Spatial and temporal analysis of wildfires in Suceava and Botoșani counties (Romania) during 2019-2024

Analyse spatiale et temporelle des incendies de forêt dans les comtés de Suceava et Botoșani (Roumanie) entre 2019-2024

Andrei – Ionuț PAVĂL[1]*, Dumitru MIHĂILĂ[1], Petruț – Ionel BISTRICEAN[1]

[1]Department of Geography, Ștefan cel Mare University of Suceava, Romania

* Correspondence to: Andrei – Ionuț PAVĂL. E-mail: andreipaval032@gmail.com.

Vol. 36.1 / 2026, 1-13

GEOREVIEW

Received:
12 September 2025

Accepted:
29 October 2025

Published online:
17 November 2025

ABSTRACT: Vegetation fires are processes with a significant impact on the geosystem, whose widespread occurrence on Earth has taken place from the beginning of the Carboniferous period to the present day, a period of time in which the potential factors triggering and propagating them and their causes have diversified against the backdrop of changes in the natural geographical environment, compounded by increasingly pronounced human intervention. In this paper, we analyze and present the spatial and temporal distribution of vegetation fires between 2019 and 2024 for the counties of Suceava and Botoșani (Romania), to which we add the identification and examination of the factors that favor the occurrence of these processes, using information obtained in the field. Our results show that, from a spatial point of view, the number of vegetation fires increases considerably from the mountainous to the plains, and temporally, the number of events studied fluctuated, influenced by a combination of predominantly anthropogenic factors.

KEY WORDS: Vegetation fire, fire, spatiality, temporality, fire regime, land management

RÉSUMÉ: Les feux de végétation sont des processus ayant un impact significatif sur le géosystème, dont la propagation à l'échelle mondiale s'est produite depuis le début du Carbonifère jusqu'à nos jours, période durant laquelle les facteurs potentiels qui les déclenchent et les propagent, ainsi que leurs causes, se sont diversifiés dans un contexte de changements de l'environnement géographique naturel, aggravé par une intervention humaine de plus en plus prononcée. Dans cet article, nous analysons et présentons la distribution spatiale et temporelle des feux de végétation entre 2019 et 2024 pour les comtés de Suceava et Botoșani (Roumanie), à laquelle nous ajoutons l'identification et l'examen des facteurs qui favorisent la survenue de ces processus, à partir d'informations obtenues sur le terrain. Nos résultats montrent que, d'un point de vue spatial, le nombre d'incendies de végétation augmente considérablement de la montagne à la plaine, et que, d'un point de vue temporel, le nombre d'événements étudiés a fluctué, sous l'influence d'une combinaison de facteurs principalement anthropiques.

MOTS-CLÉS: Incendie de végétation, incendie, spatialité, temporalité, régime des incendies, gestion des terres

How to cite this article:
Pavăl, A.-I. Mihăilă, D., Bistricean, P.-I. (2025) Spatial and temporal analysis of wildfires in Suceava and Botoșani counties (Romania) during 2019–2024. Georeview, 36, 1, https://doi.org/10.4316/GEOREVIEW.2026.01.01

1. Introduction

Vegetation fires are phenomena that disrupt natural and anthropogenic ecosystems and occur when three essential elements, known as the "fire triangle," coexist: oxygen, fuel, and an ignition source. These processes began in the Early Devonian period, 420 million years ago, as evidenced by fossil coal dating from this geological period (Pyne, 2019), and continue to this day, posing a threat to the geosystem.

Over time, vegetation fires have been a topic of interest to researchers, as evidenced by the significant number of studies of unquestionable value published in specialist journals such as the International Journal of Wildland Fire, Fire Ecology, Fire, Journal of Fire Sciences, etc., against the backdrop of increasingly frequent processes in the context of climate change, the consequences of which we feel every day.

The analysis of fires at an international level is a topical issue, as evidenced by studies that have addressed the problem of numerous uncontrolled fires that have affected the environment, such as those in California between 2017 and 2018 (Brown et al., 2020; Goss et al., 2020), in Australia between 2019 and 2020, with the summer also known as "Black Summer" (Davey & Sarre, 2020; Filkov et al., 2020; Levin et al., 2021), or in Siberia, in the Russian Federation in 2020 (Conard and Ponomarev, 2020). Many other examples could be added to these, given that fires have been occurring in increasingly large areas of the Earth's land surface in recent years.

In Europe, Akyürek (2023) and San-Miguel-Ayanz et al. (2024), in their work analyzing the spatiality and temporality of vegetation fires, highlight that the most vulnerable states are located mainly in the south of the continent, due to a multitude of factors analyzed by Ganteaume (2021). However, other regions should not be neglected, as Pausas (2022) specifies that between 2001 and 2021, an intensification of processes was observed in other areas of the continent, noting that these are smaller in size.

In Romanian literature, Stan et al. (2014) examined stubble burning in Romania, compared to other European countries, and the impact this practice has on soil, agriculture, and the environment. Romania's forest vegetation and its risk of fire were analyzed by Burlui I. and Burlui C. M. (2019), while Drăgan and Munteanu (2024) focused on general statistics for the entire country, including the temporal and spatial distribution of fires, their probable causes, and the types of vegetation affected.

