Mini Review

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Mangroves as a tool against climate change: a focus on how mangroves can be used in design to facilitate the impending changing climates

Abstract

Background: Mangroves can be beneficial natural barriers to be used in design to mitigate climate change issues such as sea level rise, tropical storms and chronic flooding. Utilizing ways for mangroves to grow with the sea level can be useful to protect the coast from erosion, as well as to protect from greater inundation. This research was done in conjunction with a graduate architectural design studio at the Syracuse University School of Architecture focused on changes in the built environment due to climate change. The studio was focused on St. Petersburg, FL which has significant concern for climate change issues and have made regulations to protect their mangrove population around the peninsula.

Keywords: mangrove, sea level rise, coastal regions, environmental design

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Introduction

Mangroves are natural infrastructures used in tropical countries to protect the coastal region, but the mangrove population has been declining due to "aquaculture, tourism, industrial/urban development, or overexploitation of mangrove timber".[1] The importance of mangroves exists in their ability to attenuate inundation and tropical storms, and their potential to develop with sea level rise as long as the topography does not rise too greatly, and the area isn't overly developed.[2] Tropical places in Asia became an important place to research mangroves as 42% of the world's mangroves occur in tropical Asia as well as the area being species rich in mangroves.[3] A study done by Blankespoor, Dasguta and Lange researched the importance of site selection when using mangroves for coastal protection and observed that while a large amount of countries only had surge inundation reduced by less than 15%, some countries had a larger amount of reduction with examples of China, with 84% reduction, Vietnam with 54% reduction and Pakistan with 58% reduction.[4] It is important to consider the environmental factors of every location before determining if it is a good option for the site in question with the climate issues it is facing or will face. A popular mangrove in St. Petersburg as well as tropical Asia and the Western coast of Africa, the *Rhizophora mangle* (Red Mangrove) became the main focus of the research as it tends to grow along the coastline with strong, buttress-like roots, called stilt roots, that penetrate the ground supporting the plant while protecting the shore.[5] The proliferation of *R. mangle* happens as the parent tree disperses seedlings into the tidal current.[6]

Design implications

Designers of the built environment have begun to experiment with the potentials of mangroves to protect coastal regions.[7] As part of the design studio at the Syracuse University School of Architecture, students gathered information and a design was developed by Ashley Nowicki and Yiwen Dai to create a de-constructible walkway that allows for the growth of the mangroves until the proliferation of the mangroves overtakes the area and is completely re-introduced into the area. The conceptual design experiments with the idea of planting mangroves through reusable and removable planters filled with the needed nutrients for the mangroves, while giving people the ability to experience mangrove forests as well as care for the mangroves when they are younger (Figure 1). As the mangroves grow, the walkway is deconstructed, allowing for the mangroves to once again take over their natural habitat (Figures 2), (Figure 3). Conceptual designs like this one allow conversations about the importance of certain aspects of mangroves when integrating them into environmental designs, especially when focusing on climate change, protecting the coastal shoreline as well as marine life safety. Mangroves that are proven to be more resilient to climate change are known to either be in deep sediments or along areas with access to large amounts of sediments, are in remote areas, the ability to migrate inland (without infrastructure blocking their entry) or are within dense mangrove forests.[8] When focusing on wave energy attenuating, the mangroves' potential depends on many characteristics. Some of these characteristics focus on the tree as an individual, as it discusses the tree diameter and the proportion of biomass above ground versus in the roots, while other characteristics focus on the width and slope of the forest, the density of the forest, the forest location and the soil texture.[9] When planning to use mangroves for environmental design, it is important to understand the location being used, as well as the potential circumstances that may affect the area of mangroves, such as tropical storms or tsunamis, although a couple characteristics that seem important in this research is the density of the forest as well as the sedimentation available in the area.

