



Coastal Geomorphology: Monitoring Mangrove Soil Surface Elevation Tables in Salt River Bay National Historical Park and Ecological Preserve

2020

Importance

Mangrove wetlands provide flood control, storm protection, shore stabilization, water filtration (capturing soil runoff), carbon sequestration, and habitat for fish and wildlife communities. The economic value of the services derived from mangroves has been estimated as high as \$200,000–\$900,000 per hectare (Wells et al. 2006).

Soil elevation, hydrology, and mangrove forest health exist in a feedback loop. The soil elevation in mangrove forests affects tidal inundation period and frequency, overall hydroperiod, sedimentation, erosion, and the shrink and swell of soil materials, all of which affect mangrove seedling species recruitment, community composition, and survival (Whelan et al. 2005; Whelan et al. 2009). If the rate of relative sea level rise (2.5 millimeters per year [0.098 inches] in St. Croix, VIIS; tidesandcurrents.noaa.gov) is greater than the rate at which mangrove soil elevation increases, the trees die off and there is no mangrove recruitment to replace them. These areas will eventually convert to shallow open water marine habitats and the mangrove forest will move inland (upslope).

Understanding the rate of change in mangrove soil elevation is critical to predicting the long-term ability of mangrove forests to regenerate.

Objectives and Approach

The objective is to monitor rates of soil accretion and erosion to determine if soil processes are keeping pace with the rate of relative sea level rise. The approach uses Soil Surface Elevation Tables (SETs) and marker horizons. A SET instrument is designed to temporarily (Figure 1) attach to a permanent benchmark and fiberglass pins are lowered to measure the distance to the sediment surface. The marker horizons are a layer of feldspar placed on the soil surface allowing measurement of deposition at the site using soil cores (Figure 2). There is one soil elevation monitoring station located in Salt River Bay National Historical Park and Ecological Preserve (SARI).

Our approach has been documented using a [protocol implementation plan](#) with seven standard operating procedures and four appendices specific to this network (Whelan et al. 2016).



Figure 1. Kevin Whelan, SFCN ecologist, is measuring soil surface elevation using the Soil Elevation Table (SET). The SET is attached to a permanent benchmark. The height of the pins transcribes the elevation of the soil and standardizes it to a fixed reference point (the metal arm). Repeated measurements over time monitor the rate of soil elevation change.



Figure 2. Measuring accretion, which is the material deposited above the white line. The white line is feldspar, a mark layer placed at the site on a previous sampling event. Here we can see turtle grass (*Thalassia testudinum*) that is becoming incorporated into the soil. This sample was taken at Biscayne National park.



Results

Due to COVID19, no monitoring was conducted in spring or fall of 2020. The overall soil surface elevation at Salt River Bay National Historical Park and Ecological Preserve (SARI) seems to be decreasing, since its establishment in June 2012 (Figure 3). There have been 27 attempts to establish feldspar accretion plots that have consistently washed away, suggesting erosion of the surface soil. There appears to be a significant decline in soil surface elevation from 2012 to 2016, then beginning in 2017 there is an increase again (Figure 3). This pattern may be due to the overland flow of water moving sediment and deposition material to the site.

In 2017 the Salt River SET site was hit by Hurricane Irma and Hurricane Maria (Figure 3). Since the hurricanes, the site has exhibited signs of severe wind storm damage (Figure 4). Immediate effects of the storms on the elevation data is unclear. However, the long term impacts of mangrove die-off are yet to be known and will require continued long-term elevation monitoring.

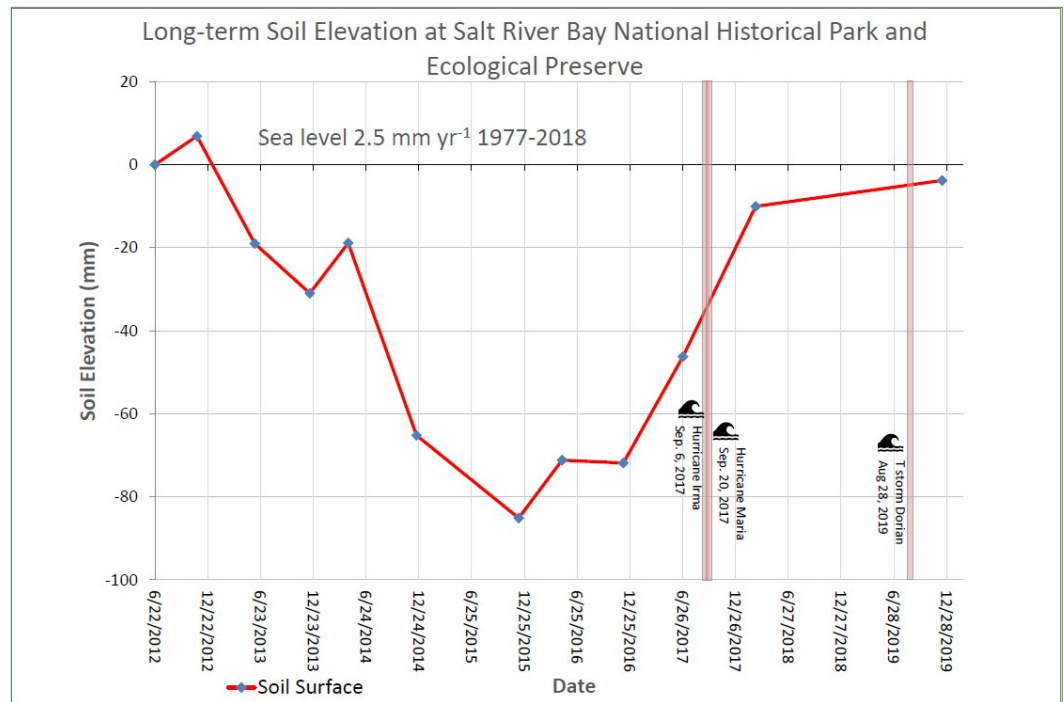


Figure 3. The graph depicts the absolute change in mangrove soil surface elevation at the SARI SET site. The vertical bars indicate storm events and the sea-level estimate is from the Lime Tree Bay NOAA tide gauge station (<https://tidesandcurrents.noaa.gov>)



Figure 4. Hurricane damage at the Salt River SARI SET site. Severe wind damage caused debris deposits, mangrove die-off, and missing or damaged platform boards.

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