



# Blue Carbon: A transformational tool for marine management and conservation globally

Dr. Emily Pidgeon  
Conservation International

the  
**BLUE  
CARBON**  
initiative

CONSERVATION  
INTERNATIONAL



United Nations  
Educational, Scientific and  
Cultural Organization



Intergovernmental  
Oceanographic  
Commission

# Oceans play a vital role in controlling greenhouse gases

Deforestation



+

Fossil Fuels



Atmosphere  
46%

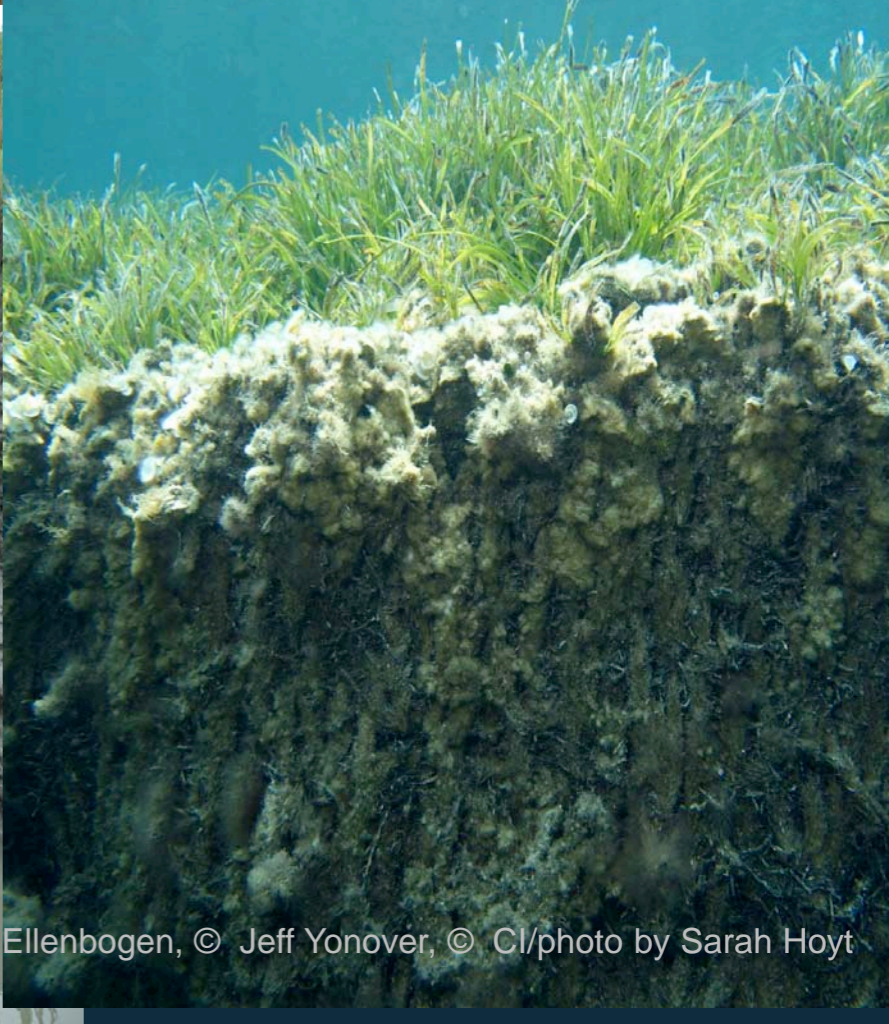
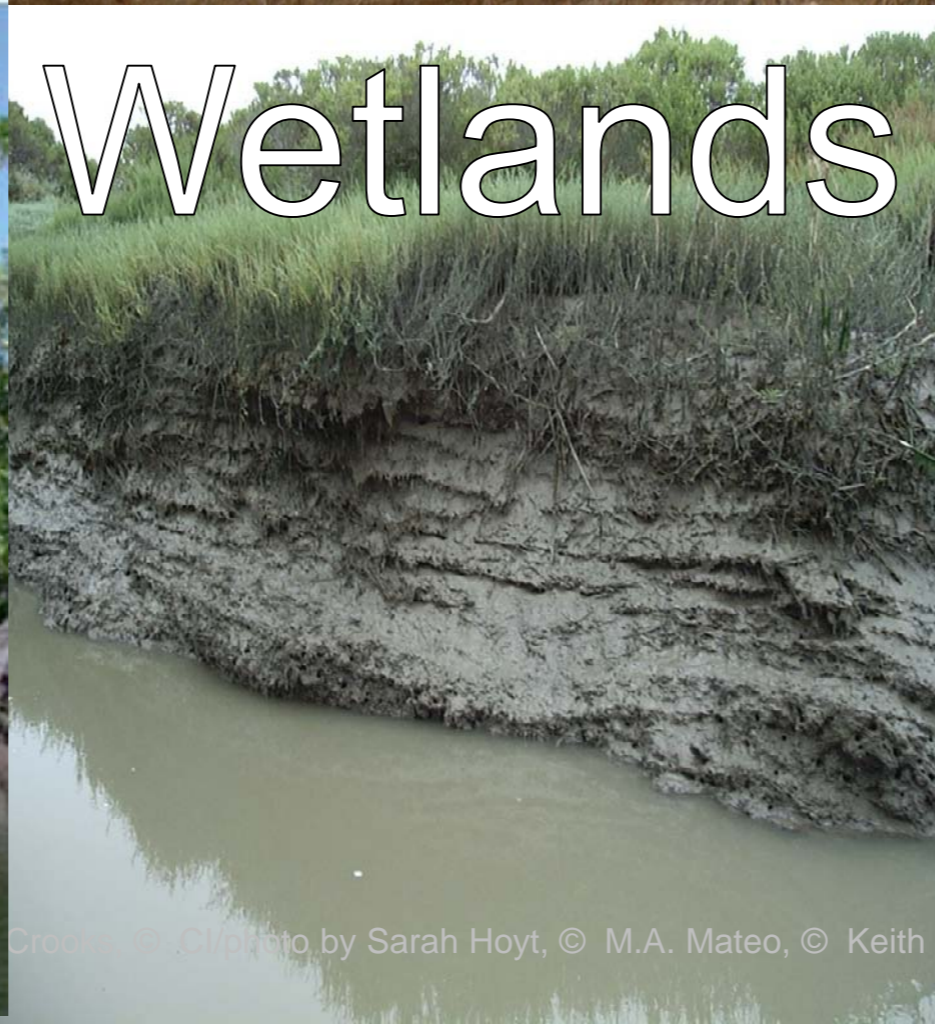
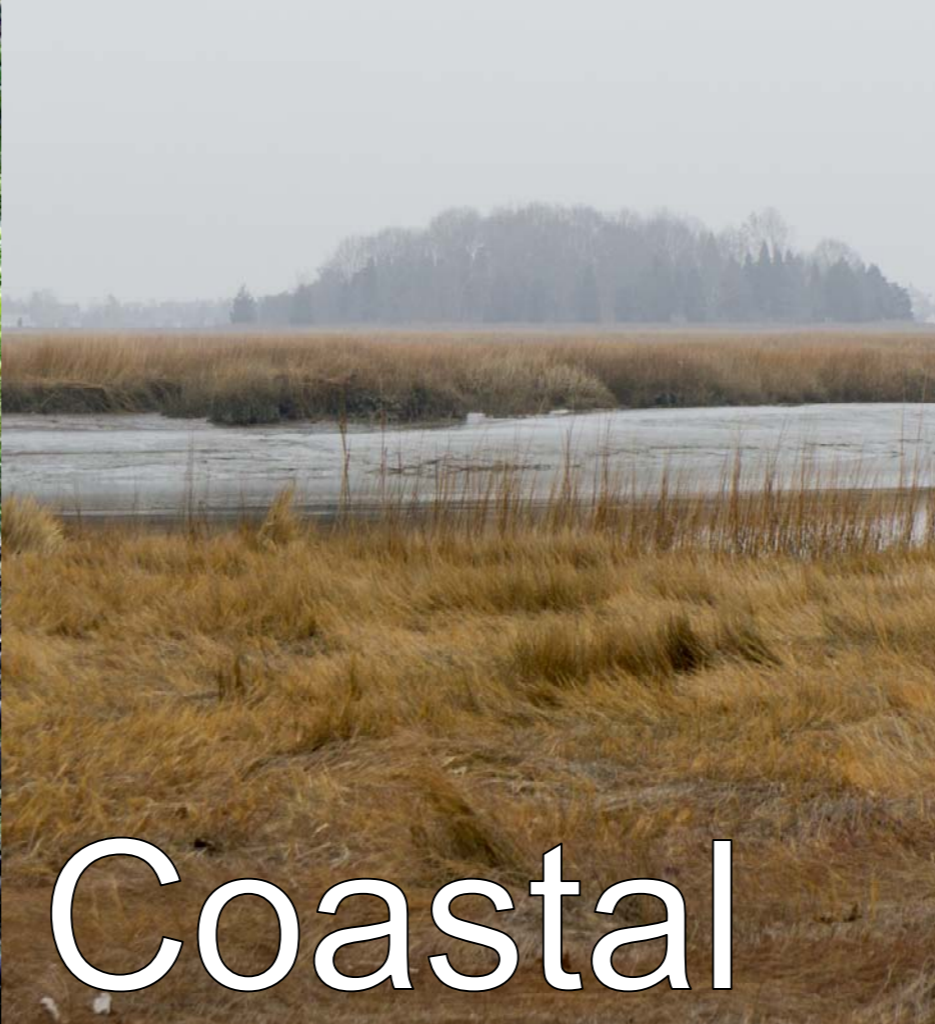


