

How Hurricanes Have Impacted Sediment Transport on the Renourished Beaches of Gasparilla Island State Park in Boca Grande, FL.

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INTRODUCTION

This study focuses on Gasparilla Island State Park on Boca Grande, FL (Figure 1-2). With observed sediment shifts using satellite imagery, we measure beach renourishment longevity and effectiveness, how storms have impacted the beach, and overall sediment transport. The Florida Gulf has approx. 30 barrier islands. These islands are dynamic systems shaped by natural processes and human activity, and are increasingly vulnerable to climate change, sea level rise, and storm impacts.

- Located along the Gulf of Mexico between Siesta Key and Fort Myers Beach, FL.
- Tourist destination for its beaches and sport fishing.
- Research evaluates beach evolution south of Belcher Road for years 1995-2025, and past renourishment efforts (2007, 2013, 2019).
- Wildlife impacts are also considered, particularly for the approx. 50 sea turtle nests found annually in the park.

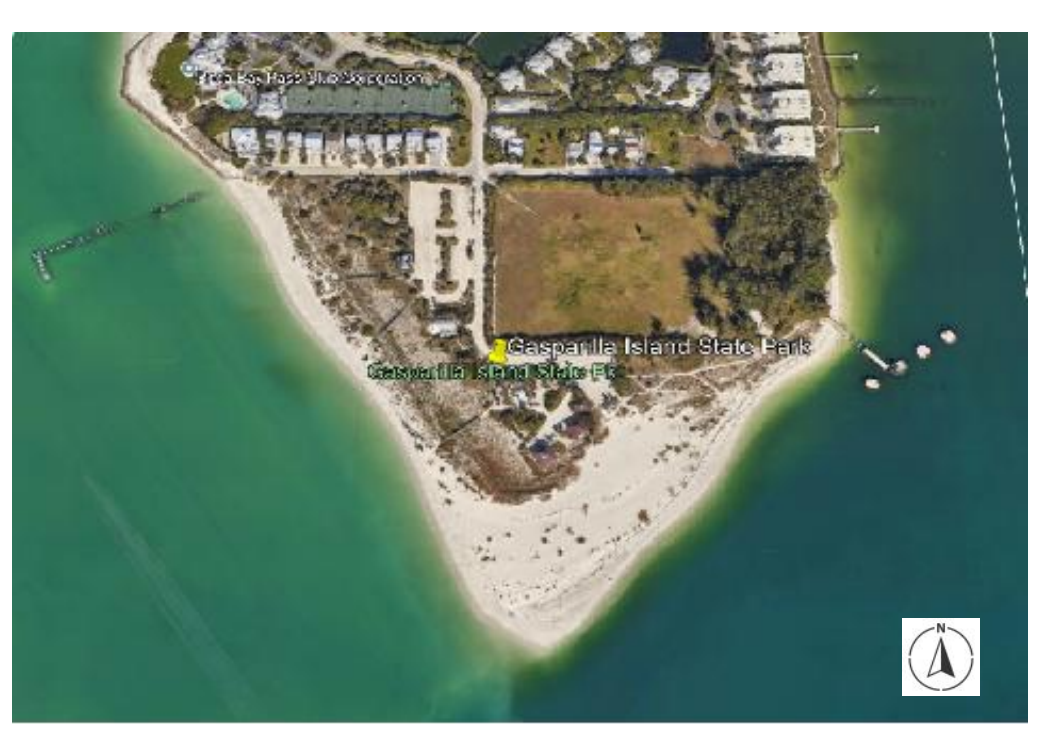


Figure 1. Gasparilla State Park Feb. 2025

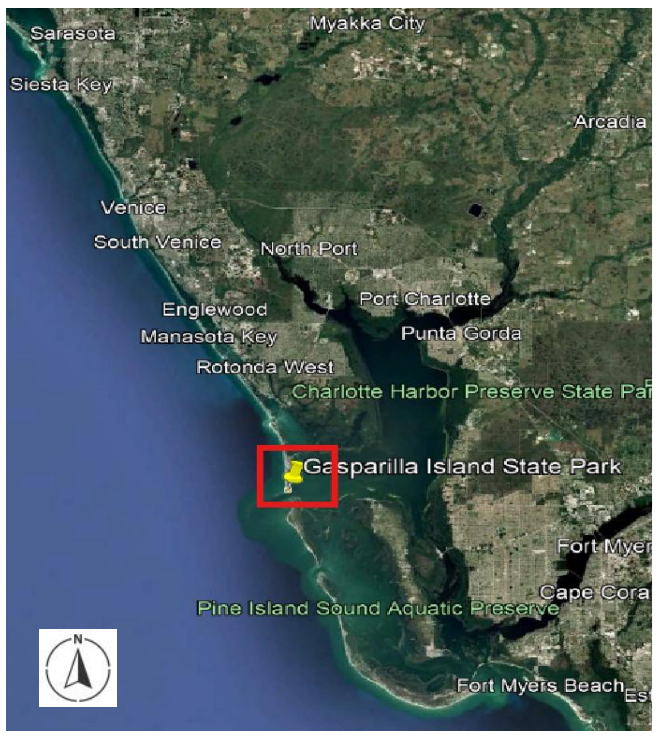


Figure 2. Florida Gulf Coast. Zoomed out version of Gasparilla State Park location.

COMMUNITY PARTNER & OBJECTIVES

Community Partner: Park Manager, Byron Maxwell

In the park industry for 23 years. Started as a ranger in North Florida and worked his way up to management. From a prescribed fire background in North Florida. Started with Gasparilla State Park in 2020 and manages 4 other parks in the area.

The objectives of this project are to:

1. Establish the longevity and effectiveness of past renourishment projects.
2. Determine how they been affected by storms, tourism, and other contributing factors.
3. Provide insight to the geological patterns of sediment transport.
4. Determine if there are biological consequences.

