In author's edition

A new book on European Russian forests in the series "Plant and Vegetation" published by Springer

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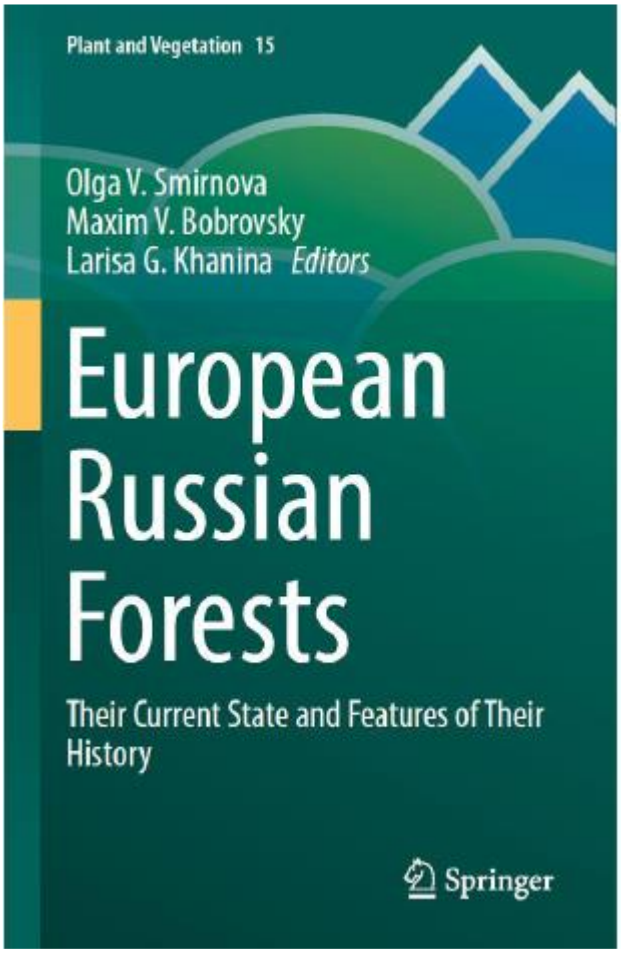
Abstract. The article contains a description of the book "European Russian Forests: their current state and features of their history", published by Springer in the late 2017 / early 2018 in the Plant and Vegetation series (editor of the series is Prof. M.J.A. Werger). To some extent, the book is the English analogue of a collective monograph published by Nauka in 2004 and edited by Prof. Olga Smirnova "Eastern European forests: the Holocene history and the current state". In the meantime, the book of 2017 is substantially revised in terms of availability and presentation of the material for the international reader; it is supplemented with new sections. The editors of the book are Olga Smirnova, Maxim Bobrovsky and Larisa Khanina. The article describes the content and the most important findings of each chapter; the authors of the chapters are indicated. In the book, the European Russian forests are described within the boreal, hemiboreal and nemoral forest regions; floodplain forests are also characterized. The book presents a classification and description of forest vegetation, soil characteristic and the assessment of plant diversity and successional status of forest plant communities. Structure and composition of vegetation in early- and late-successional forests are analyzed with an emphasis on forests in Nature State reserves and National parks. Features of the historical land-use are discussed for each forest region. The book contains analysis of the general dynamics of the forest cover during the last two decades; the main stages of transformation of forest landscapes in European Russia during the Holocene are shortly reviewed in connection with the development of the production economy of people.

Keywords: forest vegetation, European part of Russia, classification of vegetation, old-growth forests, forest soils, history of forest ecosystems, biodiversity, successions, forest gap-mosaic, tree fall with uprooting



Springer has published a collective monograph “European Russian Forests. Their Current State and Features of Their History” / Ed. by Olga Smirnova, Maxim Bobrovsky and Larisa Khanina. 2017. 566 p. ISBN 978-94-024-1172-0. DOI: 10.1007/978-94-024-1172-0. Series Plant and Vegetation (Series editor Marinus J.A. Werger, Utrecht, The Netherlands), Springer. V. 15.

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The book is devoted to the memory of Lyudmila Borisovna Zaugolnova – one of the main authors of the monograph, Doctor of Biological Sciences, the author of vegetation prodromuses of boreal and hemiboreal forests.

