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Assessment of Vegetational Status of Zabarwan Forests, Kashmir, India

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Abstract

The present study was carried out in Cheshmashahi area of Zabarwan forests of Kashmir valley. The aim of the study was to assess the vegetational status of the area with respect to the frequency, density, abundance and importance value index (IVI), species diversity, species dominance, and to document woody flora. The present study was undertaken from the year 2016 to 2018. Analysis of cumulative data revealed that this area hosts 15 families (12 Angiosperms and 3 Gymnosperms) and 30 species (7 Angiosperms and 8 Gymnosperms) out of which 12 were shrubs and 18 were trees. Dicotyledons contribute about 92% of the total angiosperms observed at study site. The study site was dominated by Rosaceae family followed by Pinaceae, Fabaceae, Salicaeceae. Among the shrub species *Paratiopsis jacquemontiana* revealed the highest IVI and was the most dominant species on all the altitudinal gradients/aspects. While tree species viz. *Cedrus deodara* and *Pinus roxburgii* is currently recruiting its species on the Zabarwan forests than other conifers at faster rate and may constitute a dominant climax species in future. Present 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.

Keywords: Forests, Flora, Vegetational status, Zabarwan forests.

I. Introduction

Vegetational 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. The phytosociological 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

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harbours rich woody flora. Zabarwan forests (the present 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$04'57" N latitude and $74^0$52'36" 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. Keeping the multipurpose uses of forests in view a study entitled . "Assessment of Vegetational Status of Zabarwan Forests, Kashmir, India" was undertaken.

II. Material and methods

The study was conducted from the year 2016 to 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 total of 180 quadrats were laid down. Quadrats of size 10×10 m^2 and 5×5 m^2 were laid out randomly for shrub and tree 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)

$$\text{Frequency (\%)} = \frac{\text{Total No. of quadrants in which species has occurred}}{\text{Total No. of quadrants studied}} \times 100$$

$$\text{Density } (m^{-2}) = \frac{\text{Total No. of individuals of the species}}{\text{Total No. of quadrants studied}}$$

$$\text{Abundance} = \frac{\text{Total No. of individual of species}}{\text{Total No. of quadrants in which species has occurred}}$$

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 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 and Discussion:

The contemporary study about the "Assessment of Vegetational Status of Zabarwan Forests" revealed that the area harbours about 30 species with 15 families out of which 18 belongs to tree species and 12 belongs to shrubs (Table 1).

In order to know the vegetational status of woody flora (shrubs and trees) of Zabarwan forests with respect to the species composition, species diversity, species dominance, importance value index (IVI) was worked out during the study (Table 2&3).

Frequency (%): Frequency is indicative of the dispersion of a particular species in a community. Thus, the low frequency indicates that the species is either rare or irregularly distributed in a particular area of forest or stand. Chen *et al.*, (2000) reported that the frequency distribution of plant species as a measure for expressing biological abundance and dominance has been used to describe species composition and its spatial pattern in different plant communities. The frequency of plant species along an altitudinal range appraises species ecological amplitude or niche breadth and depicts its distributional limits to realize the species

turn-over along the gradients (Behera *et al.*, 2005).

The frequency of shrub species varied along the altitudinal gradient (Table 2). The frequency at lower altitude (1730-1940 m asl) of North West aspect showed highest frequency of (100%) in *Berberis lyceum, Cytisus scoparius* and *Rosa* webbiana the same frequency on North East aspect was recorded in *Berberis lyceum, Cytisus scoparius, Paratiopsis jacquemontiana, Rubus fructicosus* and *Rubus pungens.* Similarly, on South East aspect highest frequency (100%) was recorded in *Rosa moschata* and *Rosa webbiana.* While lowest frequency (50%) was recorded in *Paratiopsis jacquemontiana* on North West aspect. *Crataegus oxycantha, Indigofera gerardiana* and *Rosa webbiana* on North East aspect and *Berberis lyceum* and *Paratiopsis jacquemontiana* depicted minimum frequency of (60%) on South East aspect. At the middle altitudinal range of (1940-2150 m asl) *Paratiopsis jacquemontiana* showed highest frequency of (100%) on all the three aspects viz. North West, North East and South East aspect while the shrub specie that showed minimum frequency of (80%) were *Berberis lyceum, Cytisus scoparius* and *Rubus pungens* on North West aspect; *Daphne oleoides, Indigofera gerardiana* and *Rubus fructicosus* on North East aspect and *Berberis lyceum, Cytisus scoparius* and *Indigofera gerardiana* on South East aspect.The North West aspect at upper altitudinal range of (2150-2360 m asl) showed highest frequency of (100%) in *Daphne oleoides* and *Paratiopsis jacquemontiana; Jasminium humile* and *Rosa moschata*on North East aspect and *Paratiopsis jacquemontiana* on South East aspect while lowest frequency (60%) was recorded in *Ziziphus vulgaris* on North West aspect.

