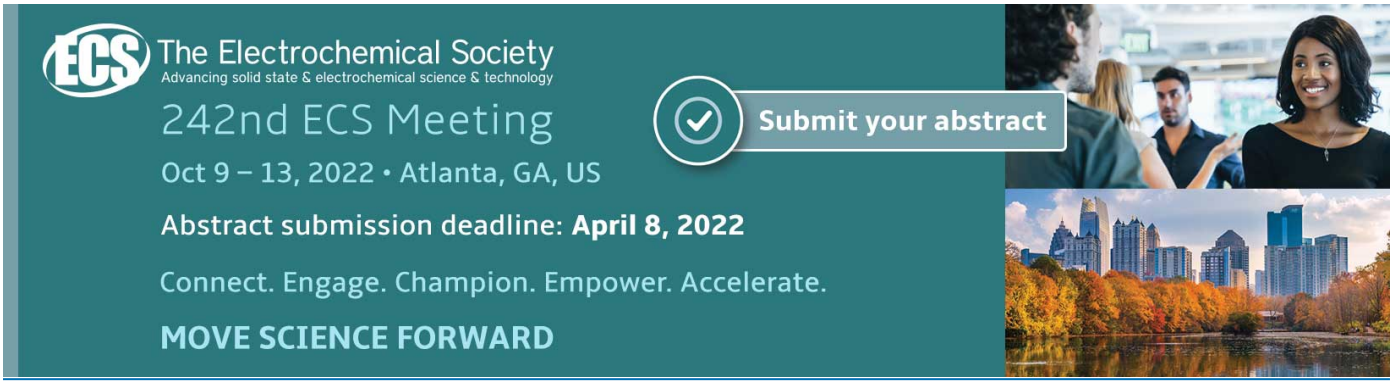
The dynamics of forest fires and their impact on the environment



The dynamics of forest fires and their impact on the environment

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Abstract. The article analyzes the registered forest fires on the territory of the Republic of Bashkortostan in the period from 2018 to 2020. It is established that during the period under review there was an increase in the number and area of forest fires. The causes of most fires were natural (thunderstorms) and human factors.

1. Introduction

Fires have always been one of the main problems of forests [1].

The annual increase in forest fire areas shows not only material damage to the republic, but also negative environmental impact. Fires in forests pollute the atmosphere with harmful substances emitted during the combustion of forest combustible materials, which spread not only in the territory of the republic, but also outside it [2].

The number of forest fires in the period from 2018 to 2020 in the territories of the lands of the forest fund of the Republic of Bashkortostan amounted to 474 fires on an area of 6879 hectares, on the lands of specially protected natural territories - 16 fires on an area of 1999.5 hectares.

2. Object of study

The object of the study is forest fires in the Republic of Bashkortostan.

The total area of forests in the Republic of Bashkortostan is 6307.7 thousand hectares, including forests located on the territory of the forest fund - 5747.7 thousand hectares, on the lands of specially protected natural territories (protected areas) - 380.6 thousand hectares.

Forests are unevenly distributed throughout the territory of the republic, the percentage of forest cover in individual areas is different and depends on physical-geographical, climatic and soil conditions, forest cover ranges from 6-10% in the southwestern regions, to 60-90% in the eastern and northeastern regions of the republic [3].

In accordance with the scale of natural fire danger of plantations, developed by academician I. S. Melekhov, the forest fund within the borders of the Republic of Bashkortostan is distributed in all classes of fire danger [4]. In all regions of the Republic there are forest areas where there is a high fire hazard. The average class of natural fire hazard is 3.1 (Table 1). At the same time, forests of classes I and II of fire danger occupy 22% of the area of forests of the Republic of Bashkortostan (Figure 1).

Table 1. The area of forests of the Republic of Bashkortostan by fire hazard classes.

