PHYTOSOCIOLOGICAL ANALYSIS OF WOODY SPECIES UNDER BURNT AND UNBURNT COMMUNITIES AT PAURI GARHWAL, WESTERN HIMALAYA, INDIA

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ABSTRACT

Fire is an ecological factor that influences critical attributes of plant species. In this study, we characterise the effect of prescribed fire on vegetation dynamics. We investigated the effects of fire by comparing the two sites burnt protected site (BPS) and unburnt protected site (UPS) at Pauri Garhwal. Both sites were essentially equivalent before the fire, allowing the unburned site to serve as a reference or control area. Each site was sampled for species composition, distribution pattern, Shannon-wiener diversity index (H), the concentration of dominance (Cd) and evenness. Density and Shannon-wiener diversity index (H) ranged between 500-5700 ind ha^{-1} and 1.29-4.09 respectively for trees, sapling, seedling and shrub for both sites. Our findings demonstrate density was higher for BPS than UPS. *Pinus roxburghii* were dominant in all the three strata trees, sapling and seedling at both sites. In the shrub diversity *Berberis asiatica* (860 ind ha^{-1}) was the dominant shrub at BPS whereas *Himalrandria tetrasperma* was dominant at UPS (880 ind ha^{-1}). Contagious distribution was common. Carl-Pearson Correlation Coefficient was also calculated between two sites. The present study provides comparative diversity composition among forests and furnish the interaction of vegetation with fire and thus with its environment.

Keywords: Prescribed fire, Attributes, Diversity index, Distribution pattern.

INTRODUCTION

Fire is perceived as one of the dramatic natural forces determining the biotic community over time (Ahlgren 1974). Vegetation and fire are interrelated so that a change in any of two variables can affect the other (Ruiliang *et al.*, 2007). Forest fires represent a considerable threat and are primarily disturbance to the forests of Uttarakhand, India. The correlation among fire and Pinus ecosystem in the vegetation of Central Himalaya is one of the most distinguished examples of ecosystem dependency on disturbance mostly in Oak ecosystems. Earlier Singh *et al.*,1984 examined that the Pine is light demanding, fire-adapted but fire-promoting species and Oak forests being inflammable had experience a good deal from pine spreading fires (Champion *et al.*, 1968). Literature review suggests that open canopy forests are more inclined to fire than closed forests as the floor in open forests is drier than closed forests due to a greater extent of sunlight infiltration (Stolle *et al.*, 2003). The relationship flanked by fire severity and plant community response is relevant not only in wildfire settings but also for assessing management performances as in prescribed burning (Miller *et al.*, 2000).

Among the western Himalayan region, Uttarakhand is reported to have the highest incidences of forest fires. The devastating forest fire of 1995 mainly set in Pinus slopes results in a catastrophe effects to the large tracts of forests of Uttarakhand. In 2016 ferocious forest fire cover become prominent and wreaking havoc in almost all the forest regions of Uttarakhand. While by applying intentional prescribed fire (Controlled burning) typically acts well if handled suitably. The objectives of the present examination were to find out the impacts of a prescribed fire on aboveground woody vegetation (structure and composition) on Burnt protected site (BPS) and on control site as Unburnt Protected Site (UPS).

MATERIALS AND METHODS

STUDY AREA

The study was assessed out in the natural forest of Garhwal Himalaya. Geographically, the Garhwal Himalaya is one of the hot spots of biodiversity situated in the Western part of Central Himalaya. Uttrakhand Himalaya, a part of Indian Himalaya region is tranquil of two divisions called Garhwal and Kumaon Himalaya. The Garhwal Himalaya lies between

Fig. 1. Map showing study site

the latitudes 29°26' to 31°28' N and longitudes 77°49' to 80°60' E with a total area of 3000 km^2 exhibiting submontane to alpine climates with distinct characteristics of the specific vegetation types. The present work was undertaken and assessed in Pine dominated forest ecosystem**.** Two permanent plots were marked in Pinus dominated forest of which one was burnt at Manda Khal (1800-2000 m asl) and other was unburnt at Dadapani (1700-2000 m asl) (Fig. 1). The study was carried prior to 4 months after prescribed treatment applied by forest officials. There was no previous fire history at the unburnt site. The area enjoys sub-tropical to a temperate climate with cool winter and pleasant summer. Temperature ranges from 2^0C in January and 24-36^0C in July.