The frequency values of tree species observed varied on all the altitudinal gradients and aspects (Table 3). The frequency at lower zone (1730-1940 m asl) of North West aspect showed highest frequency of 80% was recorded in *Cupressus torulosa* and *Celtis austalis* on North East and South East respectively while while lowest frequency (20%) was recorded in *Morus alba* on North West and North East aspect and *Pyrus communis* on South East aspect. At the middle altitudinal range of (1940-2150 m asl) *Cedrus deodara* showed highest frequency of (100%) on North East and South East aspect while lowest frequency of (20%) was recorded in *Aesculus indica* and *Morus alba* and *Pinus canariensis* on North West aspect, *Morus alba* on North East aspect and *Pinus canariensis* and *Pyrus communis* on South East aspect. At upper altitudinal range of (2150-2360 m asl) showed highest frequency of (100%) in *Cedrus deodara* on North East and South East aspect while lowest frequency (40%) was recorded in *Celtis australis, Pinus wallichiana* and *Quercus ilex* on North West aspect and *Celtis australis* on the South East aspect. Our results is in conformity with reports of Panday (2003) who clearly mentioned that the frequency values ranging between (20-100%) in mixed oak conifer forest of central Himalaya. Similarly, Agni *et al.,* (2000) and Pande *et al.,* (2002) have reported the frequency range of (10-100%) and (10-80%) in Central and Western Himalayas respectively. Verma *et al.,* (2005) has also reported while analysing plant diversity in plantation forest that frequency values range between (10-100%) and attributed this to change in micro climate.

Density: Plant density is the primary character of the community. The community set up is affected to a certain extent by the density of different species forming the community. According to Grytnes (2003), Nogues-Bravo *et al.,* (2008) and Kessler, (2009) reported that the changing pattern in species density with altitude are attributed to a range of factors acting independently or in concert. There is a change in environmental stress with increase in altitude including climatic

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factors such as temperature, disturbance, competition for resources and geographic factors associated with isolation (Korner, 2002).

The density of shrub species varied along the altitudinal gradient (Table 2). *Berberis lyceum* and *Rosa webbiana* recorded maximum density (5.4 m^{-2}) at lower altitude (1730-1940 m asl) of North East and South East aspect respectively. While minimum density of (2.6 m^{-2}) of all the aspects was recorded in *Indegofera geradiana.* At middle altitudinal range of (1940-2150 m asl) *Paratiopsis jacquemontiana* resulted maximum density of (6.6m^{-2}) on North East aspect. While minimum density of (4.2m^{-2}) was recorded in *Cytisus scoparius* at North West aspect. The maximum density (6.2m^{-2}) of shrubs on upper altitudinal range of (2150-2360 m asl) was recorded in *Paratiopsis jacquemontiana* on North West aspect while *Ziziphus vulgaris* showed lowest density (3.2m^{-2}) on the same altitude and aspect.

