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ORIGINAL ARTICLE **OPEN ACCESS**

Assessment of the Plant Biological Diversity and soil characteristics in the net ash tree stand and in mixture with beech (a case study of Lavij-Noor, Iran)

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ABSTRACT

The present study has been done to evaluate the impact of pure Ash mass and mixed that with beech on The herbaceous coating biodiversity and soil properties in the jungles of Noor city. There is a unique mass of Ash in the jungles of Noor city and at 1900-2100 meters, above sea level which is rarely seen like that in the northern jungles of Iran. Shannon Wiener diversity indexes (H΄), Simpson index of dominance (D), Margalef richness (R_1) and Pilo uniformity were used to analyze biodiversity. Sampling was conducted also, to investigate physical and chemical properties of soil (Bulk density, acidity, electrical conductivity, soil moisture, soil lime, Nitrogen and organic carbon) in each sample plot and at two depths (10 and 20 cm) were sampled. It should be noted that, the total number of 26 soil samples (13 soil samples at each depth) in pure Ash mass and 24 soil samples (12 soil samples at each depth) from this type of mass mixed with Beech dominance were taken. The results of plant species biodiversity showed that, between the pure Ash mass and mass mixed with Beech, there is a meaningful difference at the 99% probability level in terms of Shannon-Wiener diversity, Margalef richness, and Simpson dominance. There is also a meaningful difference at the 95% probability level between the two masses under study in terms of Pilo uniformity index. The results of soil factors also showed that, at the depth of 10-20 cm, acidity factor has meaningful difference with its adjacent mass at the 99% probability level. There is also a meaningful difference at the 99% probability level in terms of acidity (0-10) cm and soil moisture at the depth of 10-20 cm between the two areas, but there isn't any meaningful difference between the areas under study in terms of electrical conductivity and lime factors in two depths and also, moisture content at the depth of 0-10 cm. It should be noted between the mass and soil nitrogen, organic carbon and Bulk density parameters in both depth (0-10 and10-20) significant difference at 95% confidence level is shown.

Keywords: *Ash, biodiversity, pure mass, soil, Iran*

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INTRODUCTION

Currently, there is a sharpened debate about the importance of preserving biological diversity. Along with the degradation of natural resources, so many animal and plant species undergoes the risk of extinction which could adversely affect global biodiversity as well. Environment protection measures could not be realized until the vegetation cover and biological diversity of the region of interest is completely comprehended. Identification of plant species, the assessment of biological forms and plant geography of the region are not only of fundamental importance for environmental studies, but also they determine the regional capacity for multiple purposes for the current and upcoming periods [1].

The term biodiversity includes biodiversity and ecosystem diversity, but at the local and regional scale, species diversity makes up the main part of biodiversity. The species diversity is formed by two indices of species richness and uniformity index. The first indicator is the number of species and the second indicator is concerned with the distribution of the species biomass. In addition to the number of species, Species diversity can be defined in terms of cover or biomass. So as a practical measure, estimating species diversity is often based on sampling [2]. Habitats that have more biodiversity are considered to be more fertile, dynamic and ecologically sustainable in response to changes times [3].

Soil is among the most important factors in determining and assessing the status of biodiversity. In fact, soil is known as an important part of the ecosystem which plays an important role in the development of forest vegetation and the improvement in the quality of biodiversity [4]. Soil and vegetation development is a complex process resulting in changes and differences in soil characteristics, which per se affects the

composition of forest vegetation and its growth rate [5]. In fact, what affects the absence or presence of species, are the physical and chemical soil and topography factors. Thus for evaluation and classification of habitat fertility and its classification, understanding soil's physical, chemical and biological characteristics are essential [6].

On account of the discussions on the management of the sustainability of forest ecosystem's products, the need to evaluate soil properties have risen [7]. To examine the habitat fertility and its classification, understanding the physical, chemical and biological soil quality criteria is obligatory [8] because these features are often spatially and temporally significant different [9].

Ash trees is basically heliophyte, Mesophytes with high nutrient demand which are characterized with a broad dense canopy. However, beech trees are sciophytic with a dense broad crown. On account of the differences in the structure and amount of light passing the canopy and reaching the forest floor which is an important determiner of understory vegetation growth, and given the differences in soil characteristics in the two stands, this study set out to identify the biological diversity in the forest conservation projec's domain of Lavij, Mazandaran province.

Since the establishment and growth of plant species depends on soil and the plant composition, this study strives to find answers to the following questions:

- Whether the soil under the ash tree stand is richer compared with the beech tree stand.
- Whether the biological diversity in the ash tree stand is richer compared with the beech tree stand.

