



E-ISSN: 2278-4136

P-ISSN: 2349-8234

www.phytojournal.com

JPP 2021; 10(1): 734-741

Received: 01-11-2020

Accepted: 03-12-2020

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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) ^[9, 12]. 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.

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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 Bhabha valley is located adjacent to the Pin valley of Lahaul and Spiti district of Himachal Pradesh and starts from

Wangtu on NH-5 giving way to Pin valley as its interior end with which it is connected by Pin-Bhabha 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.

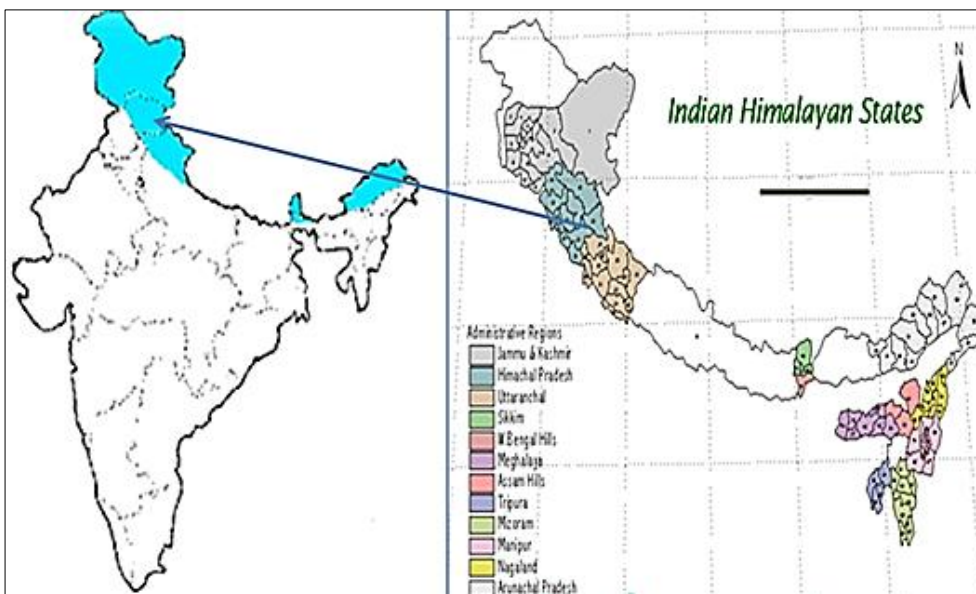


Fig 1: Map of India showing Himachal Pradesh an Indian Himalayan state of western Himalaya (Not to scale)

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) [6] for measuring species diversity and phytosociological parameters (Table 1).

Table 1: Bhaba valley and stratified two stage random sampling

Altitudinal range (m)	Altitudinal zones	Study sites									
		IA		IB		IC					
3500-4500	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					
1500-2500	Lower zone (III)	IIA _(i)		IIA _(ii)		IIA _(iii)		IIIB		IIIC	
		IIIA _(i)		IIIA _(ii)		IIIA _(iii)		IIIB _(i)		IIIB _(ii)	
		IIIB _(i)		IIIB _(ii)		IIIB _(iii)		IIIC _(i)		IIIC _(ii)	
		IIIC _(i)		IIIC _(ii)		IIIC _(iii)					

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 quadrat size came out to be 10×50 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 _(i)	II.	IA _(ii)	III.	IA _(iii)	IV.	IB _(i)	V.	IB _(ii)	VI.	IB _(iii)	VII.	IC _(i)	VIII.	IC _(ii)	IX.	IC _(iii)
Site 4 (IIA)				Site 5 (IIB)				Site 6 (IIC)									
X.	IIA _(i)	XI.	IIA _(ii)	XII.	IIA _(iii)	XIII.	IIB _(i)	XIV.	IIB _(ii)	XV.	IIB _(iii)	XVI.	IIC _(i)	XVII.	IIC _(ii)	XVIII.	IIC _(iii)
Site 7 (IIIA)				Site 8 (IIIB)				Site 9 (IIIC)									
XIX.	IIIA _(i)	XX.	IIIA _(ii)	XXI.	IIIA _(iii)	XXII.	IIIB _(i)	XXIII.	IIIB _(ii)	XXIV.	IIIB _(iii)	XXV.	IIIC _(i)	XXVI.	IIIC _(ii)	XXVII.	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.

Results and Discussion

Study sites

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

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.

