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# Floristic composition and species diversity of woody elements in different altitudinal zones of Bhaba valley in Himachal Pradesh

# Mast Ram Negi and IK Thakur

#### Abstract

Loss of biodiversity is a serious threat to the natural ecosystem in any particular area which leads to ecological imbalance as a whole globally. Study of plant biodiversity is an important parameter to understand and assess plant community structure. The present paper deals with floristic composition and species diversity of woody species in Bhaba valley. The study area was divided into three altitudinal zones, *viz.*, lower (1500 -2500 m), middle (2500-3500 m) and top zone (3500-4500m). Three sites were taken from each zone and in each site three quadrates were further laid on the basis of species area curve for the study of floristic composition and species diversity. In the present study, it was observed that in total there were 73 woody species belonging to 48 genera and 27 families out of which 31 were tree species and 42 shrub species characterizing moist alpine shrub vegetation in the study area. Maximum species (56) were recorded in lower zone with 23 tree species and 33 shrub species followed by 36 species in middle zone with 12 tree species and 24 shrub species, whereas minimum 18 species were recorded in top zone with 8 tree species and 10 shrub species, respectively. It was further observed that *Pinus wallichiana* and *Prunus cornuta* were present in the entire valley area showing wide adaptability of these two species.

Keywords: Floristic composition, woody species diversity, Bhaba valley, Himachal Pradesh

#### Introduction

The Himalayas, a young and complex chain of mountains, is well known for its floral and faunal diversity, aesthetic beauty, geo-hydrological settings and cultural values. Frequent orographic changes, large surface removals due to geological instability and cyclic climatic changes have greatly influenced the floral and faunal communities in these mountains. According to the palaeoclimatologist, the Miocene orogeny led to drastic changes in the vegetation and the contemporary flora has been almost entirely replaced by the modern flora (Vishnu-Mittre 1972, Singh and Singh 1987, 1992)<sup>[9, 12]</sup>. Extending for about 2,500 km from east to west, the Himalayan arc covers more than ten degrees of latitudes, i.e., 27-38° north and exhibits an interesting pattern of rainfall from west to east (increasing gradient) and south to north (decreasing gradient).

Himachal Pradesh, a hilly state situated in the lap of lofty Western Himalayan ranges has a rich and diversified flora in its different geographical regions. It is located in the north-western part of the Himalayas and supports varied agro climatic zone. Bhaba valley is located in Kinnaur district of Himachal Pradesh and its area comes under Rupi-Bhaba Wildlife Sanctuary of the state. The valley beginning at the confluence of Bhaba stream and Satluj river follows W-shape where left hand forms Anyar dhar and right hand Mukim dhar and is nested by Dauladhar range at south, Zhanskar range at north and Great Himalayan mountain range at east and west into an insect's body of what Zhanskar forms head, Great Himalayan mountain range thorax of the body and Dhauladhar range the abdomen.

The Bhaba valley has a wide range of altitudes, temperature, precipitation and topography, which results in a diversified and rich forest flora varying from northern subtropical deciduous forest to alpine pastures. There is heavy biotic pressure on the forest of this area through the local populations, nomads and other developmental activities such as construction of roads and hydroelectric projects. The main economy of the people of the area revolves around keeping traditional agricultural practices and some established and upcoming apple orchards along with large herds of sheep, goats and cattle. Transitional movement of herds is still common phenomenon with the change in season. To increase the biomass production of grasses for use as fodder, local residents set the forest and grazing ground on fire during the winter months, which damages the growing primordial of not only grasses but also of shrubs and trees.

Hence, the present studies were carried out with objectives to study floristic composition and the diversity of woody species existing in the study area.

### **Material and Methods**

#### The study area

The Bhabha Valley (from 31.54°N and 77.95° E to 31.78° N and 78.05° E; between 1,500 and 5,600 meter above msl) lies at the basin of Bhabha, also known as River Wangar, a small tributary of River Sutlej in district Kinnaur of Himachal Pradesh.

The Bhaba valley is located adjacent to the Pin valley of Lahaul and Spiti district of Himachal Pradeh and starts from

Wangtu on NH-5 giving way to Pin valley as its interior end with which it is connected by Pin-Bhaba Pass. It lies in Nichar block of Kinnaur district of Himachal Pradesh an Indian Himalayan state along upper Sultej valley and is situated on the western Himalayas Fig 1. The valley has its own significance and is famous for its rich floral and faunal diversity. It is among one of the major pastureland of the state and supports large livestock population of Himachal Pradesh by providing open grazing grounds for the shepherd community from four districts of the state, *viz.*, Kinnaur, Shimla, Kullu and Lahaul and Spiti in the summer months from April to late September.

