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Original Article

General Characteristics and Distribution of Forest Relicts in Central Anatolia

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Abstract

The Central Anatolia region has an area of about 15 million ha constituting 21% of the country's surface area. While the destruction of forests continues, it is still debated whether the Central Anatolian steppes are natural or not. This research may be considered as a preliminary study to conclude these discussions to some extent. This study aims to determine the forest relicts in the Central Anatolian region and to reveal their characteristic features. For this purpose, (1) forest relicts were detected for creating a forest relict map of Central Anatolia using remote sensing and (2) general characteristics of forest relicts were investigated using terrestrial methods. The results indicated that forest relicts were generally located in the mountains. Due to the variation of the ecological condition depending on the geographic and geomorphological factors, while the forest relicts and variety of species were dense in the north of the region, the forest relicts were found only on volcanic mountains and oak was the only dominant tree species with increasing drought in the south of the region. A lower occurrence of forest determined by nature was detected, which was varied by location. Under the lower occurrence of forest may be accepted as natural steppe. However, forest relict above this limit should not be considered as a relict of the grove forest, which needs to be categorized and redefined. Q1

Keywords: Desertification, forest degradation, semi-arid, shadow effect, the lower occurrence of the forest

Introduction

Grassland as an ecological land type is defined as "land on which the vegetation is dominated by grasses" (FGTC, 1991). Geographically, kinds of grasslands include meadows, prairies, rangeland, savannas, steppes, or tundra are often referred to as natural grasslands. Even though the steppe is a particular sub-type of grassland, it is also located in Palaearctic biogeographic realms (Wilson et al., 2012). The term steppe is usually used for the region being too dry to support the growth of forest (Werger & van Staalduinen, 2012). However, depending on the characteristics of the woody species, trees can grow in steppes areas somehow which are called tree steppe, bushy steppe, and spiny steppe (Reinecke, 2021). The steppe is also characterized by a semi-arid climate, sometimes forming the transition with the desert areas. Central Anatolian is one of the steppe areas of the world with forest relicts in certain areas.

As Palaearctic Steppe, Central Anatolia is a big semiarid region including about 15 million ha. of land surface. Although the region has a great surface, the woodlands cover a small area and are mainly much degraded. The reason for the low level of forest cover has been discussed for a long time. Some scientists claimed that long-term human impact had a great influence on the deforestation of Central Anatolia (Louis, 1939; Uslu, 1960). Other scientists said that Central Anatolian was never covered with high forests (Inceoğlu et al., 1987). According to Palynological investigations which provided information about the vegetation coverage of the region since the last ice age, natural tree species have not been changed, but the borderline between forest types varied (Bottema et al., 1993/94).

As seen in other paleatric steppes, there are natural steppe and semi-natural steppe in the Central Anatolian. Centuries or millennia of low-intensity land use since the beginning of the Neolithic period resulted in the semi-natural steppe (Mikaeili, 2015). Many rangelands are located in arid, semi-arid, and dry sub-humid ecosystems (drylands), which cover about 41% of the Earth's land area (MEA, 2005). Therefore, changes in vegetation

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structure induced by grazing can promote strong changes in ecosystem functioning in drylands (Dlamini et al., 2014). As a result of many years of exploitation, not only forest areas but also steppe lands have been degraded and desertification has begun in Karapınar, where the drought arrives at the deepest level in Central Anatolia (Demiryürek & Taysun, 2007).

The forest relicts in the Central Anatolian let suggest the existence of larger forest areas. However, drought known as water deficit can alter composition, structure, and canopy (Reinecke et al., 2021). The dry subhumid conditions dominated 60% of total land areas of Turkey (Çalişkan & Boydak, 2017), and about 35% of the land surface is classified as semi-arid and arid (Akbaş, 2014). Although drought-resistant species naturally grow in this region, drought is a factor that determines the spread area and stands form of these species. To find the exact boundaries between steppe and forest, it is necessary to do a lot of multi-disciplinary studies. Furthermore, restoration of degraded forest areas is among the major challenges in Arid and semi-arid ecosystems. Recent studies showed that restoration of degraded forest areas with natural species may be successful (Yıldız & Altundağ, 2021). This study aims to determine the forest relicts in the Central Anatolian region and to reveal their characteristic features. For this purpose, (1) forest relicts were detected for creating a forest relict map of Central Anatolia using remote sensing and (2) general characteristics of forest relicts were investigated using terrestrial methods.

