ANALYSIS ON THE INFLUENCING FACTORS OF FOREST NATURAL REGENERATION IN NORTHERN CHINA

by

Baichuan Huang

FACULTY OF NATURAL RESOURCES MANAGEMENT
LAKEHEAD UNIVERSITY
THUNDER BAY, ONTARIO

April 2021

Analysis on the Influencing Factors of Forest Natural Regeneration in Northern China

by

Baichuan Huang

An Undergraduate Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Honours Bachelor of Science in Forestry

Faculty of Natural Resources Management
Lakehead University

April 2021

Dr. Han Chen
Major advisor

Dr. Jian Wang
Second reader

LIBRARY RIGHTS STATEMENT

In presenting this thesis in partial fulfillment of the requirements for the HBScF degree at Lakehead University in Thunder Bay, I agree that the University will make it freely available for inspection.

This thesis is made available by my authority solely for the purpose of private study and may not be copied or reproduces in whole or in part (except as permitted by the Copyright Laws) without my written authority.

Signature: _____ April 2021

A CAUTION TO THE READER

This HBScF thesis has been through a semi-formal process of review and comment by at least two faculty members. It is made available for loan by the Faculty of Natural Resources Management for the purpose of advancing the practice of professional and scientific forestry.

The reader should be aware that opinions and conclusions expressed in this document ae those of the student and do not necessarily reflect the opinions of the thesis supervisor, the faculty or of Lakehead University.

MAJOR ADVISOR COMMENTS

ABSTRACT

Huang, Baichuan, 2021. Analysis on the Influencing Factors of Forest Natural Regeneration in Northern China. 27 pp.

Keywords: natural regeneration, environmental factors, human disturbance

The purpose of this paper is to clarify that the differences in natural regeneration between the two forests in northern China are caused by precipitation, altitude, temperature, and canopy density. Similarly, the regeneration ability is related to the composition of tree species in the forest. Generally, the growth trend of a hardwood forest is not as good as that of a conifer forest in the northern cold area. At the same time, we also explored the possibility of human disturbance in forests. Due to the different geographical locations of the two forests, the human disturbance of Tuoketuo forest farm is more serious, which is also one of the reasons for the weak forest regeneration ability. By comparing the natural regeneration data of Guandi mountain and the natural regeneration data of Tuoketuo Forest Farm collected by previous scholars, the results showed that: (1) there were 17 seedlings and 44 saplings in ten Guandishan 20 m × 20 m square sampling plots. 9 plot has the highest regeneration density was 250 stems/ ha which canopy density was 0.25. When canopy density higher than 0.25, the regeneration density decreased significantly with the increase of canopy density; when canopy density higher than 0.80, there was no regeneration. (2) Four 1 × 1 (m) (1 m^2) small plots were set in 2 × 2 (m^2) plant plots to examine the natural regeneration frequency of Tuoketuo county. The total area of regeneration is 10756.8 ha, the total number of regeneration plants is 236650 stems, and the average number of regeneration stems per hectare was only 22 stems. (3) The regeneration quantity of young forest and seedling in Guandishan mountain forest is more. Light, altitude, and other factors were the main factors affecting the regeneration of *Larix principis-rupprechtii* Mayr on Guandishan Mountain. The forest in Tuoketuo county is not only affected by stand structure, site conditions, climate and other natural conditions but also affected by human disturbance.

CONTENT

TABLES

ACKNOWLEDGEMENTS

I would like to thank my thesis advisor Dr. Han Chen for aiding me in the creation of this project and helped me throughout this project with any questions I had. I would also like to thank my second reader Dr. Jian Wang and my friend Linlin Kong who I have spoken with and consulted with for helping give me insight to this emerging sector and who assisted with this project in any way. Lastly, I would like to thank my parents Weijun and Chaoping Huang for supporting me during my education, I would not be where I am today if it were not for the two of you.

1.0. INTRODUCTION

Natural regeneration is an extremely complicated biological process in forest ecosystem (Wang et al. 2020), which ensures the self reproduction and restoration of forest ecosystem and ensures the sustainable management of forest ecosystem (Wiegand et al. 2009). Natural forest regeneration mainly depends on the regeneration of young forests through its own restoration ability. In other words, young forests and seedlings determine the future forest community structure (Chen 2005). This means that natural regeneration is the key factor for the survival and development of the whole forest. Therefore, the significance of the research on natural regeneration is to ensure that the forest can have a stable development trend.

