

Study of Forest Fire Incidences and Management in Mussoorie Forest Range, Dehradun, Uttarakhand, India

Androse Chiri, Manish Kumar, Vikaspal Singh*, Sandhya Goswami, A K Uniyal, Rashmi T Chamoli

Department of Forestry, Dolphin PG Institute of Biomedical and Natural Sciences, Dehradun, India

ABSTRACT

The greater fire incidences were reported in the month of March to May of fire season in the studied forest ranges. Forest fire not only influences the vegetation but also damage the natural habitats of different associated faunal species. More fire incidences were recorded in the year of 2021, 2019 and 2018 while the years of 2020 and 2017 with less fire incidences. Forest ranges of Raipur and Mussoorie has encountered more fire incidences during year 2017 to 2021 as compare to rest of forest ranges in the study area. The majority of lower altitude forest areas of these ranges are composed of Sal (*Shorea robusta*) and Chir pine (*Pinus roxburghii*) mixed forest. The water bodies and upper layers of the soil in these forest areas gets dried up during the summer season due to heat, which making it highly prone to fire.

Keywords: Forest fire; Forest ranges; Garhwal himalayan; Mussoorie

INTRODUCTION

Forest fires are used as tool in different ecosystems according to management and regeneration requirements. The species mix, habitat structure and biodiversity may influence by controlled and uncontrolled fire in an ecosystem (Global Wildfire Information System-2019) [1]. Severe impacts can be seen by forest fires such as loss of human life, biodiversity, habitat, production and productivity; degradation of landscapes and disruption of livelihoods (ISFR-2021). Forest fire prone classes in Uttarakhand state are as extremely fire prone (0.20%), very highly fire prone (3.12%), highly fire prone (16.75%), moderately fire prone (24.22%) and less fire prone (55.71%) as per classified by ISFR-2021.

Various studies in relation to forest fire have been investigated in different parts of India. Fule recently accessed a study on frequent burning in chir pine forest of Uttarakhand and concluded that ongoing frequent surface fire regimes linked to human land use as prominent disturbance factors in chir pine forests [2]. Singh in Chamoli and Bageshwar Forest division of Uttarakhand observed that fire frequency largely determined by moisture conditions and the traditional practices of biomass collected by local people [3]. Forest fire activity changes in central Indian part have been investigated by Jain, by using satellite observation during 2001 to 2020 and from 2001 to 2020, 70% of yearly forest fires over the region occurred during March (1,857.5 counts/month) and April

(922.8 counts/month) [4].

In the central Himalaya, particularly Uttarakhand, frequent man-made fires are associated with the chir-pine (*Pinus roxburghii*), banj oak (*Quercus leucotrichophora*) forest zone (generally between 800 to 2000 m altitude) and promote the regional dominance of chir-pine at the expense of broadleaf oak forests [5]. In context of sub-montane and montane zone of Garhwal Himalaya, Tiwari reported the most of forest fires were manmade or intentional fire. Kumari carried out a comparative study in two different; burned and unburned forest communities, revealed that burnet forests were more dense and rich than unburned forests [6,7]. In the Eastern-Himalayan part of India, Sharma observed forest fire as a potential environmental threat in recent years in Sikkim. Present study is an attempt to compare fire incidences and management practices in Mussoorie forest range of Dehradun district during the year 2017 to 2021 [8].

Study area

The study area was Mussoorie forest range of district Dehradun in Uttarakhand. The area comprised of temperate Oak and coniferous forest as per Chmapiion & Seth classification [9]. *Quercus leucotrichophora* is most abundant oak species and under conifer forest, species of *Cedrus deodara* and *Pinus roxburghii* occurred in the study area. The geographic locations of studied forest ranges are represented in Table 1.

Correspondence to: Vikaspal Singh, Department of Forestry, Dolphin PG Institute of Biomedical & Natural Sciences, Dehradun, India, E-mail: vikaspals@gmail.com

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Table 1: Geographic location of the studied Forest Ranges of Mussoorie Forest Division.