Land  
29%



Oceans  
26%





# Coastal Wetlands

# Coastal Ecosystems – many critical ecosystem services



Fisheries

Coastal protection & erosion control

Coastal Water Quality

Livelihoods (tourism etc.)

Cultural value

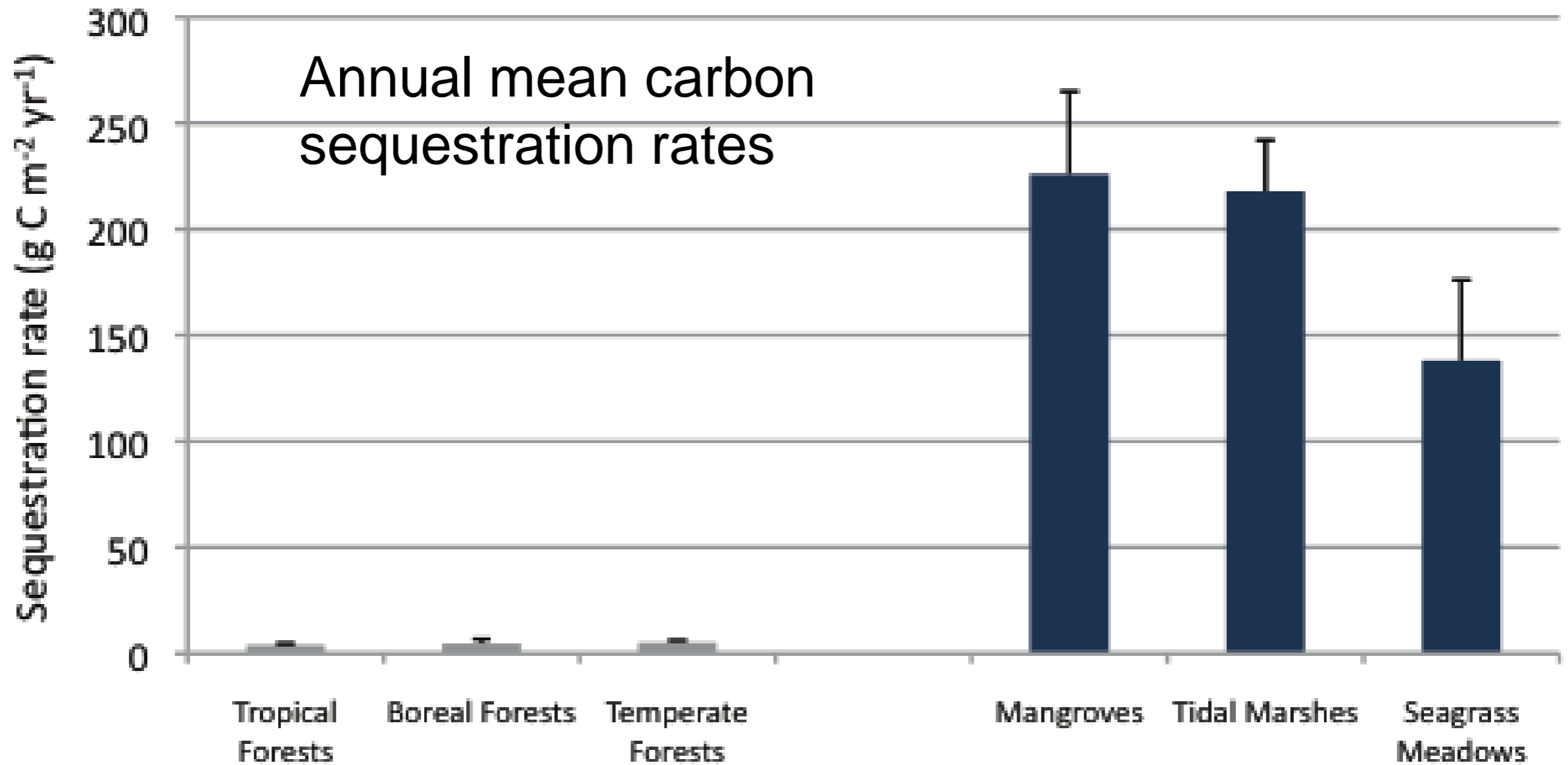
Food

Biodiversity

Carbon sequestration and storage

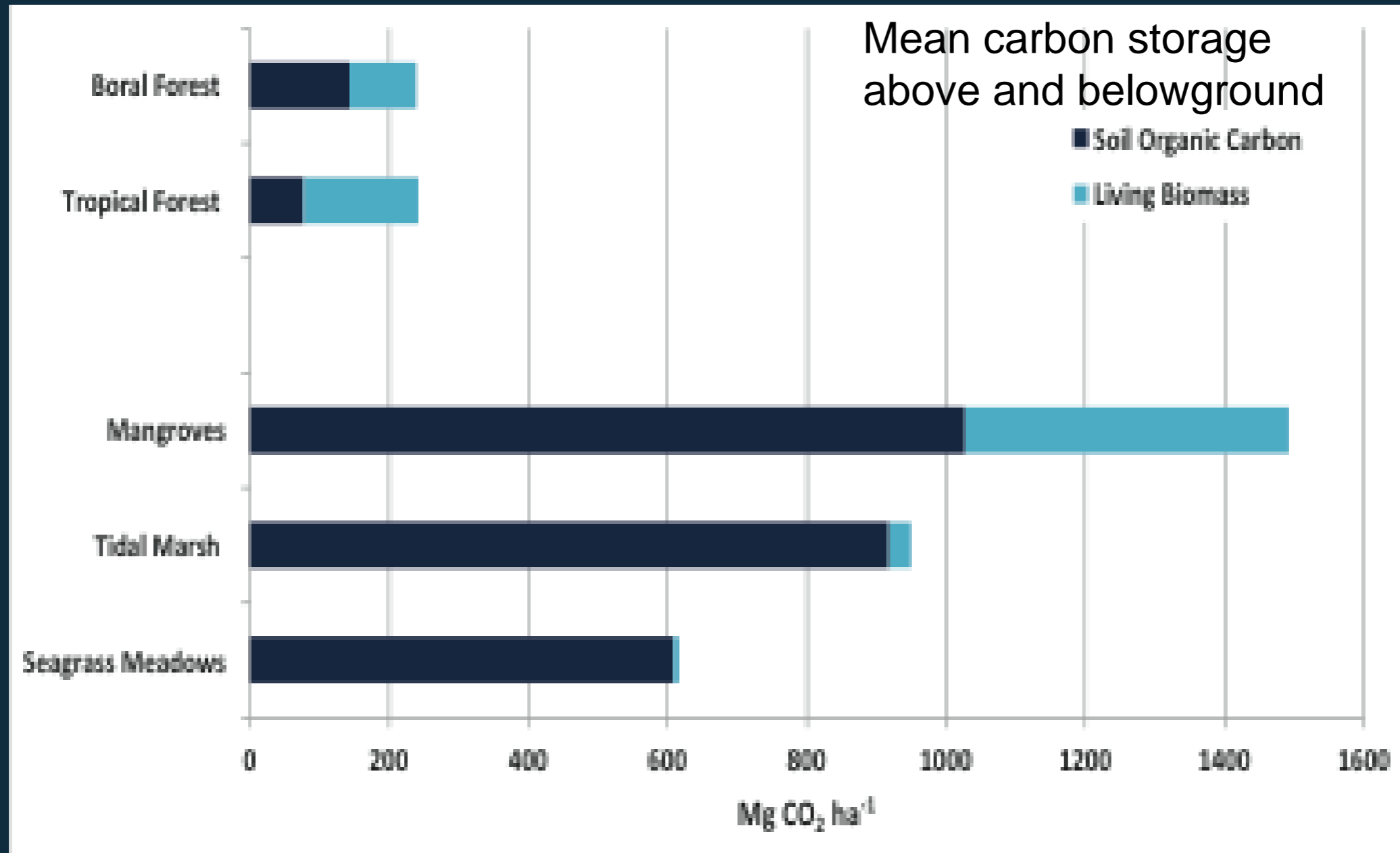


# Costal Ecosystems Highly Efficient at Carbon Sequestration



Modified from McLeod et al. 2011

# Coastal Ecosystems Have Rich Carbon Stores



(Fourqurean et al. 2012; Pan et al. 2011; Pendleton et al. 2012)





© Boone Kauffman

# These ecosystems are being rapidly lost

Ecosystem	Global extent (Mha)	Current conversion rate (% yr <sup>-1</sup> )
Mangroves	13.8-15.2 (14.5)	0.7-3.0 (1.9)
Tidal Marsh	2.2-40 (5.1)	1.0-2.0 (1.5)
Seagrass Meadows	17.7-60 (30)	0.4-2.6 (1.5)
Total	33.7-115.2 (48.9)	

(Modified from Pendleton et al. 2012).



# Numerous causes of degradation and destruction



Aquaculture



Agriculture



Development



Pollution

# Globally significant emissions from Coastal Ecosystems

Ecosystem	Global extent (Mha)	Current conversion rate (% yr <sup>-1</sup> )	Near-surface C susceptible (top meter sediment+biomass, Mg CO <sub>2</sub> ha <sup>-1</sup> )	C emissions (Pg CO <sub>2</sub> yr <sup>-1</sup> )
Mangroves	13.8-15.2 (14.5)	0.7-3.0 (1.9)	373-1492 (933)	0.09-0.45 (0.24)
Tidal Marsh	2.2-40 (5.1)	1.0-2.0 (1.5)	237-949 (593)	0.2-0.24 (0.06)
Seagrass Meadows	17.7-60 (30)	0.4-2.6 (1.5)	131-522 (326)	0.5-0.33 (0.15)
Total	33.7-115.2 (48.9)			0.15-1.02 (0.45)

For comparison:

Tropical deforestation net emissions = 4.8 Pg CO<sub>2</sub> y<sup>-1</sup>

(Modified from Pendleton et al. 2012; Pan et al. 2011).



