Oceanic Solutions – Coastal Sea-Level Mitigation

By John Benson

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1. Introduction

Sometimes you need to be ready to give something away to save it. The coasts of Earth's oceans are like that. Many of these, which are not preserved by governments, are prime development-land. But the only way we can preserve them is by moving these developments away from the coasts, give these back to Mother Nature, and let her grow forests and salt-water marshes on them. At the least this will greatly slow their erosion, and, if we otherwise slow down climate change, they may even be able to reclaim some land that was previously under water.

I wrote the following about six months ago in the post described and linked below.

Wet NET: "*Have a Plan B, and maybe even a Plan C. Because unexpected changes are most difficult to handle when we don't have a backup."*

— Germany Kent, American Print and Broadcast Journalist

Having looked at the subject of climate change quite a bit, there are many ways we can fix this problem, IF we work on it diligently. However humans have a habit of doing really dumb things, like not fixing a big problem we created, one that has already screwed up our climate big time, and is likely to create even worse problems in the future.

And thus my argument for all of the Plan Bs and Plan Cs we can find.

Most of my readers know that NET stands for Negative Emissions Technology. The title NET are carbon dioxide negative emissions technologies that involve the oceans.

https://energycentral.com/c/rm/wet-net

At the time I wrote the above post, I missed a major chapter. This post will supply this. The subject is mangrove forests.

2. Mangrove Forests

Often dismissed as mosquito-ridden, unproductive swamps, mangroves are in fact biodiverse ecosystems whose protection delivers more carbon sequestration bang per buck than almost any other intervention. Although they occupy only 0.5% of the earth's shorelines, they account for up to 15% of coastal carbon-storage capacity, holding the equivalent of more than 21 gigatons of $C0_2$, roughly as much as China currently emits over two years. The salt-tolerant trees are adept at filtering pollutants from seawater, and their extensive root systems are important nurseries for fish, home to a wide variety of crustaceans, and the feeding grounds for migrating birds, crocodiles, and even big cats – mangrove aficionados claim that Rudyard Kipling's fictional The Jungle Book, with panther Bagheera and tiger Shere Khan, must have been set in the Bay of Bengal's Sundar bans, the largest contiguous mangrove forest in the world.[1]

[1] Aryn Baker Karachi, Time, July 4/11, 2022 Issue (hardopy), page72, "The Mangrove Moment," To order a copy of a Time issue, call 800-843-8463.

Those roots also trap sediment, preventing erosion and protecting coastal communities, especially during storms. When a massive tsunami swept through the Indian Ocean in 2004, killing at least 225,000 and leveling towns from India to Indonesia, areas still fronted by mangrove forests were largely spared. As sea levels rise because of global warming, mangroves will play an even more important role in protecting coastal cities like Karachi from flooding. The United Nations environment program estimates that between fisheries, tourism, and coastal protection, mangroves provide ecosystem services to humanity worth $462 billion to $798 billion per year.

The problem is that mangroves grow in tropical regions where river deltas meet the sea-often the type of oceanfront property prized by developers, the agriculture industry, and shrimp farmers. As a result, more than a third of the world's mangroves have been chopped down for firewood and construction materials, cleared to make space for development or aquaculture, or poisoned by pollution resulting from nearby industrial growth.

But these days, mangroves are having a bit of a moment. Their astonishing carbon-sequestration capabilities–acre for acre, they store up to four times as much as terrestrial forests do–has spurred interest from carbon-capture investors. When British marine scientist Steve Crooks started developing mangrove restoration projects a decade ago, he struggled to find funding. Now he regularly gets calls from investors seeking to put $100 million into carbon-capture projects-with some such proposals edging into the billion-dollar range. So called blue-carbon projects that tap the sequestration potential of the world's oceanic and coastal ecosystems are in high demand, says Crooks. The fact that mangroves provide other climate-related benefits makes them even more attractive. Private investors as well as major global corporations such as Microsoft and Amazon, he says, "…are all realizing that they need carbon credits, but they don't just want any carbon credits. They want carbon credits that are socially and environmentally impactful!" Mangroves are the perfect one-two punch investment, says Crooks: sequestering carbon while protecting communities, and providing food and livelihoods. "It comes with a bright shiny halo!"

