International Scholars Journals

Advances in Agriculture and Agricultural Sciences ISSN 2381-3911 Vol. 6 (2), pp. 001-007, February, 2020. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Influence of anthropogenic factors on the diversity and richness of woody species in Sariska Tiger Reserve, Rajasthan, India

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Accepted 09 February, 2020

Effect of anthropogenic factors against species richness and diversity of the woody vegetation was analyzed in the Sariska Tiger Reserve, Rajasthan, North-West India from February to May 2009. Sixteen transects, ranging from 1.8 to 2 km in length were laid throughout the 80 km² study area covering all the available habitat types. 10 m radius circular plots were laid to enumerate tree layer and degree of various anthropogenic factors making a total of 318 plots throughout the study period. These factors were quantified in each plot at a scale of 0 to 4 (0-none and 4-very high). Along with ocular observations, software EstimateSWin750 was used to calculate richness and diversity of trees along each transect. The ocular results showed highest number of trees in Malajodka (369) and the least number of trees in Kiraska (93). Observed tree diversity was found to be maximum for the transect of Pandupol – Kiraska (18±3.05). Whereas, least diversity was found to be in the transect of Sadar I (6±2.23), having lesser degree of disturbance than former. Richness estimates showed highest value of richness (32.95±16.44) in transect of Malajodka which is in hilly tracts and least value for richness (6±0.43) in the transect of Sadar I.

Key words: Anthropogenic factor, diversity, richness, vegetation plots, Sariska.

INTRODUCTION

The tropical dry forests of the northwestern state of Rajasthan in India are no exception and, over many decades, have been subjected to heavy exploitation and over-utilization by a growing rural population (Kleine et al., 2009). Today, tribal people are largely dependent on cash support from the government, food-for-work programmes and migration to find adequate employment for their subsistence (Kleine et al., 2009).

Historically, Sariska has been subject to varying degrees of biomass extraction, including state-sponsored timber extraction, grazing and collection of non-wood forest produce (Johari, 2003; Shahabuddin and Kumar, 2006). However, since its declaration as a tiger reserve, part of the core zone of Sariska has been strictly protected from anthropogenic disturbance by patrolling, while some of the other areas continue to undergo intensive grazing and other biomass extraction activities (Shahabuddin and Kumar, 2006). The study aims at gathering adequate information of how and to what degree these various anthropogenic factors affect the richness and diversity of woody species in the dry deciduous forest of Sariska.

The Sariska Tiger Reserve, spread over an area of 881 km^2, is located in the Aravalli Hills (79°17'-76°34'E, 27°05'-27°33'N). It is divisible into two distinct zones (Shahabuddin and Kumar, 2006): the 274 km^2 National Park and the 607 km^2 Sanctuary (Figure 1a). The Sariska terrain is undulating to hilly in nature and there are numerous narrow valleys (Sankar, 1994). The dominant vegetation is Northern tropical dry deciduous forests and Northern Tropical Thorn forest (Champion and Seth, 1986). *Anogeissus pendula* is the dominant tree species