Table 3: Geographical location of different sites in different zones of the study area

Sr. No.	Altitudinal range (m amsl)	Altitudinal zones	Name of the site	Latitude longitude	Average altitude (m)	Aspect
XXVIII.	3500-4500	Top zone	Taudor	N 31°.43'.353" E 77°.59'.020"	4010	Western
			Nigul	N 31°.42'.975" E 77°.59'.249"	3940	Northern
			Goldas	N 31°.43'.060" E 77°.58'.178"	3580	Eastern
XXIX.	2500-3500	Middle zone	Muling	N 31°.41'.732" E 77°.51'.901"	3381	Northern
			Anyar	N 31°.41'.115" E 78°.00'.526"	3481	Western
			Homti	N 31°.39'.113" E 78°.00'.981"	2903	Northern
XXX.	1500-2500	Lower zone	Kangarang	N 31°.33'.857" E 78°.04'.110"	2360	Northern
			Kafnu	N 31°.35'.92" E 78°.03'.133"	2489	Western
			Bai	N 31°.34'.639" E 78°.02'.345"	2279	Western

Nine different sites were randomly selected from the entire valley with three from each altitudinal zones. Twenty seven permanent quadrates 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) ^[3] 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 acuminata*, *Cotoneaster bacillaris*, *Cotoneaster integrifolius*, *Desmodium elegans*, *Desmodium sambuense*, *Deutzia staminea*, *Elaeagnus umbellata*, *Elscholtzia polystachys*, *Hippophae salicifolia*, *Hippophae rhamnoides*, *Indigofera pulchella*, *Jasminum humile*, *Myrsine semiserrata*, *Nepeta podostachys*, *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 relationship among themselves because of the interactions between the species or of the similar responses of the species to the same environment (Bawa, 1986) ^[1]. 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) ^[4] 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) ^[10] 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) ^[12] 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) ^[12] conducted the study on structure and ethnobotany of woody