METHODS

Prescribed burnt treatment was carried out in January 2014. The Phytosociological analysis was carried out in each of the (burnt and unburnt) sites. Within each plot, random stratified sampling quadrat method was followed (Misra 1968). 10 quadrats of 10×10m were carried out for trees and 20 quadrats of 5×5m were used for shrubs. In each quadrat, all trees (>31.5 cm cbh) and saplings or shrubs (10.5-31.4 cm circumference) were individually measured for circumference from the ground. The individuals of trees with less than 10 cm circumference were recorded as seedlings.

Data analysis

The vegetational data were quantitatively analysed, separately for each species and for each layer, for frequency, density, abundance (Curtis *et al.*, 1950) and for importance value index (IVI) following (Philips 1959). The abundance to frequency (A/F) was used to interpret the distribution pattern of the species, a ratio less than 0.025 indicates regular distribution, random distribution if it falls between 0.025 and 0.05, and contagious distribution if the value is greater than 0.05 (Curtis *et al.*, 1956). Total basal cover (TBC) of all species was measured to reflect the area occupied by the particular species. In the present study, several indices were used and were calculated separately for each stratum (tree, sapling, seedling and shrub) on the basis of density. The diversity (H) was determined using the Shannon Wiener information index (Shannon *et al.*, 1963), H = (ni/n) 2log2 (ni/n), where ni is the density of a species and n is the sum of the total density of all species in that forest type. The Simpson's concentration of dominance (Simpson 1949) was measured as Cd = Pi^2, where Pi = ni/n.

Statistical analysis

Carl Pearson correlation coefficient was calculated to identify the relationship of different phytosociology parameters between BPS and UPS.

RESULTS AND DISCUSSION

Community composition and vegetation analysis

The studied forests are composed of evergreen (conifer forests) mainly dominated by *Pinus roxburghii*. Total frequency and abundance of all the strata are shown in (Fig. 2). It is evident that *Pinus roxburghii* had maximum density, basal cover and IVI. On both the sites trees, sapling and seedling strata were dominated by *Pinus roxburghii.* In ideal conditions, the associated species cannot-out complete Pinus due to its broad ecological amplitude and specialised niche in subtropical zone (Ahmad *et al.*, 2010). Strata wise attributes studied like frequency, density, abundance, mean and total basal cover, A/F, concentration of dominance, diversity and evenness for trees, saplings, seedlings and shrubs for both sites are given in (Table 1). Individual wise parameters are shown in for all strata (Table 2 & 3).

