

DOUGLAS FIR (*PSEUDOTSUGA MENZIESII* (MIRB.) FRANCO) FROM BANATULUI MOUNTAINS

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Abstract

The study has identified 844 Douglas fir stand elements in the 12 Forest Districts that cover a total surface of 2544.50 ha. The largest percentages were registered in the following forest districts: Băile Herculane (318.5 ha), Mehadia (266.9 ha), Berseasca (262.5 ha) and Ojetul Roșu (191.4 ha). As such, the purpose of this paper is to analyse the main stand and environment characteristics of areas where Douglas fir species are present. These are followed by the specie's distribution, altitude, relief forms, soils, forest types, mixture, stand structure and productive class. The age of these stands ranges between 1 to 100 years, with approximately 46.6% of stands having ages between 21 to 30 years. The Douglas fir stands show an even-aged stand structure (71%). The majority of Douglas fir stands are situated at altitudes between 601 to 800 m (31%). The slope is the main field configuration, covering a surface of 1987.9 ha. The soils on which this species vegetates are: common eutric cambisol (1546.2 ha), luvisol (220.4 ha), and dystic cambisol (448.4 ha). The most representative forest types are: hill common beech on skeletal soils with mull flora (554.7 ha), mountain common beech on skeletal soils with mull flora (423.6 ha), and normal common beech with mull flora (468.2 ha). The identified Douglas fir stands have average and high productivity classes (1st class = 500.8 ha; 2nd class = 986.5 ha). Green Douglas fir is a forest species that has a special interest for both the European silviculture as well as for the Romanian one.

Key words: age, altitude, consistency, soil type, Banatului Mountains.

INTRODUCTION

Douglas fir is an important tree species that originates from North America. The species was discovered in 1792 by Archibald Menzies and introduced in 1826 in Europa by David Douglas (Kleinschmit et al., 1999). The species was used by Indian tribes in treating different illnesses: kidney and urinary problems, venereal diseases, excessive menstruation, intestinal bleeding, stomach problems, coughs or as a cataplasm for cuts, burns, scars or other skin diseases (Pădure et al., 2008). Since then, the species was planted on a large scale in most European countries where it currently covers approximately 750.000 ha (Bastien et al., 2013; Nicolescu et al., 2014; Boiffin et al. 2017). In present times, Douglas fir covers more than 800.000 ha from which 50% are in France, 25% in Germany, and the rest of 25% are distributed in other European countries. In Germany and Austria, 2% and 0.2% from the country's total forest surface are covered by Douglas fir (Eckhart et al., 2019).

The interest for planting Douglas fir species has increased substantially in the last years as the species is seen as a potential option towards climate change. Due to its growth potential, vigour and wood quality, the species was introduced in many countries around the world, including New Zealand, Chile, Argentina, Australia and France (Hermann et al., 1999; Hintsteiner et al., 2018; Thurm et al., 2016).

The species was introduced a century ago in Bulgaria, but it became widely spread at the end of the 1950s and 1960s. The plantation surfaces amount to approximately 7.372 ha (Petkova et al., 2014).

In north-west Spain, Douglas fir has become the fourth most important species planted in the last decade (Zas et al., 2003).

In Romania, the species was introduced 100 years ago on considerable surfaces from Aleșd, Marghita, Dobrești, Nădrag basin, Crișbav, Râșnov, Săcele, Fântânele etc. (approximately 30.000 ha). Douglas fir prefers the oceanic, mountain climate, either warm and humid, either cold and humid. The most favourable

areas are located in West Transylvania and Banat. The species prefers light, airy and drained soils (substratum of crystalline schists, granite, conglomerates).

This tree species is renowned for its durability and superior mechanical properties (Longo et al., 2019). The wood is strong, moderately hard and very rigid. It is easy to process and difficult to impregnate with preservatives (Remeš, 2014). Douglas fir is more resistant to drought than the Norway spruce and it has become known as the “dry Norway spruce” (Vejpustková et al., 2019).

Pseudotsuga menziesii (Mirb.) Franco is a species with a fast and economically valuable growth, being at the same time one of the most beautiful coniferous species (Dorofeeva et al., 2019). It is also one of the most promising exotic tree species from Europe (Castaldi et al., 2020). Furthermore, it has a silvicultural value due to its high quality wood, as well as an ornamental value due to its crown's shape and its needle's smell.

Douglas fir is a valuable resource for flavoured terpenoid products. Because of this fact, Douglas fir forests ensure a valuable resource of non-wood forest products in many areas of the country (Pleșca et al., 2019; Blaga et al., 2019; Cântar et al., 2020; Tudor et al., 2019; Dincă et al., 200; Vecchiu et al., 2019).

