STRUCTURE STANDS EVALUATION USING VERTICAL DIFFERENTIATION INDEX

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Abstract

The use of the vertical differentiation index in terms of establishing the structure of some stands and assessing the correlations between the values of this index and the percentage of wood affected by disturbing factors and variations in land inclination provides practical information for external factors. This paper aimed to determine the vertical differentiation index for stands with different structures and to correlate these values with the percentage of wood in the total volume of stands affected by destabilizing factors, as well as to correlate this index with the slope.The vertical differentiation index shows the structure of the stand in relation to the variations in height of the neighbors of each trees analyzed. When this index is close to the value 1, we have strong stands in front of disturbing factors, while the index is closer to the value 0, the stands are extremely vulnerable to the action of the disturbing factors.

Key words: vertical differentiation index, correlation, stand structure, disturbing factors

INTRODUCTION

The knowledge of the stands structure and their capacity to satisfy the assigned functions established by the technical norms, and the analysis carried out by the forest management in accordance with the realities in the field make the establishment of the structure of the stands acquire a crucial influence. In a sense, the structure of the stands with the functions it must perform and its inclusion in the functional type determines the type of treatment that can be proposed by the forest management and then applied by those who manage the forest (Roibu, C.C., et al., 2007).

In recent decades, there have been clearer signs that mention the danger of environmental degradation by decreasing the areas covered by natural forests with uneven age structures (Duduman G., 2011) and the degradation of their structure mainly composed of spruce but also other forest ecosystems that were traditionally not affected by extreme weather events.

This thinks that stand structures will have to be built in the future taking into account extreme weather events, including their impact on the forest.

The „structure“ of a forest may be defined by the spatial distribution of the tree positions, by the particular mingling patterns of the different tree species and by the spatial arrangement of their dimensions. Several tree species

may occur in a given forest, each with its own diameter distribution. The different species and tree sizes may be found in close proximity to each other and thus exhibit a high degree of "mingling", or they may be spatially segregated (Gadow et al., 2014).

Structural diversity is often seen as an indicator of ecological diversity (Kint, et. al., 2014). This is a debatable assumption. However, a forest's spatial structure is one of its chraracteristic attributes. The problem which presents itself is how to characterize and describe forests with different species compositions and size distributions more accurately, using affordable assessment techniques (Merganic et al., 2014).

The vertical differentiation index shows the structure of the stand in relation to the variations in height of the neighbors of each trees analyzed.

MATERIAL AND METHOD

As a material used, 30 trees were measured from each stand, each of them was determined to be neighboring trees in numbers of three to seven and for them the tree heights were determined. The analyzed trees were statistically randomly distributed so that any tree in the stand had the chance to be part of the analyzed survey. The heights were determined with the hypsometer and the neighbors of the trees chosen in the survey (the thirty) were established based on the smallest distances from the tree chosen in the survey.

The determination of the vertical differentiation index for each analyzed stand was made using the following relation(după Ciubotaru A., Păun M., 2014):

$DH_n = 1/N * \sum[1/n \sum(1-X_{ijmin}/X_{ijmax})]$

in which:

- DHn is the vertical differentiation index;
- *N* - number of trees measured;
- *n* – the number of trees considered neighbors of the analyzed tree *i*;
- *Xijmin* – the lowest height in each group of trees analyzed,
- *Xijmax* - the highest height in each group of trees analyzed.

For each tree analyzed, regardless of whether it is pure or mixed stand, the determination of the vertical differentiation index was made. For these values, the correlation was determined with the percentage of the volume affected by destabilizing factors, respectively with the slope of the land.

RESULTS AND DISCUSSION

The index of the vertical differentiation have values in the range [0; 1]. Values close to 0 indicate small differences in tree height (even -age

stands, continuous profile), while values close to 1 indicate large differences in tree heights (uneven age stands, wavy, lacy or stepped) (after Ciubotaru, Păun, 2014).

Regarding the results obtained from the statistical processing, the following were found: there is quite marked variability between the values of the index of vertical differentiation in stands of all types of structures which supports the statement that forestry interventions can change in a sense or else these values and on the other hand the correlative type links between this index and the percentage of wood affected by destabilizing factors are quite strong. In this sense, the following representative graph (see figure 1) is presented below:

