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FOREST STANDS FROM ACCUMULATION AND NATURAL LAKES SLOPES FROM THE SOUTHERN CARPATHIANS

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Abstract. The Southern Carpathians are situated in the central part of Romania, between Prahova Valley and the Danube, being the highest and most massive mountains from the Romanian Carpahtians. The relief and vegetation are similar to the Alps. These mountains conserve the most representative glaciar relief from Romania, with cuaternar glaciar tracks. Some of its peaks, namely Moldoveanu, Negoiu, Parângul Mare and Peleaga exceed 2500 m. From its total 217.889 ha occupied by forests with water protection functions, the forests located on lake slopes occupy 9.746 ha, namely 5%. The forests from this area are composed of spruce (*Picea abies* L.H. Karst) and beech (*Fagus sylvatica* L.), accompanied by other species such as birch (*Alnus glutinosa*, L., Gaertn.) and pine (*Pinus* sp.). From the point of view of the field's orography, these forests are located on lands with an middle inclination on all exposition categories, but predominantly on the North-East, one at an average altitude of 1050 m. From the point of view of site conditions, the characteristic flora type is *Asperula-Dentaria*, while the main soils are dystric cambisol and eutric cambisol.

1. Introduction

The Southern Carpathians are situated within Prahova Valley in the east, and Timiş-Cerna valleys in the west, Getic Subcarpathians and Mehedinți Plateau in the south and Transylvania's basin in the north. Timiş-Cerna and Bistra - Hunedoarei basin aisles separate them from the massives located in the Occidental Carpathians (Oprea , 2017).

The high area of the Southern Carpathians was under the influence of glaciers during the Pleistocene era when they have descended on the valleys at altitudes of

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1050-1200 m. As such, this sector is well represented by glacier meso forms such as valleys and circles, as well as by sculptural and accumulation forms. These allow the creation of barrier basins transformed in lakes after the retreating of glaciers, while the smallest ones were completely cogged up (Vespremeanu-Stroe et al., 2008).

Romania is renowned for its 3450 lakes (2300 natural lakes that represent 67% and 1150 artificial lakes – 33%), with a total surface of 2.620 km^2, that covers 1,1% of the total Romanian surface (Mihăiescu et al., 2012).

At our country's level, mountain lakes were classified based on their type: accumulation lakes, sliding lakes, glacial lakes and volcanic lakes. Natural lakes are known for their genetic diversity, lacustrine basin forms, as well as for their more stable hydrologic equilibrium compared with antropic lakes. The majority of glacier lakes from the Southern Carpathians are grouped in its main massifs: Făgăraș, Cândrel, Surianu, Parâng, Retezat, Godeanu and Țarcu (Pișota, 1971). The most representative glacier lakes from the Southern Carpathians are: Bâlea, Capra, Podragu (Făgăraș Mountains), Gâlcescu (Parâng Mountains), Bucura and Zănoga (Retezat Mountains) (Gâsteșcu,1971; Gâștescu, 2010; Giurgiu and Silvăşan, 2001).

Glacier and periglacial lakes as well as carstic, volcanic and anthropic lakes can be found in the Southern Carpathians. The periglacial and glacier lakes are more emphasized in the alpine area where they were sculpted and modelled by the action of quaternary glaciers. The tracks left by these glaciers can be seen in the Southern Carpathians, in Rodna Mountains and especially at altitudes between 1.700 and 2.400 meters. Bâlea lake is one of the most renowned glacier lakes from Făgăraș, with a surface of 180 hectares around the lake that was declared scientific reservation in 1932 (Pop et al., 2012).

The health state of forests from this area was observed through periodic measurements in permanent sample surfaces (Badea et al., 2012). The protection of water resources from the mountain area can be realized through adequate silvicultural methods (Constandache et al., 2018).

2. Materials and methods

Based on their functions, the forests from our country are grouped in two categories (named functional categories), Group 1: Forests with special protection functions and Group 2: Forests with production and protection functions. On its part, functional group number 1 is divided into five subgroups with the first one known as *Subgroup 1: Forests with water protection functions*. Eight functional categories are present within this subgroup, including 1,1B category = Forests from direct slopes of existent or approved accumulation and natural lakes. The purpose

of this article is represented by forests from the Southern Carpathians situated within this functional category.

The work material was represented by forest management plans from all forest districts located in the Southern Carpathians are created during 1982-2006 (*** Amenaj.). Forests belonging to the functional 1-1B category were then extracted. The very large number of stand elements characteristic to this functional category (2231) ensures a good statistical data representation and interpretation. As such, the following elements were analyzed: the surface occupied by these forests, their location and age, the species that comprise them, field exposition, inclination and altitude, flora, soil and station type.

