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Differentiation Ecosystem Units of Caspian Forests in Relation to physiographic factor and Some of Soil Characteristics

A. Kialashaki[1 *] and S. Shabani[2]

[1]*Forestry, Iran- Mazandaran State, Nowshahr City, Islamic of Azad University, Iran*
[2]*Forestry, Tarbiat Modares University, Iran-Mazandaran State, Chalous City, Iran*

ABSTRACT

Due to differentiation ecosystem units and related soil physico - chemical and physiographic characteristics, 75 ha of virgin forest in Aghouzchal were studied. Vegetation data and information (trees, shrubs, and herbs) were collected from 60 sample plots with systematically random method (20 m × 20 m) which were then analyzed by using of TWINSPAN program. The data were classified to four ecological groups. Some of physical, chemical and characteristics of soil, such as soil acidity (pH), bulk density, soil moisture, organic carbon, total nitrogen, available phosphorous, soil texture litter carbon, and litter nitrogen were measured. Elevation, aspect and slope were recorded in every plot, too. Principal component analysis (PCA) was used to determine correlation as well as distribution in each ecological group of environmental factors. It was noticed that 2nd, 3rd ecological groups had the highest correlation with the 1st axes whereas 1st and 4th ecological groups demonstrated the highest correlation with the 2nd axes. The results indicated that the ecological group's distribution pattern was mainly related to elevation factor and soil characteristics such as pH, phosphorous, organic nitrogen, and soil nitrogen.

Keywords: Aghouzchal forest, Ecological Species Group, Environmental Condition, Iran.

INTRODUCTION

The temperate forests in north of Iran are the richest forests in world throughout (Marvie Mohadjer, 2005). The differences of physiographic and soil characteristics in forest sites created several plant community in this region (Zahedi Amiri, 1998). Relation between site conditions and plant vegetation surveyed in many researches (Whitney, 1991; Hix & Pearcy, 1997; Kashia & Barnes, 2000; Kashian *et al.*, 2003). Exist of environmental special condition such as light, moisture, temperature and soil characteristics incuse of creation of distinct plant composition that nee to ecological species group (Debinski & Holt, 2000; Witte, 2002). On the other hand ecological species group display relation between plant community and site environment. While often all species of a group occur together on a site, presence of one species of a group has been

interpreted to suggest that the site meets requirements of all species of that group (Kashian *et al*., 2003). Including several species in a group for indicating environmental conditions may compensate for absences of individual species resulting from reasons unrelated to environmental site factors (Barnes *et al*., 1998). This has been perceived as an advantage of using species groups, rather than individual species, for indicating environmental conditions (Host & Pregitzer, 1991).

So that described before, physiographic factor and soil characteristics are the best factors in severance of species group. In the dissected steep lands adjacent to the great escarpment of forest regions, plant community patterns show close relationships with landform and site attributes (Mc Nab, 1993). Notable among these patterns are consistent disjunctions between plant communities on opposing physiographic conditions. Physiographic factors are widely known as a factor potentially significant in generating differences in ecosystem characteristics. Its impacts are various due to its compound character, potentially encompassing external variables such as solar radiation budget, exposure to air streams, hydro meteoric inputs and cloud cover (Bale et al, 1998). Thus, the complex of these factors affected on the vegetation cover distribution.

Variation in soil resource levels is basic and important to plants, too (Fu *et al*., 2004). At relatively large spatial scales, the resources available to plants change as the soil type changes, and this variation has well known effects on the distribution and severance of plant species (Fu *et al*., 2000). At smaller spatial scales, soil resources continue to show considerable spatial heterogeneity, often down to the smallest scale at which measurements are taken (Jackson & Caldwell, 1993). Small-scale heterogeneity can have a large impact on the performance of individual plants (Vinton & Burke, 1995), and hence, on the structure and dynamics of plant populations and communities. The subjects displayed that soil characteristics in both situation large and small scale affected on the type of plant cover. This work aimed to study the effects of physiographic and soil factors on the ecological species group in north of Iran forests. We have one hypothesis for this study that consists of: soil factors are starker factors in severance species group in forest local.

