ISFOR 2017

International Symposium on New Horizons in Forestry

18-20 October 2017, Isparta - Turkey

PROCEEDINGS & ABSTRACTS BOOK

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International Symposium on New Horizons in Forestry

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International Symposium on New Horizons in Forestry

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Preface

Natural resources such as forest ecosystems offer many functions. Apart from the production of wood and non-wood products, forest ecosystems play an essential role in climate regulation and carbon sequestration, biodiversity, water and soil conservation, rural development, the protection of cultural values. Unfortunately, these ecosystems always been disturbed by natural disasters and human activities; such as wildfires, pests, overexploitation for production of raw materials and conversion into other land uses, throughout the history of the mankind. Nowadays, they face somewhat new issues including climate change and desertification. 80 countries with 40% of the world's population are already suffering from water shortages. At the end, we all pay the price for all these destructions and adverse developments in forest ecosystems.

In this context, we are pleased to host the "International Symposium on New Horizons in Forestry". This symposium aimed to provide a platform for the exchange of interdisciplinary scientific information, as well as offering an open forum for the discussion on the issues related to forestry, in light of new developments. During the three-day symposium, 148 oral and 97 poster presentations were presented in 35 sessions at 5 halls. I wish that this symposium will improve our understanding of forest ecosystems and its components, and in return help us resolve some of the problems related to our environment.

I would like to express my sincere thanks to all the participants for their invaluable contribution during this event.

Prof.Dr. Hüseyin FAKİR
Dean of the Faculty of Forestry

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ISFOR 2017 International Symposium on New Horizons in Forestry
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Keynote presentation

Alien and invasive species of harmful insects in Bosnia and Herzegovina

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Abstract: An alien species – animal, plant or micro-organism – is one that has been introduced as a result of human activity to an area it could not have reached on its own. In cases where the foreign species expands in its new habitat, causing environmental and economic damage, then it is classified as invasive. The maturity of foreign species in the new area may also be influenced by climate changes. The detrimental effect of alien species is reflected in the reduction of biodiversity as well as plant vitality. A large number of alien species of insects are not harmful to plants in new habitats, but there are also those that cause catastrophic consequences to a significant extent. The aim of this paper is to present an overview of newly discovered species of insects in Bosnia and Herzegovina. The research area, for this work included forest and urban ecosystems in the territory of Bosnia and Herzegovina. For the purposes of this paper, an overview of the species found is provided:

- *Leptoglossus occidentalis* Heidemann; (Hemiptera: Coreidae) - The western conifer seed bug, found at two sites in Central Bosnia, in 2013 and 2015;
- *Arge berberidis* Schrank; (Hymenoptera: Argidae) - The berberis sawfly, recorded in one locality (Central Bosnia), in 2015;
- *Pontania viminalis* Linnaeus; (Hymenoptera: Tenthredinidae) - Pea gall sawfly, recorded in one locality (Central Bosnia), in 2015;
- *Obolodiplosis robiniae* Haldeman; (Diptera: Cecidomyiidae) - Black locust gall midge, found on a large number of localities in Western Bosnia, in 2010;
- *Oxycarenus lavaterae* Fabricius (Heteroptera: Lygaeidae) - Lime seed bug, recorded in Teslić (Central Bosnia), in 2012;
- *Cydalima perspectalis* Walker (Lepidoptera, Crambidae) – Box Tree Moth, recorded in Brčko (Northern Bosnia) in 2013 and then spread in whole country;
- *Aproceros leucopoda* Fabricius (Hymenoptera, Argidae) – Elm sawfly, recorded in Vareš (Central Bosnia), in 2017.
- *Corythuca arcuata* Fabricius (Heteroptera: Tingidae) – Oak lace bug, recorded in Vareš (Central Bosnia), in 2017.

Due to the intense traffic of goods and passengers, these days, it is almost impossible to prevent entry of new insect species in a particular area. However, timely detection of new alien and invasive species is a good starting point for successful eradication and their localization.
Keywords: Alien species, Invasive species, *Leptoglossus occidentalis, Arge berberidis, Pontania viminalis, Obolodiplosis robiniae, Oxycarenus lavaterae, Aproceros leucopoda, Corythuca arcuata,* Bosnia and Herzegovina

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Keynote presentation

Administration of forest resources: Improvement, protection and responsible utilization of trees and wood (Wood supply prospects of fibre and particle board industries in Turkey)

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Abstract: The "Forest Products and Wood Processing Sector (excluding pulp and paper plants)" in Turkey employs (including associated transportation and marketing services) approximately one million people and the sector's enterprise value is about 12 billion USD. There is a shortage in the supply of chip wood as a raw material. Furthermore, the chip wood prices in the local markets are higher than the international markets. This paper aims at putting forward proposals which can help to increase wood production output from local forests and to reduce chip wood prices in the local markets.
The proposals to increase wood production from state forests can be summarized under three main headings which are;

✓ Increasing the Rate of Allowable Annual Cut
✓ Extending Commercial Thinning Programmes, and
✓ Establishing Industrial Forest Plantations

The volume of wood growth occurred within a vegetation period in a forest stand is defined in terms of "Current Annual Increment" (CAI). The Directorate General of Forestry (DGF) has a long-standing forestry policy for optimising the structure of forests in Turkey. In this context, nearly half (approximately 45%) of the CAI is taken for assessing the quantity of "Allowable Annual Cut" (AAC), in accordance with the DGF's guidelines. According to the DGF estimates, the total quantity of standing forest volume was estimated "935.512.150" m^3 in the year 1973, whereas it reached up to "1.611.774.193" m^3 in 2015. These figures indicate that the total quantity of standing forest volume has increased by 72% in the period of last 42 years in Turkey. As a result, an accumulation of standing wood volume is achieved in the forests and a greater quantity of increase in the CAI is ensured for the successive years. A portion of the increased wood demand could be met by increasing the ratio to assess the quantity of AAC in suitable forest sites gradually. In this context, more than half (approximately 55%) of the CAI could be assessed as AAC, and the remaining quantity (approximately 45% of the CAI) could be left as standing trees in the stand to accumulate further volume growth in forests. As expressed above, an increase of about 10% in the rate of AAC/CAI may result in an increase of about 4 to 5 million m^3/year in the quantity of AAC. The first commercial thinning in a pine stand is usually performed when the trees reach chip wood size, about 15 to 20 cm in diameter. In a plantation, the trees are generally between 12 and 18 years old when they reach this size. In a natural stand, the trees will probably reach this size in 20 to 30 years. Experiments indicate that the implementation of regular thinning programmes may result in an additional chip wood production of at least 2 million m^3/year only from the stands of *Pinus brutia* in Turkey. It is obvious that wood production could increase further if the thinning programmes are extended to the stands of other tree species. A scenario of industrial forest plantation programme was arranged for Turkey using the data obtained from a series of experimental field trials. The scenario envisages to conduct an establishment of industrial forest plantations for a rotation period of 25 years on an area totalling to 40.000 ha/year. The scenario recommends use of *Pinus brutia* seedlings for plantations to be established in the Mediterranean and Aegean regions, and *Pinus pinaster* seedlings from Corsican origin for plantations to be established in the Marmara and Western Black Sea regions. At the end of the 25-year rotation period, the establishment of industrial forest plantations will be completed in an area totalling one million hectares which will produce 15 million m^3 of industrial wood annually. It should be noted that, according to this scenario, the total size of plantation land to be established (1 million ha) will amount to only 4,5% of the total forest area, whereas total wood production from these plantations will amount to 68% of the total wood production from natural forests. Chip wood prices in Turkey are twice more expensive compared to those in the European countries and three times more expensive than those countries in the Continental America. The reasons for expensive chip wood prices are mainly due to higher overhead costs and value added tax as explained below. The current price of coniferous chip wood is 73 TL/metric cordwood, of which 52% of this cost (38 TL/cordwood) is made up of the first three input costs (the bulk is wood production cost) and the remaining 48% (35 TL/cordwood) of this cost represents overheads. It is obvious that share of overheads (of which a proportion is not born strictly from forestry activities) doubles the chip wood prices and creates problems for fibre and particle board producers. Therefore, some components of the overheads should be removed from the DGF Working Capital Budget, and should be transferred out to other budget items or probably to general budget. In many countries, where Turkish producers of fibre and particle board are competing against, the Value Added Tax (VAT) rates for chip wood are around 6% and 8% of the purchase price. In Turkey, the VAT rate for chip wood is 18% of the purchase price, which is much higher than those countries Turkish manufacturers are competing against. Therefore, a proposal is put forward herewith to reduce the VAT rate on the raw material chip wood from 18% to 8% of the purchase price, in line with the international competition.
Keywords: Wood supply,

1. Introduction

The "Forest Products and Wood Processing Sector (excluding pulp and paper plants)" in Turkey employs (including associated transportation and marketing services) approximately one million people and the sector's enterprise value is about 12 billion USD. The forest products and wood processing sector constitutes mainly two sub-sectors: a) furniture and decoration industries, and b) fibre and particle board industries. The output products from the fibre and particle industries are the main intermediate products consumed by the furniture and decoration sector. In recent decades, fibre and particle board industries have made considerable investments in modern technologies, achieving a significant share of the world production capacity. The annual capacities for production and chip wood consumption of the fibre and particle board sector are stated below (Source: Association of Fibre and Particle Board Producers):

Production capacity:	
Fibre board	5.622.400 m^3/year
Particle Board	5.350.000 m^3/year
Total	10.972.400 m^3/year

Chip wood consumption capacity:	
Fibre board	7.530.000 tons/year
Particle Board	6.150.000 tons/year
Total	13.680.000 tons/year

Although the wood consumption capacity of the established processing facilities in the sector is determined as 13.680.000 tons/year, the quantity of wood raw material that the sector could supply was only 9.500.000 tons last year, as stated below:

The sources and the quantities of chip wood supplied by the sector;	
State forests	3.700.000 tons/year
Wood residues	900.000 tons/year
Private plantations (poplar)	400.000 tons/year
Private stands	1.500.000 tons/year
Imported wood	3.000.000 tons/year
Total	9.500.000 tons/year

As indicated above, the fibre and particle board production sector in Turkey is supplied with 9,5 million tons of raw material chip wood annually; whereas the established processing capacity for chip wood is 13,7 million tons/year. These figures indicate that there is a shortage in the supply of chip wood as a raw material. Furthermore, the chip wood prices in the local markets are higher than the international markets, partly due to shortfall in supply to meet the demand, and partly due to high Value Added Tax (VAT) and high levels of overhead costs allocated by the state. Consequently, this situation stifles investment in the forest and wood product sector, and reduces its competitiveness both in domestic and international markets. This paper aims at putting forward proposals which can help to increase wood production output from local forests and to reduce chip wood prices in the local markets.

2. Proposals to increase local wood production

Nearly all of the forests in Turkey are state owned and administered by the Directorate General of Forestry ("DGF") in line with the sustainability principles. Wood production from local forests can be increased if some implementations are carried out regularly by the DGF. The proposals to increase wood production from state forests can be summarized under three main headings which are;

- ✓ Increasing the Rate of Allowable Annual Cut
- ✓ Extending Commercial Thinning Programmes, and
- ✓ Establishing Industrial Forest Plantations

2.1. Increasing the rate of allowable annual cut

The volume of wood growth which occurs within a vegetation period in a forest stand is defined in terms of "Current Annual Increment" (CAI). The DGF has a long-standing forestry policy for optimising the structure of forests in Turkey. In this context, nearly half (approximately 45%) of the CAI is taken for assessing the quantity of "Allowable Annual Cut" ("AAC"), in accordance with the DGF's guidelines. Therefore, less than half of the quantity of the current annual increment is removed from forests by harvesting and the remaining quantity (about 55% of the CAI) is left as standing trees in the stand for further growth.

According to the DGF estimates, the total quantity of standing forest volume was estimated "935.512.150" m^3 in the year 1973, whereas it reached up to "1.611.774.193" m^3 in 2015. These figures indicate that the total quantity of standing forest volume has increased by 72% in the period of last 42 years in Turkey. As a result, an accumulation of standing wood volume is achieved in the forests and a greater quantity of increase in the CAI is ensured for the successive years.

At present, total demand for wood has increased considerably due to increase in population and improvements in social and economic conditions in Turkey. Therefore, a greater quantity of wood material is required to be supplied from the local markets. A portion of the increased wood demand could be met by increasing the ratio to assess the quantity of AAC in suitable forest sites gradually. In this context, more than half (approximately 55%) of the CAI could be assessed as AAC, and the remaining quantity (approximately 45% of the CAI) could be left as standing trees in the stand to accumulate further volume growth in forests.

As expressed above, an increase of about 10% in the rate of AAC/CAI may result in an increase of about 4 to 5 million m^3/year in the quantity of AAC. It is obvious that an increase in standing forest volume results in greater quantity of CAI. Higher levels of CAI in forests could encourage the DGF to assess greater quantity of AAC, which results in an increase of wood supply to the market.

2.2. Extending commercial thinning programmes

The first commercial thinning in a pine stand is usually performed when the trees reach chip wood size, about 15 to 20 cm in diameter. In a plantation, the trees are generally between 12 and 18 years old when they reach this size. In a natural stand, the trees will probably reach this size in 20 to 30 years.

Within a few years, after the diseased, damaged, poorly formed, and weak trees are removed by thinning, the branches and roots of the remaining trees will grow to fill in the gaps in some sites. Inevitably, as time elapses, the same crowded condition that existed before thinning will redevelop. Therefore, it is important to repeat the thinning process again, before the trees get over crowded, slowing down their growth.

Thinning is an important silvicultural practice that redistributes the growth potential of the site for the best trees. Diameter growth rates are maintained or increased in remaining trees after thinning, which increases the return on investment from higher-value trees. Biologically, thinning accelerates stand development by favouring the tallest, best-formed trees over those that are diseased, overtopped, crooked, forked, or otherwise undesirable and likely to die if they were left in the stand long enough. In addition, thinning raises periodic income, improves access for equipment, provides recreation and hunting grounds, and creates a generally healthier stand.

The dominant tree species in the ORMA Hinterland (south-west Turkey) is ***Pinus brutia*** which naturally generates even aged and dense stands following clear cut and forest fires. A considerable proportion of *Pinus brutia* stands is accumulated in the younger age classes in the *Pinus brutia* zone in the southern and western Turkey. The majority of such *Pinus brutia* stands needs thinning to accelerate the reduced growth rate. Total size of forests in need of thinning may exceed a million hectares and therefore, regular thinning programmes are urgently needed to be actioned by the DGF.

Experiments indicate that the implementation of regular thinning programmes may result in an additional chip wood production of at least 2 million m^3/year only from the stands of *Pinus brutia* in Turkey. It is obvious that wood production could increase further if the thinning programmes are extended to the stands of other tree species.

2.3. Establishing industrial forest plantations

Natural forests play a very important role in maintaining the ecological balance in the world. The demand for wood has been growing continuously, as the population grows, and the world economy develops. As a result, it is envisaged that the global demand for wood may reach up to circa 5,5 billion m^3/year by 2020. Currently, the worldwide wood production capacity from natural forests is around 3,5 billion m^3/year. Hence, the global wood demand can no longer be met solely from natural forests. Therefore, the protection and maintenance of world natural forests have gained greater importance. As a consequence, additional wood production from industrial plantations with fast growing forest tree species appears to be the most rational way to meet demand. It should be noted that some countries have already established industrial forest plantations on extensive areas and almost 2 billion m^3 of industrial wood is produced annually to meet the excessive demand for wood in the world.

Poplar plantations are considered to be a fast growing industrial plantations for wood production. The poplar clones used in industrial plantations are among the most important fast growing tree species due to their relative high growth rate within a shorter period of rotation, and their ability to adapt to a wide range of site conditions around the world.

In Turkey, a great majority of poplar plantations are established by farmers on their small scale private land using the clones of indigenous poplars (*Populus nigra* L) and exotic poplars (*Euramericana* hybrids and *Populus deltoides*). The quantities of annual wood production obtained from plantations of indigenous and exotic poplar clones are estimated approximately 1,5 million m^3/year and 2,0 million m^3/year, respectively, which altogether make a total poplar wood production of about 3,5 million m^3/year in Turkey. It should be noted that a proportion of the growing wood demand is met by the wood produced from poplar plantations, which mitigates the demand pressure over natural forest resources to a certain extent.

In Turkey, large scale corporate investments for industrial plantation investments are not yet widespread. At present, there are only two examples for such corporate plantation investments, which are “ORKAV–Plantation Forestry and Agricultural Intercropping & Trade Inc.” established by Mr Şevket Demirel and “ENAT–Industrial Forest Plantations & Trade Inc.” established by Mr Nihat Gökyiğit.

Widespread extension of corporate investments for large scale industrial plantations can help to produce wood in considerable quantities to meet the growing demand for wood in Turkey. It is important to point out that plantation land of adequate size with suitable natural conditions and other financial and technical facilities are available to establish such

industrial forest plantations in Turkey. State forestry sector's initiative is considered to be essential in establishing large scale industrial forest plantation investments. Large scale plantations at adequate extension could be established by the state sector, creating the bulk of a locomotive power for private entrepreneurs to follow up large scale industrial forest plantation investments.

A scenario of industrial forest plantation programme was arranged for Turkey using the data obtained from a series of experimental field trials. The scenario envisages to conduct an establishment of industrial forest plantations for a rotation period of 25 years on an area totalling to 40.000 ha/year. The scenario recommends use of *Pinus brutia* seedlings for plantations to be established in the Mediterranean and Aegean regions, and *Pinus pinaster* seedlings from Corsican origin for plantations to be established in the Marmara and Western Black Sea regions. At the end of the 25-year rotation period, the establishment of industrial forest plantations will be completed in an area totalling one million hectares which will produce 15 million m^3 of industrial wood annually. The total forest area in Turkey covers 22.342.935 hectares of land and a total annual allowable cut was estimated as 22 million m^3 in 2017. It should be noted that, according to this scenario, the total size of plantation land to be established (1 million ha) will amount to only 4,5% of the total forest area, whereas total wood production from these plantations will amount to 68% of the total wood production from natural forests.

3. Proposals to reduce chip wood prices

Chip wood prices in the local markets are much higher compared to those in the international markets. Chip wood prices in Turkey are twice more expensive compared to those in the European countries and three times more expensive than those countries in the Continental America. Consequently, the share of the raw wood material amounts to 45 – 50% in the total cost of fibre and particle board production, reducing the competitiveness of the Turkish Fibre and Particle Board Sector in the international markets significantly. Therefore, the chip wood prices need to be reduced to in order to improve the competitiveness of the Turkish producers in the international markets.

The reasons for expensive chip wood prices are mainly due to higher overhead costs and value added tax as explained below.

3.1. Exemption of overheads from DGF working capital

There are four main input costs for the chip wood prices which are; wood production costs, tariff costs, marketing costs and overheads. The level of first three cost components are similar to those in the international markets, and hence, do not cause any distortions to international competitiveness. The fourth cost component "overheads and general expenditure" is a major cost item, included in the "Working Capital Budget" of the Turkish Forestry Service (DGF), allocating numerous indirect costs and different activities carried out by the DGF. For example, the forest roads are build and maintained for performing various forestry activities, but in many cases forest roads are used to a great extend for public transport purposes. Infect roads for public transport should be financed by the Government's General Budget but not by the Working Capital Budget of the DGF. The forest fire fighting infrastructure and activities are another example which are carried out to protect not only the state forests but also all sorts of public property in and around the forests. Therefore, some components of the Overheads should be excluded from the DGF's Working Capital Budget.

The current price of coniferous chip wood is 73 TL/metric cordwood, of which 52% of this cost (38 TL/cordwood) is made up of the first three input costs (the bulk is wood production cost) and the remaining 48% (35 TL/cordwood) of this cost represents overheads. It is obvious that share of overheads (of which a proportion is not born strictly from forestry activities) doubles the chip wood prices and creates problems for fibre and particle board producers. Therefore, some components of the overheads should be removed from the DGF Working Capital Budget, and should be transferred out to other budget items or probably to general budget.

3.2. Reduction of the rate of VAT in chip wood purchases

Wood is a raw material which is required to be processed in several steps by numerous organizations before the final goods are sold to consumers. Each wood processing step and organization creates considerable capacity of employment which is an added value.

In many countries, where Turkish producers of fibre and particle board are competing against, the Value Added Tax (VAT) rates for chip wood are around 6% and 8% of the purchase price. In Turkey, the VAT rate for chip wood is 18% of the purchase price, which is much higher than those countries Turkish manufacturers are competing against.

High raw material prices (partly due to high VAT and high overhead cost allocation) discourage further investment in the wood production sector to improve its production capacity at lower cost. Consequently, high raw material prices have an adverse knock on impact on the downstream industries (furniture and decoration sector, fibre and particle board industries) that rely on cheap supply of raw material and intermediary products. Thus, the output of the downstream industries is reduced further, limiting employment, and adversely impacting its competitiveness.

Therefore, a proposal is put forward herewith to reduce the VAT rate on the raw material chip wood from 18% to 8% of the purchase price, in line with the international competition. Such a reduction in VAT would increase the competitiveness, output and employment of the downstream industries that rely on wood as a raw material, generating higher tax revenues for the government, unlike a static calculation would otherwise suggest.

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Oral presentation

Identifying potential sites for ecotourism in Burdur Province using GIS & AHP

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Abstract: The aim of this study is to identify and assess the natural resources having tourism potential to be developed in Burdur province. In this study, characteristics of the land ecosystems; landscape, wildlife, topography, accessibility identified as indicators of suitability. The evaluating process for ecotourism site conducted based on chosen criterias; land use/cover, reservation/protection, elevation, slope and distance from roads. GIS and AHP was used for the analysis and calculations required in regard with these parameters to identify the potential ecotourism sites in Burdur province. As a result of the study, ideal areas for ecotourism usage are defined and the land suitability map for ecotourism was created. Based from the suitability map ecotourism potential areas was classified as highly suitable (S1), moderately suitable (S2), marginally suitable (S3) and not suitable (N) for ecotourism. Highly suitable areas (S1) can be used for education as well as conservation. Moderately suitable areas (S2) can be developed as ecotourism destination by facilitating proper ecotourism infrastructure and services. Marginally suitable areas (S3) are the most appropriate areas for development. And not suitable (N) areas are currently not suitable for ecotourism, including areas with several effects of development and degraded environment. The proposed methodology has been useful in identifying ecotourism regions by associating important criteria with the province's real resources. And the findings of this research can be useful for ecotourism resource utilization and development of tourism facilities in Burdur province.
Keywords: Site suitability evaluation, Ecotourism, GIS, AHP, Burdur

1. Introduction

Ecotourism emerged as an alternative form of tourism in the 1990s to mitigate the faults of conventional (mass) tourism in meeting the needs of sustainable development (Leksakundilok, 2006). Ecotourism is the most pervasive tourisms of all and it plays important role in various countries differently. Ecotourism was first proposed in 1983 by Ceballos-Lascurain, a special consultant of the International Union for Conservation of Nature and Natural Resources (Hummel, 1994).

According to Lascurain, the tourism boom is to study, admire, appreciate and enjoy the natural landscape and observe the flora, fauna, cultural features and find local communities in the past and present times (Niyazmand, 2004).

Ecotourism is now defined as "responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education" by The International Ecotourism Society (TIES, 2015).

Generally, Ecotourism is responsible to travel to natural areas that its aim is to protect the environment and improve the quality of life for local people. Ecotourism creates minimal damage to nature and culture of the region. Ecotourism has a strong correlation with sustainable tourism (Prabhu et al., 1999). Ecotourism makes a social relation between people of various communities. It can increase social interactions among nations and present different cultures and religions and cause to world peace (Babapour, 2001). However, ecotourism can be classified as a possible threat to ecosystems because ecotourism attractions are based on fragile ecological relations (OK, 2006).

Ecotourism's perceived potential as an effective tool for sustainable development is the main reason why developing countries are now embracing it in their economic development and conservation strategies (Rahman, 2010). Ideally, ecotourism should satisfy several criteria such as conservation of biological and cultural diversity through ecosystem protection promotion of sustainable use of biodiversity with minimal impact on the environment being a primary concern (Ryngnga, 2008). This can be judged with the help of criteria and indicators approach, which is basically a concept of sustainable ecotourism management developed in a set of principles, criteria and indicators (Prabhu et al., 1999). A multi-criteria approach can thus be adopted based on application of relative weights to each criterion in a GIS environment (Wanyonyi et al., 2016).

Strategic planning to develop ecotourism area is not measured in terms of the landscape only, but many factors should be considered such as topography, climate area, soil type and many more. This planning can be overcome by using a method in which the existence of AHP technique with the help of GIS (Mohd Ujang, 2016).

To identify potential sites for ecotourism, it is necessary to first evaluate the land ecological suitability for ecotourism. In other words, identifying suitable sites for ecotourism is the first important step to ensure their roles and functions (Kalogirou, 2002; Malczewshi, 2004; Gillenwater et al., 2006).

2. Study area

The area chosen for this current research is specially focused on the land ecosystems of Burdur Province in Turkey.

Burdur is located between 36-53 and 37-50 northern latitudes and between 29-24 and 30-53 eastern longitudes in South-Western Anatolia, also called Turkish Lakeland, in Western Mediterranean Region.

The land area of Burdur is 6.840 square kilometers and covers 0.88 percent of the country's land area. The average height is 1.000 meters (Anonymous, 2012).

Burdur is composed of 11 districts, 183 villages and 14 municipalities (TODAİE, 2016). Burdur is located in southwest Anatolia, surrounded by Antalya in the east and south, Denizli in the west, Muğla in the south, Afyon and Isparta in the north (Figure 1).

Figure 1. Location map of the study area

3. Materials and methods

3.1. Materials

This study focuses on land suitability evaluation of ecotourism in Burdur using GIS and AHP techniques. Data used in this study were assembled from a variety of sources (Table 1).

Firstly, the primary data from the field survey were collected through interviews and questionnaires answered by 20 experts in the related fields of study for identifying factors that are important for ecotourism in Burdur province.

Secondary data were gathered from land use-land cover map 2012 and topography map of the study region. In addition, national institutions are also contacted for the collection of necessary information and literatures. The thematic maps were prepared and edited. Then they overlaid with weighted sum method in the suitability analysis of ecotourism using ArcGIS 10 software of ESRI.

Table 1. List of data and their original sources

Data	Scale	Source
Land Used/Cover Map	1:100.000	Corine Land Cover-2012
Protected Areas	1:50.000	Thematic map Published map-General Directorate Of Forestry-2017
DEM (View-shed Map)	1:50.000	U.S. Geological Survey (USGS)
Road Map	1:50.000	Thematic map Published Map-General Directorate Of High Ways-2016

3.2. Methods

This study demonstrates a methodology for identifying potential ecotourism sites using GIS and AHP techniques as case study of Burdur Province, Turkey. The AHP weights calculated using Microsoft Excel and ArcGIS 10 software which were used in the suitability map producing process. The work flow to produce land suitability map for ecotourism are; finding suitable factors to be used in the analysis, assigning factor priority, class weight (rating) to the parameters involved and generating land suitability map of ecotourism.

In this process, experts' opinions were asked to calculate the relative importance of factors involved. The AHP is one of the most extended Multi-Criteria Decision Making (MCDM) techniques. This method provides a structural basis for qualifying the comparison of decision elements and criteria in a pair wise technique (Bunruamkaew, 2012).

The decision of factors : landscape/naturalness (land use/cover), wildlife (reservation/protection), topography (elevation, slope) and accessibility (distance from roads).

First, the AHP method was applied to determine the relative importance of all selected criteria. Each criterion received a weight and a score which represented its relative importance in the suitability evaluation. The total score for suitability is achieved by multiplying criterion score with its appropriate weight. At the next stage, spatial data of the factors as a set of GIS layers were overlaid together for final suitability using weighted sum method. Then in raster-based format suitability map reclassified into 4 classes. At the end, the suitability map for ecotourism development is generated. In the suitability map the degree of suitability of each factor classified as Highly suitable (S1), Moderately suitable (S2), Marginally suitable (S3) and Not suitable (N).

3.3. Determination of factors and classifications

This study identifies the following factors as indicators of suitability within the land ecosystems of Burdur Province. Factors; landscape/naturalness, wildlife, topography and accessibility.

The evaluation for ecotourism sites was conducted based on the chosen criteria : land use/cover, reservation/protection, elevation, slope, distance from roads and settlement size (Table 2).

Table 2. Factors and criteria in land suitability analysis for ecotourism

Ecotourism Requirement			Factor Suitability Rating			
Factors	Criteria	Unit	High Potential (P1)	Moderate Potential (P2)	Low Potential (P3)	No Potential (N)
Landscape	Land use/ cover	class	High	Moderate	Low	Not
Wildlife	Reservation/ Protection	protected areas class	High	Moderate	Low	Not
Topography	Elevation	meter	>1581	1083-1581 m	475-1083 m	<475
	Slope	percentage	0-5 %	5-25 %	25-35 %	>35 %
Accessibility	Distance from roads	kilometer	Areas outside of any buffers around all roads	Areas within 2 km buffer around third main roads	Areas within 5 km buffer around second main roads	Areas within 10 km buffer around major roads

3.4. Classification of criteria maps

There are 5 criteria in the table which are incorporated for suitability analysis for ecotourism. The related factors and criteria in table were created and kept as GIS layers. The data of all the selected criteria maps shown in table are created and evaluated separately.

a) Landscape

- Land use/ cover

Land use map reclassified from Corine map 2012 into 10 classes of land use/ cover according to bio-physical vegetation characteristics of ecotourism potential resources as seen in Table 3.

These are forest, orchard, water body, plantation, crop land, farm land, urban and built-up land, degraded forest, grassland and mine.

Table 3. Land use/ cover classification for ecotourism potential resources (Banerjee U.K. et al., n.d.).

LULC Type	LULC Suitability
Forest	Highly importance for ecotourism, can serve as major ecotourism attraction, area need to be conserved.
Orchard	Highly importance for agro-tourism can serve as main ecotourism attraction.
Water body	Active recreation as boating, parks and natural zoological parks.
Plantation	Should be properly monitored and protected from any encroachment.
Crop land and Farm land infrastructure	Area under agriculture and farm should not be converted to other schemes. Any infrastructure development should be restricted.
Grassland	Suitable for recreational activities, area need to be conserved.
Urban and built-up land	Suitable for eco-tourist infrastructure development
Degraded forest	Need to be managed, properly with possibilities of new plantations. Important from point of view of medicinal plantations and agro-forestry scheme.
Mine	Active or abandoned mines no importance for ecotourism.

Therefore forest areas are ranked as Highly potential (P1); orchard and water body areas are ranked as Moderately potential (P2); plantation, crop and farm lands, grass lands are ranked as Low potential (P3); urban and built-up land, degraded forest, mine areas are ranked as No potential (N). The result of the reclassified land use/cover map is shown in Figure 2.

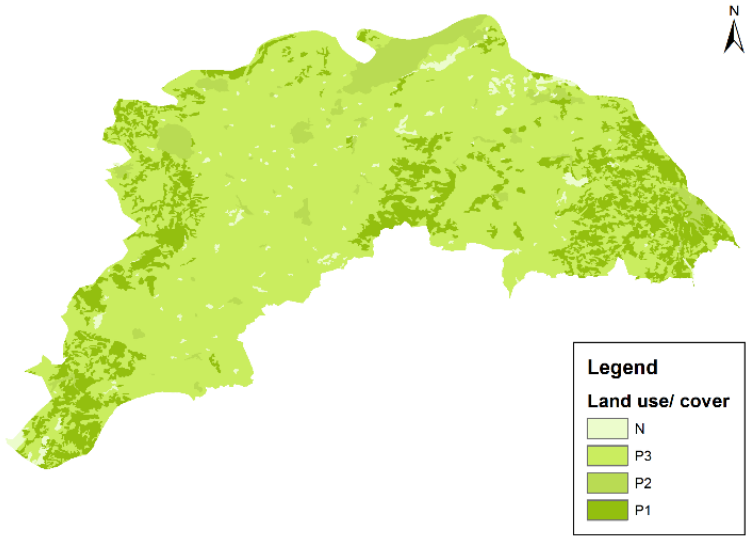

Figure 2. Land use/cover map

b) Wildlife

- Reservation/ Protection

The reservation-protection factor was classified by the type of protected areas which are suitable for habitat and wildlife abundance with regards to wildlife reserve, rare species and newly found species.

(Bunruamkaew, 2012). Protected Areas were known from the Burdur Province Protected Areas Map published by General Directorate of Forestry. From the map areas added to map as polygon feature data and new reservation/ protection map formed in ArcGis.

In this study, Wildlife Protection and Improvement Areas and Non Hunting Areas are ranked as Highly potential for habitat (P1); Wet Land and Nature Park areas are ranked as Moderately potential for habitat (P2); and Non Forest Reserve areas are ranked as Low potential for habitat (P3). On the other hand, the areas outside of these areas are ranked as No potential for habitat (N). The result of the reclassified reservation/ protection map is shown in Figure 3.

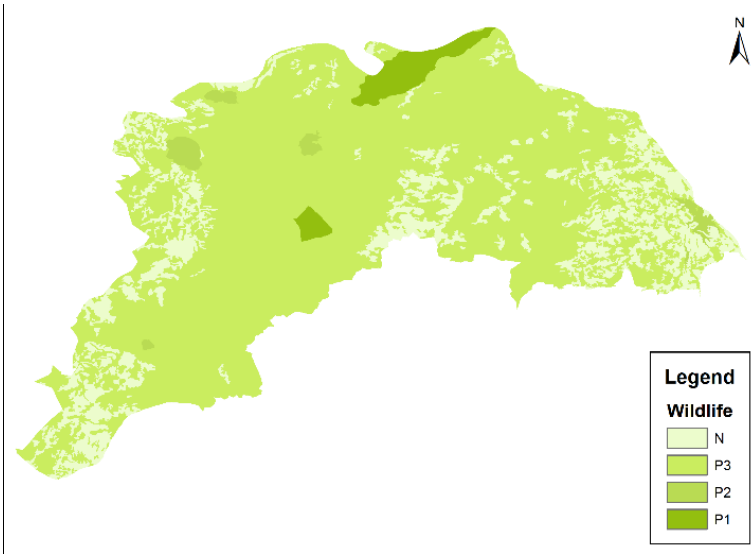

Figure 3. Reservation-protection map

c) Topography

- Elevation

In this study, elevation factor was generated from a Digital Elevation Model (DEM). The elevation classes are evaluated based on the basis of attractiveness in landscape or the topographic attractiveness for tourism significant feature (Geremew and Hailemeriam, 2015).

The elevation was reclassified based on altitude using natural breaks (jenks) technique into four classes and new values N, P3, P2, P1 were given to elevation ranges. The classes are; (<475 m) No potential (N); (475-1083 m) Low potential (P3); from (1083-1581 m) Moderate potential (P2); from (>1581 m) High potential (P1). The result of the reclassified elevation map is shown in Figure 4.

- Slope

In this study, slope factor was generated from a Digital Elevation Model (DEM). Slope of the terrain surface can be explained by degree or percent for change of slope. In this part, the reclassified slope map was given from the percentage measurement unit for ecotourism requirement.

The slope was reclassified into four classes as described by Jangpradit (2007) and new values N, P3, P2, P1 were given to slope ranges. The classes are; over (>35 %) No potential (N); from (25-35 %) Low potential (P3); from (5-25 %) Moderate potential (P2); from (0-5 %) High potential (P1). The result of the reclassified elevation map is shown in Figure 5.

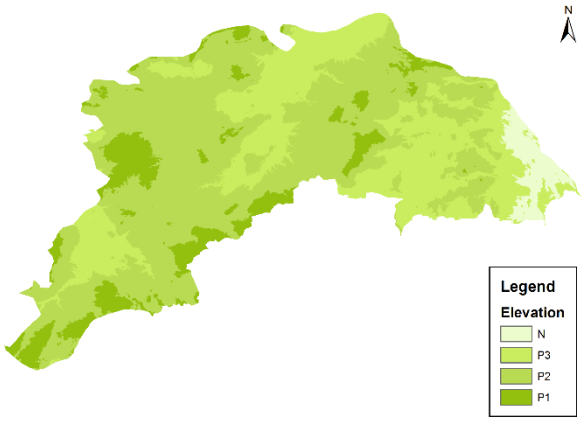

Figure 4. Elevation map

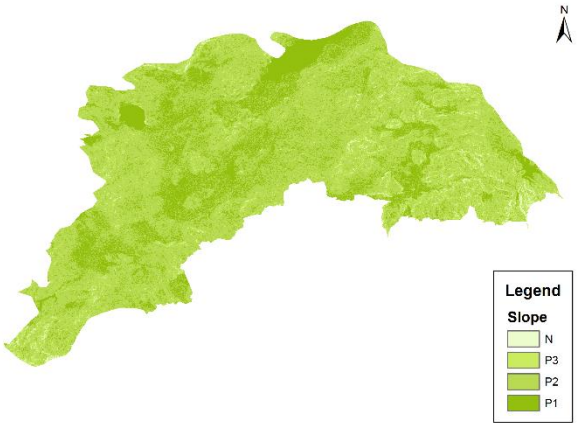

Figure 5. Slope map

d) Accessibility

- Distance from roads

This criterion was classified based on the transport condition by access types and distance from the road types according to remote areas are the best suited for ecotourism attractions and experiences (Bunruamkaew, 2012).

The distance from roads map classified into four classes with buffer analysis as described by Boyd et al. (1995) and new values N, P3, P2, P1 were assigned to each class. The classes are; the areas outside of any buffers around all roads are ranked as High potential for ecotourism development (P1); the areas within (2 km) buffer around third main roads are ranked as Moderate potential (P2); the areas within (5 km) buffer around second main roads are ranked as Low potential (P3); and the areas within (10 km) buffer around major roads are ranked as No potential (N). The result of the reclassified distance from the roads map is shown in Figure 6.

Figure 6. Distance from roads map

3.5. Determination of weight value for each criterion using AHP

The AHP is one of the most extended Multi-Criteria Decision Making (MCDM) techniques. This method provides a structural basis for quantifying the comparison of decision elements and criteria in a pair wise technique (Arabinda, 2003). After establishing the level framework and related factors of potential ecotourism resource area in this study, pair-wise comparison questionnaires were used to compare the importance of level framework factors in pairs, and a scale of 1 to 9 were assigned to quantitate the related factors (Tseng et al, 2013). Typically, the priority of each factor involved in the AHP analysis is determined based principally on the suggestions from experts (Tienwong, 2008). To ensure the credibility of the relative significance used, AHP also provides measures to determine inconsistency of judgments mathematically. Based on the properties of reciprocal matrices, the consistency ratio index (CR) as shown in Equation (1) can be calculated (Bunruamkaew, 2012). Saaty (Saaty, 1980) suggests that if CR is smaller than 0.10, then degree of consistency is fairly acceptable. But if it's larger than 0.10, then there are inconsistencies in the evaluation process, and the AHP method may not yield meaningful results.

$$Cr = \frac{CI}{RI}$$

In this process, 20 experts' opinions were asked to calculate the relative importance of the factors and criteria involved. CR was also calculated and found 0.10 acceptable to be used in the suitability analysis. The calculations of pair wise comparison matrix is given in Table 4.

In order to produce land suitability map, actual factor weight (or rating) for parameters involved in the study are needed. These were determined systematically based on the AHP. The priority of each factor involved in the AHP analysis is determined based principally on the expert's opinions. The method is implemented using the pair wise comparison technique that simplifies preference ratings among decision criteria (Geremew and Hailemeriam, 2015).

Table 4. Pair wise comparison matrix and weights

Factor		C1	C2	C3	C4	C5	Normalized Principal Eigenvector
Landscape/ Naturalness	(C1)	1	1	1	3	3	24,39
Wildlife	(C2)	1	1	1	5	5	30,50
Elevation	(C3)	1	1	1	3	5	28,39
Slope	(C4)	1/3	1/5	1/3	1	1/5	5,79
Roads	(C5)	1/3	1/5	1/5	5	1	10,93

The eigenvector of weights: land use land use/ cover 0,2439, wildlife 0,3050, elevation 0,2839, slope 0,0579 and road is 0.2439 respectively. Output evaluation was then computed for suitability map by multiplying each factor by these eigenvector weight values using weighted sum method.

Suitability Map = 0.24 (Land use-land cover map) + 0.31 (Wildlife map) + 0.28 (Elevation map) + 0.06 (Slope map) + 0.11 (Road map)

4. Results and discussions

The land suitability map for ecotourism was classified as Highly suitable area (S1), Moderately suitable area (S2), Marginally suitable area (S3), and Not suitable area (N), seen in Figure 7.

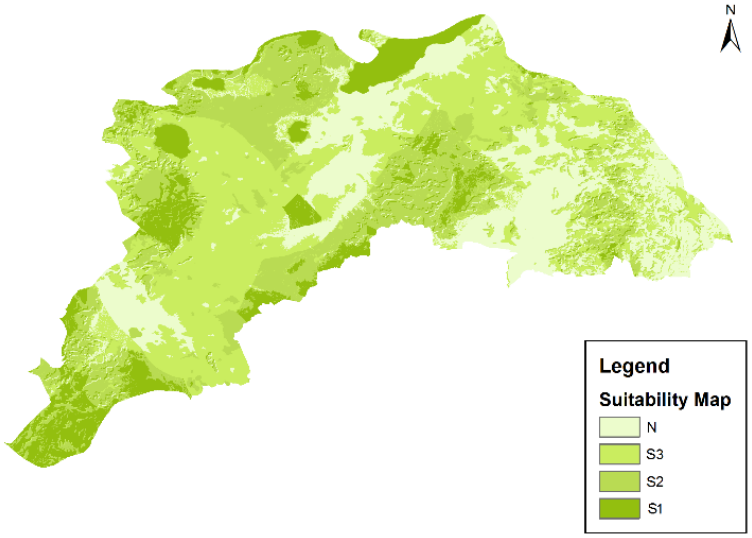

Figure 7. Suitability map

Based from the suitability map, it was found that the areas of Not suitable (N) is about 23 %, Marginally suitable (S3) is about 43 % and the Moderately suitable areas (S2) make up about 22 %. Highly suitable (S1) areas was found low as 12 % (Figure 8).

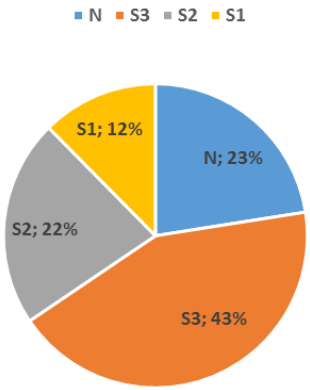

Figure 8. Ecotourism suitability areas in Burdur province

Not Suitable for Ecotourism (N);

From the findings it was determined that 23 % of the study area not suitable for ecotourism. These areas are located around Burdur city and north-east of Gölhisar, west of Bucak, south of Narlı and north of Pınarbaşı. Settlement areas and active or abandoned mines or built up lands can be seen in these areas. These areas have no importance for ecotourism.

Moderately Suitable for Ecotourism (S3);

From the findings it was determined that 43 % of the study area marginally suitable for ecotourism development. These are located around Tefenni, Yeşilova and Karamanlı, south-east of Burdur city. Major roads, farm lands and grasslands can be seen in these areas. These areas have low sensitivity and available for exploitation. These areas which are suitable for tourism development can control and promote tourism services.

