

HISTORICAL WOOD COLLECTION AT THE DENDROCHRONOLOGY LABORATORY, VYTAUTAS MAGNUS UNIVERSITY

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Abstract

Historical wood has been collected at Kaunas dendrochronology laboratory since the laboratory foundation in 1968. The wood is used for constructing long-term tree-ring chronologies and as the source of material for high-resolution isotopic investigations. Subfossil oaks from river gravels, pines from peat bogs and wood from archeological excavations are the main constituents of the collection. The oldest radiocarbon date of pine sample is 8380 \pm 60 B; the oldest oak is dated to 6130 \pm 40 BP. Though only part of wood samples is relatively crossdated by using dendrochronological synchronization of tree ring series, C-14 dating reveals significant fluctuations in sample depth throughout several millennia. During last two millennia fluctuations in subfossil oak and subfossil pine sample depth are noticeably coherent.

Keywords: *dendrochronology, palaeoecology, subfossil wood.*

Introduction

Dendrochronological investigations are based on laminar wood structure consisting of annual tree rings. In this structure information on environmental conditions during the formation of annual wood layers is recorded. Fluctuations in ring width of different tree species are widely used for reconstructing past climatic conditions and environmental events. The great advantage of the dendrochronological method is the possibility to use not only living trees with the life span usually no longer than 200 years, but also historical wood preserved *in situ* under favourable conditions or in wooden constructions and artefacts. Such historical wood can prolong time series of annual tree rings for several millennia [1,2].

At present time modern methods of physical - chemical analysis are more and more often applied for reconstructing past environmental conditions from tree rings. Investigation of ^{14}C isotope fluctuations in tree rings revealed variability of the isotope content in the atmosphere and made it possible to calibrate radiocarbon dates and investigate cosmogenic driving forces [3-5]. Records of stable isotope ratios of oxygen, carbon and hydrogen from tree rings are more and more widely used for palaeoclimatic investigations [6,7]. Therefore historical wood becomes not only a source of information for constructing long-term tree ring chronologies but also a valuable material for high-resolution physical - chemical analyses. Collection and preservation of valuable historical wood is the necessity of such investigations.

Subfossil wood collections

Historical wood has been collected at Kaunas dendroclimatochronology laboratory since the laboratory foundation in 1968. Shortly after foundation three sites rich in subfossil timbers were selected and investigated. One site was selected near Smurgainiai (Smorgon, present Belarus) in which subfossil oak (*Quercus robur* L.) trunks were collected from Neris river gravel deposits [8]. Subfossil pine (*Pinus sylvestris* L.) samples were collected in two peat bogs with pine trunks embedded in oligotrophic peat layers. One of subfossil pine sites was Užpelkių Tyrelis bog in Plungė district, North-West Lithuania [9], another site - bog Aukštoji Plynia is located in Šakiai district in South-West part of Lithuania [10].

More than hundred samples (cross-sections) of oak trunks (black oak) from different depth of gravel deposits were collected in Smurgainiai site. Most of the samples are radiocarbon dated at the Radioisotopes laboratory of Vytautas Magnus University using LSC Quantulus-1220. The dates of subfossil oaks range 5490 \pm 40 to 710 \pm 40 years before present (BP) with an expressed tendency to group within particular time intervals.

In Užpelkių Tyrelis bog more than 300 samples of pine stumps and stems preserved in oligotrophic peat layers were collected. Twenty eight specimens were radiocarbon-dated in the Estonian Institute of Zoology. ^{14}C dates ranged from 2090 \pm 50 BP to modern. Dendrochronological crossdating of the pine tree ring series has revealed five phases of pinewood spread interrupted by periods of open-land type vegetation dominance [11], [12] (see Fig. 1.). The largest amount of the collected subfossil pine specimens comes from the bog pinewood phase coinciding to the medieval warm epoch around AD1000. During the little ice age in the second half of the second millennium AD open-land type vegetation dominated in the bog, therefore no pine samples exist from this time.

More than 300 subfossil pine samples were also collected in Aukštoji Plynia bog [13]. Despite the fact the pine stumps were found in different depth [10] radiocarbon dating at the Radioisotopes laboratory of Vytautas Magnus University and dendrochronological crossdating of tree ring series [13] showed most of the samples came from one pinewood spread phase which also took place during the medieval warm epoch.

