



Coastal Topography Change at Gulf Islands National Seashore, Florida and Mississippi: 2018-2022 Data Summary

Jeff Bracewell

Gulf Coast I&M Network, National Park Service
700 Cajundome Blvd.
Lafayette, LA 70506



Contents

Summary and Key Findings 3

Introduction 4

Study Area 4

Methods 5

 Standard Operating Procedures..... 5

 Timing and Accuracy of Surveys..... 5

 Natural and Anthropogenic Events affecting Coastal Geomorphology..... 5

 Topographic Measurements..... 5

Results and Discussion 7

 Mississippi Unit Changed More Than Florida 7

 Within Florida, Perdido Key Changed More Than Fort Pickens 10

 Within Mississippi, Horn Island Lost More Than Petit Bois Island..... 10

 Within Mississippi, Gulf-Side Lost More Than Sound-Side 12

 Shoreline and Topography Survey Comparison 12

 Areas of Special Interest 12

 Problems and Concerns..... 12

 Protocol Changes 13

 Additional Information 13

Literature Cited..... 13

Please cite this publication as:

Bracewell, J., 2023. Coastal Topography Change at Gulf Islands National Seashore, Florida and Mississippi: 2018-2022 Data Summary. Gulf Coast I&M Network, National Park Service, Lafayette, Louisiana. irma.nps.gov/DataStore/Reference/Profile/2297211

ON THE COVER

Data collection for topography transect pk13 at Perdido Key, Florida. Photo by NPS

Summary and Key Findings

In the spring of 2018 and 2022, the Gulf Coast Network collected coastal topography data at Gulf Islands National Seashore as a part of the NPS Vital Signs Monitoring Program. Monitoring was conducted following methods detailed in *Monitoring Coastal Topography at Gulf Coast Network Parks: Protocol Implementation Plan* (PIP; Bracewell 2017).

Key findings from this effort are as follows:

- Three pilot monitoring transects were added in April 2022, west or down-drift from the already established transects at Perdido Key.
- Fort Pickens was more stable than Perdido Key, showing advances in shoreline position and gains in dune profile area.
- Evidence suggests that Horn Island lost more sediment than Petit Bois for the reporting period.
- The overall losses in shoreline and dune crest position, as well as dune profile area, were greater in the Mississippi Units than the Florida Units (Horn, Petit Bois and West Petit Bois Islands vs Fort Pickens and Perdido Key).
- Overall dune profile height was almost unchanged in the Florida Units (0.07m) and was elevated by 0.21m in the Mississippi Units.

This project is in the early phases of implementation and will benefit from future surveys to better understand the influence of slight changes in survey timing and other environmental variations.

Introduction

As stated by Psuty et al. (2010)

Changes in coastal topography, whether caused by erosion or accretion, vary both spatially and temporally. Understanding these variations is key to early recognition of potential problems affecting natural resources and cultural resources in coastal parks. For managers, an understanding of the spatial and temporal patterns of geomorphologic change is basic to optimal management of any coastal park because the interface of marine and land systems: (1) is highly dynamic and driven by multiple forcing mechanisms; (2) results in alterations to resource patterns and dynamics at habitat and ecosystem levels; and (3) can eventually result in the loss of static resources. The establishment of local, long-term monitoring programs provides metrics . . . to help understand the processes that are driving coastal change of beaches, dunes, and bluffs within the parks.

Methods for monitoring coastal topographic change were developed by the Northeast Coastal and Barrier Network in Psuty et al. (2010) and adapted for use by the Gulf Coast Network (GULN) in Bracewell (2017). Following this guidance, the Gulf Coast Network has created a network of permanently established reference points that allow for the collection of highly accurate elevation data along beach and dune transects at Gulf Islands National Seashore (GUIS) and Padre Island National Seashore (PAIS). Profiles created from these elevation data are tracked through space and time to better understand geomorphic processes and spatial patterns as they relate to park resources.

This report provides a summary of changes in coastal topography at Gulf Islands National Seashore between 2018 and 2022.

Study Area

Gulf Islands National Seashore (GUIS) consists of several units in Florida and Mississippi. The Mississippi section (GUIS-MS) consists of five islands and a small mainland headquarters area. The authorized boundary includes not only the barrier islands themselves, but also portions of the Gulf of Mexico and Mississippi Sound. From west to east, the islands of GUIS-MS are: Cat, Ship, Horn, West Petit Bois, and Petit Bois Islands and are only accessible by boat. Horn Island is the largest and Cat the most recently acquired of the GUIS-

MS islands. Davis Bayou is the only mainland area in the GUIS-MS park section.

The Florida section (GUIS-FL) consists of portions of two islands, Santa Rosa Island and Perdido Key, and two small mainland areas. Three park units are located on Santa Rosa Island: Fort Pickens, Santa Rosa Area, and Okaloosa Area. The Naval Live Oaks Area is on a peninsula forming part of the eastern mouth of Pensacola Bay. Unlike GUIS-MS, all areas of GUIS-FL, including the islands, are accessible to vehicles. The water bodies surrounding GUIS-FL include Santa Rosa Sound, Big Lagoon, Pensacola Bay, Choctawhatchee Bay, and the Gulf of Mexico (Cooper et al. 2005).

There are many aquatic and terrestrial ecosystems in Gulf Islands National Seashore, including Gulf, bay, dunes, salt marsh, maritime forest, barrier islands, seagrass beds, and other marine systems. Hydrology and water-related issues are of central importance because 80% of the park is submerged land (Anderson et al. 2005). The mainland portion of GUIS-FL consists of live oak, sandhill, and marsh communities; the mainland portion of GUIS-MS consists of pine/palmetto flatwoods, mixed pine/hardwood, lowland hardwood, and tidal marsh.

Hurricanes are one of the biggest concerns for the park, as they can have devastating effects on biological communities as well as park structures and facilities and cause rapid morphological shoreline changes through erosion and overwash of the islands. Hydrologic alterations (e.g., jetties and navigation channels) disrupt sediment input and transport, limiting the ability of these systems to recover on their own between storms. To combat erosion, the beaches of Gulf Islands National Seashore have been regularly nourished with sand, which generally comes from the dredging of navigation channels. Although these nourishment projects are beneficial for the reduction of erosion, there is concern regarding the rates of revegetation, adverse effects on macroinvertebrates, and reduction of the vegetative seed bank (Cooper et al. 2005).

The purpose of this document is to report the most recently collected data from within the park as part of an ongoing long-term topographic-change monitoring program. Other data and reports related to this work are available at the Gulf Coast Network Coastal Topography Monitoring Project (<https://irma.nps.gov/DataStore/Reference/Profile/2238503>).

