Mangrove Ecosystems Fact Sheet

Poster · February 2016

CITATIONS
0

READS
1,794

1 author:

Kimberlee Baldry
University of Tasmania
11 PUBLICATIONS **3** CITATIONS

SEE PROFILE

KAUST
FACT SHEET

Mangrove Ecosystems

Everything you need to know about "sea trees"

Kimberlee Baldry
Red Sea Research Center, King Abdullah University of Science and Technology

What are they?

A mangrove is a small tree that grows in intertidal zones on coastal areas. The trees have complex root systems that extend out of the water to allow the aeration of submerged roots. The roots provide shelter for many small fish and invertebrates, further acting as a nursery for young reef fish, sea turtles, rays, and sharks. Mangroves also provide habitat to regional terrestrial animals such as birds, snails, frogs, and insects. Sesarmid crabs play an important role in mangrove ecosystems, recycling the litter from the mangroves. Collectively, all of these things, and their environment make up a mangrove ecosystem (Fig. 1a). Other members of the mangrove ecosystem not represented below are micro-algae and macro-algae.

Figure 1a: A schematic of the mangrove ecosystem. Animals represent broad taxonomic groups and not species. Mangrove ecosystems are highly diverse and vary with location.

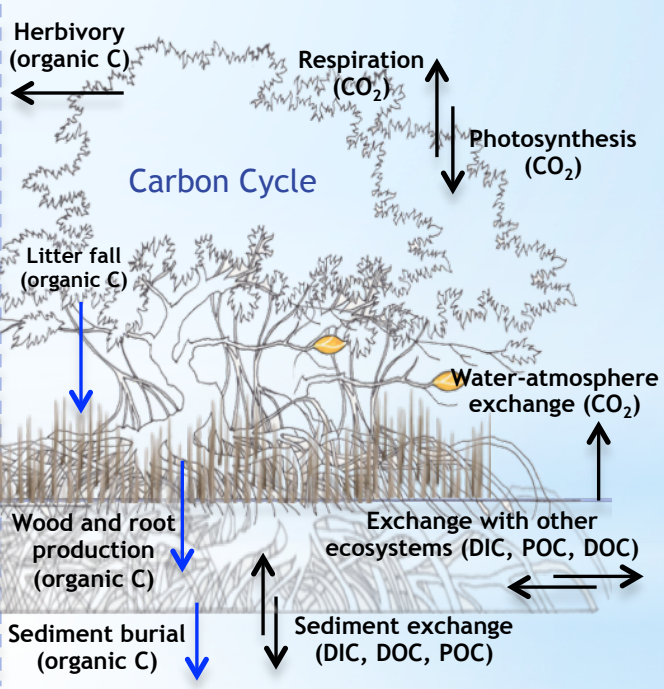

Figure 1b: The organic and inorganic carbon cycle in mangrove ecosystems. Blue arrows indicate flow of Blue Carbon. Organic C = organic carbon, DOC = dissolved organic carbon, DIC = dissolved inorganic carbon, POC = particulate organic carbon

Where are mangrove ecosystems found?

Mangroves are mostly found in the tropical and subtropical latitudes, but can extend into temperate latitudes. They grow in muddy, soft sediment in areas that are protected by extreme wave action (e.g. lagoons, estuaries).

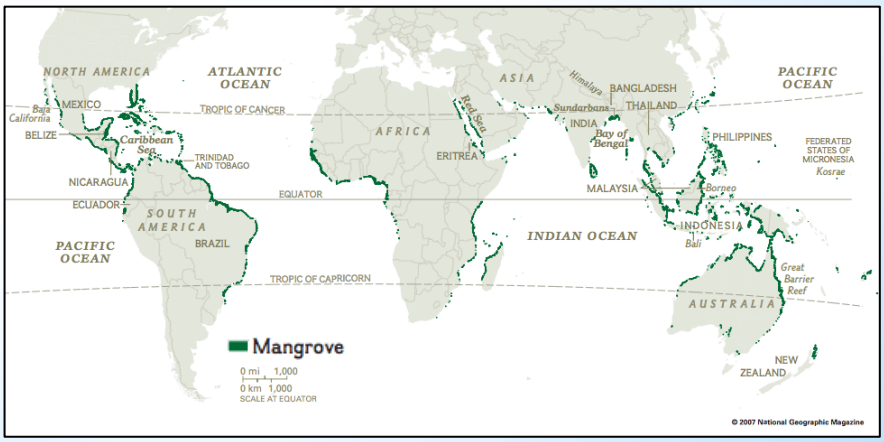

Figure 2: The global distribution of mangroves, obtained using GIS. (Taken from Giri *et al.* (2011))

