

ИНСТИТУТ БОТАНИКИ АН ЛИТОВСКОЙ ССР
БОТАНИЧЕСКИЙ ИНСТИТУТ АН СССР им. КОМАРОВА
КОМИССИЯ ПО ДЕНДРОКЛИМАТОЛОГИЧЕСКИМ ИССЛЕДОВАНИЯМ АН СССР
при научном совете «Биологические основы рационального использования,
преобразования и охраны растительного мира»

БИОЭКОЛОГИЧЕСКИЕ ОСНОВЫ ДЕНДРОХРОНОЛОГИИ

(Материалы к симпозиуму XII-того международного ботанического
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(Symposium Materials of XII-international Botanical Congress.

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ELABORATION OF BIOEKOLOGICAL FUNDAMENTALS OF DENDROCHRONOLOGY IN THE U.S.S.R.
РАЗРАБОТКА БИОЭКОЛОГИЧЕСКИХ ОСНОВ ДЕНДРОХРОНОЛОГИИ В СССР

(Appendix. The report in English)
(Приложение. Доклад на английском языке)

Annual tree-rings appear to be valuable indices of different climatic phenomena of the past. The combination of investigation of changeability regularities of the width of annual layers of modern forest with the information obtained from the wood of remote ages enables to get sequences of climatic information for the space of several millenia. Spatial investigation of the relation of annual tree-rings to climate allow us to clear up the dependence of local influencing factors on globally occurring phenomena.

When improving the processing methods, and particularly comparing scientific data of trees different in bioecological peculiarities or habitat conditions and, these data being also viewed under the wide spatial aspect, we are able to accumulate considerably more information than we can imagine during the initial stages of our work.

Dendroclimatological research work because of its wide modification - changeability of initial data, specific difficulties connected with the cross-dating method, carry dendroclimatologists along the easiest way - ignorance of existing in nature statistical regularities, with those locally existing or accidental phenomena or relations being declared as significant regularities. Sometimes an undeserved reproach is pronounced to the address of dendroclimatological method due to this fact. On the whole, it is possible to avoid it if we know well every time of what value is the information obtained, not making to the method such requirements which it cannot and ought not to meet.

Such an extensive introduction is not accidental - some climatologists are still looking suspiciously upon dendroclimatological investigations, declaring the long - term prognoses of natural events to be practically impossible due to the fact that climatological information sequences available are too short, thus, giving up the very idea of reconstructing regularities of atmospheric circulation by means of nature memory and calling in question any attempts in reconstructing the working mechanism at these processes. Such views are characteristic of those scientists who treat the Earth as a closed system wishing to find the pushing powers in biosphere, in its atmospheric and hydrospheric cover.

Very high claims are raised to works and working hypothesis of the investigators who look for methods of long-term prognostication based on the mechanism

of outer influence. Furthermore, the fact that everything that has been done up till now, it has been done by enthusiasts - lone persons, without sufficient financial support and sponsorship of those scientific departments which are just obliged to exert every effort in order to verify and take into account all the probable hypotheses providing the key to determination of long - term prognoses of macroenvironment conditions. Accumulation of dendrochronological information, its processing and utilization - this is an entire scientific field, and in the Soviet Union a rather numerous group of research workers is engaged in dendrochronology and dendroclimatology. Only in close collaboration with biologists, foresters, climatologists, mathematicians and oth., the entire mechanization for processing of bulky information material being done, one can apparently obtain the data meeting the demands of modern science.

The relationships of radial plantation increment are revealed by means of climatic factors - precipitation, weather temperature, soil humidity. Increment rhythm under definite environment conditions shows its relation to the solar activity. Increment relationships and climatic factors may change the index as well as trustworthiness in time depending on a number of factors the influence of which it is difficult to take into account, e. g. that of secular solar activity. Some relationships appear to be rather accurate under extreme environmental conditions, where one of leading factors (moisture, temperature) exerts limiting influence; nevertheless, the possibility that regularities of changeability of atmospheric circulation in trees increment may occur in natural regions showing no deficiency in moisture or temperature, such as e. g. the Baltic region, is not excluded.

Relationships and regularities revealed by dendrochronology method are used for retrospective reconstruction of climatic changes in present forests for the climatic periods during which no instrumental observations had been done by man.

In Russia dendrochronological investigations had been first started by F.N. Shvedov, the professor of the Odessa University, who published his paper on the subject in "Meteorological Herald" in 1892. He set forth basic principles of dendrology (dendroclimatology) which are not considered to be out of date up to the present time¹⁾.

In the beginning of the 20th century a number of interesting works on seasonal increment had been carried out by prof. A.P. Tolskyj [1, 2] and other classics of Russian forestry at a forest - experimental summer cottage [3, 4].

In 1952-1964 a number of papers had been published by V.A. Rudakov who presented a rather thorough analysis with respect to application possibilities of the sliding methods in dendroclimatology, hydrology and some other scientific fields, the measures of their utilization being outlined as well.

