International Journal of Botany Studies
ISSN: 2455-541X
Impact Factor: RJIF 5.12
www.botanyjournals.com
Volume 2; Issue 6; November 2017; Page No. 200-204

Ecological studies on some herbs and shrubs of Paniyali range of Kotdwara region, Uttarakhand, India

[*1] Mehnaz Bano, [2] Bilal Ahmed, [3] Mohammad Urfan, [4] Mehjabi Ansari
[1, 3] Department of Botany, University of Jammu, Jammu, Jammu and Kashmir, India
[2, 4] Department of Botany, Dr. PDBH Govt College, HNB Garhwal University, Srinagar, Uttarakhand, India

Abstract
The aim of our present investigation was to provide basic information about floristic distribution and species diversity of Paniyali range located in Kotdwara region in Uttarakhand. In this region the climatic conditions favour the existence of a large number of plant species. Phytosociological data viz. plant species composition, density, frequency, dominance, IVI and FIV was determined. A total of 20 plant species belonging to13 families were encountered of which the maximum IVI was of *Sida rhombifolia* (26.6), followed by *Cassia occidentalis* (26.08). Apocynaceae and Malvaceae were the dominant families in the forest.

Keywords: ecological analysis, environment, desertification

Introduction
Himalaya being one of the biodiversity rich regions of the world is considered as most unusual ecosystems on Earth (Salick *et. al*., 2009) [11]. The area covered by Indian Himalayan region (approximately 4, 19,873 Km^2) has unique physiographic, climatic conditions and soil characteristics which have lead to differential habitats and a significant biological diversity. The Himalayan region constitutes about 8000 plant species (47.06% of the total flowering plants of India) of which 30% are endemics to this region, 10.2% are trees, 8.44% wild edibles, and over 15% are medicinally important plants. Since time immemorial the humans and livestock are dependent on this rich plant diversity (Dhar *et. al*., 1997) [3].

Flowering plants because of having great socio-economic potential are used for a large number of purposes such as medicines, ornamentals, timber, fodder, etc. There are some important ecological attributes for example forest composition, species richness, diversity pattern and spatial or temporal distribution pattern of species that are significantly linked with prevailing environmental conditions as well as anthropogenic changes (Gairola *et. al*., 2008, Ahamad *et. al*., 2011, Rawat & Chandra, 2012) [4, 1, 9]. A large number of environmental factors such as elevation and habitat influence the species richness and composition (Chandra *et. al*., 2010) [2]. As reported by Slobodkin and Sanders (1969) [13], floral diversity of any community is determined by the severity, variability, and predictability of the environment in which it develops and is affected by abiotic as well as biotic factors of the environment.

The phyto-sociological studies include mainly the description of plant species and functional aspects of the vegetation. It also provides information about habit of plant species and is supposed that the structure of a community is actually defined by the dominating plant species, not by any other characteristic (Odum, 1971) [6]. The species composition, relative number and diversity of species define the structure of a vegetational unit. It has been explained that there is regular increase in plant diversity during succession process that ultimately leads to climax stage. The biodiversity has been associated with long term health and vigour of the biosphere, as a global environment indicator and also regulates the functioning of ecosystem (Solbrig, 1991, Rawat & Chandra, 2014) [14, 10].

Several factors viz. phenotypic plasticity, genotypic adaptability and competitive, reproductive and tolerance capacity of the species are responsible for the distribution of species (Sharma, 1986) [12]. By synthesising the percentage values of relative frequency, relative density and relative basal area or relative dominance, ecological status of a species with respect to the community structure can be obtained and these values summed up together result into IVI on the basis of which an association is derived (Phillips, 1959) [8]. Therefore, present investigation was carried out to determine the floristic distribution and species diversity of Paniyali range, Kotdwara, Uttarakhand.

