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Anthropogenic disturbances and regeneration status of *Pinus roxburghii* Sarg. in Ponda Watershed, Rajouri, Jammu and Kashmir

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Key words: Anthropogenic disturbance, regeneration status, watershed, cumulative score etc.

Abstract

The present work was conducted with an aim to study the anthropogenic disturbances and regeneration status of *Pinus roxburghii* Sarg. in Ponda watershed of Rajouri Forest Range, J&K, India. Random sampling was carried out by laying forty sample plots, covering different forest sites of the study area, using 20 x 20 m and 5 x 5 m size of sample plots for studying trees and shrubs/saplings and 1m×1m for seedlings laid within in each of 20m×20m sample plot laid for trees in forest area, respectively. A semi-quantitative assessment of disturbances was carried out using a six-point scale (0-5). Results of the study revealed that forests in study area suffer from various anthropogenic disturbances like burning, over-grazing, felling, soil erosion, resin tapping, damage to trees/mortality, litter removal, etc. having varied levels of severity. Grazing was found having very high severity in study area with cumulative score of 86, whereas, litter removal, fire and mortality showed high severity of disturbance having cumulative score of 67, 61 and 60, respectively. The overall regeneration status of *Pinus roxburghii* was fairly good in the study area with density of seedling, saplings and adults of 6050, 258 and 211.25 individuals/ha, respectively.

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Introduction

The ecological security of our country depends on the health of its forests as most of the rural population in our country depends upon forest for its daily needs (Khosla, 1992). Diversity of forests generates a variety of natural resources which help sustain the livelihood of local community (Kumar *et al.*, 2006; Negi, 2009). Forest also contributes to the process of carbon sequestration and act as carbon sink by reducing greenhouse gases and in turn global warming (Chandrasekharan *et al.*, 2010). However forests are under great anthropogenic pressure due to rapid socioeconomic development, expansion of agriculture, over-grazing, increased demand for fodder, timber and the firewood, excessive resin tapping and recurrent forest fires, *etc.* has led to the forest degradation in the Himalaya (Awasthi *et al.*, 2003; Negi, 2009; Gurarni *et al.*, 2010; Mitra *et al.*, 2013).

The state of Jammu and Kashmir being one of the North-Western Himalayan states of India, witnessed exponential increase in human and livestock population, urbanization and a spurt in developmental activities over the years.

These developmental processes have resulted in loss of forest area accompanied by an overall degradation of forest vegetation and forest soils (Anon., 2011) along with loss of biodiversity and reduced forest productivity. Rajouri is one of the hilly district of Jammu and Kashmir rich in floral wealth and rural people are heavily dependent on these forest resources for their subsistence needs which result in excessive exploitation of these forests for various purposes leading to serious ecological imbalance and biodiversity erosion of the region.

Subtropical region of the district Rajouri is mostly dominated by chir pine (*Pinus roxburghii* sarg.) forests, which are ecologically and economically very important. Due to the close proximity of forests to human settlements these forests have faced various levels of disturbance as the people in the study area are economically weak, rare cattle, sheep, goat, *etc* and

completely depend on nearby forests. Anthropogenic influences like frequent fire and persistent exploitation of the forests for fuel, fodder, over grazing and encroachment for habitation and agricultural land are the chief biotic influences that are continuously degrading these chir pine forests. Thus keeping in view the various problems related to forests of the study area a maiden attempt has been made to study the anthropogenic disturbances and regeneration status of *Pinus roxburghii* Sarg.

Materials and methods

Study area

The study area i.e. Ponda Watershed, selected for present investigation lies in Rajouri Forest Range, Rajouri, Jammu and Kashmir. It is located between 33° 50' to 33° 30' N latitude and 74° to 74° 10'E longitudes and spread over an area of 81 km² with altitude varying between 800 m to 1000 m asl. Landscape consists of low lying undulating hills with steep slopes mainly having east and west aspects. The Climate of study area is sub-tropical with the average temperature varying from 7.42 °C to 37.4 °C. The average annual rainfall received is 1150 mm and maximum rainfall in the area is received through southwest monsoon during July-September.

