Blue Carbon Initiative Transforming science into effective policy & management

Emily Pidgeon

Vice President Ocean Science and Innovation

> **CONSERVATION** INTERNATIONAL





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

http://thebluecarboninitiative.org/







ited Nations Interg cientific and Ocea

Intergovernmen Oceanographic Commission

Mangroves among the most carbor the tropics

Daniel C. Donato¹*, J. Boone Kauffman², Daniel Murdiyarso³, Sofyan k and Markku Kanninen⁵

Mangrove forests occur along ocean coastlines throughout the Overlooked in this o tropics, and support numerous ecosystem services, including along the coasts of m fisheries production and nutrient cycling. However, the areal extent of mangrove forests has declined by 30–50% over the \sim 30–35% to the globa swamps alone^{4,6,12}. Ret past half century as a result of coastal development, aquaincluding fisheries and culture expansion and over-harvesting¹⁻⁴. Carbon emissions storm/tsunami protec resulting from mangrove loss are uncertain, owing in part to a lack of broad-scale data on the amount of carbon stored rapidly as a result overharvesting, and d in these ecosystems, particularly below ground⁵. Here, we quantified whole-ecosystem carbon storage by measuring tree the past half-century may functionally disar and dead wood biomass, soil carbon content, and soil depth in 25 mangrove forests across a broad area of the Indo-Pacific wenty-first century s threat to mangroves¹ panning 30° of latitude and 73° of longitude changes by migrating l mangrove area and diversity are greatest^{4,6}. These data indi Although mangr cate that mangroves are among the most carbon-rich forests in the tropics, containing on average 1,023 Mg carbon per and flux rates16-22, data carbon storage-the hectare. Organic-rich soils ranged from 0.5 m to more than 3 m in depth and accounted for 49-98% of carbon storage in these land-use conversion. reported, most notab systems. Combining our data with other published information, we estimate that mangrove deforestation generates emissions organic-rich soils22-2 of total ecosystem ca of 0.02-0.12 Pg carbon per year—as much as around 10% of emissions from deforestation globally, despite accounting for thick, tidally submerg muck') supporting ar noderate to high C co

just 0.7% of tropical forest area^{6,7}. moderate to high C cc Deforestation and land-use change currently account for 8–20% of global anthropogenic carbon dioxide (CO₂) emissions, second only to fossil fuel combustion^{7,8}. Recent international climate agreements highlight Reduced Emissions from Deforestation and Degradation (REDD+) as a key and relatively cost-effective option for mitigating climate change; the strategy aims to maintain terrestrial carbon (C) stores through financial incentives for forest conservation (for example, carbon credits). REDD+ and similar programs require rigorous monitoring of C pools and emissions^{8,8}, geog underscoring the importance of robust C storage estimates for Stud

nature climate change

Global patterns in mang and losses

Trisha B. Atwood^{1,2*}, Rod M. Connolly³, Hanan / Carolyn J. Ewers Lewis⁵, Xabier Irigoien^{7,8}, Jeffrey J. Kellev Oscar Serrano^{10,12}, Christian J. Sanders¹³, Isaac Santos¹³, A and Catherine E. Lovelock^{1,15}

CONCEPTS AND QUESTIONS

Assessing the risk of car emissions from blue car

Catherine E Lovelock^{1,2*}, Trisha Atwood^{2,3}, Jeff Baldock⁴, C: Pere Masque^{6,8,11}, Peter I Macreadie¹², Aurora M Ricart^{9,10}, C

"Blue carbon" ecosystems, which include tidal marshes stocks of organic carbon (C_{org}) in their soils. These car degraded – can be released to the atmosphere in the for relative risk of CO₂ emissions from degraded soils, then projects and establishing a means to prioritize manager emissions after various kinds of disturbances can be acc soil C_{org} stock at a site and the likelihood that the soil C

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Wetlands (2011) 31:831-842 DOI 10.1007/s13157-011-0197-0

