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REINFORCEMENT OF THE HYDROGRAPHIC NETWORK USING *ALNUS GLUTINOSA* (BLACK ALDER) WITHIN THE HYDROGRAPHIC WATERSHED OF RÂUL MARE – CUGIR

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Abstract
The purpose of the present paper is to highlight the hydrologic role of Alnus glutinosa - the black alder, which is spread in two stands within the hydrographic basin of Râul Mare – Cugir. As they are pure stands, meaning stands made of the same species (alder) and equi (trees with the same age), they serve as a typical example of a homogenous statistical collectivity. In the P.U. III Râul Mare, the forestry formation "alders made of black alder" is covering a surface of only 1.2 ha out the total area of forest fund, situation that leads to significant amounts of sludge collected from the entire hydrographic network and the hydrographic basin taken into study.
Within the present study, 2 administrative units were selected, covering 1.2 ha surface within the Forestry District of Cugir – P.U. III Râul Mare where one established 8 plots, 4 in each administrative unit, and measurements were carried out on a total number of 220 trees. Within the 1B administrative unit, 84 trees were measured, predominantly from the quality class IV, having diameters between 12 and 42 cm and heights between 14.2 and 19.2 m, while within the 41E administrative unit a number of 136 trees were measured, being in the majority in the same quality class IV, with diameters between 8 and 34 cm and heights between 12.7 and 13.5 m.

Keywords: black alder, hydrographic network, hydrologic role, reinforcement.

1. INTRODUCTION

„Vegetation, and especially the forest vegetation, is the most effective mean of mitigating torrential floods and, implicitly, of fighting soil erosion. However, until the vegetation is brought into the position of effectively fulfilling its hydrological role, the objetives endangered by floods must be protected, a goal that is achieved by means of hydrotechnical works. The latter are used for landscaping the basin slopes or river beds and represent important components within the development complex ", said the remarkable scientist and illustrious forester Stelian Munteanu, in 1982.

In the last decades, due to the technological progress, the need for water has become more and more acute. Thus, one can also explain the magnitude of the research on the hydrological role of the forest and, in particular, those related to the study of the hydrological parameters of the forest: interception, leakage, infiltration, evapo-transpiration. So far the results obtained have revealed that the values of these parameters are influenced by several factors, such as: climate, geomorphological

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conditions of the hydrographic basins, the surface management in the basin etc. The above factors are also variable, some of them on rather small surfaces, which has led some researchers to have reservations about the possibility of generalizing the results obtained by various researchers (Clinciu and Lazar, 1997).

The purpose of this paper is to highlight the hydrological role of *Alnus glutinosa* – the black alder, on the surface of two stands within the hydrological basin of the Râul Mare Cugir. As they are pure stands, meaning stands made of the same species (alder) and equi (trees with the same age), they serve as a typical example of a homogenous statistical collectivity.

2. MATERIALS AND METHODS

The torrential and land degradation processes produce important disruptions and imbalances both from the ecological point of view and in human activity and life, even leading to catastrophes with human casualties. The main determinant factor of the torrential processes is the disturbance of the hydrological regime of the watercourses. This disturbance alters the protection functions against the superficial runoff and the accelerated erosion of the plant cover, as well as the degradation of the physico-biological functions of soils, as a result of the exploitation processes of the natural resources in mountain and hilly areas, in particular through unreasonable exploitation and wild destruction of forests.

The management of the torrential hydrographic basins, in the hydrological sense of the notion, consists in applying, on the surface of the basins, of a set of organizational measures, of biological, agro-technical, forestry and hydrotechnical works for the main purpose of water and soil control (Munteanu, 1975). One should underline the fact that achieving the hydrological balance is inconceivable without achieving the ecological balance in the basin. These two forms of equilibrium are associated, are concurrently performed and condition each other. Besides the role of soil conservation and protection against erosion, the forest vegetation installed on degraded land also has the role of continuous soil improvement.

The study of scientific literature for the specific species in our country indicated the lack of information on the evaluation of the hydrological and biometric parameters of trees, both at individual, population and species level, the more so as these stands have an intra-zonal character and present distinctive peculiarities influenced by the site conditions.

Having in view the conditions of the current forestry, when a great emphasis is placed on the ecological reconstruction of calamity stands and the formation of stable stands, achieving this goal requires not only the use of high productivity species, but also of species with a lower economic value, but which, through their role, provide a greater stands' stability.

If these aspects show the ecological role of the black alder, its economic importance must not be neglected. In recent years, the European markets are increasingly looking for black alder veneer furniture, and it also has other uses in the village households and finally being used as firewood (Chichifoi, 1996).

Within the present study, 2 administrative units were selected within the Forestry District of Cugir, more precisely from P.U. III Râul Mare. One established 8 plots, 4 in each administrative unit, and measurements were carried out on a total number of 220 trees.