From the perspective of the study area, the montainous unit of Suceava County was researched by Burlui (2013) through a doctoral thesis that conducted an in-depth study exclusively on forest fires occurring between 1990 and 2009, in contrast to the present work, which considers all types of vegetation affected by fire, over a much larger area, from a geographical perspective, without analyzing the operational component of the military personnel responsible for extinguishing these events.

Another relevant study concerning the researched geographical area is that conducted by Horodnic et al. (2020), which examined how vegetation fires manifested in Suceava and Botoșani counties during the period 2009 and 2018, with particular attention given to the general spatial and temporal distribution of the phenomena. In contrast to this study, the present research proposes, in addition to analyzing these two dimensions, an in-depth approach to the variables that condition these phenomena, complemented by a special focus on the cause-effect relationship.

The main purpose of this study is to examine, from a geographical perspective, the current situation of vegetation fires in Suceava and Botoșani counties for the period 2019–2024, using data collected in the field by firefighters and provided by the Emergency Situations Inspectorates with responsibilities in the two counties.

The objectives of the study are: *i)* to identify and analyze the factors that influence the occurrence of vegetation fires, *ii)* to develop statistics that include the spatiality and temporality of the processes triggered, *iii)* to examine the effects generated as a result of their occurrence.

2. Study area

The counties of Suceava and Botoșani, located in northeastern Romania, have a total area of 13,520 km² and are bordered to the north by Ukraine, to the east by the Republic of Moldova, to the south by the counties of Iași, Neamț, and Harghita, to the southwest by Mureș, to the west by Bistrița – Năsăud, and in the northwest by Maramureș (Figure 1).

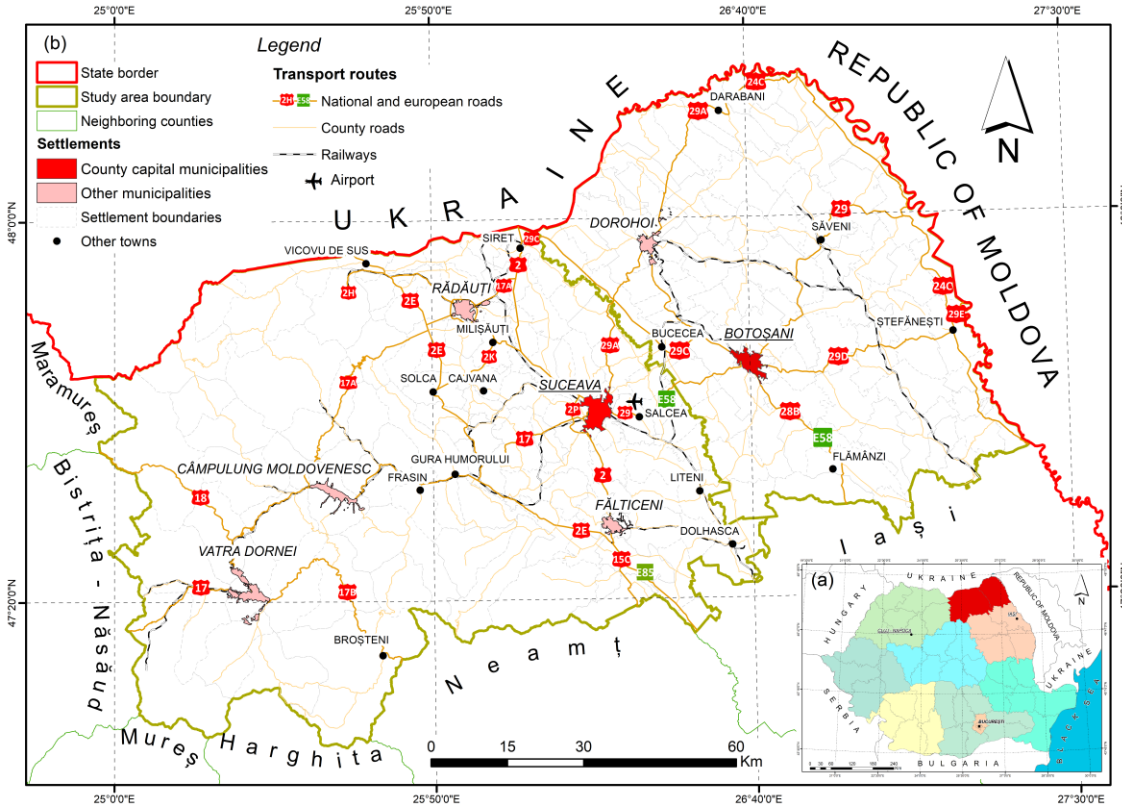

Figure 1 (a) Location of the study area in Romania and (b) the two counties analyzed.

The geographical characteristics of the study area are complex, based on the high amplitude of the relief (2043 m; the maximum altitude is in the Călimani Mountains, Pietrosu peak - 2100 m, and the minimum is in the Prut River valley, in the Botoșani locality of Santa Mare - 57 m). The location of the Eastern Carpathians in the western half of Suceava County and their transition to the Moldavian Plateau via the Moldavian Subcarpathians gives the relief a stepped arrangement in a west-east direction.

