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Review

Forest Fires in the Western Himalayan Region of India: A Review

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ABSTRACT
The ecosystems in the Himalaya are highly stressed due to over-increasing pressures on land due increased human populations and associated anthropogenic pressures. The inhabitants of the region are highly dependent on various resources like wild edibles, fodder, fuelwood, medicinal plants etc. from the forest ecosystems. The vegetation in the state of Himachal Pradesh is primarily dominated by Evergreen needle leaf forest, Evergreen Broadleaf Forest and Deciduous Broadleaf Forest. Studies have reported that the deciduous forests are more vulnerable to fire and thus large area of vegetation and wildlife is destroyed each year. Very limited number of studies have addressed issues pertaining to forest fires. In the present study an attempt was made to understand the number of forest fire incidences in the different districts of the state, causal factors responsible for the frequent forest fires and their after effects in the state of Himachal Pradesh. The suggestive conservation and remedial measures can help in the protection of forests and wildlife.

Key words: Himalaya, Forest fire, anthropogenic, factors

INTRODUCTION

Fire is considered as an important ecological factor that determines ecosystem functioning and its increased intensity, and frequency may result into fragmented vegetation, destructed wildlife, changed soil properties and decreased fertility (Garcia-Chevesich et al. 2010, Castillo et al. 2017). The incidences of wildfires and their severity have increased over the recent decades affecting millions of hectares of forest flora and fauna causing damage to forest resources, biodiversity, and environment (Sodhi 2004, North et al. 2015, Jolly et al. 2015). It has been reported that six million km^2 of forest have been lost around the world in less than 200 years mainly due to forest fires (Dimopoulou and Loannis 2002).

Several factors have been considered as the drivers of fire occurrence that include physical (elevation, slope), climatic and biotic factors (human interference, increased population) and warmer and drier conditions (Gonzalez et al. 2018, McWethy et al. 2018, Gomez-Gonzalez et al. 2019). It is important to take initiatives that prevent, manage and fight wildfires. Methods to evaluate potential damages by wildfires and management strategies to recover ecosystems after fire damage are essentially required (Keeley 2009). Forest fires due to anthropogenic activities are many that include slash and burn agricultural practices, camp fires by tourists, and deforestation (Gubbi 2003, Wooster et al. 1998, Bond et al. 2005, Di Bella et al. 2006).

In the present study we have undertaken a detailed literature review of the previous studies on forest fires in the state of Himachal Pradesh. This elaborated study shall provide an idea of the extent of forest incidences in the different districts of the state that can act as guide for the conservation of wild flora and fauna.

MATERIAL AND METHODS

Study Area

The present study was undertaken for the state of Himachal Pradesh that is located between 30º22' N to 33º12'N latitude and 75º45' E to 79º04' E longitude and has an area of 55,673 km^2. The state is bordered by Jammu & Kashmir in the North, Punjab in the West, Haryana in the South and Uttarakhand in the Southwest. The state is predominantly a mountainous region and divided into three distinct regions the Shiwaliks with altitude upto 1500m,

middle Himalayan region between 15,00m to 3,000m and the Himadri higher than 3,000m. The state has 12 districts and the temperature varies between sub-zero to 35ºC due to varying altitudinal gradient (Fig. 1).

According to Champion & Seth classification of Forest Types (1968), the state of Himachal Pradesh belong to eight type groups that are further divided into 39 forest types with broader classification into Coniferous forests and broad-leaved forests. The distribution of species follows altitudinal zonation and the vegetation varies from dry scrub forests at lower altitudes to alpine pastures at higher altitudes. A wide variety of vegetation comprising of mixed deciduous forests, Bamboo, Chir Pine, Oak, Deodar, Kail, Fir and Spruce are found.