# Can coastal “blue” carbon leverage better management, conservation and restoration of coastal ecosystems?

- Increase recognition of mitigation value
- Improve management and regulation
- Provide basis for incentives to conserve or restore

# The International Blue Carbon Initiative

Increased conservation, restoration and sustainable management of coastal blue carbon ecosystems



<http://thebluecarboninitiative.org/>

CONSERVATION  
INTERNATIONAL



# International Blue Carbon Scientific Working Group



International Blue Carbon Scientific Working Group Meeting, Rio Grande Brazil

Detail global relevance, Create standards, Develop guidelines, Foster scientific collaboration, Identify priority science needs, Support coastal conservation and management globally, Support Policy

## Mangroves among the most carbon-rich forests in the tropics

Daniel C. Donato<sup>1\*</sup>, J. Boone Kauffman<sup>2</sup>, Daniel Murdiyarso<sup>3</sup>, Sofyan Kurnianto<sup>3</sup>, Melanie Stidham<sup>4</sup> and Markku Kanninen<sup>5</sup>

Mangrove forests occur along ocean coastlines throughout the tropics, and support numerous ecosystem services, including fisheries production. Overlooked in this discussion are mangrove forests, which occur along the coasts of most major oceans in 118 countries, adding

extent of mangrove past half century a culture expansion resulting from mangrove a lack of broad-scale in these ecosystem quantified whole-ec and dead wood biom 25 mangrove forest region—spanning 30 mangrove area and cate that mangrove in the tropics, con hectare. Organic-ric in depth and accoun systems. Combining we estimate that ma of 0.02–0.12 Pg car emissions from def just 0.7% of tropical

Deforestation and of global anthropoge only to fossil fuel c agreements highlight Degradation (REDD- for mitigating clima terrestrial carbon (C) conservation (for ex programs require rig underscoring the im various forest types, C density and widesp

Tropical wetland organic soils up to se organic C reserves disproportionate im climate change has reepeat fires associated atmospheric CO<sub>2</sub> e fossil fuel emissions specifically address change mitigation str

<sup>1</sup>USDA Forest Service, P Mast Rd., Durham, New <sup>4</sup>USDA Forest Service, I Resources Institute (VIT

REVIEWS REVIEWS REVIEWS

## A blueprint for blue carbon: t improved understanding of t vegetated coastal habitats in s

Elizabeth Mcleod<sup>1\*</sup>, Gail L Chmura<sup>2</sup>, Steven Bouillon<sup>3</sup>, Rodney Salm<sup>1</sup>, M Catherine E Lovelock<sup>7</sup>, William H Schlesinger<sup>8</sup>, and Brian R Silliman<sup>9</sup>

Recent research has highlighted the valuable role that coastal and m bon dioxide (CO<sub>2</sub>). The carbon (C) sequestered in vegetated coastal seagrass beds, and salt marshes, has been termed “blue carbon”. Alth of mag area to matter and sal at criti seques improv tems. I

Front Ecol En

The glob concert December 20 has reached

- Despite th ecosystems disproport when com
- Although natural sin key mech associated
- These “bl action is urgently required to prevent further degradation and loss
- Improved scientific understanding of the factors that influence carbon sequestration in these ecosystems is needed to identify sites that are high priorities for restoration and/or conservation management

<sup>1</sup>The Nature Conservancy, Honolulu, HI \* (emcleod@tnc.org);

mechanism by more recent ap gle emissions reducing anth supporting CC tion of natural and capacity (0

## Seagrass ecosystems as a globally significant carbon stock

James W. Fourqurean<sup>1\*</sup>, Carlos M. Duarte<sup>2,3</sup>, Hilary Kennedy<sup>4</sup>, Núria Marbà<sup>2</sup>, Marianne Holmer<sup>5</sup>, Miguel Angel Mateo<sup>6</sup>, Eugenia T. Apostolaki<sup>7</sup>, Gary A. Kendrick<sup>3,8</sup>, Dorte Krause-Jensen<sup>9</sup>, Karen J. McGlathery<sup>10</sup> and Oscar Serrano<sup>6</sup>

The protection of organic carbon stored in forests is considered as an important method for mitigating climate change. Like terrestrial ecosystems, coastal ecosystems store large amounts of carbon, and there are initiatives to protect these ‘blue carbon’ stores. Organic carbon stocks in tidal salt marshes and mangroves have been estimated, but uncertainties in the stores of seagrass meadows—some of the most productive ecosystems on Earth—hinder the application of marine carbon conservation schemes. Here, we compile published and unpublished measurements of the organic carbon content of living seagrass biomass and underlying soils in 946 distinct seagrass meadows across the globe. Using only data from sites for which full inventories exist, we estimate that, globally, seagrass ecosystems could store as much as 19.9 Pg organic carbon; according

OPEN ACCESS Freely available online

PLOS ONE

## Estimating Global “Blue Carbon” Emissions from Conversion and Degradation of Vegetated Coastal Ecosystems

Linwood Pendleton<sup>1,2</sup>, Daniel C. Donato<sup>2,3\*</sup>, Brian C. Murray<sup>1</sup>, Stephen Crooks<sup>3</sup>, W. Aaron Jenkins<sup>1</sup>, Samantha Siffleet<sup>4</sup>, Christopher Craft<sup>5</sup>, James W. Fourqurean<sup>6</sup>, J. Boone Kauffman<sup>7</sup>, Núria Marbà<sup>8</sup>, Patrick Megonigal<sup>9</sup>, Emily Pidgeon<sup>10</sup>, Dorothee Herr<sup>11</sup>, David Gordon<sup>1</sup>, Alexis Baldera<sup>12</sup>

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# How much carbon? Where? What are the potential emissions?

study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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These authors contributed equally to this work.

### Introduction

tidal marshes, mangroves, and seagrass beds. These coastal carbon stocks are increasingly referred to as “blue carbon” [2,3]. The

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# 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands

