



Shoreline Change at Timucuan Ecological and Historic Preserve

2018–2019 Data Summary

Natural Resource Data Series NPS/SECN/NRDS—2019/1239



ON THE COVER

Picture of American Beach, located east of the Nana Dune. Picture taken facing north displaying the high tide line at the beginning of the spring 2019 shoreline data collection on 26 March 2019.

NPS Photo / SECN

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Summary and Key Findings

In 2018 and 2019 the Southeast Coast Network collected shoreline data at Timucuan Ecological and Historic Preserve as part of the NPS Vital Signs Monitoring Program.

Monitoring was conducted following methods developed by the National Park Service Northeast Barrier Coast Network and consisted of mapping the high tide swash line using a global positioning system (GPS) unit in the spring of each year (Psuty et al. 2010). Shoreline change was calculated using the Digital Shoreline Analysis System developed by the USGS (Theiler et al. 2008).

Key findings from this effort are as follows

- A mean of 673.90 meters (m; 0.42 miles [mi]) of shoreline were mapped from 2018 to 2019 with a mean horizontal accuracy of 10.83 centimeters (4.26 inches [in]).
- The mean shoreline distance change from 2018 to 2019 was -7.01 meters (-22.00 feet [ft]) with a standard deviation of 2.59 meters (8.50 ft). The shoreline change distance ranged from -11.74 meters to 0.62 meters (-38.52 to 2.03 ft).
- Two high erosion areas were identified in the study area. 7.7 % of the transects located in the analysis exhibited erosion greater than the ± 10 meter (32.8 ft) uncertainty, which equates to 50 meters (164 ft) of the surveyed shoreline distance.
- No accretion areas were present in the 2018 to 2019 shoreline survey analysis beyond the ± 10 meter uncertainty range

Introduction

The problem of land loss and gain and landscape alteration at the marine edge is fundamental to the many issues facing coastal park resource stewards. Shoreline change is a prime geoindicator of coastal environmental resource threats within parks. Change in shoreline position drives the alteration and replacement of established natural habitats, and shoreline retreat may destroy cultural resources, facilities, and other infrastructure. Geomorphologic change is a basic concern because it also influences change in other natural resource areas of interest within the National Park Service such as estuarine and subsurface water quality, species and habitats of concern, recreational visitor use, and even resource extraction. Spatial variability is inherent in shoreline change. Early identification of changes in past trends, along with an understanding of normal variability, is key to recognizing ecological problems in coastal parks. For managers, an understanding of the spatial and temporal patterns of geomorphologic change is important for optimal management of any coastal park because: (1) the interface of marine and land systems is very dynamic and is driven by multiple forcing mechanisms, (2) it results in alterations to resource patterns and dynamics at habitat and ecosystem level, and (3) it will eventually result in the loss of static resources. Developing an understanding of these effects will benefit from the establishment of local long-term monitoring programs.

To effectively monitor diverse and dynamic coastal resources, the Southeast Coast Network has implemented a monitoring approach which consists of mapping the high tide swash line along the oceanfront beaches using GPS equipment. The

data collected is post-processed to attain higher accuracy data and analyzed using the Digital Shoreline Analysis System (DSAS) created by USGS (Theiler et al. 2008). This approach is modeled after the *Northeast Coastal Barrier Network Geomorphological Protocol: Part 1—Ocean Shoreline Position* (Psuty et al. 2010).

The monitoring objectives for which data are collected and analyzed as part of this effort are (Baron 2018a):

1. Determine inter-annual changes in mean high-water shoreline position (average and standard deviation of change in position at fixed transects, and cumulatively within management units).
2. Determine the magnitude, direction, and spatial distribution of observed shoreline change including the identification of areas of highly dynamic shorelines, and areas of accretion versus erosion.

This report provides a summary of shoreline monitoring data collected by the network to address these objectives at American Beach at Timucuan Ecological and Historic Preserve (TIMU) from 2018 through 2019 (Figure 1). Data used in this report are available at <https://irma.nps.gov/DataStore/Reference/Profile/2267045>.