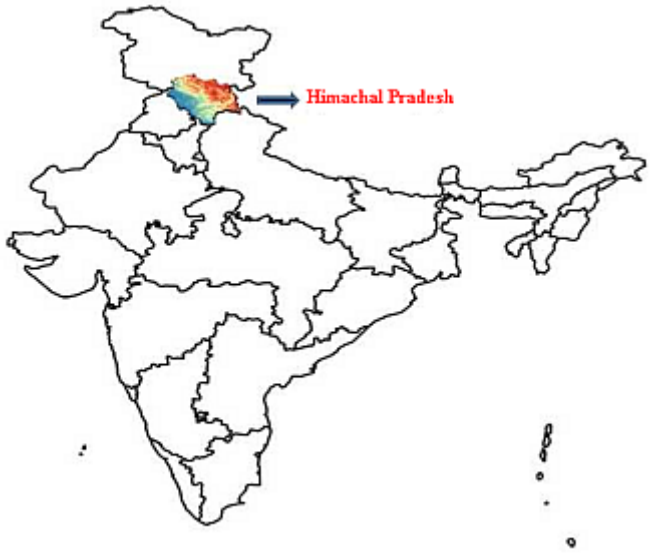


Figure 1. Map of study area

Data Collection

Scientific search engines like PubMED, Science Direct, SpringerLink, Web of Science, Scopus, Wiley Online, SciFinder, and Google Scholar were searched using specific keywords like Forest fires, Himalayan region, Himachal Pradesh etc. The data pertaining to the incidences of forest fires per year in the different districts of the state for Himachal Pradesh was taken online from the website (http://www.fsi.org.in/monitor_fire.php). The site is being managed collaboratively by the Forest Survey of India (FSI) and National Remote Sensing Centre (NRSC) for real time monitoring of forest fires from the active fire locations.

Data Analysis

The excel sheets containing data regarding forest fires was downloaded for each district and data was further analyzed. The interpretation was done for the seasonal variation in the incidences of the forest fires. The data was mapped using Q-GIS tool and DEM was prepared using satellite imagery (ASTER).

RESULTS

Comparison of the annual data on forest fires

Data analysis of the annual data on forest fires for the year's 2015 to June 2021 (Fig. 2) showed that maximum number of incidences have occurred in the year 2021 (5262 incidences) followed by 2019 in which the reported incidences of forest fires were 2436 (Table 1). The number of incidences were less for the year 2015 (258 no.) and 2017 (404 no.).

Table 1. Total number of forest fire incidences per year

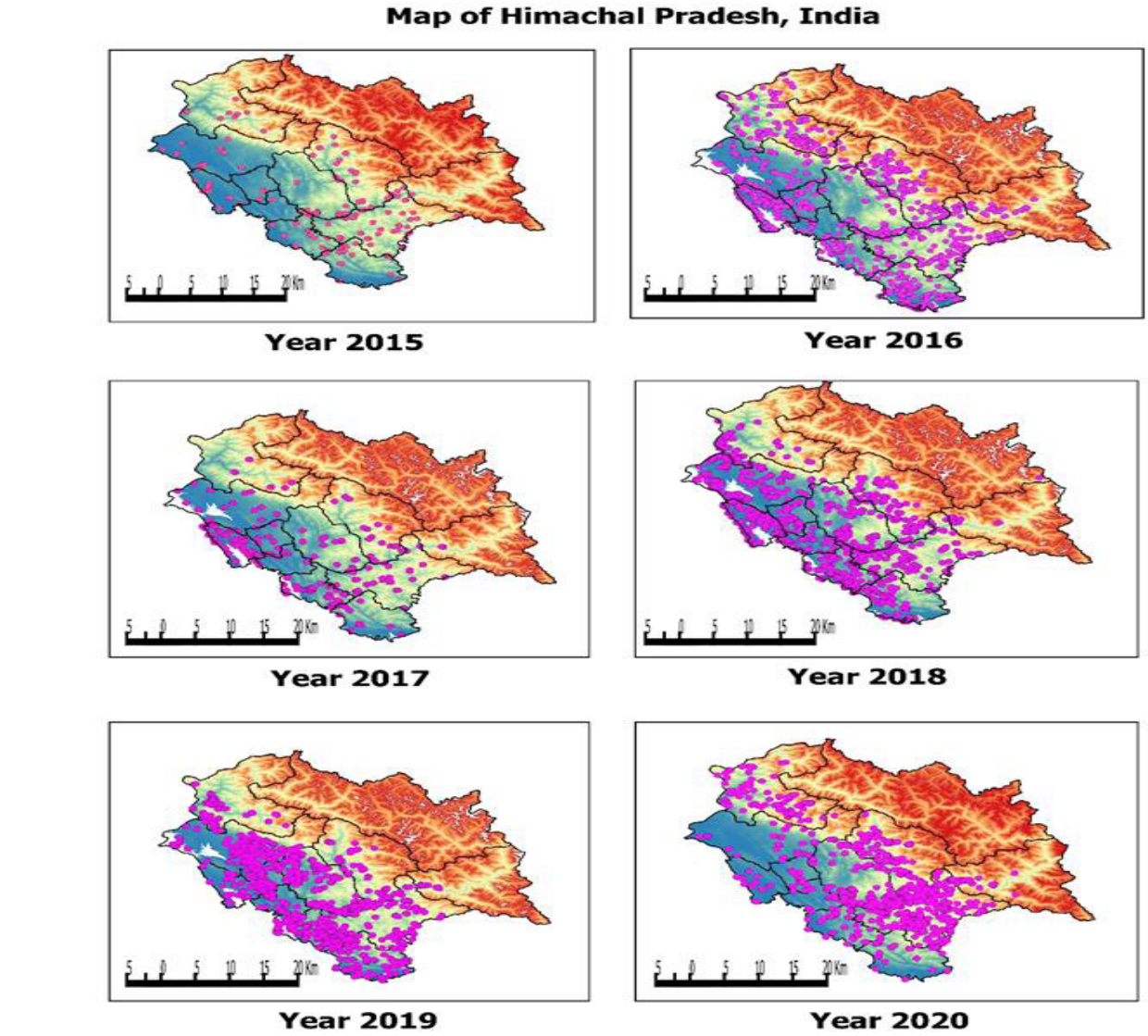
Year	Total No. of Incidences
2015	258
2016	2001
2017	404
2018	1780
2019	2436
2020	1631
2021 (till June)	5262

