THE WIND INFLUENCE ON THE FOREST LANDSCAPE IN THE UPPER BASIN OF MUREȘ RIVER

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Abstract. The wind effects on the slopes bounding Giurgeu Depression manifest themselves differently on the forestry landscape according to the features of the abiotic components of environment: geological structure, exposition, slope, configuration of secondary valleys, precipitation, drainage, local winds. Forestry landscape of the lower part of the slopes in the depression suffers, almost cyclically, the most visible changes due to wind, even though it is situated in a concave area dominated by calm (60%), but which, by local and occasional amplification of the wind, causes frequent ruptures and breakages of trees (sometimes associated with biotic factors), with negative effects on the activity of population in the area as well as to landscape as a whole.

Keywords: wind, ruptures, forestry landscape, Giurgeu Depression.

1. INTRODUCTION

Forestry landscape in the upper basin of Mureș, respectively in Giurgeu Depression can be taxonomically classified within the derived landscapes; the limit of humanization in the forest overcomes the geographical limit of depression due to pastoral activities. The paleogeographical evolution of the forests in the area is determined by the spatial-temporal events of climatic parameters, which give to the forestry landscape a natural setting of altitude with pronounced phytogeographic inversions here and there. In the recent years due to global warming and steady growth of massive deforestations (many of them illegal!), some of the forestry areas have become vulnerable to wind events, emphasizing or leading, depending on the local conditions, to ruptures on important areas, with visible effects in the landscape and in the forestry economy of the region. Although we are in an area where the atmospheric calm lasts over 60% of the year, the breakages and ruptures due to wind sometimes associated with the snow have most of the time mixed genesis, along with climatic abiotic factor (wind and snow), but a substantial contribution has also the biotic factors, fungi and parasites of trees as well as the deer.

2. GENERAL CLIMATIC PARTICULARITIES WITH REFERENCE TO WIND

The extension of Giurgeu basin to NNW-SSE direction, on a distance of 72,5 km and an average width of only 22-23 km, on east-west direction, makes

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possible the influence of all four major barrel centers of semi-permanent nature with thermic and dynamic origin. Winds are not considered characteristic climatic elements for a unit with a concave relief. In Giurgeu basin, winds are strongly influenced by the features of the general circulation of the atmosphere and the active surface, which cause an increased frequency of atmospheric calm. In January, the activity of Siberian anticyclone and indirectly of the Mediterranean cyclone is noted, while in July, the cyclone is situated in a medium-barrel field, between the Azores anticyclone and the south-east cyclone, with very stable horizontal gradients. These general medium barrel situations may be changed by situations of thermodynamic circumstance, that occur at very short intervals. Thus, the Norse, Iceland and Greenland anticyclones frequently make sudden and significant changes in the appearance of the weather, such as late summer frost ("ice saints"= nocturnal cooling with ground frost in May) and early autumn frosts, which are produced under the influence of Scandinavian anticyclone, and which could be quantified as modifying agents of the forest landscape. From the recorded data along 40 years in the weather station in Toplița, it is shown that the highest annual rate of wind is recorded in the northwest and west sector, in proportions of 20-22%. Air currents in the western sector, generally predominate in all seasons, bringing polar air masses in winter and - more rarely, sometimes - tropical temperatures in summer. Sometimes, over the peaks of the Carpathians (most frequently from the west), it may occur meetings of some air masses of different origins and properties, or parts of an air mass with a relatively low height, separated by the mountains that it has passed off , altering its features according to the crossed underlying surface. Following such meetings, orographic fronts can be developed and generate thermic changes, strong wind (catabatic) and hydrometeorological phenomena with manifestation of natural hazard.

The active underlying surface has characteristic features due to concave hollow relief, which is characterized by higher air humidity, frequency of hoarfrost and dew deposition, atmospheric calm (50%), diurnal and nocturnal obvious thermic contrasts, as well as seasonal, "lakes of cold "in winter, with variable thickness to a few hundred meters (stationary and laminated), leading to installation of thermic inversion, accompanied by early and late frosts.

