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SCIENCE DIRECT
Forest Ecology and Management 225 (2006) 178–189
Forest Ecology and Management
www.elsevier.com/locate/foreco

Effect of micro-environment and human disturbance on the diversity of woody species in the Sariska Tiger Project in India

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Received 7 June 2005; received in revised form 30 October 2005; accepted 16 December 2005

Abstract

Species richness, diversity, basal cover and importance value index of the woody vegetation were analyzed in the Sariska Tiger Project in the north-eastern part of Rajasthan, NW India. Four study sites were selected on the basis of degree of human disturbance: (a) the Slopka forest (undisturbed), (b) the Kalighati forest (previously partially disturbed, now has been protected since 1979), (c) the Bharthari forest (partially disturbed) and (d) the Hajipur forest (highly disturbed). In the undisturbed Slopka forest, cumulative number of woody species increased from 20 in the valley to 38 up to the summit of hill slopes. The Shannon–Wiener diversity index and the Simpson's index were very low, i.e. 2.10 and 0.2, respectively. Observations on density, basal cover and IVI suggest that the elevation and various aspects of hill slopes maintain the rich species diversity of the woody vegetation in the severe arid climate of this forest. The anthropogenic disturbances have adverse impact on the woody vegetation. Species richness was higher in the undisturbed Slopka forest (38) as compared to the partially disturbed Bharthari forest (19). However, it was also relatively higher in the highly disturbed Hajipur forest (25). The diversity index of woody species was highest in the undisturbed forest (2.10) and lowest in the highly disturbed forest (1.6). Although the density and basal area of most of the woody species declined with increase in human disturbance, the density of dominant tree *Anogeissus pendula* increased from 1.6 in the undisturbed forest to 9.2 per 100 m^2 in the highly disturbed forest which suggests its high regeneration potential even in harsh environmental situations. Sorenson's index of similarity declined to 0.40 in the highly disturbed forest. The 0.63 similarity index between the vegetation of Slopka and Kalighati forest indicates that the original species composition of the undisturbed natural forest may not be restored once changed by human disturbance.

Keywords: Basal area; Drought conditions; Importance value index; Slopka forest

1. Introduction

Plant community structure of dry deciduous forests is greatly influenced by the prevailing disturbances (Murphy et al., 1995; Dunphy et al., 2000). Murphy and Lugo (1986) observed that the number of species tends to increase along moisture gradient in a semi-deciduous dry Guanica forest in Puerto Rico. Marod et al. (1999) reported low stem density and basal area, and relatively high species diversity in the natural mixed deciduous forest in western Thailand, and attributed it to bamboo undergrowth and frequent fires which prevent continuous regeneration. Sabogal and Valerio (1998) evaluated the structure and natural regeneration of trees in a dry deciduous forest in Nicaraguan and observed that these forests are in process of biological degeneration and economic depletion. Natural disturbances such as hurricanes (Kelly et al., 1988), typhoon (Shibuya et al., 1997), salt sprays and other coastal influences (Smith and Vankat, 1992; Hare et al., 1997) have great impact on the species diversity of dry deciduous forests. The deleterious effects of human disturbances on the floristic structure of such forests have also been evaluated (Rai, 1985; Murphy and Lugo, 1986; Pauline et al., 1996; Hare et al., 1997).

Tropical dry deciduous forest constitutes about 38% of the total forest area in India (Dixit, 1997). Only a few attempts have been made to evaluate the structure of plant community of these forests (Singh and Misra, 1978; Khan, 1996; Pauline et al., 1996; Dixit, 1997; Parthasasrthy and Sethi, 1997). The Aravalli mountain range sustains the tropical dry deciduous thorn forest in the semi-arid climate of the eastern part of Rajasthan, NW India (Fig. 1). The extreme conditions of temperature in summer and winter seasons, low relative humidity for 9 months in a year and frequent occurrence of droughts limit the natural regeneration potential of plant species in these forests. These

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doi:10.1016/j.foreco.2005.12.058

