PART III

# SUN ACTIVITY, CLIMATE AND PROGNOSIS OF ENVIRONMENTAL CONDITIONS

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Radial growth of woody plants and tree stands is one of the basic indicators of variation in ecological conditions existing during their growth. Also reflected is the character of the surrounding environmental conditions of a broader territory. This information is of great value so it would be possible, by means of annual date, to reconstruct past conditions of growth of trees for several hundred and even thousand of years and, on the basis of observed regularities in variation, to predict the envi-ronmental conditions for the next ten year period.

## Scientific innovation

Methodological bases for dendroclimatochronological research have been worked out as follows:

Retrospective analysis is carried out on temporal and spatial variability of growth for pine and oak forests in Lithuania and in the territoties of adjacent republics.

The influence of changes of hidrometeorological conditions in forest tracts in various ecotopes is established and this is expressed in composite climatic indices.

Methodogical bases are established for obtaining accurately dated wood for revealing changes of natural radioactivity in accordance with the content of C-14 in annual tree-rings asso-ciated with the problem "Astrophysical Phenomena and Radiocarbon".

By using radiocarbon and cross-dating information has been obtained for thousand-years series of annual rings for pine from peat bogs (peat bog Uzhpialkiu Tirialis) and for oak from sand-gravel pits of river Neris (Smorgon).

## Principles and results of retrospective analysis

The regularity of variability of annual rings makes it possible to formulate the principles analysis and to predict the most probable changes in environmental conditions. In order to do this it is necessary to establish profiles, or, still better, a network of dendroscales distributed relatively evenly in space and having as much depth in time as possible.

It is not easy, of course, to find trees with an age of several centuries in all territories of the former Soviet Union as a con-sequence of intensive exploitation of forest tracts and forest fires in inhabited and sparsely inhabited regions. Our experience shows that it is completely realistic to excpect to cover the forest and the forest steppe zone of mountain forestry with scales for ages of 250-300 (400) years. For certain periods, by using a method of cross-dating, we can cover 500 to 1000 and more years in length [1-3].

Especially significant for retrospective analysis and prognosis is the knowledge of the regularities in variability of annual rings under the most wide-spread conditions of growth sites. Thus, it become possible to establish the length and amplitude of rhythmicality in 100-year aspects of solar activity. Conditions in Lithuania, that is the section of the Northern latitudes most "affected" by the Sun, clearly express the influence of a 22-year cyclicity that is well-preserved and is obvious in swampy pine growth sites. In growth sites of normal soil conditions an 11-year cycle is clear. However, in swamp conditions, a 22-year cycle patern of growth variability is usually clearly expressed in swamp pine.

The end of the 19-th century and the current 20-th century have been exceptionally favorable for human management activity and biological productivity. A composite study of "Uzhpialkiu Tirialis"

peat bogs reveals a picture of 100-year variability in climatic conditions.

The pollen, botanical, radiocarbon and dendrochronological methods have shown the existence of 600-year natural rhythms. The climate 2500-2200 years ago was cool and damp according to dating using radiocarbon-botanical-pollen analysis. Optimal conditions for the growth of pine (warm and dry climate) prevailed for approximately the same length of time (1990-2200). Large-scale dying of trees occurred at the beginning of a new period of abverse climatic conditions. Again fuscus peat prevails. The quantity of spruce and alder pollen increases, while the percent of pollen from pine and heather decreases.

