Research Paper Engineering

Structural Elements Specific to the Artificial Norway Spruce Stands Affected by the Windfalls

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ABSTRACT

The aim of this paper is to present some specific structural characteristics of the Norway spruce stands damaged by wind in one of the most affected area, in the north of the Romanian Eastern Carpathians. The increase in damages to the environment, especially against the forests, brought by the isolated windfalls have been highlighted by: the analysis of certain specific biometric elements, the display of the stands structure in relation to the trees' diameter, as well as the quantification of some elements concerning the spatial structure of the Norway spruce stands affected by the wind. The result was the fact that the evolution of the structural parameters in the development of the Norway spruce stands is made under the influence of the complex of the non-biotic disturbing factors (wind, snow) whose action may generate strong unbalances in certain moments.

Keywords : windfalls, Norway spruce, Eastern Carpathians, stand structure

INTRODUCTION

Analyzing the temporal evolution of the concern shown by the foresters in our country regarding the issue of the windfalls, we may distinguish four main steps: the step of the historical notes (up to the Second World War); the step of the description and the statistical analyses of the significant windfalls (the 1940-1974 period); the step of the integration of the statistical data concerning the windfalls in mapping systems and empirical models (the 1974-1995 period); the step of the mathematical modeling and simulation of the windfalls (after 1995) [4], [5], [7], [8], [9], [10], [12], [13], [14], [15].

The modern research realized in the windfalls field have targeted the following: the concept of windfall risk; the modeling of the risk of windfalls with catastrophic effects; the likelihood of occurrence of windfalls with catastrophic effects; the statistical modeling of the trees stability against the wind action; the modeling of the stands stability against the wind action; systems of mapping the risk in windfalls [12].

The foreign scientific research in the matter of windfalls may be structured in the same steps, but the research concerning the modeling and the simulation of windfalls are much vaster. One of the first directions of research in the area of stand stability against the wind was the identification and the quantification of the factors intervening in the process, as well as the way these influence the stands resistance [1], [2], [3], [6], [11], [16].

At the moment, at an international level there are already expert systems of windfalls risk evaluation set in place by integrating the modern analysis techniques [12].

Taking into consideration the above, we considered appropriate to tackle in the present article the following objectives referring to the stands in windfall risk areas: the stands structure against the trees diameter; elements regarding the spatial structure of the Norway spruce stands affected by the windfalls based on quadrate classes; the spatial structure of the stands expressed in competition indicators.

STUDY AREA

The field researches have been located within the Tomnatic Forest District, situated in the level of mixed stands of resinous and beech, from Eastern Carpathians, where the frequency and the intensity of the Norway spruce stands windfalls are significant (Fig. 1).

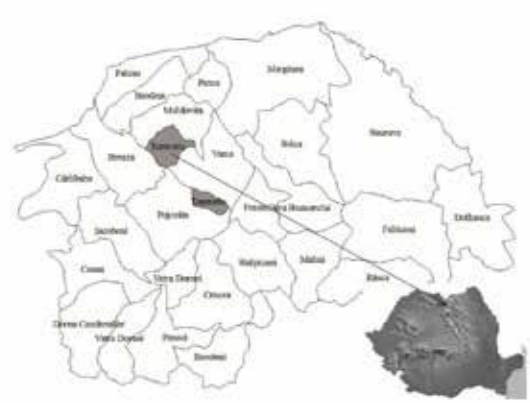

Figure 1: Study area

MATERIALS AND METHODS

The research material is represented by 6 experimental plots installed in artificial Norway spruce stands, differently affected by the wind, to ensure the primary data representativeness (table 1).

In order to get to know the state of the artificial Norway spruce stands in the north of the Eastern Carpathians, affected by the windfalls, the field works have consisted in statistical itinerary inventories, in permanent experimental blocks.

The method we used is the rectangular experimental blocks with a surface of 1.0 ha.