Methods

The GULN established a framework of equally spaced cross-shore transects in a Geographic Information System (GIS) along the entire shoreline of GUIs. From this framework, a set of monitoring sites was selected to support high-priority park resource management decisions and other GULN vital signs monitoring projects. The GULN monitors topographic change at Fort Pickens, Perdido Key, Petit Bois Island, West Petit Bois Island, and Horn Island (Figure 1). To collect monitoring data, a crew member records elevation using precision Global Navigation Satellite System (GNSS) survey equipment at the topographic inflections in the beach and primary dune complex along the transect (Figure 2).

Standard Operating Procedures

There are five standard operating procedures (SOPs) that describe how data are collected, analyzed and reported on for this project. They are CT03: Survey Timing and Mission Planning, CT04: Settings for Collection of Topography, CT05: Conducting the Survey, CT06: Initial Post Survey Processing, and CT07: Data Analysis and Reporting (Bracewell 2017). These SOPs are critical to maintaining continuity between data sets across many surveys so results are comparable. All SOPs are currently in version 1 with no significant changes between 2018 and 2022.

Timing and Accuracy of Surveys

Topographic surveys are timed to be concurrent with GULN shoreline position surveys, which are conducted during neap tides in April and May of every other year. Neap tides are the two periods per month when high and low tides are least different. Although lower water levels make surveying lower beach elevations easier and safer, the topographic survey is not dependent on neap tides to complete the work and to produce comparable results. The first surveys were in 2018, followed by the next event in 2021, a year later than prescribed, due to COVID-19 travel restrictions in 2020. The 2021 surveys were truncated by weather challenges and a limited survey window, leaving unsurveyed six of 16 transects in Mississippi. The current report focuses on the subsequent survey in 2022 and comparisons with 2018 data. The dates and transects surveyed for 2022 are listed in Table 1.

Positional accuracy is recorded regularly during fieldwork, to ensure datasets are within the monitoring protocol's stated tolerances of 0.05m horizontal and vertical. For the 2022 event, differences between the field-collected and published

control coordinates of survey marks were below 0.05m, except for a few horizontal differences at Horn and Petit Bois Islands (0.05 to 0.07m). Even so, the reduced accuracy is a minor concern in this dynamic system, keeping in mind that 0.07m is about the short-sided width of a dollar bill.

Natural and Anthropogenic Events affecting Coastal Geomorphology

Numerous tropical storms impacted GUIs from 2018 to 2022. During the particularly active 2020 hurricane season, the park experienced impacts from Hurricanes Sally, Delta, and Zeta. The most recent dredging for the reporting period occurred at Pensacola Pass, where a 0.5 mile stretch of beach at Perdido Key was restored and added about 181,000 cubic yards of sediment to the gulf-facing beach and primary dunes. More detailed information about recent weather and dredging can be found in [Bracewell \(2023\)](#).

Topographic Measurements

Figure 3 presents the key topographic dimensions for an example profile. Each profile distance measurement originates at a physical or virtual benchmark (0.0 meters horizontal). Measurements are taken in the active part of the beach/ dune system and may not extend to the origin. All elevation measurements are referenced to NAVD 88, Geoid 12B. Profile area is the two-dimensional area under the profile measured to 0.0 NAVD 88. Throughout this document, 'dune crest' refers to the foredune crest, and 'shoreline position' refers to 'distance to 0.0m NAVD 88'.

Distance and elevation measurements are used to describe the topographic profiles for each surveyed transect in 2018 and 2022 and the change that occurred over that period. Negative numbers for change represent landward retreat or lower elevations. Change in profile area for each transect is calculated as $[(\text{final area} - \text{initial area}) / \text{initial area}]$, and overall change across all transects in a unit is calculated as $[(\sum \text{final area} - \sum \text{initial area}) / \sum \text{initial area}]$. Graphical depictions of each profile in each year are provided in a supplemental materials document (available at irma.nps.gov/DataStore/Reference/Profile/2297211).

Pilot monitoring transects 6-8 on Perdido Key were added in April 2022, west or down-drift from already established transects (Figure 1). These transects are expected to provide a better understanding of the processes associated with longshore currents and, more specifically, the longer-term outcomes of dredging at Pensacola Pass.