METHODS

To track total sediment area changes overtime:

1. Sediment area was tracked and measured over years 1995-2025 using Google Earth Pro.
2. Renourishment dates (2007, 2013, 2019), and hurricane dates were recorded (Table 1).
3. Relative sea level change, mean tidal range, and mean wave height data were collected from three NOAA buoy and stations (Figure 3) to establish Coastal Vulnerability Index (CVI) (Table 2).
4. Three transects from the west, south, and east sides of the park were drawn and measured to consider tidal range impacts.
5. Error analysis was then conducted using Excel to quantify tidal range impact when measuring the change in beach area over time.
6. Regular communication with my community partner via email and phone call.

Year	Event
Apr-07	Renourishment
Dec-13	Renourishment
Sep-17	Irma
Oct-08	Micheal
Jul-19	Renourishment
Sep-22	Ian
Aug-23	Idalia
Sep-24	Helene
Oct-24	Milton

Table 1. Year and event documentation.

Variable	Value	Rank	Notes
Geomorphology	Sandy Barrier Island	5	
Coastal Slope (%)	0.25%	4	0-520m Offshore
Relative Sea Level Change (mm/yr)	4.97 mm/yr	5	Station: 8726384 Station: 8726724 Port Manatee, ClearwaterAvg.
Shoreline Erosion/Accretion (m/yr)	.6 m/yr	5	1995-2025 (30 years)
Mean Tidal Range (m)	.55 m	5	Station: 8726384 Station: 8726724 Station: 8725114 Port Manatee, Clearwater, Naples Bay Avg.
Mean Wave Height (m)	0.50 m	1	Bouy: 42098 Egmont Channel

Table 2. Coastal Vulnerability Index established.



Figure 3. NOAA Egmont Channel buoy, Naples Bay, and Port Manatee stations.

RESULTS

From 1995–2025 (Figure 4 & 5), the park has lost 18 m² of beach area, averaging 0.6 m²/yr despite renourishment efforts. The CVI was calculated at 20.4, and tidal range error (Figure 6) at 21.2-71.8 m. Frequent hurricanes in recent years have accelerated erosion, moving sediment around the southern tip and into Boca Grande Pass.