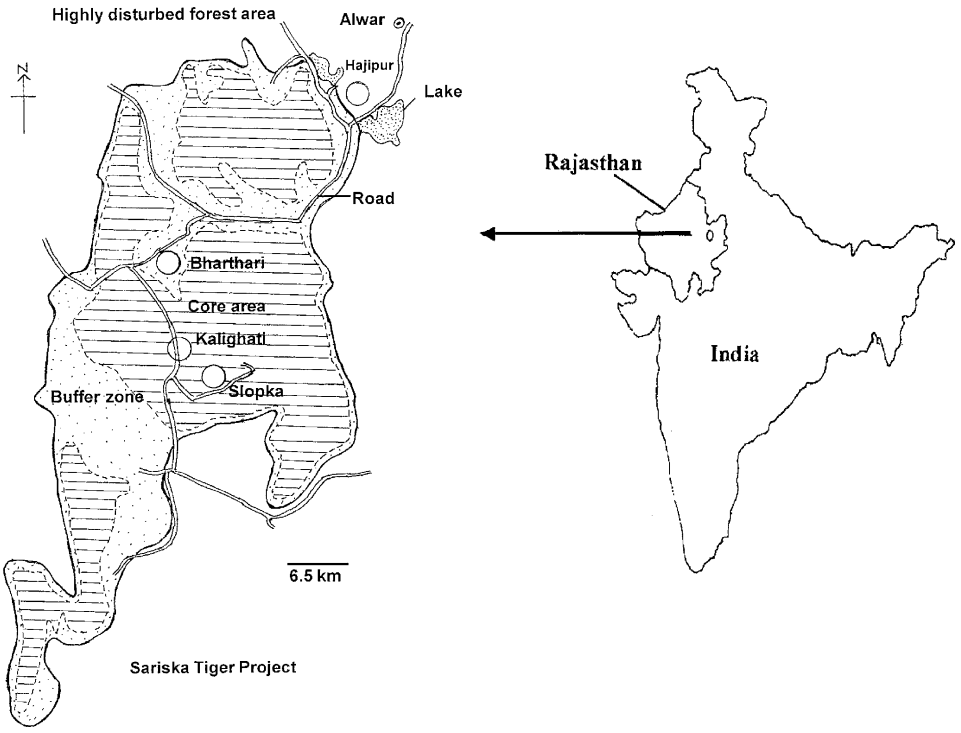

Fig. 1. Map showing the location of the study sites in the Sariska Tiger Project.

forest ecosystems are also under tremendous pressure of the swelling human and cattle population. Thus, the tropical dry deciduous thorn forests of Rajasthan may be characterized as fragile ecosystems according to criteria given by Nilsson and Grelsson (1995). Despite government protection, human disturbances such as felling and lopping of trees, grazing and removal of plants for medicinal use by the local rural population pose a serious threat to the survival of these natural forests. However, no serious attempt has been made to study the species diversity of the tropical dry deciduous thorn forest in Rajasthan. Hence, the objectives of the present study were to evaluate the shrub and tree species diversity of the Sariska Tiger Project in relation to varying micro-environmental conditions and human disturbance. The information collected may be valuable in the conservation of this unique fragile forest ecosystem.

2. Methods

2.1. The study site

The Sariska Tiger Project which covers an area of about 800 km^2, is situated between 76°17′ and 76°34′E and 27°5′ and 27°33′N in the north-eastern part of the Rajasthan, NW India (Fig. 1). It is a tropical dry deciduous thorn forest according to the classification of forests given by Champion and Seth (1968). The Sariska forest was a private hunting site of the Princely state of Alwar during the British rule. The British officers and the rulers of various states in India used to visit this forest for hunting wild animals. The Duke of Cannot (son of Queen Victoria) also came to the Sariska for a Royal shoot (Soni, 2000). After the independence of India it was declared as a reserve forest by the government of Rajasthan in 1955. In view of the conservation of the rich biodiversity of this forest, it was declared as the Sariska Tiger Project by the government of India and the Rajasthan state in 1979. The Sariska Tiger Project consists of a central forest area known as the core area which is fully protected against human disturbance, and a peripheral area surrounding the core area is know as buffer zone in which the lopping of trees for non-timber forest products and moderate grazing is allowed to local population.

The terrain of this forest is hilly with many valleys of various width and wide undulating plateaus. The plateaus are at a height of 377–380 m and the peaks of the world's oldest Aravalli mountain ranges in the Sariska Tiger Project are as high as 640 m above sea level. The most remarkable characteristics of the hills are their homogeneitic regularity of height, level summits and uniform appearance, stretching out from north-east to south-west, in more or less parallel lines (Soni, 2000). The rocks comprise of schists, granite, schistose, quartizites and crystalline limestone (Mayaram, 1968). The depth of soil layer is more than 1 m in valleys, whereas it is only a few centimetres deep on the hill slopes. The soil is sandy loam and alkaline with pH varying from 7.25 to 8.00 (Table 1).

The climate of the Sariska Tiger Project is monsoonal, hot and dry with three distinct seasons in a year. The summer season which commences from the middle of March and extends up to the end of June is extremely hot with temperature rising to 45 °C and is lashed by hot westerly winds (Soni, 2000). The rainy season is from July to September with 90% of the 650 mm annual rainfall occurring during this period (Fig. 2). The winter season is from October to February with minimum