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Effects of extractive disturbance on bird assemblages, vegetation structure and floristics in tropical scrub forest, Sariska Tiger Reserve, India

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Abstract

A study was carried out in a tropical scrub forest in India, to investigate the effects of extractive activities such as fodder and firewood collection, on native bird communities and to study the relative influences of altered vegetation composition and structure. The study was based on comparison between six 'disturbed' (extracted) and four 'undisturbed' (non-extracted) sites that were delineated using quantitative disturbance indicators. Birds were sampled seven times over two different seasons utilising the fixed radius point count method. Six different variables related to vegetation structure (canopy cover, basal area, average forest height, tree density, tree height diversity and tree species richness) were quantified, as was tree species composition. There was no significant difference in number of recorded species or bird abundance between disturbed and undisturbed sites. However, bird species diversity was significantly lower in disturbed sites in comparison to undisturbed sites. Overall, bird species composition also differed significantly between disturbed and undisturbed sites. Nine of 38 locally abundant bird species (23.6%) showed significant selection for either disturbed or undisturbed habitats. Of these nine species, seven chose undisturbed habitats and two chose disturbed. All seven species adversely affected by disturbance are primarily insectivorous. Canopy cover, tree basal area and height of trees were significantly lower in disturbed sites in comparison to undisturbed sites. In both habitats, bird species composition was significantly dependent on these components of altered vegetation structure. Tree species composition was also significantly altered by disturbance in scrub forest. However, altered tree species composition did not significantly affect bird species composition. Partial Mantel's tests confirmed that there were no significant residual effects of tree species composition on bird composition after the effects of vegetation structure were accounted for. Our study indicates that rural biomass extraction can have significant effects upon bird species composition of tropical scrub forest which is caused principally by alteration of vegetation structure, rather than by changes in forest tree composition.

Keywords: Avifauna; Diversity; Bird species composition; Biomass extraction; Forest degradation; Indicator species

1. Introduction

Biomass extraction, in the form of grazing, fuelwood and non-timber forest product (NTFP) collection, may be the most widespread pressure on forests in developing countries, where rural populations depend significantly on them for their sustenance as well as livelihoods (e.g. Hegde and Enters, 2000; Harris and Mohammed, 2003). In some ecosystems, the contribution of NTFP to rural income may be as much as fifty percent leading to high levels of extractive pressure on forest resources (Hegde et al., 1996).

There is evidence that the long-term extractive use of forests may cause significant changes in both vegetation structure and composition of forests (e.g. Murali et al., 1996; Shankar et al., 1998; Tilman and Lehman, 2001; Sagar and Singh, 2004). Changes in vegetation attributes caused by anthropogenic disturbances, in turn, have the potential to influence native forest fauna, particularly species that are rare, resource-specialised or habitat-restricted (Bawa and Seidler, 1998; Terborgh, 1998; Shahabuddin and Prasad, 2004). Yet the consequences of rural biomass extraction for forest fauna have been scantily studied despite the fact that such information is essential for effective conservation planning in developing

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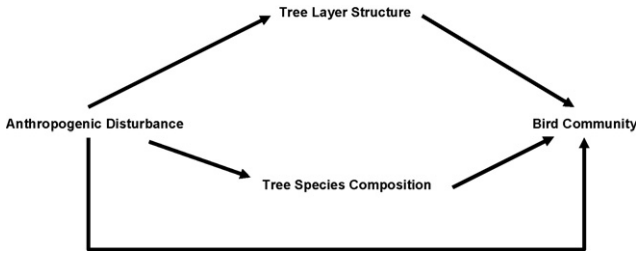

Fig. 1. Schematic of inter-relationships between bird species composition, vegetation structure and vegetation composition being investigated.

countries (but see Du Plessis, 1995; Laiolo, 2003). Studies on the influence of biomass extraction in tropical dry forest ecosystems are, in particular, very limited, despite the fact that this biome comprises nearly half of all tropical forests and faces heavy pressure for subsistence extraction (Sagar and Singh, 2004; Sagar et al., 2003; Sanchez-Azofeifa et al., 2005).

