Tropical Wetlands:
Their value and potential for climate change adaptation and mitigation strategies

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Tropical wetland forests

Ecosystems that are inundated or saturated for all, or parts of the year. Wet conditions drive ecosystem processes and functions, supporting unique biological communities physically and physiologically adapted to a wet (hydric) environment.

Mangroves

Freshwater peat swamp forests

Tropical Peat forests

(freshwater wetlands)

- Peat swamp forests have high root/shoot ratios and occur on organic-rich soils that can be up to several meters deep (Komiyama et al. 2008, Fujimoto et al. 1999, Page et al. 2002).
- About 441,000 km^2 of tropical peatlands ~11% of the total peatland area; volume is ~18 -25% (Page et al. 2010).
- Southeast Asia is home to 25 million ha of peatlands, or 56% of all tropical peatlands.
- Total C storage in these ecosystems may be among the largest forest C pools on Earth. Yet data are lacking quantifying these globally significant carbon stores.
- Tropical peat forests are excellent candidates for inclusion in REDD+ strategies, but critical information on carbon pools and land use is needed in order to be effective.

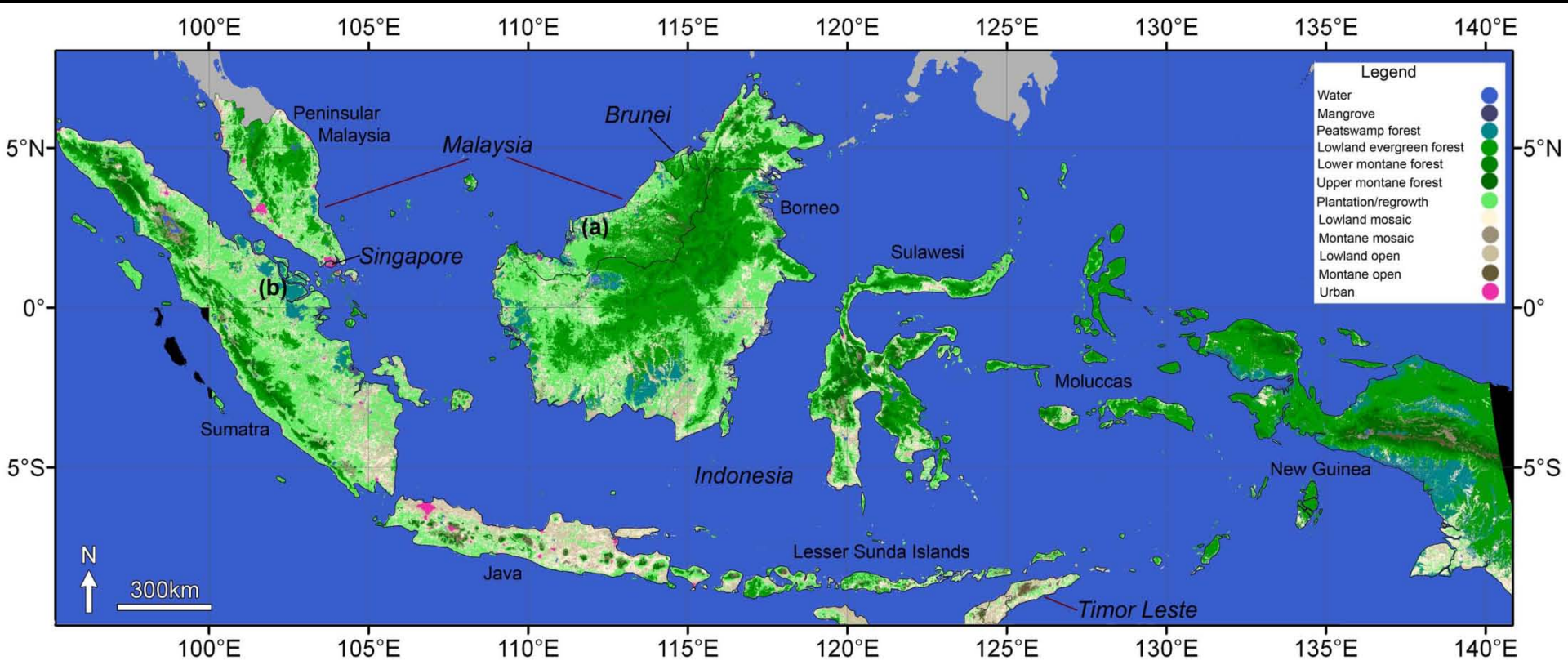
Mangroves

- Tidal wetland forests
- Globally about 140,000 km^2
- Mangroves are found along coastlines and estuaries in 118 countries
- Rapid C assimilation and high C storage in suboxic and anoxic soils
- 49-98% of ecosystem C stored belowground (Donato et al. 2011)
- Mangrove deforestation may account for 10% of annual GHG emissions from deforestation, while accounting for only 0.7% of tropical forest area (Donato et al. 2011).

Indo-Pacific and SE Asia:
The global epicenter of tropical peatlands & mangroves

- Southeast Asia is home to about 25 million ha (56%) of tropical peatlands. Approximately 47% are found in Indonesia (Page et al. 2010)
- Indonesia alone contains about 3 million ha (23%) of the world's mangroves. There are more mangroves in Indonesia than in any of the Earth's continents. -Giri et al. 2011

Miettinen et al. 2011



Ecosystem Services

The processes by which the environment produces resources that we often take for granted such as:

- clean water,
- timber,
- habitat for fisheries, and
- pollination of native and agricultural plants.



