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Dendrochronological potential of the tropical wet miombo trees unveiled through African Fieldschools

Participants of the 3rd African Dendrochronological Fieldschool, 2023*

3rd African Dendrochronological Fieldschool, Kitwe, Zambia, 24 July–2 August 2023

Environmental challenges have had a negative impact on African forest resources, which has subsequently adversely affected some ecosystem services that are required for the survival of people. Dendrochronology is a science that helps solve these problems. However, the use of dendrochronology in Africa has been limited due to a lack of experts to support research and training. The African Dendrochronological Fieldschool program was established to develop human capacities in the field of tree-ring science and research. The program was initiated by the Copperbelt University (CBU); through the Copperbelt University Africa Centre of Excellence for Sustainable Mining (CBU-ACESM) in Zambia, to provide basic scientific knowledge and skills to participants in sample collection, preparation, tree-ring measurement, cross-dating, chronology building, and interpretation of results. After completing the training, participants are expected to have gained basic knowledge to help solve various environmental problems.

Training format

The training adopts the North American Dendroecological Fieldweek format. Participants are introduced to various projects on the first day after touring the potential sampling sites. Each participant then chooses the project of their interest. The assigned facilitator takes participants through the project, from the beginning to the end of the training (Speer et al. 2006).

Study focus

During the training, participants were divided into four groups to focus on four different topics in the wet miombo woodlands of Zambia:

i) Dendroecology: Establishment of the arboreal diversity and dynamics of wet miombo woodlands.

ii) Dendroclimate: Determining the effects of precipitation on the growth of *Brachystegia longifolia* and *Julbernardia paniculata*.

iii) Dendrochemistry: Evaluation of the metal concentration in *Brachystegia longifolia* induced by copper mining pollution.

iv) Wood Anatomy: Determining the anatomy of selected tree species from the wet miombo woodlands.

Field sample collection

All samples were collected from the African Explosive Limited (AEL) site in Mufulira District on the Copperbelt Province of Zambia (Fig. 1).

Laboratory sample preparation and analysis

After sample collection, tree-ring cores were mounted, sanded and scanned. We measured tree-ring widths in the software application CooRecorder and cross-dated using CDendro (Maxwell and Larsson 2021). We also used COFECHA program (Holmes 1983) to check the dating quality of samples.

Workshop outcome

Organizers and six facilitators from three different countries (USA, UK and Zambia) trained 25 people from 10 countries (Democratic Republic of Congo, Egypt, Ghana, Kenya, Mexico, Mozambique, Namibia, USA, Zambia, and Zimbabwe). Each of the four groups (Dendroecology, Dendroclimate, Dendrochemistry, and Wood Anatomy) that we formed during the training reported interesting results. The Dendroecology group worked on 49 tree species that were sampled in a half hectare plot, and found that the Fabaceae family plants had the highest species richness with 28.5%. This group further found that wet miombo tree species produce annual growth rings responsive to seasonal climate, and are useful for dendrochronology. They determined a series intercorrelation of 0.45 and average mean sensitivity of 0.465 from a master chronology of 14 tree species. The dendroclimate group recorded a significant positive relationship (r-value = 0.589, p-value = 0.0005) between ring width of a mixed species chronology of *B. longifolia* and *J. paniculata*, and precipitation totals for Zambia's wet season (October–April). The group that worked on dendrochemistry found that arsenic, barium, calcium, lead, zinc, manganese, and strontium bio-accumulate in *B. longifolia*. Workshop participants also worked on a number of trees from the wet miombo woodlands, which included the common species of *Brachystegia, Julbernardia* and *Isoberlinia* to understand their anatomical properties. The species were found to be diffuse porous.

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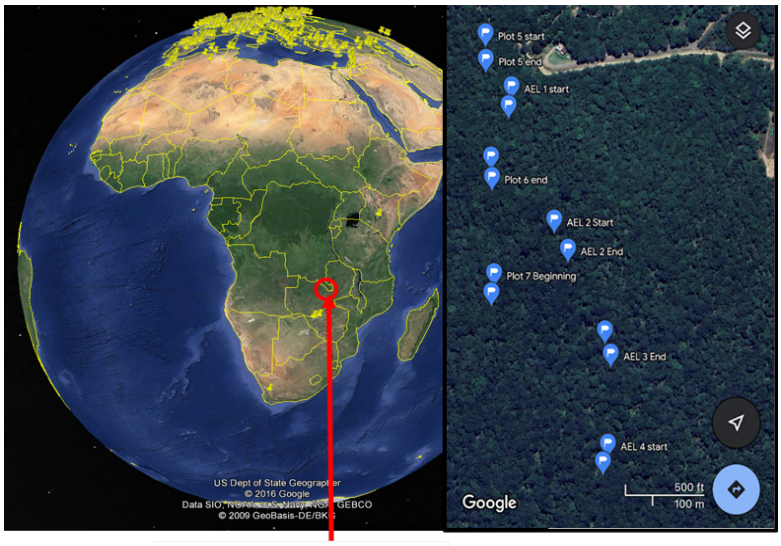

Figure 1: Distribution of sample sites at the AEL site in ßMufulira District, Zambia. The yellow pinpoint icons show the locations with chronologies as reported in the International Tree-Ring Data Bank (ITRDB - notice the lack of chronologies in sub-Saharan Africa). The blue pinpoint icons show the beginning and end of the 40 m transect for the dendroecology study.