Pith-to-bark profiles of xylem vessel traits reveal unique information on tree performance in a tropical moist semi-deciduous forest of the Congo Basin

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What and why?

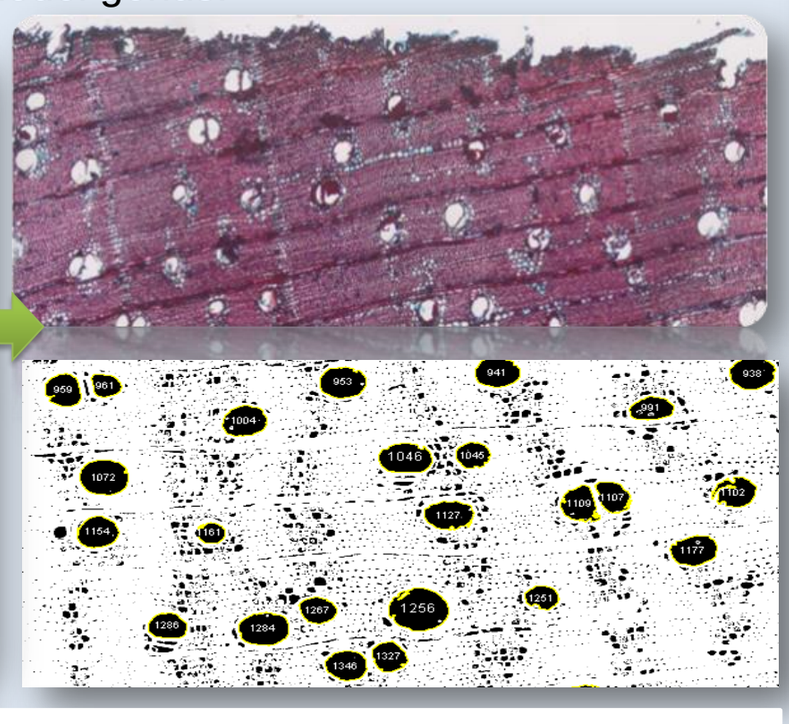
Xylem **vessel features** are being analyzed for:

- **ecophysiological** projects aiming at understanding sap flow and **vulnerability to drought (or warming) and cold stress**;
- **timber identification** as one of the first steps: they can easily be observed even with a hand lens; and
- evaluating **growth rate of trees in diameter and height**; and
- prediction of **tree mortality in adverse climatic conditions**

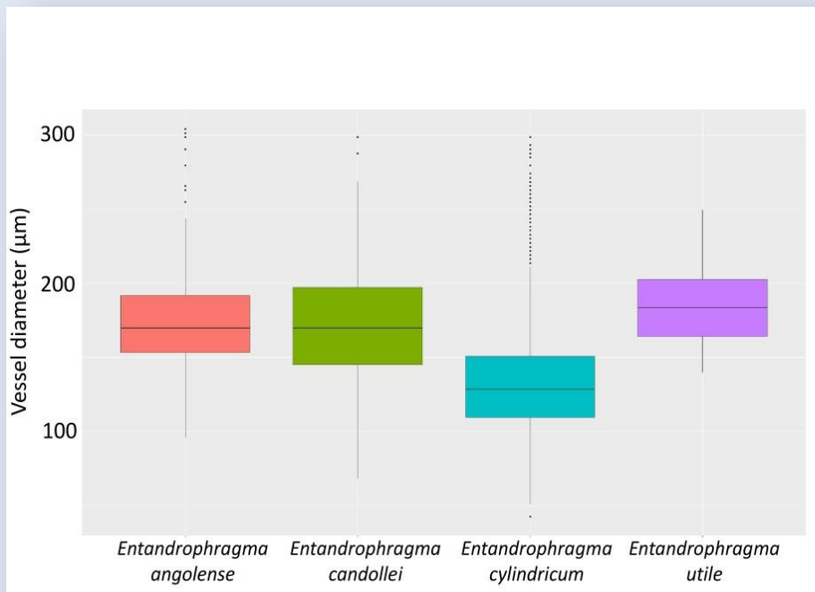
As the functional groups of **species of a tropical rainforest** are based on height grow rate (related to light needs), it is expected that **pith-to-bark profiles of vessels reveal information on temperament of the species.**

How and where?

