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RESEARCH ARTICLE

EFFECTS OF FOREST FIRE ON FOREST ECOSYSTEM, BIODIVERSITY AND LOSS OF PLANT AND ANIMAL SPECIES

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Abstract

Forests fires though considered a natural disaster by many it is a result of combined natural and anthropogenic causes. Loss of habitat due to forest fire is the greatest threat to biodiversity. Frequent forest fires in the forests around the globe have been blamed for forest deterioration. It is true that frequent fires on large scales cause air pollution, affect quality of stream water, threaten biodiversity and spoil the aesthetics of an area, but fire plays an important role in forest ecosystem dynamics. In this paper effects of fire on various forest elements, biodiversity and its threat to flora and fauna of a forest area is analyzed and reviewed with the help of existing publications and research papers.

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Introduction:-

In many terrestrial ecosystems, fire is the most spectacular natural occurrence. It changes the environment for plants and animals in a matter of minutes, and the impacts can last for years. Although fire has a negative influence on creatures, it has long been a component of the forest ecosystem and has played a significant role in sculpting the flora and fauna (Wikars, 1997; Chandra and Bhardwaj, 2015). Furthermore, additional human activities, in addition to fire, are destroying the woods (Chandra and Bhardwaj, 2015).

The devastation that flames due to creatures is widely recognized, but it is less generally understood that some species require fires to survive (Jeronimo, 2003). Fires may have occurred for as long as there has been vegetation on the planet, and they are thought to have had a significant influence on terrestrial animal evolution. As a result, fire adaptations that allow species to withstand fire in situ as well as utilise early post-fire successions should be expected.

Effect of Forest fire on Forest Biodiversity:

Plant invasions are connected to grazing and fire. *Imperata cylindrical* (a perennial rhizomatous grass endemic to tropical and subtropical Asia, Micronesia, Melanesia, Australia, and Africa) swiftly recovers after a fire and may respond by increasing its cover (Parashar and Biswas, 2003).

Through allelopathic route ways, invasive organisms decrease an area's biodiversity. *Terminalia chebula*, *T. bellirica*, and *T. tomentosa*, all of which have considerable economic and therapeutic importance, are suffering major problems in the Indian Himalayas owing to forest fires that have left behind inadequate stocking. Species such as *Lantana camara*, *L. indica*, *Eupatorium glandulosum*, *Parthenium hysterophorus*, *Cassia tora*, *C. occidentalis*,

and others have encroached on numerous important forest biodiversity conservation areas (Parashar and Biswas, 2003).

Many people feel that flames are harmful, yet they are vital for promoting variety. Forest species composition changes following fire, which can be beneficial or detrimental depending on the utility of the stands that preceded and followed the fires (Parashar and Biswas, 2003).

Early successional forest stages, vast numbers of deciduous trees, and freshly created deadwood, ecosystems that are mostly absent in a forest landscape, can all be affected by forest fires. Burnt wood, charred bark, excessive heat exposure, a reduction in the ground layer of organic materials, and the exposing of bare mineral ground are all examples of distinct substrates and direct impacts created by fire. Fires can alter the availability of food and shelter for species in the boreal forest because of their extensive effects on the plant structure (Fredriksson, 2021).

Impact on endemic and native plant species

Global warming has created a shift in plant distribution, resulting in changes in the natural flora. In addition, wildfires are becoming more intense and frequent, posing a danger to Himalayan ecosystems. Understanding the behaviour of native flora in changed climatic circumstances requires modelling a species' biological niche and possible distribution under expected consequences of climate change and wildfire dispersion (Chitale and Behera, 2019).

The future distribution of four indigenous tree species in the Indian Himalayas, *Pinus roxburghii*, *Quercus semecarpifolia*, *Rhododendron arboretum*, and *Cedrus deodara*, is anticipated under two conditions: (i) without wildfire and (ii) with wildfire (Fredriksson, 2021). According to the study's estimates, the 'with wildfire' scenario will result in a considerable decline in the geographic spread of the indicator species when compared to the 'without wildfire' scenario (Chitale and Behera, 2019).

Due to increasing moisture availability, the future distribution range was pushed towards the research area's northern and north-eastern parts. The ranges of *C. deodara*, *R. arboretum*, and *P. roxburghii* were anticipated to shrink by 2030, 2050, and 2080, respectively, whereas the distribution of *Q. semecarpifolia* remained stable. In a summary, the study anticipated that climate change will cause endemic plant ranges to shrink, expand, and move, potentially causing changes to the Himalayan endemic flora (Chitale and Behera, 2019).

Threat to biodiversity and extinction of species:

According to research performed, forest fires have been widely observed throughout Indonesia every year, generating economic and ecological costs. The fire is categorized as a surface fire that has spread to the crown. Forest fires may have both direct and indirect effects on plants. As a direct impact, fire may kill or injure plants. Indirectly, fire can leave open wounds on plants, allowing pests and diseases to enter (Syafina et al., 2018).

Several research have been conducted since 2015 to understand more about the impact of forest fire on species diversity. Based on the definition of extinction, forest fires did not result in the extinction of a species. Extirpation occurs when a species is extinct or gone in one area but still exists in another. Extinct means that the world's last individual species has perished beyond a doubt. Furthermore, many previous studies have found that fire has a negative influence on species numbers in 29% of cases, while 58 percent have found a positive impact in 58% of cases, and 13% have found no change (Yanto and Catharina, 2020).