Chapter 1 of the collective monograph describes topography and hydrography of the territory, climate, vegetation and soil (authors I.S. Voskresensky, N.V. Zukert, S.S. Bykhovets, L.B. Zaugolgova, O.V. Smirnova, M.V. Bobrovsky, S.A. Turubanova, L.G. Khanina). The first section of the chapter depicts geomorphological provinces in the Russian Plain territory and surrounding areas: plains and ridges of Eastern Karelia and the Kola Peninsula, northern, middle and southern parts of the Russian Plain, and western slope of the Urals. The characteristic of the river network of the territory is given, the largest lakes and water reservoirs are described, swamps are briefly characterized. The second section gives climatic characteristics of the territory, original maps of spatial distribution of climatic parameters are given (the amount of PAR for days with an average daily temperature above 5 degrees Celsius, annual precipitation, cumulative temperatures for the period with the temperature above 10 degrees Celsius and Selyaninov hydrothermal coefficient); changes in these values over the last century are briefly discussed. The section devoted to the general description of vegetation characterizes three forest regions identified on the territory of the Russian Plain and its adjacent areas: boreal, hemiboreal and nemoral forests; it provides maps with areas of dominant tree species (*Picea spp.*, *Abies sibirica*, *Quercus robur* and *Tilia cordata*) and maps with modern distribution of dominant tree species, taking into account their coverage (according to Bartalev et al., 2004). The last section of the first chapter gives a general description of forest soils which are typical of the three abovementioned forest regions taking into account soil-geographic zoning by Glazovskaya (1973). The names of the soils are given according the International Classification World Reference Base for Soil Resources (2006).

Chapter 2 describes the main research methods (authors O.V. Smirnova, M.V. Bobrovsky, S.A. Turubanova, L.B. Zaugolnova, L.G. Khanina, P.V. Potatov, A.Yu. Yaroshenko, V.E. Smirnov). It lists 43 objects; on the basis of their research the book has been written. The chapter demonstrates their location on the territory of the European part of Russia. It defines eco-coenotic groups of plant species;

explains the eco-coenotic approach to vegetation classification which was used when describing coenobanks of boreal, hemiboreal and nemoral forest vegetation. The chapter describes modern approaches to mapping and monitoring the forest cover. Methods of gathering and analyzing field data are also described including diversity estimation techniques, estimation of forest vegetation dynamics according to ontogenetic structure of tree populations, estimation of successional stages of forest ecosystems.

Chapter 3 is devoted to the description of boreal forests in the European part of Russia (authors L.B. Zaugolgova, M.V. Bobrovsky, V.N. Korotkov, O.I. Evstigneev, A.A. Aleinikov, O.V. Smirnova, N.S. Smirnov, M.V. Zaprudina, L.G. Khanina, V.E. Smirnov). The first section demonstrates the vegetation prodromus and describes the distribution of boreal forests: it describes in detail the sections both of widespread lichen, green moss, boreal swamp and sphagnum forests, and rare for boreal zones large fern and boreal tall grass forests on watersheds. The second section describes specific features of historical nature management in the boreal zone. It is shown that fires connected with human activity and forest felling are the most common impacts in the region. Fires caused by human activity have occurred for at least fifteen hundred years. Forest felling has been common over the past five centuries, especially since the mid-19th century. The next section analyzes post-fire successions in the Kostomuksha State Nature Reserve. It is shown that if there has been no fire for 200 years or more and if there is an available source of seeds of Picea abies, forests with the common pine dominance in the reserve are gradually replaced by forests with the European spruce dominance; the soil cover with the dominance of lichens is replaced by green moss and then by small grasses and green moss. The fourth section describes and analyzes in detail the old-growth dark coniferous forests of the Pechora-Ilych State Nature Reserve. It is shown that despite the close composition of the tree layer, five types of forests can be distinguished within the coniferous forests; they differ in the composition of the soil cover. Three types of forests - high-grass boreal, large-fern and green-moss forests - are located at similar positions in the relief, in

the absence of waterlogging; two types of forests - sphagnum and nitrophilous tall grass forests - are located under the conditions of stagnant moisture and in riverian positions, respectively. The structure of these forests associated with the mosaic of renewal gaps and wind-soil complexes is analyzed; it is shown that the highest species diversity is observed in tall grass boreal and nitrophilous forests. The last section of the third chapter presents a comparative analysis of the species diversity and soil cover features in old-age dark coniferous forests located in the western and eastern parts of the boreal region of the European part of Russia. It has been shown that the diversity of vegetation in the “west” and “east” changes in a similar way: it is maximum in tall grass boreal and nitrophilous forests and minimum in green-moss forests. An analysis of fire traces in vegetation and soil cover allowed the authors to conclude that fires are the main factor determining the existence of different types of forests in similar environmental conditions. In general, on the basis of studies of vegetation, soil, and historical nature management, the authors of the chapter conclude that most of the boreal zone forests are formed under the influence of multiple fires and forest felling, which simplified the structure of boreal forests and led to widespread occurrence of green moss and suffruticose forests with relatively low species diversity and the predominance of soils with mor and mor-moder horizons. Dark coniferous forests, rich in number of species and structural diversity of vegetation, dominated by tall grasses and with a moder-mull humus horizon were found in places of fire refugiums, both in small river and stream valleys, and on watersheds. The presence of gap mosaic, wind-soil complexes associated with large tree fall outs, as well as the presence of dead wood of different stages of decomposition and overgrowing are the main features of these forests, which are at the latest stage of succession, from those observed by the authors in the boreal region.