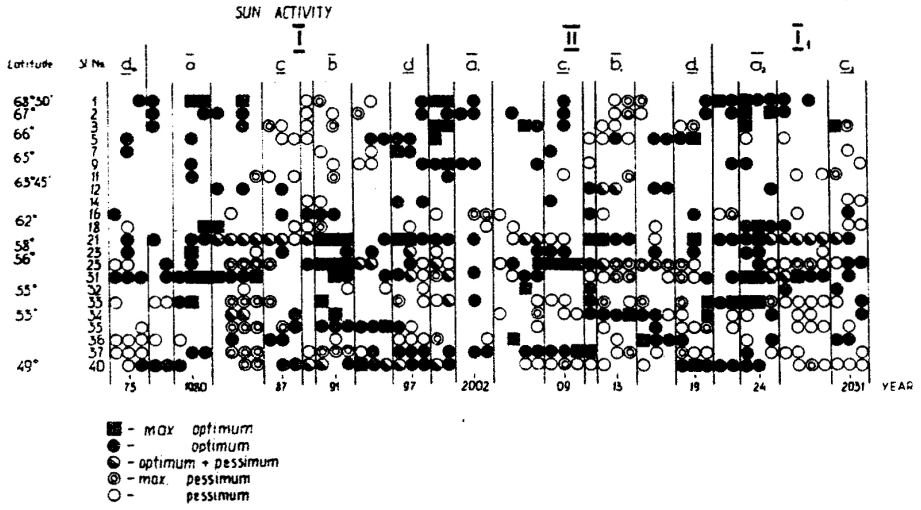


Fig. 1. Dendrochronological profile Murmansk - Lithuania - Carpathians. Ecological prognosis in Pinetum myrtillose claccinio-sum. Black points - optimal years, bright points - pessimal years

The period around 1600-1400 years became more dry, and annual rings less changeable, but pine in the swamp was rather depressed. Optimal growth conditions in the swamp were manifested from 1000 up to 900 years (starting with 600-year, growth conditions again worsened). Fuscous peat is laid down with little decomposition. Pine stumps are rare, small in size, and of limited age. In recent centuries the climate has become warmer and exploitation, such as draining of peat bogs has occurred. Scales for trees of extreme age and from normal site growth conditions illustrate a dependance of temperature changes in the air. This information was based on models of extreme age utilizing carbon (C-14) research results. Pessimal conditions for tree growth appeared in the Western Caucasus 1410-1480(1545) and 1740-1850, in Bashkiria - 1610-1650 and 1840-1885, in Lithuania - 1715-1775 (for oak) and 1726-1825 (for pine). Optimal conditions for tree growth appeared in the Caucasus 1602-1630, in Bashkiria - 1800-1820, in Lithuania - 1825-1950.

The indicated Eastern European dendrochronological dates have shown, that the end of the 19-th and the beginning of the 20-th centuries were climatically optimal. This circumstance had almost a global character and prevailed in many parts of Europe as well as in other continents.

The three years with extreme values of Wolf's sunspot numbers are considered pointer years. We attached the yearly data of tree-rings and their indices to the pointer years of solar activity and studies the growth trend for given regions, sites and species. Confirmed data can date the Wolf sunspot numbers as far back as 1749, which at present, form twenty-one 11-year and eleven 22-year cycles. Solar activity series in the pointer year systems were checked according to Shove's system (fig. 2-3).

Ecological forecasting is based upon the definite prognoses of 11-year and 22-year cycles of solar activity (fig. 1-3). It is known that the prognosis of the solar activity is guided by mathematical modeling of regularities in variability of Wolf's sunspot numbers. Utilized was the method of overlapping epoch (superposit epoch) while developing a generalized series of solar activity by hydrological years to reveal the distinctive features of 22-year cycles, as well as 44-year and 88-year cycles in time.

With this pointer year system, it is easy to make tables of the relationships between dendroclimatological dates and the pointer years of past solar activity. If there are long enough

series of natural phenomena (e.g., tree-ring indices, air temperature, precipitation, comlex climatic indices, earthquakes, etc.), the method can be connected to solar activity with some regularity. The width of tree-rings or calculated yearly indices can be easily attached to the maximum and minimum 22-year cycles of solar activity from the year 1745 to the present. This mathematical and graphical method enables one to link different increments of tree-ring growth to different phases of solar activity.

The illustrations here represent our dendroclimachronological laboratory's results of two dendrochronological profiles of extre-me ring increment prognosis. The illustrations provided are prepared in accordance with the Krie (superposit epoch) method.

The first dendrochronological profile (fig. 1) was based on conifer wood samples gathered between Murmansk-Lithuania-Carpatians profile. It was based on dendroscales generated by ordinary measures of radial increments taken from normally dry forest growth areas (Pinetum myrtiloso - vacciniosum). Presented are ring increment extremes that were created under varying phases of the Sun activity. Time periods are noted as follows - the years of maximal activity of the Sun (a, b), stabile years (c, d), decreasing activity (ac, bd), and increasing activity (da, cb) time periods. Extremes of more than 15 % from the average tree-ring widths are indicated in black, whereas extremes of less than 15 % from the average ring widths are indicated by white circles. The more powerfully significant extremes of "maximum optimum" are indicated by black squares, whereas "maximum pessimum" are indicated by a circle within a white circle.