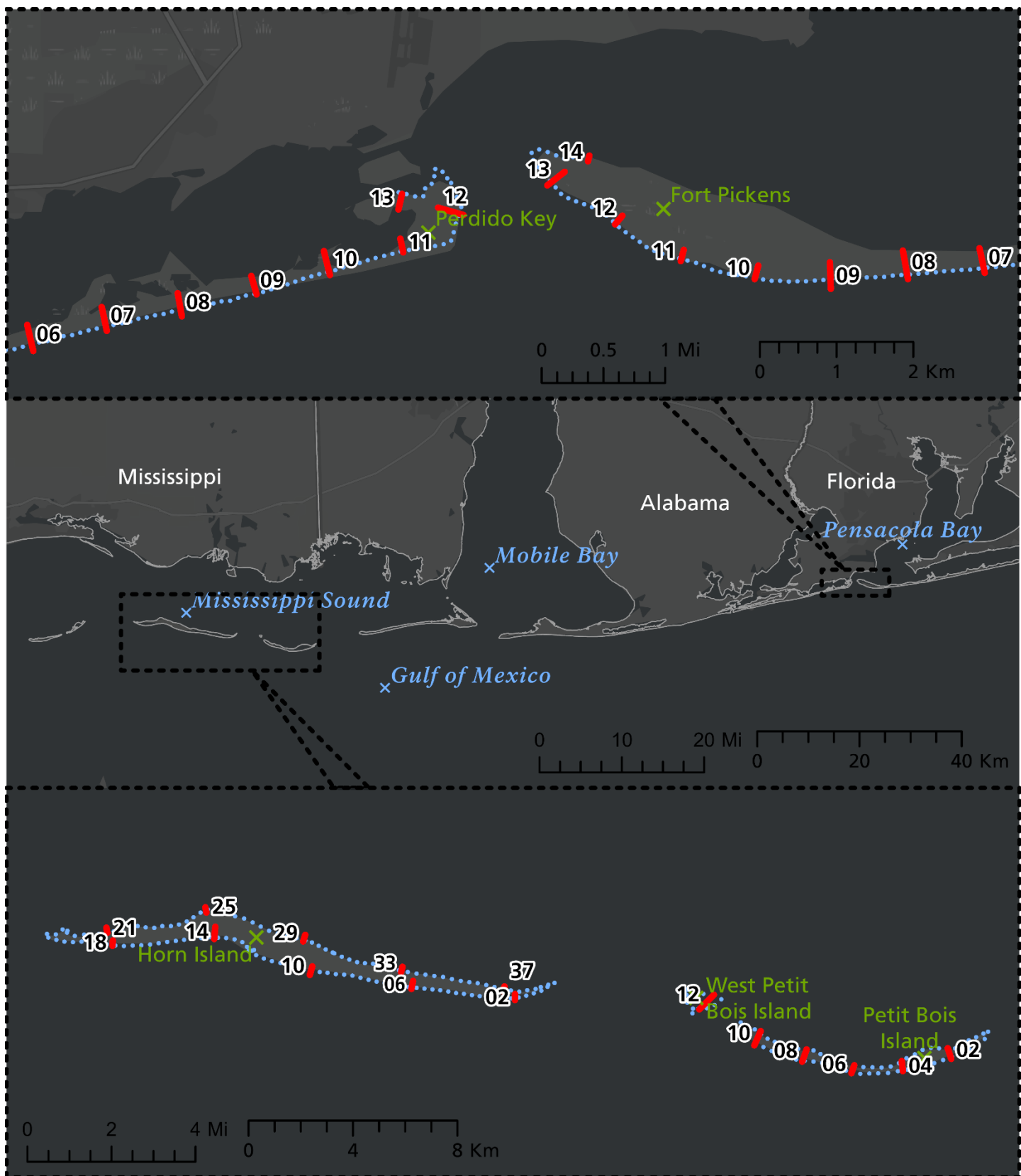


Figure 1. Gulf Coast Network's coastal topography survey transects at Gulf Islands National Seashore. Numbered monitoring transects are shown in red. Dotted lines in the detail maps represent the recent shoreline position.



Figure 2. Surveyor measuring beach topography in April 2022 at Fort Pickens, Gulf Islands National Seashore. NPS photo / GULN staff.

Table 1. Table listing survey dates, and the horizontal and vertical Global Navigation Satellite System (GNSS) positional accuracy compared with established geodetic benchmarks. Park units are Fort Pickens (fp), Perdido Key (pk), Horn Island, (hi), and Petit Bois Island (including West Petit Bois Island, pb). Pre and post survey differences are the report offset from geodetic control, measured in meters.

Park Unit	Survey Date	Pre-Survey Differences (Horizontal, Vertical)	Pre-Survey Published Benchmark ID	Post-Survey Differences (Horizontal, Vertical)	Post-Survey Published Benchmark ID	Correction Service
fp	4/12/2022	0.027, 0.035	872 9882 A TIDAL	0.036, 0.009	fp14	Florida RTN
pk	4/13/2022	0.005, 0.040	48 84 A24	0.012, 0.036	MCRAE	GUI2_RTCM3x
hi	4/26/2022	0.067, 0.008	hi18	0.073, 0.032	hi14	GUI2_RTCM3x
hi	4/27/2022	0.052, 0.040	hi10	0.013, 0.001	DB boatyard	GUI1_RTCM3x
pb	4/28/2022	0.064, 0.020	pb10	0.053, 0.025	pb4	GUI1_RTCM3x
Average		0.043, 0.029		0.037, 0.021		

Since this project began in 2018, six transects were added to the Florida units, three at Fort Pickens in 2021 and three more at Perdido Key in 2022. Accordingly, these transects had no data in 2018 to address change for this report. The missing start-point data-gap was filled by sampling elevations along each newly established survey transect from a 2018 lidar digital elevation model (NOAA 2023a).

Results and Discussion

Mississippi Units Changed More Than Florida Units

In the Florida units, shoreline and dune crest positions changed by 1.87 and -0.76m, respectively (Table 2). These are

small values compared with Mississippi, where average retreat rates were -22.69m for shoreline and -3.12m for dune crest. In terms of change in profile area, the Mississippi units lost 4% and the Florida units, 3%. Although the average profile area losses in Mississippi do not appear extreme, it’s worth noting that they correspond with high shoreline and dune-crest retreat rates which indicates substantial retreat of the entire beach and foredune zone. Said another way, minor changes in profile area mask more profound rates of retreat and is a reminder that distance, height and area should be considered together when assessing geomorphic change.

Transect pk 12: area year 1 = 453.5, area year 2 = 488.9

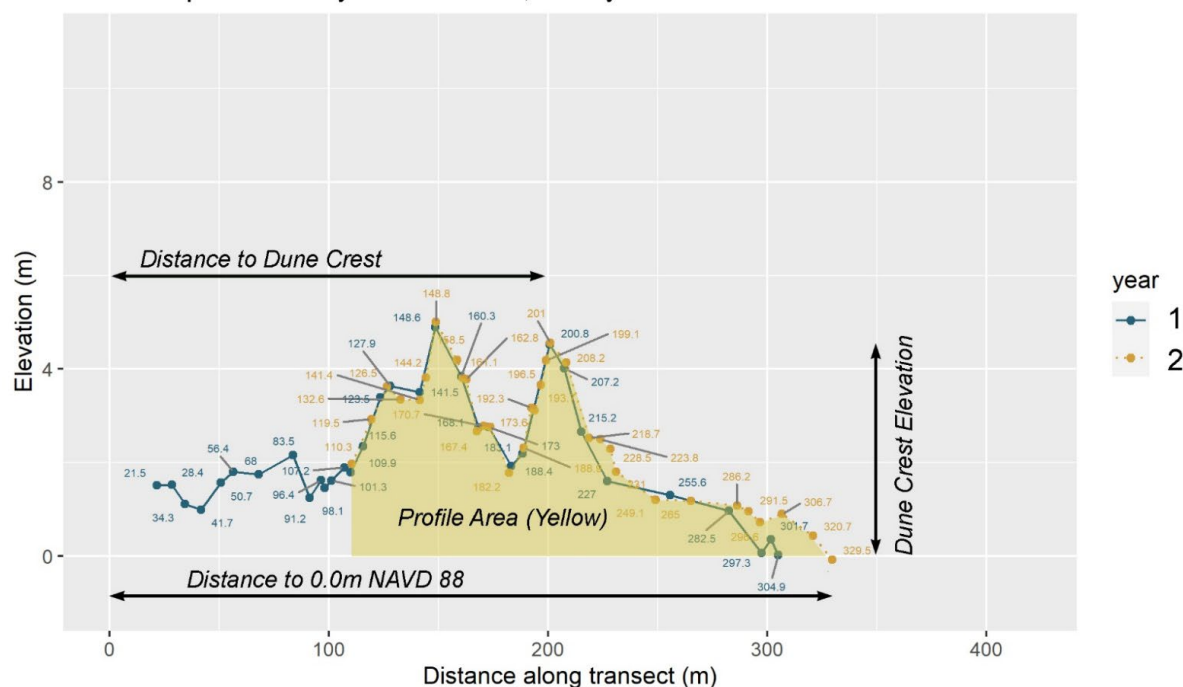


Figure 3. Example graph showing key profile dimensions. Arrows indicate: Distance to dune crest, Dune crest elevation, and Distance to 0.0 meters NAVD 88. The shaded portion under the 'year 2' profile represents the area calculated for profile area dimension. Only the overlapping parts of the profile are compared in profile area change. Each topographic measurement point is labeled with 'distance from benchmark' for each year. In cases where a transect crosses the entire island, Distance to 0.0 meters NAVD 88 is replaced with shore width. Shore width measures from sound-side 0.0 NAVD 88 to gulf-side 0.0 NAVD 88.