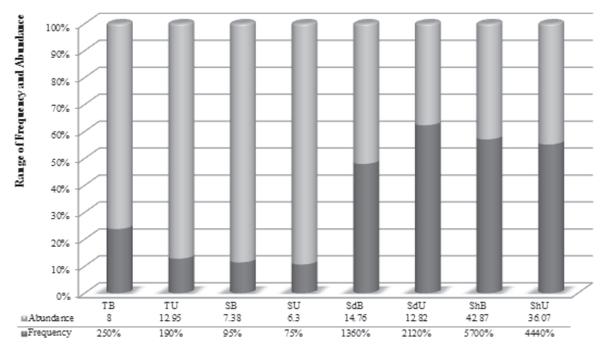

Fig. 2. Total Frequency and Abundance of all Strata

Table 1. Phytosociological attributes of the BPS and UPS

Parameters	Trees		Saplings		Seedlings		Shrubs	
	Burnt	Unburnt	Burnt	Unburnt	Burnt	Unburnt	Burnt	Unburnt
SR	5	6	5	4	8	7	26	23
Frequency	250	190	95	75	160	295	790	645
Density	500	560	600	500	1360	2120	5700	4440
Abundance	8	12.95	7.38	6.3	14.76	12.82	42.87	36.07
MBC	0.090	0.178	0.008	0.0159	0.00012	0.00002	0.0026	0.0037
TBC	14.945	26.441	1.151	2.468	0.026	0.007	0.532	0.533
A/F	0.239	0.643	0.683	0.686	1.474	0.726	2.415	2.068
Cd	0.421	0.476	0.380	0.546	0.378	0.224	0.076	0.089
H	1.60	1.54	1.78	1.29	2.04	2.40	4.09	3.91
Evenness	0.995	0.861	1.107	0.931	0.984	1.237	1.256	1.247

Abbreviations TB=Trees Burnt Site TU=Trees Unburnt Site SB=Sapling Burnt Site SU=Sapling Unburnt Site SdB= Seedling Burnt Site SdU=Seedling Unburnt Site ShB=Shrub Burnt Site ShU=Shrub Unburnt Site

Burnt protected site and unburnt protected site

A total of 5 tree species were recorded on burnt site. The associated tree species with *Pinus roxburghii* were *Quercus leucotrichophora*, *Myrica esculenta*, *Lyonia ovalifolia* and *Debregeasia salicifolia*. *Pinus roxburghii* showed dominance, exhibit density of (300 ind ha^{-1}) to its high TBC (12.284 m^2 ha^{-1}) and IVI (182.192), with co-dominance of *Quercus leucotrichophora* and *Myrica esculenta*. The minimum density was showed by *Debregeasia salicifolia* (10 ind ha^{-1}) with TBC (0.127 m^2 ha^{-1} and IVI (6.852) (Table 2). In the sapling layer, *Quercus leucotrichophora* and *Myrica esculenta* were found to be co-dominant in addition to dominant *Pinus roxburghii*. These two species were also co-dominant in the seedling layer. A total of 26 shrubs were documented. Among the shrubs, *Berberis asiatica* showed maximum density (860 ind ha^{-1}) to its high TBC (0.220 m^2 ha^{-1}) and IVI (66.508) followed by *Himalrandria tetrasperma* in TBC (0.140 m^{2}ha^{-1}) but density was followed by *Rubus ellipticus* (660 ind ha^{-1}) (Table 3). *Rosa brunonii* and *Urena lobata* showed minimum density (20 ind ha.)

In the unburnt site, a total of 6 tree species was recorded. *Pinus roxburghii* exhibit absolute density (370 ind ha^{-1}) to its TBC (23.051 m^2 ha^{-1}) and IVI (205.883) and was owed by *Cupressus torulosa*, *Myrica esculenta*, *Quercus serrata*, *Cedrus deodara and Toona ciliata* (in parenthesis Table 2). Minimum density was recorded for *Cedrus deodara* and *Toona ciliata* (10 ind ha^{-1}). In the sapling strata, *Myrica esculenta* was found higher in dominance in addition to *Pinus roxburghii*. The seedling was higher of *Pinus roxburghii* followed by *Quercus serrata*, *Myrica esculenta* and *Quercus leucotrichophora* was found competing with each other. A total of 23 shrubs were recorded. *Himalrandria tetrasperma* was the dominant shrub on UPS with maximum density (880 ind ha^{-1}) with TBC (0.27 m^2 ha^{-1}) and IVI (85.402) shown in parenthesis in (Table 3). *Rubus ellipticus* and *Eupatorium adenophorum* indicate the competing density. *Berberis aristata* and *Pyracantha crenulata* showed the minimum density (20 ind ha^{-1}). Chir forests do not show variation in all three layers (Singh *et al.*, 2014). The values for density in Pinus dominated forests reported from Garhwal Himalaya ranged between 7-410 m^2 ha^{-1} and the TBC ranged between 0.003-14 for both burnt and unburnt sites (Mehta *et al.*,1997). The total density, basal cover and species richness were 370 plant ha^{-1}, 779 cm^2 ha^{-1} and 5, respectively from temperate forests (Kumar *et al.*, 2010). In the present study, density was higher for burnt plot than unburnt plot; it suggests that fire prompts the vegetation frequently and result in more species. The increase in density of vegetation in burnt plot as compared to unburnt plot reinforced the earlier findings Brockway *et al.*, 1997 which suggested that due to reduction in fuel loading and less release of various allelochemicals from pine-needle litter and