The data on vegetational status recorded manifests that among the tree species (Table 3), at lower zone (1730-1940 m asl) maximum density of (2.8 m^{-2}/ha) was recorded in *Cupressus torulosa* on North East aspect while minimum density of (0.4 m^{-2}/ha) was recorded in *Morus alba* on the same aspect. Minimum density was also observed in *Morus alba, Populus nigra* and *Robinia pseudo acacia* on North West aspect. *Pyrus communis* also showed minimum density of (0.4 m^{-2}/ha) on South East aspect. The middle altitudinal range of (1940-2150 m asl) on North East aspect maximum density (9.2m^{-2}/ha) was observed in *Cedrus deodara* while minimum density of (0.4 m^{-2}/ha) was recorded in *Morus alba* on same aspect. Minimum density of (0.4 m^{-2}/ha) was also recorded in *Aesculus indica, Morus alba* and *Pinus canariences* on North West aspects and on South East aspect same density (0.4 m^{-2}/ha) was observed in *Pinus canariensis* and *Pyrus communis.*The density of trees on upper altitudinal range of (2150-2360 m asl) observed maximum (8.8 m^{-2}/ha) on North East aspect was recorded in *Cedrus deodara* while minimum density (2 m^{-2}/ha) was observed in *Quercus ilex* on the same aspect. Our results are in the conformity to the findings of Takyu *et al.*, (2003) and Aiba *et al.*, (2004) that support the inference and differences in forest structure found among sites even over a short distance with stem density exhibiting increasing trend with increase in elevation.

Abundance: Abundance is the total number of individual of species in a particular area and is usually measured as the large number of individuals found per unit of sample area. The abundance of plant species varied greatly on aspects along the altitudinal gradients (Table 2&3).

The abundance of shrub species also varied from different altitudinal range to different aspects as depicted in (Table 2). In lower zone (1730-1940 masl) high abundance (7.3) in shrub species was recorded in *Rosa webbiana* of North East aspect whereas *Cytisus scoparius* showed lowest abuncance of (4.2) on North West aspect. At the middle altidude of (1940-2150 m asl) maximum abundance (6.6) was observed in *Parratiopsis jacquemontiana* on North East aspect whereas low abundance (4.8) was recored in *Rubus fructicosus* on North West aspect. On upper gradient of (2150-2360 m asl) the abundance value of shrub species on South East aspect shows maximum (7) in *Rosa webbiana* and minimum (4) value of abundancefor *Ziziphus vulgaris* on South East aspect.The results are also with consonance with a similar study of Agni *et al.*, (2000) who reported species abundance values in the range of 1.85 to 8.40 in Tarai- Bhabhar tract of Kumaun Central Himalaya.

The abundance of tree species varied greatly on aspects along the altitudinal gradients (Table 3). Among the tree species at lower altitude (1730-1940 masl) of North West aspect high abundance (4) was exhibited by *Cupressus torulosa* and low abundance (2) at same aspect was shown by *Celtis australis, Juglans regia, Morus alba, Populus alba, Populusnigra, Prunus cerasifera* and *Robinia pseudo acacia* whereas, low abundance (2) was also recorded in *Juglans*

regia, *Morus alba* and *Robinia pseudo acacia* on North East aspect. *Juglans regia*, *Morus alba*, *Populus albs*, *Pyrus communis* and *Robinia pseudo acacia* showed lowest abuncance of 2 on the South East aspect.The abundance of tree species at the middle altidude of 1940-2150 m asl on North West aspect was high in *Pinus roxburgii* (10) whereas low abundance (2) was recored in *Aesculus indica*, *Morus alba*, *Pinus canariensis*, *Pyrus communis*and *Robinia psedo acacia.* Minimum abundance of 2 at the North East aspect was recorded in *Morus alba*, *Pinus canariensis* and *Pyrus communis.* Whereas lowest abundance (2) on South East aspect was exhibitedby *Pinus canariensis*, *Pyrus communis* and *Robinia psedo acacia.* In upper zone (2150-2360 m asl) of North West aspect low abundance (2) was recorded in *Celtis australis* and also in *Celtis australis* on South East aspect while high abundance (10.6) was recorded in *Cedrus deodara* on South East aspect. Our findings are in conformity to similar study from Kunihar Forest Division Himachal Pradesh by Verma *et al.,* (2005) who reported species abundance value ranges between the range of 1.0 to 7.8.

Importance Value Index (%): 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).

