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-RESEARCH ARTICLE-

The comparatively examination on some bio-ecological properties of two scot pine forests on Koyulhisar, Sivas

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Abstract

Scots pine forest properties will help us in obtaining information about how to use the forests within the system and about their capacity, as well as learning their bio-ecological features. Such information will support the knowledge about their protection and use conditions. This study aims to reveal the bio-ecological characteristics of the Igdırdag and Sisorta scots pine forests in Koyulhisar. Also, to compare two scots pine forests in terms of their characteristics. Five stations were determined in each forest. The geographic position was determined with GPS and 15 scots pines were randomly selected for each station. The age, the bark thickness, the tree height and the diameter were measured. The amount of accumulated litter on the soil surface and the physical properties of soil were also determined in the laboratory. Sisorta scots pine forest had higher elevation and lower slope, and also, scots pine tree in Sisorta has larger diamter. In terms of soil properties, the soil of Igdırdag scots pine forest had higher lime content than Sisorta scots pine forest. Aspect of each station in two forests is different from each other. The two forests had similar properties for scots pine properties except diameter. Similarly, soil properties except lime content show homogeneity. Aspect and slope of each station could be cause those differences. The more researcher stated that shading aspect is positively effect on site index for different species. In conclusion, Koyulhisar scots pine forests is healty. The increasing human population has a negative impact on the forest and the establishment of new forests is unavoidable.

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Introduction

Forests are a natural source offering many economic, ecological, social and cultural benefits (OGM, 2014). Forests as an ecosystem are a living system, as mutually interact with each other in other plant and animal communities and microorganism in the soil. Sanderson et. al., (2002) stated that the most of world's ecosystem including forest are affected by humans activity. Continuity of this priceless natural resources depends on administration with the principles of sustainability (OGM, 2014). Based on latest inventory assessments (ENVANIS), there is around 21.9 M ha of forest in Turkey (27 % of the country), 54 % considered "productive" (above 10 % of forest cover) and 46 % considered "degraded" (between 1 % and 10 % of forest cover) (Bouyer & Serengil, 2016) and 50 % of all over forests are coniferous. The most common species in Turkey forests is red pine (27 %). The distribution of forest area by region changed between 3 % and 24.9 %. Scots pine, which has the widest geographical distribution within the existing pine species that about 3700 km width and 14700 km in length has a wide natural range in Europe and Asia. Scots pine shows a wide spread between 38° 34', 41° 48' north latitude and 28° 00', 43° 05' east longitude. It can seen around the Black sea region (Of and Surmene town), whereas, can seen range up 2100 at Artvin and Rize province. Moreover, scots pine can shows spread on Zigana and Ilgaz mountain, Giresun, Amasya, Sinop, Ayrancık, İnebolu, Boyabat, Tosya ve Kastamonu. In total, 738192 ha covered by scots pine in Turkey.

There are few studies on increment and growth of scots pine in Turkey. As a result of analysis of the statistics, Boydak, (1982) investigated how effective the factors determined by the end effect on the planting interval and, suggested the planting intervals for pure scots pine reforestion. Çepel & Dündar (1983) researched to relationship between increment and relief and soil properties of the scots pine on Aladağ, Bolu. Çepel & Dündar (1985) investigated on the relationship between level of the nutrients in needle leaves and high increment in the scots and red pine forests. Atalay (1998) investigated the factors affecting efficiency in reforestation in 54 sample areas for scots, black and red pines forests. Fakılı (2012) researched growth characteristics of scots pine stands in Ankara-Çamlıdere region. He collected his data from 51 plots, age between 62-142, site quality between I-V and density degree between 0.2-0.8. Şenyurt & Saraçoğlu (2012) proposed to develop site index models and tables for estimating forest site quality for Scots Pine in West Black Sea Region including Kastamonu, Bolu, Zonguldak and Ankara Regional Forest Directorates. For this purpose, they obtained 100 temporary sample plots from study area. Similarly, Kahriman & Yavuz (2012) researched that variable density yield tables were developed for Scots pine and oriental beech mixed stands in Black Sea Region. The data used for this study were obtained from 162 temporary sample plots measured in evenaged Scots pine and oriental beech mixed stands. There is a few research on soil properties such as pH and lime content for scots pine forests. Tolunay, (2003) investigated soil properties on the upper soil layer (A horizon) for scots pine stands in Bolu Aladağ. Similarly, Gol et al., (2010) investigated soil pH for fir and scots pine stands in Ilgaz mountain. Soil properties in Ardahan Yalnızçam and central region were investigated by Özdemir, (2011). Zengin, (2010) investigated soil properties for scots pine soil in Alucra, Giresun.