Later on besides to these larger wood sample collections subfossil samples from other sites were occasionally collected. Here we can mention recent finding of several subfossil bog oak samples from Biržai district, North Lithuania [14]. Five samples were radiocarbon dated at the radioisotopes laboratory of Vytautas Magnus University in Kaunas. The established ^{14}C dates of the specimens ranged from 6130 \pm 40 to 5490 \pm 40 years before present. These are the first investigated bog oak samples demonstrating that boggy oak-woods existed in Lithuania during Atlantic period. Specific dark colour is characteristic of oak wood that has been laying in wet ground or water for long time (such wood is called “black oak”).

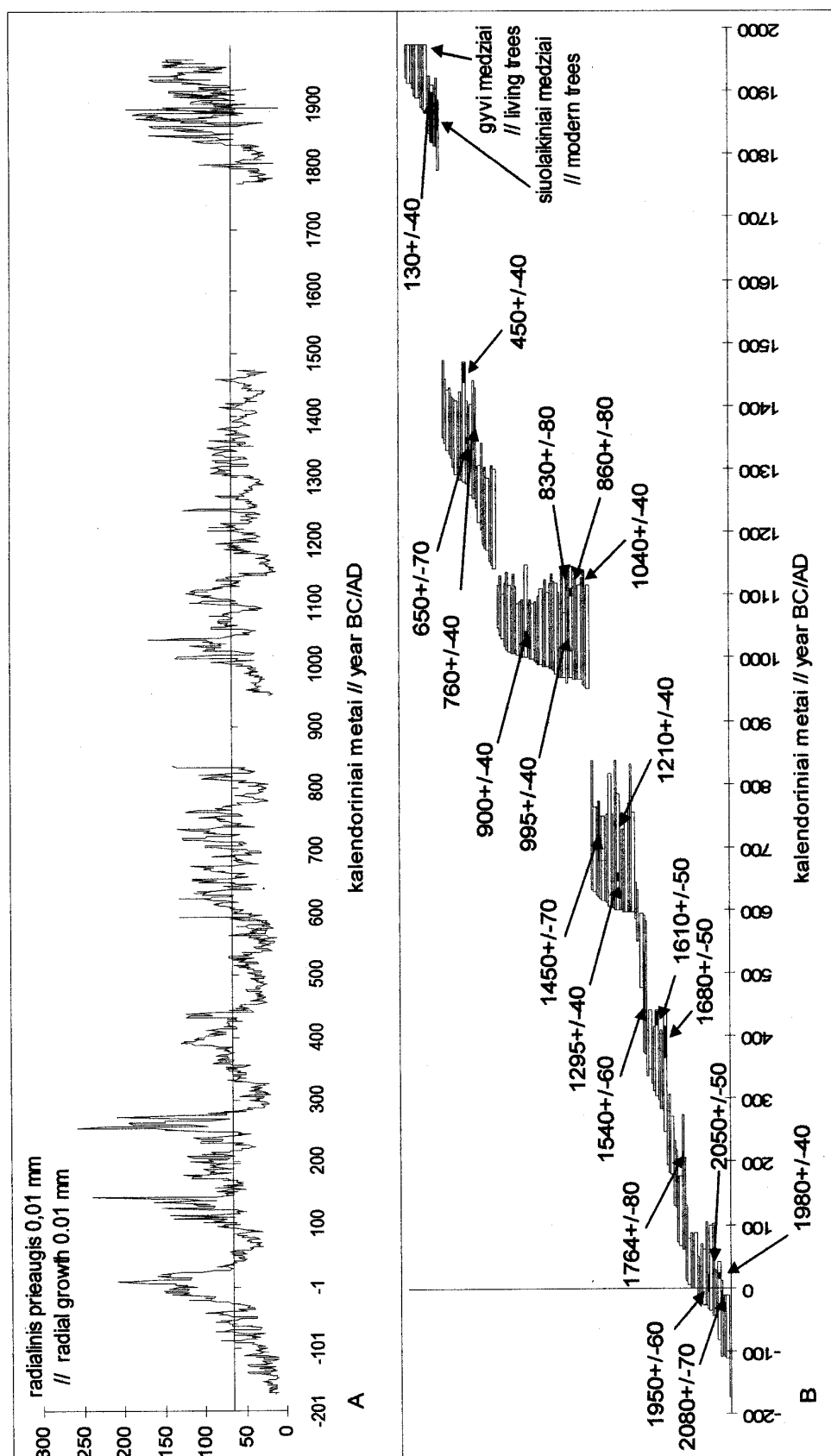


Fig. 1. Temporal distribution of the life spans of the subfossil pines from Užpelkių Tyrelis peat bog collected at the laboratory (part B). The distribution is established based on dendrochronological crossdating and radiocarbon dates (BP). Part A represents the annual growth fluctuation of the pines