Fire hazard class	Area, ha
1	164391.8
2	1055227.7
3	2274518.4
4	2023659.1
5	229896.0

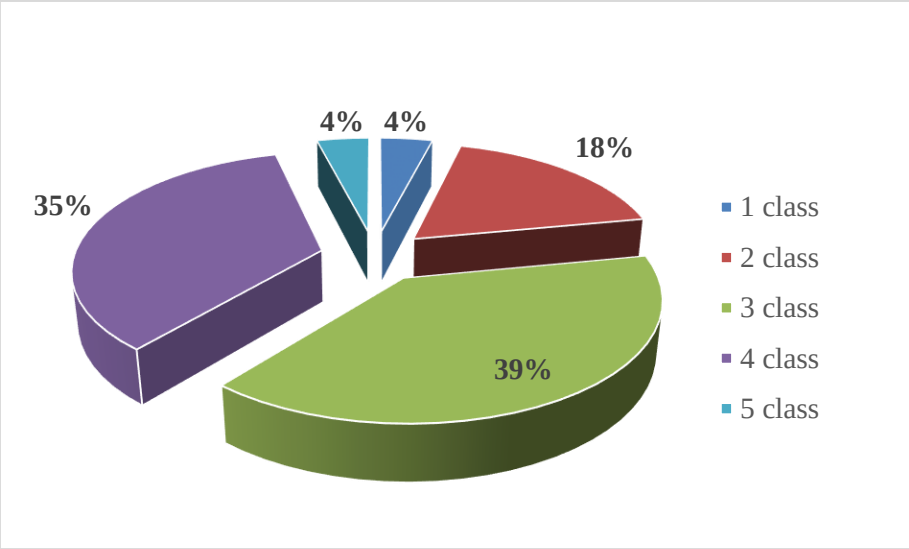

Figure 1. Distribution of the forest fund of the Republic of Bashkortostan by classes of natural fire hazard.

The greatest danger, from the point of view of the occurrence of forest fires, are the forests of the Urals, Trans-Urals and the Ufa plateau of the republic, in which conifers prevail. The first class of fire hazard includes most of the forests in areas located in areas inaccessible for fire extinguishing [5].

3. Methods and results of research

To study the dynamics of forest fires, a method was used to analyze statistical information on forest fires according to the data of the Main Directorate of the Ministry of Emergencies of Russia for the Republic of Bashkortostan, the Ministry of Forestry of the Republic of Bashkortostan and the Center for Prevention and Extinguishing Forest Fires of the Republic of Bashkortostan.

Analysis of forest fires shows that over the past three years, 2020 has been the most fire hazardous. In 2020, there were 165 forest fires on the lands of the forest fund on an area of 3727 hectares, on the lands of the protected areas - 7 fires on a total area of 1972.4 hectares. (Figure 2, 3). The largest number of fires was established by Beloretsk (36 foci on an area of 1435 hectares), Uchalinsky (32 foci on an area of 1512.81 hectares), Zilairsky (30 foci on an area of 164.3 hectares) and Burzyansky (21 foci on an area of 2107.45 hectares) districts (Table 2).

Table 2. Number of fires in the districts of the Republic of Bashkortostan.

Name of the district	Number of fires by year		
	2018	2019	2020
Abzelil	9	3	14
Alsheev	3	6	0
Baymak	2	14	11
Belebey	0	2	0
Beloretsk	24	19	36
Birsk	2	0	0
Buzdyak	0	0	0
Burzyan	18	31	21
Gafuriysk	4	4	6
Duvan	1	1	0
Dyurtyuly	4	1	0
Zianchura	1	3	4
Zilair	25	53	30
Ishimbay	5	4	5
Kugarchinsky	0	0	3
Mechetly	5	4	0
Miyaky	3	0	0
Sterlitamak	12	4	5
Tuymazy	1	2	1
Ufa	0	1	1
Uchaly	19	12	32
Haybullinsky	11	4	3

The largest natural fire in 2020 occurred in the Burzyan district on the lands of the specially protected natural territory of the Bashkir State Nature Reserve, the area covered by the fire was 1936 ha.

