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A Study on Phytosociological analysis of Zabarwan Forests, Kashmir, India

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Abstract
The present study was carried out in Zabarwan forests of Kashmir valley. The aim of the study was to present the scenario of phytosociology with respect to the importancevalueindex(IVI),speciesdiversity,speciesdominance, and to document the herbal and woody flora. The present study was undertaken from the year 2016 to 2018. Analysis of cumulative data revealed that this area hosts 43 families (40 Angiosperms and 3 Gymnosperms), 74 Genera (70 Angiosperms and 4 Gymnosperms) and 88 species (80 Angiosperms and 8 Gymnosperms) out of which 58 were herbs, 12 were shrubs and 18 were trees. Dicotyledons contribute about 92% of the total angiosperms observed at study site. The study revealed that flora of Zabarwan forests provides information about the total number of species present in the forest area that could be used as a source of basic data including their identification, composition, distribution, medicinal values and their utility for the future management and conservation planning. Furthermore, there is a need to develop awareness programs to replenish this Reserve forest.

Keywords: Herbaceous taxa, Vegetation status, Zabarwan forests.

I. INTRODUCTION

Phytosociological studies are vital for guarding the natural plant communities and biodiversity as well as understanding the modifications experienced in the past and continuing on into the future. Most of the developed countries have completed these basic studies and defined vegetationmaps (Tel *et al*, 2010). Vegetation analysis is the key factor to enable us to understand the structure and functioning of an ecosystem. The vegetation analysis provides information regarding the interaction among species in a particular community as well as about the organization of the species within the community and reflects the effect on the entire environment (Billings, 1952). Vegetation analysis is important for understanding the functioning of a community with respect to the species composition, distribution, diversity, dominance and development (Bhatti *et al*, 2014). Kashmir valley supports a rich plant wealth, which catches the eyes of everyone, be a botanist, a naturalist, a poet or a layman. Kashmir valley harbours a rich repository of diverse flora including cultivation of medicinal plants due to its varied topography and spatialheterogeneity,owingtogreatvariationinaltitude,climateand edaphic factors resulting in a vast array of habitat types (Malik *et al*, 2011).

III.STUDY AREA

Kashmir harbours rich forest flora. Zabarwan forests (study area) extending over an area of 1028 hectares including Cheshmashahi, Bashiwan and Shankeracharia is one of the richest forest areas of the valley. It is located at a distance of 8 km to the South Eastern side of the Srinagar city that lies between $34^0$05'57" N latitude and $74^0$52'24" E longitude at an elevation of 1740 m asl and is serving as catchment area of the world famous Dal lake. However, for the present study, Cheshmashahi under forest cover extends over 668 hectares has been selected.

II. MATERIAL ANDMETHODS

The phyto-sociological analysis of vegetation was carried out in the year 2016 - 2018. Main study area Cheshmashahi was divided into lower, middle and upper zones from 1730-1940, 1940-2150 and 2150-2360 m asl, respectively. At each altitude and aspect 10×10 m quadrats were defined in 20×50 m plot all the vascular plant species was recorded. Quadrats of size 1×1 m and 5×5 m were laid out randomly for herbaceous and shrub

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species respectively to determine frequency, density, abundance and the relative values were summed up to importance value index (IVI) following Risser and Rice (1971) and Mishra (1968). Ten (10) quadrats at each altitude (lower, middle and upper) and at all the three aspects were laid down for herb, shrub and tree species making the total of 270 quadrats. In order to express the dominance and ecological success of any species with a single value, the concept of importance value index (IVI) has been developed. The IVI is the sum of relative density, relative frequency and relative dominance and were calculated as :

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

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

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

The relative density, relative frequency and relative dominance values were added to get importance value index.

IVI = Relative Density + Relative Frequency + Relative Dominance

III. RESULTS ANDDISCUSSION:

The contemporary study about the vegetation of Zabarwan forests revealed that the area harbours 43 families (40 Angiosperms and 3 Gymnosperms), 74 Genera (70 Angiosperms and 4 Gymnosperms) and 88 species (80 Angiosperms and 8 Gymnosperms) out of which 58 were herbs, 12 were shrubs and 18 were trees (Table1).

Table 1: List of forest flora (Herbs, Shrubs and Trees) with their common names and family and life form spectra along an altitudinal gradient in Zabarwan forests.