As a result, mangrove restoration is on the rise. Over the past 20 years, mangroves have gone from being one of the fastest diminishing habitats on earth to being one of the best protected, with 42% of all remaining mangrove areas under some kind protective status, according to the Global Mangrove Alliance. The rate of mangrove loss, once more than 3% a decade, is now down to less than 1%-and in some places, like Bangladesh and Pakistan, coverage is actually increasing. While restoring mangroves to their full 1980 extent-when global measurements were first taken-is difficult because of the irreversible growth of cities like Karachi, returning coverage to 1996 levels is "probably likely" says Catherine E. Lovelock, a professor of biological sciences at the University of Queensland, Australia, and one of the world's foremost experts on mangrove restoration…

3. Mangrove Forests in the U.S.

Mangrove forests occupy a unique ecological niche in inter-tidal zones of the world's tropics and subtropics, and their extent and health have important implications for both science and policy. In the contiguous United States, these warm temperature- and saltwater- loving trees only grow in three states: Texas, Louisiana, and Florida. However, these forests are highly dynamic, and their extent can shift, expand, and contract over time if they are impacted by forces such as climate change, sea-level rise,

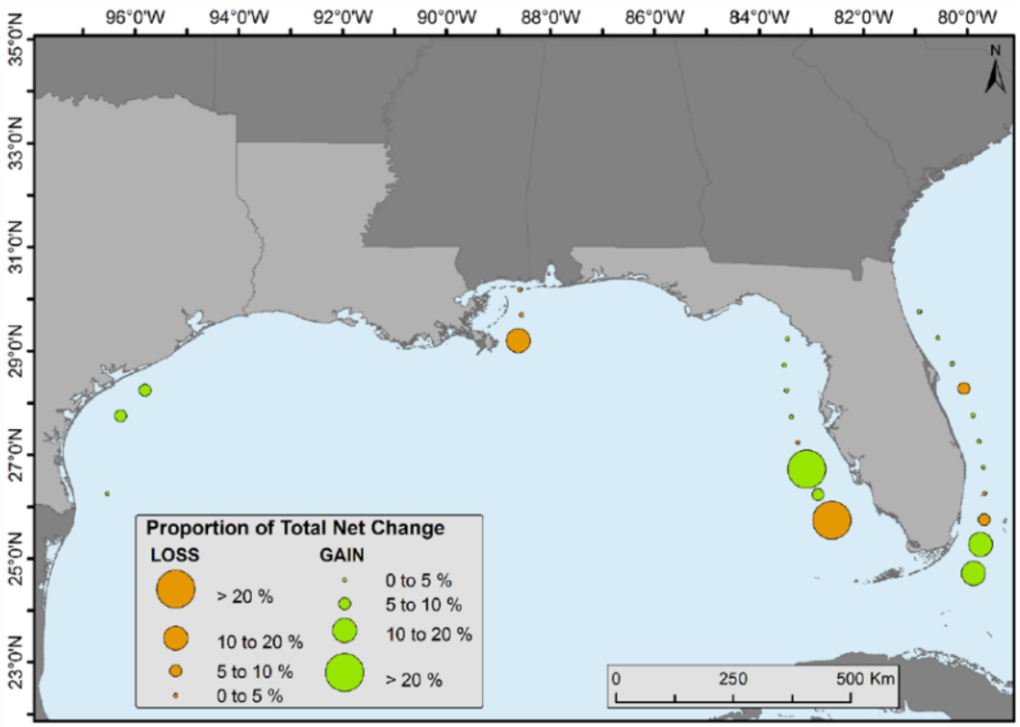
more/less sedimentation, fire, and human construction. Knowing exactly how mangrove forests grow and migrate in the face of climate change will allow scientists to predict whether this unique species can withstand and recover from future sea-level rise and more extreme storms.[2]

Mangroves like these grow along inter-tidal zones in Texas, Louisiana, and Florida. This picture was taken in Florida's beautiful Everglades.

