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Investigation of Plant diversity in natural and plantation alder stands

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ABSTRACT: Diversity index is the best criteria for evaluating sustainability of forest ecosystems. Current study carried out in Alder (*Alnus subcordata* C. A. Meyer) stands that located in north forests of Iran. The aim of the study is express the plant diversity indices and positive role of the trees both natural and plantation forms. Data of Alder trees and associated species were recorded in sample plots which lay down in study area randomly. The abundance, density, percentage of frequency of each species was calculated by standard methods. The results of analysis revealed that, 47 species (21 trees and shrubs species and 26 herbaceous species) were abundant in 80 sample plots both in natural and plantations Alder stands. Whilst the results showed that the number of species in natural area (44 species) was more than plantation stands (37 species). Comparison of species distribution in different physiographical situation showed that some species such as *Alnus subcordata*, *Parrotia persica*, *Rubus hyrcanus* and *Prunus sp* recorded in spread rang of physiographic variables as elevation, slopes and aspects. The biodiversity criteria as Shannon H' and Simpsons D and 1/D indexes showed that they were more in natural stands than plantation areas.
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Key words: Forest, North of Iran, Alder, *Alnus subcordata*, Plant diversity

1. Introduction

Plant diversity indexes are useful for indicating the forest sustainability. The relationship between biodiversity and ecosystem function has been a central issue in ecological and environmental sciences during the last decade. Greater diversity leads to greater productivity in plant communities, greater nutrient retention in ecosystems and greater ecosystem stability (Hector *et al*. 1999; Tilman *et al.*, 1996, 1997). Diversity is of theoretical interest because it can be related to stability, maturity, productivity, evolutionary time, predation pressure and spatial heterogeneity (Hill, 1973). It is also of vital importance for conservation of natural communities which are increasingly threatened by industrial and urban expansions and forest clearing (Naveh and Whittaker, 1980). Some aspects of biodiversity consisted to estimating species niches, calibrating indicator value for species, mapping distribution of individual species and modeling potential distribution of species and plant communities (Jong-Won 1986; Jong-Won and Nakamura, 1988; Jong-Won and Joon-Ho, 1988; Jong-Won, 1996; Abrary, 1994; Chytry and Rafajova, 2003). This data can be used for variety of other purpose such as determining changes in vegetation, the environmental factor and vegetation distribution (Moustafa and Zaghloul, 1995; Regato-Pajares and Elenna-Rossello, 1995) which can use some analysis criteria such as Shannon's index (Magurran 1988, Pielou 1975). Generally, biodiversity measurement typically focuses on the species level and species diversity is one of the most important indices which are used for the evaluation of ecosystems at different scales (Ardakani, 2004).

Alder is the name of a genus of flowering plants (*Alnus*) belonging to the birch family (Betulaceae). The genus comprises about 30 species of monoecious trees, distributed throughout the North Temperate Zone. Alders trees are sturdy and fast-growing, even in acidic and damaged sites. The alder is primarily a pioneer and opportunist species, and is capable of direct colonization of even the rawest of soil material. The species acts as a pioneer on hydrosphere, being capable of colonizing at very early stages in the primary succession if good seed is available (McVean, 1956). Species of *Alnus subcordata* C. A. Meyer is native to temperate regions in North forests of Iran. The Hyrcanian vegetation zone is a green belt stretching over the northern slopes of Alborz mountain ranges and covers the southern coasts of the Caspian Sea. The specific environmental conditions in these forests have been led to occurrence of different forest communities (Sagheb-Talebi, 2004). In the temperate vegetation zone, natural and old growth forests still exist and can

be regarded as highly valuable habitats in terms of biodiversity. Temperate forests are extremely variable ecosystems and maintain a high diversity (Dudley, 1992). However, the objectives of current manuscript are evaluation and comparing biodiversity criteria in natural and man-made Alder stands and express the role of the trees communities in sustainable management of Iranian temperate forests.

2. Material and Methods

This research carried out in even aged pure Alder stands in Sari forest region (north forest of Iran). Geographical positions is latitude from 36° 16′ 32″ N, and longitude 53° 09′ 05″ E with altitude about 950 meter from free sea level (MSL). In geology point of view, Sediments of survey area is including to calcareous, siltstone, argillite with Lomashals and some Conglomerate stones. The survey area covered by brown forest soils. The soil texture emphasized by parent materials (eg. Existence of Marl, calcareous, siltstone and argilice). The soil texture are semi heavy texture (clay loam) to heavy (clay) with 30 to 60 percent clay. Average precipitations of region also is 900mm. Mean temperature of entire area is about 14.6 C^0 and absolute minimum and maximum temperature ranged -6.5 to 40 C^0. Mean humidity in survey areas were measured from 60 to 85%. Dominant plant community is Rusco-fagetum and important tree species in survey area are *Fagus orientalis, Carpinus betulus, Alnus subcordata, Diospyrus lotus, Parrotia persica* and *Acer insigne.*

Randomize systematic design was used for sampling and collecting data in natural and plantation Alder stands. The pure alder stands were identified based on information of Sari Natural Resources Service (SNRS). Trough frequent visits, natural and plantation stands of Alder were marked on contour line (25_m) map (scale 1:50000). Based on Alder stands existence, Eighth altitude zone consider by 200 m interval from 0 to 1700 MSL. According to minimum number of stands in each altitude zone, 10 stands and 10 sampling plots were selected randomly. These selected stands distributed homogenously in whole study area which 40 sample plots from natural stands and remaining 40 sample plots were representing plantation stands. Each sample plot was circular in shape, with an area of about 500 m^2 and in nested form with macro and sub plots. Macro-plots were representing the whole plot with radius of 12.61 m. While sub-plots (micro-plots) was about 50 m^2 area which located at center of macro plot. Data collection in Macro-plots were measured of geographical position (latitude and longitude) by GPS (Garmin), Altitude (MSL) by Altimeter, aspect (Azimuth), or direction of slop by compass, slop of aspect (in percent) by Abny level or Slop meter, age of plantations and natural stands (by information of SNRS), Land forms (flat, hills, flood plain, terrace, bench including lower slop etc.), dominant tree and herbaceous species, regeneration type (Natural/plantation), crown covers (Percent of crown of trees on ground as shade or percent of browsing area), percent of understory (Percent of ground plant cover) and Diameter at Breast Height (DBH) of alders and other trees and shrubs (by Caliper or Meter bund). Also regeneration and number of seedlings of trees/shrubs and number of herbaceous species at floor were collected in micro-plots.

Observations on frequency, abundance and density of associated species with Alders for both natural and plantation stands were recorded in sample plots lay down randomly in study area. The plant species including the herbaceous were recorded carefully and their identification was confirmed by flora of Mazandaran province. The abundance, density, percentage of frequency of each species was calculated as per the method of Misra (1968) by using following formulae.

$$\text{Percentage of frequency} = \frac{\text{Number of quadrates in which species occurred.}}{\text{Total number of quadrates studied.}} \times 100$$

$$\text{Density} = \frac{\text{Total number of individuals of a species in all quadrates.}}{\text{Total number of quadrates studied.}}$$

$$\text{Abundance} = \frac{\text{Total number of individuals of species in all quadrates.}}{\text{Total number of quadrates in which species occurred.}}$$

Based on frequency data, species were grouped into five percentage frequency classes (Raunkiers, 1937). Frequency percentage: A:1-20%, B: 21-40%, C: 41-60%, D: 61-80% and E: 81-100%.

Shannon-weaner index and Simpson index were used for the calculation of plant community diversity (Raunkaier, 1934 and Stromberg, 1993). Study of plant diversity was done by calculating plant

diversity index (Shannon-Weaner and Simpson formula) in 80 sample plots.

