

WINDTHROWS IN ROMANIA CASE STUDIES FROM THE NORTH AND CENTRAL GROUP OF THE EASTERN CARPATHIANS

OCTAVIA BOGDAN¹, MARIA COȘCONEA²

ABSTRACT. Windthrows in Romania. Case-studies. The present paper is a sequel to the study of blown-down trees in Romania published in the previous issue of *Riscuri și Catastrofe* volume. The areas most affected by such wind-related phenomena occur in the Eastern Carpathians, basically in the north-east of Romania (the Counties of Suceava, Maramureș, Neamț and Harghita), but also in Covasna and Brașov counties in the Carpathian Curvature area. Over the past three-four decades, as the climate has been warming up, the incidence of trees brought down has been increasing. Major such events occurred on September 23-24 and November 5/6, 1995 in the Curvature Carpathians; March 6-8, 2002 in the Obcinele Bucovinei (low mountain area); December 24-25, 2002 around Bucharest City and on June 2-4, 2009 on the Southern slopes of *Meridional Carpathians*. These catastrophic events, except the last two cases, caused great damage to the national economy and to the environment. In the present paper are analyzed the cases in the north-east of Eastern Carpathians considered the most favorable territory for such events namely: the blown-down trees from 12-16 VII 1969 and from 6-8 III 2002, which by its consequences had a catastrophic nature. An account is given of each case, e.g. location of the event and the causes generating it (synoptic, meteorological and local), mode of manifestation and consequences.

Key words: windthrows, blown-down trees, broken trees, Eastern Carpathians, Romania

1. Introduction

In a previous issue of this magazine (Year IX, Vol, 8, no. 1/2010), we published a material referring to the causes of windthrows in Romania (Bogdan, Coșcinea, 2010).

The present paper is a sequel to the questioned subject, by presenting few case studies of these blown-down trees, that although occur relatively seldom, it

¹ Institute of Geography, Romanian Academy, Bucharest, e-mail: octaviabogdan@yahoo.com

² Administratia Nationala de Meteorologie, Bucharest Romania, e-mail: maria.coscinea@meteoromania.ro

takes only one to put down 10 to 15 mil. m³ of timber at once, on an surface of hundred to tens of thousands ha.

This phenomenon affected mostly the terrains situated in north-east and east Romania, respectively Obcinele Bucoviniei and Eastern Carpathians (especially the northern half) and seldom in Meridional Carpathians, Apuseni Mountains, Getic Subcarpathians or in plain areas.

In the last four-five decades, the most important windthrows, by the amplitude and consequences, occurred on September 23-24, 1964 and November 25-26, 1964 in the northern part of Eastern Carpathians; on 12-14 of July, 1969 in Eastern Carpathians, especially in Obcinile Bucoviniei; on the 5/6 of November, 1995 in Curvature Carpathians (Covasna district); on the 6-8 of March, 2002, being felt in almost all over the country (in 38 districts out of 41), but most powerful in Tomnatic Forestry in Bucovina; on 24-25 of December 2002, around Bucharest, as well as on 2-9 of June, 2009, in Meridionals Carpathians.