The differentiations of the underlying active surface are determined by the exhibition and inclination of slope, altitude, hydrography, vegetation coverage, soil and its moisture. Thus, in wet meadows, frost occurs late because of the thermic moderator role of water but in areas with forest vegetation, diurnal thermic variations are insignificant; the first frosts occur earlier at the edge of the forest, while the late frosts are maintained for a longer period of time within the forest, because the heating of the active surface is prevented. The prevailing of the wind directions do not show significant changes from one month to another, being directly related to the opening, orientation and depth of fragmentation of relief towards the surrounding mountains. Changes in the wind direction can be noticed from the analysis of the cardinal at the two weather stations in the hearth of

depression, at Toplița the dominant frequency is from north-west and owns 16% of the total (while the atmospheric calm owns 52.2%) and at Joseni, the dominant frequency is from the west, with 9.8% (while the calm atmosphere holds 66.3%). The higher frequency of atmospheric calm is a direct function of the relief, shelter and exhibition, which is reflected in the differentiation
of practical observations in the field.

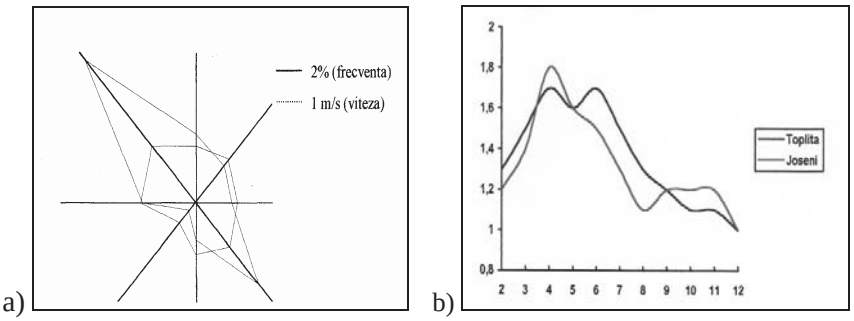

Figure no. 1. a)*The cardinal at Topliţa weather station; b)Monthly and annual chart of wind speed at the weather station in Giurgeu Depression (1961–2000)*

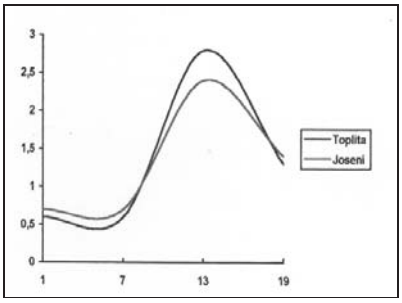

Figure no. 2. ***Diurnal regime of wind speed at the observation hours in Giurgeu Depression (1961–2000)***

Multiannual average speed recorded monthly is of 0.1 m / sec, with its maximum and minimum differentiated by occasional factors and sometimes of hazard. Annual average speed is nearly identical for the two weather stations in the hearth of the basin, being of 1.36 m / sec., at Toplița and 1.3 m / sec. at Joseni. Monthly maximum averages are characteristic to April, May and June (almost 2 m / sec.), deviations are determined by generated conditions, as it happened in February 1990 and in December 1988, when the highest values of ground blizzard were registered (15.4 days).The minimum average values are specific to fall-winter, when in some years we encounter values below 1.0 m / sec, as in February and October 1987 at Toplița, with values of 0.3 m / sec.