Material and Method
Site Description
Kotdwara is one of the main entrance points to Garhwal Himalaya in the state of Uttarakhand and lies in 29° 45' 0" North latitude & 78° 31' 48" East longitudes. The river Khoh flows through this region. Paniyali range is a small section of Kotdwara region and lies in the vicinity of this town where the office of the Forest Division Kotdwara is also located. This area is highly diverse in vegetation and includes numerous species of herbs, shrubs and trees. The region has sub-tropical to temperate climate which remains pleasant throughout the year. Temperature descends to a minimum of 4℃ in January and the annual mean temperature for this region ranges from 25℃ to 30℃. The Kotdwara area having high density of forests receives adequate rainfall, generally commencing from mid-June and extends till mid-September. Annual average rainfall in Kotdwara is 210 cm, maximum of which is

concentrated during the monsoon. The average relative humidity varies from 55% to 65% (Forest Division, Paniyalli range, Kotdwara). Vegetation of Kotdwara is of sub-tropical type, including herbs, shrubs & trees, having broad & deciduous leaves. Kotdwara is one of the biodiversity rich regions of Himalaya and inhabit a large number of species of economically important plants.

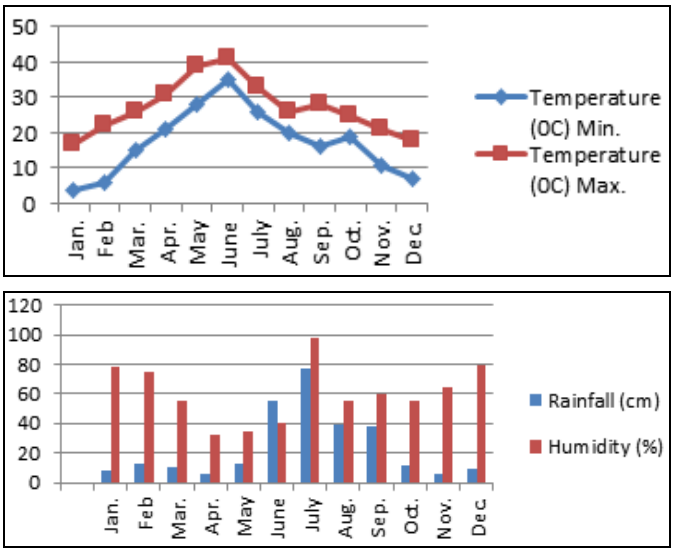

Fig 1: Climatograph of Kotdwara (2011-12) collected from Forest Division Kotdwara

Data collection and techniques

For the collection of data, stratified random sampling technique was applied and quadrants were laid down in the selected places of Paniyali forest area and were distributed spatially. Quadrants of the size 5 m × 5 m were used for shrubs and 1 m × 1 m for herb species. Vegetation was analysed quantitatively for basal area, frequency, density and abundance using appropriate methods (Mishra, 1968) [5]. Similarly, based on these observations relative frequency, relative density and relative dominance were calculated. The Importance Value Index (IVI) of all the plant species under study was finally computed (Phillips, 1959, Pala *et al*., 2016) [8, 7]. The following formulae were used for the calculation of ecological data:

$$\textbf{Frequency} = \frac{\text{Sampling units in which species occured}}{\text{Total sampling units studied}} \times 100$$

$$\textbf{Density} = \frac{\text{Total number of individuals of single species}}{\text{Total number of quadrates taken}}$$

Basal area = πr^2 [where, r = radius; π = 3.14]

After calculating frequency, density and basal area of the identified herbs and shrubs, the relative frequency, relative density and relative dominance were calculated by using the following formulae:

$$\textbf{Relative Frequency} = \frac{\text{Frequency of a single species}}{\text{Total frequency of all the species}} \times 100$$

$$\textbf{Relative Density} = \frac{\text{Density of single species}}{\text{Total density of all the species}} \times 100$$

$$\textbf{Relative Dominance} = \frac{\text{Basal area of single species}}{\text{Total basal area of all the species}} \times 100$$

Finally, the values of relative frequency, relative density and relative dominance were added to get the Importance Value Index (IVI).

Importance Value Index (IVI)

Relative frequency + Relative density + Relative dominance.

Family Importance Value Index (FIV)

Add IVI for different species of the same family.

Results and Discussion

Floristic Composition

A total of 20 species belonged to 13 families; among the families Caesalpinaceae (2 species), Malvaceae (3 species), Apocynaceae (3 species), Poaceae (2 species), Rutaceae, Fabaceae, Verbinaceae, Nyctagenaceae, Euphorbiaceae, Asteraceae, Solanaceae, Mimosaseae and Capparidaceae were represented (Table 1).

