. South of this line the fast land is immediately adjacent to the coast and the shoreline is comparatively bold. North of this line the fast land generally recedes from the coast, the intervening salt marshes varying greatly in width from a few yards to several miles. Here the high water line is sharply defined by the grass and muddy edges of the marsh or an occassional spot of sandy beach, but the location of the low water line is uncertain. The sea here is extremely shallow, the bottom even and nearly level;
"northers" frequently blow the water far from shore. Save on the Gulf side of Hog Island and the Anclote Keys there are no breakers and thus, owing to the shallowness of the water and gentle incline of the bottom, are never dangerous. The entire coast is free from signs of wreck or drift. Recently a light house has been established near the south end of the Anclote Keys, inside of which is safe and commodius anchorage for vessels drawing 8 or 9 feet of water. This harbor is the rondezvous for the sponge fishermen who have their "pounds?" for curing and storing sponges on the north key. This is the only harbor, between Tampa Bay and Cedar Keys, for vessels drawing more than 3 feet of water. Shelter for small vessels can be found back of Hog Island, at the entrances of the Pithlochasscootie, Wekiwoochee and other streams, but the channels are narrow, intricate and poorly defined.
The eastern sides of the islands are fringed with mangroves but on the main shore the Mangrove trees have in most instances been killed by frosts. Palmetto and Pine also grow on the islands where there is very little arable land. On the main land the forest growth consists of Palmetto, Pine, Cypress, Cedar and several varieties of Oak including Live Oak. There is a great deal of scrub both Oak and Palmetto.
The extensive salt marshes of Hernando County are interspersed with islands of solid ground, often showing outcropping rocks, on which grow Palmetto, Pine and Cedar trees of large size. The trees having been cut from some of these islands they are now entirely devoid of vegetation. The marshes are covered with a rank growth of "saw" grass and are intersected by numerous creeks, some of which are of considerable size and most of which have their origin in the woods on the fast land. Many small, irregular and often detached marshes run up into the fast land. Some of these have been reclaimed by ditches and dykes; the land thus gained is very rich and repays cultivation several years in succession at small expense. A company of English Capitalists, headed by Sir Edward J. Reed, has acquired title to a large trust of marshland in Hernando County and was engaged in reclaiming it at the time this survey was made. Many small muddy depressions are found, particularly in Hillsboro County, which in 1884 were dry (said to be an unusual occurrence), but which in 1886 contained from 3 to 4 feet of water. Sinks of fresh water, always found with limestone rock, are passed at varying intervals along the most traveled roads. A deep and powerful spring of fresh water was found in the Gulf between Yellow Bluff and Bay View.
There is a much larger proportion of arable land near the coast in Hillsboro County than in Hernando County, but the land in the latter county, while it lies further back, is in general of a better quality.
In Hillsboro County the settlements of Clearwater, Dunedin, Yellow Bluff, Bay View, Anclote and Tarpon Springs are made up largely of northern people who cultivate Oranges, Lemons and Vegetables. They have direct steamboat connections with each other and with Tampa and Cedar Keys twice a week. The steamer "Governor Safford" was built expressly for this route. A smaller light draught steamer, the "Mary Disston", runs from Clearwater to Tarpon Springs. During "northers" or when the water near shore is shoal, the larger boat is