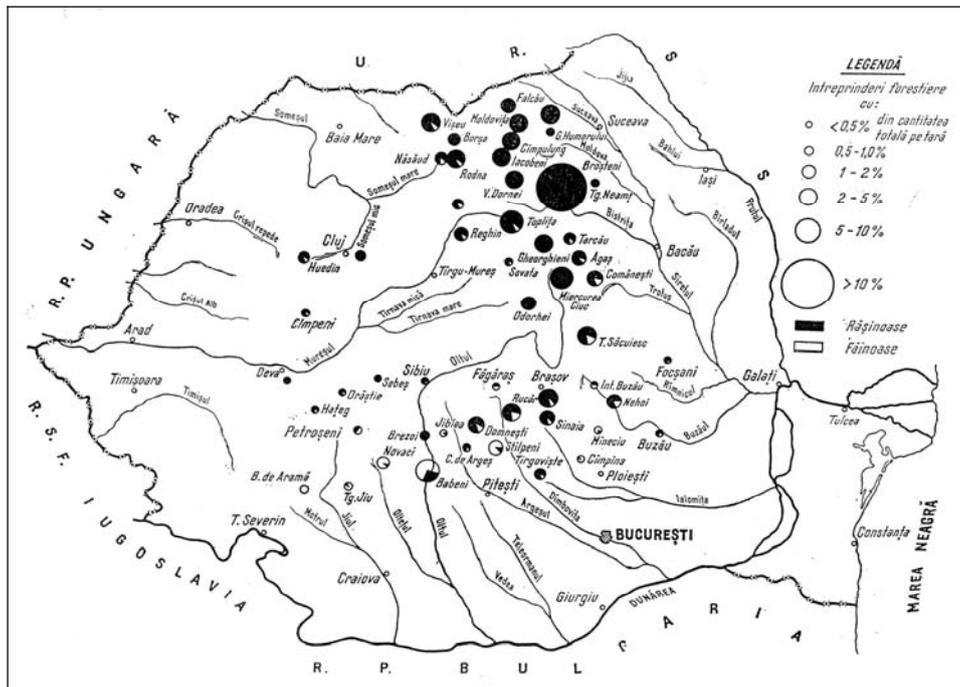


Figure 1. The map of windthrows occurred in autumn 1964 (23-24 of September and 25-26 of November) in Romania (after Marcu Marcu and collab., 1969).

Except the last two “endemic” events, the other ones are included in the category *catastrophic windthrows*, which determine most of the loss of the national economy and the environment. Given that the windthrows that occurred in

September and November 1964 have been the subject of an extensive study (Marcu and collab., 1969), we are going to refer to those that took place in the north-eastern Romania (Bucovina) and Curvature Carpathians, less known in the literature of this domain, which we are going to present in the following pages.

2. Case studies analysis

In the present paper are analyzed the two most important cases of catastrophic windthrows occurred in Romania (North and Central group of Eastern Carpathians, that are considered to be the most important areas that favor such events).

Judging by their consequences, they are placed after the cases from September and November, 1964, studied previously, as well as after the one from 5/6 of November, 1995, that is the subject of another material, present in this magazine.

2.1. The windthrows form 12-14 of July 1969

This is one of the windthrows cases that took place in the warm period of the year, meaning in the summer, in June.

2.1.1. Localization

The area affected by these windthrows, as well as the associated phenomena have large surfaces in Eastern Carpathians (Suceava district), especially in Obcine (Obcina Feredeului and Obcina Mestecănişului) and also in Moldova Valley, which separates them.

The peaks' orientation is north-east-south-west, parallel with the mountain edges (Maramuresului Mountains and Suhard Mountains) and their maximum altitude is of approx. 1400-1500 m (1479 m and respectively 1473 m).

With their geographical position, they are the first orographic barrier in the way of air advections with several characteristics, especially in north-west, north and even south-east, in the case of the Mediterranean Cyclones, with retrograde character with respect to the way air currents are directed.

2.1.2. Genetic conditions

The causes that concurred to the trigger of the phenomenon have been on one side, synoptic causes and on the other side, meteorological causes, as well as local causes.

- *Synoptic causes* have been characterized by the presence of retrograde depressions, located in the north-east side of Romania, concurrent with the presence of the Azores Anti cyclone dorsal, extended to the Baltic Sea area.

This conjuncture favored the penetration of the polar cold air, carried by this dorsal towards the south-east of the continent, attracted by the presence of the mentioned baric depression.

The penetration towards the south of the polar cold air masses and the contact with the warm tropical air that favored the shaping of cyclonic altitude centers, at approximately 500 hPa (5 000 m). At the same time, at the High Planetary Frontal Zone, in the cold and low polar tropopause and warm high tropical, occurred a thermal contrast, that stirred up the very fast Jet-stream Current.