MATERIALS AND METHODS

Data from management plans from 12 Forest Districts has been used in order to identify and analyse Douglas fir stands. The data was centralized and process through Excel. The following stand and environment characteristics were analysed in areas where Douglas fir is present: spread, altitude, relief forms, soils, forest types, mixture, stand structure, current growth and production class.

RESULTS AND DISCUSSIONS

Based on the realized research, 844 Douglas fir stand elements were identified in 12 Forest Districts that cover a total surface of 2544.50 ha. The largest Douglas fir surface is found in Băile Herculane Forest District (318.50 ha), while the smallest surface is in Văliug Forest District (1.10 ha) (Figure 1).

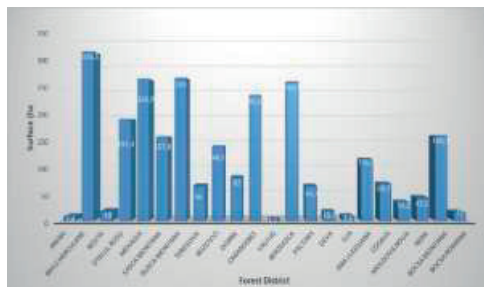


Figure 1. The surface occupied by Douglas fir in Banatului Mountains

The slope is the **relief form** characteristic for these stands, occupying 1987.9 ha (78%) of the total stands' surface (Figure 2).

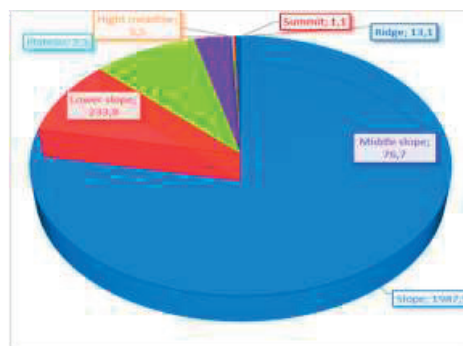


Figure 2. Relief forms characteristic for Douglas fir stands from Banatului Mountains

The most common **field incline** for Douglas fir stands located in Banatului Mountains is of 26-30 degrees (Figure 3).

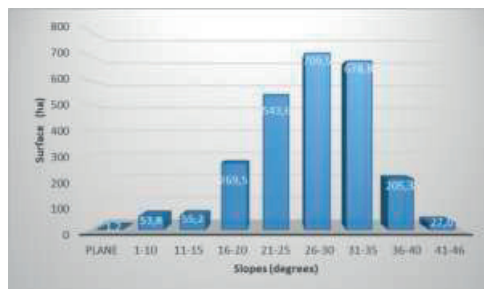


Figure 3. Field incline for Douglas fir stands from Banatului Mountains

The specific **field exposition** for these stands is north-east, south-east, south-west and north-west (Figure 4).

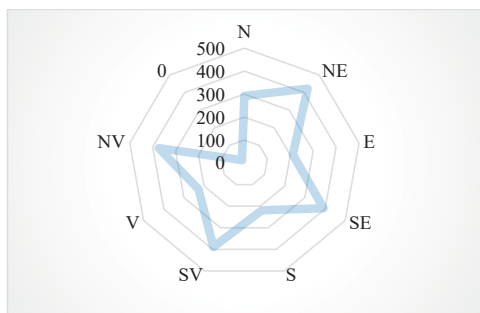


Figure 4. Field exposition for *Pseudotsuga menziesii* stands from Banatului Mountains

The altitude at which these stands are present ranges between 150 m and 1300 m. Our analysis has shown that 31% of the surface occupied by Douglas fir varies between 601 m and 800 m altitude (Figure 5).

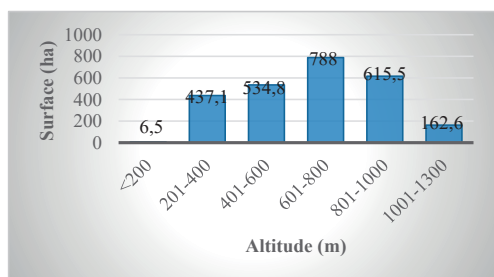


Figure 5. Altitude for Douglas fir stands from Banatului Mountains

The soils on which Douglas fir vegetates are: common eutric cambisol (1546.2 ha), luvisol (220.4 ha) and dystric cambisol (448.4 ha). These soils are rich in humus (Dincă et al., 2017; Oneț et al., 2019), in nutritive elements (Crișan et al., 2017; Dincă et al., 2019) and are well supplied with water (Dincă et al., 2018; Crișan et al., 2020). In Central Europe, Douglas fir was mainly introduced on well-drained, aerated and carbonate-free soils (Eckhart et al., 2019).