obliged to land passengers and freight on pier heads built off shore.
The settlements along the coast of Hernando County, as Port Richie, Hudson, and Bay Port, are made on island surrounded by salt marsh but are connected by good roads in the interior. Sailing vessels of very light draught are the only means of communication by water between these places and Cedar Keys.
Surveys for a railroad from Tampa to Brooksville were made in 1886 and it was understood that the rails would at once be laid. This road as surveyed is within easy access of all the places named above. Saw mills are located at Dunedin, Bay View, Anclote and Tarpon Springs but a great deal of lumber used on this coast is furnished by the Fennissore? Mills (Fairchild's) at Cedar Keys. The sawmills of the Fabre and Eagle Pencil Companies are located at Cedar Keys.
Tarpon Springs was projected by ex-Govervor Safford of Arizona, Mr. Disston of Philadelphia and others as a resort for health and pleasure. It is regularly laid out with side avenues and streets, pleasant drives have been arranged to best conform with the topography of the country and a fine hotel erected. A number of people have established their winter homes at this place.
Bayport for many years has been a place for shipping cedar logs. This traffic is not so intensively carried on as formerly owing to the growing scarcity of trees of large size. Mr. John Parsons, who for many years has controlled the interests of this place and vicinity maintains, mostly at his personal expense, a road and a telephone line to Brooksville, distant 17 miles.
There are no settlements directly on the coast between Bayport and Cedar Keys; the most important, Crystal River and Homosassa, are from six to eight miles inland. Homosassa, formerly a noted estate belonging to Senator Yulee of Florida, is now owned by ex Governor Chamberlain of Maine and others.
Throughout this entire section real estate agents and land speculators were using every effort to induce settlers to take up lands and were appearantly[sic] quite successful.
The unclaimed and unoccupied land covered by this survey is of little value as much of it is liable to overflow or, where it is elevated above flooding, the soil is light and barren.
Submitting the above I am
Yours very respectfully,
W. Irving Vinal,
Assistant U.S.C and G. Survey

U.S Coast and Geodetic Survey
O.H Tittinann, Superintendent
State: Florida
Descriptive Report,
Topographic Sheet No. 2576

Locality:
Mouth of Withlacoochee River, Gulf of Mexico Fla.
1901
Chief of Party:
Henry L. Marindin Asst.
To accompany Topographic Sheet 2576
Title:
U.S. Coast and Geodetic Survey
O.H. Tittinann Supt.
Plane Table Survey of Mouth of Withlacoochee River Florida Surveyed by H.L. Marindin, Asst.
October 1901
Scale 1/5000
Note: This work was done before the triangulation was completed by the
measurement of a short baseline on the plank walk, and from which the points "Sand" and "Inglis flag staff" were determined by plane table, subsequently these two points were observed upon and their Geographic Positions well determined, and the projection placed on sheet after my arrival at this office in Washington DC.
H.L. Marindin Asst.

Description:
The survey represented on this sheet (# 2576) was incidental to the request of the Dunnellon Phosphate Co and Port Inglis Terminal RR Co. for an Hydrographic survey of an anchorage for ocean going steamships, while loading Phosphate rock from the Co's mines in the vicinity of the Withlacoochee River.
The plane table work was done while waiting the completion of the arrangements to secure a suitable steamer to do the sounding and other work.
The sheet covers that part of the river where, for nearly two years, these companies have been at work improving the navigation of the river by dredging. The improvement begins just above the fork at the upper end of Chambers Island and extends to the line of outer oyster reefs, at the points marked "Cage Stake" and "Barrel Stake".
The one large island indicated on the sheet to which the name of Chambers Island now attaches, was formerly cut in two by a river froming two small Islands. This river is now filled up and the space grown up with marsh grass. The original name of Chambers Island was given to the southernmost Island. It is now proposed to call the present Island and vicinity "Port Inglis" in honor of Captain John L. Inglis the President of the Dunnellon Phosphate Co. and Vice President of Port-Inglis Terminal RR.Co. who now owns the grounds and who has built a "Bungalow" and cottages for workmen thereon.
The shores at the mouth of the Withlacoochee River are low and marshy, here and there within the marshes hammocks of trees are found, where the ground is somewhat higher. The trees are Cabbage Palm, Gum, Cypress, and some Cedar formerly than were found many mangroves but they were nearly all killed by the severe frosts of 1885-6.
Chambers Island can be reached from the Gulf side by boats with a draft of 5 or 6 feet of water, by entering the mouth of the river where improved by the Terminal Co. the entrance is now marked by a "Cage" beacon and a "Barrel" beacon on either side of the channel; thence proceeding up river to a small wharf or now known as the "Blacksmiths' Wharf".
The route from the landside starts from Rockwell Fla., by train on the Port-Inglis Terminall RR. to "Inglis" then by the steamer "Barker" also belonging to the P.I.T. Co. RR. down river 8 miles to the Blacksmith Wharf on the island. As both the R Road and steamer belongs to the P.I.T. Co. and the Island also, there is at present no regular schedule for the public, but the Boat usually makes a trip each day and the trains one trip every other day, between Rockwell and Inglis.
The highest tides cover the marshes and communication from the Blacksmith Wharf to the other parts of the Island is by plank walk built above the highest tides there, walks are indicated on the sheet.
The highest part of the island lies at its southern end where the material dredged from the channel of the South Pass was pumped up consisting principally of dead oyster shells and coral sands. The ground on which Capt. Inglis' "Bungalow" and cottages have been built is about 7 feet above mean high tide.
Shell mounds are found along the shores. Two of these are found on the Island which are of considerable magnitude, thus are shown on the survey.
The shores abound in oyster reefs, most of which are bare at the lowest tides. Good fishing can be found around the Island and in the river above the "fork" of the South Pass.
Respectfully submitted
Henry L. Marindin
Assistant

