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REEF RESEARCH

UTILISATION OF ENCASEMENT TECHNOLOGY IN RESTORATION OF MANGROVE FOREST ON ST. CROIX, U.S. VIRGIN ISLANDS

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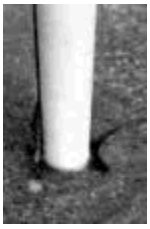
Mangrove forests are important for many reasons. Not only do they provide essential habitat for many species of animals such as birds, crabs, insects and larval fish, but their existence benefits people as well. Mangroves help to protect shorelines against erosion by buffering the land against storms. The trees trap sediment and debris in their root systems, thereby keeping our bays and reefs clean and healthy. Mangroves are also able to absorb contaminants through their roots, and so are important mitigators of Nonpoint Source (NPS) Pollution.

Background

The old growth mangrove forest within Sugar Bay, a sub-watershed of Salt River Bay, was nearly 100% destroyed when the island of St. Croix sustained a direct hit by Hurricane Hugo in 1989. When these mangroves were destroyed, valuable habitat, storm buffers and mitigators of NPS Pollution were lost. The St. Croix office of the VI Marine Advisory Service (VIMAS), a part of the University of Puerto Rico Sea Grant College Program and the University of the Virgin Islands' Marine and Environmental Investigations Unit, is working in partnership with the St. Croix Environmental Association (SEA) to restore the mangrove forest within Sugar Bay.

Salt River Bay is a Category 1 (threatened) watershed consisting of 3510 acres, making it the second largest watershed on St. Croix. Salt River Bay is recognised as highly significant by both territorial and federal governments. Established as Salt River Bay National Historical Park and Ecological Preserve in 1992, the area is also a territorial marine reserve and wildlife sanctuary.



This summer, VIMAS and SEA began a three-year project to restore one of the most important watersheds on St. Croix. During the course of the project, 18 000 red mangroves (*Rhizophora mangle*) and 3000 black mangroves (*Avicennia germinans*) will be planted in Sugar Bay. This project is utilising a planting method called the Riley Encased Methodology© (REM) to replant the red mangrove

propagules. This technology was developed for planting red mangroves along high-energy shorelines to assist in shoreline protection, estuary restoration and to bolster the health of the marine environment. In addition, this methodology allows for a natural protective structure rather than concrete breakwaters and revetments, which usually only offer temporary solutions to shoreline erosion.

On the left, a root begins to protrude through the longitudinal split. At right, the split will continue to widen as the young tree develops. ©Robert W. Riley, Jr.

Young mangrove trees are especially vulnerable to several environmental factors. Substantial wave action, tides, upland run-off and damage from debris all threaten the success of any restoration project. Since Sugar Bay is a relatively sheltered bay, VIMAS and SEA conducted a pilot project to determine the effectiveness of the REM in 1997.

Pilot Project

In the pilot project, a one-piece PVC encasement was used for half (500) of the planted propagules. In the monitored test plots, a survival rate of 31.7% was observed. This overall low survival rate is attributed to the inadequacy of the one-piece system to account for the considerable estuarine influences experienced within Sugar Bay. During the pilot project, the seasonal high tide and run-off from rain events totalled between eight and 10 inches. However, even the limited protection provided by the one-piece encasement proved to be invaluable. Of the propagules that did survive, 74.3% were encased.

From this data, the project partners decided to encase all of the propagules for the current project. In addition, to compensate for the mean high tide as well as the seasonal high tide and estuarine influences (run-off), the two-part REM was chosen. The methodology used in the current project incorporates a two-part PVC system to encase the red mangrove propagule during the first few years of development. The encasement provides protection against extended periods of submersion (due to tidal action and estuarine influences), damage from the wrack line (floating debris) and crab predation on the young trees.

Methodology

The two-part encasement system utilises a bottom piece of PVC of variable height. The bottom piece is longitudinally split to allow for drainage, maintenance of water level equilibrium and root migration. An artificial bottom is created by filling the pipe with sediment to the level of the mean high tide. This piece will split successively lower as the tree grows and widens. As the split becomes wider, the artificial bottom material will drop lower, encouraging the roots to migrate down to the natural substrate and anchor the developing tree. This bottom piece is designed to reach just above the mean high tide mark and is attached to the top with a PVC coupling.

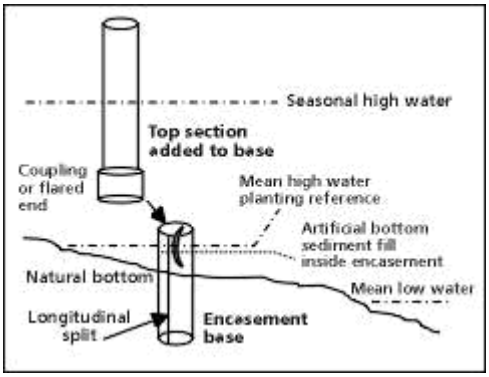
The top piece is of uniform length, and compensates for the seasonal high tide and run-off. Once the young tree has established prop roots (about two years), the top piece of PVC can be removed allowing it and the coupling to be reused. The bottom

piece of PVC cannot be removed without uprooting or damaging the young tree. Over time the bottom piece becomes encrusted with organisms, reducing its appearance and improving aesthetics at the site.

This project is also testing the performance of a one-piece encasement made of cardboard. The project partners are hoping to determine whether the cardboard would be an effective substitute for the PVC in areas with similar conditions to those within Sugar Bay (high estuarine influences, limited high-energy wave action). The main benefit from using a cardboard encasement would be that, over time, it would naturally break down eliminating any effect from PVC left within the bay (aesthetic or environmental). The drawbacks that have been experienced so far are that the one-piece encasement is bulky, heavy, and since it is one-piece, it is difficult to see down into the encasement.

Conclusion

The project to reforest Sugar Bay is important for many reasons. The restoration of the mangrove forest will provide a significant and unique habitat for thousands of organisms, provide protection from storm events, help to reduce NPS pollution and will educate many people about the importance of mangroves in our island ecosystem. Project planting volunteers have included individuals from many different organisations as well as students from several local high schools. This project has already benefited these students by teaching them about the life cycle of the mangrove and its important role in our ecosystem. This project will continue to provide hands-on learning for students from nearly every elementary and middle school on St. Croix, who will learn about mangroves through field trips and presentations.



This diagram shows the two-part Riley Encased Methodology©, used in the current project. Reprinted with permission from Robert W. Riley, Jr. of the Mangrove Replenishment Initiative.

An additional component of the project will be the enhancement of the mangrove exhibit at the St. Croix Aquarium. The existing exhibit will be enlarged and a collection of photos depicting the reforestation procedure will be displayed. As a result of the pilot project in 1997 an educational module about mangroves was created for inclusion in SEA's 'My Environment' program.

Planting volunteer, and UVI Science Professor, Dr. Stuart Ketcham demonstrates how to set the cardboard encasement to students from the St. Croix Educational Complex Science Club. Photo courtesy of Emy Thomas, SEA.

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For more information on this project please contact Paige Rothenberger of VIMAS at (340) 779-3141, or by e-mail prothen@uni.edu. For more information on the Riley Encased Methodology©, please see the Mangrove Replenishment Initiative web site (www.mangrove.org).