Among the shrub species, (Table 2) while *Berberis lyceum* maximum IVI of (57.89%) on North West aspect. *Parratiopsis jacquemontiana* displayed minimum IVI of (21.42%) on North East aspect at the lower altitude range of (1730-1940 m asl) (Table 6,7&8). At the middle altitudinal gradient of (1940-2150 m asl) while maximum IVI of (91.63%) was exhibited by *Parratiopsis jacquemontiana* on North West aspect while the minimum IVI (47.22%) was recorded in *Dalphne oleoides* on North East aspect. At the upper altitude of (2150-2360 m asl) maximum IVI of (97.2%) was observed in *Parratiopsis jacquemontiana* on South East aspect while minimum IVI (42.85%) was exhibited by *Ziziphus vulgaris* on North West aspect.

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 (66.82%) was exhibited by *Cupressus torulosa* on North West aspect, the minimum IVI of (11.01%) of tree species on North West aspect was exhibited by *Robinia pseudo acacia* at lower gradient of (1730-1940 m asl) (Table 3). At middle altitudinal range (1940-2150 m asl) *Aesculus indica* exhibited highest IVI of (98.51%) on South East aspect, whereas low IVI value of (10.28%) was recorded in *Aesculus indica* on North West aspect. At upper altitudinal range (2150-2360 m asl) maximum IVI of (150.26%) was observed in *Cedrus deodara* on South East aspect and minimum IVI (33.86%) was exhibited by *Celtis australis* on North West aspect. 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.

IV. Conclusion:

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

2. Analysis of cumulative data revealed that this area hosts 15 families (12 Angiosperms and 3 Gymnosperms) and 30 species (7 Angiosperms and 8 Gymnosperms) out of which 12 were shrubs and 18 were trees. Dicotyledons contribute about 92% of the total angiosperms observed at study site.
3. The study site was dominated by Rosaceae family followed by Pinaceae, Fabaceae, Salicaeceae. Families with representation of only one specie included Cannabaceae, Cupressaceae, Cupuliferae, Hamamelidaceae, Juglandaceae, Moraceae, Oleaceae, Rhamnaceae, Sapindaceae, Thymelaeaceae.

4. During the course of study twelve (12) species of shrubs and eighteen (18) tree species were recorded from the quadrates on different aspects of Zabarwan forests.
5. Among the analysis of shrub species, *Paratiopsis jacquemontiana* revealed the highest IVI and was the most dominant species on all the altitudinal gradients/aspects.
6. Due to the improvement in site conditions (micro-environment) shrubs has greatly expended over a period of induced secondary succession. Thus the study area gave shelter to other new species on the hillock from the adjoining areas.
7. *Cedrus deodara* and *Pinus roxburgii* is currently recruiting its species on the Zabarwan forests than other conifers at faster rate and may constitute a dominant climax species in future.
8. 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 *Cedrus deodara.*
9. *Cupressus torulosa* formed dominant plant community on lower altitude, *Paratiopsis jacquemontiana* and *Cedrus deodara* on middle altitude and *Paratiopsis jacquemontiana* and *Cedrus deodara* was the principal plant association on upper altitude.

The floristic study of Zabarwan forests reveals that the area is rich in flora. It was the first attempt to study the vegetation status of Zabarwan forest (Cheshmashahi) ecosystem that provides information about the total number of shrub and tree species present in the forest area, their identification, composition, distribution and their utility but there is a need in future to explore whole flora of Zabarwan forests including Shankeracharia and Basiwan ranges. The present study can be used as a source of basic data for the future management and conservation planning. Furthermore, there is a need to develop awareness programs to replenish this Reserve forest.