U.S. Coast and Geodetic Survey
R.S. Patton, Director

DESCRIPTIVE REPORT
Topographic Sheet No. R6350
State: FLORIDA
Locality: Apalachee Bay
St. Marks River
1935
Chief of Party:
C.A. Egner

TOPOGRAPHIC TITLE SHEET
The Topograhic Sheet should be accompanied by this form filled in as completely as possible, when the sheet is forwarded to the Office.
Field No.: R.
REGISTER NO. 6350
State: Florida
General locality: Apalachee Bay
Locality: St. Marks River
Scale: 1/5000
Date of survey: June-July, 1935
Vessel: Field Party #23
Chief of Party: C. A. Egner
Surveyed by: H. P. Theus, Observer.
Inked by: C. A. Egner.
Heights in feet above:....to ground to tops of trees [left blank]
Contour, Approximate contour, Form line interval:.....feet [left blank]
Instructions dated: Supplemental June 5, 1935.
Remarks: A double-sided bristol board, no work having been done on reverse side having projection for sheet "Q" upper portion of St. Marks River.

Descriptive Report to accompany Topographic Sheet R:
Instructions
This work was covered by Supplemental Instructions dated June 5, 1935, which called for an extension eastward to St. Marks Lighthouse of the original Instructions of Nov. 30, 1934.
Limits
This sheet covers the middle section of the St. Marks River, three sheets on a scale of 1/5000 being laid out to extend from St. Marks L. H. up the river as far as the settlement of St. Marks. Sheet Q joins it on the north; Sheet W on the south.
Field sheet Q has not been received, probably not surveyed.
Purpose
To revise existing surveys; to deliniate the shoreline since aerial surveys do not as yet reach this far eastward; to provide control for hydrography; to establish permanent recoverable stations for later revision work; and to provide control for aerial photographs if and when they are taken.
Methods and Instruments
All of the work was done with the usual planetable outfit. Since no aerial photographs are available for this area, complete topography was taken of all shoreline as far as the hydrography was to be extended. This covered the main body of the St. Marks River, and its major branches as far as fixed position hydrography was feasible. The shoreline along the water was rodded in; no attempt was made to outline the tree line inland from the marshy areas. All signals were located by intersection from triangulation stations, or from set-ups using those triangulation stations for control.
Control—Horizontal
Depends upon third order triangulation broken down from first order work of 1934, by the 1st order party in 1935, and further extended by this field party. Several stations of previous work were used in this "breakdown" operation. All were tied together in a continuous scheme. All stations are on the N. A. 1927 datum.
Control—Vertical
None, as the area is all practically at sea level.
Marking of Stations
Aside from the triangulation, which was monumented and referenced in the usual manner, several stations of the U. S. Engineers Dept., which has been engaged in preliminary work preparatory to channel dredging in this river, were recovered and incorporated in our work. These stations are all marked with 2" galv. pipe, are well located, and are considered quite permanent in character. These were used as recoverable stations and so noted in our records.
Landmarks
None worthy of record.

