CONDITION AND DYNAMICS OF CEDAR FORESTS OF WESTERN SIBERIA (TOMSK REGION)

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ABSTRACT

The first and only annotated index of the domestic literature on cedar for 1755–1957 «Cedar forests and integrated use» was compiled by well-known local historian M.F. Petrov and published in Sverdlovsk in 1961. The index includes 614 works combined into 7 sections: fruiting of cedar forests, pine nuts, resin tapping of cedar, physicochemical properties of cedar wood, natural regeneration and cedar cultures, insect pest and complex use of cedar forests. Interest in study and use of cedar forests increased sharply after the decree of the Council of Ministers of the RSFSR of October 26, 1957 «On measures to improve the use of cedar plantations, development of handicrafts and increase in harvesting of pine nuts, fur peltries, upland fowl and wild berries» and the All-Russian scientific and production conferences about cedar problems in September 1959 in Novosibirsk and in August 1969 in Tomsk. In the central and northern parts of the Tomsk region Siberian Cedar (*Pinus sibirica* Du Tour) forms large forests and is present in the plantations of all the main forest-forming species. In 1989, the cutting of cedar was prohibited and therefore, there was an increase in the area of forests of this species in the region, but a decrease in the area of cedar forests is due to forest fires, diseases and forest pests. In this paper the assessment of state and dynamics of Siberian Cedar in Tomsk region was made, that allows estimate economic and environmental importance of cedar forests in the region.

Keywords: Western Siberia, Siberian cedar pine, forest fund.

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حالة وديناميكيات غابات السدر في غرب سيبيريا (منطقة تومسك)

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المستخلص

يهدف البحث الى دراسة ديناميكيات غابات السدر للفترة 1755–1957 "و شملت الدراسة على 614 بيانات متكاملة من 7 أقسام: ثمار غابات السدر ، الصنوبر ، التصنيف ، الخواص الفيزيائية والكيميائية لاشجار وغابات السدر ، التجدد الطبيعي وثقافات سكان منطقة السدر ، الآفات الحشرية والاستخدام المعقد للسدر و باهتمام بالغ لاستخدامات السدر زيادة حادة بعد صدور قرار مجلس وزراء جمهورية روسيا الاتحادية الاشتراكية السوفياتية المؤرخ 26 أكتوبر 1957 حول "التدابير الالزمايةإلى تحسين استخدام مزارع السدر وتطوير الحرف اليدوية وزيادة حصاد الصنوبر والبيلط والفراء والطيور المرتفعة والتوت البري والمؤتمرات العلمية والإنتاجية لعموم روسيا حول مشاكل السدر في تومسك. و في الأجزاء الوسطى والشمالية من منطقة تومسك ، حيث يشكل السدر في سيبيريا غابات كبيرة وهو موجود في مزارع جميع الأنواع الرئيسية لتكوين الغابات. في عام 1989 ، تم حظر قطع السدر ، وبالتالي ، كانت هناك زيادة في مساحة الغابات في المنطقة ، الا انه حصل انخفاض في مساحة غابات السدر بسبب حرائق الغابات والأمراض والآفات . تم في هذا البحث تقييم حالة وديناميكيات السدر في سيبيريا في منطقة تومسك ، مما يسمح بتقدير الأهمية الاقتصادية والبيئية للغابات في المنطقة.

الكلمات المفتاحية: غرب سيبيريا ، صنوبر السيبيري ، كثافات الغابات.

