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Spatial Variability of Forest Fires in the Polish Voivodeships in the Period of 2009–2018

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ABSTRACT

The article deals with the issue of forest fire risk and regional differentiation of this phenomenon in Poland. A set of indicators characterizing forest fires in voivodeships (equivalent of provinces) was developed, including: area indicators, variability indicators, 10-year indicators, normalized indicators and a synthetic indicator. The study is based on the data for the years 2009-2018 provided by the Local Data Bank. Assessment of the severity of forest fires phenomena in the analysed period was presented. The results of the assessment were compared to theoretically designated fire risk categories. Areas where the actual number of fires, average area and the burned area were adequate to the forecasted degree of fire risk were indicated. Additionally, the obtained results allowed to identify the voivodeships where the characteristics of forest fires for the analysed period differed from the forest fire risk degree found in the literature. This indicates the complex nature of the phenomenon resulting from, inter alia, large variability of factors that determine the occurrence of forest fires. An example of such a situation is the Lubuskie Voivodeship which is assigned to the medium fire risk category, while the actual intensity was found to be low. Another example is the Podkarpackie Voivodeship with a medium and low fire risk, where over the past 10 years the intensity of the phenomenon was high.

Keywords: forest fire, fire statistics, fire risk

INTRODUCTION

Forest fires are a threat with far-reaching consequences in the natural, economic and social terms. The spatial extent of this phenomenon is significant at local, sub-regional, regional, national, continental, as well as global levels. The studies conducted by Van Lierop et al. [2015] indicated that the annual burned forest area is highest in the tropical domain and in the South American region. It is estimated that over 40% of the world's forests are under threat, while in Europe even over 60% [Grajewski 2017, Szczygieł 2012]. The scale of the problem can be illustrated by the statistical data for the selected 22 countries of Western, Northern and Central Europe for recent years. For example, in 2018 there were 53584 fires with the burnt area amounting to 342,502 ha, while in 2017 there were 63522 fires and 984,762 ha of burnt area [JRC Technical Report 2019, 2018]. In the case of European countries, the nature and intensity of the phenomenon vary considerably due to the climate differences, elevation, terrain characteristics, and hence the vegetation cover. The Southern European countries are considered to be the most threatened by fires, primarily those in the Mediterranean basin, due to hot and windy weather in summer and flammable vegetation [Lemasson, 1998; Mierczyk and Mycke-Dominko 2013]. The statistical analyses performed by Grajewski [2017] for the years 1990-2015, regarding the number and size of forest fires located in Portugal, Spain, Greece, and Croatia indicate an upward trend. The most favourable situation in terms of the number and the area of forest fires, is found in Scandinavia, mainly due to the existing natural conditions. However, the occurrence of forest fires is not only

related to the climate and weather conditions. It is also associated with such anthropogenic factors as land use, location of built-up areas, population density, as well as the agricultural use of neighbouring areas and cultural factors.

Expanding the knowledge on location and timing of forest fires occurrence, including ignition cause, lead into more efficient prevention measures that can be oriented to limit the specific factors favouring ignition occurrence. Such activities include public education, legislative instruments governing land use planning and land management, as well as law enforcement and vigilance in case of intentional arson [Gonzalez-Olabarria et al. 2015].

Poland, in relation to other European countries, is rated at an average level in terms of the number and frequency of forest fires. Medium and high fire risk concerns about 83% of forest area [Szczygieł 2012]. In the national level, however, there is visible spatial differentiation in the level of intensity of the phenomenon, which is caused by several reasons. For the purpose of determining the fire risk categories according to similar levels of susceptibility to fire, the following factors were identified: frequency of fires in the last 10 years, forest stand features (age, forest site types), climatic conditions (average relative air humidity and percentage of days with litter humidity below 15%) and anthropogenic conditions (number of inhabitants in relation to the forest area). The criteria listed above were published in the Regulation of the Minister of the Environment of 22 March 2006 on detailed rules of forest fire protection (Dz.U. 2006 No. 58, Item 405, as amended). In accordance with the Regulation, three categories of forest fire risk were designated: category I – high risk, category II – medium risk, category III – small risk. Classification of areas into a given category may take place on both forest districts and national parks levels, as well as in relation to administrative units [Szczygieł 2012].

The results of this type of categorization are applied in the recommendations for forest management plans, plans for the protection of national or landscape parks, as well as the objectives and development directions set up in planning documents of administrative units at various levels. Consequently, public administrative authorities use them as the guideline for decision making on various types of actions, directly and indirectly related to fire protection. One of the priorities of spatial policy is the protection of forest land from the pressures of increasing urbanisation, and land changes to non-forest purposes occur to a small extent [Pawłat-Zawrzykraj and Podawca 2019, Podawca and Pawłat-Zawrzykraj 2019].

