

Published by:

Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Editors:

Ivana Radojčić Redovniković

Tamara Jakovljević

Jasna Halambek

Mladen Vuković

Dina Erdec Hendrih

Cover&logo design: Hendrih Feldbauer d.o.o.

Text prepared by:

The information provided in the Proceeding is based on the submitted abstracts of conference participants. Authors are fully responsible for the text and its quality. Language corrections were not made.

ISBN 978-953-6893-04-1

A CIP catalogue record for this book is available from the National and University Library in Zagreb under **892094**.

Organized by

Croatian Forest Research Institute
Faculty of Food Technology and Biotechnology, University of Zagreb
Faculty of Forestry, University of Zagreb
Institute for Adriatic Crops and Karst Reclamation
Croatian Society of Biotechnology
Croatian Chamber of Economy

Supported by

International Union of Forest Research Organizations, Division 9 - Forest Policy and Economics (IUFRO)
European Forest Institute (EFI)
European Biotechnology Thematic Network Association (EBTNA)

Under the auspices of

Prof.dr.sc. Ivo Josipović, President of the Republic of Croatia
Croatian Academy of Sciences and Arts
Ministry of Science, Education and Sports of the Republic of Croatia
Ministry of Environmental and Nature Protection
Ministry of the Economy
Ministry of Agriculture
University of Zagreb
Croatian Environment Agency
City of Jastrebarsko

Chair of the Conference

Dijana Vuletić, Croatia

Organization committee

Chair: Tamara Jakovljević, Croatia

Co-chair: Ivana Radojčić Redovniković, Croatia

Members

Mirjana Hruškar, Croatia

Milan Oršanić, Croatia

Slavko Perica, Croatia

Vesna Zechner-Krpan, Croatia

Marija Gradečki-Poštenjak, Croatia

Elvis Paladinić, Croatia

Sanja Perić, Croatia

Igor Kolar, Croatia

Silvija Krajter Ostoić, Croatia

Ivan Seletković, Croatia

Dinka Matošević, Croatia

Željko Zgrablić, Croatia

Damir Ježek, Croatia

Karin Kovačević Ganić, Croatia

Marina Cvjetko Bubalo, Croatia

Jasna Halambek, Croatia

Petar Ćurić, Croatia

International Scientific Committee

Chair: Ivana Radojčić Redovniković, Croatia

Co-chair: Tamara Jakovljević, Croatia

Members

James Clark, UK

Mauro Serafini, Italy

Davide Pettenella, Italy

Alessandra De Marco, Italy

Senka Čurčin, Serbia

Nenad Potočić, Croatia

Hrvoje Marjanović, Croatia

Tomislav Dubravac, Croatia

Milan Pernek, Croatia

Ivan Balenović, Croatia

Mladen Ivanković, Croatia

Višnja Gaurina Srček, Croatia

Tonči Rezić, Croatia

Mladen Brnčić, Croatia

Verica Dragović-Uzelac, Croatia

Suzana Rimac Brnčić, Croatia

Marijan Šušnjar, Croatia

Renata Pernar, Croatia

Lukrecija Butorac, Croatia

Conference Secretary:

Mladen Vuković

GREEN2014-Zagreb@sumin.hr

Sponsors

Croatian Forest Ltd.

Croatian Chamber of Forestry and Wood Processing Engineers

Zagreb County

Zagreb County Tourist Board

Croatian National Tourist Board

Biovega d.o.o

Zigante tartufi d.o.o.

Maraska d.d.

Exhibitors

Zagrebačka banka d.d.

Instrumentalia d.o.o.

Hebe d.o.o.

Crux d.o.o.

UTP d.o.o.

KemoLab d.o.o.

