DOI: 10.5152/forestist.2018.004
Forestist 2018, 68(1): 36-41

Original Article

The effects of trekking activities on physical soil properties in the Bolu-Aladağ fir forests

Bolu-Aladağ göknar ormanlarında doğa yürüyüşü faaliyetlerinin bazı fiziksel toprak özelliklerine etkisi

Ahmet Duyar[1], Seyfettin Kiniş[2]

[1]Department of Forest Engineering, Karabük University Faculty of Forestry, Karabük, Turkey
[2]Division of Non-Wood Forest Products and Services, Bolu Regional Forest Directorate, Bolu, Turkey

ABSTRACT

In this work, we study the effects of trekking on the soil physical properties in the Turkish Bolu-Aladağ fir forests. One hundred people walked in a straight line in the case study area, and their effects on a number of soil physical properties, such as litter fall thickness, soil bulk density, soil moisture, and soil compaction, were investigated. The study comprised three replicates over two tracks in two consecutive years. The thickness of the surface litter fall (mm) was measured and its amount determined in (gr/m^2) as the dry weight of the soil samples collected in the sampling area. Soil bulk density (g/L) was measured using cylindrical samples. Soil moisture (%) was determined based on the difference between the fresh and dry weights. The results indicate that the surface litter thickness decreased on trekking routes (r=0.568), and the fresh (r=0.440) and dried (r=0.423) soil bulk densities increased. However, there appeared to be no effect on soil moisture. Compared to the control samples, an average of 14% compaction was detected in trampled soils as a result of human pressure. Furthermore, the physical effects of trekking caused compaction of the litter fall and soil. As a result, such activities could lead to a decrease in soil infiltration capacity causing soil erosion and degradation in the future.

Keywords: Ecotourism, litter fall, soil bulk density, soil compactness, and soil moisture

ÖZ

Bu çalışma, Bolu Aladağ göknar ormanlarında, doğa yürüyüşlerinin toprağa etkisini araştırmak için yapılmıştır. Çalışmada 100 kişi ölçüm alanından tek sıra halinde yürümüş, doğa yürüyüşünün ölü örtü kalınlığı, toprak hacim ağırlığı, toprak nemi ve toprak sıkışması gibi fiziksel özelliklere etkisi incelenmiştir. Çalışma iki yıl peş peşe, iki ayrı parselde ve üçer tekerrürlü olarak yapılmıştır. Ölü örtü kalınlığı (mm) örnekleme sırasında ölçülerek, miktarı (gr/m^2) 25cm*25cm alandan toplanan örneklerin kuru ağırlığına bağlı olarak belirlenmiştir. Toprak hacim ağırlığı (g/L) hacim silindirleri kullanılarak, toprak nemi (%) de taze ve kuru ağırlık farkından yararlanılarak belirlenmiştir. Yapılan ölçümler ve değerlendirmelerin sonucunda; doğa yürüyüşü yapılan alanda ölü örtü kalınlığının azaldığı (r=0,568), taze (r=0,440) ve kurutulmuş (r=0,423) toprak yoğunluğunda artışa neden olduğu belirlenmiştir. Ancak toprak nemi üzerinde etkisi görülmemiştir. Kontrol alanına göre kıyaslandığında çiğnenen alan toprağında ortalama %14 oranında sıkışma meydana geldiği bulunmuştur. Doğa yürüyüşü esnasında çiğnenen toprakta meydana fiziksel etkiler ölü örtüde ve toprakta sıkışmaya neden olmuştur. Dolayısıyla toprağın geçirgenlik kapasitesini düşürecek, devamında yabanlaşmaya ve erozyona yol açabilecektir.

Anahtar Kelimeler: Ekoturizm, ölü örtü, toprak hacim ağırlığı, toprak sıkışması, toprak nemi

Cite this paper as:
Duyar, A., Kiniş, S., 2018. The effects of trekking activities on physical soil properties in the Bolu-Aladağ fir forests. Forestist 68(1): 36-41

Address for Correspondence:
Ahmet Duyar
e-mail:
ahmetduyar@karabuk.edu.tr

Received Date:
20.10.2016
Accepted Date:
29.10.2017

INTRODUCTION

Tourism, crucial for the economic development of many countries, has gained impetus over the last few decades. Any investment in the tourism sector creates action and dynamism in the economy and truly affects the level of a country's economy in various ways. In association with the rapid urbanization of recent years, the desire to access and be involved more in tourism activities in natural areas has increased. Thus, the concept of ecotourism was developed and is it now used in the regular tourism sector to satisfy the increasing number of people who want to experience nature (Erdoğan and Erdoğan, 2005).