- Shannon-weaner index:

$$H^1 = -\sum_{i=1}^{m} Pi \times LnPi \ , \ Pi = (\frac{ni}{N})$$

- Simpson index:

$$D = \sum \frac{ni(ni-1)}{N(N-1)}$$

Where H^1 is Shannon-weaner H^1index, Pi is the proportional abundance and Ln Pi is natural logarithm of proportional abundance ni is the number of individuals and N is the total number of individuals, D is Simpson index (Biodiversity is expressed as 1-D and 1/D). The analysis of similarity which calculated by presents or absent of the species in sample plots was done by using clustering method by software (SPSS Ver. 11.5 and Biodiversity Ver. 2) and related similarity dendrograms were illustrated.

3. Results

The results in Table 1 revealed that there are 53 trees, shrubs and associated herbaceous species in natural and plantation Alder pure stands (more than 90% of composition of stand occupied by Alder). The trees and shrub species number is 23 and herbaceous species number was 30 in whole study area. The plant diversity information in Alder stands indicated that the number of plant species in plantations area (37) is less than natural stands (50).

Table 1: Number of species in natural and plantation Alder stands.

Form of plant	Natural Stands	Plantation Stands	Common species (both stands)	Total species
Trees and shrubs	21	14	12	23
Herbaceous species	29	23	22	30
Total species	50	37	34	53

The results of phyto-sociological analysis in sample plots showed in Table 2 revealed that the range of percentage of frequency of species viz. *Fagus orientalis, Carpinus betulus, Viola odrata and Greamineae sp* was highest i.e. between 41 to 60% in natural stands of study area. Following species had the percentage of frequency between 21 to 40%; *Parrotia persica, Acer Sp, Quercus castinofolia, Diospyrus lotus, Rubus hyrcanus, Sumbucus ebulus, Carex sp, Ruscus hyrcanus, Oplismenus undulatifolius, Pteridium aquilinum, Asprola odrata* and *Euphorbia helioscopia*. The remaining plants had percentage of frequency, which ranged less than 21%. From the same table it was revealed that the abundance value more than one was recorded for plants viz. *Rubus hyrcanus, Viola odrata, Greamineae sp, Sumbucus ebulus* and *Carex sp*. All of the remaining species was having abundance value less than one.

The study of density of plant species (Table 2) clearly showed that in natural stands highest density (more than two) was for plants viz. *Rubus hyrcanus, Cyglamen europaeun, Viola odrata, Greamineae sp, Urtica dioica, U. alba, Sumbucus ebulus, Poa bolboza, Malva sativa, Hypericum androsaemum, Rumex sp, Trifolium sp, Carex sp, Ruscus hyrcanus, Oplismenus undulatifolius, Pteridium aquilinum, Gundelia tournefortii, Mentha sp, Asprola odrata, Euphorbia helioscopia, Polysticum vulgare* and *Artimisia annua*. The remaining plants had density less than 2.

From the Table 3 it was seen that in plantation stands all the plant species (without Alder) were recorded in range of percent of frequency less than 21%. The range of frequency more than 10% in the stands was for plant species viz. *Carpinus betulus, Crataegus ambigua, Greamineae sp, Urtica dioica, Sumbucus ebulus, Poa bolboza, Carex sp* and *Oplismenus undulatifolius*. The abundance value in plantation stands for *Carex sp* was more than one, while for other plants it was less than one. The value of density also indicated that in plantation stands the species viz. *Greamineae sp, Sumbucus ebulus, Trifolium sp, Feragaria vesca, Carex sp, Ruscus hyrcanus* and *Oplismenus undulatifolius* had density more than four for plant species viz. *Rubus hyrcanus, Crataegus European, Viola odrata, Urtica dioica, Poa bolboza, Rumex sp, Feragaria sylvestris, Ilex spinigera, Pteris cretia, Pteridium aquilinum, Gundelia tournefortii, Mentha sp* and *Polysticum vulgar* had density more than two, while remaining plants had density less than two.

The list of trees and shrubs in different conditions which noted in sample plots showed in Table 4. The analysis of distribution of trees and shrubs species revealed that the number of trees and

shrubs such as *Alnus subcordata*, *Parrotia persica*, *Rubus hyrcanus* and *Prunus sp* spread in wide range of physiographic variables (elevation, slopes and aspect). The species of *Albizia julibrisin* and *Salix alba* were recorded from low lands (range altitude less than 400 MSL) and *Quercus macronteria*, *Juglans regia* and *Zelcova azadrach* was in high altitude (range 1200 to 1600 MSL). Some species *viz Albizia julibrisin* and *Salix alba* growing only in lands with low slopes (slopes range 0 to 15%).

Results of table figures 1 and 2 were shown that number of herbaceous and trees species in pure plantation stands with frequency more than 20% (B and C Raunkiers groups) was less than natural pure stands. However every species in plantation Alder stands were located in A Raunkiers group. Also results of figure 3 indicated that number of herbaceous, shrubs and trees species in pure natural stands with frequency more than 30% was more than plantation areas. Whilst Abundant Results in figure 4 clearly explained that herbaceous, shrubs and trees species abundance in natural Alder stands were less than plantation stands. Also abundance of herbaceous species was more than trees and shrubs. Abundance in trees species was maximum for *Fagus orientalis* after Alder. In herbaceous species the abundance was maximum for *Greamineae sp* and *Sumbucus ebulus*. In figure 5 results of density shown that density of Alder in Pure plantation stands is more than natural areas. Despite for *Fagus orientalis* it was adversely resulting.

The results in Table 5 showed the list of important herbaceous species in natural Alder stands. The species *viz*. *Oplismenus undulatifolius*, *Poa bolboza*, *Carex sp*, *viola odrata*, *Greamineae sp*, *Urtica dioica*, *Sumbucus ebulus* existed in spread range of physiographic variables as elevations, slopes and aspects. The species of *Gundelia tournefortii*, was only in high altitude range (1200 to 1600 MSL) and *Smilax exelsa* and *Rumex sp* were in low altitude (less than 400 MSL). Some species viz *Artimisia annua*, *Plantago magor* and *Gundelia tournefortii* grew in lands with low slopes (0 to 15%). Species of *Artimisia annua*, *Feragaria vesca* prefer to certain aspect and was reordered only in south aspects.

The analysis of plant diversity in plantation stands showed in table 6 indicated that minimum number of species was in plot number five in location of Naghibdeh with altitude 700 MSL and maximum species were in plot number seven in location of Karname with altitude 1080 MSL with five and 16 species respectively.

The number of individual plant showed that the highest number of plants was in plot number seven with 110 plants. The sample plot number 54 located at Bobolkenar with altitude 200 MSL had minimum individual plants equal to eight.

In natural stands minimum number of species was in plot number 59 at Bobolkenar with altitude 200 MSL and maximum species were in plot number 45 located at Sadatmaheleh with altitude 1050 MSL with 10 and 20 species respectively (Table 7). Average number of individual plants in natural stands also showed that the highest number of plants was in plot number one with 86 plants at Suchelmah area with altitude 950 MSL.

The sample plot number 56 located at Bobolkenar with altitude 250 MSL had minimum individual plants with 13. The results recorded in Tables 6 and 7 also revealed that list of species in sample plots and diversity indexes (Shannon H' and Simpsons D and 1/D). The highest diversity in plantation stands was found in plot number 49 located at Karnam area with altitude 1550 MSL and plot number 51 at Babolkenar area with altitude 150 MSL, while the lowest diversity was in plot number 15 i.e. Ahangarkola location area with altitude 210 MSL.

The highest diversity in natural stands was found in plot number 45 at Sadatmahaleh with altitude 1050 MSL and lowest in plot number 73 at Naghibdeh with altitude 1300 MSL (table 7). Overall mean of Shannon H' and Simpsons D and 1/D indexes of survey area revealed that diversity indexes in natural stands was more than plantation stands.