Figure 6. Tidal range error analysis using 3 transects. This was used to establish the variability between 21.2 m - 71.8 m based on slope differences of the west, south, and east side transects.

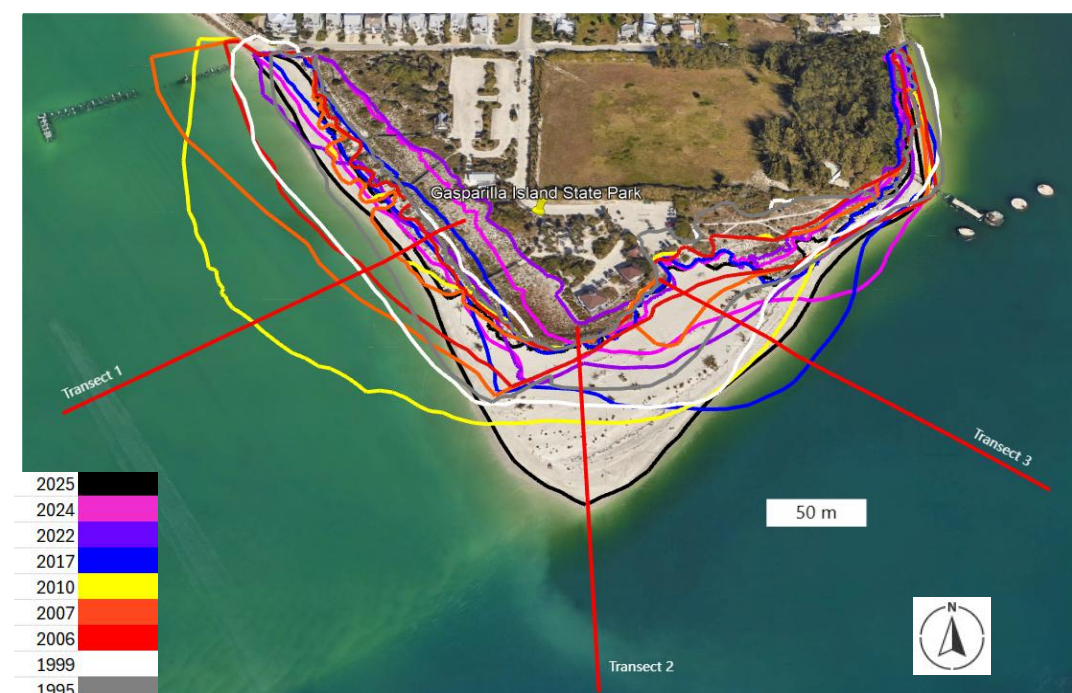
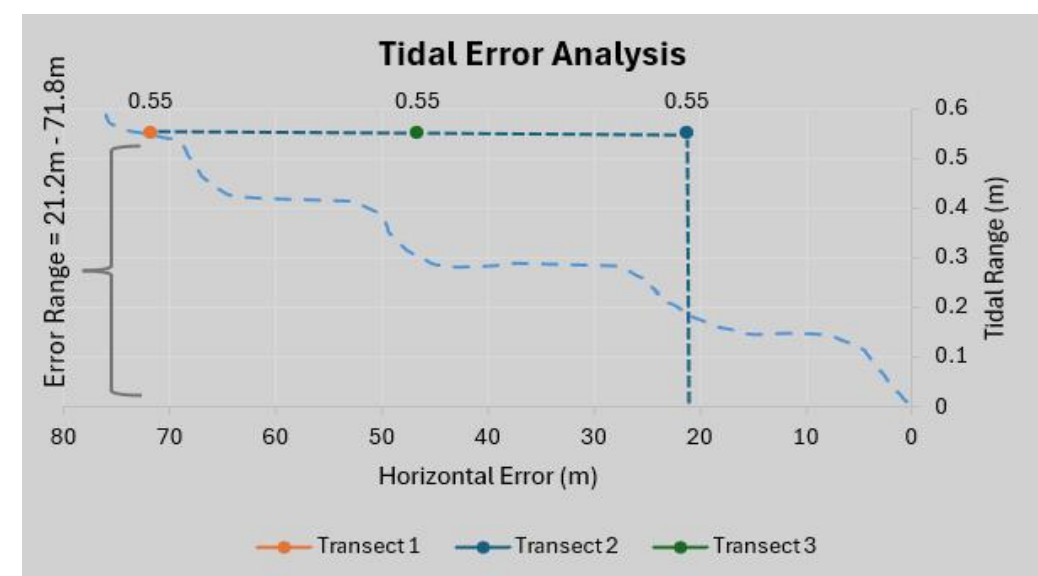