3. RESULTS AND DISCUSSIONS

For the sampling of the trees used within the present study, pure black alder stands were selected, located in similar topo-climatic conditions, regenerated from shoots. One also took into account the aspect of accessibility in the area. The stands taking part at the study have the composition of 10

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Ann and a consistency of 0.7. In the study squares were included trees of all categories, according to the Kraft classification.

Within the 1B administrative unit, 84 trees were measured, predominantly from the quality class IV, having diameters between 12 and 42 cm and heights between 14.2 and 19.2 m. In the 41E administrative unit a number of 136 trees were measured, being in the majority in the same quality class IV, with diameters between 8 and 34 cm and heights between 12.7 and 13.5 m.

In each of the two layout units, one established 4 circular control samples, with a radius of 12.62m and an area of 500 m² and measurements were made on a number of 220 trees. One determined the diameter at a height of 1.3 m *(d)*, the total height *(h)*, the pruned height *(h_e)*, the visually assessed quality class, the diameter of the crown and the Kraft positioning, and the procedure specific to each measurement was described below.

From a typological point of view, both administrative units are classified in the site type 5.2.4.1. (Hilly European beech stand Bi, low brown edaphic) and forest type 4333 (European beech stand mixed from the hilly area with *Luzula luzuloides* (i)). The soil type is part of the Cambisoil class, the brown type, the typical subtype 3305. In terms of altitude, the values are situated between 470-530 m with an average inclination of 17º.

The following table summarizes the analytical data from one of the eight surveyed areas taken into study with the values and items recorded.

Table 1. ***Quantified elements of trees from sample area 1, plot 1B***

1-1B				
No.	**Diameter**	**Height**	**Quality class**	**Pruning**
1	18		4	0.3
2	22		3	0.4
3	24		4	0.4
4	36		2	0.5
5	26	16.3	3	0.2
6	28	18.2	3	0.4
7	32		4	0.3
8	30	17.5	4	0.5
9	20		4	0.3
10	14		4	0.2
11	26	14.3	4	0.4
12	28	18.2	3	0.4
13	32		3	0.6
14	36	18.9	4	0.5
15	32		4	0.4
16	38		3	0.6
17	24	15.7	4	0.3
18	28	17.6	4	0.3
19	30		4	0.4

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The distribution of trees by diameters in the stands taken into study was done using the frequency function, where one considers the average diameter and the dispersion of the individual values around this diameter. The *average arithmetic diameter* $(\bar{d})$ is calculated as the average of all tree diameters within the stands and for diameters grouped in categories of diameters, it shall be calculated using the general relationship:

$$\bar{d} = \frac{\sum d_i n_i}{N}$$

where:

N – total number of trees,
d_i – categories of diameters in the stands,
n_i - number of trees for the diameter class i.

The stand with this diameter is called the average arithmetic tree. The position of the average arithmetic diameter depends on the shape of the frequency curve. In the case of a symmetrical distribution of the frequency curve, the average arithmetic stand is 50% one and overlaps with the average stand for the maximum frequency. Due to the asymmetry of the frequency curve encountered in reality, the average arithmetic diameter is of less practical importance, but is indispensable for statistical calculations (Giurgiu and Decei, 1997).
The following table presents the average diameter calculated for the stands inventory.

Table 2. ***Average diameter calculation***

d_i (cm)	n_i	d_i x d_i	$\bar{d}\bar{d}$ (cm)
8	11	88	$\bar{d} = \frac{\sum d_i n_i}{N}$
10	12	120	
12	22	264	
14	21	294	
16	26	416	
18	19	342	
20	11	220	
22	18	396	
24	11	264	
26	12	312	
28	18	504	
30	8	240	
32	14	448	
34	5	170	
36	6	216	
38	3	114	
40	1	40	
42	2	84	
Total	220	4532	20.6

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Within the studied stands one measured the heights for a part of the inventory trees. These heights were determined using the Suunto hypsometer. The measurements were carried out during the spring period, after the trees' budding and lasted until the crown was fully developed, so that trees' top could be well observed. The pruned height of the trees was visually appreciated as the distance from the base of the tree to the height of the trunk where the first branches forming the crown were inserted (expressed as a percentage of the total height of the trees). The height of the crown was determined as a difference between the total height of the tree and its pruned height. The heights of all measured trees were graphically represented using the frequency of heights on categories of diameters, also drawing the compensated curve of the heights (Giurgiu et al., 2004).