KAUST
FACT SHEET

Mangrove Ecosystems

Everything you need to know about "sea trees"

Kimberlee Baldry
Red Sea Research Center, King Abdullah University of Science and Technology

Mangrove ecosystems and climate change

Climate change is the term given to the human induced change in the environment. The two main climate change effects due to the release of carbon dioxide gas into the atmosphere are Global Warming and Ocean Acidification. About 25% of the carbon dioxide released is dissolved into the ocean, changing the carbonate chemistry of the ocean and increasing its acidity.

Blue Carbon

Mangroves absorb carbon dioxide through photosynthesis and transform it to organic carbon, providing another fate for human released carbon dioxide that does not alter the acidity of the ocean. This organic carbon is termed "blue carbon" and can be stored in the ecosystem in roots, the trunk, as litter, in shallow sediment, deep sediment, or transported to the open ocean to support separate ecosystems. It is estimated that mangrove coverage is declining at a rate of 35%. The deforestation of mangroves allows soils to release the carbon dioxide that was once stored in the sediments. Restorative projects have been shown to be successful, and the new planted communities function just as well as natural communities. So by preventing the destruction of mangrove ecosystems and by planting new mangrove forests, humans can reduce the impact of climate change.

Coastal Engineering Solutions

Due to Global Warming, the oceans are expanding and sea ice is melting, causing sea level rise. This sea level rise is a threat to low lying coastal communities. Rising sea levels are predicted to cause increases in wave height and other wave properties which can increase flooding events and coastal erosion. Additionally, climate change increases storm frequency in some areas, acting as another mechanism to increase coastal erosion. Mangroves extensive root system and structure, are able to reduce coastal erosion by dissipating wave energy and adding structure to otherwise soft sediments (Fig. 3). This can act as a mechanism that protects coastal communities (or at least reduces impacts) from events such as those seen on the east coast of Australia.

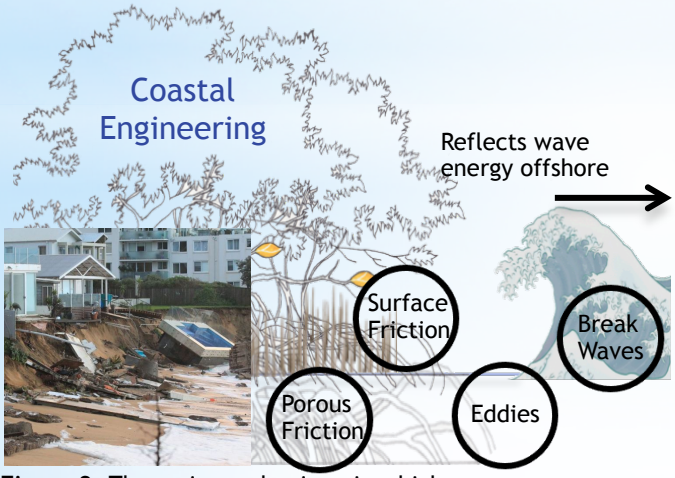

Figure 3: The main mechanisms in which mangroves can dissipate wave energy and aid to prevent coastal erosion (shown bottom left)

Comparison to terrestrial forests

In 2000 mangroves cover was 137,760 km^2, just 0.7% of the total area covered by terrestrial forests at that time. Although mangroves do not grow as tall as terrestrial forests, mangroves have the ability to store a considerably higher amount of carbon per unit of biomass (Fig. 4). This is attributed to their ability to store disproportionally large amounts of carbon deep in the sediments, and their ability to filter out carbon species from the water column. Consequently are considered to be as important as terrestrial forests.