The principle reason for the gradual increase in natural tourism and increased interest in life in the villages (Dönmez et al., 2015) is the economic and ecological potential in those areas (Koçoğlu, 2008). There are several reasons why ecotourism is concentrated in protected natural areas and some of these may be the unique natural and cultural resources themselves. Therefore, rules are necessary, limits need to be set, and there must be vigorous control of any activities that may have a detrimental effect on nature and the environment (Mol, 1979).

The concept of ecotourism embraces many factors including social and cultural activities. The World Conservation Union (IUCN) defines ecotourism as the "*Environmentally responsible travel to natural areas, in order to enjoy and appreciate nature (and accompanying cultural features, both past and present) that promotes conservation, has a low visitor impact and provides for the active beneficial socio-economic involvement of local peoples" (IUCN, 2001).* Officially, the Ministry of Culture and Tourism defines ecotourism as encompassing many activities such as upland tourism, ornithology (bird watching), photo safaris, water sports (canoeing), farming tourism, botanical tourism (plant identification), cycling tours, horse riding, camping, caving, mountain tourism, and trekking (Özgen, 2010; Url, 1).

The United Nations Sustainable Development Commission declared 2002 as the International Year of Ecotourism and appointed the World Tourism Organization in charge of the task (Koçoğlu, 2008). Similarly, the United Nations declared 2002 as the International Year of Mountains (Erdoğan and Erdoğan, 2005).

Besides their positive contributions, ecotourism activities come with some shortcomings that need to be taken into consideration. In addition to the identification of the fauna and flora of the region where the ecotourism is planned, uncovering the likely environmental effects necessitate and, in fact, contribute to the determination of the natural resource capacity. Erroneous selection of location and overuse of areas beyond their carrying capacity causes detrimental effects on the environment resulting in the degradation of natural resources during the realization of ecotourism activities (Kaypak, 2010). If the natural resource inventory is completed in our country, the carrying capacity of each region would be determined, thus studies related to ecological productivity would be based on solid research. In fact, it is necessary to determine the ecological effects of ecotourism and take these into account during the planning phase.

Bolu province, having some of the important natural resources in the western Black Sea region, has remarkable ecotourism capacity in the Aladağ region spread over the Köroğlu continuous mountains (Türker, 2013). The Bolu forests offer splendid and diverse fauna and flora, each season has its own beauty and provides tremendous capacity for ecotourism activities (Url, 2). However, these activities should be thoroughly planned in order to unlock the potential capacity of the region. Effective planning requires an immediate and thorough inventory of the natural resources and analysis of the ecological impacts.

This study focuses on the effects of trekking, one of the most widely exercised ecotourism activities, on forest soils. Specifically, we investigated the possible effects of trekking on some of the physical characteristics and properties of soils in the important Bolu-Aladağ fir forests of the western Black Sea region.

MATERIALS AND METHODS

The Study Area

The study area is located within the Şerif Yüksel Research Forest, Aladağ Forest, south Bolu province. The sample points were established in a forested area with relatively gentle relief (slope <5%) and a southern aspect at elevations between 1500 and 1550 m. The extent of the area was (ED50 datum) 40°35′58.62″N-31°39′34.17″E and 40° 37′ 57.97″N-31° 35′ 31.02″E (Figure 1).

The trekking route starts from the corner of the Bolu-Seben highway in Aladağ then continues through the Değirmenözü Plateau, the center of the Aladağ Forest, the Kızık, Doğancı Village and Avşar Plateaus, and ends in the high Hıdırşeyh Plateau. The total route length is 10 km. Existing paths and forest roads were used during the trekking experiment, however, trekking did take place in forested areas when the sample points were located within them.

Method

During May 2010, two strips were determined for measurement along the main trekking routes. One of them is Avşar Plateau, the other is "International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests" (ICP) plot side. The trekking strips were designed to be 100 m long and 1–2.5 m wide under a pure fir canopy and take walkers in single file. The edges of the strips were marked with tape to make it easy to follow the sampling line (Figure 2).