Forest range	Latitude	Longitude	Elevation (m)
Raipur	30°19'12.00" N	78°05'60.00" E	483
Kempti	30°29'16.24" N	78°02'12.49" E	1364
Mussoorie	30°27'17.93" N	78°04'14.45" E	2005
Benog	30°27'35.67" N	78°03'59.04" E	2200

METHODOLOGY

The study was conducted in the year of 2019 and due to COVID protocol the limited field observation was carried out. Therefore secondary sources of authentic data from Forest department were used as data collection and observation for the study as per method used by Singh [3]. Data on incidences of forest fire events, reports, risk zone maps, management plan were collected from D.F.O Mussoorie Forest Division Office, Mussoorie, Uttarakhand. The data of fire incidence in different forest ranges was collected through forest department and compiled for analysis of year 2017 to 2021.

RESULTS AND DISCUSSION

Different forest ranges and the forest area of studied Mussoorie forest division are presented in Table 2. The fire sensitive zone map of ITGC (Information Technology & Geo informatics Centre), PCCF Office, Dehradun, indicated that the forest ranges of Raipur, Mussoorie and Jaunpur comes under most fire sensitive zone as compare to other forest ranges (Figure 1) [10]. Forest ranges of Raipur and Mussoorie has encountered more fire incidences during year 2017 to 2021 as compare to rest of forest ranges in the study area. The majority of lower altitude forest areas of these ranges are composed of Sal (*Shorea robusta*) and Chir pine (*Pinus roxburghii*) mixed forest. The water bodies and upper layers of the soil in these forest areas gets dried up during the summer season due to heat, which making it highly prone to fire.

The reserve forest area of all studied ranges, severely influenced by forest fire. It was recorded that during the year of 2017 to 2021, the Mussoorie and Raipur forest ranges faced greater number of fire incidences as compare to Kempti and Benog wildlife sanctuary ranges (Table 3). As per response of forest filed officials and record, most of fires are manmade to ensuring better forage in the studied forest ranges. Singh reported similar findings regarding to manmade fire to hasten the growth of grasses and enhance production [3]. However, the introduction of fire adopted (*Pinus roxburghii*) and invasive species (*Eupatorium adenophorum*) shows negative aspect of forest fires as observed by Kumari [7]. Some forest areas of studied ranges with the dominance of chir pine (*Pinus roxburghii*) and promote forest fires in the studied forest ranges, as

per record. Chir pine needles in forest floor have high flammable characteristic which causes surface fire. The large amount of chir pine (*Pinus roxburghii*) needles accumulation and dry conditions during summer months has been reported to cause forest fires in chir pine (*Pinus roxburghii*) forests of Garhwal Himalaya and Indian Western Himalaya, respectively Kumar and Murthy [11,12].

The greater fire incidences were reported in the month of March to May of fire season in the studied forest ranges (Table 4). More fire incidences were recorded in the year of 2021, 2019 and 2018 while the years of 2020 and 2017 with less fire incidences. Pre monsoon season (March to mid-June) reported with high frequency of fire incidences in Uttarakhand [3]. Forest ranges are located in different altitudinal ranges as lower, middle and higher altitudes indicate the lower and middle altitudes consist of more human habitations. Thus frequent fire incidences were recorded in the lower and middle altitudes in all studied forest ranges. In Himalayan Mountains, middle elevations associated with dense human population and associated watersheds [3,13]. The findings of fire incidences and factors in present study are more or less similar to earlier studies in Garhwal Himalaya, Uttarakhand.

Forest fire not only influences the forest vegetation but also damage the natural habitats of different associated faunal species. Various faunal species depend under different stratum of forest vegetation for fulfillment of their basic requirements. Number of avian fauna, carnivores and herbivore species directly associated with existing forests. The plant composition of preset studied forest ranges associated with variety of faunal diversity as recorded by Prasad and Singh [14,15]. Thus damage encountered through forest fire leads to loss of floral diversity as well dependent faunal diversity in a forest.

It may be a good indication in context of fire management as modern practices and techniques are adopted by forest department in India. Forest Survey of India (FSI) since 2004, has been assisting the State forest departments and other agencies to deal with the problems associated with forest fire by using the latest remote sensing and communication technology. At present time Forest Survey of India (FSI) provide country wide forest fire related services as near real-time forest fire monitoring, large forest fire monitoring, early warning alert based on forest fire danger rating system, FSI Van Agni Geo-portal, Identification of Fire Prone Forest areas and sharing of WMS (Web Map Services) and WFS (Web Feature Services) to State Forest Departments (ISFR, 2021) [16]. Beside this at forest department level various management practices against forest fire are also in concern such as control burning, fire lines, awareness programs, efficient firefighting tools and coordination with other line department as revenue, PWD, Irrigation, Police and local people [17,18].

