

ADVANCES IN FOREST FIRE RESEARCH

2022

Edited by
**DOMINGOS XAVIER VIEGAS
LUÍS MÁRIO RIBEIRO**

Forest fire history of Poland

Jan Kaczmarowski*¹; Wojciech Kędziora²

¹General Directorate of State Forests. ul. Grójecka 127, 02-124 Warsaw, Poland,
{jan.kaczmarowski@lasy.gov.pl}

²Warsaw University of Life Sciences. ul. Nowoursynowska 159, 02-787 Warsaw, Poland,
{wojciech_kedziora@sggw.edu.pl}

*Corresponding author

Keywords

Fire regime, wildfire, fire causes, pyrogeography, forest fire statistics

Abstract

Scots pine (*Pinus sylvestris* L.) covers around 60% of Poland's forests. Pine stands are considered as fire prone, which exposes a large area of forests to the risk of fire ignition and spread. This is confirmed by the statistics, among which Poland belongs to the group of European countries where forest fires occur most often. In addition, the most common cause of fires is deliberate arson. The contemporary fire pattern in lowland forests in Poland is characterised by a large number of fires with a small burnt area.

Understanding historical fire regime is important for the correct assessment of contemporary phenomena. However, compared to boreal or Mediterranean biomes, the characteristics of historical forest fires in Poland are not well researched. To fill this knowledge gap, a review of national thematic literature and historical documents was carried out. There is a limited literature describing a historical fire situation and just few studies have quantified the historical frequency of forest fires. Documentary records are often incomplete, both in time and space. In our research, to better understand the forest fire history paradigm, we took a holistic approach, integrating data from archives, historical sources (research literature and handbooks), press reports, scientific papers, and existing fire databases. An attempt to reconstruct the history of forest fires was carried out for Poland, considering that the modern borders were established in 1945. The reconstruction of fire event chronology and statistics (annual number of fires and burnt area) is presented, which will give a picture of this phenomenon in its various aspects, including periodisation in the decades, with particular emphasis on the 20th and 21st centuries.

This research allowed for the reconstruction of fire statistics in the period from 1920 to the present day. Due to historical conditions, the data for the period 1920-1945 are incomplete, mainly the information on the number of fires is unavailable. The available data show that at least 210,000 ha of forests were burnt during this period. In the years 1946-2020 in Polish forests 342,204 fires occurred, as a result of which 407,093 ha were burnt. The largest number of forest fires (17,088) was recorded in 2003, while the largest area was burnt in 1992 (43,755 ha). On an annual average, in the years 1946-2020 there were 4,562 fires on an area of 5,428 ha, and the area of a single fire was 1.19 ha. In the analysed period, it was observed that the largest number of fires occurred in the decade of 2001-2010 (approx. 9.4 thousand per year), and the largest area of fires in the decade of 1991-2000 (approx. 11 thousand ha per year). The average area of a single fire decreased from 2.35 ha in the decade of 1951-1960 to 0.44 in the last decade.

It is the first such complete study of the history of fires in Poland and it may establish the basis for further work on understanding the fire regime of Central European lowland forests.

1. Introduction

Due to the historical socio-economic transformations and development of silviculture knowledge, as well as climate and soil configuration, Scots pine became the dominant species in the Central European lowlands in the 19th century. This species finds the most suitable growing conditions in Poland. This is the main reason *Pinus sylvestris* is the dominant species in Polish forests and currently covers over 60% of the forest area. Pine stands, because of the high flammability of resins and essential oils, are susceptible to fires, which exposes a large area of forests in Poland to the risk of ignition and their rapid spread – an example of such a devastating fire was the one in 1992, during which almost 10,000 ha were burnt. This means that the species composition of Polish stands is an environment favourable to the growth of fire of considerable size.

The influence of the dominant species on the possibility of fire ignition is confirmed by the statistics, among which Poland belongs to the group of European countries where forest fires occur most often. In addition, the fact that the most common cause of fires is deliberate arson raises the problem to a higher level. Poland, Spain and Italy are the only three European countries where deliberate fires are the most representative cause. In all other European countries, outbreaks of forest fires result from human activity with no intention of causing damage (i.e. accident or neglect).

