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Russian Approaches to the Forest Type Classification

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Abstract. The results of researches characterizing the geographical distribution of forest-ecological, phytocoenotic, and genetic classifications of forest types in the Russian Federation nowadays are presented in the thesis. A comparative analysis was carried out for the following items: the inclusive concept of a classification unit (a type of habitat conditions; a type of forest); features of distinguishing the border of the classification units; classification features used to determine the type of habitat conditions; features of the classification of phytocoenoses used to determine the forest type; the degree to which the successional dynamics of forest stands are taken into consideration; the degree to which the influence of anthropogenic factors are taken into consideration; the level of implementation in forest management and forestry practice; regions of implementation. In the process of development of forest typologies, the concept of a forest type changed from understanding it as a forest area homogeneous by composition, structure, and appearance (homogeneity in space) in natural classifications to the concepts of a forest type, in which priority is given to homogeneity in origin (genesis), as well as developmental processes and dynamics (homogeneity in time) in genetic and dynamic typologies. Currently, there is the following forest type classification in the Russian Federation: forest-ecological, phytocoenotic, genetic, and dynamic. When classifying forest areas within the forest-ecological direction provided by E.V. Alekseev – P.S. Pogrebnyak, the priority is given to the characteristics of the habitat conditions. Within the phytocoenotic direction provided by V.N. Sukachev, the priority is given to the phytocoenosis characteristics. Within the genetic approach provided by B.A. Ivashkevich – B.P. Kolesnikov, a forest type is considered as a series of alternating phases – types of phytocoenosis within the same type of habitat conditions. In this case, phytocoenotic classifications can be a part of the genetic classifications for the climax forest phytocoenosis. And the dynamic approach provided by I.S. Melekhov is very close to the genetic one and is a superstructure over the classical phytocoenotic forest typology provided by V.N. Sukachev. The current use of forest typological classifications by forest inventory management enterprises in the Russian Federation was studied. A map of the geographical distribution of forest typologies of the above-listed directions of forest typology researches was created. Forest-ecological classifications are used mainly in the southern regions of the European part of Russia and the North Caucasus. Forest typologies created based on a genetic approach to the forest type classification are used in Western Siberia, in the south of the Far East and Eastern Siberia, and in some regions of the Urals. Phytocoenotic classifications of forest types are used in other regions of the Russian Federation.

1. Introduction

Modern rational forestry systems are based upon forest typologies. The most intensive development of key forest typology study directions occurred in different countries of the Northern Hemisphere from the end of the XIX, and almost until the end of the XX century. Results include forest type classifications that are actively used in forest management of the said countries. In the beginning of the XXI century scientific and practice-oriented interest of forest researchers shifted towards development of forest type classifications allowing harmonization of national forest inventory systems using criteria and indicators of sustainable forest management [1- 4].

Second decade of the XXI century featured an increase in numbers of publications describing effects the local climate changes have upon the habitats and forest vegetation, including effects the changes have upon the use of the forests, and indicators used for multiple purposes, including forest type defining [5 — 11]. Keeping this in mind, improvement of forest topology patterns under conditions of current climate changes, and anthropogenic pressure remains among the key directions of forest typology research.

Scientists from the Russian Empire and USSSR developed several original approach towards forest typology development, and their research results are still actual [6, 7, 12]. Despite a certain decrease in the number of publications on the topic in Russian Federation in the late XX- early XXI centuries, that was primarily due to social and economic factors, Russian scientists continue research and development in this area [13 — 20].

Necessity of research aimed at harmonization of Russian Federation's national forest inventory systems at the level of sustainable forest management indicators criteria is determined by the fact that Russia is among the countries that joined Montreal and Pan-European processes [2, 21 – 22] aimed at harmonization of national forestry systems. Success of the initiative depends upon a number of factors including familiarity with forest classification types used at national and international levels by the specialists from different countries joining Montreal and Pan-European processes in the areas of creating forest inventory, and forest management. Free access to research results in this area is extremely important ecologists and people making decisions at the industrial, national and International levels.

The goal of the work was to perform comparative analysis for the main forest type classifiers used in Russian Federation

2. Key forest type classifications used in Russian Federation

Key approaches to classification of the woods, phases of forest typology development in Russian Empire and USSR, and specifics of the forest type classifications were covered in [6, 7, 12, 20]. Specialists distinguish the following periods and directions of forest typology studies in Russia – pre-Morozov period, A. Krüdener's classification of forest types, forest ecology direction by E. Alekseev and P. Pogrbnyak, V. Sukachev's phytocoenotic forest typology; geographico-genetic forest typology by B. Ivashkevich and B. Kolesnikov, and dynamic typology by I. Melekhov. Directions of forest typology research listed after A. Krüdener's classification were developing simultaneously.

