CARBON STOCKS IN TROPICAL FORESTS OF MEXICO

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INTRODUCTION

•Tropical forests represent the largest carbon pool in the terrestrial biota and the world's most productive ecosystems

•Natural or anthropogenic disturbances may convert tropical forests in important sources of carbon to the atmosphere

•Also, they can capture and store atmospheric carbon by natural regrowth or through management practices, but there are uncertainties regarding the quantities

•Temperate and tropical forests cover ca. 30% of Mexico's land area

•Data on C pools in tropical forests at different spatial scales are scant, particularly at the ecosystem level which include biomass, necromass, and soil

•This information is needed to evaluate the consequences of deforestation and land use/cover change, and to parameterize process-based simulation models

THE DRY TROPICS

THE HUMID TROPICS

Aboveground C pools (Mg/ha) in tropical dry forests of western México

	Site				
	Chamela	San Javier	Cosalá	Huacana	Cuicatlán
ABG-Live	36	30	25	17	31
ABG-Dead	23	5	3	5	3
Total	**59**	**35**	**28**	**22**	**34**
Rainfall (mm)	*780*	*655*	*910*	*908*	*553*

ABG = aboveground (From: Jaramillo et al. 2003a; Martínez-Yrízar et al. unpbl.)

Dry forests of the Yucatán Peninsula (MgC/ha)

ABG	Rainfall (mm)
81	892
73	1144
61	1418

(Estimated from Read & Lawrence 2003)

•The range of variation in C pools of the western forests in Mexico may reflect differences in rainfall or conservation status

•The Yucatán forests probably represent the upper limit of the range of C pool values in the aboveground biomass of tropical dry forests in Mexico

•Reduction of the uncertainties in these ranges has implications for C capture scenarios through management or natural regeneration

Ecosystem C pools (Mg/ha) in tropical forests of México

	Forest type			
Component	Deciduous (Chamela)	Semideciduous (Chamela)	Evergreen (Tuxtlas)	Evergreen (Lacandona)
ABG-Live	36	153	185	233?
ABG-Dead	23	28	10	-
Sub-total	*59*	*181*	*195*	*233*
Roots	7	13	9	43*
Soil	76	113	210	176
Sub-total	*83*	*126*	*219*	*219*
Total	**142**	**307**	**414**	**452**

* = estimated (From: De Jong et al. 2000; Hughes et al. 2000; Jaramillo et al. 2003a,b)

•The biomass C pool (ABG + Roots) in the semideciduous forest is 3-fold higher than in the deciduous forest of the same region. However, biomass C pools in the semideciduous (194) and the Los Tuxtlas evergreen (204) forests are similar, despite the large differences in annual rainfall (~700 mm vs ~ 4000 mm, respectively)

•Implication: water availability regulates C accumulation in biomass, either by differences in the landscape position of the plant communities or by differences in precipitation

•Soil C pools are 59% (semideciduous), 76-103% (evergreen) and 121% (deciduous) of the C pools in the ABG-biomass of these forests

•The relative importance of C storage in the soil increases as water availability decreases; although, storage is also influenced by soil physico-chemical properties

Are site measurements comparable to estimates at the regional level obtained through a combination of direct and indirect methods?

•ABG-biomass estimates for SE Mexico based on Cairns et al. (2000)

•15-41 MgC/ha "small selva" vs 17-36 (Western forests) y 61-73 (Yucatán forests)

•20-127 MgC/ha "tall/medium selva" vs 181-233 (Chamela, Los Tuxtlas, Lacandona)

Differences may reflect an intrinsic bias in the estimates, but also the effect of heterogeneity within the country's tropical forest landscape (primary, secondary, disturbed)

Site-specific measurements are critical to constrain values that require different methods (top down) to provide regional level estimations

SECONDARY TROPICAL FORESTS

C pools (Mg/ha) in secondary tropical forests of México

	Site			
Component	Chamela	Tuxtlas*	Yucatán*	Morelos*
ABG-Biomass	19	2 - 137	5 - 47	-
Roots	5	3 - 10	-	-
Soil	56	207	-	38 - 40
Total	80	211 - 354	-	-

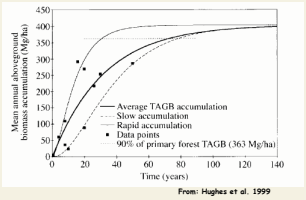
*Ranges are for forests of different ages. The Yucatán data includes only the live component of ABG-biomass.
From: Hughes et al. 1999; Read & Lawrence 2003 (estimated from their biomass data); Saynes et al. 2005; Romero-Duque in prep.

Secondary forest C as a percentage of primary forest pools

•Chamela – ca. 27 years since abandonment
32% of aboveground, 78% of soil, 56% of ecosystem
•Yucatán - 2-25 years since abandonment
8-72% of live aboveground
•Morelos – 10-60 years since abandonment
107%-112% of soil in top 10 cm
•Tuxtlas - 6 months to 50 years since abandonment
1-74% of aboveground, 100% of soil, 51-86% of ecosystem

How long does natural regeneration take to recover aboveground C pools to levels comparable to primary forest?

Model for aboveground biomass accumulation in the "Los Tuxtlas" forest



From: Hughes et al. 1999

79 years are needed to reach 90% of the total biomass of the primary forest

How do dry and humid tropical forests of México compare in terms of potential C emissions to the atmosphere from land-use change?

Regional Perspective

Potential C emissions from dry and humid tropical forests in México as a function of their areas and combustion factors

	Forest type	
	Dry	Humid
C pool	2.3 Pg	2.4 Pg
Combustion factor	0.72	0.51
Potencial C emission	708 Tg	569 Tg

From: Jaramillo et al. 2003a

These values likely represent upper-bound limits, estimates that better reflect tropical forest heterogeneity are needed.

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