Marginally Suitable for Ecotourism (S2);

From the findings it was determined that 22 % of the study area moderately suitable for ecotourism. These areas are located around Akçaören, Aziziye, Büyükyaka, Armutköy, Akçaköy, Gökçekaya, north-east of Kemer and south of Karacaören. Major roads, settlements can not be seen in these areas. These areas have low slope and high elevation. These areas can be considered for ecotourism attractions. Marginally suitable areas are available for tourist activities such as camping, trekking, sightseeing and any activities with minimum development.

Highly Suitable for Ecotourism (S1);

From the findings it was determined that 12 % of the study area highly suitable for ecotourism development. These areas are located in the south of Kemer, south of Tınaztepe, Salda, Yarışlı, Karataş, Akgöl, Burdur lake and around Gölhisar. Wetlands, wildlife protection and improvement areas can be seen in these areas. Highly suitable areas has the most sensitive areas. As seen from the suitibilty map most of these areas are outside human influence. These areas can be used for education as well as natural resource management and community based ecotourism development. Some of the highly suitable areas are located in the protected areas. For this reason, ecotourism should be controlled and managed to preserve the original conditions of the resources. High suitable areas are suitable for all kinds of ecotourism activities, especially bird watching.

Burdur province have many attributes and potentials that can be explored and utilized for a successful ecotourism development. But alternative scenarios needed for ecotourism management based upon resource management and biodiversity conservation. The final outcome of this study was the prioritization of the area which is best suited for ecotourism in Burdur province.

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Perceptions and expectations of different interest groups towards poplar production: Samsun case study

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Abstract: If the different society groups have knowledge general view about poplar culture, its importance and contribution to the country economy, it will create a social consciousness on poplar culture, help development and spreading of poplar culture, thus it will contribute to close supply deficit of wood raw materials. Therefore, it is important to determine the opinions and thoughts of different society groups in this regard and to direct the poplar production accordingly. In this study which was carried out with this point of view, in the Samsun province (Çarşamba, Terme), the knowledge level, opinions and experiences about poplar production of different society groups (interest groups) interacting with poplar producers and having interest and knowledge poplar production, were investigated. In this respect, the level of knowledge, opinions and experiences about poplar production of public institutions, non-governmental organizations and private sector representatives representing interest groups were analyzed and compared, and the differences were checked. The data used in the study was obtained from questionnaires applied to interest groups representatives, the previous studies and the record of the related institutions. The questionnaire form consisting of 36 questions with mostly 5 Likert scale in three parts were applied by face-to-face interview method in 2015. In the study, a total of 58 interest group representatives (28 public institutions, 10 non-governmental organizations and 20 private sector organization representatives) were interviewed using the full-field conscious sampling method. The obtained data were explained and evaluated by descriptive statistics and charts. The control of differences of knowledge levels and opinions of interest groups was tested with the Kruskal-Wallis H-Test. It was understood that interest groups interacting with poplar producers generally had intermediate level of knowledge about irrigation, struggle with tree pests and monoculture tree cultivation in poplar plantation, that they did not have more detailed and technical knowledge about poplar culture and that this situation did not differ according to the interest groups. The reasons of poplar production were determined by all interest groups as getting mass money in the future, no need for intensive care of poplar, and not leaving the land empty. Also, the satisfaction level from poplar sapling planting and production were not different according to the interest groups, and the satisfaction level of all groups was positive. Likewise, the level of knowledge about the hybrid poplars was not different according to the interest groups. It was also determined that the interest groups had similar knowledge sources about poplar sapling and production, and all society and especially interest groups should be made aware and educated. According to the findings, some suggestions were developed for development and dissemination of poplar culture, and increasing its contribution to the country economy.
Keywords: Poplar culture, Interest group**,** Perception and expectation, Samsun, Turkey

1. Introduction

The supply deficit of wood raw materials also increases due to the increase of world population and industrialization. This situation puts pressure on natural forests. As a result of this situation, it's foreseen that global wood raw material demand will reach to 5.5 billion m^3 per year in 2020s. However, in the world, total wood production capacity of natural forest is approximately 3.5 billion m^3 per year. So, since natural forest are inadequate to meet the needs of wood raw material production of the global demand, it's the most rational way to meet the meet the needs by producing fast growing species with industrial afforestation (Birler, 2010).

Parallel to the progresses in the world, the supply deficit of wood raw materials in Turkey increases. For this reason planting with poplar and fast growing species is of great importance in order to close the supply deficit of wood raw materials. In Turkey, annual industrial wood consumption is met by government treats with the General Directorate of Forestry (16.6 million m^3), private sectors (3-3.5 million m^3) and imports (1-2 million m^3) (OGM, 2016). It's not possible to meet the wood raw material demand by producing wood production from natural forests. In Turkey, more than 90% of industrial wood production which is not done by government forests consists of poplar trees production (OGM, 2012). For this reason, it seems as a solution way to produce fast growing species especially poplar trees with industrial afforestation for meeting the wood raw material demand. This kind of plantations contributes to the protection of natural forests and the prevention of their destruction.

The fact that different parts of the society are knowledgeable about poplar culture and its contributions to the country's economy will contribute to a social consciousness about poplar culture, to the development and spreading of poplar culture, thus closing the supply of wood raw materials. Therefore, it is important to identify the opinions and thoughts of different parts of the society in this subject and to orient the poplar production accordingly. Although poplar culture is very important for Turkey's forestry and wood industry, it cannot be said that enough levels of consciousness have been formed in different

parts of the society about poplar culture. The fact that the society is knowledgeable in this regard and the formation of a certain level of consciousness will contribute to the growth of poplar culture, to the increase of wood production, to the reduction of the pressure on natural forests and to the sustainable management of forests.

Poplar culture is an alternative production activity that generally is made by small and medium-sized landowners in private land to meet the demands of wood raw materials. For this reason, in a sense, poplar producing is private afforestation and it is usually done as family business administration. Although there are some studies on poplar production (Gökçe, 1978; Ayberk et al., 1996; Akay et al., 1998; Uzunöz and Çiçek, 1998; Karakaya, 2010; Kareemulla et al., 2005; Kılıçaslan et al., 2005; Dwivedi et al., 2007; Bozorgmehr et al., 2014; Wani and Malik, 2014; Karakaya et al., 2107), there is no research on the identification of the views and ideas of different parts of the society and the direction of poplar production accordingly.

In Turkey, poplar production is done in waterable and fertile lands by traditional methods, and the Samsun province in the Black Sea Region comes at the beginning as a province in which poplar production is done intensively. In this study which was carried out with this point of view, in the Samsun province, the knowledge level, opinions and experiences about poplar production of different society groups (interest groups) interacting with poplar producers and having interest and knowledge poplar production, were investigated. In this respect, the level of knowledge, opinions and experiences about poplar production of public institutions, non-governmental organizations and private sector representatives representing interest groups were analyzed and compared, and the differences were checked. So, it's intended to contribute for improvement of poplar production policy for target group and do successful poplar production, direction of the poplar studies in the region, and to close the supply deficit of wood raw materials.

2. Material and method

2.1. Study area

The Samsun province, where intensive poplar activities were conducted, was chosen as the study area. The Samsun province is located in the middle part of the Black Sea coastline and between the Yeşilırmak and Kızılırmak deltas (Figure 1). There are 17 districts, 40 towns and 946 villages in the Samsun province with a mild climate. The population is 1,279,884 and 32% of which live in rural areas. The area of the province is 9,083 km^2 and the population density is 141 people. The Bafra and Çarşamba plains, having the highest agricultural potential, are located in the Samsun province. As poplar culture was intensively carried out in the Terme and Çarşamba districts in the coastal, the study was carried out in these districts (Figure 1). The total population in the Çarşamba and Terme districts is 208,685 (TUİK, 2016). 6.2% of the agricultural land of the Çarşamba district and 12.3% of the Terme district are poplar land. There are 90 thousand decares (da) of poplar land in the province of Samsun (SİGHM, 2016), 12,236 da of which are in the Terme and Çarşamba districts (SİGHM, 2015).

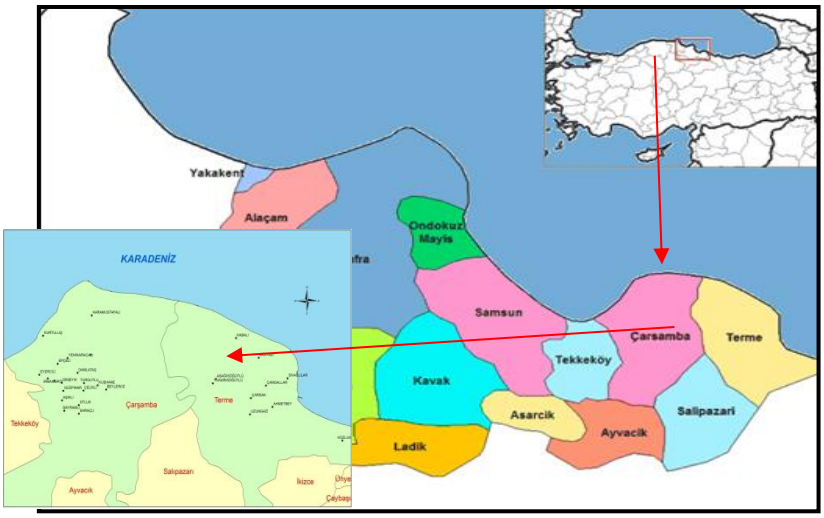

Figure 1. Study area.

2.2. Data and evaluation

The data used in the study was obtained from questionnaires applied to interest groups representatives, the previous studies and the record of the related institutions. The questionnaire form consisting of 36 questions with mostly 5 Likert scale in three parts were applied by face-to-face interview method in 2015. In the study, a total of 58 interest group representatives (28 public institutions, 10 non-governmental organizations (NGOs) and 20 private sector organization representatives) in the Çarşamba and Terme districts of Samsun were interviewed using the full-field conscious sampling method (Table 1).

Table 1. Distribution of interest groups interviewed.

Representatives of Public Institutions	Number
Directorate of Agriculture	3
Forest Enterprise Directorate	2
Forest Management Chieftaincy	5
Forest Nursery Directorate	3
Governorship	2
Municipality	2
State Hydraulic Works (DSI)	2
National Education Directorate	1
Public Hospital	1
Commander of the Gendarmerie	1
Agricultural Research Institute	2
Faculty of Agriculture	4
Total	28

Non-Governmental Organizations	Number
Chamber of Commerce and Industry	2
Chamber of Agriculture	3
Chamber of Tradesmen	1
Agricultural Credit Cooperative	2
Reeves Association	1
TEMA	1
Total	10
Members of Private Sector Organizations	**Sayı**
Poplar Wood Fields and Processors	13
Poplar Nursery Producers	2
Private Nurseries	2
Neighboring Landowners	3
Total	20

General Total: 58

The obtained data were explained and evaluated by descriptive statistics and tables. Also, the control of differences of knowledge levels and opinions of interest groups was tested with the Kruskal-Wallis H-Test (Kalıpsız, 1981; Özdamar, 2002; Daşdemir, 2016). Excel-2010 and SPSS (22.0 version) programs were used for data analysis.

3. Results

3.1. Knowledge levels of interest groups on poplar production

Knowledge levels of poplar producing members of interest groups (public institution, NGOs and private sector) interacting with poplar producers were measured by a 5-point Likert scale of "1-Never", "2-Little", "3-Medium", "4-Much", "5-Very Much". The answers given by the 58 interest group representatives to the first 9 questions about the level of knowledge about poplar production in the first part of the questionnaire are given in Table 2 as number and percentage values by interest groups.

Table 2. Knowledge levels of interest groups on poplar production.

Expressions for poplar production*		Groups	n	Never		Little		Medium		Much		Very Much		$\bar{X}$	S
				n	%	n	%	n	%	n	%	n	%		
1	Non-natural tree production	Public	28	5	17.9	4	14.3	6	21.4	3	10.7	10	35.7	3.32	1.54
		NGO	9	2	22.2	4	44.4	3	33.3	0	0.0	0	0.0	2.11	0.78
		Private	18	4	22.2	2	11.1	0	0.0	6	33.3	6	33.3	3.44	1.61
		Total	55	11	20.0	10	18.2	9	16.4	9	16.4	16	29.1	3.16	1.52
2	Wood agriculture on agricultural land	Public	27	8	29.6	3	11.1	5	18.5	5	18.5	6	22.2	2.92	1.56
		NGO	10	3	30.0	3	30.0	2	20.0	2	20.0	0	0.0	2.30	1.15
		Private	16	6	37.5	3	18.8	0	0.0	4	25.0	3	18.8	2.68	1.66
		Total	53	17	32.1	9	17.0	7	13.2	11	20.8	9	17.0	2.73	1.52
3	Hybrid tree production	Public	25	4	16.0	7	28.0	8	32.0	1	4.0	5	20.0	2.84	1.34
		NGO	10	4	40.0	2	20.0	2	20.0	1	10.0	1	10.0	2.30	1.41
		Private	15	3	20.0	1	6.7	3	20.0	2	13.3	6	40.0	3.46	1.59
		Total	50	11	22.0	10	20.0	13	26.0	4	8.0	12	24.0	2.92	1.46
4	The need to irrigate the poplar plantation areas	Public	28	5	17.9	3	10.7	4	14.3	5	17.9	11	39.3	3.50	1.55
		NGO	10	0	0.0	1	10.0	4	40.0	3	30.0	2	20.0	3.60	0.96
		Private	20	0	0.0	0	0.0	3	15.0	3	15.0	14	70.0	4.55	0.75
		Total	58	5	8.6	4	6.9	11	19.0	11	19.0	27	46.6	3.87	1.31
5	Afforestation competing with natural forest trees	Public	28	9	32.1	7	25.0	5	17.9	5	17.9	2	7.1	2.42	1.31
		NGO	10	2	20.0	2	20.0	3	30.0	3	30.0	0	0.0	2.70	1.15
		Private	20	5	25.0	2	10.0	2	10.0	5	25.0	6	30.0	3.25	1.61
		Total	58	16	27.6	11	19.0	10	17.2	13	22.4	8	13.8	2.75	1.40
6	Manufacture of genetically modified organisms (GMOs)	Public	25	13	52.0	2	8.0	6	24.0	2	8.0	2	8.0	2.12	1.36
		NGO	9	5	55.6	3	33.3	0	0.0	1	11.1	0	0.0	1.66	1.00
		Private	12	8	66.7	1	8.3	1	8.3	0	0.0	2	16.7	1.91	1.56
		Total	46	26	56.5	6	13.0	7	15.2	3	6.5	4	8.7	1.97	1.34
7	Monoculture (single species) tree production	Public	27	4	14.8	5	18.5	8	29.6	6	22.2	4	14.8	3.03	1.28
		NGO	8	1	12.5	2	25.0	3	37.5	1	12.5	1	12.5	2.87	1.24
		Private	16	2	12.5	2	12.5	2	12.5	3	18.8	7	43.8	3.68	1.49
		Total	51	7	13.7	9	17.6	13	25.5	10	19.6	12	23.5	3.21	1.36
8	Combating tree pests	Public	26	7	26.9	5	19.2	7	26.9	3	11.5	4	15.4	2.69	1.40
		NGO	10	1	10.0	2	20.0	3	30.0	1	10.0	3	30.0	3.30	1.41
		Private	19	3	15.8	1	5.3	1	5.3	3	15.8	11	57.9	3.94	1.54
		Total	55	11	20.0	8	14.5	11	20.0	7	12.7	18	32.7	3.23	1.53
9	Increasing the quality of wildlife habitat	Public	28	10	35.7	6	21.4	5	17.9	4	14.3	3	10.7	2.42	1.39
		NGO	9	2	22.2	1	11.1	2	22.2	0	0.0	4	44.4	3.33	1.73
		Private	18	5	27.8	3	16.7	2	11.1	2	11.1	6	33.3	3.05	1.69
		Total	55	17	30.9	10	18.2	9	16.4	6	10.9	13	23.6	2.78	1.57
		General Average												2.95	1.45

*Cronbach Alpha Value of Scale Reliability is 0.722

As can be understood from Table 2, the first three statements with the highest knowledge level of interest groups are as follows;

1. The need to irrigate the poplar plantation areas ($\overline{X}$ =3.87),
2. Combating tree pests ($\overline{X}$ =3.23),
3. Monoculture (single species) tree production ($\overline{X}$ =3.21).

The issues that the knowledge level of interest groups is weakest are;

1. Manufacture of genetically modified organisms (GMOs) ($\overline{X}$ =1.97),
2. Wood agriculture on agricultural land ($\overline{X}$ =2.73),
3. Afforestation competing with natural forest trees ($\overline{X}$ =2.75).

As a result of Kruskal-Wallis H-test applied to check H_0 hypothesis established as “the level of knowledge about poplar culture does not differ according to interest groups”, χ^2=1.36 and p=0.51 (p>0.05) were found. In other words, the knowledge level about polar culture did not differ according to public institutions, NGOs and private representatives, and all interest groups thought the same. According to the general average (2.95) in Table 2, it can be said that interest groups have "medium knowledge of poplar production".

3.2. Knowledge levels of interest groups about hybrid poplars

In order to measure the knowledge level of the members of the interest group about the hybrid poplars, 14 proposals with 3 scaled as "1-True", "2-False" and "3-Unknown" were presented to them. According to the received answers, the most correctly answered information question answered by the participants is "Hybrid poplars contribute to the country's economy" (52 participants; 89.7%) and the least accurately answered question is "Canadian poplar is Italian hybrid poplar clone" (15 respondents; 25.9%) (Table 3). According to the answers given by the interest group members to the 14 information questions about the hybrid poplars, their sequence, from the most correct answered answer to the least correct answered answer, was as follows;

1. Hybrid poplars contribute to the country's economy (%89.7),
2. Hybrid poplars are important for the wood industry (%70.7),
3. Hybrid poplars are not harmful to human health (%63.8),
4. Hybrid poplars are tree species that have been imported from other countries or crossed in Turkey (%62.1),
5. Hybrid poplars are non-natural tree species (%58.6),
6. Hybrid poplars substitute imports (%56.9),
7. Hybrid poplars are used in city landscapes, parks and gardens (%55.2),
8. Hybrid poplar fields should be increased (%53.4),
9. R&D study is done on hybrid poplars (%51.7),
10. Thrushes bearing seeds of hybrid poplars cause environmental pollution (%44.8),
11. The female poplar clones of the hybrid poplars give the cotton cane (%44.8),
12. Hybrid poplars are obtained using biotechnology (%36.2),
13. Hybrid poplars are a relatively new species for the Samsun region (%29.3),
14. Canadian poplar is Italian hybrid poplar clone (%25.9).

On the other hand, as a result of the Kruskal-Wallis H-Test applied to check whether the level of knowledge about the hybrid poplars differs according to the interest groups, χ^2=2.96 and p=0.23 were found (p> 0.05). According to this, the knowledge level about hybrid poplars was not different according to public institutions, NGOs and private sector representatives, and all interest groups thought similar.

Table 3. Knowledge levels of interest groups about hybrid poplars.

Information*		Groups	n	1.True		2.False		3.Unknown	
				n	%	N	%	n	%
1	Hybrid poplars are a relatively new species for the Samsun region (False)	Public	28	10	35,7	12	42,9	6	21,4
		NGO	10	5	50,0	1	10,0	4	40,0
		Private	20	11	55,0	4	20,0	5	25,0
		Total	58	26	44,8	17	29,3	15	25,9
2	Hybrid poplars are non-natural tree species (True)	Public	28	19	67,9	6	21,4	3	10,7
		NGO	10	3	30,0	5	50,0	2	20,0
		Private	20	12	60,0	3	15,0	5	25,0
		Total	58	34	58,6	14	24,1	10	17,2
3	Hybrid poplars are not harmful to human health (True)	Public	28	20	71,4	1	3,6	7	25,0
		NGO	10	5	50,0	2	20,0	3	30,0
		Private	20	12	60,0	1	5,0	7	35,0
		Total	58	37	63,8	4	6,9	17	29,3
4	Hybrid poplars are important for the wood industry (True)	Public	28	22	78,6	3	10,7	3	10,7
		NGO	10	6	60,0	3	30,0	1	10,0
		Private	20	13	65,0	3	15,0	4	20,0
		Total	58	41	70,7	9	15,5	8	13,8
5	Hybrid poplars are used in city landscapes, parks and gardens (False)	Public	28	6	21,4	18	64,3	4	14,3
		NGO	10	3	30,0	3	30,0	4	40,0
		Private	20	6	30,0	11	55,0	3	15,0
		Total	58	15	25,9	32	55,2	11	19,0
6	Hybrid poplars are obtained using biotechnology (True)	Public	28	12	42,9	5	17,9	11	39,3
		NGO	10	4	40,0	0	0,0	6	60,0
		Private	20	5	25,0	6	30,0	9	45,0
		Total	58	21	36,2	11	19,0	26	44,8
7	Hybrid poplars contribute to the country's economy (True)	Public	28	27	96,4	1	3,6	0	0,0
		NGO	10	8	80,0	1	10,0	1	10,0
		Private	20	17	85,0	0	0,0	3	15,0
		Total	58	52	89,7	2	3,4	4	6,9
8	Hybrid poplars substitute imports (True)	Public	28	12	42,9	6	21,4	10	35,7
		NGO	10	5	50,0	1	10,0	4	40,0
		Private	20	16	80,0	1	5,0	3	15,0
		Total	58	33	56,9	8	13,8	17	29,3
9	Thrushes bearing seeds of hybrid poplars cause environmental pollution (True)	Public	28	15	53,6	9	32,1	4	14,3
		NGO	10	2	20,0	4	40,0	4	40,0
		Private	20	9	45,0	7	35,0	4	20,0
		Total	58	26	44,8	20	34,5	12	20,7
10	The female poplar clones of the hybrid poplars give the cotton cane (True)	Public	28	13	46,4	1	3,6	14	50,0
		NGO	10	3	30,0	0	0,0	7	70,0
		Private	20	10	50,0	2	10,0	8	40,0
		Total	58	26	44,8	3	5,2	29	50,0
11	R&D study is done on hybrid poplars (True)	Public	28	16	57,1	0	0,0	12	42,9
		NGO	10	6	60,0	0	0,0	4	40,0
		Private	20	8	40,0	4	20,0	8	40,0
		Total	58	30	51,7	4	6,9	24	41,4
12	Hybrid poplar fields should be increased (True)	Public	28	16	57,1	5	17,9	7	25,0
		NGO	10	3	30,0	2	20,0	5	50,0
		Private	20	12	60,0	4	20,0	4	20,0
		Total	58	31	53,4	11	19,0	16	27,6
13	Hybrid poplars are tree species that have been imported from other countries or crossed in Turkey (True)	Public	28	15	53,6	1	3,6	12	42,9
		NGO	10	5	50,0	1	10,0	4	40,0
		Private	20	16	80,0	1	5,0	3	15,0
		Total	58	36	62,1	3	5,2	19	32,8
14	Canadian poplar is Italian hybrid poplar clone (True)	Public	28	7	25,0	2	7,1	19	67,9
		NGO	10	1	10,0	1	10,0	8	80,0
		Private	20	7	35,0	3	15,0	10	50,0
		Total	58	15	25,9	6	10,3	37	63,8

*Cronbach Alpha Value of Scale Reliability is 0.798

3.3. Opinions of interest groups on poplar production

We asked form members of interest groups to give their opinions about poplar production as “1-Definitely Participate", "2-Participate", "3-Undecided", "4-Disagree", "5-Definitely Disagree". According to the answers given to 9 questions, the highest average score (2.78) is "poplar production is a good choice for the landowners", and the lowest average score (2.01) is "the poplar damages by shading the border agricultural land" (Table 4).

Table 4. Opinions of interest groups on poplar production.

Opinions on Poplar Production*		Groups	n	1		2		3		4		5		$\bar{X}$	S
				n	%	n	%	n	%	N	%	n	%		
1	Poplar production is a good choice for the landowners	Public	26	2	7,7	5	19,2	12	46,2	3	11,5	4	15,4	3,07	1,12
		NGO	10	1	10,0	5	50,0	1	10,0	3	30,0	0	0,0	2,60	1,07
		Private	20	8	40,0	4	20,0	2	10,0	2	10,0	4	20,0	2,50	1,60
		Total	56	11	19,6	14	25,0	15	26,8	8	14,3	8	14,3	2,78	1,31
2	Poplar plantations are a kind of agricultural forestry	Public	28	8	28,6	11	39,3	4	14,3	3	10,7	2	7,1	2,28	1,21
		NGO	10	3	30,0	5	50,0	0	0,0	2	20,0	0	0,0	2,10	1,10
		Private	20	11	55,0	6	30,0	0	0,0	1	5,0	2	10,0	1,85	1,30
		Total	58	22	37,9	22	37,9	4	6,9	6	10,3	4	6,9	2,10	1,22
3	Landowners should rent their land to any person or institution for the production of poplar	Public	24	5	20,8	6	25,0	4	16,7	6	25,0	3	12,5	2,83	1,37
		NGO	10	0	0,0	6	60,0	1	10,0	3	30,0	0	0,0	2,70	0,94
		Private	19	11	57,9	5	26,3	1	5,3	0	0,0	2	10,5	1,78	1,27
		Total	53	16	30,2	17	32,1	6	11,3	9	17,0	5	9,4	2,43	1,33
4	Making poplar culture in agricultural areas is a wrong decision	Public	26	12	46,2	5	19,2	6	23,1	3	11,5	0	0,0	2,00	1,09
		NGO	9	7	77,8	1	11,1	0	0,0	1	11,1	0	0,0	1,44	1,01
		Private	20	8	40,0	4	20,0	0	0,0	3	15,0	5	25,0	2,65	1,72
		Total	55	27	49,1	10	18,2	6	10,9	7	12,7	5	9,1	2,14	1,39
5	Poplar production is a good land use for generally "marginal" areas	Public	25	5	20,0	12	48,0	4	16,0	2	8,0	2	8,0	2,36	1,15
		NGO	9	3	33,3	5	55,6	0	0,0	0	0,0	1	11,1	2,00	1,22
		Private	20	11	55,0	4	20,0	2	10,0	1	5,0	2	10,0	1,95	1,35
		Total	54	19	35,2	21	38,9	6	11,1	3	5,6	5	9,3	2,14	1,23
6	Poplars threaten agricultural land because they take water and nutrients from the field	Public	25	8	32,0	3	12,0	7	28,0	6	24,0	1	4,0	2,56	1,29
		NGO	10	2	20,0	4	40,0	3	30,0	0	0,0	1	10,0	2,40	1,17
		Private	19	11	57,9	2	10,5	0	0,0	3	15,8	3	15,8	2,21	1,65
		Total	54	21	38,9	9	16,7	10	18,5	9	16,7	5	9,3	2,40	1,39
7	The poplar damages by shading the border agricultural land	Public	28	13	46,4	4	14,3	4	14,3	5	17,9	2	7,1	2,25	1,40
		NGO	9	5	55,6	2	22,2	1	11,1	0	0,0	1	11,1	1,88	1,36
		Private	19	12	63,2	3	15,8	2	10,5	1	5,3	1	5,3	1,73	1,19
		Total	56	30	53,6	9	16,1	7	12,5	6	10,7	4	7,1	2,01	1,32
8	Poplar production is a profitable investment	Public	26	0	0,0	9	34,6	12	46,2	3	11,5	2	7,7	2,92	0,89
		NGO	10	2	20,0	3	30,0	3	30,0	1	10,0	1	10,0	2,60	1,26
		Private	20	7	35,0	5	25,0	2	10,0	2	10,0	4	20,0	2,55	1,57
		Total	56	9	16,1	17	30,4	17	30,4	6	10,7	7	12,5	2,73	1,22
9	Poplar production helps to conserve natural forests	Public	28	6	21,4	9	32,1	6	21,4	4	14,3	3	10,7	2,60	1,28
		NGO	10	3	30,0	5	50,0	1	10,0	0	0,0	1	10,0	2,10	1,19
		Private	20	13	65,0	3	15,0	0	0,0	1	5,0	3	15,0	1,90	1,51
		Total	58	22	37,9	17	29,3	7	12,1	5	8,6	7	12,1	2,27	1,37
		General Average												2,33	1,31

*1-Definitely Participate, 2-Participate, 3-Undecided, 4-Disagree, 5-Definitely Disagree
Cronbach Alpha Value of Scale Reliability is 0.640

Sorting of the answers given by the participants for opinion on poplar production, from the most accepted answer to the least accepted answer, was as follows;

1. The poplar damages by shading the border agricultural land ($\bar{X}$ =2.01),
2. Poplar plantations are a kind of agricultural forestry ($\bar{X}$ =2.10),
3. Making poplar culture in agricultural areas is a wrong decision ($\bar{X}$ =2.14),
4. Poplar production is a good land use for generally "marginal" areas ($\bar{X}$ =2.14),
5. Poplar production helps to conserve natural forests ($\bar{X}$ =2.27),
6. Poplars threaten agricultural land because they take water and nutrients from the field ($\bar{X}$ =2.40),
7. Landowners should rent their land to any person or institution for the production of poplar ($\bar{X}$ =2.43),
8. Poplar production is a profitable investment ($\bar{X}$ =2.73),
9. Poplar production is a good choice for the landowners ($\bar{X}$ =2.78).

In addition, χ^2 = 4.74 and p = 0.09 (p> 0.05) were found as a result of the Kruskal-Wallis H-Test used to check the difference of opinion about poplar production of public institutions, NGOs and private sector representatives. Accordingly, the views on poplar production were not different from those of public institutions, NGOs and private sector representatives, all the groups' opinions were the same as ranked above. Likewise, according to the general average in Table 4 (2.33), it can be said that interest groups responded to the proposals as "participate".

3.4. The best land type according to people and organizations making poplar production

The members of the interest group interviewed were asked about the type of the most suitable land according to the persons and institutions producing the poplar, and the answers were given in Table 5.

Table 5. The most suitable land type for persons and institutions making poplar production.

Person or institution to plant and grow poplar	Place for poplar planting and growing*							
	Their own private lands		Rented private lands		State treasury lands		Most preferred opinions	
	Number	%	Number	%	Number	%	Number	%
Forest Organization	35	14,7	1	0,6	22	17,5	22	
Agriculture Organization	21	8,8	5	3,4	30	23,8	30	
State Hydraulic Works (DSİ) Organization	29	12,2	1	0,6	25	19,8	25	36
Municipality	34	14,3	1	0,6	21	16,7	21	
Local People	44	18,5	6	4,1	7	5,6	44	16
Non-Local Person	22	9,3	31	21,2	4	3,2	31	
Domestic Company	16	6,7	37	25,2	4	3,2	37	48
Foreign Company	12	5,0	42	28,6	3	2,4	42	
Nursery Industry	25	10,5	23	15,7	10	7,8	23	
Total	238	100,0	147	100,0	126	100,0	275	100

*More than one answer received form participants

According to this, 48% of the participants have the opinion that poplar saplings should be planted and cultivated by the non-local person, domestic or foreign company and the nursery industry in the rented private lands, 36% have the opinion that the poplar saplings should be planted and cultivated by Forest, Agriculture, DSİ and Municipal organizations in the state treasury lands, and 16% have the opinion that poplar saplings should be planted and cultivated by the local people in their own private lands.

3.5. Reasons for landowners making poplar production by interest groups

The list, which is with 8 items and can be marked more than one item, was presented for the members of interest groups about the reasons for the landowners to produce poplar. According to the answers given, the reasons for the landowners to produce poplar were determined as follows;

1. The purpose of collecting mass money in the future (%17.3),
2. Poplar culture is a type of business that does not require intensive care (%16.5),
3. For not leaving land empty (%14.9) (Table 6).

Table 6. Reasons of landowners for making poplar production.

Reasons for preference*	Number	%	Rank
The purpose of collecting mass money in the future	43	17,3	1
Poplar culture is a type of business that does not require intensive care	41	16,5	2
For not leaving land empty	37	14,9	3
The economic gains that neighboring landowners have earned from poplar farming	31	12,4	4
The goal of additional income	31	12,4	4
The land is suitable for poplar plantation	29	11,7	5
Thinking that it is a profitable investment	20	8,0	6
Observation of successes of neighboring landowners planting poplar saplings	17	6,8	7
Total	249	100	

*More than one answer received form participants

3.6. Information sources of interest groups on poplar planting and producing

The list showing the sources of information of interest groups about poplar planting and production, which is with 11 items and can be marked more than one item, was presented to them. The first information source with 20% of participants about poplar planting and production were neighbors/friends. This was followed by conversations and meetings made with forest organization employees with 17.8% and internet web pages with 12.2% (Table 7).

Table 7. Information sources on poplar planting and producing.

	Information Sources*	1.Yes		2.No	
		Number	%	Number	%
1	Conversations and meetings with forest organization employees	32	17.8	26	5.7
2	Conversations with other government officials	13	7.2	45	9.8
3	Conversations with the employees of the Poplar and Fast Growing Forest Research Institute and its publications	15	8.3	43	9.4
4	Internet web pages	22	12.2	36	8.0
5	Books	16	8.9	42	9.2
6	Newspapers	7	3.9	51	11.1
7	Journals	12	6.7	46	10.0
8	TV and Radio Programs	12	6.7	46	10.0
9	Information Brochures	8	4.4	50	10.9
10	Neighbors/friends	36	20.0	22	4.8
11	Poplar producers	7	3.9	51	11.1
	Total	180	100	458	100

*More than one answer received form participants

3.7. Satisfaction level of interest groups on poplar planting and producing

In the questionnaire study, interest groups were asked to indicate their level of satisfaction from poplar planting and production. The answers are; definitely positive (37.9%), slightly positive (22.4%), neutral (17.3%), strictly negative (12.1%) and slightly negative (10.3%) respectively (Table 8).

Table 8. Satisfaction level on poplar planting and producing.

Satisfaction Level	Number	%	Rank
Definitely positive	22	37.9	1
Slightly positive	13	22.4	2
Neutral	10	17.3	3
Slightly negative	6	10.3	5
Strictly negative	7	12.1	4
Total	58	100	

Kruskal-Wallis H-Test was applied to check whether the level of satisfaction from poplar planting and production differs according to public institutions, NGOs and private sector representatives. At the end of the test, it was understood that the satisfaction level from poplar planting and production was not different according to the interest groups and the satisfaction levels of all groups were generally "positive" because of χ^2=2.77 and p=0.25 (p> 0.05) were found.

4. Discussion and conclusions

It was understood that the knowledge, opinions and thoughts of interest groups about poplar culture were not different at this study conducted in the province of Samsun (Çarşamba, Terme districts) where poplar is intense in order to determine the knowledge, opinions and thoughts on poplar culture according to the different parts (interest groups) of the society interacting with poplar culture and to direct poplar production accordingly. At the end of study, it was determined that all interest groups (public institutions, NGOs and private sector) had moderate knowledge about irrigation, struggle with tree pests and monoculture tree cultivation in poplar plantation, but they had no knowledge in more detailed and technical matters, many of poplar growers sold by traditional methods their poplar seedlings and they regarded as official regulations for sales, they determined demand estimates for poplar seedlings according to the previous year's wholesale and retail sales numbers.

The interest groups accepted most "poplars damages by shading the border agricultural land" and at least "poplar production is a good choice for landowners" from the proposals for poplar production. It was understood that the answers given were not different according to the interest groups and all interest groups support to the proposals as "participate". In this issue, a study was conducted in Tokat-Niksar (Fidan et al., 2014); It was stated that the most important problem of the effect of the shadow over the neighboring agricultural areas, the poplar for the landowners is the most profitable, easy and indispensable agricultural activity. All Interest groups were in the same mind as poplar producers about the causes of poplar production, which were listed as collective mass money in the future, no need for intensive care of poplar, and not leaving the land empty.

Most of the participants think that poplar saplings should be planted and cultivated in private places or treasury land by persons, companies, nursery industry and Forestry, Agriculture, DSİ and Municipal organizations. However, none of the poplar producers provided saplings from state nurseries and they usually obtained saplings from the producers growing poplar saplings. Similarly, Karakaya (2010) stated that saplings should be procured from state nurseries or producers who produce in quality of state nursery in order to increase success of poplar studies to be made in the Sakarya region. Also, it was proposed to fill in the information gaps in this area firstly, to carry out integrated project studies and to put them into practice under the coordination of General Directorate of Forestry in order to improve and develop the growth of poplar saplings in Turkey.

It was also understood that the satisfaction level of poplar planting and production was not different according to the interest groups and the satisfaction level of all interest groups was "positive". On the other hand, the National Poplar Commission of Turkey decided that society awareness should be raised in order to overcome the negative perceptions as harmful effects of poplar trees on environment and human health (TMKK, 2014). For this reason, to raise awareness interest groups having negative perceptions about poplar is especially important in terms of continuity of poplar.

The information sources of interest groups about poplar planting and production were "neighbors/friends, conversations and meetings made with forest organization's employees, and internet web pages". However, these information sources are insufficient, and it was suggested to develop the available web pages of the Poplar and Fast Growing Forest Trees Research Institute and to present it interest groups to access. Interest groups should have knowledge about poplar culture and its contributions to the country's economy in general, which will cause the formation of a social consciousness about poplar culture, and its spreading and development. For this, all parts of the society need to be made aware and educated.

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Trace elements concentrations in Turkey species of wild growing edible mushrooms: A review

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Abstract: Turkey has great mushroom-producing potential due to environmental conditions. It is a popular natural food in Turkey. This article review presents scientific information on trace element (Cu, Cd, Zn, Pb, Mn, Fe, Cr, Ni).The studies included 17 species which collected from several regions in Turkey. The lowest Cu levels obtained was in *Rhizopogon roseolus* (2.19 ug/g) and, the highest level of Cu was in *Melanoleuca stridula* as 75.40 mg/kg dw). The lowest Cd contents was 0.024 µg/g in *Morchella costata*,and the highest concentration of Cd in reviews was found in *Hydnum repandum* (7.45-0.124 mg/ kg).The zinc content was found vary from 9.74 mg/kg in *Craterellus cornucopioides* to 354.0 mg/kg in *Helvella leucopus*. Minimum and maximum levels of Pb were measured as 0.9 mg/kg and 9.2 mg/kg dry matter in *Morchella esculenta* and Lactarius deliciosus. The highest concentration of Mn in the studied mushrooms was found in 197 mg/kg *Melanoleuca stridula*, whereas the lowest manganese content was 0.83 µg/g in *Morchella costata*.The highest and the lowest levels of Iron were found in *Rhizopogon roseolus* and Cantharellus cibarius. The highest chromium content (22.7 mg/g d.w.) was found in Armillaria mellea, whereas the lowest chromium content (0.074 mg/g d.w.) was found in *Rhizopogon roseolus* . *Armillaria mellea* and *Rhizopogon roseolus* had the minimum and maximum Ni concentrations at 0.04 ug/g and 17.44 mg/ kg respectively. The different results due to soil properties, species of mushroom, mushroom structure and morphological type, geographical origins, environmental conditions, method analysis used. The purpose of reviews is to evaluate the level of toxic elements (Cd, Pb, Cr, Ni) and essential elements (Cu, Zn, Mn, Fe) in some species of mushrooms from Turkey. These scientific data are useful in the fields mushroom science, food science and health science.
Keywords: Trace elements; Wild mushrooms, Turkey

1. Introduction

Mushrooms along with other fungi are something special in the living world, being neither plant nor animal (Cheung, 2008). But had for long been classified as plants. It was only in 1969 that Whittaker reclassified these organisms into a separate kingdom, the Fungi (Whittaker, 1969).The number of mushrooms on Earth is estimated at 140,000, yet maybe only 10% (approximately 14,000 named species) (Wasser, 2002). Not far from 14,000 mushroom species, described according to the rules of mycological nomenclature.More than 2000 species are safe for consumption, and almost 700 species are known to possess significant pharmacological properties (Kalač, 2016). Mushroom, also known as mantar in Turkey. Turkey is rich in mushrooms diversity, as well as medicinal plant. Turkish public have a tradition of using a number of mushrooms for food, instead of the treatment of infectious diseases and various ailments (Akyuz, Onganer, ERECEVIT, & Kirbag, 2010).

Heavy metal concentrations in mushroom are considerable higher than those in agricultural crop plants, vegetables and fruits (Manzı et al., 2001). As a result of their effective take-up mechanism. Several reviews of trace element contents in mushrooms were published (Stijve &Roshnik, 1974;:KalacÏ & Svoboda,1998; Seeger, 1982; Vetter, 1994).

The fruiting bodies of mushrooms are characterized by a high level of well assimilated mineral elements. Major mineral constituents in mushrooms are K, P, Na, Ca, Mg and elements like Cu, Zn, Fe, Mo, Cd form minor constituents (Bano and Rajarathanum, 1982; Bano et al., 1981). Mushrooms have been found to accumulate heavy metals like cadmium, lead, arsenic, copper, nickel, silver, chromium and mercury (Wondratschek and Roder, 1993;Svoboda et al., 2001; Issilogglu et al., 2001; Malinowska, 2004). The mineral proportions vary according to the species, Heavy metals are individual metals and metal compounds that can impact human health.

Furthermore, The principal factors influencing the accumulation of heavy metals in macrofungi has been noted to be affected by environmental and fungal factors. Environmental factors, such as organic matter contents, PH, metal concentrations in soil or substrate and fungal factors, such as species of mushroom, fungal structure, development of mycelium and fruit bodies, age of mycelium and biochemical composition are known to affect metal accumulation in macrofungi (Kalac and Svoboda 2000; Isiloglu et al. 2001).

The purpose of reviews is to evaluate the level of toxic elements (Cd, Pb,Cr ,Ni) and

essential elements (Cu,Zn,Mn,Fe) in some species of mushrooms from Turkey . These scientific data are important in the fields, mushroom science, food science and health science.

2. Mycological terms

A mushroom is the fleshy, spore-bearing fruiting body of a fungus .The fruiting body (carpophore, mycocarp) in higher fungi is found mostly above ground. A fruiting body grows from spacious underground mycelia (hyphae) by the process of fructifying . The lifetime of the bulk of fruiting bodies have a short lifetime only about 10-14 days (Kalač,2009).This figure illustrates the life cycle of mushroom.

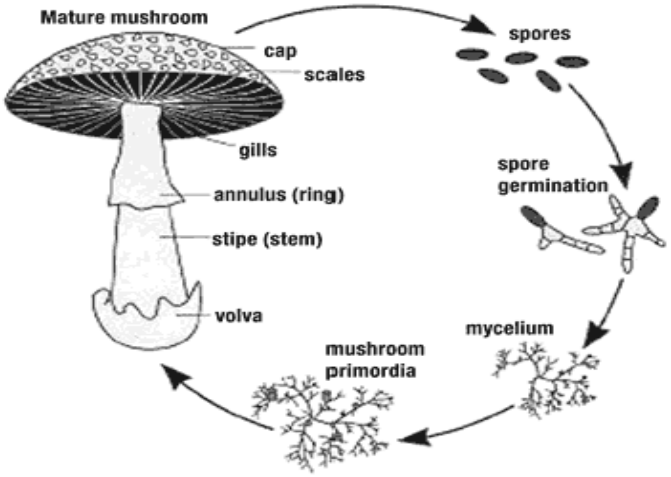

Figure 1. Life cycle of mushroom (www.mushroomgrow.com)

3. The content of major mineral elements

The comparison of the results given in table below,the concentration levels of (Cd, Pb,Cr ,Ni ,Cu,Zn,Mn,Fe) in 17 species which collected from several regions in Turkey .