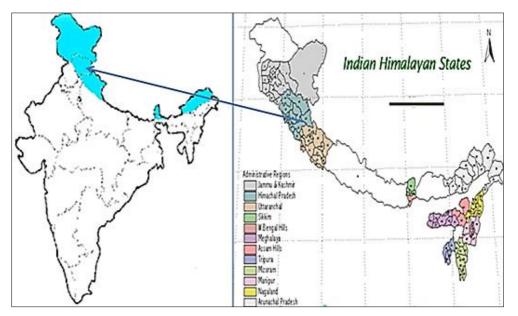


Fig 1: Map of India showing Himachal Pradesh an Indian Himalayan state of western Himalaya (Not to scale)

## Sampling and laying out of quadrates

Sampling done in the present study was through stratified two stage random sampling in which the complete study area was divided into three altitudinal zones, *viz.*, lower (1500 -2500 m), middle (2500-3500 m) and top zone (3500-4500m). Three

sites were taken from each zone and in each site three quadrates were further laid on the basis of Species Area Curve as proposed by Oosting (1958)<sup>[6]</sup> for measuring species diversity and phytosociological parameters (Table 1).

Altitudinal range (m)	Altitudinal zones	Study sites			
3500-4500	Т	IA	IB	IC	
5300-4300	Top zone (I)	IA(i) IA(ii) IA(iii)	IB(i) IB(ii) IB(iii)	IC(i) IC(ii) IC(iii)	
2500-3500	Middle zone (II)	IIA	IIB	IIC	
2300-3300	Middle zone (II)	IIA(i) IIA(ii) IIA(iii)	IIB(i) IIB(ii) IIB(iii)	IIC(i) IIC(ii) IIC(iii)	
1500 2500	Louise zono (III)	IIIA	IIIB	IIIC	
1500-2500	Lower zone (III)	IIIA(i) IIIA(ii) IIIA(iii)	IIIB(i) IIIB(ii) IIIB(iii)	IIIC(i) IIIC(ii) IIIC(iii)	

Table 1: Bhaba valley and stratified two stage random sampling

**Notations:** (I), (II) and (III) = Altitudinal zones, A, B and C = Study sites, (i), (ii) and (iii) = Quadrates

Number of sites = 9 Quadrates in each site = 3 Total number of quadrates = 27 quadrates was not possible. On the basis of Species Area Curve, the quadrate size came out to be  $10 \times 50$  m and three quadrates were laid in each site for species enumeration as depicted below (Table 2).

Since the terrain of the study sites has undulating topography, rectangular quadrates were laid as laying of square or circular

**Table 2:** Sampling procedure for laying out of quadrates

Site 1 (IA)			Site 2 (IB)			Site 3 (IC)											
I.	IA <sub>(i)</sub>	II.	IA(ii)	III.	IA(iii)	IV.	IB <sub>(i)</sub>	V.	IB <sub>(ii)</sub>	VI.	IB(iii)	VII.	IC <sub>(i)</sub>	VIII.	IC(ii)	IX.	IC(iii)
Site 4 (IIA)				Site 5 (IIB)			Site 6 (IIC)										
Χ.	IIA(i)	XI.	IIA(ii)	XII.	IIA(iii)	XIII.	IIB <sub>(i)</sub>	XIV.	IIB(ii)	XV.	IIB(iii)	XVI.	IIC <sub>(i)</sub>	XVII.	IIC <sub>(ii)</sub>	VIII.	IIC(iii)
	Site 7 (IIIA)				Site 8 (IIIB)			Site 9 (IIIC)									
XIX.	IIIA(i)	XX.	IIIA(ii)	XXI.	IIIA(iii)	XXII.	IIIB <sub>(i)</sub>	XIII.	IIIB(ii)	XIV.	IIIB(iii)	XXV.	IIIC(i)	XVI.	IIIC <sub>(ii)</sub>	KVII.	IIIC(iii)

#### **Species enumeration**

Floristic survey of all the sites was carried out during the study period (July 2014 to June 2015) to assess and document total number of woody species (trees and shrubs) present in the entire valley i.e., from Wangtu to Goldas.

