

Project *brief*

Thünen-Institut of Forest Ecosystems

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Forest fire history in Germany (2001-2020)

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- **Coniferous forests are more affected by forest fires**
- **Human wrongdoing is the most frequent cause of forest fires**
- **Brandenburg is the federal state most affected by forest fires**

Background

Prolonged periods of heat and drought have in recent years repeatedly led to an increased risk of forest fires in Germany. In addition to meteorological conditions and topography, forest and site characteristics influence the forest fire risk. The joint FNR-project ErWiN (*Expansion of ecological, silvicultural and technical knowledge on forest fires*) expands the information base through the retrospective analysis of forest fire data from the past 20 years and thus generates important foundations for the knowledge-based management of forest fires.

Study aim

At the Thünen Institute of Forest Ecosystems, the development of dynamic vulnerability maps is planned, which, in addition to weather-based forest fire risk indices, also take into account relevant forest structural parameters.

Approach

A geographic information system was created from forest damage reports and forest fire statistics of the last 20 years. The data on location, area size and occurrence of the fires, as well as information on the cause of ignition are linked with data on forest structural parameters and weather conditions and thereafter spatially and temporally analysed.

First results

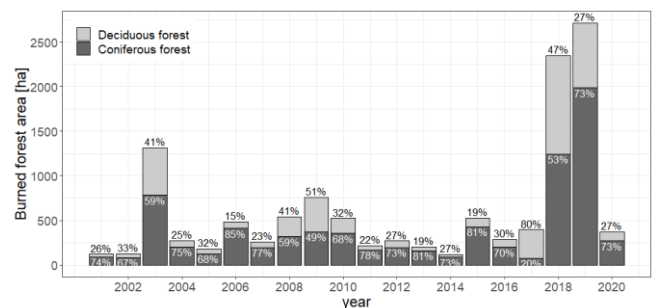
Temporal and spatial distribution of forest fires

Between 2001 and 2020, a total of 18.138 forest fires with damage to a total area of around 12.068 ha were registered in Germany, 65 % of them in coniferous forests. In the years 2003, 2018 and 2019, forest fire occurrence was particularly high both in terms of frequency and burned area (Figure 1).

Between 2001 and 2020, Brandenburg was the most affected region, with almost 32 % (=5.782) of all forest fires recorded in Germany, accumulating to 51 % (=6.154 ha) of the nation wide burned area (Figure 2).

With 2.524 fires, by far the most forest fires were recorded in 2003. The largest forest fire losses in terms of area within one year were registered in 2019 with a total of 2.711 ha, with a share of affected coniferous stands at 73 % (=1.985 ha).

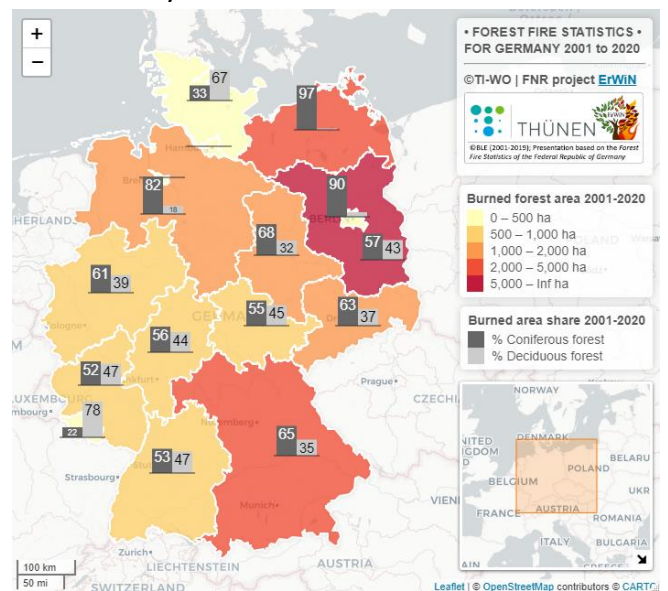
Figure 1: Annual totals of forest fire areas in Germany (2001-2020) grouped by coniferous and deciduous forest



Source: Waldbrandstatistiken der Bundesrepublik Deutschland (BLE, 2021)

The spatial pattern in the ranking of the federal states most affected by forest fires is also reflected in the distribution of coniferous forests. This is also reflected in a gradient between the north-eastern lowlands and the federal states in the south-west and Schleswig-Holstein in the north of Germany. The focus of forest fires is Brandenburg, which has the highest proportion of pure coniferous forests in Germany at 49 % (BWI3, 2012).

