SAFARI 2000 Tree Ring Data, Mongu, Zambia, Dry Season 2000

Abstract

This data set contains tree ring data from three sites located about 25 km of the meteorological station at Mongu, Zambia. Data from about 50 individual trees are reported. In addition, chronologies (or site mean curves) that better represent common influences (e.g., in this study, the climatic signal) were developed for each site based on the individual data (Trouet, 2004; Trouet et al., 2001). The series covers a maximum of 46 years, although most series do not extend longer than 30 years. The data were collected during the SAFARI 2000 Dry Season Field Campaign of August 2000.

Background Information

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Project: SAFARI 2000

Data Set Title: SAFARI 2000 Tree Ring Data, Mongu, Zambia, Dry Season 2000

Site: Near Mongu, Zambia
Westernmost Longitude: 23°15'50"
Easternmost Longitude: 23°19'05"
Northernmost Latitude: -15°11'40"
Southernmost Latitude: -15°26'45"

Data Set Citation:

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Tree Ring Chronology

A chronology (or site mean curve) is constructed to emphasize the common signal (e.g., in this study, the climatic signal) in the growth of trees from a site (Trouet, 2004; Trouet et al., 2001). By constructing a chronology, possible false rings can be excluded from the tree ring series as well as random noise and individual tree growth responses to factors such as competition. If a representative mean curve can be constructed from the individual tree ring series at a site, we can support the hypothesis of a common influence on tree growth there, and characterize the annual tree rings formed. At this point the values of the chronology are no longer absolute tree ring values, but are standardized values and thus can only be used to correlate the tree ring series to other yearly time-series.

Data File Information

There are two files for each site, one containing integer values representing tree ring widths (raw data files), and the other containing standardized values (chronology files), for each year. The tree ring widths are measured in 10 micron increments and the standardized values, detrended by a moving average, are unitless.

The column headings are the names of individual disc samples. These names were assigned to each disc after their inclusion in the Xylarium at the Royal Museum for Central Africa in Tervuren, Belgium. Every individual sample (tree stem disc) has an official registration number and this is the column heading. The rows are the years of tree ring width or chronology.

The data files are stored as ASCII table files in comma-separated-value (.csv) format, with column headers. The file names are listed in **Table 1** under study sites.

Study Sites

Samples were taken at three sites, located in the vicinity (less than 25 km) of the meteorological station at Mongu. Site two and site three were about one kilometer apart from one another. Site one was located about thirty kilometers south of the other two sites.

Table 1: Location and file names for each site.

Site Name	Latitude (deg S)	Longitude (deg E)	Date	Raw Data & Summary Files
Site 1	15°26'45"	23°19'05"	August 2000	mongu_tree_ring_site1_chron.csv mongu_tree_ring_site1_data.csv
Site 2	15°11'45"	23°15'28"	August 2000	mongu_tree_ring_site2_chron.csv mongu_tree_ring_site2_data.csv
Site 3	15°11'40"	23°15'50"	August 2000	mongu_tree_ring_site3_chron.csv mongu_tree_ring_site3_data.csv

The miombo vegetation at the three sampled sites is part of the drier miombo zone, but is influenced by specific conditions due to the 30 m of Kalahari sands on which it grows and therefore also defined as *Brachystegia spiciformis* Kalahari woodland (Jeanes and Baars, 1991). The area where the sites were located is flat and adjacent to the Zambezi River floodplains. On sites 2 and 3, both without slope, the canopy cover is dominated by *Brachystegia spiciformis*, next to *Burkea Africana* Hook, *Guibourtia coleosperma* (Benth.) J. Léonard, *Brachystegia bakeriana*, and *Ochna pulchra* Hook. Site 1, with a slight southward slope, is dominated by *Brachystegia bakeriana*. Sampling was conducted at all sites in August 2000. The miombo vegetation at all sites underwent primitive harvesting for subsistence earlier the same year, thus samples could be taken from freshly cut trees and no living trees were cut for this study.

Methodology

Ten to 23 samples were taken at each site from *Brachystegia* species. *Brachystegia bakeriana* was sampled at site 1; *Brachystegia spiciformis* at sites 2 and 3. Age of the trees used for sampling, varied between 17 and 46 years for the different sites.

Table 2: Sampling and chronology characteristics for the three sites.

Site	Species	Number of Samples	Number of Samples Used in Chronology	Age (years) of Chronology	Sensitivity Index of Chronology
Site 1	*Brachystegia bakeriana*	10	7	46	0.234
Site 2	*Brachystegia spiciformis*	16	12	46	0.207
Site 3	*Brachystegia spiciformis*	23	19	31	0.259

At all sites, samples consisted of full stem discs. Where possible, samples were taken at breast height (1.3 m), but often, for practical reasons, sampling height was approximately 0.7 to 1 m. All samples collected have been incorporated in the Xylarium of the Royal Museum for Central Africa in Tervuren, Belgium (accessions Tw56575 to Tw56670). Note that not all samples were used in the chronologies. Some of the samples did not show the same general trend, and thus could not be cross-dated with the other samples and included in the chronology.

In order to optimize growth ring detectability, transverse surfaces of all stem discs were sanded and polished (grain 180 to 1200) and observed under oblique lighting conditions. Before carrying out any measurements, all stem discs were analyzed microscopically (stereo microscope) to carefully delineate and positionally register the presence of any wedging rings (Trouet et al., 2001). Growth ring widths were then measured to the nearest 0.01 mm using LINTAB equipment and TSAP software (Rinn and Jäkel, 1997). Four radii per sample disc were measured.

Statistical Analysis

Cross-dating and response function analyses were performed by routine dendrochronological techniques. By cross-dating, series from four radii of a tree were combined (using TSAP software) to give a mean curve per tree. Long-term growth trends associated with increasing trunk radius were removed from each

individual curve (Cook and Kairiukstis, 1990) by division by a one-sided backwards moving average over five years (Rinn and Jäkel, 1997). Mean curves per site (chronologies) were obtained by averaging cross-dated and detrended curves of individual trees. Although rare, note that since the data are standardized values, in extreme cases (very thin rings), these values can be negative. Mean sensitivity values are calculated for all chronologies to provide a measure of between ring variability (Schweingruber, 1988):

$$\overline{S} = \frac{\sum_{i=1}^{n-1} \left| S_i + 1 \right|}{n-1} \quad \text{with} \quad S_i = \frac{\left(x_i - x_{i-1} \right) \cdot 2}{\left(x_i + x_{i-1} \right)}$$

The success of the cross-dating of chronologies, was investigated using the Gleichläufigkeitskoeffizient (GLK), which is expressed for two curves by the following equation (Schweingruber, 1988):

$$G_{(x,y)} = \frac{1}{n-1} \sum_{i=1}^{n-1} \left| G_{ix} + G_{iy} \right|$$

and a t-value, which is a measure for the degree of correlation (Fritts, 1976).

Table 3: Gleichläufigkeitskoeffizient (GLK) and t-value for the cross-dating of the chronologies of the three sites.

Sites	GLK	t-value
Site 1 & Site 2	66	3.9
Site 1 & Site 3	76	4.1
Site 2 & Site 3	90	4.9

Additional Sources of Information

References

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