Sampling

For the assessment of disturbance and regeneration of pine, stratified random sampling has been carried out by laying forty sample plots covering different sites of study area, using 20 x 20 m and 5 x 5m size sample plot for trees and shrubs in forest area, respectively. In each sample plot, all trees having cbh ≥ 30 cm were individually measured at breast height, i.e. 1.37 m from the ground. Seedlings and sapling were studied in plot size of 1m×1m and 5×5m respectively in each of 20m×20m sampled plots laid in forest of study area. For the determination of biotic disturbance in the study area the incidence of various indicators like number of tree felled, tree lopped, incidence of fire, grazing, cutting, litter removal, soil erosion, landslide, resin tapping and mortality were noted down.

Data analysis

A semi-quantitative assessment of disturbance was carried out using a six-point scale (0-5), with 0= No disturbance, 1= 0-20% of the sample plot disturbed, 2= 21-40% of the sample plot disturbed, 3= 41-60% of the sample plot disturbed, 4= 61-80% of the sample plot disturbed, 5= 81-100% of the sample plot disturbed (Anderson and Currier, 1973). The cumulative score of each disturbance in all studied sample plots was calculated and classified into four classes i.e. Low=1-25, Moderate=26-50, High=51-75, Very High=76-100. The cumulative score of each plot having different intensity of disturbance was also calculated and further classified into five categories viz., Very Low (1-10), Low (11-20), Moderate (21-30), High (31-40) and Very High (41-50). Regeneration status of species was totally based on population size of seedlings and saplings. Good regeneration if seedlings > saplings > adults; fair regeneration, if seedlings > or ≤ saplings ≤ adults; poor regeneration, if the species survives only in sapling stage, but no seedlings (saplings may be <, > or = adults). If a species is present only in an adult form it is considered as not regenerating (Khan *et al.*, 1987).

Results and discussion

Anthropogenic disturbances

The human interference or various indicators of disturbance like fire, grazing soil erosion, landslides, felling, cutting, lopping, resin tapping, litter removal and mortality were assessed in the study area (Table 1). Grazing was observed very high in three sample plots with high severity in five plots and moderate in seven plots, whereas, litter removal and mortality was observed with high severity in five sample plots. The severity of soil erosion was observed very high in only one plot and four plots suffered from moderate severity of erosion. The over extraction of resin has remained a serious problem playing with the health of the trees.

During the study moderate to very low severity of disturbance was also observed in the form of resin extraction from chir pine, tree cutting and felling (Fig.

1). Low incidence of 7.5 percent and 15 percent was found for lopping and landslide, that too with low to very low severity. Results pertaining anthropogenic disturbances also revealed that overall very high severity of disturbance was shown by grazing which was observed in thirty four plots out of a total forty plots studied with cumulative score of 86. Incidences of Litter removal, Mortality and fire were present in thirty six, thirty five and twenty one sampled plots with cumulative score of 67, 60 and 61, respectively showing high severity of disturbance (Fig. 2). The incidence of cutting was found in twenty six sample plots followed by soil erosion and felling each in twenty four sample plots with moderate level of disturbance.

Table 1. Incidence of anthropogenic disturbance in study area.

Disturbance Type	Incidence	%age
Fire (Fi)	21	52.5
Grazing (Gz)	34	85
Lopping (Lo)	06	15
Cutting (Ct)	26	65
Felling (Fl)	24	60
Liter removal (Lr)	36	90
Soil erosion (Es)	24	60
Landslide (Ls)	03	7.5
Resin tapping (Rt)	10	25
Mortality (Mo)	35	87.5

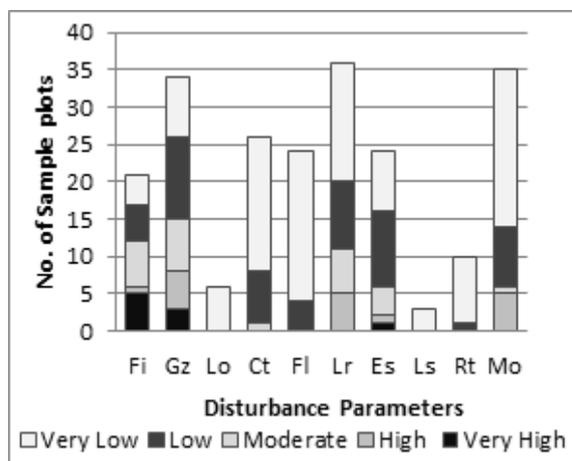


Fig. 1. Severity level of anthropogenic disturbances in sample plots.