Goldas, since there is gradual rise in altitude of the valley towards Goldas side. Moreover, accessibility to the forest area was an important factor in taking the sites for study as some areas of the valley are quite steep with rocky mountains and devoid of thick and continuous forest because of its rocky strata and aspect. However, there are some patches of forest present especially above site Kangarang.

#### **Results and Discussion**

### Study sites

The study area was restricted to the forest between sites Bai to

Sr. No.	Altitudinal range (m amsl)	Altitudinal zones	Name of the site	Latitude longitude	Average altitude (m)	Aspect
51.110.	Antituuniai range (in anisi)	Antituumai zones	Name of the site	N 31°.43'.353"	Average attitude (III)	пърссі
			Taudor	E 77°.59'.020"	4010	Western
XXVIII.	3500-4500	Top zone	Nigul	N 31°.42'.975	3940	Northern
XX v III.	3500-4500	Top Zone	Nigui	E 77°.59'.249"	5740	Normern
			Goldas	N 31°.43'.060"	3580	Eastern
			Goldas	E 77°.58'.178"	5500	Lustern
	2500-3500	Middle zone	Muling	N 31°.4'1.732"	3381	Northern
				E 77°.51'.901"		Northerin
XXIX.			Anyar	N 31°.41'.115"	3481	Western
717171.				E 78°.00'.526"	5401	western
			Homti	N 31°.39'.113"	2903	Northern
			Homu	E 78°.00'.981"	2905	rtortilerii
			Kangarang	N 31°.33'.857"	2360	Northern
			Rungarang	E 78°.04'.110"	2500	rtortilerii
XXX.	1500-2500	Lower zone	Kafnu	N 31°.35'.92"	2489	Western
<i><b>M</b></i> <b>MM</b> .	1500-2500	Lower zone	Kailla	E 78°.03'.133"	240)	western
			Bai	N 31°.34'.639"	2279	Western
			Dal	E 78°.02'.345"	2219	western

Table 3: Geographica	l location of differer	nt sites in different zo	nes of the study area
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Nine different sites were randomly selected from the entire valley with three from each altitudinal zones. Twenty seven permanent quadarates were laid in the entire study area i.e. between sites Bai and Goldas at different altitudinal ranges with different aspects. The geographical situation of all the study sites taken randomly from three altitudinal zones of the valley were marked as depicted above (Table 3).

During the study period (July 2014-June 2015) in all the nine study sites in marked quadrates, a total of 73 woody species were recorded of which 31 were trees and 42 were shrubs (Table 4). The maximum species 56 were recorded in lower zone with 23 tree species and 33 woody species followed by 36 species in middle zone with 12 tree species and 24 shrub species whereas minimum species 18 were recorded in top zone with 8 tree species and 10 shrub species respectively (Table 5).

This could be attributed to intermediate disturbance hypothesis (Cornell, 1978; Horn, 1975) <sup>[3]</sup> which proposes that highest diversity is maintained at intermediate levels of disturbance. Soon after a severe disturbance, propagules of a few pioneer species arrive in the open space. If further disturbances occur frequently, gaps will not progress beyond the pioneer stage and the diversity of the community as a whole will be low. As the interval between disturbances increases, the diversity also increase because sufficient time is available for the invasion of more species. This is the situation at an intermediate frequency of disturbance. At very low frequencies of disturbance, most of the community of the time will reach and remain at the climax, with competitive exclusion having reduced diversity.

It was further observed that *Pinus wallichiana* and *Prunus cornuta* were present in the entire valley area showing wide adaptability of these two species. However, *Aesculus indica, Cedrus deodara, Corylus colurena, Lonisera quinquelocularis, Pinus roxburghii, Pistacia integerrima,* 

Prunus armeniaca, Prunus cerasoides, Prunus persica, Pyrus pashia, Rhus cotinus, Rhus semialata, Rhus wallichii, Robinia pseudoacacia, Salix daphnoides, Sorbus microphyla, Taxus baccata, Ulmus villosa, Ulmus wallichiana Artemisia vulgaris, Berberis kunawurensis, Caragana brevispina, Caragana geradiana, Coriaria nepalensis, Cotoneaster acuminate, Cotoneaster bacillaris, Cotoneaster intregrifolius, Desmodium elegans, Desmodium sambuemse, Deutzia staminea, Elaegnus umbellata, Elscholtzia polystachys, Hippohhae salicifolia, Hippohhae rhamnoides, Indigofera pulchela, Jasminum humile, Myrsine semiserrata, Nepeta podostrachys, Origanum vulgare, Plectranthus rugosus, Prinsepia utilis, Rhododendron anthopogon, Rosa moschata, Sorbaria tomentosa, Spiraea canescens, Verbascus thapsus and *Zanthoxylum alatum* have sparse distribution in the valley with least association (Table 6).