Methods

Research Site

The present study was conducted in the Central Anatolian Region as one of the seven geographical regions of Turkey including 12 Provinces (Figure 1). Two types of morphology are characteristic for Central Anatolia: (1) Neogene basins (Ovas-plains) and (2) hilly and mountainous areas (mountains) (Altın & Altın, 2011). The Central Anatolian highland is one of three large basin areas of the Eurasian chain mountain belt (Balkan, 2017). Multiple collisional events and extensional tectonics played a major role in the evolution of Central Anatolia during the mid-to-late Cenozoic. As a plateau, Central Anatolia includes sediment-filled basins and larger-scale volcanic fields with dispersed volcanic cones (Seyİtoğlu & Işik, 2015). The Central Anatolian Crystalline Complex constitutes the basement rock of the region composed of crystalline rocks showing evidence of regional metamorphism and magmatism. Generally, the basins are filled with assemblages of sedimentary rocks (conglomerate, sandstone, mudstone, limestone, shale, marl) with discontinuous volcanic sequences (basalt, andesite) (Göğüş et al., 2017). According to the soil classification system of the World Reference Base for Soil Resources**,** the Leptosols, Calcisols, Cambisols, Fluvisol, and Vertisol are the dominant soil type (Kapur et al., 2018).

Meteorological Data

According to the Köppen–Geiger climate classification, Central Anatolia belongs to climate region B (cold zone, Bsk semiarid climate) and climate region D (continental climate, Dsa, Dsb with either hot or cold dry seasons) (Öztürk et al., 2017). Meteorological data of research sites (monthly precipitation, temperature, and humidity) were obtained from the General Directorate of Meteorology, which was taken from 12 main stations (Table 1). The average annual total precipitation varies between 570.3 mm (in Yozgat) and 329.2 mm (in Konya). While the highest maximum average annual temperature was 12.5°C in Kırıkkale, and maximum the average annual humidity was 66.80% in Yozgat.

Vegetation

According to the data taken General Directorate of Forestry in 1997, the research site had an area of 14.6 million ha and 0.64 million ha are

