The Science of Blue Carbon

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Ecosystem services from coastal environments

Biodiversity is an important value of tropical wetlands
Ecosystem services - Fisheries

75% of all tropical commercial fish species spend part of their lives in the mangroves, where they encounter:

- nursery grounds
- shelter
- food
Coastal protection, education, ecotourism, science, and traditional and spiritual values are also important services provided by coastal ecosystems.

Estero Damas, Costa Rica
Carbon sequestration sinks include:

Seagrass meadows

Seagrass, Babeldoab Island, Palau
Mangroves (tall & dwarf): *Rhizophora* spp., *Pelliciera rhizophorae*, *Avicennia germinans*, *Laguncularia racemosa*

Estero Damas, Costa Rica
Salt marshes

Reserva Biosfera Sian Kaan, México
Coastal ecosystems have high carbon sequestration rates

Adapted from Laffoley & Grimsdich eds. 2009
Total ecosystem carbon stocks: Costa Rican upland forests vs. mangroves

Kauffman, Cifuentes, et al. In prep
Coastal habitats protect significant amounts of carbon

- **Seagrasses**
- **Tidal Salt Marsh**
- **Estuarine Mangroves**
- **Oceanic Mangroves**

Soil-Carbon for first meter of depth only (Total depth = several meters)

**Stocks of carbon (Mg/ha)**

- Mean soil organic carbon
- Mean living biomass

Sources: IUCN, Duke Nicholas Institute
These ecosystems are being lost rapidly

- Upstream disruptions
- Aquaculture
- Rice/Agriculture
- Road development/hydrological disruptions
- Pollution
Data from rainforest and methods to predict emissions from fires are from Guild et al. (2004) *Ecol Apps* 14:232-246.
Mangrove emissions are based on the assumptions of 1 the oxidation of top 30 cm of soils C.
Global carbon emissions

• Global emissions from conversion:
  • Mangroves: 0.02 – 0.12 PgC yr\(^{-1}\)
  • Seagrass: 0.06 – 0.3 PgC yr\(^{-1}\)
  • Salt marshes: unknown

• Or as much as:
  • 10 - 23% of emissions from deforestation
  • 40% of peat swamp emissions

1 terragram (Tg)= 10\(^6\) Mg or 10\(^{12}\) g (1 million Mg)
1 gigaton (GT) = 10\(^{15}\)g = 1 petagram (Pg) (1 billion Mg)

Pan et al. 2011
Donato et al. 2011
Fourqurean et al. In prep.
Costa Rica: demonstration site

- REDD+ FCPF country
- Technical and human capacity
- Payment for ecosystem services system
- Strong institutionality
- Political support and legal frameworks

Térraba-Sierpe, Costa Rica
Summary

• Coastal ecosystems as important providers of multiple environmental services

• They can play an important role in climate change mitigation efforts
  – Large carbon stocks & high rates of accumulation
  – Threats to their persistence

• Costa Rica as a blue carbon demonstration site
¡Gracias!

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Sunset at Térraba-Sierpe
National Wetland
Costa Rica