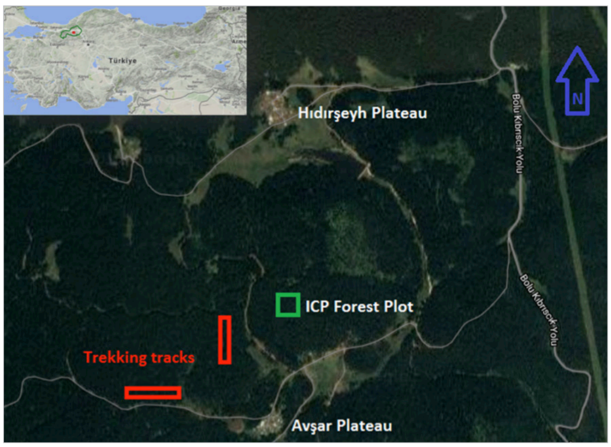

Figure 1. Map of study area (Google maps)

For sampling purposes, trekking activities were organized during June in both 2010 and 2011. One hundred people walked the same sample trekking strip in both years. As soon as the trekking activity finished, litter fall and soil samples were taken from both the sample trekking strips and control areas located in the near vicinity, and the effects of trekking on soil properties were determined.

Three samples of litter fall and soil were taken from the same depth at three different points within the trekking strips and the same from the control areas. To determine the level of soil compactness, cylinders of soil, 5 × 5 cm in length and diameter and with a pure constant bulk density, were taken from the upper soil layer (Figure 3). The same parameters were applied to additional samples taken for use in other analyses. All the soil samples were labeled and packed in a way that maintained their natural moisture levels, they were then transported to a lab for testing and soil moisture analysis. The litter fall samples were taken using 25 × 25 cm quadrants and their thicknesses were measured (Figure 3).

The oven dry weights of the cylinder samples (105°C, 24 hours) were used to determine the level of soil compaction. The soil moisture and water contents were identified from the same cylinder samples by measuring both the fresh and dried net weights of the samples. Then, both weights were divided by the cylinder volume to determine the soil bulk density (g/L). The thickness of the litter fall was measured directly in the forest. The amount of litter fall per unit area (g/m^2) was determined based on the dried weight of the samples (65°C, 24 hours). In 2010, the soil types in the sampling areas (distribution to unit diameters) were identified using the Bouyoucos Hydrometer method (Gülçur 1974; Kantarcı 2000).

SPSS statistical software was used to analyze the statistical relationship between the measurements and the laboratory results. The Pearson correlation analysis method was used to determine the relationships among all dependent and independent variables. Furthermore, one-way ANOVA was used to determine the effects of independent variables related to the research year and sampling area on the dependent variables related to the soil samples, at $p<0.05$ level of confidence.

Figure 2. Trekking in the designated measurement area

Figure 3. Sampling the soil and litter

Table 1. Correlation analysis of soil properties

	Litter Thickness (mm)	Litter Amount (g/m²)	Fresh Soil Bulk Density (g/L)	Dry Soil Bulk Density (g/L)	Soil Moisture (%)	Sand (%)	Clay (%)	Water Contents (g/L)	Compactness (%)
Year	0.144	0.119	0.088	0.140	-0.087	.a	.a	-0.036	0.154
Sampling area	0.144	0.253*	-0.392**	-0.272**	-0.185	0.747**	-0.068	-0.414**	-0.176
Strips area	-0.568**	-0.417**	0.440**	0.423**	-0.077	-0.162	0.743**	0.273**	0.471**
Litter Thickness (mm)	1	0.780**	-0.323**	-0.283**	-0.006	0.210	-0.532**	-0.243*	-0.359**
Litter amount (g/m²)	0.780**	1	-0.369**	-0.337**	0.027	0.223	-0.286	-0.256*	-0.330**
Fresh Soil Bulk Density (g/L)	-0.323**	-0.369**	1	0.903**	-0.007	-0.694**	0.681**	0.712**	0.433**
Dry Soil Bulk Density (g/L)	-0.283**	-0.337**	0.903**	1	-0.430**	-0.579**	0.671**	0.341**	0.504**
Soil Moisture (%)	-0.006	0.027	-0.007	-0.430**	1	0.196	-0.462**	0.688**	-0.231*
Sand (%)	0.210	0.223	-0.694**	-0.579**	0.196	1	-0.494**	-0.552**	-0.434**
Clay (%)	-0.532**	-0.286	0.681**	0.671**	-0.462**	-0.494**	1	0.190	0.684**
Water Content (g/L)	-0.243*	-0.256*	0.712**	0.341**	0.688**	-0.552**	0.190	1	0.123
Compactness (%)	-0.359**	-0.330**	0.433**	0.504**	-0.231*	-0.434**	0.684**	0.123	1

Correlations at * (p<0.05) and **(p<0.01) confidence levels.