## Chapter 4 Coastal Wetlands

### Coordinating Lead Authors

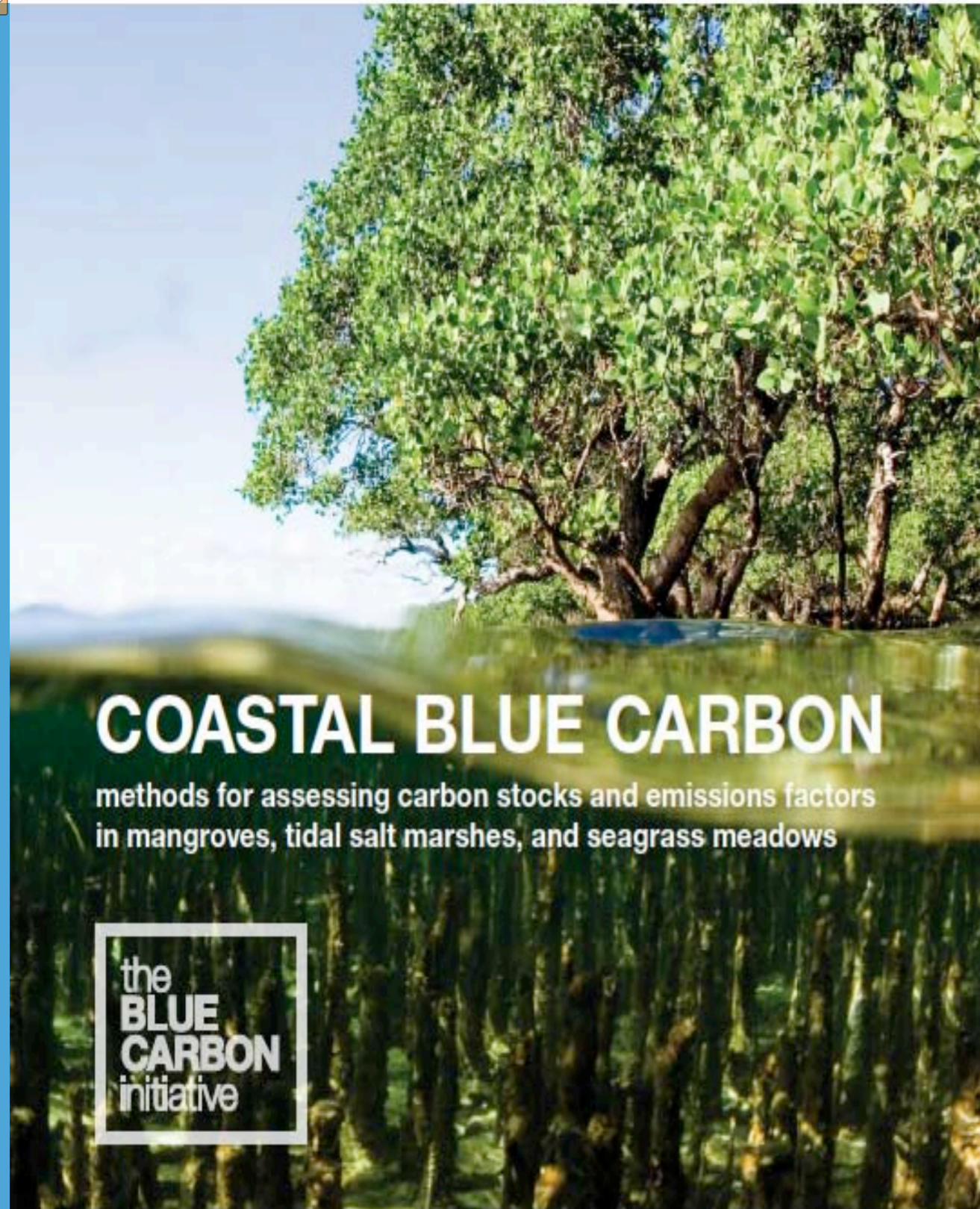
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# COASTAL BLUE CARBON

methods for assessing carbon stocks and emissions factors  
in mangroves, tidal salt marshes, and seagrass meadows



Free to download:  
[thebluecarboninitiative.org/manual](http://thebluecarboninitiative.org/manual)



# Outreach & Communication



# International Blue Carbon Policy Working Group

- Provide guidance for blue carbon policy development
- Build integrated blue carbon community

## BLUE CARBON POLICY FRAMEWORK 2.0

Based on the discussions of the International Blue Carbon Policy Working Group



# United Nations Framework Convention on Climate Change (UNFCCC)

"stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (1992)

Overarching framework for other treaties or protocols (e.g. Kyoto Protocol, Bali Action Plan.....)

How to integrate coastal ecosystems?

# Coastal Ecosystems in UNFCCC mechanisms

## **Nationally Appropriate Mitigation Actions (NAMAs)**

- Measurable, reportable and verifiable nationally appropriate mitigation commitments or actions
- Funding through multi-/bilateral initiatives providing fast-start finance
- *Coastal Carbon projects should be eligible*

## **Reducing emissions from deforestation and forest degradation (REDD)**

- Mechanism for recognizing the climate mitigation value of forest management within developing countries
- Climate mitigation value must be measured, monitored and verified
- Numerous funding sources support readiness activities including improving data on carbon content and drivers of deforestation and degradation
- *Mangrove systems are eligible (generally)*

# Climate Change Mitigation Funding

Funds exclusively supporting REDD+ (USD millions)

Fund / Initiative	Pledged	Deposited	Approved	Disbursed	No of projects approved
Amazon Fund	1032.44	102.79	168.71	45.94	33
Forest Carbon Partnership Facility - Carbon Fund (FCPF-CF)	218.3	138.1	0.57	0.2	1
Forest Carbon Partnership Facility - Readiness Fund (FCPF-RF)	239.4	212.59	31.03	11.46	27
Forest Investment Program (FIP)	612	446	50.96	3.59	24
Norway International Climate and Forest Initiative (NICFI)	1,607.82	1,607.82	533.21	276.44	13
UN-REDD	151.49	118.89	116.13	97.93	18
Australia's International Forest Carbon Initiative (IFCI)	216.27	67.06	125.54	31.7	9
Congo Basin Forest Fund (CBFF)	165	165	95.38	18.59	37

Schalatek et al 2012

Nationally Appropriate Mitigation Actions (NAMA) Facility  
- Initial funding \$100 million (UK and Germany)

Green Climate – 2020 Fundraising Goal  
- \$100 billion per year

# Where can carbon offset payments come from?

## Mandated Carbon reductions

- Compliance markets
- Intergovernmental transfers
- Nationally appropriate mitigation actions
- REDD+

## Voluntary carbon markets

- Wetlands restoration protocols

## Corporate social responsibility





## Considering “Coastal Carbon” in Existing U.S. Federal Statutes and Policies

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*Coastal ecosystems such as mangroves, salt marshes, and seagrasses provide important ecosystem services, including nursery habitat for fish, shoreline protection, and the recently recognized service of carbon sequestration and storage. When these wetland ecosystems are degraded or destroyed, the carbon can be released to the atmosphere, where it adds to the concentration of greenhouse gases (GHGs) that contribute to climate change. Many federal statutes and policies specifically require that impacts on ecosystem services be considered in policy implementation. Yet, no federal statute, regulation, or policy accounts directly for the carbon held in coastal habitats. There are a number of federal statutes and policies for which coastal carbon ecosystem services could reasonably be added to environmental and ecosystem considerations already implemented. We look at a subset of these statutes and policies to illustrate how coastal carbon ecosystem services and values might affect the implementation and outcomes of such statutes generally. We identify key steps for the inclusion of the ecosystem services of coastal habitats into the implementation of existing federal policies without statutory changes; doing so would increase the degree to which these policies consider the full economic and ecological impacts of policy actions.*

Both Pendleton and Sutton-Grier contributed equally to this article.