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INTRODUCTION

Siberian cedar pine (*Pinus sibirica* Du Tour) is one of the most valuable forest-forming species in Russia. It is characterized by high concentration of trees per unit area, large size and high quality timber, increased cost of the resulting timber, and nut-bearing capability, which is of significant nutritional and feed value for both people and forest animals. Increased ecological, water protection and hunting potential of cedar forests determines their complex economic value and use and makes them the forest-forming dominant of Siberia. The analysis of the forest-forming characteristics of cedar and the dynamics of cedar forests shows that cedar formation in current climatic conditions is very stable not only within its habitat, but also in adjacent areas. This is confirmed by the presence of productive cedar stands in northern taiga and successful cultivation of artificial cedar plantations to the south of the border of its natural distribution in Siberia and European Russia from Murmansk region to the forest-steppe zone of Orel region. Within the West Siberian lowland, Siberian cedar pine rarely forms pure stands; it much more often grows with other species creating mixed dark coniferous cedar forests. In these forests, cedar shows the longest life span, and at mature age (150–180 years) it becomes dominant. Cedar forests feature broad-leaved species, which dominate at early stages of stand succession (9). Sustainability of Siberian cedar pine and forest communities formed by this species depends on forest growth conditions, potential of forest-forming species, effects of biotic and abiotic factors on forest phytocenoses (14), effects of changing climate conditions (15), and anthropogenic load. Forest biodiversity conservation (11, 12) requires forest monitoring to describe forest plant communities (13) and to evaluate the genetic constitution of plantations (10). Cedar forests in Western Siberia are the most complex forests in composition, constitution, and age and restoration dynamics. The main stand, undergrowth and grass cover include a large number of plant species. Forest stands with Siberian cedar pine dominating up to 7–8 units occupy small areas. These are mainly highly productive plantations with associate species cut down during cultivation of the taiga and transformation of cedar plantations into cedar forests located in the vicinity of settlements. In taiga conditions, cedar forests are old and pyrogenic plantations (3, 5). The aim of the study was to evaluate the status and dynamics of cedar forests in Tomsk region. The specific objectives of the study were to: 1. analyze the forest lands of Tomsk region based on materials from the State Forest Registry of Tomsk region; 2. evaluate the status and dynamics of cedar forests in Tomsk region.

MATERIALS AND METHODS

The object of the study was the forest lands of Tomsk region, which is considered as a regional ecological-economic system. The material for the study was data from the State Forest Registry of Tomsk region, which is a detailed and systematic collection of documented data on forests, their use, conservation and reproduction. The author has studied and analyzed thematic maps on territorial and administrative zoning of the region, data from the State Forest Registry, and forestry management regulations of Tomsk region.

Study area

Tomsk region is part of the Siberian Federal District. Administratively, Tomsk region borders with Tyumen region to the north, with Krasnoyarsk region to the east, with Kemerovo and Novosibirsk regions to the south, and with Omsk region to the west. The area of Tomsk region is 314.4 thousand km^2; it stretches for 780 km from west to east and for 600 km from north to south. The distance along the Ob river between the extreme points in the south and in the north is 1,065 km (7). The climate of Tomsk region is continental with short and warm summer, long and cold winter, late spring and early autumn frosts, and uniform humidity. The flat surface and openness of the terrain to the north and south are favorable for free penetration of air masses from the Arctic and Central Asia, one of the causes of weather instability (drastic changes in weather components within relatively short periods). Arctic and temperate air masses participate in circulation processes throughout the year, and in summer, these are tropical air masses (1). Tomsk region is located in the south-eastern part of the West Siberian plain.

The terrain of the region includes Ket-Tym, Chulym, Priarginsk, East-Barabinsk and Vasyugansk inclined plains. In the central part of the region, the Ob-Tym lowland extends from the southeast to the northwest, with the Ob river valley located within the lowland (8). The soils of Tomsk region are characterized by increased hydromorphism due to swampiness of the region, and to the south, the soils feature strong freezing and slow thawing. Other specific features include the presence of the second humic layer in sod-podzolic and gray forest soils; the presence of ortsands in light soils; low soil temperature. The soil cover of Tomsk region is diverse. According to the main morphological and chemical characteristics (thickness of the humic layer, constitution, mechanical and chemical composition, the extent of soil formation and economic value), three groups of soils can be distinguished: automorphic, semi-hydromorphic and hydromorphic (7, 8).

RESULTS AND DISCUSSION

As reported by the Department of Forestry of Tomsk Region, on 1 January 2018 the total forest area of Tomsk region was estimated to be 28,772 thous. ha, of which 67% is forested area. Coniferous plantations account for 53.5% of the total forest area. Of these, the main forest-forming coniferous species are presented in the following ratio: pine – 53.85%, cedar – 35.53%, fir – 5.96%, spruce – 4.58%, and larch – 0.08% (Fig. 1). The total timber stock is 2,844.9 mln m^3, including softwood (conifer) timber amounted to 1,597.4 mln m^3, of which 678.6 mln m^3 is mature and overmature trees.

