Beach Stabilization and Dune Restoration in Progreso, Yucatan, Mexico

Samarcel, LLC

WEDA SUMMIT & EXPO '18

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Project Team Members

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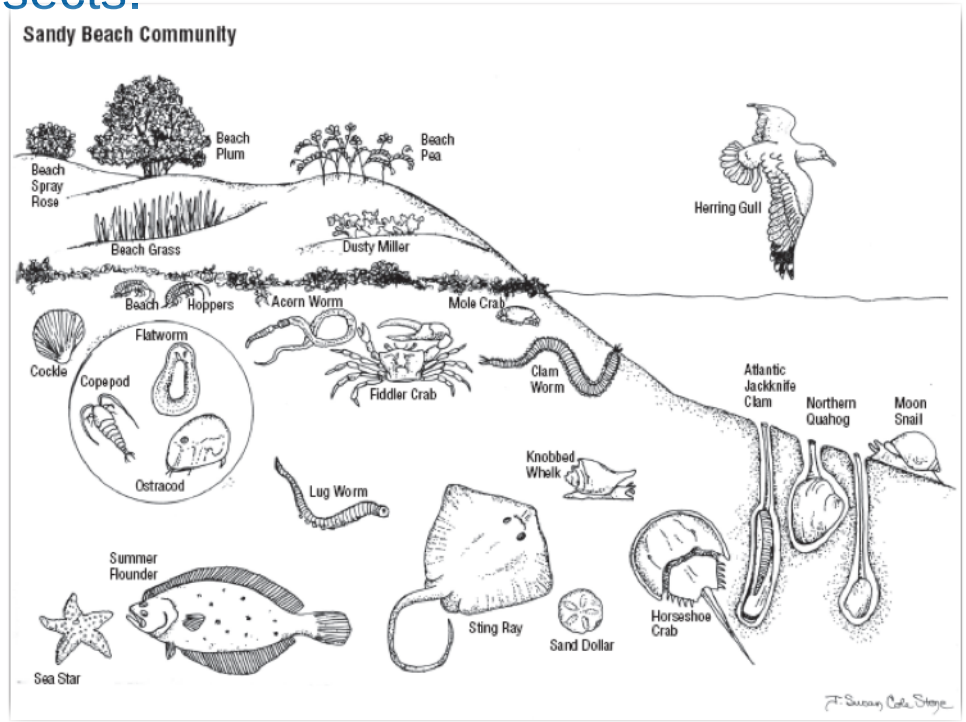
- Amine Dahmani: SAMARCEL LLC, Storrs, CT, SESI Consulting Engineers, UCONN.
- Ismael Mariño: Centro de Investigación y Estudios Avanzados del Instituto Politécnico Nacional, Mérida, Yucatán, México

What is a Healthy Beach?

- Hundreds of species of plants and animals inhabit a healthy coastal environment.
- The coastline extends from the low tide beach to the grasslands and sand dunes.
- The primary tool in assessing the health of a beach is its ability to have a balanced erosion and accretion cycles and to support a variety of plants, invertebrates, birds and insects.



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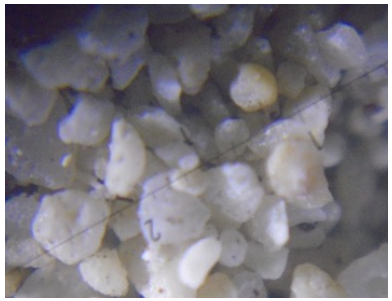
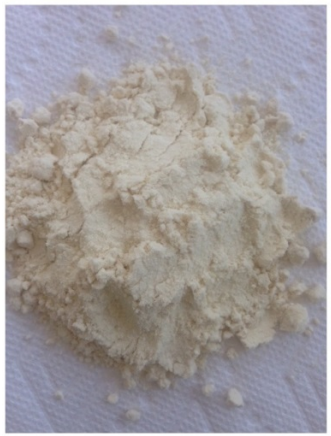
SAMARCEL BEACH STABILIZATION TREATMENT PROCESS

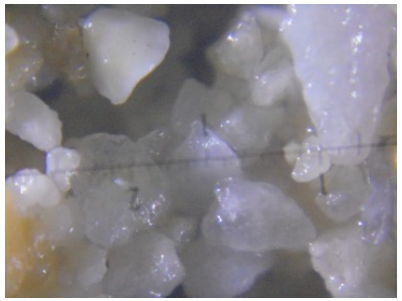
- Natural biodegradable proprietary polysaccharide protein biopolymers, PPBs.
- PPB formulation, SandFirst (SF) designed through laboratory testing with sand from the site.
- When the PPB SF product is applied, the natural color and texture of the sand are not altered.

without SandFirst





with SandFirst



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Project Site in Progreso, Yucatan, Mexico

Figure 1. Location of the study area. T100-T400 represent the profiles measured in the Treatment zone and profiles O100-O200 and E100-E200 correspond to the West and East Control zones, respectively.