TABLE OF CONTENTS

Scientific papers

Session A: Natural resource management and potential of rural area

Participation of stakeholders on protected area management in Turkey: case of Küre mountains national park Gül Akbulut, Erdoğan Atmış, Hikmet Batuhan Günşen	1
Forest certification in Bosnia-Herzegovina and Slovenia: obstacles and effects Mersudin Avdibegović, Bruno Marić, Dženan Bećirović, Senka Mutabdžija Bećirović, Špela Pezdevšek Malovrh	8
Stand growth characteristics of common beech (<i>Fagus sylvatica</i> L.) – projection of even-aged to multi-aged stand structure Jura Čavlović, Krunoslav Teslak, Hrvoje Marjanović	14
First results of the study on the structure of standing dead wood in managed forests of Croatia Hrvoje Marjanović, Maša Zorana Ostrogović Sever, Jura Čavlović	19
Does mountain forest characteristics influence visual appeal? A study case in an Alpine Valley in Italy Fabio Pastorella, Admir Avdagić, Azra Cabaravdić, Merisa Osmanović, Alessandro Paletto	25
Green Care FOREST – diversification as an opportunity for forestry Petra Isabella Schwarz, Renate Cervinka, Jan Höltge, Laura Pirgie, Markus Schwab, Jennifer Sudkamp, Daniela Haluza, Arne Arnberger, Renate Eder, Martin Ebenberger	32
Impact of the actual structure and management on the future development and sustainable management of the Pedunculate oak forests in eastern Croatia Krunoslav Teslak, Jura Čavlović, Karlo Beljan, Dario Tomašević	35

Session B: Functional food and useful products from natural sources

Probiotic fermented milk with freeze dried immobilized <i>Lactobacillus casei</i> atcc 393 cells on apple pieces Dimitra Dimitrellou, Panagiotis Kandyliis, Yiannis Kourkoutas	43
Turkish cacik and labneh production methods and some properties Zekai Tarakçi	48
The effects of starter culture on chemical composition, textural and sensory characteristics of turkish tulum cheese with half fat during ripening Zekai Tarakci, Omer Faruk Celik	53
Effects of adding cherry laurel (<i>Laurocerasus officinalis</i>) on –micro mineral concentrations of tarhana Zekai Tarakçi, Yusuf Durmuş, Beşir Dağ	60

Session C: Implementation of green technology

Green solvents for green technologies Marina Cvjetko Bubalo, Kristina Radošević, Višnja Gaurina Srček, Jasna Halambek, Natka Ćurko, Karin Kovačević Ganić, Ivana Radojčić Redovniković	64
Isolation of flavonoids from propolis by supercritical CO₂ extraction Filip Hajek, Marko Rogošić, Tina Perko, Željko Knez, Mojca Škerget	70
Green approach to preventing corrosion of metals and alloys Jasna Halambek	75
The potential of poplar (<i>Populus nigra</i> var. <i>italica</i>) in the phytoremediation of lead Tamara Jakovljević, Marina Cvjetko Bubalo, Karla Hanousek, Marija Sedak, Nina Bilandžić, Darija Papst, Ivana Radojčić Redovniković	81
Properties of starches in mixtures with supercritical CO₂ and their use as carriers in pgs micronization process Tina Perko, Denis Čuček, Mojca Škerget, Željko Knez	87
Deep eutectic solvent choline chloride: glycerol as selective solvent for extraction of pyridine and thiophene from n-hexane Aleksandra Sander, Maja Žužić, Marina Cvjetko Bubalo	92
Liquid–liquid equilibrium for the systems hydrocarbon – thiophene – 1-hexyl-3,5-dimethylpyridinium Aleksandra Sander, Marko Rogošić, Borna Ferčec	97
Separation of thiophene from n-hexane by the mixture of ionic liquids Aleksandra Sander, Mladena Dujmenović, Marina Cvjetko Bubalo	102
Aqueous two-phase extraction of polyphenols from red and white wine in a microextractor Anita Šalić, Ana Jurinjak Tušek, Bruno Zelić	107
The possibilities of water recycling in the production of bitumen based products Dinko Vujević, Aleksandra Anić Vučinić, Petra Strahija, Mateja Novak, Tito Todorović	112

Session D: Biomass and sustainability

Optimising the environmental sustainability of short rotation coppice biomass production for energy Ioannis Dimitriou, Željka Fištrek, Rita Mergner, Dominik Rutz, Laurie Scrimgeour, Ioannis Eleftheriadis, Ilze Dzene, Tomaš Perutka, Dagnija Lazdina, Gordana Toskovska, Stefan Hinterreiter	117
Effect of pH and temperature on acidogenesis of sucrose using free and immobilized mixed anaerobic bacteria on mineral kisseris Katerina Lappa, Panagiotis Kandyliis, Argyro Bekatorou, Maria Kanellaki, Athanasios Koutinas	124
Chemical composition of wheat straw as a potential raw material in papermaking industry Ivana Plazonić, Željka Barbarić-Mikočević, Vesna Džimbeg-Malčić	130
Use of forest residues in a final cut of reproductive felling Milorad Danilović, Aleksandra Vorkapić, Dušan Stojnić, Dragomir Grujović	135