Analytical methods used by inductively coupled plasma mass spectrometry (ICP-MS) or Atomic absorption spectrometry (AAS)

3.1.Copper

Copper is an essential trace element that is a great source to the health, it is essential for proper functioning of organs and metabolic processes. Copper plays a critical role in a variety of biochemical processes (Yaman and Akdeniz 2004).but may be toxic to both humans and animals when its concentration exceeds the safe limits (Gast et al. 1988). In general, the copper content in mushrooms is higher than vegetables. usually 100–300 mg/kg, which is not considered a health risk (Soylak et al. 2005). The copper content of the data presented ranged from 2.19 µg/g to 75.40 mg/kg dw,the results given in table (1) showed that the lowest concentration of copper observed in *Rhizopogon roseolus*, whereas *Melanoleuca stridula* had the highest.

Table (1): Element concentrations of the mushroom species:

Species	Cu	Cd	Pb	Zn	Mn	Fe	Cr	Ni	Unit	Region	Reference
Armillaria mellea	45.6	0.5	2.1	70.3	28.2	312	22.7	15.9	µg/g	Middle black sea region	Isildak et al., 2004
Armillaria mellea	15.6		1.4	43.5	49.1	510			mg/kg	Black sea	Sesli et al., 2008
Boletus badius	26.8	0.5	2.1	51.6	19.8	287	1.9	ND	mg/kg	Kastamonu	Isildak et al., 2004
Boletus badius	8.4	0.14	8.9	64.4	24.8	377	1.2	9.5	mg/kg	Kastamonu	Mendil et al., 2004
Hydnum repandum	55.1-5.15	7.450.124	1.38-0.453						mg/kg	YesËilyurt forestry	Demirbaş, 2000
Hydnum repandum	11.2	N.D	N.D	36.2	20.8	199	2.74	0.58	µg/g	East Black Sea	Ayaz, 2011
Hydnum repandum	23.80	0.26	2.34	48.80	56.80	502	5.24	5.68	mg/kg	Anatolia	Yamaç et al., 2007
Amanita ovoidea	5.00	0.26		29.78	9.23		4.59		mg/kg	Bigadiç (Balıkesir)	ŞEN, Alli, ÇÖL, Celikkollu, & Balci, 2012
Amanita ovoidea	19.0	0.91	4.6	83.0	33.0	710	11.8	14.8	mg/kg	Mugla	Sarikurkcu, Tepe, Solak, & Cetinkaya, 2012
Craterellus cornucopioides	3.58		0.44	9.74	7.23	300			µg/g	Istanbul	Gezer et al., 2015
Craterellus cornucopioides	73.8		1.8	167	145	502			mg/kg	Black sea	Sesli et al., 2008
Cantharellus cibarius	37.30	0.22	n.d	71.5	25.2	130	2.09	1.10	µg/g	East Black Sea	Ayaz, 2011
Cantharellus cibarius	15.5		1.3	72.5	131	1741				Black sea	Sesli et al., 2008
Cantharellus cibarius		0.036	0.04				0.69	0.17	µg/g	Western black sea	Konuk et al., 2007
Cantharellus tubaeformis	63.4		2.2	106	87.4	205			mg/kg	Black sea	Sesli et al., 2008
Cantharellus tubaeformis	44.6	0.14	n.d	57.5	48.4	166	1.57	0.77	µg/g	East Black Sea	Ayaz, 2011
Morchella vulgaris		0.036	0.06				0.08	0.04	µg/g	Western black sea	Konuk et al., 2007
Morchella vulgaris	32.6	0.3	2.1	42.3	15.2	174	4.2	2.8	µg/g	Middle black sea	Isildak et al., 2004
Morchella esculenta	ND	1.1	3.5	41.4	20.4	243	8.2	2.5	µg/g	Mddle black sea	Isildak et al., 2004
Morchella esculenta	16.4	0.79	0.9	84.0	27.9	148	21.00	7.3	mg/kg	Osmaniye	Sarikurkcu et al., 2012
Lactarius deliciosus,	13.4	0.10	9.2	47.1	15.4	180	1.2	9.2	mg/kg	Kastamonu	Mendil et al., 2004
Lactarius deliciosus,	10.60	0.47	0.42	69.80	16.80	146	4.24	2.46	mg/kg	Anatolia	Yamaç et al., 2007
Lactarius deliciosus,		0.030	0.02				0.36	0.18	µg/g	Western black sea	Konuk et al., 2007
Rhizopogon roseolus	2.19	0.029	0.37	11.02	8.49	39.97	0.074	0.206	µg/g	Denizli	Gezer et al., 2015
Rhizopogon roseolus	33.80	0.47	0.54	62.40	18.20	824	9.44	17.44	mg/kg	Anatolia	Yamaç et al., 2007
Russula delica,		0.034	0.03				0.16	0.08	µg/g	W Western black sea	Konuk et al., 2007
Russula delica,	37	1.04	2.5	52	66	470	0.10	5.4	mg/kg	Isparta	Sarikurkcu et al., 2012
Melanoleuca stridula	75.40	1.30	9.04	90.60	197.40	524	3.30	4.54	mg/kg	Anatolia	Yamaç et al., 2007
Melanoleuca stridula	37.97	0.60		35.73	17.51		3.92		mg/kg	Bigadiç	ŞEN, Alli, ÇÖL, Celikkollu, & Balci, 2012
Morchella costata		0.43	0.47	10.72	0.83		0.082	0.361	µg/g	Denizli	Gezer et al., 2015
Morchella costata		0.024	0.02				1.68	0.40	µg/g	Western black sea	Konuk et al., 2007
Lepista nuda	68.8	2.9	3.5	47.6	49.3	321	10.4	4.2	µg/g	Middle black sea region	Isildak et al., 2004)
Lepista nuda	20	1.1	1.4	45	16	568			mg/kg	Western black sea	Turkekul, Elmastas, & Tüzen, 2004)
Helvella leucopus		6.06	1.0	354.0			2.30	3.0	mg/kg	Isparta	Sarikurkcu et al., 2012
Helvella leucopus		0.03	0.007				0.80	0.30	µg/g	Western black sea	Konuk et al., 2007

The copper content of *Rhizopogon roseolus* from Denizli region had the lowest copper concentration whereas Anatolia region had the highest (2.19 µg/g .33.80 mg/kg) respectively, whereas *Melanoleuca stridula* from Anatolia region had the highest copper concentration compared in Bigadiç region (75.40 mg/kg, 37.97 mg/kg), respectively. The WHO permissible limit for copper in all foods is 40 mg/kg (Zhu, 2011: Bahemuka, 1999). Copper concentrations of mushroom samples in the literature have been reported to be in the ranges: 4.71– 51.0 mg/kg (Tüzen et al. 1998), 11.4-15.8 mg/kg (Li, 2011), 10.3–145 mg/kg (Sesli and Tüzen 1999), and 15–73 mg/kg (Sesli et al. 2008), respectively.

3.2. Cadmium (cd)

Cadmium has been considered the second risky mushroom trace element after mercury. It is a very toxic metal. Cadmium (Cd) has no known useful role in higher organisms (Hogan 2010). Cadmium levels in blood serum increased following

mushroom consumption, it is accumulate in kidneys, spleen, and liver (Kalač, 2000). The results in table (1) show that the amounts of cadmium recorded for species of mushrooms varied between 0.024 µg/g in *Morchella costata* (WESTERN BLACK SEA REGION) and 7.45 mg/kg in *Hydnum repandum* (YesËilyurt forestry) .

These results of cadmium levels are agreement with that reported by (Svoboda et al. 2001) 0.81–7.50 mg/kg.

On the other hand, The Cadmium content was 0.433 µg/g in *Morchella costata* from Denizli region, while 0.62,0.124, 3.12,3.42,5.43 ,0.26 mg/kg, dry-weight in *Hydnum repandum* (YesËilyurt forestry region).

Not all results were compatible with the WHO mentions maximum permissible levels in raw plant materials for cadmium which amount to 0.30 mg/kg.

Mushrooms may contain large amounts of Cd. It can enter the environment (air, water, soil and Human activities) .

3.3. Lead (pb)

Lead has been considered the third risky mushroom trace element after cadmium and mercury.

lead is toxic and non-essential metals as they are toxic even in traces (Unak et al. 2007). García, (2009) reported that some factors could affect lead concentrations of the edible mushrooms: species, ecology, morphological part and soil characters, such as metal levels, pH and organic matter . The preceding table shows the minimum and maximum levels of Pb were measured as 0.9 mg/kg and 9.2 mg/kg dry matter in *Morchella esculenta* (Osmaniye regine) and *Lactarius deliciosus*(Kastamonu regine), respectively.Most of results less than 4.5 mg/kg except *Morchella esculenta* (9.0), *Melanoleuca stridula* (9.04) and *Boletus badius* (8.9). Levels in raw plant materials for lead which amount to 10.0 mg/kg (WHO, 1998).The lead results of all mushroom species were in agreement with WHO and literature .

Lead concentrations of mushroom samples in the literature have been reported to be in the ranges*:* 0.67 to 12.9 mg/kg (Zhu, 2011), 0.75– 7.77 mg/kg (Tüzen et al. 1998), 0.40–2.80 mg/kg (Svoboda et al. 2000), 1.43–4.17 mg/kg (Tüzen 2003), 0.800–2.700 mg/kg (Türkekul et al. 2004), 0.82–1.99 mg/kg (Soylak et al. 2005), and 0.9– 2.6 mg/kg (Sesli et al. 2008), respectively.

3.4.Zinc (Zn)

Zinc is very important mineral needed by our body systems. It is also very important in protein, nucleic acid, and energy metabolism. It supports a healthy immune system.

In addition it is very important in protein, nucleic acid, and energy metabolism. A review results show that the zinc content of the mushrooms studied was found to vary from 9.74 mg/kg in *Craterellus cornucopioides* to 354.0 mg/kg in *Helvella leucopus* (Table). More than two-thirds of the samples were under the permissible limit of 60 mg/kg recommended values in foods (WHO 1982).

Zinc concentrations of edible mushroom samples in the literature have been reported to be: 30.0 – 150.0 mg/kg (Kalac and Svaboda, 2000), 29.0 – 146.0 mg/kg (Sarikurkcu et al. 2011), 29.3 – 158.0 mg/kg (Isiloglu et al., 2001), 26.7 – 186.0 mg/kg (Genccelep et al. 2009) and 21.0 – 100.0 mg/kg (Cayir et al., 2010) . The Zn results of most mushroom species were in agreement with those found in the literature.

3.5. Manganese(Mn)

Manganese, one of the least toxic metals. Mn is essential in normal reproductive functions and normal functioning of the central nervous system. Its deficiency causes myocardial infection and other cardiovascular diseases and also disorder of bony cartilaginous growth in children and rheumatic arthritis in adults (Khan et al., 2008). It plays a vital role in the activation of a large number of enzymes including in the tricarboxylic acid cycle (Chandra, 1990).The (FAO/WHO., 1984). The range of Mn concentration in selective medicinal plants of Egypt was between 44.6 ppm to 339 ppm Sheded et al. (2006).Toxicity limits of manganese for plants are high (400–1,000 mg/kg) (Zhu, 2011). In the present work, the highest concentration of Mn in the mushrooms studied was found in 197 mg/kg *Melanoleuca stridula* (Anatolia region) , whereas the lowest manganese content was 0.83 µg/g *in Morchella costata* (Denizli region) . The reported manganese concentrations in previous studies for wild-growing mushrooms were : 7.6–56.2 µg g-1 (Demirbas 2001b), 14.5–63.6 µg g-1 (Isıloglu et al., 2001), 5.0–60.0 µg g-1 (Kalaˇc and Svoboda 2001), 21.7–74.3 µg g-1 (Mendil et al., 2004), 18.1–103 µg g-1 (Mendil et al., 2005), 14.2–69.7 µg g-1 (Soylak et al., 2005), 13.5–113 µg g-1 (Zhu et al., 2011) respectively. Most of The manganese values in this study are in agreement with results in the literature.

3.6. Iron(Fe)

Iron is highly required physiologically formation and to enhance oxygen carrying capacity of red blood cells.Fe is necessary for the formation of haemoglobin and also plays an important role in oxygen and electron transfer in human body. Its deficiency causes gastrointestinal infection, anaemia, nose bleeding and myocardial infection (Ullah et al.,2012).

The results show that, all species of mushrooms except one species , The iron concentrations ranged in *Rhizopogon roseolus* were (39.97 µg/g) Denizli region ((824 mg/kg) (Anatolia region)), While *Cantharellus cibarius* Black sea region(recorded that the highest level 1750mg/kg.The iron concentrations in selective medicinal plants the WHO (FAO/WHO., 1984) limit has not yet been established for iron. Kalac and Svoboda (2000) reported iron content was found to vary between 30.0 and 150.0 mg/kg.

The range of iron in selective medicinal herbs of Egypt in the study carried out was between 261 ppm to 1239 ppm (Jabeen et al., 2010).

Previous studies indicate that iron concentrations was as follows : 31.3–1190 mg/kg (Sesli, 1999), 30–150 mg/kg (Kalač, 2000),56.1–7162 mg/kg (Mendil, 20040. The results thus obtained are compatible with reported value in the literature.

3.7. Chromium

Chromium can be considered even a trace element, but in excessive dose is a toxic for health. Chromium (VI) compounds are toxins and known human carcinogens, whereas Chromium (III) is an essential nutrient.

But the chromium contents were higher than those reported earlier and the chromium levels were lower than literature values. The trace metal contents in the mushrooms are mainly affected by acidic and organic matter content of their ecosystem and soil (Gast et al. 1988). Mushrooms have significantly higher chromium content than other food (Barancsi, 2002)

To illustrate the results,The highest chromium content (22.7 µg/g d.w.) was found in *Armillaria mellea* (middle black sea region) ,whereas the lowest chromium content (0.074 µg/g d.w.) was found in *Rhizopogon roseolus*(Denizli region) . The Cr contents of mushrooms seem to differ with respect to sampling areas.

These values were well below the FDA recommended daily intake of chromium for foods and feeds, which is 120 mg/kg (Haider et al. 2004).

Chromium values in mushroom samples have been reported to be in the ranges: 7.0–11.0 mg/kg (Sivrikaya et al. 2002) and 1.95–73.8 mg/kg (Yamaç et al. 2007).The Chromium values in the present study are in good agreement with the reported values in the literature.

3.8. Nickel (Ni)

Nickel is useful as an activator of some enzyme systems (Zhu, 2011), but harmful if its found at high levels.There is evidence that nickel helps with disease tolerance in plants, although it is still unclear how this happens. Nickel (Ni) plays important roles in the biology of microorganisms and plants (Sigel et al. 2008).

Nickel has various biological functions in the body. It plays important roles as a catalytic centre in redox and non-redox enzymes, where it has important ramifications in terms of human health (e.g. urease), energy science (e.g. hydrogenase) and the environment (e.g. carbon monoxide dehydrogenases) (Martin el,2013). According to the results in this study, maximum nickel level was 0.04 µg/g in *Morchella vulgaris* (WESTERN BLACK SEA REGION) and 17.44 mg/kg in *Rhizopogon roseolus* (Anatolia). The WHO recommended daily intake of nickel was between 100 and 300 mg/kg WHO.(1994).Nickel values have been reported in the ranges 8.2 – 21.6 mg/kg (D.Mendil,2004) and 1.22 – 58.60 mg / Kg (Yamac,2007), respectively. The results obtained, in the current study, indicated that nickel content of the investigated mushroom samples were found to be comparable with those reported in the literature.

4. Conclusion:

According to the results in this study that microelements or trace elements generally are essential for humans. That is include iron, zinc, copper, manganese, nickel and chromium, Other trace metals like, lead and cadmium are toxic to humans.

The levels of metal concentrations in the samples were also compared with those reported in the literature. The results of this review are generally in agreement with the reported results.

It should also be noted that some variance is possible due to the different analytical techniques used.

In addition metal concentrations vary over a wide range within the mushrooms species, by cause of the accumulation rate.

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Biodiversity and its economic importance in the lakes region (Türkiye)

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Abstract: Biodiversity means the richness of plant and animal species and the variety richness within species. The Flora of Türkiye have a floristic richness as much as a continent ones. It is also like an open air museum. From an economic point of view, the majority of the Flora of Türkiye is composed of high-economic species such as drugs, food, spices, and paint. Plant diversity of the Lakes Region has been determined to a large extent. 2300 and 1600 vascular plant taxon grow in Isparta and Burdur, respectively. The flora of Konya, Denizli, Antalya and Afyonkarahisar were adequality not studied as far as those of Isparta and Burdur. The basic principles that biodiversity is to be gain to economy in the region are given below:

- To determine the natural or cultural plant diversity of the region, and to produce, process and market those with economic importance,
- To give weight to production of the plant groups (rose, apple, strawberry, aromatic plants etc.) which the gene center is the Lake Region,
- To focus on importance to industrial plants, especially essential oil plants,
- To reduce the sale of raw materials over time and to give weight to the manufactured goods and consumables,
- To obtain longer usage and sales duration by drying and distilling agricultural products,
- To focus on local production and small-scale management, such as family business or KOBİ; to ensure that the processing of the place where the harvest is made can be done,
- To become a brand and to obtaine geographical registration in certain products,
- To establish local botanical gardens, gene banks and research centers etc.

Approximately 120 plants of the Lakes Region are candidate to be the industrial plant. These plants list and their economical usage aims are the basic issue of our work. These important plants are as follows; poppy (*Papaver somniferum*), caper (*Capparis* spp.), centaury (*Hypericum* spp.), rose/ rosehip (*Rosa damascena, R. dumalis, R. canina, R. alba, R. semperflorens*), lavander (*Lavandula* spp.), Sütçüler oregano (*Origanum minutiflorum*), Dedegül tea/ Kafaotu (*Cyclotrichum origanifolium*), special-mint (*Calamintha nepeta*), melissa (*Melissa officinalis*), baby's-breath (*Gypsophila arrostii* var. *nebulosa*), sahleb (*Orchis, Ophyris* and *Dactylorrhiza* spp.) blackberry (*Rubus* spp.), terebinth (*Pistacia terebinthus*), carnation (*Dianthus* spp.) etc.
At the end of the report, the relationship between flora, vegetation, climate and culture of it was emphasized. A list of the important plants produced for industrial purposes are given in different areas of the region; suggestions for the development of agriculture have been made. It is seen that the floristic structure is very important especially in medicinal and aromatic plants in local agriculture. It was understood that the elements of wild flora were a sign of the well-developed breed and the families that had to be produced in the local agriculture. It was explained that the success of the strawberry creations in Şarkikaraağaç city is the success from Kızıldağ flora and the success in the production of sugar beans is one (Fabaceae/Leguminosae) of the first 3 families of natural flora pulses. The success in the production of oil rose is coming from the Dedegül mountain which is the gene center of rose genus.

1. Introductıon

Since the time of creation, mankind has paid attention to the environment. Meeting the nutritional, health and shelter needs of people throughout history has been a major problem. Most of people did not look at the same plant, some men saw. The men classified the plants to benefit. Useful and harmful, medical-aromatic; toxic-healing; food, timber, furniture purposes etc. They went to produce the plants they thought were very important, so that natural and agricultural plants emerged. Among all plants, those with high economic value and high added value are called "Economic Plants".

Wild (natural) plants are cheaper than cultivated plants and are more suitable for health. They are also ecologic to grow in the most suitable environment. They are the most important source of vitamins, antioxidants, minerals and nutrients. They are the ancestors of the cultivated plants. The first group used the plants for the treatment of many diseases. At the beginning of these plants are coming Medicinal and Aromatic plants. These group plants are also used in perfumery and cosmetics as skin care products. As their usage becomes widespread, they become industrial plants and they are switched to mass production. Drugs, food, spices, dyes, fiber, forage plants, furniture and decor plants are at the head of industrial plants.

Türkiye is a rich country attracting in the world with its biological diversity. For this reason, it is likened to an open air museum. This wealth is only in plants, species, breeds etc. but also the ecosystem diversity. The fact that the plants on the list are economically important. For example, the legume family in Flora of Turkey (Davis, 1965-1985; 1988) was written as a single volume. It is a family based food and feed plants. The wheatgrass (Poaceae) is the same. The family of Ballıbabagiller (Lamiaceae) and Cereals (Apiaceae) are also ones of the families are rich in medicinal and aromatic plants. These groups are

large families in terms of number of taxa in Türkiye. Similarly, plant species developed in Türkiye, which are rich in the number of taxa, are generally economically valuable plant groups. Rosaceae, *Astragalus* (Geven in Turkish, *Onobrychis* (Korunga in Turkish), *Salvia, Sideritis* (Adaçayı in Turkish), *Trifolium* (Üçgül in Turkish), *Verbascum (*Sığırkuyruğu in Turkish), *Olea europea* (Zeytin in Turkish), *Hypericum (*Kantaron in Turkish) *Cyclotrichum origanifolium* (Kafaotu in Turkish), Papaver spp. (Gelincik in Turkish). Samples can be duplicated.

The Mediterranean region is the center of medicinal and aromatic plants. In the ornamental plants, families Gülgiller (Rosaceae), Karanfilgiller (Caryophyllaceae) and Sıracaotugiller (Scrophulariaceae) are rich plant groups of Türkiye(Davis, 1965-1985; 1988).

The gene center of wild roses is identified as Dedegül Mountain (Isparta-Konya) in the Lakes region. Afyon (*Papaver somniferum*) is an important medicinal raw material. Its agriculture is a plant that is based on very old ones in the region. Afyonkarahisar has been given a source of inspiration for the name. Cotton (*Gossypium hirsutum*) is an important fiber plant of the Turks brought from Central Asia. It has been produced for centuries in the Mediterranean region. Hemp (*Cannabis sativa*) is also an important plant produced in the region for fiber purposes. Watermelon (*Citrullus lanatus*), Cucumber (*Cucumis sativus*) are the plants brought from Central Asia (Özçelik, 2017).

In recent times, there has been an increase in the number of natural plants in each area. The researches on the traditional use of plants have also increased significantly (Duran, 1998, Özçelik, 1987, Özgökçe and Özçelik, 2005, Arıluluk, 2010, Özçelik and Pesen, 2016).

2. Materials and methods

From 1994 year to the present day, the flora of the natural areas in the Lakes Region (Özçelik and Serdaroğlu, 1998; Özçelik and Öztürk, 1999; Özçelik and Korkmaz, 2002; Özçelik et al., 2014-2015, 2016), vegetation were carried out on medicinal and aromatic plants, field weeds (Muca et al., 2011) grown in agricultural areas. Flores of the provinces (Arıtuluk, 2010, Özçelik et al., 2013-2014, 2016) were excluded. The collected plant samples were pressed according to the method, dried and adhered to their cartons. After the diagnosis (Davis, 1965-1985; 1988), they were put into GUL Herbarium in Süleyman Demirel University. Some examples were given to GAZI Herbarium. Information and literature on local flora (medical, aromatic, poisonous, food, dye, fiber plants, etc.) for economic purposes in flora (Aslan, 2015, Baydar, 2005, Kaya et al., 2003). In addition, industrial facilities operating food, medical, aromatic plants on the site were visited. The products have been examined. In this report, natural flora, field weeds are analyzed and plants which have an important place in the cultivation of the region are listed by being interpreted with ecological conditions. Information about their economic importance and specific values was given. The ones important for the area were identified. Some proposals have been made to increase economic returns in agricultural production. In local plant names with the English name was written in general. The names of plants in Latin in the text were written for the first time, shortened for again by the initial letter. Authors of plants not written. Relations between the flora of the mountains and the well-grown agricultural plants of Lakes Region were interpreted and some suggestions were made.

3. Findings and discussion

In the Lakes Region, a rich flora has emerged depending on the climate, soil and rock varieties. It is known that the region is one of the important plant differentiation centers of Türkiye. Many plants that have escaped from natural flora to agricultural areas have been spontaneously cultivated. Others are grown in the region by bringing them from natural flora or other areas. Microclimate, rocks, soils, flora, vegetation and human endeavors have all been influential in the success of agriculture in the region. From the surrounding volcanic rocks, vast mineralized loamy soils have formed. The most important of the volcanic rocks is pumice and boron. It is known that this material is effective in fertile soil formation. There are various minerals in the structure of the rocks in the region. The mineral amount and varieties that the plant needs is in these rocks. Well-developed economic plant groups in the region and their relationship with flora are described below:

3.1. Food plants

Vegetable and fruit farmings are common in the region. There are a large number of naturally occurring taxa belonging to the Solanaceae family. Poaceae and Fabaceae also share the top three natural floral research areas. Plants that are cultivated are provided with a natural flora, both taxon-based and diversity-based.

- Kebere/ Kapari, Capper (*Capparis* spp.): Although they are perennial plants and have been in Türkiye for many years. Their importances have been understood in recent years (Özçelik and Koca, 2011). Beside being evaluated as vegetable, it is used abundantly in medicine, cosmetics, paint and feed industry in many world countries. In Türkiye and in the region are two species of the capers as *Capparis spinosa* and *C. ovata*. Buds, berry, and root bark of them are known as diuretics, constipation and forceps. Used part economically of them is mainly buds. The buds are generally used for food. Flower buds collected from nature in Türkiye, between 1995 and 2000, it started to take an important place in exports with an average production amount of 5000 tons and a value of 15 million dollars. The lamb is considered to be a suitable plant in economic evaluation of areas considered as non-agriculture (Özçelik and Koca, 2011). In the food industry, *C. ovata* is the most preferred.
- Salep, Sahlep (*Orchis, Ophyris, Cephalentheera* and *Dactylorhiza* spp.): An important part of the diversity of sahlep plants

is the Lakes Region. But what kinds of genres exist in the area? The population sizes of species are also not specific. The locusts are used for food and medical purposes. It is common sense that it gives a feeling of satiety and is useful against gynecological diseases. In the Bucak district, sahlep oysters are collected for commercial purposes. The most important place in the production of sahlep in Türkiye is Bucak city. Bucak sahleb is the most famous. Bucak district is also a center where other medical and aromatic plants are collected and traded. Approximately 120 million sahlep lids per year are removed in Türkiye.

- Zeytin, Olive (*Olea europea* subsp. *sylvestris*): The motherland is considered Eastern Mediterranean, ie Türkiye. Wild olive grows wild in the Mediterranean region up to 800 m. In Çandır (Sütçüler) and Senir (Keçiborlu) it naturally grown on the sides. Oil is obtained from both fruits and seeds. The amount of fat in the fruit is about 12%. Oil droplets are collected in mesocarp cells. It is possible to produce oil from both fruit and kernel (seed). Olive is a valuable food ingredient at the same time. The most important of these is the raw material of the medical material. Bioactive substances have recently been obtained from olive black water (waste). *Oleuropein* is one of these. Leaves have a higher bioactive content.
- Yağgülü, Rose (*Rosa damascena*): Smile in Türkiye is done only in the Lakes region. Approximately 10,000 families have income from this sector. About 12,000 tons of rose flower are processed annually. After this process, about 2000 kg of rose oil is produced. The economic value of this oil is about 50,000 TL / kg. It is nearly exported to France. In the food sector, it has an important place in the production of confectionery. Ice cream, Turkish delight, vinegar, syrup etc. is used as a raw material for roses or as a food additive in about 20 food products. It is also used for medical and cosmetic purposes. It is used in the cosmetics sector in approximately 120 jugs.
- Yerelması (*Helianthus tuberosus*): It is a food that is widely consumed in the region and is eaten raw, especially for diabetes.
- Böğürtlen, Blackberry (*Rubus fruticosus*): It is produced for household needs in home gardens, specially for syrup and fresh food. Thorny, uneven; fruit are spherical and long type. Fruit, roots and leaves are used against diabetes. *R. ideus* (Raspberry, Ahududu) is also used and produced for the same purposes. A large number of *Rubus* species naturally grow on the mountain of Dedegül. It is a species that is produced in the region for both landscape and food purposes. There are a large variety of species grown on roadside refuges, in home gardens and in parks. It's a protection against diabetes. Fresh fruits are eaten or syrup made.
- From fruit trees; Kızılcık/ Ergen, Cornelian (*Cornus mas*), Ayva, Quince (*Cydonia oblonga*), Ceviz, Walnut (*Juglans regia*), Kiraz, Cherry (*Cerasus avium*), Vişne, Cherry (*Cerasus vulgaris*), Elma, Apple (*Malus sylvestris*), İncir, Figs (*Ficus carica*), Karadut, Black mulberry (*Morus nigra*), Alıç, Hawthorn (*Crataegus* spp.), Kuşburnu, Rosehip (*Rosa* spp.), Asma/ Üzüm, Grape (*Vitis vinifera*), Hünnap, Jujube (*Ziziphus jujuba*), Ahlat, Wild pear (*Pyrus* spp.), Muşmuşa/ Beşbıyık, Medlar (*Mespilus germanica*) etc. are widely produced in the region.
- There are some families in the region that are important for bee farming and honey production. Important families and Turkish names are mentioned below: Ballibabagiller (Lamiaceae), Maydanozgiller (Apiaceae/ Umbelliferae), Gülgiller (Rosaceae), Baklagiller (Fabaceae), Papatyagiller (Asteraceae), Hodangiller (Boraginaceae), Çamgiller (Pinaceae) are some of these.
- In the past years, these aims have been expanded while mushroom picking has been medical and nutritional. However, the concern that people have about mushroom poisoning limits the amount of consumption. In the country, almost 40 edible mushrooms are collected for cooking purposes and 25 of them are traded or exported abroad. Lamb breast: *Morchella esculanta* var. *rotunda*, *Morchella conica* var. *deliciosa,* Domalan (*Rhizopogon luteolus, Russula delica* etc. The mushrooms that have a high economic importance and are eaten in the Lake Region:

White mushrooms: Dolaman (*Rhizopogon luteolus*),

İstiridye mantarı (*Pleurotus ostreatus*) is found both locally and culturally. Burdur producing İstiridye mantarı can sell fresh İstiridye mantarı edible mushrooms from 8-15 TL / Kğ in the neighborhood markets. On the marine side, for medicinal purposes, on the side of Korkuteli (Antalya), the production of mushrooms for culinary purposes has recorded important steps. There are only restaurants in Denizli that produce food on mushrooms.

Yellow mushrooms: Çıntar (*Lactarius deliciosus*), in some places also called Kanlıca Mantarı. These mushrooms are cooked and eaten.

Black mushrooms: Truffle mushroom (*Tuber* spp.) is also an important herbal value. Some countries produce this mushrooming and gain serious economic benefits. 2000 Tl / kğ on the domestic market. It can be sold in Europe up to 3000 Euros. The people of the Lake Region can not make use of this mantel sufficiently. Most mushroom trade is done in Burdur province.

Almost everywhere in Türkiye, the mushrooms (*Morchella* spp.) are collected from nature and consumed or sold every year. In 2014, the Kuzugöbeği mushroom, which is 60-80 TL / kg, is an important source of income for local people. Most places traders come and buy fresh from the villagers. In the same way, Çıntar mushroom is sold in abundance in Burdur and Muğla circles especially on roadsides. It is known to the people of the region that this mushroom scorpion, bee etc. against putting poisonous animals, it is beneficial. In recent years, mushroom production has increased in the region. *Agaricus bisporus* (edible mushroom, cultured mushroom) was started to produce oyster mushrooms. Experiments are also carried out for the production of lamb breasts and mushroom.

As side effects of medicines are learned and health problems increase, the functional tendency towards alcoholic beverages increases and the products are diversified. Functional foods gradually become a sectoral structure. The economic value of these foods is several times that of normal foods.

As the side effects of medicines are learned and health problems increase, the functional tendency towards alcoholic beverages increases and the products are diversified. Functional foods gradually become a sectoral structure. The economic value of these foods is several times that of normal foods.

Important functional food plants that can be produced for industrial purposes: Geyik elması (*Eriolobus trilobatus*), Alıç /Yemişen (*Crataegus* spp.), Kuşburnu (*Rosa* spp.), Hünnap (*Ziziphus jujuba*), Beşbıyık (*Mespilus germanica*), Frenküzümü (*Ribes rubrum*), Kestane (*Castanea sativa),* Kiraz (*Prunus avium),* Elma (*Malus sylvestris*), Böğürtlen (*Rubus fruticosus* İdris/ Mahlep (*Cerasus mahalep*), Yerelması (*Helianthus tuberosus,* Gül (*Rosa damascena*), Kebere (*Capparis* spp.), Kanola (*Brassica napus),* Salep (*Orchis, Ophrys, Dactylorrhiza* spp.).

Oil plants: Zeytin/ Olive (*Olea europea*), Menengiç/ Çöğre, Gum Tree (*Pistacia terebinthus*), Susam, Sesame (*Sesamum indicum*), Ayçiçeği, Sunflower (*Helianthus annuus*), Pamuk, Cotton / Pamb (*Gossypium hirsutum*) (Özbek et al., 2004).

Food coloring: Aspir (*Carthamus tinctorius*), Şekerciboyası (*Phytolacca americana*), Gül, Rose (*Rosa damascena*), Siyah üzüm/Asma (*Vitis vinifera*), Sumak/ Mavru, Sumach (*Rhus coriaria*), Kırmızı pancar, Red beet (*Beta vulgaris* var. *cruenta*), Domates, Tomato (*Lycopersicon esculentum*), (Özçelik, 1987).

Functional aromatic plants important from an industrial point of view: Laden/ Pamukluk otu/ Karağan (*Cistus creticus*, *C. salviifolius*), Püren/ Funda (*Erica arborea*), Adaçayı spp. (*Salvia officinalis, S. tomentosa, S. argentea, S. aethiopis*), Kekik (*Tymbra spicata* and *Thymus* spp., *Satureja* spp.), Mercanköşk/ Kekik (*Origanum minutiflorum, O. majorana, O. sipyleum, O. onites*), Hatmi *(Althea officinalis* and *Alcea* spp.), Kafaotu/ Kafasüpürgesi/ Karabaşotu (*Cyclotrichum origanifolium),* Çörek otu/ Karacotlam (*Nigella sativa*), Hasnane (*Calamintha nepeta*), Anason *(Pimpinella anisum*), Kişniş (*Coriandrum sativum)*, Anason (*Pimpinella anisum)*, Rezene (*Foeniculum vulgare)*, Dereotu (*Anethum graveolens*), Kimyon (*Carum carvi)*, Susam *(Sesamum indicum),* Nane *(Mentha* spp.), Beyşehir Çöveni (*Gypsohila arrosti* var. *nebulosa*) *(*Marotti ve Piccaglia, 1992; Muca vd., 2011; Telci, ve Sahbaz, 2005; Viljoen vd., 2006; Karadoğan vd., 2000-2003; 2016; Korkmaz ve Özçelik, 2011).

3.2. Feed crops

Animal feeds are plants or special blends that hold an important place in the feeding. For example, Çakşır, Çaşır/ *Ferula, Prangos* (Apiaceae) and some Fabaceae species are fresh, although they are poisonous, they are harvested at the end of the growing season and fed to the animals by being dried and mixed with other foods. So, in animals, sickness is reduced, reproductive speed is increased etc. So some essential oil plants have aphrodisiac effect. Essential oils of some medicinal and aromatic plants, such as Biberiye, Kuşdili, Rosemary (*Rosmarinus officinalis*), Kekik, Thyme (*Thymus* and *Origanum* spp., *Satureja* spp., *Satureja* spp.) and Lavanta, lavender (*Lavandula* spp.) which are confined to fish feeds, open the fish's appetite, as it grows faster. Breeding can be increased in all animals by eating lavender oil and rose pudding.

Animal breeding can not be done without feed plants. Natural meadows and horses are the areas where quality meals are abundant and cheapest produced. In many countries where conscious livestock is made, pastures form the backbone of fattening. Feeding rate is considered an important measure of your development rate. Because if livestock are not produced, livestock must be made with fraudulent food. There are important grazing areas in the Lakes Region. These areas are mostly located around Şarkikaraağaç, Yalvaç, Eğirdir, Aksu, Senirkent (Isparta), Beysehir (Konya), Düger, Bucak, Ağlasun, Yeşilova, Karamanlı (Burdur). In the pastures, there are regular grazing plans, fair distribution of herbage yield to animal producers and breeding programs of degraded beverages.

Arum italicum (Danaayağı), *Solanum nigrum* (İt üzümü), *Ranunculus* spp. (Düğünçiçeği) are very poisonous when fresh (flowering). But if they are dried after flowering they does not show the same effect. *Vicia freyniana* (an endemic species to the region), *Sorghum halepense* (Kanyaş, Kaynaşık, Gelemge ayrığı), *Trifolium subterraneum* and so on are also effective when they are fresh in animals, while they are little effective or ineffective when dry. From these plants, *Vicia freyniana* is an endemic species of Lakes Region and is a fast growing species. It is an important plant that can be cultivated as a feed plant.

Table 1. Important feed crops of the Lakes Region (*: culture form).

Species	Turkish name	Used part	Economic priority
Vicia spp.	Fiğ	All over ground axles	Near Akseki and Isparta, the local people give the name "Fink". They are plants produced for feed purposes.
Onobrychis spp.	Korunga	All over ground axles	Some species are produced
Trifolium spp.	Üçgül	All over ground axles	It is also known as "scarlet". It grows naturally. It is fed to the animals.
Trigonella spp.	Çemenotu	All over ground axles	It grows naturally. It is fed to the animals.
Medicago spp.	Yonca	All over ground axles	It grows naturally. It is fed to the animals.
Secale montanum	Çavdar	All over ground axles	Naturally grown and cultivated. It is fed to the animals.
*Hordeum vulgare**	Arpa	All over ground axles	It is grown for food purposes. The other part is straw and used as bait after the harvest has been completed.
*Triticum vulgare**	Buğday	All over ground axles	It is grown for food purposes. After the barn has been harvested the other part is shredded, takes the name of straw and used.
Avena fatua	Yulaf	All over ground axles	It is grown for food purposes. The other part is straw and used as bait after the harvest has been completed.
*Beta vulgaris**	Şeker Pancarı	Tuber roots	After the sugar is obtained, the waste (bagasse) is packaged into commercial feed. It's the cheapest bait.
*Zea mays**	Silajlık Mısır	All over ground axles	Agriculture is done. It is grown for herb value. Then it is chopped into silage. Widely used.
Brassica rapa var. *rapa*	Yem şalgamı	Whole plant	Agriculture is done.

Feed plant: Kocafiğ (*Vicia freyniana* (Endemic to the region), Fiğ (*Vicia* spp.), Korunga (*Onobrychis* spp.), Mısır/ Kacadarı (*Zea mays*) bir türü), Nohut (*Cicer arietinum*), Arpa (*Hordeum vulgare*), Buğday (*Triticum aestivum*).

3.3. Medicinal and aromatic plants of the region

Taurus nomadic herders and shepherds often used tar obtained from the dwarf Pine (*Pinus* spp.), Juniper (*Juniperus* spp.), Fir (*Abies cilicica*) and Cedar (*Cedrus libani*) trees when treating animals, are known. They use this tar against the Crimean Congo Hemorrhagic Disease and the "Tetanus Disease".

The tar called "Black Physician" which we frequently encounter in animal treatment is used as "Yakı" (Yarar, 2014) in the recovery of cold sores and injuries in low back pain. Recently Katran Soap has been produced and sought after with modern techniques.

Aromatherapine is a spice plant based on. Important medicinal and aromatic plants in the field are:

- Ceviz/ Walnut (*Juglans regia*): They expressed the definite cures by using "Yakı" making and applying by blowing with water.
- Çam/ Pine (*Pinus* spp.): Chewing chewing gum protects your dental health.
- Çıtırık/ Çedimek/ Menengiç (*Pistacia terebinthus*): It says that the defeat of the fruit protects the teeth. A food is prepared from the fruit with the name "Menengiç Kahvesi/ Menengiç Coffee Shop". The oil is very valuable in terms of medicine. It grows abundantly in the region naturally. Kadıntuzluğu/ Sarıçalı/ Karamuk (*Berberis vulgaris*): In the autumn, its roots are removed, cleaned and boiled. Gargling is done after the cold. It is expressed that toothache and wound in the mouth are good. Ebegümeci (*Malva* spp.): If gas is produced as a result of cold and chilling cold. It is mixed with the barley flour and it is used as "yakı". The leaves and flowers are used in effective substance. It is used against coughing and as an emollient.
- Hatmi/ Gülhatmi/ Gülfatma (*Althea officinalis):* Homeland is Eurasia. Especially the leaves are used. Effective substance is a trick. It is used against throat infections and inflammations. The tea of the flowers is drunk against infectious diseases. Drinking liquid extract obtained with water vapor is useful for lung diseases. Chest softener. *Alcea* genders are also used for the same purpose. The flowers are collected and shaded and dried. There are many kinds in the region and it naturally grows in abundance.
- Koyunotu/ Oğlanotu (*Teucrium polium*): It is boiled in a cold, waiting for 5-10 minutes, then 2 sips are drunk. It does not drink too much because it is painful. It grows abundantly in the region naturally.
- Suteresi/ Gölotu (*Nasturtium officinale*): Salad cancer patients are sick if the disease is fed. Recently, this plant has been largely forgotten. Even the number of those who now know the consumption side is very small. It seems that this drug was made against cancer in USA. Again in the United States, the algae of water algae (*Spirogyra* etc.) are used against goitre disease. It is known that all plants living in the water are rich in iodine, diseases such as tonsillitis and goitre are also caused by iodine deficiency in the body, and a germicidal mixture is made with the name of tentide iodine by dissolving in iodine alcohol.
- Papatya, Daisy *(Matricaria chamomilla):* Homeland Mediterranean Region. It is the flower of the plant used as medicine. *Tripleurospermum* and *Anthemis* species are also used for the same purpose. The species diversity in the region is excessive. Some are smelly.
- Acıyavşan/ Pelinotu (*Artemisia absinthium*): Homeland is Eurasia. Fresh branches and flowers of the plant are used. In the chemical composition absinthine is glucose. In addition, it has tannin, etheric oil etc. It is used against stomach discomfort (car retention, digestive disorders, etc.) and muscle weakness. *A. campestris* is known in the region as "Püren". Its branches are spread over fig, apricot etc. the fruits of the plants are dried. The name of a local area around Gölcük Lake is Pürenovası. Take the name from this plant.
- Civan perçemi/ Ayvedana (*Achillea millefolium*): Homeland is Europe. Branch leaves and flowers are used. A glycoside named Achillein is on its way. It is used against indigestion and cancer. Plant sap is a powerful antiseptic. The water is used against the degradation of food. *Achillea* and *Tanacetum* species are very common in the region. It grows naturally.
- Meryemana dikeni/ Virgin Mary (*Silbyum marianum*): Can also be used for liver. In the morning they are boiled and drunk. It is recommended to drink local tea against many internal diseases. These plants are exported to Türkiye.
- Aspir/ Safflower (*Carthamus tinctorius*) plant is an old food additive plant that was started to be cultivated in Anatolia 3000 years ago (Özçelik and Koca, 2011). In 2004 year, 582 thousand tons of aspirate were produced in 720 thousand hectares of field in the world. The cartharmin substance produced from aspir flowers is important as natural dye raw material and also used as a spice. Several species of *Carthamus* are naturally grown in the region. Sage/ Medical Sage (*Salvia officinalis*): Homeland is the Mediterranean region. It is produced for economic purposes in the region. Aromatic plants are usually sold to transmissions. Especially Sütçüler is exported to Europe.
- Oğulotu/ Melissa (*Melissa officinalis*): Homeland The Mediterranean region is mostly grown in Central and Southern Europe. It is the leaves of the plant used as medicine. Aphrodisiac is effective. The wild forms are grown in abundant amounts on the sides of the Sütçüler, Aksu, Yenişarbademli cities.
- Kekik/ Zahter, Thyme (*Thymus serphyllum*): Homeland is Eurasia. The plant that is used as medicine is branches, leaves and flowers. The active substance is thymol. It is used against coughing and stomach discomfort. In the region, it is cultivated. One source of healing is thyme (*Thymus, Origanum, Satureja* and *Thymbra* spp.) and thyme oil. They are frequently used in both colds and tonsillitis. Oregano volatile oil is widely used both externally and externally in all infectious diseases in Taurus nomads.