District-wise comparison of forest fire incidences

The study showed that maximum number of incidences of forest fires was observed in the district Shimla from 2015 to June 2021 followed by Solan, Mandi, Kangra, Sirmour and Kullu districts. Least number of incidences was reported for the district Lahaul-Spiti, Kinnaur, Bilaspur, Hamirpur and Chamba (Fig. 3).

Monthly incidences of forest fires

The analysis of data depicted that maximum forest fires occurred in the months May (3923 no.) followed by April (3354 no.), June (1591 no.), December (1085 no.), March (1077 no.) and January (978 no.) (Fig. 4). Least number of incidences were observed for the months July (1 no.), August (1 no.) and September (0 no.).



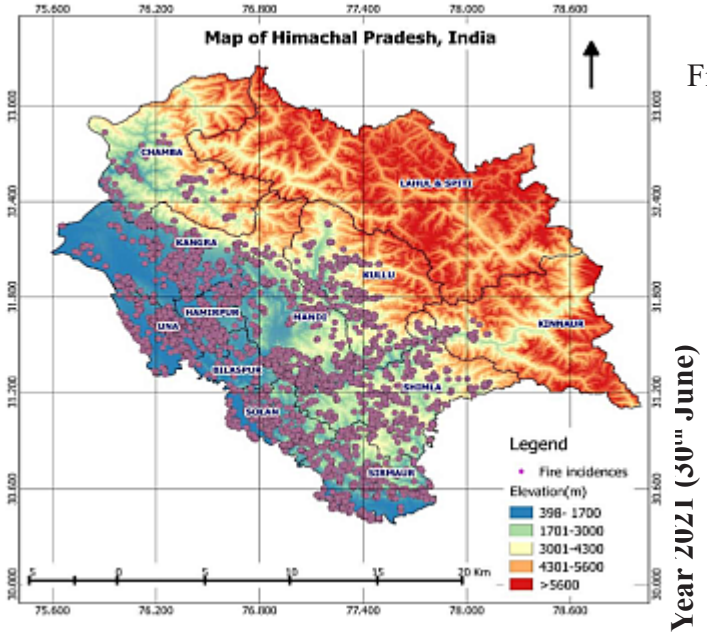


Figure 2. Maps depicting the extent of forest fires in the different years

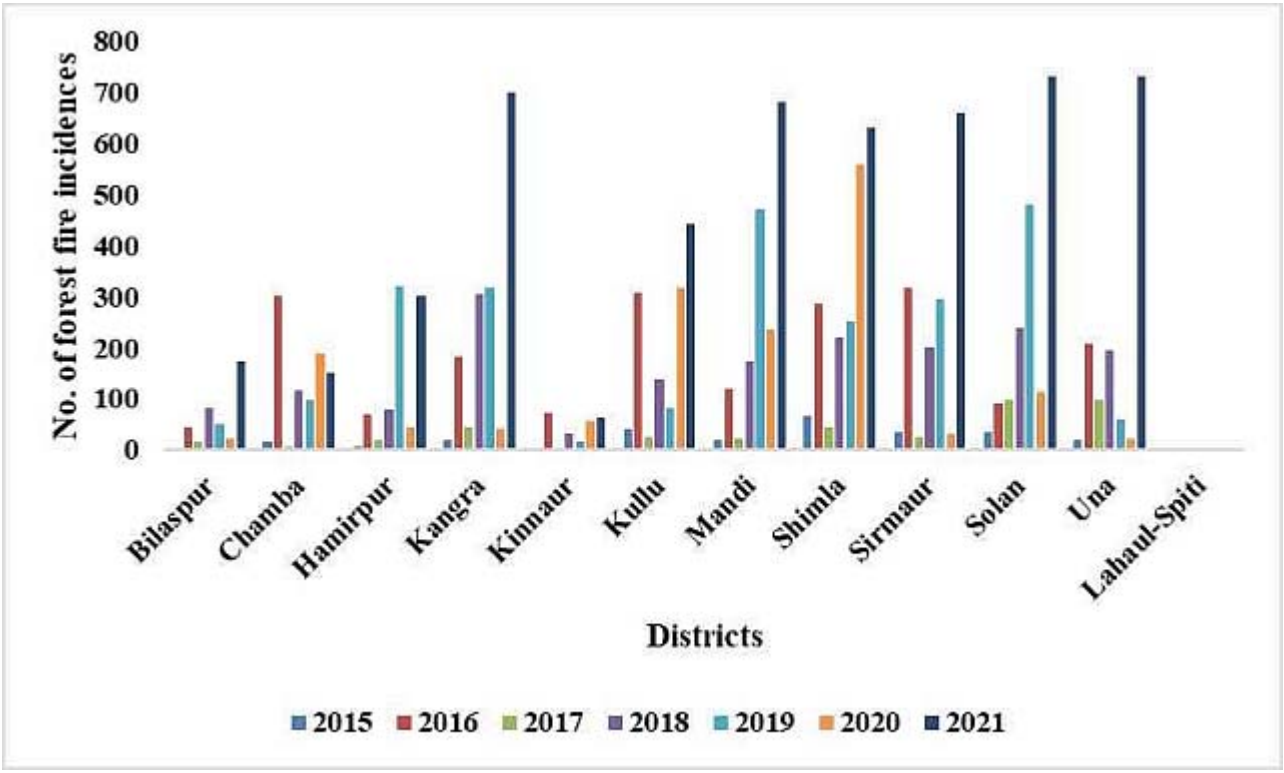


Figure 3. District wise number of forest fire incidences in the different years

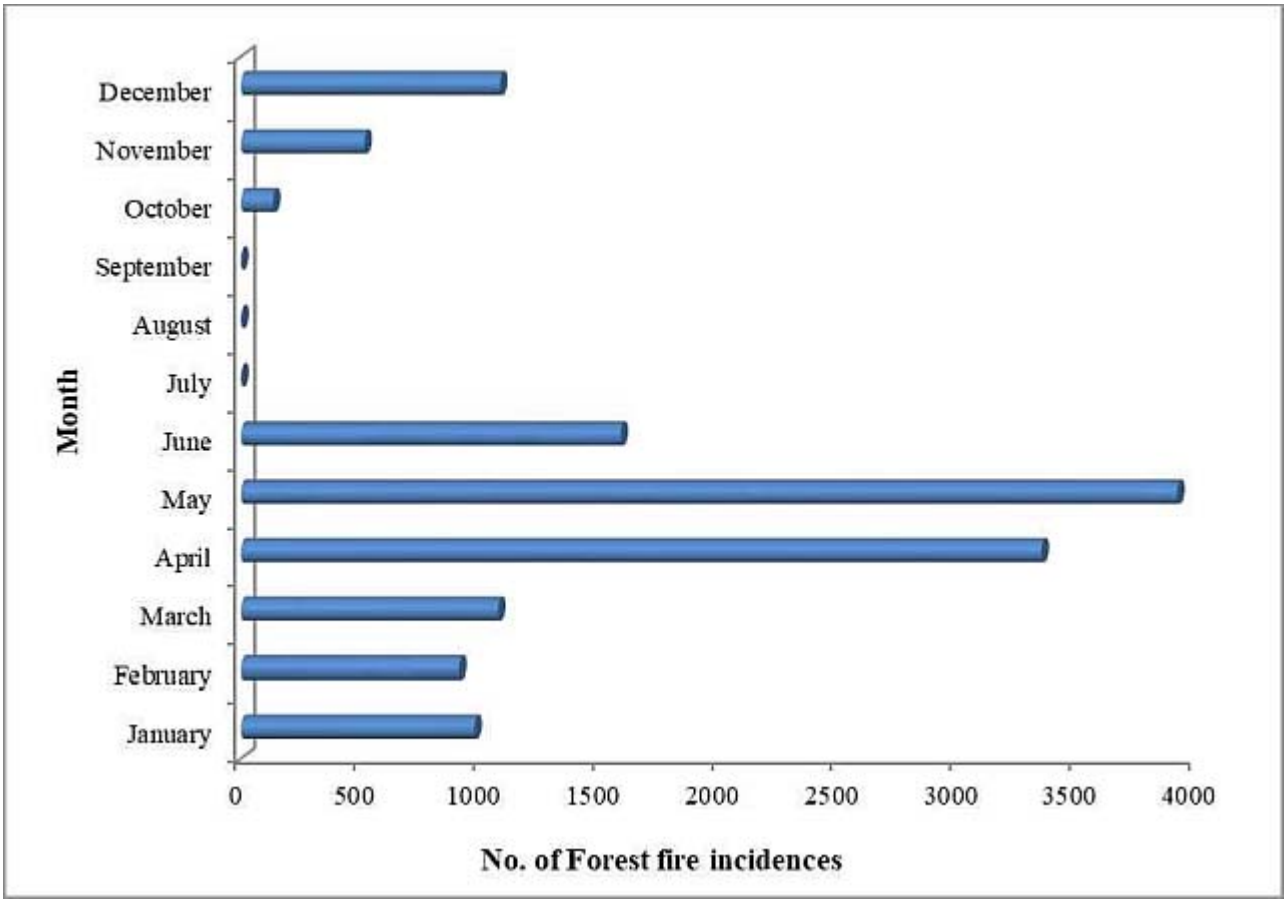


Figure 4. Monthly incidences of forest fire occurrence in the state of Himachal Pradesh

DISCUSSION

In the present study we have discussed in detail about the extent of forest fire incidences in the state of Himachal Pradesh. We have compared the data for different districts in the different years. This will help in identifying the areas that are easily prone to forest fires. Studies have shown that