Production of wood biomass in coniferous forests of the Republic of Serbia Milorad Danilović, Aleksandar Vorkapić, Slavica Antonić, Dušan Stojnić	145
Energy balance of wood chips production and delivery Marijan Šušnjar, Zdravko Pandur, Dubravko Horvat, Marko Zorić	152
Optimization of energy wood chips quality by proper raw material manipulation Dinko Vusić, Željko Zečić, Elvis Paladinić	159

Session E: Biodiversity and ecosystem services

The role of forest vegetation in karst on soil protection from erosion Lukrecija Butorac, Vlado Topić, Nikola Pernar, Goran Jelić	166
The structure and dynamics of mixed-species stand of scots pine, norway spruce and silver fir on mountain Klekovača (BIH) Vojislav Dukić, Branko Stajić, Danijela Petrović, Aleksandra Karanović	173
Nitrogen deposition measurement in Croatia and Slovenia Tamara Jakovljević, Daniel Žlindra, Mitja Skudnik, Karla Hanousek	179
Box tree moth (<i>Cydalima perspectalis</i>), new invasive insect pest in Croatia Dinka Matošević	184
Relationship of stand structure in Croatian Pedunculate oak and common hornbeam forests with growth and yield tables as guidelines for forest management: current state and challenges Vladimir Novotny, Stjepan Dekanić, Tomislav Dubravac	187
The evaluation ground vegetation structure by the time series analyses in turkish red pine (<i>Pinus brutia</i> ten.) plantations in the western black sea region in Turkey Halil Barış Özel	193
Nutritional status and stress tolerance index in effective selection of Poplar clones Nenad Potočić, Davorin Kajba, Igor Anić, Stjepan Mikac, Ivan Andrić	203
Studies on morphogenetic characteristics of juvenile and one year old seedlings of some registered Brutian pine (<i>Pinus brutia</i> ten.) seed stands in lakes district Cengiz Yücedağ, Abdullah Gezer	209

THE STRUCTURE AND DYNAMICS OF MIXED-SPECIES STAND OF SCOTS PINE, NORWAY SPRUCE AND SILVER FIR ON MOUNTAIN KLEKOVAČA (BIH)

Vojislav Dukić^{1*}, Branko Stajić², Danijela Petrović¹, Aleksandra Karanović¹,

¹Faculty of Forestry, Banja Luka, Bosnia and Herzegovina

²Faculty of Forestry, Belgrade, Serbia

*vojodukic@yahoo.com

Introduction

Forest stand dynamics is the study of changes in a forest stand structure over time, including stand behaviour during and after disturbances. Stand structure is the physical and temporal distribution of trees and other plants in a stand [1]. Understanding stand dynamics helps to focus management objectives by predicting future stand structures and development patterns, reducing silvicultural costs; increasing stand productivity, obtaining management information rapidly and inexpensively; obtaining desirable species compositions or physiognomies; developing diagnostic criteria for determining, prescribing, and making decisions for silvicultural operations; and enabling stands to be used as a general environmental "bioassay" for determining when stands are growing abnormally—perhaps as a result of pollution or other factors [2].

Materials and Methods

The research of the dynamics and structure was carried out in mixed stands of Scots pine (*Pinus sylvestris* L.), Norway spruce (*Picea abies* Karst.) and Silver fir (*Abies alba* Mill.) on mountain Klekovača. Significant complexes of that forest type are located in the western part of Bosnia and Herzegovina. The researched stand is exempted from regular management (seed stand). Mixed stand of Scots pine, Norway spruce and Silver fir, *Abieti Piceetum illyricum* (Fuk.) Stef. 1962 subass. *pinetosum sylvestris*, is the successive stage of pine forests with spruce *Piceo-Pinetum illyricum* Stef. 1959, towards the permanent stage *Abieti Piceetum illyricum* (Fuk.) Stef. In 1962.

For the study of the dynamics and structure of these mixed stands in the area of mountain Klekovača, the site Ravna Glavica at an altitude of 958 to 1011 m was selected (forest management unit "Klekovača-Drinić"), where 5 sample circular plots (n) were set (radius of 30 m). In addition to surveying the main elements of the trees growth, those had diameter at breast height (dbh) larger than 5 cm were cored with increment borer at height of 0.5 m from forest floor, to estimate tree age. Corim maxi (instrument) was used to determine the tree-ring width from core samples. To estimate the stem volume of each tree volume tables of Špiranec [3] and Bezak [4] were used.

