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DATUM | DATE  
9 april 2019

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REVIEW REPORT EYOB GEBREHIWOT  
GEBREGEORGIS

## Review report

PhD thesis on:

### **Annual to Intra-annual Dendroclimatic Studies of *Juniperus procera* at Blue Nile's Basin, Gonder Ethiopia**

#### **Eyob Gebrehiwot Gebregeorgis**

Supervisor: Dr. hab. Marcin Koprowski

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#### General remarks

The candidate performed a study of the climatological information stored in tree-ring series of *Juniperus procera* in the region around the city of Gonder in de basin of the Blue Nile, in northern Ethiopia. The main justification for this topic choice is that tree rings are the best proxy for information on climate changes, given that other proxies are not available in the region. The classical resolution of tree-ring studies is annual, when working with series of tree-ring widths. The resolution can be sub annual if time series can be established with measurements at the level of tracheids, what constitutes a principal part of the Phd dissertation. The candidate collected cores from a total of 31 different trees, all from 4 church grounds. He verified carefully the annual nature of the measured rings through bomb peak C14 dating which allowed him to apply routine dendrochronological techniques. He managed to construct 4 mean chronologies that are to be understand as exceptionally strong, given the low number of

sampled trees. He further used pointer year analysis to detect extreme droughts and selected ring series for a high resolution and very detailed analysis of tracheid series. The four ring width chronologies appeared to be strongly responsive to the amount of summer rain, as well as to annual precipitation and this for a period between 1901 and 2013. The tracheids constituting the first 60 % of a tree ring were significantly affected by rainfall in June, July and August. The rest of the rings expressed the rainfall between September and January.

#### Comments on the chapters

The introductory chapter contains a rather clear formulation of the objectives and research questions. There are some typos, a few lacking references and imprecise statements. The discussion on tree rings (2.2.1.) misses the opportunity to include the wood anatomical concept of ring distinctness which might have been relevant for the thesis. Terms like “common wall” (p. 9) and “xylems” (p. 10) are confusing. These text fragments might have profited from systematically referring to the IAWA lists of standardized features.

I miss a comment on the importance of cross dating in defining dendrochronology (2.4.1) in a strict or larger sense.

In the text about “tropical dendrochronology” it seems to be essential to make a clear difference between the main biomes in the tropics. Analyzing tree rings in the dense tropical rainforest is quite different from drier tropical areas.

It might be good to discuss more extensively the Mokria papers and to make clear the particular niches that are still to be filled in the reconstruction of precipitation history and Nile flow amounts.

A more critical discussion is possible on the cross dating techniques and principles (p. 20). Why would cross dating ensure absolute confidence? Isn't it a statistical issue?

On p. 26 the calibration of radiocarbon is being discussed in a very comprehensive way. It would be good to comment on the issue of calibrating equatorial material, next to material from northern and southern hemispheres as well as the minimum number of rings to be analyzed. The material and methods part is well structured and easy reading. Missing is perhaps a good quantitative overview of the number of occurrences of false and double rings, which could be incorporated in the results part.

The terminology used on p. 39 is not very clear. It might, again, be good to refer to the IAWA list of softwood features and not to use “resonating”, “unlignified” parenchyma, “straight columns”,.... It would have been interesting to make some longitudinal sections in order to elucidate on the parenchyma issue of *Juniperus*.

Figure 10 is not convincing. Intuitively the second ring from the left could be qualified as an intra-annual density fluctuation. The rightest ring on the lower image might also be an IADF type E.

If Mork type latewood cannot be found, how is the transition between early wood and latewood defined? When it is visually being done, it should be possible to formalize the procedure I guess. On p. 65 the sentence: “The chronologies which showed...” needs to be rephrased to understand what it is about.

p. 56 How does the revealed false ring that has been removed looks like?

The resulting chronologies are quite strong (there are very high correlations). This would profit from a comparison with quantitative results from the literature, even if this is from American or European trees.

p. 64 How would the cell walls look like? A strong magnification might be instructive.

The image analysis of the tracheid observation is quite impressive, but it might be good to reconsider the graphical presentation of the results (Fig. 30 and following). These figures are quite blurry and not very informative.

The discussion on the radiocarbon dating and the anomalous rings is very to the point and interesting.

It is not clear what is meant with “optimal autocorrelation” (p. 99).

The last paragraph of p. 100 needs to be clarified.

The analysis of the anatomical features – a recurrent comment throughout the chapters - should maximally use the standardized wood anatomical terminology (see “organic deposits in heartwood tracheids, resin plugs/spools/plates).

p. 103: the acronyms make the text often difficult to follow.

p. 106: also some other tropical or subtropical conifers contain low quantities of latewood: refer to *Pinus aristata*, *Podocarpus* and *Widdringtonia*.

p. 118: It is not convincing that *Juniperus* produces parenchyma cells as a reaction to stress. It is not clear whether this is explicitly been tested.

#### Evaluation

The dissertation is the report of a sound scientific approach with a clear problem definition, a relevant applied methodology, a concise presentation of results and an interesting discussion.

The graphical material is of good quality and the text is well written, though some sentences need clarification and editing is needed to avoid typos.

#### Conclusion

The candidate gave proof of scientific authority and performed original research on a topic that is highly relevant. He applied state of the art methodologies, including confocal microscopy, C14 bomb peak dating, X-ray spectroscopy, auto fluorescence and different modelling and data processing techniques. Moreover he developed new software (SabaTracheid) for quantitative wood anatomy. The results are interesting and reliable and correctly discussed. I would suggest that the candidate is allowed to do the next steps in the procedure resulting in a doctoral degree.

Yours sincerely,

Dr.ir. Hans Beeckman, senior scientist and curator  
Service of Wood Biology and Xylarium