The geographical position gives the temperate transitional climate a continental nuance. The researched area also suffers from Scandinavian-Baltic influences. The characteristics of the relief impose a stratification of the climate and, consequently, of the vegetation, which, through its properties, represents the fuel that feeds the flames. Distributed in layers, the vegetation is diverse, as evidenced by the multitude of species present in the study area, such as subalpine associations, conifers, deciduous trees, forest-steppe, steppe, hydrophilic plants in river floodplains, halophilic plants, etc.

The above-mentioned elements, together with anthropogenic components, are of particular importance because they are factors which, in the intervals in which they act and simultaneously present certain particularities, influence the outbreak and spread of vegetation fires.

3. Methods

This work was made possible by going through several stages of research, including: *i)* laboratory research, which involved consulting available specialized bibliographic resources, databases that could be used, and the legislative framework, *ii)* field research, which involved visiting the relevant institutions in order to obtain relevant statistics on vegetation fires, and *iii)* processing the information collected, accompanied by a coherent interpretation and a series of relevant conclusions.

The database provided by ISU "Bucovina," the institution responsible for Suceava County, and ISU "Nicolae Iorga," with responsibilities in Botoșani County, allowed for the extraction of many categories of information collected by the military personnel mobilized to extinguish the fires, including: the causes of the fires, their effects, duration of the event, spatial and temporal distribution, and affected area. The data was made usable through the use of research methods: the statistical-mathematical method, which was the basis for processing the database; the modeling method, which allowed for the creation of graphical and cartographic representations; and the analysis method, which involved examining them. Microsoft Excel facilitated the creation of graphs using simple calculation formulas for fast and efficient database processing, while ArcGIS Desktop 10.8 contributed significantly to the accurate representation of the reality on the ground with the help of well-structured thematic maps.

4. Results and discussions

4.1. Temporal manifestation of vegetation fires

In the study area, we can see that vegetation fires had a high incidence, as evidenced by the 1,419 incidents recorded by firefighters between 2019 and 2024, of which 885 were in Suceava County and 534 in Botoșani County. However, the number of these events could be much higher because some vegetation fires are not reported to the authorities until the flames get out of control, requiring rapid intervention by specialists. Drăgan and Munteanu (2024) classify the two administrative – territorial units among the geographical areas with the fewest firefighter interventions, which include the central, northern, and eastern regions of the country, according to their analysis conducted for the period between 2000 and 2020. At the opposite end, in Romania, the most affected counties were located in the southeast, with Ilfov ranking first.

Over the years, the number of vegetation fires (Figure 2) was relatively stagnant at the beginning of the period analyzed (in 2019, there were 222 fires, and in 2020, the number reached 228). The

annual number of fires fluctuated, with a peak in 2022 (480 fires) and a low in 2023 (47 fires). Even though a combination of factors is necessary for a vegetation fire to start, in the case of Suceava and Botoșani counties, climatic factors played a particularly important role because, according to the report of the National Meteorological Administration (ANM) published in 2025, it was found that 2024, 2023, 2019, 2020, and 2022 had the highest average temperatures since 1900.

The ANM's annual activity reports specify that, at the national level, 2021 was marked by a higher average annual rainfall of 695.3 mm, followed by 2023 with 661.3 mm, compared to 2022, when rainfall was only 553.2 mm. These rainfall data can be correlated with the number of vegetation fires mentioned above.

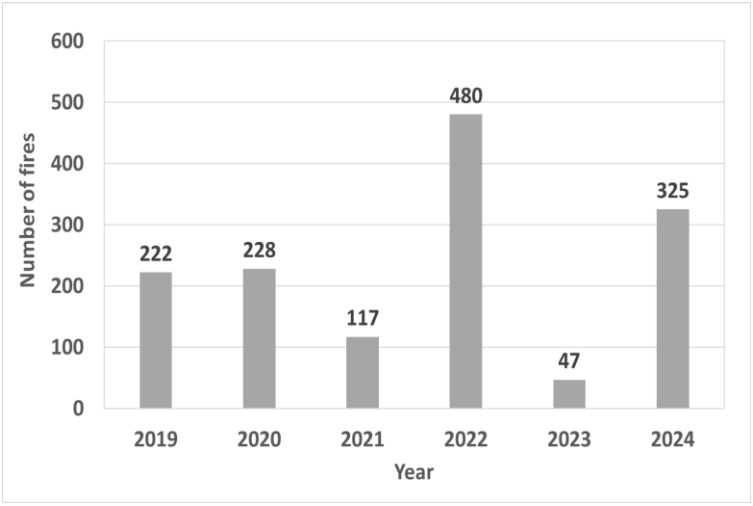

Figure 2 Multi-year pattern of the number of vegetation fires in Suceava and Botoșani counties.

Seasonally (Figure 3), most vegetation fires occurred in the spring (55.5%), unlike the other seasons, which had similar percentages, slightly higher in winter (16.7%), followed by summer (14.4%) and autumn (13.5%).

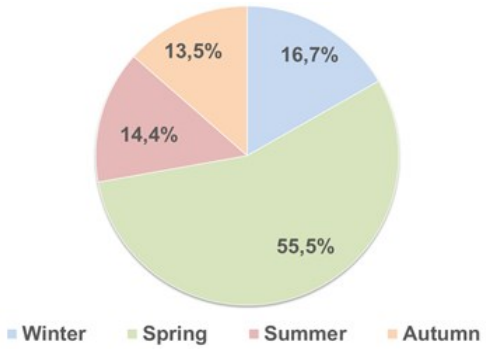

Figure 3 Percentage distribution (%) by season of vegetation fires in Suceava and Botoșani counties (2019–2024).