MATERIALS AND METHODS

The understudy region in the Aghouzchal forest region in Mazandaran state is located in the northern part of Iran, having the northern latitude of 36º 32´ and eastern longitude of 51º 47´ standing at the height of 700 meters with the average slope of 30 % the average temperature for the coldest and the highest of the year is 0 and 32, respectively with the annual rainfall of 1100 mm. The kind of best rock involved is the Silt – Loamy and Clay -Loamy stone, and soil type is the forest brown. The trees species in region consists beech (*Fagus orientalis*) and maple (*Acer velutinum, Acer cappadocicum*), hornbeam (*Carpinus betulus*), alder (*Alnus subcordata*), wild cherry (*Prunus avium*), elm (*Ulmus glabra*) and wild service tree (*Sorbus torminalis*) and Lime tree (*Tilia begonifolia*).

This study does in area 75 ha of Aghouzchal virgin forests. 40 number plots with randomly-systematic methods with area 400 m^2 (20 m × 20 m) used for determination of plan cover (Kent & Cocker, 1994). The size of inventory lattice was 150 m * 200 m, also for sampling of plant cover inside every plot was recorded species name, species number, and cover percent of trees and shrubs (with measurement small and big diagonals) (Hedman *et al*., 2000; Grant & Loneragan, 2001). Inside every of this plots pitched microplots with area 1 m^2 and recorded be plant species name and cover percent of herby species (Hedman *et al*., 2000; Grant & Loneragan, 2001). Therefore inside every plots name of plant species recognized and abundance –

dominance of species was estimated with Braun – Blanquete paragon (Kent & Cocker, 1994). Elevation, aspect and slope were recorded in every plot, too.

Also for studying soil characteristics after species group determining, with randomly method for every ecological species group to take into consideration three plots and were graved soil profile (50 × 50 × 30 cm). Soil samples was separate for mineral and litter layers. Prior to the soil analysis, except for soil moisture content, all the soil samples were air-dried and sieved (<2 mm). Particle size analysis was carried out by the hydrometer method using sodium hexametaphosphate as a dispersant (Bouyoucos, 1962); pH was measured in distilled water and 1 MKCl (soil: solution ratio 1:2.5) with a glass electrode; total carbon was determined by dichromate oxidation (Walkley & Black, 1934), and it was converted to organic matter by multiplying the percentage of carbon by 1.72; total nitrogen was measured by the Kjeldahl method (1883). Available P was determined by Bray II method (Bray & Kurtz, 1945).

In this study for determination of ecological species group was used of TWINSPAN software, then with PCA analyzes was denoted slice of every one of factors in ecological species group segregation than other factors (Kent & Cocker, 1994).

RESULTS

For determination ecosystem units in region was used of TWINSPAN software. According to results, in first level 40 plots was divided to two groups, thus in left (negative) was settled 30 plots that was without indicator species, and in right (positive) was settled 10 plots that indicator's species consist of Fagus orientalis and epimedium pinnatum (Figure 1). In second level was settled in right 21 plots without indicator species and in left nine plots with indicator species inclusive Tilia begonifolia and Carex aquitformis (Figure 1). In tertiary level 21 plots was divided to two groups, thus was settled in right eight plots with indicator species inclusive Acer cappadocicum and Tamus communis, and in left 13 plots with indicator species inclusive A. cappadocicum, Alnus subcordata and Lamium album (Figure 1). Therefore was created four ecological species group that consist of: group (A): Fagus orientalis and Epimedium pinnatum; group (B): Acer cappadocicum and Tamus communis; group (C): Acer cappadocicum, Alnus subcordata and Lamium album; and group (D): Tilia begonifolia and Carex aquitformis (Figure 1).

Placing situation of every one of ecological species group are reported in figure (2). B and C groups with first axis, and A and D groups with second axis have high correlation. B and C groups have intense propinquity together and see both of them in right of first axis (Figure 2). Thus observe that every ecological specie group with one axis had intense propinquity and this placing condition of ecological species group in axis space is reflex of species response than environmental factors. Figure (3) are displayed distribution and terrestrial position of environmental factors in PCA analyze in Aghouzchal forests. Therefore is distinct that variables consist of Sand, soil moisture, pH, N soil, N litter, P, and Bd in first axis right had created a group that show physical and chemical characteristics in that group (Figure 3). Silt and slope placed in left before group. Also in negative position of first and second axis a group consists of C soil, C/N litter, C/N soil, elevation, aspect, C litter, clay and silt is created that display environmental condition in this group (Figure 3).