The forest of Guandishan mountain in northern China is mainly composed of pure *Larix principis-rupprechtii* Mayr forest and a few mixedwood forests. Tuoketuo county forest is composed of *Populus alba* L., *Salix matsudana*, *Ulmus pumila* L. and some artificial plantation hardwood tree species. According to existing studies, tree species regeneration and its distribution pattern are affected by many factors, which directly affect the structure, composition and dynamics of the forest stand or community (Hernandez-Stefanoni 2008; Lin 2020; Phmv 2015). Through the research of Zheng et al., we can roughly divide these factors into two types: environment and terrain(Zheng 2020). First of all, among many environmental factors affecting regeneration, light is essential. The effect of light on the regeneration of tree species is related to shade tolerance of tree species. In addition, the regeneration of seedling

stock in natural forests is mainly carried out under the forest. Canopy density and grass canopy in the forest will have a direct impact on the regeneration of seedlings through influencing light factors. The second environmental factor is temperature. Temperature is also one of the most important ecological factors. Either too high or too low temperature will cause seeds to enter dormancy or inhibit seed germination. The third factor is precipitation. Water is also indispensable, which is one of the key factors affecting seed germination and seedling growth, especially during the primary stage. The second main type is the topographic factor. In general, with elevation, many environmental factors change, such as more light, lower temperature, more moisture in the soil and air, etc. In the same way, other methods of classifying factors affecting forest regeneration are also very suitable. For example, it can be divided into climate, competition and terrain factors (Wang 2020). However, the disturbance caused by these factors to forest regeneration seems to be dwarfed by human disturbance. This is a serious challenge that forest management must face. In many countries, due to the early industrialization process, a large number of forest resources have been cut down and utilized irrationally. China has been facing these problems since the 1990s, which mainly include insufficient forest resources, poor ecological environment, and unable to harvest timber resources in a long-term and sustainable way (Chen et al. 2014; Zhu et al. 2019).

Through the research, we decided to use the experimental data that came from the Institute of forestry monitoring and planning of Inner Mongolia Autonomous Region (for Tuoketuo forest), and Shanxi Agriculture University of forestry (for

Guandishan Mountain forest) for analysis. The previous experimental data showed that the natural regeneration ability of the Guandishan Mountain forest was obviously stronger than that of the Tuoketuo forest (Li et al. 2020; Feng et al. 2021).

Therefore, the research purposes of this paper are as following: (1) according to the existing regeneration grade evaluation standards, determined the difference of the natural regeneration density (trees per hectare) between Guandishan mountain natural forest and Tuoketuo forest in northern of China. (2) further analyzed the influence of altitude, temperature, precipitation, soil and canopy density on forest regeneration in Guandishan mountain and Tuoketuo. Larix principis rupprechtii is more sensitive to warm and dry climate. Generally, the mortality of *Larix principis rupprechtii* seedlings increases significantly with increasing temperature or decreasing precipitation. Warm and dry climate is not conducive to the regeneration of *Larix principis rupprechtii* population (Liu 2009). The cold and humid climate in Northern China is more suitable for the regeneration of *Larix principis rupprechtii*. (3) At the same time, this paper also defined clearly that due to the different geographical locations of the two forests, the human disturbance in the Tuoketuo forest farm is more serious. (4) Finally, we need to rationally estimate whether the forest in these two different areas can have a stable development trend. We also discussed whether there is a possible way to improve the regeneration ability of the Northern hardwood forest in the following forest management.

We hypothesised: (a) the strong regeneration ability of Guandishan mountain is mainly related to the existing environmental conditions of the forest. (b) The

coniferous species: *Larix principis rupprechtii* and spruce, are more suitable for the low-temperature climate in northern China than hardwood species: poplar and elm.(c) In addition to the environmental disturbance and the characteristics of tree species themselves, the poor forest regeneration ability in Tuoketuo county may also be caused by human disturbance. (d) Finally, because a part of the forests in Tuoketuo county is made up of artificial forest, the growth and regeneration ability of the forest may be weaker than that of the natural forest in Guandishan mountain.