Geographic Names
Charted ones have been retained.
Magnetic Meridian
Obtained at [triangulation symbol] Leon June 17, 1935.
Method of transfer of signals and shoreline to Hydro. Sheet.
Recoverable stations by dms and dps.; others, and shoreline by tracing.
Changes since last survey
No important changes are noted. It is expected that in case the U. S. E. Dept. proceeds with river and harbor development considerable alteration will take place, with the channel deepened and straightened and consequent changes in the marshy shoreline.
Respectfully submitted,
H. P. Theus, Observer.
Approved and forwarded:
C. A. Egner
Chief of Party.

LIST OF RECOVERABLE STATIONS

Name	Latitude	Meters	Longitude	Meters	Description
Cow (USE Mac)	30 07	788.5 (1059)	84 12	93 (1513)	2” galv, pipe showing 2’
Kit (USE Otha)	30 07	371 (1476.5)	84 11	1456 (150)	Do.
Pig (USE Hunt)	30 07	26 (1821)	84 12	484 (1122)	Do.
USE Reed	30 06	996 (851.5)	84 12	794 (812)	Do.
USE Cap	30 06 6	1308 (539.5)	84 12	199 (1407.0)	Do.

GEOGRAPHIC NAMES

Date: Nov. 14, 1935
Survey No. 6350
Chart No. 181
Diagram No. 181

Approved by the Division of Geographic Names, Department of Interior *
Referred to the Division of Geographic Names, Department of Interior.
R Under Investigation. Q Four Mile Pt.

Status	Name on Survey	Name on Chart	New Names in local use	Names assigned by Field	Location
	St. Marks River	Same			
		Hunting Bayou			
		Three Mile Pt.			
		Four Mile Pt.			

Names approved Jan. 14, 1936
C. A. Egner
Review of Topograpphic Survey No. 6350 (1935) Field Letter R
Title (Par. 56) St. Marks River, Apalachee Bay, Florida

Chief of Party: C. A. Egner
Surveyed by: H. P. Theus
Inked by: C. A. Egner
Ship: Field Party No. 23
Instructions dated: Nov. 30, 1934
June 5, 1935

Surveyed in: June-July, 1935
1. The survey and preparation for it conform to the requirements of the Topographic Manual. (Par. 7, 8, 9, 13, 16.)
2. The character and scope of the survey satisfy the instructions.
3. The control and closures of traverses were adequate. (Par. 12, 29.)
4. [Scratched out]
5. The delineation of -contours-formlines- is satisfactory. (Par. 49, 50.)
No contours - Flat Area
6. There is sufficient control on maps from other sources that were transmitted by the field party to enable their application to the charts. (Par. 28.)
None submitted
7. High water line on marshy and mangrove coast is clear and adequate for chart compilation. (Par. 16a, 43, 44.)
8. The representation of low water lines, reefs, coral reefs, and rocks, and legends pertaining to them is satisfactory. (Par. 36, 37, 38, 39, 40, 41.)
None of these features are shown
9. Rocks and other important details shown on previous surveys and on the chart were verified. (Par. 25, 26, 27.)
No rocks in the area except oyster reefs, which were not located topographically.
10. [Scratched out]
11. [Scratched out]
12. [Scratched out]
NOTE: Strike out paragraphs, words or phrases not applicable and modify those requiring it. Paragraph numbers refer to those in the Topographic Manual. Use reverse side for extending remarks.
13. The descriptive report covers all details listed in the Manual, in so far as they apply to this survey. (Par. 64, 65, 66, 67.)
14. [scratched out]
15. The descriptions of recoverable stations and references to shore line were accomplished on Form 524. (Par. 29, 30, 57, 67 except scaling of DMs and DPs, 68.)
16. A list of landmarks for charts was furnished on Form 567 and plotting checked. (Par. 16d, e, 60.)
17. The magnetic meridian was shown and declination was checked. (Par. 17, 52.)
Meridian shown but no evidence declinatiore was checked.
18. The geographic datum of the sheet is N. A. 1927 and the reference station is correctly noted. (Par. 34.)
19. Junctions with comtemporary surveys are adequate.
There is a discrepancy in the shoreline of about 11 meters in azimuth at the junction with T-6351 (1935) on the south (east shore). T-6351 should be used for that section of the shoreline common to both sheets because the control on that sheet is better.
20. Geographic names are shown on the sheet and are covered by the Descriptive report. (Par. 64, 66k.)
21. The quality of the drafting is good. (Par. 31, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42, 45, 46, 47, 48, 49, 50.)
22. No additional surveying is recommended. This can not be considered a complete survey of this area, however, since aerial photographs will eventually be taken no additional plane table work is recommended.
23. The Chief of Party inspected and approved the sheet and and the descriptive report.
24. Remarks:
Reviewed in office by: R. L. Johnston April 14, 1936