Table 2. Phytosociological parameters of trees, sapling and seedlings studied at BPS and UPS (in parenthesis)

S. No.	Plant Stratum	Density (ind ha^{-1})	TBC (m^2 ha^{-1})	IVI	A/F	H	Cd	Ev
	Trees							
1	*Debregeasia salicifolia* (D.Don) Rendle)	10	0.1273	6.852	0.1	0.113	0.0004	0.07
2	*Cedrus deodara* (Roxb. ex D.Don) G. Don	(10)	0.3821	8.494	0.1	0.104	0.0003	0.058
3	*Cupressus torulosa* D.Don	(90)	(0.962)	(40.762)	(0.0563)	(0.424)	(0.0258)	(0.237)
4	*Lyonia ovalifolia* (Wallich) Drude	20	0.1921	13.286	0.05	0.186	0.0016	0.115
5	*Myrica esculenta* Buch.-Ham. ex D.Don	70 (60)	0.8023 (1.4738)	35.368 (26.815)	0.0438 (0.15)	0.397 (0.345)	0.0196 (0.0115)	0.247 (0.193)
6	*Pinus roxburghii* Sargent	300 (370)	12.2843 (23.0515)	182.194 (205.883)	0.03 (0.037)	0.442 (0.395)	0.3600 (0.4365)	0.275 (0.220)
7	*Quercus leucotrichophora* A. Camus	10	1.5395	62.301	0.0156	0.464	0.04	0.288
8	*Quercus serrata* Murray	(20)	(0.2854)	(9.914)	(0.2)	(0.172)	(0.0013)	(0.096)
9	*Toona ciliata* Roemer	(10)	(0.2864)	(8.132)	(0.1)	(0.104)	(0.0003)	(0.058)
	Total	**500 (560)**	**14.945 (26.441)**	**300**	**0.239 (0.643)**	**1.60 (1.54)**	**0.421 (0.476)**	**0.995 (0.861)**
	Sapling							
1	*Celtis australis* L.	60 (60)	0.0546 (0.0271)	30.537 (26.431)	0.0666 (0.15)	0.332 (0.367)	0.0100 (0.0144)	0.206 (0.265)
2	*Lyonia ovalifolia* (Wallich) Drude	40	0.0845	24.538	0.1	0.26	0.0044	0.162
3	*Myrica esculenta* Buch.-Ham. ex D.Don	40	0.0688	17.904	0.4	0.26	0.0044	0.162
4	*Pinus roxburghii* Sargent	340 (360)	0.7259 (2.0509)	167.100 (221.756)	0.0420 (0.036)	0.464 (0.341)	0.3211 (0.5184)	0.288 (0.246)
5	*Quercus leucotrichophora* A. Camus	120	0.2172	59.921	0.075	0.464	0.04	0.288
6	*Quercus serrata* Murray	40	0.3361	28.284	0.4	0.291	0.0064	0.21
	Total	**600 (500)**	**1.151 (2.468)**	**300**	**0.683 (0.686)**	**1.78 (1.29)**	**0.380 (0.546)**	**1.107 (0.931)**
	Seedling							
1	*Celtis australis* L.	40 (180)	0.0005 (0.0007)	7.812 (25.878)	0.4 (0.113)	0.150 (0.302)	0.0009 (0.0072)	0.072 (0.155)
2	*Cupressus torolosa* D.Don	(40)	(0.0001)	(5.209)	(0.4)	(0.108)	(0.0004)	(0.056)
3	*Engelhardtia spicata* Leschenault ex Blume	60	0.002	18.429	0.15	0.199	0.0019	0.095
4	*Ficus racemosa* L.	100	0.002	21.17	0.25	0.277	0.0054	0.133
5	*Glochidion velutinum* Wight	40	0.0007	8.563	0.4	0.15	0.0009	0.072
6	*Myrica esculenta* Buch.-Ham. ex D.Don	120 (240)	0.0005 (0.0006)	23.106 (33.845)	0.075 (0.0375)	0.309	0.0078	0.149