- In Türkiye, such as *Satureja, Thymus, Thymbra, Coridothymus* and *Origanum* are also called thyme, and there are about 270 different species of plants used as thyme throughout the country. 70 of these species belong to the genus *Thymus,* 1 belong to the genus *Coridothymus* and some 10 belong to the genus *Satureja.* At least ¼ of these are grown or raised in the Lakes Region.
- Mercanköşk/ Kekik, Marjoram, Merzengus, Thyme *(Origanum* spp.): The motherland is the Mediterranean region. There are about 20 species in the country. *O. majorana* in Akseki (Antalya) is known as "İncirkekiği". *O. minutiflorum* is known by the name of "Aşkekiği, Çorbakekiği, Sütçüler kekiği, Totakekiği". *O. onites*; It is known as "Eşekkekiği, Bilyalıkekik, İzmir kekiği". *Origanum vulgare* subsp. *viride* is known as "İstanbul kekiği". Leaves and fresh bodied foods are used as spices. For this reason, *O. majorana* is called "Figurine" in the vicinity of Akseki. *Origanum* species have been used as medicines and spices since ancient times. Exported products of Türkiye. Our best selling products. While dairy cows are the most preferred, there is no problem in the normal conditions of sale of all thyme to Europe. In recent times, cultural studies have accelerated. The most produced İzmir Kekiği, Donkey tyme. The quality of the thyme produced is lower than the wild ones. Approximately 700 kilograms of thyme (rough weed) can be produced from a declination. It can be trimmed 3 times a year. Commercial value is 5 Tl / kg as roughage.

Origanum species usually carry carvacrol and thymol as essential ingredients in essential oils. Essential oils obtained from *Origanum* species have some therapeutic effects, mainly coletogenic and antimicrobial effect. They can also be used in the pharmaceutical, cosmetic, perfume, liquor and soap industries.

- Kafaotu, Kafasüpürgesi, Karabaşotu, Dedegülçayı (*Cyclotrichum origanifolium*): It starts from Lake Region and spreads to Amanos Mountains (Adana, Hatay). While the top part is used as a spice, the oil is used for medical purposes (brain blood vessels, blood sugar lowering, blood pressure lowering etc.). It is a plant that is sold in abundance in Isparta. The fat content is 3-4%. There are 5 species of *Cyclotrichum* genus in Türkiye. *C. niveum* species grow abundantly in the steppe on the Malatya side and the oil content is 6% (very high) but the oil composition is not as good as *C. origanifolium*. The head swab is called Head Beauties because it opens the brain vessels and increases the blood flow to help solve the problems in the brain. It is used more extensively for *Lavandula stoechas.* Cultivation ways must be sought. Soap can also be used in the industry.
- Nane, Yarpuz/ Mint *(Mentha* spp.): It is etheric / volatile oil which is called "menthol" which gives noxious taste and pleasant smell. These oils are collected in secretory follicles and secretory glands on the epidermis covering the fresh body and leaves. Menthol is widely used in the pharmaceutical industry. It is exported products of Türkiye. Yarpuz, Mint (*Mentha piperita*): Homeland is Western Europe. The part used as medicine is the leaves of the plant. The active substance is the menthol. It is used in mouth water production and soothing. There are about 10 kinds in Isparta. *M. pulegium* carries 42-49 % mentol. The region is cultivated. Approximately 10 wild formulas grow in abundance on the side of Sütçüler, Aksu, Yenişarbademli. Especially *M. spicata* and *M. longifolia* are very common. They are used in oil production. For *Calamintha nepeta,* the villagers of Aksu (Isparta) give the name "Hasnane" and volatile oil is removed. It is a precious oil.
- Lavanta, Lavender (*Lavandula stoechas, L. angustifolia*): They have a separate prescription for the Lake District. They have very good odor. The flowers are collected while they are about to open and distilled to obtain volatile oil. The flowers are a force transmitter and diuretic. Its tea is drink against rheumatism. Used externally as soothing. It is known that active ingredients in Lavantia suppress hepatitis B and C virus, which cause liver cancer. It is an important plant group used in the perfumery industry. The flowers protect from drying clothes from insects. As an insect repellent, it can be used in place of naphthalene (asifinic), which is prohibited for its use as carcinogenic in recent years. The distillation of lavender herb with water vapor also changes the economic value of the essential oil, oily water or oil water produced. Recently Kuyucak village (Keçiborlu) is going to introduce lavender fields and products with tourism. *Lavandula angustifolia* has a separate prescription for the Lake District. Very good odor. The flowers are collected while they are about to open and distilled to obtain volatile oil. The flowers are a force transmitter, a diuretic. Drink tea against rheumatism. Used externally as soothing.

There are 2 species (*Lavandula stoechas, L. angustifolia*), 1 hybrid (*L. x hybrida*) called lavandin and 20 cultivars (*Super A, Grasso, Grassotina, English, Akme, Munstead, Duch, Abrial,* etc.), members of the lavender (*Lavandula*) genus are raised in the Mediterranean region only under the influence of Burdur Lake in the vicinity of Keçiborlu-Dinar, especially between Isparta-Burdur-Afyonkarahisar. The efforts to create a collection garden of all lavender varieties of Türkiye in MAREM (Isparta) have been going on for years.

- Defne, Laurel (*Laurus nobilis*): The motherland is the Mediterranean region. In countries with pre-sea coasts, abundance is found in and around the creek beds. By local people in Taurus mountains, it is known as Tehnel or Tehni. The smell is hardly understood from the outside. Because etheric oil is an in-plant secretion. When the tissue is disintegrated, the odor will emerge. As a spice, in food it is very popular. It is an etheric oil and bitter substance that gives smell and taste. Leaves are especially preferred in fish dishes. The oil is very economically valuable. Especially, it is preferred in making soap for medical purposes.
- Anason, Anise (*Pimpinella anisum*): Motherland is Asia. It has an etheric oil called anethol. This is also the substance that gives a burning flavor and anointense to the anise. Anise is flavored with some cakes and alcoholic beverages. It is also used in throat inflammations and stomach pain.

Isparta's important fragrant plant richness and vernacular names: There are aromatic plant varieties which can be cultivated around 190 in Isparta province. The areas in which these crops are predominantly cultivated are Aksu, Sütçüler and Yenişarbademli districts which is rich in flora. From wild herbaceous plants; Kafaotu/ Karabaşotu/ Kafasüpürgesi/ Dedegül çiçeği (*Cyclotrichum origanifolium*), Sahlep (*Orchis, Ophrys, Dactylorrhiza* spp.), Aşkekiği/ Yaylakekiği/ Bilyalı Kekik/ Eşekkekiği (*Origanum minutiflorum*), Yarpuz/ Nane (*Mentha* spp.), Evelik/ Kuzukulağı/ Labada (*Rumex* spp.), Madımak, Çobandeğneği (*Polygonum* spp.), Çöven/ Çevgen (*Gypsophia* spp.), Karanfil (*Dianthus* spp.), Oğlanotu (*Teucrium polium*), Bodurmahmut (*Teucrium chamaedrys),* Karakekik (*Tymbra spicata*), Adaçayı, Yaylaçayı, Dağçayı, Dallı, (*Sideritis* spp.), Şalba, Adaçayı (*Salvia officinalis, S. tomentosa*), Papatya (*Anthemis, Matricaria* and *Tripleurospermum* spp.),), Herdemtaze/ Altınotu/ Marsuvanotu (*Helichryssum* spp.), Ebegümeci (*Malva sylvestris, M. neglecta*), Yavşan/ Pelin (*Artemisia absinthium*),) Nevruzotu/ Arslanağzı (*Linaria* spp.), Nergiz (*Stenbergia lutea, Narcissus tazetta*), Çiğdem (*Crocus* spp.), Zambak (*Lilium, Iris* spp.), Meryemana Dikeni/ Devedikeni (*Silybum marianum*), Dişotu/ Hıltan (*Ammi visnaga*), Öksürükotu (*Tussilago farfara*), Kardelen/ Nergiz (*Galanthus* spp.), Kantaron/ Binbirdelikotu (*Hypericum* spp.), Gülhatmi/ Gülfatma (*Alcea* and *Althea* spp.), Ballıbaba (*Lamium* spp.), Misk Adaçayı (*Salvia sclerae*), Gıvışkanotu (*Silene vulgaris*), Güneyik (*, Chondrilla juncea* and *Taraxacum* spp.), Karahindiba (*Cichorium intybus)*, Sütlük (*Scariola* and *Sonchus* spp.), Isırgan (*Urtica dioica*), Şakayık (*Paeonia mascula*), Kediotu (*Valeriana officinalis, V. dioscoridis*), Yoğurtotu (*Galium* spp.), Dana ayağı (*Arum* spp.), Melekotu (*Angelica sylvestris*), yabani soğanlar (*Allium* spp.), Sümbül (*Muscari bourgaei, M. muscarimi*), Ayrıkotu (*Agropyron repens*), Çakşırotu (*Prangos* and *Ferula* spp.), Yaraotu (*Glaucosciadium cordifolium*), Böğürtlen (*Rubus* spp.), Sakızotu (*Scorzonera* and *tragopogon* spp.), Şevketibostan (*Cnicus benedictus*), Çördük/ Tarhanaotu (*Echinophora* spp.) etc.

From forest trees: Günlük/ Sığla (*Liquidambar orientalis*), Katran/ Sedir (*Cedrus libani*), Ardıç (*Juniperus excelsa, J. foetidissima, J. oxycedrus*), Çam (*Pinus brutia, P. nigra*) , İledin/ Göknar (Abies cilicica), Palamut Meşesi (*Quercus ithaburensis* subsp. *macrolepis*), Söğüt (*Salix* spp.) etc.

From the shrub group; Kebere/ Kapari (*Capparis spinosa, C. ovata*), Sumak/ Mavru (*Rhus coriaria*), Papazkülahı (*Eunymus laifolius*), Gelinyemişi, Erguvan (*Cercis siliquastrum),* Ihlamur (*Tilia platypllos*), Karaçalı/ Çaltı (*Paliurus spina-christi*), Defne (*Laurus nobilis*), Sivrikekik, Et kekiği (*Satureja* spp.), Karağan/ Laden (*Cistus* spp.), Mersin/ Murt (*Myrtus communis*), Kuşburnu/ İtburnu (*Rosa dumalis, R. canina, R. hemisphaerica, R. micranrantha* etc.), Püren, Funda (Erica spp.), Tesbih Çalısı/ Ayıfındığı (*Styrax officinalis*), Üvez/ Tekeelması (*Sorbus* spp.), Geyikelması (*Eriolobus trilobatus*), Hayıt (*Vitex agnus- castus*) etc.

From herbal culture plants; Carnation, Clove, Haşgeş (Poppy / Afyon), Garlic, Onion, Aspir, Cumin, Radish, Turnip, Dill, Tere, Rocket, Fennel, Broccoli, Cabbage, Mint, Thorn, Corn, Pumpkin, Hiyar, Melon. A science called "ethnobotanic" refers to how plants are used throughout human history, especially for therapeutic purposes. The use of plants for treatment is a common occurrence in non-industrial countries. According to the World Health Organization (WHO) estimate; 80% of people in some Asian and African countries are still treating with this type of plant.

Spice plants that benefit from the seed: Hardal, Mustard (*Sinapis* spp.): The motherland is the Mediterranean region. Mustard seeds have an etheric oil and a glycoside called sinigrin in this oil. There are two types: *S. alba* (Ak hardal in Turkish), *Brassica nigra* (Kara hardal in Turkish). Their seeds are not bitter and can be used in meals.

Some plants used as spices in Lakes Region: These plants are important for honey bees. It is aimed at increasing the yield of honey or against the disease of bee. The pines that eat the fresh body and leaves of the pine trees are called "basara in Turkish". The pine honey produced by eating these babies is also called " başara balı in Turkish ". Here are some local names of some bee plants: Basara çamı/ Kızılçam: *Pinus brutia*, Kekik: *Thymus* spp., *Satureja* spp., *Origanum* spp., Gül: *Rosa damascena* and *R. semperflorens,* Geven: *Astragalus* spp., Lavanta: *Lavandula stoechas, L. angustifolia* and *L. x hybrida*.

Important herbaceous aromatic plants cultivated in the Region: Dereotu, Dill/ Anise: *Anethum graveolens*, Kişniş, Coriander: *Coriandrum sativum*, Anason, Anise: *Pimpinella anisum*, Rezene, Fennel: *Foeniculum vulgare*, Kimyon, Cummin: *Carum carvi*, Turp, Radish: *Daucus carota*, Çörekotu: *Nigella sativa*, Canola: *Brassica napus,* Haşgeş/ Haşhaş/ Afyon/ Poppy *(Papaver somniferum),* Pamuk, Cotton *(Gossypium hirsutum),* Susam/ Sesame *(Sesamum indicum)…*

From trees: Kestane, Chestnut(*Castanea sativa),* Kiraz, Cherry (*Prunus avium),* Elma/ Apple (*Malus sylvestris),* Badem/ Padem/ Payam, Almond *(Amygdalus communis),* Ceviz, Walnut *(Juglans regia),* Ayva, Quince *(Cydonia oblonga),* Beşbıyık/ Muşmula, Medlar *(Mespilus germanica).*

- Ihlamur, Linden *(Tilia* spp.): The motherland is unknown. It is the flowers and bracts of the plant used as medicine. Effective items are Hilamar and etheric oil. The hymen has a gelatinous structure. It has diaphoretic and diuretic potency. Along the Aksu stream, there are natural linden communities. In recent years, it is a tree widely used in urban landscape. The economic value of flowers and wood is high. The economic value of flowers is around 250 Tl / Kg.
- Mürver, Elderberry *(Sambucus nigra*): Homeland is Asia. The part used as medicine is its fruits and flowers. The effective ingredients are amygdalin, a chelate, an etheric oil, a tannin and a glycoside. The plant has diuretic and sweating effects. In Yeni Mahalle, Gelincik, Yakaören villages and old house ruins of Isparta are grown in abundance. *S. ebulus* is also very common in the region. Its fruits are of medical value.
- Kediotu, Valerian (*Valeriana dioscoridis*): Homeland is Eurasia. Rhizomes and leaves of the plant are used. Its active ingredient is valerian acid and various etheric oils. In case of nervous weakness, it is used against hysteria and heart attack. It has aphrodisiac effective and sedating. The plant are used for eye diseases. *V. officinalis* is also used for the same purposes. However, it does not grow naturally in the region and it is provided from the transmissions.

- Ardıç, Juniper (*Juniperus foetidissima*): It is common in the Northern Hemisphere. Meat cones of it are used. The active substance is pinicrin glycosides and etheric oils. It's good for throat inflammation and indigestion. *J. communis, J. excelsa, J. oxycedrus* are used for the same purposes. *J. excelsa* and *J. foetidissima* logs are laid on the bottom of water wells to disinfect water. A bucket (water container) is made from the logs. Its woods are valuable. Primitive vegetation of the region is juniper forests. Lately, the soap made for medical purpose has been made widespread after the oil has been taken.

- Meyankökü, Liquorice *(Glycyrrhiza glabra*): Homeland is Asia. The active ingredient is glycerin, asparagine, resin, sugar and glycyrrhizin. It is usually used in the production of cough medicines. The raw materials are exported. This plant grows on the side of Konya. It is raw material of collagen. The fibers are kept cold in water for 2 hours than drink.
- Zambak, Süsen, Lily (*Iris germanica*): Domestic culture plants grown for ornamental purposes in the entire country. In recent years, in Isparta is an industrial plant. Lily oil is a very rare, valuable cosmetic raw material for this reason. The oil is important for smell and health. The fragrance called pilgrimage is the lily essence. In perfumeri sector, it is preferred for pleasant odor. Volatile oil is obtained like other volatile oils. That is, its oil is obtained by water vapor distillation of crushed rhizomes. The volatile oil can be in various tones of blue color. This depends on the type of distillation used and the method of distillation. The Robertet company (Keçiborlu) is the only company in the production and sale of this product. She sells her products to France.

Important industrial plant species and Turkish names are mentioned below:

Üçgül (*Trifolium* spp.), Puren/ Funda (*Erica arborea*), Laden/ Karağan (*Cistus creticus, C. salviifolius*), Karaçalı/ Çaltı (*Paliurus spina-christi),* Kekik/ Mercanköşk *(Origanum onites, O. vulgare* subsp. *hirsutum),* Şalba/ Adaçayı *(Salvia tomentosa, S. argentea, S. aethiopis),* Çam (*Pinus brutia, P. nigra*), Ihlamur (*Tilia argentea*), Ayçiçeği (*Helianthus annuus*), Kestane (*Castanea sativa*) and Kocayemiş (*Arbutus unedo*, *A. andrachne*) are very important plant species in beekeeping (Sales and Division, 2015).

3.4. Significant Toxic Medical Plants in the Region

The richest family on this subject is Solanaceae.

- Banotu (*Hyoscymus niger*): Homeland is Eurasia. Leaves and seeds are used. Hypocrite, a poisonous alkolide, is an active ingredient. Used as a drug. It is a common species throughout the country.
- Tatula/ Boru çiçeği/ Tatula, Pipe flower (*Datura stramonium*): It is a common species throughout the country. Its leaves and seeds are used as medicines. Effective materials of it are Atropine and Hyocyamin. It is used for asthma and cough. Atropine and Hyocyamine are suitable for the production of alkaloids. *D. inoxia* naturally grows on the side of Keçiborlu.
- Yüksük otu, Thorny grass *(Digitalis purpurea*): Homeland Central Europe. Leaves are used. Inherent substance Digitalin alcohololide. It is specially grown for production.
- Eğreltiotu, Fern (*Aspidium filix-mas*): Used as a rhizome drug. It has Felix acid, floroglucin and tannin. It is used as a worm reducer.
- Ökseotu/ Çekem/ Burç, Mistletoe/ Zodiac (*Viscum album*): This species grows naturally in fruit and forest trees in abundance. Birds are used as food and medicine. It is fed to pets at certain intervals for pharmaceutical purposes. Growers in forest trees are used for lung cancer, and those who grow in fruit trees are used for stomach cancer.

3.5. Important ornamental plants: Şakayık / Ayıgülü (Paeonia mascula), Erguvan

Gelin Yemişi (*Cercis siliquastrum*), Gül (*Rosa odorata*, *R. canina, R. dumalis, R, alba, R. moschata, R. centifolia, R. banksiae, R. alpina* etc.), Kekik (*Origanum* spp.), Karağan, Çobançırası (*Phlomis grandiflora* etc.), Papazkülahı (*Eunymus latifolius*), Akçaağaç (*Acer* spp.), Mürver *(Sambucus nigra*).

3.6. Fiber plants: Kendirotu/ Kenevir (Cannabis sativa), Pamuk/ Pambuk (Gossypium hirsutum), Keten (Linum usitassimum).

Conclusion and Recommendations:

Turks did not want to leave the experience of nomadism throughout history. Despite the fact that this style of life has weakened in recent years, it is still not abandoned. This experience is not an obligation, it is a choice. Therefore, local people who live especially in rural areas know wild plants more closely than our resident adaptable people and know better to use them. Over time, they begin to cultivate the most beneficial crops, and so the plants are cultured and traded. Local people who are in harmony with established life are less familiar with wild plants and less skilled in hand because they can easily reach to modern hospitals and pharmacies. Because the obligation in the countryside is not inhabited, there is not much need for folk medicine. The place of folk medicine leaves to modern medicine.

Since the days of mankind, mountains, hills, meadows, pastures, slopes and valleys, basins have always been regarded as a natural medicine pharmacy. In the 21st century, due to the understanding of the side effects of synthetic medicines, people have turned to supply natural necessities again. Treatment with medicinal plants or in other words preventive medicine or aromatherapy applications are being studied with great care. Of course, one of the most important features of treatment with medicines is; food, and strengthening the immunity (resistance) system of the living body.

The use of poisonous plants is not included in Turkish public pharmacy applications. There is an important level of consciousness among the Turks in the use of medicinal plants. In Jaundice ill, they use yellow flowering plants, yellow flowers, yellow roots. *Ranunculus* flowers (for joints) are used against sun-blooming leaves of the species of the genus *Salix* (willow), hyacinths for the rheumatic diseases, seeds of *Hyoscyamus* and *Datura* are used against the worms in the eye and mouth wounds.

Helichryssum stoechas (Altınotu in Turkish) ... tried to reduce urinary tract ailments and stones. The results are positive. *H. plicatum* is good for pregnant women in diabetic women. Experiments were performed in rats given tea extract. Plants carrying vitamin C are also antioxidants. Article 18c,j of the Biological Diversity Convention sees the folk medicine and demands the continuity of folk medicine (Sezik, 2016).

Keçiborlu and its surroundings produce rose, lavender and lily. The industrial facilities related to the topic of the field where the other fragrant plants such as thyme, sage, juniper etc. are also processed are intensified. It will be a correct name to say "Itır Valley/ Fragrance Valley" in this area and it will be an effective slogan in tourism. Local authorities are expected to consider this proposal. The Provincial Directorate of Agriculture is also advised to evaluate the Keçiborlu area for scented plants.

Rosa L. are known as the genus of fragrant and beautiful-looking plants in Roseaceae family. It is known that roses have been used for medical purposes for at least 5000 years. The industrial smile in Türkiye is based on the cultivation of *Rosa damascena* Mill. (Isparta Gülü, Yağ Gülü) in the Lakes Region and the gain by processing the flowers in about 25 factories. There are about 25 oil rose (R. damascena) genotypes in Türkiye is estimated. This income is only a source of income for approximately 10,000 families in the province of Isparta. In recent times, terms such as fruit rose, paint rose, cut flower, miniature rose, glass rose have been introduced and the smile has been diversified. Landscape roses are also classified as cane roses, uneven roses, ivy and seat roses. Rose oil, rose concreti, rose absolute and rose water from rose are obtained. These raw materials are going to be used in cosmetics, perfumery, cleaning products, food and candy, and the products are diversified. Approximately 65% of the world's needs are met from Türkiye.

Lakes Region's industrial scented plants: According to the order of importance; rose, lavender, lily, kebere, thyme, yakbin, juniper etc. It is based on rose production based to *R. damascena.* Essential oil is obtained from these scented flowers. The economic value is about 8500 Euro / Kg.

The present study was undertaken in all parts of Türkiye between 2006 and 2007. All provinces were surveyed and all forms of scented roses were collected and identified. Notes have been taken during surveys by interviewing local people. The most diverse use of roses found in Gümüşhane province. Industrial use of roses was found most in Isparta, Tokat and Gümüşhane provinces. *Rosa* x *damascena* was the industrial type and approximately 25 different forms of this species were identified in this study. Damask rose had the highest percentage of volatile oils when collected during early morning hours (0,05 %), and amount of distilled volatile oil declined when flowers were collected afternoons (0,02 %). Naturally grown species had the lowest levels of volatile oils in their flowers. Number of factories is 25; for each day 50 tones rose flower produce in Isparta province. There are 2 factories to produce rose fruits in both Tokat and Gümüşhane provinces. The most common usage of scented roses was production of rose jams and marmalades from petals and fruits, rose water, rose syrup, dried flowers and petals for decoration and smelling, rose vinegar. Fruits of wild roses were used to make rose tea, in general.

It is under the influence of a microclimate formed by the influence of Burdur Lake in the central state of the aromatic plants such as Keçiborlu (Kılıç, Senir, Ardıçlı, Kuyucak, Saracık, Gülkent villages) and Güneykent (Gönen) and Burdur center villagers (İnar, İlyas, Karakent, Kavak, Başmakçı etc.). It is imperative to understand and protect the ecological significance of Burdur Lake in order to sustain the cultivation of aromatic plants in the region. There are important initiatives in the villages near Burdur Lake. They are both skilled in producing different agricultural plants and producing agricultural products. For example, in the village of İlyas (Burdur) vinegar varieties have been made since ancient times. The village is the most experienced field in vinegar production of the region. At the same time, settlement centers around Lake Burdur are the center of production and processing of medical aromatic plants. In the light of these endings, the suggestions for the development of agriculture in the region are as follows:

- Organizations related to fragrant plants should be strengthened. Exchange of volatile oil plants should be established. Action plans should be prepared in line with the objectives of improving the sector's development and regional cooperation by evaluating the existing potential of the city; working groups and committees should be established to pass these plans to life.
- In the vicinity of Keçiborlu-Dinar, agriculture-based industry should be encouraged. In fact, large industrial enterprises should be replaced by family/ peasant type enterprises, factories should also undertake marketing of oil produced by small enterprises as well as production. Solid-fuel, portable, easily portable distillation equipment (boilers) are needed for villagers, families and small businesses. KOSGEB, BAKA and Rural Development should support such initiatives.
- More than 10,000 families earn money from oil rose. We have over 100 years of experience. We have high product processing capacity (800 tons of rose flower for per day). We have trained personnel and modern laboratory facilities. Tourism activities are increasing in the world, there is an increase in demand for safety. Rose and other aromatic plants are also rising in tourism potential. Especially with the production of rose and rose products, we have an important place in the aromatic plant sector both in the country and in the world. Isparta Rose is a brand value. For this reason, there is a need for meaningful rose festivals, far from the daily politics of competing in literature, agriculture, production, product processing and development.
- A rose museum in our city is unfortunately not established and its establishment is not on the agenda. SDU. Botanical Garden is a very important opportunity for especially Isparta. The city regards this place as a promenade and a political polemic tool. We must increase our contributions to the region and country's economies by completing our missing

directions and evaluating our Isparta province according to competitive conditions.

- We should also go to the rose sapling production and the fruit rose. We must capture modern technology in the process of roses.
- Fragrant plants for industrial purposes, especially oil roses, should be evaluated in the context of industrial plants. Oil rose is still in support of ornamental plant status. The rose farmer is hurting himself.
- Producer certified seedlings / seedlings should be given. In this way, production is standardized and brand value is increased. The sale of oil rose should be prohibited except for for oil rose farming. The varieties should be determined according to the purpose and ecological environment, and the value of rose flowers should be appreciated according to the variety and production technique (such as organic agriculture).

Table 2. Cosmetic product exports of Türkiye for 2010-2013

Products	2010 (USD $)	2011 (USD $)	2012 (USD $)	2013 (USD $)
Essential Oils	17.493.000	22.176.000	24.793.000	25.154.000
Mixtures of fragrant materials used as raw materials in the industry	23.567.000	27.767.000	37.194.000	50.512.000
Perfumes and Toilet Waters	36.045.000	37.757.000	43.990.000	44.946.000
Beauty-Makeup & Skin Care Products	96.350.000	125.085.000	130.455.000	140.683.000
Hair Care Products	105.601.000	118.036.000	124.808.000	152.657.000
Oral-Dental Health Products	9.489.000	9.193.000	11.168.000	15.163.000
Shaving Products, Body Deodorants, Toilet Products	203.512.000	218.699.000	248.797.000	277.225.000
TOTAL	492.057.000	558.713.000	621.205.000	706.340.000

- Most of the fruit trees are of Mediterranean origin. At least half of the fruit trees in Türkiye are for the Rosaceae family. Mediterranean region is gene centers of medicinal and aromatic plants. Why is an extract and package factories established in a region that is the gene center of Umbelliferae (Kerevizgiller), Lamiaceae (Balıibagagiller) and Rosaceae (Gülgiller), the question is still unanswered.
- In addition to *Iris germanica* species, *Lilium* type may be more profitable if produced. *Lilium candidum* is a value that is more effective volatile oil than the current zambia.
- It is a late work selection process in all fragrant industrial plants, especially rose, lavender and lily varieties. The types that are efficient and compatible with the Isparta ecological conditions should be identified, registered and agricultural production should be spread over those types. This is a result that can be achieved in collaboration with Industry-University.
- In addition to the essential oil, the production of oiled plant waters should also be emphasized. Especially this process falls into small businesses. The inadequacy of quality rose water production in Isparta is sad. In order to increase processing time, drying and storage of raw material should be sought.
- In Süleyman Demirel University, there is a need for an accredited laboratory that can analyze volatile oils and standardize volatile oils. In this way, the needs of the sector will be covered in Isparta.

The economic value of the Sahlep group is very high. The gathering is also excessive in this measure. These crops must also be protected. The plans and projects should be carried out for the economic purposes of each taxon and for the continuity of the generations after the studies for determining the distribution areas are made (Anonymous, 2015).

The production of some mushrooms from the nature has increased considerably in the region. In the end, the region became a mushroom production center. Drying facilities were established. However, it was not possible to reach the expected sales. While mushroom production and processing are becoming widespread in the region, ways to sell and make medicines should be sought.

Important industrial plants from medical point of view: Afyon *(Papaver somniferum),* Karabaş otu/ Lavanta (*Lavandula* spp.), Ökseotu/ Burç (*Viscum album*), Gül (*Rosa damascena*), Kuşburnu (*Rosa alba, R. dumalis, R. canina, R. beggeriana* vs.) Acıyavşan/ Pelinotu (*Artemisia absinthium*), Yüksük otu *(Digitalis purpurea*), Mürver *(Sambucus nigra*), Meryemana dikeni (*Silbyum marianum*), Civan perçemi/ Ayvedana (*Achillea millefolium* etc.), Kantaron/ Binbirdelikotu (*Hypericum* spp.), Tatula / Boru çiçeği *(Datura stramonium*, *D. inoxia),* Papatya *(Matricaria chamomilla*), Kırlangıçotu (*Chelidonium majus*), Eğirkökü (*Acorus calamus*), Gölsoğanı (*Leucojum aestivum*), Şekerotu (*Stevia* spp.) (Orav vd., 2006).

Table 3. A comparison of the floristic studies performed in and around the study area.

Research Areas	Total Taxa	Endemism Ratio %	The biggest 3 families*	The biggest 3 genera**
Kasnak Meşesi Nature Protection Area (Isparta) (Özen and Fakir, 2015)	442	15,61	Fabaceae, Asteraceae, Lamiaceae	*Trifolium, Astragalus, Silene*
Yaylabel (Isparta) (Şenal, 2011)	271	13,65	Asteraceae, Fabaceae, Lamiaceae	*Silene, Astragalus, Centaurea*
Dedegül Mountains (Isparta-Konya) (Peşmen and Güner, 1976)	824	18,69	Asteraceae, Fabaceae, Caryophllaceae	*Silene, Astragalus, Ranunculus*
Sütçüler (Isparta) (Özçelik and Korkmaz, 2002)	587	26,20	Fabaceae, Asteraceae, Caryophyllaceae	*Silene, Trifolium, Ranunculus*
Aksu (Isparta) (Özçelik and Öztürk, 1999)	658	25,20	Asteraceae, Lamiaceae, Caryophyllaceae	*Silene, Veronica, Astragalus, Centaurea*
Barla Mountain (Isparta) (Bekat, 1987)	645	17.05	Asteraceae, Fabaceae, Lamiaceae	*Astragalus, Centaurea-Trifolium- Silene-Euphorbia, Veronica*
Bozburun Mountain (Antalya-Isparta-Burdur) (Fakir, 2006)	645	16,12	Fabaceae, Asteraceae, Lamiaceae	*Silene, Trifolium, Ranunculus*
Burdur (Özçelik et all., 2016)	1580	25,31	Asteraceae, Fabaceae, Lamiaceae	*Astragalus, Verbascum, Centaurea*
Kızıldağ National Park (Isparta) (Mutlu and Erik, 2003).	786	15,72	Asteraceae, Fabaceae, Rosaceae-Poaceae	*Ranunculus, Allium, Veronica*
Davras Mountain (Isparta) (Özçelik et all., 2001)	415	25,80	Fabaceae, Asteraceae, Brassicaceae	*Silene, Veronica, Astragalus*
Kovada Gölü National Park (Isparta) (Fakir, 2007)	367	15,25	Fabaceae, Asteraceae, Brassicaceae	*Silene, Trifolium, Astragalus*
Gölcük Lake (Isparta) (Fakir and Dutkuner, 1999)	227	28,20	Fabaceae, Carypophyllaceae, Asteraceae	*Astragalus, Silene, Vicia*
Kovada Arboretum (Çetinkaya, 2005)	350	12.3	Asteraceae Fabaceae Lamiaceae	*Galium, Silene, Ranunculus*
Beyşehir Lake and its Environs (Konya) (Küçüködük, 1988)	-	10.12	Fabaceae, Poaceae, Asteraceae	*Trifolium, Astragalus, Trigonella*
Köprülü Kanyon National Park (Antalya-Isparta) (Özçelik et all., 2002)	707	32.50	Lamiaceae, Fabaceae, Asteraceae	*Ranunculus*, *Veronica*, *Geranium*
Yeşildağ-Kurucuova (Konya) (Serin and Çetik, 1984)	512	11.52	Poaceae, Asteraceae, Brassicaceae	*Astragalus, Trifolium, Silene*
Sultan Mountains (Afyon-Isparta-Konya (Ocakverdi, 1984; Özçelik and Özhatay, 2005)	587	14.0	Asteraceae, Fabaceae, Poaceae	*Astragalus, Silene, Hypericum*
Yandağ (Isparta) (Kargıoğlu and Ertuğrul, 1995)	729	13.80	Fabaceae, Asteraceae, Poaceae	*Salvia,Astragalus, Trigonella*
Akşehir (Konya) (Küçüködük and Çetik, 1984)	-	0.80	Asteraceae, Poaceae, Fabaceae	*Ranunculus, Juncus, Polygonum, Potamogeton*
Derebucak-İbradı-Akseki (Demirelma and Ertuğrul, 2009).	960	17.3	Asteraceae, Caryophyllaceae, Liliaceae	*Sideritis, Astragalus, Silene*
Isparta (Özçelik and Serdaroğlu, 2000)	2280	28.50	Asteraceae, Fabaceae, Poaceae	*Astragalus, Silene, Verbascum*

*The order of three families involving the most taxa; **The order of three genera involving the most taxa;

Table 3 shows that; there are very different habitats in Lakes region. The plant groups of each habitat indicate that the cultivation of the cultivated plants from the same group in the relevant area will be appropriate. In front of the Fabaceae family around Isparta, Sultan Mountains, Köprülü Canyon, indicates the suitability of the ecological environment for growing legumes. The first place around Lake Beyşehir shows the most suitable growing area for Legumes like sugar bean. The presence of the Caryophyllaceae family and the genus Silene in the vicinity of Lake Gölcük indicates that the production of carnations in the village of Deregümü village (Isparta) will be successful. The arrival of the Rosaceae family in the Kızıldağ (in Şarkikaraağaç) indicates that the production of strawberries will be successful. Samples can be duplicated. At the same time, the natural flora provides vital plant material for agriculture to the region. The richness of local flora in terms of economic plants has made the region an important agricultural center. The success of rose cultivation is explained by the fact that the gene center is the Dedegül mountain. This wealth is reflected in technology over time. In Burdur and Isparta, important agricultural machines are produced.

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Determining forest priority areas by using multi-criteria decision making method and geographic information system in Kahramanmaraş City

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Abstract: Nowadays, the importance of water resources increases a lot depends on rapid population growth, industrialization and climate change. Lands in a certain area must be used in accordance with their characteristics to achieve sustainable water resource management. Forest ecosystems are one of the most protective measures which allow us to benefit from water resources both effectively and without harming natural life. Thus, it is too important to determine priority forest areas in a certain area. Benefits of afforestation or rehabilitation practices to water resources in relatively more priority areas are higher than less priority ones. In this study, priority forest areas in Kahramanmaras city which has important water resources of Turkey were determined. In order to determine priority forest areas, analytic hierarchy process (AHP), one of the Multi-criteria decision making methods, and Geographic Information System (GIS) were used. Elevation, slope, land capability class, soil type, soil depth and erosion status were considered as criteria in AHP. A score between 1 and 4 was assigned to sub-criteria of each criteria considering forest priority level. Weight score of each criterion was calculated with the help of pairwise matrix. Weight scores of criteria and scores of the sub-criteria were reached by the help of expert opinion and literature. Then, each criteria map was overlaid by using weighted overlay tool in ArcGIS, and priority forest map was produced. According to results, first grade forest priority areas constituted 31.43% of study area, whereas second, third and fourth grade forest priority areas constituted 40.29%, 15.78% and 9.17% of study area. Consistency ratio of pairwise matrix was calculated as 0.02.
Keywords: Water resource, Priority forest areas, AHP, GIS

1. Introduction

It is known that forest ecosystems have a rehabilitative impact on water resources (USDA, 2000). This impact is due to ecological function of forest (hydrological, erosion prevention, climatic, community health care, nature conservation, esthetics, recreation, etc.) (Führer, 2000). There are many effects of forest on quality, quantity and flow pattern of water resources. For example, some studies reported that forest areas receive 15%- 50% more rain compared to other areas. It was determined that forest made 44% of rainfall received into usable water, whereas this ratio in non-forest areas was 14 % (Mizrakli et al., 2008).

Recently, climate change and global warming due to primarily industrialization get to become efficient. It was reported that increases in number and frequencies of natural disasters will occur along with climate change in different parts of the World (IPCC, 2012). It is expected that global warming may cause ecological degradations relating to water resource decrease, forest fires, drought and desertification in Turkey which is among the risk countries in terms of potential effects of global warming (Turkes et al., 2000). Climate change may also lead to adverse effects on agriculture, forestry and water resource in particularly semi-arid and semi humid regions (central Anatolia, southeastern Anatolia, Aegean and Mediterranean) under desertification threat in Turkey (Turkes, 1998). In this context, forest, known as one of the most significant CO_2 sinks, has an important role in combating against climate change. Forest lands together with agricultural, rangeland, wetland and green areas in settlements; sequestrate average 25% of CO2 emitted to atmosphere (CSB, 2013).

One of the positive impacts of forests on water resources is to reduce erosion and sedimentation (Gellis et al., 2006). So, forest prevents to decrease in storage capacity of dam some of which has recently larger area than natural ones, and takes an important place in human life due to its services such as potable and utility water supply and energy generation. Soil removed from any place of watershed reduces water storage volume by entering dam systems, and gives rise to shorten economics life of dams (Sabir et al., 2013).

Water is one of the important components in agricultural production. In Turkey, water use of agricultural sector is more than domestic and industrial water (Evsahibioglu et al., 2010). Major part of water in agricultural production is supplied from dams and draw well. Especially areas where water was not supplied by irrigation canal, groundwater becomes very important and ensures sustainability of production (Evsahibioglu et al., 2010). Therefore, increasing of groundwater quantity and quality is essential. Forest ecosystems reduce runoff and infiltrate more water into soil. Litter composing of decayed leaves, needles, branches, etc. under forest trees constitutes a spongy layer. A well-developed spongy layer covering soil, conserves soil surface structure, reduces runoff due to its very high water holding capacity, and increase water amount infiltrating into soil(FAO, 2008; Gomyo and Kuraji, 2016; Neri et al., 2013). Besides, ıt is known that litter layer has an effect increasing water quality (Fulton and West, 2001; Neary et al., 2009).

Nowadays, water becomes important political and economic power (Selby, 2003). So, we have to benefit from water resources effectively and sustainable. Forest ecosystems are one of the most protective measures which allow us to benefit from water resources both effectively and without harming natural life (Kreye et al., 2014). Therefore, practices such as

expanding forest area and rehabilitation have to be performed. When these practices are performed, priority forest areas are prioritized to get the highest efficiency.

Recently multi criteria decision making methods have become a widespread methods used to solve problems regarding to ecosystem functions (Altunel and Akyuz, 2007). MCDM includes selecting among alternatives and grouping and arraying alternatives by taking a few alternatives into consideration (Esen, 2016). AHP, one of the MCDM methods, tackles problems hierarchically and based on pairwise comparison (Saaty, 1980). Priority areas can be determined by using AHP with geographic information systems (Akbulak, 2010).

Kahramanmaras city center is located in Mediterranean region where is expected to be influenced by climate change in Turkey. In the city center which has large water reservoir, dams and weirs in commissioning, under construction and planned stages and streams exist (Yücel et al., 2013). In irrigated farming areas, groundwater is also used as both irrigation and potable water (CSB, 2012). Erosion which is one of the most important problems in Mediterranean belt poses a threat to dams in study area (Verheye, 2009).

In this study, it is aimed to determine forest priority areas whose essential function is natural protection such as especially soil and water conservation, and so generate data considered in land use planning in future.

2. Material and method

2.1. Study area and data

Study area is 33626.89 ha and covers city center and immediate area (98% of Kahramanmaras administrative border) of Kahramanmaras located in Mediterranean region (figure 1). Average elevation is 568 m, and it increase up to 3000 m above in north part of study area. Average slope is 44.6%. Annual average rainfall and temperature are 727.7 mm and 16.9 °C respectively. Average maximum temperature is 47.5 °C in August, while average minimum temperature is -9.6 °C in February (DMI, 2017). Winters are warm and rainy, summers are hot and dry. In the study area, Menzelet, Klavuzlu, Sır, Ayvalı, Sarıguzel, Suçatı ve Cataloluk dams exist. Dominant land use types are forest, rangeland, cultivated and settlement areas.

Figure 1. Location of study area on satellite image

In order to generate maps used in the study, contour, land capability class, soil type, soil depth and erosion maps were used. Results obtained were evaluated in conjunction with current forest management plan including study area.

2.2. Method

In this study, it was aimed to determine priority forest areas in Kahramanmaras city. A gıs based AHP method was used to produce priority forest areas map. This method is a robust and flexible decision-making tool that is used for finding solutions of complex multicriteria problems such as a determining the priority of conservation practices (Fallah et al., 2016; Valente and Vettorazzı, 2008), landslide susceptibility mapping (Pektezel, 2015) or soil erosion risk assessment (Wu and Wang, 2007; Rahman et al., 2009).

The AHP method consists of four steps:

(1) Structure the problem into a hierarchy having different levels, i.e., goal, criteria, sub criteria, and alternatives
(2) Make pair-wise comparison matrix $A=[aij]n\times n$, where n is matrix size and $aij\geq 0$ $aij\times aji=1$, aij – importance of the ith decision factors over the jth decision factors by using table 1.
(3) Calculate the relative weights (priorities) of decision factors using prioritization method, e.g. eigenvalue (EV) method (Srdevıc, 2005).
(4) Make synthesis of the priorities. All matrix must satisfy consistency test by using formula 1, i.e., judgment matrix are accepted if consistency ratio (CR) obtained using consistency index (CI) and random index (RI) is less than 0.10 (Vulević et al., 2015) or if also first eigen value equals matrix size (Arslan, 2010).

Table 1. The fundamental scale of absolute numbers (Saaty, 2008)

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgment slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation A reasonable assumption

$$CR = CI / RI \quad (1)$$

Where; CR = Consistency Ratio

CI = Consistency Index, $CI = (\lambda max - n) / (n-1)$

RI = Random Index (table 2), λmax = First eigen value, n = Numbers of factor

Table 2. RI values for different values of n. (Triantaphyllou and Mann, 1995)

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Elevation, slope, land capability class, soil type, soil depth and erosion status were considered as criteria in AHP. A score between 1 and 4 was assigned to sub-criteria of each criteria considering forest priority level. 1 represented the lowest priority, while 4 represented the highest priority in this study. Weight score of each criterion was calculated with the help of pairwise matrix. Weight scores of criteria and scores of the sub-criteria were reached by the help of expert opinion and literature.