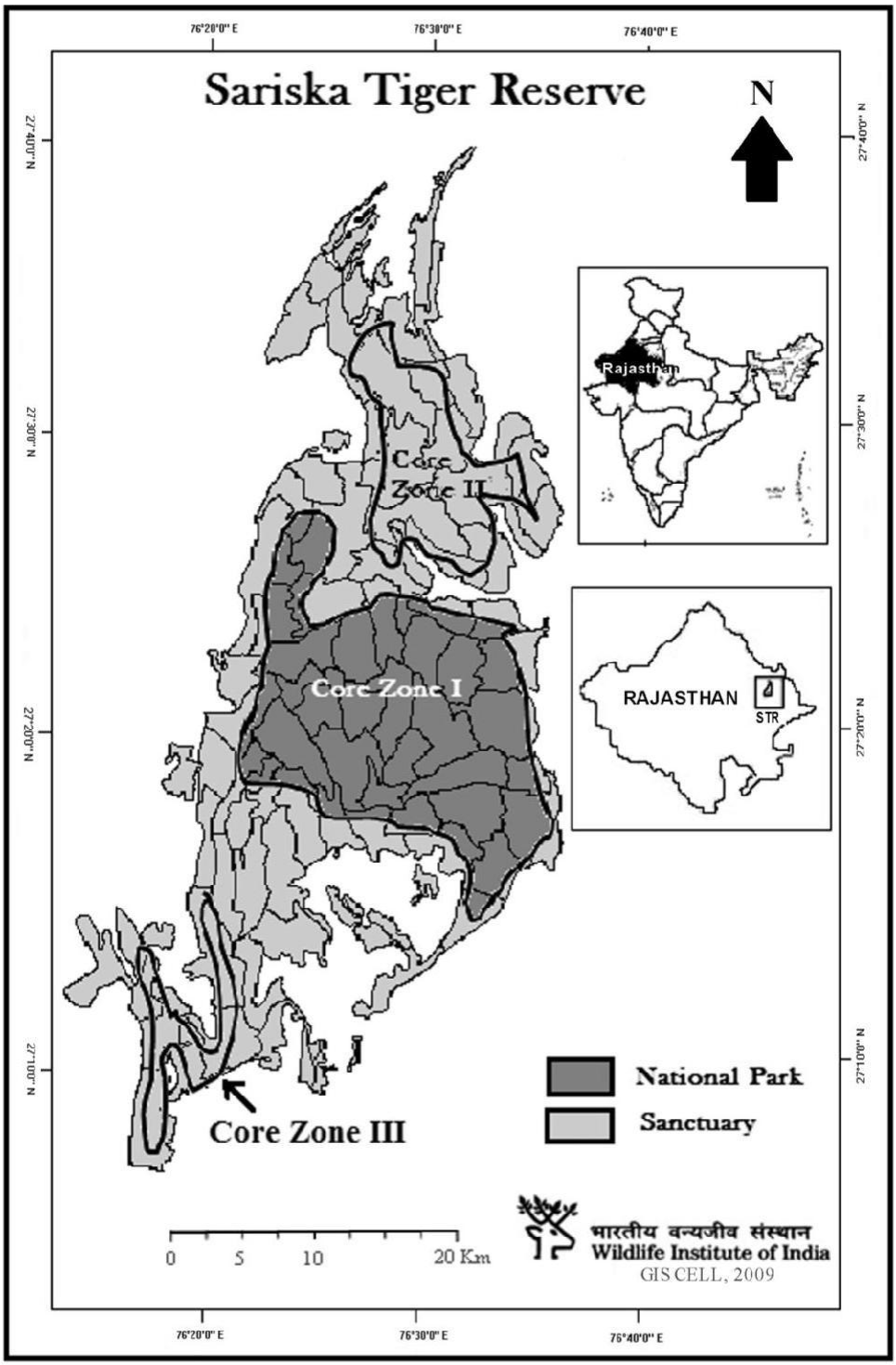

Figure 1a. Location of Sariska Tiger Reserve (Kidwai et al., 2011).

that covers approximately 40% of the forest habitat. *Boswellia serreta* and *Lannea coromandelica* grow largely on rocky patches, *Albizia lebbeck, Diospyros melanoxylon, Holoptepia integrifolia* and *Ficus* sp. are dominant plant species in moist localities (Sankar, 1994).

There are 31 villages in Sariska Tiger reserve (STR) out of which 10 villages are in the core zone I of STR which are still due for relocation since 1984 (Sankar et al., 2009; Sankar et al., 2013). The total population of people in these villages would be approximately 3000

(Shahabuddin et al., 2007). One the village 'Bhagani' has already been successfully relocated in November 2008 (Sankar et al., 2009). People living in these villages mostly belong to the Gujjar community, traditionally dependent on livestock for milk – production economy along with the Meenas inhabiting some villages. The overall livestock population comprised 2643 buffaloes, 896 cows, 6160 goats and 234 sheep in all the 10 villages of Core Zone 1 (Sankar et al., 2009). However, according to Yadav and Gupta (2009), the forests in Aravalli mountain Range in Alwar district have been subject to large scale disturbances except for Sariska Tiger Reserve and Bala fort forest.

People in Sariska, frequently lop forest vegetation for stall-feeding their livestock and collect deadwood and tree branches from the Sariska forests to meet their fuelwood requirements (Shahabuddin et al., 2005; Shahabuddin and Kumar, 2006). Trees are also fallen occasionally for firewood (Shahabuddin and Kumar, 2006).