The main reason behind such varied floristic composition is that all the species in a natural community are not isolated. They may exhibit either a positive or a negative relationhip among themselves because of the interactions between the species or of the similar responses of the species to the same environment (Bawa, 1986)<sup>[1]</sup>. These floristic compositions also indicate the spatial distribution pattern of one species to another in a community (Misra and Misra, 1981). Itow and Nakanishi (1980)<sup>[4]</sup> for a community in Japan reported that large area contained more varied habitat type than smaller ones; and each of the habitat types supports a specific set of its own, which is more or less different that from of other habitat types.

In similar study (Negi 2002) <sup>[10]</sup> studied woody species diversity of Sangla valley in Himachal Pradesh and recorded a total of 26 woody species of which 17 were tree and 9 shrub species. (Chawla *et al.*, 2008) <sup>[12]</sup> studied the species diversity of higher plants in Bhabha valley of western Himalaya and their analysis revealed a total of 313 species of higher plants.

The major representations were from the families Asteraceae, Rosaceae, Lamiaceae, and Poaceae. (Singh 2011) <sup>[12]</sup> conducted the study on structure and ethnobotany of woody

elements of Dodra Kawar forest range of Himachal pradesh and recorded a total of 42 woody species which includes 20 tree speces and 22 shrub species.

Table 4: Total number of species of oc	ccurrence in the study area
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24.Juniperus recurvaCupressaceae+-25.Myrsine semiserrataPrimulaceae-+26.Nepeta podostrachysLamiaceae-+27.Origanum vulgareLamiaceae-+	1.         2.         3.         4.         5.         6.         7.         8.         9.         10.         11.         12.         13.         14.         15.         16         17.         18.         19.         20.         21.	Name of speciesArtemisia vulgarisBerberis aristataBerberis chitriaBerberis kunawurensisBerberis lyciumCaragana brevispinaCaragana gerardianaCoriaria nepalensisCotoneaster acuminataCotoneaster bacillarisCotoneaster microphyllaDesmodium sambuenseDesmodium sambuenseDeutzia stamineaElaeagnus umbellateElscholtzia polystachysHippophae rhamnoidesHippophae salicifoliaIndigofera hebepetalaIndigofera heterantha	FamilyAsteraceaeBerberidaceaeBerberidaceaeBerberidaceaeBerberidaceaeFabaceaeFabaceaeCoriariaceaeRosaceaeRosaceaeRosaceaeRosaceaeFabaceaeElaeagnceaeElaeagnceaeElaeagnceaeElaeagnceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeElaeagnceaeElaeagnceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceae	+ - - - - - - - - - - - - - - - - - - -	- + + - - - - - - + + - - - - - - - - -	- + + + + + + + + + + + + + + + + + + +
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26.Nepeta podostrachysLamiaceae-+27.Origanum vulgareLamiaceae-+	1.         2.         3.         4.         5.         6.         7.         8.         9.         10.         11.         12.         13.         14.         15.         16         17.         18.         19.         20.         21.         22.         23.	Name of speciesArtemisia vulgarisBerberis aristataBerberis chitriaBerberis kunawurensisBerberis lyciumCaragana brevispinaCaragana gerardianaCoriaria nepalensisCotoneaster acuminataCotoneaster bacillarisCotoneaster microphyllaDesmodium sambuenseDesmodium elegansDeutzia stamineaElaeagnus umbellateElscholtzia polystachysHippophae salicifoliaIndigofera hebepetalaIndigofera pulchelaJasminum humile	FamilyAsteraceaeBerberidaceaeBerberidaceaeBerberidaceaeBerberidaceaeBerberidaceaeFabaceaeFabaceaeCoriariaceaeRosaceaeRosaceaeRosaceaeFabaceaeElaeagnceaeElaeagnceaeElaeagnceaeElaeagnceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeFabaceaeElaeagnceaeFabaceae	+ - - - - - - - - - - - - - - - - - - -	- + +	- + + + + + + + + + + + + + + + + + + +
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28. Plectranthus rugosus Lamiaceae +	1.         2.         3.         4.         5.         6.         7.         8.         9.         10.         11.         12.         13.         14.         15.         16         17.         18.         19.         20.         21.         22.         23.         24.         25.         26.	Name of speciesArtemisia vulgarisBerberis aristataBerberis chitriaBerberis kunawurensisBerberis lyciumCaragana brevispinaCaragana gerardianaCoriaria nepalensisCotoneaster acuminataCotoneaster bacillarisCotoneaster microphyllaDesmodium sambuenseDeutzia stamineaElaeagnus umbellateElscholtzia polystachysHippophae rhamnoidesHippophae salicifoliaIndigofera hebepetalaIndigofera pulchelaJasminum humileJuniperus recurvaMyrsine semiserrataNepeta podostrachys	FamilyAsteraceaeBerberidaceaeBerberidaceaeBerberidaceaeBerberidaceaeBerberidaceaeFabaceaeFabaceaeCoriariaceaeRosaceaeRosaceaeRosaceaeRosaceaeFabaceaeElaeagnceaeElaeagnceaeElaeagnceaeFabaceaeFabaceaeElaeagnceaeElaeagnceaeFabaceaeFabaceaeFabaceaeElaeagnceaeFabaceae	+	- + +	- + + + + + + + + + + + + + + + + + + +
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29.	Prinsepia utilis	Rosaceae	-	-	+
30.	Rhodendron lepidotum	Ericaceae	+	-	-
31.	Rhododendron anthopogon	Ericaceae	+	+	-
32.	Rhododendron companulatum	Ericaceae	+	+	-
33.	Rosa macrophyla	Rosaceae	-	+	+
34.	Rosa moschata	Rosaceae	-	-	+
35.	Rosa webbina	Rosaceae	+	-	+
36.	Senecio chrysanthemoides	Asteraceae	+	-	+
37.	Sorbaria tomentosa	Rosaceae	-	-	+
38.	Spiraea canescens	Rosaceae	-	-	+
39.	Verbascus Thapsus	Scrophulariacea	-	+	+
40.	Viburnum nervosum	Adoxaceae	+	-	+
41.	Vibrunum conitifolium	Adoxaceae	-	-	+
42.	Zanthoxylum alatum	Rutaceae	-	-	+