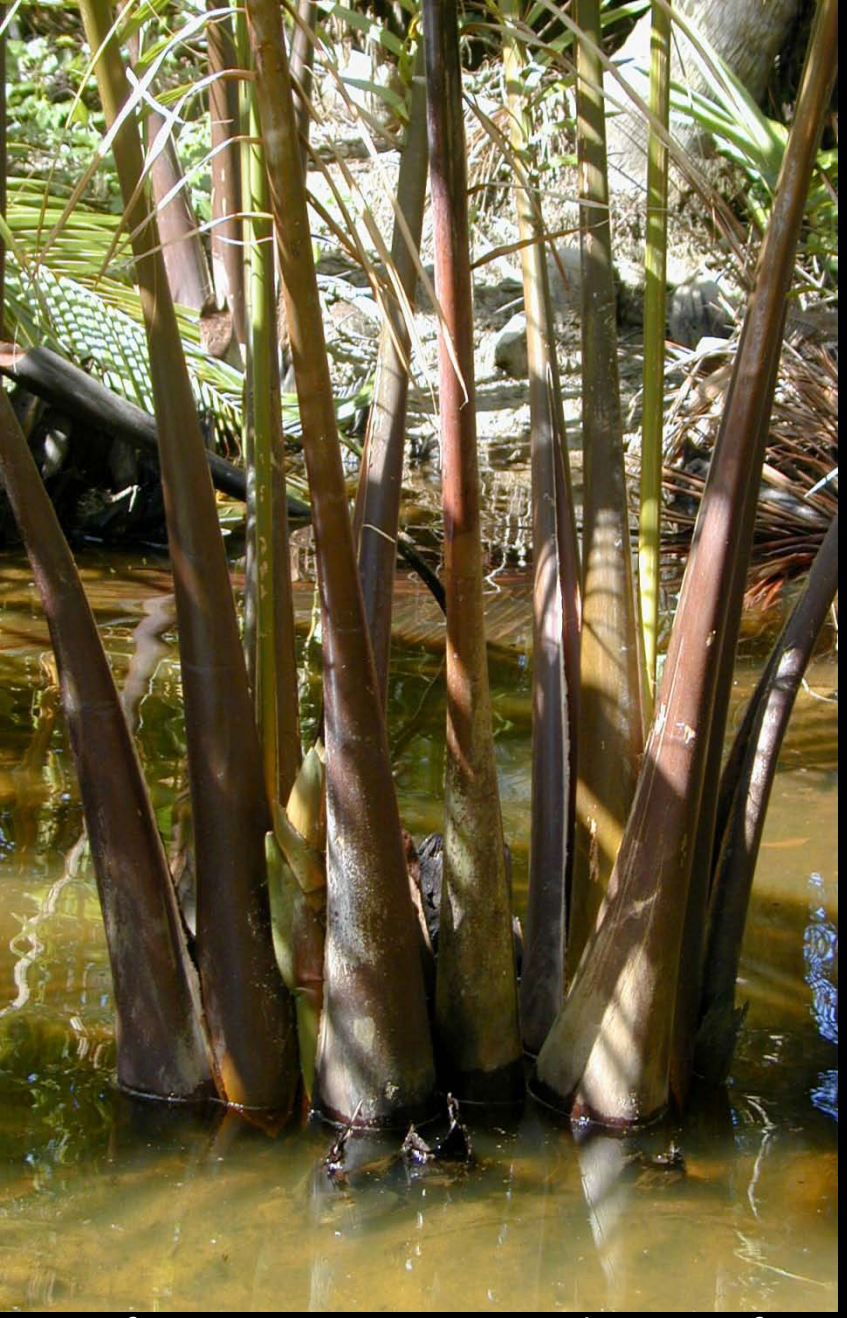


Coastal Protection:
Tsunami, Storm Surge, Erosion, Salt Spray

Sundarbans, Ganges River Bangladesh from B. Kauffman

Mangroves Killed by Hurricane Wilma in Everglades National Park
Date Taken: May 20 2010
Photographer: Paul R. Nelson, , USGS