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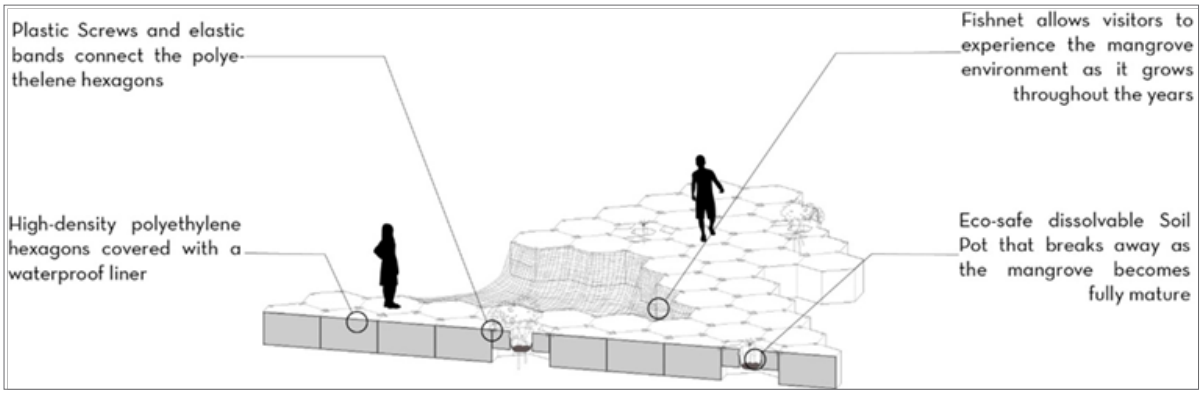

Figure 1 Walkway in the beginning of mangrove growth.

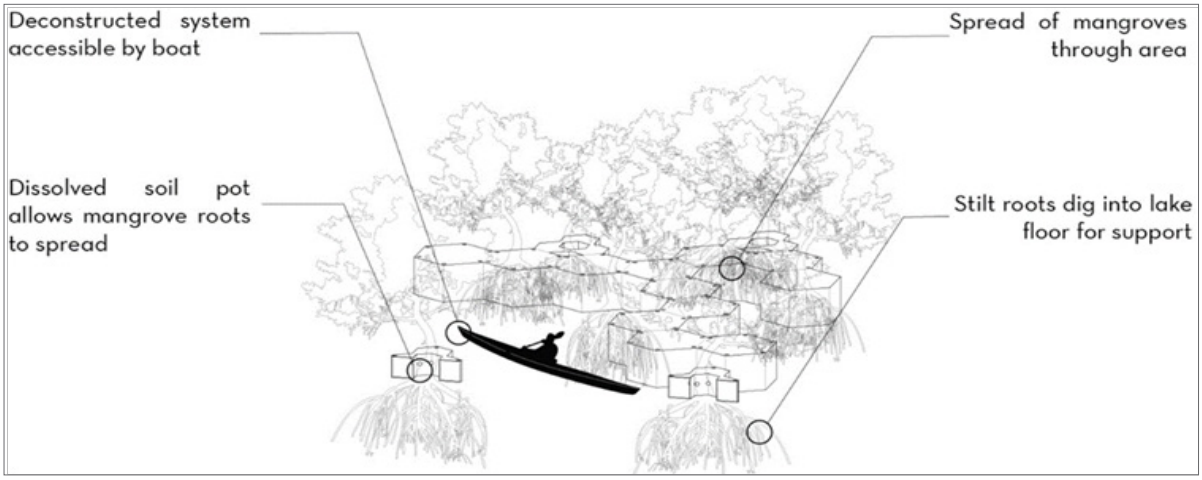

Figure 2 Walk way midway through deconstruction.

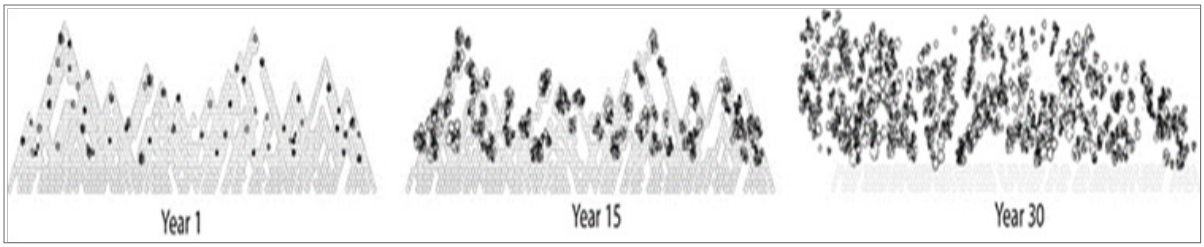

Figure 3 Walkway in the beginning of mangrove growth.

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Conflict of interests

Authors declare that there is no conflict of interest.

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