MATERIALS AND METHODS

Surveys were conducted from February to May 2009, within the 80 km² national park (Figure 1a), which was divided into four sections (Figure 1b) for the purposes of the study. Within each section four line transects were laid, ranging in length from 1.8 to 2 km and covering all major vegetation and terrain types representative of the national park. Diversity of woody species was estimated by laying 10 and 5 m radius plots at each 100 m on the line transect (Baker and Pearson, 1981). While degree of various anthropogenic factors such as wood cutting, lopping, grazing, grass cutting, and livestock dung, was estimated by laying 10 m radius circular plots at each 100 m on the line transects. These factors were quantified at each plot in a scale of 0 to 4 (0-none, 1- low (Less than 25%), 2-medium (25 -50%), 3-high (50-75%) and 4-very high (Above 75%)). Thus, a total of 318 sampling plots were laid in the intensive study area to estimate the aforementioned parameters for evaluating the degree of human disturbance and its effect on the ecosystem.

A software 'EstimateSWin750' (Colwell, 1997) was used to estimate diversity and richness of trees on each transect.

RESULTS

The results regarding degree of disturbance observed with respect to the terrain of the transects are shown in Table 1.

Out of these 16 transects, 6 transects had very high disturbance (>75%) either in terms of livestock grazing or cutting and lopping of trees. Three transects had high disturbance (50-75%), four transects had medium disturbance (25-50%) and three transects had low disturbance (<25%). Mainly, the areas with very high disturbance rate comprised of mixed forest on Plain terrain. Low disturbance was observed in hilly transects which could be attributed to the fact that there is less access to people and livestock in hilly areas (Yadav and Gupta, 2006).

Results from Ocular observations

The following observations were made while walking the transects. Number of trees and number of total individuals of each tree were computed and compiled to obtain a profile along with vegetation type, terrain and disturbance level at each transect (Table 1).

The number of species were found to be maximum for the transect of Pandupol – Kiraska (n = 18) where interestingly, there is high level of disturbance. Whereas, the least number of species were observed from the transect of Sadar I (n = 6), which was found to have lesser disturbance as compared to the transect of Pandupol –Kiraska.

The number of individuals were found to be maximum in Malajodka (n = 369) which is again a transect on hilly terrain and the degree of disturbance was found to be low on this particular transect. Whereas, the least number of individuals were noted from the transect of Kiraska (n = 93), which is laid on a Plain terrain and passes through a village.

Results from EstimateSWin750

To give a scientific base to the aforementioned results, this ocular profile of transects was cross checked with the results acquired from the Sobs richness and Chao diversity index values derived at each transect through EstimateSWin750. The results acquired were almost similar to that of ocular estimation. The results obtained could be seen in Table 2.

Maximum diversity of trees ±SE (18±3.05) was found to be in transect number 15 (laid in Pandupol-Kiraska) which was highly disturbed. Whereas, the least diversity ±SE (6±2.23) was found in transect number 1 (laid in Sadar1), where disturbance is not as much as in the previous one. The richness (±SE) however, was found to be maximum (32.95±16.44) in transect number 11 (laid in Malajodka) followed by the transect number 1 (Sadar I) having least value for richness ±SE (6±0.43).

To illustrate the above analysis, the following graphs were prepared for the effect of disturbance on diversity and richness of trees on the 16 transects (Figures 2a and b). The diversity of trees was interestingly found to be more in the areas of very high disturbance with almost an oscillating pattern to the other categories. While, richness on the other hand, was found to be more pronounced in the areas of low disturbance.

