Scientific Papers. Series E. Land Reclamation, Earth Observation & Surveying, Environmental Engineering. Vol. IX, 2020
Print ISSN 2285-6064, CD-ROM ISSN 2285-6072, Online ISSN 2393-5138, ISSN-L 2285-6064

FRAMING AND DESCRIBING COMMON BEECH STANDS FROM THE SOUTHERN CARPATIANS IN THE SMART FORESTS CATEGORY

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Abstract

The present paper intends for the first time to frame common beech from the Southern Carpathians in the smart forest's category, a new concept similar with Climate-Smart Agriculture. This framing is based on data from forest management plans characteristic to higher than 40-year-old common beech stands as well as by offering a grade for 16 of its characteristics. As such, it was observed that beech smart forests are located in the Southern Carpathians, especially in Fagaras Mountains as well as in Retezat, Valcan, Sureanu and Candrel. These forests have relatively high ages (80-130 years), are located on fields with large slopes and at altitudes between 510 and 1200 meters. The predominant soil is eutric-cambisol, while the site types is normal common beech with mull flora and the production subunit is Regular forest with common assortment. The framing of some forests from Romania's forest area in the smart forest category is important for their proper management, while knowing their site characteristics can lead to choosing optimum silvicultural solutions for using them at their maximum potential.

Key words*: beech, site, smart forests, soil, Southern Carpathians.*

INTRODUCTION

Common beech (*Fagus sylvatica* L.) occupies 2.115.613 ha in Romania, namely 30.5% of the national forest fund (http://roifn.ro/site/rezultate-ifn-2/), being one of the most widespread species in our country (Șofletea and Curtu, 2007). Even though it is one of the most resistant species, common beech is affected by some harmful biotic or abiotic factors (Chira et al., 2003; Mihal and Cicak, 2007; Roibu et al., 2011).

The concept of Climate-Smart Agriculture (CSA) was defined in 2010 at FAO Hague Conference on Agriculture, Food Security and Climate Change. It aims at sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change and reducing greenhouse gas emission. A similar concept is now being defined and implemented for forests, namely "smart forest" (http://climo.unimol.it/). In this way, discussions and studies are being developed concerning stand characteristics that can be framed in the "smart forests" concept (Blaga et al., 2019; Dincă et al., 2019).

This present articles intends to frame common beech stands from the Southern Carpathians in this new "smart forests" category based on numerous data present in forest management plans as well by analyzing their characteristics.

MATERIALS AND METHODS

Only pure common beech stands have been analyzed (100% composition). Stands up to the age of 40 were not taken into consideration. The data that have been used belong to forest management plans realized during 1980-2008 for state forests. As such, all forest districts from the Southern Carpathians were analyzed, studying 2547 sub parcels.

Each analyzed parameter has obtained a grade from 1 to 5, namely: 1 = very low; 2 = low; 3 = average; 4 = high; 5 = very high. In total, 16 parameters specific to the stands or station were taken into consideration (Table 1).

A total grade has resulted by adding all these values characteristic for each sub parcel. Based on this, common beech stands from the Southern Carpathians were distributed.

Table 1. Grade obtained based on the stand's characteristic

Nr crt	Characteristic	Grade				
		1	2	3	4	5
1	Lopping	0.1; 0.2	0.3; 0.4	0.5	0.7	0.6
2	Vitality	5	4	3	2	1
3	Average diameter (cm)*	8-20	22-28	30-36	38-44	46-98
4	Average H (m)*	8-17	18-20	21-23	24-26	26-37
5	Production class	5	4	3	2	1
6	Volume (m^3)*	24-176	177-227	228-285	286-328	329-638
7	Current growth (m^3/an/ha)*	0.3-2.1	2.2-3.9	4.0-5.9	6.0-7.6	7.7-12.5
8	Structure		1	2	3	4
9	Consistency	0.1-0.4	0.5-0.6	0.9	0.7	0.8
10	SUP	O; C	A; D	J, V	G, M	E, K
11	Functional group + Functional category	2.1C	1.4J; 1.5L; 2.1B	11A; 1.1B; 1.1C; 1.1G	1.2A; 1.2B; 1.2C; 1.2L	1.5A; 1.5I 1.5J
12	Litter	1	2	3	4	5
13	Flora	45; 68	36; 42; 46	32; 34; 44	43; 51	21; 31; 41
14	Soil type	3305, 4102	3107, 4101	1701, 2401, 3301,	2201	3101, 3102
15	Forest type	5151, 9821	1341, 4117, 4212	4114, 4115, 4131, 4142, 4151, 4161, 4221, 4241	4112, 4141 4331	4111, 4211
16	Station type	3120, 4120,	3321, 3331, 4210, 4311, 4321, 4331, 4410, 5231	3322, 3332, 4220, 4332, 4420, 5232, 5242	5142, 5233, 5243	3333, 4430

*For these characteristics, the entire value range was divided in 5 categories, 1 = the smallest (ex: average diameter between 4-20 cm), 5 = the highest (ex: current growth higher than 5-21 m^3/year/ha). Grades were given for each category. The category division was realized so that the analyzed biometric characteristics are respected. In addition, a balanced division was intended as number of values for each category.

