After Hurricanes Irma and Matthew: Living Shorelines Stabilize Sediments

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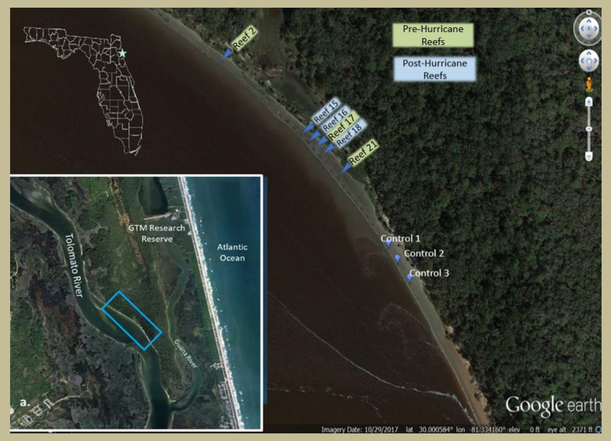


In 2012, the GTM Research Reserve in Northeast Florida constructed 28 oyster reefs to combat shoreline erosion. Sediment cores (22 cm) were taken before and after the hurricanes to compare the sediment profiles and determine if the sediment had become unstable due to these storms. Sediment cores were also taken from 3 control sites before the hurricanes where no reef is present.

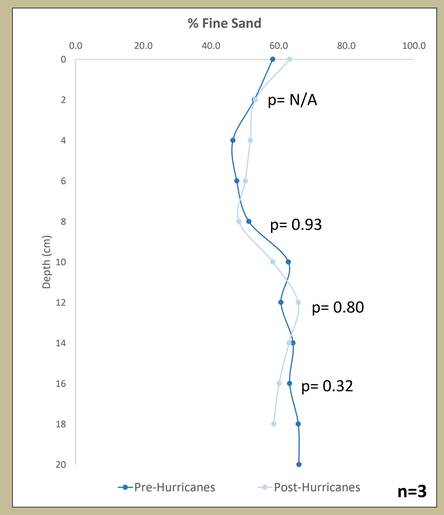
Hurricanes Matthew (2016) and Irma (2017) caused considerable damage to man-made structures but did the hurricanes have an effect on the sediment behind the oyster reefs? High energy storm events, such as hurricanes, can potentially mix fine and coarse sediments, leading to unstable sediment and erosion. However, the restoration of oyster reefs along the Tolomato River should buffer oncoming high wave energy from storms and boat wakes. Therefore, if the oyster reefs are buffering waves as predicted, then sediment data collected after the hurricanes should be similar to pre-hurricane data.

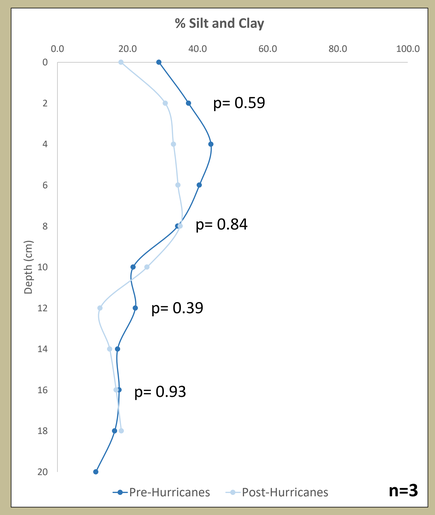
Pre-Hurricanes

Post-Hurricanes

The oyster reefs appear significantly damaged after the two hurricanes when compared to photos before the storms. Although the sediment is stable, the oyster reefs themselves may require intervention to provide further protection from erosion.

Similar Sediment Profiles Reveal Success of oyster reefs





The similarity of the sediment profiles before and after the hurricanes suggests the sediment behind the oyster reef was relatively unaffected by the high energy storm events; thus, the oyster reefs effectively stabilized the sediment behind them. Two-tailed t-tests ($\alpha = 0.05$) show insignificant differences between pre- and post-hurricane percentages of fine sand and silt and clay, indicated by the p-values displayed next to their corresponding test depth.

Determining Sediment Particle Sizes

30 g of sediment was measured into a Nalgene bottle.

30% Concentrated Hydrogen Peroxide was added to the sediment in 15 mL increments.

The sediment mixed with concentrated hydrogen peroxide was placed in the oven overnight to dry.

After the addition of 100 ml of sodium hexametaphosphate, the sample was shaken for two hours.

The mixture was wet sieved to separate the sand from the silt and clay.

The sand was poured into a beaker and placed into the oven to dry overnight.

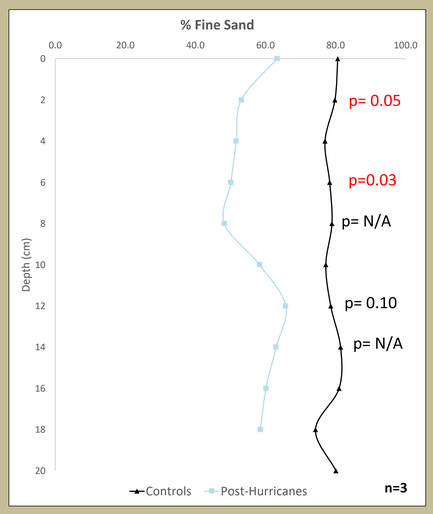
The dry sand samples were in the sieve shaker for 15 minutes.

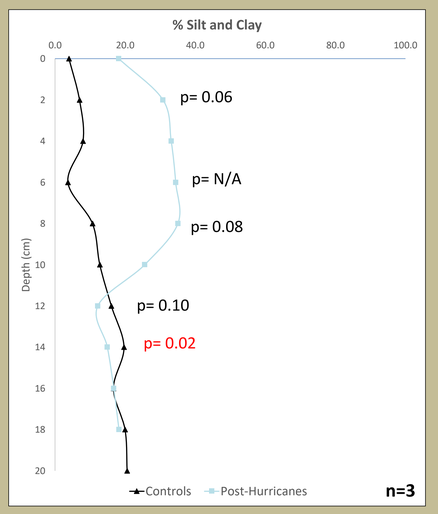
The individual sand fractions were weighed in grams.

Sediment May Be Stable But Oysters Are Not

The lab analysis of the post-hurricane sediment samples shows distinctive layers of fine and coarse sediment, like pre-hurricane data. Therefore, the oyster reefs provided substantial shoreline protection against two strong hurricanes. Although the sediments remained stable throughout these storms, the current condition of the reefs will likely not provide shoreline protection unless we mediate.

Controls vs. Post-Hurricanes Show Differences





The p-values highlighted in a red font emphasize the significant differences between the control samples and the post-hurricane samples, further showing that oyster reefs accumulate fine sediments. Depths marked N/A did not have 3 samples for each depth due to inadequate sediment in one or more reefs; therefore, two-tailed t-tests could not be performed.

Acknowledgements

A warm thank you to Dr. Nikki Dix and the GTM Research Reserve, and John Wooldridge, Lab Manager
Dr. Melissa Southwell, Colin Herbert, Chris Blanco, Dani Cayouette, Tim Mullen, Cody Burns, Aubrey Kemper, Courtney Cunningham, and the Flagler College Science Department.

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