Criteria maps were classified taking sub criteria score into account in ArcGIS environment. All maps must be raster format and same grid size in this study. So, vector maps were converted to raster maps with 30x30 m grid size. Finally, each criteria map was overlaid by using weighted overlay tool in ArcGIS, and priority forest map was produced.

Results were examined considering current forest management map of study area. Thus, forest priority map was overlaid with current forest management map.

3. Results and discussion

Main goal of this study was to determine areas on which forest practices must focus so that effectiveness and efficiency principles were provided in water and soil protection. In order to determine these areas, AHP method and GIS were used. Elevation, slope, land capability class, soil type, soil depth and erosion status were considered as criteria in AHP method.

It is clear that soil resources must be primarily protected for water resources protection. Erosion had the highest weight value because it is the leading factor posing a threat to soil resources. Criteria following the erosion, slope and elevation had 0.24 and 0.14 weight values respectively. Table 3 shows criteria weight and sub criteria score obtained from AHP method, expert opinion and literature.

Table 3. Weight values of criteria and scores of sub criteria

Criteria	Weight	Sub criteria	Score
Elevation (m)	0.14	<800	1
		800 - 1000	2
		1000 - 1400	3
		1400 - 2000	4
		>2000	1
Slope (%)	0.24	0 - 2	1
		2 - 6	1
		6 - 12	1
		12 - 20	2
		20 - 30	3
		> 30	4
Land capability class	0.12	1	1
		2	1
		3	1
		4	2
		5	4
		6	3
		7	4
		8	1
Soil type	0.04	Alluvial	1
		Brown	2
		Reddish brown mediterranean	2
		Reddish brown	3
		Colluvial	4
		Brown forest	4
		Non-calcareous brown forest	4
		Non-calcareous brown	3
Soil depth (cm)	0.07	<30	4
		30 - 60	3
		60 - 90	3
		90 - 150	2
		>150	1
Erosion	0.39	No or very low	1
		Moderate	2
		High	4
		Very high	4

After determination of criteria weight and sub criteria score process, each criteria map is overlaid in GIS environment. As a result of this process, forest priority map obtained is presented in figure 2.

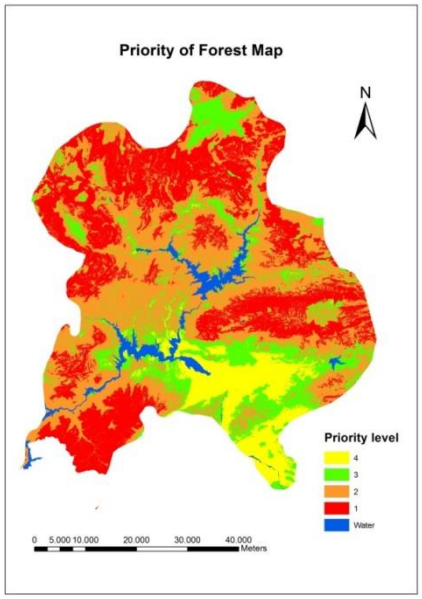

Figure 2. Forest priority classes map

Study area was divided into 4 classes in terms of priority. Areas with highest priority, called first degree priority areas, constituted 31.43% of study area, while second, third and fourth degree priority areas constituted 40%, 15% and 9.17% of study area respectively (table 4).

Table 4. Areal distribution of priority classes

Priority level	Area (ha)	Percent (%)
1	105894.3629	31.43
2	135734.1500	40.29
3	53171.3300	15.78
4	30881.7800	9.17
water surface	11245.2600	3.34
Total	336926.8829	100.00

When examine current management plan of study area, 43.35% of 1st degree areas comprised of degraded stands, while 28.41%, 12.22% and 0.53% of 2nd, 3rd and 4th degree areas comprised of degraded stands respectively. In addition to this, it was determined that forest was dominant land use in 1st and 2nd degree priority areas; whereas agriculture was dominant in 3rd and 4th degree priority areas (table 5).

Table 5. Land use distribution of priority classes

Priority level of forest	Areal distribution (ha)		Percent (%)
1	agriculture	7253.4885	6.85
	settlement	278.0031	0.26
	open space	19818.0700	18.71
	rangeland	463.7776	0.44
	degraded stand	44849.6040	42.35
	afforestation	1583.3760	1.50
	Stands with 1,2,3 crown closure	31300.0700	29.56
	others	347.9737	0.33
	total	105894.3629	100.00
2	agriculture	26215.7900	19.31
	settlement	1709.9000	1.26
	open space	23135.2500	17.04
	rangeland	109.3400	0.08
	degraded stand	38558.5700	28.41
	afforestation	1080.1590	0.80
	Stands with 1,2,3 crown closure	43937.8600	32.37
	others	987.2810	0.73
	total	135734.1500	100.00
3	agriculture	19482.9900	36.64
	settlement	4380.8500	8.24
	open space	11345.3100	21.34
	rangeland	0.0300	0.00
	degraded stand	6497.5600	12.22
	afforestation	434.0260	0.82
	Stands with 1,2,3 crown closure	9605.3000	18.06
	others	1425.2640	2.68
	total	53171.3300	100.00
4	agriculture	25479.9200	82.51
	settlement	3385.2700	10.96
	open space	950.9300	3.08
	rangeland	0.0000	0.00
	degraded stand	164.9300	0.53
	afforestation	80.4400	0.26
	Stands with 1,2,3 crown closure	800.2000	2.59
	others	20.0900	0.07
	total	30881.7800	100.00

It was seen that 3rd and 4th degree areas were generally located in lower slope areas according to slope map (figure 3).

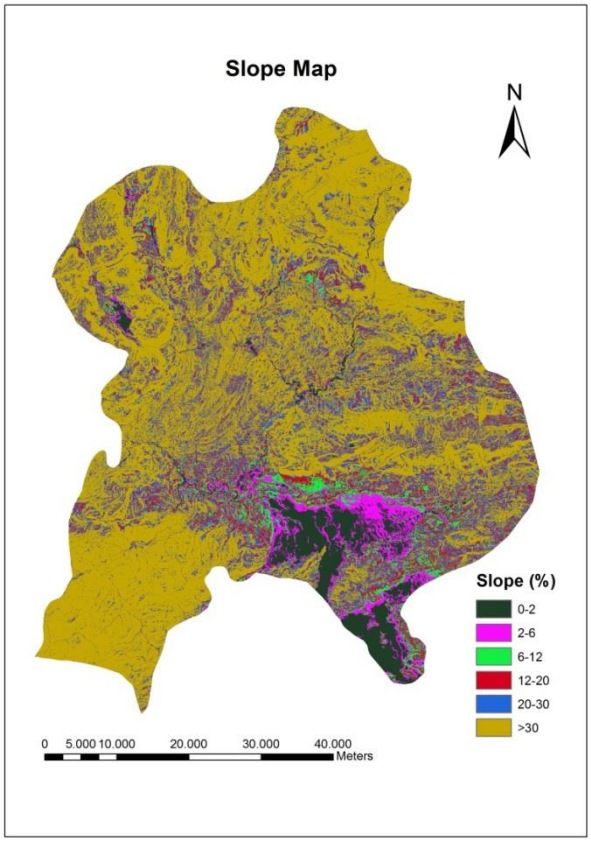

Figure 3. Slope classes map

Relatively lower agricultural area ratio (6.85%) in 1st degree areas indicated forest rehabilitation and afforestation practices may make more contribution than measures in agricultural areas to water and soil protection practices, when compared to other priority classes. When afforestation practices in priority classes are evaluated, 1st degree priority class has the highest value as both area and ratio (1.50%), while afforestation ratios of 3rd, 2nd and 4th degree priority classes are 0.82%, 0.80% and 0.26% respectively (table 5). This situation indicates that priority area approach is not considered adequately in study area.

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Mystical and holistic aspect of the monumental trees, and their importance for ecotourism

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Abstract: Ecotourism is a sort of tourism activities which is realized for different purposes like holistic belief, scientific curiosity, and feeling of respect and appreciation to nature. The monumental trees are invaluable sources for ecotourism purposes with their huge physical dimensions on circumferences, diameters, heights and ages, and the interesting appearances on their trunk occurred in time due to the pathological formations. They also have special places in local history and folklore. Because of the extraordinary longevity when compared to human life in addition to immeasurable inspirations that they create on the poets and artists, the monumental trees also stimulate feeling of love, respect to the nature and the national history on the young generation's mind too. All of these peculiarities carried by the monumental trees make them living cultural heritage of human being in the whole countries all over the world impressing deeply the social, mystical, and cultural lives of the communities all along the human history. The mystical and holistic aspects of the trees having monumental characteristics, and, their importance on ecotourism from the standpoint of holistic belief, scientific excursion, and nature respect are focused in this paper. After clarifying cultural relationships between the monumental trees and the mystical belief of human thought on tree worship, some of the concepts concerning the cult of tree like the Tree of Life, the Tree of Knowledge, and the Tree of Immortality are explained in the context of ecotourism realized for holistic belief. Due to their magnificent trunks and huge branches monumental trees affect in depth the spiritual worlds of people by showing the endless and creative power of god. They are also accepted as the living witness of historical events finished with victory or defeat in the country. Visiting to monumental trees arouse feeling of love, respect to nature and the national history in common mind. There is no doubt that, the tourism activities made in the framework of cultural consideration or scientific aims should also be evaluated in the ecotourism concept too. Turkey is full of many monumental trees which could be classified under different ecotourism actions. Existing samples related to the holistic belief, nature respect, and, scientific excursion will be shown in this paper respectively. Before giving some knowledge about ecotourism potential of Turkey in this course, technical procedures applied in age estimation of monumental trees will also be outlined in short in the paper.

Keywords: Monumental tree, Ecotourism, Cultural tourism, Scientific tourism

1. Introduction

Ecotourism is a form of tourism fulfilled by sensitive and respectful visitors feeling responsible to relatively undisturbed and fragile ecosystems, and, to local culture and belief of the inhabitant people surrounding in order to recognize their culture and to observe marvelous landscape and the wildlife habitats. Visitors are directed towards to the areas pristine and virgin natural environments or interesting unusual geological formations rather than conventional tourism areas like sunny beach and famous historical ruins. It provides interesting experiences and unforgettable memories to visitors and, a good income for the host people as well as being a sustainable finance source for natural environment conservation actions. The monumental trees, old growth forests and, the forest remnants those are isolated by local topographic and climatic conditions currant for thousands of years are invaluable sources for ecotourism activities.

The trees having extraordinary physical dimensions in respect to circumferences, diameters, heights and ages or interesting images appearing in time due to the pathological formations on their trunk, and also having a private place in local history and folklore are called as monumental trees if they have a long life enough for being a bridge between the past and future of the people surrounding (Asan, 1987). Although the dominant character seems high or diameter in this definition, ages are the most effective physical diagnosis in that course however. Poplar and willow trees for instance, cannot become monument because of their short longevities. Consequently, abnormal dimensions, fantastic visual effects, and having a sociocultural values in the context of local history, folklore and mystical believes of the people are the privileges of monumental trees (Asan, 1992; 2017/a).

Because of their impressive dimensions and longevity compared to human life in addition to their unique appearances, the trees having monumental character played very important role on development of the spiritual worlds of varying societies living on different geographical regions on the earth (Asan, 1993; 2015). The Tree of Life (The World Tree, The Cosmic Tree or The Sacred Tree in other words), The Tree of Knowledge and, The Tree of Immortality are the most well-known examples for instance in this course (Asan, 2009). Although they appeared under different names in the countries placing in different continents -Yggdrasil in the Northern countries, Bayterek, Bay Kayınk, Tamir Terek or Mönküterek in Central Asia and Siberia (Karakurt, 2011)-, most of them had been imagined as the same form except tree species existing around depending on

the ecological conditions currant in the region. Yggdrasil for example; sometimes considered as a yew (Taxus baccata L.), sometimes as an ash tree (Faxinus spp).

Before living together as in the small tribes and clans the primitive men were surviving by hunting the wild animals and, by collecting berries and roots of plants, and, by taking shelter in the hollows of huge trees individually (Fig.1). Since, there was no societal memory while he was living alone primitive man could not aware of the long livings of huge trees at all. The thing that he noticed first after arising common memory was the length of longevity of giant trees seems himself endless. This awareness did stimulate a deep respect together with a little fear and admire to giant trees providing him food and shelter facilities.

Figure 1. The hollows of huge trees had been used as shelter by primitive men

These mystical feelings changed to tree worship in time and, reflected as the first creature alive was a giant tree into genesis myths of the societies living in the north-east and central Asia (Asan, 2016a). Thus, the trees having monumental characteristics were accepted as totem by some primitive tribes in olden ages. Two sort of cult can be considered in this issue; a) direct worshipping to the sacred trees themselves representing gods such as Bayterek mentioned in the Epic of Manas; b) to use trees as a tool to make a contact with god such as Ulu Kayıng mentioned in Epic of Er Sogotoh (Asan, 2016a; 2017a). Basic thought of tree worship comes from the spirit of tree belief. According to the researches of Sir J. G. Frazer published in 1890 under the name "The Golden Bough: The Roots of Religion and Folklore", there was a common belief among the primitive clans concerning the trees existing in sacred groves that, about carrying sprits of dead people. In other words, sprits of dead people were going on their life under the shadow of trees in sacred groves. The spirit of dead people was bothering when the tree was injured (Frazer, 1890).

There are some slight differences however, among the concept of the Tree of Life, the Tree of Knowledge and the Tree of Immortality, although they were descripted similarly in varying myths and epics. Common specifications in their descriptions given in various references are here; an incredible trunk on a magnificent root system like Yggdrasil expressed in Norse Mythology, very huge spreading leaves and branches covering the whole sky like Sidrat al Muntaha alluded to in hadiths (Oral explanations attributed to Muhammed The Prophet on definite subjects out of Quran) and tafsirs (Oral and written explanations belonging to Islamic authorities in order to clarify the subjects written in Quran) in Islamic Belief, and a long tall establishing a linkage between the sky and underground. It stands on a small hill occupying in a plain as it was told in the Legend of Er Sogotoh (Çoruhlu, 2011), An eagle or god sits at the top, and a dragon lives among the roots of tree (Fig. 2).

Figure 2. Common specification of The Tree of Life in various epics and legends

The term of "Tree of Life" is an olden concept as well as the human history. It is a utopian consideration system created by the ancient societies arisen in different parts of the world because of their mystical faiths. Thus, it is a common motif in the olden religions and mystical beliefs as well as mythology, and philosophy. The term Tree of Life is also be used as the synonym for cosmic tree, world tree and sacred tree. Referring to the researches made by Holmberg and Middendorf, Çoruhlu expresses the definition of the Tree of life as following, regarding the legend of White Youth in his study named «Main Branches of the Turkish Mythology» (Çoruhlu, 2011);

« *White Youth wanted to see the place where he was born. He saw a great and magnificent tree on a small hill existing in the middle of a large and smooth plain while he was looking for it. The tree was illuminated by a mystical light coming somewhere. Top of the tree was reaching to the seventh store in the sky where Urun ay Toyon's thorn standing and, its roots were going to deepest places under the ground. Leaves of the tree were talking to inhabitants of sky*».

From the stand point of mystical and religious aspects, The Tree of Knowledge term belongs to a tree only existing in the Garden of Eden having the forbidden fruit on its branch. Since, Adam and Eve noticed difference between good and bad after eating the forbidden fruit, both of them began to gain knowledge to understand the events happening around. Thus, the tree having the forbidden fruit in the Garden of Eden is being called as The Tree of Knowledge after that, due to causing born of human wisdom and intelligence. The term «Knowledge:Sagacity» is a title given to old person who has broad experience and knowledge concerning the historical, social and cultural life of the societies because of his witnesses on various events during his long living time. Since, the monumental trees become just inside of the whole social events happened around, they are the most important alive witness of local folklore and the history full of with victories and defeats. Consequently, The Tree of Knowledge term can also be adapted to whole monumental trees, except far away from the inhabitant areas, in the context of sociocultural consideration (Asan, 2016b; 2017b).

The Tree of Immortality is an abstract concept assumed for some trees believed giving an eternal life to the legendary heroes by means of elixir leaking their trunks and branches. Too many epics and legends produced based on this consideration especially among the olden societies in the northern parts of the Europa, Siberia and the Central Asia. The trees called as Bayterek, Bay Kayınk, Tamir Terek or Mönküterek, and Yggdrasil mentioned in the legends of White Youth, Er Sogotoh, and Manas are very famous examples on The Tree of Immortality. On the other hand, there is still a widespread conventional habit among the people living in the forests of Turkey that is called as "Yalamuk"; peeling the inner barks of pine trees in order to lick the juice of trees due to the belief on the cure of various illnesses especially tuberculous (Asan, 2015).

There is no doubt that, neither The Tree of Life and The Tree of Knowledge, nor The Tree of Immortality could be evaluated directly as an ecotourism motive unless they are transformed into real objects due to their conceptual utopian meanings even though they play very important role on the religious belief system of the local indigenous people. Beside their huge dimensions, to have a folkloric or historical tale, or spacing in a holistic sacred area may be evaluated as a reasonable consideration in order to establish a sound bridge for this transformation. Consequently, the imaginary definitions of the Tree of Life and The Tree of Immortality can be expressed by means of the marvelous appearance and the huge magnitude of monumental trees, and, utopian definitions of The Tree of Knowledge can be concretized with the help of historical or mystical tales attributed to the trees. Having a space in the sacred areas like the tomb where a holy man is buried, or courts of mosques, churches and other kinds of temples are other factors which may be used in this context (Asan, 2016b).

Due to their unique appearance and sociocultural values, the single monumental trees and old growth forest remnants are taken under protection umbrella by legislative arrangements almost all the countries in the world. The giant sequoias in USA, the old cedar stand in Bischer Village in Lebanon, the sacred olive orchard in Gehtsemane around Jerusalem, another olive orchard remnant in Kalkanlı Village in Cyprus, and, the giant baobab trees in Sought Africa are the most well-known

examples in this course. Either their magnificent dimensions or, their historical, folkloric and holistic features create an important ecotourism opportunity to the countries having them.

Turkey is full of many monumental trees and old growth forests and forest remnants which could be evaluated for different ecotourism actions. Some of them will be introduced below regarding their sociocultural aspects. Before giving some knowledge about ecotourism potential of Turkey in this course, technical procedures applied in age estimation of monumental trees will also be outlined in short in the paper.

2. Sociocultural aspects of the monumental trees

Turkey is a rich country with regard to monumental trees. There are many relatively undisturbed and untouched old growth forests and forest remnants on the upper zone of the high mountains far away from human impact suitable for visiting by the people excessively fond of nature in order to respect to natural environment, and, to observe natural process ongoing in the forest ecosystems. Scientific excursions are also organized by scientist to the old growth forests and forest remnants for understanding natural rules and struggles among the fauna and flora present in the system too. There are also many single trees in the inhabitant areas that religious people visit them for the sake of holistic belief or, folkloric behavior in Turkey. Some of the single monumental trees existing in the forests are visited by the people in order to satisfy their curiosities. A few samples are given here in the section following.

2.1. Monumental trees representing holistic belief

Monumental trees having a space in the sacred areas especially standing near a tomb belonging to holy men famous with their religious services or due to their national efforts heroically are visited for the sake of holistic belief. A dead Cupressus sempervirens trunk in Koca Mustafa Pasha Mosque (Fig.3a), and Platanus orientalis in Eyüpsultan Mosque (Fig.3b) in Istanbul; and an Olea europaea in the courts of Sarı Selim Mosque (Fig.3c) in Hatay-Payas can be sampled for the holistic belief.

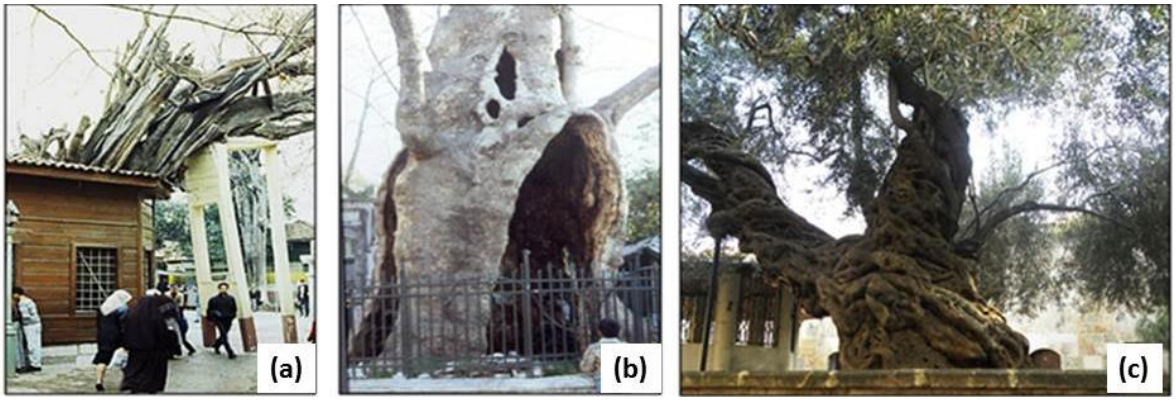

Figure 3. a) Cupressus sempervirens trunk , b) Platanus orientalis, c) an Olea europaea

2.2. Monumental trees having historical value

The monumental trees those are having a private place in local history and folklore are called as sagacious trees if they have a long life enough for being a witness to the social events happened around, and for being a bridge between the past and future of people living in the area. Since, plane trees (Platanus spp.) were accepted as the symbol of state by the Ottoman sultans, there are many olden plane trees today gained monumental character in the cities of Bursa, Edirne and Istanbul. Three of them are shown in the figure 4.

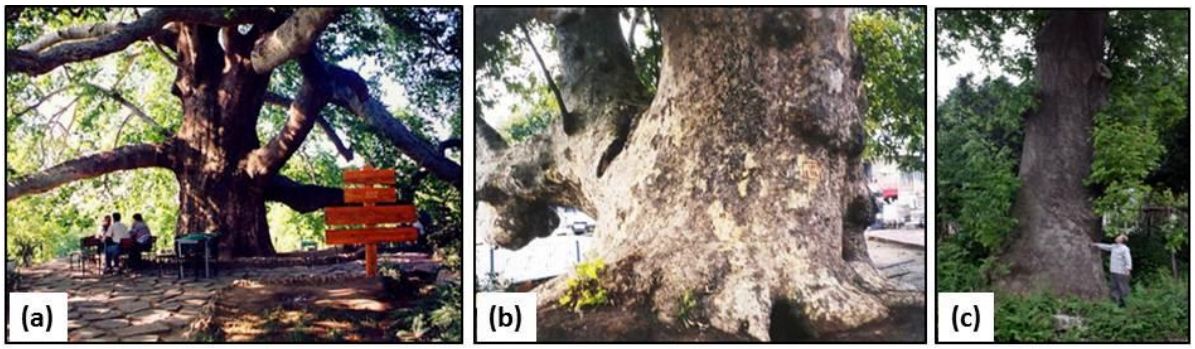

Figure 4. a) The Plane of Inkaya in Bursa, b) The Plane of Çakıllı around of Edirne, c; The Plane of Tokatköy Beykoz, Istanbul.

2.3. Monumental trees having folkloric value

Folkloric values of the monumental trees originate from the tales which are told on a monumental tree concerning moral and ethical principles current in authentic customs among people. These tales sometimes may be involved in holistic beliefs, sometimes relevant to common sociocultural subjects too. Three of them are shown in the figure 5.

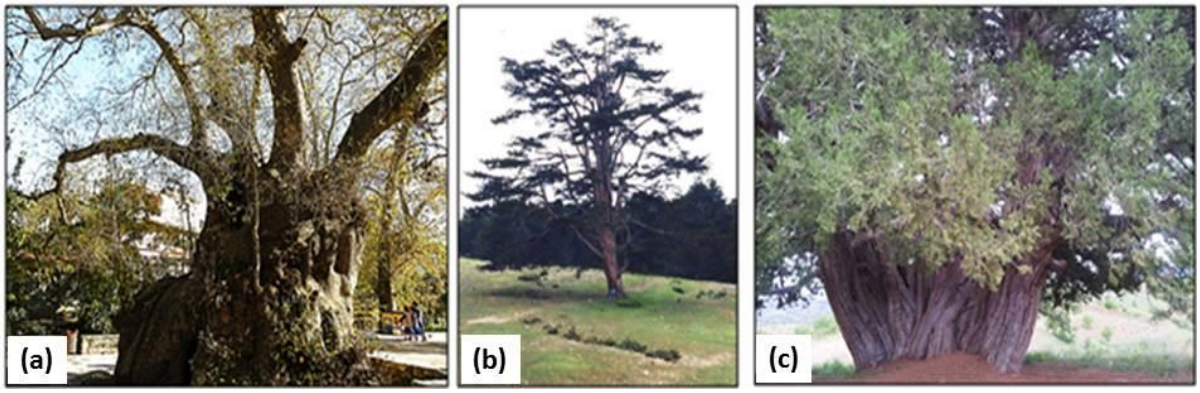

Figure 5. a) The Plane of Moses in Hatay-Samandağ, b) The Pine of Uşaklı around of Abant Güvemköy, and, c) The Ağılardıç in Taşkent-Konya.

2.4. Old growth forests and forest remnants in Turkey

Some of the monumental old growth forests that can be seen at different parts of the country, and the number monumental trees measured in these forest remnants are compiled in Table 1.

Table 1: Old growth forests and average physical measurements observed

Name of Forest	Provence/Town	Tree Species	Nr. of measured Trees	Average DBH (m)	Average height (m)	Estimated Age / in the year of
Ambardağ	Giresun/Bulancak	*Fagus orientalis*	7	1,63	43,0	310 / 1987
Kemaliye	Trabzon/Akçaabat	*Fagus orientalis*	18	0,87	44,0	350 /1997
Örümcek	Gümüşhane/Torul	*Picea orientalis*	16	1,65	52,2	700 / 1997
Kürtün	Gümüşhane/Torul	*Picea orientalis*	5	1,41	47,4	300 /1987
Kartalgölü	Denizli / Eskere	*Pinus nigra*	11	1,40	18,0	600 / 1986
Incirköy	Muğla / Fethiye	*Pinus brutia*	6	1,10	39,5	260 / 1987
Tezli	Muğla / Fethiye	*Cedrus libani*	6	1,62	30,4	440 /1984
Bölükkatran	Antalya / Elmalı	*Cedrus libani*	10	1,69	23,7	740 / 1984
Dibekçukuru	Antalya/Kumluca	*Cedrus libani*	15	1,51	24,1	1220/1984
Güzelsu	Antalya / Akseki	*Cedrus libani*	7	1,72	24,6	1180/1984

Forest remnants are a sort of forest area covered by the natural tree species those are seen seldom around normally. These forests are patch wooded lands staying far away and in isolated form from their main spreading areas. Pinus nigra stands in the Kastro bay around of Kırklareli-Vize, Pinus silvestris stands in Yozgat, Pinus pinea stands around of Artvin, Cedrus libany stands in Çatalan –Erbaa, Quercus vulcanica stands in İsparta-Eğidir, and Phoenix theophrasti in Datca peninsula are the most well-known forest remnants in Turkey.

3. Age estimation methods useable on monumental trees

According to definition given at the beginning of introduction section, age is the most important component in determining monumental characteristic of the trees for assuming them monument. Age is not only as a physical component, but also a diagnostically stipulation to gain monumental peculiarity for a tree. Common meaning of tree age is a time interval passed between the years of first annual ring appears after germinating the seed, and the year of growth finish. The tree is alive during this period. Tree species having some kinds of etheric oils and resinous tissues stay standing a long time after dead nevertheless. Age prediction gets importance in this case. Thus, correct age estimation of the monumental trees is most important work to do while in data collecting studies. Technical procedures in age estimation of the monumental trees can be classified as below;

1. Annual rings counting directly on increment cores taking out from the sample trees.
2. Proportionating of average annual ring width obtained from the sample trees onto diameter without bark measured at breast height
3. Benefitting from relationship between the age and diameter at breast height measured on sample trees.

4. Using a suitable multiplying coefficient (Age converting factor) and the diameter at breast height measured on sample trees directly.
5. Finding out a correlation between the age of monumental trees and the establishment date of historical buildings or archaeological remnants.
6. Radiocarbon (14C) Method.

Using possibilities and restrictions of each method is outlined below.

3.1. Annual rings counting method

This method is based on to count annual rings on the increment cores taken out from the trees. This is very simple and a distinct procedure for age prediction. Conditions required for this method are listed below:

• Annual rings could be seen directly and definitely,
• Annual rings belonging to the first and last years must be present on the increment core as it can be seen in Fig.6,
• No extra or lost annual rings should be exist on the increment core
• No hollow or rotten parts in the trunk of tree

Figure 6. Conditions required for ring counting method

3.2. Proportional approach

This method is used in case of decay or hollow existence in the trunk. Due to lost large number of rings in the stem, it is impossible to find out real age of tree by using ring counting on the whole increment core (Fig.7).

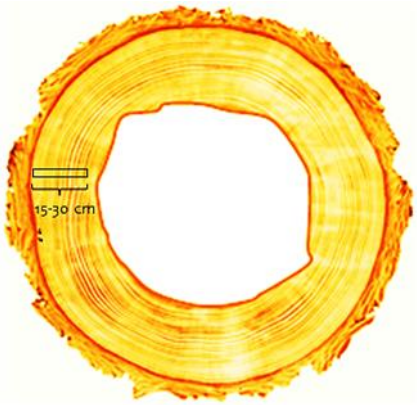

Figure 7. Age prediction on the hollow trees

Thus, partial ring counting approach is realized on increment cores with 15-30 cm length taken from the sound parts of stem. Number of annual rings is counted, the length of core is measured, and radius without bark is determined. The ratio between radius and increment core length is calculated by dividing radius to increment core length. Age estimation procedure is completed by multiplying this ratio with the number of annual rings counted on increment core. This procedure must be repeated two times at least on the same tree in order to obtain a reliable result.

3.3. Age and diameter relationship method

As a general rule in the nature, the larger the diameter the longer the life of the trees. This statistical rule is expressed with the relationship established between the age and diameter and, implemented with the equations calculated by using age and diameter measurements collected from the sample trees. Such an equation and its correlation coefficient obtained by Köse and Güler (2015) are given below:

$T_{years} = 0{,}3808 * D_{wbrk} + 6{,}5517$ $R^2 = 0{,}9987$

Where T: age in year, D: diameter without bark in mm

Data belongs to 50 olive trees were used in the research. Only dbh outside bark and, two sided bark thickness measurements are necessary for using this equation (Köse and Güler, 2015). Although this equation is found out for olive tree, it can be used for other slow growing tree species too like Fagus, Quercus and Carpinus spp. among broad leaves, and for Cupressus, Taxus and Cedrus among coniferous in the case of rough age estimation however. But, it should not be used in age estimation of fast growing tree species at all.

3.4. Estimation with age conversion factor

Age and diameter relationship can also be established with more simple way instead of special equation for each one of the tree species. Two groups' common coefficients belonging to slow growing and fast growing tree species respectively ignoring species of the trees may be produced by using the data set derived from age/diameter ratio calculations.

A study related to age conversion factor was completed by Asan (2016). 44 sample trees totally (17 samples among fast growing, 27 samples among slow growing groups) were used during in construction of conversion factor equations. Results of the study are presented as graphically in Fig. 14, and as numerical within 50 cm diameter intervals in Table 2.

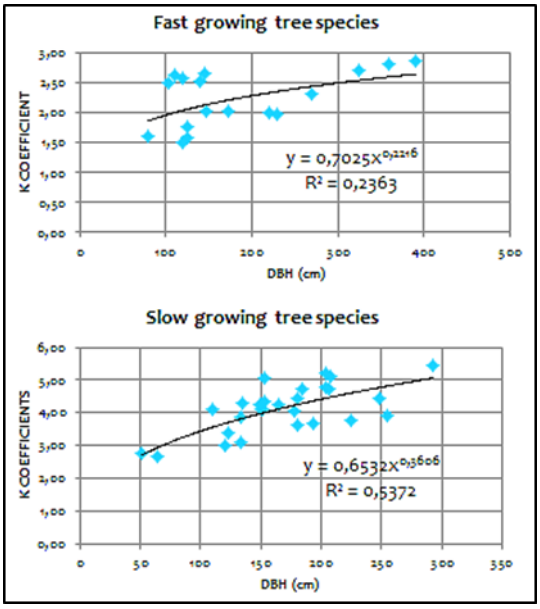

Figure 8. Changing of K coefficient factors with regard to diameter at breast height

Table 2. Conversion factors useable for age prediction with the help of DBH

DBH (cm)	Conversion factors		Ages (Years)	
	Fast growing's*	Slow growing's**	Fast growing's	Slow growing's
100	1,95	3,44	195	344
150	2,13	3,98	320	597
200	2,27	4,41	4,54	882
250	2,30	4,78	575	1195
300	2,49	5,11	747	1533
350	2,57	5,40	900	1890
400	2,65	5,66	1060	2264

• Fast growing tree species: Fraxinus, Castanea, P.brutia, P.Pinea, Abies equitrojani, and Platanus spp
• Slow growing tree species: Cedrus, Picea, Juniperus, Cupressus, Abies, Quercus, Fagus and Taxus spp

3.5. Comparison method

As a conventional behavior coming from history, a single or a group of tree is planted by the architects and engineers around of public buildings like palaces, churches, synagogues and mosques when their construction were finished. Since the buildings and the trees are at the same age approximately, establishment date of historical buildings can be used for age estimation of the monumental trees adjacent in this case. This approach was approved while in age prediction of some monumental trees in Istanbul province.

3.5. Radiocarbon method (^{14}C dating)

3.5.1. Basic explanations of Radiocarbon (^{14}C) dating

Age estimation by means of radiocarbon method is an instrument for age determination of an object containing organic material which ones have been part of a living organism. The method is based on the comparison of two carbon isotopes having 12 atomic molar mass (^{12}C), and having 14 atomic molar mass (^{14}C), and, instability of the ^{14}C isotopes due to radioactive decay appearing in time. Isotopes are the atoms of same element having the same number of protons and electrons insides, but they have different number of neutrons in the nucleus of atom that is changing the atomic masses (Meriç, 2015).

^{14}C isotope is produced by the cosmic rays in the upper atmosphere. Nitrogen atoms are converted into radioactive ^{14}C isotopes at the end of these cosmic actions. Since, all of the radioactive elements are unstable ^{14}C isotopes begin to loose mass in time and back to nitrogen again. ^{12}C and ^{14}C isotopes turned to $^{12}CO_2$ and $^{14}CO_2$ after oxidation in atmosphere and they are absorbed by the plants while in photosynthesis and, then they are passed to animals and human bodies through the food chain. Therefore, all of the living organism have the same amount of $^{12}CO_2$ and $^{14}CO_2$ as in the atmosphere and, there is a same constant ratio (^{14}C compared to ^{12}C) among them unless living organism die. Since, regeneration of $^{14}CO_2$ goes on continuously in the atmosphere, the stability of ^{14}C / ^{12}C is assumed constant in this method. Replacement of ^{14}C stop when living organism die, and amount of ^{14}C begins decay. Half amount of ^{14}C isotopes in the dead organism decay in 5730 years. This radioactive decay can be used as a "clock" due to its unaffected physical and chemical conditions appearing in atmosphere.

Thus, there are three variables that are needed for age estimation of a dead organism; 1) the percentage of ^{14}C isotope compare to ^{12}C in the dead organism, 2) the half-life of the sample which is accepted as a constant figure 5730 years, and 3) the ratio of decay; in other words, in portion of ^{14}C / ^{12}C in the atmosphere as a constant figure -0,693. Following equation is used in the ^{14}C dating:

$t= [\ln(^{14}C / ^{12}C) / (-0{,}693)]*t_{1/2}$

Where $t_{1/2}$ is the half-life of the ^{14}C isotope (5730 years), t is the age of the dead organism (or the date of death), -0,693 is rate of natural decay, and ln() is the natural logarithm. For example, if the proportional value of ^{14}C / ^{12}C is found as 35% in a dead organism, the age of fossil will be $t= [\ln(0{,}35) / (-0{,}693)]*5730 = 8680$ years old.

3.5.2. Use of ^{14}C dating for age determination of the monumental trees.

As it can be understood easily, ^{14}C dating method is a suitable instrument for age estimations of the dead organism rather than living ones. Since, the inner parts of huge trees, except a few cm under the bark are consisting of dead tissues almost; this method can also be used for age estimation of the monumental trees too when it is possible taking out suitable sample parts from inside of the trees. Annual rings those are closed to centrum of stem are the oldest and dead rings of trees. Thus, sample parts required for age estimation should be taken out from the places adjacent to centrum if there is no hollow inside the stem. In case of hollow existing samples should be taken out nearby hollow (Fig 15), and, an age belonging to a sound tree standing around and having diameter as well as hollow width should be added onto the estimated age of monumental trees determined by ^{14}C dating method.

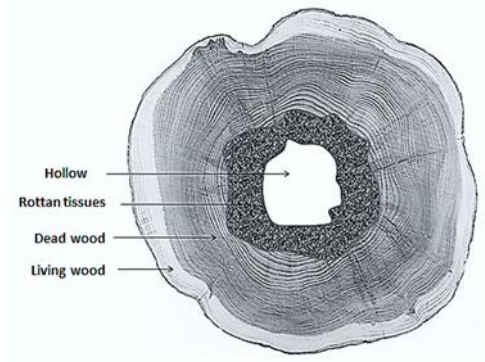

Figure 9. Place of sample necessary for age determination by using ^{14}C dating method in the hollow trees

4. Ecotourism potential of the monumental trees and forest remnants in turkey

As it is outlined under the headline 2, Turkey is a rich country from the sand point of monumental trees, old growth forests and the forest remnants suitable for ecotourism actions. There are also huge amount of single monumental trees around of inhabitant areas beside them too. Some of the individual trees such as . The Plane of Inkaya in Bursa (Fig. 6), The Plane of Moses in Hatay-Samandağ (Fig. 9), *Cupressus sempervirens* in Koca Mustafa Pasha Mosque (Fig.3), and The plane of Eyüpsultan (Fig.3) in Istanbul have thousand by thousand visitors each year however, but there are still a big potential out of the cities for ecotourism activities. Old growth forests in Muğla-Fethiye, Giresun-Bulancak and, Denizli-Eskere, and, the forest remnants especially Çatalan-Erbaa and Kırklareli-Vize are invaluable ecotourism sources waiting for valuation.

5. Conclusions and proposals

The trees having monumental characteristics are accepted as reverential motives by various societies for development of their religions and holly beliefs throughout history. Due to the sacred meanings attributed themselves, huge trees especially in the olden groves played the most important spiritual and religious role in that course. And besides, with their excellent habitus and extraordinary longevities, monumental trees arose feeling of appreciation of human that see themselves. In addition to immeasurable inspirations that, they create on the poets, and other artists they stimulate love, and respect to the nature and national history on the young generation's mind.

The mystical and holistic aspects of the trees having monumental properties, and, their importance on ecotourism from the standpoint of holistic belief, scientific excursion, and nature respect were focused in this paper. Relationships between the monumental trees and the mystical belief of human thought are explained in the context of ecotourism actions realized for holistic belief.

Making a visit to one of the old growth forest full of monumental trees or to a forest remnant staying there for thousands of year without change arouse feeling of respect to nature in common mind. All of these feelings appearing in human thought create self-satisfaction for escaping from the stresses caused by daily problems consequently. Thus, to create awareness on the monumental trees and forests for ecotourism should be accepted an inevitable job for the foresters to fulfill for either spiritual or physical health of human.

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Oral presentation

The effects of sand-dune afforestation in the Sinop Region on economic and social life

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Abstract: Sand-dune afforestations have significant effects on economic and social life as well as benefits such as stopping soil erosion, securing settlements and access roads, participating in production of empty and inefficient areas, correcting the degraded ecosystem balance and ensuring the continuity of some endemic plants. Investigation of these effects will further enhance the importance of sand-dune afforestations. Therefore, in this study; the effects of sand-dune afforestations carried out between 1975 and 1981 in the Sinop (Sarıkum) region, which is an example of Turkey's sand-dune afforestation history, on economic and social life were multidimensional examined. For this purpose, firstly the sand-dune afforestation in Turkey were briefly explained, and its amount in the Sinop region, the species used, planting and maintenance studies and methods, plantation costs, growing and success conditions of species were determined. For this, the relevant literature was used, the records of the forestry institutions were utilized, and observations and determinations on the fields were made. Additionally, semi-structured talks were held with 25 local people about economic and social life before and after sand-dune afforestation. The obtained data were evaluated by a logical analysis and synthesis, and some findings were visualized with figures and photographs. Based on the data, status of sand-dune fields before and after afforestation was compared with the growing and success of the used species. The impacts of sand-dune afforestation on the agriculture and livestock works of local people in the region, employment and migration prevention and therefore economic and social life were determined. According to the findings, until the 1975s, the villagers of the Sarıkum Lake side lived in highland in the summer months because they could not shelter in their villages due to the sand-dune movement and only in the villages during the winter months when it slowed down. Since the sand-dune movement was stopped as a result of afforestation, the villagers settled in their villages by escaping nomadicity-shepherding and built houses, cages and stables in the villages. The number of literate, workers in jobs with social security, and the return of the retired villagers to their villages increased after the permanent settlement. They began to deal with the cultivation of agriculture, pasture crops, greenhouses, forestry work, local mushroom trade and fishing activities. Additionally, they reached spiritual peace because the grave sites have not disappeared by the prevention of sand-dune movements. On the other hand, positive contributions were made to Sinop-Ayancık road transportation due to sand-dune afforestation. Likewise, the number of visitors coming to see the area and the nature park has increased day by day and thus positive contributions were made to ecotourism because the area including Sarikum village, Sarıkum Lake and sand-dune afforestation, and Subasar forest land were declared as a natural protection area in 1987. Thus, it was determined that economic and social life activated, employment opportunities and income level increased, migration was prevented, lifestyle changed, and positive contributions were made to many sectors (agriculture, animal husbandry, transportation, tourism etc.). According to the results, some proposals were developed about the effects of sand-dune afforestation on economic and social life and its importance.
Keywords: Sand-dune, Afforestation, Economic and social effect, Sarıkum, Sinop, Turkey.