Chapter 4 contains a description of hemiboreal forests (authors L.B. Zaugolgova, M.V. Bobrovsky, A.I. Shirokov, O.V. Smirnova, T.Yu. Samokhina, M.V. Zaprudina, V.A. Spirin, D.L. Lugovaya, V.N. Korotkov, L.G. Khanina). Similarly to the chapter on boreal forests, the first section contains a detailed

description of the forest vegetation prodromus and forest distribution in the region: sections of lichen, green moss, grass (including boreal-pine, small grass-boreal, boreal nemoral, nemoral and tall grass) forests are described, as well as hemiboreal swamp and sphagnum forests. The second section analyzes the features of historical nature management. It is shown that the zone of hemiboreal forests differs from other forest regions in the highest variety of methods and intensity of nature management. Compared to the boreal zone, agriculture and forestry began to develop here earlier and in larger areas. Agriculture played a significant role in transforming the forest cover. The time and extent of deforestation and the spread of agriculture significantly varied in different parts of the hemiboreal zone. The third section of the chapter describes typical features of the best-preserved hemiboreal forests on the examples of the Visim and Sabarsky Nature Reserves and the Kilemarsky Reserve: the variety of vascular plants is described, the ontogenetic structure of tree populations and the features of vegetation diversity in connection with the microsite communities structure are analyzed; features of dead wood decomposition stages and the concomitant diversity of bryophytes, vascular plants, and macromycetes are described. It is concluded that there is a close relationship between the structural and species diversity of forest communities. The fourth section describes the post-fire and post-felling successions in the east of the Kostroma Region. It is shown that successional restoration of vegetation after felling and fires occurs in a similar way: the number and proportion of nemoral and tall grass species increases, and the eco-coenotic structure of communities becomes more complicated. The main factors hindering the vegetation restoration are the remoteness of communities from the sources of primordia of the regional flora and the high degree of previous anthropogenic transformation of the territory, including fires. The last section of the chapter describes succession stages and diversity of vegetation after felling and plowing in the south of the Moscow Region on the example of the Gorki State Nature Reserve; it forecasts the development of forest communities and describes the experiments on artificial restoration of broad-leaved forests with spruce in place of post-arable birch forests. It is shown that

spontaneous restoration of hemiboreal forests with dominance of dark coniferous and broad-leaved tree species in the nearest centuries is impossible in island forests remote from the sources of promordia of late succession tree species. The artificial restoration of such forests should be carried out by simulating a gap mosaic in the forest canopy (with an optimal size of 0.1 to 0.3 ha) and planting the missing species of trees, shrubs and grasses. In general, the authors of the chapter conclude that over the past 300 years, almost all hemiboreal forests of the European part of Russia have experienced human impact in the form of felling, fires, creation of forest crops and agricultural development. In the forest cover of this zone, pioneer forests with the dominance of birch, aspen and pine prevail. Only in the least populated, economically underdeveloped places we can find forests with a pronounced gap mosaic, presence of wind-soil complexes and dead wood, dominated by spruce, Siberian fir and small-leaved linden. However, due to the overlap of ranges of many boreal and nemoral plant species, as well as due to the diversity and intensity of anthropogenic impacts, a relatively high level of forest biological diversity is maintained in the hemiboreal region as a whole.

Chapter 5 contains a description of nemoral forests of the European part of Russia (authors T.Yu. Braslavskaya, M.V. Bobrovsky, L.G. Khanina, E.A. Starodubtseva, N.V. Ivanova, O.I. Evstigneev, V.N. Korotkov, O.V. Smirnova). The first section of the chapter shows the prodromus of forest vegetation and describes the distribution of nemoral forests; forests of the grass section are described in greatest detail: subsections of nemoral-grassy, nemoral-nitrophilous-grassy, boreal-nemoral, xerophilous-nemoral (boreal) -grassy, meadow-grassy, nitrophilous-grassy forests. The second section describes the features of historical nature management in the region. It is shown that due to the long-term economic development of the territory, which began in the middle-late first millennium AD, the forest vegetation of the nemoral zone is significantly transformed. Old-growth broad-leaved forests are currently located in nature reserves and national parks; to the greatest extent they were preserved in areas which belonged to protective forests of the Moscow state of the 16th and 17th centuries. In general, the region