Table 2. Variance analysis of soil properties by year

	2010	2011	Standard Deviation	p
Litter Thickness (mm)	16.6	19.2	0.9	0.176
Litter Amount (g/m²)	3635.0	3870.0	972.0	0.264
Fresh Soil Bulk Density (g/L)	1321.0	1351.0	162.0	0.407
Dry Soil Bulk Density (g/L)	854.9	889.3	121.0	0.187
Soil Moisture (%)	54.5	52.8	9.9	0.416
Water Contents (g/L)	467.0	461.0	74.0	0.737
Compactness (%)	4.2	8.9	15.0	0.147

RESULTS AND DISCUSSION

According to the correlation analysis: the trekking activities have a negative correlation with or effect on the thickness (r=–0.568**) and amount (r=–0.417**) of litter fall, and a positive correlation with the fresh weight of soil bulk density (r=0.440**), dry weight of soil bulk density (r=0.423**), water content (r=0.273**), and ratio of soil compaction (r=0.471**). The amount and thickness of litter fall show negative correlations with the fresh and dry weights of soil bulk density, the water content, and the rate of soil compaction (Table 1).

An increase in the amount of litter fall caused an increase in soil porosity and a reduction in weight. Soil bulk density showed a negative correlation with sand content and positive correlations with clay and water contents, and the rate of soil compaction. Furthermore, the rate of soil compaction is positively correlated with clay content and negatively correlated with sand content (Table 1).

The trekking activities took place in June in 2010 and 2011. An ANOVA test, carried out to determine the effects of trekking activities on the physical properties of soils in various years, revealed no apparent differences between the soil properties and the year (Table 2).

There are both similarities and differences in the soil properties of samples taken from two sampling strips. For example, there are differences (p<0.005) between the samples in terms of soil bulk density, and sand and clay content. However, litter thickness, soil moisture, clay content, and the rate of soil compaction seem to show similarities (Table 3).

When the soil properties of the samples from the trekking strips and the control areas were compared, all variables, except soil moisture and sand content, were found to be significantly different (p<0.05) (Table 4). The litter fall was squeezed during the trekking activities becoming 40% compacted, while a further 20% of the litter fall was ground down and dispersed to the soil. Both the fresh and dry bulk density of soil exposed to the trekking activities indicated a >10% increase. The amount of clay in the trekking and the control samples was found to be statistically different and the level of difference in the two sampling areas was less than 2%.

This work focuses on the creation of adequate information necessary for determining the effects of trekking, a widely exercised ecotourism activity, on forest soils. The trekking activities in fir forests caused a reduction in the level of litter fall by crushing, and increasing the soil bulk density and compactness. Jim (1987) carried out similar research in a rural park exposed to camping activity and found that soil trampling

Table 3. Variance analysis of soil properties based on sample area

	ICP Side	Avşar Plateau	Standard Deviation	p
Litter Thickness (mm)	16.7	19.2	8.5	0.176
Litter Amount (g/m²)	3476.9	3975.8	972.0	0.016
Fresh Soil Bulk Density (g/L)	1416.3	1287.3	162.0	0.000
Dry Soil Bulk Density (g/L)	915.7	848.8	121.0	0.009
Soil Moisture (%)	55.7	52.0	9.9	0.081
Sand (%)	40.7	44.5	2.6	0.000
Clay (%)	40.3	40.2	1.3	0.695
Water Contents (g/L)	500.6	438.5	74.0	0.000
Compactness (%)	10.2	4.9	15.0	0.096

Table 4. Variance analysis of the effect of trekking on soil physical properties

	Trekking Areas	Control Areas	Standard Deviation	p
Litter Thickness (mm)	13.3	23.0	8.5	0.000
Litter Amount (g/m²)	3373.0	4179.0	972.0	0.000
Fresh Soil Bulk Density (g/L)	1410.0	1268.0	162.0	0.000
Dry Soil Bulk Density (g/L)	926.0	825.0	121.0	0.000
Soil Moisture (%)	52.7	54.3	9.9	0.472
Sand (%)	42.2	43.0	2.6	0.344
Clay (%)	41.2	39.3	1.3	0.000
Water Contents (g/L)	483.4	443.3	74.0	0.009
Compactness (%)	14.0	0.0	15.0	0.000

caused degradation in soil structure, and a decrease in soil porosity, organic matter content, infiltration, and water holding capacity. The bulk density of the upper soil in areas used as skidding forest trails and therefore exposed to more pressure, was found to be 60% higher than in other areas (Makineci et al., 2007). Similarly, penetrometer resistance was measured as 50% higher in the upper soils of skidding trails due to compaction (Demir et al., 2010).