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APPLICATION AND EVALUATION

- 85-m long treated beach. 1 kg of SF per meter was applied at low dosage (4 g/L) over a 6-month period.
- Evaluated changes in Treatment zone and two Control zones (evolution of the coastline and sediment volumes) using 136 profiles and a linear regression analysis of the data.
- Evaluated the changes in sediment volumes for a section of the profile corresponding to 30 meters (approximately 10 m of dry beach and 20 m of submerged beach) bounded between the levels +1.0m to -1.5m was selected.
- Determined if there were differences in the sediment balance between Treatment and Controls. An analysis of variance was also performed.

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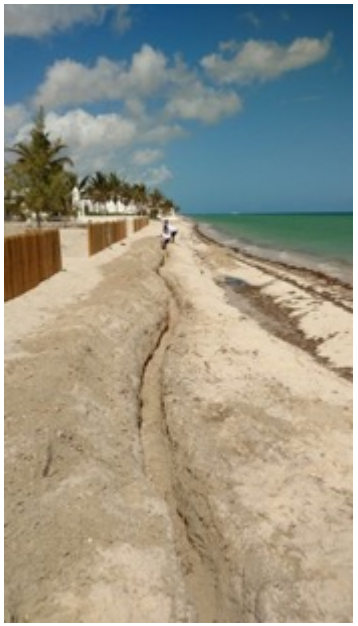
Treatment Application



June 23, 2016

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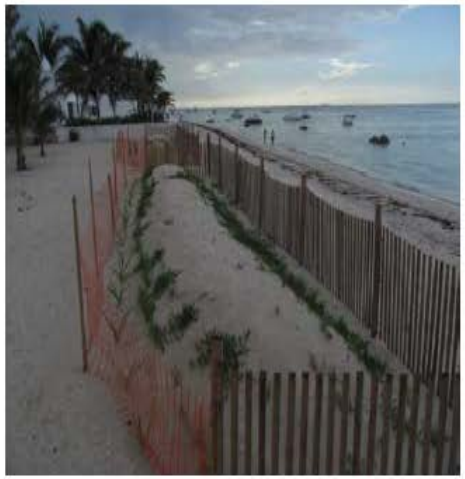
Dune Restoration

Reclaimed windblown sand



Native plant species placement, sand fence installation and application of the PPB SandFirst for dune stabilization

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Profile Evolution

August 5, 2016

August 20, 2016

September 6, 2016

Bathymetry- Sept. 10, 2016

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Profile Evolution

Sea turtle, Sept. 10, 2016

Application - Sept. 12, 2016

October 18, 2016

After a storm, Oct. 31, 2016

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Profile Evolution

November 16, 2016

Control West - Nov. 16, 2016

February 4, 2017

Control West- February 4, 2017

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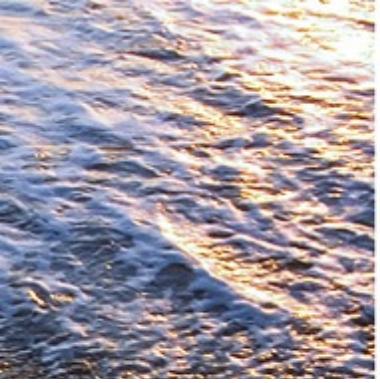