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Human-wildlife conflict in national parks: Examples from Turkey

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Abstract: Although useful as a way of protecting many natural areas, declaration of an area as national park is not sufficient to protect these natural resources. Especially, the implementation of strict preservationist conservation approaches has often aggravated feelings of disenfranchisement and injustice among rural communities, as well as frustration toward national parks. For example, conflicts between human and wildlife have been widely recognized as one of the most challenging issues for wildlife protection worldwide. In this study has been investigated human & wildlife conflict in national parks. The research is covering the years between 2011-2013 and has been carried out in various stages such as preliminary study, population determinations, interviews, surveys, habitat identifications and data evaluation in office environment. During the preliminary study stage, observations have been made in order to recognize the field after the acquisition of literature scans and topographical maps. In order to determine the habitat preference of wild animals, their habitat sharing was determined with the use of presence - absence method by considering the seasonal, geographical and elevation values. Night observations and camera traps were also used to support the research; investigations were conducted with local people residing in or outside the borders of national park through survey and interview methods within the scope of the study. The local people's wildlife experiences, approaches, conflicts have been identified and the necessary solutions were tried to be determined through these investigations. According to research results, there are occasional conflicts between human and wildlife living in protected areas. For instance; wildlife may harm agriculturalists and their domesticated animals. On the other hand the fertilizers and agrochemicals used by agriculturalists may harm the wildlife. In order to prevent said conflicts, instead of implementing only passive protection based prohibitions, approaches should be adopted that emphasizes the participation of both parties and their educations.
Keywords: Human&wildlife conflict, National park, Kovada National Park, Kızıldağ National Park, Turkey

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Population status, problems and proposal for solutions of wild goat (*Capra aegagrus*) distributed in Antalya Düzlerçamı Wildlife Development Area

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Abstract: The wild goat, one of the most important rings of the biodiversity chain, is the most important game animal of Turkey. The wild goat (Capra aegagrus Erxleben 1777) is one of 9 species belonging to the genus Capra around the world. The others; C. hircus Linnaeus 1758, C. ibex Linnaeus 1758, C. caucasica Güldenstaedt & Pallas 1783, C. cylindricornis Blyth 1841, C. pyrenaica Schinz 1838, C. falconeri Wagner 1839, C. nubiana F. Cuvier 1875 and C. lervia Pallas 1777. The study area is between the boundaries of Korkuteli, Döşemealtı, Kepez and Konyaaltı districts of Antalya. The distance to the south border of the area by road from Antalya city center is 15 km. The total area of the area is 29,033 hectares. The study is carried out each year to determine the size of wild goat populations between 2014-2016 in cooperation with Suleyman Demirel University Faculty of Forestry Department of Wildlife Ecology and Management and 6th Directorate of Nature Conservation and National Parks. In the inventory studies, "Count on Point" method is used for counting in big mammal populations. As a result of the inventories, a total of 660 individuals (403 female, 132 kid, and 125 male individuals) in 2014, a total of 1040 individuals, (556 female, 245 kid and 239 male individuals) in 2015 and a total of 745 individuals (456 female, 117kid and 172 male individuals) in 2016 were identified respectively. Considering the activities of the wild goat during the day, it can be seen maximum at sunrise and sunset times. In the observations we made in the area, it became clear that the most important problem of the wild goat was the illegal hunting activities and the human pressure. The habitats of the wild goat are getting narrower. The biggest reason for this is; Local people are settled in small neighborhoods near wild goat living areas, excessive recreation in the area and other human activities. So it is exposed to human pressure and can not move freely. This study focuses on the results obtained from the 3-year inventory studies on Düzlerçamı Wildlife Development area, the dynamics of wild goat populations, problems, and proposal for solutions.
Keywords: Wild goat (Capra aegagrus), Düzlerçamı, Population, Inventory

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Teaching of engineering design in forest engineering program: An evaluation of situation and improvement possibilities in Faculty of Forestry, Istanbul University

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Abstract: Engineering design is a systematic, intelligent process in which designers generate, evaluate, and specify concepts for devices, systems, or processes whose form and function achieve clients' objectives or users' needs while satisfying a specified set of constraints. The designer must combine different disciplines dealing with engineering area in a designing process. In general, forest engineers may not produce devices but plan some processes and generate artificial systems in Turkey. As an example of engineering design in forestry, afforestation or reforestation activities can be shown. Forestation process needs to combine the knowledge on meteorology, soil science, ecology and techniques on cultivation under defined social conditions and restricted economic budget. Similarly, restoration of any habitat in wildlife needs to design a new life system by using zoological, botanical and ecological knowledge and technical methods regarding specific socio-economic sources and conditions.According to criterion set for accreditation, any engineering program must prove that alumni can design at least a product or process by using basic sciences, techniques and social or economic principles learned from different courses in the program. Regarding that criteria, it has been started to be discussed under the framework of the curriculum of forest engineering program in Faculty of Forestry of Istanbul University on teaching of engineering design before accreditation of the program. At the education period of 2011 – 2012, two new courses titled as Engineering Design I (at 7th semester, 0 hour theory, 2 hours application, 1 credit and 4 ECTS) and Engineering Design II (at 8th semester, 0 hour theory, 2 hours application, 1 credit, 3 ECTS) have been agreed upon in Forest Engineering Division. Students in the program have participated these courses in the education period of 2014-2015. Thus, teaching of engineering design in any forestry program in Turkey has started for the first time in our faculty. A document on Principles of Teaching Rules for Engineering Design I and II has been prepared by managers of the division responsible for the program. After first education period, important problems were observed in the design of the courses and teaching approach. The document on teaching principles was mainly revised. Two courses in 7th and 8th semesters were combined as Engineering Design at 7th semester (0 hour theory, 4 hours application, 2 credit and 7 ECTS). The aim of this study is to discuss the teaching approach of engineering design regarding official document on teaching principles and the experiences in the period of first three years. Under the framework of this study), official documents, evaluation reports and products generated by students of Engineering Design courses were investigated and compared with accreditation criteria and general understanding on engineering design in the literature. As a result, it is seen that courses titled as engineering design have focused on investigation of any subject in forestry. Principles in official documents have important weakness for teaching process on design and could not generate a system to facilitate integration of different disciplines of forestry sciences under a design process. Reports generated by students in Engineering Design course could not prove to win a design competence in forestry.
Keywords: Engineering design, Forest engineering, Education, Accreditation

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Factors affecting changes in forest areas in Turkey

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Abstract: According to World Bank data, forest areas covering 31.8% of Earth's surface in 1990 have decreased to 30.8% by 2015 (WB, 2017). Many adverse factors, such as, politically-motivated legislative regulations, illegal use, opening of forest areas for agriculture, and climate change, play a role in the reduction of forest areas. Yet, as a result of rapid population growth, humanity is becoming more and more dependent on forests. Forests play an important role in the survival of all living creatures on Earth. Decrease in forests causes floods, storms, severe weather conditions, extreme drought, etc. and causes people to suffer greater damages. Biodiversity is adversely affected by deforestation and this also affects human life. In order to eliminate the causes of deforestation in the world and establish new forest areas, following the United Nations Environment and Development Conference in 1992, many mechanisms have been established at national and international level and various processes have been started. Although there is an overall decline in forest areas in the world, Turkey is one of the countries that saw increases in its forest areas. In Turkey, the forest area ratio of 27.2% in 2006 has increased to 28.7% by 2015 (GDF, 2017). In this study, the differences in the ratios of increases or decreases in forest areas throughout Turkey and the socioeconomic indicators that were influential on those changes have been examined. In order to be able to carry out an accurate comparison and evaluation, province level was chosen as the area unit. Variables were created by utilizing the official statistics from the Ministry of Development, General Directorate of Forestry, and Turkish Statistical Institute, covering the years 2006 to 2015. The data for variables were collected for all 81 provinces in Turkey. These variables were then evaluated and interpreted by statistical analysis. The population of the residential area and the expectations of its population from the forests play an important role in the direction of the changes with regards to the quality and quantity of the forests. The results of the correlation analysis showed that there is a significant (-0,273*) negative correlation at 95% confidence level between the change in forest area (%) and the change in provincial population (%). Accordingly, forest areas have been observed to be decreasing in the provinces where the population is increasing. The percentage of forest areas of 61 provinces in Turkey have increased at various levels between 2006 and 2015. While the forest areas of 19 provinces have been decreasing, there has been no change in Hakkari province. Bayburt province has been the province that increased its forest areas the most. 14.163 ha of forest area covering 3.9% of the province in 2006 increased by 15.630 hectares to 8.3% by 2015. Adıyaman has been the province where the forest areas have decreased the most during the same period. 185.145 ha of forest area covering 25.1% of the province in 2006 decreased by 26.564 hectares to 21.5% by 2015.

Keywords: Demography, Migration, Forest villagers, Urbanization, Management

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Plant species diversity in home gardens which is one of the agroforestry practices

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Abstract: The Eastern Black Sea Region is a remarkable region with its rich and varied natural plant species. However, it requires some Agroforestry techniques which can target many products over the same area in the cultivation of the products obtained from soil having limited and rough land structure. Determination the potential of the region is necessary in order to apply these techniques. In this respect, home gardens can give important clues to practitioners. Home gardens are good examples of agroforestry practices that are artificially established and become part of nature. The objective of the present study is to reveal the plant species diversity in the home gardens of the Eastern Black Sea Region. Plant species diversity was addressed by general features such as the distribution of quantities of agricultural products, forest or fruit trees and versatile utilization in home gardens. Accordingly, researches based on interviews and observations with the people living in villages and neighborhoods in Rize and Trabzon were conducted. 22 home gardens in Rize and 26 home gardens in Trabzon were selected. As a result of the study, home gardens in the eastern and southern provinces of Trabzon and the Rize region were richer in plant species diversity. In contrast, the average plant species diversity in Trabzon is generally higher than Rize. The average number of perennial plant and vegetable species diversity (23,73) in home gardens of Trabzon was higher than Rize (20,91). It has also been found that the home gardens of Trabzon region are richer in plant and vegetable species diversity in the very old and new home gardens. Hazelnut is grown together with various fruit forest trees in Trabzon region, and vegetable agriculture is also quite common. It has been observed that greenhouse cultivation has been carried out, with local possibilities, in areas where land is suitable. The need to earn additional income was occurred some reasons such as the richness of natural plant diversity in Rize region, the washing of soil due to the rainfall effect and so poverty of the land, the inability to obtain the expected income from the agricultural product. In recent years, the public has begun to pay attention to cultivate kiwi as second agricultural crop, and beekeeping in their home gardens.
Keywords: Home garden, Agroforestry, Rize, Trabzon, Plant species diversity

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Vandalism in recreation areas

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Abstract: Vandalism have usually been used for explaining to damage the defenseless thing intentionally and without any purpose. Although it is not a very common word in our daily life, but unfortunately it has become a very commonly encountered phenomenon and usually related with physical and economic deterioration of the environment. However, economic, demographic, social and educational factors have usually effects the intensity of vandalism. It is well known that people who are not sympathetic to the others or unpleasant in society, are usually reveals more aggressive feelings and may not considered no matter how sturdy they are. Hence, the vandalism, which emerged as a complicated behavior and actions target in gall materials in various levels and results. At the present time, demands on recreational activities are increasing especially in cities and near environs. For that reason, the sustainable usage and protection of landscape values has become great importance. However, the concept of protection is ensuring the participation of the public in recreational are a sand integrated with the public. A number of activities could be considered as vandalism; destroying, breaking, cutting, burning, throwing paint, etc. However, vandalism are mostly shown in landscape assets as follows; lighting fixtures, seating benches, floor coverings, garbage cans, information billboards, signs, plants, playgrounds, etc. Moreover, with well designs and protection programs, the effects of vandalism may be minimized. Hence, the ownership of the public may help to care, and prefers for appropriate preservation of assets. Moreover, rapid fix or replacement of damaged equipment, or removal of damages could help prevent against vandalism. In this study, it was aimed to determine the causes of vandalism in the context of user- environment interactions in recreation areas. The vandalism phenomenon, which causes material and asset loss, will be discussed in detail. Some examples in the framework of urban design and recreational areas and some suggestions will be made against vandalism.
Keywords: Vandalism, Recreation, Landscape values

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Investigating the distribution of forest engineer in the state forest enterprises by using Atkinson Inequality Index: Kahramanmaras Regional Forest Directorate sample

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Abstract: Income distribution refers the distribution of the national income generated in a given period among the production factors in the country. It is an important indicator of the economic well-being of a country. The categorical, individual and global distribution of income indicates that income is not equally and equitably distributed among the individuals. Income distribution shows the change over time in the applied economic and social policies. The ownership of the production means, the level of public services, the social and traditional relations, the organizational level and horizontal-vertical mobility of the workforce, the forms of political participation and all these changes over time affect income distribution. Income distribution directs to the economic policies. It is revealed to investigate the social and income distribution relations among the factors that constitute national income. Numerous indexes have been developed to measure income inequality. From these inequalities, the Atkinson index is derived from the social welfare function. The social welfare function consists of the sum of each individual's welfare function and has additive, symmetric, non-decreasing with income, concave function properties. This index assumes that social benefit is comparable with social and economic charecteristics. The Atkinson index is based on the social utility function. It gives different results depending on the normative sensitivity of society. This index takes values ranging from 0 to 1. Also, Atkinson index indicates that there are cosistency among indicators belonging to different segment of society. Demands for forest enterprises increases and diversifies along with the social, socio-cultural and economic change of the society. Forest enterprises should be involved in actions to meet the demands taking into account the demands of the people. For this reason, taking into consideration the characteristics such as work and area density the distribuion of forest enginner shuld be the most appropriate level. In this study, using the Atkinson index to investigate the loss of social benefit for forest engineer who served in the 7 State Forest Enterprises located in Kahramanmaras Regional Forest Directorate in 2016 has been evaluated. The number of forest engineers, the total forest area of the forest enterprise, allowable cut, the amount of wood production, the expenditure and the gross sales were obtained from the Kahramanmaraş Regional Forest Directorate. The values indicating the loss of social benefit of forest engineers, who are working for the State Forest Enterprises vary between 0,585 and 0,917. In this reason, when different characteristics of the enterprises were taken into consideration, 68 forest engineers, working in Kahramanmaraş District Directorate,felt between 37 and 61 people.
Keywords: Atkinson inequality index, National income, Loss of social benefit, Social welfare function, Distribution of forest engineer

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Human - wildlife conflict in Kastamonu Region

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Abstract: It is significantly important to include a human dimension to wildlife management. Human-wildlife conflict existed since humans and wild animals have shared the same resources and areas. Human–wildlife conflict is defined by the World Wide Fund for Nature (WWF) as "any interaction between humans and wildlife that results in negative impacts on human social, economic or cultural life, on the conservation of wildlife populations, or on the environment". Human- wildlife conflict could result to injuries, death, disease transmission and economic losses. Invasion of people to wildlife areas, pressure of carnivorous animals, destroying natural habitat of wildlife and unsustainable consumption of natural resources makes the human - wildlife conflict worse. Kastamonu is an important area with its rich geographic advantages having agricultural areas, forests, wetlands, mountains, caves and canyons. Having these habitats is also makes Kastamonu is an important area for the wildlife fauna. Local people of Kastamonu mostly complaints about brownbear (*Ursus arctos*), wolf (*Canis lupus)* and boar damages (*Sus scrofa*). In this study Human – Wildlife conflict in Kastamonu region will be explained by direct observations and analyzing damage records of Ministry of Forestry and Water Management 10th District Directorate.
Keywords: Human – Wildlife conflict , Wildlife, Kastamonu

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Economic importance of hunting and wildlife in america and europe

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Abstract: Hunting has to fulfil a number of tasks, not least the management of wildlife and reducing damages caused by game. But not only that, hunting represented also an enormous economic factor.
Hunting in America is big business, generating more than $67 billion in economic output and more than one million jobs in the United States. The vast majority of Americans embrace hunting lock, stock and barrel for its social, cultural and conservation contributions. Like baseball and apple pie, hunting is an American tradition shared by young and old, rich and poor, regardless of social or economic status. Hunting is not Democratic or Republican; it knows no geographic or congressional boundaries. Its history and heritage crosses all racial and ethnic boundaries. It is big business, which generates $25 billion in retail sales, $17 billion in salaries and wages, and employs 575,000 Americans, creating sales tax, state income tax and federal income tax revenues for government agencies and the people they serve. But hunting is more than a positive economic force. It is also a strong, wholesome influence on American society. It is a healthy American activity, steeped in heritage, which touches the most important aspects of our lives, like families and friends, and a sense of stewardship for all things wild. It is no wonder that more than 13 million Americans age 16 and older hunted in 2001. When you look at hunting and target shooting combined, a 2001 Roper Starch study verified that more than 26 million Americans participated in all shooting sports. That same independent scientific researched revealed that the public accepts the shooting sports just as it accepts tennis and golf. Hunters are good for the economy. They not only purchase hunting gear, trucks and boats; they also fill their gas tanks and coolers. They stay at motels and resorts. They buy hunting clothes and those goofy hunting hats with sayings that are sometimes funny and always a conversation piece. On average, each hunter spends $1,896 per year on hunting, which is 5.5% of the typical wage earner's annual income. These expenditures then "ripple" through the economy generating three times more impact for the U.S. economy. For many communities, hunting dollars keep them afloat. In Europe, there are a total of 6.7 million hunters who provide an economic output estimated at EUR 16 billion. 65% of our European countryside is managed by hunters in a variety of forms. The European hunter spends an average of € 2,400. In 2015, hunting in France was worth € 3.6 billion and supported 25,800 jobs. The 850,000 Italian hunters spend annually € 3.26 billion and hunting is estimated to provide nearly 43,000 jobs. In the UK, a recent study found that hunting contributes to the British economy £ 2.5 billion (€ 3.2 billion). £ 250 million (€ 295 million) are spent each year for conservation measures by shooting provides. Such conservation activities are labour intensive and are approximately worth 3.9 million working days, equivalent to 16,000 full-time jobs.
Keywords: Hunting, Economic value, America, Europe, Wildlife

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İstanbul Belgrad Forest's wild animals and habitat problems

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Abstract: Istanbul's green areas and water resources are under pressure due to rapid population growth from one side and adverse effects of industrialization on the other. Many wild animal species that prefer these areas as habitat. Population growth has caused the city to expand horizontally and vertically and new settlements to be built on open spaces, agricultural areas, water basins and forests. Population grows effects natural areas. Activities such as picnics, hiking, jogging, mountain biking, motocross, off-road in-forest and hunting are made in natural areas. In addition, the number of stray dogs is increasing day by day in natural areas. Stray dogs attacks the wild animals. Located on the old forest in the north of Istanbul. Belgrad Forest is one of the important habitats of wild animal species. The Belgrad Forest continues to preserve its biodiversity under the pressure of the city. This process is getting harder and harder day by day. The faunistic diversity of Belgrad Forest is a very important place for Istanbul city. Today, the Belgrade Forest hosts 24 frogs and reptiles, 160 birds and 23 mammals. Our observations in the Belgrad Forest since 1996. The projects and researches carried out in the study area reveal the problems faced by forest animals and forest wildlife. In these studies, direct and indirect observations, game camera studies, point and line observations and counting methods were used to obtain data. The problems encountered by wild animals in the Belgrad Forest include stray dogs, forestry operation practices, poaching, increasing traffic intensity, off-road, motocross sports, increasing number of recreation areas, picnic outside the recreation areas. Other factors include the plowing of pets in the jungle, water wells and stations opened to the run, illegal cuts, rubble and garbage. In this study, wild animal species which are important elements of the wildlife of the Belgrad Forest were examined and factors affecting their habitat negatively.
Keywords: Belgrad Forest, Wildlife, Fauna, Birds, Mammals, Stray dog

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A historical review on the effects of settlement problems on Turkish forestry

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Abstract: In the historical process, protection of forests in Turkish forestry has been the most important forestry problem. Since the declaration of the Republic, many efforts have been made to prevent the forest destruction. The most important of these efforts is the Forest Law of the date of 1937, which can be named as forestry revolution. This law aims to protect the forests first of all. This law has aimed to end the system of free use of forests without exception. It was thought that mechanical measures will be sufficient to ensure this. On the other hand, it was understood that forests could not be protected by police measures very soon after the implementation of the law. So other measures were started to be discussed. On the other hand, it was understood that forests could not be protected by police measures very soon after the implementation of the law and other measures were started to be discussed. One of these measures has been the relocation of the villages. The forest law, at the same time has also caused many obstacles. For this reason, changes were made to the regulation in 1950, but the problems were not resolved yet. Many scientists have settled on the settlement problem of the forest villagers in the focus of Turkey's forestry problems. They have agreed that the protection of the forests will not be possible without the settlement problem being solved. As a result, in 1956 the Law No. 3116 was abolished and replaced by the Forest Law No. 6831, which was still in force. One of the priorities of this law has been the placement of forest villagers elsewhere. However, by law, it was planned that the forest villagers would be placed in forest areas again. Roughly speaking, the forest villages which have limited opportunities on the hillside, high slope areas and have to attack the forest in order to survive will be placed in the forested areas in the plains. The abandoned areas of forest villages will also be afforested. Plan is this. A sub - regulation was issued for the transactions to be made under Articles 2 and 13 of the Law, and these transactions were made between 1958 and 1960. However, the villagers who were placed on the plains did not leave their villages on the slopes. So, this solution method itself, which is tried to be realized in order to protect the forests, has become a forest destruction factor. Although this practice was abandoned in 1960 and the matter was secured by the 1961 Constitution, a struggle was made to reintroduce these areas, which had previously been allocated to the peasants, shortly after the passage of free elections. First of all, the Constitution 1961 has been amended and practices for removing forest areas, which are now called 2 / B, have been initiated. No significant application was made to the transfer of forest villages until today. Instead, destroyed forests were leaved from forest regime. Thus, forests were destroyed on one side and forest villagers on the other were abandoned to their fate. Today, an important part of the forest villagers have migrated from their places and those remaining in these villages still constitute the poorest part of the society.
Keywords: Settlement, Forest village, Protection of forests, Forest law, 2B

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Investigation on the effects of urban open-green areas on the socialization of people: Trabzon sample

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Abstract: This research was conducted to examine the effect of urban open green spaces on the socialization of people. For this purpose, within the boundaries of Trabzon province as a study area. Because of its historical value and accessibility, Atapark has been chosen and The Yüzüncü Yıl Park, which has an abundant user and dense green area, has been chosen. The Urban Park Identity Card, Observation Form, Activity Maps and the Effect of Open-Green Areas on the Socialization of People were developed by the researchers as a data collection tool. These data collection tools will be applied at the Yüzüncü Yıl Park and Atapark. The impact of these two parks with different features on the socialization of the people will be determined according to the statistical analyzes to be carried out. Comparing the two parks will reveal the components of the urban park that are influential in socializing. Planning and design recommendations will be presented in this direction.
Keywords: Open-green areas, Urban parks, Park components, Socialization

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Strategic key points of improvement of ecotourism at southern part of Isparta Province

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Abstract: The Isparta Province is located on the western area and the central part of the Mediterranean Region. It is at the center of the "Lakes Region". The high and hilly grounds of the province are surrounded by natural borders, such as the Sultan Mountains from the northeast and east, the southern extensions of the Beyşehir Lake and Göl Mountains, higher parts of the Antalya Basin from the south, the Karakuş Mountains, Söğüt Mountains, Burdur Lake and Ağlasun and Bucak plateaus from the west and southwest. The land of the Isparta Province is hilly in general. In addition to the mountains reaching a height of 3.000 meters, also the plains characterized as lowlands and valleys as well natural lakes of different sizes in the region define the natural structure of the province. The province has an altitude of approximately 1.050 m. The Isparta Province is one of the provinces comprising the highest number of lakes and ponds within its borders in Turkey and even across the world. All or parts of the Lakes of Eğirdir, Beyşehir, Gölcük, Kovada and Burdur are located within the borders of the province. Isparta Province, east to west, north to south, is a region with extremely large geographical diversity. Geographic locations and locations as the natural environment integrated with our villages , nature based on all kinds of sports activities (mountaineering, trekking, paragliding, horseback excursions , rafting, biking and motor trips , etc.), organized possible. Farms or villages for leisure tourists who choose the "natural flavors to" be here, given that the waters, forests, mountains, prevent pollution, agriculture and livestock depend on traditional modes of production survival of great importance. In short, a place of rural tourism and culture for the continuity of nature conservation is essential. This work was carried out in two stages. The sources of ecotourism and their potentials have been investigated in the first stage. At this stage, the potential of ecotourism destinations has been identified. SWOT analysis was used as a research method. These destinations are; Kızıldağ National Park, Kovada Lake National Park, Kasnak Oak Natural Reserve Area, Sığla Forest Natural Reserve Area, Yazılı Canyon Natural Park, Gölcük Natural Park, Başpınar Natural Park, Isparta City Forest, Historical Ayazmana Promenade, Natural Monuments, Caves, Mountains, Tablelands, Hunting Areas. In the second stage ecotourism supply and demand situation has been researched. Ecotourism supply and demand aspects of the assessment to be able to demand located at the tourists, on the supply side the rural population, trades and operators and responsible for regulation in the public sector to the persons involved the method has been applied by individual interviews. Eight strategic areas have been identified in order to make the Isparta Province become a brand in ecotourism by 2023. These strategies are; development and planning strategies, educational strategies in the tourism sector, promotional and marketing strategies, strategies on diversification of tourism, strategies on the development of archaeological and cultural assets, infrastructure and transportation strategies, strategies on visitor management, monitoring strategies.
Keywords: Ecotourism, Ecotourism destinations, Supply and demand relations, SWOT analysis, Questionnaire, Isparta

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Valuing flood control service by cost-based approaches: a case of study in southern of Turkey

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Abstract: Forest ecosystems provide several goods and services. These goods and services are generally grouped into four categories: provisioning, supporting, regulating, and cultural services. Flood control service is one of regulating services of forests. Flood control service has both ecologic and socio-economic dimensions. Because, when occuring floods, agricultural lands and settlements are damaged. Even people and animals might lose their lives. For preventing floods or decreasing damages of them, watersheds should be planned. For this aim, not only ecological effects of floods, but also its economical effects should be evaluated. In order to determine of values of regulating services of forests (soil and water protection, climate regulation etc.), several methods are used. One of them is cost-based methods. In this group, the most common ones are Damage Cost Avoided Method and Replacement Cost Method. The aim of study is to determine value of flood control service using cost-based methods. For this aim, Erdemli Basin was selected in Mersin Province in southern of Turkey. In 2012, a flood was occured in the basin. In the study, the general information about flood was given. In addition, the costs belong rehabilitation activities after flood were determined. Thus, the value of flood control was approximately accounted.
Keywords: Flood control, Costs-based approaches, Erdemli Basin

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Invasive species *Anoplophora chinensis* (Forster, 1771) (Coleoptera: Cerambycidae) in Turkey

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Abstract: *Anoplophora chinensis* is a poliphagous woodboring beetle native to Eastern Asia with a host range quite wide causes damage on more than 100 species of trees and shrubs. The beetle gets its name from the damage caused to citrus groves in its native China. Unlike many cerambycids that primarily attack dead trees, this beetle attacks apparently healthy trees and sever tissues that carry nutrients, water, and subsequently kill the host tree The citrus long-horned beetle has been introduced to Europe in several occasions. It was first discovered in Europe in 2000 at Parabiago, Italy and respectively it has been recorded in Netherlands and France (2003) and Switzerland (2006). Adults of *A. chinensis* were captured on 12 June 2014 in Sile region of Istanbul province and it was given as a new record to Turkish invasive alien insect species fauna. And also on the same dates identified as the second time from Bartın. *A. chinensis* is a new threat on a wide range of broadleaved trees and shrubs in Turkey. Therefore its distribution areas and the behaviour of the pest in these areas should be investigated.
Keywords: *Anoplophora chinensis*, Citrus longhorned beetle, Cerambycidae, Turkey

1. Introduction

Within *Anoplophora chinensis* the genus *Anoplophora* (Coleoptera: Cerambycidae) consists of 36 species of longhorned beetles indigenous to the temperate and tropical regions of Asia (Lingafelter and Hoebeke, 2002). This poliphagous woodboring beetle native to Eastern Asia and damage on more than 100 species of trees and shrubs (Peverieri et. al., 2012; EPPO, 2013a). Unlike many cerambycids that primarily attack dead trees, this beetle attacks apparently healthy trees and sever tissues that carry nutrients, water, and subsequently kill the host tree (Chambers, 2002; Lance, 2002). The citrus longhorned beetle has moved to Europe on several occasions. It was first discovered in Europe in 2000 at Italy and respectively, recorded in Netherlands and France (2003) and Switzerland (2006) according to FAO (2009). In Italy more than 18000 plants have been removed for the eradication program and the cost has amounted to about 12 million euros (Jucker and Lupi, 2011).

A. chinensis first detected in Istanbul province and it was given as a new record to Turkish invasive alien insect species fauna by Hizal et al. (2015). And also on the same dates identified as the second time from Bartın (Yıldız, 2017). *A. chinensis* is a new threat on a wide range of broadleaved trees and shrubs in Turkey. Therefore its distribution areas and the behaviour of the pest in these areas should be investigated.

Attacks numerous species of hardwood trees including *Acer* spp., *Aesculus hippocastanum*, *Alnus* spp., *Betula* spp., *Carpinus* spp., *Citrus* spp., *Cornus* spp., *Corylus* spp., *Cotoneaster* spp., *Crataegus* spp., *Fagus* spp., *Lagerstroemia* spp., *Malus* spp., *Platanus* spp., *Populus* spp., *Prunus laurocerasus*, *Pyrus* spp., *Rosa* spp., *Salix* spp., *Ulmus* spp., *Casuarina* spp., *Cryptomeria* spp., *Ficus* spp., *Hibiscus* spp., *Litchi* spp., *Mallotus* spp., *Melia* spp., *Morus* spp. (EPPO, 2013)

2. Material and methods

Adult samples (Figure 1) were collected from a private nursery in Bartın region (Figure 2) on ornamental plants consisting of *Acer palmatum purperea, A. negundoflamingo* and *A. platanoides* by a Japanese umbrella.

Figure 1 . *A. chinensis* that collected from nursery

Figure 2. Location of *A.chinensis.*

Specimens were photographed with Samsung Pro-815 digital camera and they were examined under the Olympus SZX7 stereomicroscope. The identification process was carried out using specific literature (Lingafelter and Hoebeke, 2002; Gyeltshen and Hodges, 2005; EPPO, 2013). The samples are stored in the collection of Bartin University, Faculty of Forestry, Department of Forest Entomology and Protection.

3. Result and discussion

3.1. Morphology

The beetle is large, stout, and approximately 21 to 37 mm long with shiny black elytra marked with 10 to 20 white round spots (Lingafelter and Hoebeke, 2002). Generally males are smaller than females, and have their abdomen tip entirely covered by the elytra, in contrast to the partially exposed abdomen of females. Also, the male elytra are distally narrowed compared to the rounded female elytra. Another difference between males and females are antennal sizes. The male's antennae are approximately twice as long as its body compared to the female's antennae which are only slightly longer than the body. Each segment of the long, 11-segmented antennae is basally marked with white or light blue bands (Gyeltshen and Hodges, 2005). The base of the elytra has numerous short tubercules, a morphological character that may help to differentiate *Anoplophora chinensis* from the, *A. glabripennis* (Gyeltshen and Hodges, 2005) (Figure 2 A-B).

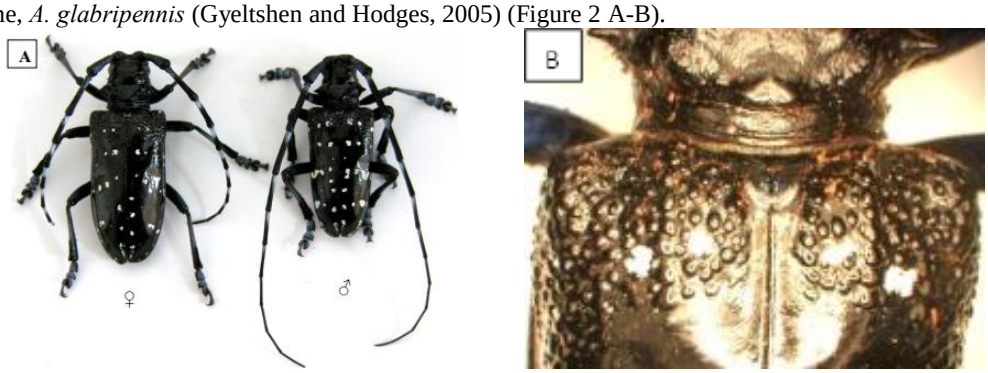

Figure 2. *A. Anoplophora chinensis B. Tubercules on the base of the elytra*

In the study, adults of *A.chinensis* were detected in private nursery on maple trees (*Acer palmatum purperea*, *A. negundo flamingo* and *A. platanoides*) that imported from China. These beetles were recorded in the same time as it was recorded first time in Istanbul. Due to its polyphagous character, host plant is considered under high risk of attack, especially *Acer* species. The pest is a serious problem for the nursery industry, in the production of ornamental trees; it is also a potentially pest of citrus orchards and of many other deciduous trees.

Adults feed on the fresh bark of small twigs and branches, and sometimes on leaf petioles. The females also chew from the bark of the host tree to the cambial layer, forming ‘egg scars’; then inserts her ovipositor and lays a single egg (Lingafelter and Hoebeke, 2002). Larvae feed and develop in the wood of the main roots and trunks, where they create tunnels (Figure 3 A-E). Exit holes have been found only at the base of trees heavy infestations can kill the host trees (Maspero et al., 2005).

Figure 3. A. Larva damage B. Adult damage C. Feed on leaf petioles D. Feed on the fresh bark E. Eggs

This species as regard to European Union *Anoplophora chinensis* commission decision of 1 March 2012 and law no. 2012/138/EC, specifically, by law is prepared and on 17 June 2014 law no. 29033 promulgated on Official Gazette and entered in force (Anonymous, 2014).

Ministries and municipalities should be informed following the detection of the infested areas. Quarantine procedures should be applied of the *Anoplophora chinensis* damage to prevent epidemic and also infested plants should be destroyed. Quarantine zone should be fumigated systematically with insecticides beside physical control methods in line with relevant workplace safety procedures and instructions. Countries should work on the legal regulations regarding the wood packaging in terms of trade. All necessary prevention methods, inspections and strict packaging and shipping regulations should be applied for national and international trade of all kinds of wooden material, ornamental and citrus plants.

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Oral presentation

A review on the condition of "Public interest and necessity" related to the permits granted in state forests

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Abstract: The main concern of the Law is that it is mainly based on justice and equity and that where a right has begun the boundaries of another one is drawn. This fact forms the basis of the rules of law. For this reason, and especially at the point where a benefit or right appealing to the whole society is at stake, and at the same time, other interests and rights must be restricted; the importance of this phenomenon is further increased. In short, these benefits and rights, so known as public interest, are very much discussed in our legal system, and is an important topic heading up to the constitution in the field of forestry. The public interest provided by the forests is an unquestionable fact, and in this study, it is aimed to discuss the legal nature of the public interest and necessity taken as a base for the permits granted in the state forests within the framework of the forestry legislation. It is a fact that there is a conflict of interests among the natural resources, but in practice, it is thought that the public interest that is sometimes overlooked when forests are maintained as forests. For example, while mining permits issued by state forests provide public benefits to only a fraction of the population, forests that provide public welfare to a larger segment of society when it is preserved as forest. For this reason, the main aim of the study is to determine how equitably the determination of the public interest is made for the permits granted in State forests in which such conflict of interest is being experienced. In order to make this aimed examination, the concepts of public interest, benefit of society and superior public interest will be explained first and then the legal basis of the condition of public interest in the forestry legislation will be revealed together with the judicial case law. In the light of the findings, it will be discussed that whether or not the condition of “public interest and necessity” sought in the permits granted for state forests can be determined with objective criteria with reference to the application examples, and finally, various suggestions will be made on the subject.
Keywords: Law, State forest, Public interest, Criteria

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Modeling of current and future distribution of *Ips mannsfeldi* (Wachtl) (Curculionidae: Scolytinae) in Turkey

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Abstract: Climate change has reached the highest rates of the last 1.000 years. This has begun to attract the attention of researchers, and the number of studies on estimation of the environmental impacts of climate change on species has also begun to increase. *Ips mannsfeldi* (Wachtl) is a bark beetle (Curculionidae: Scolytinae) species spreading on black pine (*Pinus nigra*) fields in Turkey. This study aims to model the future (2070) distribution of the species according to two different global climate change scenarios. GPS records of *I. mannsfeldi* specimens were gathered from the literature. Current and future potential distribution areas of the species have been determined using maximum entropy modeling. RCP4.5 and RCP8.5 emission scenarios reported in IPCC5 were used to model the future potential distribution of the species. As a result of the study, it is determined that the species distributes on the Black pine (*Pinus nigra*) forests throughout the Mediterranean and the inner part of the Aegean region (around the Kütahya province) of Turkey at the present time. For 2070, it is estimated that the distribution area will expand towards the Southern part of the Aegean region, Western Black Sea region and high altitudes of the Taurus mountains and will shrink low altitudes of the Mediterranean region according to RCP4.5. In the RCP8.5 emission scenario, the distribution of the species expands towards the Southern part of the Aegean region and Western Black Sea region but shrinks at Eastern Mediterranean region and low altitudes of Western and Middle Mediterranean region. Depending on the changing climatic conditions, it can be seen that this species expand its distribution area and may be a potential pest that causes economic damage to black pine fields in the coming period.

Keywords: *Ips mannsfeldi*, Maxent, *Pinus nigra*, Climate change, Future prediction, Modeling

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Oral presentation

Adult emergence success of mass produced predatory insect, *Calosoma Sycophanta* L. Larvae in pine forests in Turkey

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Abstract: Larvae of two *Thaumetopoea* (Lepidoptera: Thaumetopoeidae) species (*T. pityocampa* and *T. wilkinsoni*) are very harmful to *Pinus brutia* (Ten.) forests in Turkey. Their urticating hairs cause allergic reactions in human and animals. *Calosoma sycophanta* L. is a good and important predator of *Thaumetopoea* species in Turkey. This predator consumes both the larvae and pupae of these forest pests. Mass production and releasing of *C. sycophanta* have been used against the *Thaumetopoea* species in many countries. More than two hundred thousand *C. sycophanta* are released in each year in Turkey. But we have little information about adult emergence success of *C. sycophanta* larvae in forest conditions. Therefore in this research, we aimed to search effects of development sites that soil depths (10, 20, 30 and 40 centimeters), altitudes (0-250, 251-500, 501-750 and 751-1000 meters) and directions (north and south) on adult emergence success of *C. sycophanta* in field conditions. According to our results the directions and altitudes of the forest area that released the larvae are important factors on adult emergence success rates. The north direction has more adult emergence rates compared to south direction. The emergence success rates of adults were compared for altitudes; at 0-500 meters we were recorded more and statistically significant adults than 501-1000 meters. The depth of development area that released the larvae was not effect on the emergence success rates of the adult beetles.
Keywords: Adult emergence success, Forest, Mass production, *Calosoma sycophanta*

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A preliminary study on some tree parameters in *Dendroctonus micans* (Kugelann) (Coleoptera: Curculionidae) attacked and unattacked oriental spruce trees in Artvin, Turkey

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Abstract: *Dendroctonus micans* (Kugelann) (Coleoptera: Curculionidae) that was first discovered in 1966 in Posof has well established and built up outbreak populations in oriental spruce forests in Turkey. It killed millions of trees along its distribution area in Europe and Turkey. There are both attacked and unattacked neighbouring trees in a stand, and there may be only succesful attacks, aborted attacks or a number of aborted attacks as well as successful attacks on same tree. In this study, some tree characteristics affecting beetle's successful establishment to the host are investigated. Phloem thickness, recent tree growth rates (the mean annual increment in the past five and ten years, and annual increament in the last year), tree size (diameter of breast height) and the average number of xylem cells (tracheids) in a radial file formed in the last ten years were investigated to figure out tree characteristics of attacked and unattacked trees. Field studies were performed at a pure spruce stand that was in the stand closure at 1683 m a.s.l. and in southwest aspect in Taşlıca – Artvin. Tree cores were extracted from ten naturally attacked and ten unattacked healthy spruce trees on June 23, 2016. Leica M60 stereomicroscope and Olympus BX53 light microscope were used to make measurements. There were difference between phloem thickness, the mean annual increment in the past five and ten years, and annual increament in the last year, and the number of xylem cells in a radial file in attacked and unattacked spruce trees.