3. Results and discussions

From the total area of 217.889 ha occupied by forests with water protection functions from the Southern Carpathians, the forests from lake slopes occupy a surface of 9.746 ha, namely 5%. The largest surface (183.970 ha, namely 85%) is occupied by 1-1C, (forests from river and creek slopes from the mountain and hill area that supply present or approved accumulation lakes, situated at distances of 15 up to 30 km upstream of the accumulation limit, based on the lake's volume and surface, alluvial transportation and the basin's torrentiality), (fig. 1), followed by

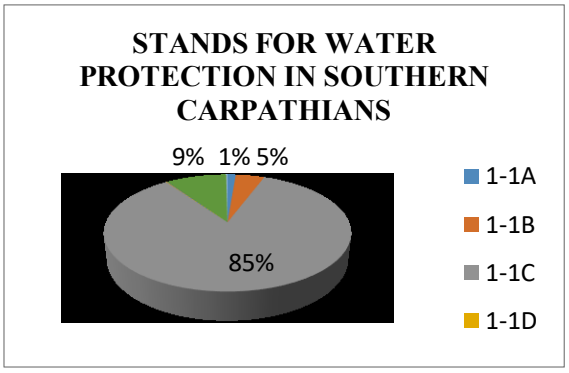

Fig. 1. The surface occupied by functional tree categories from the subgroup of forests wth water protection functions from the Southern Carpathians

1-1G (forests from torrential basins or with excessive alluvial transportation, determined by hydrologic studies, for forest or hydrographic basin management plans) with 20.492 ha (9%). The functional categories 1-1A (forest located in areas destined for protecting springs, mineral, drinkable or industrial water sources, exploited or approved, demarcated by specialty studies approved by ministries), 1-1D (forest strips composed on one plot row along non-dammed rivers, as they do

not decrease significantly the drainage sections of waters under the necessary limits), 1-1E (forests situated in the major riverbed of rivers as they do not decrease drainage sections under their necessary limit and forests for protecting water riverbeds, including those from the mountain areas) and 1-1H (forests strips composed of entire forest units from around springs intercepted for supplying trout farms or located on direct trout farm slopes, as they do not damage the stability of springs or overflood trout farms) occupy insignificant surfaces (fig. 1).

The most widespread species from this forest category are spruce (*Picea abies* L., H. Karst.) and beech (*Fagus sylvatica* L.). Other species present in these forests are birch (*Alnus glutinosa* (L.) Gaertn.) and pine (*Pinus* sp.), (fig. 2).

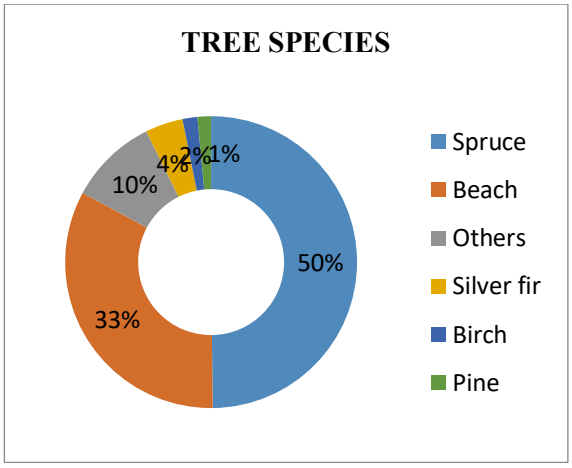

Fig. 2. The surface occupied by species from water protection stands located in the Southern Carpathians

The stand's age is well represented, especially for the 21-40 years and 81-100 years categories (fig. 3). However, we must consider that some stands (alder, birch, etc.) are exploited at younger ages of under 100 years, explaining why older stands (over 100 years) occupy a more narrow surface.

In regard with the **distribution of expositions,** the stands from direct accumulation and natural lakes from the Southern Carpathians (fig. 4) are relatively uniform distributed, with smaller surfaces spread out in the South-West exposition and slightly higher on the North-East one.

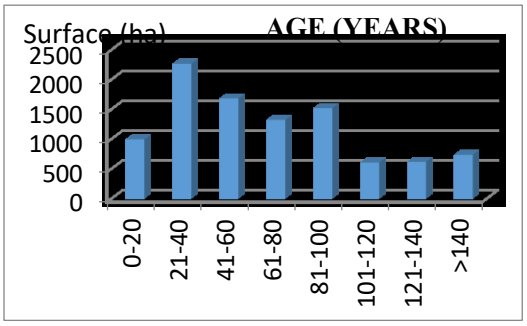

Fig. 3. Age of water protection stands from the Southern Carpathians

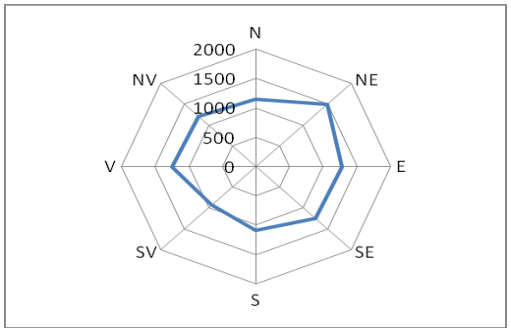

Fig. 4. .Exposition of water protection stands from the Southern Carpathians

Field inclination. The majority of stands from this category are situated on fields with a slope of 26-30 degrees, as well as on slopes of 21-25 degrees and even higher than 30 degrees (fig. 5).

