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THE CHARACTERISTICS OF FORESTS SITUATED IN KARST AREAS FROM BANATULUI MOUNTAINS

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Abstract

The present paper intends to synthesize stand characteristics from karst areas located in Banatului Mountains, based on data from forest management plans realized during 1995-2007. As such, 1220 stand elements were analysed from this area where forests occupy a total surface of 2.904 ha. Common beech is the most widespread species from this area. The stand's age distribution is relatively uniform, with a slight increased number recorded for the age class of over 120 years. The stands vegetate al altitudes between 185-1005 m, with an average altitude of 665 m for all studied stand elements. Asperula-Dentaria is the most common flora type, while calcic eutric cambisol is the most widespread soils type. Bm common beech mountain-premontane, average edaphic rendzinic is the most well represented station type.

Key words*: Banat, forests, carst, stand composition, station types.*

INTRODUCTION

Banatului Mountains are located in southwest Romania, between Reșița-Caransebeș basin in the north and Danube's Pass in the South and includes the following units: Dognecei Mountains (northwest), Aninei Mountains (central part), Semenic Mountains (east), Locvei and Almaj (south). Aninei and Locvei Mountains contain an important calciferous area and one of the largest and compact carbonate areas from Romania - Reșița - Moldova Nouă sinclinorium which covers 800 km^2. The low mountains landscape is characteristic for the entire area (Iurkiewicz et al., 2005).

Some of the karst's distinctive features are represented by rivers going underground, great springs emerging from the ground, independent hollows and basins instead of connecting valleys, deep potholes and vast caves, and isolated tower like hills (Jennings et al., 1971).

A multitude of dry and blond karst valleys complete Banatului Mountains' landscape and show an advanced karstification of chalk and the hydrographical network's disarray. From the total of 908 caves recorded in Banatului Mountains, 655 are mapped (70 caves being active) (Nae, 2008). Many geomorphologic sites, such as karst springs, caves, gorges and karst plateaus with a high density of karst features are situated in this area (Artugyan, 2017).

Taking into consideration the vast surface of 800 km^2 occupied by Reșița - Moldova Nouă sinclinorium, a large part of Banatului Mountains' forests are located in karst areas and have field and soil protection purposes.

Silvicultors have tried many times to classify forests based on their purpose.

A first forest classification in forests destined to wood production (*production forests)* and forests destined to fulfil certain protection functions (*protection forests*) dates back to the XVIth century. Professor Viktor Dieterich (1953) has classified forests based on their functions: production functions, protection functions and social functions (Blum, 2004).

In present times, the following functions are attributed to forests (Hasanagas and Shoesmith, 2002; Blum, 2004):

1. Ecologic functions: a) to regulate climate, air quality, water systems and soil potential; b) to protect against natural risks and noises; c) to conserve biodiversity;

2. Economic functions: a) production (wood and other wood and non-wood products), b) activities and services;
3. Social functions: landscape, recreation, educational, cultural and social functions.
In our country, forests are classified based on their attributed functions and the technical norms for managing forests and for choosing and applying treatments in 2 functional groups, Group 1: Forests with special protection functions and Group 2: Forests with production and protection functions.
In its turn, the first functional group is divided in five subgroups that contain Subgroup 2: Forests with field and soil protection functions. This subgroup also contains 12 categories, including 1,2K category = Forests situated in karst areas.

MATERIALS AND METHODS

The object of this article is represented by forests from Banatului Mountains situated in the 1,2K functional category = Forests situated in karst areas. The used data were taken from forest management plans realized during 1995-2007 for four forest districts that manage national forests from Banatului Mountains (*** Forest management plans, 1995-2007). A total number of 1220 value groups were used that correspond to stand elements from this area, complemented by eight studied characteristics, namely: surface, species, composition, stand structure, altitude, flora, soils and station type. The data was analysed with the help of the Excel program.

RESULTS AND DISCUSSIONS

Forests from Subgroup 2. Forests with field and soil protection functions occupy a total surface of 147.378 ha in Banatului Mountains. Amongst them, the 1,2K functional category = Forests situated in karst areas are widespread on 2.904 ha. The forests situated in karst area occupy the fourth place (2%) amongst all forest situated in Subgroup 2. The first places are occupied by Forests situated on cliffs, on deep erosion fields and on fields with a slope higher than 35 degrees (75%), Forests situated on fields with very vulnerable erosion and landslide lithologic substratum (19%) and Forests strips from around alpine gaps (3%), (Figure 1).