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Table 1: List of forest flora (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	Berberidaceae	*Berberis lyceum*	Indian barberry/Kawdach	S	+	+	-
2	Cannabaceae	*Celtis australis*	Nettle tree/Brimji	T	+	-	+
3	Cupressaceae	*Cupressus torulosa*	Bhutan cypress/Sarvikul	T	+	+	-
4	Cupuliferae	*Quercus ilex*	Holm oak	T	-	+	+
	Fabaceae	*Robinia pseudoacacia*	Black locust/Kikar	T	+	+	-
		Indigofera geradiana	Himalayan indigo/Neel	S	+	+	-
5		*Cytisus scoparius*	Common broom	S	+	+	-
6	Hamamelidaceae	*Parrotiopsis jacquemontiana*	Parrotia/Hatab	S	+	+	+
7	Juglandaceae	*Juglans regia*	Wallnut/Doon	T	+	-	-
8	Moraceae	*Morus alba*	White mulberry/Tul	T	+	+	-
9	Oleaceae	*Jasminium humile*	Yellow Jasmine	S	+	+	+
	Pinaceae	*Pinus helpensis*	Aleppo Pine	T	-	+	-
		Cedrus deodara	Himalayan cedar/Deodar	T	-	+	+
		Pinus roxburghii	Chir pine/Chir	T	-	+	-
		Pinus canariensis	Canary Island Pine	T	-	+	-
10		*Pinus wallichiana*	Blue pine/Kail	T	-	-	+
11	Rhamnaceae	*Ziziphus vulgaris*	Zizyphus/Bre	S	-	-	+
	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	+	+	-
12		*Rosa moschata*	Rose hip	S	+	-	+
	Salicaeceae	*Populus alba*	Silver poplar/Dodhi fres	T	+	-	-
		Populus nigra	Black poplar/Bati fres	T	+	-	-
13		*Salix fragilix*	Brittle willow	T	+	-	-
14	Sapindaceae	*Aesculus indica*	Indian horse chestnut/Haandoon	T	+	+	-
15	Thymelaeaceae	*Daphne oleoides*	Dafne spatolata	S	-	+	+

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

Table 2: Phyto-sociological attribute of forest flora (Shrubs) on available aspects along altitudinal gradient at Zabarwan forests, Kashmir.

Aspect	North West				North East				South East			
Parameter	**F**	**D**	**A**	**IVI**	**F**	**D**	**A**	**IVI**	**F**	**D**	**A**	**IVI**
Species & Altitude												
1730-1940 (Lower zone)												
Berberis lycium	100	5.2	5.2	57.89	100	5.4	5.4	41.7	60	3.2	5.33	26.04
Crataegus oxycantha	-	-	-	-	60	4	6.67	21.42	80	4.4	5.5	33.11
Cytisus scoparius	100	4.2	4.2	37.71	100	5	5	34.75	80	4.6	5.75	35.51
Indigofera gerardiana	60	2.6	4.33	32.7	60	4.2	7	26.89	80	4	5	32.27
Jasminium humile	-	-	-	-	80	4.4	5.5	27.17	80	3.6	4.5	34.25
Parrotiopsis jacquemontiana	50	3.5	7	43.62	100	5	5	37.78	60	3	5	25.14
Rosa moschata	60	3	5	22.71	80	5	6.25	26.43	100	5	5	36.47
Rosa webbiana	100	4.4	4.4	35.6	60	4.4	7.33	22.6	100	5.4	5.4	38.09
Rubus fructicosus	80	3.6	4.5	27.81	100	4.6	4.6	29.21	80	5.2	6.5	39.12
Rubus pungens	80	4.6	5.75	41.97	100	4.8	4.8	32.05	-	-	-	-
1940-2150 (Middle zone)												
Berberis lycium	80	4.6	5.75	47.83	-	-	-	-	80	4.6	5.75	53.15
Cytisus scoparius	80	4.2	5.25	58.35	-	-	-	-	80	5	6.25	53.36
Daphne oleoides	-	-	-	-	80	4.6	5.75	47.22	-	-	-	-
Indigofera gerardiana	-	-	-	-	80	5	6.25	55.33	80	4.4	5.5	48.86
Jasminium humile	-	-	-	-	100	6	6	61.75	-	-	-	-
Parrotiopsis jacquemontiana	100	5.6	5.6	91.63	100	6.6	6.6	83.87	100	6.4	6.4	82.74
Rubus fructicosus	100	4.8	4.8	50.29	80	5	6.25	51.83	100	5.6	5.6	61.88
Rubus pungens	80	4.4	5.5	51.91	-	-	-	-	-	-	-	-
2150-2360 (Upper zone)												
Daphne oleoides	100	5.8	5.8	67.35	80	4.4	5.5	55.24	-	-	-	-
Jasminium humile	80	5	6.25	55.35	100	5.2	5.2	75.07	80	4.6	5.75	72.25
Parrotiopsis jacquemontiana	100	6.2	6.2	79.55	80	3.4	4.25	48.6	100	6	6	97.2
Rosa moschata	-	-	-	-	100	5.2	5.2	64.3	-	-	-	-