Table 2. Changes in key geomorphological measurements for GULN monitoring transects between spring 2018 and 2022 at Gulf Islands National Seashore. Change is calculated as 2022 minus 2018 for the following variables: distance from benchmark to '0' elevation (NAVD 88), distance from benchmark to foredune crest, and foredune crest elevation. Change in dune profile area is calculated as percent change. Transects are grouped by park unit and summarized to provide average and standard deviation. Minimum and maximum values for each unit are shown in bold italics. Park units are Fort Pickens (fp), Perdido Key (pk), Horn Island, (hi), West Petit Bois Island (pb12 and 12s) and Petit Bois Island (remaining pb). *Indicates a shore to shore transect. **Indicates a Mississippi Sound side transect. †Indicates that the profile was created from 2018 lidar Digital Elevation Model.

Transect ID	Change in Distance from Benchmark to 0 Elevation (NAVD 88, m)	Change in Distance from Benchmark to Foredune Crest (m)	Change in Foredune Crest Elevation (m)	Percent Change in Dune Profile Area, Unit Averages Weighted by Area
fp07*	11.08	-22.91	-1.08	-3%
fp08*	4.45	1.56	0.19	2%
fp09	2.56	0.44	0.25	12%
fp10	4.90	-0.90	0.03	3%
fp11	23.00	8.00	0.25	33%
fp12	-5.50	-1.10	-0.16	-10%
fp13	21.20	0.20	0.09	9%
fp14	2.00	1.00	-0.95	-3%

Transect ID	Change in Distance from Benchmark to 0 Elevation (NAVD 88, m)	Change in Distance from Benchmark to Foredune Crest (m)	Change in Foredune Crest Elevation (m)	Percent Change in Dune Profile Area, Unit Averages Weighted by Area
Average for Fort Pickens	7.96	-1.71	-0.17	4%
Standard Deviation for Fort Pickens	9.85	9.03	0.54	
pk06*	21.56	0.99	0.05	1%
pk07*	-5.99	-0.62	0.37	-3%
pk08	-5.37	0.01	-0.01	-8%
pk09*	-32.20	-0.30	0.32	-15%
pk10*	-26.10	-0.70	-0.18	-14%
pk11*	2.50	5.30	-0.05	-6%
pk12	10.40	0.30	0.01	5%
pk13*	1.50	-3.40	-0.27	-4%
Average for Perdido Key	-4.21	0.20	0.03	-6%
Standard Deviation for Perdido Key	17.82	2.43	0.22	
Average for FL units (Perdido Key and Fort Pickens)	1.87	-0.76	-0.07	-3%
Standard Deviation for FL units (Perdido Key and Fort Pickens)	15.26	6.47	0.41	
hi02*	-32.75	-2.82	0.42	-34%
hi37	-30.70	-5.70	0.58	-53%
hi06	-9.30	0.10	-0.08	-7%
hi33	-4.90	-3.00	-0.42	-23%
hi10	-55.10	-0.30	0.72	-28%
hi29	-28.10	-13.30	-0.01	-20%
hi14	-15.30	-0.40	0.11	4%
hi25	-15.30	-1.10	0.54	-7%
hi18	-65.00	2.10	0.49	-3%
hi21	-6.70	-9.10	-0.08	42%
Average for Horn Island	-26.32	-3.35	0.23	-14%
Standard Deviation for Horn Island	20.45	4.75	0.37	
pb02	-36.40	-7.00	0.22	-29%
pb02s	-0.10	-1.50	0.59	42%
pb04	-13.80	1.00	0.50	4%
pb04s	3.79	0.70	0.01	19%
pb06	-39.50	2.40	0.56	-16%
pb06s	-9.40	-7.60	0.36	-10%
pb08	-20.80	-0.20	0.32	0%
pb08s	-11.50	-11.70	-0.61	46%
pb10	-22.30	-0.20	0.15	6%
pb10s	-10.60	-11.20	-0.14	31%
Average for Petit Bois Island	-16.06	-3.53	0.20	-2%
Standard Deviation for Petit Bois Island	14.04	5.31	0.37	
pb12	-66.60	0.10	0.14	-2%
pb12s	-8.90	0.10	0.14	3%
Average for West Petit Bois	-37.75	0.10	0.14	-4%
Standard Deviation for West Petit Bois	40.80	0.00	0.00	
Average for MS units (Horn Island and Petit Bois Island)	-22.69	-3.12	0.21	-4%
Standard Deviation for MS units (Horn Island and Petit Bois Island)	19.79	4.78	0.34	

Within Florida Units, Perdido Key Changed More Than Fort Pickens

Consistent with the 2023 Shoreline Change Report (Bracewell 2023), Fort Pickens was more stable than Perdido Key, showing advances in shoreline position and gaining in dune profile area, despite a slight retreat in dune crest position and a slight loss in dune crest height (Figure 4, Table 2). Also previously reported, transects pk09 – pk11 at Perdido Key showed a pattern of sediment loss despite slight shoreline and dune crest positional advances. A beach nourishment project deposited sediment in this overwash-prone extent in the spring of 2022, primarily after the GULN survey, and it is anticipated to stabilize this area. At Fort Pickens, fp14 stands out in Figure 4, with a loss of about 1m in dune crest height. Fp14 is a short transect on the north side of the Fort Pickens

unit close to a public fishing pier and to Pensacola Pass. The transect crosses a thin strip of beach with no dune and is bounded by a seawall on its landward edge. Profile area at fp14 changed only 1m², suggesting more of a redistribution of sediment rather than an alarming rate of loss. Similarly, fp07 experienced a loss of about 1m in dune crest height but only slight change in profile area. On the plus side, fp11, near Battery Cooper, helped to anchor an overall accretional signature at Fort Pickens.

Within Mississippi Units, Horn Island Lost More Than Petit Bois Island

For the Mississippi units, Horn Island lost more sediment than Petit Bois, as evidenced by both shoreline retreat rates and profile area losses being higher (Figure 5, Table 2).