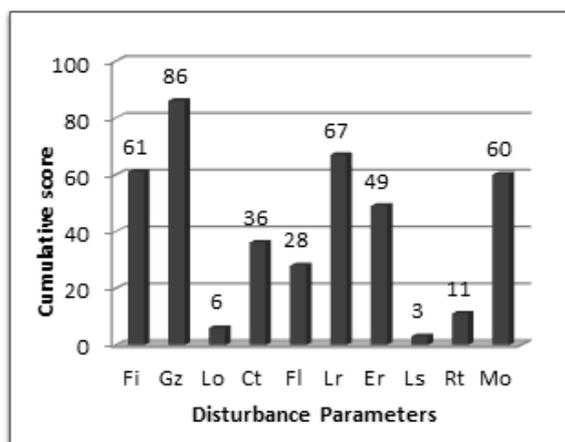


Fig. 2. Severity level of anthropogenic disturbances in study area.

The chir pine forest are rich in resin and litter and are usually burnt by the local resident mainly *Gujjar* and *Bakarwal* during summer when temperature is at peak and before start of monsoon in order to increase the production of grasses for grazing their cattle during off season and for clearing the area from bushes to increase agriculture area (Kumar and Ram, 2005; Sharma *et al.*, 2008).

The grazing pressure in the area is high as the local people in the vicinity of area graze their cattle in the forests due to less availability of grazing land other than forest area. Also, the nomads i.e., *Bakerwals* return from the Kashmir valley along with their sheep and goats during winter months and graze their livestock in the forests. This is putting additional pressure on plant species especially the shrub species like *Carissa opaca* (Kumar, 2010; Dangwal *et al.*, 2012). Taddess *et al.* (2002), Krzic *et al.* (2006); Sharma *et al.* (2008); Kumar and Hamal, (2009) reported impact of grazing on forests and were of the opinion that higher population of livestock is the cause of deforestation and loss of plant species because regeneration is hampered due to grazing beyond the carrying capacity of the forests in the study area. Brahmi *et al.* (2011) also studied the impact of intense open grazing in Kathua and Udhampur forest divisions due to nomadic grazers in winter.

The high incidences of felling of mature chir pine trees were observed in forest mainly caused by locals in order to weaken the stem of trees. Tree felling and tree cutting in the area is mostly illegal and is mainly done for the extraction of timber for various purposes and is generally done for timber to be used in construction of houses by the locals (Yadav and Gupta, 2006; Sharma *et al.*, 2008). The soil erosion and landslide problem was also observed in the forests sites studied for which the steep slopes and various anthropogenic activities are responsible. The removal of ground vegetation cover or litter by forest fire and overgrazing expose the soil to erosion mainly due to heavy and continues rain during monsoon (Sharma *et al.*, 2008; Kumar, 2010). It was also observed that litter along with pine needles from forest floor is also collected in order to use them as roofing material for their houses. During the present study the main cause of high mortality was due to frequent and heavy fire which is responsible for killing the plants also reported by Ilyas and Khan (2005). Over grazing coupled with excessive lopping is responsible for mortality of plants and low regeneration in the study area.

Regeneration status of Chir Pine

The density values of seedling and saplings are considered as regeneration potential of a species. The presence of good potential shows suitability of a species to the environment. Climatic factors and biotic interference influence the regeneration of different species in the vegetation (Daulkhandi *et al.* (2008). The regeneration status of dominant tree species i.e., *Pinus roxburghii* was assessed in forests of the study area, which revealed that only three sample plots showed a good regeneration, whereas in twenty seven, seven and three sample plots showed fair, poor and no regeneration, respectively (Fig. 3). However, overall regeneration of chir pine trees in the study area was good with 6050 seedlings/ha, 268 saplings/ha and 211.25 adults/ha (Fig. 4).