DISCUSSION AND CONCLUSION

According to results about soil physical and chemical characteristics and physiographic factor can be elevation is best physiographic factor and pH, litter and soil nitrogen and phosphorous are the best soil variables in severance ecological species group in this study (Table 1). First axis with fertility variables and second axis with components of forest soil physical had showed the best correlation. Thus, can say charactersistics of first axis are very important in severance ecological species group in region. This result is according to Zahedi Amiri and Mohammadi Limaei (2002); and Mahmoudi *et al* (2005). In this study Bd and soil texture wasn't very operative in severance of species group. Soil texture is characteristic that change in far distances and seldom (Muscolo *et al*., 2007). The level of soil texture can affected on Bd and to be this probable that naught high changes in soil texture reason constancy of Bd (Fallahchay & Marvie Mohadjer, 2005). Whatever from axis left pass to axis right changes pH soil and pH desire to be alkaline and finally settle calcimorph species. Soil pH is one of important affective variables in severance of society and ecological groups (Zahedi Amiri, 1998). Soil moisture in second and third species groups was maximum and had show relative addend value. Whatever of second and third groups moved to position of first and fourth groups decreased influence of phosphorous. Phosphorous is one of important soil variables, that had settle under effect soil moisture and micro organism activity (Doweling *et al*., 1986; Dodor & Tabatabai, 2003). This element is variable that have high role in severance of ecological species group. Also, nitrogen as one of the important effective factor on specie group type is in this study that according to results Rastin (1992); and Nakano and Miauchi (1996). Thus B and C groups to reason contain of Acer and Alder created litter and soil with the high level of nitrogen that have increasing role on spreading plant cover in this region. Leaves, branches, buds and seeds of these trees have high amount of nitrogen that with decaying increased the amount of nitrogen in soil (Michael *et al*., 1999). The nitrogen elements similar to phosphorous have intense effect in severance B and C groups than other groups.

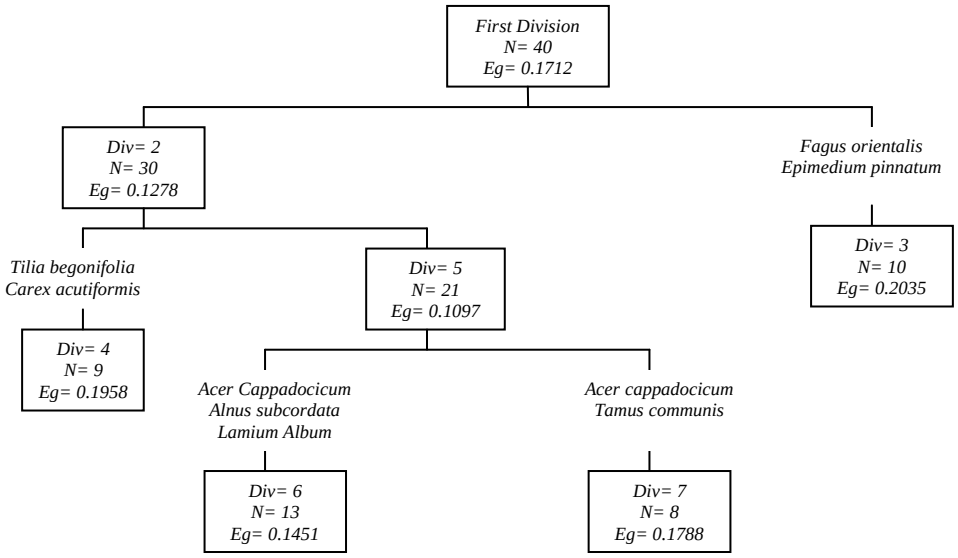

Figure 1. Classification of plant covers information in Aghouzchal forest with TWINSPAN

The PCA results on measuring environmental factor in region show those first and second principle components explain 77.93 and 18.75 of plant cover changes, respectively. Between environmental factors toward B and C groups nitrogen and phosphorous had higher Eigen values. Thus, can be that group (B) with species Acer cappadocicum and Tamus communis; and

group (C) with species Acer cappadocicum, Alnus subcordata and Lamium album high set under effect nitrogen and phosphorous. Also can described that elevation is importance factor in severance group A (Fagus orientalis and Epimedium pinnatum) with other groups. Slope factor can know operative on group D (Tilia begonifolia and Carex aqutiformis) distribution in region, too.