According to the fire risk assessment of poviats (county level units) and voivodeships (equivalent of provinces) developed by Szczygieł et al. [2009] for 2008 data in accordance with the current criteria, poviats were classified as follows:

- forest fire risk category I – 197 poviats (mainly in the centre and in the West of the country),
- forest fire risk category II – 153 poviats were included
- forest fire risk category III – 30 poviats were included.

Classification by voivodeship:

- forest fire risk category I – 6 voivodeships were included (Kujawsko-Pomorskie, Lubuskie, Łódzkie, Mazowieckie, Podlaskie),
- forest fire risk category II – 10 remaining voivodeships,
- forest fire risk category III – none.

The assessment carried out by Szczygiel was reviewed by Pokojska in 2015. The results of the study showed that the share of poviats in categories I and III of fire risk (high and small risk) decreased slightly, while in category II (medium risk) it increased. In both studies, the greatest risk level was assigned to the areas located in the Śląsko-Łużycka Lowland (Lubuskie and Dolnośląskie Voivodships) and the eastern part of the Mazowiecka Lowland (the Mazowieckie Voivodship).

The goal of the study

The main purpose of the analysis was to compare and verify the theoretically determined classification of forest fire hazards in Poland, based on the methodology proposed by Szczygieł [2009] and Pokojska [2015] with the actual state of this phenomenon, as it occurred in the years 2009-2018.

Additional goals were to present the diversity of the voivodeships in terms of the number of forest fires, the actual burnt forest areas, and the size of a single fire incident.

The study covers not only a quantitative assessment but also an analysis in temporal context. The obtained results enable to observe the trends occurring in the yearly reference periods for the individual voivodeships in relation to particular parameters describing the forest fire hazard.

METHODS

In the literature concerning forest fires, many publications have sort of data reporting character, limited to the number of forest fires and the area burnt as a result of these events. This appears to be a too narrow approach in terms of presenting the fire threat degree, and certainly is insufficient in the context of spatial and comparative diversification of this phenomenon. The study proposes an analysis of statistical data based on a set of additional indicators, divided into area, variability and synthetic categories.

The area indicators

Three indicators were used to assess the forest fire situation that occurred in the individual voivodeships:

1) The incidence density indicator $W_{d\text{-}in}$, according to the formula (1):

$$W_{d-in} = \left[\frac{N_{in(20xy)}}{A_{f(20xy)}}\right] \cdot 1000 \text{ [1/1000 ha]} \quad (1)$$

where: N_{in} – number of forest fires [pcs];
A_f – the total forest area [ha],

The indicator is intended to illustrate the frequency of fires in relation to the total forest area in a voivodeship and show whether the number of fires is positively correlated with the size of forest area.

2) The burnt forest area indicator W_{bf}, expressed by the formula (2):

$$W_{bf} = \left[\frac{A_{bf(20xy)}}{A_{f(20xy)}}\right] \cdot 1000 \text{ [–]} \quad (2)$$

where: A_{bf} – burnt forest areas [ha];
A_f – the total forest area [ha],

The indicator shows the percentage of burnt forest areas calculated per 1000 ha.

3) The indicator of average forest fire size W_{af}, calculated by the formula (3):

$$W_{af} = \left[\frac{A_{bf(20xy)}}{N_{in(20xy)}}\right] \text{ [ha]} \quad (3)$$

The indicator aims to determine the degree of a single fire threat and at the same time, the potential duration of a firefighting operation. It was assumed that the smaller the area of a forest fire, the more efficiently it was extinguished and therefore, its spread was limited. It may be a measure of the effectiveness of the forest fire protection system.

Variability indicators

In order to assess the improvement or deterioration of the forest fire situation in the voivodeships, it was decided to show the trend of changes over last 10 years. The following three trend indicators were implemented:

1. The indicator of changes in the number of fires, expressed by the formula (4):

$$WT_{d-in} = \left[\frac{N_{in(20xy)}}{A_{f(20xy)}}\right] \cdot 1000 - \left[\frac{N_{in(20xy-1)}}{A_{f(20xy-1)}}\right] \cdot 1000 \quad (4)$$

The indicator illustrates the increase or decrease in the number of fires in the current year in comparison with the previous one;

2. The indicator of changes in the destruction degree caused by forest fires WT_{bf}, calculated by the formula (5):

$$WT_{bf} = \left[\frac{A_{bf(20xy)}}{A_{f(20xy)}}\right] - \left[\frac{A_{bf(20xy-1)}}{A_{f(20xy-1)}}\right] \quad (5)$$

The indicator shows a decrease or increase in the share of burnt forest area.

3. The indicator of changes in the average fire area WT_{af}, expressed by the formula (6):

$$WT_{af} = \left[\frac{A_{bf(20xy)}}{N_{in(20xy)}}\right] - \left[\frac{A_{bf(20xy-1)}}{N_{in(20xy-1)}}\right] \quad (6)$$

The indicator presents changes in the degree of forest fire risk, i.e. whether they cover larger or smaller areas in relation to a single incidence.