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Rosa webbiana	80	5	6.25	54.9	80	4.6	5.75	56.78	60	4.2	7	60.47
Ziziphus vulgaris	80	3.2	4	42.85	-	-	-	-	80	4	5	70.08

F = Frequency; **D** = Density; **A** = Abundance; **IVI** = Importance Value Index.

Table 3: Phyto-sociological attribute of forest flora (Tree species) on available aspects along altitudinal gradient at Zabarwan forests, Kashmir.

Aspect	**North West**				**North East**				**South East**			
Parameter	**F**	**D**	**A**	**IVI**	**F**	**D**	**A**	**IVI**	**F**	**D**	**A**	**IVI**
Species & Altitude												
1730-1940 (Lower zone)												
Aesculus indica	40	1.2	3	31.6	-	-	-	-	-	-	-	-
Celtis australis	40	0.8	2	30.78	-	-	-	-	80	2	2.5	54.01
Cupressus torulosa	60	2.4	4	56.11	80	2.8	3.5	66.82	-	-	-	-
Juglans regia	60	1.2	2	26.41	60	1.2	2	36.3	40	0.8	2	27.39
Morus alba	20	0.4	2	17.59	20	0.4	2	16.36	60	1.2	2	37.79
Populus alba	40	0.8	2	27.58	-	-	-	-	40	0.8	2	28.88
Populus nigra	20	0.4	2	13.43	40	2	5	36.16	-	-	-	-
Prunus armenica	60	2	3.3	39.45	60	1.6	2.6	41.21	40	1.2	3	28.46
Prunus cerasifera	40	0.8	2	21.42	-	-	-	-	60	1.6	2.67	39.82
Pyrus communis	-	-	-	-	40	1.6	4	41.52	20	0.4	2	20.87
Robinia pseudo acacia	20	0.4	2	11.01	40	0.8	2	28.54	40	0.8	2	25.55
Salix fragilis	40	1.2	3	24.63	40	1.2	3	33.09	60	1.6	2.67	37.24
1940-2150 (Middle zone)												
Aesculus indica	20	0.4	2	10.2878	40	2	5	27.92304	-	-	-	-
Cedrus deodara	80	7.6	9.5	84.9574	100	9.2	9.2	82.58808	100	8.8	8.8	98.51453
Cupressus torulosa	40	1.6	4	27.79291	60	2.8	4.6	37.93748	40	2	5	36.33042
Morus alba	20	0.4	2	11.80509	20	0.4	2	12.5983	-	-	-	-
Pinus canariensis	20	0.4	2	16.95608	40	0.8	2	23.84657	20	0.4	2	24.33331
Pinus helpensis	40	1.2	3	24.99141	40	2	5	34.20775	40	3.2	8	35.44947
Pinus roxburghii	40	4	10	56.9334	60	4	6.6	55.56951	60	4.8	8	59.1583

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Pyrus communis	40	0.8	2	21.92739	40	0.8	2	25.32927	20	0.4	2	19.26058
Quercus ilex	40	1.2	3	25.10289	-	-	-	-	-	-	-	-
Robinia psedacacia	40	0.8	2	19.2456	-	-	-	-	40	0.8	2	26.95339
2150-2360 (Upper zone)												
Cedrus deodara	60	6.4	10.6	110.7419	100	8.8	8.8	133.2318	100	10.8	10.8	150.2694
Celtis australis	40	0.8	2	33.86	-	-	-	-	40	0.8	2	49.22066
Pinus wallichiana	40	4	10	88.41081	80	5.2	6.5	112.5316	80	5.6	7	100.5099
Quercus ilex	40	2	5	66.98725	60	2	3.3	54.2366				

F = Frequency; **D** = Density; **A** = Abundance; **IVI** = Importance Value Index.

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