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# Phytosociological status of trees and shrubs of Romshi range of Shopian forest division in Kashmir valley

**Syed Naseem Geelani, Gulam Nabi Bhat, Arshid Mughal, Mohit Husain, QN Qaiser and PA Khan**

**Abstract**
The present investigation entitled "Phytosociological status of trees and shrubs of Romshi Range of Shopian Forest Division in Kashmir valley, India" was conducted in Shopian district in Jammu and Kashmir India during 2015-2016. A total of 16 plant species were recorded from the study area out of which 8 were trees and 8 were shrubs. The maximum average density in case of trees was found for *Picea smithiana* (400/ha), whereas in case of shrubs it was recorded in *Parrotiopsis jacquemontiana* (622/ha). Among trees *Abies pindrow* exhibited highest frequency value of 100% at Walkhain (2600-2800m). In case of shrubs *Parrotiopsis jacquemontiana* were the most frequent species at Kooler (2200-2400m). The maximum average basal area in case of trees was found for *Abies pindrow* (158.76 $m^2$/ha) at Walkhain (2600-2800m). In shrubs it was found maximum for *Parrotiopsis jacquemontiana* (3.65 $m^2$/ha) at Kooler (2200-2400m). The IVI of the tree species indicated that *Abies pindrow* was most dominant species atWalkhain (2600-2800m) with IVI value of (172.41). In case of shrubs the maximum IVI was recorded in *Viburnum grandiflorum* with IVI value of (168.11). Among trees the maximum value of Shannon Weiner diversity index was (1.66) at Gadder (2400-2600m) whereas the minimum value (0.69) was recorded at Walkhain (2600-2800m). In case of shrubs Shannon Weiner diversity index shows a decreasing trend from Kooler (2200-2400m) to Walkhain (2600-2800m) with maximum value of (1.74) at Kooler (2200-2400m). In trees the maximum value of the species richness index (1.15) was at Gadder (2400-2600m), whereas in case of shrubs the maximum value of the index was (0.96) at Gadder (2400-2600m).

**Keywords:** Phytosociological, trees, shrubs, Romshi range, Shopian forest division, Kashmir valley

## Introduction
The State of Jammu and Kashmir with a total area of 10.13 million hectare inside line of control, forms an important phytogeographical region in the North Western Himalaya. The state is known for its rich biodiversity and for this reason it has been designated as the "Biomass State''. The valley of Kashmir is bestowed with a lush green of forests. The State is located in North-Western extremity of India between 32°-17´ and 38°-58´ North latitude and 73°-35´ and 80°-36´ East longitude with an average altitude of 1,586 metres from the mean sea level and annual precipitation of about 794.7 mm. From North to South, it extends over 640 km in length and from East to West over 480 km in breadth [2]. The total geographical area of Jammu and Kashmir is 2,22,236 sq. km, which constitutes about 6.47 per cent of the total area of the country. The total forest area of Jammu and Kashmir is 20,230 Sq. kms, in the provinces of Jammu, Kashmir and Ladakh. Out of the total geographical area 15,948 $km^2$ of Kashmir about 51 per cent (8128 $km^2$) of its land area is occupied by forests. Forests occupy a place of considerable importance in the economy of the state and are more popularly known as green gold. They restore ecological balance of all ecosystems, maintain biological diversity, act as catchments for soil and water conservation and prevents floods also.

According to many authors plant sociology (or phytosociology) is defined as the discipline which concerns itself with the study of vegetation as such, with its floristic composition, structure, development and distribution, whereas the term ecology is restricted to the study of the habitat [15]. Phytosociological studies are essential for protecting the natural plant communities and biodiversity as well as understanding the changes experienced in the past and continuing on into the future.

A key component of these biodiversity studies is the phytosociological analysis, with the aid of sampling techniques; the organization and structure of communities can be studied and expressed quantitatively both in absolute terms of species with respect to all other plant species of the area.

It indicates species diversity which determines the distribution of individuals of among the species in a particular habitat. Species diversity in the tropics varies dramatically from place to place. Compared to other tropical forest types, dry deciduous forests are among the most exploited and endangered ecosystems of the biosphere [7].

Phytosociology attempts to describe the diversity in plant communities and its methods often involve the quantative estimation of various parameters of vegetation like cover, abundance and frequency etc. Phytosociological surveys are important tools of ecologists to assess and evaluate the vegetation types of given ecosystem. The phytosociological information about each individual tree species is essential for understanding their ecology and establishing conservation management policies for these under pressure forests [9]. Although much work has been conducted in Eastern and Western moist temperate Himalayan forests, the Kashmir Himalayas have not been given proper attention due to remoteness, lack of infrastructure and danger, being at India-Pakistan border [12].

