VOL 1, No 74 (74) (2021)

The scientific heritage
(Budapest, Hungary)
The journal is registered and published in Hungary.
The journal publishes scientific studies, reports and reports about achievements in different scientific fields.
Journal is published in English, Hungarian, Polish, Russian, Ukrainian, German and French.
Articles are accepted each month.
Frequency: 24 issues per year.
Format - A4
ISSN 9215 — 0365

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INFLUENCE FROM FOREST FIRES ON THE ENVIRONMENT

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Abstract
The climate change prognosis in the Kharkiv region shows an increasing danger of forest fires and negative consequences for the environmental components. Research on the impact of forest fires on ecosystems is a very pressing issue, especially in the face of climate change. In this work the negative impact from forests fires on the environment have been analyzed. The level of danger of soil contamination by heavy metals due to forest fire has been determined

Keywords: forest fires, climate change, soils, environment.

The problem of occurrence of fires and minimization of their consequences is global in scale, because there are about 7 million fires annually on Earth. In Ukraine, the annual average quantity of forest fires is about 3500, and the damage from them more than 5000 ha of green forest. The more vulnerable zones are located in the north and eastern Ukraine, where the annual percentage of forest fires is 37 and 40 respectively [1].

The increase of anthropogenic influences is boosting the forest fires rates. The main reasons of forest fires are: intense character of the public access to forest lands, close settlement allocation and recreational facilities, local traffic and climate conditions. The spreading of fires depends on condition and structure of plants and wind speed. Most fires happen in forests near big metropolises [2].

Among land fires, the most dangerous are forest fires, which are responsible for destroying wildlife, eroding soil and altering the river balance. The forest fires are the most serious phenomenon in the environment which leads to significant economical and ecological consequences.

The forest fires are the reason for the decrease of water regulation function, soil repair, sanitation, climate and environmental functions of the forest in natural ecosystems. The coastal forest destruction leads to the stagnation of river banks and siltening [2].

The ecological effects after forest fires are based on the air pollution with carbon dioxide and pirolises products from flammable timber materials and oxygen burning. The carbon dioxide is the major percentage in the anthropogenic pollution mass concentration. The ecological importance of the carbon burning processes and organic decomposition depends on a fire scale and the time that is needed for the vegetation recovering [3].

The carbon black, which is basically free carbon and the products of incomplete timber burning, include different organic components with lots of phenolic compounds, which have mutagenic and cancerogenic qualities, are thrown out in the air from the forest fires.

Smoky air leads to the deterioration of the surface microclimate, increases foggy days, and reduces the atmospheric transmittance, because of this visibility, brightness and ultraviolet radiation.

Forest fires have an influence on the radiation balance reduction, the increase of the heat are also affected to the soil, the turbulence heat stream change and convection strengthening. Due to the large surface of damaged forests, there are more than 100 Ha. The consequence of this could be local climate change.

Heat and smoke emissions from large forest fires change the atmosphere dynamic, the process of air recirculation, and weather conditions in some regions. The landscape features in some areas, which are placed in valleys and inter-mountain hollows, are formed from the stagnation of air masses, clear wind direction, and long periods of calm weather, that cause intense and long periods of smokiness from forest fires, which creates serious threats for the public health.

Huge amounts of contamination elements discharge to the water bodies with surface runoff from the woodlands after fires [4].

Periods of fire maximum and fire peak often coincide with the summer low water period. This is especially dangerous for small rivers because it can cause runoff and even lead to death [2,4].

Forest plantations cause an impact on the quality of the surface runoff and have an influence on the temperature balance of water objects. The forest creates the transition between surface runoff to the ground, and moreover decreases critical loads of surface runoff [2].

Forest fires destroy large areas of forest, which creates a risk of violation to the environmental sustainability of small rivers and increases the risk of flooding, so the implementation of measures to reduce this negative impact on the formation of aquatic ecosystems is an urgent task [4,5].

Forest fires have the responsibility for soil contamination through chemical substances including heavy metals, which lead to the ecosystem degradation.

Soil contamination by heavy metals is a threat to the plants, animals, surface and ground waters and human health [6,7].

Microorganisms have one of the most crucial roles of the sustainable level of soil productivity by the organic matter decomposition and recycling nutrients. But, their quantity could be reduced by stress factors such as extreme temperatures, pH, mineralization, chemical pollution [8].

The viability of microorganisms is decreasing with the increment of heavy metal contamination. Studies [9] showed that the heavy metal contamination in the soil has seriously affected the microorganism's community structures. In accordance with the study conclusion, the negative correlation has been noticed with the soil microbe biomass and heavy metal concentration.