The intensity of colour change is sometimes used as an indicator of oak wood age. But the wood of the investigated bog oaks is lighter (dark grey colour) in comparison with the wood of much younger oak trees from Neris river gravels (black colour) [8]. This confirms that darkening of oak wood depends more on the amount of iron ions in sediments than on the wood age [15]. Fast growing peat is not as rich in iron ions as river gravels therefore black colour of bog oaks is less intensive.

Archaeological and architectural wood collections

Archaeological wood and wood from architectural monuments is the second constituent of the historical wood collection. First samples of timbers from former inn in Plungė district were collected in 1969. During 1969 – 1971 about 100 samples from barns, granaries, living houses in villages, also churches and Kaunas town hall were collected. In villages of western part of Lithuania and in Kaunas town hall spruce was more often used than pine. Timbers with short sequences of wide tree rings predominated in most village houses built in XIX – XX Cs. Therefore later historical timbers have been collected mainly from buildings in cities and towns. Several groups of timbers were sampled in restored manor houses: Adomynė estate (Kupiškis district), Veliuona estate (Jurbarkas district), Ilguvos estate (Šakiai district), Kazliškėlis estate (Rokiškis district), Freda estate (Kaunas city).

A large group of archaeological wood samples was collected during excavations in Klaipėda and its environs (western Lithuania). Pine timbers were analysed and the results were presented in an issue of the series of publications of Dendroclimatochronological laboratory by V. Brukštus [16]. Timbers from the first half of the second millennium AD were also collected during excavations in main Lithuanian castles: Trakai castle, Kaunas castle [17], Vilnius Lower castle [18], also in Kernavė, medieval capital of Lithuania. Timbers from the last centuries of the second millennium AD were sampled in several Vilnius and Kaunas churches: Vilnius Cathedral, Vilnius St. Nicolaus, Vilnius Benedictines church and cloister, Vilnius Trinapolė cloister, Kaunas Jesuits church, Kaunas St Georges church, etc.

Historical wood collection at the laboratory also contains wood samples from remains of technological constructions: wells, bridges. Last year a group of samples from remains of wooden constructions of Kaunas bridges from the first half of the XX c. was collected. Recently in collaboration with archaeologists investigating Stone Age dwellings a large collection of wooden posts from lake dwellings has been collected. 57.1% of posts were made from ash wood, 6.0% - from pine [19]. The earliest radiocarbon date of ash post is 5970 \pm 60 (VDU-164). Most of the posts of broadleaved species are from Atlantic period, from around 4000 BC. Radiocarbon dating of pine posts has revealed the pines were used in Boreal period: the date of one pine post was 8380 \pm 60 BP (VDU-167). These are the oldest samples in our collection. Unfortunately tree ring series of these pines are very short, no longer than 35 years.

