

Assessment Of Species Diversity Along Different Altitudinal Gradients In Bandli Wildlife Sanctuary District Mandi, Himachal Pradesh

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Abstract: *The present study provides details of species diversity in Bandli Wildlife Sanctuary of district Mandi in Himachal Pradesh. Because of vast altitudinal variation (600 – 2162 m), the Sanctuary experiences a strong degree of seasonality, and it was well reflected in diversity of microhabitats and species. For conducting floristic surveys, the study area was initially divided into three altitudinal zones (Zone-I: 600 - 1200 m; Zone-II: 1200 - 1700 m; Zone-III: 1700 - 2162 m) by using Global Positioning System. The Simpson's concentration of dominance was higher at higher elevation in both northern (0.032) and southern (0.034) aspect of study area. The Simpson index of diversity and reciprocal index were higher at lower altitudinal zones. Results of similarity index illustrated that Zone-I and Zone-II had more common specie and Zone-II and Zone-I or Zone-I and Zone-III had few common species.*

I. INTRODUCTION

The Himalaya constitutes one of the richest and most unusual ecosystems on Earth. The distinctive physiography, vast geographical expanse and varied environmental condition with a strong degree of seasonality make these mountains highly rich in biodiversity (Samant *et al.*, 1998). With more than 18,000 plant species, the Himalayan region has been known as one of the biodiversity hotspots in the world (Myers *et al.*, 2000).

Species diversity is one of the most important key indices used for assessing the sustainability and strength of plant communities. The information on the species diversity of any area is essential for its management and conservation of biodiversity (Verma *et al.*, 1999). The community features differ with respect to elevation gradients, aspect and slope even in the same vegetation and these are chief determinants of vegetation distribution due to their direct impact on

microclimate of the habitat (Srivastava *et al.*, 2005; Singh *et al.*, 2009).

According to Ellu and Obua (2005) difference of altitude and slope influence the species richness and dispersion behavior of tree species. Some important findings on vegetation analysis and species diversity have been given by various authors (Singh *et al.* 2016; Shaheen *et al.* 2011; Behera *et al.* 2002; Srivastava *et al.* 2016; Saima *et al.* 2016) in different parts of Himalayas. Similar studies have been carried out by Bhatt and Bhatt (2016) in Nepal Himalaya, Bhatt and Bankoti (2016) in Kumaun Himalayas, Thakur and Kumar (2008) in Solan forest division, Himachal Pradesh, Verma and Kapoor (2010) Pooh valley of Kinnaur district and Sharma and Thakur (2016) in Sirmour and Una districts, Himachal Pradesh.

II. MATERIAL METHOD

Present study was carried out at Bandli Wildlife Sanctuary of Mandi district in Himachal Pradesh and it is located between 31°25'21"-31°29'02" North latitude and 76°52'04"-76°56'54" East longitude. The Sanctuary has a geographical expanse of 41.33 km² and experiences huge variation with respect to altitude (600 and 2162 m amsl). The average annual precipitation in this area is around 1,525 mm and temperature revolves between 1 °C to 35 °C. Study on plant diversity was conducted during July 2012 to June 2014 on monthly basis. For conducting present floristic surveys, the area of Wildlife Sanctuary was initially divided into three altitudinal zones (Zone-I: 600 - 1200 m; Zone-II: 1200 - 1700 m; Zone-III: 1700 - 2162 m) by using Global Positioning System (GPS). With a view to cover maximum possible area for data collection, the first year sampling was done only on north facing side (northern aspect) of the Sanctuary. South facing areas (southern aspect) were surveyed during second year of study. Details about floristic sampling are illustrated below:

✓ SIMPSON (1949) INDEX OF DOMINANCE

The equation used to calculate Simpson's index was

$$D = \sum \left(\frac{n_i}{N} \right)^2$$

Where D = Simpson (1949) Index of dominance, n_i = total number of individuals of particular species, and N = total number of individuals of all species.

The Simpson's Index of diversity was calculated as 1-D, and Simpson's Reciprocal index as 1/D.

✓ SORESENSEN'S SIMILARITY INDEX (MAGURRAN, 1988)

The equation used to calculate Sorensen's similarity index was

$$IS = \frac{2C}{A + B} \times 100$$

Where IS = Index of similarity, A = total number of species in one community, B = total number of species in another community, and C = number of species which occur in both communities.

III. RESULTS

During the present study of two years, a total of 163 plant species were enumerated and they belong to 123 genera of 63 families and included 46 species of trees, 48 of shrubs, five of climbers and 64 of herbs. The aspect wise (north/ south facing) floristic composition revealed that the north facing localities were found to have more species in each altitudinal zone of the Sanctuary. The north facing sites of each zone during the first year of study showed that in Zone-I a total of 89 species, comprising of 28 trees, 23 shrubs, 4 climbers and 34 herbs were present. In Zone-II the number of trees, shrubs and herbs was 27, 18 and 31, respectively. The total numbers

of species were 83 and no climber was found. The north face of Zone-III was inhabited by 69 species; out of these 21 were trees, 19 were shrubs, one was climber and 28 were herbaceous in habit.

