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RESEARCH ARTICLE

Reconstruction of Low-value Plantings as an Element of Sustainable Forest Management in the South of the Russian Far East

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ABSTRACT

The article presents the research results of low-value oak plantations in which, in the first half of the 90s of the XX century, measures were taken to reconstruct these objects by forest plantation development created by planting Korean cedar seedlings in previously prepared corridors in the south of Primorsky Krai. The paper analyzed the variability of the main taxation characteristics of the created stands according to the following indicators: average height, average diameter, volume of growing stock as of 2021. The capacity for survival of plants in stands, diameter distribution were studied.

According to the research results, it was found that the work performed on the reconstruction of oak forests of mixed origin, despite the admitted deviations from the reconstruction project, has led to positive results. To achieve the best results, it is necessary to adjust the rate of planting seedlings per hectare of the area. The optimal planting rate is 1-1.5 thousand of pcs/ha. It is advisable to increase the distance between plants in the planting row up to 1.5 -2.5 m. After reconstruction works, it is necessary to provide for forest tending in the plantations aimed at creating optimal conditions for the formation of valuable cedar-broad-leaved plantations.

It is concluded that it is advisable to carry out the work on reconstruction of low-value plantations of coppice and mixed origin in the southern regions of the Russian Far East in order to achieve the goals of sustainable forest management of the region's forests, including the preservation of their biodiversity.

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Introduction

One of the main directions of ensuring sustainable forest management is to maintain the environmental sustainability of forest ecosystems [9]. In this regard, the conservation of biological diversity in forest areas is of great importance.

In the southern regions of the Russian Far East, in terms of biological diversity, unique uneven cedar-broad-leaved forests are distinguished which is practically without equals by numbers of tree species with different biological properties which form part of the stands of these plantations – up to 50 species [6].

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These plantings have been exposed to intensive forest-industry activity for a long period of time. For example, in Primorsky Krai, the area of cedar-broadleaf forests decreased by 294.6 thousand hectares, or 12.1 percent, from 1966 to 2001 [5]. In 2010, the area of cedar forests in the Primorsky Territory was a little more than 2.1 million ha [2]. In the long term, anthropogenic pressure would inevitably lead to the degradation of these unique ecosystems which are the habitat of many rare and endangered species of plants and animals, including the Amur tiger and the Far Eastern leopard [10].

The anthropogenic factor in this degradation is the main one. In a relatively short historical period (approximately 150 years), the impact on cedar forests in the form of main felling of various intensity, multiple damage to forest areas by fires has led to a significant reduction in a number of

ecological functions of these plantations, including their biological diversity. The main types of logging in cedar-broad-leaved forests were conditional clear felling, voluntary-selective cutting and selection felling [8]. As a rule, the same cutting areas were cut down several times, choosing the most valuable cedar wood, while the felling was deprived of the sources of seeding, thus, the restoration processes of the Korean cedar were stretched for a long period. Besides, fires, which often took place after cutting, resulted in changing of the prevailing species to low-value ones. For example, in the Khekhtsir experimental farm of the Khabarovsk Territory, within 50 years after the termination of the main felling, only 20 percent of the areas of "cedar" forest types was occupied by plantations with a predominance of cedar, while the rest of the area was formed by secondary forests with a predominance of secondary species [4]. The probability of oak stands formation on the site of cedar-broad-leaved forests is particularly high [4]. In the southern regions of the Far Eastern Federal District (Primorsky and Khabarovsk Territories, the Jewish Autonomous Region) there are about 680 thousand ha of oak stands forming the reconstruction fund for the restoration of cedar-broadleaf forests. Reforestation in these areas should ensure not only the restoration of climax forest, but also the preservation of forest biological diversity and other useful functions.

In the southern regions of the Far East, much attention has traditionally been paid to such a method of reforestation as the reconstruction of low-value plantings by planting Korean cedar seedlings in corridors 3-4 meters wide being cut through 7-10 meters.

Due to this, it was supposed to achieve a significant improvement in the quality of coppice oak forests.

However, in recent decades, it has been suggested that the creation of such facilities in the region is impractical [1]. In our opinion, the work on the reconstruction of low-value oak stands in the southern regions of the Far East should be continued and expanded, since if this method of reforestation is abandoned, the prospects for the formation of cedar–broad-leaved stands in their place will stretch for a long period of time, which is often unacceptable in terms of achieving the objectives of sustainable forest management, including the conservation of their biodiversity.

The purpose of our work is to monitor the state and development of Korean cedar culture created by the way of the reconstruction of low-value oak plantations on the territory of Ussuri urban district and Ussuri branch of RSPI "Primorsky Forestry".

We have surveyed two plantations, where the work was carried out on the reconstruction of oak stands.