MATERIALS AND METHODS

Covering an acreage of about 17 hectares, the study area lies between 36 17 19 and 36 17 52N and from 52 04 09 to 52 04 58 E at an elevation range of 1900 to 2100 m asl. in Noor urban district in Mazandaran Province. The two stands cover an area of about 10 and 7 ha respectively. It should be noted that the two adjoining stand are totally similar in terms of elevation, slope gradient, and sloping direction.

Methodology

Sampling was carried out on a grid with the dimensions of 50 × 100m on each row every 50 meters using rectangular plots with dimensions of 30 × 20 m. A total of 28 plots in the homogeneous ash tree stand and 24 plots in heterogeneous stand were established. Then, to measure biodiversity in each of these segments, the percentage of herbaceous species in both stands was calculated. Sampling in each plot was carried out at two depths of 10 and 20 cm. soil samples were then transferred to the lab for further analysis including: Bulk density by the cylinder (ring) technique, moisture content by weighing and drying, chemical properties of the soil such as: total nitrogen content according to the Kjeldahl method, soil organic carbon according to the Walkley-Black method, carbonate content according to the calcimetry method, pH by using a pH meter, and electrical conductivity using EC meter [10].

Data analysis

To compare biodiversity in the two populations, the percentage coverage of herbaceous species per plot and each stand were introduced into the Past software and the diversity, richness and uniformity were respectively measured by Shannon-Wiener index, Simpson, Margalov index and Pilo index. Then to analyze the terrestrial biodiversity and soil data, SAS software version 9.1 was used. mean comparison was done with Excel software based on the SNK method.

RESULTS

Biodiversity grass

The results showed that the Shannon-Wiener diversity index, Margalov index, Simpson dominance index were significantly different between the two populations at the 99% probability level. In terms of Pilo's uniformity index there was a significant difference between the two populations at the probability of 95% so that the amount of all indices were higher in the homogeneous Ash tree stand compared to the heterogeneous stand (Fig 1).