Table 3. Phytosociological parameters of Shrubs studied at BPS and UPS (in parenthesis)

S.No.	Species	Density (ha)	TBC	IVI	A/F	H	Cd	Ev
1	*Asparagus adscendens* Buch.-Ham. ex Roxb.	40 (240)	0.0003 (0.0010)	1.385 (11.805)	0.4 (0.037)	0.050 (0.227)	0.00005 (0.0029)	0.015 (0.073)
2	*Berberis aristata* DC.	280 (20)	0.0571 (0.0294)	25.764 (6.737)	0.010 (0.2)	0.213 (0.035)	0.00241 (0.00002)	0.066 (0.011)
3	*Berberis asiatica* Roxb. ex DC.	860 (280)	0.220 (0.172)	66.508 (45.643)	0.033 (0.034)	0.412 (0.251)	0.02276 (0.0039)	0.126 (0.080)
4	*Campylotropis speciosa* (Royle ex Schindler)	(40)	(0.00005)	(2.461)	(0.1)	(0.061)	(0.00008)	(0.02)
5	*Carissa opaca* Stapf ex Haines	80	0.0003	4	0.05	0.086	0.0002	0.027
6	*Cotoneaster rotundifolia* Wallich ex Lindley	120 (60)	0.0292 (0.0134)	10.124 (5.413)	0.075 (0.15)	0.117 (0.084)	0.00044 (0.0001)	0.036 (0.027)
7	*Daphne papyracea* Wallich ex Steudel	120 (60)	0.0031 (0.00030)	8.377 (3.733)	0.0148 (0.066)	0.117 (0.084)	0.00044 (0.0001)	0.036 (0.027)
8	*Desmodium multiflorum* DC.	200 (180)	0.0001 (0.00007)	5.418 (8.717)	0.222 (0.05)	0.170 (0.187)	0.00123 (0.0016)	0.052 (0.060)
9	*Eupatorium adenophorum* Sprengel	500 (500)	0.001 (0.002)	14.760 (23.287)	0.061 (0.022)	0.308 (0.355)	0.00769 (0.0126)	0.095 (0.113)
10	*Flemingia fruticulosa* Wallich ex Benth.	400 (280)	0.0001 (0.0002)	12.735 (12.550)	0.049 (0.043)	0.269 (0.251)	0.00492 (0.0039)	0.083 (0.080)
11	*Himalrandria tetrasperma* (Roxb.) Yamazaki	580 (880)	0.1405 (0.275)	42.876 (85.402)	0.058 (0.027)	0.335 (0.463)	0.01035 (0.0392)	0.103 (0.148)
12	*Hypericum oblongifolium* Choisy	60 (80)	0.00003 (0.0007)	2.958 (5.048)	0.066 (0.05)	0.069 (0.104)	0.00011 (0.0003)	0.021 (0.033)
13	*Indigofera heterantha* Wallich ex Brandis	320 (300)	0.0011 (0.0016)	9.617 (9.390)	0.088 (0.333)	0.233 (0.263)	0.00315 (0.0045)	0.072 (0.084)
14	*Inula cappa* (Buch.-Ham. ex D.Don)	40 (120)	0.00003 (0.0002)	1.972 (6.626)	0.1 (0.048)	0.050 (0.141)	0.00005 (0.0007)	0.015 (0.045)
15	*Leptodermis lanceolata* Wallich	60 (80)	0.00005 (0.00005)	2.327 (3.362)	0.15 (0.2)	0.069 (0.104)	0.00011 (0.0003)	0.021 (0.033)
16	*Myrsine africana* L.	80 (260)	0.0002 (0.0003)	3.964 (12.131)	0.05 (0.040)	0.086 (0.240)	0.0002 (0.0034)	0.027 (0.076)
17	*Phyllanthus parvifolius* Buch.-Ham. ex D.Don	100 (100)	0.00005 (0.00005)	4.295 (5.362)	0.062 (0.062)	0.102 (0.123)	0.00031 (0.0005)	0.031 (0.039)
18	*Pyracantha crenulata* (D.Don) M. Roemer	40 (20)	0.0235 (0.0152)	6.386 (4.088)	0.1(0.2)	0.050 (0.035)	0.00005 (0.00001)	0.015 (0.011)
19	*Reinwartia indica* Dumortier	100 (80)	0.00005 (0.00004)	4.295 (4.135)	0.062 (0.088)	0.102 (0.104)	0.00031 (0.0003)	0.031 (0.033)
20	*Rhus cotinus* L	60	0.0002	2.358	0.15	0.069	0.00011	0.021
21	*Rhus parviflora* Roxb.	280 (80)	0.0305 (0.0041)	15.068 (5.678)	0.057 (0.05)	0.213 (0.104)	0.00241 (0.0003)	0.066 (0.033)