S. NO.	Family	Species	Common name/Vernacular name	Life form	Altitude (m asl)		
					1730-1940	1940-2150	2150-2360
1	Apiaceae	*Foeniculum vulgare*	Common fennel/Baidanii	H	+	+	-
		Cuminum cyminum	Cumin/Zur	H	+	+	-
2	Apocynaceae	*Vinca major*	Bigleaf periwinkle/Sada bahar	H	-	+	+
3	Asteraceae	*Ophioglossum vulgatum*	Adder's Tongue/Chonchur	H	+	+	+
		Chichorium intybus	Chicory/Handi posh	H	+	+	-
		Taraxacum officinale	Dandelion/Hand	H	+	+	+
		Artemisia absinthium	Worm wood/Tethwan	H	+	+	+
		Tragopogon pratensis	Meadow Salsify	H	-	+	+
		Cardus nutans	Musk thistle	H	-	+	+
4	Amaranthaceae	*Amaranthus* cruentus	Pigweed/Bustan Afroz	H	-	+	-
5	Berberidaceae	*Berberis lycium*	Indian barberry/Kawdach	S	+	+	-
6	Boraginaceae	*Lycopsis arvensis*	Small bugloss/Handi gaasi	H	-	+	-
7	Campanulaceae	*Campanula colorata*	Bell flower/Chari hakh	H	-	+	-
8	Cannabaceae	*Celtis australis*	Nettle tree/Brimji	T	+	-	+
		Cannabis sativa	Hemp/Bhang	H	+	+	+
9	Caprifoliaceae	*Lonicera quinquelocularis*	Translucent Honey suckle/Pakhur	H	+	+	+

10	Caryophyllaceae	*Dianthus angulatus*	Himalayan Pinks	H	+	+	-
		Phytolacca acinosa	Indian Poke	H	-	-	+
		Lychnis coronaria	Rose campion	H	-	+	+
11	Chenopodiaceae	*Chenopodium album*	Lamb's quarters/Lachij	H	+	+	-
12	Convolvulaceae	*Cuscuta europaea*	Devil's hair/Wozul kukli poot	H	+	+	-
		Cuscuta cuspidata	Golden thread/Kokil pot	H	-	+	-
		Convolus arvensis	Bindweed/Soi posh	H	-	+	-
13	Cupressaceae	*Cupressus torulosa*	Bhutan cypress/Sarvikul	T	+	+	-
14	Cupuliferae	*Quercus ilex*	Holm oak	T	-	+	+
15	Dioscoreaceae	*Dioscorea deltoidea*	Yam/Krisch	H	-	+	+
16	Fabaceae	*Robinia pseudoacacia*	Black locust/Kikar	T	+	+	-
		Indigofera geradiana	Himalayan indigo/Neel	S	+	+	-
		Lespedeza cuneata	Chinese bush clover	H	+	-	+
		Medicago sativa	Lucerne/Poshi gassi	H	+	+	-
		Trifolium repens	White Clover/Batak nur	H	+	-	-
		Trifolium fragiferum	Clover/Batak laut	H	+	+	-
		Melilotus alba	Sweet clover	H	-	+	-
		Trigonella emodi	Himalayan Fenugreek	H	-	-	+
		Cytisus scoparius	Common broom	S	+	+	-
17	Hamamelidaceae	*Parrotiopsis jacquemontiana*	Parrotia/Hatab	S	+	+	+
18	Hypericaceae	*Hypericum Perforatum*	Amber	H	-	-	+
19	Iridaceae	*Iris nepalensis*	Graceful himalayan iris/Mazar mond	H	+	+	+
20	Juglandaceae	*Juglans regia*	Wallnut/Doon	T	+	-	-
21	Labiatae	*Salvia moorcroftiana*	Kashmir Salvia/Sholer	H	+	+	+
22	Lamiaceae	*Thymus serphyllum*	Breckland thyme	H	+	+	+
		Origanum vulgare	Oregano	H	+	-	-
		Nepeta cataria	Cat mint/Gandi soi	H	+	+	-
23	Malvaceae	*Malva sylvestris*	Blue Mallow	H	-	+	-
		Malva rotundifolia	Dwarf mallow/Sochal	H	-	-	+
		Peganum harmala	Syrian Rue/Isband	H	+	-	-
24	Moraceae	*Morus alba*	White mulberry/Tul	T	+	+	-
25	Oleaceae	*Jasminium humile*	Yellow Jasmine	S	+	+	+
26	Ophioglossaceae	*Rumex orientalis*	Spinach dock/Jungli abuj	H	+	-	+
27	Oxalidaceae	*Oxalis corniculata*	Creeping wood sorrel/Khati buti	H	-	-	+
		Oxalis acetosella	Wood sorrel	H	-	-	+
28	Pinaceae	*Pinus helpensis*	Aleppo Pine	T	-	+	-
		Cedrus deodara	Himalayan cedar/Deodar	T	-	+	+
		Pinus roxburghii	Chir pine/Chir	T	-	+	-
		Pinus canariensis	Canary Island Pine	T	-	+	-
		Pinus wallichiana	Blue pine/Kail	T	-	-	+