This article was only possible with the help of many individuals at several federal agencies who provided their expertise via interviews. The following individuals provided extensive time and insight in support of this analysis. Their contributions to this article do not indicate any action or recommended action by any federal agency. Inclusion on this list only recognizes contribution of facts regarding federal statutes and policies and does not imply individual or agency approval of any of the recommendations listed in this article. Aileen Smith, NOAA; Charley Chesnut, U.S. Army Corps of Engineers; Dwight Trueblood, NOAA; Marie Bundy, NOAA; Steve Kokkinakis, NOAA; Robyn Colosimo, U.S. Army Corps of Engineers; Peter Edwards, NOAA; Carolyn Currin, NOAA; Alison Leschen, Waquoit Bay National Estuary Research Reserve; Tibor Vegh, The Nicholas Institute for Environmental Policy Solutions, Duke University. We also thank Megan Jungwiwattanaporn for her help formatting the article. The ideas and opinions contained in this article represent those of the authors and not those of the National Oceanic and Atmospheric Administration.

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*National Environmental Policy Act*  
Includes a mandate to consider  
impacts on coastal habitats and  
**ecosystem services in  
planning federal actions**

*Clean Water Act*  
Requires compensatory mitigation  
for unavoidable impacts  
Impacts to carbon stores not  
currently considered

*Coastal Zone Management Act*  
Programs could consider including  
carbon



**THE ABU DHABI BLUE CARBON DEMONSTRATION PROJECT**  
Building Blue Carbon Projects - An Introductory Guide



*Priority Agenda*  
Enhancing the Climate Resilience

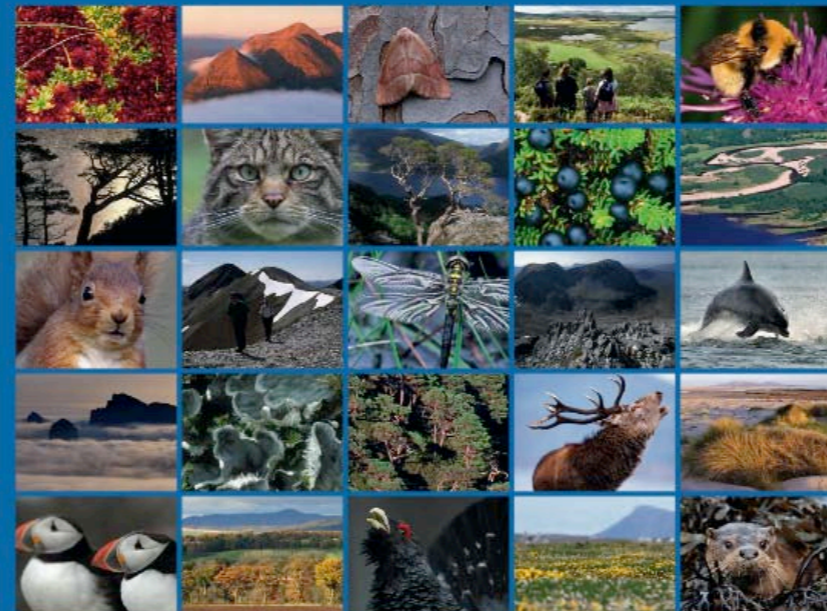


*of* America's  
Natural Resources

COUNCIL ON CLIMATE PREPAREDNESS AND RESILIENCE

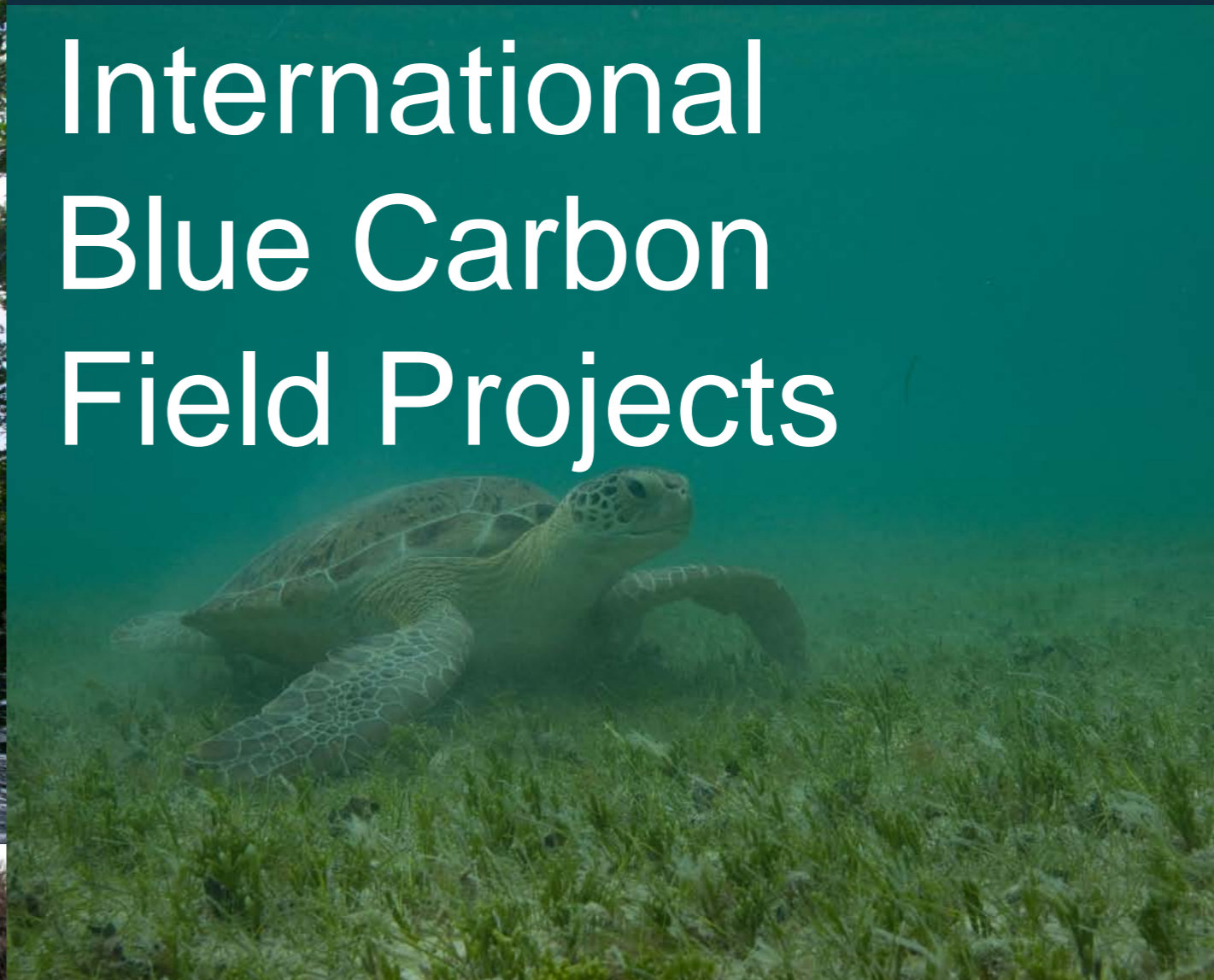
Scottish Natural Heritage  
Commissioned Report No. 761