After their placing, we proceeded with the integral inventory of the trees by measuring their main biometric characteristics (diameter, height, positional class, quality class).

The primary data collected on the field were the following: the 1.30 m diameter for the stand trees; the height of the trees; the pruned height; the x and y distances.

The methods of information processing and analysis of the obtained results have consisted in the following: (1) the analysis of the influence of the endemic windfalls on certain biometric elements in the Norway spruce stands; (2) the highlighting of certain specific elements concerning the spatial structure of the Norway spruce stands affected by the windfalls by means of some ecological and forest indicators (the spatial structure of the stands in relation to the number of trees by quadrates -elementary statistical units of 100 m2; the spatial organization of the stands in relation to the distances between trees; the quantification of the spatial structure of the Norway spruce stands affected by the windfalls by means of the competition indicators, in relation to the distance between trees; the analysis of the homogeneity of the Norway spruce stands affected by the windfalls by means of the Camino indicator).

TABLE 1
ELEMENTS CHARACTERIZING THE EXPERIMENTAL PLOTS RESEARCHED IN THE WORKING SECTION I DEMACUŞA, TOMNATIC FOREST DISTRICT

Stand	Surface (ha)	Age (years)	Density	Site class	Site type	Forest type	Exposure	Slope (^{0})	Altitude (m)
12J	6.2	75	0.7	1	3640	1214	Plane	0	770
48AS1	26.9	80	0.7	2	3333	1312	Plane	0	820
48AS2	26.9	80	0.7	2	3333	1312	Plane	0	830
43H1	6.4	65	0.7	2	3640	1313	Plane	0	750
43H2	6.4	65	0.7	2	3640	1313	Plane	0	750
104D	7.2	70	0.8	2	3333	1312	SV	15	820

RESULTS AND DISCUSSIONS

The structure of the stands in relation to the diameter of the trees

The reduction of the diameters' variability as the stands were more intensely affected by the wind is suggestively expressed in figure 2, where the decrease of the coefficient of variation of the diameters is visible with the reduction of the number of trees·ha^{-1}.

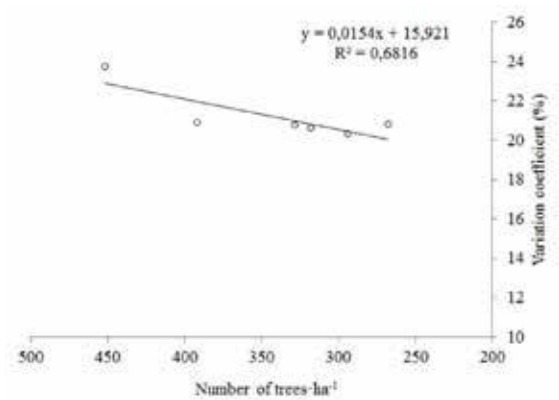

Figure 2: Relation between the number of trees per hectare and the coefficient of variation of the diameters

The influence of the windfalls in the plane of the stands structure diversity in relation to the diameter of the trees is emphasized by means of the Shannon – Wiener ecological indicator (H').

What is remarkable is the considerable reduction of the Shannon – Wiener indicator as the stands' density index is decreasing, which means that the structural diversity referring to the diameter of the trees is significantly diminished in relation to the number and the intensity of the windfalls (Fig. 3).

Spatial structure of the Norway spruce stands affected by the windfalls on quadrate classes

The effect of the windfalls on the spatial structure of the stands is presented in figure 4, where there's a dynamics specific to the indicator of spatial analysis (average number of trees per quadrate) for certain density states sustained by the stands as a result of the wind effect.

As the stands were more affected by the wind, we registered a specific reduction of the statistical unit, accompanied by the increase of the stands' spatial structure variability.