Scots pie forests, one of the principal types of Turkey, can be divided in forests with heights up to 20-40 m and slim trunks in the youth period, gabled withthin branches, well-rounded trunks in old ages and broad-leaved according to their different habitats. Such classification will help us in obtaining information about how to use the forests within the system and about their capacity,

as well as learning their bio-ecological features. Such information will support the knowledge about their protection and use conditions. It is important to monitor forests in order to understand the impacts of global climate changes on terrestrial ecosystems. To characterize forest changes, it is useful to parameterize a forest using several parameters, such as biomass, basal area, tree density, tree height, and trunk diameter (Kim & van Zyl, 2001). This study aims to reveal the bio-ecological characteristics of the Igdırdag and Sisorta scots pine forests in Koyulhisar. Another purpose is to compare these two forests in terms of their characteristics. For this reason, the age, the bark thickness, the tree height and the diameter was measured and also the amount of accumulated litter on the soil surface and the physical properties of soil were also determined. Moreover, slope, evelation, aspect of each station and geographic position were determined for each station in study area.

Materials and Methods

The study area is Igdırdag and Sisorta scots pine forests, located Koyulhisar town in Giresun Forest District Directorate and, five stations were determined in the each forest area and 15 scots pines were randomly selected for each station (Figure 1). The research was conducted in November of 2015 for Igdırdag forest and, in May of 2016 for Sisorta forest. A part of this study, including only Igdırdag scots pine forest results, were presented as a poster on International Forestry Symposium (IFS) in 2016. This study was expanded by obtaining the information and data of the Sisorta scots pine forest, and the two scots pine forests in the Koyulhisar were compared.

The geographic position was determined with GPS (GARMIN OREGON 650). The slope of the sample area and elevation was measured with clinometer (LECIA) and GPS (GARMIN OREGON 650), respectively. The aspect of each station was determined with compass (BRUNTON). Tree height was measured three times by the Blume-Leiss hypsometer (Carl Leiss, Berlin, Germany), and the average value was used as the tree height value (Yan et al., 2012) and, the diameter was measured with caliper (Haglöf Mantax Blue). Bark thickness was measured using a standard thickness gauge (Haglöf, Barktax, Sweden) (Lawes et al., 2011), and age determined with increment borer and spoon (Haglöf Sweden AB) (Barrett & Arno, 1988).
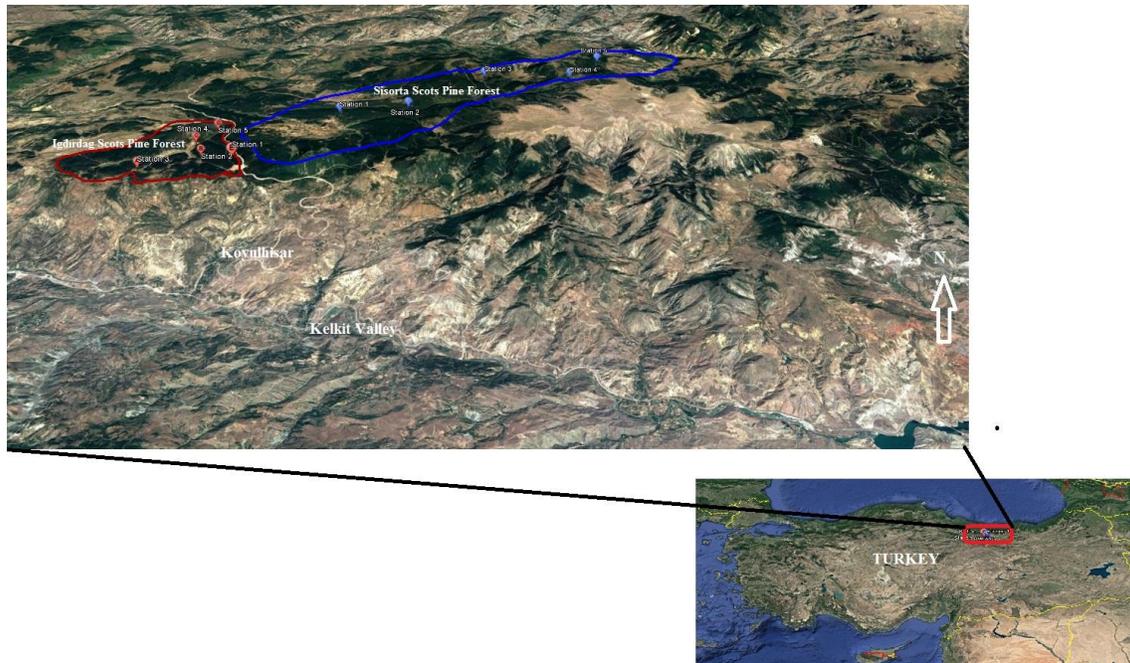
Figure 1. Igdırdag and Sisorta scots pine forests and each stations