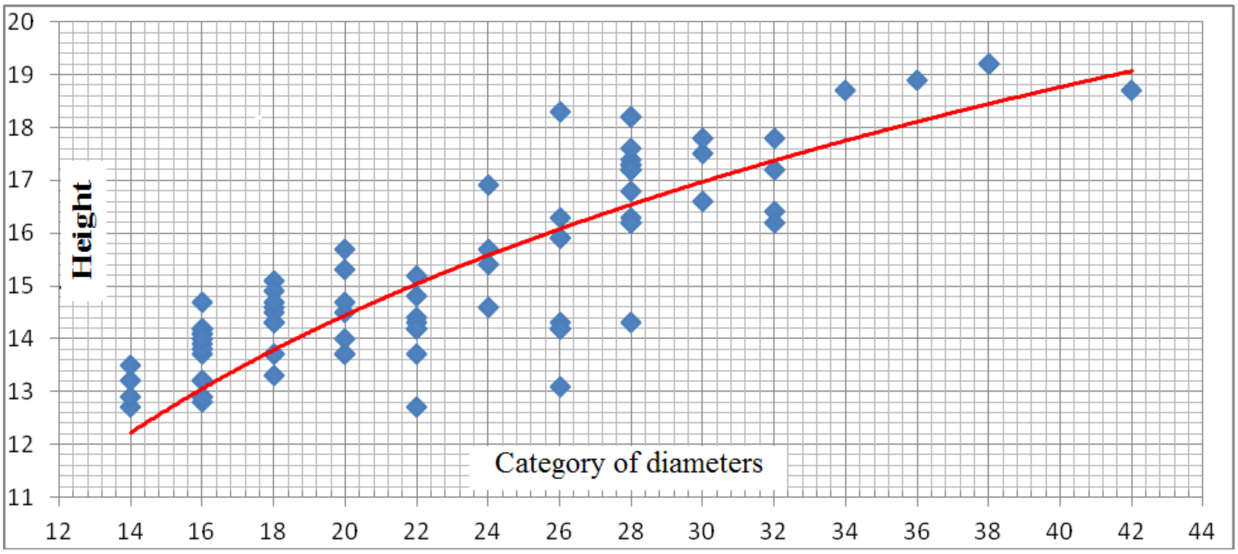

Figure 1. ***Curve of heights drawn through the middle of the correlation field***

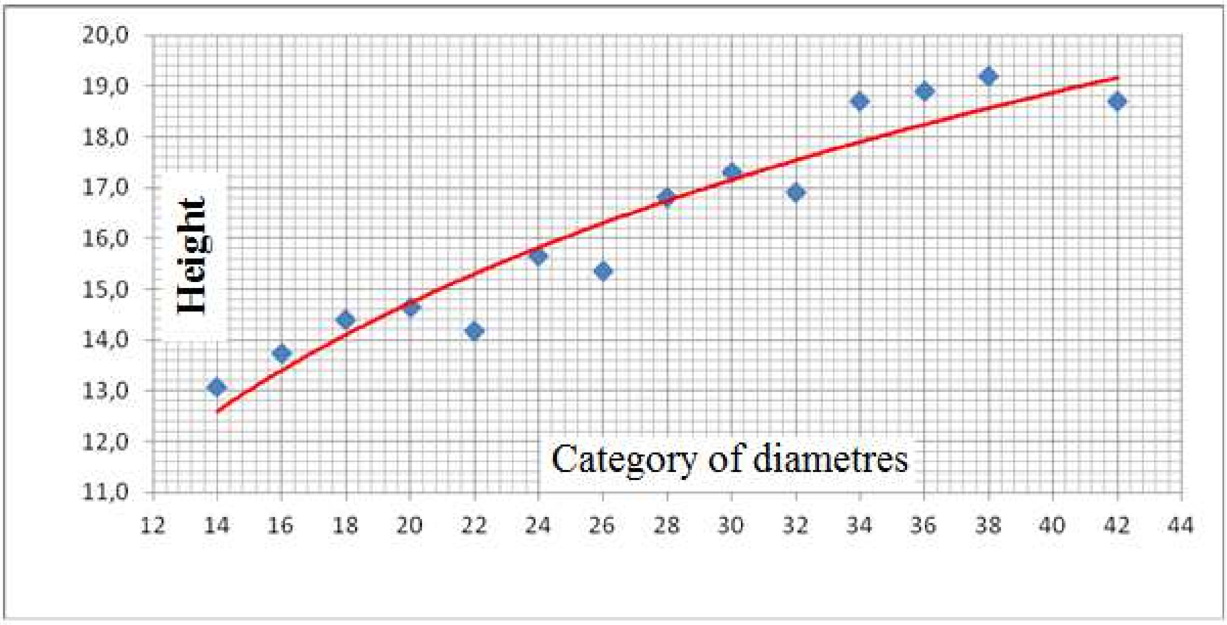

Figure 2. ***Curve of heights drawn based on the average heights on classes of diameters***

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As a consequence of the tree differentiation and due to the need for their grouping into distinct differentiating units, which are the basis for forestry interventions, one reached to numerous numerical or functional classifications regarding the relative position occupied by trees in the stand. Out of the many classifications of the coenote tree position, for the characterization of the studied stands one took into account the most frequent classification, namely that proposed by Kraft. The classification makes a connection between dominance and growth, each of the 5 constituted classes being composed of trees with equal growth potential. The data regarding the distribution of trees on Kraft coenote classes within the studied perimeter are presented in Figure 3.