Evolution of the Coastline

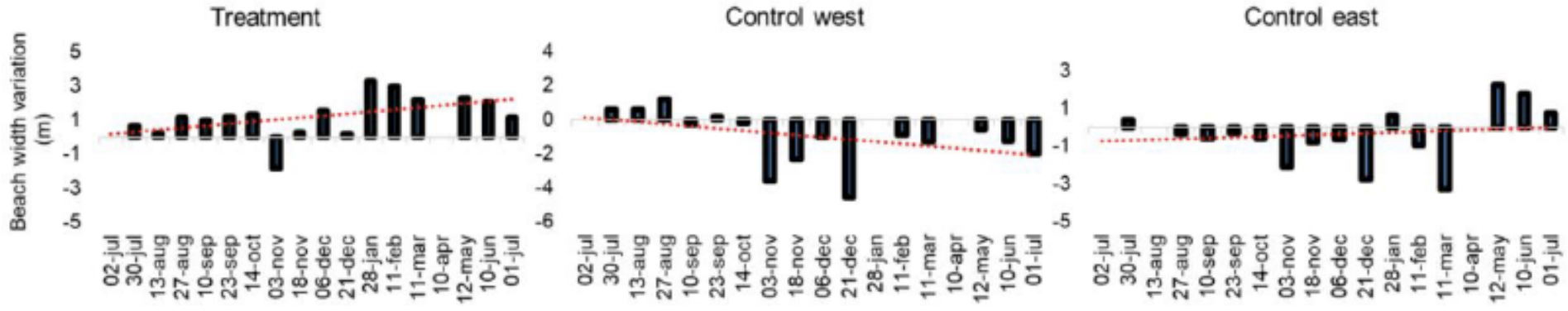
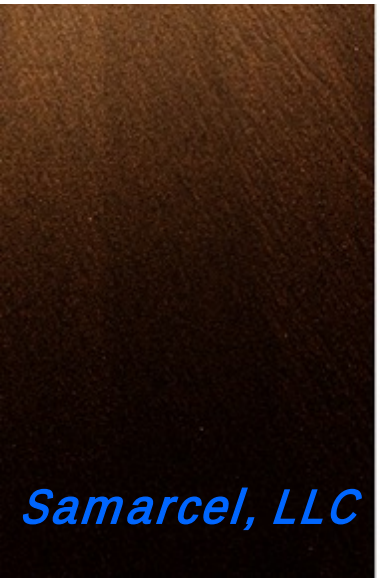


Figure 5. Time series of the coastline in the Treatment zone and the Control zones



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Sand Volume Variations

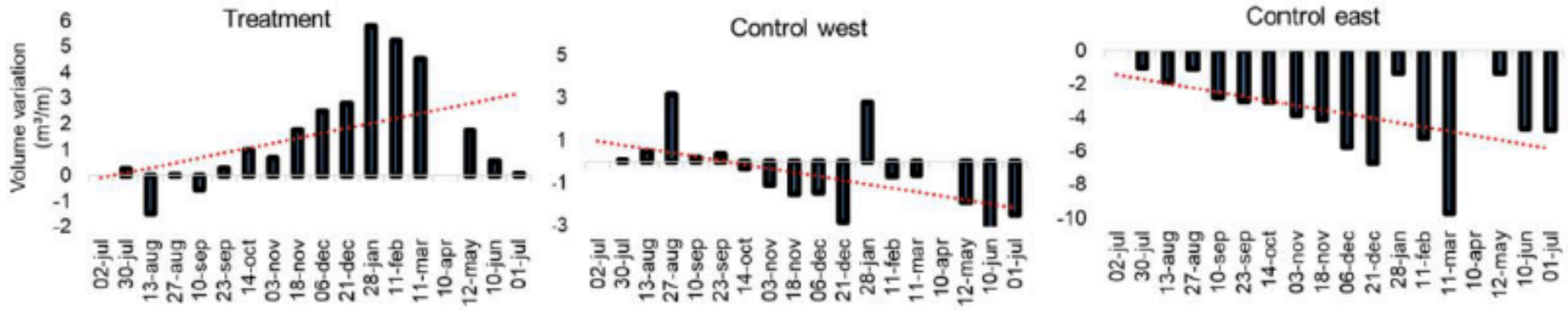
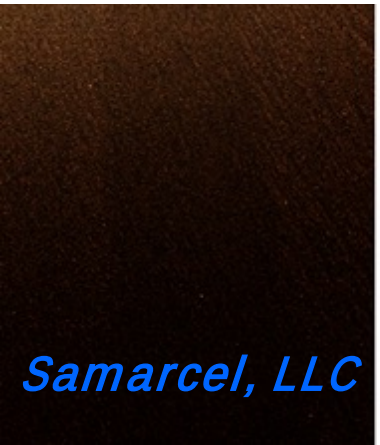


Figure 7. Average variation of the sand volume, and tendency (red line) in the Treatment zone and in the Control zones



