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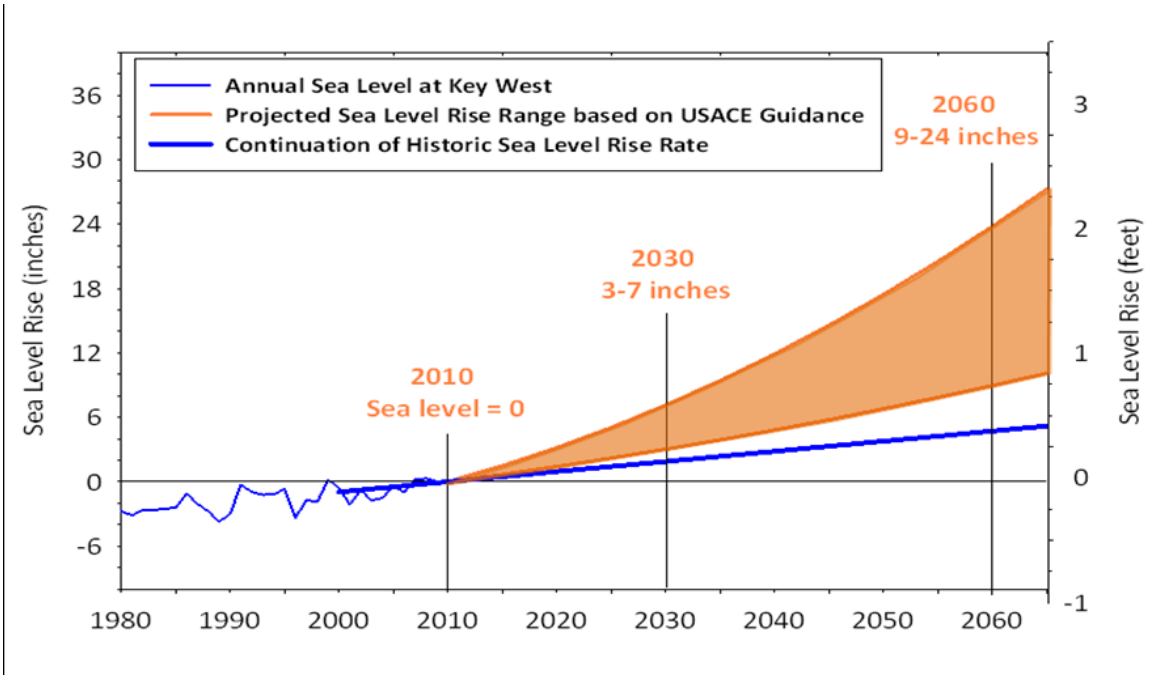
Impacts of Sea Level Rise on Ecosystem Services in Florida

Introduction:

Climate change is widely accepted by the scientific community. Currently the sea level is raising an average of 2.3 millimeters per year along coastal areas in Florida (1). It is projected that between the years 2050 and 2100 that Florida will see significant impacts from sea level rise. Most of the coastal areas of the State sit at sea level or just slightly above sea level. Florida has limited land left for future development along coastal areas and many areas of the state are starting see the effects of sea level rise (SLR).



Graph illustrating how SLR is rising more rapidly.
Photo Credit: 1

With an estimated 1200 miles of shoreline, Florida encompasses several important coastal ecosystems such as mangrove swamps, seagrass meadows, salt marshes and other estuarine habitats (2). These unique habitats are a significant economic resource to the state in the form of habitat for commercially important species, and perhaps more importantly, provide opportunities for recreation and ecotourism. This article will target five ecosystem services that are impacted by SLR. An ecosystem service can be defined as any service that people can find benefit from through natural resources. The following ecosystem services will be discussed;

habitat, recreation, flood control, and water storage and treatment, and economic impact of ecosystem services.

Habitat

Coastal areas provide habitat for a multitude of both plants and animals. Gulf Oysters (Crassostrea virginica) and hard clams (Mercenaria mercenaria) for example are an essential part to Florida's habitat and provide significant financial benefit to the state. Both oysters and clams help decontaminate the water by removing sediments and algae coming out the river deltas and the runoff from land. Oysters and clams are also excellent sustainable food sources and provides Florida with one of its most profitable segments of aquaculture (4).