Where + = present; - = absent

Table 5: Total numbers of species of occ	currence in different altitudinal zones
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Sr. No.	Name of species	Family
	Top zone (T)	
	Trees	
1.	Abies spectabilis	Pinaceae
2.	Acer caesium	Sapindaceae
3.	Betula utilis	Betulaceae
4.	Lonisera quinquelocularis	Caprifoliaceae
5.	Pinus wallichiana	Pinaceae
6.	Prunus cornuta	Rosaceae
7.	Salix daphnoides	Salicaceae
8.	Sorbus microphylla	Rosaceae
	Shrubs	
1.	Artimisia vulgare	Asteraceae
2.	Cotoneaster intregrifolius	Rosaceae
3.	Juniperus recurva	Cupressaceae
4.	Origanum vulgare	Lamiaceae
5.	Rhododendron anthopogon	Ericaceae
6.	Rhododendron companulatum	Ericaceae
7.	Rhododendron lepidotum	Ericaceae
8.	Rosa webbiana	Rosaceae
9.	Senecio Chrysanthemoides	Asteraceae
10.	Vibrunum nervosum	Adoxaceae
10.	Middle zone (M)	Ацолассас
	Trees	
1.	Abies pindrow	Pinaceae
2.	Abies spectabilis	Pinaceae
3.	Acer caesium	Sapindaceae
4.	Acer caesium Aesculus indica	-
5.	Betula utilis	Sapindaceae
5. 6.		Betulaceae
7.	Corylus jacquemontii	Betulaceae
	Juglans regia	Juglandaceaee
8.	Picea smithiana	Pinaceae
9.	Pinus wallichiana	Pinaceae
10.	Populus ciliate	Salicaceae
11.	Prunus cornuta	Rosaceae
12.	Taxus baccata	Taxaceae
	Shrubs	
1.	Berberis aristata	Berberidaceae
2.	Berberis chitria	Berberidaceae
3.	Berberis lucium	Berberidaceae
4.	Cotoneaster microphylla	Rosaceae
5.	Desmodium elegans	Fabaceae
6.	Indigofera hebepetala	Fabaceae
7.	Indigofera heterantha	Fabaceae
8.	Jasminum humile	Oleaceae
9.	Rhododendron companulatum	Ericaceae
10.	Rhododendron lepidotum	Ericaceae
11.	Rosa macrophyla	Rosaceae
12.	Vibrunum conitifolium	Adoxaceae