The synthetic indicator

Synthetic assessment of the diversity of the fire situation in the years 2009-2018 was carried out in three stages. In step one, 10-year indicators were calculated for individual area indicators and for each voivodeship, according to the formula (7):

$$W_{d-in10(bf10)(af10)} = \frac{\sum_{n=1}^{10} W_{d-in(bf)(af)}}{10} \quad (7)$$

In the next step, in order to allow comparison, the 10-year indicators for each voivodeship were normalized according to the formula (8):

$$W_{d-in10norm(bf10norm)(af10norm)} = \\ = \frac{W_{d-in10(bf10)(af10)}}{W_{d-in10\,max(bf10\,max)(af10\,max)}} \quad (8)$$

In the last step of the spatial analysis of the fire situation in the years 2009-2018, the synthetic indicator for each voivodeship was determined, according to the formula (9):

$$W_{synt} = 0.5W_{bf10norm} + 0.3W_{af10norm} + \\ + 0.2W_{d-in10norm} \quad (9)$$

In the formula above, appropriate weights were used to reflect the importance of each criterion. It was assumed that from the point of view of environmental protection and sustainable development, the least destruction of forest areas by fires is paramount (weight 0.5). The second most important factor (weight 0.3) is a quick response of the fire services to extinguish the fire, which is reflected in the smallest possible area of a single fire. The lowest weight (0.2) was given to the number of incidents, assuming that the forest fire would be extinguished efficiently and would not lead to the destruction of a large area of forest.

Characteristics of voivodeships in terms of forest fires

The data presented in Table 1 were taken from the Local Data Bank [BDL] in the Agriculture, Forestry and Hunting category for the years 2009-2018. The information relating to forest areas came from the group *Private and commune forests* and subgroup *Forest land area*. The information concerning the number of forest fires and their area came from the group *Threats and forest environment protection* and subgroup *The Forest fires by causes of occurrence.* In addition, the source data were obtained from the annual reports entitled "State Forests in numbers" and from the National Forest Fire Information System.

RESULTS

The values the indicators calculated for annual reporting periods from 2009 to 2018 for each voivodeship are presented in Figures 1–3. According to the obtained results, the larger number of forest fires in relation to 1000 ha took place in the Mazowieckie, Łódzkie, Świętokrzyskie and Śląskie voivodeships, the least in the northern part (Zachodniopomorskie, Pomorskie, Warmińsko-Mazurskie, Podlaskie) and in the southern Poland (Podkarpackie, Małopolskie). It can be also stated that the highest dynamics of changes in the number of fires was observed in