## Materials and Methods

### Site location

The present investigation entitled "Phytosociological status of Romshi Range of Shopian Forest Division in Kashmir valley, India" was conducted in Shopian district in Jammu and Kashmir India during 2015-2016.

The Shopian Forest Division covers an area of 565.19 sq.kms of which 333.42 sq. kms is under the administrative control of territorial forest and remaining 231.77 sq. kms is under control of Wildlife Protection department (Hirpora Wildlife Sanctuary). The Forests of Shopian Forest Division are spread over a vast tract situated between 33º - 30´ to 33º - 48´ North Latitude and 74º-30´ to 74º-50´ East longitude in South Circle of Kashmir Province.

The community composition and other phytosociological characteristics of the vegetation were studied at the three selected sites, through field surveys during three prominent seasons Spring (March-May), Summer (June-August) and Autumn (September-November) at three elevations along altitudinal gradient. The vegetation analysis was carried out by stratified random sampling. Quadrats of 10m×10m and 5m×5m for trees and shrubs respectively were laid at all the three sites. A number of quadrats were laid in each block depending upon the type of plant community that exists there.

### Layout of sampling plot

The present study on floristic composition was carried out in the sample plots laid out in different compartments of Romshi range on the basis of altitude. The area of the Romshi range was divided into three altitudes and stratified random sampling was carried out in the given area with 0.01% sampling intensity [1]. In all the 18 sampling plots, blocks of 40× 40 m (1600 $m^2$) size were laid on all the three sites/altitudes.

### Sampling procedure

Sampling was carried out by stratified random sampling

| | | |
|---|---|---|
| Number of sites | | : 03 |
| Number of transects | | : 03 per site |
| Number of blocks or sampling plots | | : 02 per transect |
| | | |
| Plant community | Quadrant size | No. of quadrates laid per block |
| Tree | 10m×10m | : 03 |
| Shrub | 5m×5m | : 06 |
| Herb | 1m×1m | : 09 |
| Total number of quadrats for trees | | : 54 |
| Total number of quadrats for shrubs | | : 108 |
| Total number of quadrats for herbs | | : 162 |
| Total number of quadrats | | : 324 |

### Floristic composition

Presence or absence of species was recorded during each sampling season (Curtis and McIntosh, 1950).

### Density

Density is defined as the number of individuals of a species that occurs within a given sample unit or study area. It was recorded as:

$$\text{Density} = \frac{\text{Number of individuals of the species}}{\text{Total number of quadrats studied}}$$

### Frequency

Frequency is defined as the number of times a plant species is present in a given number of sample units. It was calculated by the formula:

$$\text{Frequency (\%)} = \frac{\text{Number of quadrates in which the species occurred}}{\text{Total number of quadrats studied}} \times 100$$

### Basal area

Basal area is the term used to describe the average amount of an area (usually an acre) occupied by tree stems. It is defined as the total cross sectional area of all stems in a stand measured at breast height, and expressed as per unit of land area (typically square feet per acre). It will be calculated as:

$$\text{Basal area} = \frac{\pi D^2}{4}$$

Where 'D' is the Diameter of tree at Breast Height.

### Importance Value Index (IVI)

This index is used to determine the overall importance of each species in the community structure. The important value index (IVI) for each site was worked out by using formula given by Misra (1968). IVI = RF + RD + RBA

Where,

$$\text{RF (relative frequency)} = \frac{\text{Frequency of individual species}}{\text{Frequency of all species}} \times 100$$

$$\text{RF (relative density)} = \frac{\text{Density of individual species}}{\text{Density of all species}} \times 100$$

$$\text{RBA (relative basal area)} = \frac{\text{Basal area of individual species}}{\text{Basal area of all species}} \times 100$$

**Similarity and Dissimilarity Indices**

Similarity Index is used to compare vegetation communities of various sites. Indices of similarity and dissimilarity was calculated by using formulae as per Sorensen (1948) as follows:

Index of similarity (S) = 2C/A+B

Where, S = Similarity, A = Number of species in the community A, B = Number of species in the community B, C = Number of common species in both the communities.

Index of dissimilarity = 1-S

**Diversity, Species richness and Dominance indices**

**a) Diversity**

Shannon Weiner Index is a measure of the amount of information needed to describe every member of the community. Species diversity was computed using Shannon Weaver Index (Shannon and Wiener, 1963). The formula for calculating the Shannon diversity index is:

$H' = - \Sigma\, pi \ln pi$

Where, $H'$ = Shannon index of diversity, $pi$ = the proportion ni and N i.e, $pi = ni/N$

$ni$ = Total number of individuals of one species

N = Total number of individuals of all species

**b) Species richness**

The species richness of plants was determined by Margalef's (1957) species richness index. Dmg = (S-1)/In N

Where, Dmg = Margalef's index of richness, S = Total number of species, N = Total number of individuals.