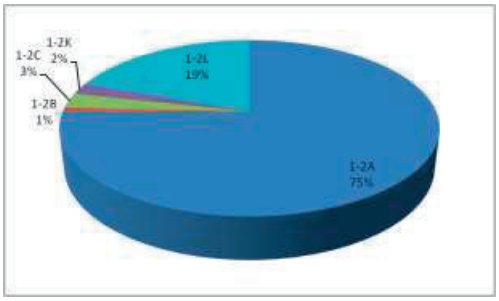

Figure 1. The surface occupied in Banatului Mountains by functional category forests from the subgroup of forest with field and soil protection functions

These forests are widespread in Anina (1970 ha), Berzeasca (516 ha), Reșița (411 ha) and Sasca Montană Forest Districts (2 ha).
The most widespread species from this forest category located in Banatului Mountains are: fir (*Abies alba* Mill.) = 202 ha, hornbeam (*Carpinus betulus* L.) = 297 ha, beech (*Fagus sylvatica* L.) = 1686 ha, ash (*Fraxinus excelsior* L.) = 106 ha, Norway spruce (*Picea abies* (L.) H. Karst.) = 111 ha, maple (*Acer platanoides* L.) = 50 ha, black pine (*Pinus nigra* J.F. Arnold) = 38 ha, and lime (*Tilia cordata* Mill.) = 113 ha (Figure 2).
Other species present in these forests are: wild cherry (*Prunus avium* L.), sessile oak (*Quercus petraea* (Matt.) Liebl.), larch (*Larix deciduas* Mill.), birch (*Betula pendula* Roth.), manna ash (*Fraxinus ornus* L.), aspen (*Populus tremula* L.), goat willow (*Salix caprea* L.), and black locust (*Robinia pseudoacacia* L.).
Oak stands have an extremely important purpose against landslides and erosion (Dincă and Achim, 2019). Furthermore, they are not affected by grazing as it happens in other European areas (Hinkov et al., 2019). Norway spruce is also spread on these fields even though this is not his optimal ecologic environment (Dincă et al., 2019). The pine from this area is naturally widespread, unlike many other areas from the country where it was introduced artificially in order to improve degraded lands (Constandache et al., 2019; Popov et al., 2017; Vlad et al., 2019). On the other hand, locust was planted (Murariu et al., 2019).

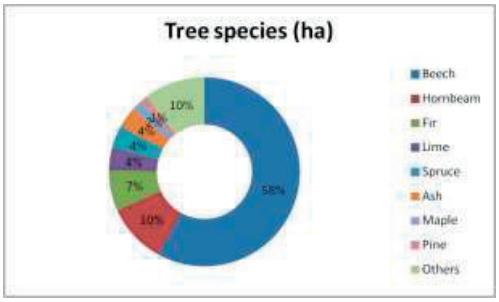

Figure 2. The surface occupied by species in forests from Banatului Mountains situated on karst

The stand composition is mainly mixed (96% of the surface occupied by these stands), with one or more species being present in a stand (Figure 3).

As an individual percentage, the most widespread stands are those in which the dominant species occupies 100% of the composition (398 ha), followed by 70% (331 ha) and 60% (227 ha). The stands in which the stand's element participation is very small (between 10 and 50%) are the most common. This is a general characteristic of stands from Banatului Mountains, but also a characteristic of stands that vegetate here on karst areas.

Pure stands are generally composed on common beech or Norway spruce, while linden, ash, manna or fir do not form pure stands.

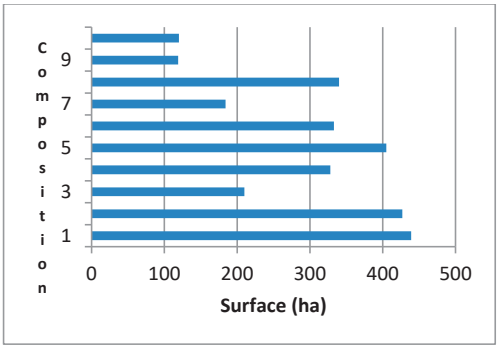

Figure 3. Stand composition of forests situated in karst areas from Banatului Mountains

The stands' distribution on age classes is relatively uniform, with the exception of the first age class. As such, a lack of very young stands can be observed and can be explained by the maintenance of old stands in order to protect these fields (Figure 4). This fact contributes to the high percentage of stands with ages over 120 years.