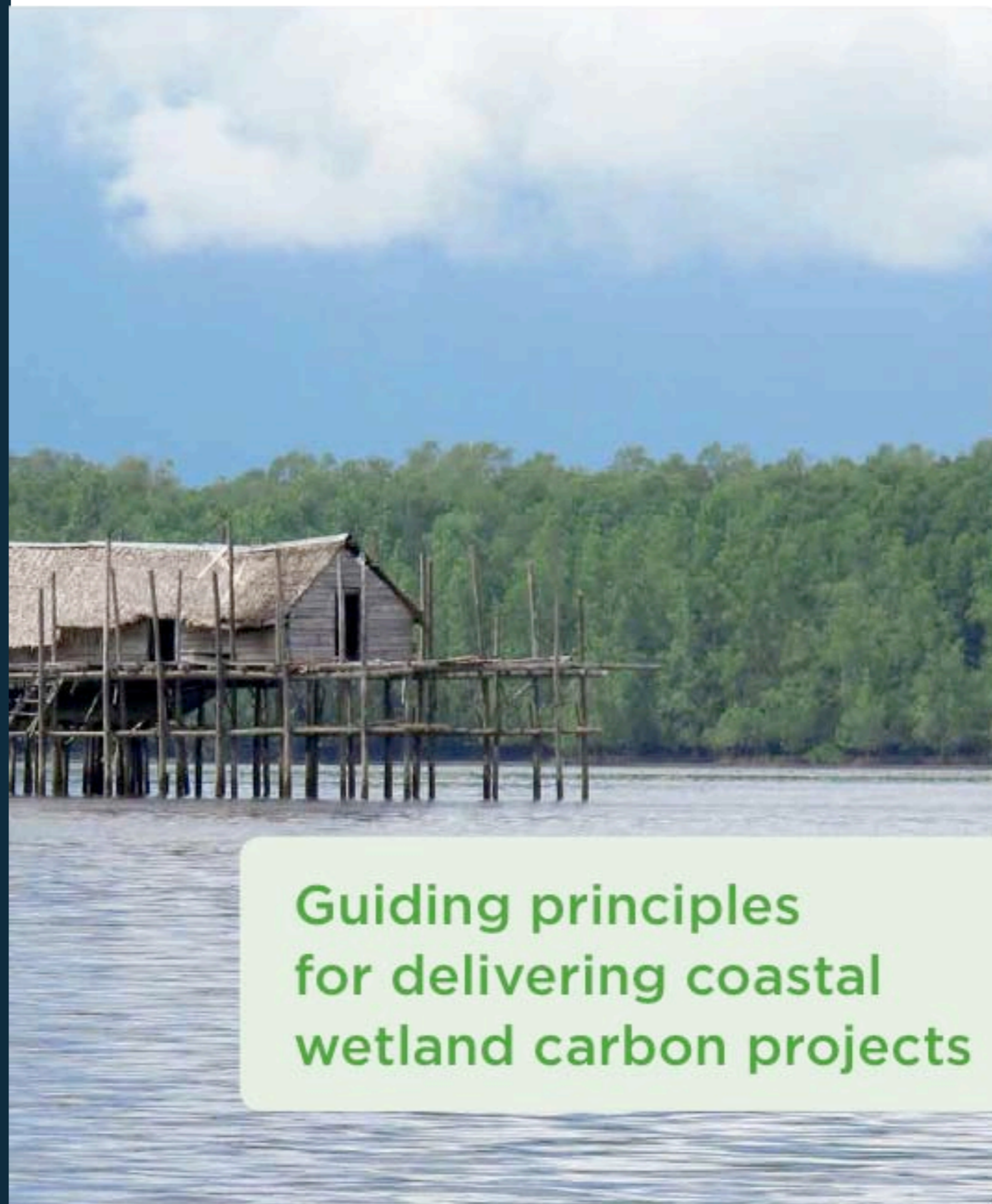
Assessment of carbon budgets and potential blue carbon stores in Scotland's coastal and marine environment





# International Blue Carbon Field Projects



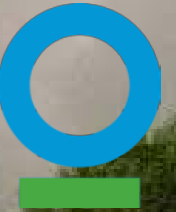


**Guiding principles  
for delivering coastal  
wetland carbon projects**



# Gulf of Nicoya - Costa Rica

CONSERVATION  
INTERNATIONAL



Develop and support policy and management that conserves and promotes sustainable use of the mangroves.