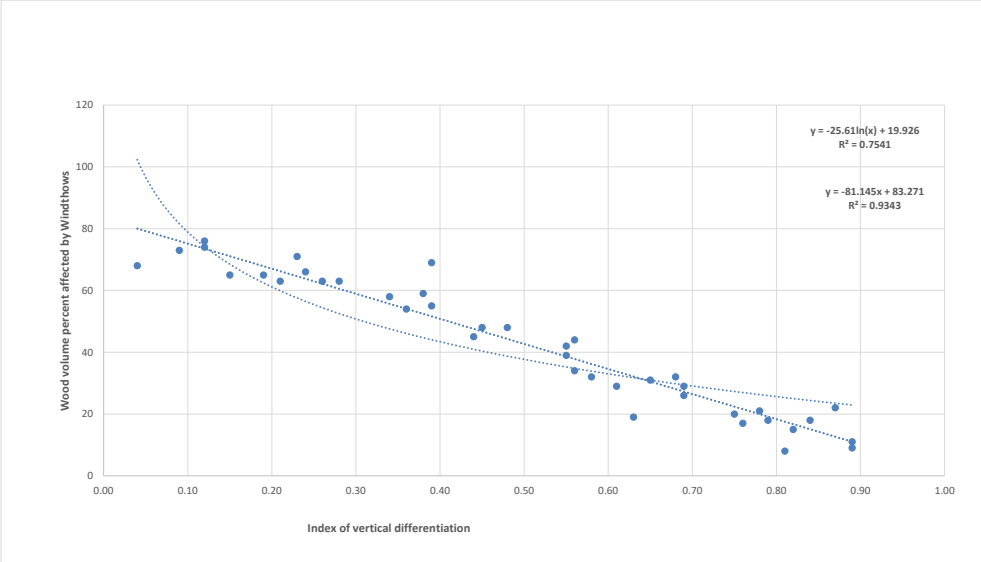

Fig. 1 Wood volume percent affected by Windthows in correlation with vertical differentiation index

The correlative type links between the vertical differentiation index and the slope of the terrain are not as strong (see figure 2) as in the previous case. Thus the correlation coefficient determined in this case has the value of 0.61 while for the previous correlation it had the value of -0.96. This shows that there is a strong inverse correlation between the percentage of wood affected by destabilizing factors and the values of the vertical differentiation index.

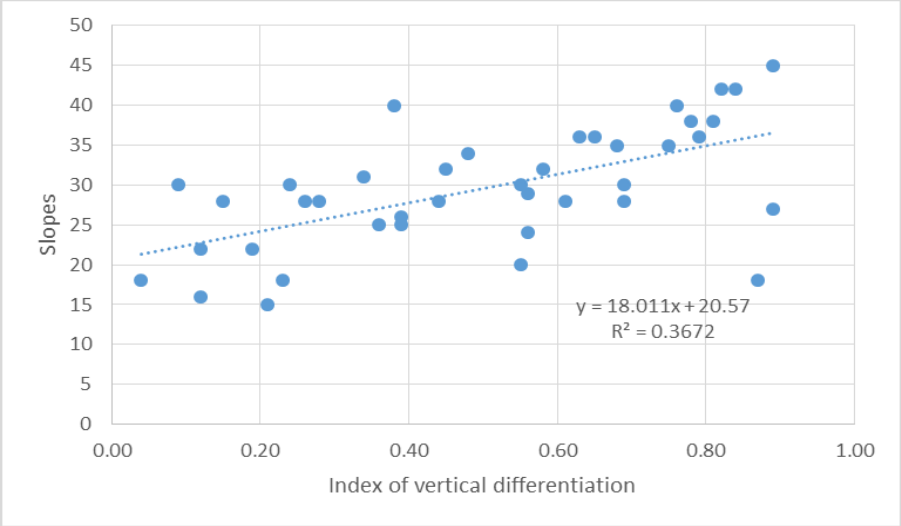

Fig. 2 - Slopes in corelation with vertical differentiation index

CONCLUSIONS

The vertical differentiation index is useful in forestry practice in order to be able to build stable stands in the future due to disturbing factors. When this index is close to the value 1, we have strong stands in front of disturbing factors, while the index is closer to the value 0, the stands are extremely vulnerable to the action of the disturbing factors.

REFERENCES

1. Ciubotaru A., Păun M., 2014, Structura arboretelor, Editura Universității Transilvania Brașov, pp 19-31
2. Duduman, G., 2011. A forest management planning tool to create highlydiverse uneven-aged stands. Forestry, vol. 84, no. 3, pp. 301 – 314.
3. Gadow K., Hui G.Y.,2014, Characterizing forest spatian structure and diversity, Institute of Forest Management University of Gottingen, Sustainable Forestry in Temperate Regions; Proc. of an international workshop organized at the University of Lund, Sweden: p. 20- 30
4. Kint V., Lust N., Ferris R., Olsthoorn A.F.M., 2014, Quantification of forest stand structure applied to scots pine *(Pinus sylvestris* l.) forests, Invest. Agr.: Sist. Recur. For.: Fuera de Serie n.º 1-2000 p.147-163
5. Merganic J., Katarína Merganičová, Marusak R., and Vendula Audolenska ,2012, Plant diversity of forests, Publisher in tech, Forest Ecosystems - More than Just Trees Edited by Dr Juan A. Blanco p. 1-18, http://www.intechopen.com/books/forest-ecosystems-more-than-just trees/plantdiversity of-forests
6. Roibu, C.C., Popa, I., 2007.The use of Ripley function for spatial structure study of natural forest "Humosu Old Growth Beech Forest". Proceeding of the Romanian Academy, Series B, no. 2, pp. 171 – 17