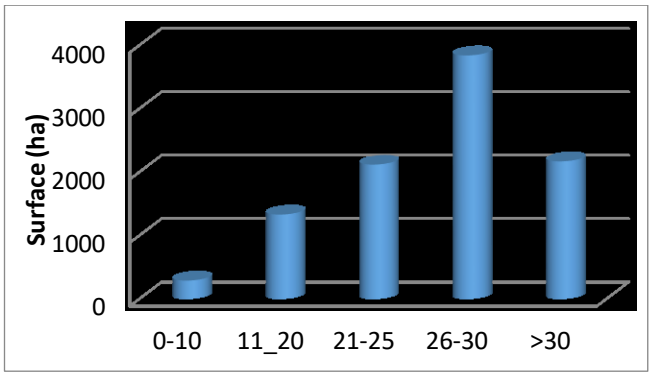

Fig. 5. Terrain slope of water protection stands from the Southern Carpathians

The average altitude of stands from this area is of 1050 m, while the majority of stands are situated at altitudes of 1200-1400 m (fig. 6).

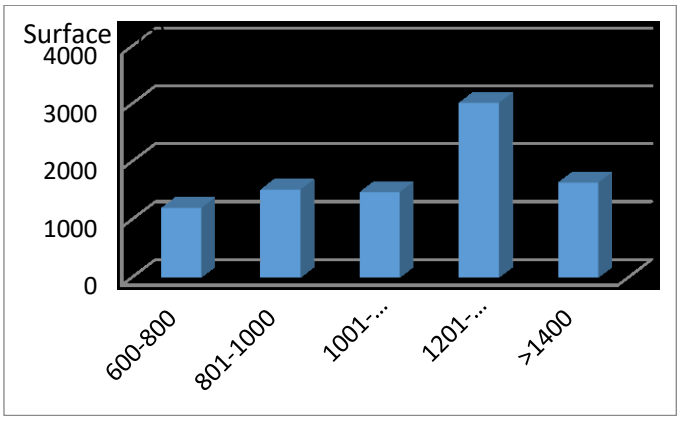

Fig. 6. Altitude of water protection stands from the Southern Carpathians

The specific flora of these stands is represented by *Asperula-Dentaria* (3649 ha), *Oxalis-Dentaria* (2090 ha), *Vaccinium* (1147 ha) and *Luzula albida* (620 ha).

The most common soils present in these stands are dystric cambisol (3622 ha), eutric cambisol (2303 ha) and entic podzol (1694 ha). The first two soils are spread out on the entire terrain occupied by forests in Romania (Dincă et al., 2014; Spârchez et al., 2017). The soils from this area are well supplied with water (Dincă et al., 2018), rich in humus and nutritive elements (Dincă et al., 2015; Enescu and Dincă, 2018; Enescu et al., 2018), being generally favorable to forest vegetation.

4. Conclusions

Numerous natural and artificial lakes are present in Romania, most of them located in the Southern Carpathians. The forests from this area are situated in Group 1: Forests with special protection functions, *Subgroup 1: Forests with water protection functions*, functional category 1-1B= Forests from direct present or approved accumulation and natural lakes, occupying a surface of 9.746 ha, namely 5 % of the forests with protection water functions from this area. These forests are mainly composed of Norway spruce and beech, with average ages, situated on North-East expositions, on fields with an average slope of 26-30 degrees, mainly at altitudes of 1200-1400 m, on dystric cambisol eutric cambisol soils, with *Asperula-Dentaria* flora.

Knowing the general characteristics of these forest types is useful for establishing their adequate management measures as well as for diminishing damages caused by different natural calamities (wind breaks, droughts, landslides, etc.). In addition, the results obtained through this study represent a premiere as they represent a synthesis of a large amount of data.

The forest ensures, in the long term, an unequaled role in the hydrological stability and balance of the mountain river basins. This role is variable with the degree of afforestation of the basins and is manifested only if the forest maintains, without major disturbances, a structural state of dynamic equilibrium.

In the management of forests with hydrological functions of great importance, but also of the lands in the mountain hydrographic basins, it is necessary first of all to aim at the permanent management of the trees towards states and structures that can offer the best stability and ecosystem diversity, as well as a good efficiency, including water protection.

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