Inspected by: A. L. Shalarp?
Examined and approved:

C. K. Green — Chief, Section of Field Records

Fred L. Peacock — Chief, Section of Field Work

L. O. Polbert? — Chief, Division of Charts

G. Pude? — Chief, Division of Hyd. and Top.

25 Jan 17, 1936
EUD?

Topographic Sheet No. 782
From the north side of the mouth of the Chassahowitzka River southward to Raccoon Point Sig.
Feb. and Mar. 1859

NOTE ON ACTUAL T-SHEET:
Vessels drawing eight and nine feet find a safe anchorage north of "Black Rock" as indicated by position of the Schr. "Jos Henry". The line of the woods and main land, could not be determined without much delay and difficulty as in many places the marsh extends back several miles into the interior, and is nearly impenetrable.
"St. Martins Rees," extend all along this coast from opposite the Crystal River, to the southward, 15 or 20 miles; and extending from, 4,,to ,,15,, miles into the Gulf.
They consist of scattering Rocks sharp and jagged exceedingly dangerous to navigation and generally barely covered at low water. The channel leading into the Chassahowitzka River is only navigable by very light craft drawing ,,2,, or ,,3,, feet. At low water it is nearly dry.

DESCRIPTIVE REPORT
Topographic Sheet No. W 6351
State: Florida
Locality: Apalachee Bay
St. Marks River
1935
Chief of Party: C. A. Egner.

TOPOGRAPHIC TITLE SHEET
The Topographic Sheet should be accompanied by this form filled in as completely as possible, when the sheet is forwarded to the Office.
Field No.: W
Register No.: 6351
State: Florida
General Locality: Apalachee Bay
Locality: St. Marks River
Scale: 1/5000
Date of Survey: June-July 1935
Vessel: Field Party #23
Chief of Party: C. A. Egner
Surveyed by: H. P. Theus, Observer

Inked by: H. P. Theus
Heights in feet above.....to ground to tops of trees
Contour, Approximate contour, Form line interval....feet
Instructions dated: Supplemental June 5, 1935
Remarks: This is a single sided bristol board.
DESCRIPTIVE REPORT
to accompany Topographic Sheet W
Instructions
This work is covered by Supplemental Instructions dated June 5, 1935, which called for an extension eastward to St. Marks Lighthouse of the original Instructions of Nov. 30, 1934.
Limits
Three sheets on a scale of 1/5000 (W, R, Q) were laid out to cover the St. Marks River from the Lighthouse to the settlement of St. Marks. This sheet is the lower one of the three.
Purpose
To revise existing surveys; to deliniate the shoreline since aerial
photography does not extend over this area; to provide control for hydrography;
to establish permanent recoverable stations for later revision work; and to
provide field control for photographs if and when they are taken/
Methods and Instruments
The usual planetable outfit was used. Since no aerial photography has yet been flown over this area, complete topography was taken of all shoreline as far as the hydrography was extended. This covered the main body of the river and prominent tributaries, the scale of the sheet being such that laterally is was expected that adjacent sheets would cover much of these tributaries on a scale of 1/10000. The shoreline along the water was rodded in; tree lines back from the marshy areas were not deliniated. All signals, including the numerous channel beacons, were located by intersection from the triangulation stations or from set-ups based on them.
Control—Horizontal
A third order scheme of triangulation was established in this area for this control. It was based on stations of the 1st order work of 1934, supplemented by "breakdown" stations inserted by the 1st order party, and by several recovered stations of old work.
Control—Vertical
None, as the area is all practically at sea level.
Work of the U. S. Engineer Dept.
While this work was being done, the U. S. E. Dept. was engaged in preliminary investigations looking forward to channel and port development at St. Marks. Control stations of their work were tied in to our datum, and several of their stations marked with 2" galv. pipe were included in our list of recoverable stations.
Marking of Stations A
As noted above, several stations of the U. S. E. D. were located and included in our list. These, with the numerous triangulation stations furnish recoverable stations for future revision work.
Landmarks
None, except St. Marks L. H. already charted.
Geographic Names
Charted ones have been retained.
Magnetic Meridian
Obtained at [triangulation symbol] IND July 15, 1935.
Transfer of signals
Recoverable stations by dms and dps; others by tracing.
Changes since last survey
None worthy of note.
Respectfully submitted,