2.0. METHOD AND MATERIALS

2.1. Study area

Guandi mountain is located in the middle of Lvliangshan mountains, with the latitude of 37 ° 45 '～37 ° 59' N, the longitude of 111 ° 21 '～ 111 ° 37' E, altitude of 1800～2830 m. It belongs to the temperate continental climate, with mean annual temperature of 4.2 ℃, and mean annual precipitation of 822.6 mm (in year 2019). The frost-free period of whole forest is 100 ~ 125 days. The soil types from bottom to top were cinnamon soil, mountain cinnamon soil, mountain leaching cinnamon soil, mountain brown soil, and subalpine meadow soil. *Larix principis rupprechtii* is one of the main constructive species of natural secondary forest in this area. It is mainly distributed in the sub-alpine zone above 1800 m above sea level, forming pure or mixedwood forests.

Tuoketuo county belongs to Hohhot City, Inner Mongolia Autonomous Region. It is located in Tumochuan Plain, which at the south of Yinshan Mountain and the

North bank of the boundary between the upper and middle reaches of the Yellow River. Its geographical coordinates are 40 ° 5 ′ 55 ″ ~ 40 ° 35 ′ 15 ″ N and longitude of 111 ° 02 ′ 30 ″ ~ 111 ° 32 ′ 21 ″ E. The total land area is 1416.8 km2. With an average altitude of 1016 m, the terrain is high in the southeast and low in the northwest and southwest. It is a transition from hilly terrain to broad plain terrain. The soil includes cinnamon soil, Neogene soil, moisture soil and saline soil. The climate type belongs to the temperate continental climate. The annual average temperature was 9 ℃, and the annual average precipitation was 316 mm (data in 2016). Most of the precipitation appears from July to September, accounting for 70% of the annual precipitation. The average annual evaporation is 1938.2 mm.

2.2. Experimental data

The two main sources of data in this study are: (1) forest resources planning and design survey and forestry professional survey in Tuoketuo County in 2016, concluded by Feng Qiannan, et al. (2)Li Jin and others measured the sample plots with GPS analyzer in June 2019, and measured each tree in the sample plots; recorded the coverage and dominant species of herb layer and shrub layer in the sample plots. The evaluation of forest regeneration capacity adopts the standard of Technical Regulations for Continuous Inventory of Forest Resources issued by the State Forestry and Grassland Administration of China in 2020 (Table 1 which shared below). Based on the survey data, this study compared and analyzed the status of

forest natural regeneration in the two areas, and evaluated the results. In order to be more intuitive, we sorted out Table 2 to compare the altitude, location, temperature, precipitation, soil types, and stand types information of the two forests.

Table 1 Rating standard of natural regeneration

Height class /cm	**Regeneration density / (tree/ha)**	**Level**
< 30	> = 5000	Good
	3000 ~ 4999	Medium
	< 3000	Bad
30 ~ 50	>= 3000	Good
	1000~2999	Medium
	<1000	Bad
> 50	>= 2500	Good
	500~2499	Medium
	<500	Bad

Source: State Forestry and Grassland Administration of China in 2020

Table 2 Characteristics of the two study forests

Name	**Altitude (m)**	**Location**	**Annual average temperature (℃)**	**Annual average precipitation (mm)**	**Soil types**	**Stand types**
Guandishan forest	1800 ~ 2830	37°45' ~ 37°59' N; 111 ° 21 ' ~ 111°37' E	4.2	822.6	cinnamon soil, mountain cinnamon soil, mountain	natural

					leaching cinnamon soil, mountain brown soil and subalpine meadow soil	
Tuoketuo forest	1016	40°5 55″ ~ 40°35′15 ″ N; 111°02′30 ″ ~ 111°32′21″ E	9	316	cinnamon soil, Neogene soil, moisture soil and saline soil	natural and artificial

Source: Tuoketuo and Guandishan forest data information

3.0. RESULTS

The number of natural regeneration of different tree species has been summarized in Table 3. The average regeneration density (number of regeneration per hectare) of each tree species can be calculated. The regeneration density of *Larix principis rupprechtii* was lower than that of spruce in the Guandishan forest. After conversion, the average natural regeneration density of *Larix principis rupprechtii* is 152.5 stems/ha and the average regeneration density *Picea spp*. is 3127.5 stems/ha. When the canopy density of a plot higher than 0.25, the regeneration density decreased significantly with the increase of canopy density; when canopy density higher than 0.80, there was no regeneration. The canopy density of plot 6 and plot 9 was low.