Study [10] show that the presence of heavy metals is usually the reason of the decrease soil breathing and the negative correlation between the soil microbe breathing and heavy metal concentration is observed.

This paper is dedicated to the determination of the threat from the forest fires due to the presence of the heavy metals in the soil [11]. As the results of the calculations show, before the fire, the value of the integrated soil chemical contamination index (IPCS) corresponds to 2 classes (good condition), after the fire – 4 classes (bad condition) (Table 1)

Table 1

Integral assessment of chemical contamination of soils due to forest fire

The name of the substance, the moving form	Concentration (C)	maximum permissible concentration MPC tr	C/MPC tr	J a factor that takes into account the hazard class	PCS Elemental index of soil chemical contamination	Grade
before the fire						
Manganese (Mn), mg/kg	65	220	0,30	1	0,30	
Cuprum (Cu), mg/kg	0,9	3,5	0,26	1,28	0,33	
Zinc (Zn), mg/kg	4,3	23	0,19	2,35	0,44	
Nickel (Ni), mg/kg	2	6,7	0,30	1,28	0,38	2
Chrome (Cr), mg/kg	2	6	0,33	1,28	0,43	
Plumbum (Pb), mg/kg	3,2	35	0,09	2,35	0,21	
Integral indicator of soil chemical contamination (IPCS)					2,09	
after the fire						
Manganese (Mn), mg/kg	670	220	3,05	1	3,05	
Cuprum (Cu), mg/kg	1,9	3,5	0,54	1,28	0,69	
Zinc (Zn), mg/kg	20	23	0,87	2,35	2,04	
Nickel (Ni), mg/kg	2,8	6,7	0,42	1,28	0,53	4
Chrome (Cr), mg/kg	2,9	6	0,48	1,28	0,62	
Plumbum (Pb), mg/kg	4,5	35	0,13	2,35	0,30	
Integral indicator of soil chemical contamination (IPCS)					7,24	

The studies of soil pollution by heavy metals due to forest fire in the pine forest in the Chuhuev district of the Kharkiv region (the village of Malunivka) showed that the multiplicity of excess gross of heavy metals by copper is 3.41 times, by zinc – 2.87 times, by manganise – 2.24 times (fig.1).

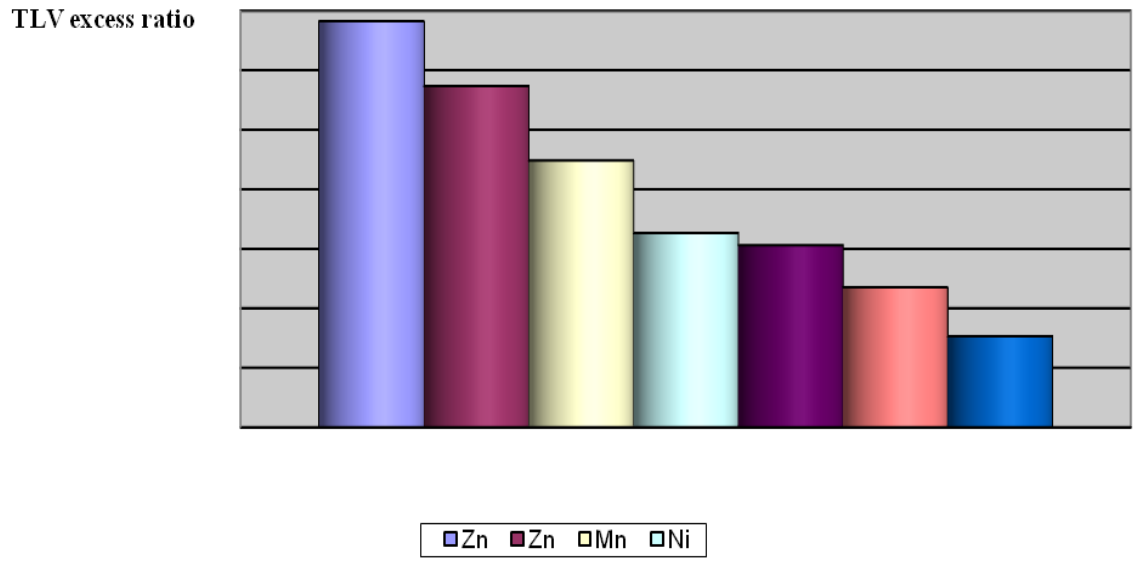

Fig. 1. The ranking of the polluted components by the multiplicity exceeding of the gross content of the metals in the soil as a result of the forest fire in the pine forest in the Chuhuiv district of thew Kharkiv region (the village of Malunivka)

After the concentration of heavy metals increased, due to the forest fire, they were then flushed by the storm and melt waters to the water objects. In this connection, the development of the measures for the water ecosystem protection from the surface wastewaters after a forest fire is reasonable.