Results and Discussion

For the researched forest stand site classes were determined by comparing the tree-species height curves with standard site classes curves [5] as follows: for the Silver fir class I / II, for Norway spruce class III and for Scots pine site class I. The estimated average number of trees (having dbh greater than 5 cm) per hectare is 798. The variation of the number of trees on

the sample plots, expressed by the coefficient of variation, is 14.8%. In the total number of trees the largest share has Silver fir with 46%, and the lowest Norway spruce with 19%. By observing species per sample plots, the largest variations are in the number of Silver fir trees (38.7%) and the lowest in the number of Norway spruce trees (15.7%). Estimated standing volume is $745.7 \text{ m}^3 \text{ ha}^{-1}$ with a variation of 9.2% in the sample plots. Contrary to the number of trees, the largest share in the standing volume has Scots pine with 69%. Volume increment is $11.54 \text{ m}^3 \text{ ha}^{-1}$ with a variation of 11.5% for all sample plots (Table 1).

Table 1. Basic stand structure elements (number of sample plots - n, number of trees – N, volume – V, current annual increment – Iv) and descriptive statistics (standard deviation - Std. dev., and coefficient of variation - CV)

Tree species	n	N			V			Iv		
		ha^{-1}	Std. dev.	CV	$\text{m}^3 \text{ ha}^{-1}$	Std. dev.	CV	$\text{m}^3 \text{ ha}^{-1}$	Std. dev.	CV
			ha^{-1}	%		$\text{m}^3 \text{ ha}^{-1}$	%		$\text{m}^3 \text{ ha}^{-1}$	%
Silver fir	5	370	143	38.7	116.5	44.0	37.7	3.08	1.15	37.4
Norway spruce	5	154	25	15.7	108.1	49.4	45.7	2.63	1.01	38.4
Scots pine	5	271	68	25.1	518.0	112.7	21.7	5.83	1.21	20.8
Total	5	798	118	14.8	745.7	68.5	9.2	11.54	1.33	11.5

Diameter distribution of trees is shown in Figure 1. By using the appropriate statistical indicators, based on the measured trees diameter, the parameters that characterize the diameter distribution of the studied stand were obtained and presented in Table 2.

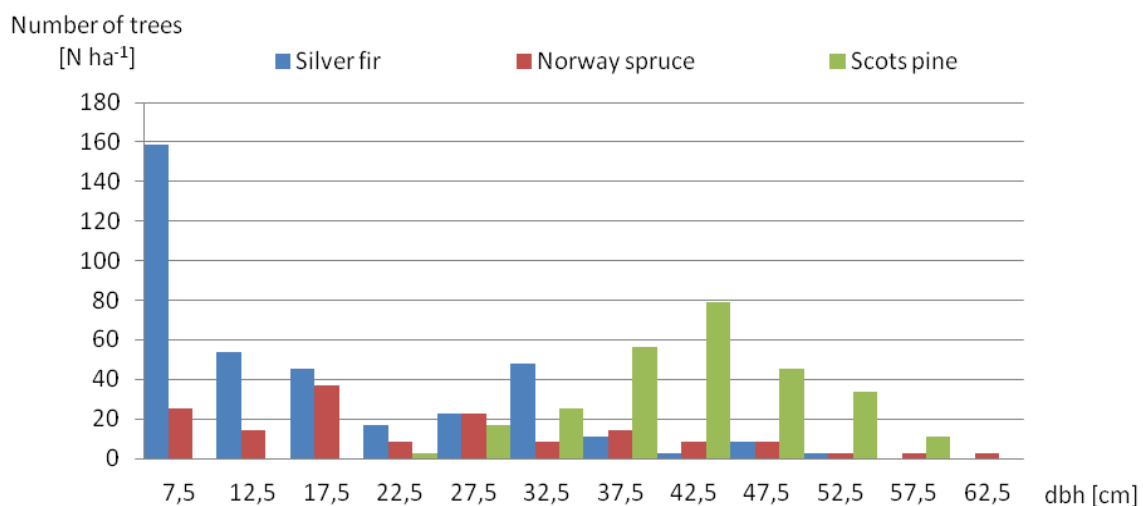


Figure 1. Diameter distribution of trees.

