Which factors control tree growth in a tropical mountain forest? The case of *Cedrela montana* in Southern Ecuador

Susanne Spannl[1], Sven Günter[2], Thorsten Peters[1], Franziska Volland-Voigt[1], Achim Bräuning[1]

[1] University of Erlangen-Nuremberg, Institute of Geography Erlangen, Germany
[2] Technical University of Munich, Institute of Silviculture, Freising, Germany

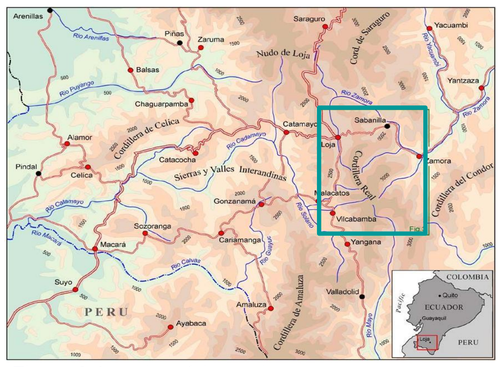


Figure 1: Location of the study area: Reserva Biológica San Francisco (rectangle) [http://bergregenwald.de]

Study aims are …

- …to examine the main influencing factors of tree growth in a tropical mountain rain forest - Reserva Biológica San Francisco [**Figure 1]**
- …to understand the linkage between tree growth rates and seasonal climatic patterns
- …to determine the relationship between competition for light and tree growth

Figure 2: *Cedrela montana* [Volland-Voigt 2009]

Cedrela montana (Meliaceae) …

- …is a slow growing deciduous broad–leaved tree species
- …maximum growth height is up to 30m
- …its wood is characterized by its hardness and high durability that causes a high economic value of the species
- …occurs in the tropical mountain rainforests of southern Ecuador

Influencing factors

Climatic conditions

Since April 2006, radial stem diameter variations of four *C. montana* were measured in 30 min intervals with high-resolution dendrometers. **Figure 3** shows the cumulative radial stem diameter variations, (upper panel), and its connection with daily sums of precipitation and daily maximum vapor pressure deficit (lower panel).

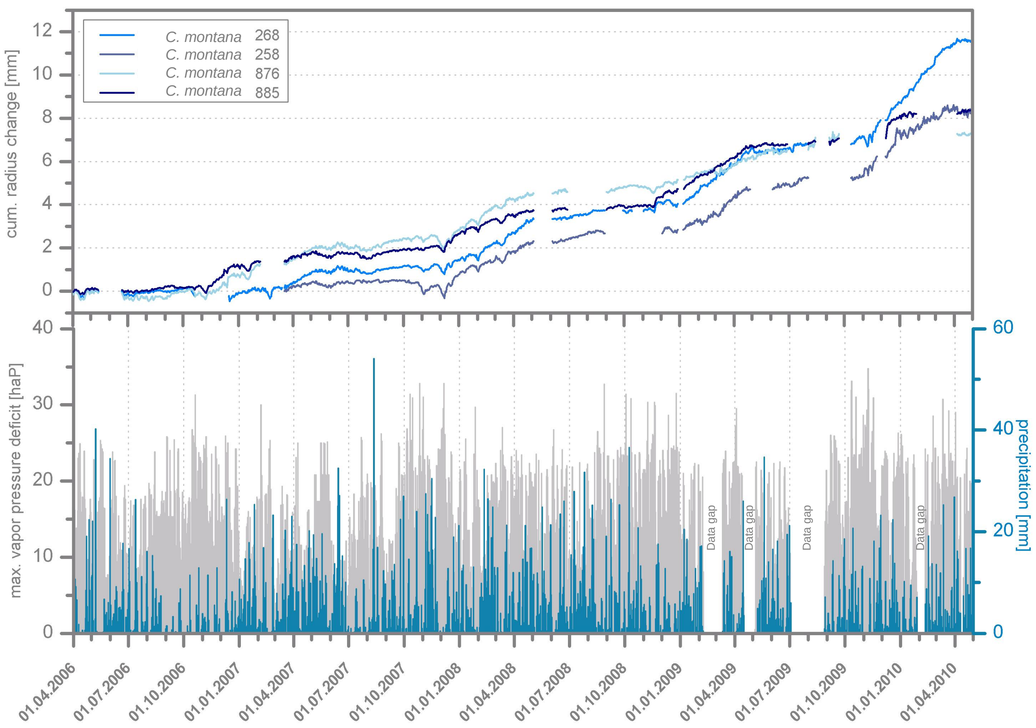


Figure 3: Cumulated daily radial stem variations of four *C. montana* individuals and climatic conditions during April 2006 to May 2010

Cumulative growth curves are quite homogenous between the four studied trees. The long-term trend of the dendrometer curves shows a seasonality of cambial activity during January to April, as indicated by a drastic increase in radial diameter. In the beginning of May, growth rates decrease and only minor stem diameter variations are observed [Bräuning et. al 2008].

Beside this general growth trend, the dendrometer curves also reveal synchronized short-term variations which are characterized by a radical stem shrinkage during rainless periods. **Figure 4** examines the relationship between daily maximum vapor pressure deficit and daily amplitude of stem diameter variations for two *C. montana* individuals at two different times (wet period: 03.08. – 14.08.2007; dry period: 26. – 08.12.2007).