On the basis of mass material some research on increment dynamics investigation of three main tree species under different habitat conditions for the space of 30 years had been carried out by the Latvian foresters. Annual indices of pine (*Pinus silvestris* L.) fir (*Picea excelsa*), birch (*Betula verrucosa* et *pubescens*) appeared to be good sources of information on different response of tree species under different habitat conditions. E.O. Dmitrijev's work on tree increment dynamics of different habitats in the Karelian strait is found to contain analogical information.

In the Lithuanian SSR (since 1953) scientific research works on increment dynamics investigation of black alder, pine, fir and some other tree species had been carried out at the Institute of Forestry, in the Academy of Agriculture and Forest

¹⁾ F.N. Shvedov named this method as dendrometric

Designing management. Pine (simple) was studied throughout the republic territory for the space of 100-300 years. Considerable differences in increment dynamics under habitat conditions, differing in soil moisture regime, had been established. Under the guidance of prof. V.G. Nesterov, T.T. Bitvinskis was among the first in the Soviet Union to maintain a thesis on dendroclimatological investigations, the research still being continued at the institute of Botany of the Lithuanian SSR Academy of Sciences. All the research results had been presented in the monograph by T.T. Bitvinskis "Dendrochronological investigations". It had been established that growth dynamics of pine plantations in the Lithuanian SSR clearly shows the 11 - and 22 - year rhythm of solar activity and climatic fluctuations under some habitat conditions. In some forest sites considerable fluctuation amplitude (that depending on climatic factors) was found to reach - 70 to + 100 %. Methods for establishing influence of the factors investigated on current increment had been worked out with due regard for the change of climatic components. A number of complex hydrothermic indices, showing influence of environmental conditions on forest growth had been formed, linear dependence of increment fluctuations of pine wood on amplitudes of solar activity in 22-year cycles being also established.

At the Lithuanian Forestry Research Institute the academician L.A. Kairiukštis, and his coworkers gave much attention to peculiarities of seasonal growth of trees.

In particular, they recommended a differentiation approach to climate factors (temperature, moisture, light), their registration ought to be done during those vegetation periods when they exert directly influence on annual increment formation. Besides, dependence of the tree development class and intensity of its growth during the last year upon the size of the formed bud should be also taken into consideration.

At the institute of archeology (USSR Ac. Sci.) prof. Kolchin and N.B. Chernich made up some dendroscales in Eastern Europe, the Novgorod scale being best known, duration of which makes up approx. 1300 years at present. The works of the Institute of Archeology dealt with dating of archeological objects. Crossdated fossil wood is not observed to be such a precise record of past events in comparison with trees from known habitats or the wood preserved in the peat bog layers. The wood for the Novgorod constructions arrived from a rather wide region of the Novgorod province, thus, showing fluctuations of environmental conditions of Southern taiga of "normal" growth conditions.

European taiga fir-groves had been dendroclimatologically investigated by G.B. Gortinskyj (The Arkhangelsk Forestry Institute) in 1967-1973. He managed to reveal peculiarities of the relation of plantations increment dynamics of fir to climatic factors of Northern and Southern taiga. B.G. Kolishtchuk (Botanical institute of the Ukrainian SSR Ac. Sci.) worked out an original methods for studying regularities in width changeability of annual rings of elfin wood species (*Pinus montana* Mill. and *otr.*) [9]. Besides, he examined to some extent tree species in the Carpathians, the area close to the upper forest boundary being included as well.

With respect to dendrochronological investigation of Northern and Central Urals as well as of Western Siberia much had been done by the Institute of Ecology of Plants and Animals (the USSR Ac. Sci.) Particularly C.G. Shiatov's works on the study of condition changes in the upper forest boundary by means of dendrochronological methods and his dendrochronological scales for the Urals and western Siberia [11] ought to be also mentioned. G.E. Komin established influence of cyclic climatic fluctuations on growth and recurrent structure of woody plantations namely in

the same longitudes of the country [12].

In the northern latitudes (both the European and Asian regions of USSR) extensive investigations had been carried out by N.V. Lovelius (Botanical institute of Ac. Sci., USSR) who examined extreme (mountainous) growth conditions of woody vegetation [13]. V.N. Adamenko (The main Geophysical observation) applied a number of new mathematical methods to dendroclimatological investigations [14].

In southern RSFSR areas increment dynamics of simple pine and oak had been examined by prof. S.I. Kostin (Voronezh, Forestry Institute) [15]. O

In Central Asia K.D. Mehamedshin and his associates examine many juniperus species [16].

Dendroclimatological investigations appear to have a wide application to different scientific branches in USSR: in judicial expertise (M.I. Rozanov, 1966-1972) in archaeology (B.A. Kolchin, 1962 and otr.), glaciology - in works of avalanche and mud flow laboratories of the Moscow State University named after Lomonosov [18], in hydrology R.J. Pakalnis [19] and G.I. Galazyj [20], in forestry (A.A. Molchanov [21], E.P. Shpalte [22] and otr.).