Timucuan Ecological & Historic Preserve Study Area

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Figure 1. Map showing the shoreline monitoring area (red oval) of American Beach. The area monitored stretches from the Burney Park beach access north to the Lewis Street access. Note that on the inset map, the study area is park property but is not included in the park boundary.

Study Area

Timucuan Ecological and Historic Preserve is located within Duval and Nassau Counties and the city limits of Jacksonville and Amelia Island, Florida. The preserve is operated as a partnership park and encompasses approximately 46,000 acres of mostly salt marshes, open water, and river (including a reach of the Intracoastal Waterway) between the St. Johns and Nassau Rivers (DeVivo et. al 2015).

Long-term shoreline monitoring efforts have been concentrated on a small section of beach in the northern portion of the preserve named American Beach. This is a small 0.4-mile (mi; .65-kilometer [km]) stretch of beach located on Amelia Island in northern Florida. The area is rich in African-American history. Many historic structures still exist along this stretch of beach located just east of the Nana Dune, the tallest sand dune in Florida. The area is also a stopover spot for migratory birds and an important area for nesting sea turtles.

The stretch of oceanfront beach monitored by the network and contained in this report is not Timucuan E&H P&P property; however, it is located approximately 152 meters (500 ft) east of park property. Although the park does not have jurisdiction on the oceanfront beach, the management of park resources is affected by the long-term shoreline change along this stretch of American Beach.

The purpose of this report is to deliver the most recently-collected data from within the park as part of an ongoing long-term shoreline-change monitoring program.

Methods

Standard Operating Procedures

Table 1 lists the Standard Operating Procedures (SOPs) utilized in the long-term shoreline monitoring data collection, processing, and reporting. These SOPs are critical to maintaining continuity between data sets across many surveys to ensure comparable results. The version numbers in the table apply to both 2018 and 2019 data sets.

The shoreline was mapped along the oceanfront sandy shoreline of American Beach following the methods developed by the National Park Service Northeast Coast Barrier Network (Psuty et al. 2010). The Digital Shoreline Analysis System (DSAS; Theiler et al. 2008) was used to analyze the shoreline change. Annual shoreline change distances were calculated by determining the distance between two shorelines. Shoreline surveys were collected in 2018 and 2019; therefore, the shoreline change that occurred between those two time periods is analyzed in this report (Figure 2).

As stated in SOP 2.3.11 *Coastal Shoreline Monitoring Annual Change Analysis—Version 1.0* (Baron 2018b), the uncertainty of the individual shoreline survey is ± 5 meters (16.4 ft). This value is derived from the: (1) GPS accuracy, (2) differential tide position, (3) meteorological effects—wave dimension and run-up, and (4) interpretation of the line (Psuty et al. 2010). The annual comparisons deduced using two individual shoreline surveys will have an uncertainty of ± 10 meters (32.8 ft; Psuty et al. 2010). Refer to Psuty et al. 2010 for additional information regarding shoreline survey uncertainty.

Shoreline Data Collection

Shoreline data is collected according to SOP 1.3.22 *Conducting the Shoreline Survey—Version 1.0* (Baron 2018c). The high tide swash line is mapped using a Trimble® GPS unit. The data collected is post-processed according to SOP 2.3.10 *Post survey GPS data processing—Version 1.0* (Baron 2018d) using Pathfinder Office software to obtain higher accuracy data. The corrected data is exported as an ESRI shapefile. The ESRI shapefile is then edited, formatted, and uploaded to a personal geodatabase to analyze using DSAS.

Shoreline Change Analysis

The two shorelines were analyzed using DSAS. The annual shoreline change was performed by analyzing the 2018 and 2019 shoreline data collected. The 2018 shoreline was collected on 3/25/2018 and the 2019 shoreline was collected on 4/8/2019. The two shorelines were analyzed by calculating the distance the high tide line has moved from 2018 to 2019, along cross-shore transects spaced 10 meters (32.8 ft) apart. This analysis is termed "net shoreline movement" in DSAS.

High erosion areas were determined as areas having negative shoreline change distance less than the uncertainty range of the data (± 10 meters). Accretion areas were determined as locations with positive shoreline change distances greater than the uncertainty range (± 10 meters).