The forest soils in which the Douglas fir is present are: hill common beech on skeletal soils with mull flora (554.7 ha), mountain common beech on skeletal soils with mull flora (423.6 ha), and normal common beech with mull flora (468.2 ha).

The age of the Douglas fir stands ranges between 1 and 100 years. Approximately 46.6% of stands have 21-30 years, 26.6% have

11-20 years and 20.5% have 31-40 years (Figure 6).

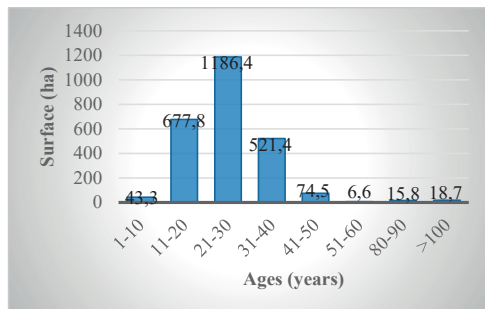


Figure 6. The age of Douglas fir stands from Banatului Mountains

Stand structure is predominantly even-aged (453.3 ha), relatively even-aged (1831.1 ha), relatively uneven-aged (243.2 ha) and uneven-aged (16.9 ha) (Figure 7).

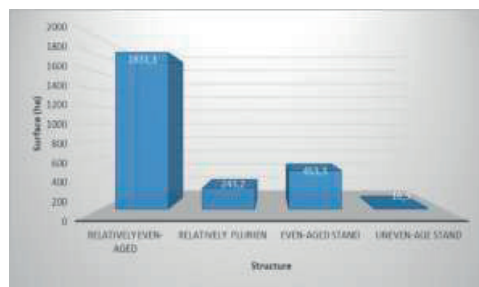


Figure 7. Structure of *Pseudotsuga menziesii* stands from Banatului Mountains

The composition is mixed (intimate + groups = 901.1 ha) and in groups (409.8 ha) (Figure 8).

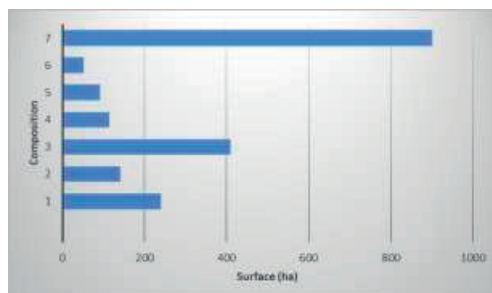


Figure 8. Composition of *Pseudotsuga menziesii* stands from Banatului Mountains

The stands' production class is average (3^d class = 1044.7 ha) and superior (1st class = 500.8 ha; 2nd class = 986.5 ha).

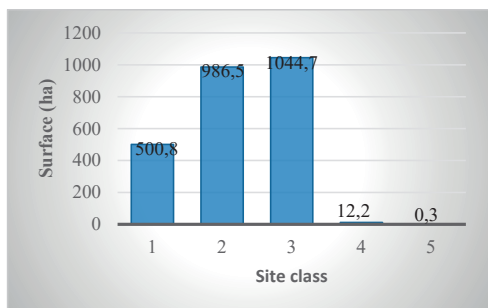


Figure 9. Site class of Douglas fir species from Banatului Mountains

Stand consistency is appropriate (0.7-0.8). However, there are some barrenland stands (0.4-0.5) or that must be thinned (0.9) (Figure 10).

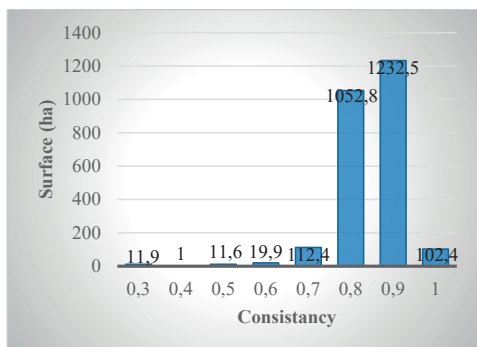


Figure 10. Consistency of Douglas fir stands from Banatului Mountains

CONCLUSIONS

The present study has identified 844 Douglas fir stand elements that cover a total surface of 2544.50 ha. From the identified characteristics, the followings are of special interest: 72% of Douglas fir stands are found on slopes, with common eutric cambisol being the main soil type (1546.2 ha); the age ranges from 1-100 years, approximately 46.6% of stands having 21-30 years; the stands have an average production class (3^d class = 1044.7 ha). The majority of Douglas fir stands are situated at altitudes between 600-801 m. The soils on

which this species vegetates are: eutric cambisol (1546.2 ha), luvisol (220.4 ha), and dystric cambisol (448.4 ha).

Douglas fir is a forest species that poses a special interest for both European silviculture as well as for Romania's silviculture.

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