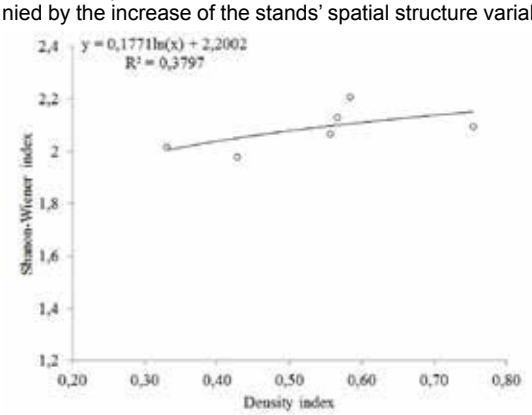

Figure 3: Relation between the density index and the Shanon-Wiener indicator

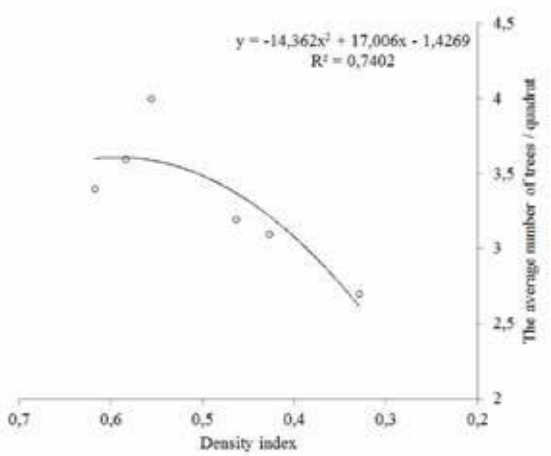

Figure 4: Relation between the density index and the average number of trees per quadrate

Spatial structure of the stands expressed by means of competition indicators

Out of the numerous competition indicators categorized in relation to the method of calculation (based on the distance between trees or not), the significant one is the indicator resulted from the proportion of the basal area of the analyzed tree and the mean basal area of all the trees in the stand (IC).

The relation between the heights of the trees and the value of the contest index for the analyzed stands is presented in figure 5.

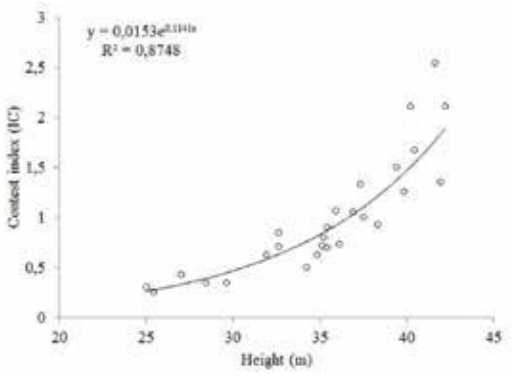

Figure 5: Relation between the height of the trees and the value of the contest index

The indicators of competition (IC) characterize the relations between the individuals of a population based on its dimensions, their social position expressed by means of certain indicators, but also by the way they are placed on the plane.

This indicator (IC) is referring to the ability of certain trees to develop and react more efficiently than others inside the same population, under the influence of the modifications brought by competition and the benefit of new resources as a result of the windfalls.

Therefore, a tree is more vigorous and more competitive when the value of the contest index is elevated and corresponds to a reduced state of competition.

In the analyzed stand, we remarked that the areas with the maximum competition, characterized by indicators of competition superior to 1, exist in the trees with diameters bigger than those corresponding

CONCLUSIONS

The windfalls constitute the main disturbing factor of the mountain ecosystems, with negative ecological effects, through the structural modifications it induces, and also economic, through the value losses of the timber volume and the disturbances determined in the coherent application of the plans of forest management.

The evolution of the biometric, structural and qualitative parameters researched within the Norway spruce stands is made under the influence of the set of abiotic disturbing factors (wind, snow) whose action may sometimes generate strong unbalances of the stands development in the researched area. The negative influence is also directed on the specific productivity of the affected Norway spruce stands.

The ecology of the disturbing factors is a new field of the fundamental and applied scientific research with major importance in the knowledge of the interaction interface between the forest ecosystems and the disturbing environment factors.

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