Benefits for Society

In addition to being a sink of anthropogenic CO_2 which is beneficial to the global society, mangrove ecosystems can provide the following benefits at a local scale:

- Coastline protection
- Support fishery stocks by providing a nursery to reef fish
- Increase resilience of nearby coral reef ecosystems, which can benefit tourism
- Provide habitat for 80% of seafood species
- Natural filter for pollutants and nutrients from terrestrial runoff, buffering against algal blooms which can be toxic

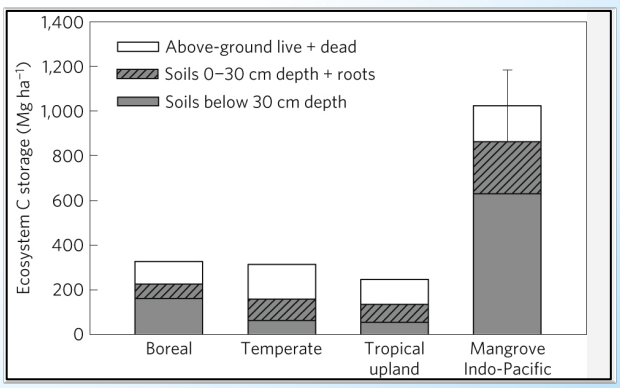

Figure 4: Comparison of carbon storage between mangroves and terrestrial forests (Taken from Donato *et al.* (2011))

Mangrove Ecosystems

Everything you need to know about "sea trees"

Kimberlee Baldry
Red Sea Research Center, King Abdullah University of Science and Technology

Resources

Mangrove Ecosystems

- Robertson, A.I. (1991). **Plant-animal interactions and the structure and function of mangrove forest ecosystems.** Austral Ecology, 16(4), pp.433-443. doi:10.1111/j.1442-9993.1991.tb01073.x
- Nagelkerken, I., *et al*. (2008). **The habitat function of mangroves for terrestrial and marine fauna: a review.** Aquatic Botany, 89(2), pp.155-185. doi:http://dx.doi.org/10.1016/j.aquabot.2007.12.007
- Lugo, A.E. and Snedaker, S.C., 1974. **The ecology of mangroves.** Annual review of ecology and systematics, 5(1), pp.39-64. doi:http://www.annualreviews.org/doi/pdf/10.1146/annurev.es.05.110174.000351
- Luther, D.A. and Greenberg, R. (2009). **Mangroves: A Global Perspective on the Evolution and Conservation of Their Terrestrial Vertebrates**. Bioscience,59 (7): 602-612. doi:10.1525/bio.2009.59.7.11

The Distribution of Mangroves

- Giri, C., *et al*. (2011). **Status and distribution of mangrove forests of the world using earth observation satellite data.** Global Ecology and Biogeography, 20(1), pp.154-159. doi:10.1111/j.1466-8238.2010.00584.x

The Carbon Cycle and Mangroves

- Bouillon, S., *et al*. (2008). **Mangrove production and carbon sinks: a revision of global budget estimates**. Global Biogeochemical Cycles, 22(2). doi:10.1029/2007GB003052
- Dittmar, T., *et al*. (2006). **Mangroves, a major source of dissolved organic carbon to the oceans**. Global biogeochemical cycles, 20(1). doi:10.1029/2005GB002570
- Alongi, D.M. (2012). **Carbon sequestration in mangrove forests**. Carbon Management, 3(3), pp.313-322. doi:http://dx.doi.org/10.4155/cmt.12.20
- Gattuso, J.P., *et al*. (1998). **Carbon and carbonate metabolism in coastal aquatic ecosystems.** Annual Review of Ecology and Systematics, 29(1), pp.405-434. doi:10.1146/annurev.ecolsys.29.1.405

Climate Change and Mangroves

- Alongi, D.M. (2008). **Mangrove forests: resilience, protection from tsunamis, and responses to global climate change**. Estuarine, Coastal and Shelf Science, 76(1), pp.1-13. doi:http://dx.doi.org/10.1016/j.ecss.2007.08.024
- Hickey, S.M., *et al*. (2017). **Is Climate Change Shifting the Poleward Limit of Mangroves?**. Estuaries and Coasts, pp.1-12. doi:10.1007/s12237-017-0211-8
- Duarte, C.M., *et al*. (2013). **The role of coastal plant communities for climate change mitigation and adaptation.** Nature Climate Change, 3(11), pp.961-968. doi:10.1038/nclimate1970

Mangroves vs. Terrestrial forests

- Donato, D.C., *et al*. (2011). **Mangroves among the most carbon-rich forests in the tropics.** Nature Geoscience, 4(5), pp.293-297. doi:10.1038/ngeo1123
- Valiela, I., *et al*. (2001). **Mangrove Forests: One of the World's Threatened Major Tropical Environments**. Bioscience, 51(10), pp.807-815. doi:http://dx.doi.org/10.1641/0006-3568(2001)051[0807:MFOOTW]2.0.CO;2