The main factors causing soil compaction are the power required for compaction, litter thickness, soil structure, size of granules, and soil moisture (Adams and Froehlich, 1981). In this study, an increase in litter thickness and the amount of sand present provided a soil structure that showed more resistance to compaction, yet an increase in clay content caused an increase in the rate of soil compaction. According to Pickering and Hill (2007), recreational activities in forests affect soil compaction, surface litter, and the hydrological balance. In general, 40% of the bulk density in an average forest soil is solid mass (minerals and organic matter), 25% is air, and 35% is filled with the water. Soil compactness refers to the increase in soil bulk density resulting from the degradation of soil structure due to exposure to external conditions or forces and the agglomeration of soil granules (Adams and Froehlich, 1981).

Significant changes were detected in the amount and thickness of surface litter between the trampled and natural areas. Research conducted at recreational sites in Belgrad forest indicated that the amount of surface litter was reduced to half on areas exposed to certain trampling activities compared with undisturbed areas (Çakır et al., 2010). Similarly, Demir et al., (2007) showed that on skidding trails in beech forests the amount of surface litter was reduced to half that in undisturbed forests. These results indicate that intensive use of forest areas for recreation and skidding activities affects the amount of surface litter more than trekking.

Soil compaction normally causes an increase in soil bulk density, degradation in soil porosity, changes in hydrological transmission and air perforation, and an increase in the physical resistance to roots (Turgut, 2012). Furthermore, microbial activity is lost to certain degree in compacted soil, which has a degraded structure in terms of aggregation and porosity. As a result, decomposition and mineralization of nutrients are affected (Hoorman et al., 2011). This situation causes a loss of soil productivity along with degradation and erosion.

There were no statistical differences between the measurements taken in the same areas in 2010 and 2011. However, a certain level of increase was observed in bulk density and rate of compaction in 2011. We believe that the trampling effects from the previous year continued in the following year. Soils exposed to compaction may recover over time (Thorud and Frissell, 1976). Turgut (2012) indicated that soils exposed to heavy compaction take a long time to recover.

When the sample points were compared with each other, the fresh and dry soil bulk density, and the water content were found to be higher (~10%) in the sample from the ICP side than from the sample located in Avşar Plateau. This could be attributed to the more granular soil structure from the 10% more sand in the Avşar Plateau sample; the clay content was the same in both areas. However, besides the changes in soil properties no significant difference in soil compactness was observed.

While an almost 10% increase in water content was observed in the trekking strip samples compared with the control samples, interestingly there were no significant differences in soil moisture. This can be attributed to the fact that soils continue to hold their water content, even though they lose porosity, during the shrinkage in granularity when exposed to a certain level of pressure. However, soil moisture decreases significantly in areas such as skidding trails heavily exposed to intensive trampling (Demir et al., 2007).

CONCLUSION

A widely practiced ecotourism activity, trekking can cause noticeable effects on the physical properties of soils, particularly when exercised by a large group of people. The principle direct effects are ground-down surface litter, soil compaction, and an increase in soil bulk density. There are also some indirect effects such as degradation in soil porosity, and changes in ground infiltration, water holding capacity, and aeration may be caused.

Large crowds of people taking part in activities that are not part of the natural process, such as trekking, have the potential to cause changes in the natural structure and dynamics of the landscape. One of the other environmental features impacted by trekking is the composition and structure of ground vegetation. Thus, it is recommended that new research needs to be designed to study and evaluate any impacts on the natural structure and dynamics. Other environmental features impacted by trekking include the forest wildlife and the microorganisms that mostly live under the surface litter. Further research is also needed to study the wildlife resources affected by any anthropogenic disturbance such as trekking.

Acknowledgments
This research was conducted with support from the research project entitled "Evaluating the environmental, social, and economic effects of potential ecotourism activities in the Bolu-Aladağ region" and granted by the General Directorate of Forestry (grant agreement no: 08.8301/2009–2013).