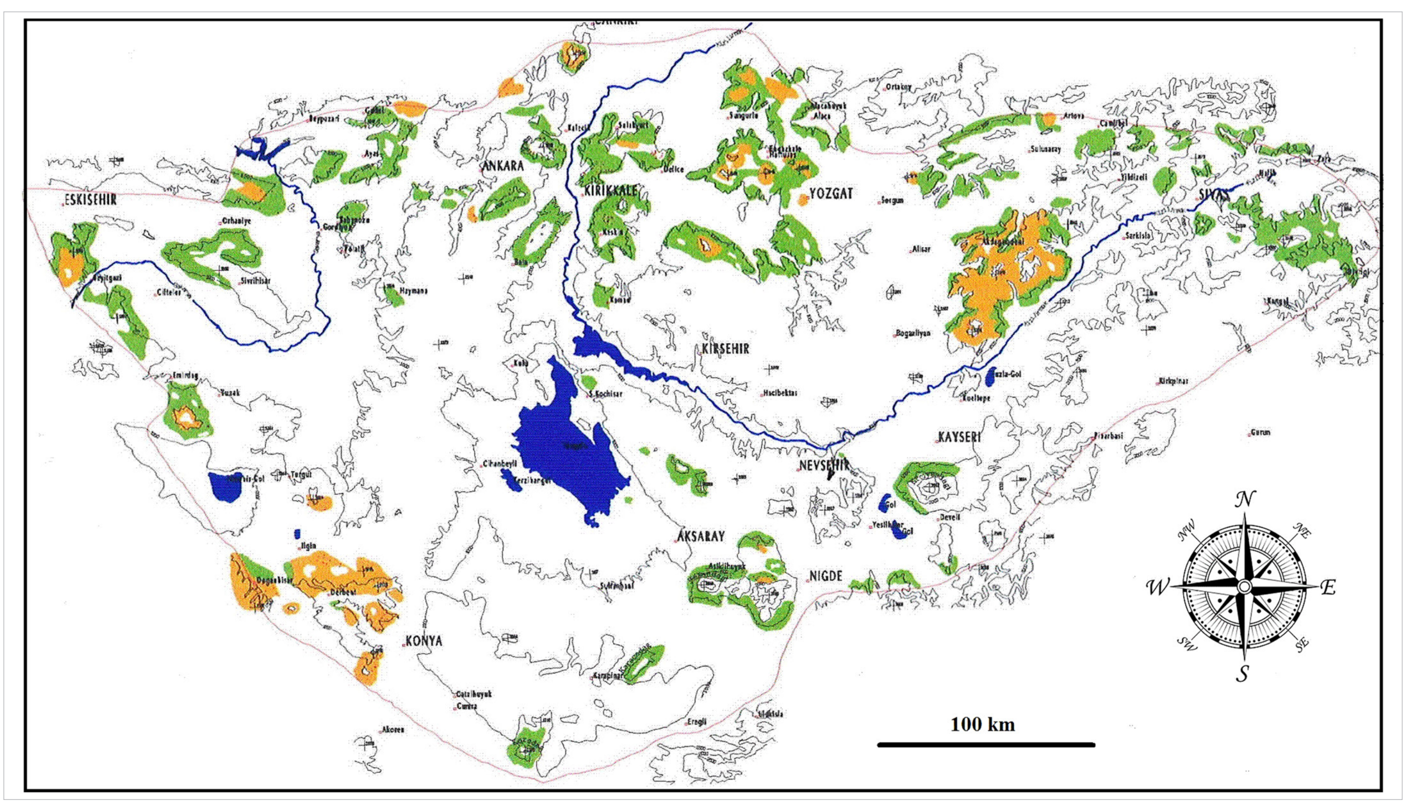

Figure 1.
Forest Relic Map of Central Anatolia. Quercus spp. *(Green colored), Pinus nigra (Braun colored).*

as official forest declared. The majority of forests are located in provinces with high precipitation (Table 1, Table 2). In general, the steppes ecosystem is known as area with high biodiversity (Wilson et al., 2012). However, the number of woody species in forest relicts is relatively low. The following woody species were determined during the study: *Quercus* spp. (*Quercus cerris* L., *Q. pubescens* Willd.), *Juniperus excelsa* M. Bieb, *Juniperus foetidissima* Willd, *J. oxycedrus* L., *Pinus nigra* J.F.Arnold subsp. *pallasiana* (Lamb.) Holmboe, *Cedrus libani* A. Rich, *Amygdalus communis* L., *Berberis crataegina* DC., *Crataegus orientalis* Pall. ex M.Bieb., *C. monogyna* Lacq., *Cotoneaster nummularius* Fisch. & C.A.Mey., *Colutea cilicica* Boiss. & Balansa, *Cistus laurifolius* L., *Jasminum fruticans* L., *Lonicera sp.*, *Paliurus spina-christi* Mill., *Cornus sanguinea* L. subsp. *Australis,* (C.A.Mey.) Jáv., *Origanum minutiflorum* O.Schwarz & P.H. Davis., *Pistacia palaestina* Boiss., *Pyrus elaeagnifolia* Pall. *subsp. elaeagnifolia, Prunus domestica* L., *Rhamnus rhodopea* Velen., *Rosa canina* L., *R. pulverulenta* M. Bieb., *R. thymifolia* Bornm., *Spiraea crenata* L., *Ulmus minor* Mill.

Sampling Methods

Forest relicts were investigated using aerial and terrestrial methods. In aerial methods, forest relicts and surrounding areas were identified using aerial photographic images. About 30,000 two-dimensional aerial photographs were interpreted as three-dimensional objects using an optical-mechanical technique (WILD ST4, Singapore). In addition, 1:25,000 scale topographic base maps were used for preparing the topographic maps of forest relicts. Unauthorized use of 1/25,000 maps and aerial photographs was prohibited during the period of this study. Therefore, infrastructure facilities of the General Directorate of Forestry were used for this purpose. The forest relicts determined in the aerial photographs were first transferred onto photocopies of 1:25,000 scale topographic base maps. Later, it was transferred to the 1:1,000,000 scale topographic map taken as a hard copy from the General Command of Mapping. While detecting forest remains, single-standing trees were not taken into account. Only three groups were identified.

