

## ZONAL FOREST COMMUNITIES AND FOREST ZONING OF WESTERN SIBERIA (RUSSIA)

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### ABSTRACT

Forests of Siberia are heterogeneous in species composition, productivity, types and nature of renewability. They are also heterogeneous in patterns of forest distribution on different categories of land, marshes, bare mountains, meadows and percentage of forest cover. This research investigates the main types of woody plants and geographical distribution of forest communities in Western Siberia. The forest zoning of Western Siberia was analyzed to reveal the features of zonal formation of forest biogeocenoses. Forest zoning and ecological and economic assessment of the productivity of forest communities within zones and regions make the basis for outlining the strategic priorities in the given territory, and help to develop a system of forestry and timber processing activities aimed to improve ecological and economic efficiency of forest resources.

**Key words:** Western Siberia, forest zoning, forest communities.

ماسنيكوف

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التوزيع المناطقي للغابات في شرق سيبيريا - روسيا

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المستخلص

غابات سيبيريا غير متجانسة من حيث الانواع و المكونات و طبيعة النمو ، كذلك هجينة في توزيعها الجغرافي و المناطقي في الاراضي و الاهوار و نسبة المساحات المغطاة بالغابات . يبحث هذا البحث عن الانواع الرئيسية من الغابات الخشبية و التوزيع الجغرافي و الكثافة و انواع الغابات الموجودة و اهميتها الزراعية و الاقتصادية في شرق سيبيريا .

كلمات مفتاحية : غابات المناطقي ، مجتمعات الغابات ، الانواع ، البيئة

## INTRODUCTION

The West Siberian Plain is one of the global accumulation plains. Its area exceeds 3.2 million square kilometers, and the absolute marks vary within 40–280 meters a.s.l. In the north, it is covered by the tundra, which extends to the south and merges into the forest-tundra, and then is replaced by the forest zone. To the north of the Trans-Siberian railway, the taiga merges into the forest-steppe, and in the south, it is replaced by steppe landscapes. Lowland boreal forests stretch from north to south for 1,000–1,200 km, and from west to east, they reach 1,200 km wide covering Tomsk region and most of Tyumen region, the Khanty-Mansi and Yamal-Nenets autonomous areas, as well as the northern regions of Kemerovo, Novosibirsk and Omsk regions. Taiga communities are located in two flat boggy valleys, which are separated by groups of hills and flat ridges – Siberian Uvaly – north of 60° N all the way from the Urals to the Yenisey river. The main types of the forest zone relief are river valleys and watersheds with slightly incised watercourses. In the south and partly in the north-west, there are low ridges. Between the ridges, there are flat basins, hollows and dells with numerous small lakes. The soil cover differs significantly from taiga soils in the European part of Russia and Eastern Siberia (1, 12). Genetic types and subtypes of tundra, bog, meadow-bog, podzolic, podzolic-bog, gray forest podzolized, gray forest podzolized-solodized, gley and other soils are common to this area. More than half of the territory is occupied by permafrost soils. The southern boundary of permafrost is represented by small islands of permafrost peatlands in treeless areas. On the whole, the boreal forests are confined to cool and humid climate with a cold snowy winter, and a moderately warm and sufficiently humid summer. The amount of precipitation exceeds potential evaporation. Humidity in summer is relatively high. The environmental conditions of the West Siberian Plain are complicated; however, abundant light and fertility of most types of soils create favorable growing conditions. This research aims to investigate forest zoning and to assess the productivity of forest zones in Western Siberia.

The goals of this research are:

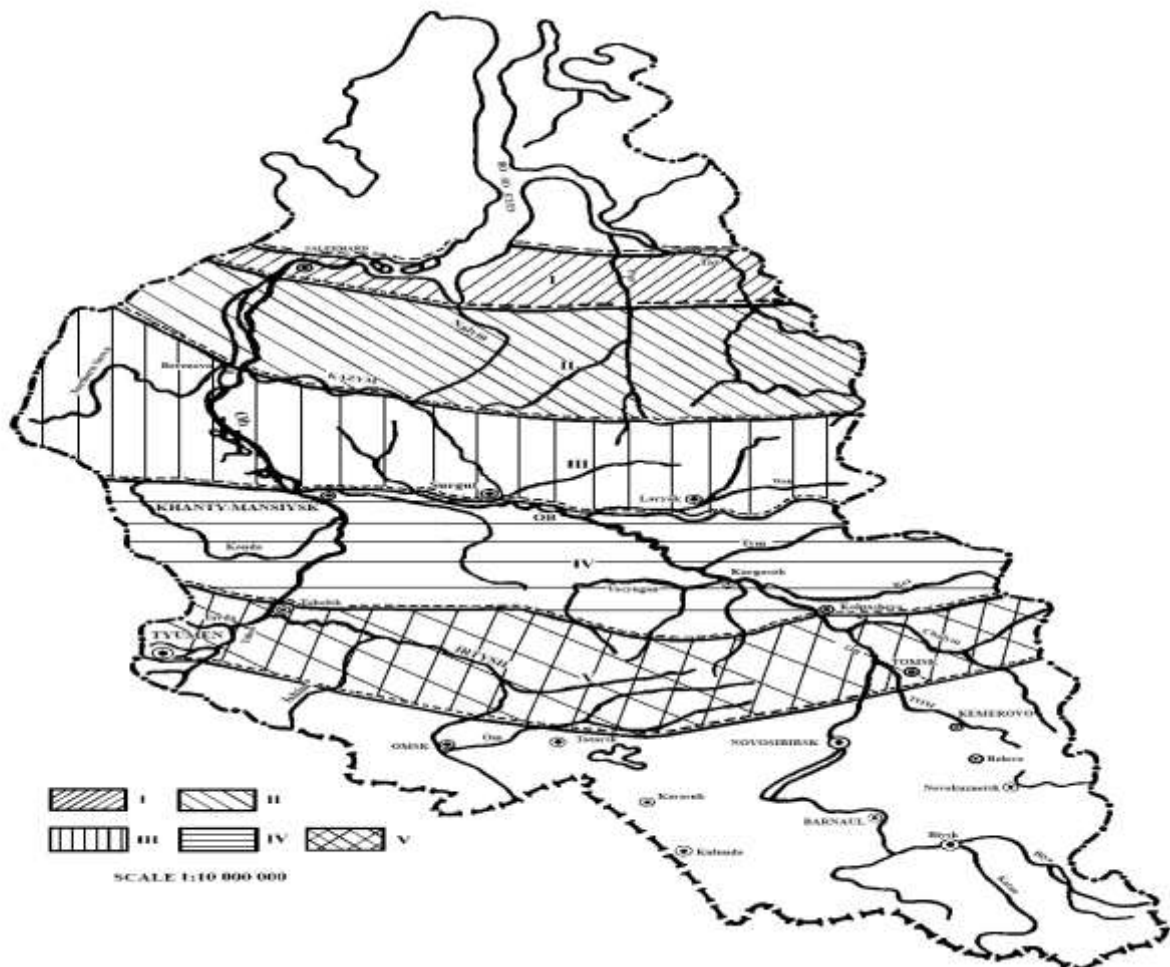
- 1- To study the main types of woody plants in Western Siberia and the geography of forest zones in the region.
- 2- To analyze the geographical distribution of forest communities based on the forest zoning of Western Siberia.

## MATERIALS AND METHODS

The object of the study is forest communities of Western Siberia regarded as an ecological and economic system within forest zoning. The author studied and analyzed the thematic maps on the forest zoning of Western Siberia. Comparative, descriptive, analytical and differentiated methods were used to study the forest communities in Western Siberia. The zoning of Western Siberia has a long history (20). Grouping of natural areas and botanical-geographical provinces was first proposed by N.I. Kuznetsov (9), B.N. Gorodkov (2), P.N. Krylov (8), V.V. Reverdatto (13), and L.V. Shumilova (19). The subsequent study of the regional environment and industrialization of its resources improved zoning. The scheme of geobotanical zoning of the forest area was proposed by V.B. Sochava, T.I. Isachenko and A.N. Lukicheva (17). They distinguished the subzones of pre-tundra sparse forests; northern, middle and southern taiga; deciduous forests. This grouping was recognized as successful and, with some specifications, has been used by many authors to date. Simultaneously, schemes were developed for geomorphological (14), soil (5), bog (3) and climatic (15) zoning. Forest zoning was first proposed by G.V. Krylov in the main provisions on zonal-typological based forestry development (7). The proposals were developed and significantly updated in the General schemes for the development of the timber industry and forestry in Tomsk, Tyumen, Kemerovo and Novosibirsk regions. The scheme of forest zoning of Western Siberia on a two-step basis (zone, area) was first developed by I.V. Taran (21). The territory covered by the taiga forests is divided into five zones: forest-tundra, extreme northern taiga, northern taiga, middle taiga and southern taiga. The boundaries of the zones and areas are correlated with the boundaries of forest districts and the administrative division of the territory. The team from Sukachev