ARTICLE

Salinity Influence on Methane E1 from Tidal Marshes

Hanna J. Poffenbarger &Brian A. Needelman & J. Patrick Megonigal

Received: 2 August 2010/Accepted: 13 June 2011/Published online: 5 # Society of Wetland Scientists 2011

Abstract The relationship between methane emissions and salinity is not well understood in tidal marshes, leading to uncertainty about the net effect of marsh conservation and restoration on greenhouse gas balance. We used published and unpublished field data to investigate the relationships between tidal marsh methane emissions, salinity, and porewater concentrations of methane and sulfate, then used these relationships to consider the balance between methane emissions and soil carbon sequestration. Polyhaline tidal marshes (salinity >18) had significantly lower methane emissions (mean \pm sd=1 \pm 2 gm⁻² yr⁻¹) than other marshes,

nature geoscience

Seagrass ecosystems as a globally significant carbon stock

James W. Fourqurean^{1*}, Carlos M. Duarte^{2,3}, Hilary Kennedy⁴, Núria Marbà², Marianne Holmer⁵, Miguel Angel Mateo⁶, Eugenia T. Apostolaki⁷, Gary A. Kendrick^{3,8}, Dorte Krause-Jensen⁹, Karen J. McGlathery¹⁰ and Oscar Serrano⁶

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 stores. Organic carbon storems, we compile published and unpublished measurements of the organic carbon store 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 to a more conservative approach, in which we incorporate more data from surface soils and depth-dependent declines in soil carbon stocks, we estimate that the seagrass carbon pool lies between 4.2 and 8.4 Pg carbon. We estimate that present rates of seagrass loss could result in the release of up to 299 Tg carbon pre year, assuming that all of the organic carbon in seagrass

The remineralization of organic carbon (C_{org}) stored in C_{org} storage in seagrass soils has rarely been quantified, becaus

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Estimating Global "Blue Carbon" Emissions from Conversion and Degradation of Vegetated Coastal Ecosystems

> Stephen Crooks³, W. Aaron Jenkins¹, J. Boone Kauffman⁷, Núria Marbà⁸, Gordon¹, Alexis Baldera¹²

PLOS ONE

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Jnited States of America, 2 Ecosystem & Landscape Ecology Lab, i:ates, San Francisco, California, United States of America, 4 United ica, 5 School of Public and Environmental Affairs, Indiana University, vironmental Research Center, Florida International University, North ersity, Corvallis, Oregon, United States of America and Center for anean Institute for Advanced Studies, Esporles, Iles Balears, Spain, D Conservation International, Arlington, Virginia, United States of Intel States of America, 12 The Ocean Conservancy, Baton Rouce,

tion in vegetated coastal ecosystems—marshes, nversion'). Relatively unappreciated, however, is ols of previously-sequestered carbon. Residing nere when these ecosystems are converted or aluate its economic implications. Combining the n-surface carbon stocks in each of the three 0.15–1.02 Pg (billion tons) of carbon dioxide are hat account only for lost sequestration. These Iresult in economic damages of \$US 6–42 billion

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CO₂ Efflux from Cleared Mangrove Peat

Catherine E. Lovelock^{1*}, Roger W. Ruess², Ilka C. Feller³

1 School of Biological Sciences, The University of Queensland, St. Lucia, Queensland, Australia, 2 Institute of Arctic Biology, University of Alaska Fairbanks, Fai United States of America, 3 Smithsonian Environmental Research Center, Edgewater, Maryland, United States of America

Abstract

Background: CO₂ emissions from cleared mangrove areas may be substantial, increasing the costs of continued lo these ecosystems, particularly in mangroves that have highly organic soils.

Methodology/Principal Findings: We measured CO_2 efflux from mangrove soils that had been cleared for up to 20 y the islands of Twin Cays, Belize. We also disturbed these cleared peat soils to assess what disturbance of soils after may have on CO_2 efflux. CO_2 efflux from soils declines from time of clearing from , 10 600 tonnes km² ² year² ¹ in year to 3000 tonnes km² year² ¹ after 20 years since clearing. Disturbing peat leads to short term increases in CC_2 (27 umol m² ² s² ¹), but this had returned to baseline levels within 2 days.