The meaning of terms used in Table 1 is rendered below:

Vitality: 1 = very vigorous; 2 = vigorous; 3 = normal; 4 = weak; 5 = very weak.

Structure: 1 = even aged stand; 2 = relatively even aged stand; 3 = relatively uneven aged stand; 4 = uneven aged stand.

Production/protection subunits (SUP) (excerpt): A = Regular forest, normal assortments: wood for timber, constructions, celluloses; E = Reservations for the integral protection of nature according to the Environment Protection Law; G = Gardened forest; J = Quasi-gardened forest; K = Seed reservations; M = Forests under the extreme conservation regime; O = Fields that will be taken out of the forest fund.

Functional group (GF) and functional category (FCT) (excerpt): 1.1C = Forests from river slopes located in the mountain and hilly areas that supply existent accumulation lakes or whose management has been approved, situated at distances of 15 up to 30 km upstream from the accumulation limit, based on the lake's volume and its surface, alluvium transportation and basin torrentiality; 1.2A = Forests located on rock lands, screes, on fields with gully erosion, on fields with the slope higher than 35 degrees, or on flysch, sand or gravel with a slope higher than 30 degrees; 1.2C = Forest strips from around alpine holes, with widths of 100-300 m; 1.2L = Forests located on fields with lithological substratum, very vulnerable to erosion and landslides; 1.5L = Forests created in protection areas (buffer areas) from reservations; 2.1B = Forests destinated to mainly produce voluminous trees of superior quality for timber.

Litter: 1 = missing litter; 2 = narrow interrupted litter; 3 = narrow continuous litter; 4 = normal continuous litter; 5 = thick continuous litter.

Flora: *Mixture common beech and resinous forests and pure mountain common beech stands:* 31 = *Asperula-Dentaria*; 32 = *Rubus hirtus*; 34 = *Festuca altissima*; 35 = *Luzula-Calamagrostis*; *Hill forests with common beech participation:* 41 = *Asperula-Asarum*; 42 = *Carex pilosa*; 44 = *Festuca altissima*; 45 = *Luzula albida*; 46 = *Vaccinium-Luzula*.

Soil type: 1701 = specific rendzina; 2201 = specific preluvosol; 2401 = specific luvosol; 3101 = specific eutricambosol; 3102 = mollic eutricambosol; 3107 = lithic eutricambosol; 3301 = specific districambosol; 3305 = lithic districambosol; 4101 = specific prepodzol; 4102 = lithic prepodzol; 9101 = specific litosol.

Forest type (TP): 1341 = Mixture of resinous and common beech on skeleton soils; 4111 = Normal common beech with mull flora; 4112 = South common beech of high altitude with mull flora; 4114 = Mountain common beech on skeleton soils with mull flora; 4115 = Limit common beech with mull flora; 4131 = Mountain common beech with *Rubus hirtus*;

4141 = Common beech with *Festuca altissima*; 4151 = Mountain common beech with *Luzula luzuloides*; 4161 = Mountain common beech with *Vaccinium myrtillus*; 4211 = Hill common beech with mull flora; 4212 = Hill common beech on skeleton soils with mull flora; 4221 = Common beech with *Carex pilosa*; 4241 = Hill common beech with acidophil flora.

Station type (TS): 3311 = Mountain mixture Bi small edaphic luvosol with *Vaccinium* and other acidophilus; 3312 = Mountain mixture Bm(i) podzolic sub-average edaphic with moss and other acidophilus; 3321 = Mountain mixture Bi luvosol and preluvosol small edaphic with *Luzula* +- *Calamagrostis*; 3322 = Mountain mixture Bm(i) luvosol and preluvosol average edaphic with *Festuca*+-*Calamagrostis*; 3332 = Mountain mixture Bm eutricambosol average edaphic with *Asperula-Dentaria*; 3333 = Mountain mixture Bs eutricambosol high edaphic with *Asperula-Dentaria*; 4120 = Common beech mountain-pre-mountain Bi, rockland and excessive erosion; 4220 = Common beech mountain-pre-mountain Bm, average edaphic rendzinic; 4311 = Common beech mountain-pre-mountain Bi, small edaphic luvosol with *Vaccinium*; 4332 = Common beech mountain-pre-mountain Bm, average edaphic preluvosol and luvosol with *Festuca*; 4420 = Common beech mountain-pre-mountain Bm, average edaphic eutricambosol with *Asperula-Dentaria*; 4430 = Common beech mountain-pre-mountain Bs, high edaphic eutricambosol with *Asperula-Dentaria*; 5231 = Common beech hill Bi, small edaphic luvosol with *Vaccinium-Luzula*; 5232 = Common beech hill Bm, average edaphic luvosol with *Festuca*; 5233 = Common beech hill Bs, average edaphic luvosol stagnic with *Carex pilosa*; 5242 = Common beech hill Bm, average edaphic eutricambosol edafic with *Asperula-Asarum*.