Farmer harvesting clams.
Photo Credit: 2

The oyster aquaculture industry made over 8.5 million dollars in 2012 and the clamming industry made approximately 53 million dollars in 2007 with that number expected to rise. The clamming industry is becoming an increasingly popular sector of aquaculture (4,6). SLR is expected to affect both clams and oysters because they cannot grow in deep water. These organisms also require brackish water from the estuaries to survive and SLR is expected to increase salinity to unlivable levels. SLR will make it difficult for farmers to maintain crops and plots for viable areas to harvest both clams and oysters. This is just one example on how SLR can effect on habitat.

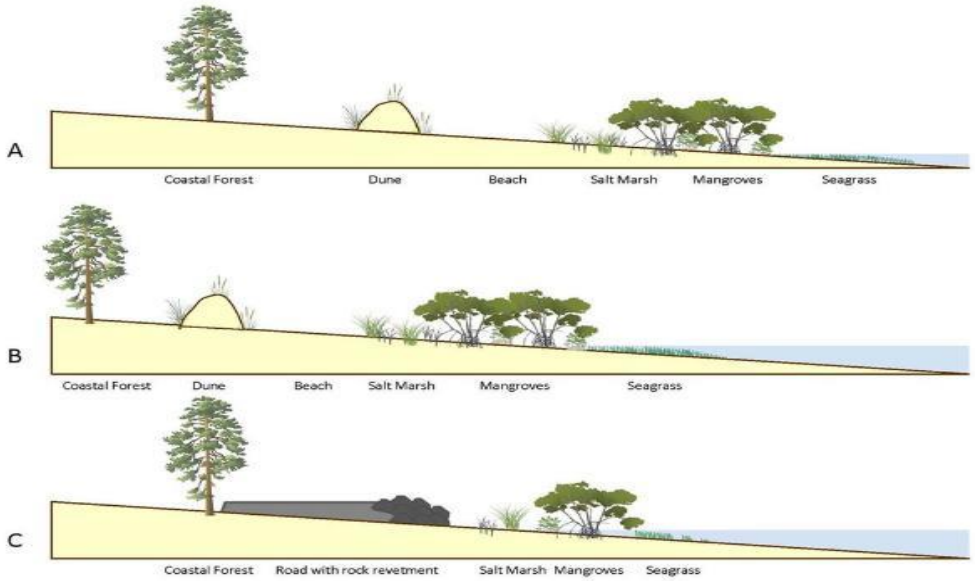
Recreation

Florida provides many natural recreational activities such as fishing, boating, biodiversity, relaxation, and kayaking amongst many others. SLR will eventually alter the coastal ecosystems(2,3). Plants and animals such as mangroves, sea grass, oysters, and clams in these ecosystems help keep the water clean, clear, and reduces harmful contaminants. Over time, beaches could erode completely leading to

saltwater marshes and mangrove forests retreating further into uplands. It is also expected that fresh water marshes will slowly turn into saltwater environments. As the sea level gradually rises many plants and animal species will either become nonexistent or evolve to adapt with the rising waters and food webs will change therefore creating big impacts on Florida's recreational activities.

Flood control

Barrier islands are an essential asset to the state because they not only house the beaches they also provide natural flood control to the coastline. Whenever hurricanes or major storms come inland they are the first line of defense. Sometimes these events are so significant it can create new inlets allowing more coastline susceptible to storm surge (3). When theses strong weather events occur it causes erosion to the beach.



Picture illustrating the coastal squeeze
Photo Credit: 3

While the front side of the island slowly gets eroded away every year, the back side of the island or the side that is closest to the coast generally rolls or grows back towards the coastline. This phenomena is called the "coastal squeeze" which eventually backs the island all the way up the coast or it erodes away in shallow waters (5). Once the barrier islands have completely been eroded it leaves other coastal habitats on the mainland venerable for flooding. For areas of the coastal areas that do not have barrier islands for buffered protection, SLR is expected to cause catastrophic storm surges due to hurricanes.

Water storage and treatment

The most important ecosystem service of the state is fresh water. Florida's primary source of fresh water is housed in the Florida aquifer and in fresh water wells. SLR

has a very real potential to impact Florida's fresh drinking water supplies. Currently Southeast Florida is the most populated area of the state which houses 5.7 million residents. Southeast Florida is already seeing noticeable consequences of salt water intrusion into shallow wells and the Biscayne Bay Aquifer due to SLR (7).