Table 2: Studied forest ranges and their forest area.

Head division	Forest range	Headquarter	Area of reserve forest (in hectare)	Private/ Municipal/ Cantonment forest area (in hectare)	Total (in hectare)
Dehradun	Kempti	Kempti	517.1	-	517.1
	Mussoorie	Mussoorie (Brookland)	8900.36	4202.11	13102.47
	Raipur	Kidduwala	3524.6	-	3524.6
	Benog wildlife sanctuary	Dhobi ghat (Mussoorie)	1081.97	-	1081.97
Grand Total			14024.03	4202.11	18226.14

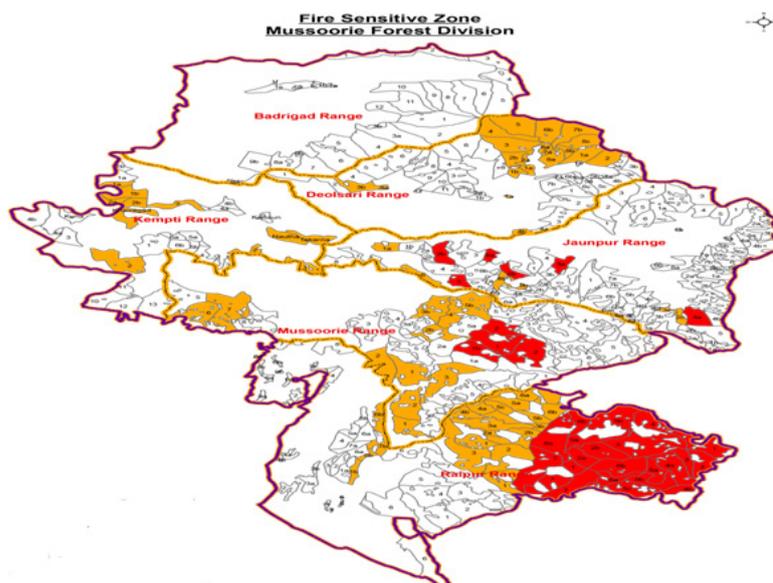


Figure 1: Fire sensitive zones in Mussoorie Forest Division (source: ITGC). Note: (█) Division boundary; (█) Range boundary; (█) Compartment boundary; (█) Most sensitive; (█) Sensitive.

Table 3: Reserved Forest Area affected by Fire during 2017-2021 in different Forest Ranges.

Year	Raipur		Mussoorie		Kempti		Binog wildlife sanctuary		Total	
	Fire incidence	Area (ha)	Fire incidence	Area (ha)	Fire incidence	Area (ha)	Fire incidence	Area (ha)	Fire incidence	Area (ha)
2017	2	3	1	1.5	0	0	0	0	3	4.5
2018	13	22	17	36.75	0	0	2	6.5	32	65.2
2019	11	18	9	10.35	0	0	0	0	20	28.4
2020	2	1.5	0	0	0	0	0	0	2	1.5
2021	18	37.8	25	34.2	3	1.5	5	9.5	51	83
Total	46	82.2	52	82.8	3	1.5	7	16	108	182.5

Table 4: Periodic fire incidences of forest fires during 2017 to 2021.

Year	District	24 Jan to 31 Mar		1 Apr to 30 Apr		1 May to 31 May		1 June to 31 June	
		No. of incidents	Area	No. of incidents	Area	No. of incidents	Area	No. of incidents	Area
2017	Dehradun	2	2.5	1	2	-	-	-	-
2018		5	6.8	5	9	22	49.4	-	-
2019		1	0.25	3	5	10	16.5	6	6.6
2020		-	-	-	-	2	1.5	-	-
2021		14	17.9	37	65.05	-	-	-	-
TOTAL		22	27.45	46	81.05	34	67.4	6	6.6

CONCLUSION

Present study revealed that current available techniques used by forest department may play a significant role in forest fire control, its damage and management. Management of forest on one hand may protect forest flora against forest fires and also may leads to protection of forest fauna on the other hand. Various Government agencies and forest department however doing a marked work in their filed related to forest, but there should also be a proper participation and positive approach form local peoples which are depend of the forest resources, specially hilly regions of our country.

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COMPETING INTERESTS

None.

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