Föhn winds found in the hearth of basin are catabatic warm and dry winds, which are formed on the slopes opposite to the general circulation of the

atmosphere, dominant from west and south-west. Their influence is reflected on the regime of all the climatic, hydrological and biogeographical elements. In Giurgeu Depression, there are quite characteristic, being responsible for the reduced amount of precipitation that is recorded from June to October, for the increased calm specific to the centre of the depression (in the area Gheorgheni-Joseni-Remetea), for the prevention of thermic convection depending on the barrel type as well as on the manifestations of short duration of wind with high and very high intensity especially in early summer, which sometimes cause, especially in the last 25 years, almost in a cyclical manner, climatic hazards (such as breakages and ruptures). Even though the manifestation of the winds in Giurgeu Depression don't seem to affect decisively the structure of forest landscape through their intensity and duration, manifestations of climatic hazard of wind cause the production of visible and immediate effects on this landscape. From the preliminary statistical data, partially processed, extracted on the basis of an existing synoptic tables in "composesorates" (associations of small-private-owners of the forest): Gheorgheni, Ditrău, Suseni, Ciumani, Joseni and the forestry districts in Toplița and Gălăuțaș result that the incidence of deforestation and forest destruction due to breakages and wind or snow ruptures during 1990-2009 is about 2-3%, and the cyclicity of the phenomenon is of 12-15 years at the intensity of destruction of over 10 hectares of the forest landscape to a hazard event. The analysis of the map that shows the evolution of deforested areas in the upper lev basin of the Mureș in the last approximative 100 years can quite easily lead us to some hasty conclusions, and even less relevant on the importance of wind analysis as a factor of hazard on forestry landscape; on one hand the low intensities of wind and the few elements of protection that are in the reach of the management of forestry landscape in the case of manifestations of climatic hazards, and on the other hand, the drastic reduction of forest area throughout the upper basin of the Mureș River (figure no. 3)

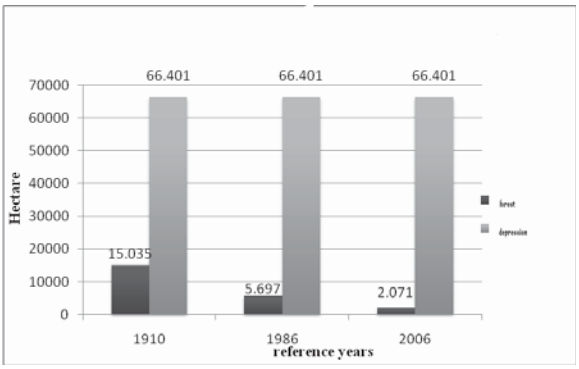

Figure no. 3. ***Deforestations in the Giurgeu Depression between 1910-2006***

3. CASE STUDY WINDFALL DURING the 14th – 16th of JUNE 2010 in the NORTHERN GIURGEU DEPRESSION

The third lower of the slopes of the North and Northwest of Giurgeu Depression were affected by windfall on the optimum background of manifestation of this natural hazards and risk phenomenon on forests. It is possible that windfalls and partial breakage due to snow in the 2009-2010 winter determined the reported effects in that early summer, which caused important material damage and formed itself into a natural hazard which manifested during the 72 hours and its side effects have great impact on the natural landscape or on the planning of territory (parks and arboreal facilities made by humans in the affected localities) The analysis of the partial climate data recorded at the weather stations in the depression -Joseni and Toplița-and correlated with the data from Bucin Step weather station-(Gurghiu Mountain) give us some data on the conditional of the environmental factors that have existed and stimulated the windfall the eastern and north-eastern slopes of Gurghiu mountains and the Gurghiu Piedmont in Giurgeu Depression: on the left bank of Mureș river at Vâgani and Zencani, at Gălăuțaș and Toplița (figure no. 4).

The dominant wind direction recorded at the three analyzed weather stations was from the West and Southwest and its intensity recorded in those days was high, but only periodically, alternating periods of calm with periods of moderate and high intensity (maximum 17 - 18 m./s. during the interval from 20,15 till 22,00 on the 15th of June, 2010). Winds from the west, which are channeled on Gurghiu Valley developed on the west-east direction, are climbing the Gurghiu mountain peaks and come down heated and with increased speed through the saddles of the Bătrâna-Măgheruș-Luncani peaks (correlated analysis with the Tg. Mureș weather station located in the Transylvanian Depression):