**c) Simpson (1949) Index of Dominance**

Simpson index of dominance gives the probability that individuals, selected at random belonged to the same species. The equation used to calculate Simpson's index, $D = \Sigma\, (pi)^2$.

Where, D = Simpson index of dominance, $pi$ = the proportion ni and N i.e, $pi = ni/N$, $ni$ = Total number of individuals of one species, N = Total number of individuals of all species.

As D increases, diversity decreases and Simpson's index will therefore usually be expressed as 1–D or 1/D.

**Results**

The phytosociological parameters such as Density (D), Frequency (F), Basal area (BA), Relative density (RD), Relative frequency (RF), Relative basal area (RBA), Important value index (IVI), Shannon Weiner index (H'), Simpsons's index of dominance (D), Margalef's species richness index (Dmg) and similarity and dissimilarity index have been tabulated in tables 02 to 23 for Kooler (2200-2400m), Gadder (2400-2600m) and Walkhain (2600-2800m) of Romshi range of Shopian Forest Division.

Out of the total families recorded, Poaceae is the dominant family represented by ten species, followed by Fabaceae with five species. Pinaceae, Malvaceae and Rosaceae were represented by three species each, followed by Asteraceae, Caryophyllaceae, Berberidaceae represented by two species each. While as other eighteen families are represented by only one species each. The data tabulated in table-1 describes the common name, family and local name of the species identified in the study area.

**Kooler (2200-2400m)**

The data tabulated in table-1 and table-4 pertaining to site Kooler (2200-2400m) of Romshi range of Shopian Forest Division revealed the presence of six tree and six shrub species. The maximum dominance was observed for *Pinus wallichiana* among trees with IVI value of (92.57), followed *by Cedrus deodara* (80.84), *Juglans regia* (42.63), *Robinia pseudoacacia* (40.94), *Ulmus wallichiana* (29.07) whereas, minimum IVI was observed in case of *Aesculus indica* (13.95). Among the shrub species present in the area *Parrotiopsis jacquemontiana* has the highest value of all the phytosociological parameters with IVI value (91.32) and was the dominant species followed by *Viburnum grandiflorum* (59.85), *Berberis lyceum* (47.79), *Sambucus wightiana* (36.92), *Cotoneaster nummularius* (34.04) whereas the species with least IVI (30.05) was *Rosa rubiginosa*.

The total basal area of trees was 73.27$m^2$/ ha with maximum contribution of *Pinus wallichiana* (33.71$m^2$/ ha) (Table-1). The total basal area of shrubs was 8.71$m^2$/ ha with maximum contribution of *Parrotiopsis jacquemontiana* (3.65$m^2$/ ha) (Table-4).

**Gadder (2400-2600m)**

The data tabulated in table-2 and table-5 pertaining to site Gadder (2400-2600m) of Romshi range of Shopian Forest Division revealed the presence of seven tree and six shrub species. The maximum dominance was observed for *Picea smithiana* among trees with IVI value of (130.60), followed *by Pinus wallichiana* (55.44), *Aesculus indica* (29.91), *cedrus deodara* (27.09), *Abies pindrow* (19.48), *Juglans regia* (19.40) whereas, minimum IVI was observed in case of *Umus wallichiana* (18.08). Among the shrub species present in the study area, *Viburnum grandiflorum* has the highest value of IVI (81.60) and was the dominant species followed by *Parrotiopsis jacquemontiana* (69.71), *Indigofera heterantha* (51.74), *Cotoneaster nummularius* (51.58), *Berberis lyceum* (31.46) whereas the species with least IVI (13.91) was *Rosa rubiginosa*.

The total basal area of trees was 167.35$m^2$/ ha with maximum contribution of *Picea smithiana* (113.83$m^2$/ ha) (Table-3). The total basal area of shrubs was 6.15$m^2$/ ha with maximum contribution of *Parrotiopsis jacquemontiana* (2.21$m^2$/ ha) (Table-5).

**Walkhain (2600-2800m)**

The data tabulated in table-3 and table-6 pertaining to site Walkhain (2600-2800m) of Romshi range of Shopian Forest Division revealed the presence of two tree and three shrub species. Among trees the maximum dominance was observed for *Abies pindrow* (172.41) whereas, minimum IVI was observed in case of *Picea smithiana* (127.59). Among the shrub species present in the area, *Viburnum grandiflorum* has the highest value of IVI (168.11) and was the dominant species followed by *Rhododendron compunulatum* (97.48), whereas the species with least IVI (34.39) was *Rosa rubiginosa*.