The following table contains results of analyzing key forest type classification currently used in Russian Federation. In some Russian regions local forest management authorities use proprietary classifications of forest types developed by researchers that were not listed above. However, these classifications usually belong to abovementioned classifications. It is also necessary to note regional forest type schemes and inventories that are widely used in forest management, research [23 — 28], and logging classifications [29, 30]. These schemes are prevailingly based on the key principles of the main classifications, and use Morozov's ideas [31, 32]. While developing forest typologies, authors clarified and extended the term of forest type, changing the concept of forest part that is homogenous in terms of composition, structure, and appearance into a forest type idea where homogeneity in terms of origin (genesis), development processes and dynamics (temporal homogeneity) is prevailing over uniform composition and structure (spatial homogeneity).

In natural classifications, i.e. ecological-sylvicultural and phytocoenotic ones, forest type is considered in terms of forest biogeocoenosis components' spatial uniformity of characteristics. In genetic classifications priority of spatial uniformity criteria for forest parts were replaced by uniformity criteria for the series of forest biogeocoenoses in time [6]. Each series of coenoses types relate to a specific forest type in genetic classification. Regional genetic classifications base upon the same common principles; however they always consider regional specifics with regards to climate, soils, and landscape, which creates regionally-specific schemes. These schemes fully implement Morozov's geographical principle due to the requirement of including forest vegetation conditions codes in the names of the forest types [23, 20, and 33]. System of alphanumerical codes was developed, allowing to represent forest type affiliation with a certain zone, subzone, province, altitudinal belt, floristic complex of biogeocenoses, and edaphic and hydrological complex of forest growth conditions (classes, groups, types) [23, 20, 33]. Altogether that provides genetic classification forest type with a precise geographic and ecological "address". That is the key fundamental difference of a genetic classification form natural typologies, as the latter have no clear boundaries for use [23]. In order to stress regional specifics of genetic classifications, they are usually referred to as geographo-genetic ones [6].

Forest type in genetic typologies is determined within the limits of certain forest growth conditions type, including relief genesis and landforms, illumination conditions, physical and chemical properties of parent rock material and soils, water regime, and specifics of plants' watering and mineral nutrition. Within the framework of genetic approach, forest type is a stage of forest genesis process [34].

Stand types or phytocoenosis types represent the phases of forest type development, meaning that forest conenoses can replace each other within a single type of forest growth conditions. Appearance, composition and structure of the conenoses can substantially differ, while they will nevertheless belong to the same forest type [34, 35]. Forest type in genetic classifications is formed by a sequence of stand types [15, 16], or, in other words, "stand type is a form of forest type existence, while the latter is represented by genetic series of stand types replacing each other in time" [34]. Forest type can be described by a certain growth sequence of forest stand, composed by specific forest forming species.

Table 1. Specifics of Key Directions in Forest Typologies Used in Russian Federation

Parameters	Forest type classification, author(s)			
	Ecological-sylvicultural (E. Alexeev – P. Pogrebnyak)	Phytocoenotic (V. Sukachev)	Genetic (B. Ivashkevich – B. Kolesnikov)	Dynamic (I. Melekhov)
Forest type definition	Forest type is a combination of forest lots with similar soil, hydrological, and climatic conditions, and considering historical factor. Forest type is determined by the type of forest growth conditions. Interpretations of the latter factor may differ from the type of conditions per se to the combination of forest biogeocoenoses viewed	Forest biogeocoenosis type, unlimited potential number of forest types	Series of interrelated forest phytocoenoses within the limits of specific site conditions, i.e. the series of forest biogeocoenoses replacing each other in time. Forest type definition is wider than in V. Sukachev's classification, and there is no limit for the number of potential forest types	Forest type definition is similar to the one by V. Sukachev, stages of forestation development added, including type of clearings and burnt

