EVIDENCE OF TRIMMED OAKS (*QUERCUS* SP.) IN NORTH WESTERN FRANCE DURING THE EARLY MIDDLE AGES (9TH-11TH CENTURIES A.D.)

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ABSTRACT: In North-western France, pollarding is still a living practice very linked to the management of a typical landscape, where hedgerow network or "bocage" constitute the main component. In Brittany, pollarding takes a particular form called "trimming" or "shredding" (Rackham, 1980). Trimming consists in cutting down regularly all of the branches of the trees, specially oak (*Quercus robur*) and chestnut trees (*Castanea sativa*). This study aims to specify the nature of the tree's reaction to this stress and adapt these event years for archaeological purposes to grasp the origin and the evolution of our existing landscape.The comparison of the tree-ring signal between living trees coming from five sites in eastern Brittany and archaeological timbers from four medieval sites in the Paris basin and the Armorican massif show very similar anatomical anomalies. This analysis gives a key to ensure the association of growth stress cycles observed on ancient woods to the practice of trimming. But the high frequency of archaeological timbers with clear signs of trimming asks the question of a possible existence of a "bocage" landscape during the early Middle Ages.
KEY WORDS: Trimming, Pollarding, Ring width, Wood anatomy, Dendrological signature, Event years, Archaeology, Brittany, France

RÉSUMÉ: L'émondage reste encore aujourd'hui une pratique vivace dans le Nord-Ouest de la France, où il contribue largement à l'entretien du bocage et de ses réseaux de haies. En Bretagne, l'arbre émondé prend une forme particulière que l'on appellera localement "ragosse", "émonde" ou "têtard". Cette pratique bocagère consiste à élaguer totalement et régulièrement les arbres, et plus particulièrement les chênes pédonculés (*Quercus robur*) et les châtaigniers (*Castanea sativa*).Cette étude a donc pour but de définir la nature des réactions d'un arbre à ce type de stress et d'adapter la signature de l'émondage au matériel archéologique, afin d'appréhender l'origine et l'évolution de notre paysage actuel.La comparaison entre le signal dendrologique d'arbres actuels issus de cinq sites de Haute-Bretagne et celui de bois anciens provenant de quatre sites médiévaux du Bassin parisien et du Massif armoricain montre de grandes similitudes dans les anomalies anatomiques observées. Cette analyse nous livre ainsi une clef pour relier en toute confiance des cycles de chutes de croissance enregistrées par des bois anciens à la pratique de l'émondage. Mais, la question d'un bocage dès le haut Moyen Age reste posée, sur la base d'assez nombreux éléments architecturaux issus manifestement d'arbres émondés.
MOTS-CLÉS: émondage, largeur de cerne, anatomie du bois, signature dendrologique, archéologie, Haute-Bretagne, France

ZUSAMMENFASSUNG: In Nordwestfrankreich besteht die Tradition des Schneitelns bis heute fort und trägt damit massgeblich zur Erhaltung des Landschaftstyps des "Bocage" mit seinen netzwerkartigen Hecken bei. In der Bretagne nimmt der geschneitelte Baum eine spezielle Gestalt an. Beim Schneiteln werden dem Baum, vor allem Stieleichen (*Quercus robur*) und Kastanien (*Castanea sativa*), in regelmässigen Zeitabständen sämtliche Äste abgeschnitten.Diese Studie hat das Ziel, die charakteristischen Reaktionen des Baumes auf diesen Stressfaktor zu definieren, damit auch an archäologischem Material erkannt werden kann, wenn ein Baum geschneitelt wurde. Dies trägt zum besseren Verständnis von Herkunft und Entwicklung unserer heutigen Landschaft bei.Die Baumringmuster von heute existierenden Bäumen (fünf Standorte in der Bretagne) und von mittelalterlichem Holz (Fundorte im Pariser Becken und dem Massif armoricain) weisen in ihren anatomischen Anomalien grosse Ähnlichkeit auf. Die Analyse lässt den Schluss zu, dass die am mittelalterlichen Holz beobachteten Wachstumseinbrüche auf die Praxis des Schneitelns zurückgeführt werden können. Der hohe Anteil an mittelalterlichem Holz mit Schneitelhinweisen lässt allerdings die Frage offen, ob es den "bocage" bereits im Hochmittelalter gegeben hat (*Translation Petra Zibulski*).
STICHWORTE: Schneiteln, Jahrringbreite, Holzanatomie, Weiserjahr, Archäologie, Bretagne, Frankreich

North-western France has today the largest area of hedgerow network landscape or "bocage" in the country (FIG. 1). The farmers' activities firstly consist of structuring features on the land, such as field patterns and field boundaries, including hedgerows. The "traditional" hedgerows are predominant in the landscapes of eastern Brittany that we are studying: the plantation of these hedgerows culminated in the 19th century. They include oak (*Quercus robur*), chestnut (*Castanea sativa*) and sometimes ash (*Fraxinus excelsior*) or beech (*Fagus sylvatica*), with a majority of pollarded trees.