29	Plantaginaceae	*Kickxia subsessilis*	Branched Cancerwort	H	-	+	+
		Plantago lanceolata	Ribwort plantain/Veuth gulla	H	-	-	+
30	Poaceae	*Cynodon dactylon*	Dūrvā grass/Dramun	H	-	+	+
		Panicum crusgalli	Cockspur/Hama	H	+	+	-
		Stipa sibirica	Stipa sibirica	H	+	-	-
		Eragrostis nigra	Love grass	H	-	-	+
		Hordeum murinum	False barley/Pingi	H	-	-	+
		Sorghum halepense	Aleppo grass	H	+	+	+
		Poa angustifolia	Meadow-grass	H	-	+	+
31	Podophyllaceae	*Podophyllum hexandrum*	Himaliyan mayapple/Ban vangun	H	-	+	+
32	Polygonaceae	*Rumex acetosa*	Sheep's sorrel/Choki chen	H	+	+	+
33	Polypodiaceae	*Adiantum capillus-veneris*	Adiantum/Gew theer	H	-	+	+
34	Porulaceae	*Portulaca oleracea*	Sweet beladona/Nunar	H	+	-	-
35	Rhamnaceae	*Ziziphus vulgaris*	Zizyphus/Bre	S	-	-	+
36	Rosaceae	*Pyrus communis*	Pear/Tang	T	+	+	-
		Prunus cerasifera	Plum/Gurdhoal	T	+	-	-
		Prunus armenica	Apricot/Cheer	T	+	-	-
		Crataegus oxycantha	Hawthorn/Ring	S	+	-	-
		Rosa webbiana	Wild rose/Arwal	S	+	-	+
		Rubus fructicosus	Black berry/Daen Chanch	S	+	+	-
		Rubus pungens	Rubus oldhamii/Rang ratch	S	+	+	-
		Rosa moschata	Rose hip	S	+	-	+
37	Salicaeceae	*Populus alba*	Silver poplar/Dodhi fres	T	+	-	-
		Populus nigra	Black poplar/Bati fres	T	+	-	-
		Salix fragilix	Brittle willow	T	+	-	-
38	Sapindaceae	*Aesculus indica*	Indian horse chestnut/Haandoon	T	+	+	-
39	Scrophulariaceae	*Linaria dalmatica*	Balkan toadflax	H	+	+	+
		Verbascum Thapsus	Tobacco/Wan tamook	H	+	+	-
40	Thymelaeaceae	*Daphne oleoides*	Dafne spatolata	S	-	+	+
41	Urticeae	*Utrica dioca*	Nettle/Soi	H	+	+	-
42	Violaceae	*Viola odorata*	Wood violet/Bunafshah	H	+	+	+
43	Zygophyllaceae	*Tribulus terretris*	Puncture Vine/Mister kund	H	+	+	+

T =Tree, S=Shrub, H=Herb, + =Present, - =Absent

In order to know the vegetational status of Zabarwan forests with respect to the species importance value index (IVI) was worked out during present study. In order to express the dominance and ecological success of any species with a single value, the concept of importance value index (IVI) has been developed (Mishra, 1968). The importance value index of herbaceous species varied on all the aspects of all the altitudinal gradients. At lower attitude of (1730-1940m asl) maximum IVI of (17.9%) was recorded in *Sorghum halepense* on South East aspect whereas minimum of (1.7%) were observed for *Iris nepalensis* and *Tribulus terretris* on North West aspect (Fig. 1). On middle altitudinal gradient of (1940-2150 m asl) maximum IVI (14.5%) were depicted by *Artemisia absinthium* and *Taraxacum officinale* on North East aspect. On North West aspect showed minimum (1.4%) in *Nepeta catara* and *Tribulus terrestris* (Fig. 2). At upper zone (2150-2360 m asl) of North East aspect maximum