A significant difference is observed in the diameter distribution of those three species of trees. Arithmetic mean of the Silver fir trees dbh is 16.14 cm, for Norway spruce is 24.15 cm,

and 41.57 cm for Scots pine. The largest absolute variation, in terms of the trees dbh, is observed for Norway spruce (14.33 cm), and largest relative variation for Silver fir trees (71.19%). Both absolute and relative variability are the lowest in Scots pine sample. Diameter distribution of Scots pine is characterized by a small negative asymmetry (Skewness = - 0.15) comparing to the distributions of Silver fir and Norway spruce trees which are characterized by strong positive asymmetry (Skewness = 1.00; 0.74; respectively). Kurtosis (factor) shows that the distribution of all three species is flattened compared to normal distribution. Testing the difference between the actual diameter distribution and normal distribution using the Shapiro-Wilk test (if the p -value is less than the chosen alpha level, then the null hypothesis is rejected and there is evidence that the data tested are not from a normally distributed population) shows that the actual frequencies of Scots pine trees match with the theoretical frequencies ($p = 0.8178$). Distributions of Norway spruce and Silver fir trees deviate significantly ($p = 0.0022$, $p = 0.0000$, respectively) relative to the normal distribution.

Table 2. Diameter distribution of trees - descriptive statistics

Tree species	dbh (cm)	Variance (cm)	Std. dev. (cm)	CV (%)	Skewness	Kurtosis	Shapiro-Wilk	
							W	p
Silver fir	16.14	132.04	11.49	71.19	1.00	-0.05	0.84992	0.0000
Norway spruce	24.15	205.35	14.33	59.34	0.74	-0.35	0.92540	0.0022
Scots pine	41.57	58.18	7.63	18.35	-0.15	-0.15	0.99168	0.8178
Total	26.36	248.96	15.78	59.86	0.14	-1.32	0.90947	0.0000

Height distribution of trees is shown in Figure 2. Estimated average height of Silver fir trees is 11.81 m, for Norway spruce is 17.80 m, for Scots pine is 29.25 m. The Scots pine height distribution has strong negative asymmetry (Skewness = -0.7486), and the distribution of Silver fir has strong positive asymmetry (Skewness = 0.6209). The observed Norway spruce height distribution is not asymmetric, actually it is flattened compared to normal distribution (Kurtosis = -1.2073). Testing the difference between the actual tree species distributions and normal distribution by using the Shapiro-Wilk test showed significant differences.

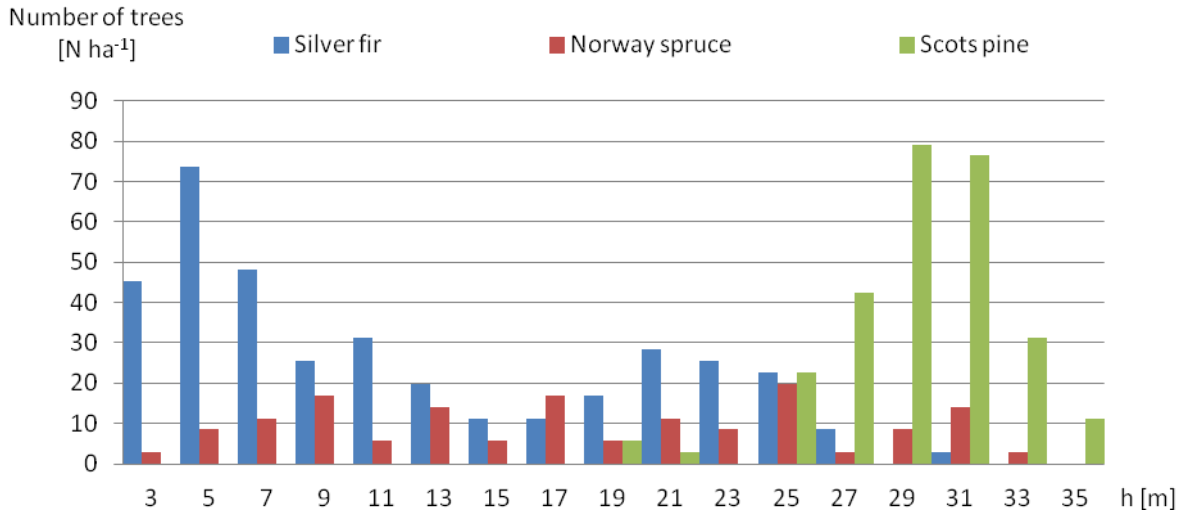


Figure 2. Height distribution of trees.