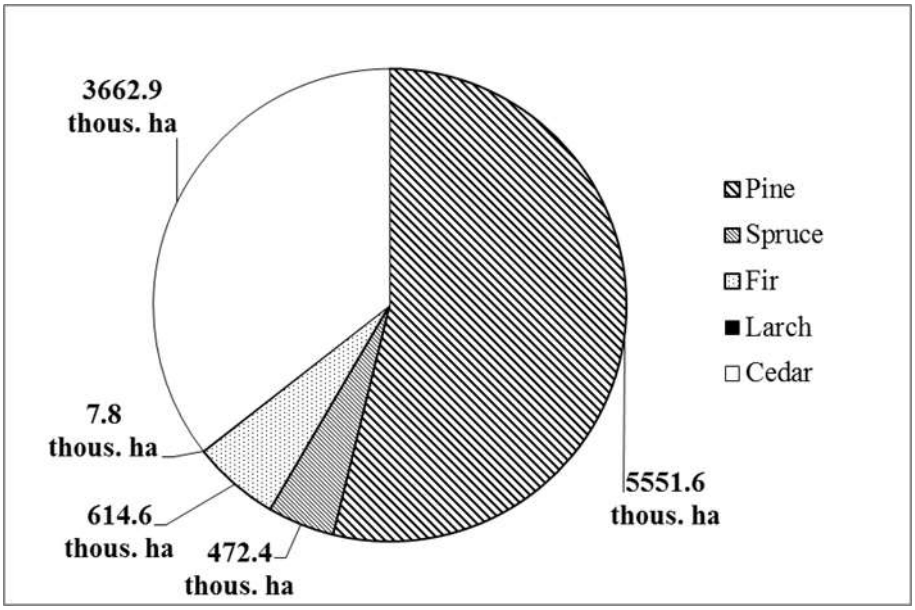

Figure 1. The area covered by coniferous plantations

There are 290 special protected areas (SPAs) in Tomsk region, which occupy 1,093.3 thous. ha of the total forest area. These include regional SPAs (16 forest reserves (1,069.1 thous. ha), 2 recreational areas (0.662 thous. ha), and 161 natural sanctuaries (16.5 thous. ha), of which 83 are botanical natural sanctuaries (7.3 thous. ha). Among botanical sanctuaries, cedar stands located in the vicinity of populated areas are of particular importance. Analysis of reforestation processes and silvicultural properties of Siberian cedar pine shows that cedar formation in current climatic conditions is stable not only within its habitat, but also in adjacent areas. This is confirmed by the presence of highly productive stands of Siberian cedar pine in the northern forest-steppe and by successful cultivation of artificial cedar plantations to the south of their natural distribution. The expansion of the area of cedar forests and increase in their productivity are feasible, and thus it is an important and urgent task (2). As of 1 January 2018, 3.84 tons of cedar seeds were harvested for reforestation and afforestation, of which 0.50 tons were collected in the seed production areas. In the restoration and age dynamics, as well as under the influence of various factors, the area and stock of cedar forests are constantly changing. In general, Tomsk region shows long-term positive dynamics (Fig. 2).