The total basal area of trees was 248.06$m^2$/ ha with maximum contribution of *Abies pindrow* (158.76$m^2$/ ha) (Table-4). The total basal area of shrubs was 3.16 $m^2$/ ha with maximum contribution of *Viburnum grandiflorum* (1.92 $m^2$/ ha) (Table-6).

**Table 1:** Floristic composition and phytosociological attributes of tree species of Romshi range at Kooler (2200-2400m)

| S. No. | Name of species | Avg. density/ha | Frequency (%) | Avg. basal area/ ha ($m^2$) | Relative density (%) | Relative frequency (%) | Relative basal area (%) | IVI |
|---|---|---|---|---|---|---|---|---|
| 1. | *Aesculus indica* | 44.44 | 33.33 | 1.27 | 3.88 | 8.33 | 1.73 | 13.95 |
| 2. | *Cedrus deodara* | 361.11 | 94.44 | 18.81 | 31.55 | 23.61 | 25.68 | 80.84 |
| 3. | *Juglans regia* | 138.89 | 55.56 | 12.16 | 12.14 | 13.89 | 16.60 | 42.63 |
| 4. | *Pinus wallichiana* | 294.44 | 83.33 | 33.71 | 25.73 | 20.83 | 46.01 | 92.57 |
| 5. | *Robinia pseudoacacia* | 222.22 | 66.67 | 3.55 | 19.42 | 16.67 | 4.85 | 40.94 |
| 6. | *Ulmus wallichiana* | 83.33 | 66.67 | 3.75 | 7.28 | 16.67 | 5.12 | 29.07 |
| | Total | 1144.44 | 400.00 | 73.27 | 100.00 | 100.00 | 100.00 | 300.00 |
| | S.E | ±50.46 | ±8.72 | ±5.07 | ±4.40 | ±2.18 | ±6.92 | ±12.43 |

**Table 2:** Floristic composition and phytosociological attributes of Shrub species of Romshi range at Kooler (2200-2400m)

| S. No. | Name of species | Avg. Density/ha | Frequency (%) | Avg. Basal Area/ ha ($m^2$) | Relative Density (%) | Relative Frequency (%) | Relative Basal Area (%) | IVI |
|---|---|---|---|---|---|---|---|---|
| 1. | *Berberis lyceum* | 355.56 | 69.44 | 1.29 | 15.46 | 17.48 | 14.85 | 47.79 |
| 2. | *Cotoneaster nummularius* | 288.89 | 61.11 | 0.53 | 12.56 | 15.38 | 6.10 | 34.04 |
| 3. | *Parrotiopsis jacquemontiana* | 622.22 | 88.89 | 3.65 | 27.05 | 22.37 | 41.90 | 91.32 |
| 4. | *Rosa rubiginosa* | 300.00 | 52.78 | 0.32 | 13.04 | 13.29 | 3.72 | 30.05 |
| 5. | *Sambucus wightiana* | 277.78 | 50.00 | 1.06 | 12.08 | 12.59 | 12.26 | 36.92 |
| 6. | *Viburnum grandiflorum* | 455.56 | 75.00 | 1.84 | 19.81 | 18.88 | 21.17 | 59.85 |
| | Total | 2300.00 | 397.22 | 8.71 | 100.00 | 99.99 | 99.99 | 299.99 |
| | S.E | ±54.79 | ±5.97 | ±0.49 | ±2.38 | ±1.50 | ±5.65 | ±9.36 |

**Table 3:** Floristic composition and phytosociological attributes of tree species of Romshi range at Gadder (2400-2600m)

| S. No. | Name of species | Avg. Density/ ha | Frequency (%) | Avg. Basal Area/ ha($m^2$) | Relative Density (%) | Relative Frequency (%) | Relative Basal Area (%) | IVI |
|---|---|---|---|---|---|---|---|---|
| 1. | *Abies pindrow* | 38.89 | 33.33 | 12.02 | 3.72 | 8.57 | 7.18 | 19.48 |
| 2. | *Aesculus indica* | 138.89 | 55.56 | 3.88 | 13.30 | 14.29 | 2.32 | 29.91 |
| 3. | *Cedrus deodara* | 122.22 | 50.00 | 4.22 | 11.70 | 12.86 | 2.53 | 27.09 |
| 4. | *Juglans regia* | 55.56 | 44.44 | 4.44 | 5.32 | 11.43 | 2.66 | 19.40 |
| 5. | *Picea smithiana* | 400.00 | 94.44 | 113.83 | 38.30 | 24.29 | 68.02 | 130.60 |
| 6. | *Pinus wallichiana* | 233.33 | 66.67 | 26.71 | 22.33 | 17.14 | 15.96 | 55.44 |
| 7. | *Ulmus wallichiana* | 55.56 | 44.44 | 2.22 | 5.32 | 11.43 | 1.33 | 18.08 |
| | Total | 1044.44 | 388.89 | 167.35 | 99.99 | 100.00 | 100.00 | 299.99 |
| | S.E | ±48.92 | ±7.57 | ±15.33 | ±4.68 | ±1.94 | ±9.16 | ±15.41 |