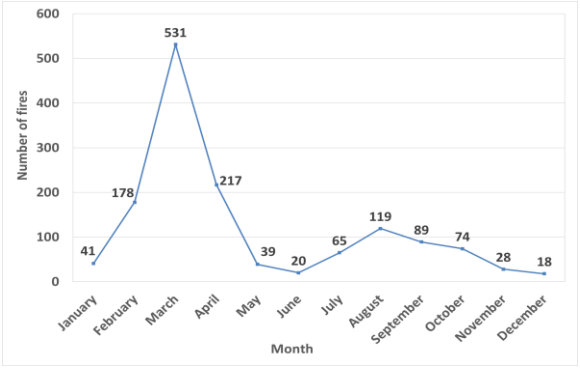

Figure 4 Annual pattern of the number of vegetation fires in Suceava and Botoșani counties (2019–2024).

The relative seasonal values presented are also reinforced by the annual pattern of the absolute number of vegetation fires (Figure 4), which shows two increases, one significant in March (531

fires) and the second, less pronounced, in August (119 fires). The increase in the intensity of agricultural activities during these months of the year involves the use of agricultural machinery that can cause vegetation fires due to technical malfunctions or sparks.

In addition, despite the fact that the country's legislation severely punishes the burning of dry vegetation and other types of waste with fines (which for individuals range from 10,000 lei to 20,000 lei, and for legal entities vary between 50,000 lei and 70,000 lei or imprisonment from 3 to 5 years, in accordance with GEO No. 92 of August 19, 2021), farmers continue to use this practice to sanitize their land or to speed up the regeneration of vegetation, especially in the spring months, but also at the end of summer, when the soil is drier. We assume that the higher frequency of vegetation fires in January (41 incidents) and February (178 incidents) is due to higher temperatures, lower rainfall, and longer periods without snow cover.

On the other hand, in months with higher rainfall, there were no reports of a high number of vegetation fires, as evidenced by December (18 incidents), when the active area is generally covered by a thick layer of snow, and June (20 incidents), during the period of maximum rainfall and maximum plant activity.

Thus, the number of vegetation fires over the course of a year is influenced by several natural or anthropogenic factors that can favor or inhibit the onset and spread of these processes.

4.2. Spatial manifestation of vegetation fires

From a spatial point of view, the vegetation fires that occurred between 2019 and 2024 (Figure 5) took place in a large number of localities, but with greater regularity within and in the vicinity of urban settlements in the study area. These include the municipality of Suceava, the county seat of the same name, where the military intervened to extinguish 48 vegetation fires, followed by the municipality of Fălticeni (45 incidents), the town of Vicovu de Sus (44 incidents), the municipality of Rădăuți (38 incidents), and the town of Dolhasca (34 incidents). In Botoșani County, the most important urban settlement, the municipality of Botoșani, faced 22 vegetation fires, as did the municipality of Dorohoi and the town of Ștefănești, a lower number than in localities such as Trușești (25 incidents) or Curtești (23 fires).

At the opposite end of the spectrum, some of the localities in Suceava County (Sadova, Pârteștii de Jos, Botoșana) or those in Botoșani County (Călărași, Manoleasa, Mihăileni, Tudora, Viișoara, Vorniceni) did not experience any vegetation fires requiring the intervention of emergency services.

This spatial distribution is caused by a multitude of factors such as: higher population density in urban settlements and neighboring localities, the presence of roads and railways connecting communities, which lead to a higher risk of vegetation fires being triggered by economic, social and recreational activities undertaken by people, but also the natural conditions of the area (weather conditions, nature of the active surface, presence of water and wetland areas, etc.).

In Figure 6, we can see a concentration of vegetation fires within the Moldavian Plateau. This relief unit is characterized by the presence of high plateaus and hilly massifs in the Suceava Plateau, separated by the Rădăuți Depression, the Moldavian Corridor, and the Siret Corridor (Băcăuanu et al., 1980), but also by lower subunits, such as the Jijia Plain, where the slopes are gentle, the valleys are wide, the interfluves are smooth, and there are a significant number of marshes and lakes of anthropogenic origin (Tufescu, 1977). To the west, the Moldavian Subcarpathians constitute the relief unit that makes the transition to two large groups of the Carpathian Mountains, the Maramureș and Bucovina Carpathians and the Moldavian-Transylvanian Carpathians, delimited from a tectonic-structural point of view in the flysch, crystalline-Mesozoic, and volcanic subunits.