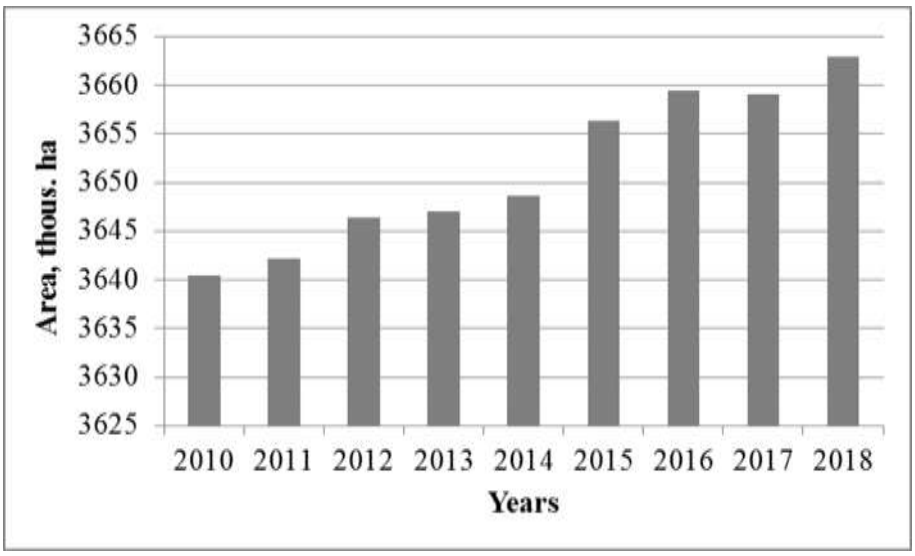

Figure 2. Dynamics of the area covered by cedar forests

Over the period from 1978 to 2000, the area covered by cedar forests increased by 226.2 thous. ha, and the timber stock grew up by 77 mln m^3. From 2000 to 2009, the area covered by cedar forests increased by 87.5 thous. ha, and the stock grew up by 15.3 mln m^3, mainly due to the transfer of farm forests to federal lands (6). The maximum share of cedar in the total forest area of Tomsk region is noted for Kargasoksky, Verkhneketsky and Aleksandrovsky districts. The minimum share of cedar is found in the forests of Shegarsky and Kozhevnikovsky districts. At present, cedar forests are dominant in the area of 3,662.9 thous. ha, which is 19% of the total forest area. Of these, cedar young growth makes up 7.8%, middle-aged plantations – 39.7%, maturing – 38.7%, and mature and overmature – 13.8% (Fig. 3). The present cedar forests were affected by forest fires, pest infestations, industrial logging in different years of the forest formation. In the process of active economic development, significant area of dark coniferous cedar forests has been replaced by deciduous trees. However, general active restoration of primary stands is currently underway.

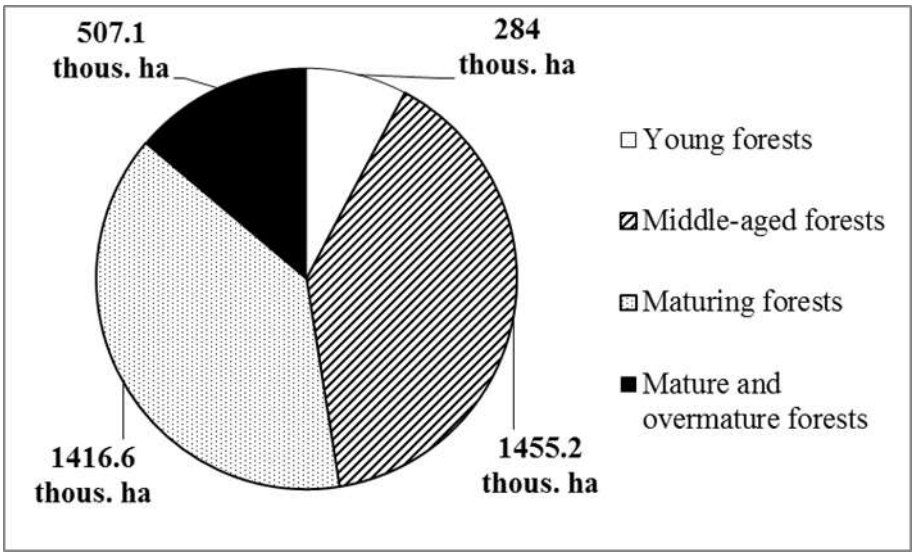

Figure 3. The area covered by cedar forests by age groups

Natural reforestation potential of cedar forest through species succession is so great that it allows planning its natural reforestation through forest management measures. Cedar planting is rational in transport-accessible areas in amounts provided by silvicultural treatment to improve the composition and functional significance of forests. The most effective method of cedar forest formation among numerous methods of forestry intervention is progressive cutting aimed to release cedar undergrowth. This silvicultural method is consistent with cedar biology, it significantly accelerates forest growth and its

active seed production, provides high stability of stands in specific forest conditions, and agrees with restoration dynamics of cedar forests. The main objects of silvicultural treatment are potential cedar forests – dark coniferous-deciduous young growth formed in the cutting areas with coniferous undergrowth preserved, and deciduous plantations with the second tier and cedar undergrowth in the amount sufficient for cedar forest formation (4). Siberian cedar pine is stable within its habitat in Western Siberia both in the mountains and in the plain. The status of cedar forests in Tomsk region within the next few decades will be determined by the restoration of native forest in the areas affected by logging, forest fires and pest outbreaks. Over the longer term, the dynamics of cedar forests will depend on changing climate conditions, distribution of cedar to the north, development of wetlands, forest fires, a sharp increase in the number of pests, spread of forest diseases, and on the intensity of anthropogenic load on forest ecosystems of Tomsk region.

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