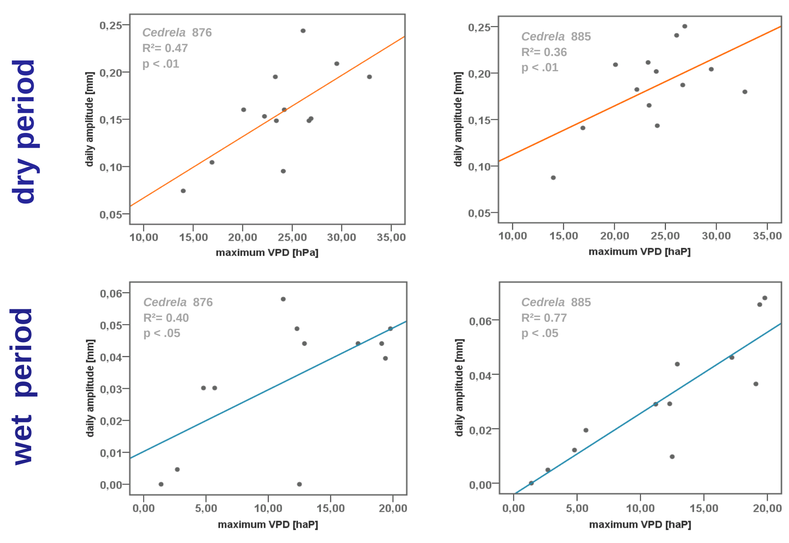
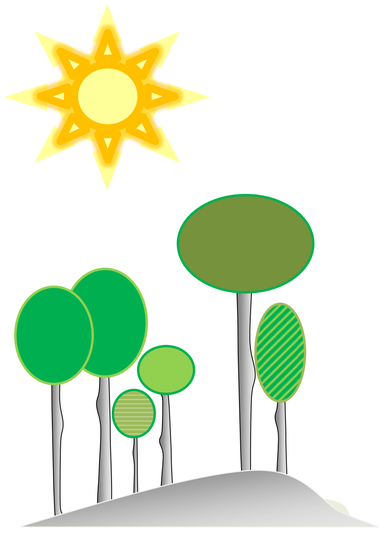


Figure 4: Linear Regression between daily maximum vapor pressure deficit and daily amplitude of stem diameter variations for two times (wet period: 03.08. – 14.08.2007; dry period: 26.11. – 08.12.2007)

The results document a positive correlation between the amplitudes of daily stem diameter variations and the amount of maximum daily vapor pressure deficit at both periods of time. During humid periods, daily stem diameter variations are considerably smaller than in rainless periods. Thus, times of stem water saturation are shorter during a dry period, implying that cambial activity is limited by available moisture even in such a very humid climate.

Competition for light

To evaluate competition-growth relationships, 38 Individuals of *C. montana* were classified according to the fivefold stepped Dawkins-Classification [**Figure 5**], that reflects the absorption of light for each tree [Dawkins 1958].



Score	Name	Definition
5	EMERGENT	Entirely exposed, free from competition for light.
4	UPPER CANOPY	Exposed in entire vertical plan but in contact with other crowns laterally.
3	LOWER CANOPY	Partly exposed and partly shaded vertically by other crowns.
2	UPPER UNDERSTORY	Entirely shaded vertically but with some direct side light
1	LOWER UNDERSTOREY	Entirely shaded vertically and laterally by other crowns.

Figure 5: Dawkins-Classification

In order to measure these effects on tree growth, the radial mean width of the year 2005 was analyzed. Enhanced absorption of light correlates negatively with annual tree growth (N= 38; r=0.33; p< 0.01). In conclusion, the more light a tree receives, the less it grows [Spannl 2009]. **Figure 6** shows the relationship between annual radial growth and light absorption. This finding confirms that drier conditions as they are induced by higher light exposure are not favorable for the growth of *C. montana*.

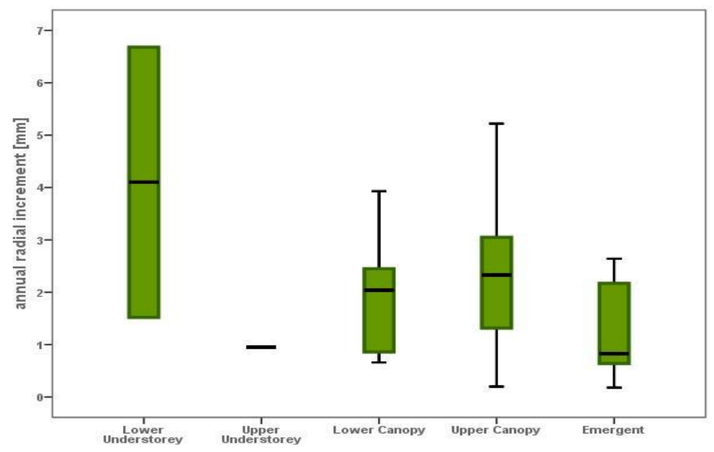


Figure 6: Relationship between annual radial growth and light consumption
Black horizontal bars represent the Median; ***Box limits*** (green) give the 25-75% quartiles;
Short horizontal bars indicate the minimum and maximum values

Conclusion

The case of *C. montana* gives first evidence that tree growth in a tropical mountain forest is not determined by just one dominant climatic element, but is rather influenced by a complex interaction of environmental factors. However, to derive general conclusions about the controlling factors of tree growth in such an ecosystem, it is mandatory to examine additional tree species belonging to different plant functional types.

References:

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