Keywords: Greater European spruce bark beetle, Successful establishment, *Picea orientalis*

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Oral presentation

Entomopathogenic protists of forest insects in Turkey

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Abstract: Protist pathogens infecting insects are known as entomopathogenic protists. These organisms are among the most diverse of insect pathogens. This group is currently reviewed in the taxa Amoebozoa, Apicomplexa, Ciliophora, Euglenozoa and Helicosporidia. As a pathogenic group, Microsporia is included by some researchers in protists. Entomopathogenic protists are found in nature and commonly isolated from host insects. According to the current literatures, they cause two type-important infections in forest insects in Turkey; desirable infections in forest pest insects and undesirable infections in predatory beetles. Both infections play important roles in forest pest controlling. Several new species have been identified from both useful and harmful forest insects. However, studies on them are partial with species description and geographical distribution. Transmission, host range, host-pathogen associations and potential use in biological control are poorly researched. In this presentation, a review of recent situation of entomopathogenic protists in forest insects in Turkey is given with the species lists from different groups.
Keywords: Entomopathogenic protists, Forest insects, Turkey

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New invasive insect species of turkey forests; current situation and risks

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Abstract: There are habitats where the invasive species can adapt in addition to the native species that threaten the forests in Turkey. Foreign species are more important than native species. It is not known how foreign invasive species will behave. In the last five decades in Turkey, several biotic elements including insects and fungi transported from other countries and even other continents have caused and still cause significant level of damage. Since Turkey is like a bridge between Asia and Europe with respect to international trade, the risk of transmission of foreign invasive species. Increased importation of plant and wood materials in recent years has resulted in an increase in the foreign invasive species in Turkey. In the last 50 years, forests in Turkey have been affected by foreign invasive species such as *Dendroctonus micans*, *Ips typographus, Ophelimus maskelli, Leptocybe invasa, Ips amitinus, Ips cembrae, Ips duplicatus, Leptoglossus occidentalis*, *Cydalima perspectalis*, *Ricania simulans Corythucha arcuata Rhynchophorus ferrugineus*, *Anoplophora chinensis* and *Dryocosmus kuriphilus*. It is very difficult to control the population of invasive species at harmless level and stabilize it when they spread. This paper present information about foreign invasive species that were transmitted to the forests in Turkey.
Keywords: Invasive alien species, Insect, forest, Turkey

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Invasive alien plants in Espiye (Giresun) forest planning unit

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Abstract: Turkey is an important country in terms of plant species diversity due to its geographical location, geomorphological structure, micro-climate diversity, plant geography and its combination with three different flora regions. Habitat fragmentation and loss of habitat are the leading factors that threaten biological diversity. Habitat fragmentation may occur naturally or anthropogenic origin (wrong land use, road construction, forestry activities, etc.). This factor, which threatens biodiversity, causes alien species to settle in natural habitats. With 11,707 taxa in Turkey, there are also alien plant species that enter Turkey's flora in different ways such as introducing or naturalizing. It has been determined that there are 319 of alien plant species which are not included in the natural flora of our country. The Eastern Black Sea Region (introduced already 23 alien plant species) is a place where foreign plant species can easily settle because of reasons such as climate characteristics and wrong land use. In this study, field observations were made between 2015-2016 years in Espiye Forest Planning Unit. 19 invasive alien plant species (*Acacia dealbata*, *Ailanthus altissima*, *Amaranthus retroflexus*, *Ambrosia artemisifolia*, *Bidens frondosa*, *Commelina communis*, *Conyza canadensis, Erigeron annuus*, *Lantana camara*, *Lonicera japonica*, *Microstegium vimineum, Paspalum distichum*, *Phytolacca americana*, *Robinia pseudoacacia*, *Sicyos angulatus*, *Solidago canadensis*, *Pinus pinaster*) were identified in the Espiye Forest Planning Unit. In addition to these invasive plants species, have determined new spreading areas for *Tradescantia fluminensis* and *Oenothera glazioviana* species. Of the 18 invasive alien species identified, 6 are woody, 13 are herbaceous species. One of the invasive alien plants belongs to Gymnospermae subdivision and the other 18 belongs to the Angiospermae subdivision. In the scope of the presentation, has been given a general information about the ecological and economic effects of invasive alien plants and also the current situation of the invasive plants in Turkey.
Keywords: Turkey, Giresun, Invasive alien plants, Plant biodiversity, Conservation

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Mine permission process in state forests and the importance of rehabilitation (Example of Bartın Province)

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Abstract: Turkey, which is a county very rich in respect to natural resources, sometimes has a conflict of priority between renewable natural resources and non-renewable natural resources due to its level of superiority. This is inevitable especially in the demand for mining exploration and exploitation in forest areas covering about 27% of the country's total surface area. Mining on forest lands is an important land use change example and is directly related to global climate change. Nowadays, while the adverse effects of global climate change are increasing at a noticeable rate and while the areas where the forests allowed as mining sites are exposed to other negative natural phenomena such as flood, erosion and so on, it is necessary that the legal background is to be very carefully formed and the permission period is to be controlled very well. For this reason, mining permits in the state owned forests have been subjected to very detailed and comprehensive legal regulations. Since forest functions should be protected the best during the operations of these activities, it is essential to forests are minimally damaged. In addition, the rehabilitation of the areas after the end of the permit periods have been arranged in detail both in the Turkish environmental and forestry legislation. In this context, according to the Article 16 of the Forest Law No. 6831 and the relevant regulation, after the mining activities are carried out in the State forests, the owner of the mining permit has to make the rehabilitation of the site to be delivered to the forest administration. The rehabilitation issue is very important when the permit period reach the expiration. The conditions such as aiming/trying to give permission from forest areas with low productivity, inspection during the permission period, examination the provisions of rehabilitation conditions at the end of the permission period and retrieval of the field, clearly, show that the forest areas are being protected in the mining permit process.
In this research, the quantities of mining permits given in the State Forests within the boundaries of Bartın province, which is rich both in terms of forest and mineral resources, will be determined and the legal process will be examined at each stage. Later on, the concerns about rehabilitation, the precautions to be taken for the fields that mining permits have expired, and the legal provisions will be evaluated
Keywords: Forest, Mine, Public interest, Rehabilitation, Bartın

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Oral presentation

Dutch elm disease in Turkey

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Abstract: Dutch elm disease (DED) is arguably the most destructive disease of broadleaf trees, killing the majority of elms (*Ulmus* spp.) in Europe and North America over the last 100 years. The first disease outbreaks were caused by *Ophiostoma ulmi* around 1910s in northern France, Belgium and Holland, but the pathogen spread to the whole Europe, to Turkey to Asia and also to North America. By the 1940s, it is likely that a second DED pathogen, *O. novo-ulmi*, which was more aggressive than *O. ulmi*, was introduced into North America, causing almost 100% mortality in mature elm. *O. novo-ulmi* now is divided into two subspecies, ssp. *novo-ulmi* and ssp. *americana*, based on the original regions of discovery. Subspecies *novo-ulmi* was first described from Moldova–Ukraine in Eastern Europe and subsequently spread throughout Europe and parts of Asia, whereas ssp. *americana* spread from central North America into Europe. Today, both subspecies occur in Europe; where their distributions overlap, hybrids are produced. DED was first detected in Turkey in the 1940s; however, the causal agent was not characterized. In early 1980s, a survey of DED distribution was carried out over most of Turkey by S. Sümer. However, the causal agents were not determined in the survey too. While some local studies addressed the disease and the causal agents in the early 2000s, more detailed information on the *Ophiostoma* species and their subspecies as well as their mating types were obtained in a number of global studies carried out by European researchers between 2001 and 2010. The current distribution of DED and the causal agents as well as their host species in Turkey however, are still not clear. The disease caused massive losses of elms populations in many regions of Turkey, including both forests and urban environments, but the overall ecological impact of these losses also remains unknown. The aim of the work reported here was to investigate the current distribution of the *Ophiostoma* species and subspecies causing Dutch elm disease in Turkey. For this purpose, survey work throughout the country has been initiated. To date, surveys have been conducted in southern, eastern and central Anatolia, particularly around Isparta, Burdur, Antalya, Uşak, Denizli, Aydın, Afyon and Çankırı. While our surveys are continuing, dead or dying trees with characteristic symptom and signs of DED were observed only in Burdur, Isparta and Çankırı so far. Characterization of the causal agents, determining their distribution and their impact on different elm species could provide beneficial information on the management possibilities and future challenges posed by the disease.

Keywords: *Ophiostoma ulmi, O. novo-ulmi, Ulmus glabra, Ulmus laevis,* Alien invasive forest pathogens

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Can alien invasive pathogen *Fusarium circinatum* threaten Turkish pine forests?

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Abstract: Invasive alien species are species whose spread outside their natural past or present distribution threatens biological diversity. Among these invasive alien species that change the functions and natural components of ecosystems, especially the ones that are carried by seeds and other plant material draw great attention. In Pathogens, carried by seeds, have a crucial role in spreading the diseases both domestically and across country borders. Among the important pathogens carried by seeds are a large number of *Fusarium* species. *Fusarium circinatum* (teleomorph: *Gibberella circinata*) is one of the most important pathogens of *Pinus* species, causing damping-off in nurseries and pitch canker in forests. This aggressive fungus may infect pine seeds and, therefore, can easily be spread long distances by the seed trade. It is a very significant threat to natural and planted pine forests, and to date it has invaded countries across five continents. At least 57 species of *Pinus* along with *Pseudotsuga menziesii* are susceptible to pitch canker to varying degrees. *F. circinatum* has recently been listed as a quarantine organism in numerous countries throughout the World. In Europe, it is currently included in the A2 list (present in the EPPO region but not widely distributed) of pests recommended for regulation as quarantine pathogens. Also in Turkey, it is among the organisms subject to quarantine. The importance of this microorganism is increasing day by day due to the large-scale losses to pine forestry in various parts of the World. For this reason, control measures against *F. circinatum* and all other invasive species should be taken and carried out without delay in the world. A thorough understanding of the epidemiology and ecology of the causal agent is an important prerequisite for managing this pathogen. Once alien invasive pests enter the country, they are usually extremely difficult to eradicate and may cause irreversible damage; hence, they set government back significant amount of money. In this study, an extensive search of literature dealing with *F. circinatum* was performed. In addition, the collaborations between Turkey and other countries were summarized.
Keywords: Fungi, *Fusarium circinatum*, Pitch canker, Pine diseases, Invasive alien species

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Antibacterial activities of juniper berry oil (*Juniperus oxycedrus* L.) against *Pseudomonas tolaasii* a causal agent of brown blotch disease on cultivated mushroom (*Agaricus bisporus*)

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Abstract: The essential oiI of Juniper berry (*Juniperus oxycedrus* L.) has been shown to be a very strong antiseptic and flavoring agent, having therapeutic and diuretic properties. In this study, the antibacterial activities of different doses (10, 20, 30, 50, 100 and 200 µg/ml) of Juniper berry oil were investigated against *Pseudomonas tolaasii*, a causal agent of Brown Blotch disease on mushroom by using volatile and serial dilution methods. The volatile effect of different doses of Juniper berry oil were determined against *P. tolaasii in vitro*. Sterile distilled water was used as a control. Antibacterial effect of Juniper berry oil was compared with that of *Thymbra spicata* var. *spicata* essential oil (50 µg/ml) which is known a very strong antibacterial essential oil. The dose, 200 µg/ml, of Juniper berry oil had a maximum antibacterial effect on *P. tolaasii.* It was thought that this antibacterial effect can be result from the presence of some main components as a □- and □-pinene, myrcene, sabinene, thujone, limonene, etc. This study is the first report on antibacterial effect of Juniper berry oil against the bacterial pathogen, *P. tolaasii*, a causal agent of Brown Blotch disease on cultivated mushroom.
Keywords: Brown blotch disease, *Juniperus oxycedrus*, Juniper berry oil, *Pseudomonas tolaasii*

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Defoliation by *Thaumetopoea pityocampa* Schiff (Lepidoptera: Thaumetopoeidae) and their consequence on Aleppo pine trees in semi-arid areas (Algeria)

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Abstract : Pine processionary moth defoliation had a significant impact on Aleppo pine, *pinus halepensis* trees growth in semi arid areas of plantation forests. based on the visual evaluation of pest damage by pine proocessionary moths in our investigation during two years infer that the rate defoliation in artificial stand were more important than in the native stand where the rate of defoliation not exceeding 10%, while in the artificial stand the rate of defoliation was varied between 25 to 50%. This may lead to decrease level of carbon in the atmosphere. The defoliations by processionary moths are variable in the aegis of the environmental conditions and in the dynamics of populations. Frequency analysis of the number of winter nests counted per tree shows a very high significant difference between the sites prospected (p=0.0001). The presence of native sites near than the artificial ones facilitated the adults migration from their origin sites where there were repeated treatments periodically into the monoculture plantations which offered a favorable conditions for this insect, it marks their presence significantly for young than for old trees of the plantations. The construction of winter nests of pine processionary moths depends to many factors; altitude, climatic conditions and number of processionary larvae. The pine processionary larvae have not only a strategy of construction of the winter nests but also a strategy of their occupation which defer from site to another and from variety of tree to another. The dimension of pine processionary winter nests was affected by the variation of the altitude, in our study we found that the nests which collected from the altitude of 1300m have a longer and larger dimension than the nests which collected from the altitude of 1200m.

Keywords: Processionary pine, Nest, Strategy of occupation

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Effect of magnetic fields on the growth of *Pleurotus eryngi* and *Pleurotus citrinopleatus* Mycelia

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Abstract: The effect of 4 different degrees of magnetic fields (2 mT, 25 mT, 50 mT and 100 mT) and 3 different exposure periods (5, 15, 30 minutes) were studied on the growth of two species of mushroom (*Pleurotus eryngi* and *P. citrinopleatus*) grown on the potato dextrose agar (PDA). The PDA medium was sterilized in autoclave for half an hour at 121 °C and then poured into the petri dishes at a rate of approximately 30 ml per dish. The dishes were vaccinated with mycelium of fungi that loaded on wheat grain. One grain of wheat was placed in the center of each dish and then an adhesive parafilm tape was placed around the edge of each dish to prevent contamination. The experiment was carried out in sterile conditions with five replicates per treatment and a total of 260 dishes. The effect of the magnetic field on the growth of the previously mentioned fungi was studied by measuring the average diameter of the fungal colony every two days for a period of 20 days. The data were analyzed using the one-way analysis of variance (ANOVA) and Student's t-test.
Keywords: *Pleurotus* sp., Magnetic fields, Mycelium

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Back-calculation of 8 January 2012 snow avalanche in Davraz Ski Center

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Abstract: A snow avalanche, which damaged ski lifts, occurred at 10:30, 8th January 2012 in Davraz Ski Center. According to field observations, avalanche release zone covers 33800 m^2. Its average slope and altitude are 39.3° and 2327 m (a.s.l.), respectively. In addition, there is no vegetation located in the avalanche area. In the present study, a back-calculation of this event was carried out by using RAMMS: Avalanche software. Snow rupture depth of release zone at the moment of avalanche was determined based on snowfalls during last three days by taking into consider contribution of transported snow by wind. Friction parameters, μ and ξ, were determined as 0.190 and 2500 as a result of many tests made for back-calculation until for obtaining simulation results which best fit with the avalanche. According to simulation results, maximum flow velocity, flow height, and impact pressure were obtained as 3.8 m, 34.0 m/s and 346.0 kPa, respectively. Because there is no observation of flow velocity and impact pressure, only flow height of back-calculation could be validated from damaged ski lifts. It was found that obtained flow height is well fitted with the avalanche event.
Keywords: Back-calculation, Davraz, Snow avalanche, RAMMS

1. Introduction

Snow avalanches can affect residential areas, energy and transportation corridors, industrial sites and back-country recreation (Jamieson et al., 2008; Aydın and Eker, 2016). That's why, an accurate prediction of avalanche dynamics (such as flow velocity, flow height, impact pressure and run-out distance, etc.) in natural three-dimensional terrain is essential. For this aim, snow avalanche dynamics models (such as RAMMS) are widely used as an important tool in snow engineering (Christen et al., 2010). These models can be used for avalanche hazard/risk mapping, visualization of hazard impact, safety assessment for building/infrastructures, planning, design, and evaluation of technical counter-measures for protection against avalanches. Snow avalanche dynamics models can also be used to back-calculate documented avalanche events. For example, Maggioni et al. (2012) used RAMMS:Avalanche software to back-calculate four well-documented avalanches artificially triggered at the experimental test site of Seehore in Aosta Valley (Northwestern Italian Alps) and many others (see Casteller et al., 2008; Christen et al., 2010; Aydın et al., 2014; 2015).

Snow avalanche dynamics models use second-order numerical solution of the depth-averaged avalanche dynamics equations. Avalanche flow heights and velocities are calculated on 3D Digital Elevation Models (DEM). DEM is used for generating calculation grid. The model assumes that no internal deformations occur in the body of avalanche (Rudolf-Miklau et al., 2014). Because RAMMS employs a Voellmy-fluid model (Voellmy-Salm model), two friction parameters, which are responsible for the behavior of the flow, plays very crucial role in back-calculation of the events. These friction parameters are dry-Coulomb type friction (coefficient μ) that scales with the normal stress and a velocity-squared drag or viscous-turbulent friction (coefficient ξ). While μ dominates when the flow is close to stopping, ξ dominates when the flow is running quickly (Bartelt et al., 2013). That's why, RAMMS was calibrated on the basis of many observed large avalanches in the avalanche winter of 1999, avalanches from the SLF avalanche database and from test site of Vallée de la Sionne (Switzerland).

Since analysis of former events is considered as starting point for avalanche studies, documentation/records of event is absolutely necessary (Hübl et al., 2002). Otherwise, prediction of avalanches is not so easy task when absence or limited existence of observation of events. Even though avalanches are a serious issue in Turkey, management of snow avalanches has not yet attracted the necessary attention (Aydın and Eker, 2016). That's why, non-availability of proper records of snow avalanches in Turkey have become crucial problem. Only a few recorded events are available and there is no updated database for snow avalanches as well as meteorological data (release height, snow density, etc.). As mentioned above, RAMMS was calibrated for Switzerland in terms of friction parameters. In order to make realistic simulations of avalanches in Turkey, these two parameters should be calibrated. However, there are quite limited avalanche observation for Turkey. A well-documented avalanche event occurred in Davraz Ski Center (Isparta-Turkey) at 10.30, 8th January 2012. Fortunately, this event only caused damages on ski lifts. Since nobody found skiing in the area in the course of the avalanche event, it did not cause any injury or death. In the present study, back-calculation of avalanche event was carried out by using RAMMS:Avalanche. Because of this event well-documented, many simulations were made in order to calibrate friction parameters to obtain simulation result which fits best with observed flow extents and flow height.

2. Material and methods

2.1. Study area

For this study, a well-documented snow avalanche, occurred in Davraz Ski Center located in the Mount Davraz (Isparta-Turkey), was selected as study area (Figure 1). Because following the announcement as a tourism center in 1995, the Mount Davraz with 2635 m (a.s.l.) where is suitable for winter activities, have become one of important ski areas in Turkey. Skiers not only from Turkey but also from Europe, Russia, Ukraine and Middle East Countries visit this area. The XY coordinates of the snow avalanche event in WGS 1984-UTM Zone 36N are 301380.16 and 4182969.07 for left and top, respectively, and 301705.66 and 4182331.59 for right and bottom, respectively. Snow release area covers 33800 m^2 with average altitude of 2330 m (a.s.l.) and with average slope of 39.3°.

2.2. Back-calculation of 8 January 2012 snow avalanche event with RAMMS

Back-calculation of 8th January 2012 snow avalanche event was carried out by using RAMMS (Rapid Mass Movement Simulation) software. RAMMS yields runout distance, flow height, flow velocities and impact pressure of dense flow snow avalanches, hillslope landslides and debris flows (for details see http://ramms.slf.ch). This software has three modules: I) RAMMS: Avalanche, II) RAMMS: Debris Flow, and III) RAMMS: Rockfall. In the present study, RAMMS: Avalanche module was used. In order to back-calculate/simulate an avalanche, Digital Elevation Model (DEM) is an important input. For this study, DEM was generated from topographic map with scale of 1/25000. This DEM data was generated by using ArcGIS 10.1, then was converted to ASCII format in order for using in RAMMS. In addition, release area and calculation domain of simulation were determined (Figure 3). Calculation domain was defined to avoid unnecessary process of unrelated areas in RAMMS. The definition of release areas and release heights have also a very strong impact on the results of RAMMS simulations. That's why, release area was drawn depending on field investigation. The release area was digitized in ArcGIS 10.1 as Shapefile (.shp) and imported into RAMMS. Fracture depth (d_0)(i.e. release height) (Figure 3) was calculated from snow depth data with intervals of 10 minutes measured by automatic weather observation system (AWOS) located at 1954 m (a.s.l.) within Davraz Ski Center. In Figure 4, ΔHS_3 is height of snow layer over the slope. Following elimination of biased or non-measured data from snow depth database, snow depth information with new snow from last 3 days (72 hours) before avalanche event (i.e. from 05.01.2012 to 08.01.2012) was used.

Figure 1. Location of 8th January 2012 Snow avalanche event

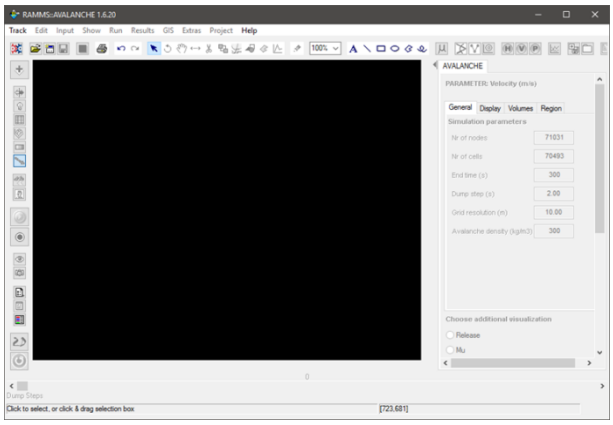

Figure 2. Graphical user interface of RAMMS: AVALANCHE

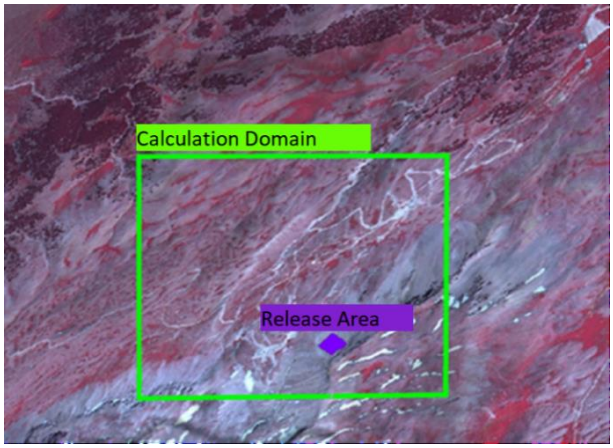

Figure 3. Release area and

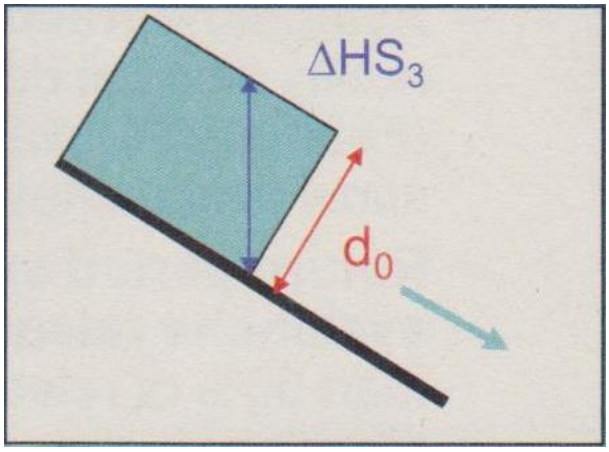

Figure 4. Snow friction depth and height of snow layer (SLF, 2012)

Snow depth measured for last 3 days before avalanche were given in Figure 5. In addition, snow depth and new snow for each day of last 3 days was given in Table 1. According to this, 89.95 cm of new snow was calculated for last 3 days.

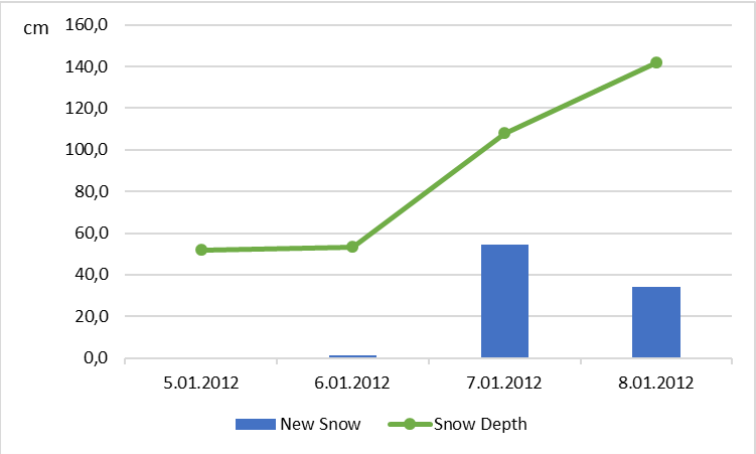

Figure 5. Snow depth and new snow for last 3 days before avalanche event

Table 1. Snow depth and new snow for each day for last 3 days before avalanche event

Dates	Snow Depth (cm)	New Snow ($d0_{new}$) (cm)
5.01.2012	51.92	0
6.01.2012	53.37	1.45
7.01.2012	107.88	54.51
8.01.2012	141.87	33.99
		$\sum d0_{new}$ = 89.95

Due to elevation difference between location of AWOS and avalanche release area, average snow depth calculated for location of AWOS was interpolated by adding 20 cm (i.e. 5 cm for each 100 m a.s.l). In addition, snow drifts by wind, which was predicted as 40 cm, was added to calculated snow depth. That's why, in total, 148.3 cm of new snow depth was calculated for snow release area. In final, a reduction factor$f(\psi)$ was applied for correction of fracture depth according to slope inclination of release area. Model for calculation of reduction factor, which was developed by Burkard and Salm (1992), was used. According to this model if $\tau_s/\tau \leq 1$ then failure can happen. Here, τ_s is shear strength, τ is shear stress (for details see SLF (2012)). Reduction factor is calculated by following equation:

$$f(\psi) = \frac{d_0}{d_0^*} = \frac{\left(\frac{1}{\rho g}\right)\left(\frac{c}{d_0^*}\right)}{\sin\psi - tg\varphi\cos\psi} = 0.291/(\sin\psi - 0.202\cos\psi) \quad (1)$$

where $\left(\frac{1}{\rho g}\right)\left(\frac{c}{d_0^*}\right)$ is cohesion factor and generally assumed as 0.291 depending on the experiences (SLF, 2012). Because cohesion is increasing proportional to the thickness of the slab (d_0^*) by sintering of the snow grains. In equation, $tg\varphi$ is angle of internal friction, which is accepted as constant as -0.202. In the present study, reduction factor was estimated as 0.61. Corrected fracture depth was obtained 90.5 cm for release area (i.e. 148.3 x 0.61). Following estimation of release height for avalanche event, many simulation was performed until obtaining fit results with the known avalanche flow extents and flow height in order to calibrate friction parameters.

3. Results

In this study, average release height was calculated as 90.5 cm for this simulations. According to this, in total, 40272.8 m^3 snow mass released from the release area. Best fitting simulation result was obtained when friction parameters were used as 0.190 for Coulomb friction (μ) and 2500 for turbulent friction (ξ). Maps for maximum flow speed, maximum flow height and maximum impact pressure were given in Figure 6, Figure 7, and Figure 8, respectively. According to these maps, maximum flow height was obtained as 3.8 m. The maximum flow height of the avalanche was about 1.5 m at places where ski lift is located. Maximum flow speed and maximum impact pressure were obtained as 34 m/s and 345 kPa, respectively. Unfortunately, these results could not be validated because there was no observation about flow speed of the avalanche. However, maximum flow height could be validated by using observations of height of snow mass that caused damage on ski lift towers. Simulation result showed good fit in with the observed flow height.

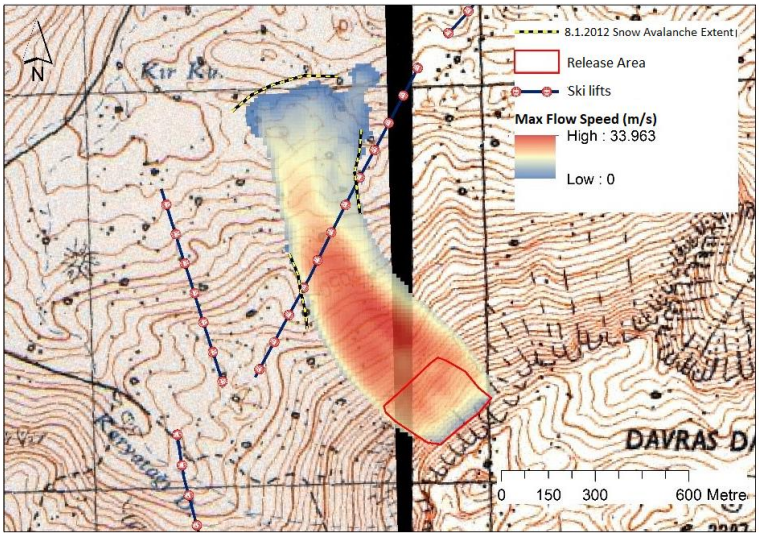

Figure 6. Maximum flow speed of 8th January 2012 snow avalanche event

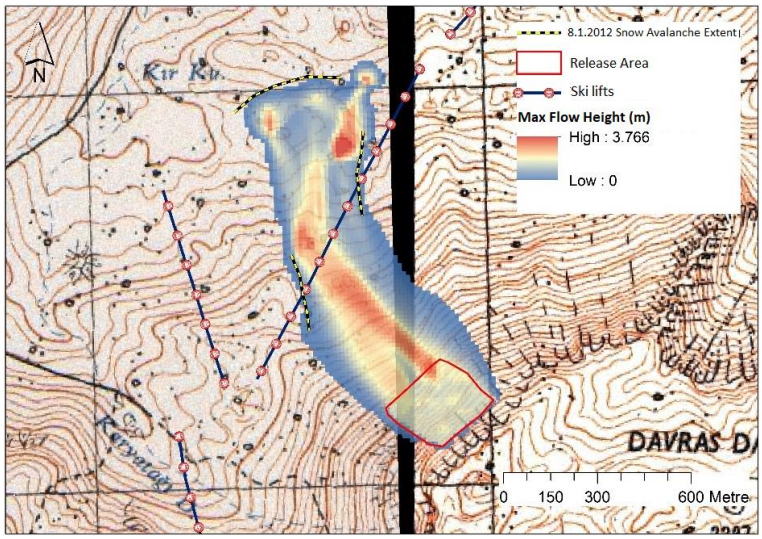

Figure 7. Maximum flow height of 8th January 2012 snow avalanche event

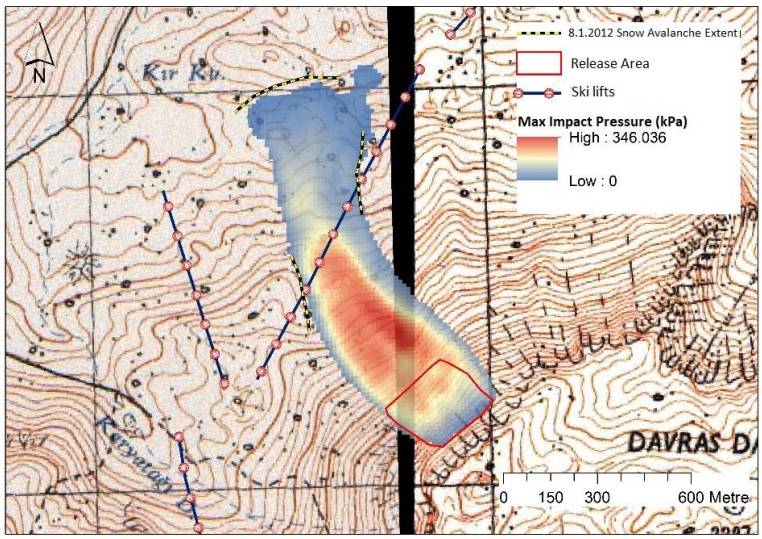

Figure 8. Maximum impact pressure of 8th January 2012 snow avalanche event

4. Conclusions

Snow avalanche dynamics models allow the user to back-calculation of snow avalanche events, thus to obtain friction parameters requiring for realistic snow avalanche simulations. This is very crucial especially when lack of adequate avalanche observations. Snow avalanche occurred in Davraz Ski Center is such a well-documented event in Turkey, thus it makes back-calculation possible. RAMMS:Avalanche software was used in the present study for back-calculation of 8th January 2012 snow avalanche event. It was observed that simulation results showed good fit in with field observations in terms of flow height and flow extent.

Acknowledgements

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Estimation of above and below ground biomass and carbon content in the grasslands of Bicakcilar and Kilickaya province in Artvin, Turkey

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Abstract: Above and belowground biomasses of grasslands are important parameters for characterizing regional and global carbon cycles in grassland ecosystems within terrestrial ecosystems. The objective of this study was to determine above and below ground biomass in the grassland areas of Bicakcilar and Kilickaya province in Artvin within Coruh River Basin located northeastern Turkey. Additionally, the amount of carbon contents were also calculated in the study areas in relation to regional distribution patterns of above and below ground biomass and their relationships with environmental factors were also investigated. To implement the study, 55 sampling sites were selected for different altitudes to determine the amounts of above and below ground biomass. For determination of above ground biomass (AGB), 1x1 meters in size wire cages were placed in the selected sample plots before the beginning of the vegetation period. These protected areas/plots (1x1 m^2) were harvested from soil levels at the end of the vegetation period and then dry weighed in laboratory. Root sampling for the below ground biomass (BGB) was also carried out using steel pipe of 6,4 cm in diameter and 30 cm in length. According to the obtained results, the amounts of AGB and BGB were ranged from 1 ton/ha to 3,8 ton/ha and from 3 ton/ha to 6,3 ton/ha in the Bicakcilar, respectively. As for the study areas of Kilickaya, the amounts of AGB and BGB were ranged from 0,8 ton/ha to 4 ton/ha and from 2,4 ton/ha to 5,2 ton/ha, respectively. The average carbon contents in the grassland of Bicakcilar and Kilickaya were estimated as 3,4 ton/ha and 3 ton/ha, respectively. At the same time, it was found that the amount of AGB increased to a certain altitude and then decreased, while the amount of BGB increased or decreased contrarily. Additionally, statistical analysis indicated that precipitation was the key determining factor for the amount of AGB and BGB in respect to the altitudinal change.
Keywords: Aboveground biomass (AGB), Belowground Biomass (BGB), Carbon, Grasslands

1. Introduction

Grasslands are potential carbon sinks to reduce unprecedented increase in atmospheric CO_2. Accurate estimation of above and below ground biomass carbon storage has gained more and more attention in the context of deepening research on the global climate change. Biomass is one of the most important grassland properties used to determine grazing capacities and their yield. Grassland biomass is under the influence of artificial and natural factors, and it shows temporal and spatial changes. Global climate change may affect ecosystem functioning by increasing temperature and changing precipitation amounts and patterns (Fiala et al., 2009), and climate is the major factor influencing carbon fluxes in grasslands (Paruelo et al., 2010). Precipitation and temperature are the main factors affecting grassland biomass (Hielkema et al., 1986; Nicholson et all., 1990; Tucker et al.,

1991; Clenton et al., 1999; DuPlessis, 1999; Wang et al., 2001). These two factors affect the biologic and physiological activities of plants such as photosynthesis, inhalation and sweating, affecting either positively or negatively amount of biomass production in the grassland ecosystems. Also, soil and climatic characteristics affect above ground biomass production as well.

Grasslands are one of the world's most common vegetation types, covering a wide area in both tropical and temperate regions. 15% of all global organic carbon in the world stored in the grasslands (Körner, 2002). Over the world, grasslands cover an area of 3.4 billion hectares and store approximately 343 billion tons of carbon. The amount of carbon stored in pasture areas is about 50% higher than the amount of carbon stored in forests (FAO, 2010a). It has been reported that there is a significant decrease in carbon accumulation due to the deterioration of grassland as a result of overgrazing in the pasturelands (Stypinski et al., 2006). In the global scale, to improve practices on grassland lands or rehabilitation of degraded grasslands that is as important as forest and agricultural areas. The coefficient used to convert the amount of biomass to carbon content in the grassland was found to be 50% (Lales et al., 2001).

In grassland ecosystems, resource allocation between above and below-ground layers, as well as root vertical exploration, are the main determinants of carbon (C) distribution (Sims and Singh 1978). About two-thirds of terrestrial C is located below-ground and this pool generally has much slower turnover rates than aboveground C (Schlesinger, 1997). Approximately 70–75% of root biomass in grassland is concentrated in the upper 15 cm of the soil horizon (Gleixner et al., 2005). The root biomass increases with age of grassland. An analysis of many published research works showed that, in grasslands below ground biomass averaged 1400 gr/m^2 and that 83% of roots occur in the top 30 cm depth (Jackson et al., 1996). In these ecosystems, the below to above ground biomass ratio reaches a value of 3.7 (Jackson et al., 1996).

Therefore, tropical and subtropical grasslands usually have a root: shoot ratio (R:S) higher than 4 (Mokany et al., 2006), while, in comparison, forest ecosystems have an R: S ratio below 1 (Cairns et all., 1997; Castro et all., 1998). This highlights the importance of below-ground biomass in grassland ecosystems. Although the amount of carbon in the above ground biomass in the grassland is small compared to the forest, but grassland is very important in terms of the carbon storage. Grazing can affect the stock and flow of C between above and below ground vegetation layers (Pineiro et al., 2009).

Grasslands have a rich and complex below-ground structure, with fine and coarse roots and a variety of below-ground organs, such as rhizomes, bulbs, corms and xylopodia, as well as a rich micro-flora and fauna (Stanton, 1988). A great deal of competition among the plants is taking place under the soil. Studies on C storage suggested that most of the C in grasslands originates from below ground biomass (Hungate et al., 1997; Jackson et al., 2002), primarily roots (Adair et al., 2009). Larger roots may be more important compared to small roots to enhance C pools (Rasmussen et al., 2010). Plants on the above ground compete for light and water and nearly twenty basic food stuffs in the below ground (roots) (Casper et al., 1997). Harris (1973), stated that in relation to root studies, "Although the importance of roots as structural repositories and physiologically active organs is well known, due to the difficulties in work it has been neglected in ecosystem studies" (Santantonio et al., 1977, 1979). Although significant research has been done on roots from 1970's to 2000, the difficulty of root work remains the most important problem. The methods used to determine the amount of below ground biomass are generally ignored because they are boring, time consuming and difficult.

In this study, we investigate the above and below ground dynamics of both biomass and carbon stocks of catchments in Coruh River Basin: Bicakcilar micro-catchments (40^0 51^I 27^{II} S, 41^0 12^I 58^{II} W), and Kilickaya micro-catchments (40^0 36^I 12^{II} S, 41^0 20^I 27^{II} W) located in Northeastern Turkey (Figure 1). Local annual precipitation of Bicakcilar and Kilickaya micro-catchments were 1274 mm and 918 mm, with the mean temperatures of 7 ^{0}C and 6,5 ^{0}C, respectively. The climate characteristics of the micro-catchments change in general, from the temperate climate features to the continental climate as you go from the Black Sea coast to inner parts of the Black Sea. Average elevations of the micro-catchments are 2287 m for Bicakcilar and 1547 m for Kilickaya above msl.

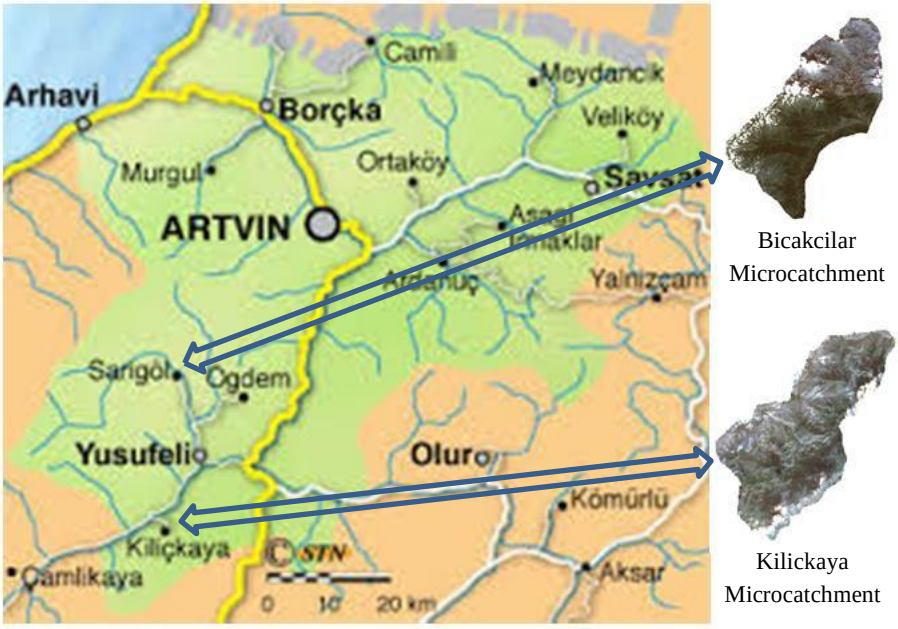
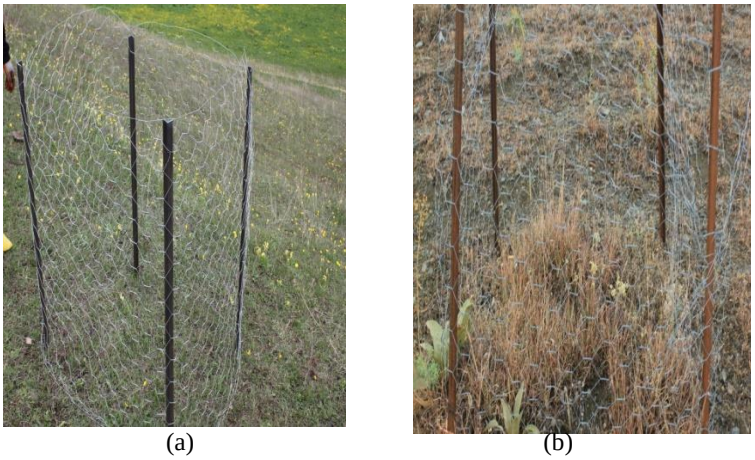


Figure 1- Micro-catchments within the study area

In terms of the land use types, Kilickaya has % 33 (8090 ha) and Bicakcilar has %42 (10998 ha) grassland area of total area. In general, the study area consists of various volcanic and metamorphic rocks and quaternary mineral deposits. The most common soil types in the study area are basaltic soil, brown forest soil, brown soil, chestnut soil and high mountain grassland soil. Most of the soils, with moderate to low productivity, have moderate to high erosion levels, especially on steep slopes (URL-1). Micro-catchments are also located in the flora region of Siberia in Europe. The Euro-Siberian (Euxine-Colchis) flora area contains all the northern parts of Turkey (Black Sea and Inner parts) and extends to a large part of the Caucasus to the Crimea and Dobrudja mountains to the east. With increasing elevation, the number of trees increases (pine, spruce, fir and mixed forest) in this region. The forests extend especially along the northern slopes, which receive more precipitation (URL-2).

2.2. Field data

In order to determine the above ground biomass in the grassland, wire cage assemblies of 1x1 meter size have been established at selected sampling points/plots (Todd ve ark. 1998) in Bicakcilar and Kilickaya (Figure 2).



(a) (b)

Figure 2- 1x1 m size cage established for determining the above ground biomass (a) before the vegetation period (b) and end of the vegetation period.

Three different elevation zones (1000-1500m, 1500-2000 m and 2000-2500m) and two different classes of aspects (shaded and sunny) were taken into account in order to estimate the amount of above ground biomass most accurately in the sampling plots. These plots were harvested from soil levels at the end of the vegetation period and placed in polyethylene bags and brought to the Artvin Coruh University Soil Science and Ecology Laboratory.

To determine the below ground biomass in the grassland, 55 sampling location were selected randomly and 220 root samples were taken randomly (4 samples were taken from each sampling location). In the study area, steel pipes with a diameter of 6,4 cm and a length of 30 cm were used for the sampling of the root (Figure 3).

Figure 3- View from root sample in the study areas

Each cylinder sample was transferred to a polyethylene bag and labeled and closed at the mouth and brought to Artvin Coruh University, Department of Soil Science and Ecology. According to the researches, the depth of 0-30 cm can represent 70-85% of the existing root mass (Eissenstat et al., 1997; Tüfekçioğlu et al., 2002).

2.3. Sampling processing and climate data

End of the vegetation period, vegetative parts was cut with scissors on the ground level to determine the above ground biomass. The dry matter weight of all sampling points was determined by sensitive scales by flushing at 80ºC for 2 days (Todd et al., 1998). The necessary transformations were made to determine the root amount in hectare (Figure 4a).

To determine the below ground biomass, all samples taken from the study area transferred to plastic bottles and added a little water, then left overnight to separate the soil from the roots. Below- ground biomass was water-washed in order to remove most of the soil attached to roots and other organs until free from all soil parts and filtration through 0,2 mm sieves. The roots that were cleaned from the soil were put into the water in white cups, and the pieces of dead cover, foreign matter and earthy soil were removed with the help of tweezers (Figure 4b).


Figure 4 (a)- Drying of the above-ground biomass samples (b)- Extraction of root samples from soil

Then, again with the help of tweezers, the roots were divided into three groups: capillary (0-2 mm), fine (2-5 mm) and coarse root (5-10 mm) and dried at 80 ° C for 24 hours and weighed at a sensitivity of 0.001 grams. The necessary transformations were made to determine the root amount in the hectare.

Meteorological data were used (rainfall and temperature) for the study area for the 30 previous years, recorded at Meteorology Station located in the research area.

3. Result and discussion

The average above and below ground biomasses and carbon amounts were presented in Table 1. When the amounts of total biomass in hectare were evaluated, it was determined that the highest value (6,38 ton/ha) was found in Bicakcilar and smallest value (4,96 ton/ha) was found in the study areas of Kilickaya.

Table 1- The average above and below ground biomass and carbon amount in the study areas of Kilickaya and Bicakcilar

StudyAreas	Average above ground biomass (ton/ha)	Average above ground carbon (ton/ha)	Average below ground biomass (ton/ha)	Average below ground carbon (ton/ha)	Precipitation (mm)	Temperature (ºC)
Kilickaya	1,57	0,78	3,39	1,70	914	6,5
Bicakcilar	1,87	0,94	4,51	2,25	1274	7

According to this data, the amount of biomass increased linearly with increasing precipitation ($p < 0.05$). Since water is an important source of plant growth, the amount of above ground biomass in the pasture areas is generally expected to decrease under arid conditions, while the judgment that the amount of below ground biomass should, on the other hand, increase under arid conditions has been supported by many investigations and findings (Tilman et al., 1992; Keller et al., 2004; Kahmen et al., 2005).