This, in the presence of the retrograde depression in the north-east of Romania, stimulated the appearance of vertical and horizontal air currents with very high speed. (fig. 2)



Figure 2. The baric field from July 12, 1969 at the 500 hPa (5 000 m altitude) levels and at ground level (after www.wetterzentrale.de)

• **Meteorological conditions** favored also windthrows happening in this region. Firstly in June, the month with maximum precipitation and average annual values of 80-130 mm, induced soil soaking with a large quantity of water, that being an important factor of instability for the slop lands.

To these were added to high rainfall in the first decade of July, prior to this event, which totaled amounts of water of more than 50 mm (respectively 50 l/m²), then during blown-down trees events, in the range July, 11-15.

Strong winds were associated with summer rainfall, which occurred at the cold front passing which totaled, in 5 consecutive days, quantities equal to or

greater than the multi annual averages from de stations in the region, exceeding in some cases, in the valleys and depressions, 70-100 mm (73.0 mm – Izvoarele Sucevei, Campulung Moldovenesc – 74.8 mm, Falticeni – 105.0 mm, 117.3 mm – Salcea, Argel – 120.1 mm, 131.2 mm – Dorohoi etc.) and slightly lower in mountainous regions (Ceahlău -Toaca – 46.1 mm, 83.7 mm – Rarău).

These amounts of water that felled on a soil already soaked by rain the previous days led to greater instability of the land, thus creating favorable conditions for windthrows production.

- **Local conditions:** the northeast position of the region in the country; the Eastern Carpathians relief configuration and especially of the Obcinele Bucovinei, with valleys and ridges parallel orientation with north-west to south-east, and altitude of 1 400-1 500 m in the “Obcine”, 1 700-1 800 m in the Maramures, Suhardului and Rarauului Mountains. All these conditions were favorable for the windthrows production, considering the direction of cold air advection from the north and north-west of the continent.

Also, note the position of outpost of Obcinele Bucovinei, the first orographic barrier to these air masses.

2.1.3. Manifestation

Stepping wind over this region was due to cold fronts crossing them from the north-west to south-easterly and also to the ground drainage of air streams, on the main valleys, which coincided with the direction of predominant orientation of the cold air. The maximum speeds reached 24m/s in the lower regions and 34 m/s in the mountainous regions bordering (table 1).

This phenomenon has manifested itself very violently since the morning of July 12, when the wind speed began to increase, reaching more than 15 to 24 m/s on the valleys (Moldova, Moldova and Suceava) and depressions (Campulung) and 28-34 m/s at mountain stations (Rarău and Ceahlau-Toaca) on 13th of July.

As can be seen in table 1, the highest intensity occurred at noon and evening (times measured at 1 and 7 p.m.), during the day, when processes of sunstroke and heat convection are the most powerful and thermal contrast barrel made by cold air advection are the largest. Wind speed began to decrease in intensity only after July 15th. A new episode windthrows in this region took place in November 1969, but the extent of the phenomenon was less.

2.1.4. Consequences

The area affected by windthrows during July 12 to 13, 1969, combined with those in November the same year, amounted 1813 hectares and the volume of put down timber was 7 mil. m³.

The ecological disaster was high, both because of the violent wind and the soil being saturated with water, which weakened the stands rooting. Consequently,

catastrophic windthrows occurred on slopes and river valleys of north-west, i.e. from the direction of the prevailing wind, direction which coincided with the orientation of the valleys, along which, its speed has increased even more.