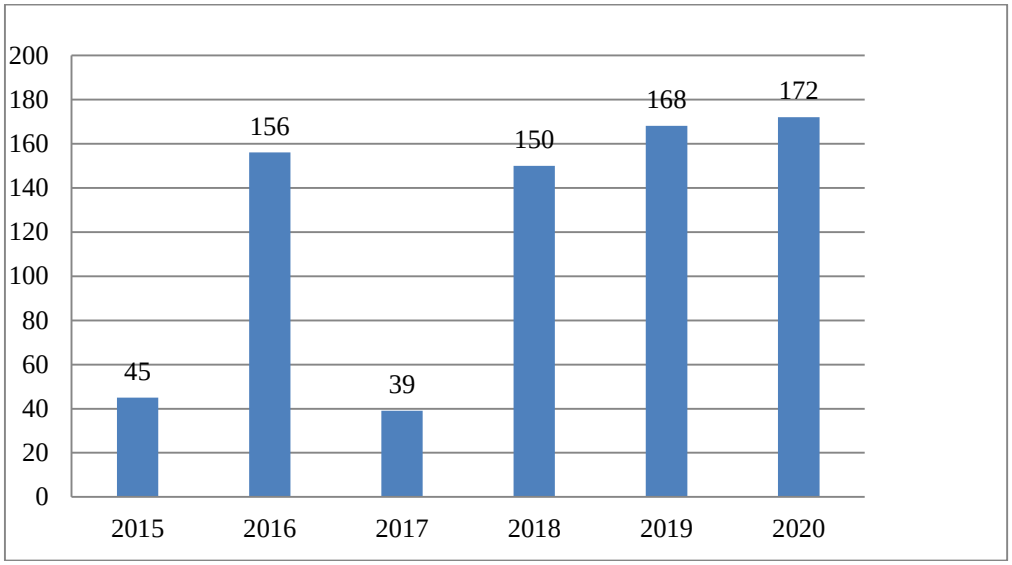

Figure 2. The number of natural fires in the Republic of Bashkortostan for 2015 - 2020.

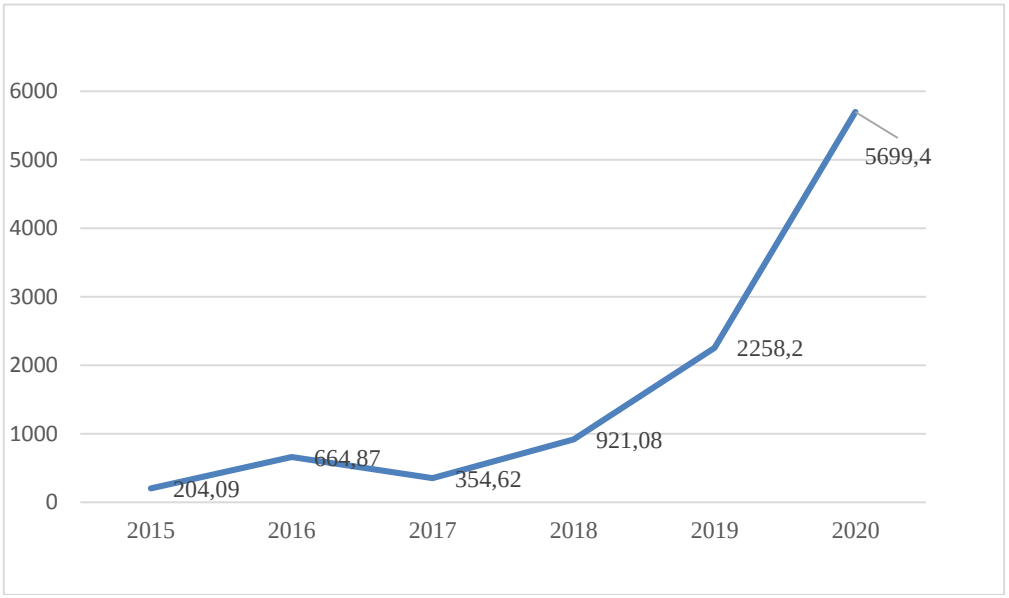

Figure 3. The area of natural fires in the Republic of Bashkortostan for 2015-2020.