Figure 2: Spatial distribution of cumulative forest fire area in the federal states of Germany from 2001 to 2020

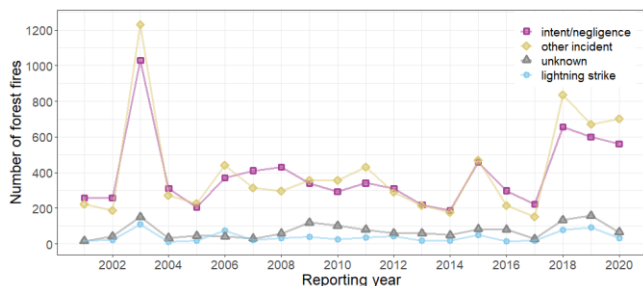


Source: Waldbrandstatistiken der Bundesrepublik Deutschland (BLE, 2021)

Causes of forest fire

The most frequent cause of forest fires in Germany between 2001 and 2020 is human wrongdoing, with 34 % (=7.756) of the forest fires and about 48 % (=3.156 ha) of the area attributed to intentional or negligent actions. In comparison, just about 5 % of forest fires and only about 2 % of the burned area are caused by lightning (Figure 3).

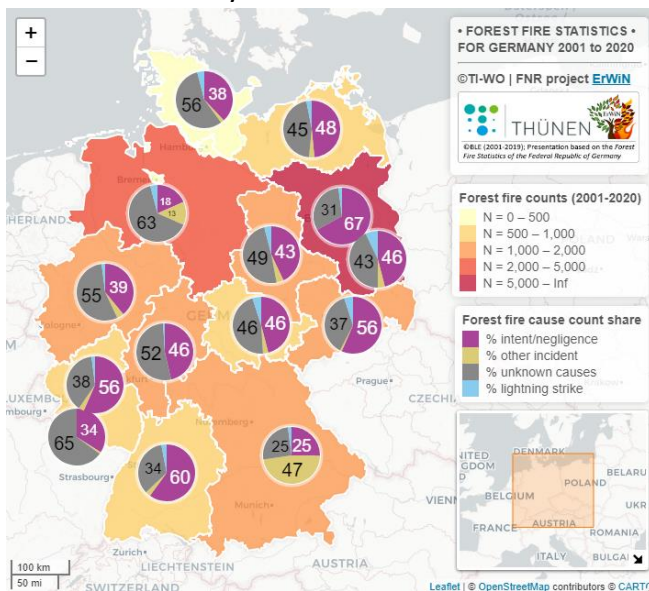
Figure 3: Annual totals of forest fire occurrences in Germany (2001-2020) categorised by forest fire causes



Source: Waldbrandstatistiken der Bundesrepublik Deutschland (BLE, 2021)

Ranking the federal states according to the proportion of intentionally or negligently caused forest fires caused in relation to the total number of forest fires, Berlin takes first place with around 67 %, followed by Baden-Württemberg with 60 % and Saxony and Rhineland-Palatinate with around 56 % each (Figure 4).

Figure 4: Spatial distribution of cumulative forest fire occurrences in the federal states of Germany from 2001 to 2020



Source: Waldbrandstatistiken der Bundesrepublik Deutschland (BLE, 2021)

Climatic context

The heat waves in 2003 and 2019 were among the strongest ever in Central Europe (DWD, 2019). During the heat waves of 2018 and 2019, the forest fire risk index (WBI) increased, especially in the northern and eastern parts of Germany. The highest forest fire risk index levels were reached on an exceptionally number of days (UBA, 2020).