H. P. Theus, Observer
Approved and forwarded:
C. A. Egner,
Chief of Party.

LIST OF RECOVERABLE STATIONS   SHEET W

Name	Lat.	Meters	Long	Meters	Description
SUE (USE East R)	30 05	1183 (664)	84 11	388 (1218)	4”x4” conc. monument showing 12”
USE MUD	30 04	1341 (506)	84 10	1574 (32)	2” galv. pipe showing 2’
USE SAW	30 05	1725 (122)	84 11	941 (665)	4”x4” conc. monument showing 14”

GEOGRAPHIC NAMES

Date: Nov. 14, 193
Survey No.: 6351
Chart No.: 181
Diagram No.: 181
Approved by the Division of Geographic Names, Department of Interior. *
Referred to the Division of Geographic Names, Department of Interior. R
Under investigation. Q

Status	Name on Survey	Name on Chart	New Names in local use	Names assigned by Field	Location
	St. Marks River	same			
	Sprague Pt.				
	St. Marks Pt.				

Names approved Jan. 14, 1936
C. A. Egner

REVIEW OF TOPOGRAPHIC SURVEY NO. 6351 (1935) Field Letter W

Title (Par. 56): St. Marks River, Apalachee Bay, Florida
Chief of Party: C. A. Egner   Surveyed by: H. P. Theus
Inked by: H. P. Theus
Ship: Field Party #23
Instructions dated: Nov. 30, 1934
June 5, 1935

Surveyed in: June-July, 1935
1. The survey and preparation for it conform to the requirements of the Topographic Manual. (Par. 7, 8, 9, 13, 16.)
2. The character and scope of the survey satisfy the instructions.
3. The control and closures of traverse were adequate. (Par. 12, 29.)
4. [scratch out]
5. The delineation of -contours-formlines- is satisfactory. (Par. 49, 50.)
NO contours, flat area.
6. There is sufficient control on maps from other sources that were transmitted by the field party to enable their application to the charts. (Par. 28.)
None submitted.
7. High water line on marshy and mangrove coast is clear and adequate for chart compilation. (Par. 16a, 43, 44.)
8. The representation of low water lines, reefs, coral reefs, and rocks, and legends pertaining to them is satisfactory. (Par. 36, 37, 38, 39, 40, 41.)
None of these features are shown.
9. Rocks and other important details shown on previous surveys and on the chart were verified. (Par. 25, 26, 27.)