A methodology has been developed to **establish pith-to-bark profiles of vessel features**, based on long microtomic sections, image analysis and machine learning. *Entandrophragma* species of high commercial value from Biosphere Reserve of Yangambi (UNESCO-MAB) in D.R. Congo were used as a model genus.



Results



	E. ang	*E. can*	*E. cyl*	*E. uti*
E. ang		ns	***	*
E. can			***	**
E. cyl				***

Figure 1: Left: Boxplots showing the vessel diameter (µm) for the four *Entandrophragma* species. Right: Significant differences based on the Mann-Whitney-Wilcoxon Test (significance levels: ns = not significant, * = p ≤ 0.05, ** = p ≤ 0.01, *** = p ≤ 0.001)

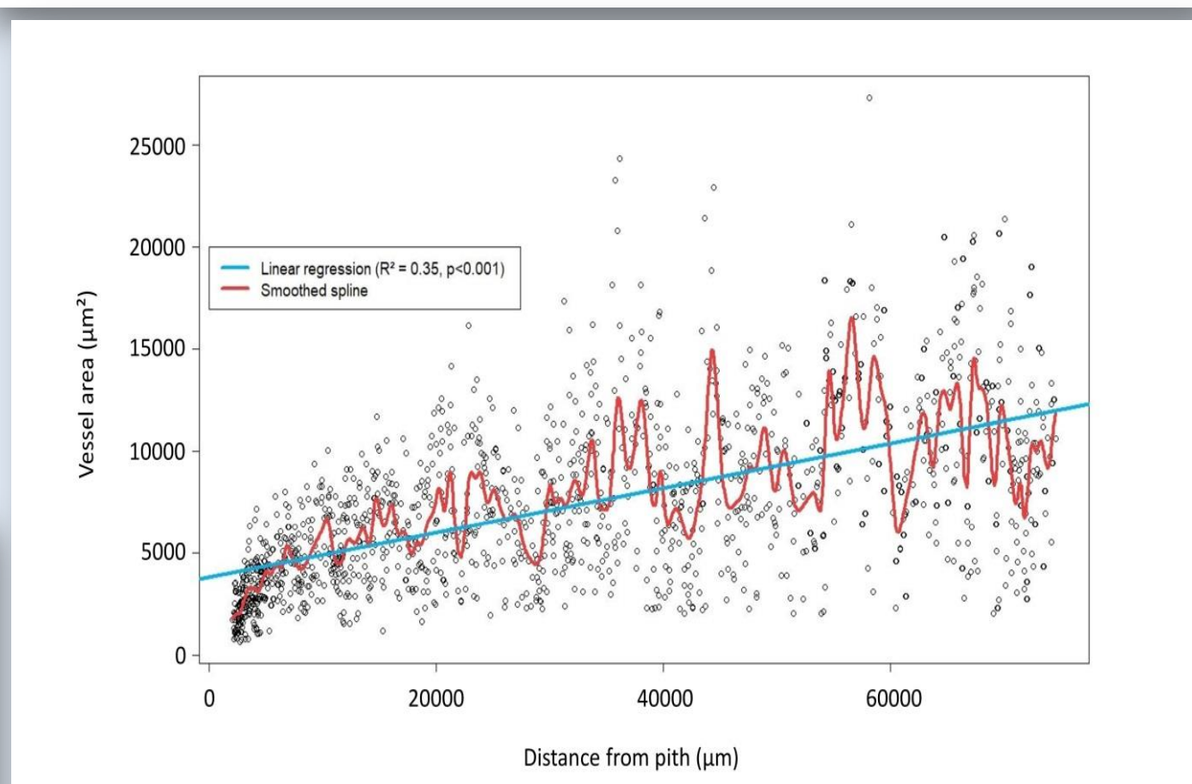


Figure 2: Example of a single sample of *Entandrophragma angolense*, showing the relationship between vessel area (µm²) and the distance from the pith (µm). The blue line represents the linear regression and the red line the smoothed spline.