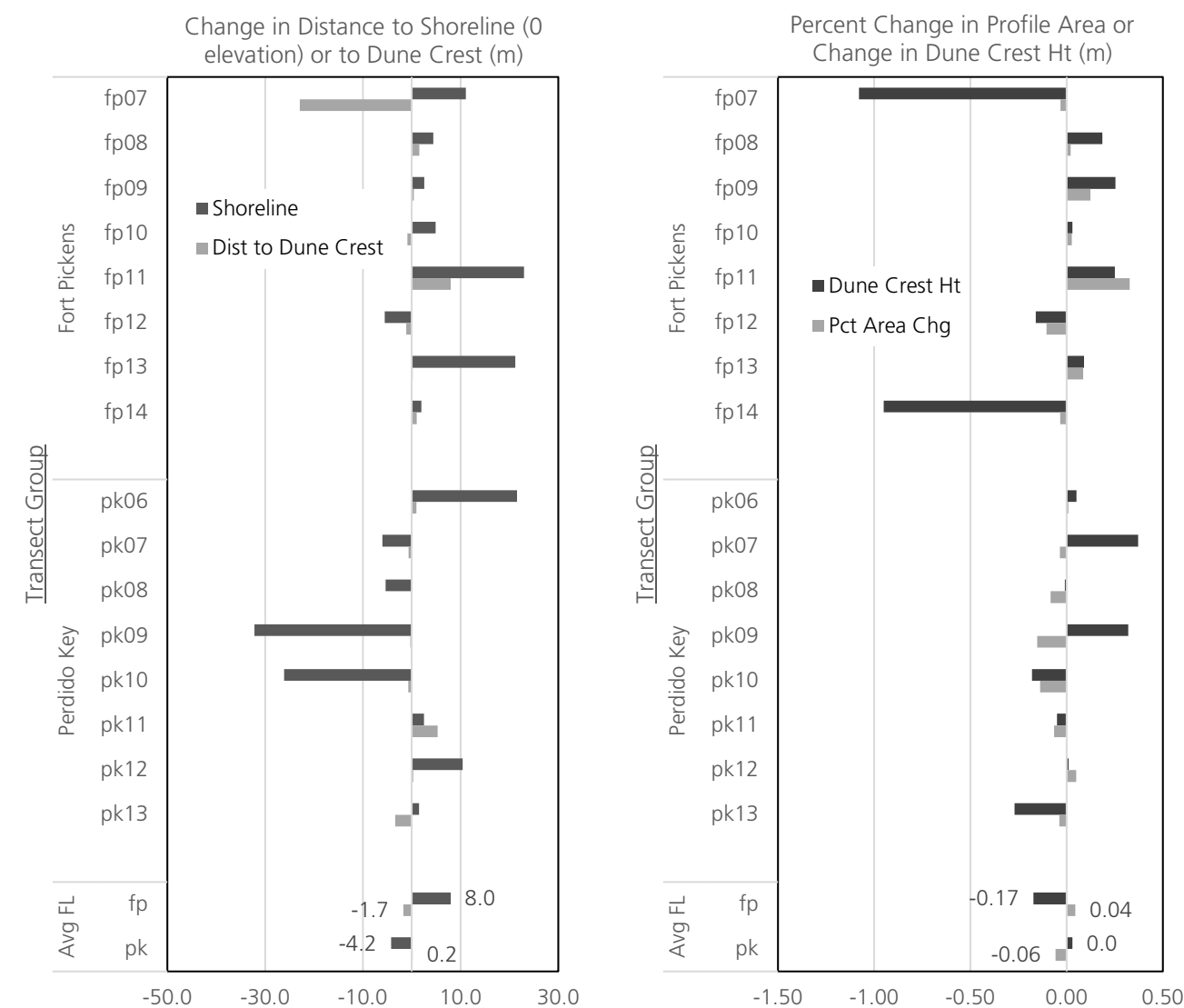


Figure 4. Summary of changes in dune crest and shoreline position (left), and dune crest height and profile area (right) at Fort Pickens and Perdido Key from 2018 to 2022. Transects are ordered in ascending order toward Pensacola Pass.