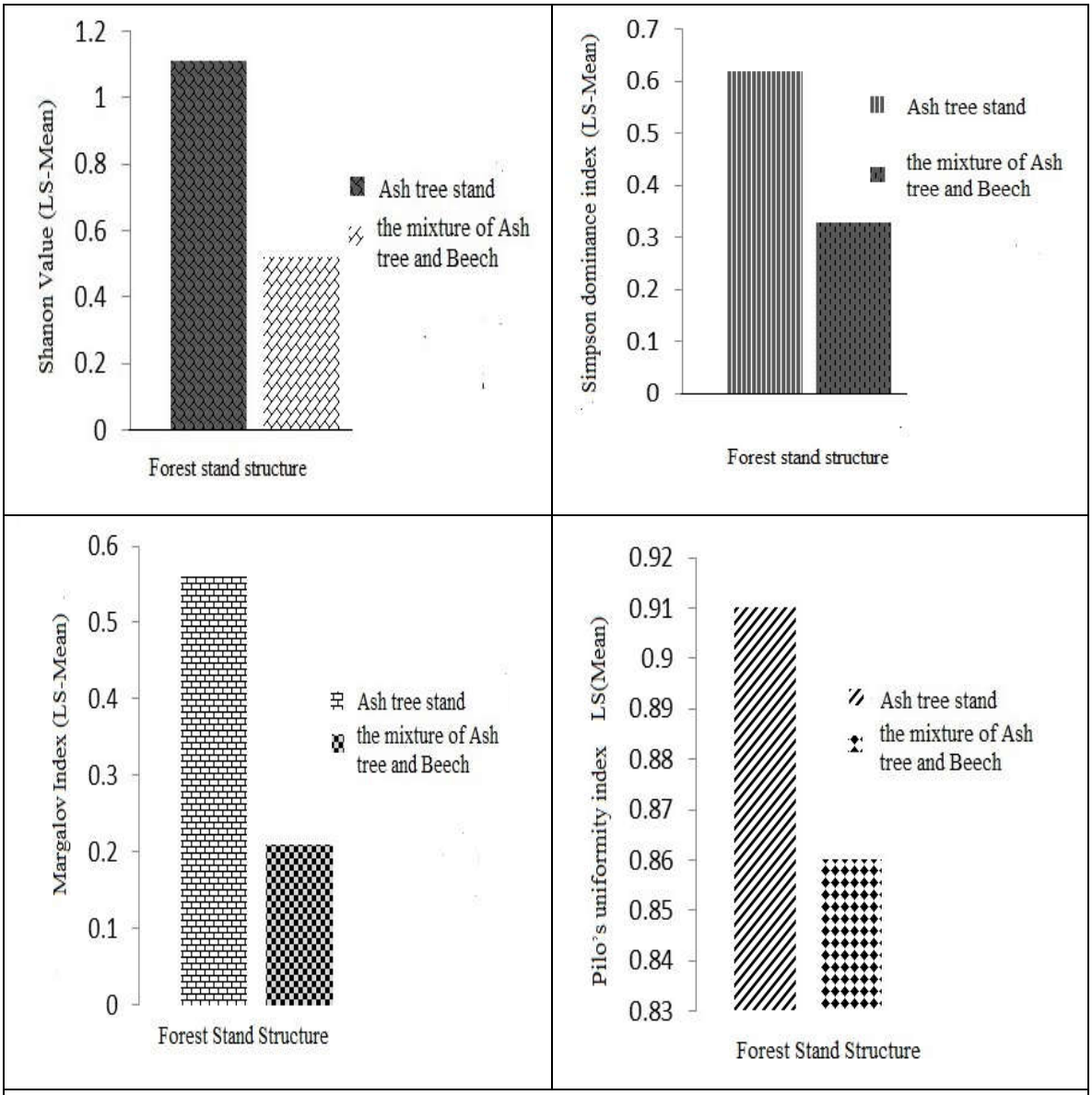

Fig 1. The biodiversity index in the homogeneous Ash tree stand compared to the heterogeneous stand

The results of the soil per depth in the homogeneous Ash tree stand and heterogeneous stand as the mixture of Ash tree and Beech:

The results of the study of the soil factors in relation to Snk test showed that the pH factor at a depth of 10-20 cm was significantly different between the stands at the level of 99%. In terms of nitrogen, organic carbon and soil bulk density there was significant difference between the two populations in both depth (0-10 and 10-20cm) at the probability of 95%. In terms of acidity (0-10cm) there was a significant difference between the two stands at the probability of 95%, but in terms of electrical conductivity and carbonate, no significant difference was observed at the two depths between the stands. The results of carbon to nitrogen ratio show significant difference at 99% at the depth of 0-10cm and at 99% in the depth of 10-20cm (Fig 2).