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IVI (16.8%) was recorded in *Sorghum halepense* while minimum IVI (2.1%) was recorded for *Hypericum perforatum, Lonicera quinquelocularis, Oxalis acetosella, Plantago lanceolata, Cynodon dactylon* and *Taraxacum officinale* North West aspect (Fig. 3). The lowest IVI of herbaceous species may be related to the anthropogenic pressure (Mandal and Joshi,2014).

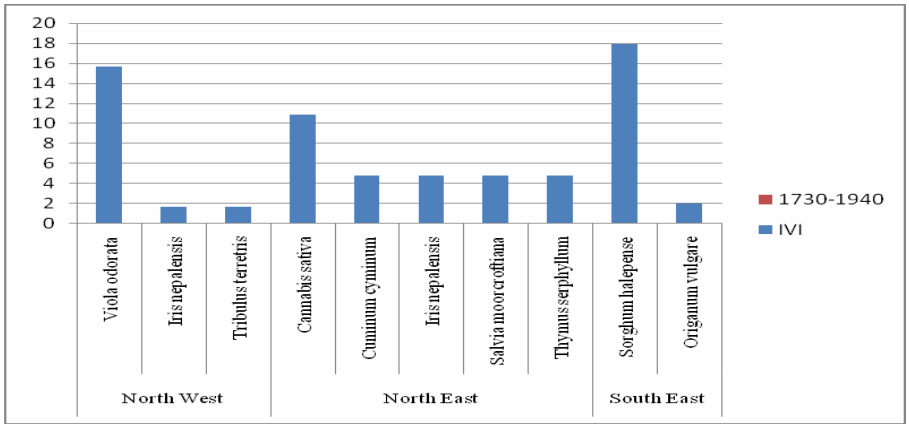

Fig 1: IVI (%) of herbaceous taxa at lower zone (1730-1940 masl) of Zabarwan Forests.

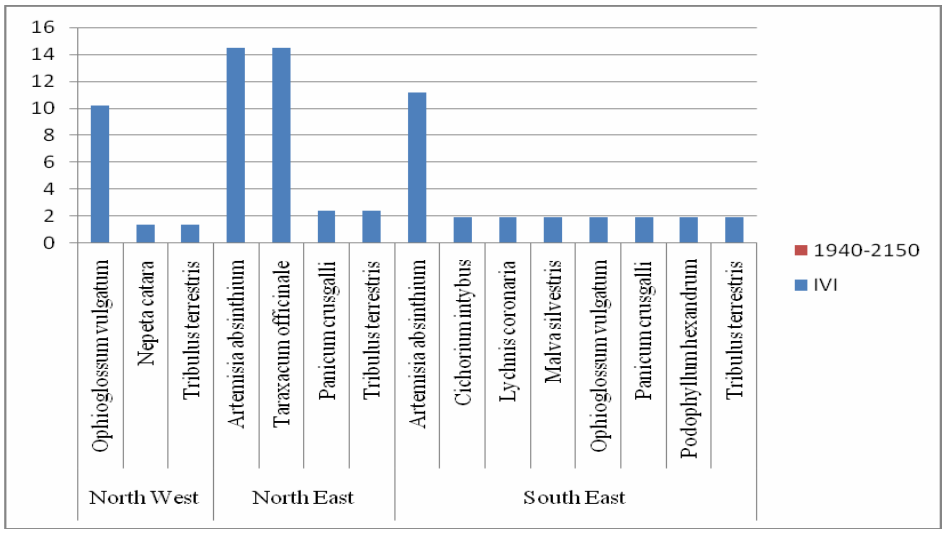

Fig 2: IVI (%) of herbaceous taxa at middle zone (1940-2150 masl) of Zabarwan Forests.