Homogeneity is defined with stand homogeneity index (H), according to De Camino [6], and it is graphically presented with the Lorenz's curve. According to Kramer [7], homogeneous stands have a higher stand homogeneity index. In even-aged stands with low thinnings, stand homogeneity indexes vary between 4 and 10, while in uneven-aged the indexes range from 1.3 and 2.8. The estimated stand homogeneity index ($H_{\text{Silver fir}} = 1.7$, $H_{\text{Norway spruce}} = 2.1$ and $H_{\text{Scots pine}} = 6.4$) and the Lorenz's curve (where N% represent sum of stem percentages up to dbh class i, and V% is the sum of volume percentages up to dbh class i) indicate a significantly higher degree of homogeneity of the Scots pine component in the stand, in relation to Silver fir and Norway spruce (Figure 3). The stand homogeneity index of Scots pine component of stands tends to have the value typical for even-aged stands. On opposite, stand homogeneity index of Silver fir and Norway spruce components tend to the typical value for uneven-aged stands.

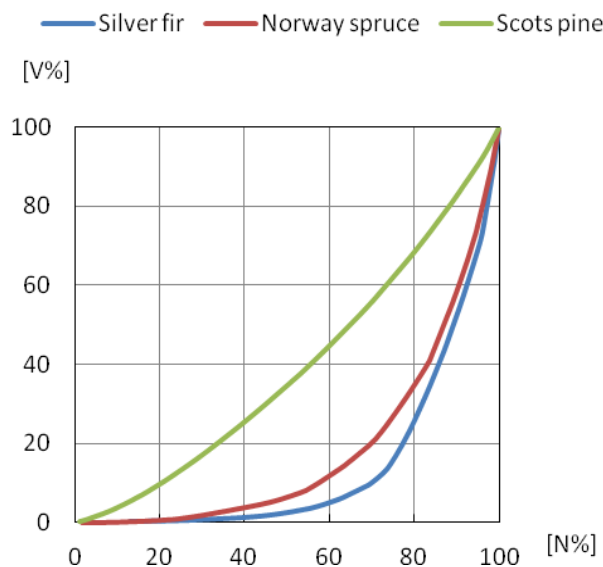


Figure 3. Lorenz's curve.

Figure 4 shows the distribution (relative frequency) of measured trees of tree species by age classes. The estimated average age of Silver fir trees is 65 years, for Norway spruce and Scots pine is 84 and 121 years respectively. The youngest Silver fir tree was 19 years old, while Norway spruce and Scots pine trees were 34 and 83 years old respectively. Accordingly, the youngest Scots pine tree reached breast height in 1930, Norway spruce in 1979 and Silver fir tree in 1994. Furthermore, in actual stand 24% of currently alive Silver fir trees, 15% of Norway spruce trees and 84% of Scots pine trees reached breast height until 1910.

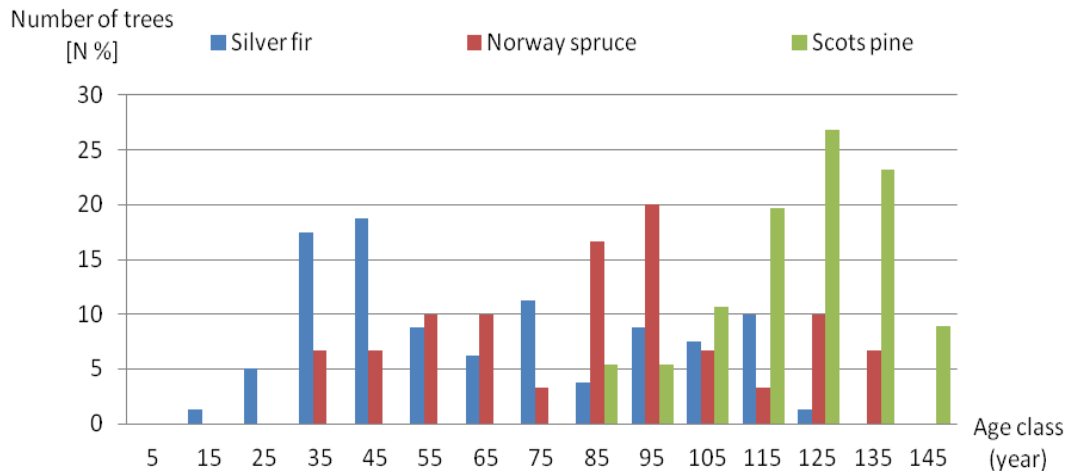


Figure 4. Age structure of living trees.