Table 1. Direction and wind speed at several meteorological stations in the territory of Suceava County

Meteo- rological station	hour	Day									
		11 VII		12 VII		13 VII		14 VII		15 VII	
		Wind (m/s)		Wind (m/s)		Wind (m/s)		Wind (m/s)		Wind (m/s)	
	D	W	D	W	D	W	D	W	D	W	
Rarău	01	C	–	N	8	N	18	N	18	N	16
	07	N	1	N	12	N	20	N	18	N	12
	13	N	4	N	18	N	18	N	16	N	12
	19	N	6	N	18	N	16	N	14	N	7
Ceahlău Toaca	01	SE	1	WNW	28	WNW	28	WNW	10	WNW	5
	07	ENE	3	WNW	34	WNW	34	WNW	18	NW	5
	13	NE	7	NW	34	NW	34	W	12	WNW	3
	19	NE	9	NW	28	NW	28	W	5	WNW	3
Târgu Neamț	01	NW	3	NNW	9	NW	17	NNW	10	NNW	9
	07	NW	7	NNW	9	NW	16	NW	9	NW	7
	13	NNW	4	NNW	17	NW	9	NW	7	N	10
	19	N	4	WNW	17	WNW	10	NNW	9	N	7
Câmpu- lung Moldo- venesc	01	C	–	C	–	NW	12	W	12	W	20
	07	C	–	NW	2	W	16	W	20	NW	8
	13	NE	1	SW	16	W	20	W	20	NW	9
	19	N	1	NW	16	W	16	WSW	18	SW	4
Suceava	01	C	–	NW	6	NW	24	NW	24	WNW	9
	07	NW	2	NW	10	NW	24	NW	24	NW	18

Thus, trees fall has coincided, both with wind direction and with the orientation of the valleys, the trees bending to the south-eastern slopes.

It is interesting that *windthrows occurred also on the eastern slopes of the two peaks* but they were caused by the wind channeling effect, with a tendency to rotate counterclockwise, a situation characteristic of cyclones, ie from left to right in the direction of the depression center.

Windthrows occurred also on Obcina Feredeului as a result of the wind broke through a deforested saddle, full kicking the forest. The most affected species were those of spruce, fir and beech.

2.2. The Windthrows from March 6-8th 2002

These windthrows occurred in early spring conditions, with temperatures of 15-25°C, especially in the lower regions of southern and eastern Romania, located below 500 m altitude.

2.2.1. Location

Meteorological phenomena that caused the windthrows within 6 to 8 March 2002 were felt almost throughout the country. Of the 41 counties, the wind increase that produced windthrows were noted in 38 of them, but especially in northern and north-east of the country. The most affected was Tomnatic Forestry from Bucovina, Suceava County.

2.2.2. Genetic conditions

- *The synoptic situation* that led to these phenomena was characterized by a large thermal contrast (over 10 ... 20°C), the warm tropical air, which influenced the weather in Romania before March 6th, and cold polar air, which invaded the country later.

Thus, March 6th 2002 was in the field of high pressure, with values between 1 030-1 035 hPa at center, attracted a mobile cyclone centered over the Caucasian Mountains, concomitantly with the presence of another Mediterranean cyclone, positioned over the Mediterranean Sea, Gulf of Genoa. It involved warm tropical air masses in its anterior side, influencing first the country's western regions.