**Table 4:** Floristic composition and phytosociological attributes of shrub species of Romshi range at Gadder (2400-2600m)

| S. No. | Name of species | Avg. Density/ha | Frequency (%) | Avg. Basal Area/ ha ($m^2$) | Relative Density (%) | Relative Frequency (%) | Relative Basal Area (%) | IVI |
|---|---|---|---|---|---|---|---|---|
| 1. | *Berberis lyceum* | 277.78 | 41.67 | 0.34 | 13.89 | 11.92 | 5.65 | 31.46 |
| 2. | *Cotoneaster nummularius* | 377.78 | 75.00 | 0.69 | 18.89 | 21.46 | 11.23 | 51.58 |
| 3. | *Indigofera heterantha* | 388.89 | 69.44 | 0.76 | 19.44 | 19.87 | 12.43 | 51.74 |
| 4. | *Parrotiopsis jacquemontiana* | 355.56 | 55.56 | 2.21 | 17.78 | 15.89 | 36.04 | 69.71 |
| 5. | *Rosa rubiginosa* | 100.00 | 25.00 | 0.10 | 5.00 | 7.15 | 1.75 | 13.91 |
| 6. | *Viburnum grandiflorum* | 500.00 | 82.86 | 2.02 | 25.00 | 23.71 | 32.89 | 81.60 |
| | Total | 2000.00 | 349.52 | 6.15 | 100.00 | 100.00 | 100.00 | 300.00 |
| | S.E | ±55.03 | ±8.94 | ±0.36 | ±2.75 | ±2.55 | ±5.85 | ±10.06 |

**Table 5:** Floristic composition and phytosociological attributes of tree species of Romshi range at Walkhain (2600-2800m)

| S. No. | Name of species | Avg. Density/ha | Frequency (%) | Avg. Basal Area/ ha($m^2$) | Relative Density (%) | Relative Frequency (%) | Relative Basal Area (%) | IVI |
|---|---|---|---|---|---|---|---|---|
| 1. | *Abies pindrow* | 394.44 | 100.00 | 158.76 | 55.47 | 52.94 | 64.00 | 172.41 |
| 2. | *Picea smithiana* | 316.67 | 88.89 | 89.30 | 44.53 | 47.06 | 36.00 | 127.59 |
| | Total | 711.11 | 188.89 | 248.06 | 100.00 | 100.00 | 100.00 | 300.00 |
| | S.E | ±38.88 | ±5.55 | ±34.73 | ±5.47 | ±2.94 | ±14.00 | ±22.41 |

**Table 6:** Floristic composition and phytosociological attributes of shrub species of Romshi range at Walkhain (2600-2800m)

| S. No. | Name of species | Avg. Density/ha | Frequency (%) | Avg. Basal Area/ ha ($m^2$) | Relative Density (%) | Relative Frequency (%) | Relative Basal Area (%) | IVI |
|---|---|---|---|---|---|---|---|---|
| 1. | *Rhododendron compunulatum* | 244.44 | 41.67 | 1.11 | 32.84 | 29.41 | 35.23 | 97.48 |
| 2. | *Rosa rubiginosa* | 111.11 | 22.22 | 0.12 | 14.93 | 15.68 | 3.79 | 34.39 |
| 3. | *Viburnum grandiflorum* | 388.89 | 77.78 | 1.92 | 52.24 | 54.90 | 60.97 | 168.11 |
| | Total | 744.44 | 141.67 | 3.16 | 100.00 | 99.99 | 100.00 | 299.99 |
| | S.E | ±80.20 | ±16.27 | ±0.52 | ±10.77 | ±11.49 | ±16.53 | ±38.62 |

**Similarity and Dissimilarity Indices of trees and shrubs**

Similarity and dissimilarity index of trees between different sites presented in (Table-7) shows that the maximum similarity index (0.77) was found between Kooler (2200-2400m) and Gadder (2400-2600m). The maximum dissimilarity index of trees (1.00) was found between Kooler (2200-2400m) and Walkhain (2600-2800m). In case of shrubs the maximum similarity index (0.83) was again found between Kooler (2200-2400m) and Gadder (2400-2600m) (Table-8).