The amount of accumulated litter on the soil surface and soil samples were collected from each station. In each station, the accumulated litter on soil surface (leaves, branches, cones, seeds, etc.) was taken up till mineral soil with sampling area (25 x 25 cm). The samples after extracted from stone and, soil were transferred to the laboratory and dried to a constant mass at 105 °C (NUVE, FN5OOi) which lasted for 24 hours. Later, dry weight was determined. Soil samples were taken from 0-10 cm depth for each station, and transferred to laboratory. Each soil samples was allowed to dry on blotter. Later, soil samples was made ready for analysis by sieving (2 mm). pH and total salinity was determined in the the soil-water mixture (ratio is 1: 2.5) with pH meter and Wheatstone bridge, respectively (Jackson, 1958; U. S. Salinity Laboratory Staff, 1954). Lime content ($CaCO_3$) was determined by Scheibler kalsimetre (Çağlar, 1949).

Data were examined for confirmation of assumptions of normality (Kolmogorov – Smirnov test) and homogeneity of variance (F_{max} test). The statistical differences of bio-ecological characteristics between Igdırdag and Sisorta scots pine forests were tested by non-parametric Mann-Whitney U test and, the correlation of bio-ecological properties with each other was tested with nonparametric Spearman's Rho. Some soil properties and accumulated litter on the soil surface were compared with parametric test ANOVA. All P-values were compared to a level of 0.05, and all analyses were conducted with the Statistical Package for Social Sciences (SPSS) version 17.0 statistical package. All means are presented with ± S.D. and range (min – max).

Results

In total, 150 scots pine were randomly chosen and measured. Tree height and diameter were measured for every scots pine tree, whereas, bark thickness and age were taken only 5 scots pine tree in each station. Geographic properties of the scots pine forests are shown in Table 1. As the seen in Table 1, the mean elevation is 1653.4 m ± 60.39 (1580 – 1710) for Igdırdag and, 1857.4 m

± 176.9 (1675 - 2052) for Sisorta. Also, the mean slope is 19.4 ± 5.4 (12 - 25) for Igdırdag and 8.4 ± 5.6 (2 - 14) for Sisorta.

Table 1. Geographic properties of each station at research area

Forest	Station	Coordinate	Slope (%)	Aspect	Elevation (m)
I G D I R D A G	1	X:4466209 Y:399712	12	North-Northeast	1707
	2	X:4466673 Y:398539	25	East	1670
	3	X:4465900 Y:396453	15	East	1710
	4	X:4468281 Y:398417	25	East-Southeast	1600
	5	X:4469201 Y:398770	20	South-Southeast	1580
	Mean		**19.4**		**1653.4**
S I S O R T A	1	X:40304 4 Y:4470162	2	Agora	1675
	2	X:41240 7 Y:4472732	9,5	East	2004
	3	X:40500 4 Y:4470440	13,3	South-Southeast	1678
	4	X:40821 3 Y:4472860	14	West-Southwest	1878
	5	X:41205 0 Y:4471961	3	South	2052
	Mean		**8.4**		**1857.4**

The descriptive statistics of the each feature of scots pine forests are shown in Table 2. The mean tree diameter is 34.3 cm ± 6.41 (22 – 55) for Igdırdag and, 38.7 cm ± 9.98 (22 – 66) for Sisorta, the mean tree height is 20 meter ± 3.66 (11 – 28) for Igdırdag and, 20.6 meter ± 2.37 (16 – 27) for Sisorta, the mean age is 91.7 years ± 11.95 (69 – 122) for Igdırdag and, 97.2 years ± 16.1 (75 – 130), the mean bark thickness is 2.7 cm ± 0.96 (1- 5) for Igdardag and, 2.5 cm ± 0.71 (1.3 – 4.6) for Sisorta were calculated for Igdırdag scots pine forest. As a result of comparison of the bio-ecological characteristics of the scots pine forests, there was statistically significant difference in tree diameter between scots pine forests (Mann-Whitney U = 2095.5, P = 0.007). Sisorta scots pine forest has larger diameter than Igdırdag scots pine forest. Furthermore, there was statistically significant difference in slope between forests and, Igdırdag scots pine forest has bigger slope than Sisorta scot pine forest. However, there was no statistically significant difference between the forests in terms of tree hight, age and bark thickness (P > 0.05). Also, there was no significant difference in mean elevation of the forests (P > 0.05).