The cluster analyses have done by plants, where present in sample plots and similarity compositions and abundances of stands. It was also illustrated as denderogram. The Figure 6 showed that Bray Curtis cluster analysis in natural stands. The results of cluster analysis revealed that plots number 24 to 30 with 65% similarity and plot number six and 10 to 20 with 60% similarity formed two big categories. In plantation stands plots numbers one to 4, 6 to 10, 12 to 17 and 19 to 23 with 70% similarity consisted of one big category (Figure 7).

Table 2: Results of phyto-sociological analysis of sample plots in natural and pure Alder stands.

No	Type of Plant	Species Name	Frequency (%)	Abundance	Density	PFC*
1		*Acer Campestre*	28.75	0.30	1.04	B
2		*Acer velutoniume*	18.75	0.19	1.00	A
3		*Albizia julibrisin*	1.75	0.12	1.00	A
4		*Alnus subcordata*	100.00	7.45	7.45	E
5		*Boxus hyrcanus*	1.25	0.01	1.00	A
6		*Carpinus betulus*	52.50	0.60	1.14	C
7		*Crataegus ambigua*	13.75	0.18	1.27	A
8		*Crataegus European*	11.25	0.11	1.00	A
9	Trees	*Diospyrus lotus*	22.50	0.23	1.00	B
10	and	*Fagus orientalis*	42.50	0.64	1.50	C
11	shrubs	*Figus carica*	1.25	0.02	1.00	A
12		*Juglans regia*	6.25	0.06	1.00	A
13		*Mespilus germanica*	5.00	0.05	1.00	A
14		*Parrotia persica*	36.25	0.36	1.00	B
15		*Prunus sp*	10.00	0.14	1.38	A
16		*Pterocarya fraxinifolia*	10.00	0.10	1.00	A
17		*Quercus castinofolia*	26.25	0.26	1.00	B
18		*Quercus macronteria*	5.00	0.05	1.00	A
19		*Rubus hyrcanus*	38.75	1.25	3.23	B
20		*Salix alba*	1.25	0.03	2.00	A
21		*Zelcova azadrach*	1.25	0.01	1.00	A
1		*Artimisia annua*	1.25	0.03	2.00	A
2		*Asprola odrata*	28.75	0.66	2.30	B
3		*Carex sp*	37.50	1.06	2.83	B
4		*Convolvulus arvensis*	3.50	0.17	3.00	A
5		*Cyglamen europaeun*	5.00	0.16	3.25	A
6		*Euphorbia helioscopia*	40.00	0.98	2.44	B
7		*Feragaria sylvestris*	1.25	0.05	2.52	A
8		*Feragaria vesca*	1.25	0.01	1.00	A
9		*Greamineae sp*	43.75	2.06	4.71	C
10		*Gundelia tournefortii*	1.25	0.05	4.00	A
11		*Hypericum androsaemum*	17.50	0.43	2.43	A
12	Herbaceous	*Ilex spinigera*	5.00	0.05	1.00	A
13	Species	*Malva sativa*	2.50	0.08	3.00	A
14		*Mentha sp*	11.25	0.29	2.56	A
15		*Oplismenus undulatifolius*	30.00	0.85	2.83	B
16		*Plantago magor*	1.55	0.15	3.00	A
17		*Poa bolboza*	11.25	0.30	2.67	A
18		*Polysticum vulgare*	2.50	0.09	3.50	A
19		*Primula sp*	12.50	0.21	1.70	A
20		*Pteridium aquilinum*	28.75	0.57	2.00	B
21		*Pteris cretia*	20.00	0.33	1.63	A
22		*Rumex sp*	1.25	0.03	2.00	A
23		*Ruscus hyrcanus*	30.00	0.69	2.29	B
24		*Smilax exelsa*	7.50	0.10	1.33	A
25		*Sumbucus ebulus*	32.5	1.10	3.38	B
26		*Trifolium sp*	3.75	0.16	4.33	A
27		*Urtica alba*	2.25	0.09	1.86	A
28		*Urtica dioica*	9.45	0.34	3.12	A
29		*Viola odrata*	12.50	0.41	3.70	A

*: PFC is Percentage Frequency Classes based on Raunkiers, 1937 in five classes A:1-20%, B: 21-40%, C: 41-60%, D: 61-80% and E: 81-100%.

Table 3: Results of phyto-sociological analysis of sample plots in plantation and pure Alder stands.

No	Type of Plant	Species Name	Frequency (%)	Abundance	Density	PFC*
1	Trees and shrubs	*Alnus subcordata*	100.00	20.65	20.65	E
2		*Fagus orientalis*	2.50	0.03	1.00	A
3		*Carpinus betulus*	10.00	0.11	1.13	A
4		*Parrotia persica*	8.75	0.09	1.00	A
5		*Figus caricca*	2.50	0.03	1.00	A
6		*Acer velutoniume*	1.25	0.01	1.00	A
7		*Acer campestre*	7.50	0.09	1.17	A
8		*Quercus castinofolia*	2.50	0.03	1.00	A
9		*Pterocarya fraxinifolia*	3.75	0.04	1.00	A
10		*Albizia julibrisin*	1.25	0.01	1.00	A
11		*Diospyrus lotus*	3.75	0.04	1.00	A
12		*Rubus hyrcanus*	8.75	0.26	3.00	A
13		*Crataegus ambigua*	10.00	0.10	1.00	A
14		*Crataegus European*	1.25	0.04	3.00	A
1	Herbaceous Species	*Asprola odrata*	1.25	0.03	2.00	A
2		*Carex sp*	13.75	0.83	6.00	A
3		*Convolvulus arvensis*	7.50	0.11	1.50	A
4		*Euphorbia helioscopia*	2.50	0.04	1.50	A
5		*Feragaria sylvestris*	3.75	0.10	2.67	A
6		*Feragaria vesca*	2.50	0.10	4.00	A
7		*Greamineae sp*	12.50	0.79	6.30	A
8		*Gundelia tournefortii*	1.25	0.03	2.00	A
9		*Ilex spinigera*	1.25	0.04	3.00	A
10		*Malva sativa*	3.75	0.06	1.67	A
11		*Mentha sp*	6.25	0.24	3.80	A
12		*Oplismenus undulatifolius*	11.25	0.51	4.56	A
13		*Plantago magor*	2.50	0.03	1.00	A
14		*Poa bolboza*	11.25	0.39	3.44	A
15		*Polysticum vulgar*	2.50	0.06	2.50	A
16		*Pteridium aquilinum*	5.00	0.15	3.00	A
17		*Pteris cretia*	6.25	0.14	2.20	A
18		*Rumex sp*	5.00	0.13	2.50	A
19		*Ruscus hyrcanus*	3.75	0.19	5.00	A
20		*Sumbucus ebulus*	13.75	0.60	4.36	A
21		*Trifolium sp*	5.00	0.26	5.25	A
22		*Urtica alba*	2.50	0.06	2.50	A
23		*Urtica dioica*	13.75	0.29	2.09	A

*: PFC is Percentage Frequency Classes based on Raunkiers, 1937 in five classes A:1-20%, B: 21-40%, C: 41-60%, D: 61-80% and E: 81-100%.