Table 1: Floristic composition

Name of the Family	Number of species
Caesalpinaceae	2
Malvaceae	3
Apocynaceae	3
Poaceae	2
Rutaceae	1
Fabaceae	1
Verbinaceae	1
Nyctagenaceae	1
Euphorbiaceae	2
Asteraceae	1
Solanaceae	1
Capparidaceae	1
Mimosaceae	1

Table 2: Observation table: L.N/C.N= Local name/ Common name, RF= Relative Frequency, RD= Relative Density, RDn= Average Relative Dominance, IVI= Importance Value Index

S. No	Botanical name	L.C/C.N	Family	Habit	RF (%)	RD (%)	RDn (%)	IVI
1.	*Cynodon dactylon* (L.) Pers.	Dhub ghass	Poaceae	Herb	8.3	10	0.63	18.93
2.	*Desmodium triflorum* (L.) DC	Black Clover	Fabaceae	Herb	4.65	13.35	0.65	18.65
3.	*Sida cordifolia* L.	Bala	Malvaceae	Herb	4.65	2.6	1.01	8.26
4.	*Sida rhombifolia* L.	Jelly leaf	Malvaceae	Herb	8.3	17.1	1.2	26.60
5.	*Ageratum conyzoides* L.	Chick weed	Asteraceae	Herb	3.7	2.1	1.11	6.91
6.	*Poa annua* L.	Blue grass	Poaceae	Herb	7.4	1.85	0.56	9.81
7.	*Malvestrum coromandelianum* (L.) Garcke	False	Malvaceae	Herb	6.45	1.4	0.96	8.81

		Mallow						
8.	*Mimosa pudica* L.	Chui-mui	Mimosaceae	Herb	1.9	0.6	0.82	3.32
9.	*Cleome viscose* L.	Tick weed	Capparidaceae	Herb	2.75	0.4	2.25	5.4
10.	*Euphorbia hirta* L.	Asthma plant	Euphorbiaceae	Herb	1.9	0.6	1.51	4.01
11.	*Lantana camara* L.	Kurri	Verbinaceae	Herb	4.3	11.15	4.42	19.87
12.	*Adhatoda vasica* Nees.	Vasaka	Apocynaceae	Herb	7.15	5	8.61	20.76
13.	*Cassia tora* L.	Charota	Caesalpinaceae	Herb	8.6	8.1	3.34	20.04
14.	*Cassia occidentalis* L.	Chakunda	Caesalpinaceae	Herb	10	12.3	3.78	26.08
15.	*Withania somnifera* (Linn.) Dunal	Ashwaganda	Solanaceae	Herb	1.4	0.8	6.89	9.09
16.	*Calotropis procera* (Aiton) W.T. Aiton	Madar	Apocynaceae	Shrub	2.85	1.9	12.84	17.59
17.	*Murraya koenigii (*L.) Spreng	Curry patta	Rutaceae	Shrub	8.6	6.55	6.5	21.65
18.	*Bougainvillea spectabilis* Willd.	Booganbel	Nyctaginaceae	Shrub	2.85	1.55	17.27	21.67
19.	*Ricinus cuminis* Linn.	Castor plant	Euphorbiaceae	Shrub	1.4	0.75	9.89	12.04
20.	*Thevetia peruviana* L.	Peeli kaner	Apocynaceae	Shrub	2.85	1.9	15.76	20.51
	Total =				100	100	100	300

Importance Value Index (IVI)

The IVI of the *Sida rhombifolia* (26.6) was highest in this forest and followed by *Cassia occidentalis* (26.08), *Bougainvillea spectabilis* (21.67), *Murraya koenigii* (21.65), *Adhatoda vasica* (20.76), *Ricinus cuminis* (20.51) and *Cassia tora* (20.04) (Table 2, Fig. 3). Five other species showed IVI range of 19.87–12.04 while eight species showed IVI less than 10. *Sida rhombifolia* showing high IVI indicates that it occupies most of the sampled area hence it is important plant species in forest.