Conclusions/Significance: Deforesting mangroves that grow on peat soils results in CO₂ emissions that are compar rates estimated for peat collapse in other tropical ecosystems. Preventing deforestation presents an opportur countries to benefit from carbon payments for preservation of threatened carbon stocks.

How much carbon? Where? Fluxes?



CO2 Efflux from Cleared Mangrove Peat

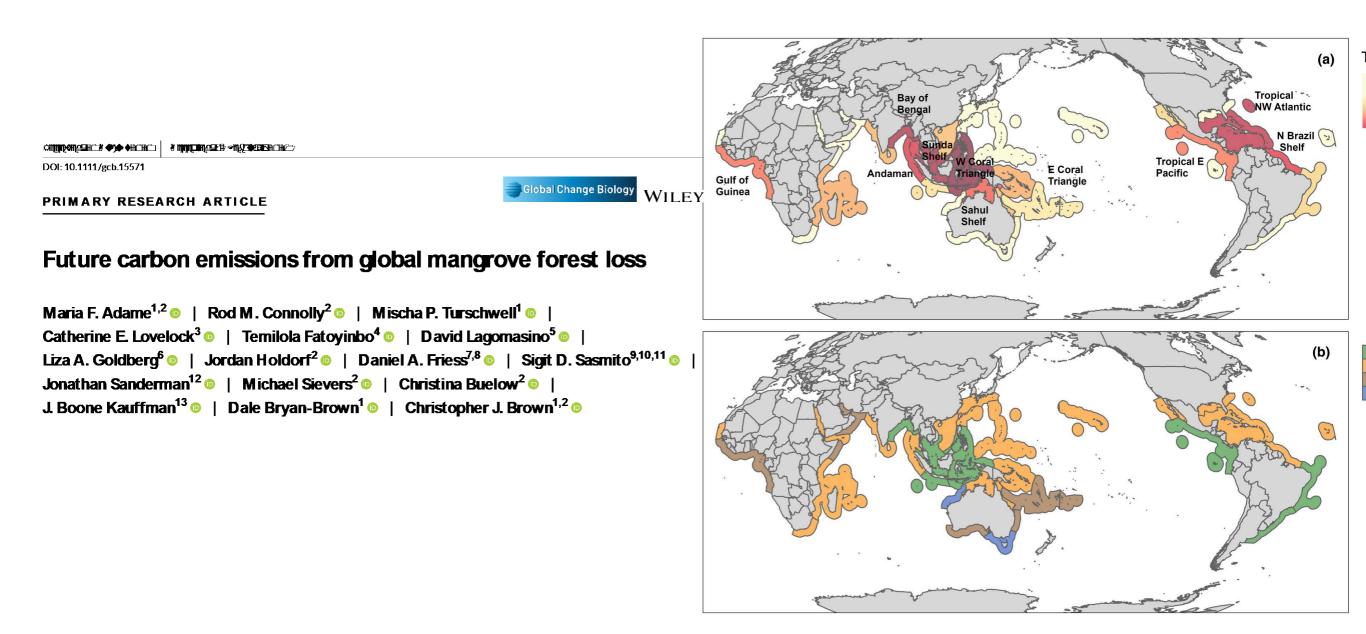
Catherine E. Lovelock¹*, Roger W. Ruess², Ilka C. Feller³

1 School of Biological Sciences, The University of Queensland, St Lucia, Queensland, Australia, 2 Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks, Alaska, United States of America, 3 Smithsonian Environmental Research Center, Edgewater, Maryland, United States of America