Terrestrial surveys were carried out in two ways, by sampling in forest relicts and by observing in much-degraded forest relicts or forest-free locations. The sampling was conducted in suitable locations with the occurrence of trees in groups including relatively old stands. Sample plots were taken in a pure and mixed stand of *Pinus nigra* (Pini), *Quercus* spp. (Quer), *Juniperus excelsa* (Juex), *Juniperus foetidissima* (Jufo) in relatively good conditions. A sampling plot was defined as an area measuring 25 × 20 m. For each sample plot, longitude and latitude (UTM), altitude (m) (Alt), exposure (°), slope (%), and human impact (HI) using the following rating system 0 = no impact; 1 = ancient and early medieval impact; 2 = cutting tree; 3 = commercial using, fire, beekeeping; 4 = destruction of the forest; 5 = complete destruction of the forest) (Samojlik et al., 2013), height and diameter of trees in the case of diameter at breast height (DBH) > 5 cm, and other observations (growth dynamics of trees, possible factors affecting the forest occurrence) were recorded. In forest relicts, 167 sampling plots were measured in 19 locations (Table 2). Observations made in areas with no forest remains (62 points) or with very degraded forest relicts (74 points) included the following data; altimetric lower occurrence of the forest (LOF), human pressures (prehistoric and present); vegetation type; etc. (Table 3).

Table 1.
Long-term (1927–2020) Averaged Climate Data Based on Observations From Meteorological Stations in the Research Site

Station	Observation Period	The Average Annual Total Rainfall	The Average Annual Temperature	The Average Annual Humidity
Ankara	93	393.2	11.9	60
Aksaray	91	362.3	12.1	51
Çorum	91	430.7	10.8	64.6
Eskişehir	92	372.8	11.3	65.2
Kayseri	29	389.3	10.7	56.33
Kırşehir	30	383.4	11.5	63
Kırıkkale	57	388	12.5	61.8
Konya	91	329.2	11.7	60
Nevşehir	30	419.5	10.7	52.58
Niğde	29	344.2	11.2	55.41
Sivas	29	431.3	9	62.08
Yozgat	91	570.3	9.2	66.8

Table 2.
Distribution of Forest Areas of Central Anatolian Region According to Official Records Taken in 1997

Forest	Forested	Forest Free	Total	% of Forest
Ankara	97255	2881039	2.978294	3.2
Kırıkkale	23174	322430	345604	6.5
Kırşehir	42714	1001267	1.043981	4.09
Niğde	40248	520071	562319	7.1
Nevşehir	8580	469484	478064	1.7
Aksaray	11148	413942	425090	2.6
Beyşehir	151161	324594	475755	31.7
Konya	132133	2.483643	2615776	5.05
Çorum	31722	268841	300563	10.5
Eskişehir	24286	112344	136630	17.7
Kayseri	105775	1636526	1741643	6.0
Sivas	11711	2568730	2580441	0.5
Yozgat	107933	1081196	118129	8.3
Total:	636679	14021243	14607976	4.3
Author:	1705018	12668943	14373961	4.2

Data Analysis

Manually produced forest relict map was digitized using ARC-Info program and numerical data about the distribution of forest relicts were generated. Statistical analysis was carried out in R. Variance analysis for testing significant difference between the independent groups statistically and Pearson correlation analysis were carried out on two datasets. Data sets one was prepared based on plots and included: the maximum diameter (MD) and maximum height (MH) of four tree species ($n = 167$; Juex = 45, Jufo = 31, Quer = 44, and Pini = 47) HI, tree density (TD) (= number of trees per plot*10,000/500) and altitude (Alt). Dataset two comprised all the diameter (D) and height (H) values ($n = 1717$; Juex = 417, Jufo = 208, Quer = 541, and Pini = 551) measured in 167 sampling plots based on species.

Results

Distribution of Forest Relicts in Central Anatolia (Results of Aerial Research)

The total forest area determined by Author using aerial photography is 14,373,961 ha (Figure 1). This amount is less than the data given (14,607,976 ha) by the General Directorate of Forestry (Table 2). The reason is that the General Directorate of Forestry considered the forest-free "forest soil" as forest areas. Forest areas constituted only 4.2% of the Central Anatolia Region and they were located in the mountainous areas. However, there were differences between the north and south of the region in terms of the spread of forest relicts. The basins in the north are much smaller compared to the basins in the south. Nord of the region does not have any higher mountains (1000–1500 m above sea level (a.s.l.)), but the landscape can generally be described as mountainous-hilly. The plains are not always at the same altitude but rather they form an undulating landscape with an altitude between 800 and 1000 m a.s.l. From this altitude, the landscape was described as mountainous. In the south of the region, there are individual high mountains and the plains are quite wide. Due to this topographic structure, drought is increasing in the south of the region, which is also reflected in the vegetation spread.