Kharkiv region is one of the regions with a high level of emergency situations, with the largest number of natural nature emergencies.

The natural fire danger of forest areas is determined by their age and breed structure. High fire risk is present in forests affected by pests and diseases, which is caused by severe climatic changes in recent years. Climatic changes provoke mass propagation of pests and spread of diseases. Moreover, the forests are weakened by industrial pollution.

The causes of fires are the high temperature conditions over a long period of time without any kind of precipitation in the southern and eastern regions, and the violation of public fire safety. The forecast of temperature change in the Kharkiv region, based on the annual monitoring from 1969 to 2017 year, predicts the increase of temperature by 1.7 °C by 2025 (fig. 2).

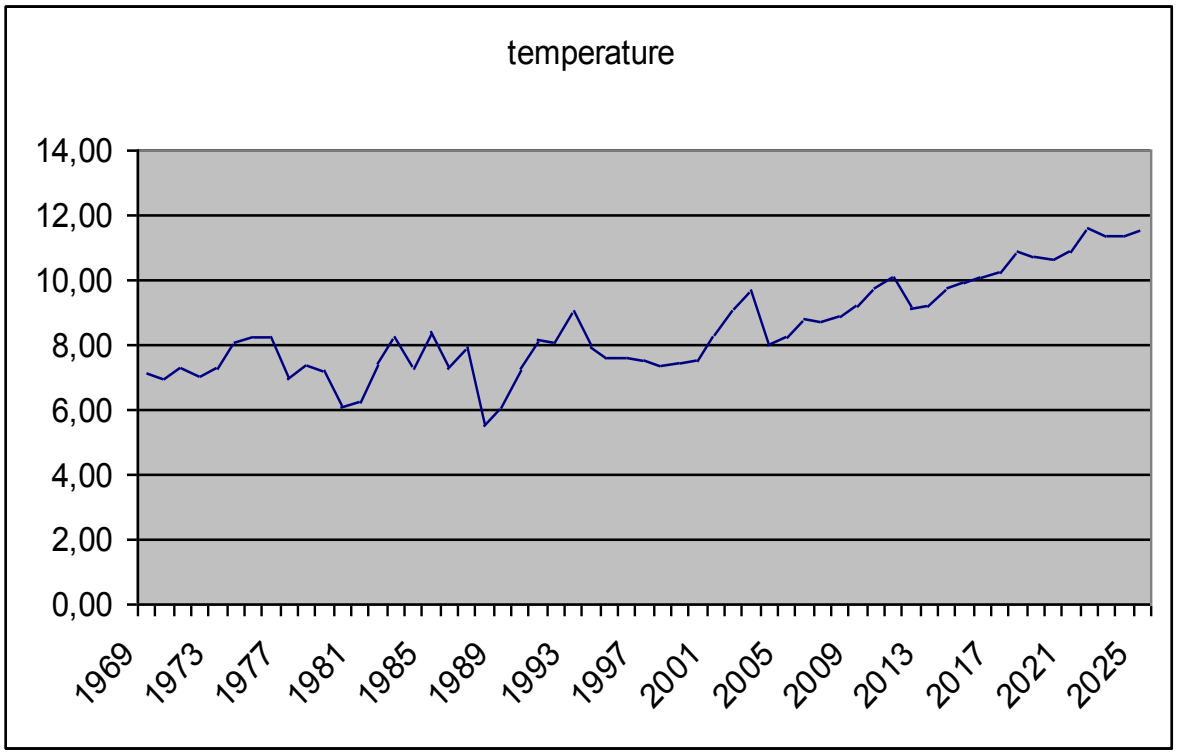

Fig. 2. Forecast of temperature change in Kharkiv region until 2025

The forecast of precipitation change is up to 2022 in Kharkiv region based on the observation from 1969 to 2017 showed a slight decrease of precipitation [6].

The forecast of climate change in the Kharkiv region shows that the risk of forest fires is continually increasing with the rising temperature and reduced precipitation [6].

Changes to land management policies, including forestry, are required to improve the resilience of forests and other ecosystems to the impact of fires in the context of climate change, especially in areas of fire risk. They can also serve to identify areas where fire risk might be increased by considering various climate change scenarios, and to take preventative fire safety measures.

CONCLUSIONS

The forest fires adversely affect all components of the natural ecosystem, especially on air pollution, surface water balance, soil, loss of wild life species and microclimate change. The forecast of the climate change in Kharkiv region indicates the danger in the increase in the incidence and area of forest fires. Therefore developing measures to protect the natural ecosystem from the negative impact of forest fires is a very urgent task.

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