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ECOLOGICAL IMPACTS OF FOREST FIRES ON NUTRIENT DYNAMICS AND BIODIVERSITY IN GARHWAL HIMALAYAN ECOSYSTEMS

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ABSTRACT:

Forest fire is a type of natural ecological disturbance that affects ecosystem composition, structure, and function on varying scales at both the landscape and regional levels. Based on the findings of the current paper, it is concluded that fire has a significant impact on nutritional position in Garhwal forests by reducing soil composition along an altitudinal gradient at any level and regardless of understory vegetation. Preserving these minerals can be achieved through better management methods, such as early controlled burning and educating the local villagers about the harmful effects of disastrous forest fires. Despite this, the majority of forest fires are caused by non-woody forest products and the growth of cultivable land, which have detrimental effects on biodiversity, nitrogen levels, and regeneration potential. Moreover, forest fires also contribute to warming of the climate and greenhouse effect. Uttarakhand, an Indian state in the Western Himalayas, experiences a significant difficulty with forest fires during summer season, which have repercussions for entire forest ecosystems of the region.

Keywords: Fire Effect, Soil Nutrients, Garhwal Himalayas, Forest

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Introduction

The Himalayan region experiences annual forest fires that have a devastating impact on the local climate, vegetation, animals, and people's livelihoods. The Chir Pine (Pinus roxburghii) trees are at risk of forest fires due to their tendency to drop their resinous leaves during the summer season.

Problems are commonly experienced during the annual cycle of forest fires. Despite the fact that the reasons for forest fires can vary, they are often deliberately started to disrupt forest procedures.

Indian woods' forest fire research reveals the crucial role that fire plays in the devastation of the entire country. In the temperate zone (1500 to 3100 m, a.s.l.), of Garhwal Himalayas, intentional fires are believed to aid in the preservation of grasses for cattle and the collection of fodder and non-wood forest

goods. (Kumar et al,.2013)

To investigate these effects on selected forest types with attention to the slope aspects involved, seven natural forest varieties were studied (NE, NW, SE, and SW) to establish their impact on forest structure, composition, or soil characteristics.

The distribution of the sample plots for each forest type was stratified random. The Importance Value Index, Shannon Wiener diversity index, Simpson's concentration of Dominance, the Simpson diversity indice, Pielou equitability, and Margalef species richness index were used to explain the differences in forest structure and composition on various slope aspects of sites using standard software.

The forest's biodiversity is greatly influenced by the variety of trees. With an increase in ecosystem resilience to disturbance, natural forest ecosystems with a range of tree species may experience greater productivity over time than those with low or no tree diversity. The productivity of species at large scales is typically linked to long-term diversity. (Sharma et al,.2010)

The predictability of the environment is reflected in species diversity within any community. Tree species diversity increases as the environment becomes more favorable and probable, which is linked to climate and forest yield. The temperature regime of any location is heavily influenced by its altitude and slope. (Holland and Steyn, 1975)

Topography, slope aspect, inclination of the slope, and type of soil also affect composition in terms of forest structure at a height. (Champion and Seth 1968) Depending on the slope aspect of the location, there may be variations in the period of insolation at different altitudes, leading to various microclimates in diverse landscapes. (Semwal, & Mehta, 1996)

Therefore, the moisture content of soil and the distribution of certain plant communities over different faces of a slope are often related to this microclimate. The south-facing slopes of the Himalayas are considered to be warmer and dryer due to longer exposure times during the day, while the north-faced slope is cooler because they receive less sunlight. (Mishra 1968)

The representation of community structure and forest productivity in mountain areas is often exaggerated in ecological studies. These studies commonly overlook the influence of slope aspects, leading to an overestimation of the parameters. This research on mountain communities fails to consider the significant role that slope aspects play in determining the community structure and forest productivity. (Fenn et al,.1998)

The Effects of Fire on Soil in the Garhwal Himalayas

P. roxburghii, Picea spinulosa and Pinus wallichians are among the forests that depend on fire as a significant source of disruption of the ecosystem. When these forests are situated in dry areas, they become highly susceptible to fires. While both P. wallichianna and P. roxburghii forests face destruction by fire annually, the mature stands of the latter species exhibit greater resistance to fire compared to the former.

Soil organic matter (SOM) can be altered chemically and partially by fire impact, for example decomposable and hydrophobic. (Bhandari et al,.2000) The variability in soil C and nutrient losses during wildfires is significant, and the estimation of SOM, C, or dietary effects due to fire is still uncertain. (Semwal & Mehta, 1996)

Fire is highly important in maintaining the energy and carbon balance in soil. When it burns organic matter in the soil, it affects the depth and structure of this matter. This, in turn, leads to changes in its chemical composition and results in an increase in noncombustible elements and nutrients. Additionally, fire has the potential to either increase or decrease the availability of nitrogen in the soil. (McKinnell, 2000)
The nutrient dynamics within an ecosystem are significantly influenced by various factors such as the specific characteristics of fires, including their type and frequency, the amount of fuel present, the timing and season of the burn, the composition of vegetation, the topography of the area, and the post-fire weather conditions.

Variation in forest types also affects the frequency of fires and tree density. Pine Forest has a higher fire frequency, which results in fewer tree species; in percentage controlled by the plant population, this effect is less pronounced in Public Counties (PF). So, while all classes of fires may help tree regeneration, low class also helps with seedlings and growth.

Conclusion

Maintaining the regeneration of species is crucial for preserving biodiversity and plant density in any ecosystem. Future in-depth studies on forest fires can be based upon this study, while additional research is required to explore the ecological implications and effects of fire on forested areas. The availability of

nutrients for plant absorption or volatilization, which causes them to disappear from the area, varies depending on the type of fire and it was observed that fire can have diverse effects on nutrients due to various factors such as carbon metabolism. (Harden et al,.2000)

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