Materials and Methods of Research

The objects of the study are located on the territory of the Ussuri rural forest district of the Ussuri branch of RSPI Primorsky Forestry (during the reconstruction work, this territory was a part of the Ussuri rural forest farm) near the village of Kraunovka and in the suburbs of Monakino village on the plot which is not currently part of the State Forestry Fund. Forest cultures in this area were established in 1995 and 1992, respectively, as a part of the reconstruction of secondary oak forests. One way of producing crops was through corridors. The reconstruction was carried out by planting cedar seedlings in the secondary oak forests, which were formed on the site of cedar-broad-leaved forests after felling and fires. The characteristics of oak stands are given in table 1.

Table 1. Characteristics of the Sampling Areas

Name	Sampling area (SA)	
	SA 1 -21	SA 2-21
Location, survey plot area, ha	Ussuri district forestry, quar21 p.1; 22,0	The object is located outside the territory of the State Forest Fund
Coordinates	N 43^{0}45'01.7" E131^{0}38'48.6"	N 43^{0}44'13" E131^{026}'58.8"
Terrain, exposure, altitude	Northslope, 12-14°, 80-100 m	North-westslope, 10-12°, 240-260 m
Foresttype	Oak forest (shrubby-mixedherbs)	Oak forest (shrubby-mixedherbs)
Stand composition	9 - Oaks, 1 - Black birch	8 - Oaks, 2 - Black birches
Origin of the stand	Mixed	Mixed
Age of the main species	75	80
Growth class	IV	IV
Undergrowth	Mediumdensity, hazel, lespedeza	Mediumdensity, hazel, lespedeza
Grasscover	Dense, sedges, ferns, wormwood	Dense, sedges, ferns, wormwood
Soil	Brown-podzolic, surface-stony	Brown-podzolic, surface-stony

The corridors were arranged with a width of 4-5 m with the help of chainsaws or bulldozers on the frozen ground. Seedlings were planted in 2 rows (the distance between plants in a row – 1m, between rows - up to 2.5 m). The inter-corridor spaces did not exceed 8 m. The number of planting spots was 1.5 thousand pcs/ha. The undergrowth and shrubs in the corridors were removed when needed. The surveyed crops in the corridors were created by hand-planting 3-year-old cedar seedlings. The characteristics of the crops are given in table. 2. When laying the test areas, the generally accepted methods were used (Fig. 2). During the preliminary survey of the plots, a quadrocopter was used to specify the location of the research object and its boundaries (Fig. 1). The stand was recalculated with an accuracy of 0.1 cm, all trees were marked, and the quality condition of each tree was described (reliable, unreliable, weak, dry).

Figure 1. General view of SA 1-21, 2-21 on the territory of the Ussuri rural district forestry

Table 2. Characteristics of Mongolian oak and Korean cedar trees on trial areas in 2021

Species	Average diameter, cm	Average height, m	Age, years	Density, pcs./ha	Standing volume, m^3/ ha
SA 1-21					
Mongolian oak	20	14	75	-	130
Korean pine	6,9	5,67	28	1110	12,5
SA 2-21					
Mongolian oak	24	14	80	-	140
Korean pine	6,1	6,46	31	1068	12,3

Research Results and Discussion

The reconstructed oak stands are simple in composition and structure (Table 1). Mongolian oak of mixed origin prevails in all areas. The reconstruction was carried out according to the traditional scheme for the forestry of the region, with some deviations from the project in terms of the distance between the plants in the rows of planting, the width of the belt of trees (Fig. 1). In addition, in both areas, during the planting of seedlings in one planting spot, three or four cedar seedlings were sometimes planted instead of one according to the project.

Figure 2. Measurement work on SA 2-21

The conducted studies have shown a high level of Korean cedar establishment in both areas. On SA 1-21, the capacity for survival was 74 %, on SA 2-21 - 71%. Of the live plants, 88.1 and 88.8% are reliable, 11.9 and 11.2% are unreliable. The latter are represented by plants with mechanical damage or signs of diseases. The condition of unreliable trees excludes the possibility of their entry into the upper storey of the stand in the future. The average diameter of cedar in the tree canopy reaches 6.9 cm on SA 1-21, and 6.1 cm - on SA 2-21. At the same time, the fluctuations in the diameter of cedar trees on SA 1-21 are 1 - 19 cm; on SA 2-21 - 1.1 – 14 cm. The average height of cedar on SA 1-21 is 5.67 m with variations from 1.8 to 8.5 m;

on SA 2 -21, the average height of cedar plants is 6.46 m with variations from 2.8 to 13 m.

In the early stages of development, Korean cedar is characterized by shade tolerance; older plants need more significant sunlight. Our observations showed that the average periodic diameter growth in Korean cedar trees had a stable tendency to increase until the age of the plants would reach 25 years, and then there was a gradual decrease in this important taxational indicator, which is directly related to the lack of solar plant nutrition (Fig. 3).