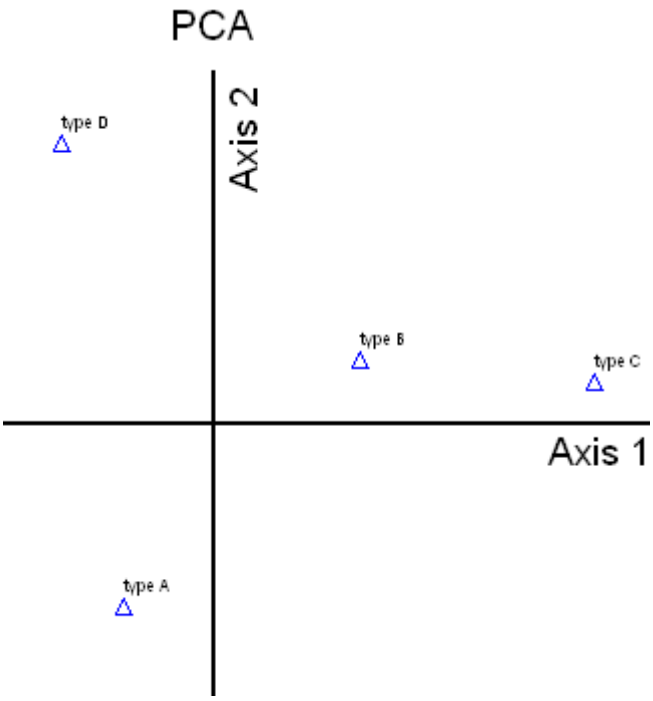

Figure 2. Distribution of ecological species group in PCA

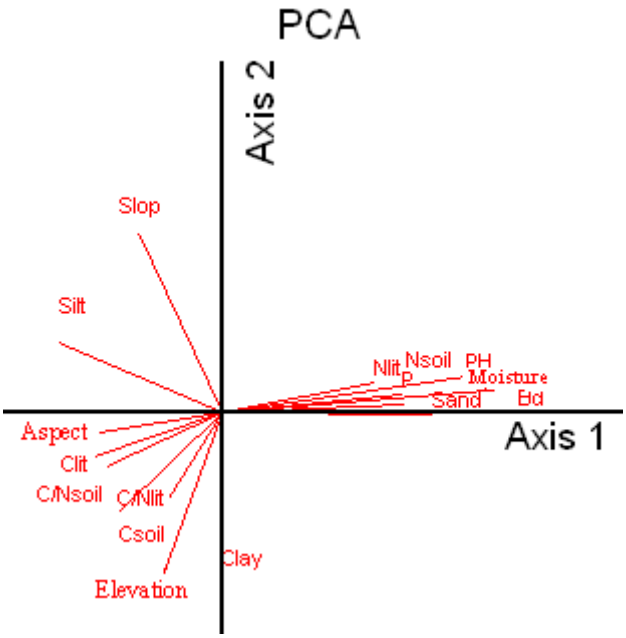

Figure 3. Distribution of environmental factors in PCA

Ecological species groups reflect the total site complex, and in conjunction with climate, physiography, and soil, they are useful in distinguishing landscape ecosystems at multiple scales. The approach is also applicable to ecosystems characterized by a wide range of disturbance regimes. Although the potentially large number of ground flora species present may intimidate

the investigator attempting to utilize vegetation for ecosystem classification, often only a few key species or groups of species are needed to distinguish sites and thus may be quite useful and hence efficient in differentiating and mapping ecosystems in the field. Ecosystems are best distinguished by employing a multifactor approach, requiring an understanding of site factors as well as biota, all operating together as a cohesive ecological system. As such, ecological species groups are vital in their role of classifying ecosystems, whether the objective is preservation, conservation, or management of forests or wildlife.

Table 1. PCA analyze oft environmental factors in ecological species group in forest region

Rank	Environmental factors	Second principle component	First principle component
1	Soil acidity (pH)	0.28	- 0.10
2	Bulk density (Bd)	0.23	- 0.20
3	Moisture	0.25	- 0.16
4	C lit	- 0.22	- 0.06
5	C soil	- 0.20	- 0.22
6	N lit	- 0.28	0.005
7	N soil	0.21	- 0.08
8	C/N lit	- 0.20	- 0.15
9	C/N soil	- 0.19	- 0.09
10	Phosphorous (P)	0.28	- 0.05
11	Sand	0.25	- 0.22
12	Silt	0.02	0.15
13	Clay	- 0.18	- 0.24
14	Elevation	- 0.28	- 0.01
15	Slope	- 0.19	0.24
16	Aspect	- 0.25	- 0.26

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