Table 2. The descriptive statistics of the each properties of scots pine

Properties	Forest	N	Mean	Sd.	Min.	Max.
Diameter (cm)	Igdırdag	75	34.3	6.41	22	55
	Sisorta	75	38.7	9.98	22	66
	Toplam	150	36.5	8.64	22	66
Tree Hight (m)	Igdırdag	75	20	3.66	11	28
	Sisorta	75	20.6	2.37	16	27
	Toplam	150	20.3	3.08	11	28
Age (Years)	Igdırdag	25	91.7	11.95	69	122
	Sisorta	25	97.2	16.10	75	130
	Toplam	50	94.4	14.30	69	130
Bark Thickness (cm)	Igdırdag	25	2.7	0.96	1	5
	Sisorta	75	2.5	0.71	1.3	4.6
	Toplam	100	2.6	0.78	1	5

The properties of scots pine obtained from all stations are tested in relationships to each other and, correlation values are given in Table 3. As the seen in Table 3, the diameter was positively correlated with tree hight, age and bark thickness. However, there is no significant correlation between the geographic features of forests and the bio-ecological properties of the trees. In other words, the bio ecological properties of trees were not affected by the slope and elevation in scot pine forest on Koyulhisar.

Table 3. The correlation values for all properties at stations

Properties	Spearman's rho	Diameter (cm)	Tree Hight (m)	Age (Years)	Bark Thickness (cm)	Elevation (m)	% Slope
Diameter (cm)	Correlation	1.000					
	P (2-tailed)	.					
Tree Hight (m)	Correlation	**0.296**	1.000				
	P (2-tailed)	**0.000**	.				
Age (Years)	Correlation	**0.411**	0.270	1.000			
	P (2-tailed)	**0.003**	0.058	.			
Bark Thickness (cm)	Correlation	**0.678**	0.108	0.175	1.000		
	P (2-tailed)	**0.000**	0.283	0.224	.		
Elevation (m)	Correlation	0.345	-0.025	-0.018	0.386	1.000	
	P (2-tailed)	0.328	0.946	0.960	0.270	.	
% Slope	Correlation	-0.012	-0.130	0.000	0.006	-0.608	1.000
	P (2-tailed)	0.973	0.721	1.000	0.986	0.062	.

The mean pH value of the soil samples that taken from 0-10 cm depths of both scots pine forests was measured as 5.67 (5.15 - 7.2) (Table 4). Both forests examined were determined to be middle acidic. In the Igdırdag scots pine forest, the pH value was changed from 5.28 to 7.2 and, the mean value was 5.89. Similarly, pH value in Sisorta scots pine forest was changed from 5.15

to 5.60 and, the mean value was 5.45. The mean lime content (CaCO$_3$) 2.5 (%) for Igdırdag and, 0.14 (%) for Sisorta was measured (Table 4). The mean salinity 0.02 for Igdırdag and, 0.01 for Sisorta was measured (Table 4). The mean amount of accumulated litter on the soil surface 5271.01 (g/m^2) ± 3120.05 (2574.8 - 9403.52) for Igdırdag and, 4251.7 (g/m^2) ± 1643.19 (2531.3 - 6613.44) for Sisorta was measured.

Table 4. Descriptive statistics of some ecological characteristics of the both forests soil

		N	Mean	Sd.	Min.	Max.
Accumulated Litter g/m^2	Iğdırdağ	5	5271	3120.05	2574.8	9403.52
	Sisorta	5	4251.7	1643.19	2531.3	6613.44
	Toplam	10	4761.3	2411.4	2531.3	9403.52
% Lime Content	Iğdırdağ	5	2,5	0.85	1.80	4
	Sisorta	5	0.14	0.01	0.13	0.16
	Toplam	10	1.33	1.37	0.13	4
% Salinity	Iğdırdağ	5	0.02	0.3	0.004	0.08
	Sisorta	5	0.01	0.00	0.010	0.02
	Toplam	10	0.01	0.02	0.004	0.08
pH	Iğdırdağ	5	5.89	0.75	5.28	7.20
	Sisorta	5	5.45	0.18	5.15	5.60
	Toplam	10	5.67	0.56	5.15	7.20

As a result of comparasion on both forest soil properties, there was statistically significant difference (F = 38.417, P = 0.000) between forests in term of lime content. The soil of Igdırdag scots pine forest has higher lime content than Sisorta scots pine forest. However, there was no significant difference in the amount of acculumated litter, salinity and pH between forests (P > 0.05).