Forest relicts were generally identified on the mountains, which may be explained by the rain shadow effect. Evaporated moisture from water bodies (the Mediterranean Sea or the Black Sea) is carried by the prevailing onshore breezes toward the drier and hotter inland areas. When encountering elevated landforms, the moist air is driven upslope toward the peak, where it also condenses into nimbuses and starts to precipitate. If the landforms are tall and wide enough to block or sufficiently delay the passage of these rain-producing weather fronts, most of the humidity will be lost to the precipitation over the windward side before ever making it past the top, and the air also forms foehn winds on the leeward side that absorb moisture downslope, therefore casting a broad "shadow" of dry climate region behind the mountain (Stockham et al., 2018). The passed humid air descending from the surrounding mountains loses its humidity as it descends to the plain and the driest air prevails in the flat areas of the plateau (Peterson, 2021).

Table 3.
Overview of Locations Related to the Terrestrial Surveys in the Research Site

Locations	Coordinates	LOF	Tree Species	Number of Samplings
Çorum-Sungurlu	40°09′54′′N,34°22′35′′E	1000	Quer, Pini	8 NP
Çorum-Boğazkale	40°01′16′′N,34°36′50′′E	1000	Quer, Pini	18 NP
Çorum - Uğurludağ	40°26′45′′N,34°27′20′′E	1000	Quer, Pini	42 NP
Yozgat	39°48′18′′N,34°49′30′′E	1400	Pini	6 NP
Kırıkkale-Keskin	39°40′38′′N,33°37′26′′E	780	Quer	2 NP
Kırıkkale -Bahşılı	39°43′42′′N,33°21′21′′E	978	Juex	10 NP
Kırıkkale-Yahşıhan	39°47′37′′N,33°21′05′′E	1013	Jufo	10 NP
Kırıkkale-Delice	39°56′57′′N,34°01′50′′E	850	Quer	2 NP
Ankara -Elmadağ	39°47′29′′N,33°15′49′′E	1011	Juex	12 NP
Ankara-Bala	39°47′29′′N,33°15′49′′E	1000	Pini	2 NP
Ankara Nallıhan	39°45′39′′N,30°57′58′′E	968	Juex	6 NP
Eskişehir-Mihalıççık	39°51′18′′N,31°30′34′′E	900	Jufo, Juex	8 NP
Eskişehir -Alpu	39°54′50′′N,31°09′23′′E	1100	Jufo, Juex	9 NP
Eskişehir -Seyitgazi	39°22′35′′N,31°02′20′′E	1047	Jufo, Juex	15 NP
Eskişehir - Çifteler	39°11′41′′N,30°43′33′′E	1200	Jufo	8 NP
Konya-Meram	39°47′29′′N, 33°15′49′′E	1080	Pini	2 NP
Konya- Ilgın	38°16′17′′N, 31°54′54′′E	1200	Pini	2 NP
Aksaray-Hasan Dağı	38°15′36′′N, 34°08′55′′E	1200	Quer	3 NP
Aksaray-Ekecik Dağı	38°39′02′′N, 34°04′50′′E	1050	Quer	2 NP
Kayseri-Erciyes dağı	38°31′56′′N, 35°27′20′′E	1300	Quer	8 NOP
Sivas South	39°26′40′′N, 37°14′04′′E	1800	Quer	4 NOP
Sivas Nordost	39°54′21′′N, 37°10′54′′E	1400	Quer	4 NOP
Ankara -Keçiören	40°02′31′′N, 32°51′13′′E	1050	Quer,	2 NOP
Ankara Çubuk	40°14′38′′N,33°02′38′′E	1050	Pini	10 NOP
Sivas-Zara	39°51′03′′N, 37°09′56′′E	1500	Quer, Pini	2 NOP
Ankara-Haymana	39°28′08′′N, 32°35′24′′E	1100	Quer	4 NOP
Ankara-Polatlı	39°35′09′′N, 32°11′24′′E	950	Quer	8 NOP
Eskişehir-Sivrihisar	39°27′16′′N,31°32′55′′E	1050	Quer	10 NOP
Bağrıkurt-Konya	38°06′57′′N, 32°29′10′′E	1190	Quer	2 NOP
Derbent	38°00′33′′N, 32°01′05′′E	1200	Pini	4 NOP
Çumra-Karadağ	37°23′36′′N, 33°08′45′′E	1350	Quer	8 NOP
Karapınar-Karacadağ	37°45′24′′N, 33°45′40′′E	1200	Quer	8 NOP

Note: LOF = altimetric lower occurrence of the forest; NP = number of sampling plots taken in forest relict; NOP = number of observation points taken in much degraded forest relicts or forest free locations.

