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**Original Research Article**

# Effects of Forest Fire on Health

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**Abstract:** ***Introduction:*** Forest fires are caused by natural, but most often are human made causes. ***Purpose***: In this review the consequences of fires on human health and quality of life are displayed. ***Methodology:*** The material of the study is consisted of articles related to the subject, that were searched in Greek and international databases, in Google Scholar, and in the Hellenic Academic Libraries Association (HEAL-Link). ***Results***: The health effects of exposure to forest fire smoke are related to the toxicity of its components, the frequency and duration of exposure and the degree of vulnerability of those exposed, such as people with respiratory problems, cardiovascular diseases, smokers, elderly, children, infants, and pregnant women. Also, during a fire the consumption of oxygen causes a feeling of drowning, symptoms of suffocation and death. ***Conclusions***: The effects of fires on the environment and humans are irreversible. They cause, among other problems, destruction of vegetation, soil erosion, destruction of fauna and primary production of an area, and the most important, they cause problems in human health, physically and psychologically.

**Keywords:** Fires, forest, forest fires, health, consequences.



## INTRODUCTION

Fire is generally characterized by the phenomenon of ignition of a material recognized by its significant heat generation and the presence of flame. Conflagration is a fire with spreading tendencies, of such intensity that it cannot be extinguished by a person with simple means (Ember, 2010).

For a fire to be created there must be the coexistence of three factors, which constitute the so-called "fire triangle" (Schmidt-Rohr, 2015):

- Fuel material
- air (oxygen)
- fire – spark

If one of the factors is missing it cannot start a fire (conflagration) and in case of fire, if we remove any of the three factors, the fire stops immediately.

The start of combustion and the creation of fire for each type of fuel require special conditions which depend on the quantitative combinations of available oxygen (air), the type of fuel and the temperature of the immediate environment. There are intentional fires, fires caused from negligence or natural phenomena (lightning). And depending on the fuel, fires are divided into urban and forest fires. After all, one of the worst anthropogenic effects on forest ecosystems is causing fire. Fires are a permanent source of damage to forests, crops, residential areas, military, or industrial facilities, with many victims and injured in recent years (Statheropoulos *et al*., 2007).

According to an interpretative declaration by the Constitution of Greece, article 24, forest or forest related ecosystem means the organic set of wild plants with woody trunk on the necessary surface of the soil, which, together with the coexisting flora and fauna, form through mutual interdependence and interaction, particular bio-community (forest bio-community) and natural environment (forest created). Forest area exists when in the above set the wild woody vegetation, high or bushy, is sparse.

Forest fires occurred regularly, even before man appeared as a willful or involuntary arsonist. Forest fires when caused by natural causes are a way of natural forest regeneration and fire plays an important

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role in the creation and conservation of Mediterranean ecosystems (Stenseng 2001 & Stefani *et al*., 2005).

The purpose of this review is to investigate the effects of forest fires on the environment and especially on human health and quality of life.

# METHODOLOGY

The methodology, was based on the review of the Greek and international literature, focusing on views for the systematic and organized response to mass disasters. The material of the study consisted of books, literature reviews, and research papers on the subject, found in Greek and international databases such as Google Scholar and the Hellenic Academic Libraries Association (HEAL-Link), studies that were mostly accessible to authors. Keywords used: fires, forest, forest fires, health, consequences. Rejection criterion was the language, only Greek and English language studies selected. Articles selected, were most accessible to the authors.

## FOREST FIRES

There are many reasons why forests are vulnerable to fires, such as prolonged hot and dry summers, mild winters (typical of the Mediterranean climate), strong winds, strong forest terrain and flammable dry vegetation, along with intense human activity, poor forest management and the perception that protection from forest fires is synonymous with forest firefighting department responsibility (Dimitrakopoulos, 2010).

The causes of forest fires are classified into (Vorisis, 2004):

- Natural. Lightning and volcanoes are the means by which nature causes the burning of its forest areas.
- Anthropogenic. They include incidents related to human activity and by negligence or accident can cause a fire, such as:

1. Arson due to negligence. Cigarettes and matches are reported, accidents that occur during the burning of agricultural waste and rubbish, shots fired from military exercises, as well as from workers in the countryside or hikers and hunters.
2. Intentional arson. They are the component of many factors and parameters that are directly related to our time.

- Unknown. They are related to human activity, but they cannot be logically explained or attributed to a known cause.

Forest fires are due to natural, but most of the time are due anthropogenic causes. They are caused in periods of minimal soil moisture, high temperatures and winds with high speeds (Tsakiris, 2009).

The main factors affecting the onset, spread and behavior of forest fires are (Kalambokidis, 2004):

- The characteristics of the fuel (texture, size, accumulation, distribution). Light fuels burn more easily and faster than heavier ones and cause the fire to spread faster. Also, the more continuous the distribution of the fuel, the greater and faster ignition and complete combustion can be achieved.
- Topography (exposure, slope, altitude, terrain). The speed of propagation of a fire is proportional to the slope of an area. This is since in soils with a steep slope, the water flows more resulting in a reduction in humidity.
- Meteorological conditions (wind, temperature, relative humidity). The direction and intensity of the wind are quantities that largely determine the intensity and spread of a fire. Lack of humidity, high temperatures, lack of rainfall and severe weather phenomena (lightning) are also essential for starting and spreading a fire.