**Diversity, species richness and dominance indices of trees and shrubes**

In trees, the maximum diversity index (1.66) was found at Gadder (2400-2600m) and the minimum diversity index (0.69) was found at Walkhain (2600-2800m) (Table-09). In case of shrubs, the diversity index shows a decreasing trend from Kooler (2200-2400m) to Walkhain (2600-2800m) (Table-09). Species richness index of trees ranged from 0.21 at Walkhain (2600-2800m) to 1.15 at Gadder (2400-2600m) (Table-10). In case of shrubs, Species richness index ranged from 0.48 at Walkhain (2600-2800m) to 0.96 at Gadder (2400-2600m) (Table-10). Simpson's index of dominance of trees ranged from 0.49 to 0.77 while as in shrubs the index ranged from 0.57 to 0.80 (Table-11).

**Table 7:** Similarity and Dissimilarity index of trees at three sites of Romshi range

| Similarity / Dissimilarity | Kooler (2200-2400m) | Gadder (2400-2600m) | Walkhain (2600-2800m) |
|---|---|---|---|
| Kooler (2200-2400m) | - | 0.77 | 0.00 |
| Gadder (2400-2600m) | 0.23 | - | 0.44 |
| Walkhain (2600-2800m) | 1.00 | 0.56 | - |

**Table 8:** Similarity and dissimilarity index of shrubs at three sites of Romshi range

| Similarity / Dissimilarity | Kooler (2200-2400m) | Gadder (2400-2600m) | Walkhain (2600-2800m) |
|---|---|---|---|
| **Kooler (2200-2400m)** | - | 0.83 | 0.44 |
| **Gadder (2400-2600m)** | 0.17 | - | 0.44 |
| **Walkhain (2600-2800m)** | 0.56 | 0.56 | - |

**Table 9:** Shannon Weiner diversity index of trees and shrubs at three sites of Romshi range

| Vegetation | Kooler (2200-2400m) | Gadder (2400-2600m) | Walkhain (2600-2800m) |
|---|---|---|---|
| Trees | 1.60 | 1.66 | 0.69 |
| Shrubs | 1.74 | 1.71 | 0.99 |
| **S.E** | ±0.07 | ±0.02 | ±0.15 |

**Table 10:** Margalef's species richness index of trees and shrubs at three sites of Romshi range

| Vegetation | Kooler (2200-2400m) | Gadder (2400-2600m) | Walkhain (2600-2800m) |
|---|---|---|---|
| Trees | 0.94 | 1.15 | 0.21 |
| Shrubs | 0.94 | 0.96 | 0.48 |
| **S.E** | ±0 | ±0.09 | ±0.13 |

**Table 11:** Simpson's index of dominance of trees and shrubs at three sites of Romshi range

| Vegetation | Kooler (2200-2400m) | Gadder (2400-2600m) | Walkhain (2600-2800m) |
|---|---|---|---|
| Trees | 0.77 | 0.75 | 0.49 |
| Shrubs | 0.80 | 0.80 | 0.57 |
| **S.E** | ±0.01 | ±0.02 | ±0.04 |

**Discussion**

The plant community organizational analysis of the study area revealed a total of 16 plant species. Observations recorded in terms of tree density, basal area, and altitudinal zone of *Cedrus deodara* and *Pinus wallichiana* were in conformation with [14] who reported the same range in terms of tree density, basal area and altitudinal zone in pine stands of Malam Jabba, Pakistan. *Abies pindrow* and *Picea smithiana* were found to prefer high elevation and dominated the vegetation between 2500 to 3000 m altitudes. *Picea* smithiana was the dominant species at middle elevation while *Abies pindrow* was the dominant species at upper elevation. The tree density in the present study ranged between 711 to 1144 individuals per hectare which is within the range value of 306 to 1619 individuals per hectare in Nagpur forests but is higher than reported [11] from Arunachal Himalaya. Among trees *Pinus wallichiana* recorded the maximum basal area at Kooler (2200-2400m), *Picea smithiana* at Gadder (2400-2600m) while as *Abies pindrow* recorded the maximum basal area Walkhain (2600-2800m). The present recorded basal area of trees ranged between 1.27 $m^2$/ha to 158.76 $m^2$/ha which is within the range value of 9.38 $m^2$/ha to 137.45 $m^2$/ha reported by (Paul, 2008) from Arunachal Himalaya. It was also observed that diversity and density of trees and shrubs decreases with the increase in basal area at the sites, which are dominated by conifers. Similar trend has been observed [8] in Taiwan. The IVI value of the tree species indicated that *Pinus wallichiana* was dominant at Kooler (2200-2400m), *Picea smithiana* was dominant at Gadder (2400-2600m) whereas at Walkhain (2600-2800m), *Abies pindrow* was the most dominant species. At Kooler (2200-2400m), *Pinus wallichiana* was dominant with IVI value of 92.57% followed by the co-dominant species *Cedrus deodara* (IVI of 80.84%).*Picea smithiana* has the highest IVI value of