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

Table 4: Total number of species of occurrence in the study area

Sr. No.	Name of species	Family	Top	Middle	Lower
Trees					
1.	<i>Abies pindrow</i>	Pinaceae	-	+	+
2.	<i>Abies spectabilis</i>	Pinaceae	+	+	-
3.	<i>Acer caesium</i>	Sapindaceae	+	+	-
4.	<i>Aesculus indica</i>	Sapindaceae	-	+	+
5.	<i>Alnus nitida</i>	Betulaceae	-	-	+
6.	<i>Betula utilis</i>	Betulaceae	+	+	-
7.	<i>Cedrus deodara</i>	Pinaceae	-	-	+
8.	<i>Celtis australis</i>	Cannabaceae	+	-	-
9.	<i>Corylus colurna</i>	Betulaceae	-	-	+
10.	<i>Corylus jacquemontii</i>	Betulaceae	-	+	-
11.	<i>Juglans regia</i>	Juglandaceae	-	+	+
12.	<i>Lonisera quinquelocularis</i>	Caprifoliaceae	+	-	-
13.	<i>Picea smithiana</i>	Pinaceae	-	+	+
14.	<i>Pinus roxburghii</i>	Pinaceae	-	-	+
15.	<i>Pinus wallichiana</i>	Pinaceae	+	+	+
16.	<i>Pistacia integerrima</i>	Anacardiaceae	-	-	+
17.	<i>Populus ciliata</i>	Salicaceae	-	+	+
18.	<i>Prunus armeniaca</i>	Rosaceae	-	-	+
19.	<i>Prunus cerasoides</i>	Rosaceae	-	-	+
20.	<i>Prunus cornuta</i>	Rosaceae	+	+	+
21.	<i>Prunus persica</i>	Rosaceae	-	-	+
22.	<i>Pyrus pashia</i>	Rosaceae	-	-	+
23.	<i>Rhus cotinus</i>	Anacardiaceae	-	-	+
24.	<i>Rhus semialata</i>	Anacardiaceae	-	-	+
25.	<i>Rhus wallichii</i>	Anacardiaceae	-	-	+
26.	<i>Robinia pseudoacacia</i>	Fabaceae	-	-	+
27.	<i>Salix daphnoides</i>	Salicaceae	+	-	-
28.	<i>Sorbus microphylla</i>	Rosaceae	+	-	-
29.	<i>Taxus baccata</i>	Taxaceae	-	+	-
30.	<i>Ulmus villosa</i>	Ulmaceae	-	-	+
31.	<i>Ulmus wallichiana</i>	Ulmaceae	-	-	+
Shrubs					
Sr. No.	Name of species	Family	Top	Middle	Lower
1.	<i>Artemisia vulgaris</i>	Asteraceae	+	-	-
2.	<i>Berberis aristata</i>	Berberidaceae	-	+	+
3.	<i>Berberis chitria</i>	Berberidaceae	-	+	+
4.	<i>Berberis Kunawurensis</i>	Berberidaceae	-	-	+
5.	<i>Berberis lycium</i>	Berberidaceae	-	+	+
6.	<i>Caragana brevispina</i>	Fabaceae	-	-	+
7.	<i>Caragana gerardiana</i>	Fabaceae	-	-	+
8.	<i>Coriaria nepalensis</i>	Coriariaceae	-	-	+
9.	<i>Cotoneaster acuminata</i>	Rosaceae	-	-	+
10.	<i>Cotoneaster bacillaris</i>	Rosaceae	-	-	+
11.	<i>Cotoneaster intregrifolius</i>	Rosaceae	+	+	-
12.	<i>Cotoneaster microphylla</i>	Rosaceae	-	+	+
13.	<i>Desmodium sambuense</i>	Fabaceae	-	-	+
14.	<i>Desmodium elegans</i>	Fabaceae	-	+	+
15.	<i>Deutzia staminea</i>	Hydrangeaceae	-	-	+
16.	<i>Elaeagnus umbellata</i>	Elaeagnaceae	-	-	+
17.	<i>Elscholtzia polystachys</i>	Labiatae	-	-	+
18.	<i>Hippophae rhamnoides</i>	Elaeagnaceae	-	-	+
19.	<i>Hippophae salicifolia</i>	Elaeagnaceae	-	-	+
20.	<i>Indigofera hebetata</i>	Fabaceae	-	+	+
21.	<i>Indigofera heterantha</i>	Fabaceae	-	+	+
22.	<i>Indigofera pulchella</i>	Fabaceae	-	-	+
23.	<i>Jasminum humile</i>	Oleaceae	-	+	-
24.	<i>Juniperus recurva</i>	Cupressaceae	+	-	-
25.	<i>Myrsine semiserrata</i>	Primulaceae	-	-	+
26.	<i>Nepeta podostrachys</i>	Lamiaceae	-	-	+
27.	<i>Origanum vulgare</i>	Lamiaceae	-	-	+
28.	<i>Plectranthus rugosus</i>	Lamiaceae	-	-	+

29.	<i>Prinsepia utilis</i>	Rosaceae	-	-	+
30.	<i>Rhododendron lepidotum</i>	Ericaceae	+	-	-
31.	<i>Rhododendron anthopogon</i>	Ericaceae	+	+	-
32.	<i>Rhododendron companulatum</i>	Ericaceae	+	+	-
33.	<i>Rosa macrophyla</i>	Rosaceae	-	+	+
34.	<i>Rosa moschata</i>	Rosaceae	-	-	+
35.	<i>Rosa webbiana</i>	Rosaceae	+	-	+
36.	<i>Senecio chrysanthemoides</i>	Asteraceae	+	-	+
37.	<i>Sorbaria tomentosa</i>	Rosaceae	-	-	+
38.	<i>Spiraea canescens</i>	Rosaceae	-	-	+
39.	<i>Verbascus Thapsus</i>	Scrophulariaceae	-	+	+
40.	<i>Viburnum nervosum</i>	Adoxaceae	+	-	+
41.	<i>Viburnum conitifolium</i>	Adoxaceae	-	-	+
42.	<i>Zanthoxylum alatum</i>	Rutaceae	-	-	+