Tsunami sediment deposition and buried organic soil.
American Samoa. USGS



Nypa fruticans growing in coastal waters of Yap.
Photograph by Eric Guinther

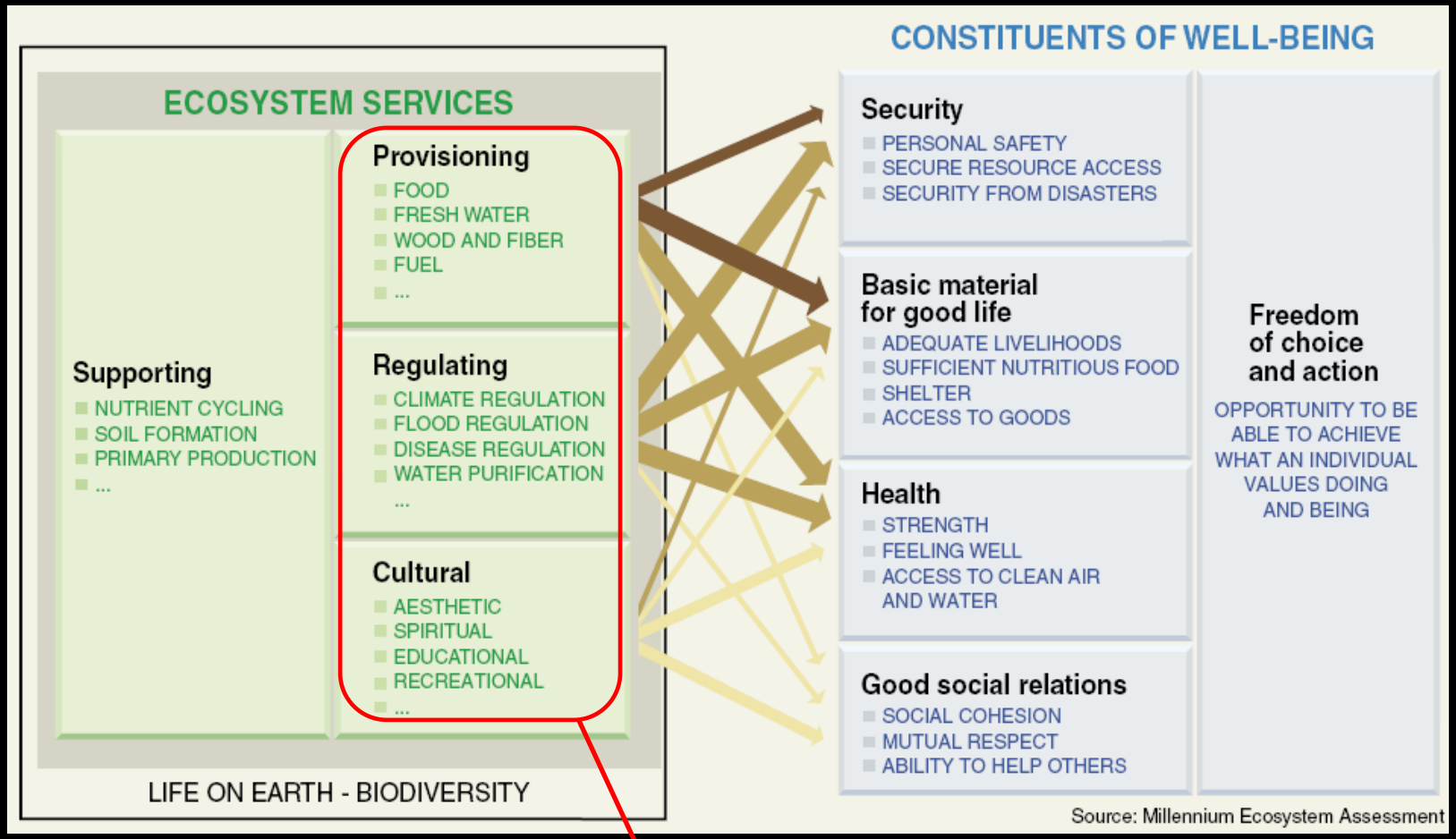
Nypa Palm

One useful wetland plant.

16 Common Uses

Roof thatching
Wall Panels
Floor mats
Baskets
Bags
Hats
Raincoats
Cigarette wrappers
Food wrapping
Brooms
Fuel
Chopped+Boiled for salt
Foodstuff
Fermented Beverage
Vinegar
Sugar

Wetlands:
Providers of ecosystem services



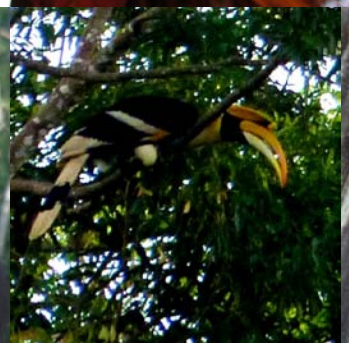
Direct benefits to the community

Biological Diversity