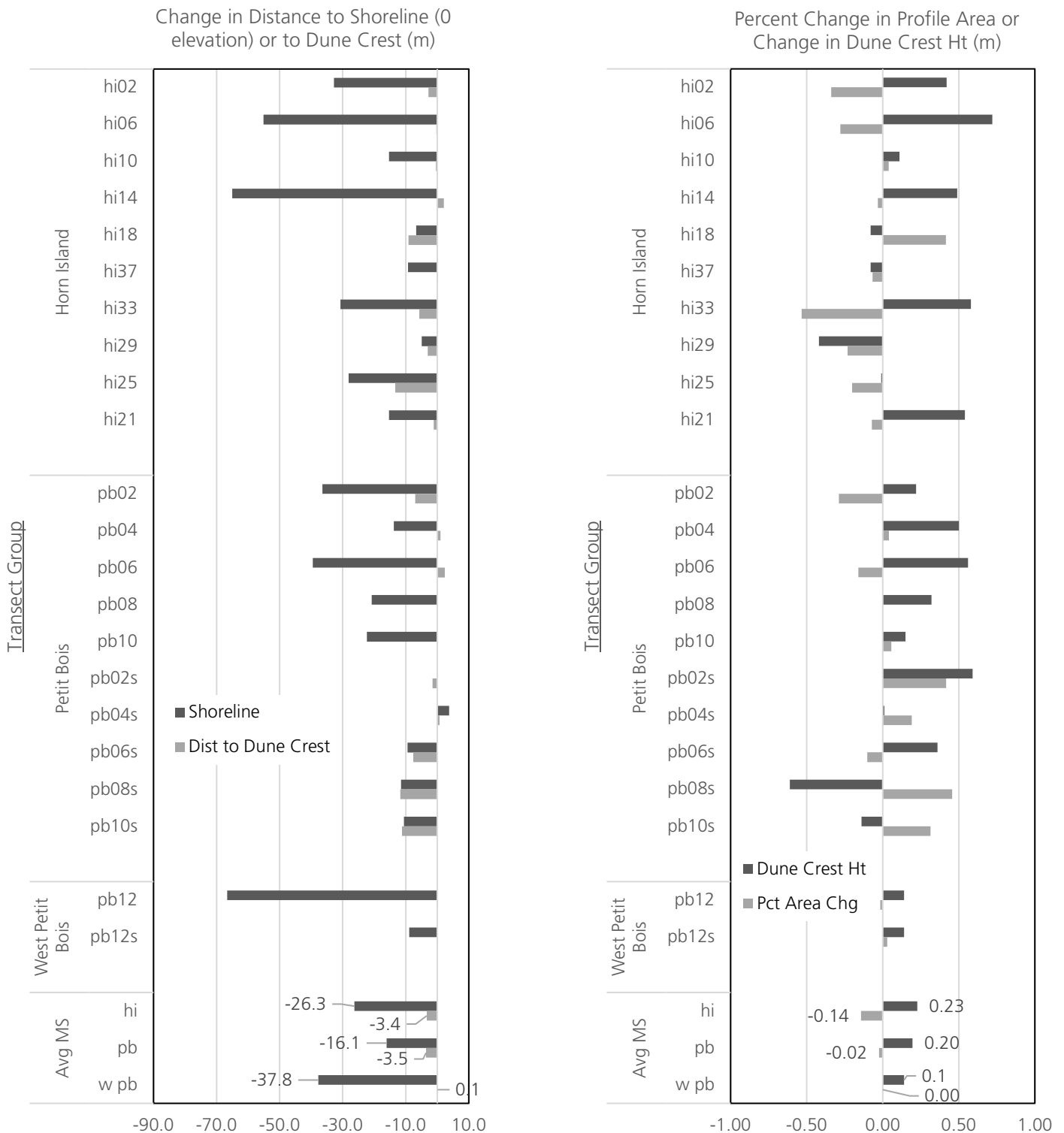


Figure 5. Summary of changes in dune crest and shoreline position (left), and dune crest height and profile area (right) at Horn, Petit Bois and West Petit Bois Islands from 2018 to 2022. Horn Island transects hi02 thru hi37 are gulf facing, transect hi21 thru hi37 are sound facing and transects are ordered in the graph from east to west. Petit Bois transects 02 thru 12 are gulf facing, transects pb02s thru pb12s are sound facing and transects are ordered from east to west.

Even so, changes in dune crest height and dune crest position were similar between the two islands. An assessment of volumetric change between 2018 and 2021 lidar datasets shows a loss of 5 percent for Horn Island and 3 percent for Petit Bois, further strengthening the case that more subaerial sediment loss occurred at Horn Island during the reporting period (NOAA 2023a, NOAA 2023b).

Within Mississippi Units, Gulf-Side Lost More Than Sound-Side

The gulf-side rate of shoreline retreat was much higher than that on the sound-side at both Petit Bois and Horn Islands. Petit Bois lost 27m on the gulf side and 6m on the sound side, and Horn lost 36m on the gulf side and 17m on the sound side (Table 3). Meanwhile, dune crest positions were stable on the gulf side but retreating on the sound sides of both islands. On the gulf sides, they moved only -0.8 meters at Petit Bois and 0.4 meters at Horn. On the sound sides, they retreated -6m at both Petit Bois and Horn. This disparity between gulf and sound is due to the comparatively small stature of the sound-side dunes, where the average dune crest height in 2022 was at least 1m shorter than their Gulf-side counterparts, 1.3m vs. 3.0m at Petit Bois and 2.7m vs. 3.8m at Horn. When summed by unit, the sound-side profile area ranged across both survey years from 110.5m² to 265.7m² vs 1234.5 m² to 1645.7m² on the gulf-side, further demonstrating the gulf-side’s prominence regarding sediment storage.

Table 3. Comparison of gulf vs sound-side changes in topographic dimensions in the Mississippi units. West Petit Bois is not included because there is only one transect per side.

Group	Dist to 0	Dist to Dune Crest	Dune Crest Ht	Profile Area
Horn Island Gulf Side	-36.2	0.4	0.3	-0.14
Horn Island Sound Side	-17.1	-6.4	0.1	-0.19
Petit Bois Gulf Side	-26.6	-0.8	0.4	-0.05
Petit Bois Sound Side	-5.6	-6.3	0.0	0.25

Shoreline and Topography Survey Comparison

This topographic change project has a companion project that focuses on shoreline positional change. The shoreline project surveys the entire shoreline of both park units. Shoreline change for each transect is presented here but is addressed more comprehensively in Bracewell (2023). When comparing the two projects, the average shoreline position change was in better agreement for the Mississippi units than the Florida units (Table 4). This outcome is likely due to a more widely

distributed topography survey effort in Mississippi than in Florida, where the topographic change monitoring effort focuses on Pensacola Pass and does not extend the entire length of these units.

To better understand the spatial distribution of the changes in profile dimensions and their relationship to the GULN shoreline positional change project, Figures 6 thru 8 show stacked profiles and their location in each park unit. Florida transects are spaced 1km apart, Petit Bois transects are 2km apart, and Horn Island transects are 4km apart.

Table 4. Shoreline position changes reported in the GULN's shoreline position change project compared with shoreline position ('0' elevation) recorded in the coastal topography changes project. Average change is measured in meters/year from 2018 to 2022.

Unit	Change in Shoreline Position from Shoreline Protocol	Change in Shoreline Position from Topography Protocol
Fort Pickens	-3.5	2.0
Perdido Key	-6.0	-1.1
Horn	-4.2	-6.6
Petit Bois	-7.5	-4.0
West Petit Bois	-11.6	-9.4

Areas of Special Interest

During scoping meetings for this project, GUIS Resource Management staff expressed special interest in the areas adjacent to Pensacola Pass. Overall, losses at Perdido Key were higher than Fort Pickens. A beach nourishment project at Perdido Key that occurred in late April of 2022, after the GULN survey, is anticipated to help stabilize an overwash prone section of that park unit. Additional beach nourishment at Perdido Key is expected to occur within the next few years.

Problems and Concerns

Horizontal accuracy was diminished in some areas, most notably at the Mississippi islands. This is likely the outcome of individual or a combination of factors including distance from the correction source, poor cellular signal, or a poorly calibrated level on the rover GNSS receiver’s range pole. As mentioned, slight straying from the protocol’s defined tolerances in this environment have a negligible impact on change analysis, however, identifying and rectifying sources of reduced accuracy will ensure high quality, comparable results.

This is the second in a continuous series of every-other-year reports related to monitoring topographic change at Gulf

Islands National Seashore. It is expected that future reports will benefit from the accumulation of data sets, allowing for better interpretation of the measurement variation attributed to geomorphic differences (e.g., slope), as well as weather, seasonal and tidal differences.

Protocol Changes

No major changes occurred to the GULN protocol implementation plan (Bracewell 2017) between its initial publication in 2017 and finalization of this report in February 2023.

Additional Information

For data and information related to this report please visit the Gulf Coast Network Coastal Topography Monitoring Project. For information about the GULN's complementary coastal dynamics project mapping changes in shoreline position, see the Gulf Coast Network Coastal Topography Monitoring Project (<https://irma.nps.gov/DataStore/Reference/Profile/2238503>).

Literature Cited

Bracewell J. 2023. Shoreline change at Gulf Islands National Seashore, Florida and Mississippi: 2018–2022 data summary. Natural Resource Data Series. NPS/GULN/NRDS—2023/1387. National Park Service. Fort Collins, Colorado. Available at <https://doi.org/10.36967/2296901> (Accessed February 2023).

Bracewell J. 2017. Monitoring Coastal Topography at Gulf Coast Network Parks: Protocol Implementation Plan. Natural Resource Report. NPS/GULN/NRR—2017/1522. National Park Service. Fort Collins, Colorado. Available at <https://irma.nps.gov/DataStore/Reference/Profile/2244086> (Accessed February 2023).