Table 1. Data concerning forest fires in the voivodeships in 2009-2018

No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Voivodeship		Zachodnio-pomorskie	Wielko-polskie	Warmińsko-Mazurskie	Święto-krzyskie	Śląskie	Pomor-skie	Podlaskie	Podkar-packie	Opolskie	Mazo-wieckie	Mało-polskie	Łódzkie	Lubuskie	Lubelskie	Kujawsko-Pomorskie	Dolno-śląskie
Index	Year																
Forest area $A_{ip(20xy)}$ [ha]	2009	826934	778863	752146	331492	400709	676165	621718	671363	257858	802158	439126	386172	706788	568601	425207	606104
	2010	828508	780795	755050	332089	399592	677673	624856	674450	258170	804912	438280	387711	707583	572620	426170	607325
	2011	830633	783340	760064	332487	399954	678226	626532	677953	258246	808810	439765	388597	708201	576420	427147	608387
	2012	832735	784649	763567	332980	401747	679898	627235	680166	258399	812973	440114	389350	709002	579237	427843	609279
	2013	834009	785648	767313	334385	402364	681014	628678	683371	258570	817869	440432	390358	709881	581002	428254	610583
	2014	834760	785998	769824	334796	402607	681537	629184	683462	258846	824660	440664	390950	710350	582405	428491	610968
	2015	835094	786497	771463	335083	402989	682244	630047	685002	258982	828607	440672	391259	710858	583447	428772	611562
	2016	833205	786015	774906	335277	403341	682783	630622	685848	259139	835112	440683	391722	711077	584477	429045	611919
	2017	840435	786783	777517	335770	403765	683461	631277	687992	258932	836080	440846	372238	711424	573550	429605	612305
	2018	841291	787065	780690	336315	404096	684089	632106	689055	259270	836789	440942	392880	711666	586630	429953	612893
Incidents of forest fires $N_{ip(20xy)}$ [pcs]	2009	260	632	261	762	819	388	305	484	205	2027	139	798	666	201	584	631
	2010	235	379	144	257	356	277	122	173	100	1057	130	238	484	156	287	285
	2011	435	810	127	700	718	332	156	353	179	1545	228	584	670	326	514	495
	2012	296	566	108	914	848	247	211	546	212	2007	308	945	563	489	542	463
	2013	229	286	120	408	342	277	137	397	86	1126	140	196	383	230	308	218
	2014	247	398	179	294	374	376	164	259	155	1169	120	279	295	219	396	321
	2015	346	837	337	665	832	431	475	457	258	3559	348	918	645	637	598	914
	2016	259	442	114	324	419	261	135	208	85	1344	97	392	278	195	356	386
	2017	67	186	89	331	279	123	63	232	88	1016	116	224	173	272	112	221
	2018	485	679	194	589	549	424	298	281	165	2110	236	540	703	418	525	671
Burned forest area $A_{bf(20xy)}$ [ha]	2009	52.5	200.73	174.38	469.98	521	104.43	559.98	283.99	43.6	986.9	47.86	376.32	62.98	111.36	149.21	256.26
	2010	89.03	95.58	403.85	125.52	182.47	53.17	298.45	81.5	35.34	280.81	46.59	86.77	73.44	61.58	40.26	171.88
	2011	194.94	121.29	45.18	308.39	336.04	38.45	292.93	158.64	45.01	404.86	82.72	178.69	91.92	96.62	94	188.09
	2012	53.56	219.25	185.02	825.26	819.16	31.26	416.94	1145.52	150.95	1358.85	401.33	608.56	183.48	373.61	194.52	268
	2013	25.44	46.94	25.42	168.86	185.93	39.57	66.75	176.47	13.4	296.26	24.96	40.77	25.21	95.23	26.47	30.86
	2014	43.34	118.41	320.14	236.34	205.22	65.97	229.13	191.49	55.05	450.38	71.46	105.73	30.91	90.91	61.12	414.85
	2015	47.67	141.41	410.77	391.3	355.25	67.26	552.37	698.38	116.03	1531.48	102.26	347.21	95.98	315.44	98.47	238.62
	2016	50.91	50.41	38.84	118.11	138.48	31.62	230.43	125.36	13.14	305.5	26.96	82.25	33	41.91	38.59	125.54
	2017	8.68	38.74	96.42	160	74	8.16	3.61	122.21	16.26	277.08	26.81	48.96	12.68	77.13	10.93	40.86
	2018	226.36	114.1	191.15	147.88	197.3	58.18	81.55	122.21	41.02	502.47	82.5	110.17	118.5	139.52	78.07	485.15

the voivodeships with high risk. The maximum differences in the calculated values were noted in the Mazowieckie Voivodeships (4.30 fires per 1000 ha of forests in 2015, 1.22 in 2017), in the Łódzkie Voivodeship (2.43 in 2012, 0.50 in 2013) and in the Świętokrzyskie Voivodeship (2.74 in 2012, and 0.88 in 2010). The most stable situation in terms of the number of forest fires exists in the Warmińsko-Mazurskie Voivodeship (observed change from 0.44 fire per 1000 ha of forests in 2012 to 0.11 in 2017), in the Zachodniopomorskie Voivodeship (from 0.58 in 2018 to 0.08 in