Table 4. Correlation between different parameters of BPS and UPS

	Site	LF	SR	F	D	A	MBC	TBC	A/F	Cd	H	Ev
Site	1											
LF	0.000	1										
SR	0.061	.81*	1									
F	0.046	.74*	.96**	1								
D	0.036	.87**	.97**	.96**	1							
A	0.047	.80*	.99**	.96**	.97**	1						
MBC	-0.200	-.75*	-0.34	-0.25	-0.44	-0.29	1					
TBC	-0.175	-.76*	-0.34	-0.25	-0.44	-0.30	.99**	1				
A/F	0.118	.89**	.93**	.83**	.91**	.93**	-0.47	-0.49	1			
Cd	-0.062	-.86**	-.88**	-.90**	-.93**	-.88**	0.48	0.48	-.80*	1		
H	0.046	.88**	.97**	.96**	.98**	.96**	-0.44	-0.45	.90**	-.96**	1	
Ev	0.057	.81*	.70*	.74*	.80*	0.67	-0.66	-0.66	0.61	-.92**	.83*	1

*Correlation is significant at the 0.05 level (2 tailed) **.
Correlation is significant at the 0.01 level (2-tailed).

Abbreviations LF=Life form, SR=Species richness, F=Frequency, D=Density, A=Abundance, MBC=Mean Basal Cover, TBC=Total Basal Cover, A/F=Abundance frequency ratio, Cd=Concentration of Dominance, H=Shannon-wiener Diversity Index, E=Evenness

enhanced release of nutrients from burnt litter induced rapid growth of the vegetation on the onset of congenial conditions. But TBC was higher at the unburnt site because of the reason fire does not affect the growth of species at this particular site. Shrub density reported between the ranges of 6639-24853 ha^{-1} from different temperate forests of Garhwal Himalaya (Gairola *et al.*, 2011). Our study also shows the same trend of shrub density. Shrubs richness prevalent among both sites may be due to the reason, Pinus having open canopy supports understorey vegetation. The higher density of shrub also suggested that forest strands are conserved.