The duration of the fire season is different and depends on the period of snow release and weather conditions [6, 7]. Snow cover on the territory of the Republic of Bashkortostan in flat areas comes off in mid-April, elevated and mountainous areas - at the end of April. According to average long-term observations, the fire hazard period begins with the southern regions from mid-April and ends at the end of October. The fire hazard season in 2018 began on April 16 and amounted to 184 days, in 2019 - the beginning of the season from April 15 lasting 198 days, in 2020 the duration of the fire hazard season was 203 days (from April 20).

Analyzing the situation related to forest fires, it can be noted that the area of fires has increased significantly compared to the previous year. In the fire-hazardous period of 2020, 5699.4 hectares of the republic's forests were covered by fires. Compared to the same period in 2019, the fire area increased by 1.495 hectares - the land of the forest fund, in 1946 - the land of the protected areas.

As can be seen from Figure 4, a large number of forest fires from 2018 to 2020 were found in May and July. So, in 2018, only 92 forest fires were discovered. In 2020, the largest number of fires (84) arose in July.

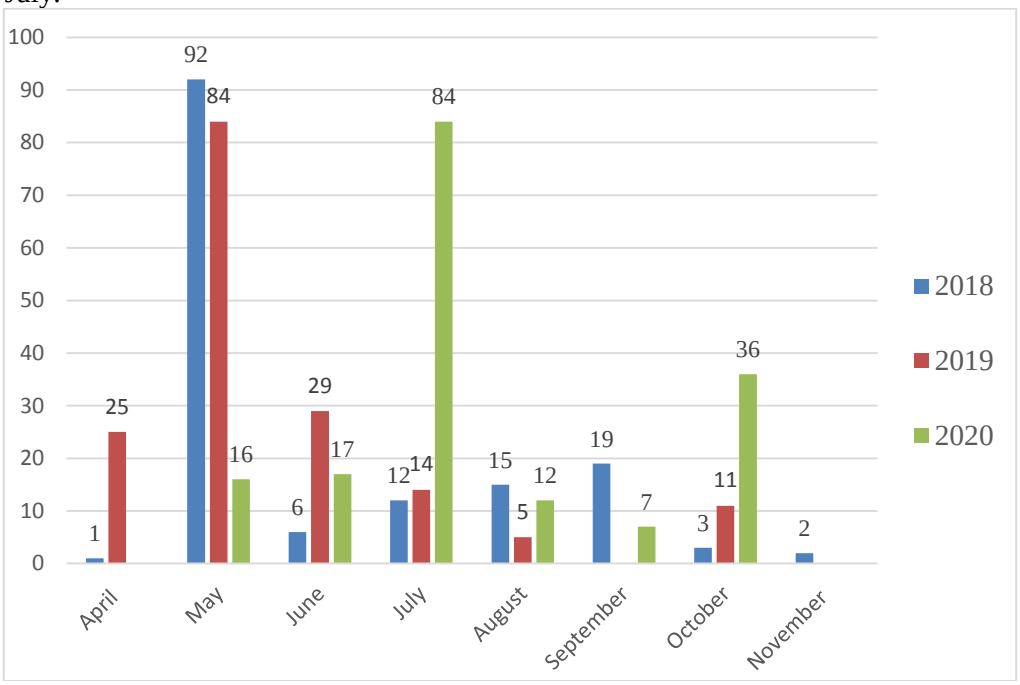

Figure 4. The number of forest fires in the Republic of Bashkortostan by month from 2018 to 2020.

Statistics on the occurrence of forest fires show that the main problem in spring is the transition of fires from lands of other categories. The main reason is the careless handling of fire by the population (50%), as well as natural phenomena in the form of thunderstorms (30%), which in most cases occur in mountainous areas (Figure 5).

