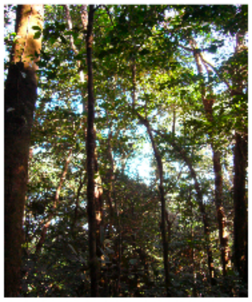

Does species dominance decreases carbon content in tropical communities?

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Introduction

Experimental studies assessing the role of biodiversity and its effects on ecosystem functioning have generally shown that a decline in species number has negative effects on ecosystem functioning (Tilman et al. 1996, Naeem et al. 2003, Spehn et al. 2006).

Even though, this relationship has been intensively study in the last ten years (Naeem et al. 2003, Balvanera et al. 2006), little is known about this relationship in natural communities where species diversity is not manipulated.

I studied the effect of biodiversity on ecosystem function in a tropical forest in Panama.

I tested the following hypothesis:

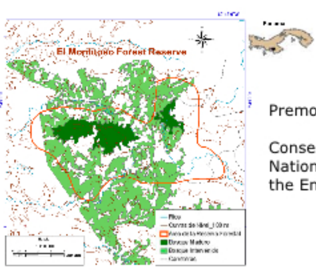
Controlling for dominance in natural communities, I expect to have a positive relationship between tree species diversity and carbon content.

Dominance is a measure of biodiversity that considers the relative contribution of a single species to the total abundance or biomass (Davidar et al. 2005, Wilsey et al. 2005).

Dominance can be useful to account for species variation in natural communities. Since the contribution to carbon content in a patch is accounted for by few species (Balvanera et al. 2005) that have greater importance values (Aide et al. 1995).

Carbon content in tropical forests has received attention in efforts to identify carbon sinks to decrease atmospheric CO_2 concentrations (Santilli et al. 2005, Malhi 2005).

Study sites and Methods



Premontane forest

Conserved by the National Authority of the Environment.

In January 2007, I developed a stratified sampling accounting for tree dominance.

After identifying a dominant patch size, I measured a patch of the same size of the adjacent forest to control as much as possible for environmental variation.

I collected data for the following species: *Calophyllum brasilense* (4 patches), *Clethra lanata* (1 patch), *Quetzalia occidentalis* (2 patches), and *Virola sebifera* (1 patch).

I measured the diameter at breast height (dbh) and wood density and identified to species woody species larger than 10 cm dbh.

To assess environmental variation, I measured elevation, slope, aspect, and soil depth every 10 m on each forest patch.

As a preliminary analysis, I used paired t-test to examine the effect of dominance on tree carbon. For this analysis, I pooled all dominant patches and compared them with no dominance patches

Preliminary Results

Table 1. Means and percent of the coefficient of variation (CV) of the variables of biodiversity, carbon content, and site characteristics measured in El Montuoso Forest Reserve for the dominance treatments. Values represent the pooling of eight paired sites. Slope values vary from 1 to 5, where 1 are flat areas and 5 steep slopes. Asterisks represent the statistical significance ($p > 0.05$) based on paired –t tests.

Variables	Dominance	No Dominance
Biodiversity		
Richness	5.06 (26)	8.13 (35)*
Shannon-Weiner	2.07 (26)	2.50 (7)*
Dominant species relative abundance (%)	34 (37)	19 (23)*
Ecosystem function		
Carbon content (MgC ha-1)	116.85 (36)	126.61 (63)
Site characteristics		
Elevation (m.a.s.l.)	911.00 (3)	917.00 (3)
Slope Index	2.75 (30)	3.29 (26)
Aspect (Degrees)	231.58 (59)	210.06 (56)
Soil depht (cm)	86.06 (15)	88.67 (9)

Controlling for dominance and environmental variation can provide a natural treatment for species diversity. Since most diversity measures show a significant difference between dominance and control.

There was no difference in carbon content.

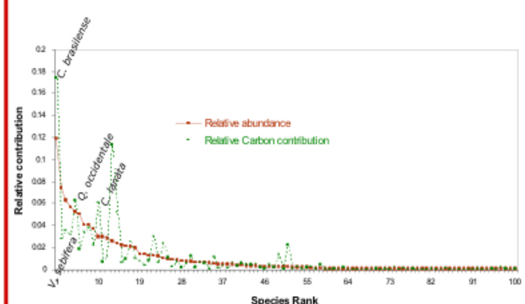


Figure 1. Comparison of the relative abundance and carbon contribution of species present in El Montuoso Forest Reserve. Species are ranked by their average relative abundance from the most to the least abundant of plots (n=12).

Conclusion

Overall, no difference in carbon content was detected between dominant patches and controls. However, evidence showed that trees contribution to carbon content is species specific in our system. The importance of species identity to carbon content have been identified by Balvanera et al. 2005 and Healey and Potvin, unpublished.

References

Aide et al. 1995. Forest Ecology and Management 77:77-86.
Balvanera et al. 2005. Ecological Applications 15: 360-375.
Balvanera et al. 2006. Ecology Letters 9: 1146–1156.
Berger & Parker. 1970. Science 168: 1345-1347.
Borda-de-Agua et al. 2002. The American Naturalist 159: 138-155.
Condit et al. 2005. Biologiske Skrifter 55: 565-582.
Davidar et al. 2005. Journal of Biogeography 32: 493–501
Hector et al. 1999. Science 286: 1123-1127.
Malhi et al. 2005. Global Change Biology 12: 1-32.
Naeem et al. 2003. In Loreau, M., S. Naeem, and P. Inchausti. Biodiversity and Ecosystem Functioning. Oxford University Press, UK. Pages 3-11.
Santilli et al. 2005. Climatic Change 71: 267-276.
Spehn et al. 2005. Ecological Monographs 75: 37-63.
Tilman et al. 1996. Nature 379: 718-72
Wilsey et al. 2005. Ecology 86: 1178-1184.

Future work

How we can detect the relationship between biodiversity and ecosystem function in natural environments?

Lowland wet tropical forest that is old-growth forest (circa 200 yr old).

4.8 ha Dynamic plot maintained by the Smithsonian Tropical Research Institute

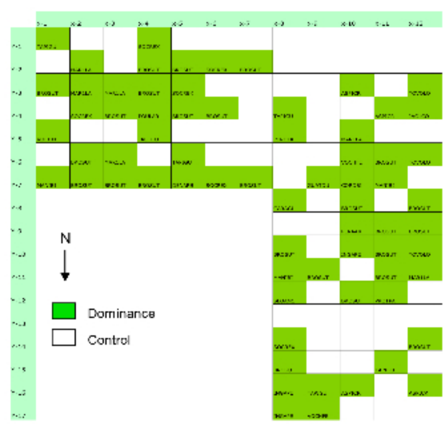
All tree species ≥ 1 cm dbh had been mapped, measured, and identified.

Maximize the possibility of sampling in areas of both high and low dominance by using randomly stratified sampling.

Dominance is considered the relative abundance and relative basal area of the most common tree species in a patch (Berger and Parker 1970, Aide et al. 1995, Borda-de-Agua et al. 2002).

Hierarchical Design

Carbon content = μ + Dominance +Identity (Dominance) + Patch (Identity (Dominance)) + Error.



I will use the distribution of trees larger than 10 cm of diameter at breast height (dbh) To stratify for dominance, I will use data of the 20 x 20 m^2 (n=124) plots in Fort Sherman from the 1999 census.

Higher dominance plots will have values larger than average dominance in the Neotropics (13.5 %; Condit et al. 2005).

Within the high dominance group, I will account for species identity by a constrained random selection of three replicates displaying dominance for each of the six most common species .

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