NOAA Office for Coastal Management Partners 2023a. 2018 USGS Topobathy Lidar: Gulf Coast Islands (AL, FL, LA). Available at: <https://www.fisheries.noaa.gov/inport/item/64345> (Accessed February 2023).

NOAA Office for Coastal Management Partners 2023b. 2021 USACE NCMP Topobathy Lidar: Mississippi [unpublished raw data].

Psuty, N. P., T. M. Silveira, M. Duffy, J. P. Pace, and D. E. Skidds. 2010. Northeast Coastal and Barrier Network geomorphological monitoring protocol: Part I—ocean shoreline position. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/664308> (last accessed January 2022).

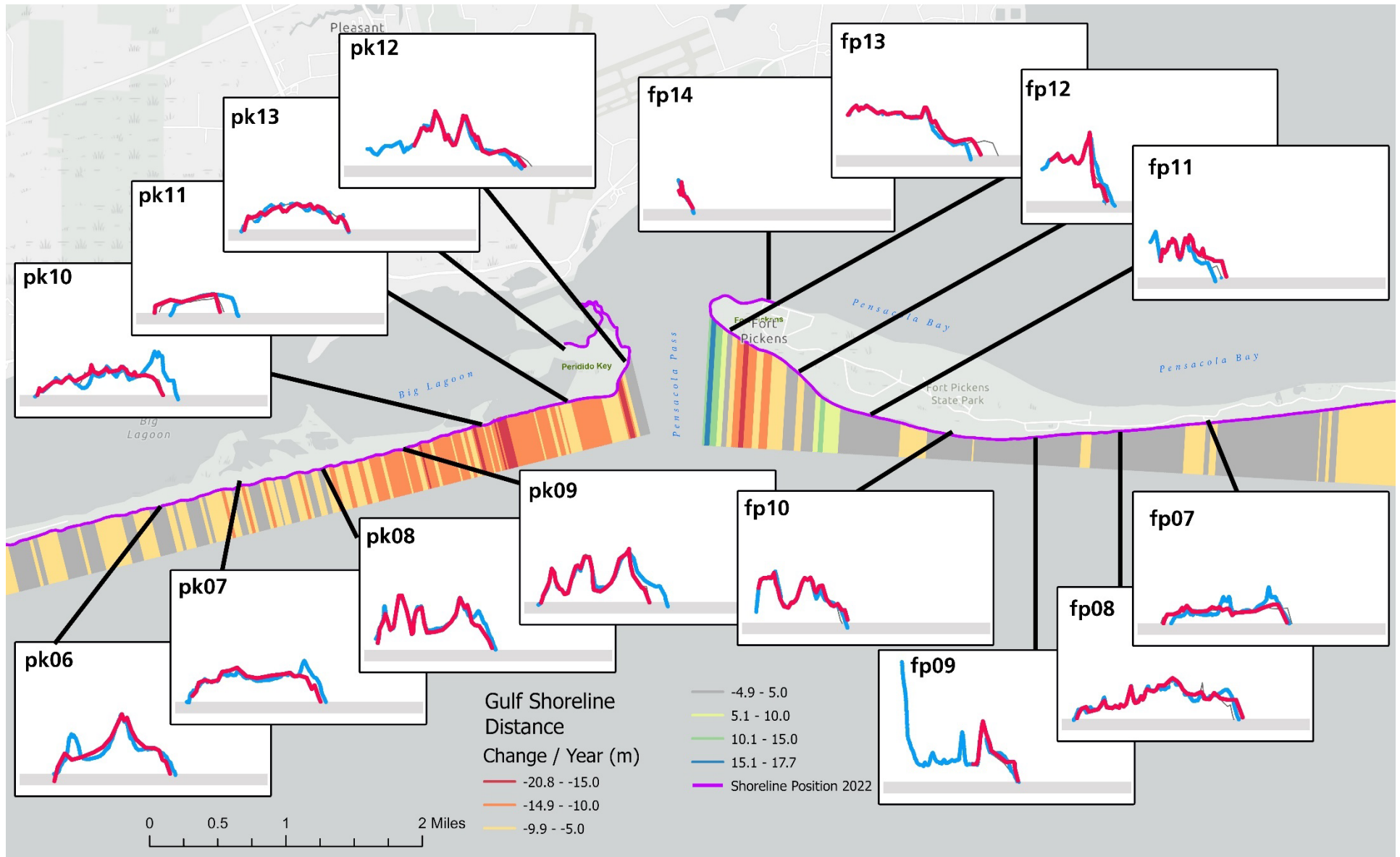


Figure 6. Topographic profiles and shoreline change for Perdido Key and Fort Pickens, FL. The topographic profiles are shown in the inset figures, with 2018 data in blue, 2021 in grey (missing from several) and 2022 in red. Shoreline change from 2018 to 2022 is shown as colored bands extending from the shoreline seaward, with different colors representing different amounts of change, in meters.