Picture on the left shows Miami Beach at low tide and picture on the right shows Miami Beach at peak lunar high tide. Photo Credit: 4

Florida's foundation is primarily limestone. Limestone is a porous rock that is very sturdy however it has many small holes in it and is formed by ancient skeletal remains of oceanic invertebrates thousands of years ago. The structure is somewhat similar to an inside of a human bone. When the sea level rises it allows for more saltwater to intrude into the aquifer. This also increase the storm surge as mentioned above and salt water can then seep in fresh water wells (7). Though Southeast Florida is most impacted at the moment, other coastal areas of Florida have also begun to see impact of salt water intrusion.

Economic impact

The majority of the people and business live along this coastline and it is estimated that 75% of the state's population resides in coastal counties (2). Most of these coastal areas sit at 6ft above sea level or less and It is estimated that approximately 1.4 million homes are located in areas that are at 6 feet or below of sea level. The real estate value alone on those homes are approximately worth $544 billion dollars. Due to Florida's many natural amenities; tourism is the leading economic income for the state, and brings in hundreds of billions of dollars. It is estimated that by 2030 the state of Florida will be worth an estimated 3 trillion dollars and it is vital for the State to look into how to distribute residential areas and zoning as well as infrastructure such as roads and government facilities, schools, and hospitals (2).

Conclusion

Sea level rise is expected to have dire consequences on these five ecosystem services in the next 50-100 years. While some aspects of sea level rise are inevitable, many things are being done and can be done to help prevent and minimize its impact. People can help support and maintain the coastline by planting mangroves,

marsh grasses, and sea grasses to keep the sediment and land in place. Beach nourishment and restoration programs funded by the government and other agencies will help maintain beaches. Both manmade and natural structures such as sea walls, jetties, and oyster beds can be put in place to help prevent erosion. Finally, slowly but surely Florida's legislatures are starting to form plans to maintain infrastructure in the event of sea level rise. These ecosystem services are important assets to the state that must be maintained in order to sustain Florida's livability and economy for future generations.

References:

1. Pinellas County-Awareness and Implications of Sea Level Rises. Tampa Bay Regional Planning Council (TBRPC). Available at: http://www.pinellascounty.org/plan/comp_plan/05coastal/ch-6.pdf (verified: 11/15/2014)
2. Strauss, B., C. Tebaldi, S. Kulp, S. Cutter, C. Emrich, D. Rizza, and D. Yawitz (2014). "Florida and the Surging Sea: A Vulnerability Assessment With Projections for Sea Level Rise and Coastal Flood Risk." Climate Central Research Report. pp 1-58.
3. Florida Oceans and Coastal Council. 2010. Climate Change and Sea-Level Rise in Florida: An Update of "The Effects of Climate Change on Florida's Ocean and Coastal Resources." [2009 Report] Tallahassee, Florida. vi + 26 p. www.floridaoceanscouncil.org.
4. Florida Shellfish Aquaculture Online Resource Guide. (n.d.). Retrieved November 27, 2014, from http://shellfish.ifas.ufl.edu/
5. The Potential of Sea-level Rise on Florida's Coastal Ecosystems1. (n.d.). Retrieved November 27, 2014, from http://edis.ifas.ufl.edu/sg131
6. Florida Seafood and Aquaculture Overview and Statistics. (n.d.). Retrieved November 27, 2014, from http://www.freshfromflorida.com/Divisions-Offices/Marketing-and-Development/Education/For-Researchers/Florida-Seafood-and-Aquaculture-Overview-and-Statistics
7. Berry, L. (n.d.). Impacts of Sea Level Rise on Florida's Domestic Energy and Water Infrastructure. 1-15. Retrieved from http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=e0f5e6f1-34f1-4bd9-8243-8b3c77e1d27d

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1., 4. Berry, L. (n.d.). Impacts of Sea Level Rise on Florida's Domestic Energy and Water Infrastructure. 1-15. Retrieved from http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=e0f5e6f1-34f1-4bd9-8243-8b3c77e1d27d
2. Florida Shellfish Aquaculture Online Resource Guide. (n.d.). Retrieved November 27, 2014, from http://shellfish.ifas.ufl.edu/
3. The Potential of Sea-level Rise on Florida's Coastal Ecosystems1. (n.d.). Retrieved November 27, 2014, from http://edis.ifas.ufl.edu/sg131