Where + = present; - = absent

Table 5: Total numbers of species of occurrence in different altitudinal zones

Sr. No.	Name of species	Family
Top zone (T)		
Trees		
1.	<i>Abies spectabilis</i>	Pinaceae
2.	<i>Acer caesium</i>	Sapindaceae
3.	<i>Betula utilis</i>	Betulaceae
4.	<i>Lonisera quinquelocularis</i>	Caprifoliaceae
5.	<i>Pinus wallichiana</i>	Pinaceae
6.	<i>Prunus cornuta</i>	Rosaceae
7.	<i>Salix daphnoides</i>	Salicaceae
8.	<i>Sorbus microphylla</i>	Rosaceae
Shrubs		
1.	<i>Artemisia vulgare</i>	Asteraceae
2.	<i>Cotoneaster intregrifolius</i>	Rosaceae
3.	<i>Juniperus recurva</i>	Cupressaceae
4.	<i>Origanum vulgare</i>	Lamiaceae
5.	<i>Rhododendron anthopogon</i>	Ericaceae
6.	<i>Rhododendron companulatum</i>	Ericaceae
7.	<i>Rhododendron lepidotum</i>	Ericaceae
8.	<i>Rosa webbiana</i>	Rosaceae
9.	<i>Senecio Chrysanthemoides</i>	Asteraceae
10.	<i>Viburnum nervosum</i>	Adoxaceae
Middle zone (M)		
Trees		
1.	<i>Abies pindrow</i>	Pinaceae
2.	<i>Abies spectabilis</i>	Pinaceae
3.	<i>Acer caesium</i>	Sapindaceae
4.	<i>Aesculus indica</i>	Sapindaceae
5.	<i>Betula utilis</i>	Betulaceae
6.	<i>Corylus jacquemontii</i>	Betulaceae
7.	<i>Juglans regia</i>	Juglandaceae
8.	<i>Picea smithiana</i>	Pinaceae
9.	<i>Pinus wallichiana</i>	Pinaceae
10.	<i>Populus ciliate</i>	Salicaceae
11.	<i>Prunus cornuta</i>	Rosaceae
12.	<i>Taxus baccata</i>	Taxaceae
Shrubs		
1.	<i>Berberis aristata</i>	Berberidaceae
2.	<i>Berberis chitria</i>	Berberidaceae
3.	<i>Berberis lucium</i>	Berberidaceae
4.	<i>Cotoneaster microphylla</i>	Rosaceae
5.	<i>Desmodium elegans</i>	Fabaceae
6.	<i>Indigofera hebeptala</i>	Fabaceae
7.	<i>Indigofera heterantha</i>	Fabaceae
8.	<i>Jasminum humile</i>	Oleaceae
9.	<i>Rhododendron companulatum</i>	Ericaceae
10.	<i>Rhododendron lepidotum</i>	Ericaceae
11.	<i>Rosa macrophyla</i>	Rosaceae
12.	<i>Viburnum conitifolium</i>	Adoxaceae
Lower zone (L)		
Trees		

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

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

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

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

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 Bhabha 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.

Reference

1. Bawa R. Structural and functional studies of three semi-grassland communities near Shimla. PhD. Thesis. HP University, Shimla 1986, P57-58.
2. Connell JH. Diversity in tropical rainforests and coral reefs. *Science* 1978;199:1302-1310.
3. Horn HS. Markovian processes of forest succession. In: Cody ML and Diamond JM. (eds.). *Ecology and Evolution of communities*, Belknap, Cambridge, MA 1975, P196-213.
4. Itow S, Nakanishi K. Floristic and vegetational diversity of epilithic bryophyte communities: A insular biogeography. *Japan Journal Ecology* 1980;30:45-54.
5. Mishra MK, Mishra BN. Association and correlation of plant species in a tropical grassland community. *Tropical Ecology* 1981;22:88-98.
6. Oosting HJ. *The study of plant communities*. Freeman & Co., San Francisco 1958.
7. Singh JS, Singh SP. *Forests of Himalaya*. Gyanodaya Prakashan, Nainital 1992.
8. Singh JS, Singh SP. Forest vegetation of the Himalaya. *Botanical Review* 1987;53(1):80-192.
9. Vishnu-Mittre. Paleobotanical evidence of the environment of early man in North Western India. *Grana* 1972;18:167-181.
10. Negi HS. Studies on woody species diversity of Sangla valley (HP). MSc. Thesis. Dr YS Parmar University of Horticulture and Forestry, Nauni. Solan 2002, P38.
11. Singh V. Structural and ethnobotanical studies of woody elements of Dodra Kwar forest range of Himachal Pradesh. MSc. Thesis. Dr. YS Parmar University of Horticulture and Forestry, Nauni. Solan 2011, P31.
12. Chawla A, Rajkumar S, Singh KN, Lal B, Singh RD. Plant species diversity along an altitudinal gradient of Bhabha valley in western Himalaya. *Journal of Mountain Sciences* 2008;5:157-177.