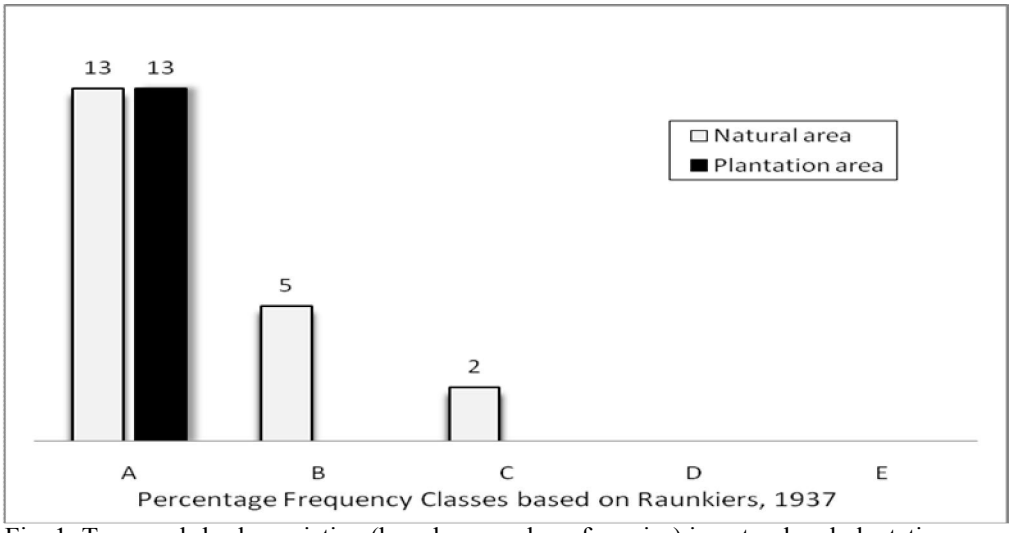

Fig. 1: Trees and shrubs variation (based on number of species) in natural and plantation area.

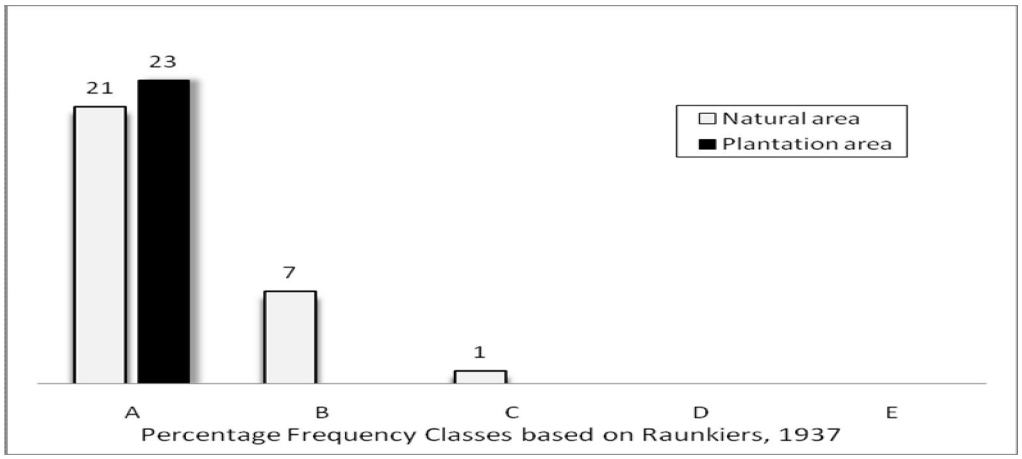

Fig. 2: Herbaceous species variation (based on number of species) in natural and plantation area.

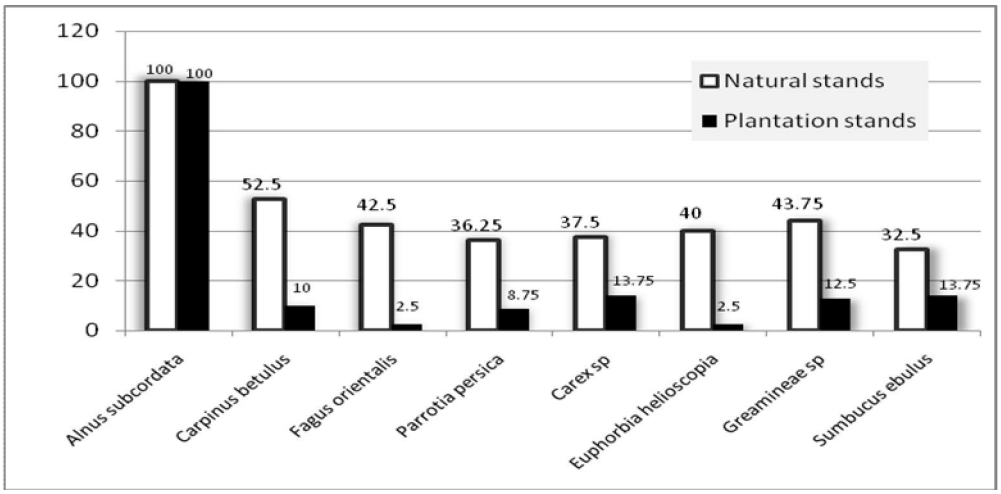

Fig. 3: Comparing frequency percent of species that are more than 30 in one of two stands

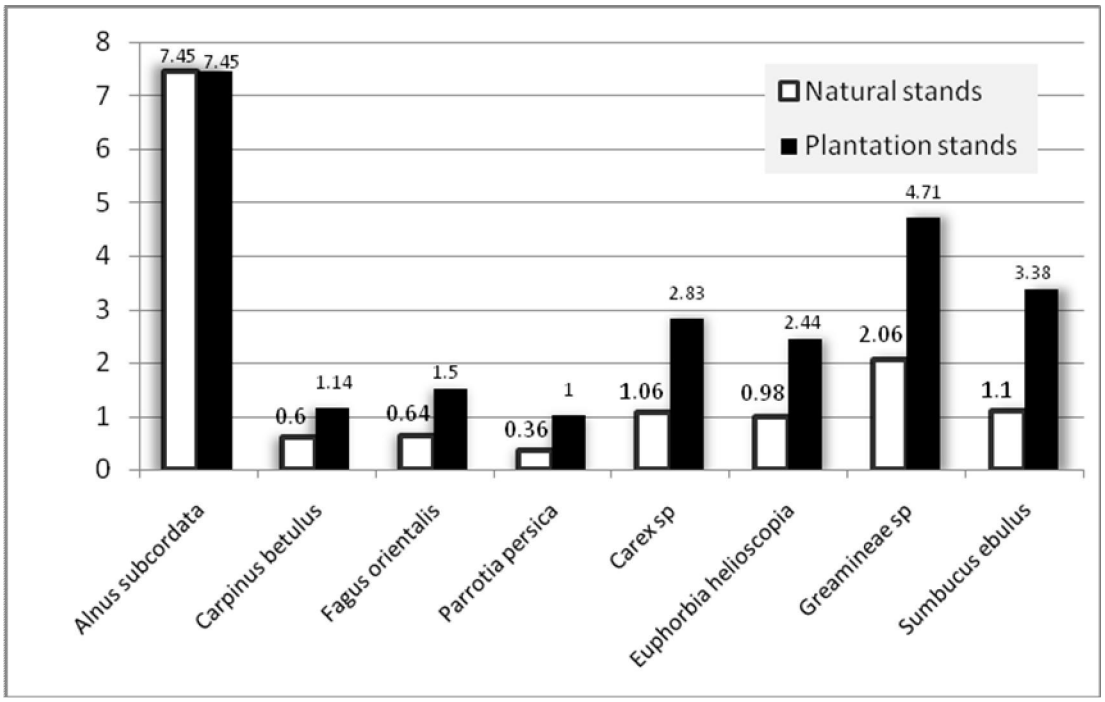

Fig. 4: Comparing abundance of species that their frequency percent are more than 30 in one of two stands