130.60% at Gadder (2400-2600m) followed by co-dominant species *Pinus wallichiana* with IVI value of 55.44%.*Abies pindrow* (IVI of 172.41%) was the most dominant species at Walkhain (2600-2800m) followed by Co-dominant species *Picea smithiana* with IVI value of 127.59%. The total shrub population varied considerably among the selected sites. Kooler (2200-2400m) shows the richest shrub population compared to Gadder (2400-2600m) and Walkhain (2600-2800m). The structural characteristics like density and basal area shows a marked variation among different sites. Higher values of density were recorded for *Parrotiopsis jacquemontiana* at Kooler (2200-2400m). The highest density and number of shrubs at Kooler (2200-2400m) may due to their development before the tree saplings evolved in the area. Similar results have been reported [3] in forest stands of Eastern Ghats of India.*Parrotiopsis jacquemontiana* recorded the highest average density per hectare (622.22) at Kooler (2200-2400m) while *Rosa rubiginosa* exhibited the lowest average density per hectare (100) at Gadder (2400-2600m).The density values of shrubs are within the same range value was reported in his study on Status of Plant Diversity along an Altitudinal Gradient in district Chamba, Himachal Pradesh [16]. The diversity index of trees was recorded highest in Gadder (2400-2600m) followed by Kooler (2200-2400m) and Walkhain (2600-2800m). A similar trend with regard to trees has been reported [4]. The diversity index of shrubs at three sites of Romshi range shows a decreasing trend from lower site to upper site, this is in agreement with the trend of diversity index of shrubs and herbs as has been reported [17]. Other factors such as soil fertility and topography may also affect the patterns of species richness along altitudinal gradient. The present value of Simpsons's index of dominance of trees and shrubs was highest on the lower altitudinal zone and lowest at higher altitudinal zones. Similar results have been obtained in the studies conducted in other parts of Himalayas (Shaheen *et al.*, 2011). High similarity in species composition was found between Kooler (2200-2400m) and Gadder (2400-2600m) while as the highest dissimilarity was between Kooler (2200-2400m) and Walkhain (2600-2800m). The high similarity could be attributed to the presence of some species which have wide geographical range. Further, there is a gradual change in altitude between these two study sites. There is highest dissimilarity between trees of Kooler (2200-2400m) and Walkhain (2600-2800m) and as a result the similarity value of all species between these two sites drops. This could be due to the reason that there is an abrupt change in altitude between Kooler (2200-2400m) and Walkhain (2600-2800m) and as a result a rapid turnover of tree species occurs. It is also reported that the regional patterns of species richness are consequences of many interacting factors, such as plant productivity, competition, geographical area, historical or evolutionary development, regional species dynamics, regional species pool, environmental variables and human activity [5]. The altitude, environmental factors, habitat and soil characteristics may be the main factors which eventually lead to the variations in species diversity and density in the three study sites.