The model of the Sun's activity which was used to calculate the length of the Sun's activity phases was also got by using superposit epoch method with Wolf's numbers, taking into account hydrological years (IX-XII, I-VIII months).

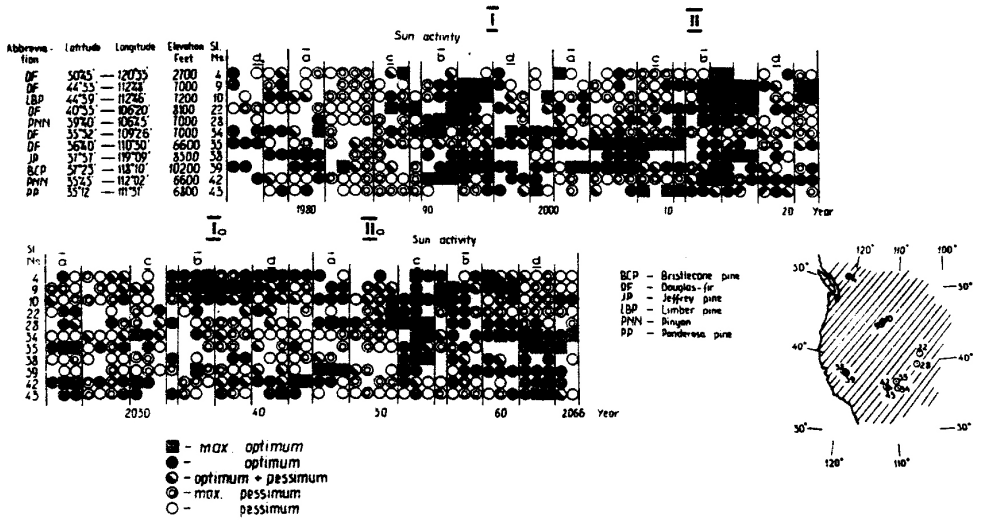


Fig. 2. Dendrochronological profile Southwestern Canada - Southwestern America. Black points - optimal years, bright points - pessimal years

Noted in Figure 1, the extremes in $68^{O}$ - $63^{O}$ Northern latitude are more concentrated and the positive and negative extremes are pronounced concurrently over several time period phases. For example, positive extremes appear in the Sun's activity phases d - ac; da; a - ac - c; d - a - ac, and negative extremes in phases c - b - bd. More south, in $58^{O}$ - $55^{O}$ Northern latitude (where Lithuania is situated), changes of extremes are more concentrated. Pessimum growth years are dominated by phases d - da, whereas phase c is a pronounced optimum and phases bd - d again indicate pessimum increment years which during testing sample plots extend to phase bd. In the entire profile, phases ac are under pessimum conditions. The view presented is particularly realistic for the time period of the last 100 years. Should nature repeat this pattern which is the assumption on which we base our prognosis, it is possible to project the dynamics of environmental conditions up to the year 2030.

As per Figure 1, it is possible to project environmentally worsening and improving conditions in the more southern areas of Northern latitudes $49^{O}$-$53^{O}$ represented by phases d - ac and Nor-thern latitudes by phases c - b - bd. It's also possible to trace certain optimum conditions developing over time and area by analo-gical methods.