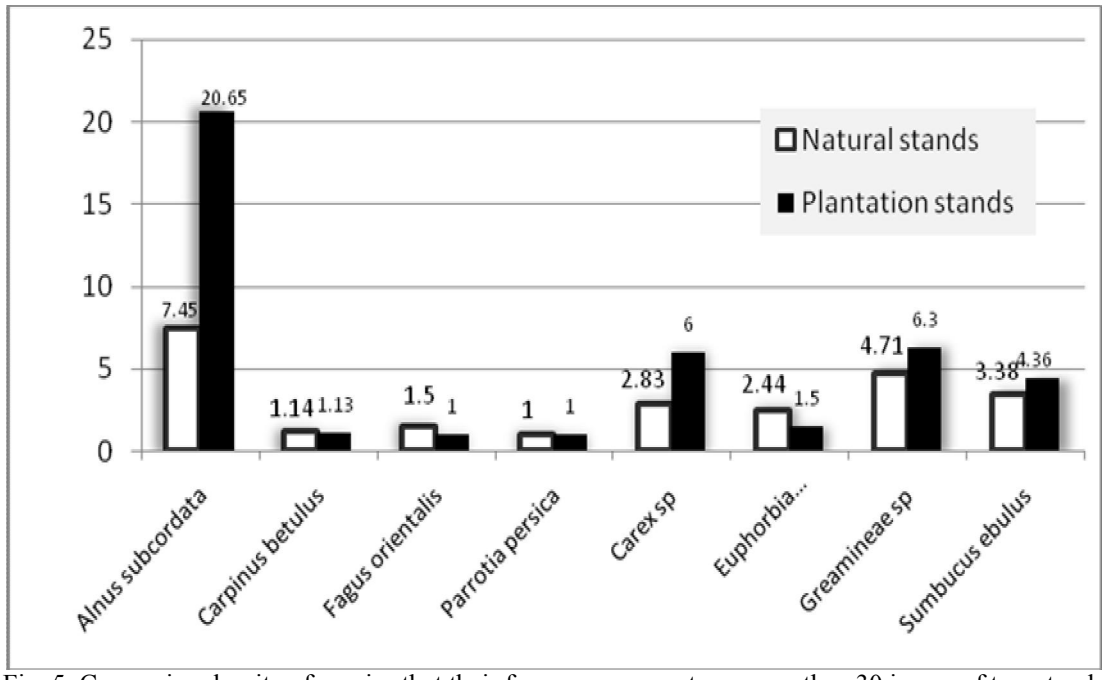

Fig. 5: Comparing density of species that their frequency percent are more than 30 in one of two stands

Table 4: Important trees and shrubs species in natural Alder stands in north forest of Iran and their presence in different physiographical situation.

No	Scientific Name of species	Elevation (MSL)				Slope (Percent)				Aspect			
		0-400	**400-800**	**800-1200**	**1200-1700**	**0-15**	**15-30**	**30-45**	**45-60**	**N**	**S**	**E**	**W**
1	*Acer campestre*	+	+	+	+	+	+	+	+	+	+	+	-
2	*Acer velutoniume*	-	-	+	+	-	-	+	+	+	+	+	-
3	*Albizia julibrisin*	+	-	-	-	+	-	-	-	+	-	-	+
4	*Alnus subcordata*	+	+	+	+	+	+	+	+	+	+	+	+
5	*Boxus hyrcanus*	+	-	-	-	-	+	-	-	-	-	+	-
6	*Carpinus betulus*	+	+	+	+	-	+	+	-	+	+	+	+
7	*Crataegus ambigua*	-	-	+	+	+	+	+	+	+	+	+	
8	*Crataegus European*	-	+	+	+	-	+	+	+	+	+	+	+
9	*Diospyrus lotus*	+	+	+	-	+	+	+	+	+	+	+	-
10	*Fagus orientalis*	-	+	+	+	-	+	+	+	+	+	+	+
11	*Figus carica*	+	-	-	-	+	+	-	-	+	+	+	+
12	*Juglans regia*	-	-	-	+	-	-	+	-	+	-	+	-
13	*Mespilus germanica*	+	+	+	-	+	+	+	-	+	-	+	+
14	*Parrotia persica*	+	+	+	+	+	+	+	-	+	+	+	-
15	*Prunus sp*	+	+	+	+	-	+	+	+	+	+	+	+
16	*Pterocarya fraxinifolia*	-	+	+	+	+	+	+	+	+	+	-	-
17	*Quercus castinofolia*	+	+	+	-	+	+	+	+	+	+	+	+
18	*Quercus macronteria*	-	-	+	+	-	-	+	+	+	-	-	+
19	*Rubus hyrcanus*	+	+	+	+	+	+	+	+	+	+	+	+
20	*Salix alba*	+	-	-	-	+	-	-	-	+	-	-	-
21	*Zelcova azadrach*	-	-	+	+	-	-	+	-	-	-	-	+

+ : indicated presence of species in physiographic condition, - : indicated absence of species.

Table 5: Important herbaceous species of natural Alder stands in north forest of Iran and their presence in different physiographical situation.

Plot No.	Scientific name of species	Elevation Range (MSL)				Slope Range (%)				Aspect			
		0-400	**400-800**	**800-1200**	**1200-1700**	**0-15**	**15-30**	**30-45**	**45-60**	**N**	**S**	**E**	**W**
22	*Artimisia anua*	-	-	+	-	+	-	-	-	-	+	-	-
23	*Asprola odrata*	-	+	+	+	-	+	+	+	+	+	+	+
24	*Carex sp*	+	+	+	+	+	+	+	+	+	+	+	+
25	*Convolvulus arvensis*	+	+	+	-	+	+	-	-	+	-	+	-
26	*Cyglamen europaeun*	+	+	+	+	-	+	-	+	+	-	+	+
27	*Euphorbia helioscopia*	+	+	+	+	-	+	+	+	+	+	+	+
28	*Feragaria sylvestris*	-	+	+	-	+	+	-	-	+	+	+	+
29	*Feragaria vesca*	-	+	-	-	+	+	-	-	-	+	-	-
30	*Greamineae sp*	+	+	+	+	+	+	+	+	+	+	+	+
31	*Gundelia tournefortii*	-	-	+	+	+	-	-	-	+	-	+	+
32	*Hypericum androsaemum*	+	+	+	+	+	+	+	+	+	+	+	+
33	*ILex spinigera*	-	-	+	-	-	-	+	-	-	+	+	+
34	*Malva sativa*	+	+	+	+	+	+	+	-	+	-	-	+
35	*Mentha sp*		+	+	+	+	+	+	+	+	+	+	+
36	*Oplismenus undulatifolius*	+	+	+	+	+	+	+	+	+	+	+	+
37	*Plantago magor*	-	-	+	-	+	-	-	-	+	+	+	+
38	*Poa bolboza*	+	+	+	+	+	+	+	+	+	+	+	-
39	*Polysticum vulgar*	+	+	+	-	+	+	+	-	+	+	+	-
40	*Primula sp*	+	+	+	+	-	+	+	+	+	+	+	+
41	*Pteridium aquilinum*	+	+	+	+	+	+	+	+	+	-	+	-
42	*Pteris cretia*	+	+	+	+	-	+	+	+	+	-	+	+
43	*Rumex sp*	+	-	-	-	-	+	-	-	-	+	+	-
44	*Ruscus hyrcanus*	+	+	+	+	-	+	+	+	+	+	+	+
45	*Smilax exelsa*	+	-	-	-	-	+	+	-	+	+	+	-
46	*Sumbucus ebulus*	+	+	+	+	+	+	+	+	+	+	+	+
47	*Trifolium sp*	+	+	+	-	+	+	-	-	+	-	+	+
48	*urtica alba*	-	+	+	+	-	-	-	+	+	-	-	+
49	*Urtica dioica*	+	+	+	+	+	+	+	+	+	+	+	+
50	*Viola odrata*	+	+	+	+	+	+	+	+	+	+	+	+

+ : indicated present of species in physiographic condition , - : indicated absence of species.