No rocks in this area except oyster reefs. These were not located topographically.
10. [scratch out]
11. [scratch out]
12. [scratch out]
NOTE: Strike out paragraphs, words or phrases not applicable and modify those requiring it. Paragraph numbers refer to those in the Topographic Manual. Use reverse side for extending remarks.
13. The descriptive report covers all details listed in the Manual, in so far as they apply to this survey. (Par. 64, 65, 66, 67.)
14. [scratch out]
15. The descriptions of recoverable stations and references to shore line were accomplished on Form 524. (Par. 29, 30, 57, 67 except scaling of DMs and DPs, 68.)
16. A list of landmarks for charts was furnished on Form 567 and plotting checked. (Par. 16d, e, 60.)
No landmarks except those previously reported.
17. The magnetic meridian was shown and declination was checked. (Par. 17, 52.)
Meridian shown but no evidence declinatoire was checked.
18. The geographic datum of the sheet is N. A. 1927 and the reference station is correctly noted. (Par. 34.)
19. Junctions with contemporary surveys are adequate.
There is a discrepancy in the shoreline of about 11 meters in azimuth at the junction with T-6350 (1935) on the north (East shore) T-6351 (1935) should be used for that section of the shoreline common to both sheets because the control on that sheet is better.
20. Geographic names are shown on the sheet and are covered by the Descriptive Report. (Par. 64, 66k.)
21. The quality of the drafting is good. (Par. 31, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42, 45, 46, 47, 48, 49, 50.)
22. No additional surveying is recommended.
This can not be considered a complete survey of this area, however, since aerial photographs will eventually be taken no additional plane table work is recommended.
23. The Chief of Party inspected and approved the sheet and the descriptive report.
24. Remarks:
Reviewed in office by: R. L. Johnston April 14, 1936
Inspected by: A. L. Shalanty?
Examined and approved:

C. K. Green	Fred L. Peacock
Chief, Section of Field Records	Chief, Section of Field Work
L. O. Polbert?	G. Rude?
Chief, Division of Charts	Chief, Division of Hyd. and Top.

25 Jan 17, 1936
EUD?

U. S. Coast and Geodetic Survey
Survey of the Homosassa River
March 1858

Scale: 1: 10,000

Register No. 691

NOTE ON ACTUAL T-SHEET:
The projection depends on the geogr. position of Tucker's Island, the magnetic meridian given on this sheet, the variation of 4 degrees 48' East by Schoff and the shrinkage obtained from the comparison of the mile given on the sheet with the true length thereof. The position of Lone (small) Palmetto Tree does not agree with the Small Palmetto of the triangulation.
July 30th 1887

E. J. Sommer
U. S. Coast and Geodetic Survey
Survey of the Western Coast of Florida from Green Point Sig, Southward to Homosassa River.
December and January 1858-1859
Scale: 1: 20,000
Register No. 779

NOTE ON THE ACTUAL T-SHEET:
Vessels drawing seven feet find a safe anchorage near "Barrel Stake" as indicated by anchorage of Cedar Vessels.
At high tide, five feet water can be carried up the Homosassa River to Yulee's Wharf 3.5 miles from the mouth. The mouth of the Homosassa can easily be found by the White Shell beach around Shell Island at its entrance and by a large White Rock nearly a mile west of the entrance. The Homosassa Islands are covered by a thick growth of mangrove bushes.

U. S. Coast and Geodetic Survey
Survey of the Western Coast of Florida from the North Side of the Mouth of the Chassahowitzka
February and March 1859
Scale: 1: 20,000
Register No. 782

NOTE ON ACTUAL T-SHEET:
Vessels drawing eight and nine feet find a safe anchorage north of "Black Rock" as indicated by position of the Schr. "Jos Henry". The line of the woods and main land, could not be determined without much delay and difficulty as in many places the marsh extends back several miles into the interior, and is nearly impenetrable. "St. Martins Rees," extend all along this coast from opposite the Crystal River, to the southward, 15 or 20 miles; and extending from, 4,,to ,,15,, miles into the Gulf.
They consist of scattering Rocks sharp and jagged exceedingly dangerous to navigation and generally barely covered at low water. The channel leading into the Chassahowitzka River is only navigable by very light craft drawing ,,2,, or ,,3,, feet. At low water it is nearly dry.

U. S. Coast and Geodetic Survey
Bay Port, Florida, Bay Port Harbor and the Keys
December 21st, 1864

Scale: 1: 20,000
Register No. 962

NOTE ON ACTUAL T-SHEET:
Supposed to be an original Plane Table Sheet by N. S. Finney.
Captured in Savannah, Ga. by the Army under Command of Maj. Gen.? W. T. Sherman.
Dec. 21st 1864

Plate 4. Coastal changes from 1852-1995 along Florida's Big Bend, 1:300,000