RESULTS AND DISCUSSIONS

From the point of view of geographic distribution, the first 20 smart forest beech stands from the Southern Carpathian are located predominantly in Fagaras Mountains (12 stands from the first 20). Other mountains from this Carpathian chain in which valuable common beech stands are present are Retezat, Valcan, Sureanu and Candrel Mountains (Figure 1, Table 2).

The majority of common beech forests are located on the north tilt of the Southern Carpathians.

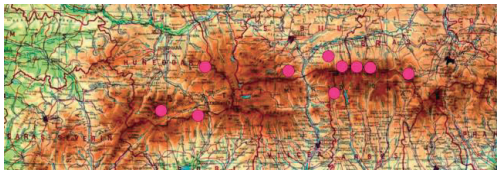

Figure 1. The distribution of the first 10 smart beech forests from the Southern Carpathians

Table 2. The characteristics of the first 20 smart beech stands from the Southern Carpathians

Nr crt	Forest District	Age (years)	SUP	Inclination (%)	Altitude (m)	Soil type	Site Type
1	Retezat	100	M	40	940	3102	4111
2	Arpas	90	A	9	510	2407	5212
3	Arpas	90	A	15	700	3101	4111
4	Sercaia	100	V	15	790	3101	4111
5	Şercaia	100	V	20	690	3101	4111
6	Arpas	110	M	14	680	3101	4111
7	Sercaia	130	M	25	560	3101	4111
8	Orastie	90	A	15	1160	3101	4211
9	Arpas	95	A	18	745	3101	4111
10	Sercaia	105	V	15	720	3101	4111
11	Vl. Sadului	110	M	36	900	3301	4111
12	Zarnesti	120	A	30	965	3101	4111
13	Lupeni	120	A	27	1200	3101	4111
14	Vidraru	80	A	27	1100	3101	4111
15	Voila	90	A	10	780	3301	2211
16	Arpas	90	A	23	695	3101	4111
17	Arpas	100	A	18	485	3101	4111
18	Voila	110	A	20	965	3101	4211
19	Arpas	110	A	24	810	3101	4111
20	Zarnesti	120	A	34	950	3101	4111

The smart beech stands from the Southern Carpathians have advanced ages (between 80 and 130 years), generally belong to the A production subunit (normal forest with common assortments: wood for timber, constructions, and celluloses). In addition, stands from the following categories are also present: M = Forests under a special conservation regime and V = Forests with recreation functions through hunting in which forest regeneration cuttings are allowed. The characteristic soil for these stands is 3101 = specific eutric cambisol. This type of soil that occupies 13% of the total surface of forests soils from Romania (Dinca et al., 2014) has

characteristics that vary with altitude (Sparchez et al., 2017). Furthermore, it is a soil characterized by a good supply with humus (Dinca et al., 2015; Filipov, 2005). The characteristic station type for these smart beech forests is 4111 = Normal common beech with mull flora. This type comprises all characteristics (edaphic, climatic and orographic) favorable to common beech (Tarziu et al., 2004).

Beech smart forests from the Southern Carpathians are spread out on fields with different inclinations, from 9% to 40%. The majority of stands are located on fields with a very high slope (Figure 2), which indicates the common beech's capacity to realize special stands even on difficult fields even though high slopes are characteristic to the mountain area with the highest peaks from the country.

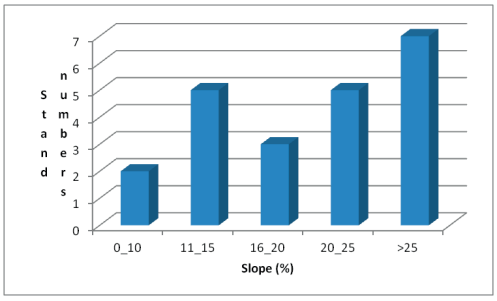

Figure 2. The distribution on slopes of the first 20 smart beech forests from the Southern Carpathians

In regard with the altitude, the common beech from the Southern Carpathians that can be situated in the smart forest category can be found at altitudes between 510 m and 1200 m, with a higher percentage at altitudes of 500-700 m (Figure 3).

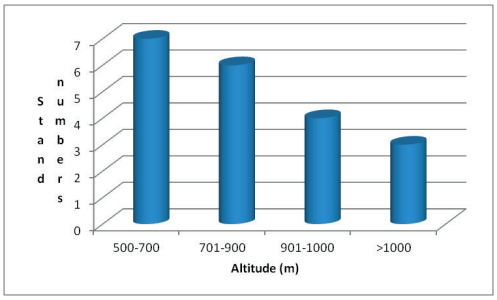

Figure 3. The distribution on altitudes of the first 20 smart beech forests from the Southern Carpathians

CONCLUSIONS

The majority of common beech smart forests from the Southern Carpathians are situated on the North tilt of Fagaras, Retezat, Valcan, Sureanu and Candrel Mountains. With ages between 80 and 130 years, these stands belong generally to the following production subunit: "Normal forest, common assortments: wood for timber, constructions, and celluloses". The stands are located especially on fields with high and very high slopes, at altitudes between 510 and 1200 meters, on eutric cambisols and on "Normal common beech stands with mull flora station types".

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