Second year of sampling, that was carried out in south facing sites revealed the occurrence of 83 species in Zone-I. Twenty five trees, 25 shrubs, 3 climbers and 30 herbs were recorded from this zone. It is important to note that all climber species found distribution in either north or south facing slopes of Zone-I only. Zone-II supported a total of 74 species in its south facing sites. They comprised of 21 tree species, 23 shrubs and 30 herbs. No climber species was recorded from this zone from any aspect. As many as 64 species were recorded from south facing sites of Zone-III. They included 18 tree species, 15 shrub species and 31 herb species. There was no representation by any climber species in southern aspect of Zone-III.

SIMPSON'S DIVERSITY INDEX: Simpson's diversity index is often used to quantify the biodiversity of a habitat. In Zone-I (or lower elevations) Simpson's diversity index was significantly higher as compared to upper elevations (Table 1). In northern aspect of Zone-I, the Simpson's concentration of dominance, Simpson's index of diversity and reciprocal index was 0.02, 0.98 and 50.0, respectively. The Simpson's index of diversity and reciprocal index of Zone-I were higher than that of Zone-II (0.97 and 35.71, respectively) and Zone-III (0.960 and 31.25, respectively). Similarly, a decrease in values of these indices was noticed in southern aspects of the Sanctuary. In Zone-I, the value of Simpson's index of diversity and reciprocal index was 0.980 and 55.55, respectively. It was 0.970 and 35.48 for Zone-II, and 0.966 and 29.41 for Zone-III.

S. No.	Aspect	Altitudinal Zone	Simpson Concentration of dominance (D)	Simpson index of biodiversity (1-D)	Reciprocal index (1/D)
1	Northern aspect	Zone-I	0.020	0.980	50.00
		Zone-II	0.028	0.970	35.71
		Zone-III	0.032	0.960	31.25
2	Southern aspect	Zone-I	0.018	0.980	55.55
		Zone-II	0.029	0.970	35.48
		Zone-III	0.034	0.966	29.41

Table 1: Simpson index of biodiversity in different altitudinal zones of Bandli Wildlife Sanctuary.

SIMILARITY INDEX: Sorensen's similarity index between different altitudinal zones is presented in Table 2. Data on Northern aspect of Zone-I and Zone-II revealed that these habitats had 26.66 per cent similarities in their species composition. Similarly, Zone-II and Zone-III exhibited 22.06 per cent, and Zone-III and Zone-I exhibited 24.05 per cent similarity in their species composition. On southern aspect, the similarity index was comparatively higher between Zone-I and Zone -II (28.02%). It was, however, slightly lower between Zone-II and Zone-III (21.02%) and Zone-III and Zone-I (21.08%).

S. No.	Similarity index (%)		
	Altitudinal Zones	Northern aspect	Southern aspect
1	Between Zone-I and	26.66	28.02

	Zone-II		
2	Between Zone-II and Zone-III	22.06	21.02
3	Between Zone-III and Zone-I	24.05	21.08

Table 2: Similarity index between different altitudinal zones of Bandli Wildlife Sanctuary

IV. DISCUSSION

Species diversity refers to variations that exist between the different forms of life. Single species population having zero diversity, regardless of the index used. Species richness, diversity, heterogeneity, and spatial or temporal distribution in an area are the central subjects of population ecology (Rawat and Chandra, 2012). The species diversity differed greatly from place to place due to difference of biogeography, habitat and disturbance (Chandra *et al.*, 2010). Srivastava *et al.* (2008) reported that the community characters differ with respect to aspect, slope, and altitude even in the same vegetation type.

In the present study the value for concentration of dominance were generally low in all altitudinal zones which indicating that dominance shared by more than one species. Moreover, concentration of dominance was lowest in lower altitudinal zones and highest in higher altitudinal zone in both site of Sanctuary area. The value of concentration of dominance decreases with increasing diversity. A higher concentration of dominance shows the lower species diversity in the forest because as they are indirectly proportional to each other (Zobel, 1976; Singh and Singh 1991). The present value of dominance is consonance to the values reported by Thakur and Khare (2006). The low altitudinal zones were relatively densely populated probably because biotic interference in these areas make possible the introduction and establishment of non-native species (Rawal and Pangtey, 1994).

The Simpson reciprocal index was calculated to evaluate the diversity of all altitudinal zones of the Sanctuary and found that Zone-I is highly diverse and rich in comparison to Zone-II and Zone-III. The Simpson index of diversity was highest on the lower altitudinal zone and lowest at higher altitudinal zones in both northern as well as southern site of sanctuary. Similar results have been obtained in the studies conducted in other parts of Himalayas (Sharma *et al.*, 2009; Sharma and Raina, 2013; Shaheen *et al.*, 2011; Sharma, 2015).

The similarity index illustrates significant differences in species composition between forests (Komo *et al.*, 2002). The analysis of the similarity indices revealed that the species composition differed between Zone-II and Zone-III of the Sanctuary area with comparatively few common species. However, the Zone-I and Zone-II seemed to be more similar than the other zones and, relatively more common species were recorded in these forests.

V. CONCLUSION

The study concludes that the species diversity in the study area is in declining trend in higher elevation due to biotic pressure. The disturbed forest slopes were found with low species diversity and dominance of few species. Intensive biotic stress and destruction of habits results in growth of unwanted species or exotic species which starts replacing native species. An ineffective implementation of plans, ignore of the impacts and prediction methods, absence of main modification in policy and human behavior continue to alter biodiversity. Thus an effective management of forest with intensive control on biotic stress could protect the natural integrity of forest ecosystem.

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