Discussion

Forests are a living system, as mutually interact with each other in other plant and animal communities and microorganism in the soil. It is important that bioecological properties of forest such as age, diameter, height and bark thickness is known. Also its geographic properties. For this reason, it was researched some bioecological properties at Koyulhisar scots pine forests. According to the results, it was found that there is significant differences between forests for diameter and forest slope. Also, lime content is significantly different between forests soils. Similarly, aspect of each station is different from each other except station 2 and 3 in Igdırdag forest (Table 1). In other words, it can be say that forests have homogen for tree hight, age, bark thickness and, elevation, pH, salinity and accumulated litter. Aspect of each station could be cause those differences. Özel and Ertekin, (2010) stated that aspect of research area is effect on the precipitation and temperature. Shading aspect (North, Northeast, Northwest and East) is cooler than sunny aspect (Southeast, South, West, Southwest) (Özel & Ertekin, 2010). The more researcher stated that shading aspect is positively effect on site index for different species such as scots pine, beech, fir, spruce and stand mixture etc. (Daşdemir, 1987; Bozkuş, 1987; Atalay, 1992; Peters, 1992). However, regional differences can be revealed for effect of aspect on site index. Çepel et al., (1977) stated that scots pine forest on Northern has more developed than the others at Central Anatolian, whereas, there is no relationships between them for aspect of forest at Black Sea and East Anatolian Regions. The high slope can adversely affect the water holding capacity of the soil. Rain and melt snow waters

flow easily at high slopes. In forests that has higher slope, the amount of precipitation per unit area is decreases, surface flow is increases. Depending on these, the usable water capacity is reduced. Hence, in highly sloping areas, there are arid and poor lands which are not suitable for water and food economy (Günlü et al., 2006). There was significant negative correlation between slope and productivity of forest. It was found that negative relationship between slope and productivity in different tree species (Çepel et al., 1977; Zech & Çepel, 1982; Eruz, 1984). Perhaps the reason why the Igdırdag forest has a low tree diameter is that it has a high slope.

Ovideo et al., (2015) researched some soil properties in scots pine forest at South Western Europe. They found that pH at depth 0-10 cm is mean 4.6. In Spain, the soil pH of natural scots pine forests in different ages, 2-3 years-old, 10-12 years-old, 40 years-old and 80 years-old, are 4.67, 5.05, 4.75 and 4.79, respectively (Marcos et el., 2007). In our country, Tolunay, (2003) found that soil pH is 5.52 for scots pine forest in Bolu Aladağ. Similarly, Gol et al. (2010) stated that soil pH was changed 4 and 7.1 for fir and scots pine forests in Ilgaz. It was determined that soil pH is 5.28 in Yalnızçam, Ardahan (Özdemir, 2011). Acidity ratio is higher in the surface part of the soil, because decomposition is more on that. In this research, pH value of forest soil was found slightly higher than Europe. However, it was similar with Turkey. Dindaroğlu et al., (2015) found that the lime content of Andırın forests changed between 4.54 and 32.26 and, the mean of lime content was 8.8. They classed it as having very rich lime content. Moreover, lime content value changed between 2.35 and 3.05 and, the mean value was 2.62 in pasture rehabilition on Bartın (Genç Lermi et al., 2016). However, Korkut, (1983) stated that lime content in the soil is positively affects the uptake of some nutrients. The lime content of Igdırdag and Sisorta scot pine forests soil was measured as 2.5 and 0.14. As a result of this research, the lime content is similar with the other research. The mean salinity was determined 0.03 dS/m in socts pine forests (Zengin, 2010) and, this value is regarded as salt-free soil (Zengin, 2010). Similarly, Genç Lermi et al. (2016) found that the salinity changed between 0.05 dS/m and 0.09 dS/m and, the mean salinity was 0.07 dS/m in Bartın. The salinity of Igdırdag and Sisorta scot pine forests soils was measured as 0.01 dS/m and 0.02 dS/m, respectively. These results parallel with the other research in Turkey.

In conclusion, the scots pine forests of Koyulhisar is healty and that the soil properties of forests are in parallel with other regions of Turkey. However, increasing human population and consequent increasing pressures are threaten on the future of the scots pine forests. For this reason, accelerating the region's rejuvenation work requires the establishment of new stands.

Acknowledgement

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