Regarding the types of forest fires, they are distinguished based on the fuel and the location of the fire in relation to the ground surface as follows (Konstantinidis, 2003 & Vorisis, 2004):

- Ground or underground fires. In this case, the organic matter burns below the surface of the forest foliage, the combustion is slow and difficult to perceive.
- Surface fires. Burn dry organic matter and vegetation up to 2 meters. They have a high speed of propagation, especially when there is air, with flame and heat.
- Above surface fires. They burn the aerial fuel at a height of more than 2 meters above the ground, as well as the branches of trees.
- Mixed. When all 3 types of fire coexist, as each burns a different type of fuel, sweeping the existing vegetation.

In addition, fires regarding the risk of their occurrence are distinguished in (General Secretariat for Civil Protection, 2021):

- Risk Category 1 (Low). The risk of fire is low. The probability of a fire is not very high.
- Risk Category 2 (Medium). The risk of fire is common during the summer. If fires occur, they will be of medium difficulty.
- Risk Category 3 (High). The risk of fire is high. Several fires can occur, which will be difficult to deal with when local conditions are favorable.
- Risk Category 4 (Very High). The risk of fire is particularly high. Many fires are expected to occur, and each fire can become large as long as it escapes the initial attack.
- Risk Category 5 (Alarm Status). The risk of fire is extreme. A very large number of fires are expected to occur, which are likely to be very large, and can quickly escalate.

The consequences of forest fires can be (Vorisis, 2004):

- Immediate. They are caused by the destruction of forest products, vegetation, agricultural crops, livestock-beekeeping facilities, or other units.
- Indirect. They are the ecological disasters, the overgrazing, and the health ones that concern the physical and mental health, especially of the sensitive groups.

**FOREST FIRE AND HEALTH**

The forest is the planet's oxygen factory and filters polluted air while retaining pollutants. The effects of forest fires have not only catastrophic consequences on the environment and the ecosystem, as they affect not only the flora and fauna of the ecosystem but also human health (psychological-pathological) (Lekkas, 2000). Risks for humans may come from (Giouroukos, 2015):

*The fire itself*. It is the exposure of the person to the flames and hot products of combustion. This risk is zeroed by moving away from the fire at a considerable distance.

*Smoke and toxic combustion gases*. This hazard extends long distances from the fire area and comes from smoke and toxic combustion gases, such as carbon monoxide (CO).

The health effects of exposure to forest smoke are related to the toxicity of its components, the frequency and duration of exposure and the degree of vulnerability of those exposed, such as people with respiratory problems, cardiovascular disease, smokers, the elderly, children, infants, and pregnant women. Symptoms can be immediate, short-term, or long-term. High temperatures can affect humans directly, in the event of contact with fire, with a serious risk of ignition of clothing and burns. The high temperature also causes dehydration of the human body and burns, which can lead to death (Maurikius, 2009 & Maronikolaki, 2011).

The hot gases cause hyperthermia, dehydration, shock, burns, respiratory problems, heart problems, etc. Also, during a fire the consumption of oxygen causes a feeling of drowning, symptoms of suffocation and death.

In addition, smoke that develops in a fire contains exhaust gases, ie suspended particles of carbon and tar with adverse effects on the human body, such as dizziness, fainting and suffocation, which can occur mainly in conditions of limited oxygen, such as in the phase without flame, during the resurgence of the fire. Furthermore, smoke develops irritants of the respiratory system, which cause inflammation of the mucous glands and carcinogens such as benzene and aromatic hydrocarbons which can cause cancer in humans (Maronikolaki, 2011).

The effects of fire on people's mental health are also important. Forest fires are known to adversely affect human psychology. Fiery destruction does not always count human lives, but it does have an impact on human souls. The psychosocial cost of fires is time and financially many times greater than that directly caused by the disaster (Spyridopoulos *et al*., 2006).

It is also noted that not only those affected by the fire, but also people who come into audiovisual contact with the disaster can develop post-traumatic psychopathology, with *physical* and *mental* manifestations, such as (Ventouratou D., 2009):

- difficulty concentrating
- constant irritability and difficulty sleeping
- tachycardia and palpitations
- sweating and dry mouth
- feeling dizzy and unstable
- feeling of fainting
- fear of death

In the long run, the usual post-catastrophic psychopathological manifestations include generalized anxiety disorder, various phobic symptoms, psychosomatic symptoms, depression, and the abuse of alcohol or other substances (Paparoupa, 2009).

## CONCLUSION

The effects of fires on the environment and humans are irreversible. They cause, among other things, destruction of vegetation, soil erosion, damage to fauna and primary production of an area, and most importantly, create problems in human health physically and psychologically (Siafakas, 2008). All this leads to the degradation of the ecosystem, as well as the quality of life and health of the inhabitants of the fire-affected areas. For this reason, we all must not forget that our existence depends on the natural environment and its protection is the duty of all of us, because its degradation undermines even the next generations (Simou, 2008).

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