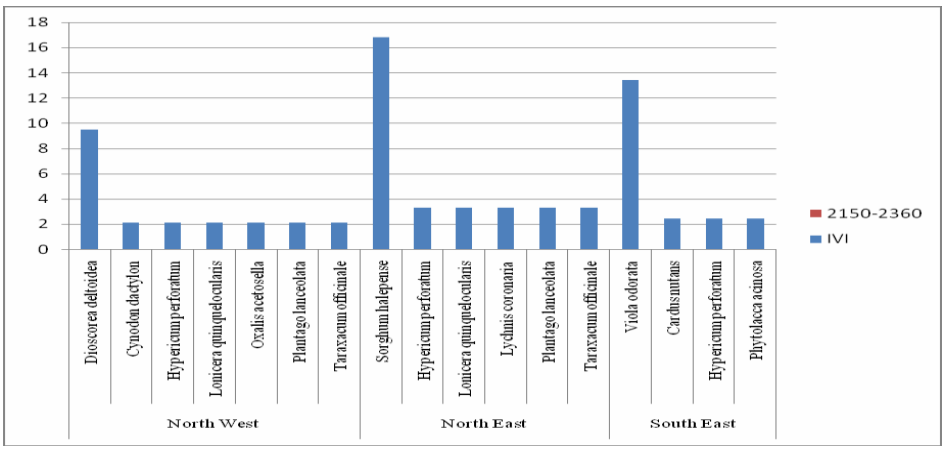

Fig 3: IVI (%) of herbaceous taxa at upper zone (2150-2360 masl) of Zabarwan Forests.

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Among the shrub species, while *Berberis lyceum* maximum IVI of 35.81% on North West aspect. *Parratiopsis jacquemontiana* displayed minimum IVI of 16.22% on South East aspect at the lower altitude range of 1730-1940 m asl (Fig. 4). At the middle altitudinal gradient of 1940-2150 m asl while maximum IVI of 46.05% was exhibited by *Parratiopsis jacquemontiana* while the minimum IVI 35.10% was recorded in *Indigofera geradiana* (Fig. 5). At the upper altitude of 2150- 2360 m asl maximum IVI of 62.82% was observed in *Parratiopsis jacquemontiana* on South East aspect while minimum IVI (27.08%) was exhibited by *Ziziphus vulgaris* on North West aspect (Fig. 6). Minimum IVI of shrub species could be related to aspects and altitudinal variations (Sanglam, 2013)

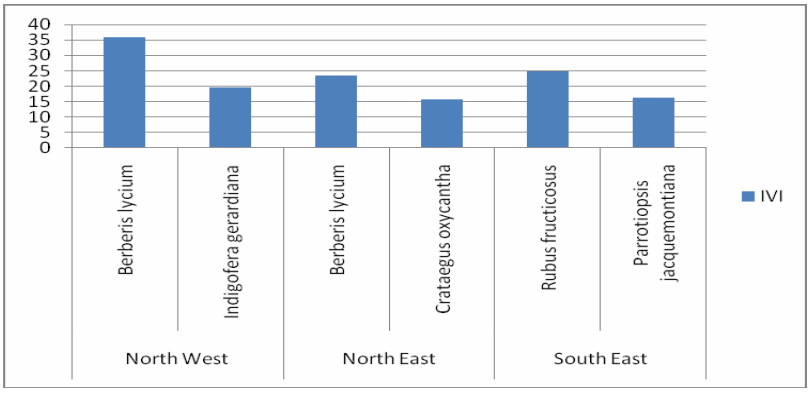

Fig 4: IVI (%) of shrub species at lowe zone (1730-1940 masl) of Zabarwan Forests.

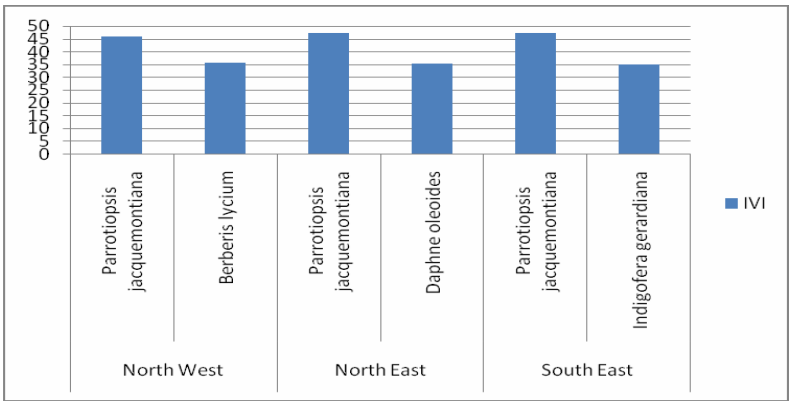

Fig 5: IVI (%) of shrub species at middle zone (1940-2150 masl) of Zabarwan Forests.