DISCUSSION

According to this study, maximum diversity was found in

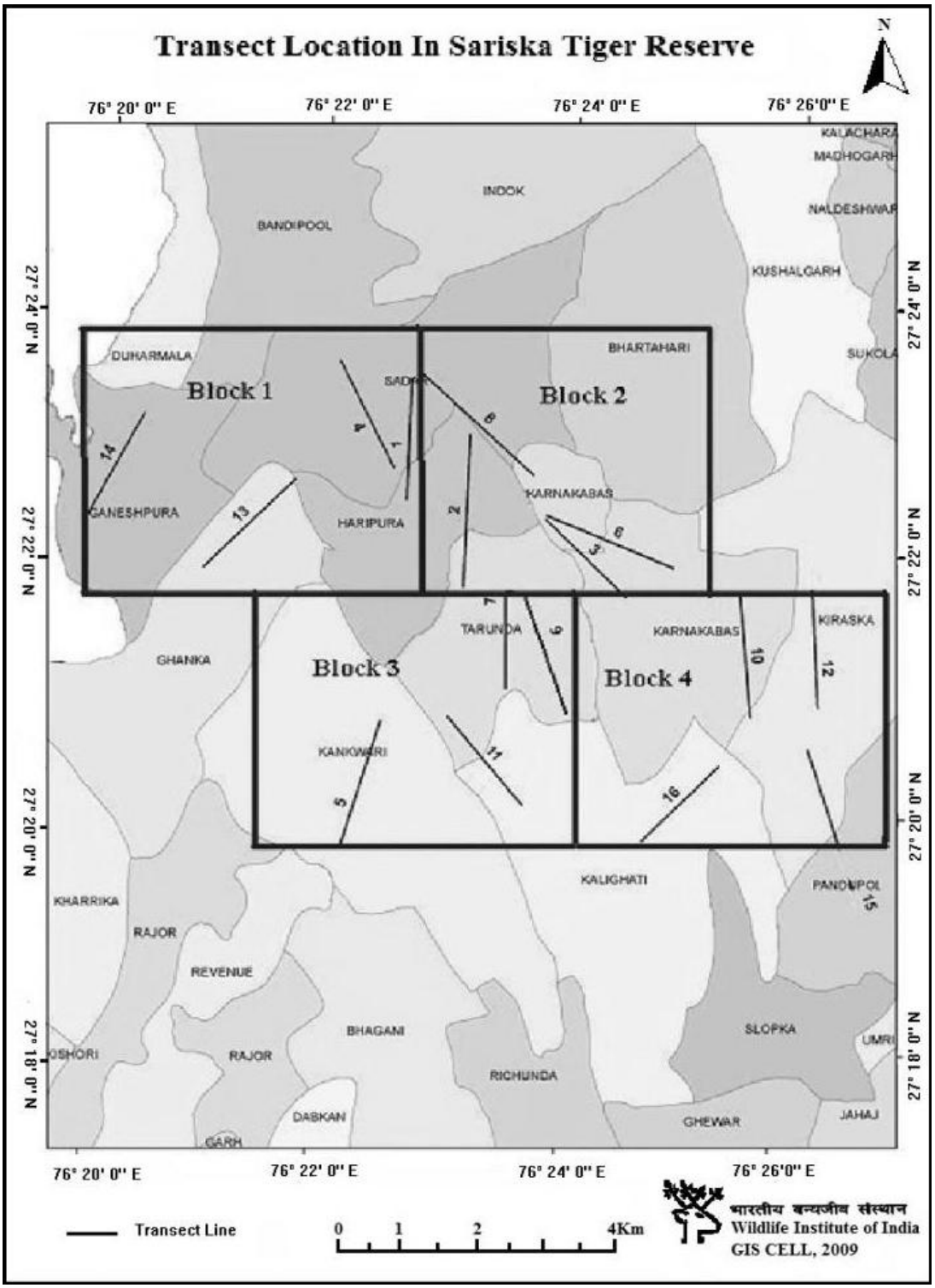

Figure 1b. Location of study area and line transects (Kidwai et al., 2011).

the transect of Pandupol-Kiraska (18±3.05), which starts around the Pandupol temple up to the plateau of Kiraska. The transect ends on the plain that leads to a village, which could be the reason of the transect to be subjected to very high degree of disturbance. The reason for the high value of tree diversity in this transect could be attributed to the fact that there is a perennial supply of water in the area. Similarly, the transect of Kiraska

Table 1. Line transect profile in Sariska Tiger Reserve, Rajasthan estimated through ocular estimation.