Table 1. SOPs used for shoreline position data collection, processing, and reporting

SOP number	SOP title	SOP version
1.3.21	Survey timing and GPS mission planning	1.0
1.3.22	Conducting the GPS shoreline survey	1.0
2.3.10	Post survey GPS data processing	1.0
2.3.11	Coastal shoreline monitoring annual change analysis	1.0
2.3.09	Coastal shoreline monitoring annual reporting	1.0

Water Levels

Two shoreline surveys of the high tide swash line included in this report were conducted during neap tides. The survey window was chosen based on the predicted tides using the closest NOAA tide gage with predicted tides (Fernandina

Beach, Florida—Station ID 8720030; NOAA 2018). The actual tide heights that occurred before the surveys included in this annual report are listed in Table 2. The two previous high tides prior to the shoreline surveys conducted have similar water levels.

Table 2. High tide levels surveyed for the spring TIMU shoreline monitoring (m—meters).

Season	Survey collection date	Previous high tide height* (m)	Previous high tide time
Spring 2018	3/24/2018	1.81	1400
Spring 2019	3/26/2019	1.67	1354

* Tide heights are relative to Mean Lower Low Water, Fernandina Beach, Florida—Station ID 8720030

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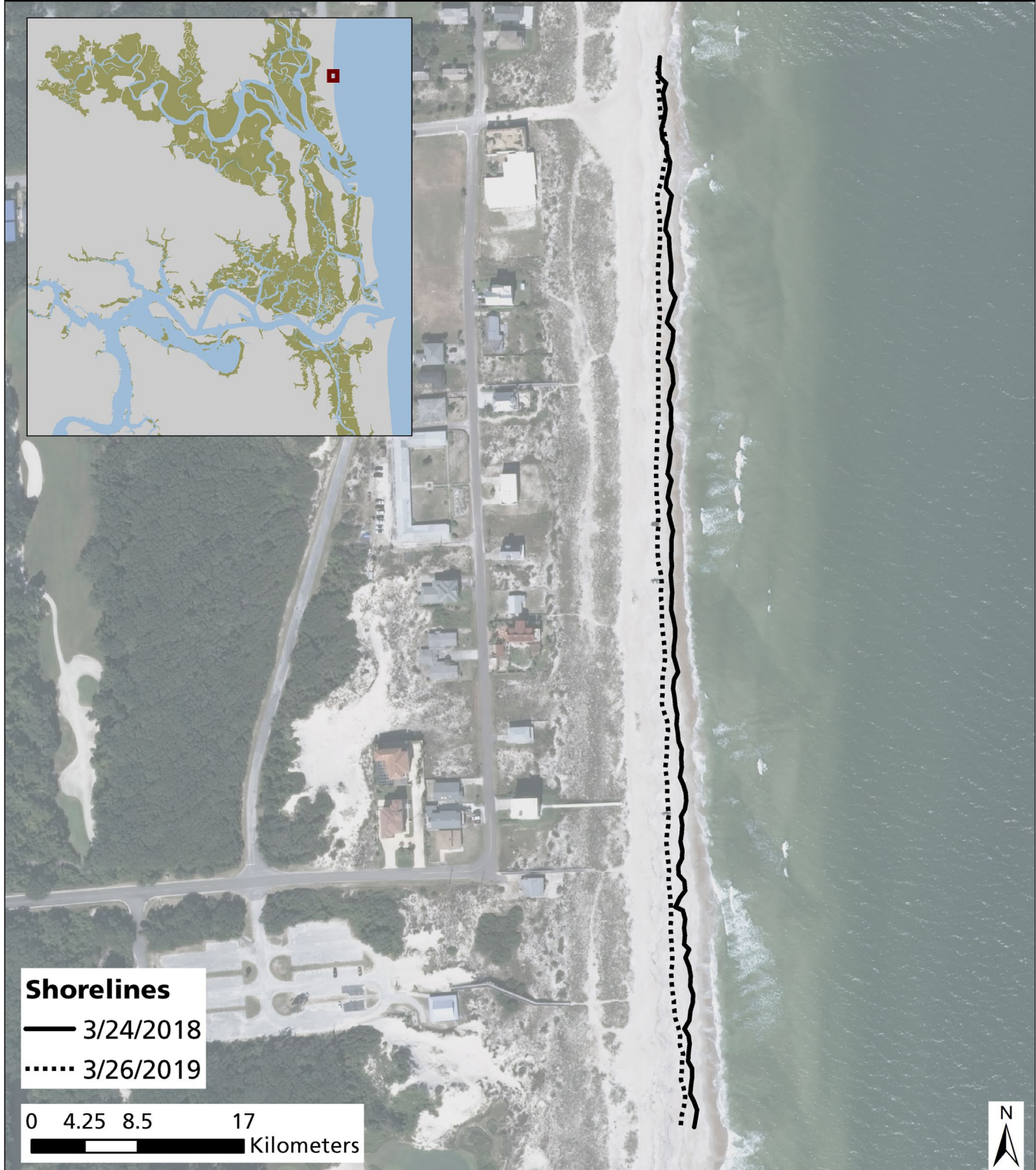