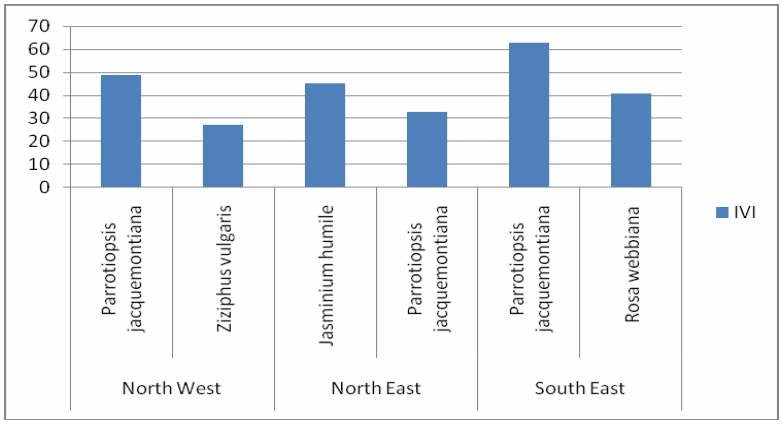

Fig 6: IVI (%) of shrub species at upper zone (2150-2360 masl) of Zabarwan Forests.

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As an indicator of dominance IVI has been considered the major contributor of various strata's at different aspects varied at various altitudinal gradients. Among the tree species, while maximum IVI of 57.61% was exhibited by *Cupressus torulosa* on North West aspect, the minimum IVI of 11.88% of tree species on South East aspect was exhibited by *Prunus cerasifera* at lower gradient of 1730-1940 m asl (Fig. 7). At middle altitudinal range (1940-2150 m asl) *Cedrus deodara* exhibited highest IVI of 114.75% on South East aspect (Fig.8), whereas low IVI value of 12.13% was recorded in *Aesculus indica* on North West aspect. At upper altitudinal range (2150-2360 m asl) maximum IVI of 145.64% was observed in *Cedrus deodara* on South East aspect and minimum IVI (33.48%) was exhibited by *Celtis australis* on north West aspect (Fig. 9). Our study may be attributed to the study of Mandal and Joshi (2014) who reported the lowest IVI of plant species due to anthropogenic pressure and variation in aspects.

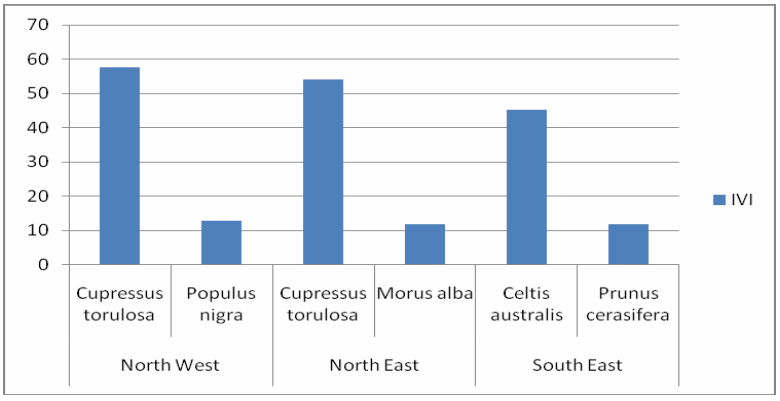

Fig 7: IVI (%) of tree species at lower zone (1730-1940 masl) of Zabarwan Forests.

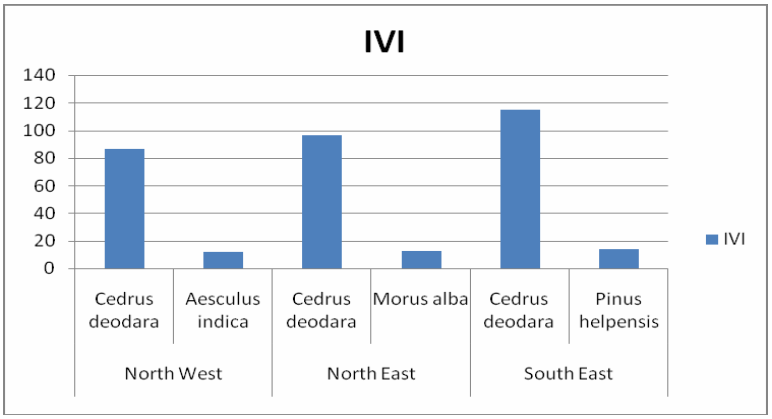

Fig 8: IVI (%) of tree species at middle zone (1940-2150 masl) of Zabarwan Forests.