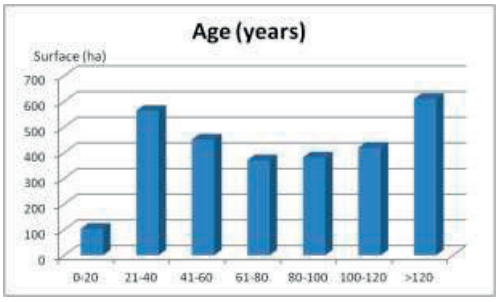

Figure 4. The age of stands situated in karst areas from Banatului Mountains

The stands' structure is relatively uniformed distributed between three structure types (the uneven-aged structure stands are lacking entirely): even-aged (1108 ha), relatively even-aged (889 ha), relatively uneven-aged (907 ha).

The altitude at which these stands are widespread ranges between 185 m at Sasca Montană and 1005 m at Berzeasca. An average altitude of 665 m was obtained by calculating the average altitudes of all 1220 analysed stand elements. The most common altitudes are of 600-800 m (Figure 5).

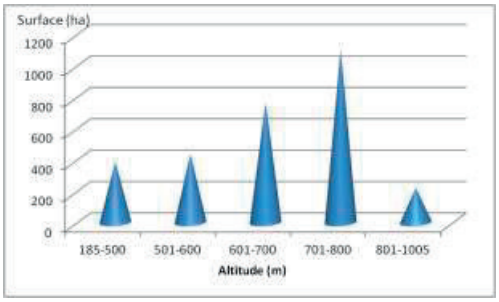

Figure 5. The altitudes of stands situated on karst areas from Banatului Mountains

The flora characteristic for these stands is *Asperula-Dentaria* (which appears on 1897 ha), *Asperula-Asarum* (955 ha) and *Festuca altissima* (30 ha).

The most common soils for these stands are the following: calcic eutric cambisol = 2071 ha, rendzina = 306 ha, eutric cambisol = 210 ha, lithic eutric cambisol = 203 ha, and lithic rendzina = 111 ha. These soils are influenced

by the karstic substratum through a high $CaCO_3$ quantity (calcic eutric cambisol and rendzina) and through a reduced depth (lithic subtypes from eutric cambisol and rendzina). In addition, they are rich in humus and nutritive elements (Crișan et al., 2017; Dincă et al., 2018), being favourable in general to forest vegetation (Chisăliță et al., 2015).

The most representative forest stations are the following: Bm common beech mountain-premontane, average edaphic rendzinic = 768 ha, Bs common beech mountain-premontane, high edaphic eutricambosol with *Asperula-Dentaria* = 599 ha, Bm common beech mountain-premontane, average edaphic eutricambosol with *Asperula-Dentaria* = 486 ha, Bm common beech hill, average edaphic eutricambosol with *Asperula-Asarum* = 234 ha, and Bi common beech hill, low edaphic eutricambosol= 177 ha.

CONCLUSIONS

Forest areas from Banatului Mountains shelter important forests that vegetate on some of the largest karst areas from our country. According to the group forest framing, these forests are situated in Group 1 - Forests with special protection functions, Subgroup 2 - Forests with field and soil protection functions and category 1-2K - Forests situated in karst areas. As such, these forests are under a conservation regime.

The forests from Subgroup 2 - Forests with field and social protection functions occupy 147.378 ha in Banatului Mountains. Amongst them, the 1-2K functional category (Forests situated on karst areas) occupy 2.904 ha. The forests from karst areas can be found in the following forest districts: O.S. Anina (1970 ha), O.S. Berzeasca (516 ha), O.S. Reșița (411 ha) and O.S. Sasca Montană (2 ha).

Common beech is by far the most widespread species present in forests located in karst areas from Banatului Mountains (1686 ha), followed by hornbeam (297 ha) and fir (202 ha). Significant surfaces are also covered by linden, Norway spruce, ash, maple and black pine. The stands' composition is mixed for the 96% of the surface covered by them.

In regard with the stands' age that vegetates on karst areas from Banatului Mountains, the age class distribution is relatively uniform, with the exception of the first age class (0-20 years). As such, the conservation and maintenance of old stands in order to protect these areas has led to their higher percentage, especially for those that exceed 120 years.

The stands from these karst areas vegetate at altitudes between 185 m (O.S. Sasca Montană) and 1005 m (O.S. Berzasca). The average altitude for all 1220 studied stand elements is of 665 m.

Asperula-Dentaria is the most widespread flora type from this area and can be found on 1897 ha. Calcic eutric cambisol is the most widespread soil (2071 ha), while the most common station is Bm common beech mountain-premontane, average edaphic rendzinic (768 ha).

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