	within the limits of forest growth conditions. The typology is used in the regions where the types of forest site condition well match the forest stand types, thus in order to determine forest type it is enough to just determine forest growth conditions using edaphic grid that allows using only 24 combinations of forest growth conditions			areas. For the forest type a transition is possible from one type into another, and there are no limits for the potential number of forest types
Forest type boundary	By the boundary of forest growth conditions for forested and deforested sites	By the boundary of forest phytocoenosis for forested sites only, considering the forest growth conditions	By the boundary of site conditions for forested and deforested areas	By the boundary of forest phytocoenosis for forested and deforested sites, considering the forest growth conditions
Parameters used for classification of forest growth conditions	Parent rock, soil type, composition, trophicity, and humidity	Direct impact factors (soil trophicity, moistening and aeration modes) are considered using indirect factors: indicators of living ground vegetation, position of landscape, and moistening regime	Altitude over sea level (altitude class) for highlands or regional complex of forest growth conditions for lowlands, moistening regime, landscape and soil specifics	Similar to V. Sukachev's classification
Features of biocoenosis used to determine forest type	Stand composition within the limits of forest growth conditions, considering requirements of plant species for soil trophicity and humidity	Stand composition, living ground vegetation indicators, forest management and taxation parameters, growth class and reproduction	For forested sites method uses parameters from V. Sukachev's classification, including key ones of stand productivity, and specifics of natural reproduction (species, numbers, and age). For deforested sites key features include presence and species of tree undergrowth, and dominant species ground vegetation	Ground vegetation features are used for deforested sites. For phytocoenoses method uses parameters from V. Sukachev's classification

Considering seral dynamics	Initial theoretical attempts followed by efforts to consider seral dynamics in classification schemes	In theory (classification schemes have an ability to forecast stand replacement based upon reproduction data)	Both theoretically and in classification schemes, age and reproduction dynamics are presented as series of potential phytocoenoses types replacing each other under the same growth conditions. Method has specific patterns used in organizing forest management activities	Developed typology of clearings and burnt areas as a stage in reproductive dynamics, preceding actual formation of a forest type; type transition into another is considered in theory.
Considering impact of anthropogenic factors	At the level of theory for direct impacts. Indirect impacts are not considered	At the level of theory for direct impacts. Indirect impacts are not considered	Both theoretically and in classification schemes, by the logging type (with and without burning), that are used for forest management activities. Indirect impacts are not considered	Developed typology of clearings and burnt areas. Indirect impacts are not considered
Level of use in forest management activities, regions of use	High (Southern regions of Russia)	Very high (Western Russia, Eastern and Western Siberia)	High (some regions of Russian Far East, Urals, and Western Siberia, some regions in European Russia)	Jointly used with V. Sukachev's classification

It is necessary to note that natural classifications consider stand type, forest type, and forest biocoenosis as synonyms, forest type is a broader term in genetic classification. Genetic approach to forest type classification does not discard natural typologies, but supplements and extends them [7, 36, and 37]. For example, genetic classification by Ivashkevich and Kolesnikov is based upon the results of classification proposed by Sukachev, supplemented with data on duration, direction, and pace for different change types.

One of the shortcuts for natural forest typologies is relatively low attention they pay to anthropogenic impact. That was corrected in a dynamic typology suggested by I. Melekhov, which was based upon the classification by V. Sukachev, but with extended interpretation of a forest type. Forest type in this classification similarly to the genetic typology by Ivashkevich and Kolesnikov is considered in space and time, as forest type is considered to represent a stage or several stages in forest development [7]. Dynamic typology considers exo- and endogenous changes that occur in the woods, ability for transition from one forest type into another or the link among the stages within a single forest type. Seral cases occurring at the clearings represent the restoration (demutation or de-mutation) schemes. Initial demutation stage corresponds with a clearing type determined based upon the number of forest growth conditions, which is at term evaluated based on conditions of forest growth, i.e. specifics of the plants present in the initial forest type before logging.

3. Geography of using forest typology classifiers in Russian Federation

Figure 1 presents a map that shows modern use of forest typology classification created on the base of data obtained from responses sent to the regional divisions of state forest inventory enterprise "Roslesinforg", studying regional forest plans, and the review by Yu. Neshataev [38]. Details on names, parameters, authors and organizations that [developed classifications for certain regions of Russia and USSR are not listed here due to limited space. Classification by I. Melekhov was not considered separately, but as an extension and development of V. Sukachev’s phytocoenotic classification. We have also shown Ukraine (Ukr) and Belarus (Blrs) in Figure 1, as this allows us to more clearly represent the areas of creation in the USSR and the current distribution of ecological-sylvicultural and phytocoenotic classification of forest types.

Genetic typologies are used in thirteen regions of Russian Federation. Ecological-Sylicultural typologies are used in fourteen regions. Two regions use classifications from phytocoenotic and forest ecology types, other regions that are not listed here, use phytocoenotic classification.