Figure 2. Map of the shoreline surveys collected from 2018 to 2019 at Timucuan Ecological and Historic Preserve. The shoreline survey collected March 24, 2018 is shown as a black solid line and the shoreline survey collected March 26, 2019 is shown as a black dotted line. Base data from FDOT 2014.

Results

Shoreline Data

Shoreline data was collected in 2018 and 2019. On average, 673.90 meters (0.42 mi) of shoreline were mapped during the time period analyzed with a mean horizontal error of 10.83 centimeters (4.26 in; Table 3).

Annual Shoreline Change

Figure 3 displays a map of the spring shorelines collected in 2018 and 2019. The annual shoreline change distance is displayed by the transects between the two shorelines, which are clipped to the extent of shoreline change and colored according to the shoreline change distance. A negative shoreline change distance denotes erosion, shown in warmer colors. Positive shoreline change distances are depicting accretion, and is shown in cooler colors (if present). The lowest shoreline change distance was -11.74 meters

(-38.52 ft) and the highest shoreline change distance was 0.62 meters (2.03 ft; Appendix A). The mean shoreline distance change for the area mapped was -7.01 meters (22.00 ft) with a standard deviation of 2.59 meters (8.50 ft).

7.7 % of the transects located in the analysis (5 of 65) exhibited erosion greater than the ± 10 meter uncertainty (Figures 3 and 4). Because the transects are located every 10 meters (32.8 ft) along the baseline, it can be inferred that erosion is occurring along a cumulative 50 meters (164 ft) of the study area surveyed. There are two erosion areas present within the study area. No accretion was observed in the 2018 to 2019 spring shoreline survey analysis. Data used in this report are available at <https://irma.nps.gov/DataStore/Reference/Profile/2267045>.

Table 3. Table listing the length and positional error of the shorelines collected during 2018 and 2019 with the mean length and horizontal precision calculated by averaging across the entire shoreline feature [cm—centimeters; m—meters].

Collection Date	Mean Horizontal Accuracy (cm)	Length (m)
3/25/2018	11.26	2,305.22
4/8/2019	10.00	2,147.23

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Figure 3. Map of shoreline change distance (meters) for the 2018 and 2019 surveys collected at American Beach at Timucuan EHP&P. The more negative shoreline change denotes more erosion and is shown in warmer colors. The less negative shoreline change denote less erosion and in some cases can represent accretion (when positive) and is displayed as cooler colors. The grey transects denote shoreline change distance within the uncertainty range of the data (± 10 meters).