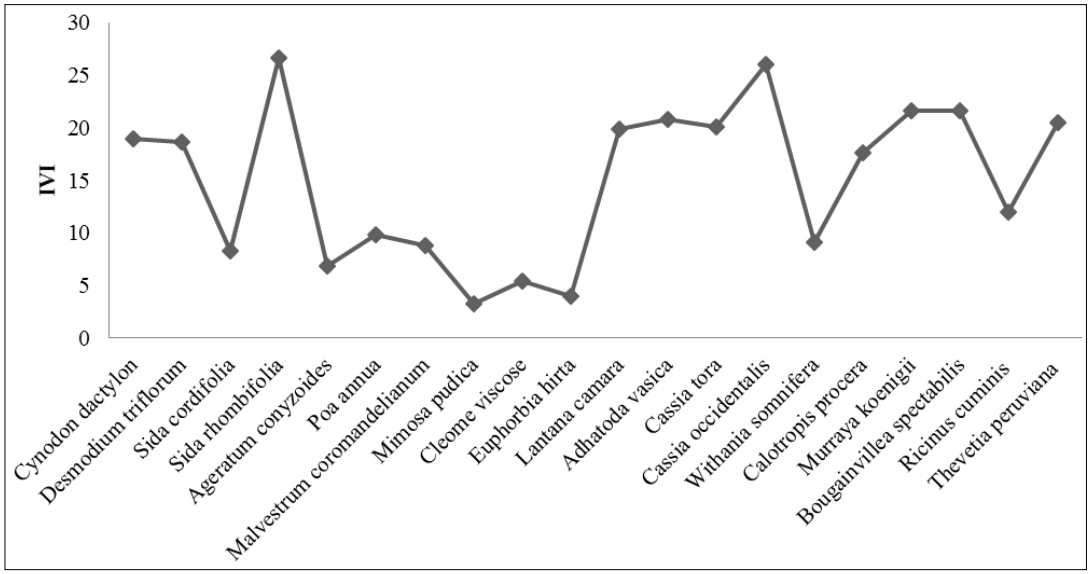

Fig 3: IVI values of individual plant species

Family Importance Value Index (FIV)

The FIV of Apocynaceae was very high (58.86) followed by Caesalpinaceae (46.12), Malvaceae (43.67) and Poaceae (28.74) (Table 3, Fig. 4).

Table 3: Family value index (FIV)

S. No.	Family	Number of species	FIV
1.	Apocynaceae	3	58.86
2.	Ceasalpinaceae	2	46.12
3.	Malvaceae	3	43.67
4.	Poaceae	2	28.74
5.	Nyctaginaceae	1	21.67
6.	Rutaceae	1	21.65
7.	Verbinaceae	1	19.87
8.	Fabaceae	1	18.65
9.	Euphorbiaceae	2	16.05
9.	Solanaceae	1	9.09

10.	Asteraceae	1	6.91
11.	Capparidaceae	1	5.4
12.	Mimosaceae	1	3.32
Total		20	300

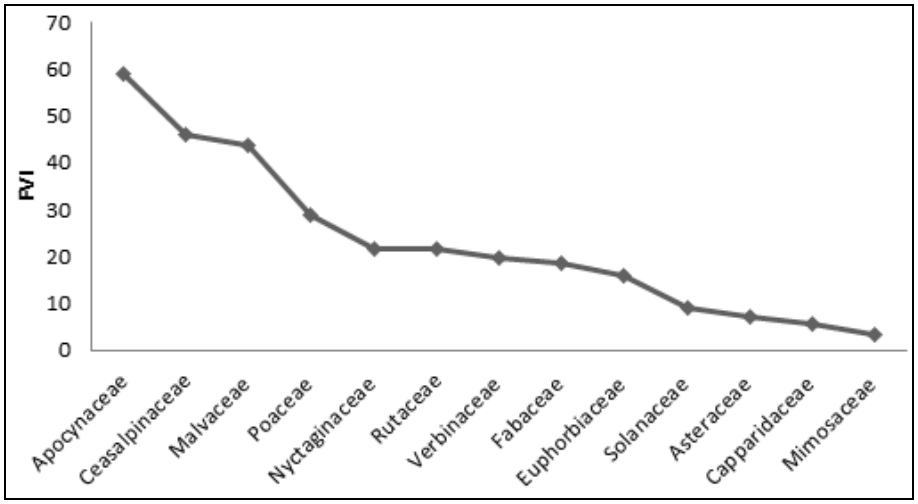

Fig 4: FVI values for 13 families.