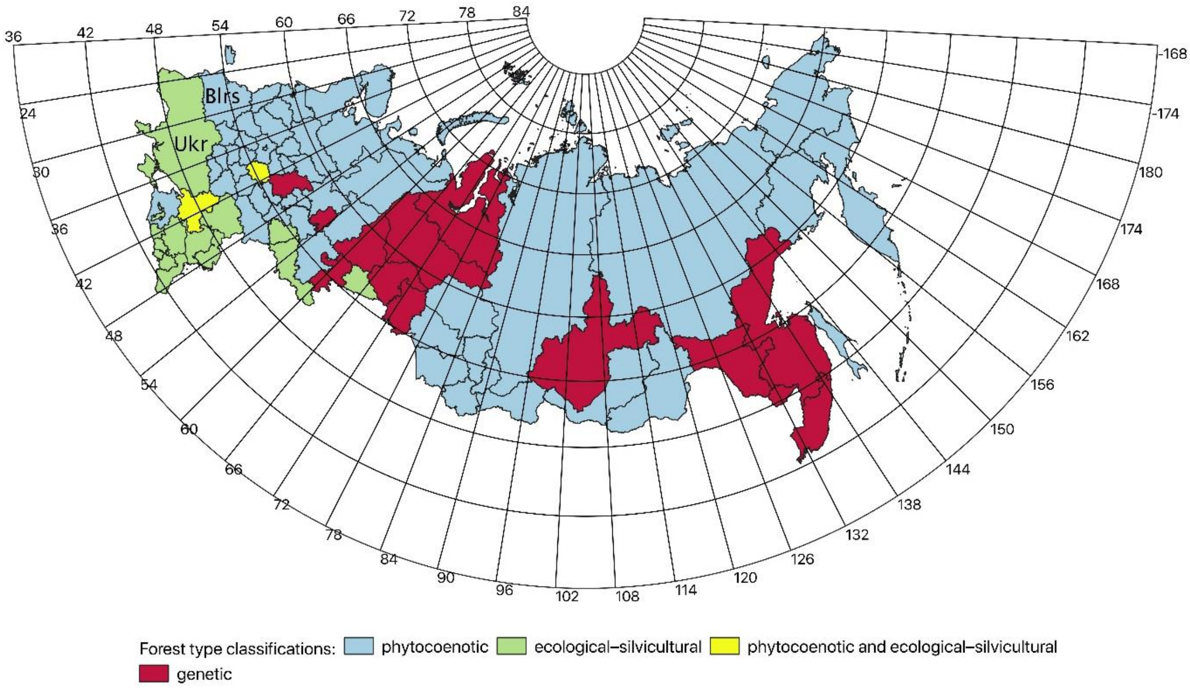

Figure 1. Use of key forest type classifications in Russia, and former Soviet Union republic: Ukraine (Ukr) and Belarus (Blrs). Dynamic classification was considered to be an add-on for phytocoenotic classification, and thus it was not presented on the page

4. Conclusions

1. In course of developing forest typologies, the concept of forest type changes from the uniform fragment of forest with uniform appearance, composition and structure in natural classifications to the concepts of a forest type, in which priority is given to origin (genesis), as well as developmental processes and dynamics (homogeneity in time) in genetic and dynamic typologies.

2. All approaches to vegetation classification and now required to consider climatic and edaphic factors, and assess their role in differentiation of the plants, even if initially plant units (forest types and other syntaxons) were selected mainly using features of the plants. Nevertheless, Morozov’s geographic principle is fully implemented only in genetic forest typology due to the use of alphanumerical codes for reflecting forest type affiliation with a certain zone, subzone, province, altitudinal belt, floristic complex of biogeocenoses, and edaphic and hydrological complex of forest growth conditions (classes, groups, and types).

3. Key problem of modern typologies is related to taking into account seral dynamics of forest biogeocoenoses. Best solution of this problem is available in genetic topology, where key diagnostic features for determination of forest types include stable parameters of forest growth, and the concept of dynamic series of biogeocoenoses' formation and development is introduced.

4. Issue of considering anthropogenic impacts is actual for all reviewed typologies and is actively discussed on theoretical level. Practical applications involve development of regional classifiers for clearings and burnt wood types in genetic and dynamic typologies. At the same time lack of consideration for anthropogenic impacts is considered to be the shortcoming of natural forest typologies.

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