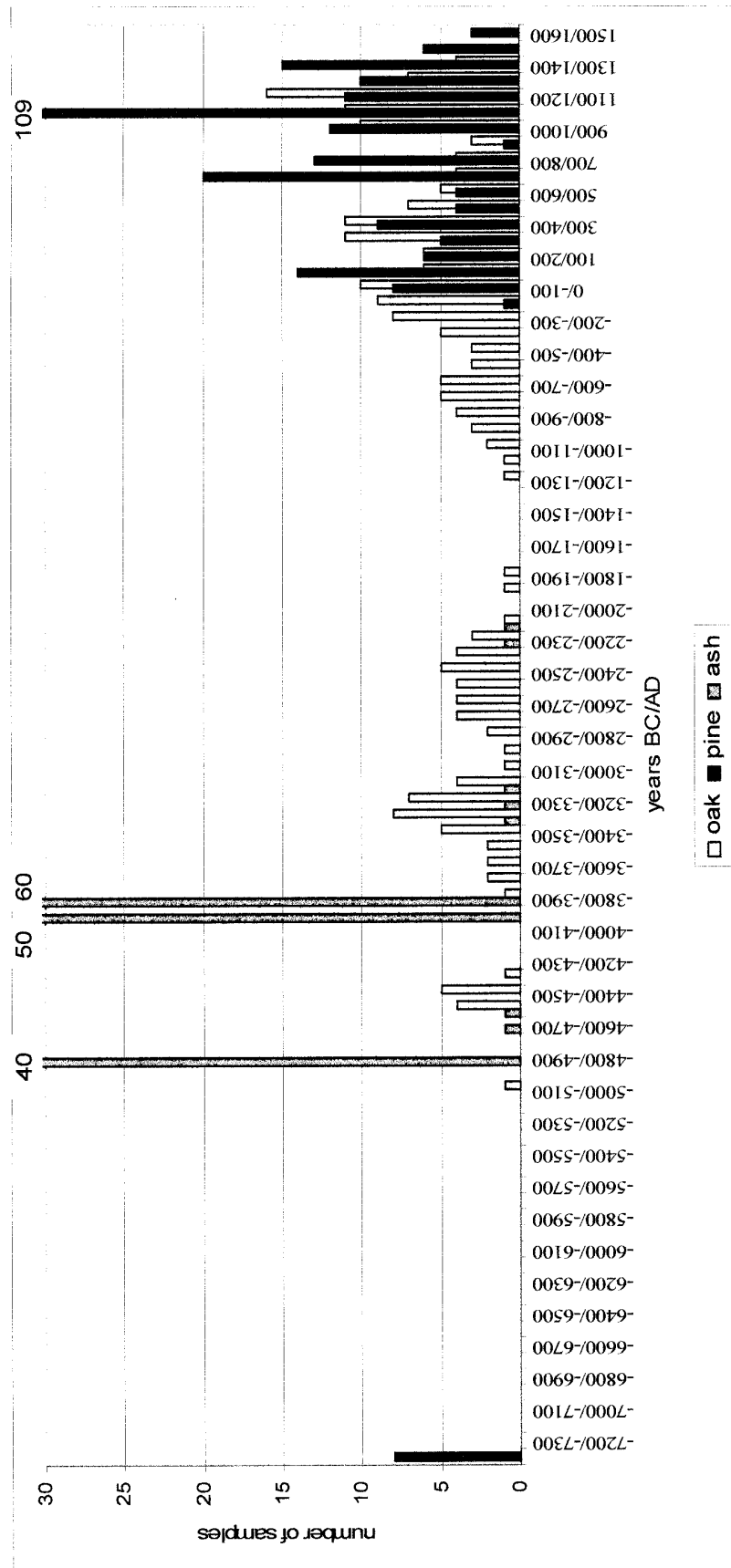


Fig. 2. Historical wood collection at the Kaunas dendrochronology laboratory: fluctuation in the number of wood samples collected from different centuries of the Holocene

In Figure 2 distribution of the historical wood samples coming from different centuries of the Holocene is presented. Significant fluctuation in sample depth of different species throughout the Holocene is noticeable. Part of this fluctuation can of course be explained by the uneven temporal distribution of the sampled objects. But undoubtedly the part of the variation is due to different availability of the samples of certain species in different periods. This can especially be said about the big groups of subfossil wood samples preserved *in situ* like Smurgainiai oaks and peat bog pines. Increasing number of subfossil pines from the last century BC reflects the well-known vegetation change at the beginning of Subatlantic period. During last two millennia fluctuations in subfossil oak and subfossil pine sample depth are noticeably coherent. This coherence should be the reflection of changes in environmental conditions influencing the availability of both pine and oak subfossil samples.

Not only Lithuanian wood but also wood from other European regions is stored in the wood collection of the laboratory. The largest is the collection of archaeological wood from Novgorod (Russia) excavation, containing more than thousand samples. There are also samples of several long-lived trees from Bashkiria, Karelia and Russia.

The laboratory is only place in Lithuania in which such an archive of natural history is collected. Tree ring sequences of the wood gathered during 30 years can be used for different analysis. The concern about long-term environmental changes challenging investigation of the past environmental conditions and processes makes the collection an invaluable source of information. Such an unrepeatable archive should be supplemented and protected in future.

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