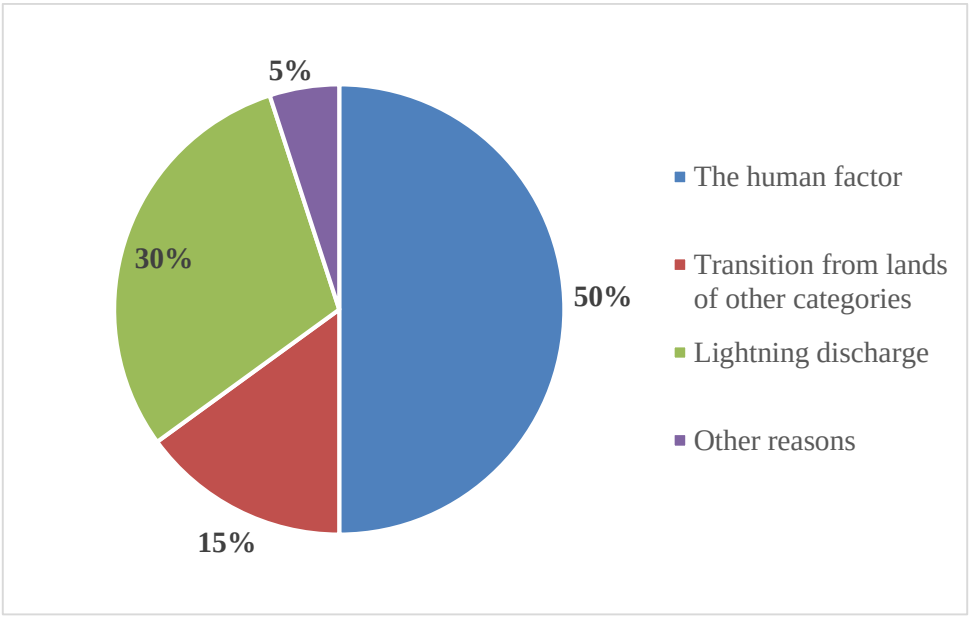

Figure 5. Causes of forest fires.

4. Conclusion

Thus, having studied and analyzed the dynamics of natural fires in the Republic of Bashkortostan over the past three years, a significant increase was established not only in the number of fires, but also in the area of fire. The main causes of fires are the human factor and thunderstorms.

Analysis of forest fires for the period from 2018 to 2020 shows that the maximum area covered by the fire was noted in the Burzyansky district on the territory of the Bashkir State Nature Reserve, which is a specially protected natural area. The fire was eliminated within 6 days after detection, the total area covered by the fire was 1936 ha. The long time of extinguishing a fire in the Burzyansky district is associated with the geographical features of the location of forests and the difficulties of the entrance of fire equipment.

References

[1] Orlovskij S N 2016 *Fighting forest, steppe and peat fires* (Krasnoyarsk: Krasnoyarsk state agrarian university) p 299
[2] Gazizov A M and Gainullin A A 2015 *Environmental Consequences of Forest Fires* (Sterlitamak: Petroleum engineering Publ.) pp 81-83
[3] Korobova Y V and Yusipova I V 2018 Problems of forest protection from fires J. *Alley of Science* Ufa 10(26)2018
[4] Zalesov S V 2006 *Forest pyrology* (Ekaterinburg: Publishing house «Basko») p 312
[5] Gazizov A M and Gainullin A A 2015 *Environmental Consequences of Forest Fires* (Ufa: Aeterna Publ.) pp 35-37
[6] Shvidenko A Z 2000 *Fire, climate change, and carbon cycling in the boreal forest* (Berlin-Heidelberg-New York: Springer-Verlag) pp 132–50
[7] Perminov V 2013 *Mathematical modeling of forest fires taking account of the firebreaks* Advances in Forestry Letters **2** 1