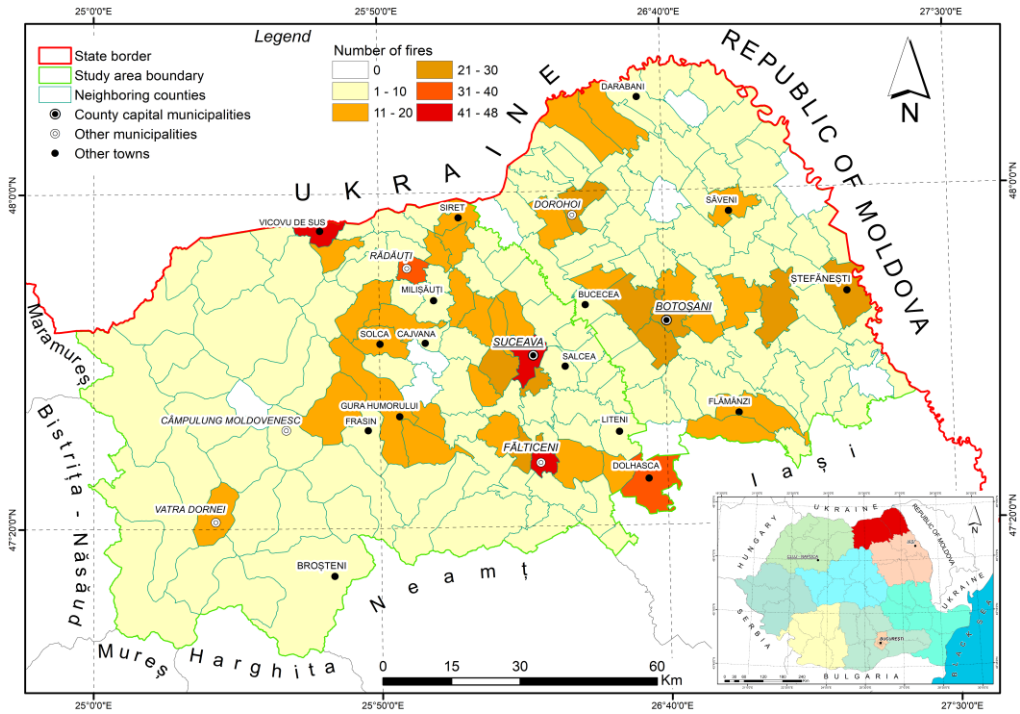

Figure 5 Distribution of vegetation fires between 2019 and 2024 in the localities of Suceava and Botoșani counties.

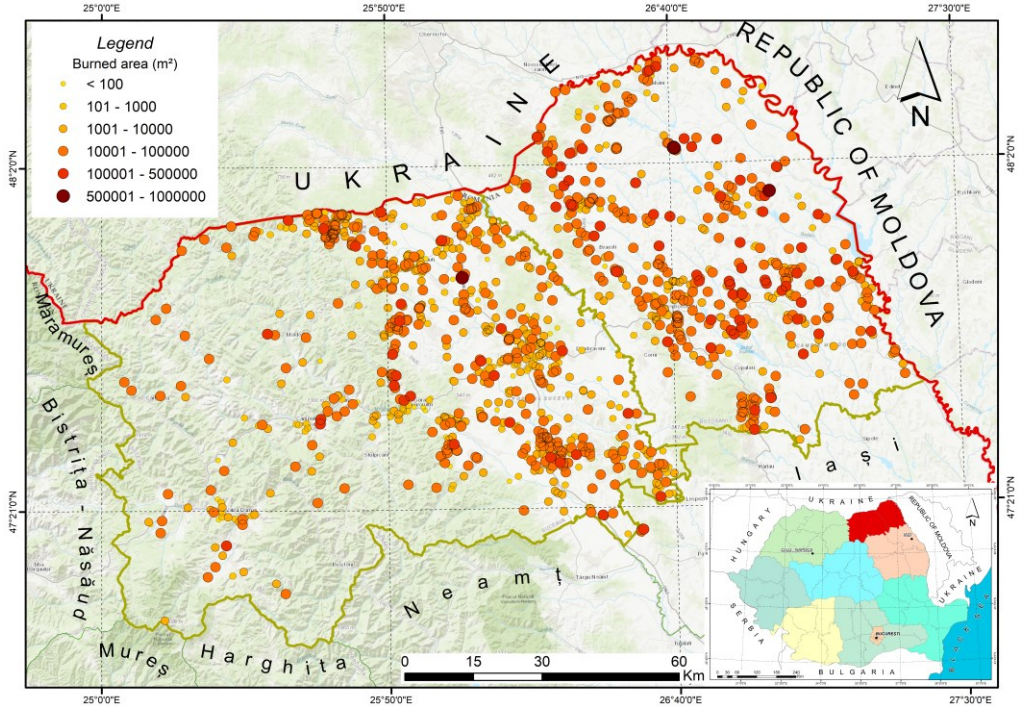

Figure 6 Distribution of vegetation fires by burned area between 2019 and 2024 in Suceava and Botoșani counties.

Even though a multitude of conditions could favor the outbreak and spread of vegetation fires in mountainous areas (such as steep slopes that cause the fuel at the top to preheat or their exposure to the sun when the degree of brightness is at its maximum), their number is low. Fires have occurred more frequently along access roads, valley corridors, and depressions. The distribution of vegetation fires is limited by the low accessibility of mountain slopes to the population (which can reach altitudes of up to 2,100 meters at the Pietrosu peak in the Călimani Mountains) and by the presence of "barriers" to the spread of flames (outcrops, bare land, landslides, animal trails, or sharp ridges).

In addition to the relief, the distribution of vegetation fires is also influenced by climatic characteristics, as fuel is more vulnerable to flames when temperatures are higher, atmospheric precipitation is lower, and atmospheric pressure is higher, conditions that are more favorable to the plateau than to the mountains.

