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Burning effect on Biodiversity in Satna Region

Abstract

Prescribed burning is a common and valuable management tool for forest practitioners, but both frequent burning and the exclusion of fire may result in significant changes in vegetation communities. As a result, there has been considerable debate regarding the costs and benefits of prescribed burning for biodiversity with little resolution. This study presents some of the results and uses these to highlight issues for biodiversity conservation in fire management planning. Anthropogenic burning regimes resulted in changes to plant species diversity within the study area but these changes were minor and less than the magnitude predicted from other studies. The major change occurring within the study appeared to be a natural response of the vegetation to the time since the last wildfire and this occurred independently of the imposed management regime. These results suggest that, while some prescribed burning regimes have minimal direct adverse impacts, they also fail to stimulate the recruitment of many plant species and thus may have longer term indirect impacts. In developing fire management plans, consideration should also be given to the intensity, seasonality and frequency of the burns because these factors will affect the conservation of biodiversity.

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Introduction

The term “biodiversity” or “biological diversity” has been defined as “the variability among living organisms and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems” (Parviainen and Päivine 1998). An ecosystem is a community of organisms and their environment, which functions as an integrated unit. Conserving biodiversity is receiving international attention. World-wide, numerous species are going extinct, and even more that have not yet been identified are likely to be similarly threatened. The “red lists” and the “red data books” published by the “world conservation monitoring centre” indicate that in 1994, just for species about which enough is known to assess their status, nearly 5,400 animal species and more than 26,100 plant species were threatened (Dallmeier, 1998).

Prescribed burning is a commonly applied management tool in forest ecosystems worldwide (e.g. Turner et al. 1994). Managers aim to reduce the risk and intensity of future wildfires by reducing or removing forest fuels through burning under mild conditions (Morrison et al. 1996; Bradstock et al. 1998; Fernandes et al. 2003). Prescribed burning can also encompass ecological burns, post-logging burns and strategic burns. Frequent prescribed burning is associated with significantly lower costs than the occasional but more destructive wildfire, particularly for commercial forests. As a consequence forest managers may attempt to maintain low fuel loads by regular burning to protect the timber resource. Altered fire regimes are considered to result in significant ecological change (Whelan 2002). Land managers, therefore, have a requirement to develop fire management strategies that help control wildfires while maintaining biological diversity and ecosystem processes (Gill 2001). Frequent fire has generally been considered to have negative effects on biodiversity throughout Australia (e.gTrainor and Woinarski 1994; Bradstock et al. 1997). As a consequence, frequent fire is listed under threatened species legislation in a number of states. For example, in NSW the Ecological Consequences of High Frequency Fire has been listed as a key threatening process under the NSW Threatened Species Conservation Act 1996. (DECC 2007). There is strong theoretical and empirical evidence regarding the impacts of frequent fire at the site or local population level (Keith 1996). However, at the landscape level where prescribed burning operations are planned and implemented,

Materials and Methods

The experiment was carried out in an arable crop farm that was not disturbed by fire for the preceding five years. The experimental plot was divided into two parts each measuring 50x50m in size. The species diversity and population density in each part of the plot were estimated by random throw of 1x1m quadrate at the commencement of the study in June 2011. Percentage matter content in each part of the plot was determined by collecting soil at two centimeter depth and determining the organic matter content by Walkley and Black (1979) method. In one part of the plot, herein referred to as Treatment B(TB), fire was set on the vegetation after collecting the initial data on species diversity and populationdensity as well as the organic matter content. The other part, Treatment A (TA) was left intact. After two years (2013), another set of readings on species diversity, population density and organic matter content was taken and Treatment B set on fire again and allowed to stand for another two years after which another set of data on the parameters cited above was taken in 2015. Each time data was collected from TB, similar set of data was collected from TA, the control plot and the sets data from the two plots were compared.

Table 1: (TA) Collected Data of Unburned Species Within Five Years

S. No.	Name of Species	2011	2013	2015
1	Cassia auriculata(L.)	5	6	8
2	Cassia tora(L.)	4	5	8
3	Cynodonductylon (L.)	2	4	7
4	Carrasiacorodon(L.)	4	6	7
5	Saccarummunj (L.)	3	6	9
6	Saccarumspontanum(L.)	3	4	6
7	Boerhaviadiffusa (L.)	5	7	8
8	Agaratumconsoides (L.)	4	6	7
9	Zizyphusnumularia (L.)	4	6	7
10	Ipomeapalmuta (L.)	2	4	5
11	TrabulusTerestris (L.)	4	5	7
12	Solanumxanthocarpum(L.)	3	5	6
13	Lantanacamera(L.)	5	6	8
14	Zizyphuszimginoidis (L.)	3	5	6

Table 2: (TB) Collected Data of Burned Species after Every Two Years

S. No.	Name of Species	2011	2013	2015
1	Cassia auriculata(L.)	5	3	1
2	Cassia tora(L.)	5	3	0
3	Cynodonductylon (L.)	2	0	0
4	Carrasiacorodon(L.)	4	3	1
5	Saccerummunj (L.)	3	0	0
6	Saccarumspontanum(L.)	5	4	2
7	Boerhaviadiffusa (L.)	5	3	0
8	Agaratumconsoid (L.)	6	4	0
9	Zizyphusnumularia (L.)	5	3	0
10	Ipomeapalmuta (L.)	5	3	0
11	TrabulusTerestris(L.)	4	3	0
12	Solanumxanthocarpus(L.)	3	1	0
13	Lantanacamera (L.)	5	2	1
14	Zizyphuszimginoidis (L.)	4	2	0

Results

The study revealed presence of fifteen species of flowering plants with varied population density. Seven of the flowering plants were shrubs, five herbs and the other two were grasses. The only grass species disappeared completely after the first burning in TB and did not appear again to the end of the experiment. The herbs survived the first burning but decreased in density and completely disappeared after the second burning**.** The shrub species however continued to decrease in density after the first burnings and in the second burning some species were decreased in numbers and also some were disappeared.

Dicussion

Results obtained indicated fire on vegetation to have both depressive and stimulatory effects depending on the type of species. For grasses and herb that are usually characterized by soft herbaceous tissues, relatively light seed and shallow roots, fire suppresses growth and lead to the disappearances of the species. In these species, heat generated by fire accelerate rate of transpiration, rapid drying of leaves and eventual burning of the stock plant. The light seeds are easily carried away by wind and deposited far away from the mother plant. The few seeds that are dispersed close to the mother plant are mostly on the surface and easily destroyed by fire. West (1965), Holdworth and Uhl (1997) and Aliero (2004) reported change in the direction of vegetation succession due to effect of fire on vegetation. The herb species survived the first burning due probably to presence of prennating buds that may have been buried underground under soil suffered only a partial effect of fire but completely destroyed after the second burning. The shrub species were stimulated by burning. This is probably due to partial dormancy break of buried seeds of these species after burning. The stem of these species being woody may also sprout from the base to grow and produce new foliage at the onset of the next rainy season. In the control plot, species of grass tripled their original numbers, herb doubled their numbers but shrubincreased in numbers only slightly (Table 1). Burnt ash is easily blown away by wind and leached by rain water consequently the loss in percentage organic matter content. Fitzpatric (1990), Waziri and Aliero (2005) reported soil fertility as an aspect of soil-plant relationship where the plant material is removed, the relationship changes and part of the organic matter lost. In conclusion, burning of vegetation, results in decreased biodiversity, population density of herbaceous species and loss of organic matter in soil. Burning also has stimulatory effect and could be used as a tool to promote growth of certain desired species in a directed succession.

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