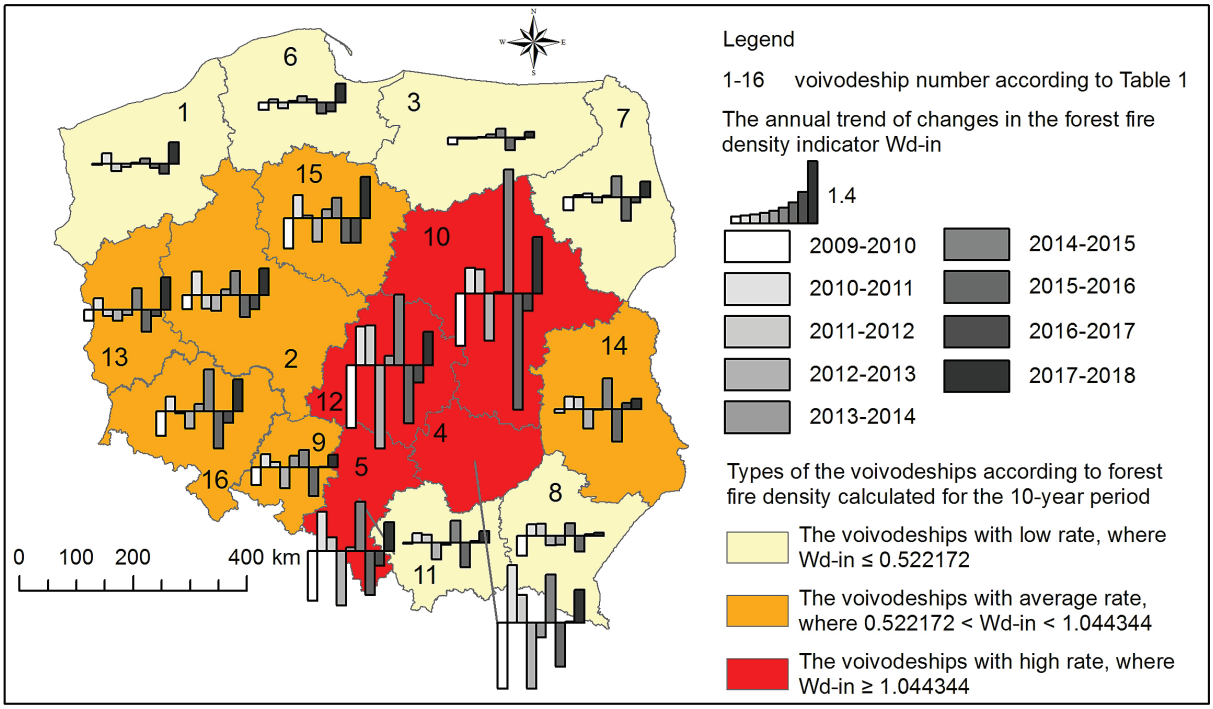

Fig. 1. Diversification of the voivodeships according to forest fire density and the annual changes of the $W_{d\text{-}in}$ indicator

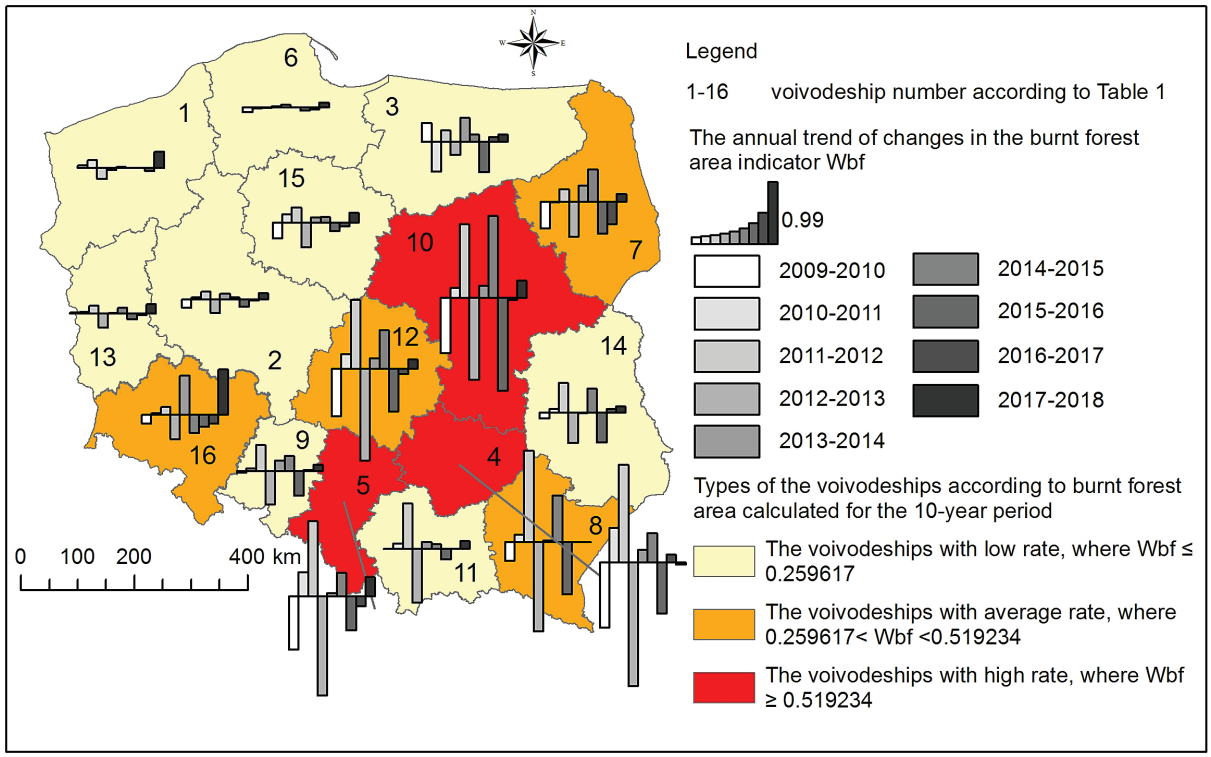

Fig. 2. Diversification of the voivodeships according to the burnt forest area and the change tendencies

2017) and in the Pomorskie Voivodeship (from 0.63 in 2015 to 0.18 in 2017).