Good regeneration of pine in only few plots was observed in the area which is may be due to negligible

incidences of fire and grazing as some forests are closed and also the sites are away from habitation. As observed in the field the regeneration of seedlings and saplings of pine were found more in the plots where accumulation of litter and more moisture in the soil. Good regeneration of *Pinus roxburghii* had also been reported by Joshi and Tewari (2011) ; Ballabha *et al.* (2013) from forest of Kumaun, Central Himalaya and subtropical forest of Garhwal Himalaya, respectively. The poor to fair density of seedlings and saplings in majority of the sample plots laid in the forests of study area can be attributed to easy accessibility of the villagers to the forests in the vicinity which in turn is responsible to cause forest fires, use-pressure on species, excessive grazing, trampling of soil, habitat degradation etc. Poor regeneration status of *Pinus roxburghii* had also been reported by Dangwal *et al.*, 2012 from the forest of Nowshera block of Rajouri district. The impact on regeneration potential due to increase in the disturbance level has also been reported by Kennard *et al.* (2002), Tripathi *et al.* (2004); Harish (2007); Sen *et al.* (2008); Pokhriyal *et al.* (2010); Pant and Samant (2012). The overall degradation has also resulted in very low density of *Pinus roxburghii* adults in the study area, which is mainly due to anthropogenic disturbances.

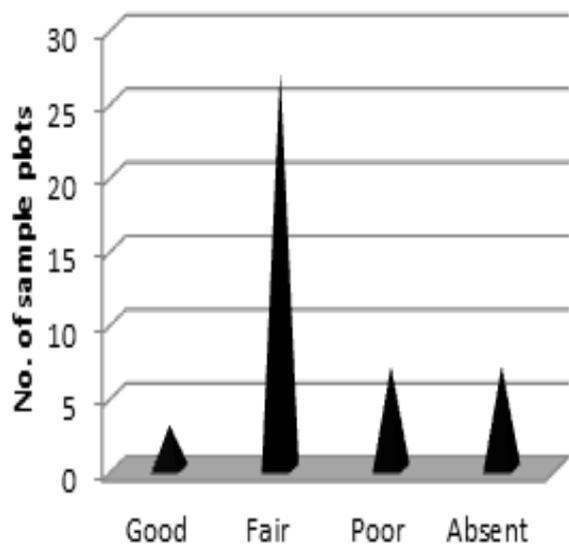


Fig. 3. Regeneration status of *Pinus roxburghii* Sarg. in study area.

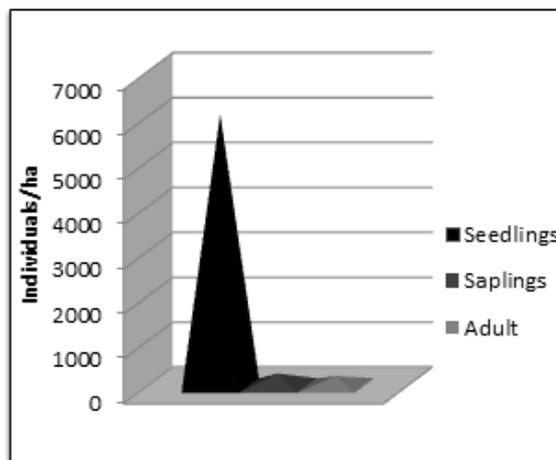


Fig. 4. Density of seedlings, saplings and adults of *Pinus roxburghii* Sarg. in study area.

Conclusion

Forests present around the agricultural fields of the study area are highly degraded due to continuous anthropogenic disturbances. Villagers frequently graze their cattle in the adjoining forest, which increases the pressure, beside frequent forest fires, lopping of trees for fuel and fodder *etc.* which has resulted in very low density of *Pinus roxburghii* adults in the region. The changing environmental conditions coupled with high anthropogenic pressures may lead to depletion of population of the tree species and replacement by spiny species with no or very little economic value. Thus, biotic factors, particularly fire and grazing had a significant effect on the regeneration of pine tree in study area and it deserve more attention for conservation.

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