Many flagship species for conservation find refuge in wetland forests. Countless plants, fungi, fish and insects remain poorly known or undescribed






Carbon Storage

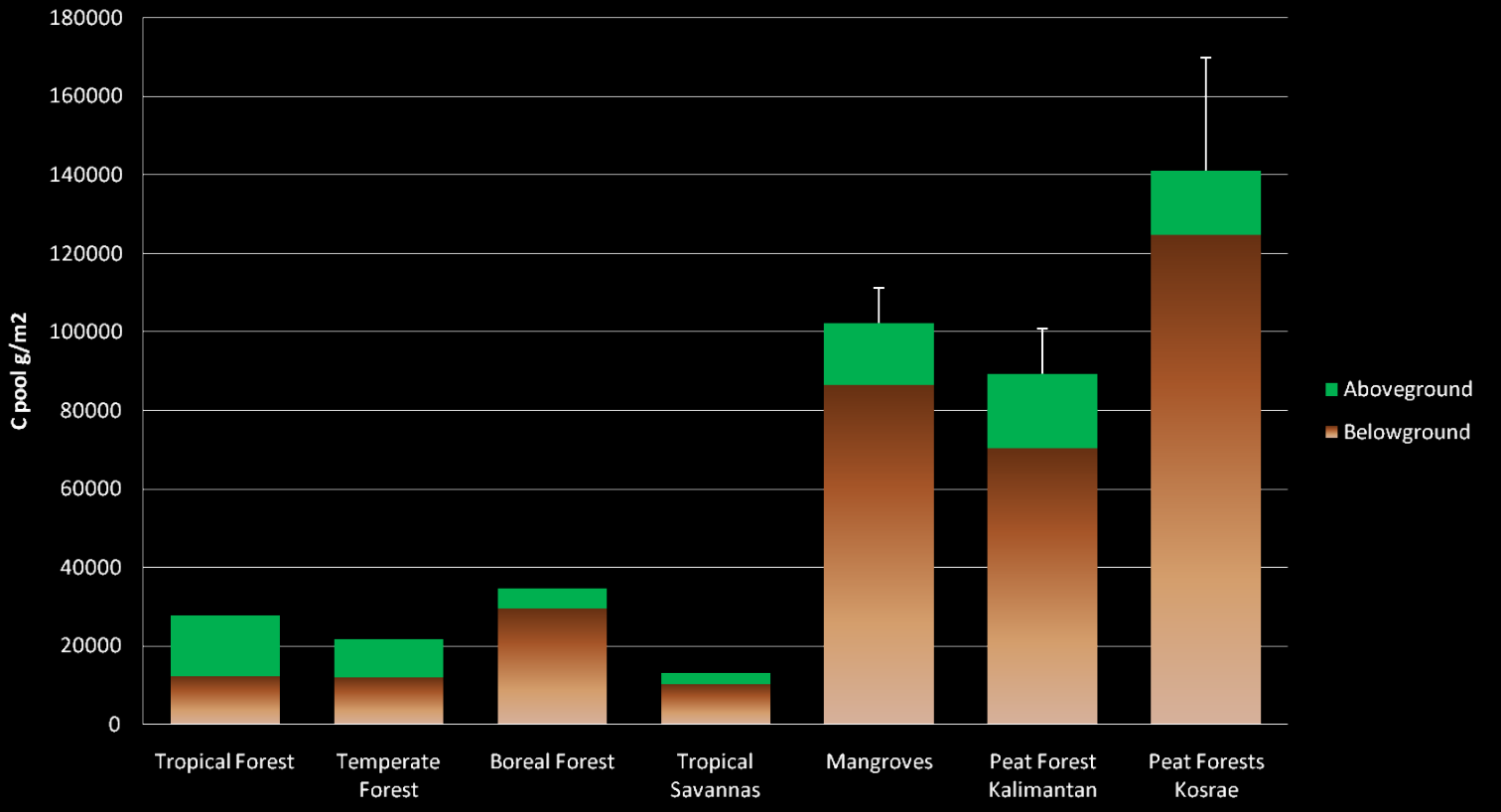
- Tropical wetlands store more C per ha than any other tropical forest types
- Tropical peatlands store about 88.6 Gt C, 15-19% of the world's total
- Estimates range from about 2000-3000 Mg C/ha (Page et al. 2010)
- Mangroves store and additional 4-20 Gt C globally (Donato et al. 2011)
- Estimates are uncertain, and need to be refined with additional data