the type of vegetation in an area determines the extent and severity of forest fires (Rodríguez y Silva et al. 2010). Vegetation types at different geographical locations also influence the extent and severity of forest fires. The species (*Pinus* spp.) (Fig. 5) having high amount of resin is highly inflammable that favours spread of fire (Murray et al. 2013, Babu et al. 2016). Deciduous forests are the most susceptible to forest fires and accounts for around 40% of all the forest fires in India (Rodgers et al. 2002, Wikramanayake et al. 1998). The forest fire season varies according to location and in India fires mostly occur during months of February to June (Kanga et al. 2017) and similar results was observed in the present study. Further the Southern or Western aspects in the Himalayan region are primarily covered with more dry and mixed forest types leading to forest fires in these aspects.

Several studies have revealed that anthropogenic activities (human interference) and climate change are the main causes of forest fires in India and it is the major cause of degradation of Indian forests (Saha and Howe 2001). Public habitations close to the forests and road connectivity are often observed as the precursors of the forest fires (Kanga et al. 2017). Studies have reported that forest fires are initiated by the local people in the western Himalayas of India for good grass growth in the next season. Fire is also ignited by locals for collecting forest products like honey, gum etc. Accidental fires occur due to burning matchsticks and cigarettes by the local people in the forests (Bahuguna et al. 2002). It is essentially required to assess forest fires in a country like India where around 55% of the total forest cover is prone to fires annually (Kanga et al. 2014).

Fire Intensity Levels can be high due to large load of dry and fine plant biomass combined with high calorific contents of the shrub species present. The studies on fire behavior in relation to vegetation and soil are scarce. It is important that in-depth studies are carried out and correlated with local climate conditions.

Figure 5. Fire in the Pine forest in district Kangra

CONCLUSION

Forest degradation is an important issue which needs proper management. From past few years forest fires has received the public attention globally due to their significant impact on the various components of forest ecosystems. Satellite remote sensing can be an important tool for fire mapping, fire monitoring and fire control in the forests. Public awareness and training for managing forest fires at local levels can be very effective in controlling forest fires.

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Authors' contribution: All authors contributed equally.

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