Transect No	Transect name	Length	Vegetation type	Terrain	Disturbance	No of tree species	No of total Individuals
1.	Sadar I	2	Scrubland	Plain	Medium	6	183
2.	Haripura	2	Scrubland	Plain	Very high	13	118
3.	Karnakawas	2	Woodland	Plain	High	10	222
4.	Kalakuan	2	Scrubland	Plain	High	12	157
5.	Kankwadi	2	Mixed forest	Plain	Very high	9	115
6.	Algual - Karnakawas	2	Woodland	Plain	Very high	9	175
7.	Tarunda II	2	Mixed forest	Hilly	Low	13	124
8.	Sadar II	2	Scrubland	Plain & Hilly	Medium	8	117
9.	Tarunda I	1.8	Scrubland	Plain	High	9	145
10.	Algual - Kiraska	2	Woodland	Plain & Hilly	Very high	14	122
11.	Malajodka	2	Woodland	Hilly	Low	10	369
12.	Kiraska	2	Mixed Forest	Plain	Very high	15	93
13.	Ghanka	2	Scrubland	Plain	Medium	16	175
14.	Gadeshpura	2	Woodland	Hilly	Medium	12	163
15.	Pandupol - Kiraska	2	Mixed forest	Plain & Hilly	Very high	18	127
16.	Road - Kiraska	2	Woodland	Hilly	Low	9	316

Table 2. Diversity (±SE) and Richness (±SE) values obtained from EstimateSWin750 along each transect laid in the study area.

Transect No	Disturbance level	No. of tree species	No. of total Individuals	Diversity value of tress (±SE)	Richness of trees (±SE)
1.	Medium	6	183	6 (±2.23)	6 (±0.43)
2.	Very high	13	118	13 (±3.15)	13.95 (±1.44)
3.	High	10	222	97 (±1.29)	10.48 (±1.24)
4.	High	12	157	12 (±2.85)	12.95 (±1.74)
5.	Very high	9	115	10 (±2.77)	12.85 (3.99)
6.	Very high	9	175	9 (±2.59)	9 (±0.45)
7.	Low	13	124	13 (±2.98)	24.12 (±3.94)
8.	Medium	8	117	9 (±2.63)	14.27 (±2.48)
9.	High	9	145	9 (±2.62)	11.83 (±4.25)
10.	Very high	14	122	14 (±3.08)	18.75 (±5.29)
11.	Low	10	369	10 (±2.67)	35.69 (±0.45)
12.	Very high	15	93	15 (±2.95)	15.24 (±0.71)
13.	Medium	16	175	16 (±3.24)	22.65 (±6.79)
14.	Medium	12	163	12 (±2.82)	12.24 (±0.71)
15.	Very high	18	127	18 (±3.05)	19.58 (±2.11)
16.	Low	9	316	9 (±2.59)	9 (±0.12)

(transect number 12) ends around a village, which may be attributed to its high degree of disturbance and hence, least number of trees (93).

Looking at the richness values, however, it could be observed that the areas subjected to lower disturbance show higher values of richness of trees. For example, the transect laid in Malajodka was found to have the highest richness value (32.95±16.44). This could be explained as all those transects are on the hilly terrain reducing the chances of disturbance activity there, leading to more numbers of healthy trees in that area.

The results of the present study indicated that this fragile forest ecosystem is under tremendous affect from human disturbance. Along with strict nature protection, there is an urgent need to develop alternatives to the biomass-based household and livelihood needs of people living in and around PAs (Shahabuddin and Kumar, 2006). This study serves as the baseline information for