# Gulf of Nicoya

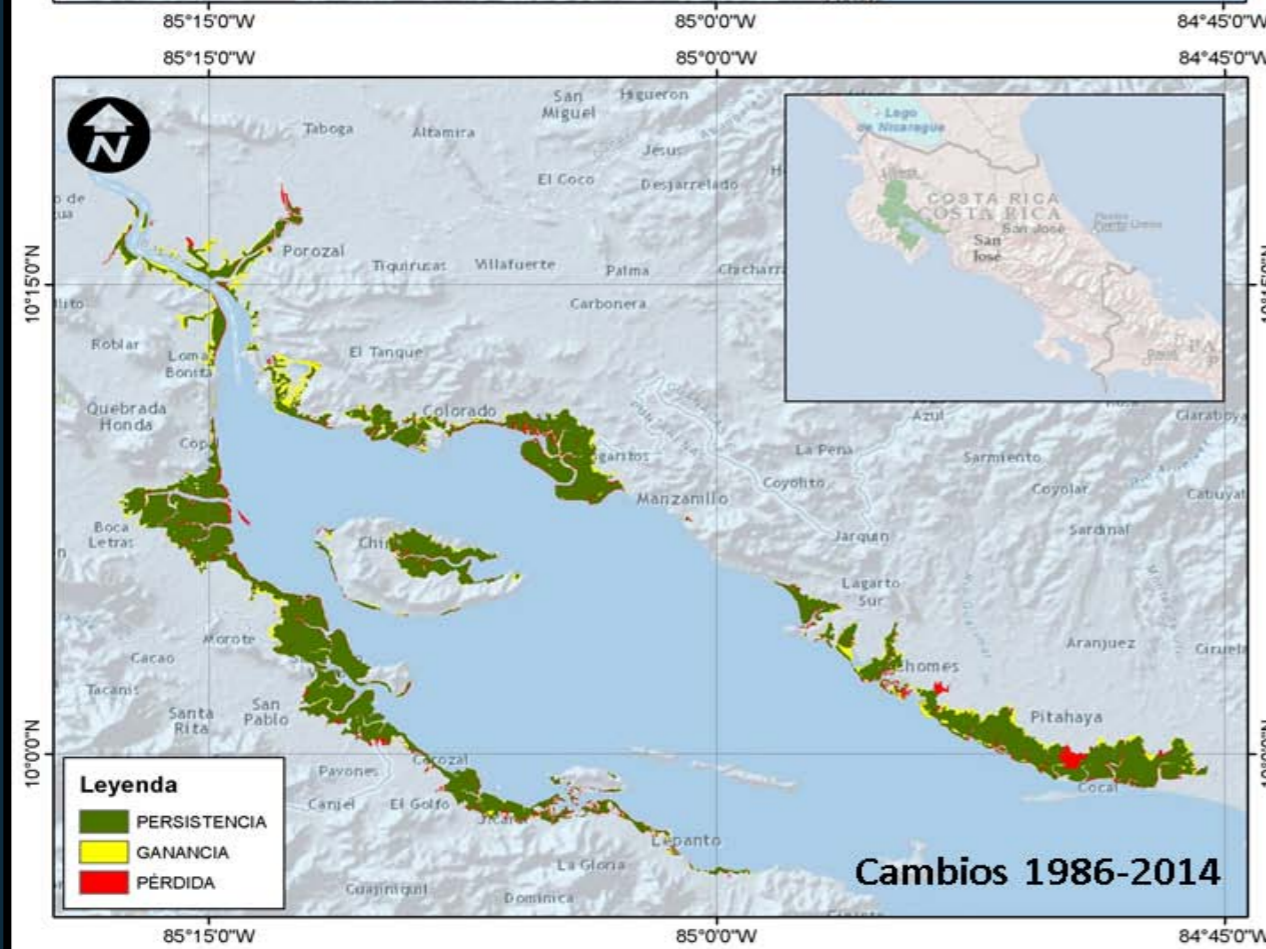
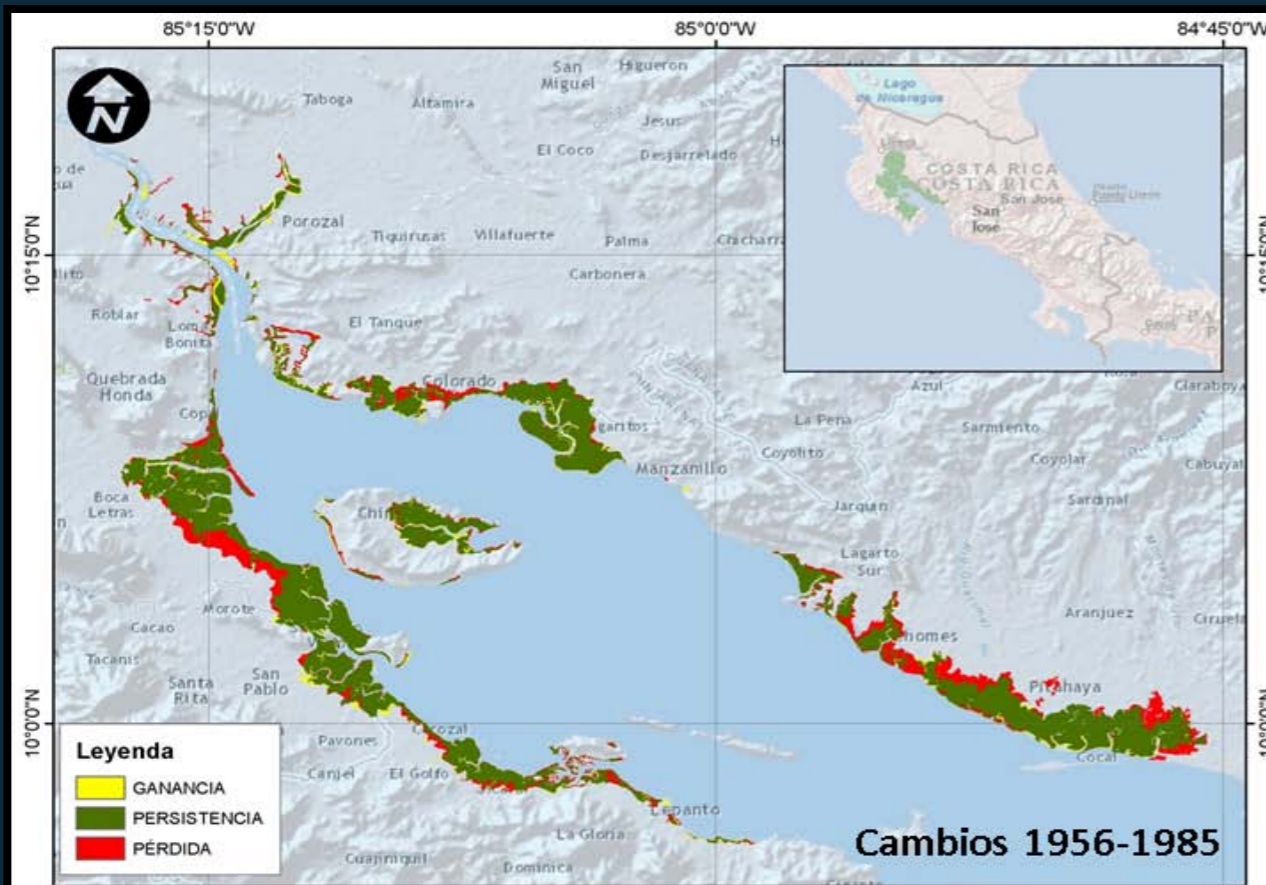
Since 1950

- 16% loss of mangroves,
- 2.2 million tonnes of CO<sub>2</sub> (eq) emissions

Project:

- Mangrove restoration and conservation
- Sustainable management
- Community Education

(Cifuentes, personal comm)



# Gracias

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