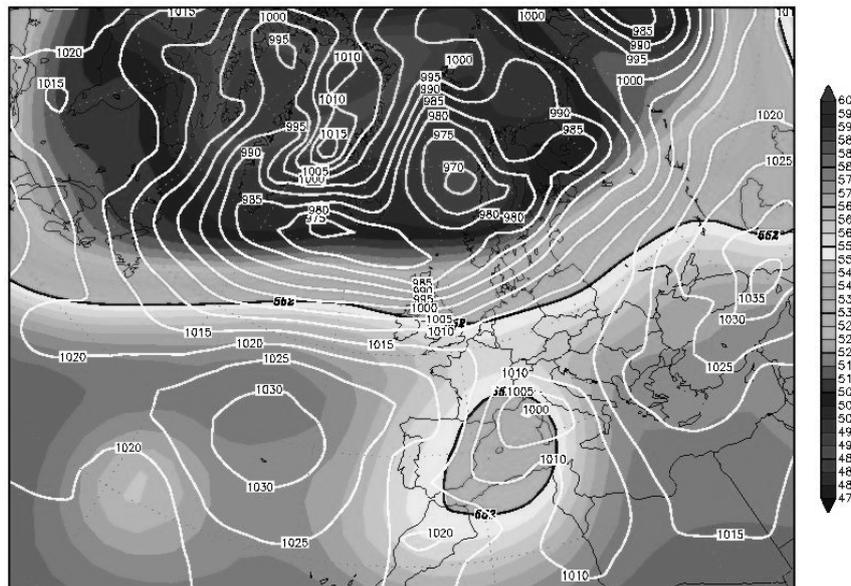


Figure 3. Synoptic situation on 6 March 2002, over Europe at 500 hPa (5000 m alt.) levels and ground level (after www.wetterzentrale.de)

Also, in the northern half of the continent acted more sub-polar depressions (fig. 3), which went down to the south in the coming days, including most of the continent. The existing core anticyclone decreased in value, and the 1015 hPa isobar, which separates the two baric formations cyclone / anticyclone descended to Greece.

The mentioned synoptic background favored the emergence of a cold atmospheric front on the evening of March 7, which was active in the north-western Romania, where he caused rain showers and lightning accompanied by strong wind.

It moved south and south-east, so that on the morning of March 8, 2002 crossed the Carpathians (fig. 4), leading to poor rainfall, while behind him, as a result of cold air entering the country from North West, the pressure began to rise.

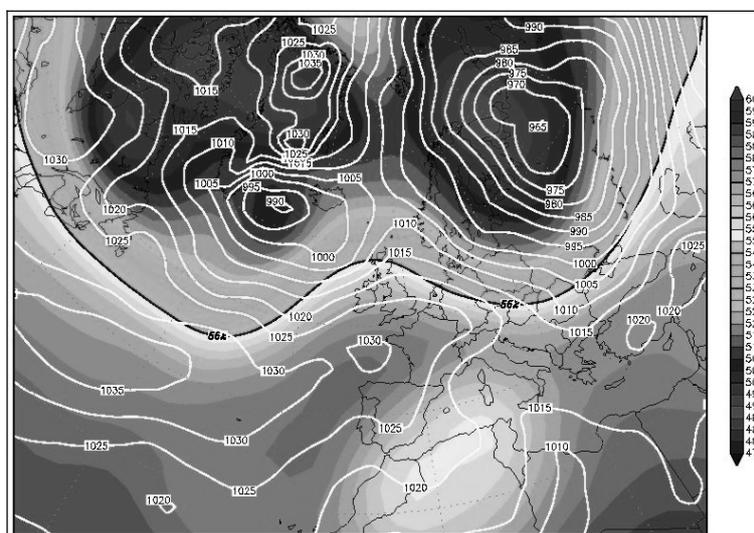


Figure 4. Synoptic situation on 8 March 2002, over Europe at 500 hPa (5000 m altit.) levels and ground level (after www.wetterzentrale.de)

• **Meteorological conditions** The first days of March were characterized by a relatively cool and calm atmosphere, followed by a period of strong sudden heating, with temperatures between 20 and 25°C, especially in southern and eastern Romania, extending then north to Warsaw and to the east to Kiev.

The high thermal contrast, 10...20°C, between the two air masses, warm tropical and cold polar of Mediterranean origin, generated wind intensification with speeds of 28 m / s (100 km / h) in the small and medium altitude regions and of 40 m / s (145 km / h) on top of the Western Carpathians (Vlădeasa-1800) and Eastern Carpathians (Călimani, Ceahlău-Toavaca and Lăcăuți).

Molding on the eastern extremity of the Wooded Carpathians and of the Maramureş Mountains, the cold air, at the contact with the warm air from the East, caused high winds intensification over the territory of Bucovina, were windthrows occurred on March 7. During the night of March 8, wind speed began to drop, together with a sudden cooling of the air, which recorded negative temperatures.