The properties of spruce (*Picea abies*), such as the arrangement of its leaves, the presence of resin or essential oils, and cellulose, favor the spread of vegetation fires because it is the main species that makes up the coniferous forest (Burlui, 2013), unlike deciduous trees, which are less prone to flames.

This argument can also be supported by the low density of phenomena in the Dealul Mare – Bour sub-unit of the Suceava Plateau, where deciduous forest vegetation predominates. The concentration of fires in the plateau unit is also determined by the forest-steppe vegetation, consisting of shrubs, dry grass, scattered trees, and bushes, which are highly flammable and ignite much more quickly.

Therefore, the spatial distribution of vegetation fires is closely related to the geographical characteristics of the study area, from anthropogenic to natural climatic, biogeographical, or geomorphological factors, and their distribution is not random.

4.3. Causes of vegetation fires

In the area studied, vegetation fires between 2019 and 2024 were caused by numerous factors, with anthropogenic causes accounting for the highest proportion (98%), compared to natural causes (1%) and technical causes (0.8%). It is important to note that 0.2% of vegetation fires had no established cause, a situation that may be due to the destruction of the elements that triggered the flames, reduced accessibility, or the lack of eyewitnesses and video footage. A differentiated analysis of anthropogenic and technical causes (Figure 7) was applied, even though anthropogenic causes determine technical causes, because they cannot be directly attributed to human actions (Burlui, 2013).

Through negligent or deliberate human actions, most of the causes of vegetation fires were: open fires in open spaces (1,324 cases), smoking (65 cases), children playing with fire (one case), and the use of pyrotechnic articles (one case). According to Hantson et al. (2022), these processes are characterized by the fact that they can occur at any time, in extreme weather conditions (evapotranspiration and intense wind gusts, which reduce the duration of flame propagation, against a backdrop of high dryness), in accessible areas where vegetation with more favorable inflammatory properties than those of forest floors with high humidity develops.

In terms of technical causes, 13 of the vegetation fires were triggered by thermal effects, short circuits, mechanical sparks, or non-compliant tools, differentiated by the absence of territorial limitations, but with a violent manifestation that can be extinguished in a very short time, in most cases due to the fact that there may be people nearby who would intervene to extinguish the flames.

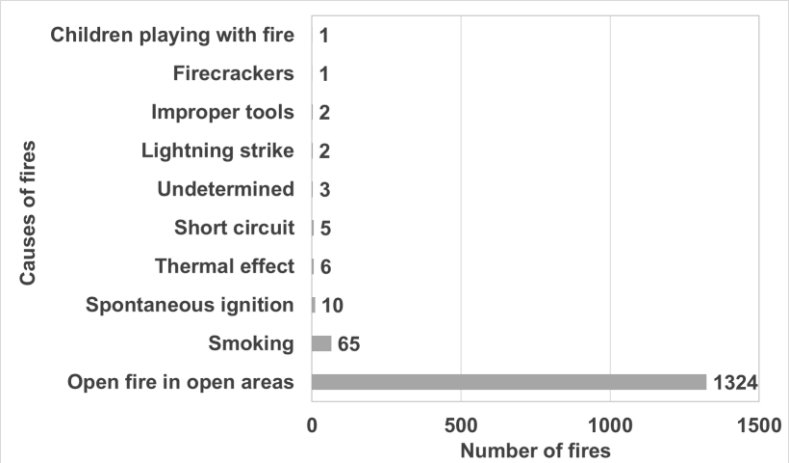

Figure 7 Probable causes of vegetation fires in Suceava and Botoșani counties between 2019 and 2024.

Without direct human involvement, vegetation fires are possible, as evidenced by the 12 fires triggered by natural causes, including spontaneous combustion (10 cases) and lightning (two cases). The first of these two processes (spontaneous combustion) occurs when there are large piles of organic matter characterized by a thermal imbalance caused by the presence of linoleic acid and microorganisms or living plant cells, which continue to release heat until they are destroyed or no longer have energy (Buggeln & Rynk, 2002).

Even though the number of vegetation fires caused by lightning is insignificant, analyzing them is important because Chen et al. (2020) believe that globally, the frequency of thunderstorms will increase due to the potential energy in the atmosphere, which is increasing, convective atmospheric instability, and vertical wind shear. The processes triggered by lightning are distinguished by the inaccessible places where they occur, their short duration, and the ability of the flames to spread from the tree canopy to other types of vegetation (Burlui, 2014). The risk of vegetation fires increases when, during a storm, precipitation is low, temperatures are high, and air circulation is intense, as the flames spread randomly (Fernandes et al., 2021).

Consequently, it has been observed that most vegetation fires were triggered by human actions, although nature, to a significantly lesser extent, is also responsible for some of these phenomena, given the complex interaction of contributing factors.

4.4. Consequences of wildfires

Fires have numerous consequences for the environment and society, posing a threat to human and wildlife life, causing the degradation or complete destruction of material goods and agricultural crops, and contributing to soil erosion, atmospheric pollution, and the slowdown of vegetation regeneration.

