Charcoal analysis and wood diameter: inductive and deductive methodological approaches for the study of firewood collecting practices

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Summary: *We present and discuss two approaches for evaluating the diameter of carbonized wood. Results from a theoretical model and its experimental validation shows that the proportions of diameter classes predicted by the model can be recognized. Even though the measured caliber classes do not correspond to the reality of the initial diameters, the measures were sufficiently different and reproductive to be discriminated through factorial analysis. These methods are promising for documenting cultural behavior of past peoples related to firewood use and management.*

Key words: *wood diameter, experimentation, firewood management, modeling*

INTRODUCTION

Since several years, societal questions have been central among anthracological questionings. The development of socio-economic approaches has made it possible to focus on topics related to firewood use and management, which document cultural traits (e.g. type of sites, seasonality of occupation, woodland management and its impact on woodland).

This evolution of the discipline was made possible by the development of new tools and grids for reading the anthracological data (Théry-Parisot, 2001; Dufraisse, 2002, 2006; Chrzavzez, 2006; Marguerie and Hunot, 2007; Paradis, 2007; Ludemann, 2008). In this paper, we present recent methodological developments related to the interpretation of the wood diameter estimated.

METHODS

Methods of estimating tree-ring curvature on charcoal fragments are now well established (Paradis 2007; Garcia and Dufraisse, in this volume). However, these measures only indicate that the fragment is situated within a specific zone in the trunk relatively to the pith. Moreover, in a log of a given size, all the diameters (or diameter classes) can be represented (Fig. 1).

Two approaches, one inductive and the other one deductive are proposed to evaluate the size of carbonized wood. The first approach is inductive (Dufraisse, 2002, 2006). It is based on a mathematical model that consists in establishing the proportion of the different diameter classes for different size of logs. The second approach is deductive (Chrzavzez *et al.*, in press). It is based on the postulate that wood calibers can reflect collecting strategies (e.g. tree felling, dead wood gathering or both).

The aim of experimentation was to test the relation between the calibers of wood prior to burning and the caliber classes resulting from the analysis of their charred products. This method is not a direct inference from situation B (measured charcoals) towards A (initial calibers), but relies on the construction of a discriminating statistical model.

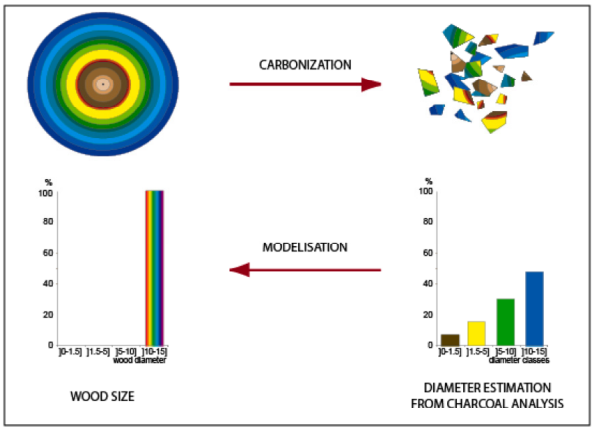

FIGURE 1. Diameter represented in a log (Dufraisse 2002, 2006)

The experiments were conducted in two kinds of structures: (i) in an open fireplace under laboratory conditions allowing limiting the known effects of external factors on the combustion process; (i) in an open-air fireplace, less controllable but closer to the archaeological conditions.

RESULTS

The inductive approach

Experimental studies realized to evaluate the mathematical model indicate that the proportions of diameter classes predicted by the model can be recognized (Chrzavzez, 2006; Paradis, 2007). However, this model has some inherent limits as it cannot correct over-representation of diameter classes. In addition,

experimental fires realized with split logs show the absence of the bigger classes.

The deductive approach

In order to verify that charcoal analysis allows discriminating wood batches of different calibers after their combustion, ten experimental combustions of pine wood (*Pinus pinaster*) were undertaken: three fires of big trunk bases (up to 30 cm), 5 fires of medium diameters (10 cm), 2 fires with a complete tree of variable calibers. A total of 4500 charcoals superior to 4 mm were measured with image analysis software. Four classes of calibers have been registered: [0-5 cm], [5-10 cm], [10-15 cm], [> 15 cm]. First, we observed that the results of the replica of a same experiment are comparable. As the profile of the histograms shows, the classes of the measured calibers are represented in the same proportions (Fig. 2). But they don't correspond to the initial diameters of the wood that has been burned. Even though, the measured caliber classes are sufficiently different and reproducible to be discriminated through factorial analysis. This analysis allows discriminating the three experimental batches of wood: small calibers (10 cm), larges calibers (> 30 cm), and the complete tree. This statistical model would allow identifying the calibers of archaeological charcoal.

FIGURE 2. Profiles of histograms from experimental referential.

DISCUSSION AND CONCLUSIONS

Both methods propose a distinct but complementary approach of same phenomena. They both present encouraging results. Nevertheless, these works have been separately developed and the experimental methods have to be homogenized. At present, the experimental referential is enlarged in order to develop a mathematical model including a larger set of situations (ANR DENDRAC, Dufraisse (dir.)).

But the question that remains to consider is how to transpose these results to archaeological samples? Successive archaeological deposits from short-term occupations, fireplace superposing or cleanings and the mixture of charcoal in a same level, tend to interfere with our interpretations. What we regard as the result of one practice is frequently an average representation of multiple practices (Théry-Parisot *et al.*, 2010).

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*Caution: the present abstract deals with a work which is still in progress. The results are likely to evolve towards slightly different conclusions. Please cite the definitive publication, when available. March 2011.