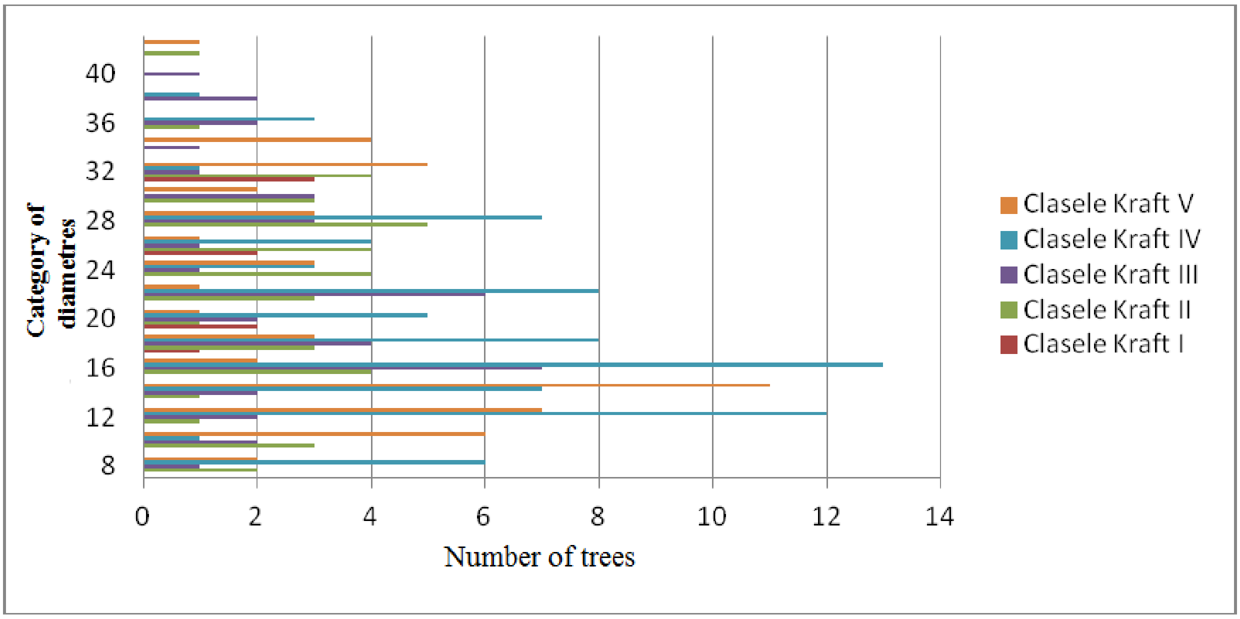

Figure 3. ***Distribution of trees on Kraft classes***

The registered data indicate that each positional class has its own structure in relation to tree diameters, the variability of diameters within each class being restricted. Between Kraft's positional classes and the categories of diameters is not a full concordance, trees from the same diameter class may be framed in 2 or more Kraft classes, so it is not possible to use the thickness categories for determining the Kraft classes. However, it can be said with sufficient certainty that thin trees fall into the lower coenotic classes, and thicker trees are often found in higher Kraft classes. The structure of stands by positional classes is more closely correlated with the distribution of trees on height classes, which is explicable based on the role of the height in the occupation by trees of different coenotic classes.

4. CONCLUSIONS

In the case of the black alder stand taken into study, the distribution of the number of trees by categories of diameters shows a typical pattern for a forest with an uneven-aged structure.
In the case of tree distribution within the stand in relation to the positional classes of trees, the data obtained indicate that between the Kraft position classes and the categories of diameters is not a complete concordance, the trees in the same category of diameters being able to be classified into several Kraft classes, therefore it is possible to use the categories of thickness in order to determine the Kraft classes.

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It is recommended, as in the torrential valleys where this phenomenon is strongly highlighted, to intervene with works for bank reinforcement, through black-alder afforestation and on the thalweg for the retention of alluvia, with transversal works.

The introduction of the black alder for the stabilization and reinforcement of the torrential formations would be a real success, as it can be seen from the data obtained from the study conducted in the hydrographic basin of Râul Mare - Cugir, Alba County.

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