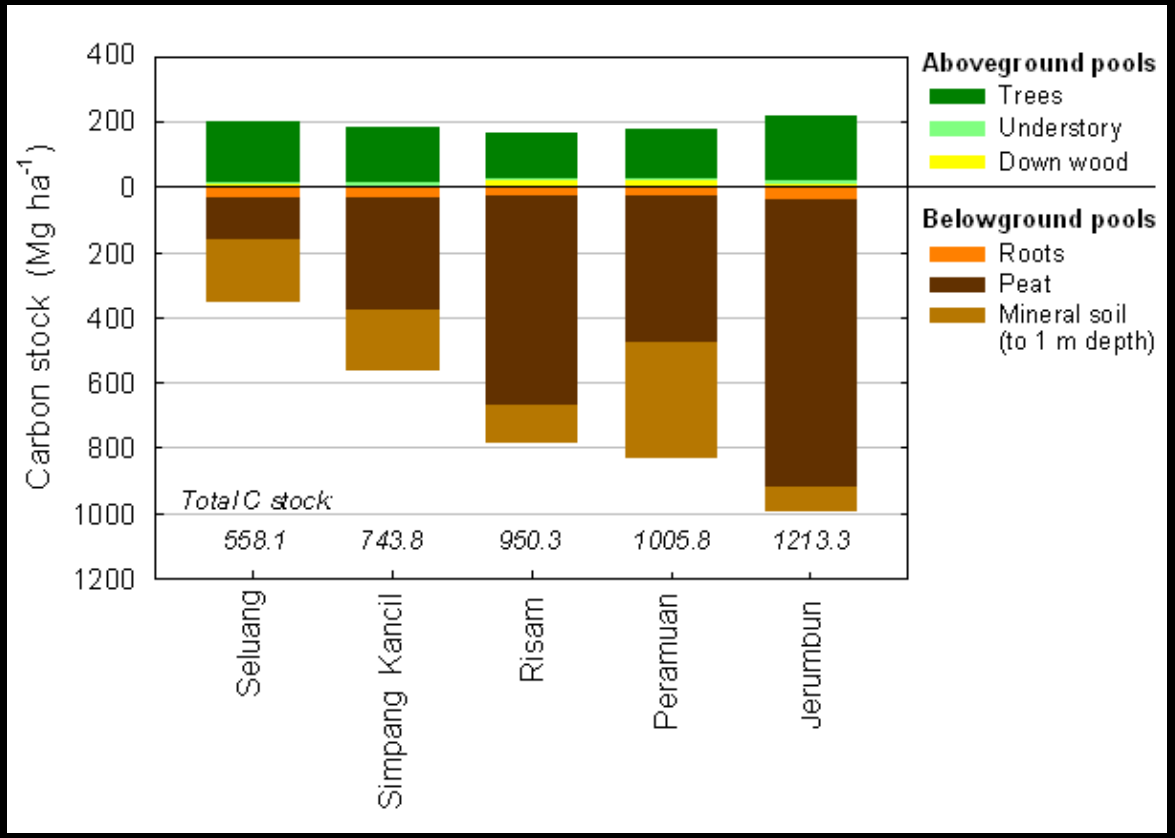

Tropical wetlands sequester and store more C/ha than other vegetation types in the upland forests

- Lack of oxygen slows decomposition, accumulating organic matter and Carbon
- Historical (millenia timescale) Carbon sinks vulnerable to disturbance and loss
