Catherine Lovelock
School of Biological Sciences
University of Queensland

Carbon emissions from degraded mangroves

- *Cleared mangroves in Belize*
- *Assessed CO_2 efflux from soils*
- *Soil "respiration" measurements over a chronosequence*
- *Models that use soil CO_2 fluxes for estimating carbon allocation to soils*

Study Site

- Twin Cays, Belize (16°N)
- 96 ha of mangrove within the Meso - American Barrier Reef
- 7-10 m of peat
- Carbon density of 300 mg C g^{-1}

Multiple episodes of illegal clearing (filling)


12 to 28m
of erosion
Length of Dock
38m
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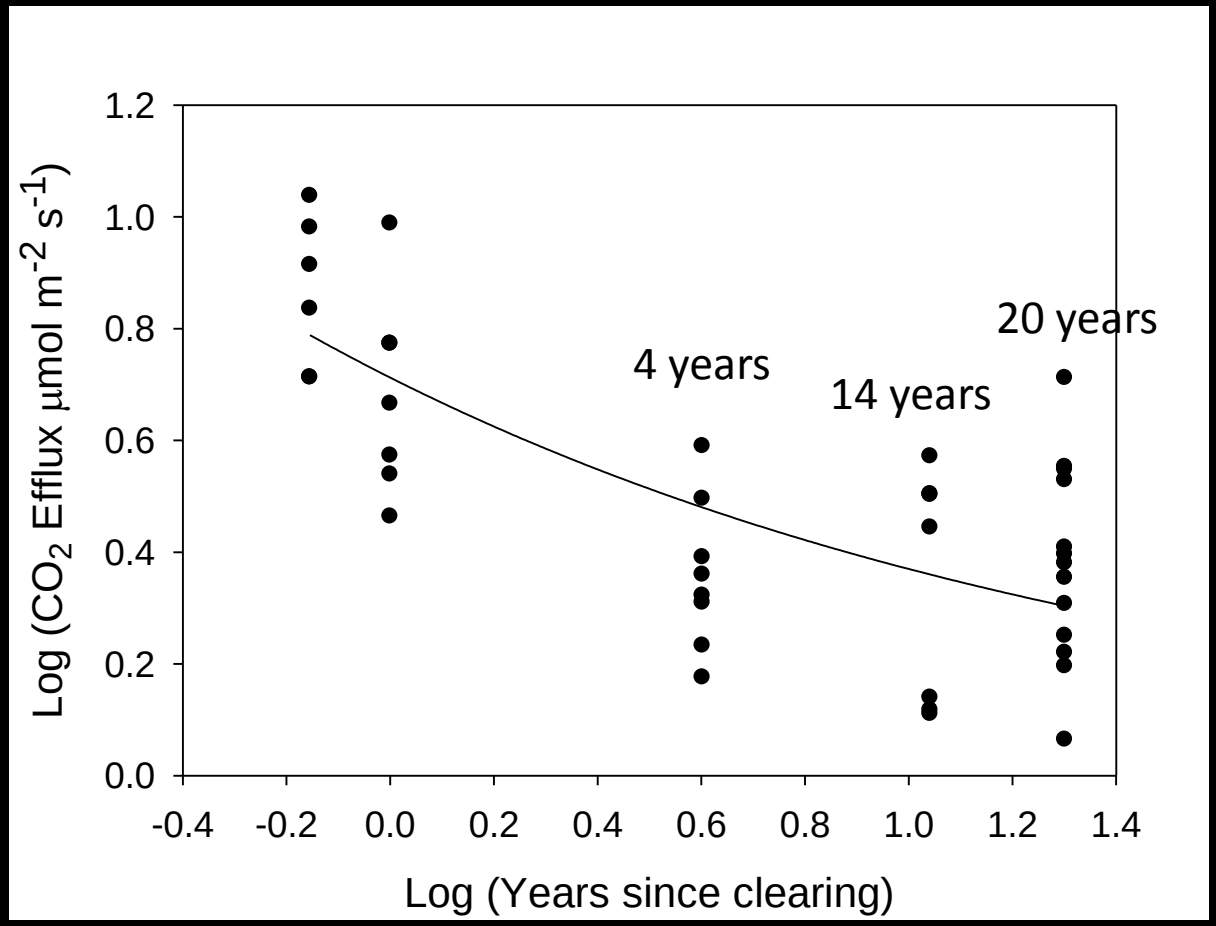
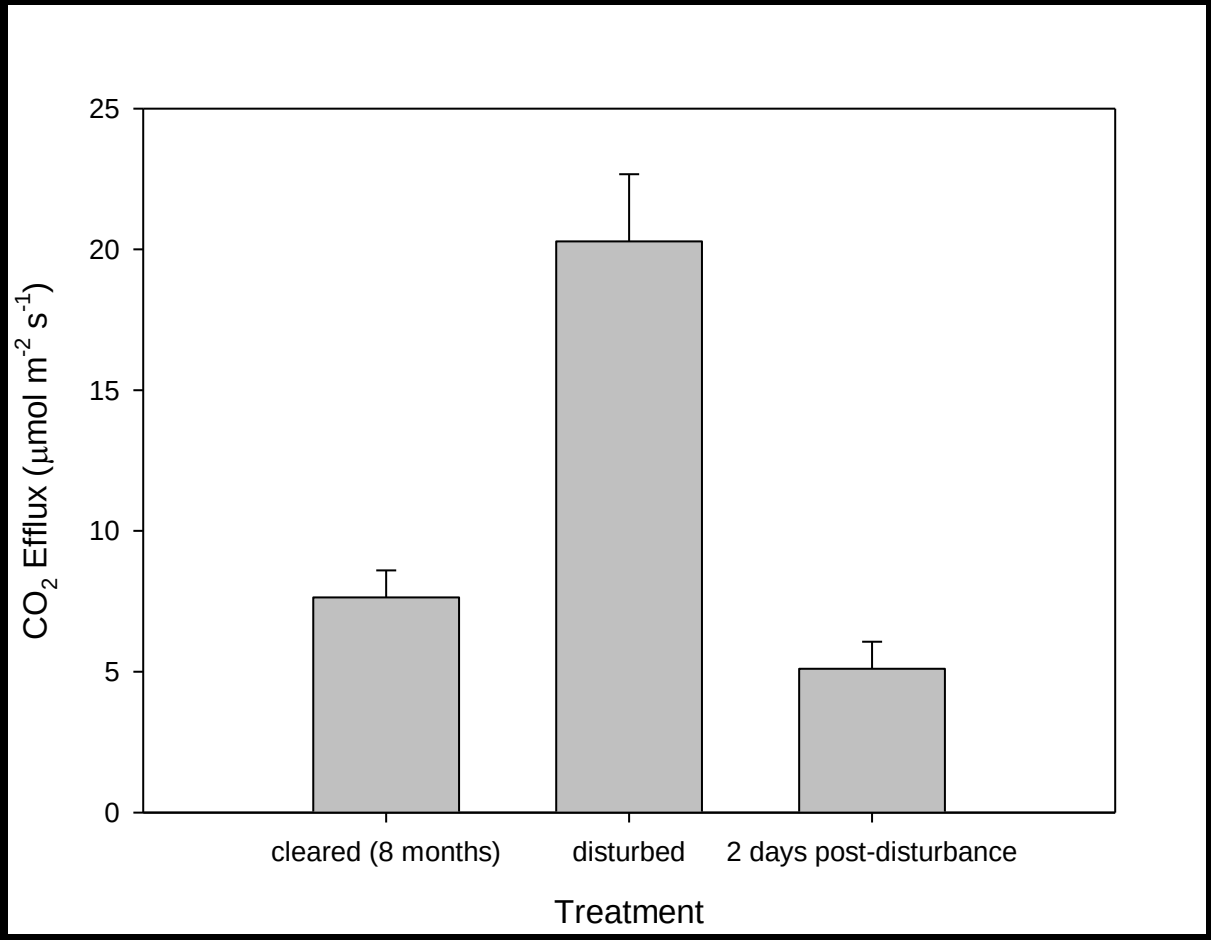
Soil CO_2 Efflux

CO_2 Efflux with time since clearing

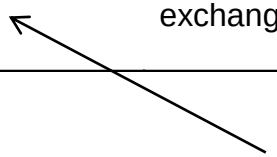


Big “puff” after disturbing the soils



Contrast with other measurements:

Habitat	Modification	CO_2 efflux tonnes km^{-2} $year^{-1}$	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 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



Vegetation intact

Moving right along:

- Loss of vegetation is the “easy” scenario (losses only)
- Soil respiration is an important process in the dynamics of carbon that is relatively easy to measure
- Can we extrapolate or model to increase our understanding of C sequestration

Terrestrial models:

Ecology, 70(5), 1989, pp. 1346–1354

BELOWGROUND CARBON ALLOCATION IN FOREST ECOSYSTEMS: GLOBAL TRENDS[1]

J. W. RAICH AND K. J. NADELHOFFER
The Ecosystems Center, Marine Biological Laboratory, Woods Hole, Massachusetts 02543 USA

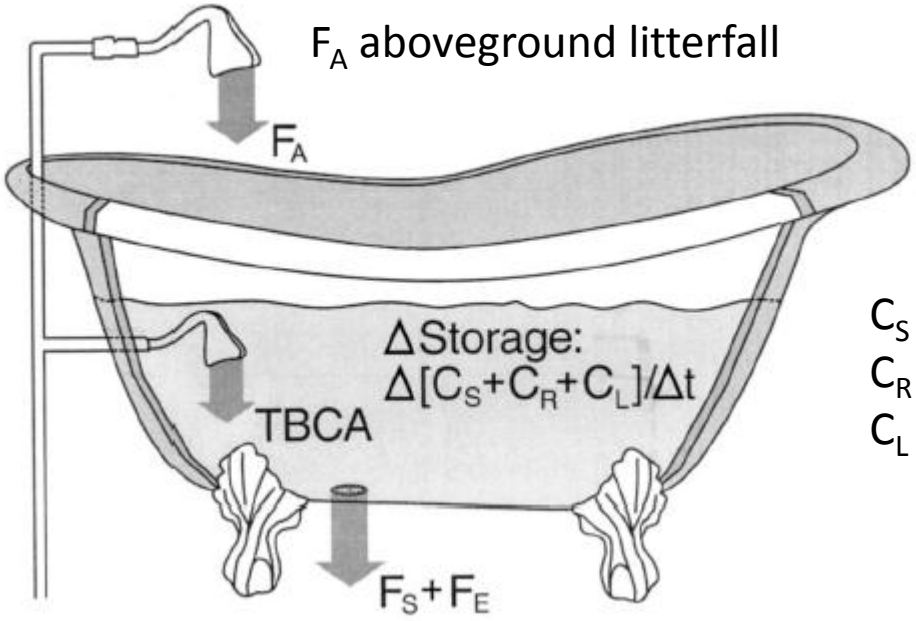
Ecosystems (2002) 5: 487–499
DOI: 10.1007/s10021-002-0130-8

ECOSYSTEMS

Total Belowground Carbon Allocation in a Fast-growing *Eucalyptus* Plantation Estimated Using a Carbon Balance Approach

Christian P. Giardina[1] and Michael G. Ryan*[2,3]

Total Belowground Carbon Allocation (TBCA)



C_S C in sediment
C_R C in roots
C_L C in litter

F_S Soil respiration, F_E Export

Through conservation of mass, the flux of water from the underwater faucet equals outputs minus inputs plus storage change

$$\mathrm{TBCA} = F_S + F_E - F_A + \Delta[C_S + C_R + C_L]/\Delta t$$

Various simplifications: e.g. TBCA = F_S - F_A

Recent Publications

- Alongi DM. 2011. Carbon payments for mangrove conservation: ecosystem constraints and uncertainties of sequestration potential. Environmental Science and Policy14: 462-470.

http://www.sciencedirect.com/science/article/pii/S1462901111000177

- McCleod E, Chmura GL, Bouillon S, Salm R, Björk M, Duarte CM, Lovelock CE, Schlesinger WH, Silliman BR. 2011. A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO2. Frontiers in Ecology and the Environment doi:10.1890/110004 http://www.esajournals.org/toc/fron/0/0

- Lovelock CE, Ruess RW, Feller IC. 2011. CO_2 efflux from cleared mangrove peat . PloS ONE 6(6): e21279. doi:10.1371/journal.pone.0021279

http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0021279