- **Local conditions** are characterized by a peak relief, with altitudes generally located between 1200 m and even over 1400 m, which increase from east to west and by slopes north-east exposed, separated by valley corridors with the same orientation, thus favoring wind channeling and increasing.

2.2.3. Manifestation

The synoptic situation with pronounced thermal contrast (10...20°C), with rainfall and high winds intensifying, with local conditions, characterized by peaks and parallel valley corridors and oriented to the direction of the mass of cold air advection have been extremely favorable conditions for windthrows production on 6-8 March 2002. They were helped by the conditions of stands (tree species, age, stand structure, biometric indices etc.), while the region is covered with deciduous forests (mainly beech) and coniferous (spruce and fir).

2.2.4. Consequences

The most affected lands were those in *Tomnatic Forestry area*, which occupies a large surface with rugged terrain.

The volume of blown down timber in that Forestry was about 500,000 m³ (Popa, 2002).

Considering **the species of trees, the spruce**, which has the lowest wood was most affected, then **the fir tree**, and the least (about 10 000 m³), the beech, which is the best wood.

Regarding **the age classes of the species**, most affected were the stands with over 60 years of age (grade IV with 61-80 years, grade V with 81-100 years and sixth grade with 101-200 years).

The catastrophic nature of these windthrows is highlighted also by the stands of young age classes II (21-40 years) and III (41-60 years).

In relation to the type of injuries (blown down, trunk split, bent or dry tree) was observed on the species:

- **the number of trees by type of injury** varies relative to the stationary conditions and tree species;

- for the **skeletal soils** on slopes with steep slope, felled trees predominate, as follows: 36% spruce, beech 54% and 60% fir tree. The phenomenon is favored by poorly developed root system on these soils;

- **on deep soils, free of water excess** predominate the trunk ruptures (60% fir tree; the beech shows trunk fractures in small trees, the others being resistant);

– *the injuries* are indirect and produced by the collapse of old trees.

The analysis of landscape digital model (Popa, 2002) highlighted the fact that in Tomnatic Forestry, the trees windthrows produced on 6-8 March 2002 have affected generally the stands on the ‘in the wind’ slopes and those on the cold air exposed hills, due to drainage and intensification of wind on Demăcușa, Petac and Tomnatic valleys, something increasingly rare.

On the ‘below the wind’ slopes, opposing cold air advection, there were no trees windthrows in this case.

REFERENCES

1. Bogdan, O., Coșcinea, M. (2010), *Riscul Doborâturilor de arbori în România (Cauzele)* - (“*The wind-blown trees hazard in Romania – Causes*”) in “Risk and Catastrophes” Journal, Year IX, Vol. 8, no. 1/2010, pp. 89-102.
2. Coșcinea, M., Marinică, I. (2006) *Factorii care au generat doborâturile de arbori din 5-6 noiembrie 1995 în județele Mureș, Harghita, Bistrița Năsăud și Covasna*, (“*Generating factors of the wind-blown trees event on November 5/6 1995 in Mures, Harghita, Bistrita Nasaud and Covasna*”), Annals of Spiru Haret University, Geography Series 8, ISSN 1453-8792, Bucharest.
3. Marcu, Gh., Stoica, C-tin., Beșleagă, N., Stoian, Rodica, Ceianu, I.G., Dissescu, R., Pavelescu, I. (1969), *Doborâturile produse de vânt în anii 1964-1966 în pădurile din România*, (“*Wind-blown tree events occurred in 1964-1966 in the Romanian forests*”)-Agrosylvical Printing House, Bucharest), 161 p.
4. Popa, I., Cenușa, R. (2002), *Analiza complexului de factori care au determinat doborâturile catastrofale produse de vânt din 6-7 martie în O.S.E. Tomnatic*, (“*Analysis of the complex of factors that led to the catastrophic wind-blown trees event, on 6-7 March, in the area of Tomnaitic Sylvical Office*”), Final scientific paper, Manuscript I.C.A.S., 56 p.