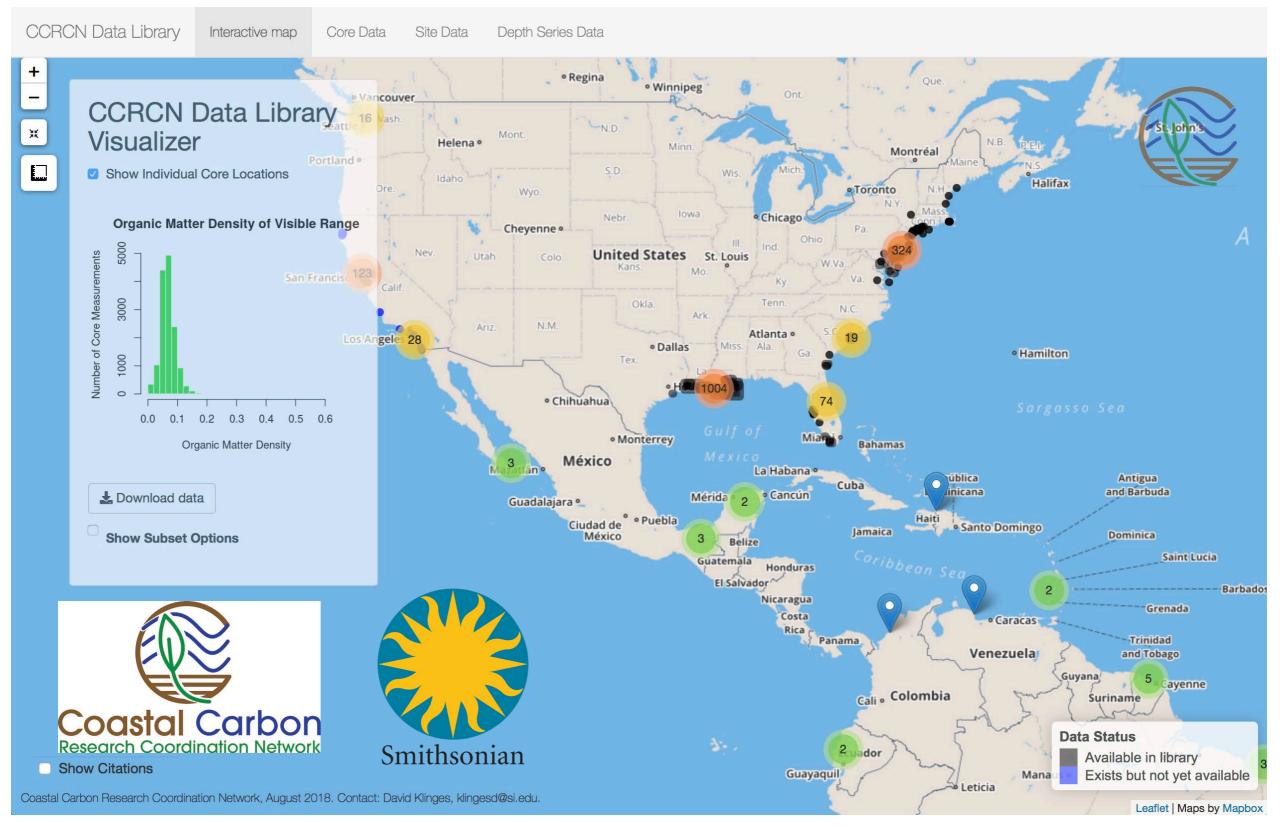
| Table 1 Estimates of QD efflux from modifie | d mangrove and other habitats with peat soils. |
|---|--|
| | a mangrove and other nabitates with pear solid |

| Habitat | Modification | CO ₂ efflux tonnes km ^{2 2} year ^{2 1} | Method | Reference |
|-----------------------|-----------------------------|--|---|--|
| Mangrove, Belize | Cleared | 2900 | CO ₂ efflux | THIS STUDY |
| Mangrove, Honduras | Forest damaged by hurricane | 1500 | Inferred from peat collapse | Cahoon et al. 2003 |
| Mangrove, Australia | Shrimp pond | 1750 (220-5000) | CO ₂ efflux | Burford and Longmore 2001 |
| Rainforest, Indonesia | Drained for agriculture | 3200 | Inferred from peat collapse and measured as $\ensuremath{\text{CO}_2}$ efflux | Couwenburg et al. 2010 and references therein |
| Tundra, Alaska | Thawed (vegetation intact) | 150-430 | Net CO ₂ exchange | Schuur et al. 2009 |

doi:10.1371/journal.pone.00212791001



Coastal Carbon Research Coordination Network



Integrating Blue Carbon Science into Policy Tools

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intercovernmental range on climate change