The reasons for the greatest distribution of forest relicts, as well as the best black pine stands in the north part of the region, may be explained by the geographical structure of the region. The river Kızılırmak and its tributaries flow through the area in the direction of the Black Sea, so that the flow allows the moist sea air free access into the interior. On one side, river systems, including their associated riparian vegetation, occupy a relatively small area in the landscape yet they fulfill key ecosystem functions and services (Hoffman & Rohde, 2011). On the other side, the river system, non-hydro geomorphological environmental influences that vary between reaches and watersheds may limit the pool of species available to respond to the hydro geomorphological factors within a given reach (Daryaei et al., 2020). Environmental influences may include temperature and precipitation and non-flood disturbance history (Camporeale, 2019), as well as the longer-term history of climate change and species' dispersal (Williams et al., 2014). This effect is seen in Akdağmadeni, located on the edge of the Kızılırmak where forests here resemble the Black Sea region. Throughout the region, forest remains are abundant in the mountainous areas around Kızılırmak (Figure 1). The second reason is that the mountains are at a lower altitude compared to the mountains in the south makes it easier to carry the sea effect to the inner regions. These conditions allow 400–600 mm of annual rainfall in the area, which means at the same time favor the occurrence of woody plants. The third reason is that the microclimatic effect allows plant species to grow in different climates in the region. Central Anatolia is known for the richness of micro-climate niches (Öztürk & Savran, 2020). Topographic heterogeneous landscapes offer a greater range of resources and microclimates, which can buffer populations against climatic variation and generate more stable population dynamics (Gillingham et al., 2012).

As the drought increases from the north to the south of the region, the proportion of oak in the forest relict increases. Except in the Beynamer Forest, the oaks dominate in the center of the region. The relics are concentrated more in peripheral areas. In the direction of Salt Lake, the relict frequency decreases from all sides. In the Salt Lake basin and Konya –Ereğli basin, there are hardly any relicts to be found, only the volcanic mountains (Karacadağ, Hasan Dağı, Ekecik Dağı) are an exception. The topographical and climatic conditions of the area certainly have a great influence on this distribution of the relics. The high Taurus Mountains in the south allow very little of the moisture from the sea to pass into the interior. The south plains of the region start right behind these high mountains (rain shadow effect). Furthermore, high evaporation rate increases drought that has a negative effect on forest growth.

General Characteristics of the Relicts of Forest in Central Anatolia (Results of Terrestrial Research)

One of the most frequently asked questions for years is "whether the Central Anatolian steppe has a natural or anthropogenic origin? To give a clear answer to this question, it is necessary to conduct multi-disciplined studies in the region. With this study, the Author hoped that this question will be answered to a certain extent. One of the most important issues of this study was the determination of "the lower occurrence of the forest." Native tree species of Central Anatolia; Pini, Quer, Jufo and Juex; are drought-tolerant species and can survive in adverse conditions of central Anatolia. If these resistant species have drawn a lower limit for their growth, trees cannot naturally enlarge under this limit anyway. The areas under this limit should be accepted as natural steppe. There are various terms and definitions for the lower boundary of the forest. Niebuhr (1950) made a more precise differentiation in the definition of these terms: (1). The lower dry line of the forest, which is a climatically conditioned dry line and requires a more or less closed forest distribution in the mountains; (2). The continental tree line, which is climatically conditioned and requires a more or less closed forest distribution in the plain; (3). The continental tree line, the dry line of the outermost natural forest islands in the plain. However, Uslu (1960) believed that this cannot be useful for the steppe area, because closed forests are very rare in steppes. He used the terms "lower dry line of the forest" and "lower tree line" synonymously, but he means the "lower occurrence of the forest." The term "Lower occurrence of the forest" was used in this study because Author was in the opinion that the "lower dry line of the forest" must be lower than the "lower occurrence of the forest," since the forests or even tree islands have been removed in favor of agricultural use.