The natural regeneration area under the forest canopy in Tuoketuo county is 10756.8 ha. The total number of regeneration trees is 236650, the number of regeneration plants per hectare is only 22, and the regeneration grade is determined as

poor level. Poplar has a large base of forest land area, while elm has a small base of forest land area. The natural regeneration density of poplar was 22 stems/ha, and that of elm was 20 stems/ha. Furthermore, the natural regeneration area of stands with a canopy density of 0.40 and 0.50 was larger (see Table 4 below).

It can be found that the regeneration density of hardwood tree species on Tuoketuo forest is obviously lower than conifer tree species on Guandishan mountain.

Table 3 Plot information summarize of Guandishan mountain

Plot number	**Canopy density**	**Number of seedlings**		**Number of saplings**	
		Larix principis rupprechtii	*Picea spp.*	*Larix principis rupprechtii*	*Picea spp.*
1	0.28	2	36	4	27
2	0.22	6	60	4	54
3	0.55	0	105	2	90
4	0.33	1	144	6	183
5	0.4	4	120	4	174
6	0.2	1	18	6	9
7	0.35	2	48	2	42
8	0.2	1	36	6	24
9	0.25	0	21	10	3

10	0.8	0	33	0	24

Source: Table Ⅰ and Table Ⅱ shared in appendixes

Table 4 Plot information summarize of Tuoketuo forest

Canopy density	Numbers of regeneration	Forest regeneration density (trees/ha)	Natural regeneration area (ha)
0.2	22092	21	1052.0
0.3	40345	21	1921.2
0.4	71339	22	3242.7
0.5	65033	21	3096.8
0.6	26972	23	1172.7
0.7	6070	24	252.9
0.8	245	24	10.2
0.9	166	20	8.3
Total	236650	22	10756.8

Source: Table Ⅰ and Table Ⅱ shared in appendixes

Table 5 Comparing two different forests' regeneration density

Forest name	Guandishan		Tuoketuo	
Tree species	Larix principis rupprechtii	Picea spp.	*Populus alba* L.	*Ulmus pumila* L.
Total number of stems	61	1251	236557	84

Average density of regeneration /(trees/ha)	152.5	3127.5	22	20

Source: Table Ⅰ and Table Ⅱ shared in appendixes & Table 3 and Table 4

4.0. DISCUSSION

By comparing the experimental data, we can found that the natural regeneration level of the Guandi mountain forest is higher than that of the Tuoketuo forest. From the analysis in Table 1 (above), we show that the altitude of Guandi mountain is higher than that of Tuoketuo. Altitude affects the vertical distribution of forest vegetation. Because of the different biological characteristics of tree species, there are also differences in forest regeneration with altitude changes (Li et al. 2020). Generally speaking, with the increase of altitude, the light intensity increases, the temperature decreases, and the soil and air humidity increases. This will bring a very suitable environment for the growth of *Larix principis rupprechtii* and spruce. *Larix principis rupprechtii* is extremely cold-resistant, and spruce is shade-resistant and cold-resistant, like cool and humid. The natural environment of Guandi mountain provides excellent natural condition for *Larix principis rupprechtii* seedlings' development. The low canopy density of example units (showed in Table 3 above) indicated that suitable shade was beneficial to the growth of *Larix principis rupprechtii* seedlings and saplings, too low canopy density can lead to slow growth of seedlings. (Guo et al. 2009). Neither too large or too small canopy closure is not conducive to natural

regeneration (Feng et al. 2021). When the canopy closure is too large, the light condition under the forest is poor, which affects the regeneration level under the forest; when the canopy closure is too small, the evaporation and transpiration under the forest are strong, the humus layer is thin, and the soil nutrient is low, which also affects the natural regeneration status.

Tuoketuo county is a semi-arid area, with large annual temperature difference, less and uneven rainfall, dry climate and large evaporation; in addition, the soil nutrient content is not high, the ability of water and fertilizer conservation is not strong, and there is a certain degree of salinization, which greatly affects the growth of vegetation. The results showed that water deficiency was one of the main reasons for seedling survival (Brendan et al. 2012; Amanda et al. 2014). In general, the existing environmental conditions in Toketo county are difficult to maintain the growth of local forests.