- dominant direction of wind recorded at weather stations was from the West and South-West at all four analyzed weather stations and its intensity recorded those days was very high, regularly alternating situations of calm with periods of moderate intensity and high wind (maximum 17 to 18 m/s., the time between 20:15 to 22:00 on June 15th, 2010). Winds from the West, who are channeled on Gurghiu Valley, which is developed on the west-east direction, climb the Gurghiu mountain and descend heated and with increased speed through saddles between Bătrâna- Măgheruș-Luncani peaks (the correlative analysis also with Tg. Mureș station located in the Transylvanian Depression);
- when on the bottom of valleys and depressions there is stagnant cold air, of thermic inversion (be it winter or summer), the wind does not reach the low altitudes of the topographical level, but slides over the bottom layer (the level of thermic inversion) characterized by stability and then climbs the second peak gaining in intensity and determining windfall (the ones along the Gălăuțaș Valley);
- where the axis of the valley is oriented in the direction of the wind these are channeled according to the direction of the riverbed, up or down

depending on the inclination of the riverbed. If the slopes are too steep ascending turbulent movements can be formed in particular at the edge of the current as well as windfall on the peaks exposed to the wind (windfalls from Vâgani and Zencani on the terraces forehead of 60 and 90 m of the Mureș River, at the entrance into the Toplița-Deda gorge)

- a final situation we have when the valley is oriented obliquely to the wind direction, when the air mass is deflected horizontally as well or tend to move along the valley, either to become perpendicular to the ridge line, the case of ruptures and breakages in Toplița area, respectively the area of the ski slopes Măgheruș and resort spa Bradu/Banfy.
- after this period, 14th -16th of June 2010, of maximum intensity of natural events of climatic hazard with windfalls and breakages, there was a period in which the weather was influenced by excessive summer events, with torrential rains and excessive heat, of which, that of 12th of August 2010 with hail of the size of a walnut, has inflicted great damage on 150 households and on the forest from Toplița area. All these phenomena are due to events caused by global climate change since 2003, and they have an increasingly frequency and intensity in this geographical region as well.

Another factor of climatic hazard, the hail, wreaked havoc in the area of Mureș-Toplița confluence in summer 2010. Hail has an average frequency of 1.4 days at Toplița, and of only 0.9 days at Joseni but the maximum frequency was recorded in 1972 (when there were recorded six days at the weather station in Joseni). During the day, hail often occurs in the afternoon when the thermic convection reaches its climax.

a)  b)  c) 

Figure no 4. ***Windthrow effects of 15th-16th July 2010 of Giurgeu Depression: a) Banfy– Toplița; b)Măgheruș–Toplița; c)Vâgani***

The duration of rain with hail is small, maximum of 10-12 minutes, and the grain size is generally of 5-15 mm in diameter. The month with the most frequent events as those is June.

The analysis of hail in Giurgeu Depression shows a very low incidence of this during 1961-2000 but, after 2003, the hail wreaks havoc on the landscape every two years!

4. CONCLUSIONS

Literature is unanimous in recognizing the great influence of how to create and run their stands on their future stability to wind. If against the hydro-meteorological factors it is impossible to struggle, by knowing the mode of action of these factors on the trees, foresters are able to make trees resistant to their action. There will never be able to remove ruptures and breakages caused by wind, but it will be thus eliminated the catastrophic effects that occur in certain conditions forest management. The study of stationary factors that favor amplification of damage allow a clear distinction of needed interventions in terms of intensity, timing and their periodicity of interventions thus increasing economic efficiency and operational safety of the stands. From the presentation we can conclude that the wind damage to forest stands and their ecological imbalance are two closely related processes. Reduction of these losses requires an ample ecological restoration of deconstructed forests.

Although the winds in well individualized depression areas have neither speed nor long duration, the atmospheric calm being predominant, local and regional dynamic factors can increase and determine climatic hazards with visible effects in the local forestry landscape.

The geographical position of slopes massively affected by these natural hazard phenomena confirms the preliminary assumptions: the hazard source → west winds → föhn wind → local conditions → produced phenomenon → material damage / risk.

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