As stated before, there is a difference between the north and south of the Central Anatolia region in terms of geographical, climatic characteristics, and the presence of forest relicts. This difference is also reflected in the lower occurrence of the forest (Table 3). While the lower occurrence of the forest is 1100 m a.s.l on average in the north of the region, it is rising to 1400 m a.s.l. on average in the south. In extreme cases, while the lower occurrence of the forest can go down to the plain (780 m a.s.l.) in some locations of the north of the region, it can reach 1500 m a.s.l. in the east of the region (Table 3). These differences may occur due to topographic structure and micro-climatic effects.

The relationship between variables MH, MD, HI, TD, and ALT was investigated on the four tree species (Juex, Jufo, Quer, and Pini). The results of the variance analyses showed that all variables have differences for their level, and MD ($p < .001$), MH ($p < .001$), TD ($p < .001$), HI ($p < .05$), ALT ($p < .05$), D ($p < .001$), and H ($p < .001$) were statistically significant. According to the results of correlation analysis applied on the variable taken 128 sampling plots set the highest relationship found between MH–MD (Quer: 0.53, Jufo: 0.70, Juex: 0.72, Pini: 0.77) and M–D with a lower correlation coefficient value (Quer: 0.52, Jufo: 0.73, Juex: 0.71, Pini: 0.72). Because the H–D relationship changed between regions due to climatic conditions, precipitation rates, seasonality (Chimner et al., 2010), temperature, and water deficits (Anderegg et al., 2012). According to the result of this study, the H–D relationship of species grown in similar environmental conditions also differs from each other. All species have different correlation coefficients from each other. While Pini had the highest H values, and Jufo had the highest D values, Quer had the lowest H and D values because of the coppice management (Figure 2). Considering all the data collected from the research area (H–D relationship of each species, TD values, and other observations), even the best forest grown in Central Anatolia cannot be qualified as a grove forest. There is the concept of a forest-steppe, which is defined as a temperate-climate ecotone and habitat type composed of grassland interspersed with areas of woodland or forest (Rédei et al., 2020). This definition may not be sufficient to identify the forest relicts in the Central Anatolian Region. It would be more appropriate to define them by rating such as tree steppe and forest-steppe, to lighted forest.

The second highest correlation was seen between TD and HI. However, this relationship also differs between species. HI and TD were directly related to human activity such as habitat destruction, deforestation, fragmentation, and over-exploitation, which had significant effects on forest structure and composition (Hauck & Lkhakvadorj, 2013). As the drought increases, vegetation fragility also increases, which is undermined during the recovery period of degradation caused by human pressure (Kahveci, 2017). In this process, uninterrupted continuation of human pressure resulted in the start of the desertification process in Karapınar, where drought reached its highest level in Central Anatolia (Demiryürek & Taysun, 2007).

Altitude is an important factor for tree growth. Treelines fluctuate with climatic change. Trees do not generally grow in places where the mean temperature of the warmest month is less than about 10°C (Trant & Hermanutz, 2014). At the same time, high temperature and lack of water are factors that affect tree growth (Brienen et al., 2017). Altitude was not correlated with any parameter of Quer, while it was correlated with the height and diameter of Pini, Juex, and Jufo. On the other hand, altitude