Table 6: Biodiversity criteria of Alder natural stands in north forest of Iran

Plot No	Number of Species	Number of Individuals plants	Shannon H' Log Base 10.	Simpsons Diversity (D)	Simpsons Diversity (1/D)
1	13	86	0.93	0.15	6.87
6	13	28	0.96	0.12	8.04
8	12	57	0.95	0.12	8.31
26	11	42	0.93	0.12	8.61
30	12	14	1.06	0.02	45.50
32	13	17	1.06	0.04	22.67
33	16	29	1.16	0.04	22.56
34	13	23	1.05	0.06	16.87
35	13	23	1.07	0.05	19.46
37	12	20	1.04	0.05	19.00
38	14	16	1.13	0.02	60.00
39	14	20	1.10	0.04	23.75
40	17	26	1.20	0.03	32.50
41	15	32	1.05	0.10	10.33
42	16	26	1.14	0.05	21.67
43	15	30	1.08	0.07	13.59
44	17	30	1.16	0.05	19.77
45	20	33	1.22	0.05	21.12
46	12	16	1.05	0.03	30.00
47	12	18	1.03	0.05	19.13
50	15	27	1.13	0.05	20.65
53	10	21	0.93	0.09	11.05
55	15	21	1.14	0.03	30.00
56	10	13	0.98	0.04	26.00
57	14	18	1.12	0.15	6.87
58	11	20	0.99	0.44	2.30
59	10	16	0.96	0.30	3.39
60	11	21	0.99	0.60	1.67
64	11	23	0.98	0.12	8.31
65	11	21	1.00	0.40	2.49
66	12	27	1.02	0.56	1.78
67	11	19	1.00	0.37	2.73
69	18	34	1.19	0.45	2.21
70	12	27	1.03	0.21	4.67
71	13	27	1.06	0.76	1.32
72	12	27	1.03	0.70	1.43
73	10	23	0.94	0.37	2.68
74	15	33	1.08	0.39	2.59
76	11	27	0.95	0.46	2.15
77	16	38	1.15	0.18	5.56
Mean	13.2	26.72	1.05	0.20	14.2

Table 7: Biodiversity criteria of Alder plantation stands in north forest of Iran

Plot No	Number of Species	Number of Individuals plants	Shannon H' Log Base 10.	Simpsons Diversity (D)	Simpsons Diversity (1/D)
2	7	83	0.53	0.44	2.30
3	7	56	0.63	0.30	3.39
4	8	65	0.40	0.60	1.67
5	5	36	0.48	0.42	2.40
7	16	110	0.90	0.20	4.96
9	8	63	0.58	0.40	2.49
10	5	43	0.40	0.56	1.78
11	9	54	0.63	0.37	2.73
12	13	51	0.62	0.45	2.25
13	8	39	0.53	0.45	2.21
14	6	28	0.69	0.21	4.67
15	7	69	0.26	0.76	1.32
16	6	60	0.30	0.70	1.43
17	9	94	0.64	0.37	2.68
18	9	92	0.63	0.39	2.59
19	7	65	0.49	0.49	2.04
20	8	67	0.53	0.46	2.15
21	6	29	0.72	0.18	5.56
22	8	80	0.38	0.63	1.60
23	8	80	0.39	0.62	1.60
24	11	83	0.60	0.41	2.43
25	10	87	0.62	0.39	2.56
27	10	69	0.72	0.30	3.36
28	7	45	0.77	0.17	5.86
29	7	43	0.79	0.15	6.59
31	10	16	0.95	0.07	15.00
36	10	21	0.96	0.08	13.13
48	8	10	0.88	0.04	22.50
49	9	11	0.93	0.04	27.50
51	15	32	1.10	0.07	15.50
52	9	26	0.89	0.11	9.03
54	6	8	0.75	0.07	14.00
61	10	21	0.90	0.42	2.40
62	10	22	0.87	0.12	8.04
63	9	22	0.90	0.20	4.96
68	8	15	0.82	0.45	2.25
75	10	37	0.77	0.49	2.04
78	8	19	0.84	0.63	1.60
79	6	15	0.65	0.62	1.60
80	6	16	0.68	0.41	2.43
Mean	8.48	47.05	0.68	0.36	5.37

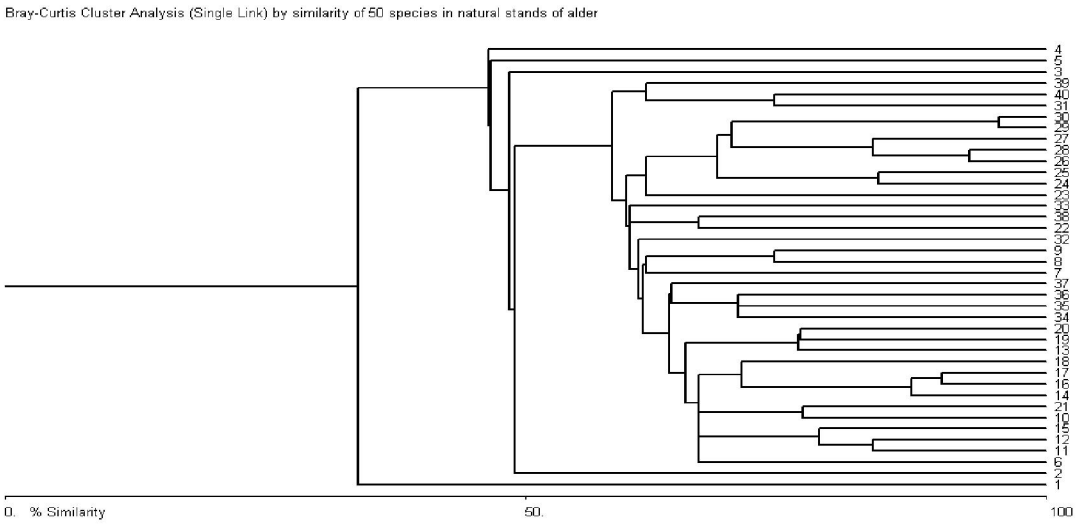

Fig. 6: Bray Curtis single link cluster analysis of Alder stands in natural area

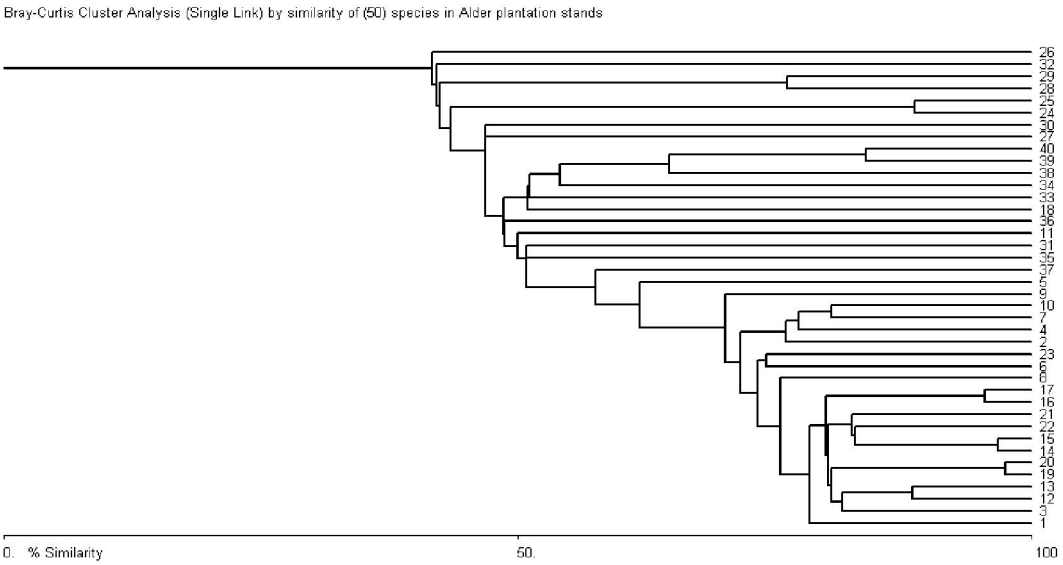

Fig. 7: Bray Curtis single link cluster analysis of Alder stands in plantation area

4. Discussions

The results of plant diversity analysis from survey areas revealed that 53 species were abundant in 80 sample plots. Twenty one trees and shrubs species and 29 herbaceous species noted in natural stands. In plantation stands they were 14 and 23 respectively. As per results, number of species in natural area (50 species) was more than plantation stands (37 species). Also number of herbaceous species in plantation area (23) is less than natural area (29). The effects of trees on the diversity of shrubs and herbs are significant because tree canopies affect the distribution of resources such as light, water-conditions and temperature available to shrubs and herbs (Kessler, 2001; Zhang, 2003; Nummelin and Zilihona, 2004). Moreover according to Knight et al. (2005) the different overstorey tree species create different understorey environments, which affect both components of the herbaceous flora: native species and exotic invaders.