1	A1 · · · 1	D,
1.	Abies pindrow	Pinaceae
2.	Aesculus indica	Sapindaceae
3.	Alnus nitida	Betulaceae
4.	Cedrus deodara	Pinaceae
5.	Celtis australis	Cannabaceae
6.	Corylus colurna	Betulaceae
7.	Juglans regia	Juglandaceae
8.	Picea smithiana	Pinaceae
9.	Pinus roxburghii	Pinaceae
10.	Pinus wallichiana	Pinaceae
11.	Pistacia integerrima	Anacardiaceae
12.	Populus ciliate	Salicaceae
13.	Prunus armeniaca	Rosaceae
14.	Prunus cerasoides	Rosaceae
15.	Prunus cornuta	Rosaceae
16.	Prunus persica	Rosaceae
17.	Pyrus pashia	Rosaceae
18.	Rhus cotinus	Anacardiaceae
19.	Rhus semialata	Anacardiaceae
20.	Rhus wallichii	Anacardiaceae
21.	Robinia pseudoacacia	Anacardiaceae
22.	Ulmus villosa	Ulmaceae
23.	Ulmus wallichiana	Ulmaceae
	Shrubs	
1.	Berberis aristata	Berberidaceae
2.	Berberis chitria	Berberidaceae
3.	Berberis kunawurensis	Berberidaceae
4.	Berberis lyceum	Berberidaceae
5.	Caragana brevispina	Fabaceae
6.	Caragana gerardiana	Fabaceae
7.	Coriaria nepalensis	Rosaceae
8.	Cotoneaster acuminate	Rosaceae
9.	Cotoneaster bacillaris	Rosaceae
10.	Cotoneaster micophylla	Rosaceae
11.	Desmodium elegans	Fabaceae
12.	Desmodium sambuense	Fabaceae
13.	Deutzia staminea	Hydrangeaceae
14.	Elaeagnus umbellate	Elaeagnaceae
15.	Elscholtzia polystachys	Labiatae
16.	Hippophae rhamnoides	Elaeagnaceae
17.	Hippophae salicifolia	Elaeagnaceae
18.	Indigofera hebepetala	Fabaceae
19.	Indigofera heterantha	Fabaceae
20.	Indigofera pulchela	Fabaceae
21.	Lonisera quinquelocularis	Caprifoliaceae
22.	Myrsine semiserrata	Primulaceae
23.	Nepeta podostachys	Lamiaceae
24.	Origanum vulgare	Lamiaceae
25.	Plectranthus rugous	Lamiaceae
26.	Prinsepia utilis	Rosaceae
27.	Rosa moschata	Rosaceae
		Rosaceae Rosaceae
27. 28.	Sorbaria tomentosa	Rosaceae
27. 28. 29.	Sorbaria tomentosa Spiraea canescens	Rosaceae Rosaceae
27. 28. 29. 30.	Sorbaria tomentosa Spiraea canescens Verbascus thapsus	Rosaceae Rosaceae Scrophulariaceae
27. 28. 29.	Sorbaria tomentosa Spiraea canescens	Rosaceae Rosaceae

Table 6: Common species of occurrence in different altitudinal zones (Top, Middle and Lower)