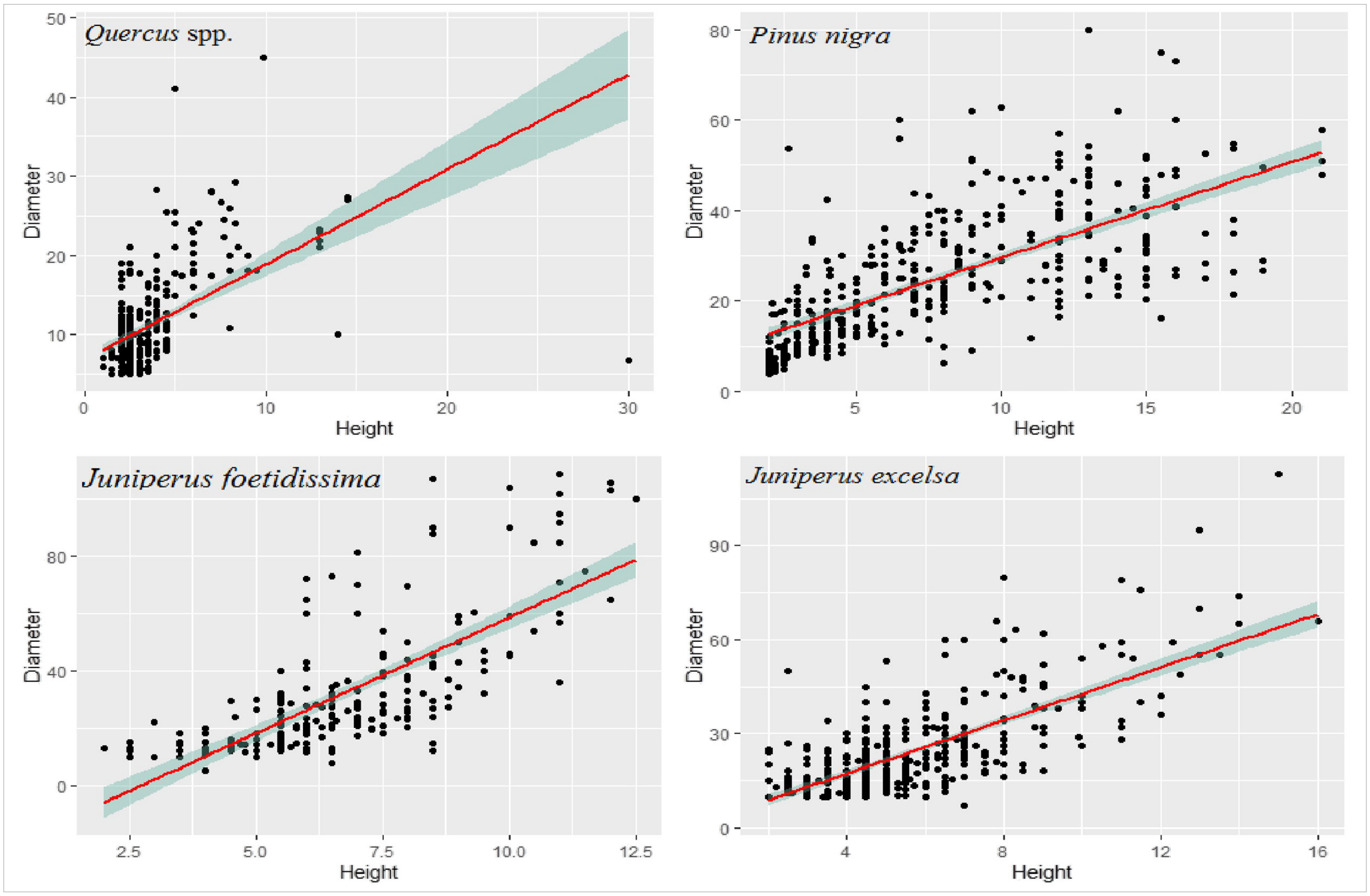

Figure 2.
Graphical Illustration About Relationship Between DBH and Height of Quercus spp., *Pinus nigra, Juniperus Foetidissima, and Juniperus excelsa.*

was correlated with all parameters of Jufo. According to the results of this study, altitude seems to be an important factor for forest existence.

The Central Anatolian region is located in the center of the country where the drought reaches the highest level and desertification begins and is accepted as the largest steppe area of the country. Long-term human activity and land degradation resulted in a significant decrease in trees number and reduced woody vegetation cover in Central Anatolia. However, it is necessary to find out "where does the border of the natural steppe begin?." This study investigated forest relicts and tried to determine the boundary between forest and steppe ın Central Anatolia. According to the results of aerial surveys applied for determining a forest relict, the forest relicts were mainly found in the mountains. The distribution of the forest relicts was decreased toward the center of the region, but the dominance of oak was increased. Results of terrestrial surveys showed that there is a line of lower occurrence of a forest. It descends to the plain in some locations in the north of the region, while in the eastern and southern parts of the region, it is quite far from the plain. Nature has set itself a lower limit for the growth of the forest in Central Anatolia, and the areas under this lower limit should be considered as natural steppes. It should not be thought that the forest relicts are the rest of the destructed high forests of Central Anatolia, because this region has steppe characteristics. These forest relicts may be remnants of different types of forest (tree steppe, forest-steppe, lighted forest), because no groves have been found even in the best fertile growing areas. If the rehabilitation of degraded forests in the Central Anatolian region is considered, it is necessary to have information about both the lower occurrence of forest and the original forest cover.

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