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Profile Evolution

March 11, 2017

Control West- March 11, 2017

Control East- March 11, 2017

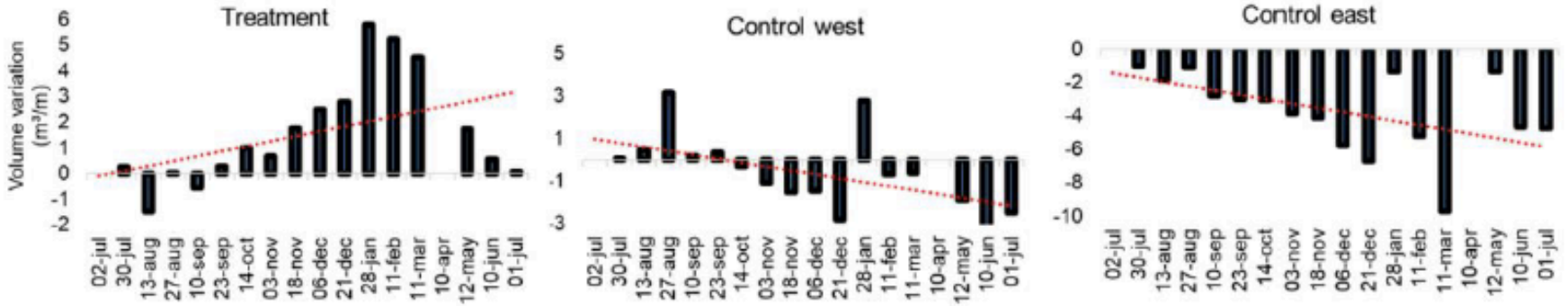

Figure 7. Average variation of the sand volume, and tendency (red line) in the Treatment zone and in the Control zones

Profile Evolution

Major Storm: May 8, 2017

Major Storm: June 10, 2017

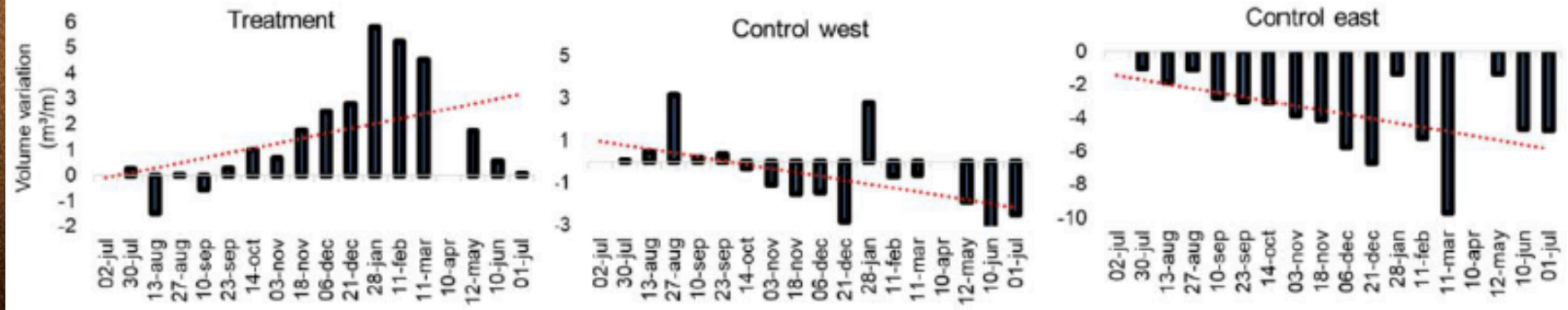

Figure 7. Average variation of the sand volume, and tendency (red line) in the Treatment zone and in the Control zones

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Dune Condition Following Storm

A severe storm affected the Yucatan coast on May 4th, 2017. The dune demonstrated its importance by preventing an inundation of the premises.

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Profile Evolution

February 26, 2018

April 23, 2018

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Project Results

- In the Treatment zone, the sediment balance (erosion/accretion rate) was stable between the supralittoral and sublittoral areas (0.06 m^3/m), while in the Control zones it had an average negative balance of -4.04 m^3/m.
- The coastline in the Treatment zone shows a tendency to expand seaward. The Controls regressed.
- Our findings suggests that the treatment is a suitable method for increasing beach resilience and may be used to complement beach renourishment projects.
- The sand dune restoration was successful. Dune vegetation was enhanced by the PPB treatment.

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Environmental Benefits

- The project increases energy efficiency by making renourishment projects more effective through enhanced sand retention and dune restoration.
- The project created a carbon sink through the restoration of the beach dune by reclaiming windblown sand and planting native species.
- The project enhanced beach resilience by increasing beach width and yielding a positive net sediment balance.

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Environmental Benefits

- Restoration of the dune created new habitat (275 m^2) that provided protection to some invertebrate species.

- The PPB treatment and sand dune and fence design/location did not impede the nesting of sea turtles as three successful nestings and hatchings were observed on the beach during the project.

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Thank You!

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