CURRENT TRIMMING PRESENTATION AND STUDY AREA

Trimming consists of cutting down all of the branches of a tree, from the bottom to the top, in order to gather its ligneous matter, mainly for heating purposes (LIZET AND RAVIGNAN 1987, RACKHAM 1980). In North-western France, this operation takes place in winter and at 7-12 year intervals.

Currently, there are two traditional and distinctive types of trimming in Brittany: the well-known "pollarded trees" (oaks, ashes and chestnut trees), which are 1.80 to 5 meters high, and the shredded trees (exclusively oaks) which are 4 to 6 meters high (RENAUDIN 1996).

The distribution area of the shredded trees is centred in the western zone of Brittany in the Rennes basin (FIG. 1).

Beyond the clear traces on the external morphology of the tree, the impact of pruning can be evidenced by ring-width series and wood anatomy. These morphological and anatomical criteria easily observable optically on ancient oak timbers, have allowed us to specifically select material on archaeological and historical sites.

Few authors have been able to show the ability of the ligneous plant to react to harsh exogenous disturbances of human origin (GUIBAL 1988, CHRISTENSEN AND RASMUSSEN 1991, HAAS AND SCHWEINGRUBER 1994).

The disturbance of the ligneous productivity in the radial growth of the wood analysed here concerns the trimming of deciduous oaks.

This study aims to (i) specify the nature of the tree's reaction to this stress by bringing the dendrological "trimming signature" to light, (ii) adapt these event years for archaeological purposes to grasp the origin and the evolution of our existing landscape where for ages hedges have been one of the main wood supplies.

MATERIAL AND METHODS

The living trees are *Quercus robur L.* which presents a wood with porous zones and come from five sites in eastern Brittany (FIG. 1). Some sections have been sampled at 1.20 m from the ground on 16 shredded trees, and a core has been sampled on untrimmed trees on each site, in order to compare the two populations. The years of the last trimmings are known for each sample thanks to an inquiry with the farmers.

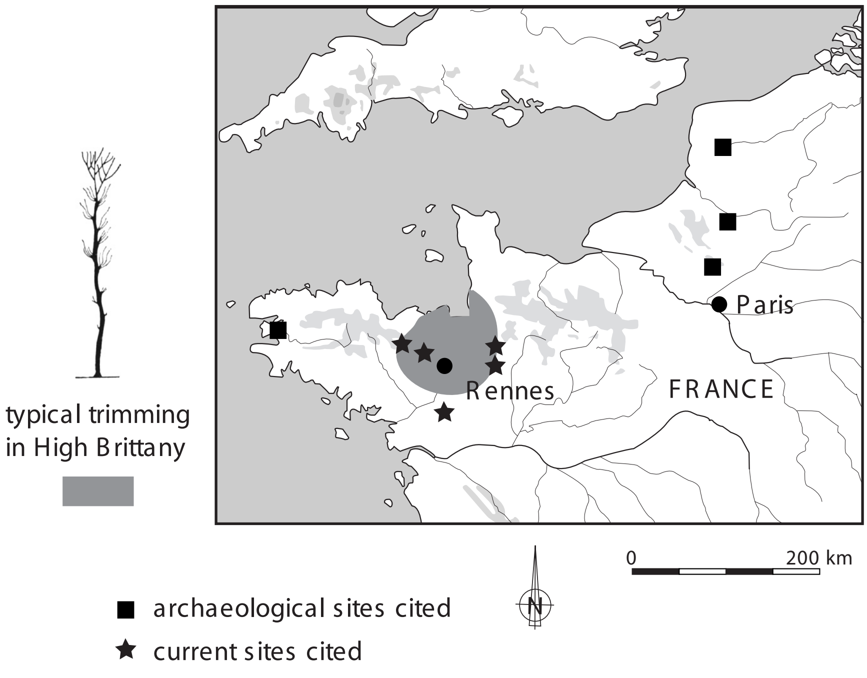

Figure 1. Study area and location of the study sites.

This has enabled us to measure the ring widths corresponding to 47 trimming cycles. The anatomy of 6 out of 47 cycles has been analysed by means of a microtome.