Institute of Forest SB RAS performed forest zoning in Siberia (16). According to this zoning, the taiga forests are part of the West Siberian lowland forest zone and include the northern, middle and southern taiga forest areas. Forest-tundra permafrost, northern taiga permafrost and northern taiga forest regions are distinguished within the northern taiga area; in the middle and southern taiga areas, these are the Trans-Ural, Central and Yenisei

forest regions. This research provides a brief description of the environmental conditions of forest zones in Western Siberia (Fig. 1) based on two-step forest management zoning by I.V. Taran (20) without distinguishing individual regions in the extreme northern and northern taiga forest zones, but preserving the number and names of the regions outlined by V.N. Smagin et al. (16) in the same areas of the middle and southern taiga zones.



I – forest-tundra, II – extreme northern taiga, III – northern taiga, IV – middle taiga, V – southern taiga.

**Figure 1. The scheme of forest zoning of Western Siberia**

## RESULTS AND DISCUSSION

Western Siberia is one of the most actively developing regions of Russia. Forest resources (4, 10, 11) are of great economic value along with the oil (22) and gas industry. Natural vegetation is represented by boreal forests. The predominant species are scotch pine (*Pinus silvestris* L.), cedar pine (*P. sibirica* (Rupr.) Mayr.), white birch (*Betula pubescens* Ehrh.), drooping birch (*Betula pendula* Ehrh.), Siberian spruce (*Picea obovata* Ldb.), and Siberian larch (*Larix sibirica* Ldb.). The

predominant forest-type groups are moss and green-moss forests of the middle taiga; sphagnum forest type of the northern taiga; blueberry-cranberry-moss, green-berry and lichen forest types of the extreme northern taiga (near-tundra forests). Bogginess of the area is sufficiently high and varies from 30 to 70% (18). The forest types that dominate in Western Siberia are pine, cedar and birch forests. Spruce and larch forests are mainly distributed in the north of the West Siberian Plain, and aspen and fir forests occur in the

south. Lime forests are found along river valleys in the north of Omsk region and in the south of Tyumen region. Separate groups and small massifs of tree-like willows and poplars grow in floodplains within the southern taiga zone. Productivity of forest communities is mainly determined by their ecological flexibility and the ability to grow in different edaphic hydrothermal conditions, but not by the biological potential of forest-forming species. Firs and aspens, which are sensitive to thermal conditions, soil fertility and moisture content, exhibit the highest productivity, whereas pines and larches occurring in a wide ecological range show the lowest productivity. The forest-tundra zone encompasses a 50–150 km strip of land that extends along the junction of taiga forest and treeless tundra boundaries. The southern boundary of the forest-tundra runs along the Sob river to the village of Kartavagi, to the north of the villages of Nadyim and Tarko-Sale towards the Taz river, and crosses the river north of the village of Krasnoselkupsk. Zonal soils are perennial permafrost, podzolic, slightly humic-illuvial, gley sandy and sandy-loam soils. Watersheds and river terraces are boggy. The forest forest-tundra zone embraces boggy watersheds and river terraces and numerous lakes and peatlands. In 1959, all near-tundra sparse forests were referred to a protection forest group. Tree species composition of the extreme northern taiga zone is poor. The dominant forest-forming species are larch in the north-east and spruce in the west. Siberian pine cedar prevails in the central and southern parts of the zone forming stable green-moss and lichen-moss forests along the river valleys and drained plakors. Pine forests grow on sandy sediments of terraces and boggy interfluves. Severe conditions of the extreme northern taiga zone predetermine low productivity and slow and complex restoration of the forests. At the same time, the forest resources require careful exploitation due to their high environment-forming and protective value. The state, productivity and qualitative characteristics of the forests show that they cannot yet be regarded as an important wood resource. The northern taiga zone is located within the Ob-Yenisei glacial accumulation plain and covers the southern part of the