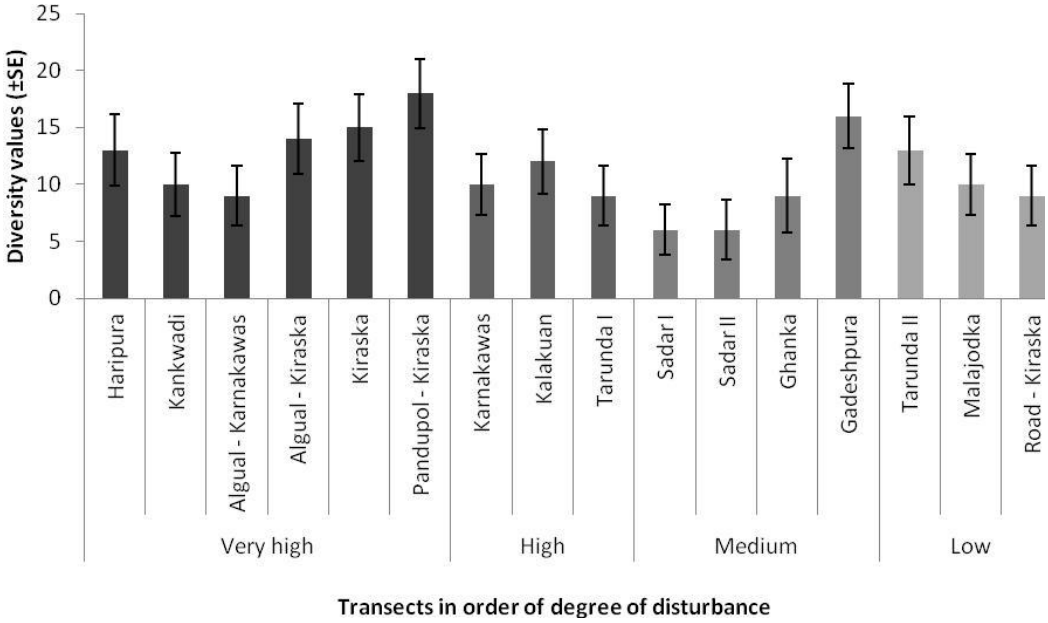

Figure 2a. Effect of anthropogenic factor on tree diversity (±SE).

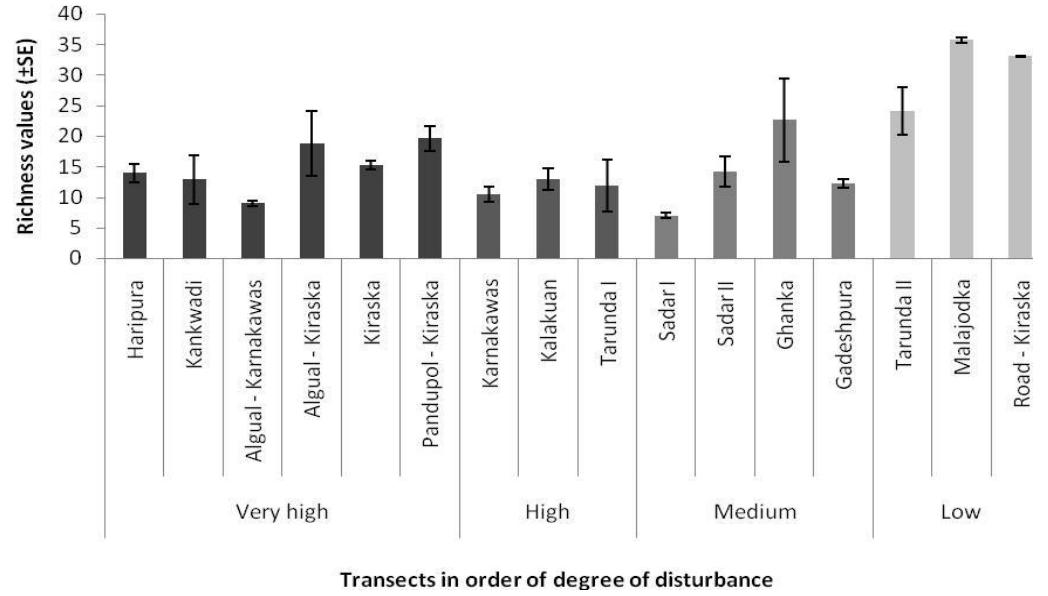

Figure 2b. Effect of anthropogenic factor on tree richness (±SE).

the effect of anthropogenic factors on trees in the core area of Sariska Tiger Reserve; however, formulating a study in a comparatively larger study area inside the core zone of Sariska could bring forth a clearer picture.

ACKNOWLEDGEMENTS

The author would like to thank Rajasthan State Forest Department for granting permission to work in Sariska. Also, thanks to Dr. K Sankar, Scientist-G and Research coordinator, and Mr. Qamar Qureshi, Scientist- F, Wildlife institute of India for their supervision. Subhadeep Bhattacharjee and Krishnendu Mondal, Research fellows of Wildlife Institute of India, Dehradun are gratefully for providing logistic support in the field and Ramesh, Jai Ram, Mamraj and Chhote Lal, our local assistants for

their help during the field work. The author is grateful to his parents and sisters for their continuous support. However, anonymous reviewers who reviewed the manuscript are also gratefully acknowledged.

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