Sr. No.	Name of species	Top (3500-4500m) Trees	Altitudinal zones Top (3500-4500m)Middle (2500-3500 m)Lower (1500-2500 m)				
1.	Abies pindrow	Trees	+				
2.	Abies spectablis	-		+			
2. 3.	-	+	+	•			
3. 4.	Acer caesium Aesculus indica	+	+	-			
4. 5.	Alnus nitida		+	+			
5. 6.			-	+			
	Betula utilis	+	+	-			
7.	Cedrus deodara	-	-	+			
8.	Celtis australis	+	-	-			
9.	Corylus colurna	-	-	+			
10.	Corylus jacquemontii	-	+	-			
11.	Juglans regia	-	+	+			
12.	Lonisera quinquelocularis	+	-	-			
13.	Picea smithiana	-	+	+			
14.	Pinus roxburghii	-	-	+			
15.	Pinus wallichiana	+	+	+			
16.	Pistacia integerrima	-	-	+			
17.	Populus ciliata	-	+	+			
18.	Prunus armeniaca	-	-	+			
19.	Prunus cerasoides	-	-	+			
20.	Prunus cornuta	+	+	+			
21.	Prunus persica	-	-	+			
22.	Pyrus pashia	-	-	+			
23.	Rhus cotinus	-	-	+			
24.	Rhus semialata	-	-	+			
25.	Rhus wallichii	-	-	+			
26.	Robinia pseudoacacia	-	-	+			
27.	Salix daphnoides	+	-	-			
28.	Sorbus microphylla	+	-	-			
29.	Taxus baccata	-	+	-			
30.	Ulmus villosa	-	-	+			
31.	Ulmus wallichiana	-	-	+			
		Shrubs					
1.	Artemisia vulgaris	+	-	-			
2.	Berberis aristata	-	+	+			
3.	Berberis chitria	-	+	+			
4.	Berberis Kunawurensis	-	-	+			
5.	Berberis lycium	-	+	+			
6.	Caragana brevispina	-		+			
7.	Caragana gerardiana	-	-	+			
8.	Coriaria nepalensis	-	-	+			
9.	Cotoneaster acuminata			+			
). 10.	Cotoneaster bacillaris	_		+			
11.	Cotoneaster intregrifolius	-	-	-			
11.		+					
	Cotoneaster microphylla	-	+	+			
13.	Desmodium elegans	-	+	+			
14.	Desmodium sambuense	-	-	+			
15.	Deutzia staminea	-	-	+			
16.	Elaeagnus umbellata	-	-	+			
17.	Elscholtzia polystachys	-	-	+			
18.	Hippophae rhamnoides	-	-	+			
19.	Hippophae salicifolia	-	-	+			
20.	Indigofera hebepetala	-	+	+			
21.	Indigofera heterantha	-	+	+			
22.	Indigofera pulchela	-	-	+			
30	Jasminum humile	-	+	-			
		+	-	-			
24.	Juniperus recurva			+			
24. 25.	Juniperus recurva Myrsine semiserrata	-	-				
24. 25.			- 	+			
24. 25. 26.	Myrsine semiserrata						
24. 25. 26. 27.	Myrsine semiserrata Nepeta podostrachys Origanum vulgare		-	+			
24. 25. 26. 27. 28.	Myrsine semiserrata Nepeta podostrachys Origanum vulgare Plectranthus rugosus		-	+++++			
24. 25. 26. 27. 28. 29.	Myrsine semiserrata Nepeta podostrachys Origanum vulgare Plectranthus rugosus Prinsepia utilis	- - - -		+ + +			
23.         24.         25.         26.         27.         28.         29.         30.         31.	Myrsine semiserrata Nepeta podostrachys Origanum vulgare Plectranthus rugosus	- - - - - +		+ + +			

33.	Rosa macrophyla	-	+	+
34.	Rosa moschata	-	-	+
35.	Rosa webbina	+	-	+
36.	Senecio chrysanthemoides	+	-	+
37.	Sorbaria tomentosa	-	-	+
38.	Spiraea canescens	-	-	+
39.	Vibrunum conitifolium	-	+	+
40.	Viburnum nervosum	+	-	+
41.	Verbascus Thapsus	-	-	+
42.	Zanthoxylum alatum	-	-	+
	-			

Where + = present; - = absent

#### Conclusion

In the present study, it was observed that in total there were 73 woody species belonging to 48 genera and 27 families out of which 31 were tree species and 42 shrub species characterizing moist alpine shrub vegetation. The maximum species 56 were recorded in lower altitudinal zone (1500-2500 m) with 23 tree species and 33 shrub species. This could be attributed to intermediate disturbance hypothesis. It was further observed that *Pinus wallichiana* and *Prunus cornuta* were present in the entire valley area showing wide adaptability of these two species.

The development activities such as construction of road, hydroelectric projects, tourism and biotic pressure by local population and nomads are posing a threat to the fragile ecology of the valley. The present study will be helpful in understanding the threats that are being faced by biodiversity of Bhaba valley and would help in deriving conservation policies. There is an urgent need for recognizing these traditionally valued natural systems at various levels and planning for their better management, ultimately aiming to conserve biodiversity.

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