Avifaunal communities are highly sensitive to changes in habitat caused by human use and modification (Raman et al., 1998; Thiollay, 1999; Lohr et al., 2002). Studies show that most changes in bird communities in degraded habitat are caused by changes in forest vegetation structure such as in the density of trees, density of bamboo understorey, tree size class variation, densities of old trees and snags, and amount of woody litter (Du Plessis, 1995; Lohr et al., 2002; Raman et al., 1998). However, in some cases, bird communities are also impacted by changing tree species composition because bird species may depend on specific nectar or fruit sources or on breeding habitat whose spatial occurrence is influenced by disturbance (Raman, 2006). Tree composition may also influence vegetation structure due to varying canopy architecture across species or changed dominance of plant groups having distinct architecture. For instance, increased abundance of bamboo or cane within tropical forests can considerably alter forest structure.

In this study, we quantify effects of anthropogenic disturbance caused specifically by altered vegetation structure and composition, on bird species assemblages of a tropical dry forest, located in Sariska Tiger Reserve in northern India. The questions that we address in the present study are: (1) does anthropogenic disturbance caused by biomass extraction affect the diversity and composition of forest avifaunal communities and if so, in what ways? and (2) what is the relative importance of altered forest vegetation structure and composition through which the changes in avifaunal community (if any) are mediated? Effects on the bird community are studied with respect to diversity, abundance and species composition while changes in vegetation structure and composition are studied with respect to attributes of the tree layer (see schematic of study questions in Fig. 1).

2. Materials and methods

2.1. Study area

Sariska Tiger Reserve (henceforth referred to as Sariska), a protected area located in the Indian state of Rajasthan in northwestern India, was one of the important areas for conservation of the endangered tiger (*Panthera tigris*) in India until its recorded local extinction in late 2004 (Johnsingh et al., 1997; Mazoomdar, 2005; see Fig. 2). Sariska covers an area of 866 km^2 and is located in the semi-arid zone delineated as biogeographic province 4A (semi-arid Gujarat-Rajputana) (Rodgers et al., 2000). The area is seasonally dry, experiencing an average annual rainfall of 650 mm and extremes of temperature with cold winters and extremely hot summers

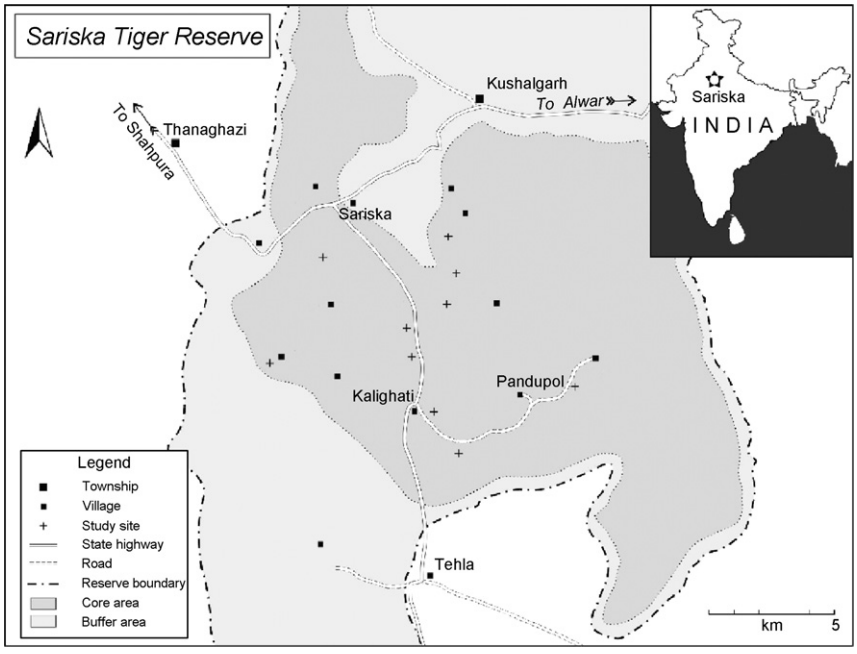

Fig. 2. Map of Sariska Tiger Reserve in Rajasthan, India, showing administrative boundaries and the location of 10 study sites in scrub forest habitat.