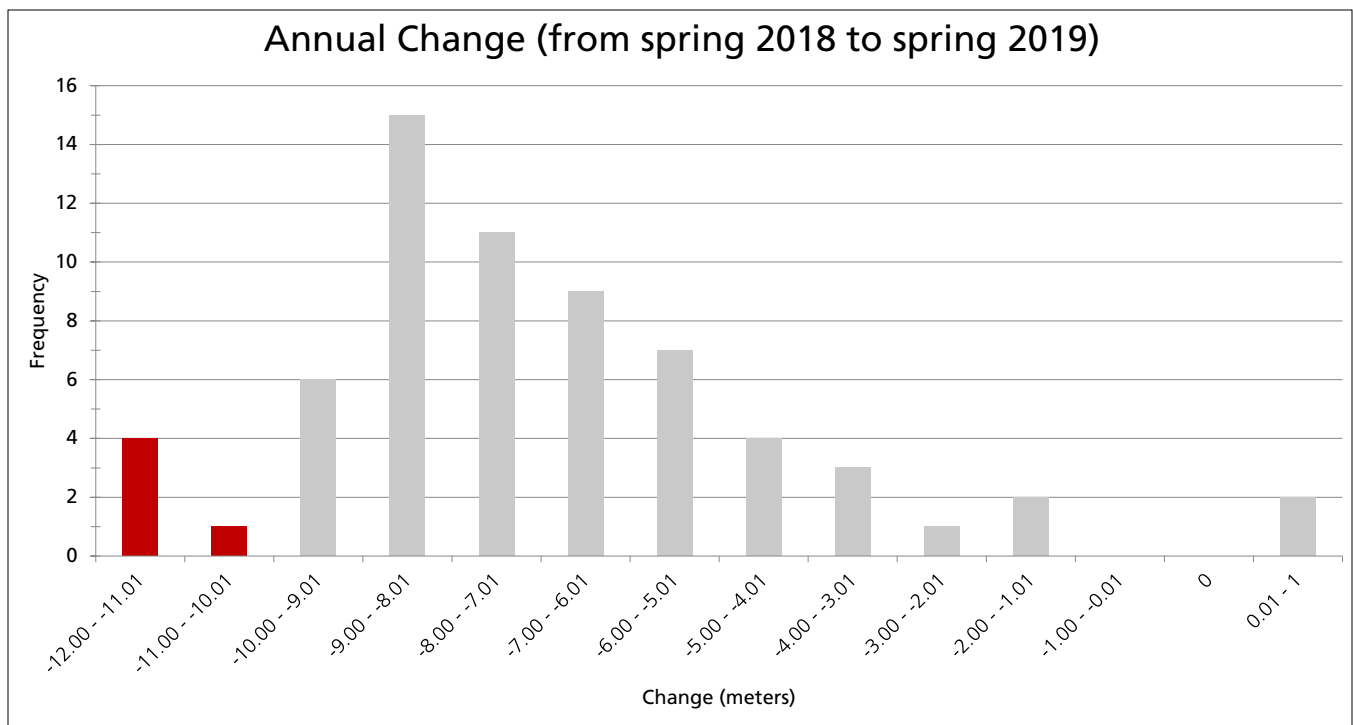


Figure 4. Histogram of transect shoreline change distances. The shoreline change distance is binned by 1-meter intervals. The bars are colored red denoting high erosion and grey for transects within the uncertainty range of ± 10 meters.

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Appendix A. Shoreline Change Distances

Table A-1. Table of the shoreline change distances for the study area analyzed. Only the transects that intersected both shorelines are included in the table.

Transect Number	Spring '18–Spring '19 Shoreline Change Distance (meters)	Transect Number	Spring '18–Spring '19 Shoreline Change Distance (meters)
6	-1.69	39	-6.18
7	-2.55	40	-7.95
8	-3.23	41	-6.07
9	0.46	42	-6.48
10	0.62	43	-7.85
11	-1.75	44	-7.14
12	-3.27	45	-7.73
13	-6.41	46	-5.61
14	-6.95	47	-7.46
15	-4.01	48	-9.07
16	-5.70	49	-8.63
17	-7.02	50	-11.10
18	-8.12	51	-10.65
19	-7.95	52	-8.57
20	-8.42	53	-8.78
21	-5.02	54	-9.01
22	-8.71	55	-5.97
23	-6.85	56	-9.63
24	-8.34	57	-3.69
25	-9.01	58	-8.75
26	-6.81	59	-8.39
27	-7.83	60	-9.63
28	-7.70	61	-11.08
29	-8.03	62	-11.22
30	-7.91	63	-11.74
31	-8.94	64	-8.90
32	-7.05	65	-4.82
33	-6.90	66	-4.41
34	-9.31	67	-5.59
35	-8.67	68	-5.87
36	-8.22	69	-4.72
37	-5.92	70	-8.93
38	-6.64		

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