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Dendrochronological Technology for Identifying a Place Of Timber Origin.

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ABSTRACT

The scientists from Moscow State Forestry University dendrochronology laboratory have developed a technology to identify a place of origin of the cut timber which makes it possible to monitor international timber traffic. The technology involves creating dendrochronological data banks which help to identify a place of timber origin as well as woodland where the tree grew. The frequency of correct identification exceeded 90% in the tests carried out in the Babayevo district of the Vologda region. A variety of ways to perform analyses makes the technology flexible and appropriate for different types of woody plants as well as for diverse forest types and various geographical conditions of European countries.

Keywords: illegal wood cutting, dendrochronological data banks, wood origin identification

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INTRODUCTION

Modern dendrochronology started from pioneer investigations of American scientist Andrew Elliot Douglass, which were carried out at the beginning of XX century. The cross-date method, which was discovered by Douglass gave the base for great number investigations in archeology (related with establish the date of tree cutting and the date of wooden construction building) and paleoclimatology (related with statistical reconstruction of the meteorological parameters).

Also, in forensic science the dendrochronological investigations help to solve the tasks of wood dating and wood organism and group equality establishing. There is a rich of the using the tree-ring information for crime investigations as in the world forensic science (Fritts 1976, Jozsa 1985, Schweingruber 1996, Wolodarsky-Franke, 2005) also in the works of Russian scientists (Rozanov 1972, Rozanov 1977, Orkin& Malokvasov 1992, Kolotushkin & Golovanov 2007; Lipatkin at all., 2010; Palchikov & Rumyantsev, 2010 and other).

One of the actually for modern Russian forestry problem is a problem of illegal felling. Methodic for it solving on the basis of using tree ring information had been formed at the Soviet time. At 60 of XX Ministry of Justice had a Scientific group with the M.I. Rosanov heading. At that time the methodic did not receive a wide dispersion. Probably, because in Soviet time the problem of illegal felling was not so actual, as in modern Russia. Also is important, that the instrumentations, which were necessary for general-purpose of dendrochronology method were absent.

For example, M. I. Rosanov describe his own dendrochronology laboratory instrumentations: binocular microscope, scaling paper and clear paper for graphic building, copybook for ring width values writing, the tables of logarithms… In instructors manual's, which was printed by his redaction, from the 14 papers about dendrochronology method 8 papers is a describe how to calculate the correlation coefficient (Methodical recommendation, 1972). Now it is difficult to imagine how hard was to calculate it at the arithmometer.

M. I. Rosanov characterizes the dendrochronology method in such kind: "Dendrochronology investigations are easy in implementation, but laborious and need in a great attention. " In present time, modern instrumentations for dendrochronology investigations once and for all solve the problem of laboriousness, and partly the problem for a great attention at the time of the work.

At present time dendrochronology method sucessufully was aprobated by Vologda police department. The own possibilities are: the establish the place of tree origin, the establish the time when the tree was cut, the prove that the trunk and the stump belong before cutting to one tree.

The great role for success of dendrochronological investigation has the modern equipment. German company RINNTECH under the direction of the inventor and degreed physicist Frank Rinn has some kinds of dendrochronological devices.

The most useful is LINTAB and TSAPWin software. It enable to analyze dendrochronological information using modern experimental statistics. On terms of tree-ring analysis it's possible to determine exactly the tree habitat, time of cutting or drying and to determine the reason of it; to prove that a trunk and a stub were the parts of the same tree; also to conduct some other examinations.

According to the Federal Forestry Agency the damage caused by illegal wood cuttings totaled 10 billion rubles in 2014. Until recently the key problem appearing when investigating crimes related to illegal wood turnover was the absence of a possibility for police to identify a place of logging after timber was sold for the first time. The social and economic importance of a method for timber origin establish is great.

MATERIALS AND METHODS

The technology involves creating dendrochronological data banks which help to identify a place of timber origin as well as woodland where the tree grew. The procedure of creating such data banks is as follows. A plot is assigned within each stratum (logging site). Then evaluation and geobotanical description of

forest phytocenosis is done according to the standard form. Wood samples (cores) are taken from 20 sample trees of the Kraft's class I-III. It is worth noting that samples are taken at the height of 1.3m with a Pressler increment borer. Then the cores are packed, labeled and transported to the dendrochronological laboratory.

At the laboratory the cores are moistened, cleaned out with a razor blade and rubbed with chalk powder. Width of annual rings is measured to the accuracy of 0.01 mm using a device LINTAB produced by the German company RINNTECH, but also it is possible to use the Velmex, which is produced by the North American company Velmex Inc. Thus individual time series of radial growth (time series of annual ring width, individual time lines of annual ring width) become available.

A Tsap-Win cross dating is used to verify whether the measurements are correct. An average general annual ring width chronology is made on the basis of built-in software functions. Each individual chronology is compared to the average group chronology while the software is computing a synchronization ratio and verifying its accuracy. If the synchronization ratio is not accurate, the sample will be measured again.

The measurement results are saved in the corresponding format and downloaded to the software package developed by the MSFU laboratory. A descriptor is made for each individual chronology. It includes a description of the plot where the wood sample was taken and tree stratum characteristics. The information is stored in a hierarchical way. Each individual chronology is included into a cluster on the basis of such features as a species, a forest district, an administrative district and a region.

RESULTS AND DISCUSSION

Software units ensure that more than 1 million possible identification algorithms are applied. The frequency of correct identification exceeded 90% in the tests carried out in the Babayevo district of the Vologda region. A variety of ways to perform analyses makes the technology flexible and appropriate for different types of woody plants as well as for diverse forest types and various geographical conditions of European countries. Search patterns (functions to realize several consecutive algorithms) can be configured to facilitate the process of algorithm testing involving several looks.

There are no similar technologies in Russia or abroad. In spite of the fact that dendrochronological information had been used to perform a court botanical expertise for a long time, a method to identify timber origin on its basis was not available until now. The possibility to perform such identification is mentioned in some Russian scientific papers. However the method itself was absent. So it was the expert who intuitively determined a place of origin of this or that timber lot. This required high professional skills. That's why only dendrochronological researchers having rich experience in field work were able to resolve such problems.

Today this technology is available for experts to identify timber origin on the basis of dendrochronological changing of annual rings (dendrochronological information).

CONCLUSIONS

At present time, prevention of illegal timber trade is possible if there is any method of identification of place of wood origin. To solve this kind of problem various methods are proposed, and the effective of them is the method for identification of place of wood origin based on dendrochronological information. Currently, by order of the Federal Forestry Agency of Russian Federation there was developed and tested a technology of identification of place of wood origin based on dendrochronological information, there was created a hardware-software system for solving this problem.

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