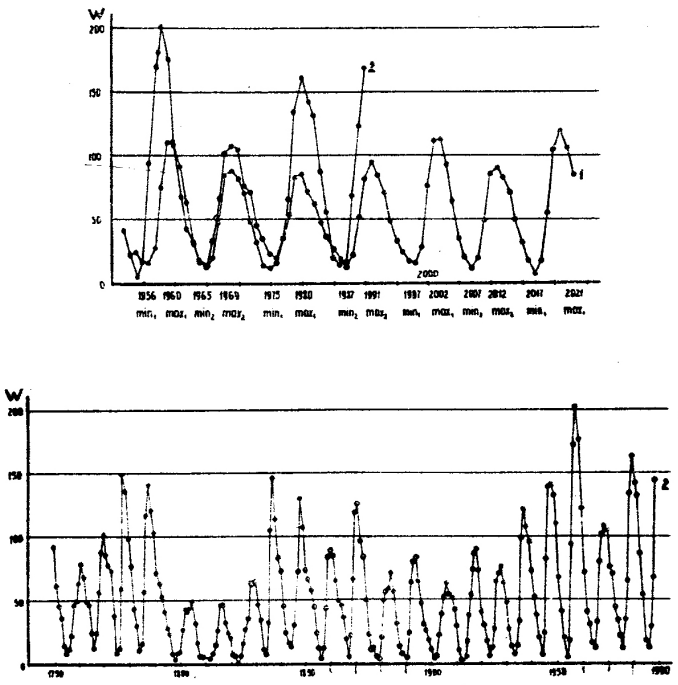


Fig. 3. The middle model of the Solar activity calculated by the method of superposit epochs (1), the real Solar activity in a hyrdological year (2 ab). W - Wolf's numbers

Figure 2 was developed using an analogical method graphing repetitive extreme environmental conditions testing Western regions of North America, $50^{O}45'$ - $35^{O}12'$ Northern latitude and $120^{O}33'$ - $106^{O}12'$ Western longitude [4]. To gain this profile, in contrast to Murmansk - Carpatian profile, six conifer tree types were utilized. In this case, the utilized dendrochronological dendroscales extend from the year 1449 and fall into 88 year cycles consisting of four 22 or two 44 - year cycles. A total of six epochs are included in this pattern of cycles, thus the statistics of extremes up to the year 2066 are valid.

## Results of particular interest

Changes in extreme factors allow a possibility to objectively project important influences in economic spheres particularly relating to agriculture.

The extreme negative environmental conditions occurring in the latest ten years compared to the reasonably favourable situation in nature during current years indicate further favourable con-ditions during the next 3 to 4 years.

Based on the previous discussions, the first factor to observe in both Figures 1 and 2 is the law of averages in the surrounding environment which existed and will probably continue on at least during the closest decades assuming extremes in time and area will correlate with phases of the Sun's activity. Extremes of tree-ring increments allow to prognosticate that certain types of grass that will appear, agricultural productivity of various grain products and important changes of climate and air temperature.

## Conclusions

The study and generalization of dendrochronological series for coniferous and deciduous wood varieties (pine, spruce, larch, oak, alder and others) have been affective and have revealed potential use of the series of the annual tree growth investigating regularities in the variability of forest and other land area productivity. It can be used in detecting ecological factors which will determine changes both in Lithuania and in other research areas [5].

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# PECULIARITIES OF DISTRIBUTION OF LEUCOCYTOZOON SIMONDI (HAEMOSPORIDIA, LEUCOCYTOZOIDAE) IN NORTH PALAEARCTIC


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Leucocytozoon simondi Mathis et Ieger, 1910 - a specific parasite of Anatidae, which induces leucocytosis in domestic and wild birds [1, 2, 8, 14]. Leucocytosis in Anatidae for the first time was in detail described [1] in North-West of Russia. This disease is rather common in the environs of St. Petersburg, Finland, provinces of Novgorod and Pskov.

Long-term studies on distribution and biology of L. simondi were carried out in North America, where mortality from leucocytosis in some regions is considered to be the main factor regulating the numbers of wild Anatidae and laying obstacles to the industrial breeding of domestic geese and ducks [3, 6-8, 12].

In West and Central Europe L. simondi was rarely registered [10, 11]. This, most probably, can be explained by the weak interest of the European researchers in this parasite. The data on distribution of L. simondi in North Europe are not numerous [5, 13]. The investigations of distribution of agents of leucocytosis in Anatidae on the vast territories of North Palaearctic eastward from the Baltic Sea were not carried.

The aim of this work is to determine the area of circulation of this pathogenic Haemosporidia on the basis of the original data of the distribution L. simondi in Anatidae in North Palaearctic and the analysis of the literary data.

## Material and methods

In July-September 1984-1988, in 5 districts of the USSR 529 individuals of Anatidae, belonging to 17 species (Tables 1, 2) were examined for the infection with blood parasites.