So far forest fires have been seen as a disaster, which caused negative impacts on living things that exist in and around the fire location. Fire is considered as a cause of the diversity loss, even extinction, of both flora and fauna species (Yanto and Catharina, 2020). Research that has been conducted at the Northern Chihuahuan Desert, stated that the diversity of small mammal species is not affected by fires, which is different from other related studies of mammals, apparently because the study looks only at the short-term effects (Tony et al., 2010). Moreover, amphibians and reptiles were not significantly affected by fire and did not differ significantly between burned and unburned areas; amphibians have moist, permeable skin and eggs, and that helps increase their vulnerability to heat and microhabitat drying (Fredericksen and Fredericksen, 2002; Stebbins and Cohen, 1995). Another research also showed that amphibians and reptiles did not appear to be disturbed by approaching fire, they responded in adaptive manners that minimized mortality (Komarek, 1969).

Arthropod biodiversity after forest fires and fire-adapted insects:

Larger animals are frequently harmed by forest fires, whilst smaller taxonomic groupings have an advantage in adapting to the flames. The post-effects of forest fires on insects were studied in research center on the Southern Alps, a mountain region in Europe. Ground beetles (*Caridae*), hoverflies (*Syrphidae*), bees and wasps (*Hymenoptera aculeate*, *Sans formicidae*), and spiders all showed a favorable influence of fire on species richness (*Araneae*). Fire had favorable tendencies in true bugs (*Heteroptera*), lacewings (*Neuroptera*), and the saproxylic beetle families Cerambycidae, Buprestidae, and Lucanidae, but no statistically significant impacts on species number or abundance. Only isopods and weevils showed negative impacts of fire on species numbers and/or abundances (*Curculionidae*). The data in the one of the studies demonstrates that burned locations, especially those that have been burned repeatedly, have more rare and endangered species than unburned ones. Old-growth species and those that are sensitive to disturbance may have long since vanished from the southern slopes of the Alps, as has been documented in many European forests (Moretti *et al.*, 2004).

Effect on Forest management and shaping

A wildfire is any fire on forestland that is not being utilized as a tool for forest conservation and management in line with an authorized plan (Parashar and Biswas, 2003; Show and Clarke, 1978; Artsybashev, 1983). *Pyrophytes* are plant species that survive flames and have reactions that result in progeny from seed. A single plant may be subjected to several flames, each with its own set of fire properties and consequences. The life cycle of the species and the fire regimes to which the species is exposed must also be considered when determining the value of adaptive features (Parashar and Biswas, 2003).

Although fire has been the primary cause of deforestation, it also plays a vital role in preserving the health of particular ecosystems as a natural process (Bhatia *et al.*, 2020). By selecting species that will continue to occupy a location, fire frequency influences the floristic makeup of a region (Forest conservation, 2020). If fire happens too frequently, too early, or too late in a species' life cycle, it can be eradicated. For example, if a fire happens before seed is formed or after the species has perished and the seed pool is inaccessible, a non-sprouting species may be lost (Parashar and Biswas, 2003).

Fire may also help to recycle nutrients from the ground-layer plants and trash to the overstorey trees, reducing infertile substrates and delaying deterioration (Richard, 1974). In comparison to smaller patches, bigger burnt patches feature more tree seedlings and shrubs, higher concentrations of opportunistic species, and poorer species richness (Turner *et al.*, 1997). The number of new habitats that may be exploited by animals is determined in part by the size and form of a burnt region. Because they have little interactions with other creatures of their own species or other species, they can invade new environments and thrive (Parashar and Biswas, 2003).

Adverse impact on Health system

In a study regarding forest fires in Indonesia impact of the fires on urban pollution was analyzed. Forest fire has undoubtedly caused great impacts on the environment through haze pollution, which spreads to the other region of fire source. The pollution may be experienced not solely by local community living surrounding the fire sources but also by others living hundred kilometers away from the fire sources. The direction and velocity of fire spread seems to depend on various factors, including: wind direction and velocity, other weather factors (rainfall, temperature and humidity), air stability, and land features. In this study it was found that haze pollution produced by forest and land fires in Riau Province spread to various adjacent locations such as: Bengkalis, Dumai, Indragiri Hulu, Rokan Hilir, Pelalawan and got across to regions in neighbor country like Malaysia including: Batu Pahat, Johor Baharu, Keluang, Muar, Pontian, Bintulu (Syaufina *et al.*, 2018).

The smoke created by forest and land fires extended to numerous communities around the fire sources, causing dense haze, reduced visibility, and harmful conditions, according to daily reports. The effects of fire on one's health are determined by factors such as age, past respiratory problems, infection, cardiovascular health, and particle size. Smoking can cause irritation to the eyes, skin, and respiratory system, as well as decreased lung function, bronchitis, asthma exacerbations, and premature mortality. Particulate matter can have an impact on the body's immune system and physiology (Syaufina *et al.*, 2018).

Conclusion:-

The different consequences of forest fires on the ecology and species have been studied over many years via several research. Along with killing wild animals, wildfire damages their environment, putting their existence in jeopardy.

Forest fires have a significant influence on animal life, since many creatures are among the first to perish as a result of the heat created. Due to the impact of fire on bird and insect eggs, future generations of a species are harmed. A forest fire has an impact on biodiversity as a whole. However, in an environment with regular fires, animals begin to adapt to the post-fire consequences, and survival rates rise. As a result, while biodiversity suffers greatly as a result of fires, certain advantages can be found in the aftermath.

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