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What branches and saplings tell us about drought sensitivity of Amazonian forests?

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In 2005 one of the most intense droughts of the past 100 years affected extensive areas of the Amazon Basin and, measurements made across a range of permanent sample plots found that larger and lighter-wooded trees were more prone to die. It thus appears that such climatic events can cause dramatic changes in the functional composition of tropical forest. Yet, it is not known how sensitive to drought Amazonian forests tree species are or what was the mechanism inducing increased mortality in large and low wood density trees as a result of the drought.

For a number of species and environments "functional" xylem density (Dx, g cm-3) has been proposed as a "functional trait" which can be used to infer how resistant trees are to breakage, drought induced embolism, water storage, and photosynthetic capacity, hydraulic efficiency and growth. Branch xylem density (Dxb) has been measured for more than three thousand trees across the basin. Patterns of Dxb indicate that there are regions (West, South, North) that tend to have low density wood while other regions paralleling the Amazon River tend to have trees with high density wood. But should this mean that (other things being equal) regions that tend to have lighter-wooded trees should loose trees faster than dense-wooded regions if the Amazon dries? In this work we extrapolate results on cavitation resistance, xylem hydraulic efficiency from branches and saplings from trees and lianas growing in forests in French Guiana to the whole Amazon basin by using Dx as the integrating key factor. Preliminary results indicate that Dx is not a predictor of resistance to drought induced cavitation for branches or saplings from French Guiana and probably not for trees across the basin. The most resistant species were those growing in highly disturbed forests and the most sensitive were those species from old growth forests. In the studied forests there were both light and dense-wooded species. Perhaps lighter-wooded trees die because a combination of age, drought, temperature and pathogens and not only as a consequence of xylem failure. In conclusion we do not know enough about branch, sapling or tree functioning to answer why large and lighted wood trees died after the 2005 drought.