The dominant Scots pine trees had the largest diameter increment (I_d) until about 1945 and after then the smallest diameter increment comparing to other tree species. From 1945 until the last decade of twentieth Century, Norway spruce trees had the largest diameter increment, while in the first decades of 21st century, Silver fir and Norway spruce trees had similar diameter increment (Figure 5).

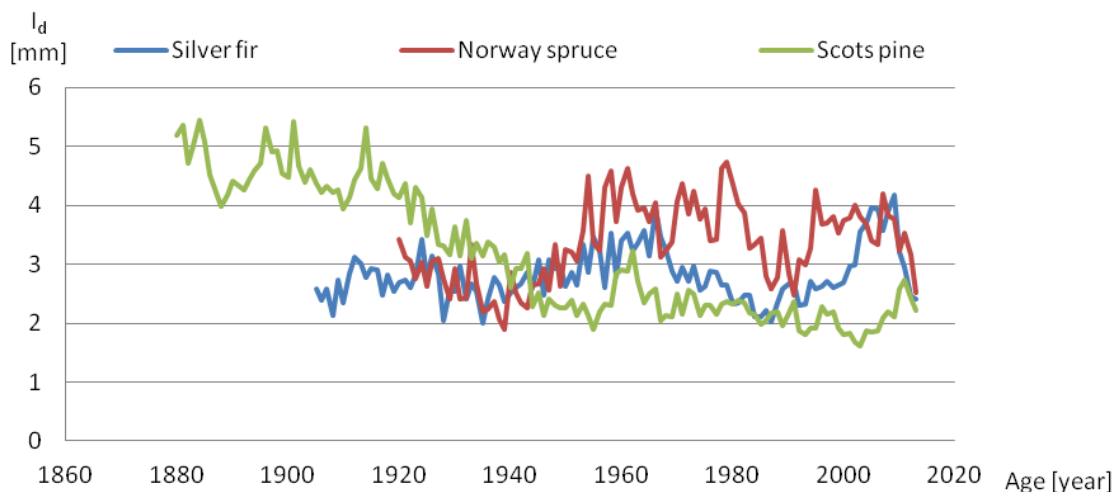


Figure 5. Average diameter increment (dominant trees, age > 100 years)

Conclusion

Performed analysis, primarily of diameter, height and age structure in the studied uneven-aged stand dominated by Silver fir, Norway spruce and Scots pine, indicated a very complex structure and dynamic change, especially in terms of the ratio of the tree species. The analysis of the age structure showed the dynamics of succession in the researched stand towards to a permanent state of *Abieti Piceetum illyricum* (Fuk.) Stef. 1962 and towards to the mixed Silver fir and Norway spruce forest. The youngest Silver fir tree was 19, Norway spruce is 34 and Scots pine is 83 years old, which means that the youngest tree of Scots pine reached breast height in 1930, Norway spruce in 1979 and silver fir in 1994. In the last two observed decades, no trees reached 5 cm at breast height, which is consequence of very high stand density currently. The estimated number of trees per hectare is 798 and standing volume is 745.7 m³ ha⁻¹.

References

1. F.C. Ford-Robertson, Terminology of Forest Science, Technology, Practice, and Products, Society of American Foresters, Washington, D.C., 1971, pp. 349.
2. C.D. Oliver, B.C. Larson, Forest Stand Dynamics, John Wiley and Sons, New York, 1996, pp. 544.
3. M. Špiranec, Tablice drvnih masa jele i smreke, Šumarski Institut-Jastrebarsko, Zagreb, 1976.
4. K. Bezak, Tablice drvnih masa cera, crnog bora i običnog bora, Radovi 5, Izvanredno izdanje (1992) 47-65.
5. V. Matić, V. Vukmirović, P. Drinić, O. Stojanović, Tablice taksacionih elemenata visokih šuma, Šumarski fakultet i Institut za šumarstvo i drvnu industriju u Sarajevu, Sarajevo, 1963.
6. R. De Camino, Zur Bestimmung der Bestandeshomogenität, Allg. Forst- Jagdztg. 147 (1976) 54-58.
7. H. Kramer, Waldwachstumslehre, Paul Parey, Hamburg-Berlin, 1988.