Phyto-sociological analysis of associated plants in pure natural Alder stands of survey area (Table 2) revealed that the species viz. *Fagus orientalis, Carpinus betulus, Viola odrata and Greamineae sp* were dominant (their range of percentage of frequency were between 41 to 60%).

While in plantation stands all the plant species were recorded in range of percent of frequency less than 21%. Based on Raunkiers (1937) and frequency data, species in pure natural Alder stands were grouped into C frequency classes and species in pure plantation Alder stands were grouped whole species into A frequency classes which expressed high variation of plants in natural stands. Some of variation in the richness and abundance of understorey plants among planted forest stands can be attributed to the amount of light available to understorey plants (Cannell 1999). Particularly dense stands can cast so much shade that they appear to literally shade out the understorey vegetation (Humphrey et al. 2002)

The highest range of frequency (more than 10%) in the stands was for plant species viz. *Carpinus betulus, Crataegus ambigua, Greamineae sp, Urtica dioica, Sumbucus ebulus, Poa bolboza, Carex sp* and *Oplismenus undulatifolius*. The number of species with frequency more than 20% (B and C Raunkiers groups) in pure and plantation Alder stands showed that it was less than natural pure stands. The abundant of herbaceous, shrubs and trees species in natural Alder stands was less than plantation. Also the density of Alder in pure plantation stands is more than natural areas. In addition comparisons of mean of Shannon H' and Simpsons D and 1/D indexes of survey area showed that biodiversity criteria in natural stands was more than plantation stands. According to Gibson and Jones (1977) and Barthod (1994), diverse forests can be healthier than monocultures, and thus the trophic dimension of the biodiversity ecosystem functioning relationship needs to be considered. Several reviews indicate that forest monocultures in all climatic regions may experience insect outbreaks that cause considerable damage. Decreased local species diversity is a widespread impact of human activity (Groombridge, 1992; Pimm et al. 1995; Vitousek et al. 1997), and may result in decreased primary production (Naeem et al., 1994; Tilman et al., 1996, 1997 and Hector, 1999). Plant species could differ in their influence over the physical protection of soil organic matter into aggregates. For example, Jastrow et al. (1998) demonstrated that fine root and mycorrhizal hyphal length (characteristics that vary among plant species) are important in promoting aggregate formation. All of above results demonstrated that tend of natural forest ecosystem to high variation which caused to more sustainability by massive community. It is widely thought that plantation forests are, on average, less favourable as habitat for a wide range of taxa, particularly in the case of even-aged, single-species stands involving exotic species (Hunter, 1990; Hartley, 2002). In support of this notion, the bird fauna of single-species plantation forests has been reported to be less diverse than that of natural or semi-natural forests (Helle and Mönkkönen, 1990; Baguette et al., 1994; Gjerde and Sætersdal, 1997; Fischer & Goldney, 1998; Twedt et al., 1999).

Comparison of species distribution in different physiographical condition showed that some species such as *Alnus subcordata*, *Parrotia persica*, *Rubus hyrcanus* and *Prunus sp* recorded in wide range of physiographic variables as elevation, slopes and aspects. Also the species like *Albizia julibrisin* and *Salix alba* recorded from low lands showed range altitude less than 400 MSL and *Quercus macronteria*, *Juglans regia* and *Zelcova azadrach* were in high altitude range 1200 to 1600 MSL. Many species had reaction to slopes and existence only in low slope lands, for example *Albizia julibrisin* and *Salix alba* grew in lands with slopes ranged 0 to 15 percent. The distribution patterns of vegetation and species diversity were often correlated with patterns of resource variation and resource gradients, which have been well established in vegetation science (Whittaker, 1967; Austin, 1990 and Zhang, 2002). Elevation gradient is one key variable that affects the variation of species diversity in communities and is frequently studied. Different plant functional groups may have different resource-use strategies, physiology, and competitive abilities (Lyon and Sagers, 2002 and Zhang, 2002).

Overall in this research obviously indicated that diversity indexes in natural pure stands are higher than plantation pure stands. For sustainable models simulation it is compulsory input some native trees and shrubs species in forest plantation. It can be utilized for silvicultural practices as plantation against degradation of forest ecosystems.

References:

[1]. **Abrary K. (1994).** Identification of different types of beech (*Fagus orientalis*) forests in different region of Khoske-Ab, Siyakle, Iran. M.S Thesis, University of Tarbiat Modarres. 78 pp.

[2]. **Ardakani, M. R., (2004).** Ecology. Tehran University Press, 340.

[3]. **Austin M. P. (1990)**, Community theory and competition in vegetation. In *J. B. Grace* and *D. Tilman* (eds.), Perspectives on Plant Competition. Academic Press, New York, pp.215-238.

[4]. **Baguette, M., Deceuninck, B., & Muller, Y., 1994.** Effects of spruce afforestation on bird community dynamics in a native broad-leaved forest area. Acta Oecologica, 15: 275-288.

[5]. **Bossuyt H. Six J. Hendrix P. F., (2005)**, Protection of soil carbon by microaggregates within earthworm casts. *Soil Biol Biochem* Vol. **37**:251–8.

[6]. **Cannell, M.G.R., 1999.** Environmental impacts of forest monocultures: water use, acidification, wildlife conservation, and carbon storage. New Forests, 17: 239-262.

[7]. **Chytry M. and Rafajova M. (2003),** Czech national phytosociological database: basic statistic of the available vegetation-plot data, Department of Botany, Masaryk University, *Kotlarska, Preslia, Praha,* Vol. **75**: 1-15.

[8]. **Dudley, N., (1992).** Forests in trouble. A review of the status of temperate forests worldwide. WWF, 260.

[9]. **Eshaghi Rad, J.; Manthey, M.; Mataji, A., (2009).** Comparison of plant species diversity with different plant communities in deciduous forests. Int. J. Environ. Sci. Tech., 6 (3), 389-394.

[10]. **Fisher, A.M., & Goldney, D.C., 1998.** Native forest fragments as critical bird habitat in a softwood forest landscape. Australian Forestry, 61: 287-295.

[11]. **Gjerde, I., & Sætersdal, M., 1997**. Effects on avian diversity of introducing spruce Picea spp. plantations in the native pine Pinus sylvestris forests of Western Norway. Biological Conservation, 79: 241-250.

[12]. **Groombridge B. (1992)**, Global biodiversity: status of the Earth's living resources: a report compiled by the World Conservation Monitoring Centre. Chapman and Hall, London, UK.

[13]. **Hartley, M.J., 2002.** Rationale and methods for conserving biodiversity in plantation forests. Forest Ecology and Management, 155: 81-95.

[14]. **Hector A. (1999)**. Plant diversity and productivity experiments in European grasslands. *Science,* Vol. **286**:1123–1127.