Distribution pattern

Odum 1971 stated that clumped (contagious) distribution is the commonest pattern in nature, and random distribution is found only in the very uniform environment. In the present study, contagious distribution was also found prevalent. Contagious distribution may be due to the reason that short-term impact of fire does not alter distribution. Analysis on both the sites indicates the range of contagious distribution pattern between (20-87.5%) followed by random (12-60%) and regular distribution (4-20%). On BPS most of the species in tree strata was mostly randomly distributed (60%) owing to major species of sapling (80%), seedling (85.7%) and shrub strata (65.3%) which were contagiously distributed. On the other hand on UPS, dominant distribution was contagious for tree stratum (83.3%) and sapling strata (75%) while as seedling and shrubs strata shows equally contagious and random distribution (42.8%) and (47.8%) respectively. Regular distribution was rare, and was found only 20% in case of trees and 11.5% in shrubs at BPS, and on UPS showed by seedling stratum (14.2%) and shrub strata (4.3%) because this type of distribution occurs where severe competition between the individuals exists (Panchal *et al.*, 2004).

Diversity and concentration of dominance

In the present study the values of H and Cd in BPS ranged from 1.60 to 4.09 and 0.076 to 0.421 while as in UPS, H and Cd ranged from 1.29 to 3.91 and 0.089 to 0.546, respectively. Present results revealed that Cd generally shows the reverse trend to diversity more significantly at the unburnt site than at burnt site. The diversity indices (H) for the shrub stratum (4.09) were higher on the burnt site followed by seedling (2.04), sapling (1.78) and trees (1.60) but Cd was higher for trees (0.421). Rather on unburnt site, H was also higher for shrubs (3.91) followed by seedling (2.40), trees (1.54) and sapling (1.29) but the Cd was higher of sapling (0.546). Negi *et al.*, 2005 reported the values of diversity from 2.156 to 2.323, 2.53 to 2.67, 2.39 to 3.20 and 3.32 to 3.94 for trees saplings, seedlings and shrubs, respectively. Owing to the above reports, the diversity index value was higher due to the reason of forest plots are protected. It was also revealed from the results, diversity index was higher on the burnt site than on unburnt site. Similar findings of higher diversity index were also reported by (Sundriyal 1987). The range for Cd reported by Rikhari *et al.,* 1999 between 0.06-0.37 from western Himalaya is comparable to the values of Cd in the present study.

Evenness

Evenness is a component of diversity and at the burnt site, it was high for sapling (1.107) followed by shrubs (1.256), trees and seedlings show evenness of approximately 0.99. At the unburnt site, evenness was high for shrubs (1.247) followed by seedlings (1.237), sapling (0.931) and trees (0.861). The evenness reported by (Malik *et al.*, 2015 and Anthwal *et al.,* 2008) from temperate grazinglands of Garhwal Himalaya ranges between 0.45-1 and 1.00-1.46 respectively. Evenness analysed in the present study also shows the similar range because of the reason that evenness probabilities for all the species may be equal.

Statistical analysis estimation

A Carl Pearson coefficient was calculated between various phytosociological attributes (Table 4). Frequency (0.96), density (0.97) and abundance (0.99), A/F ratio (0.93), H (0.97) and evenness (0.70) were significantly and positively correlated with species richness. Shannon-Wiener (-0.96) and evenness (-0.92) were significantly and negatively correlated with concentration of dominance. MBC (-0.344) and TBC (-0.349) were negatively correlated with species richness and density.

CONCLUSION

The present study concludes that the effect of prescribed forest fire on various attributes especially density responded well at BPS and can have positive short term response on conifer forests. The density of shrubs was more on occasional fire treatment site but the density of seedling was more on UPS. Contagious distribution was common. It is common at warmer sites in fire prone areas, that *Pinus roxburghii* shows dominance climax community and acts as a superior competitor by invading the climax forest of *Quercus* spp., and *Cedrus deodara* thereby decreasing the growth of these shade chosen plants. Forest fires are expected to be hindered further with changing the climate and it is predictable that the interaction between parameters become more complex. In response to the growing crisis, our findings support the process of well planned controlled /hazard reduction burning in Pine forests but other effective regional conservation strategies are readily important for maintaining Pine and Oak dominance.

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