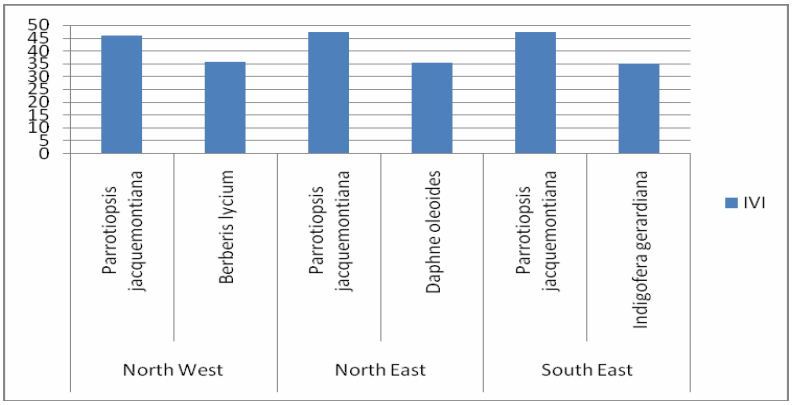

Fig 9: IVI (%) of tree species at upper zone (2150-2360 masl) of Zabarwan Forests.

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IV. CONCLUSION

The overall result of the present investigation can be concluded as under:

- The vegetation analysis analysis of herbs, shrubs and trees on different aspects revealed that this area hosts 43 families (40 Angiosperms and 3 Gymnosperms), 74 Genera (70 Angiosperms and 4 Gymnosperms) and 88 species (80 Angiosperms and 8 Gymnosperms) out of which 58 were herbs, 12 were shrubs and 18 were tree. Dicotyledons contribute about 92% of the total angiosperms observed at studysite.
- The study site was dominated by Fabaceae family followed by Rosaceae, Poaceae, Asteraceae, Pinaceae, Caryophyllaceae, Convolvulaceae, Lamiaceae, Malvaceae, Salicaeceae, Apiaceae, Cannabaceae, Oxalidaceae, Plantaginaceae and Sapindaceae. Families with representation of only one specie included Apocynaceae, Amaranthaceae, Berberidaceae, Boraginaceae, Campanulaceae, Caprifoliaceae, Chenopodiaceae, Cupressaceae, Cupuliferae, Dioscoreaceae, Hamamelidaceae, Hypericaceae, Iridaceae, Juglandaceae, Labiatae, Moraceae, Oleaceae, Ophioglossaceae, Podophyllaceae, Polygonaceae, Polypodiaceae, Porulaceae, Rhamnaceae, Sapindaceae, Thymelaeaceae, Urticeae, Violaceae and Zygophyllaceae (Table.1).
- During the course of study fifty eight (58) species of herbs, twelve (12) species of shrubs and eighteen (18) tree species were recorded from the quadrates on different aspects of Zabarwanforests.
- The vegetation analysis of herb species at different aspects/elevations revealed that *Sorghum helepense* revealed maximum IVI and was the most dominant species all along the altitudinal gradients.
- Among the shrub species *Paratiopsis jacquemontiana* revealed the highest IVI and was the most dominant species on all the altitudinalgradients/aspects.
- The number of trees varied along the altitudinal gradient on available aspects. The vegetational analysis at different aspects/altitudes revealed that *Cupressus torulosa* was predominant on lower altitudinal range of 1730-1940 m asl while middle (1940-2150 m asl) and upper altitude (2150-2360 m asl) were dominated by *Cedrusdeodara.*
- *Viola odorata, Berberis lyceum* and *Cupressus torulosa* formed dominant plant community on lower altitude, *Artemesia absinthium* and *Taraxacum officianale*, *Paratiopsis jacquemontiana* and *Cedrus deodara* on middle altitude and *Sorghum helepense*, *Paratiopsis jacquemontiana* and *Cedrus deodara* was the principal plant association on upperaltitude.

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