The largest forest areas were destroyed by fires in the Mazowieckie, Świętokrzyskie and Śląskie Voivodships, and the smallest areas in the following voivodeships: Pomorskie, Zachodniopomorskie, Lubuskie and Wielkopolskie. Obviously, the maximum changes between individual years occur in the voivodeships of greatest risk, reaching extreme values of W_{bf} indicator from 1.84 in 2015 and 0.33 in 2017 in the Mazowieckie Voivodeship, 2.48 in 2012 and 0.35 in 2016 in the Świętokrzyskie Voivodeship and 2.04 in 2012 and 0.18 in 2017 in the Śląskie Voivodeship.

The smallest range of changes was recorded in the Pomorskie, Zachodniopomorskie, Lubuskie and Wielkopolskie Voivodeships. From a statistical point of view, the most interesting cases are the voivodships with a low level of burnt forests area. However, there is also significant annual variability of this indicator. Such cases include the following voivodeships: Małopolskie (W_{bf} value from 0.91 in 2012; 0.06 in 2013, 2016, 2017), Lubelskie (0.65 in 2012; 0.07 in 2016) and Opolskie (0.58 in 2012; 0.05 in 2016).

The analysis of the average forest fire area described by W_{af} indicator, indicated that the least effective firefighting actions were observed in the Warmińsko-Mazurskie, Podlaskie and Podkarpackie Voivodeships. This problem occurred to the least extent in the following voivodeships: Pomorskie, Zachodniopomorskie, Lubuskie and Wielkopolskie. These units had the most stable situation in terms of the forest fire area, including the years with adverse weather conditions.

The most dynamic trend of changes in this parameter occurred in the Warmińsko-Mazurskie Voivodeship (with the W_{af} values from 2.80 in 2010 to 0.21 in 2013), in the Podlaskie Voivodeship (from 2.44 in 2010 to 0.06 in 2017) and in the Podkarpackie Voivodeship (from 2.10 in 2012 to 0.43 in 2018). Significant differences in the mean forest fire area in individual years, despite a statistically average threat, occurred in the voivodeships: Dolnośląskie (values from 1.29 in 2014 to 0.14 in 2013) and Małopolskie (from 1.30 in 2012 to 0.18 in 2014).

In order to perform synthetic evaluation of the situation in terms of forest fire occurrences in the years 2009-2018, 10-year indicators for each administrative unit were implemented. The obtained indicators were normalized. Finally, the synthetic indicator W_{synt}, that takes into account weighting of each 10-year surface factor, was calculated. The results are presented in Table 2 and in Figure 4.

The values of the normalized indicators as well as the proposed weight values allowed dividing voivodeships into 3 groups according to the level of the negative influence of forest fires on

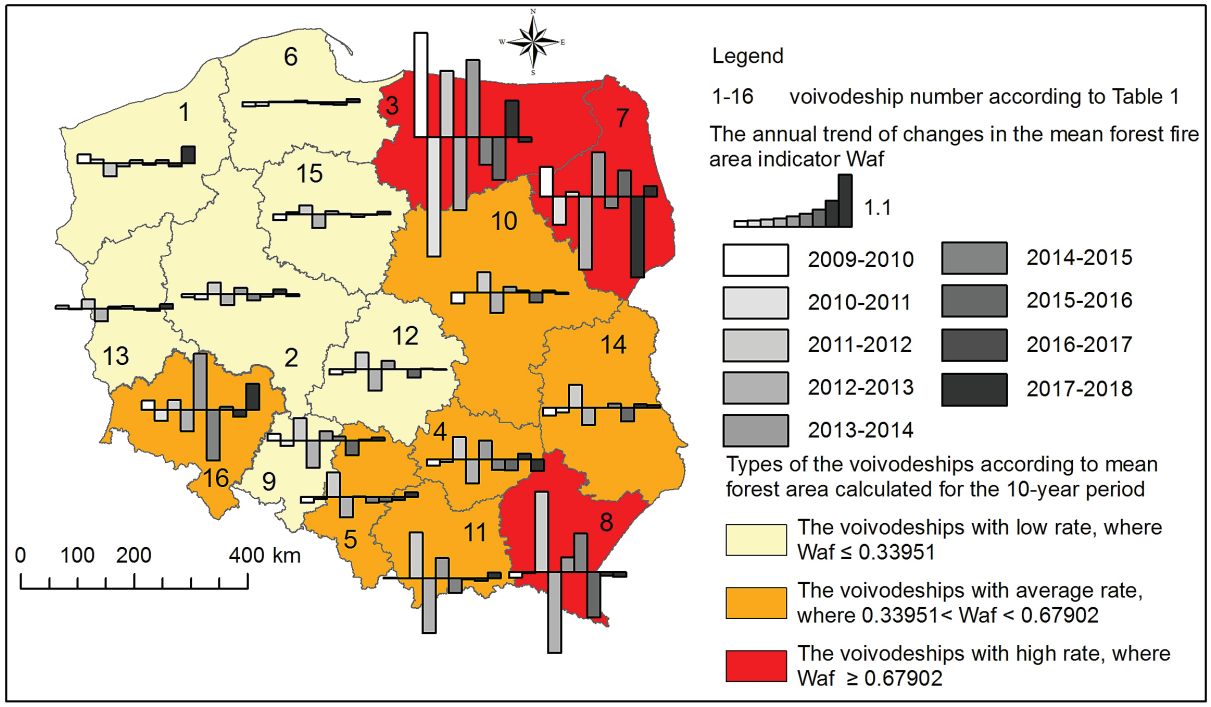

Fig. 3. Diversification of the voivodeships according to mean forest fire area and the change tendencies