REFERENCES

- Adams, P. W., Froehlich, H. A., 1981. Compaction of forest soils. [Covallis, Or.]: Oregon State University Extension Service.
- Çakır, M., Makineci, E., Kumbasli, M. 2010. Comparative study on soil properties in a picnic and undisturbed area of Belgrad Forest, İstanbul. *Journal of Environmental Biology* (31): 125-128.
- Demir M., Makineci E., Yılmaz E., 2007. Harvesting Impact On Herbaceous Understory, Forest Floor And Top Soil Properties On Skid Road In A Beech (Fagus Orientalis Lipsky) Stand, *Journal of Environmental Biology* vol.28: 427-432.
- Demir M., Makineci E., Çömez A., Yılmaz E., 2010. Impacts Of Repeated Timber Skidding On The Chemical Properties Of Topsoil, Herbaceous Cover And Forest Floor In An Eastern Beech (Fagus Orientalis Lipsky) Stand. *Journal of Environmental Biology* vol.31: 477-482.
- Dönmez, Y., Gökyer, E., Aşkın, F. K., 2015. Assessment of Ecotourism Potential of Safranbolu Yörük Village and its Surroundings by R'WOT Analysis. *Karabuk University Journal of Institute of Social Sciences* Special Issue 1: 70-83. Doi: 10.14230/joiss89 [Turkish] [CrossRef]
- Erdoğan, N., Erdoğan, İ., 2005. The Nature of Communicated Ecotourism Describes. *Journal of Gazi University Communication Faculty* 20 (1): 55-82. [Turkish]
- Gülçur, F., 1974. Physical and Chemical Analysis Methods of Soil. İstanbul University. Faculty of Forestry Publication No: 201, İstanbul. [Turkish]
- Hoorman, J. J., Sá, J. C. D. M. J., Reeder, R., 2011. The biology of soil Compaction. *Soil Tillage Res* 68: 49-57.
- Jim, C. Y., 1987. Camping impacts on vegetation and soil in a Hong Kong country park. *Applied Geography* (74): 317-332.
- Kantarcı, M. D., 2000. *Soil science*. İstanbul University publications, (Publication No: 4261). [Turkish]
- Kaypak, Ş., 2010. Sustainability of Ecological Tourism. *International Journal of Alanya Faculty of Business* 2(2): 93-114. [Turkish]
- Koçoğlu, P., 2008. Ecotourism In Sustainable Tourism Policy: Investigatıon Of The World Ecotourism Destinatıons. Expertise Thesis, pp: 101, ANKARA. [Turkish]
- Makineci E., Demir M., Çömez A., Yılmaz E., 2007. Effects Of Timber Skidding On Chemical Characteristics Of Herbaceous Cover, Forest Floor And Topsoil On Skidroad In An Oak (Quercus Petrea L.) Forest. *Journal of Terramechanics* vol.44: 423-428, DOI:10.1016/j.jterra.2007.12.001 [CrossRef]
- Mol, T., 1979. Recreation areas and forest conservation relations. *Journal of the Faculty of Forestry İstanbul University* | [S.l.]: 68-75, ISSN 1309-6257. DOI: 10.17099/jffiu.36913. [Turkish]
- Özgen, N., 2010. The determination of natural tourism potential of Eastern Anatolia Region and propositions for the planning of concerning potential. *Journal of Human Sciences* 7(1): 1407-1438. [Turkish]
- Pickering, C. M., Hill, W., 2007. Impacts of recreation and tourism on plant biodiversity and vegetation in protected areas in Australia. *Journal of Environmental Management* 85(4): 791-800.
- Thorud, D.B., Frissell, S.S., 1976. Time changes in soil density following Sıkışma under an oak forest. Minnesota Forestry Research Note 257.
- Turgut, B., 2012. Soil compaction in forest soils. *SDU Faculty of Forestry Journal* 13: 66-73. [Turkish]
- Turker, N., 2013. Evaluation Of Western Black Sea Regıon's Ecotourism Resources And An Ecotourism Route Proposal. The Journal of Academic Social ScienceStudies, *International Journal of Social Science* 6(4): 1093-1128. Doi:10.9761/JASSS886 [Turkish] [CrossRef]
- Url 1, https://www.kultur.gov.tr/TR,96269/turizm-cesitleri.html (Visit Date:18.08.2016). [Turkish]
- Url 2, http://www.bolu.gov.tr/turizm (Visit Date:18.08.2016). [Turkish]
- Yanardag, M. O., 2014. Needs Analysis of Tourism Investments in Izmir. *Adnan Menderes University, Journal of Institute of Social Sciences* Vol.: 1, Issue 1: 81-104. [Turkish]