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

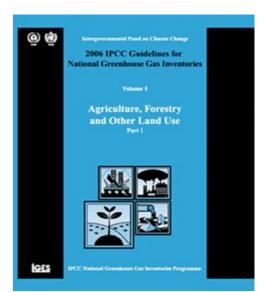
Methodological Guidance on Lands with Wet and Drained Soils, and Constructed Wetlands for Wastewater Treatment

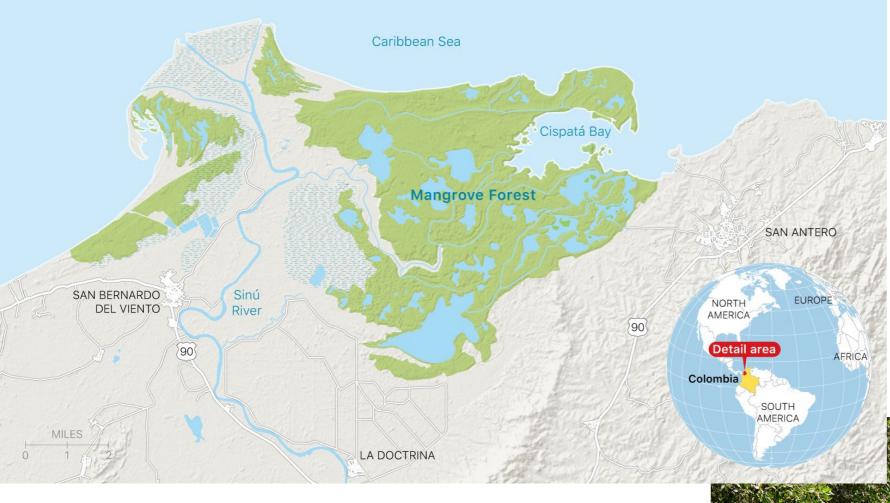


Task Force on National Gerenhouse Gas Inventories

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









Cispatá, Colombia

Protect and restore 11,000+ hectares of mangrove forests

1 million tons of VCUs

financing for sustainable ecotourism, aquaculture, and improved fishing practices in community of 12,000



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Worldwide

MANGROVE BLUE CARBON

Total organic carbon stored in **the world's** mangroves is estimated at **21,914.17** Mt CO₂e with **2,820.50** Mt CO₂e stored in above-ground biomass and **19,093.67** Mt CO₂e stored in the upper 1m of soil.

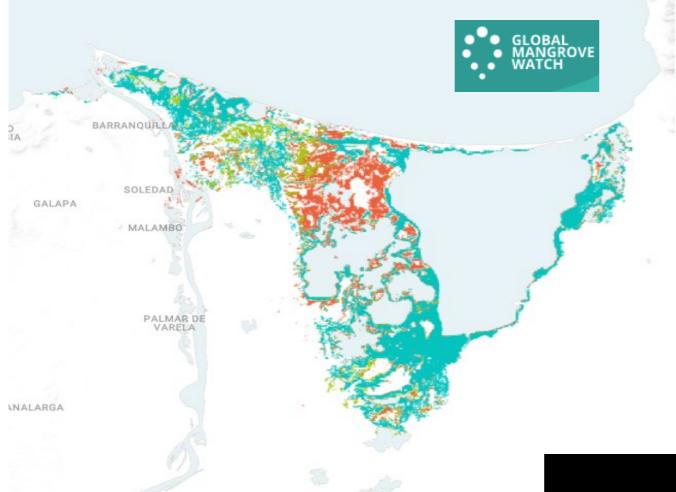
Total carbon density (t CO₂e / ha)

- 8 2800--3500
- 2100--2800
- 1400--2100
- 700--1400
- 0--700



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PANA



Ciénaga Grande de Santa Marta

Restorable area = 14,531 ha Carbon benefit from restoration = 7,309,093 MgC



Mangrove conversion to open water





Thank you

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