After analyzing the data and related data of Tuoketuo forest again, we can see that the existing forest tree species in Tuoketuo county are single in structure and incomplete. This is because part of the forest is composed of artificial secondary forest. Moreover, most of them have poor growth quality or even decline, so the protection function is also degraded, and it is difficult for tree species to recover through natural regeneration. Many environmental factors, such as stand structure, site conditions, climate, precipitation, and heat conditions, restrict the natural regeneration ability of stands to varying degrees.

Thirdly, the land is located in the plain area, close to the tributaries of rivers. The

land may suffer from soil erosion. Due to the human population growth, crop acreage continues to increase in Tuoketuo County, which will lead to degradation of soil fertility, fertilizer pollution, and reduction of forest area and other problems. In recent years, the tertiary industry has been developing continuously in this area. The development of new tourist attractions and routes will attract more tourists. It is inevitable that these human activities will cause pollution and disturbance.

Therefore, we can generally think that the strong regeneration ability of Guandi mountain is mainly related to the current good environmental factors of the forest, and the two conifers are more adaptable to the climate and environment of northern China.

Our final point is that part of the forest system in Tuoketuo County is planted artificially, the growth and regeneration ability of this type of secondary forest is weaker than that of natural forest. In order to prove the point of view, the existing experiments are not accurate enough. Since there are no control variables (tree species, environmental factors, terrain factors, etc.), we cannot directly demonstrate this view for the time being. Future experiments could try to study two different regeneration abilities of the same tree species in the same area. But we can say that in the Tuoketuo forest area, there are still a lot of problems that existed through the forest management process.

5.0. CONCLUSION

Based on the analysis of the main influencing factors of natural regeneration in forests, we can find out that the key influencing factors of tree regeneration are not consistent

for different tree species. At the same time, each factor also affects and interferes with each other, acting on the natural forest regeneration together. The factors affecting the regeneration of natural forests also include longitude and latitude of large regional scale, so the protection and restoration of natural forests cannot be completely unified on their management measures. Judging by the existing renewal grade assessment standards, we can clearly get the natural regeneration level of Guandishan natural forest in different provinces of northern China and Tuoketuo forest land. The natural regeneration level of Guandi Mountain forest is medium-well, and the Tuoketuo Forest Farm is low.

With regards to the future forest management process, we should fully consider the local natural conditions and characteristics of forest resources, vigorously protect the existing saplings, take reasonable and effective care measures, improve the survival rate and preservation rate so that they can grow into forests as soon as possible. For stands with high canopy density, appropriate selective cutting and other measures can be taken to form a gap of the suitable area and promote good stand renewal (Feng et al. 2021). Secondly, according to the principle of suitable land and suitable trees, the proportion of mixed forest should be further increased, the structure of tree species should be optimized, artificial measures should be taken to promote natural regeneration, the succession of the forest should be accelerated, and the forest layer structure of arbor, shrub and grass should be formed to give full play to the ecological protection benefits of woodland. For the forest with poor site conditions, the primary vegetation should be protected, soil erosion should be strictly controlled,

forest land management and protection should be strengthened, and the destruction rate of forest resources should be reduced. Enhance the reconstruction and restoration of degraded forests, gradually increase the area and stock of stands, steadily improve the quality of stands, further show the service function of forest ecosystem, and realize the sustainable development of forest resources.

6.0. LITERATURE CITED

Mathys, Amanda, Nicholas C. Coops, and Richard H. Waring. 2014. Soil water availability effects on the distribution of 20 tree species in western North America. *Forest Ecology and Management* 313:144-152.

Choat, Brendan, Steven Jansen, Tim J. Brodribb, Hervé Cochard, Sylvain Delzon, Radika Bhaskar, Sandra J. Bucci, et al. 2012. Global convergence in the vulnerability of forests to drought. *Nature* 491(7426):752-755.

Chen, Meng. 2005. Research and application of forest biodiversity theory and method. *Nanjing Forestry University.*

Chen, XingLiang, Qian Ju, and KunLun Lin. 2014. Development status, issues and countermeasures of China's plantation. *World Forestry Research* 27(6):54-59.

Daierfu, Wang Xiaofan, Zhu Jianjia, and Wang Xiaoli. 2020. Simulation of effects of cutting and artificial regeneration on forest area and aboveground biomass in red soil hilly region: a case study of moshao forest farm in Huitong County. *Journal of natural resources* (12):2995-3006.