[15]. **Hector A. (1999)**. Plant diversity and productivity experiments in European grasslands. *Science,* Vol. **286**:1123–1127.

[16]. **Hector A., Schmid B., Beierkuhnlein C., Caldeira M.C., Diemer M., Dimitrakopoulos P.G., Finn J.A., Freitas H., Giller P.S., Good J., Harris R., Ho¨gberg P., Huss-Danell K., Joshi J., Jumpponen A., Ko¨rner C., Leadley P.W., Loreau M., Minns A., Mulder C.P.H., O'Donovan G., Otway S.J., Pereira J.S., Prinz A., Read D.J., Scherer-Lorenzen M., Schulze E.-D., Siamantziouras A.- S.-D., Spehn E.M., Terry A.C., Troumbis A.Y., Woodward F.I., Yachi S., and Lawton J.H. (1999),** Plant diversity and productivity experiments in European grasslands. *Science*, Vol. **286**: 1123–1127.

[17]. **Helle, P., and Mönkkönen, M., 1990**. Forest succession and bird communities: theoretical aspects and practical implications. in: A. Keast (ed.), Biogeography and Ecology of Forest Bird Communities. SPB Academic Publishing, the Hague, pp. 299-318.

[18]. **Hill, M. O., (1973).** Diversity and evenness: A unifying notation and its consequences. Ecology, 54 (2), 427-432.

[19]. **Hunter, M.L. 1990.** Wildlife, Forests, and Forestry: Principles of Managing Forests for Biological diversity. Prentice- Hall, Englewood Cliffs, N.J.

[20]. **Humphrey, J.W, Ferris, R., Jukes, M.R., & Peace, A.J., 2002.** The potential contribution of conifers plantations to the UK Biodiversity Action Plan. Botanical Journal of Scotland, 54: 49-62.

[21]. **Jastrow J.D., Miller R.M., Lussenhop J. (1998)**, Contributions of interacting biological mechanisms to soil aggregate stabilization in restored prairie. *Soil Biol Biochem*., Vol. **30**:905–16.

[22]. **Jong-Won, K. (1986),** A phytosociological study of Hokkaido, Japan, Korean *Journal of Ecology,* Vol. **12** (2): 109-122.

[23]. **Jong-Won, K. and Joon-Ho, K.(1988),** Phytosociological study on montane forest vegetation at Periphery of Seoul, *Korean, Journal of Ecology,* V.**11** (2): 97-107.

[24]. **Kessler M. (2001)**. Patterns of diversity and range size of selected plant groups along an elevational transect in the Bolivian Andes. *Biodivers. Conserv*., Vol. **10**: 1897-1921.

[25]. **Knight K.S. and Reich P.B. (2005)**, Opposite relationships between invasibility and native species richness at patch versus landscape scales. *Oikos*, Vol. **109**, 81–88.

[26]. **Lyon J. and C.L. Sagers (2002)**, Correspondence analysis of functional groups in a riparian landscape. *Plant Ecol.,* Vol. **164**: 171-183.

[27]. **Magurran, A. E., (1988).** Ecological diversity and measurement. Princeton University Press, Princeton, 354.

[28]. **McVean D. N. (1956),** Ecology of Alnus glutinosa (L.) Gaertn. V. Notes on some British alder populations. *Journal of Ecology,* Vol. **44**:321-330.

[29]. **McVean D. N. (1956a),** Ecology of Alnus glutinosa (L.) Gaertn. III. Seedling establishment. *Journal of Ecology,* Vol. **44**:195-218.

[30]. **Misra R. (1968),** Ecology workbook.Oxford and IBH publishing Co., New Delhi. pp 244.

[31]. **Moustafa, A.A and Zaghloul M.S. (1996),** Environment and vegetation in the montane Saint Catherine area, South Sinai, Egypt, *Journal of Environment,* Vol. **34**: 331-349.

[32]. **Naeem S., L. J. Thompson, S. P. Lawler, J. H. Lawton, and R. M. Woodfin (1994)**, Declining biodiversity can alter the performance of ecosystems. *Nature,* Vol. **368**:734–737.

[33]. **Naveh, Z.; Whittaker, R. H. (1980).** Structural and floristic diversity of shrublands and woodlands in northern Israel and other Mediterranean areas. Plant Ecol., 41 (3), 171-190.

[34]. **Nummelin M. and I.J.E. Zilihona (2004)**, Spatial variation of arthropod communities in virgin and managed sites in the Kibale Forest, western Uganda. *Forest Ecol. Manag*., Vol. **195**: 107-114.

[35]. **Pielou, E. C., (1975).** Ecological diversity. John Wiley and Sons, INC, 165.

[36]. **Pimm S. L., G. Russell J., J. L. Gittleman and T. M. Brooks (1995)**, The future of biodiversity. *Nature,* Vol. **269**:347–350.

[37]. **Raunkiaer C. (1937)**, Plant life forms. Oxford University press, London. pp 104.

[38]. **Regato-Pajares P., Elenna-Rosselo R. (1995)**, Natural Black Pine (*Pinus nigra* Subsp *Salzmanii*) Forest of Iberian Eastern Mountains: Development of the Phytoecological Basis For Their Site Evaluation, *Ann. Sci. For.,* Vol.. **52**: 589-606.

[39]. **Reich P.B., Oleksyn J., Modrzynski J., Mrozinski P., Hobbie S.E., Eissenstat D.M., Chorover J., Chadwick O.A., Hale C.M., Tjoelker M.G. (2005)**, Linking litter calcium, earthworms and soil properties: a common garden test with 14 tree species. *Ecol Lett.,* Vol. **8**:811–8.

[40]. **Sagheb K. and Sajedi T. and Yazdian F. (2003),** Forest of Iran. Research Institute of Forest and Rangelands. No. 339 -2003.

[41]. **Sagheb-Talebi, K., (2004).** Forests of Iran. Research Institute of Forests and Rangelands press, 90.

[42]. **Tilman D., D. Wedin, and J. Knops (1996)**, Productivity and sustainability influenced by biodiversity in grassland ecosystems. *Nature,* Vol. **379**:718–720.

[43]. **Tilman D., J. Knops, D. Wedin, P. Reich, M. Ritchie, and E. Siemann (1997)**, The influence of functional diversity and composition on ecosystem processes. *Science,* Vol. **277**:1300– 1302.

[44]. **Tilman D., J. Knops, D. Wedin, P. Reich, M. Ritchie, and E. Siemann (1997)**, The influence of functional diversity and composition on ecosystem processes. *Science,* Vol. **277**:1300– 1302.

[45]. **Tilman D., Wedin D., and Knops J. (1996),** Productivity and sustainability influenced by biodiversity in grassland ecosystems. *Nature*, Vol. **379**: 718–720.

[46]. **Tilman D., Wedin D., and Knops J. (1996),** Productivity and sustainability influenced by biodiversity in grassland ecosystems. *Nature*, Vol. **379**: 718–720.

[47]. **Twedt, D.J., Wilson, R.R., Henne-Kerr, J.L., and Hamilton, R.B., 1999.** Impact of forest type and management strategy on avian densities in the Mississipi Alluvial Valley, USA. Forest Ecology and Management, 123: 261-274.

[48]. **Vitousek P. M., H. A. Mooney, J. Lubchenco, and J. M. Melillo. (1997)**, Human domination of Earth's ecosystems. *Science,* Vol. **277**:494–499.

[49]. **Whittaker R. H. (1967)**, Gradient analysis of vegetation. *Biol.Rev*., Vol. **42**: 207-264.

[50]. **Zhang J-T. (2002)**, A study on relations of vegetation, climate and soils in Shanxi province, *China. Plant Ecol*., Vol. **162**: 23-31.

[51]. **Zhang J-T. 2003**, Applied Ecology. Science Press: Beijing. (in Chinese). 237 p.

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