Figure 4. Mapped beach area changes for 1995-2025 with west, south, and east transects. 18 m² total area loss with avg. of 0.6 m² per year.

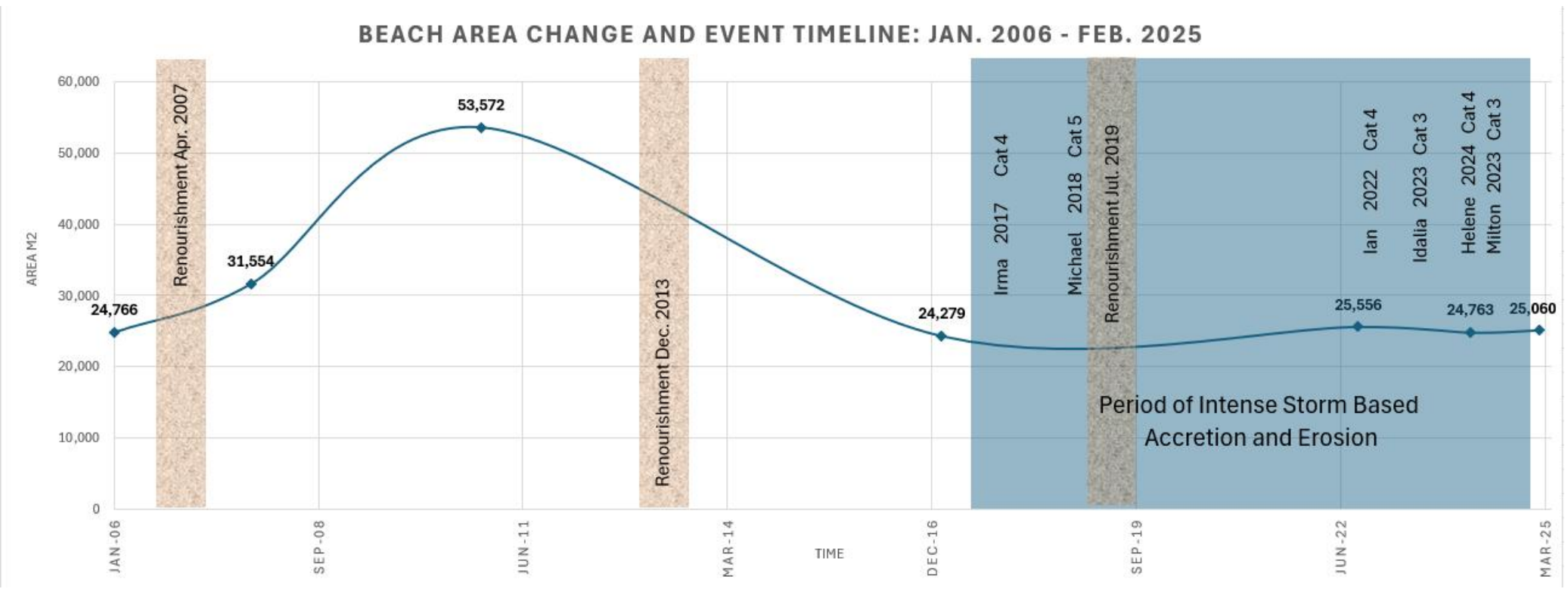


Figure 5. Beach area change over years 2006-2025 showing renourishments from years 2007, 2013, and 2019. More frequent storms at greater intensity have impacted sediment erosion and accretion rates along the southern tip of the park.