Figure 3. Korean cedar cultures created by the method of reconstruction of low-value young plants (SA 2-21)

To change the current situation, it is necessary to carry out intermediate felling in the reconstructed plantings for reducing the density of the upper storey and regulating the placement of Korean cedar trees on the plots, since the accepted spacing in a row of one meter between the plants which are set out, in 15 - 20 years after the reconstruction, leads to serious competition between cedar trees.

Conclusion

The results of the reconstruction of secondary mixedoak stands, growing in various forest site conditions, by introducing coniferous species, showed the effectiveness and usefulness of this reforestation method for cedar-broad-leaved stands in the absence of sources of seeding. Reconstruction makes it possible to ensure the formation of cedar forests within a relatively short period of time. The use of reconstructive measures ensures the restoration of biological diversity in the areas where it has significantly decreased after the destruction of indigenous cedar-broad-leaved stands under the influence of various factors.

To achieve the best results, it is necessary to adjust planting rates per hectare of the area. In our opinion, the optimal rate of planting is 1 -1.5 thousand pcs/ha. At the same time, it is advisable to increase the distance between the plants in the planting row up to 1.5 -2.5 m. Such changes in the technology of low-value planting reconstruction will not have a negative impact on the final goal of the work – the formation of valuable mixed cedar-oak plantings in a relatively short period of time. At the same time, a significant reduction in the cost of reconstruction works by planting forest crops in the corridors will be achieved, which is undoubtedly one of the incentives for expanding such works.

At the same time, studies show that the cultivation of oak and cedar stands by the reconstruction method of low-value stands is a long process. It should provide for a comprehensive system of both silvicultural and forestry measures aimed at creating optimal conditions for the formation of valuable cedar-broad-leaved plantings.

Our colleagues from "Federal Scientific Center of the East Asia Terrestrial Biodiversity" of the Far Eastern Branch of the Russian Academy of Sciences came to similar conclusions after studying the reconstruction of low-value oak stands of undergrowth origin using the method of creating subordinate forest crops [7]. They note: "The task of foresters in the reconstruction of secondary low-value oak forests is to create an optimal ecological and phytocenotic regime for cedar and oak trees in order to obtain similar taxation indicators with normal forests at an earlier age."

Unfortunately, serious financial and material costs for the production of forest cultivation work do not often give the proper result in the restoration of cedar-broad-leaved forests. Over the past 10 years, there has not been a single site in PrimorskyKrai that would be transferred into the forested area.

References

Alekseenko A.Yu. and Kovalev, A.P., 2009. *Mixed coniferous-broadleaved and deciduous forests.* A. Yu. Alekseenko, A.P. Kovalev in the book “The current condition of the forests in the Russian Far East and prospects for their use”. Ed. by A.P. Kovalev. - Khabarovsk: Dalniilkh publishing house, 129 -162.

Assessment of forest resources, forest management, harvesting and forest certification in the Russian Far East., 2013. *Forest Sector Study in the Russian Far East. Roadmap for Value-added Investment in Forest Industry.* Food and Agriculture Organization of the United Nations (FAO), –29-31.

Dyukarev, V.N. 2004. Forest World Congress IUFRO 2010 and the risks of forest management in the south of the Russian Far East// Plant and animal resources of the world's forests. *Proceedings of the international symposium on the International Year of the Forest: scientific ed.* Vladivostok Dalnauka, 38-47.

Ivashkevich, B.A., 1993. *Far Eastern forests and their industrial future.* B.A. Ivashkevich. - Moscow; Khabarovsk: Dalgiz, (Vladivostok: typo-lit. named after Wolin), 166.

Koryakin, V.N., 2009. *Cedar – broad-leaved forests.* V.N. Koryakin in the book *"The current condition of the forests in the Russian Far East and prospects for their use*. Ed. by A.P. Kovalev. - Khabarovsk: Dalniilkh publishing house, 87-129.

Kudinov A.I., 2004. *Broad-leaved cedar forests of the southern Primorye and their dynamics*. A.I. Kudinov. - Vladivostok: Dalnauka, 369.

Kudinov, A.I., Gladkova, G.A., Sibirina, L.A., Manko, Yu. I., Zhabyko E.V., and Butovets, G.N., 2016. Some results of oak forest reconstruction in Primorsky Krai. *Successes of Modern Natural Sciences,* 3: 79-84. http://natural-sciences.ru/ru/article/view?id=35827

Sheingauz, A.S., 2000. *Outlook of Underlying Causes of Deforestatin and Forest Degradation in Southern Part of Russian Far East*. A Step toward Forest Conservation Strategy. Current Status on Forests in the Asia-Pacific Region. - Tokyo: IGES, 431-455.

The Red Book of Primorsky Krai: Animals., 2005. Rare and endangered animal species. *Vladivostok: AVK "Apelsin", 488.*

Yanitskaya, T.O., and Ilina, O.V., 2010. *Conservation of biodiversity during cutting operations*. Yanitskaya, Ilina. *Lesprominform,* 3: 150-156.