As for historical and archaeological oak timbers (*Quercus sp*.), they come from a larger area including the Armorican massif and the Paris basin (Fig. 1). The main part of this corpus comes from the frameworks of medieval churches and manors, but the more ancient and the more original elements were discovered in archaeological layers dating from the Carolingian period (9th-10th centuries A.D.). These four sites belong to building phases dated by dendrochronological analysis as having occurred between 810 and 950 A.D. A total of 300 architectural timbers (posts, planks, timbers, etc.) were measured, but less than 20 presented similar growth stress. In fact, these 20 samples are not dated directly by tree-ring analysis, only by indubitable association with well dated woodworks. F. Guibal clearly showed that this sort of material is useless for dendrochronology, since the climatic signal is totally disturbed (Guibal 1988).

The tree-ring widths and anatomy inside the trimming disturbances were measured in the dendrochronological laboratory of the Centre d'études nordiques of the Laval university of Quebec, Canada thanks to the N.I.H. Image software (American public ownership). Furthermore, the tree-ring measurements have been carried out in France using a digital positioning dendrochronological table (Lintab Rinntech, accuracy: 0.01 mm).

Several dendrological variables are taken into account:
- ring width;
- earlywood and latewood width;
- vessel surface;
- number of vessels;
- vessel position in the ring.

By comparing the undisturbed rings and the disturbed ones following to the trimming, all the data, if they are pertinent, will reveal the dendrological signature of the trimming operation.