CONCLUSIONS

Given these results, we conclude that:

1. CVI is 20.4, classifying as a moderately vulnerable area.
2. Renourishment projects are sufficient approximately every 6 years, despite increased storm frequency.
3. Storms, tourism, and other factors (i.e. tide patterns, sea level, change, and wave height) do contribute to erosion, but with continued renourishment we can maintain a relatively stable beach.
4. Sediment transport moves from north to south. As the northern beaches are renourished, the State Park benefits over time from sediment accretion on the southern tip of the park.
5. There will be consequential biological impacts however, further research would need to be conducted to establish how great the impact beach renourishment has on the park's sea turtles.
6. Furthermore, 18 m² of total beach area has been lost from 1995-2025, although this is within the range of measurement error due to tidal variations.

PERSONAL LEARNING OUTCOMES

This project allowed me to gain a better understanding of how dynamic coastal systems can be, and new ways I can serve my community using my degree. I really enjoyed networking with the State Park and learning more about the area and its future.

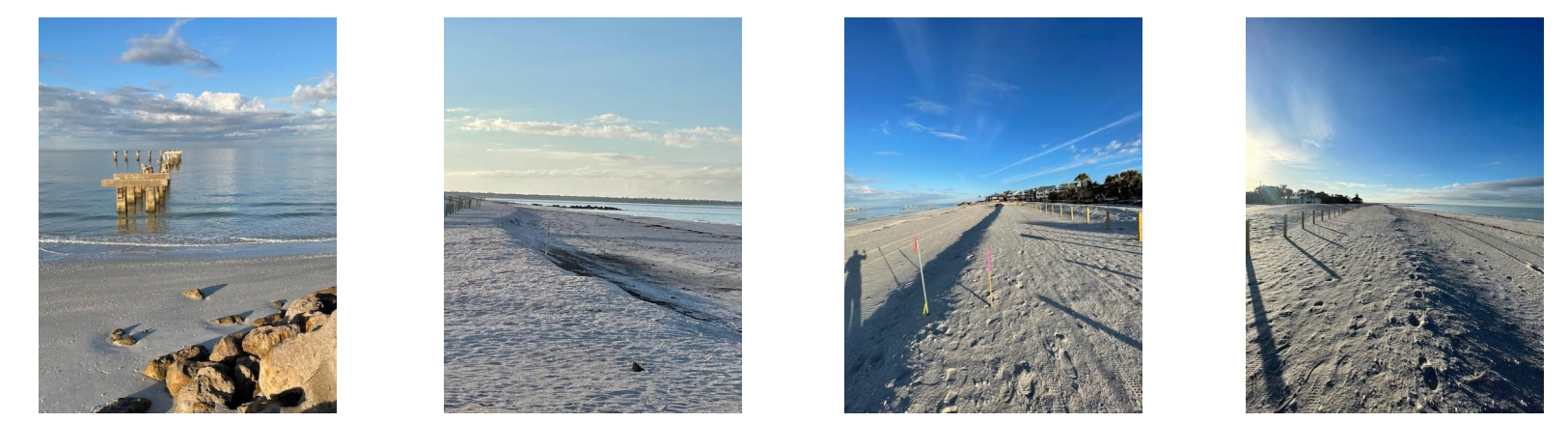


Figure 7. Field work picture collage of the beach before upcoming 2025 renourishment.

ACKNOWLEDGEMENTS

Thank you to Gasparilla Island State Park and Park Ranger Byron Maxwell for the time invested supporting this research study. Thank you to ENDEAVOR for the opportunity to present that the 2025 spring symposium.

REFERENCES

Please scan this QR code to view reference page and a visual GIF of sediment change over time.