## Conclusion

A total of 16 plant species were recorded from the study area out of which 8 were trees and 8 were shrubs. The maximum average density in case of trees was found for *Picea smithiana* (400/ha), whereas in case of shrubs it was recorded in *Parrotiopsis jacquemontiana* (622/ha). Among trees *Abies pindrow* exhibited highest frequency value of 100% at Walkhain (2600-2800m). In case of shrubs *Parrotiopsis jacquemontiana* were the most frequent species at Kooler (2200-2400m). The maximum average basal area in case of trees was found for *Abies pindrow* (158.76 $m^2$/ha) at Walkhain (2600-2800m). In shrubs it was found maximum for *Parrotiopsis jacquemontiana* (3.65 $m^2$/ha) at Kooler (2200-2400m). The IVI of the tree species indicated that *Abies pindrow* was most dominant species atWalkhain (2600-2800m) with IVI value of (172.41). In case of shrubs the maximum IVI was recorded in *Viburnum grandiflorum* with IVI value of (168.11). Among trees the maximum value of Shannon Weiner diversity index was (1.66) at Gadder (2400-2600m) whereas the minimum value (0.69) was recorded at Walkhain (2600-2800m). In case of shrubs Shannon Weiner diversity index shows a decreasing trend from Kooler (2200-2400m) to Walkhain (2600-2800m) with maximum value of (1.74) at Kooler (2200-2400m). In trees the maximum value of the species richness index (1.15) was at Gadder (2400-2600m), whereas in case of shrubs the maximum value of the index was (0.96) at Gadder (2400-2600m). Kooler (2200-2400m) hosted 6 tree and 6 shrub species. While Gadder (2400-2600m) represented 7 tree and 6 shrub species and Walkhain (2600-2800m) comprised 2 tree and 3 shrub species. The species composition and structure reveals that Romshi Forest Range is a fir- spruce dominated forest. The phytosociology of the different sites/altitudes revealed that among trees *Cedrus deodara* and *Pinus wallichiana* dominated the lower site while *Picea smithiana* and *Abies pindrow* dominated the middle and upper site respectively. While phytosociology of shrubs present at different sites/altitudes envisaged that *Parrotiopsis jacquemontiana* was the most dominant shrub species at lower site/altitude followed by *Viburnum grandiflorum* at middle and upper site/altitude. Thus, from the present study besides providing insight to the fragile Range of Shopian Forest division will also help policy makers at State, National and International level to encounter the cause of threatening, extinction that are endangering similar ecological regions.

## References


1. Anitha K, Joseph S, John CR, Ramasamy EV, Prasad SN. Tree species diversity and community composition in a human dominated tropical forest of Western Ghats biodiversity hotspot, India. Ecological Complexity. 2010; **7**(2):217-224.
2. Anonymous. State Forest Department Report. 2014. State Forest working plan for Shopian Forest Division. 2014, 4-6.
3. Bahera SK, Misra MK. Floristic structure of the herbaceous vegetation of four recovering forest stands in the Eastern Ghats of India. Biodiversity Conservation. 2006; 15(8):2263-2285.
4. Bharali S, Paul A, Khan LM, Singha BL. Species diversity and community structure of a temperate mixed Rhododendron forest along an altitudinal gradient in west Siang district of Arunachal Pradesh, India. Nature and Science. 2011; 9(12):101-105.
5. Criddle RS, Church JN, Smith BN, Hansen LD. Fundamental causes of the global patterns of species range and richness. Russian Journal of Plant Physiology. 2003; 50(4):192-199.
6. Curtis JT, McIntosh RP. The interrelations of certain analytic and synthetic phytosociological characters. Ecology. 1950; 31(1):434-455.

7. Gentry AH. Tropical forest biodiversity: Distributional patterns and their conservational significance. Oikos. 1992; 63(4):19-28.
8. Hara MK, Hirarta M, Fujihaxa K, Oono CF, Hsich. Floristic composition and stand structure of three evergreen braod leaved forests in Taiwan, with special reference to the relationship between micro landform and vegetation pattern. Natural History Research. 1997; 4(4):81-112.
9. Kharkwal G, Rawat YS, Pangtey YS. An ordination of the forest communities in Nainital catchment of Kumaun Himalaya. Journal of Environmental Biology. 2009; 30(5):853-857.
10. Margalef R. Information theory in ecology. General System Bulletin. 1957; 31(1):36-71.
11. Paul A. Study on diversity and regeneration ecology of Rhododendrons in Arunachal Pradesh. Ph.D Thesis, Assam University, Silchar, Assam, India. 2008, 59-62.
12. Shaheen H, Qureshi, RA, Zahid U, Ahmad T. Anthropogenic pressure on the western Himalayan moist temperate forests of Bagh, Azad Jammu and Kashmir. Pakistan Journal of Botany. 2011; 43(1):695-703.
13. Shannon CE, Wiener W. The Mathematical Theory of communication. University Illinois Press, Urbana. 1963, 108.
14. Siddiqui MS, Ahmed AM, Hussain MI, Iqbal J, Wahab M. Present state and future trends of pine forests of Malam Jabba, Swat district, Pakistan. Pakistan Journal of Botany. 2015; 47(6):2161-2169.
15. Tansley AG. The classification of vegetation and the concept of development. Journal of Ecology. 1920; 8(1):114-115.
16. Verma RK. Status of plant diversity along an altitudinal gradient in Dankund Beat of Kalatop Khajjiar Wild Life Sanctuary of district Chamba, Himachal Pradesh. Biological Forum -An International Journal. 2016; 8(1):540-547.
17. Verma RK, Kapoor SK. Plant species diversity in Ropa - Giavung valley in cold deserts of district Kinnaur, Himachal Pradesh. Biological Forum-An International Journal. 2011; 3(2):34-43.