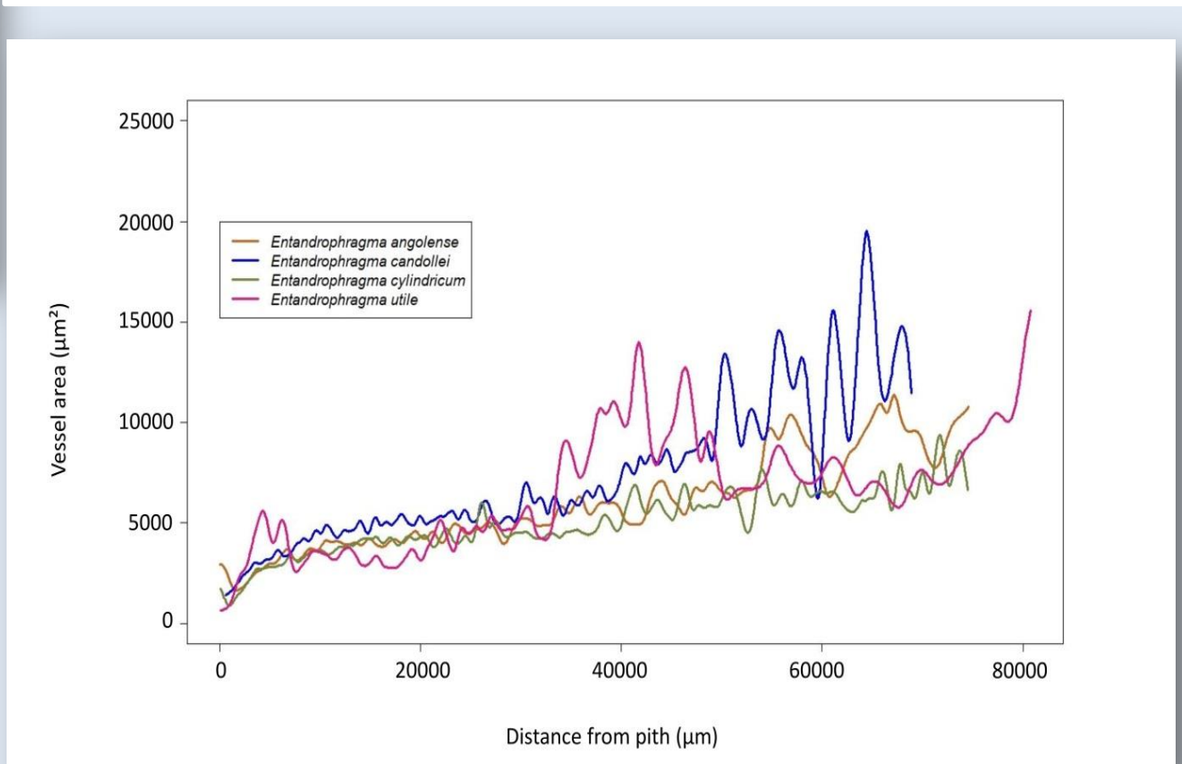


Figure 3: Smoothed spline representation of the vessel area (µm²) from pith to bark (µm) for *Entandrophragma* species. Close to the pith all species have vessels of similar sizes. *E. candollei* tends to have the biggest vessels at 5 cm from the pith, whereas *E. cylindricum* still has small vessels at the same position.

Conclusion and research perspectives

- The difference in mean vessel size is significant between every species combination except between *E. angolense* and *and E. candollei*.
- Currently, pith-to-bark vessel trends are continuing to be constructed that could help **explaining difference in vulnerability to drought or warming and growth strategy**.
- The approach offers appealing perspectives to find a formal way for sub setting tree species into functional groups and **develop indexes for growing conditions of forest sites.**

Acknowledgement for founding

"Forêt et Changement Climatique au Congo" (FCCC) project funding by Global Climate Change Alliance (GCCA) of the European Union, Xyladate project, and Fonds Lépold III pour l'exploration et la conservation de la nature.