- Often 90% of the ecosystem C is stored belowground
- Carbon storage up to 5-10 times that of upland tropical rainforests

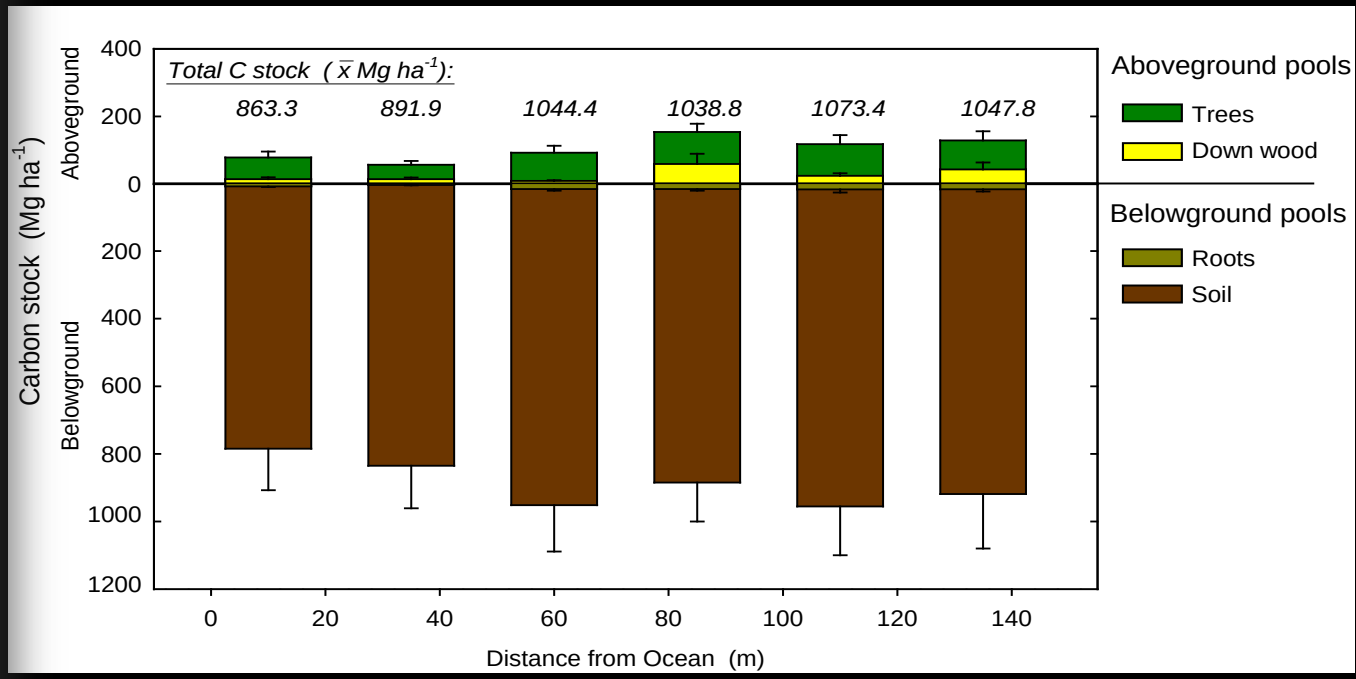


Data are from:IPCC, 2001: Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change ; Donato et al. (in press); Kauffman (in preparation)