Siberian Uvaly, the Central Siberian and a significant part of the Khanty-Mansi lowland (14). There are Vakh, Severnaya Sosva and Malaya Sosva, Agan, Lyamin, Kazym, Nazym, Tromiegan rivers and their tributaries. High-level continuous floods during a warm period do not have a significant effect on drainage of the adjacent territories. The soil cover comprises the soil types similar to those predominant in the extreme northern taiga zone; however, they are more restricted to certain elements of the relief and exhibit high forest adaptability. Podzolic soils are formed on the sandy ground. Illuvial sod-gley and meadow soils are found in the floodplains. Forest productivity in the northern taiga zone, especially in the western regions of the Ob river, is higher than that in the extreme northern taiga zone. The forests of the zone are actively used to meet local wood requirements of the oil and gas industry. However, these forests cannot currently be considered as a major source of raw materials due to high boggyness of the area, low quality of forests and limited total resources. The middle taiga zone is located to the south of the latitude section of the Ob river, within the Ob-Irtysh flat-wavy plain, which is divided into the Ob-Irtysh lowland and the Vasyugan highland (15). The Kondinskaya lowland with elevations ranging from 40 to 80 m a.s.l. covers the left bank of the Irtysh river. All the major rivers of the middle taiga zone (Vasyugan, Demyanka, Ket, Konda and Tym) flow in the latitudinal direction, along the drainage valleys. Elevated sites of the relief are occupied by podzolic sandy-loam, loamy and clay soils with a weak humus horizon (2–5 cm). Sandy-loam and loamy gley bog-podzolic soils prevail in the boggy watersheds. A characteristic feature of the middle taiga zone is a significant heterogeneity of the vegetation cover, the mosaic composition of forest and bog communities, and the predominance of the vegetation growing on the areas covered by hydrogenic and semi-hydrogenic soils. The soil moisture content and its seasonal and spatial dynamics are the factors affecting forest growth. The southern taiga zone occupies a 200–250 km southern part of the taiga. From the south-west, it is bounded by the Irtysh highland, in the central part it passes

to the Barabinsk lowland, and in the east – to the Chulym-Yenisei plateau with elevations of 130–210 m a.s.l. The density of the river network is 0.2–0.3 km/sq.km. The rivers with sinuous channels located in the ancient drainage valleys flow slowly. Numerous lakes include those which are relict remnants of freshwater basins of the glacial and preglacial periods. Wetlands and water bodies formed as a result of peatland destruction are widespread in the southern taiga zone. Soil zoning performed by R.V. Kovaleva and S.S. Trofimova (5) divides the southern taiga subzone into 22 soil areas that indicates a mosaic structure of the soil cover. The drained areas are dominated by sod-podzolic, gray forest and sod-gley soils, which are less podzolic and acidic than those of the middle taiga zone. The sod-humus horizon of the soils is 12–30 cm deep. Peat-bog soils occupy huge areas. Podzolic gley soils are prevalent. Despite late spring and early autumn frosts, the hydrothermal resources of the zone are quite favorable for growth of the main forest-forming species. Since the middle and southern taiga zones contain significant resources of commercial forests, they can be regarded as a major source of raw materials in Western Siberia for the near and distant future. Silvicultural measures should be applied to achieve a sustainable exploitation and extended restoration of forest resources. The main criteria for forest zoning are forest productivity, the intensity of forestry and timber processing activities and ecological significance of forests. The expended forestry activities require forest zoning specification and improvement to enable solution of complex forest management problems aimed to restore forests and to increase their productivity. The research has shown that forest productivity depends rather on the ecological flexibility and geographical adaptation of woody and shrubby plants than on the biological potential of forest communities. The division of Western Siberia into forest zones and regions is due to similar growing conditions, a common approach to forest management and the level of timber processing activities. Further study of the regional environment as well as the rapid pace of industrialization of forest resources require

constant updating of the zoning of Western Siberia to minimize anthropogenic effects on forest communities. An objective assessment of the industrial and ecological potential of forests based on forest zoning will enable a more rational exploitation of forest resources.

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