Blue Carbon in Mexico: A Synthesis

Jorge A. Herrera-Silveira
Coastal Ecosystems Impacts

CLIMATE CHANGE

- Storms
- Waves
- Sea level
- Temperature
- CO₂ concentration
- Run-off

External Marine Influences

External Terrestrial Influences

Natural Sub-system

Societal Sub-system

Coastal System
**What Happens in Mexico?**

- CO₂ emissions represent 1.4% of total global emissions.
- Mexico is the 13th country with the largest emissions worldwide.
- Mexico committed to reduce its emissions by 22% for 2030 (Paris Agreement).

**MITIGATION**

28 países incluyen referencias a los humedales costeros en sus NDCs en términos de mitigación

**ADAPTATION**

59 países incluyen la conservación, restauración y/o uso sustentable de sus ecosistemas costeros en sus NDCs como estrategia de adaptación.
**HOW?**

-Prioritize higher cost-benefit actions that reduce emissions and generate collateral benefits in health, food security, risk reduction and the well-being of the population. INECC, 2015.

-Conservation, restoration and sustainable use of coastal ecosystems is a cost-effective strategy for mitigating and adapting to climate change, also providing important co-benefits to communities. CCA 2017.

**Blue Carbon as an alternative?**

Fourqurean et al., 2012.
Blue Carbon Baseline in Mexico

Synthesis based on pilot sites analysis and documentary diagnosis on Blue Carbon in Mexico

Responsables: Jorge A. Herrera-Silveira, Andrea Camacho Rico, Israel Medina Gómez, Sara M. Morales, Monica Pech, Eunice Pech.
Along the Mexico coast there are environmental gradients and diversity of characteristics that favor different scenarios for development of different mangroves types.
**MANGROVES**

\[ AG = 113.6 \pm 5.5 (95\% \text{ CI } [99.3 - 118.4]) \text{ Mg C}_{\text{org}} \text{ ha}^{-1} \]

\[ BG = 385.1 \pm 22 (95\% \text{ CI } [344.5 - 431.9]) \text{ Mg C}_{\text{org}} \text{ ha}^{-1} \]

Variability according to mangrove ecological type
Mangroves mapping and carbon storage through remote sensing approach and field sampling at local level
Blue Carbon in Mexico compared to the rest of the world

Seagrasses: better and greater amount of data in Mediterranean and Australia

Mangrove: better and greater amount of data in Indopacific
Blue Carbon Science in Mexico: Most in Spanish (≈55–15 peer review)

Carbon Stocks of Tropical Coastal Wetlands within the Karstic Landscape of the Mexican Caribbean

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Coastal landforms and accumulation of mangrove peat increase carbon sequestration and storage

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Mangrove wetland productivity and carbon stocks in an arid zone of the Gulf of California (La Paz Bay, Mexico)

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4.15 Carbono en sedimentos de manglares de ambientes cársticos: la Península de Yucatán

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Methane and sulfate dynamics in sediments from mangrove-dominated tropical coastal lagoons, Yucatán, Mexico

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Seagrass blue carbon dynamics in the Gulf of Mexico: Stocks, losses from anthropogenic disturbance, and gains through seagrass restoration

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Selecting cost-effective areas for restoration of ecosystem services

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Unlike terrestrial forests, mangroves, although not have the most extent, are more important in C storage.

Production and burial "in situ" are the promoters of C stock in mangroves. Why?

(Ezcurra et al 2016)
- Mangroves conserved vs land use change to grazing

- The prediction: emissions would greater in mangroves due to land use change.

(Kauffman et al 2016)
Relation with local and regional gradients

Salinity local gradient is C stock controller
(Adame et al 2016)

Climate-Salinity regional gradient is C stock controller
(Bejarano et al 2016)
Seagrasses

![Diagram of seagrass ecosystem]

- Allochonous inputs of dissolved and particulate organic C
- C export via grazers/herbivores
- C export via physical forces
- Microbial/detrital C breakdown
- Accumulation of refractory C

**Seagrass photosynthesis/respiration**

- C bound in plant material
- Carbonates (e.g., shells)
- Plant C exudates
- Accretion
Distribución y cobertura

LANDSCAPE SCALE
Depth and Hydrodynamic

Gulf of Mexico

- Sand only
- Sand with macroalgae
- Sand with seagrasses low density
- Macroalgae and seagrasses low density
- Macroalgae and seagrasses high density
- Seagrasses with macroalgae low biomass
- Seagrasses high density

Liceaga et al. 2014

SYMOLOGY

Coverage

- 0%
- 1% - 10%
- 11% - 20%
- 21% - 40%
- 41% - 60%
- 61% - 80%
- 81% - 100%
ECOSYSTEM SCALE
Environmental gradient (salinity)

Biomass gr. dw m²

Subterránea
Aérea

Low Salinity High

Organic Carbon from 125 to 1300 g C/m²

Shoot density

Arellano et al 2012
LOCAL SCALE:

Hydrodynamyc and salinity (2–350 g C/m²).
Final Remarks:

- YP is an important region to Blue Carbon projects


- Peten and dwarf mangroves have greater carbon stocks. Hydroperiod can be a controller.

- Seagrasses store more C in habitats with lower hydrodynamic condition.

- Conservation and restoration are the principal actions for mitigation and adaptation to climate change. Landscape scale monitoring.

- Develop experimental manipulation of hydroperiod and coastal currents to determine the trajectories of recovery in mangrove and seagrass, could help determine conditions of maximum potential of carbon capture and storage.

- Research is needed on more precise estimates of the stores and flows (vertical and lateral) in these ecosystems, and their relationship with resources (N, P), stressors (salinity, sulfur), hydroperiod, type of activity, among others.

Pendleton, et al., 2014; Fourquean et al., 2014; CCA 2016
“... investigation regarding the blue carbon sequestration and storages is inconclusive. More research is required to obtain more accurate estimates of the amount of carbon deposited in these ecosystems, how much is released into the atmosphere due to change in land use, and where in the planet (Mexico) the carbon losses/capture are recorded more accelerated.”

Pendleton, et al., 2014; Fourquarean et al., 2014; CCA 2016
THE GOOD...

THE BAD...

THE UGLY...