Relative Density

The member of Malvaceae accounted 21.1% of the total individual's. Amongst the family, *Sida rhombifolia* (81.04%) was predominantly represented. Other than Malvaceae, Caesalpinaceae represented 20.4% of the total individuals with *Cassia occidentalis* representing 60.29% species. *Desmodium triflorum* (13.35%), *Lantana camara* (11.15%) and the remaining species showed less than 10 (Table 2). But in this forest *Sida rhombifolia* showed high density (17.1%) with high IVI (26.6), hence it is frequently present and predominantly occupies the sampled area.

Conclusion

The highest species number is represented by family Malvaceae (with 3 species) and Apocynaceae (with 3 species). Ceasalpinaceae, Euphorbiaceae and Poaceae represented 2 species each. Briefly, the highest and lowest IVI values were found for the *Sida rhombifolia* (26.6) and Mimosa pudica (3.32). The highest IVI value for certain species suggests that the species is dominant in the layers. Hence, *Sida rhombifolia* with highest IVI value suggested the dominance of this species in the forest and its importance within the community. Besides, Apocynaceae showed maximum FIV (58.86) indicating it an important family in the forest. Since this forest is represented by different species of Apocynaceae but *Sida rhombifolia* alone dominate the forest. These plant species are very important as for as their ecological, Economical and social benefit is concerned and therefore, their conservation and management is required at the earliest.

Acknowledgement

Authors are thankful to Dr. Preeti Khanduri for her valuable advice and Department of Botany, Govt. PG College, Kotdwara for providing necessary facilities to complete this work during.

References

1. Ahamad I, Ahmad MSA, Hussain M, Ashraf M, Ashraf M. Spatiotemporal variations in soil characteristics and nutrient availability in open scrub type semi-arid rangelands of typical sub-mountainous Himalayan tract. Pakistan Journal of Botany. 2011; 43(1):565-571.
2. Chandra J, Rawat, VS, Rawat YS, Ram J. Vegetational diversity along an altitudinal range in Garhwal Himalaya. International Journal of Biodiversity and Conservation. 2010; 2(1):14-18.
3. Dhar U, Rawal RS, Samant SS. Structural diversity and representativeness of forest vegetation in a protected area of Kumaun Himalaya, India: implications for conservation. Biodiversity & Conservation. 1997; 6(8):1045-1062.
4. Gairola S, Rawal RS, Todaria NP. Forest vegetation patterns along an altitudinal gradient in sub-alpine zone ofWest Himalaya, India. African Journal of Plant Science. 2008; 2(6):42-48.
5. Mishra R. Ecology Work Book. Oxford and IBM publishing Co Calcutta, 1968.
6. Odum EP. Fundamentals of Ecology. In: W.B. Saunders, Philadelphia, USA, 1971.
7. Pala NA, Negi AK, Gokhale Y, Shah S, Kumar M. Community Structure and Plant Diversity of Community Based Religious Conserved Forests of Garhwal Himalaya, India. Journal of Earth Science and Climate Change. 2016; 7:334.
8. Phillips EA. Methods of Vegetation Study. Henry Hill & Co Inc., USA, 1959.
9. Rawat VS, Chandra J. Tree layer vegetational analysis in temperate forest of Uttarakhand. Nature and Science. 2012; 10(10):167-171.
10. Rawat VS, Chandra J. Vegetational Diversity Analysis across Different Habitats in Garhwal Himalaya. Journal

of Botany, 2014, 5. Article ID 538242.
11. Salick J, Zhendong F, Byg A. Eastern Himalayan alpine plant ecology, Tibetan ethnobotany, and climate change. Global Environmental Change. 2009; 19(2):147-155.
12. Sharma BM. Phytosociological observations on the vegetation of burnt and unburnt areas near Ibadan, Nigeria. Journal of Range Management. 1986; 39:76-81.
13. Slobodkin LB, Sanders HL. On the contribution of environmental predictability to species diversity. In: Brookhaven Symposia in Biology. 1969; 22:82-93.
14. Solbrig OT. From Genes to Ecosystems: A Research Agenda for Biodiversity. In: International Union of Biological Sciences, Paris, France, 1991.