Feng Qiannan, An Yulin and Wei Fei. 2021. Analysis on Natural Forest Regeneration in Togtoh County. *Forestry Survey and design of Inner Mongolia* (01):4-5 + 30.

Forestry monitoring and Planning Institute of Inner Mongolia Autonomous Region,

2017. *Forest resources investigation report of Tuoketuo County.*

Forestry monitoring and Planning Institute of Inner Mongolia Autonomous Region. 2017. *Investigation report on Forestry Specialty in Tuoketuo County, Hohhot.*

Gao, Runmei, Shi Xiaodong, Wang Lin, Han Na. 2015. Drought Resistance of One-Year-Old Seedlings of *Larix principis-rupprechtii. Forestry science* 51(07):148-156.

Guo, Jinping, Li Haibo, Liu Ning, Zhang Yunxiang. 2009. Comparison of responses of Larix principis rupprechtii and Cotinus coggygria seedlings to light and competition. *Forestry science* 45 (02):53-59.

Hernandez-Stefanoni, J. L., and Dupuy, J. M. 2008. Effects of landscape patterns on species density and abundance of trees in a tropical subdeciduous forest of the Yucatan Peninsula. *Forest Ecology and Management* 255(11):3797-3805.

Lin, Jianyong, Li Juan, Li Junfu, et al. 2020. Dynamic effects of collection disturbance on population structure and quantity of Phoebe bournei. *Journal of forest and environment* 40(4):377-385.

Liu, Hongxia. 2009. Effect of meteorological factors on growth of *Larix principis rupprechtii*. Hebei Agricultural University.

Peng, Shanjiang, Huang Zhongliang, Peng Shaolin, Ouyang Xuejun, Xu Guoliang. 2004. Influencing factors of seed and seedling death in natural regeneration of plants. *Guangxi plants* (02):113-121 + 124.

Phamv, H., Chen Changxiong, Hongwei, et al. 2015, The distribution pattern of seedling regeneration of chuhai young trees under different stands. *Journal of forest and environment* 35(4):377-384.

Wang, Bin, Tian Xianglin, Liao Ziyan, Wang Zhitao, Geng Shenglian, Cao Tianjian. Natural regeneration simulation and uncertainty analysis of pine oak forest. *Journal of Applied Ecology* 31(12):4004-4016.

Wang, Dayang, Liu Qingqing, Chen Yanfang, fan Jinmei, Wang Zhengning and Liu Bo. 2020. Effects of litter location on seedling emergence and early growth of Cunninghamia lanceolata. *Journal of Fujian agriculture and Forestry University (NATURAL SCIENCE EDITION)* (06):782-788.

Wiegand, Thorsten, Isabel Martínez, and Andreas Huth. 2009. Recruitment in tropical tree species: revealing complex spatial patterns. *The American Naturalist* 174(4):E106-E140.

Zheng Yunfeng, Yin Zhunsheng, Tang Xiaojia. 2020. Study on the influencing factors of natural regeneration of tree species. *East China forest manager* 34 (02):1-4.

Zhu Zhen, Xu Zhigang, Shen Yueqin, et al. 2019. Effect of off- farm employment on the harvesting decision-making of households with different scales in China's collective forest area. *Journal of Natural Resources* 34(2):236-249.

APPENDIXES

Table Ⅰ Natural regeneration under canopy of immature, mature and over mature forests with different canopy density in Tuoketo county

Canopy density	Regenerated numbers (stem)	Regenerated area (ha)	Regeneration density (stem/ha)	Propotion of regeneration area (%)
0.2	22092	1052.0	21	9.78
0.3	40345	1921.2	21	17.86
0.4	71339	3242.7	22	30.15
0.5	65033	3096.8	21	28.79
0.6	26972	1172.7	23	10.90
0.7	6070	252.9	24	2.35
0.8	245	10.2	24	0.09
0.9	166	8.3	20	0.08
total	236650	10756.8	22	100.00

Table Ⅱ Natural regeneration under canopy of immature, mature and over mature forests with different saplings composition

Regeneration of tree species	Regenerated numbers (stem)	Regenerated area (ha)	Regeneration density (stem/ha)	Propotion of regeneration area (%)
Populus alba L.	236557	10752.6	22	99.96

Ulmus pumila L.	84	4.2	20	0.04
Total	236650	10756.8	22	100.00