The burned area, certainly one of the most analyzed indicators when considering vegetation fires, shows that in Suceava and Botoșani counties, between 2019 and 2024, it totaled 51.9 km² (0.38%) of 13,520 km², which is the total area studied. Considering the area of land affected, Figure 8 suggests that most vegetation fires (512 cases) degraded between 10,001 and 100,000 m², followed by those between 1,001 and 10,000 m² (453 cases) and small fires, between 101 and 1,000 m² (256 cases) and under 100 m² (99 cases). Vegetation fires covering areas between 100,001 and 500,000 m² (95 cases) and over 500,000 m² (4 cases) were particularly intense.

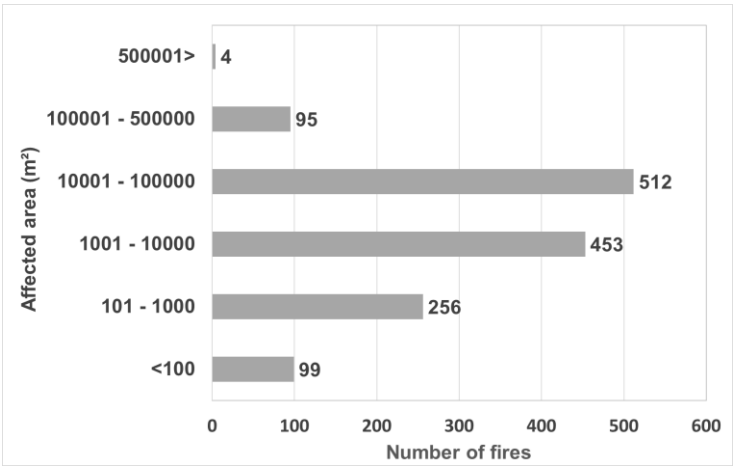

Figure 8 Ranking of vegetation fires between 2019 and 2024 according to the affected area (m²).

Although vegetation is severely affected by fires, flames can contribute to the regeneration of the vegetation cover in a much shorter time by removing dead organic matter and plants that compete with herbaceous species. Fauna is endangered due to the risks to which it is exposed, as flames can cause injury or loss of life and destroy the habitat in which they live. Humans can also be threatened by fire, as evidenced by the only case in the counties of Suceava and Botoșani during the period analyzed, which resulted in the injury of a male (aged approximately 70) from the town of Bălcăuți.

In addition to biodiversity, vegetation fires also affect the pedosphere because the pH becomes basic, organic matter and nutrients are removed, and certain characteristics such as porosity and permeability decrease due to the obstruction of pores by ash and clay minerals, leading to intense erosion (Certini, 2005).

The release of gases such as CO_2, N_2O, CH_4, and water vapor into the atmosphere causes the greenhouse effect and the possibility of humans and animals suffering from smoke poisoning (Bowman et al., 2009), and the aerosols emitted above major fires can promote the formation of Pyrocumulonimbus clouds, which are responsible for other fires through the thunderstorm phenomena that occur (Bowman et al., 2020).

In terms of material damage, apart from degraded vegetation, most fires did not cause any other damage. Exceptions include: a wooden fence, damaged over a length of 80 linear meters, two railroad ties, a corn crop covering an area of 5,000 m², an orchard destroyed over an area of approximately 7,000 m², and an acacia plantation covering 20,000 m².

Therefore, vegetation fires can cause a multitude of consequences with a major impact on the environment and society, which is why it is imperative to implement measures to prevent these processes from occurring.

5. Conclusions

The occurrence and manifestation of vegetation fires in the counties of Suceava and Botoșani is an indisputable fact, as evidenced by the significant number of phenomena that occur under the influence of a multitude of natural factors (relief, climate, vegetation, and hydrography) and anthropogenic factors (the presence of roads and railways, economic activities undertaken by society, population density) with a significant impact on the spatial and temporal regime.

From a spatial point of view, most vegetation fires were concentrated in the plateau unit, in localities with a much higher density compared to the mountainous area, where fires occurred in isolation, in the more humanized depression areas and valley corridors.

Over many years, the number of fires has fluctuated, influenced by weather conditions and the pace of economic and social activity that characterizes each period. In an average year, fires are most frequent in spring, when farmers (despite national legislation providing for penalties ranging from fines to imprisonment) burn plant debris on agricultural land to sanitise the land. Against the backdrop of regional warming, which also affects northeastern Romania, the incidence of vegetation fires is increasingly high in the winter months, when actual temperatures exceed those considered normal, and precipitation is low, leading to a much thinner or non-existent snow cover and dry vegetation with favorable inflammatory properties.

Most fires are caused by humans (98%), hence the need to adopt measures (community education programs, raising public awareness, and involving the entire community in solving and managing the problem of fires, better monitoring of vegetation fires) is imperative because the consequences can have a profoundly negative impact on many natural and anthropogenic sites. Even though the proportion of fires that can be attributed to natural and technical causes is low, analyzing them is important for a complete understanding of how the phenomenon manifests itself.

Finally, it is important to note that, given the changes that the geosystem is undergoing, the incidence of vegetation fires is expected to increase, which is why cooperation between the authorities and members of society is essential to limit the consequences that these fires could have.

References

Akyürek, Ö. (2023). Spatial and temporal analysis of vegetation fires in Europe. Natural Hazards, 117 (1), 1105-1124.

Băcăuanu, V., Barbu, N., Panzanica, M., Ungureanu, Al., Chiriac, D. (1980). The Moldavian Plateau. Nature. Man. Economy, Enciclopedică Publishing House, Bucharest.