The contemporary fire pattern in the Central European lowland forests in Poland is characterised by a large number of fires (approx. 7,300 annual average in the last decade) with a small total burnt area (approx. 3,000 ha per year). This translates into low values of the average area of a single fire (0.44 ha). This characteristic places Poland in the top three in terms of the number of fires in Europe but in terms of the area around the 10th place (depending on the year).

Understanding historical fire regimes is of fundamental importance for the correct assessment of contemporary phenomena. Understanding the characteristics of fire history might help in identifying the impacts of climate change, understanding ecosystem processes, and developing fire management principles and objectives. However, compared to boreal or Mediterranean biomes, the historical characteristics of forest fires in Poland are not well researched. To fill this knowledge gap, a review of local thematic works and historical documents was carried out. There is limited literature describing a historical fire situation, and few studies have quantified the historical frequency of forest fires. Documentary records are often incomplete, both in time and space. This situation was influenced by historical events, ranging from the partitions of the country, through the First World War, the incompatibility of various forest management systems in 3 parts of the post-war country, intense warfare during World War II, and the change of the country's borders in 1945. Moreover, during the period 1945-2020, Poland has increased its forest share from 20 to 30%, planting new forests at over 3 million ha. These changes likely affected the pattern of the forest fires as well.

2. Methodology

In this study, to better understand the forest fire history paradigm, a holistic approach was used, integrating data from archives, historical sources, available literature (both scientific and branch textbooks for the forestry sector published during the analysed period), press reports, and existing fire databases.

The collected materials made it possible to systematize the historical data on forest fires in terms of numbers and area burnt, and the following parameters were calculated: **average area of single fire** – determined as the quotient of the annual sum of forest area burned and the number of fires expressed in hectares, which is a measure of the effectiveness of the forest fire protection system, **fire concentration** – the density of the number of fires calculated per 1000 ha of forest, **burnout intensity** – determined as the quotient of the burnt area in a given year and the forest area expressed in hectares per 1000 ha. The last two parameters make it possible to compare the dynamics of changes in the number of fires and the burnt area, taking into account the changes in Poland's forest cover over time.

In addition, the research also focused on the historical background that allows for understanding the context and the changing paradigm of forest fires and their significance in individual decades.

3. Results

The research carried out in this study allowed for the reconstruction of fire statistics for the entire country from 1920 to the present. The analysis of fire data over more than 100 years also provides insight and perspective into the context of changes taking place in Polish society and forest management.

The first Polish archival records referring to the issue of forest fires appear in the "Warcki Statutes" of 1423. The legal provisions contained therein prohibited lighting fires in the forest or in its vicinity under pain of death. Documents drawn up in the following centuries mainly described bans on using fire and the penalties for disobeying them. From the mid-seventeenth century onwards, more detailed instructions on how to protect forest property against fire and how to prevent it began to appear. However, there is no aggregated source material on the extent of forest fire losses in Poland before the second half of the 20th century.

Due to historical conditions, the data for the period 1920-1945 is incomplete, mainly the information on the number of fires is missing. The available data show that at least 210,000 ha of forests were burnt during this period. After World War I and the regaining of independence, Polish forests were devastated by the predatory economy of the occupying powers and as a result of prolonged warfare. The damaged, understocked and grass covered forests often felt victim to fires. However, during the entire inter-war period (1918-1939), forest fires were of little economic importance due to the species composition of forest stands at that time, their geographical location and limited penetration of forests by the public. Losses caused by forest fires in the period of World War II (1939-1945) were estimated at 150,000 burnt hectares.

In the following post-war years (1946-1950), the fire situation remained at a similar, high level. The post-war consequences and causes of the deteriorating forest fire safety situation included: people's disinclination to obey the rules, lowered sense of responsibility and negligence, explosives and mines scattered in the forests as well as partisan units stationed in the forests.

Compared to the first years of post-war history, the situation in the following decade (1951-1960) calms down and the losses caused by forest fires decrease significantly. Forest fire protection becomes a very important issue in the national economy. Between 1961 and 1970, an average of about 1,500 fires occur annually in forests on an area of almost 2,300 ha, deliberate arson is quite rare, sporadic cases have no social significance.