has a more forested northern part, where 25% of the territory is covered with forest, and the southern part (forest-steppe), which was a “wild field” up to the 17th and 18th centuries, and then was plowed for the most part. The third section of the chapter describes in detail mesophytic old-age polydominant broad-leaved forests located in the Kaluga Zaseki State Nature Reserve; it evaluates the vegetation diversity in all types of the reserve communities; it analyzes the dynamics of forest restoration in intraforest glades - former arable lands and pastures abandoned in the early 1990s in connection with the inclusion of the territories into the reserve. It has been suggested that the preservation of the general regional vegetation diversity in the zone of broad-leaved forests is possible in the presence of open and irrigated habitats, the sustainable maintenance of which in the reserve is associated with the activity of beaver (Castor fiber) and bison (Bison bonasus). The fourth section of the chapter analyzes 80-year-old dynamics of vegetation, taking into account the landscape structure of the territory in the Voronezh State Nature Reserve. It has been shown that pine and meadow species, widespread throughout the reserve in the 1930s, are gradually replaced by nemoral grasses and shade-tolerant broad-leaved tree species; this process is observed everywhere, with the exception of floodplains of small rivers where nitrophilous grassy black alder forests dominate. Currently, the overall rather high level of biodiversity is maintained in the reserve by exogenous factors - primarily fires and catastrophic windfalls. The fifth section of the chapter describes successions in pine forests located on sandy ridges in the zandra landscapes of the Nerusso-Desna woodland. It is shown that in the absence of fires, succession in forests dominated by Scots pine on sands leads to the formation of nemoral-grassy broad-leaved forests; the animals being the main agents of succession transferring seeds of late succession species preserved in refugia. The authors of the chapter conclude that despite the small percentage of forested area in the nemoral zone (19%), the whole region has kept a rather high level of species diversity of forest vegetation, which must be maintained both by preserving and expanding forest masses, including preserving the massifs of old-growth broad-leaved forests, and

by maintaining and expanding populations of phytophages actively changing the forest environment - bisons and beavers.

Chapter 6 of the book is devoted to floodplain forests (author T.Yu. Braslavskaya). Their features are shown depending on the zonal position — forests of boreal, nemoral, subarid and arid floodplains are characterized; in each case, the differentiation of the forests floristic composition under the influence of various modes of flooding is considered. Successions of forest communities accompanying the geomorphological development of floodplains as a result of river bed evolution impact, and the role of various anthropogenic processes in regulating the outlook and dynamics of modern floodplain forests are discussed. It is concluded that river bed evolution in floodplain forests provides a high diversity of micro habitats supporting high floristic diversity of floodplain forests. The thrown out mosaic of trees, which can be formed in the absence of fellings and fires, can increase the structural diversity of forests. However, the thrown out mosaic is rarely observed in these forests in the European part of Russia due to high anthropogenic transformation of floodplain forests.

Based on the analysis of Earth remote sensing data, ***Chapter 7*** describes the dynamics of forest cover in the European part of Russia in the late 20th – early 21st centuries (authors P.A. Potapov, S.A. Turubanova, A.Yu. Tyukavina, A.M. Krylov). It is shown that the political and economic crisis of the 1990s led to a 4% increase in the forest area from 1985 to 2012. due to afforestation of the former agricultural lands that were not used anymore. However, large-scale disasters (like forest fires in 2010) and the transfer of forest land to other categories near large cities (primarily Moscow and St. Petersburg) lead to a regional reduction in forest cover.

Chapter 8 briefly analyzes the history of forest development in the European part of Russia during the Holocene (authors O.V. Smirnova, V.N. Kalyakin, S.A. Turubanova, M.V. Bobrovsky, L.G. Khanina). The chapter discusses the main stages of forest landscapes transformation in connection with the economic development of society. It is shown that since the late Pleistocene, human activity

has been the main factor in the change of forest landscapes. The hypothesis is formulated that it was human activity that led to the division of the once single biotic cover into three forest zones and into two main groups of plant communities — closed and open habitats, the latter currently requiring human assistance to maintain themselves.

The book contains an extensive bibliography. Bibliographic references are given separately for each chapter; in total about 800 sources have been cited. The book has numerous illustrations; it contains about 120 color and 85 black and white images and photographs. There are three detailed subject indices in the book: 1) basic concepts and terms (320 items); 2) plant communities listed according to floristic and eco-coenotic classifications (328 items); 3) plant species (659 items).