Table 2. The indicators describing forest fire situation in the voivodeships in 2009-2018

No.	Voivodeship	$W_{d\text{-}in10}$	$W_{d\text{-}in10norm}$	W_{bf10}	$W_{bf10norm}$	W_{af10}	$W_{af10norm}$	W_{synt}
1.	Zachodnio-Pomorskie	0.34291	0.16602	0.09500	0.10735	0.24270	0.18357	0.18889
2.	Wielkopolskie	0.66483	0.32188	0.14629	0.16532	0.22279	0.16851	0.27295
3.	Warmińsko-Mazurskie	0.21821	0.10565	0.24689	0.27901	1.11701	0.84487	0.50219
4.	Świętokrzyskie	1.57092	0.76057	0.88489	1.00000	0.53538	0.40494	0.91724
5.	Śląskie	1.37727	0.66681	0.75042	0.84805	0.50572	0.38251	0.80238
6.	Pomorskie	0.46076	0.22308	0.07324	0.08276	0.15025	0.11365	0.17385
7.	Podlaskie	0.32890	0.15924	0.43578	0.49247	1.32212	1.00000	0.68030
8.	Podkarpackie	0.49762	0.24092	0.45577	0.51506	0.78817	0.59614	0.56386
9.	Opolskie	0.59278	0.28700	0.20487	0.23152	0.30782	0.23283	0.31334
10.	Mazowieckie	2.06546	1.00000	0.78055	0.88209	0.35085	0.26537	0.90862
11.	Małopolskie	0.42298	0.20479	0.20753	0.23452	0.42948	0.32484	0.31720
12.	Łódzkie	1.31492	0.63662	0.51054	0.57695	0.33837	0.25593	0.61976
13.	Lubuskie	0.68506	0.33167	0.10263	0.11598	0.13894	0.10509	0.23001
14.	Lubelskie	0.54198	0.26240	0.24207	0.27356	0.41658	0.31509	0.35440
15.	Kujawsko-Pomorskie	0.98666	0.47770	0.18512	0.20920	0.16972	0.12837	0.34081
16.	Dolnośląskie	0.75474	0.36541	0.36380	0.41113	0.48962	0.37033	0.47973