By the end of the 1970s, as a result of post-war afforestation of wasteland and poor agricultural land, the forest cover of the country reached 27% (compared to 20.8% in 1946). Huge forest patches of pine monocultures were created (the share of this species in the forest stand composition reached 70%), which made the Polish woodlands prone to forest fires. In the decade of 1971-1980 almost 1,900 forest fires burning 2,600 ha occurred annually.

Extreme water shortages in the summers of 1982 and 1983 resulted, inter alia, in the first catastrophic (>1000 ha) forest fire after the Second World War. The '80s also showed the beginning of a worrying trend of increasing numbers of fires from arson. It resulted in increased annual number of fires (3300) and area burned (4300 ha).

Industrial pollution contributed to the increase in forest fire danger in the 1990s, damaging, to varying degrees, up to 80% of the country's forest stands. This contributed to the overexposure of stands, the weed infestation of the forest floor, and increase of fuel load. In comparison with the previous decades, there was a clear, dynamic increase in the average annual values characterising the fire seasons. During systemic transformation in Poland (1989-1991), intentional arson became an increasingly important cause of fires. The year 1992 turned out to be disastrous, when 43,755 ha of forest (resulting from 11,858 fires) were burnt. This area represented 9.68% of the total area burnt that year in the forests of Europe. The most tragic fire occurred on 26 August 1992 in Kuźnia Raciborska - it reached in total 9,062 ha. Because of the number of forces involved in its extinguishing and the tragic death of rescuers that fire has remained to this day the most tragic wildfires in the modern history of Poland. The groundbreaking events of 1992 had a huge impact on the directions of improvement of the State Forests fire protection system, the effects of which will be visible in the coming decades. Annually, more than 8,300 forest fires started that damaged over 10,000 ha.

The first decade of the new millennium brought a record annual average number of fires – 9,300 in forests of all ownership forms. This positions Poland in the group of European countries where fires occur most frequently. The largest number of forest fires was reported in 2003, when there were over 17,088 fires in a total area of 21,500 hectares. It was record year by ignition number in Poland's post-war history, which was caused by illegal and uncontrolled agricultural burning. After joining the European Union, the problem lost its importance.

Between 2011 and 2020 there were 72,785 forest fires with a total area of 31,674 ha. This means that in Poland we are dealing with a large number of small incidents. In the last decade, no further upward trend in the number and area of forest fires has been observed, which allows us to conclude that the forecasted upward trend in these characteristics, related to the effects of climate change, has not yet taken place in the area of Poland.

In the years 1946-2020, 342,204 fires occurred in Polish forests, as a result of which 407,093 ha were burnt.

Table 1 - Forest fire statistics in decades from 1951 to 2020

Years	Forest fire no.	Mean	Median	Area burned [ha]	Mean	Median	Single fire avg area	Fire concentration	Burnout intensity
1951-1960	14 998	1 500	1 585	35 294	3 529	3 423	2.35	0.20	0.48
1961-1970	15 134	1 513	958	23 388	2 339	1 607	1.55	0.19	0.29
1971-1980	18 728	1 873	1 765	26 459	2 646	1 990	1.41	0.22	0.31
1981-1990	32 929	3 293	3 431	43 220	4 322	4 085	1.31	0.38	0.50
1991-2000	83 649	8 365	8 172	109 146	10 915	7 652	1.30	0.95	1.24
2001-2010	93 909	9 391	8 979	57 833	5 783	3 572	0.62	1.04	0.64
2011-2020	72 785	7 279	6 882	31 674	3 167	2 793	0.44	0.79	0.34

4. Summary

On an annual average, in the years 1946-2020, there were 4,562 fires on an area of 5,428 ha, and the area of a single fire was 1.19 ha (table 1). In the analyzed period, it was observed that the highest number of fires occurred in the decade of 2001-2010 (approx. 9.4 thousand per year), and the largest area of fires in 1991-2000 (approx. 11 thousand ha per year). The average area of a single fire decreased from 2.35 ha in the 1950s to 0.44 in the last decade. Taking into consideration changes in forest area, fire concentration was stable until 1980s and peaked in 2001-2010, whereas burnout intensity is now very low compared to 1990s.

It is the first such complete study of the history of fires in Poland and it may make up the basis for further work on understanding the fire regime of Central European lowland.