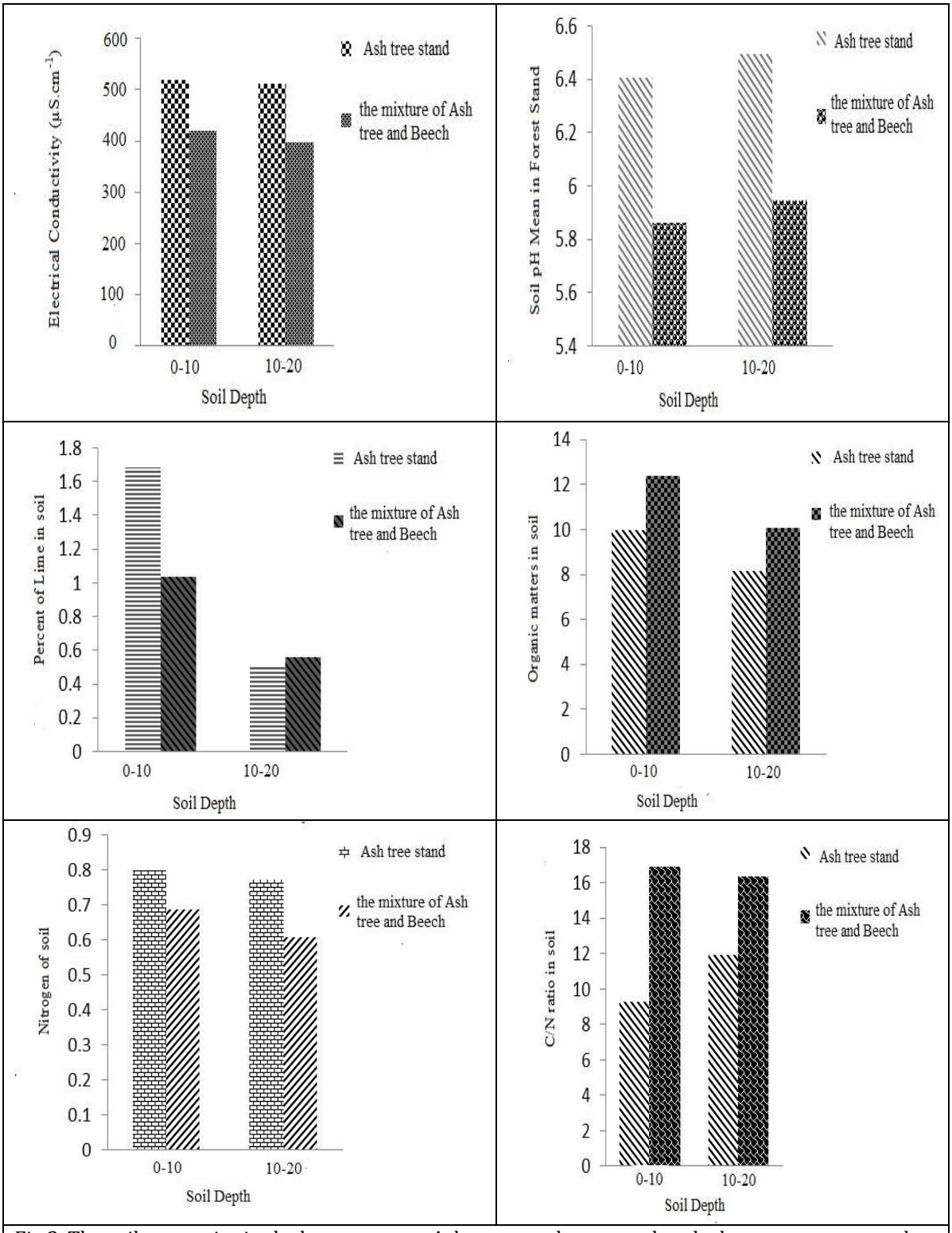

Fig 2. The soil properties in the homogeneous Ash tree stand compared to the heterogeneous stand

DISCUSSION AND CONCLUSION

In an ecosystem, plants and other parts are closely interrelated and each plays a crucial role in the ecosystem [11].

By observing the appearance of ground vegetation it becomes clear that these species choose their habitat based on their ecological nature [12]. One of the main factors influencing the distribution of plant communities is soil [13]. Comprehending the characteristics of soil is one of the basic principles of management of forest ecology that influence many silviculture and ecology options. In other words, the presence of a species in the plant community is associated with soil characteristics of the area [14].

What adds importance to the biodiversity is its role in maintaining the stability of ecosystems because the presence of more species in a region enhances the structure of the ecosystem, which improves ecosystem stability in response to changes. Diversity and species richness indices are changed by environmental factors [15]. Typically as the habitat biological diversity increases so does the ecological sustainability and ecosystem fertility which result in a more developed soil [16]. Generally speaking, attempting to comprehend the interrelations of indices could led to better understand the ecosystem itself [12]. The species of the forest floor are more sensitive to changes in environmental conditions, in particular soil. These species could be considered as proxy of biological conditions which indicate general soil characteristics [17].

Indicators of richness, biological diversity and uniformity

Lower biological diversity in the beech stand could be explained by reduced light, acidic soil and accumulation of litter which restrict plant growth. However, in the Ash tree stand, high soil nitrogen content because of rapid litterd decomposition, being located in the lowed parts and due to enjoying better moisture, have resulted in an improved species diversity which agrees to the findings of [18, 19].

Physical and chemical properties of soil

In the present study the physical and chemical characteristics of the soil had significant differences between the two populations. The lowest and highest pH values were measured respectively in the beech and ash tree stands. This is attributable to the slow rate of litter decomposition as a result of high lignin content, high C/N ratio, and high stem flow rates compared with the ash tree stand [20] which result in soil acidification. Obviously, changes in soil pH could led to alterations in nitrogen uptake and microorganism's activity, and nutrient availability at different depths [21].

Increased soil moisture content at the soil surface in the ash tree stand compared with the beech tree stand, stems from higher litter decomposition and hence soil organic matter in a sense that with higher soil organic matter, soil moisture also increases [22].

Results suggest that soil bulk density is comparatively lower in the homogeneous ash tree stand at both depths. Soil bulk density is a determiner of plant species distribution. This factor is inversely related to soil organic matter. Soils with higher bulk densities are more compact with less organic matter which restrain the establishment of new plant species [23].

Carbon and organic matter deeply influence soil chemo-physical and biological properties. The results of this study indicated that soil organic carbon differs at both depths between the two stands at the probability of 95%. Soil organic carbon decreases from the first depth (0-10cm) to the second depth (10-20cm). Higher soil organic carbon in the first depth pertains to the buildup of the litter which enhances soil physical and biological properties.

The most significant determiner of soil's mineral content is EC. Higher soil minerals result in higher EC values. Lower EC values in the heterogeneous stand could be attributed to the higher slope gradient and the existence of a parent material with proper drainage.

Ash tree stand's soil was comparatively richer because of the abundance of understory vegetation cover. Nitrogen is the most significant determiner of plant growth which is bonded in the organic compounds in the soil. Organic matter decomposition and humidification depends on the factors like temperature, moisture, its origin, and the nitrogen content in the litter [24]. Cannel and Dewar [25] studied the changes of C/N ratio as the proxy of litter decomposition. Fu et al [26] in his study, evaluated the relationships between soil, topography and species diversity in the broadleaved forest of Bijing region in China. Their study revealed that among soil properties, organic matter and total nitrogen have the greatest influence on vegetation.

The findings of the current study shows that species diversity indices are not good proxies alone for the maintenance of ecosystem stability and health. To attain a stable and healthy ecosystem, species nature, demands and biological conditions have to be identified.

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