C-stocks in peat swamp



C-stocks in mangroves

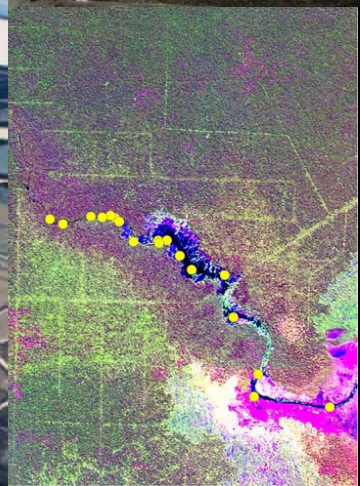


Threats to Tropical Wetland Forests:

Logging, land conversion, drainage, fire





Threats to Tropical Wetland Forests:

Global Climate Change

- Sea level rise
- Altered precipitation patterns
- Greater frequency of extreme events (floods, drought)
- Greater frequency and severity of tropical storms and tidal surge.

Coastal erosion

Threats to Tropical Wetland Forests:

Land-use change

Estimates of historical peatland area in SE Asia range from 20 – 30 Million hectares. A maximum of 36% remain. (Rieley et al. 1996; Posa et al. 2011)

30-50% of all mangroves lost in the past 50 yrs. (Duke et al. 2007)

Major peat swamp forest areas of SE Asia (Posa et al. 2011)

Initial:	182,541 km^2
Remaining:	67,243 km^2
Protected:	16,995 km^2 (9%)

Average annual deforestation rate in Borneo (Langner et al. 2007)

Lowland dipterocarp:	1.8%
Peat swamp forest:	2.2%
Mangrove forest:	8.0% (Indonesia)

Estimates of GHG Emissions from Tropical Wetlands

- Emissions from fire and land-use change are difficult at present, because baseline data and direct measurements are lacking.
- 0.81-2.57 Gt C released from Indonesian peatlands during the severe 1997 El Niño fire season (Page et al. 2002).
- 0.36-1.6 Gt C estimated for the same 1997 event (Langmann and Heil 2004)
- 0.25± 0.14 Gt C released from Indonesian peatland fires during the 2006 “typical” El Niño fire season (Ballhorn et al. 2009)
- Miettinen and Liew (2010) estimate 1.5 Gt C emitted from LULCC since 1990, and 0.08 Gt/yr are emitted annually.
- Hergoualc’h and Verchot (2011) calculate 427± 90.7 Mg C/ha emitted over 25 years when peat forest is converted to oil palm.
- Cowenberg et al. (2010) estimate 2.54 Mg C/ha emitted per year, for each 10cm increment of drainage depth.

Tropical Wetland Forests:

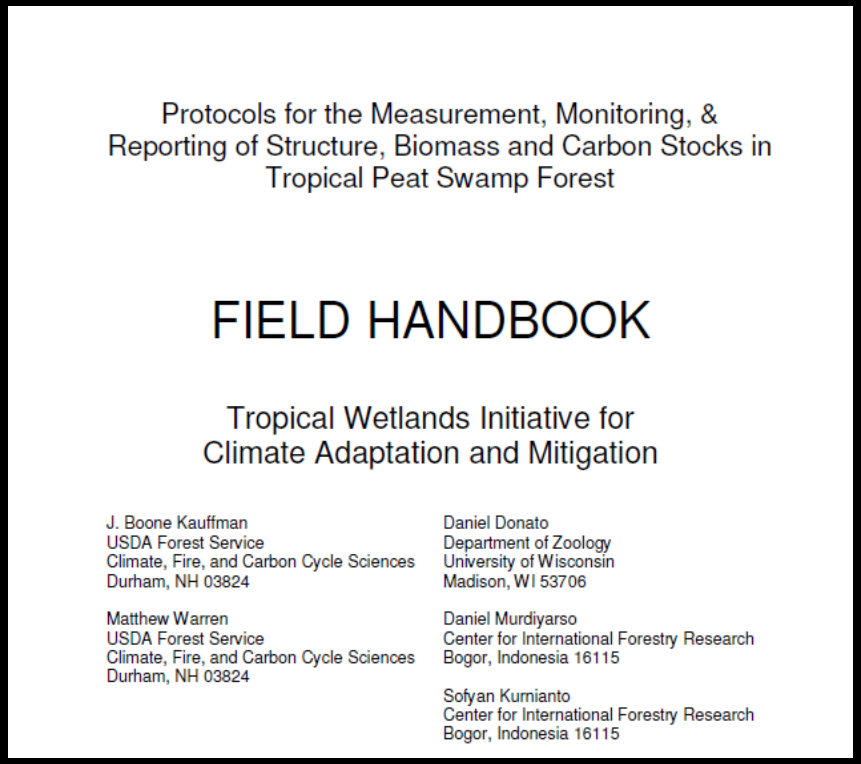
Priority targeted areas for REDD+ mechanism