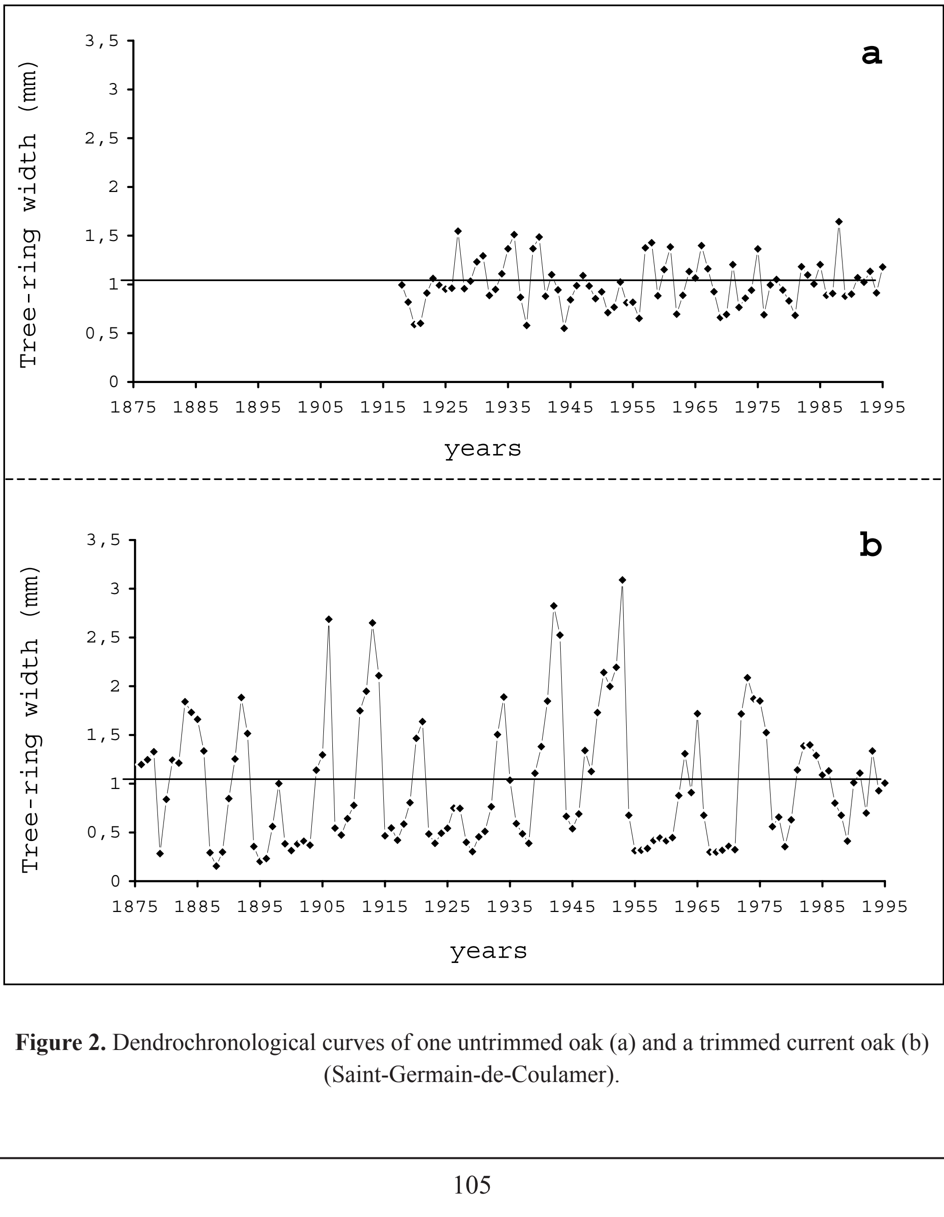

Figure 2. Dendrochronological curves of one untrimmed oak (a) and a trimmed current oak (b) (Saint-Germain-de-Coulamer).

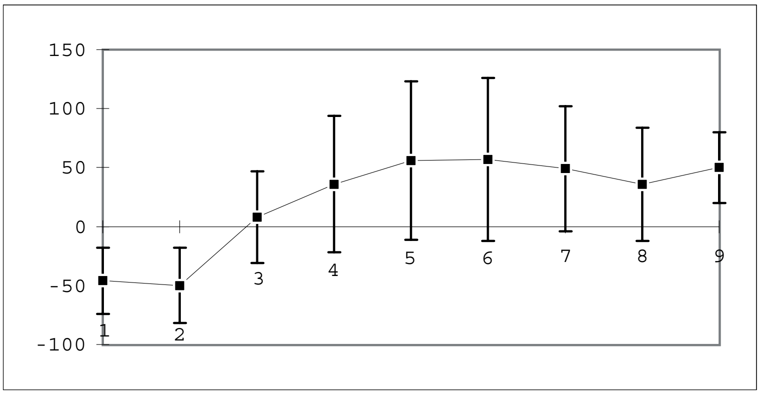

Figure 3. Ring width variations several years after the trimming.

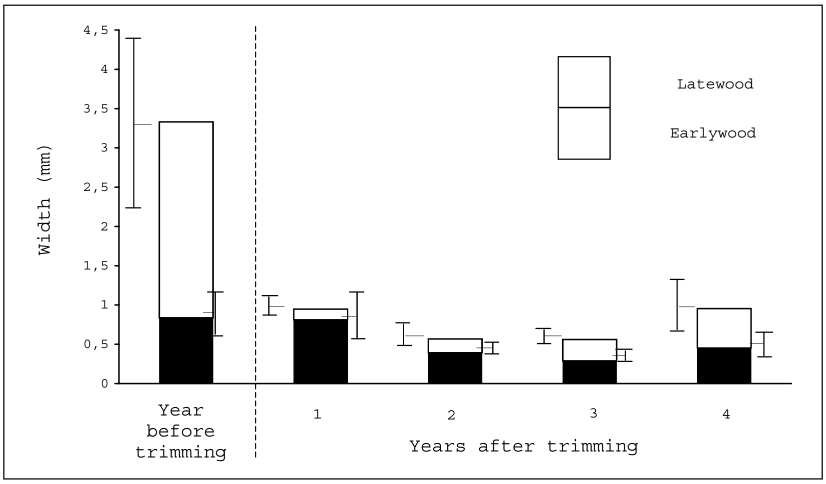

Figure 4. Widths variations of earlywood and latewood before and after trimming (n = 6 cycles).

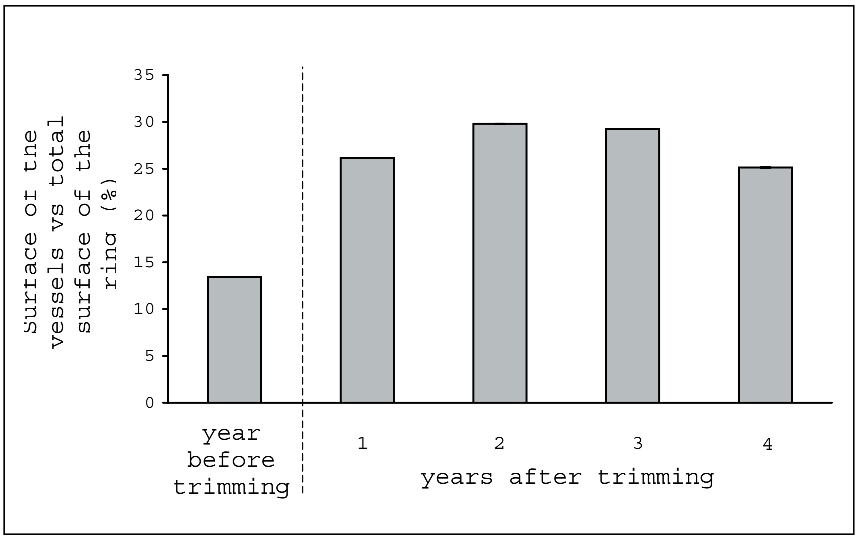

Figure 5. Mean of porosity of the rings (%) before and after the trimming (n = 6 cycles).