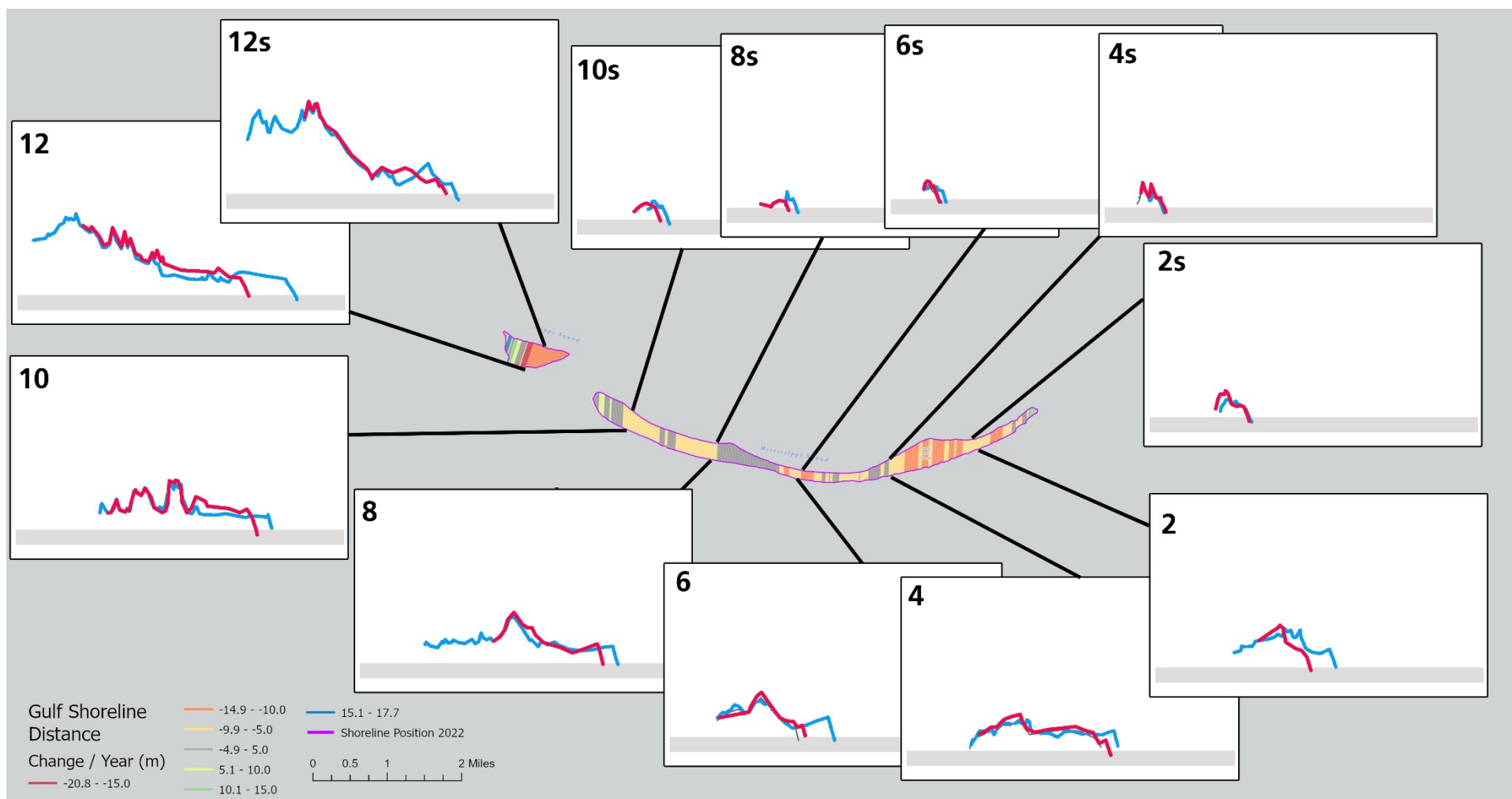


Figure 7. Topographic profiles and shoreline change for Petit Bois and West Petit Bois Islands, MS. The topographic profiles are shown in the inset figures, with 2018 data in blue, 2021 in grey (missing from several) and 2022 in red. Shoreline change from 2018 to 2022 is shown as colored bands extending from the shoreline seaward, with different colors representing different amounts of change, in meters.

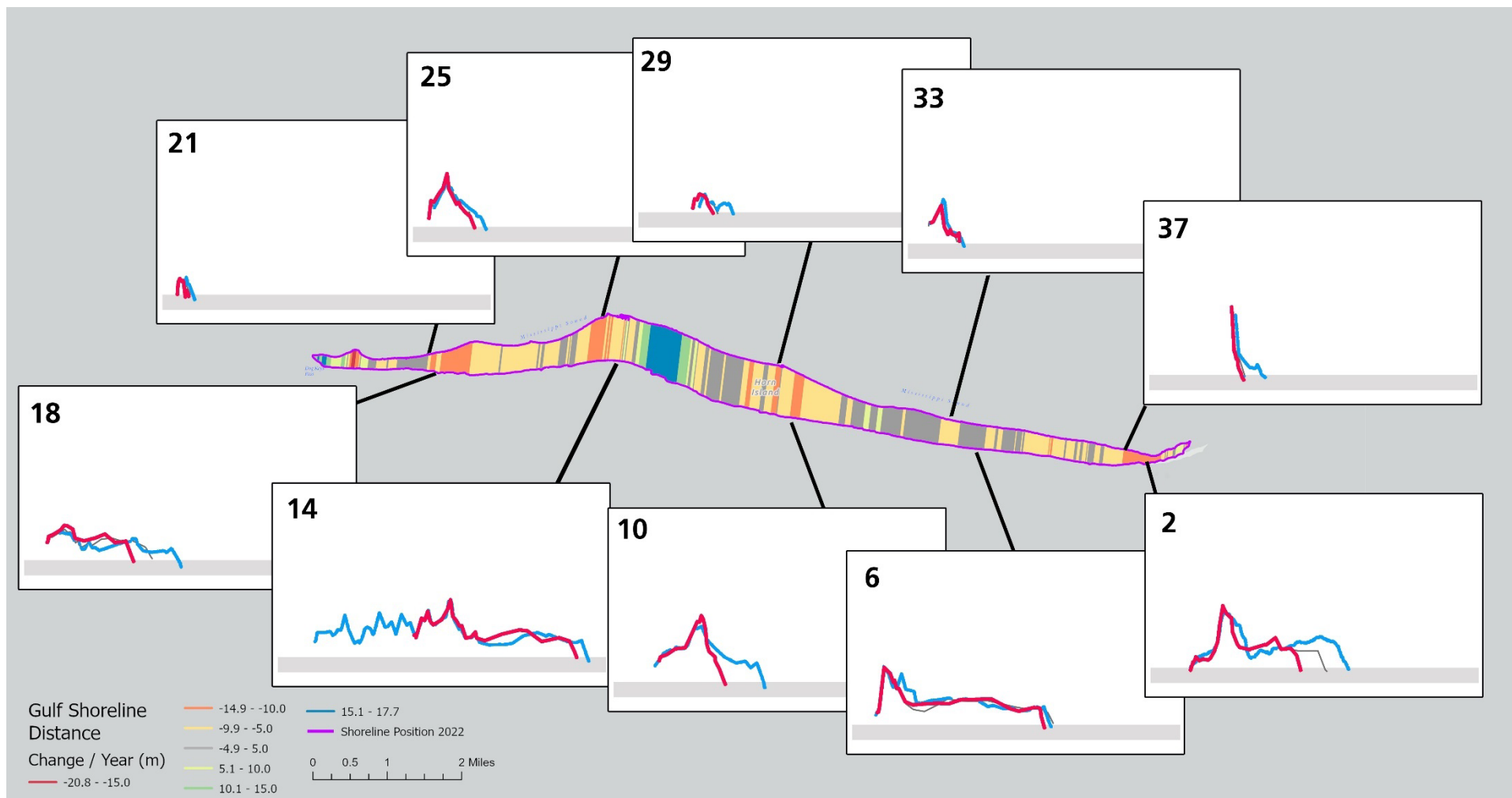


Figure 8. Topographic profiles and shoreline change for Horn Island, MS. The topographic profiles are shown in the inset figures, with 2018 data in blue, 2021 in grey (missing from several) and 2022 in red. Shoreline change from 2018 to 2022 is shown as colored bands extending from the shoreline seaward, with different colors representing different amounts of change, in mete