Bowman, D. M., Balch, J. K., Artaxo, P., Bond, W. J., Carlson, J. M., Cochrane, M. A., ... & Pyne, S. J. (2009). Fire in the Earth system. Science, 324(5926), 481-484.

Bowman, D. M., Kolden, C. A., Abatzoglou, J. T., Johnston, F. H., van der Werf, G. R., & Flannigan, M. (2020). Vegetation fires in the Anthropocene. Nature Reviews Earth & Environment, 1(10), 500-515.

Brown, T., Leach, S., Wachter, B., & Gardunio, B. (2020). The Northern California 2018 extreme fire season. Bulletin of the American Meteorological Society, 101(1), S1-S4.

Buggeln, R., & Rynk, R. (2002). Self-heating in yard trimmings: conditions leading to spontaneous combustion. Compost science & utilization, 10(2), 162-182.

Burlui, I. (2013). Fire risk management in the forests of Suceava County – Doctoral thesis, Faculty of Forestry, "Ștefan cel Mare" University of Suceava.

Burlui, I., & Burlui, C. M. (2019). Manifestation of fire risk in Romanian forests between 1995 and 2018. Journal of Forestry and Hunting, 24(45).

Certini, G. (2005). Effects of fire on properties of forest soils: a review. Oecologia , 143: 1-10.

Chen, J., Dai, A., Zhang, Y., & Rasmussen, K. L. (2020). Changes in convective available potential energy and convective inhibition under global warming. Journal of Climate, 33(6), 2025-2050.

Conard, S. G., & Ponomarev, E. (2020). Fire in the North. Wildfire, 29, 26-32.

Davey, S. M., & Sarre, A. (2020). The 2019/20 Black Summer bushfires. Australian Forestry, 83(2), 47-51.

Drăgan, M., & Munteanu, G. (2024). Vegetation fires in Romania: an overview. Risks and Catastrophes Journal. 33. 10.24193/RCJ2023_10.

Fernandes, P. M., Santos, J. A., Castedo-Dorado, F., & Almeida, R. (2021). Fire from the Sky in the Anthropocene. Fire, 4(1), 13.

Filkov, A. I., Ngo, T., Matthews, S., Telfer, S., & Penman, T. D. (2020). Impact of Australia's catastrophic 2019/20 bushfire season on communities and environment. Retrospective analysis and current trends. Journal of safety science and resilience, 1(1), 44-56.

Ganteaume, A., Barbero, R., Jappiot, M., & Maillé, E. (2021). Understanding future changes to fires in southern Europe and their impacts on the wildland-urban interface. Journal of safety science and resilience, 2(1), 20-29.

Goss, M., Swain, D. L., Abatzoglou, J. T., Sarhadi, A., Kolden, C. A., Williams, A. P., & Diffenbaugh, N. S. (2020). Climate change is increasing the likelihood of extreme autumn wildfire conditions across California. Environmental Research Letters, 15(9), 094016.

Government Emergency Ordinance No. 92 of August 19, 2021 on waste management. Avaible online: https://legislatie.just.ro/Public/DetaliiDocument/245846 (accessed on 19 october 2025).

Hantson, S., Andela, N., Goulden, M. L., & Randerson, J. T. (2022). Human-ignited fires result in more extreme fire behavior and ecosystem impacts. Nature communications, 13(1), 2717.

Horodnic, V., Mihăilă, D., Bistricean, P. I., & Efros, V. (2020). Spatial and statistical of the natural fire regime in Botoșani and Suceava counties (Romania). In Environment and sustainable development, 143-145.

Levin, N., Yebra, M., & Phinn, S. (2021). Unveiling the factors responsible for Australia's Black Summer fires of 2019/2020. Fire, 4(3), 58.

National Meteorological Administration (n.d.). Activity reports for 2019, 2020, 2021, 2022, and 2023.

National Meteorological Administration (2025). Press release. 2024 - the hottest year in the history of meteorological measurements in Romania.

Pausas, J. G. (2022). Pyrogeography across the western Palaearctic: A diversity of fire regimes. Global Ecology and Biogeography, 31, 1923–1932. https://doi.org/10.1111/geb.13569.

Pyne, S. G. (2019), Fire: a brief history, second edition, University Washington Press.

San-Miguel-Ayanz, J., Durrant, T., Boca, R., Maianti, P., Liberta`, G., Jacome Felix Oom, D., Branco, A., De Rigo, D., Suarez - Moreno, M., Ferrari, D., Roglia, E., Scionti, N., Broglia, M., Onida, M., Titan, A. et. Loffler, P., (2024). Forest Fires in Europe, Middle East and North Africa 2023, Publications.

Stan, V., Fîntîneru, G., & Mihalache, M. (2014). Multicriteria analysis of the effects of field burning crop residues. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 42(1), 255-262.

Tufescu, V. (1977). Botoșani County, "Counties of the Fatherland" collection, Academy Publishing House, Bucharest.

***2019–2024. Database requested by application to the "Nicolae Iorga" Emergency Situations Inspectorate in Botoșani regarding vegetation fires.

***2019–2024. Database requested by application to the "Bucovina" Emergency Situations Inspectorate in Suceava regarding vegetation fires.