RESULTS

Current trees

Ring width

The ring width measurements show similarities between trimmed trees: the ring widths of the trimmed trees are affected by abrupt growth changes during the 3 to 4 years following the trimming. These abrupt growth changes ("trimming valleys") appear regularly, every 7 to 12 years, on the curves representing all the trimmed trees of the different sites. These measurements show similarities between trimmed trees and differences between trimmed and untrimmed trees. The untrimmed trees do not show such growth variations (FIG. 2).

The measurements indicate negative variation rates of ring width during the first 2 years (year 0: -46%, y+1: -50%) and positive variation rates the following years (y+2: +8%). The second year following the trimming is the year when the variation rate is the smallest. The biggest variation of the values after the third year shows that the effect of trimming on the ring widths softens (FIG. 3).

Ring anatomy

The anatomical analysis of the wood of the trimmed trees shows characteristic anomalies.

The earlywood width is not altered for the first year, which follows the trimming ("year 0"). Its proportion within the ring strongly increases because of the extremely low proportion of latewood (from 15-35% within the ring before the disturbance to up to 90% within the ring after the disturbance). Furthermore, during the "year+1" and the "year+2", the widths of the earlywood and of the whole ring are the smallest, despite the latewood, the width of which increases in small proportions in comparison with the first year. After 3 to 4 years, the early wood width increases at the same time as the latewood width. Afterwards, the earlywood proportion tends to decrease in comparison with that of the latewood and as the ring width increases (FIG. 4).

The average surface area of the vessels in the early wood is also significant: it is clearly inferior in year+1, +2 and +3 whereas it is not altered in year 0 (FIG. 5).

Historical and archaeological timbers

Compared to the investigation of recent material, dendrological analyses were carried out by using the same techniques on a series of medieval timbers from four sites, where tree-ring sequences show several abrupt growth changes. These four sites belong to Carolingian building phases dated by dendrochronological analysis to between 810 and 950 A.D, Belle-Eglise, Saleux and Douai in the Paris basin and Landevennec in Brittany (BERNARD 1998). A total of 300 architectural woods (posts, planks, timbers...) were measured, but less than 20 presented similar growth stress: abrupt growth changes appear every 7 to 9 years and during the last 3 years. In spite of the small number analysed, these samples are sufficiently significant by their tree-ring series and their anatomy to be associated to the practice of trimming (BERNARD 1997). Anatomically, the two different types of trimming, pollarding and shredding, cannot be distinguished. But, in this case, we can consider that shredded trees (and not pollarded trees, because of their tall height and their typical appearance) were being maintained during High Middle Ages.

DISCUSSION

Among the signals that enable us to say that the studied trees have been affected by a disturbance, the dendrological "trimming signature" is characteristic on the ring widths and in the ring anatomy. Thanks to the regularity of the phenomenon, the absence of known infestations, the observation of these growth anomalies on each trimmed tree studied and the knowledge of the dates of the last trimmings, we can affirm these growth anomalies are due to trimmings.

Besides bringing the dendrological signature of the oak trimming to light, this study is important with regard to archaeological research. When comparing samples of preserved ligneous traces (charcoals, woods full of water, dry woods) with this signature, then we can decide, without risks, whether the wood comes from a trimmed tree or not. In the case of small charcoals, the observation of several periods of trimming is impossible or rare. If a series of minimum three periods of trimming is not preserved, it is impossible to attest that the charcoal comes from a trimmed tree (MARGUERIE AND HUNOT IN SUBMISSION).

Archaeological samples coming from sites analysed within this work, have enabled us to determine if the trees have been affected by either trimming as it is practised today, or by a disturbance similar to trimming which also produces a loss of foliage (RASMUSSEN 1988).

The high frequency of archaeological timbers with clear signs of trimming on a given site could mean the possible presence of a bocage or hedgerow network landscape. However, can we necessarily correlate "pollarded trees" and "bocage"? Future studies need to coordinate dendrochronological and palynological analysis, which, if shown to give encouraging results, could become an interesting spatio-temporal tool in the research of the setting up and the global evolution of the bocage in these regions (BAUDRY AND JOUIN 2003, MARGUERIE *ET AL.,* 2003).

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