Longer vegetation periods, as shown by the phenological observations of the intensive forest monitoring sites (Level II), combined with low precipitation and above-average high temperatures, especially in April and May, led to a deficit in the climatic water balance in large parts of Germany (DWD, 2019). This longer growing season and the pronounced heat and drought in 2018/19 contributed to a longer forest fire season with a significantly increased risk situation. In relation to the forest fire areas recorded in Germany over the last 20 years, monthly totals of more than 1.000 ha/month were reached in the months of April to August. The cumulative values for June and July reached more than 2.000 ha/month.

Table 1: Forest fire areas aggregated by month and year

hectare	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Σyear
2001	0	0	2.3	27.6	49.7	8.3	19.2	14.4	0.2	0.1	0.1	0	122
2002	0.2	0.3	13.7	38.6	16.2	14.9	16.4	11.7	10.2	0.2	0	0	122
2003	0	1.1	155	373	101	104	138	409	31.5	1.8	1.1	0	1315
2004	0	0.7	27.9	147	36.4	11.7	5.6	32.9	12.4	0.1	0	0	275
2005	1	0	4.1	47.2	33.8	49.6	40.6	1.6	4	1.7	0	0	184
2006	0	0	0.4	8.1	34	40.7	368	17.5	12.7	1.1	0	0	482
2007	0	0	22.8	169	43.1	7.3	7.3	1.6	4.2	0	0	0	255
2008	0.1	13	10.3	9.8	84.3	302	82.9	34.1	1.1	1	0	0	539
2009	0	0	62.9	252	144	13.1	134	115	35.3	1.1	0	0	758
2010	0	0	15.6	45.7	16.7	43.9	377	14.4	8.7	0.3	0	0	522
2011	0	0.7	25.2	51	67.8	33.8	11.9	1.7	2.5	4.2	15.7	0	215
2012	0.2	7.4	51.6	41.4	99.4	13.1	8	36.4	11.5	0	0	0	269
2013	0	0	6.8	21.8	23.1	5.5	77.4	51.9	10.5	1.3	0.2	0	199
2014	0.1	1.4	18.5	20.7	9.2	28.3	30	10.1	1.5	0	0	0	120
2015	0.1	0.5	14	99.1	22.7	76.8	235	67.6	2.8	3.1	2.7	2.2	526
2016	0.1	0	3.2	26.7	79.1	26.9	17.4	13.6	79.3	1.6	0	35.7	284
2017	0.01	8.5	20.3	46.7	278	74.4	12.4	11.9	2.02	0.11	0	0	455
2018	0.03	1.11	6.49	48.4	77	62.5	695	887	530	40.6	0.89	0.16	2349
2019	0.61	7.04	11.6	149	38	2115	320	53.4	16.1	0.43	0.02	0.01	2711
2020	0.03	0.08	7.65	112	106	28.6	21.8	79	11.4	0.38	0.11	0.07	368
Σmonth	2.48	41.8	480	1736	1361	3060	2616	1864	788	59.1	20.8	38.1	12068

Source: Waldbrandstatistiken der Bundesrepublik Deutschland (BLE, 2021)

It is striking that the forest fire area in June 2019 accounts for 69 % of the monthly total in the entire observation period. In relation to the annual total for 2019, this corresponds to a share of 78 % (Table 1). Spontaneous combustion in ammunition conterminated forests, such as former military (training) areas, led to a series of extensive fires in 2018 and 2019, in which several hundred hectares of forest burned near Jüterbog and in the Lieberoser Heide as well as near Lübtheen.

Conclusions and outlook

Initial findings from the GIS-based analyses of the forest fire data collected in Germany between 2001 and 2020 are:

- The majority of forest fire damaged areas are located in those federal states with a comparatively high proportion of coniferous forest type and pure coniferous stands.
- A special role in the spatio-temporal distribution and the area burned is due to ammunition contermination e.g. on former military training grounds.
- A good third of all forest fires and almost half of the forest fire areas can be attributed to human wrongdoings.

In further work steps, analyses of the proximity to settlements and fragmentation of forests, the linking with forest structure and climate parameters as well as the development of scenarios for forest fire risk modelling are planned.

Further information

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