Many scientists believe that mangroves in the U.S. are presently moving both inland as they retreat away from rising sea levels as well as northward into areas where climate change has lessened the frequency and severity of cold weather snaps. But, historical data doesn't reach back more than a few decades so it's almost impossible to know if these trends are long-term constants or if they are just artifacts of short-term local events. Scientists from the EPA (Environmental Protection Agency) and USGS (United States Geological Survey) took on the challenge to weigh in on this question: Is the geographic range of mangrove forests in the conterminous United States really expanding? Their answer: Yes, but not as much as originally thought and more so due to local than universal events.

These scientists analyzed ~35 years' worth of satellite imagery, aerial photography, and field data to track mangrove forests in the U.S. over the past several decades. They found that from 1980 to 2015 the total area colonized by mangroves increased by 4.3%, but none of the forests had systematically expanded northward. Instead, the increase in extent was caused by mangroves migrating inland.

[2] Robin McLachlan, Tracking Mangroves in the United States: Where? Why? and What's Next?" May 10, 2017, https://robinmclachlan.com/2017/05/10/tracking-mangroves-in-the-united-states-where-why-and-whats-next/



Map of the change in proportion of total mangrove forest cover from 1980 to 2015. Image from Giri and Long (2016). Creative Commons Attribution License (CC BY).

Factors responsible for forcing mangroves inland were complex and site specific. For example, in eastern Florida, mangroves are migrating landward for two reasons: 1) milder winters and 2) land management by humans. In the 1940-1960s, humans built mosquito impoundments that cut off circulation of saltwater to mangroves and killed 76% of the forests. New techniques implemented in the 1980s have allowed tidal saltwater to recirculate through the forests allowing them to rebound back. Also, dredge spoils (marine sediment brought up from estuarine beds and dumped onto land) have historically blanketed potential mangrove habitat. In the most extensively human-influenced areas, man-made ditches and dredge spoils overtook up to 80% of natural mangrove habitat. Rehabilitation of these areas began in 1999.

Inland migration of mangrove forests has intriguing implications for coastal management and the well-being of coastal communities. Extensive coastal areas around the Gulf of Mexico are losing ground as the land subsides beneath rising sea levels. The expansion of mangroves may help combat the loss of land because they trap more sediment than the salt marshes they replace, thus building up the land level and preserving coastal area and habitat…

"A lot of Pacific Rim countries are working hard to conserve and restore their mangrove forests, but rising sea levels—a consequence of the changing global climate—remain a problem," said Richard MacKenzie, a USDA Forest Service aquatic ecologist who works at the agency's Institute of Pacific Islands Forestry in Hawaii.[3]

[3] Diane Banegas and Rich MacKenzie, USDA, Forest Service, "Science is Saving the Mangrove Forests," Nov 20, 2022, https://www.fs.usda.gov/features/science-saving-mangrove-forests

They are eager to save their mangroves not only for the benefits they have long provided, but also because their tremendous capacity for storing carbon offsets greenhouse gas emissions from human activity.

MacKenzie and other U.S. scientists began working with Micronesia 15 years ago to help the countries better manage their forests…

To assist in restoring and preserving of their mangrove forests, MacKenzie and his research partners have collected data from research sites in the region. So far, the research is showing a couple of interesting findings.

They found that less than half of the sampled mangrove forests appear to be keeping up with the changes in sea levels. Those that are adapting are doing so mostly using unique aboveground root structures, trapping sediment from adjacent creeks or rivers or through tidal ocean flooding. The addition of this sediment, along with below-ground root growth, essentially raises the forest floor above sea level.

Those forests that are not adapting don't have access to the same sedimentation or are experiencing erosion and are slowly drowning.

There are about 70 species of true mangroves in the world, and all of them are unique in their ability to tolerate saltwater flooding. However, if existing forests can't raise their forest floors, the water-logged trees begin to die away, and new mangrove species move in. This permanently changes the forest composition and the ecological and commercial benefits mature mangrove forests provide to the region may be lost forever.

The good news is the team's research also revealed is that mangrove forests are more resilient than scientists originally believed…