- Among the highest ecosystem C densities on earth, with potential for large scale immediate emissions (fire) and long term oxidative losses (drainage leading to decomposition). Ecological return on investment high.
- Numerous critical ecosystem services are lost from land conversion, leading to degradation of human and environmental health.
- Vulnerability to climate change increased when ecosystem functions (such as coastal protection and water regulation) are lost.
- Associated conservation of biodiversity, including numerous highly threatened species.
- Highest rates of deforestation and degradation than any other type of tropical forest.

Challenges for REDD+ projects in tropical wetlands

- Revised guidelines for baseline emissions, activity data, and emission factors are needed for tropical wetland forests.
- Standardized protocols are needed for ecosystem C assessment in tropical wetlands, which consider the vast pools of belowground carbon.
- Special consideration is needed for Measuring, Monitoring, Reporting, and Verifying belowground ecosystem C stocks.
- Accurate measurements of belowground C can only be obtained from ground base measurements. Often difficult in remote regions.

Current USFS-CIFOR activities for tropical wetlands include



Protocols for the Measurement, Monitoring, & Reporting of Structure, Biomass and Carbon Stocks in Tropical Peat Swamp Forest

FIELD HANDBOOK

Tropical Wetlands Initiative for Climate Adaptation and Mitigation

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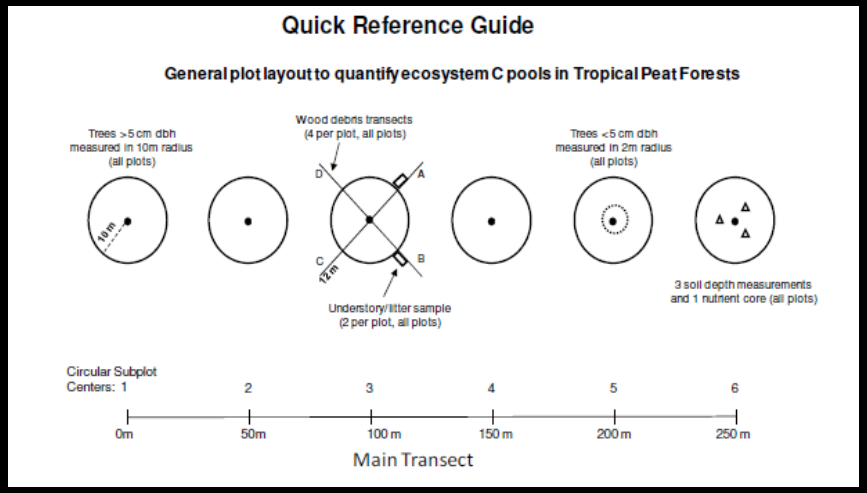

- Support the development of international REDD+ mechanisms for tropical wetland forests.
- Advance the science and knowledge of MRV and GHG emissions by conducting collaborative research and developing robust standardized protocols.
- Creating networks of governmental, non-governmental and university professionals to build and share knowledge bases of C inventories, GHG emissions, and LULCC of tropical wetlands.
- Building capacity and outreach of regional governmental and academic research institutions to engage local participation in REDD+ design and implementation.

Acknowledgements

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Additional questions or comments?
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