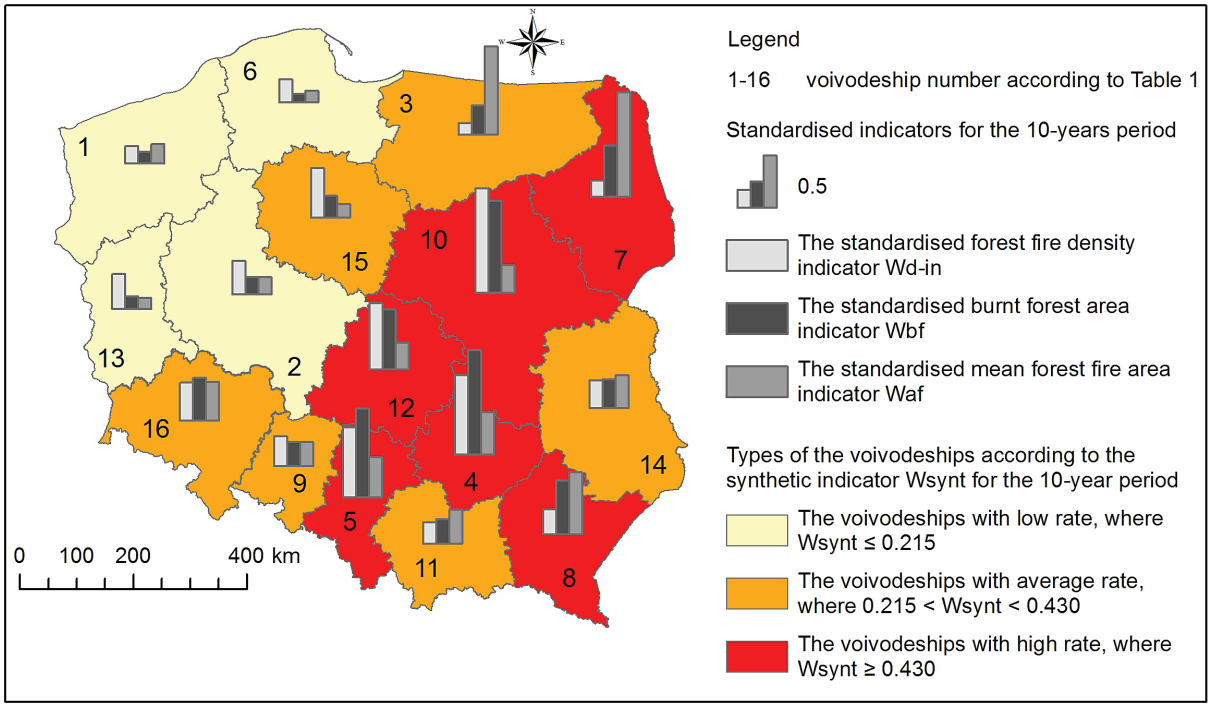

Fig. 4. Diversification of the voivodeships according to the forest fire situation in 2009-2018

the forests themselves. The first group, with the highest level of negative influence in the analysed years of 2009-2018 consists of 6 voivodeships: Mazowieckie, Łódzkie, Świętokrzyskie, Śląskie, Podkarpackie and Podlaskie. The medium level was assessed in the following voivodeships: Warmińsko-Mazurskie, Dolnośląskie, Lubelskie, Kujawsko-Pomorskie, Opolskie and Podkarpackie. The best situation was assessed in the Pomorskie, Zachodniopomorskie, Lubuskie and Wielkopolskie Voivodeships.

DISCUSSION

The study results show that assessment of the forest fire situation varies depending to the selection of parameters that were taken into account. The obtained synthetic picture of the forest fires situation in 2009-2018 was compared with the fire risk categorization carried out by Szczygieł [2009] and Pokojska [2015] that takes into account the forest stand features, climate and anthropogenic conditions.

In comparison with the classification made by Szczygieł [2009], there are three basic groups of units:

- the voivodships, where the assessed forest fire situation in 2009-2018 overlaps with the risk categories; in the case of a high risk level, this refers to the voivodeship Mazowieckie, Łódzkie and Śląskie, in the case of medium risk level, to the voivodeships: Lubelskie, Warmińsko-Mazurskie and Opolskie;
- the voivodships, where the actual fire situation was more favourable than indicated by the fire risk category; this mainly concerns the Lubuskie, Dolnośląskie, Kujawsko-Pomorskie and Wielkopolskie Voivodeships and, to a lesser extent, the Pomorskie and Zachodniopomorskie Voivodeships;
- the voivodships, where the actual forest situation was worse than shown by the fire risk category; this definitely is the case of Podkarpackie, Małopolskie and Świętokrzyskie Voivodeships;

Similar comparisons can be made regarding the categorisation made by Pokojska [2015]. The only differences are:

- in the Małopolskie Voivodeship, where the medium level of forest fire occurrences correlates with the II forest risk category (medium risk),
- in the Łódzkie Voivodeship, assigned to theoretical fire risk category II, whereas the actual situation in the years 2009-2018 was assessed at high risk level.

The most diverse situation with respect to both forest risk classifications and calculated indicators describing the forest fire situation in the last 10 years can be observed in the Podlaskie Voivodship. The assessed fire risk is high [Szczygieł 2009] or medium [Pokojska 2015], whereas the data describing the fire occurrences in 2009-2018 showed a good situation due to the low number of fire incidents, the medium in terms of the burned forests area and bad considering the average fire area.

CONCLUSIONS

Summarising the presented analysis, it should first be noted that the actual forest fire hazard in the individual voivodeships is not associated only with environmental and anthropogenic conditions. This statement is best illustrated by the case of the Lubuskie Voivodeship, which is classified in category I of forest fire risk (high risk). The data describing the actual state of forest fire situation occurring in that part of the country, do not confirm the risk. This is probably due to good monitoring, rapid and efficient response of the fire service and increasing public awareness. An example of the opposite situation is the Podkarpackie Voivodeship, where the theoretically assigned forest fire risk is low but the actual state in 2009-2018 was quite unfavourable.

The analysis of the preliminary indicators for the individual years, clearly show fluctuations in the trends regardless the voivodeship location. This proves an obvious correlation between the climatic conditions and the forest fire situation. Therefore, high values of the indicators for the years 2012 and 2015 and definitely low ones for 2010 and 2017 can be observed in the analysis.

The problem of forest fires is a global threat. However, the available ways for improving or controlling the situation can be discussed at various levels, including regional ones. One may wonder whether, apart from the aspects of the natural and anthropogenic climate changes leading to long periods of drought, high temperatures and strong winds, the human beings themselves are not the most dangerous cause of forest fires. This hypothesis is confirmed by the statistics for the analysed period, which indicate that almost 75% of forest fires were caused by arson, negligence and accidents.

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