Soviet scientists as well as the scientists all over the world arrive at a general conclusion that dendroclimatological investigations are to be carried out on a large scale: spatially by means of the dendrochronological profil method, in this case comparison of similar data both by environmental conditions and specific composition being desirable. Furthermore, formation of long-term dendroscales giving information for the last 100-600 years, which at present seems to be of rather easy access, as well as formation of thousand - year scale, yielding all possible climatic information on post glacial period, is necessary.

Recently, densitometric methods for wood investigation are becoming more and more popular. In the Soviet Union at the Kirenskyj institute of physics an original photometric device based on reflective wood properties had been made. M.I. Terskov, E.A. Vaganov and otr did not confine themselves to invention of the device - to some extent they have studied its wide application possibilities with respect to tree ring analysis [23].

Long-term prognosis of macroclimatic conditions in our planet, elucidation of the complex of local, global and spatial factors, exerting influence on climate dynamics and annual tree rings, appear to be a rather complicated, many-sided, nevertheless, conceivable task if in close cooperation with specialists in cosmophysics, geophysics, climatology, dendroclimatology, geography and otr., and automatization of scientific processes, the specialists' (in applied mathematics) coming to the aid of the bodies, solving the problem, should accelerate, facilitate and specify the job.

Wide-range introduction of the crossdating methods is found to be unrealizable without application of radiocarbon methods. In the Soviet Union a number of radiocarbon laboratories work intensively, and dendrochronologists may rest upon them. Furthermore, radiocarbon in tree rings, as it is known at present, may be of use with respect to relative dating. Carbon content variations in tree rings, as it had been shown by academician B.P. Konstantinov and prof. G.E. Kotcharov [24] are observed to be extremely valuable indices of the Earth biosphere changeability under influence of cosmic and geophysical factors. A number of radiocarbon laboratories of the Soviet Union have already carried out studies on C^{14} content in tree rings of Scotch pine (*Pinus sylvestris*) dated at the laboratory of the Institute of Botany of the Lithuanian SSR Academy of Sciences, thus arriving at a number of scientific conclusions. The data on strength and time of

flashes of the stars Tiho Brage (1572), Kepler (1604) and Kassiopei A (1700) as well as those on relations existing between the Wolf's number maximum (the generation rate minimum of radiocarbon in the Earth atmosphere) with the minimum of radiocarbon content in the atmosphere with the displacement in the phase of approx. 10 years [25]; The information on positive correlation of radiocarbon content and solar activity in 11-year cycles [26]; on possible influence of geomagnetic field of the Earth on accumulation of radiocarbon in the atmosphere and otr. had been also established [27].

Dendroclimatological information cannot be deciphered if one does not know well the changeability regularities of seasonal radial increment of trees and their relationships with climatic factors. At one time in the Soviet Union a number of research works had been carried out under the guidance of A.A. Molchanov (Forestry lab. Ac. Sci., USSR) [28], L.A. Kairiukštis (Lithuanian Forestry Institute) [29], E.D. Lobzhanidze (Tbilisi Forestry Institute) [30], nevertheless there are few stationarie where wood increment could be kept under constant observation according to hour schedule, and this seems apparently to be the main drawback in our research work.

Knowing well dendroclimatological problems which are being developed at different institute of the Soviet Union and used for different purposes and tasks, Scientific Council of the USSR Academy of Sciences for the problem "Biological principles of rational utilization, remaking and protection of the vegetable kingdom" approved the commission for dendroclimatological investigations under the guidance of the academician of the Lithuanian SSR Ac. Sci. L.A. Kairiukštis, corresponding member (Ac. Sci. USSR) Molchanov and T.T. Bitvinskas.

Formation of dendroclimatological profiles in the territory of the Soviet Union for the space of the last 300-800 years, longitudinal ones along the northern forest boundary following the 55-50 parallels and etc. and those transversal according to determined longitudes appear to be the main subject within the nearest five-year period. Some of them, e. g. the profile Murmansk - Lithuanian SSR - the Carpathians is already done by the Institute of Botany (Lithuanian SSR Ac. Sci.) Particular attention ought to be given to formation of superlong - term dendroscales (up to 8-10 thous. years) both in the Baltic region and other areas of the country by stubs and stem wood taken out of peat - bog strata, river - beds, lakes and etc.

As it had been shown above, results of particular interest could be obtained when examining the radiocarbon C^{14} content in tree rings. In the Soviet Union this problem had been formulated under the headline "Astrophysical and geophysical phenomena and radiocarbon", and it is based upon achievements of dendrochronology, at first being headed by the academician Ac. Sci. USSR B.P. Konstantinov and at present by prof. G.E. Kocharov.

Combination of both, not depending upon each other, methods that of dendrochronological and radiocarbon, enables to reconstruct and verify the dynamics of certain cosmic and geophysical phenomena and first of all - changeability of solar activity under long term and secular aspect.

СОДЕРЖАНИЕ

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