When the amount of above ground biomass is examined in the study areas of Bicaklcilar and Kilickakaya, the above ground biomass increased with the increased rainfall amounts. The amounts of above ground biomass were estimated 1,57 ton/ha in Kıilickaya (914 mm rainfall) and 1,87 ton/ha in Bicakcilar (1274 mm). Kendir (1999), calculated that the above ground biomass in Ankara grassland was 1,02 ton/ha, where the average annual rainfall was 368 mm. Yavuz et al., (2013) reported that the total above ground biomass in Duzce Esenler grassland was found to be 1,5 ton/ha. The study conducted in Artvin Aydin village grasslands by Bilgin (2010) found that the above ground biomass amount was changed from 1,5 ton/ha to 2,9 ton/ha with the average of 2 ton/ha.

In this study, the ratio of the below ground biomass to above ground biomass were found as 2,16 in the Kilickaya and 2,41 for Bicakcilar. Similar results recorded by Jiangwen et al. (2007) in China found that the ratio of below ground biomass to above ground biomass was estimated as 2.45.

The amount of total carbon (above and below ground carbon) was estimated as 2,48 ton/ha in Kilickaya, and 3,19 ton/ha in Bicakcilar and the average carbon amount was found 2,84 ton/ha (Bicakcilar and Kilickaya). The percentage of below ground carbon was changed between %69 to %76 and the percentage of above ground carbon varied from %24 to % 31 when we compared to total carbon amount in these two study areas. Glatzle (2012), reported that the ratio of below ground carbon was changed between %40 and %80 and the ratio of above ground carbon varied between %20 and %60. Also, he stated that the presence of woody species increases with increased of above ground biomass while below ground biomass decreasing.

Total biomass amounts were calculated from the study areas as 40126 ton for Kilickaya and 70167 ton for Bicakcilar (Tablo 2).

Tablo 2- Above and below ground biomass and carbon amount (ton)

Micro basins	Total above ground biomass (ton)	Total above ground carbon (ton)	Total below ground biomass (ton)	Total below ground carbon (ton)	Total biomass (ton)	Total carbon (ton)
Kilickaya	12701	6351	27425	13713	40126	20063
Bicakcilar	20566	10283	49601	24801	70167	35084

4. Conclusion

When we examine the amount of above ground biomass obtained according to precipitation amounts, the amount of above ground biomass is 1,87 ton/ha (Bicakcilar) which is highest precipitation and 1,57 ton/ha (Kilickaya) which is lowest precipitation amount. The amount of above ground carbon was calculated as 0,94 ton/ha and 0,78 ton/ha, respectively. The total biomass and carbon content depents on precipitation. According to analysis of varience, statistically significant differences were found in terms of above ground biomass and carbon contents between these micro basins ($p<0,05$). Also, the temperature determines the length or the shortness of the vegetation period and these affected to amount of above and below ground biomass.

Grasslands largely contain carbon deposits, which should be included in national carbon accounting. Although grasslands have large areas for carbon storage, more work and knowledge are needed on how changes in their composition affect the amount of carbon they can store. In order to be able to generalize the results obtained in the works done in Turkey, similar studies should be conducted in different climates, lands, aspect and geographical regions of Turkey.

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Midterm results of different intensity prescribed fires on soil microbial biomass in black pine stands

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Abstract: Soil microbial biomass (SMB) is a sensitive indicator of soil quality and has a fundamental key role in biochemical soil processes. This study was done in areas applied high and moderate intensity ground fires and adjacent control areas in old Black Pine forest stands at Kunduz series in Osmancık Forest Sub-District Directorate (Vezirköprü/SAMSUN). Soil samples were taken from 0-10 cm layers of soil, in December'13 (one month after burning), in April'15 and in July'15. Chloroform-fumigation-extraction method was used to determine the microbial biomass C and microbial biomass N (MBC and MBN). MBC and MBN values were changed between 50,69 µg g-1 – 69,91 µg g-1 and 15,70 µg g-1 – 154,79 µg g-1, respectively. SMB values were significantly lower in burned plots especially in low intensity fire plots than in control plots one month after fire and after a year approximated to control values. But again, SMB values were significantly lower in burned plots in summer period of that year. Within midterm, low intensity fire had more significant negative effect on SMB. When increase of availability of substrate considered, recovery of SMB is expected within long-term.
Keywords: Soil microbial biomass, Prescribed fire, Fire intensity, Black pine

1. Introduction

Fire has a critical role in ecosystem as devastating or beneficially. Fire in forest ecosystem, via destroying the vegetation leads to erosion and nutrient losses is unwanted (Fernandez et al., 2007). On the other hand, related to change in soil organic matter and pH after fire, amount and activity of soil microorganisms are effected directly or indirectly. Substantially nutrient is released with combustion of organic material and source for plant and microorganisms comes out. Mineral ash residue effects soil pH and so related to decomposition and nutrient turnover microbial activity is affected (Kauffman et al., 1992). Therefore, fire is an event has both positive or negative and neutral influence on forest soil and especially on soil microbiota.

Soil productivity and nutrient cycle are effected by number an activity of microorganisms which have key role in sustaining the fertility of soil. (Jenkinson and Ladd, 1981). Also soil microbial biomass acts as an important ecological indicator and responsible from decomposition and mineralization of plant and animal residues (Marinari et al., 2006). Above mentioned effect of fire is fundamentally related to fire intensity and process after fire or postfire conditions. Depending on fire intensity some nutrients are lost as gas form (Menaut et al., 1993) or depending on post-fire weather released nutrients lost in surface flow (Cerda, 1998; Meyer and Wells, 1997; Marxer, 1997) and by leaching (Korsman and Segerstrom, 1998). But an increase of microbial biomass could diminish the nutrient loses (Wüthrich et al. 2002). Also effect of fire on each fungi and bacteria groups which takes a short time or many years is related to fire intensity too (Mataix-Solera, 2009). Such an increase of soil pH and availability of nutrients which stimulates plant growth and microbial activity (Bara and Vega 1993; Korsman and Segerstrom, 1998) are positive conditions. Although fire may kill soil microbial biomass, it is considered as a restoration treatment and is a part of abiotic factors. So, as well as fire intensity, recolonization of microbial biomass occurs depending on change in soil, recovery of vegetation and postfire weather conditions (Mataix-Solera, 2009).

In this study, we investigated the effect of different intensity fire on soil microbial biomass (SMB) and correlation of SMB with other soil properties and soil respiration in black pine forests. For this purpose, at different intensity prescribed burning treatments were applied at Black pine stands in central Black sea region, Turkey.

2. Material and methods

2.1. Study area

The study area is located at county of Vezirköprü in city of Samsun in Turkey. Test sites were chosen from Kunduz serials with in boundaries of Osmancık forest sub-district directorate connected to forestry operation directorate of Corum and were determined from some black pine stands. Black pine stands in study sites are two over-storied (5-15 and 80 aged). The sites are North-west aspected, and at 1250 m elevation. Slope degree of areas was 5-10%.

Study area remains at Black sea transition zone (Between continental and temperate). Yearly mean precipitation is 527mm and yearly mean temperature is 11.4°C and relative humidity is 68% in study area.

2.2. Field studies

At test sites prescribed burning was applied as ground fire. Burning treatment was done at two different fire intensity; one is low fire intensity (LIF) plot and the other one is medium intensity fire (MIF) plot. Control plots were chosen adjacent to burned plots. Soil samples were taken from 0-10 cm soil layer in December'13 (one month after fire), April'15 and July'15.

2.3. Laboratory studies

Soil samples were air-dried for chemical and physical soil analyses and passed through a 2 mm mesh-sized sieve. Organic matter contents of the soils were determined according to the wet digestion method described by Kalra and Maynard (1991) (modified Walkley-Black method). Soil texture was determined by Bouyoucos` Hydrometer Method described by Gülçur (1974). Soil pH was determined by a combination glass-electrode in H_2O (soil-solution ratio 1: 2.5) (Kalra and Maynard, 1991).

Soil microbial biomass Carbon (MBC) was estimated by extracting 30g oven-dry equivalents of field-moist mineral soil samples in 0.5 M K_2SO_4 (1:4 w/v) by the chloroform-fumigation-extraction method described by Brookes et al. (1985) and Vance et al. (1987). MBC was calculated from the difference in extractable organic C between fumigated and unfumigated soil samples as follows: biomass C = 2.64 EC, where EC refers to the difference in extractable organic C between the fumigated and unfumigated treatments; 2.64 is the proportionality factor for biomass C released by fumigation extraction (Vance et al., 1987).

The Kjeldahl digestion–distillation–titration method was used to determine the total N in K_2SO_4 (Anderson and Ingram, 1993). Microbial N (MBN) was calculated (Brookes et al., 1985) using the equation:

biomass $N = F_N/0.54$,

where F_N = (total N from fumigated soil) - (total N from unfumigated soil).

Soil respiration was determined with the soda-lime method (Edwards, 1982).

2.4. Statistical analyses

Obtained values were analyzed statically by using SPSS™ 15 packet program. For variation and differences of fire effects and for interrelation of soil characteristics, one-way Anova and Pearson correlation analyses were applied, respectively.

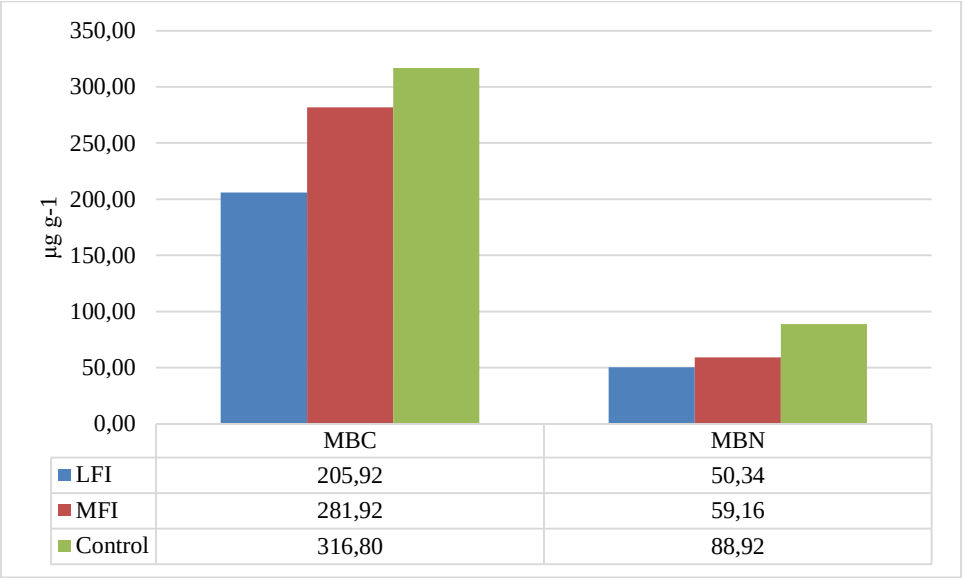
3. Results and discussion

Sand and silt contents values were not significantly different between plots, but only there was a significant difference between clay content values of plots. pH values of plots were not significantly different between plots either in December'13 or in the other terms. Analogous situation was found for soil organic matter (SOM) (Table 1). This situation is unexpected after fire but similarly some studies found fire didn't have significant effect on SOC (Johnson and Curtis, 2001; Wilson et al., 2002; Knoepp et al., 2004; Tüfekçioğlu et al., 2010) and soil pH (Dumontet et al., 1996). Clay contents of burned plots were lower than control values. If the decrease in clay content leaching oriented, pH situation of burned plots may be from same reason. Because burning treatment was done in rainy season and so released ions might be leached or carried by run off from surface soil. Likewise, litter covering of soil was destroyed by fire.

Table 1. Mean values of sand, clay and silt contents, pH and soil organic matter (SOM) rate

Plot	Sand (%)	Clay (%)	Silt (%)	pH	SOM (%)
LIF	69,46	12,99	17,55	5,75	6,90
MIF	65,01	14,91	20,08	5,87	5,48
Control	65,95	16,21	17,85	5,81	6,73

In soils of study area; highest mean value of MBC and MBN content were found in control plots. LIF plot had lowest MBC and MBN values (Figure 1). Results of one-way anova test showed a significant difference between MIF, LIF and control plots by both MBC and MBN values. Also, homogeneity test showed control values were in highest group, LIF values were in lowest group.



	MBC	MBN
LFI	205,92	50,34
MFI	281,92	59,16
Control	316,80	88,92

Figure 1. Microbial carbon and nitrogen (MBC and MBN) contents of plots

One month after the fire in December'13 and in July'15 which was the last measurement term and one more year after fire, MBC mean values were lowest in LIF plot too. But in April'15 MBC values were the highest in LIF plot (Figure 2). Also, these differences between plots were significant.

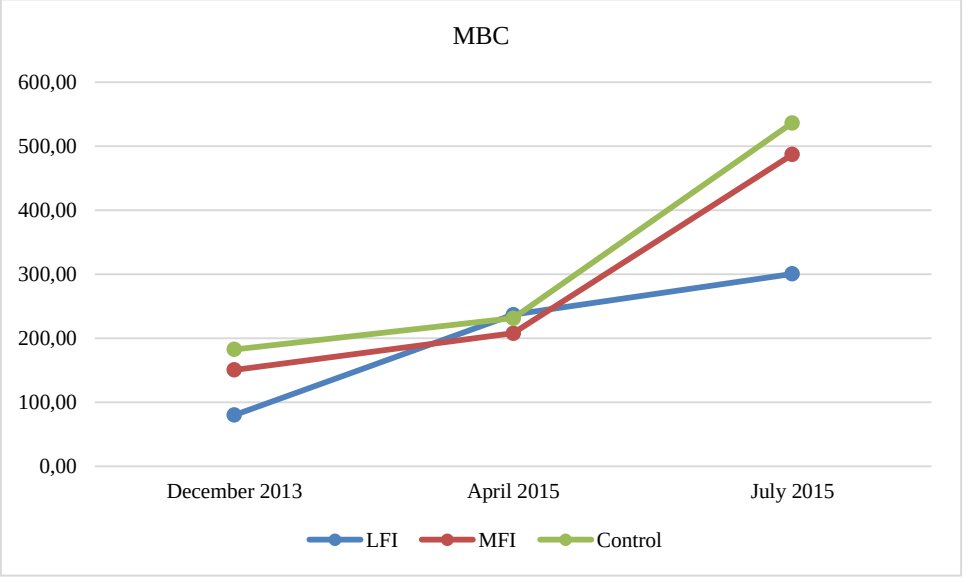


Figure 2. Change of microbial carbon (MBC) during seasons at plots

In all tree term control values of MBN were highest and LIF values were lowest except July'15 (Figure 3). These differences between plots were significant too.

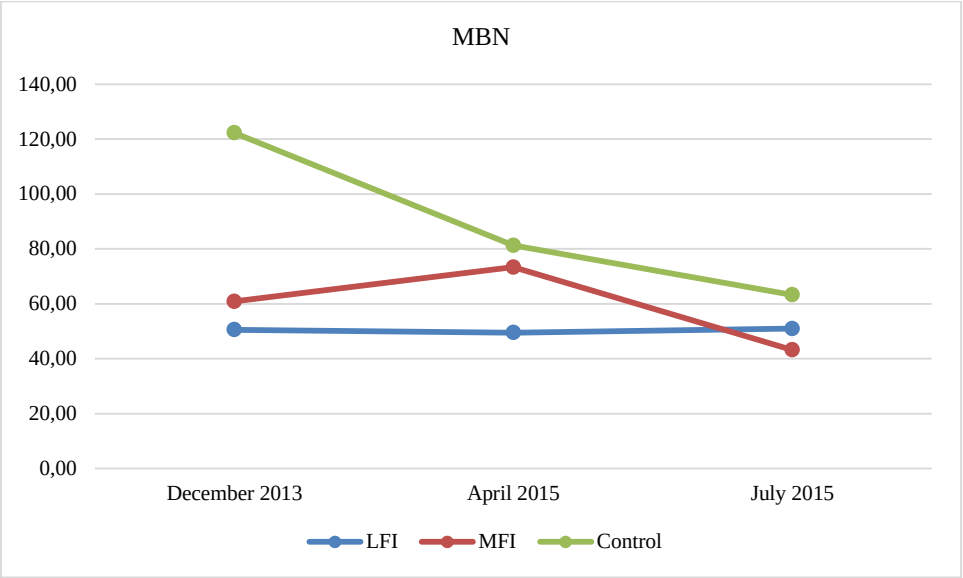


Figure 3. Change of microbial nitrogen (MBN) during seasons at plots

MBC/SOC (microbial carbon/soil organic carbon) rate was the highest in MIF plot and the lowest in LIF. Seasonally comparable results were found except first term December'13; in this term control values were higher than MIF values but mean values were almost the same (Table 2). Difference of values of MBC/SOC rates between plots were significant.

Table 2. Rate of microbial biomass to soil organic carbon during seasons and men values

Plots	December 2013	April 2015	July 2015	MEAN
LFI	0,23	0,49	0,82	0,51
MFI	0,60	0,53	1,79	0,97
Control	0,67	0,47	1,40	0,85

Like our results, in many studies, it was found that MBC (Grady and Hart, 2006; Waldrop and Harden, 2006; Rodríguez et al., 2009; Choromonska and DeLuca, 2001) and MBN (Bauhus et al., 1993; Dumontet et al., 1996) decreased with the effect of fire. High temperatures with fire kill the microorganisms in soil and recovery of microbial biomass is depended on post-fire conditions of soil exposed to fire (Díaz-Raviña, 1992; Acea and Carballas, 1996; Pietikäinen et al., 2000; Badía and Martí, 2003; Guerrero et al., 2005). Solvable carbon compounds which may be metabolize play key role at recolonization of SMB or to reach burned plots values to control values (Mataix-Solera et al., 2009). So, MBC/SOC rate which shows availability of organic substrates may indicate microbial growth or recolonization process. High rates of MBC/SOC shows that usability of organic substrate by microorganisms is well (Kara and Bolat, 2009). Above mentioned carbon compounds provide rather increase of microbiota especially bacteria (Grasso, 1996; Badía and Martí, 2003; Guerrero et al., 2005). In this study because of highest rates of MBC/SOC in MIF plots, higher intensity fire may accelerate dissolving of organic material.

Change of mean soil respiration rates of plots were like SMB, that is highest in control and lowest in LFI (Table 3). But differences between values of plots were not significant. Mean values of soil humidity and soil temperature of plots were not significant.

Table 3. Mean soil respiration, soil moisture and soil temperature values of plots

Plots	S. Respiration (g C d^{-1})	S. Moisture (%)	S. Temperature (°C)
LFI	1,47	33,58	10,33
MFI	1,58	33,08	11,26
Control	1,62	42,13	10,71

4. Conclusions

Fire experiment decreased soil microbial biomass significantly in black pine stands soils of our study. But there was no significant change at soil pH, organic matter and respiration rate even desired a change after fire. It was regarded as loss of available nutrients in ash by leaching or run off water, prevented the pH rise and microbial absorption. Although fire decreased microbial biomass, middle intensity fire increased availability of organic substrate and organic matter did not change significantly. Even if SMB decreased for once in April SMB values reached to control values. So, it was assumed that recovery of microbial biomass was related to fire intensity and other conditions such as season.

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Estimation of fuel load in maquis type vegetation of Antalya

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Abstract: An important prerequisite for successful fire management is the accurate estimation of the fuel load. Equations for estimating fuel load are an important basis for determining fire behavior, fire hazard risks, fire management plans, and decision-supporting system for fire management. An accurate estimation of fire behavior is directly associated with estimating the amount of fuel. Maquis type vegetation of Antalya are designated as first degree fire sensitive (i.e. fire prone) areas with the Calabrian pine forests of Turkey's Mediterranean regions. Maquis are generally distributed as Mediterranean-Type sclerophyllous shrubland either as understory of Calabrian pine forest or on their own areas as maquis. The purpose of this study is to determine the fuel load of maquis type vegetation in Antalya region. In this study, the total fuel load was used as dependent variable, height and diameter at breast height (DBH) of dominant shrub species, depth of litter and humus later were used as independent variables. Total fuel load estimated by samples based on fuel size classes such as foliage and branches between 0,0 and 2,5 cm. The measurements were based on a total of 30 maquis type vegetation in fire prone areas of Antalya. The highest predictable percentage as a result of linear logarithmic regression analysis for the variation in total maquis fuel load was explained the most by the height of dominant shrub species/depth of litter layer ratio, which together explained 70 % of the variation ($P<0.001$). The variation in total maquis fuel load was explained by the ratio for depth of litter and humus layers, which together explained 68% of the variation. The variation in total maquis fuel load was explained the least by the depth of litter layer, which explained 49% of the variation. Looking at the distribution of the amount of maquis fuel loads to maquis stand type, it is seen that the highest total fuel load is belonging to Mak3 type and the lowest amount of in the BM type. It has been found that there is almost 100% difference between the total fuel load between Mak1 and Mak2 types, whereas the difference between Mak3 and Mak2 types is around 20%.

Keywords: Maqui, Fuel Load, Antalya

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Estimating actual evapotranspiration using Landsat 8 Imagery: A case study of Isparta, Turkey

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Abstract: Water is the most important constraint facing agriculture in most of the countries, including Turkey. Irrigated lands are extremely vital to the economy of Turkey. Evapotranspiration (ET) can be defined as the loss of water to the atmosphere from the ground, lake, pond, and vegetative surfaces due to vaporization of water. ET is usually the largest hydrological flux through the summer months in Turkey. The ability to accurately estimate the magnitude of this flux is crucial for the water balance and planning the use of available water resources. The main objective of this study was to retrieve the actual ET from Landsat 8 satellite imagery for the city of Isparta, Turkey. The Surface Energy Balance Algorithms for Land (SEBAL) model was employed in this particular study to retrieve ET. Landsat images are a useful resource for estimating ET when high spatial resolution is desired. For this study, the Landsat 8 scene acquired on July 24, 2016 with path/row 178/34 was downloaded from the USGS webpage. The final ET map for the city of Isparta was derived at the end of the study.
Keywords: ET, LST, Remote sensing, GIS, Water

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Growth performance of *Cedrus libani* under different climates and its potential for use in Central European forestry

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Abstract: *Cedrus libani* (Lebanon Cedar) is a frost and drought tolerant evergreen conifer, mainly distributed as pure natural stands between 800 and 2200 m a.s.l along the Taurus Mountain Range of Southern Turkey. Regarding its durability and the outstanding properties of its wood, *C. libani* constitutes a valuable tree species for Turkish forestry from the economic and ecological aspect. Recently, the discussion intensifies whether *C. libani* might be a promising candidate to substitute indigenous tree species under a changing climate in Central European forestry. The aim of this study was therefore to investigate stem growth of *C. libani* under different climate and site conditions in order to evaluate its growth potential with respect to climate change. Investigations were conducted at five different sites: four natural sites were located in the Cedar Research Forest (SW-Turkey) along an altitudinal gradient and one site comprises small stands of *C. libani* which were established in the Ecological-Botanical Gardens of the University of Bayreuth (Germany) in the early 1980's. During 2013 and 2014, stem growth was monitored with point dendrometers at hourly steps on 4 – 9 trees per site. In addition, at the German site, annual stem growth was measured by sampling tree cores and tree disks of 20 trees for the time period from 1988 until 2010. Results from dendrometer records showed an altitudinal trend with later onsets and shorter durations of tree-ring formation at higher elevations. A bimodal growth pattern with cambial rest during summer drought was absent. Tree-rings were wider in years with higher annual precipitation. Correlation analysis between daily stem radius variations extracted from dendrometer records and site-climate showed that, at all sites, vapor pressure deficit and global radiation correlated negatively with stem growth while precipitation and relative humidity correlated positively with stem growth. Analysis at the German site showed that individual growth of *C. libani* was high, reaching an average tree-ring width of 4.9 mm year^{-1}. Average annual terminal growth (0.5 m year^{-1}) of *C. libani* was similar to that of *Larix decidua*, *Picea abies* and *Pinus sylvestris* growing on similar sites, and even superior for annual stem diameter growth for the last 10 years. Overall, *C. libani* showed good growth performance with higher growth rates and wider tree-rings when competition was low, light availability was high, and soil water was continuously available throughout the year. Best growth performance was observed at the German site, mainly due to a better water supply during spring and summer, underlining the potential of *C. libani* for Central European forestry under current and future climate conditions with cold winters and prolonged droughts during summer. Further studies on *C. libani* growth should explore and test its cultivation and economic potential in silvicultural plantations under different site and climate conditions.
Keywords: Assisted migration, *Cedrus libani*, Climate change, Dendrometer, Stem growth, Tree-ring

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Surface soil erosion after prescribed burn in the *Pinus nigra* stands

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Abstract: Forest fires are an integral part of the fire-depended ecosystem. However, in some ecosystem fire can create undesirable conditions like reduction in soil quality and increase in soil erosion. In this study, the effects of different forest surface fire intensities and slope levels on surface soil erosion were studied using 5x2 m runoff plots. For this purpose, four prescribed burning sites, located on high (60%) and low (10%) slope areas under old *Pinus nigra* stands subjected to high and low fire intensities, were being selected to conduct the study at Kunduz Province, Vezirkopru District in Samsun. In general, results from the study reveal that burned sites experienced almost 3 times as high surface soil erosion as did control sites. The magnitude of erosion after the prescribed burn was consider to be low (ranged from 98 to 363 kg/ha) indicating that prescribed fire can be used as fire management tool to reduce fuel load up, particularly in the low-sloped areas of forest.
Keywords: Surface erosion, *Pinus nigra* stands, Prescribe fire

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Development and structure of the Turkish National Fire Weather Index System's Software

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Abstract: Effective forest-fire management is based on sound information of the potential for ignition, fire behavior, difficulty of control, and impact of fire in a given situation. Decision support systems such as fire danger rating systems (FDRS) provide a framework for organizing and integrating scientific knowledge and operational field experience. Today, FDRS have long been a part of fire management organizations in many countries around the world to help fire managers to make sound decisions concerning fire management activities. Fire danger rating systems implemented in many countries help predict fire danger potential taking into consideration the environmental factors that have an effect on fire potential and danger. These systems have been successfully used especially in USA, Canada and Australia and are being implemented in countries such as New Zealand, China and some countries in Europe. Although there is a great need for such a system, except for a few studies conducted in recent years, there has been no major undertakings in Turkey to provide a comprehensive solution to the problem soon. In this study, the structure and development of the Turkish National Fire Weather Index System (TFWI), the concept behind it, its mathematical structure and the basis of the system's software are described. TFWI system software is being unofficially used by Turkish Fire Service. The system consists of five components: two primary sub-indexes representing fuel moisture codes (FFMC and DMC), two intermediate sub-indexes representing relative rate of spread (ISI) and fuel consumption (BUI) and fire weather index (FWI) component representing fire intensity as energy output rate per unit length of fire front. While the TFWI system refers primarily to a standard fuel type (*Pinus brutia*), it is a useful measure for forest fire danger rating in Turkey. The system uses as inputs hourly weather readings (temperature, relative humidity, wind speed and rain) from online weather forecast providers. System allows for hourly predictions of fire danger and results are displayed as a map output. The system is now being used as a prototype to forecast hourly fire danger rating and a mapping software. The software improvement process is currently underway. The successful implementation of TFWI system will be invaluable in fire training programs, raising public awareness and using fires as a management tool.
Keywords: Forest fires, Fire danger, Fuel moisture, Decision support system

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Desertification assesment using the standardized precipitation index in Çankırı, Turkey

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Abstract: Drought is an important phenomenon, which is complicated to model and define. To understand the reason of drought, scientists proposed different desertification indexes. Standardized Precipitation Index (SPI) is one of the most important index that used to predict desertification. SPI can be used for determining the wet or dry condition of an area based on the rainfall data. In this study, SPI was used for assessment and analysis the occurrence of droughts. For this purpose, used from 50 years monthly rainfall data were evaluated in 5 time periods. In the light of this, we obtained the rainfall data of Cankiri from the Turkish State Meteorological Service. Then, rainfall data was used to generate SPI values based on Gamma distribution. The generated SPI values are categorized in order to identify the wet or dry conditions. There are seven different SPI classes based on SPI values such as extreme drought, severe drought, and moderate drought, near normal, moderately wet, severely wet, and extremely wet. This categorization showed a preliminary opinion for the area we included. Then, we generated 3, 6, 9, 12, 24-moth SPI scores for Cankiri. However, we only used 3-month SPI values because it provided a seasonal estimation of precipitation. 3-month SPI was appropriate for agricultural regions. So, it was more effective in underlining available moisture conditions. Moreover, non-parametric trend analysis approach Mann Kendall (MK) is applied to the generated 3-months SPI data. We illustrated the drought and wet conditions of 50 years data with trend analysis based on SPI values. Furthermore, the results of trend analysis are investigated and the changes in weather conditions based on SPI values are underlined.
Keywords: SPI, Mann kendall, Drought, Rainfall, Drought, Trend analysis

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Gender in global warming awareness; Bartın University example

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Abstract: The purpose of this study was to reveal the knowledge levels and awareness of the students at Bartin University on global warming and its effects. In this context, a questionnaire that consisted of 16 questions was administered to a total number of 536 students by using descriptive survey method. Of the participants 314 were female and 22 were male students. Their awareness based on gender was analyzed using the Chi-square test. The results indicated that 83.8% of the male students and 87.6% of the female students were conscious of global warming. It was also found that the awareness of male students on the reasons of global warming were higher than females whilst the awareness of female students on the results of global warming were higher than males. Although there was no statistically significant difference about knowledge of Kyoto Protocol, it was seen that the level of knowledge of males were higher. It was found that females were more conscious about forest biomass (X^2 = 4,021; p = 0,045) and renewable energy (X^2 = 9,651; p = 0,008).
Keywords: Gender, Global warming, Awareness, Forests biomass

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Marginal populations of Taurus cedar (*Cedrus libani* A. Rich)

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Abstract: Taurus Cedar, shows its largest and northern distribution in Turkey. The species, which is in the monopoly of Turkey, also has 344 ha in Lebanon and 150 ha in Syria as relict stands. It is estimated that only % 5 of its former existence has remained because of overexploitation for centuries.

A valuable portion of the genetic richness and diversity of forests is held by small populations living on the borders of natural species. These populations, in which species can survive under varying and extreme climatic conditions, defined as marginal / peripheral (MaP) populations. These small and isolated populations, with low gene flow and genetic diversity, are sensitive ecosystems and may be destroyed by the loss of appropriate adaptation properties by changing environmental conditions. The Taurus Cedar in Turkey generally shows a spreading along the line of Kaş and Eğirdir Barla Mountain and Köyceğiz-Künar Mountain and Kahramanmaraş-Engizek Mountain-Ahır Mountain between 800-2000 m altitudes. Apart from this general distribution in South Anatolia, there are two isolated stands in north around Niksar and Erbaa. Also there are isolated cedar remnant stands in the Afyon-Sultandağları-Deresinek Valley and Çaykışla Valley in the steppe transition zone in the Inner Northwest Anatolia. Apart from this isolated stands, cedar stands living in the natural border form the peripheral population of this species. The other distribution except in Turkey is just a single stand in Syria in 1250-1800 m altitude; and ten remnant stands spreading between 1100-1950 m. altitudes in Lebanon. These populations, which form MaP distributions of cedar, gain importance in terms of gene conservation, thanks to the possibility of owning adaptive genes/genotypes to global climate change conditions. The necessity for the conservation of genetic resources of Taurus Cedar was assessed at the international level in 1971 at the FAO Panel on Genetic Resources Experts and in 1977 it was considered among the first priority species to be taken into in-situ conservation. Köyceğiz-Künar Mountain forms the western natural border of Taurus cedar. The Cedar forest in the southward of south of Engizek Mountain, and the north of Ahırdağı and in Yavşan Mountain form the eastern border of natural distribution. The distribution as natural stands in 650 m altitude or individuals in 620 m altitudes between Antakya Hassa-Yoluklar and Söğüt Villages form the southern border in Turkey. 460 m - Finike is the natural distribution at the lowest altitude that it could reach individually. Rises to 2000 m in Taurus, and towards the inner parts on the Mount of Aydos in the north of the Bolkardağları to 2400 m with the effect of continentality. The cedar forests in -Feke and -Andırın areas have been identified as stand remnant, and pointed out to be protected. The first place cedar seen in the east beyond the distribution of cedar in the Beydağları; is around Bucak-Sobya village, Karlık and Katran Mountains. In this study; it is aimed to draw attention to MaP populations in order to develop programs and policies for protection.

Keywords: Marginal/Peripheral population, Taurus cedar, Genetic diversity, Adaptation ability, Climate change

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Some plant ecophysiology studies and their practical contributions in forestry in Turkey

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Abstract: Plant ecophysiology is the study of physiological responses to the environment. The field developed rapidly as a relatively unexplored interface between ecology and physiology. Ecology provided the questions, and physiology provided the tools to determine the mechanism. The adaptability of plants to extreme weather conditions as a result of global climate change is necessary for sustainable forestry. Recently in Turkey ecophysiology and modeling studies have gained importance in order to understand the reaction of forest trees to environmental conditions. Ecophysiology studies can make significant contributions to plant growth practices, Silvicultural treatments, plant growth estimates in trees. Physiological reactions and acclimation of plants to stress factors (drought, frost, salinity, etc.) can be understand by experiments done laboratory or controlled environments. Due to it's specific location, Turkey has forest ecosystems with different edaphic factors and climatically diversity. For this reason in reforestation, different techniques and cultural works are needed. The susceptibilities of different species, genotypes and ecotypes of forest trees to stress factors such as drought and cold hardiness should also be determined. Thereafter, the selected resistant species, genotype or ecotypes can be used in Afforestation. Forest decline or even dieback in response to high temperatures and drought has been occurring in the last few decades. Therefore ecophislogicial studies focus on predict and model future tree responses and survival to water deficit. Arid and semi-arid areas covers about 75% of Turkey's total land area. For this reason, majority of ecophysiological studies has focused on drought tolerances of forest trees. However a number of studies have been performed for the cold and salinity tolerances of forest trees. In this study, we evaluated the Ecophysiological studies that have been conducted on the forest tree species distributed in Turkey. The contribution provided through these studies for practice and present scientific knowledges was discussed. Suggestions for their practical utilization in afforestation and silvicultural treatments were also given.
Keywords: Turkey, Ecophysiology, Drought tolerance, Cold hardiness, Climate change

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Perceptions and knowledge about global warming and climate change of university students

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Abstract: Climate change, known as warming or cooling of the seasons outside the normal course, has become a global threat with an unusual warm-up period, especially during the last 30-40 years. In this process, the temperature anomalies of the seasons are above the average values, which are beginning to give rise to problems that can be felt on the elements of global equilibrium. These problems have become a serious threat to the life of human and all other living organisms. It is important that the level of knowledge and perception of the people about this subject at the stage of the measures that can be taken especially in the process of the global warming effects. In the light of this information, in this work, which aims to reveal the knowledge levels and perceptions of university students about climate change and global warming, was conducted a detailed questionnaire survey on senior students of different faculties in Suleyman Demirel University. The findings obtained based on the questionnaire data were evaluated by various descriptive and statistical methods and suggestions were made about the subject. Results of the study, students indicate that climate change threatens the livelihood of life and this is a worrying situation. A large part of the students have the perception that measures taken in the world and Turkey related to climate change are not enough.
Keywords: Perception, Level of knowledge, Global warming, University students

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Impact of climate change on the dynamics of forests pests in Algeria

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Abstract: Pine forests are favorable to the activity of various insect pests. Severe outbreaks are periodically caused by the processionary moth, *Thaumetopoea pityocampa*, in semi-arid areas of the Mediterranean Basin, often resulting in spectacular defoliations. Currently, this defoliator has become a model for study of climate change effects on forest pest insects in that region, and its range extends year after year. Climatic variations recorded in semi-arid areas have influenced the establishment of various insect groups, particularly bark beetles that find a favorable environment for their development. The pine shoot beetle, *Tomicus destruens* is an example, which has contributed significantly to diebacks recorded in recent decades in natural pine forests. Periodic outbreaks of Lepidoptera also occur. The gypsy moth, *Lymantria dispar* and its competitors, *Catocala nymphaea* and *Ephesia nymphagoga* are concerned, being a constant threat in oak stands, some years causing substantial defoliations in Cork oak and Holm oak forests. Recently, the occurrence of xylophagous insects such as *Platypus cylindrus* and *Cerambyx cerdo* has increased in cork oak forests in the Eastern and Western parts of Northern Algeria. In elevation, the Atlas cedar forest has not escaped to defoliations by the winter and summer processionary moths, *T.pityocampa* and *Thaumetopoea bonjeani*. Similarly, diebacks recorded over the past three decades in the Belezma cedar forest are the result of behavior of xylophagous aggressors, in related to environmental, especially climatic conditions. Forest insects are very sensitive to environmental changes influencing their distribution, but differently depending on species. As a result, under the effects of climatic factors, how these species share space and time, as well, as how they disperse, largely varies among them. This makes it difficult to foresee the effects of climate change on the structure of forest ecosystems.
Keywords: Climate change, Forest Insect, Algeria

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Assessment of fire watch towers by using visibility analysis: The case of Dursunbey, Balıkesir

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Abstract: The Mediterranean region is seriously affected by forest fires due to dry climate and fire sensitive tree species. Turkey, as one of the Mediterranean countries, is subject to number of forest fires every year. The coastline from the eastern Mediterranean region to the Marmara Region, which possesses approximately 5.5 million hectare of forested lands, is the most fire sensitive area in Turkey. Forest fire-fighting team can be listed under five groups: the first response team, alert-force team, the mobile team, fire-truck team, and air support team. In order to fight against forest fires effectively, fire-fighting team must arrive to the fire area in critical response time, in which the probability of controlling forest fires rises markedly. Therefore, it is very important to alert fire-fighting team immediately just after the beginning of forest fire. One of the most important tasks for early detection of forest fires is the fire observations from fire watch towers. Especially in fire sensitive areas, fire watch towers are built for monitoring large forested areas. At these towers, the fire lookout personnel work 7-24 bases to detect and announce fires during the fire season. Fire watch towers should be carefully located in such a way that ensures fire lookout personnel to monitor most of the forested areas in the region. This study aimed to evaluate locations of fire watch towers by using GIS techniques. The study area, Yayla Forest Enterprise Chiefs, is located in the border of Dursunbey Forest Enterprise Directorate in the city of Balıkesir. Three fire watch towers located in the study area were examined by using Visibility Analysis and then their locations were evaluated. The results indicated that 81% of the forested area was visible by available fire watch towers, while rest of the forests was out of side. Besides, it was found that 57% of the area was seen by more than one tower.
Keywords: Forest fires, Fire watch towers, Visibility analysis, Dursunbey

1. Introduction

Forest fires are one of the most detrimental factor that affect forest resources. The forested lands along the coastline of Turkey from Mediterranean region to Aegean and Marmara regions are classified as fire sensitive areas at the first degree (Akay et al., 2017). In order to fight with forest fires effectively, fire-fighting team should arrive to the fire area in the shortest amount of time. Especially in fire sensitive forested areas, arrival time should be within the critical response time, in which the probability of controlling forest fires markedly rises (Akay et al., 2012). Thus, it is crucial to detected forest fires and inform fire-fighting teams immediately for fire control.

For early detection of forest fires, General Directorate of Forestry establishes fire watch towers where fire lookout personnel observe forest fires 7-24 bases during the fire season (Gülci et al., 2016). Fire watch towers are located at the highest points at which forested areas can be seen clearly. The lookout personnel in the towers should be able to see all of the forested areas in flat ground, while visible forested area should be minimum 70% at the rough terrain (Çanakçıoğlu, 1993). The forested areas should be directly visible from at least two fire watch towers. Besides, lookout personnel should see the region at the visibility angle of 360^{o} and the distance between the watch towers should not exceed 25 km (Çanakçıoğlu, 1993).

Advances in Geographical Information System (GIS) and computer technology made it possible to utilize GIS based decision support systems in forest fire management stages including fire fighting activities, pre-fire precautionary measures, and post-fire operations (Küçük and Bilgili, 2006; Akay et al., 2012). Visibility analysis of GIS tools can be used to evaluate observation capacity of the fire watch towers (Singh et al., 2014). Besides, current locations of fire watch towers can be evaluated and alternative locations can be investigated for new towers by using visibility analysis (Aşkın, 2004; Akbulut and Özdemir, 2008).

The location of the fire watch towers plays important role in visibility range which is very important in effective observation of forest fires. In this study, the observational capability of fire watch towers located in Yayla Forest Enterprise Chief (FEC) of Dursunbey Forest Enterprise Directorate (FED) was evaluated by using Visibility Analysis function of ArcGIS 10.2.

2. Material and methods

2.1. Study area

The study area was Yayla FEC within the borders of Dursunbey FED which is classified as first degree fire sensitive area (Figure 1). The visibility analysis was run to evaluate locations of three fire watch towers in which two of them are within the

Yayla FEC. The third tower is located in nearby FEC called Candere and some part of the Yayla FEC can be observed from that tower. The information about these towers are provided in Table 1.

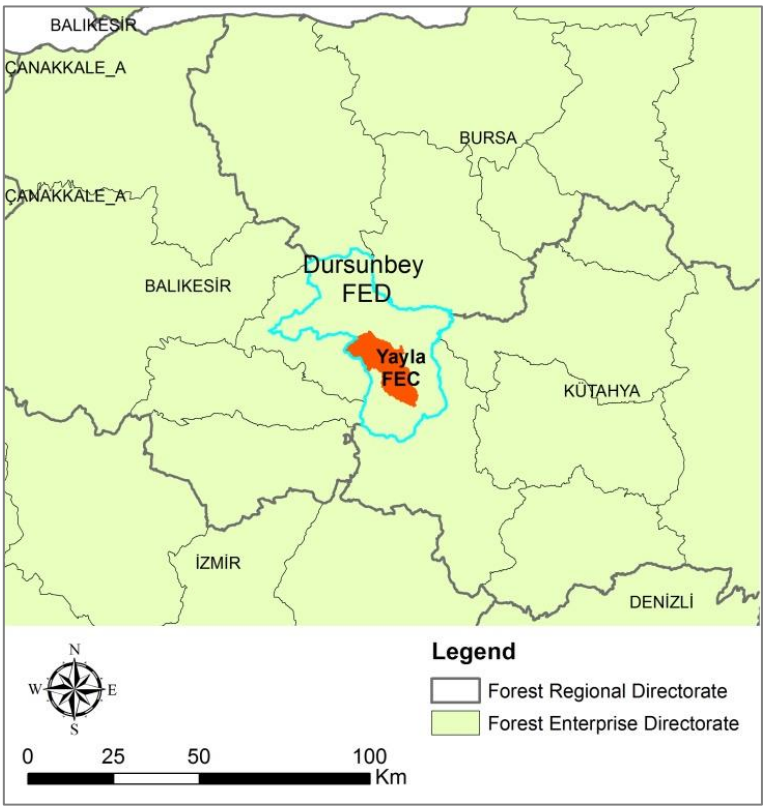

Figure 1. The study area map

Table 1. Fire watch towers

Towers	FEC	UTM Coordinates		Elevation (m)
		X	Y	
Tepepınar	Yayla	35 S 4372041	650489	917
Civana	Yayla	35 S 4360445	660081	1622
Kılıçoluk	Candere	35 S 4365300	650485	1110

2.2. GIS database

2.2.1. Digital elevation model

The accuracy of the visibility analysis mostly depends on reliable Digital Elevation Model (DEM). In this study, DEM (10 m x 10 m) was generated based on contour map (1:25000) with 10 m intervals (Figure 2). The contour map was obtained from Dursunbey FED.

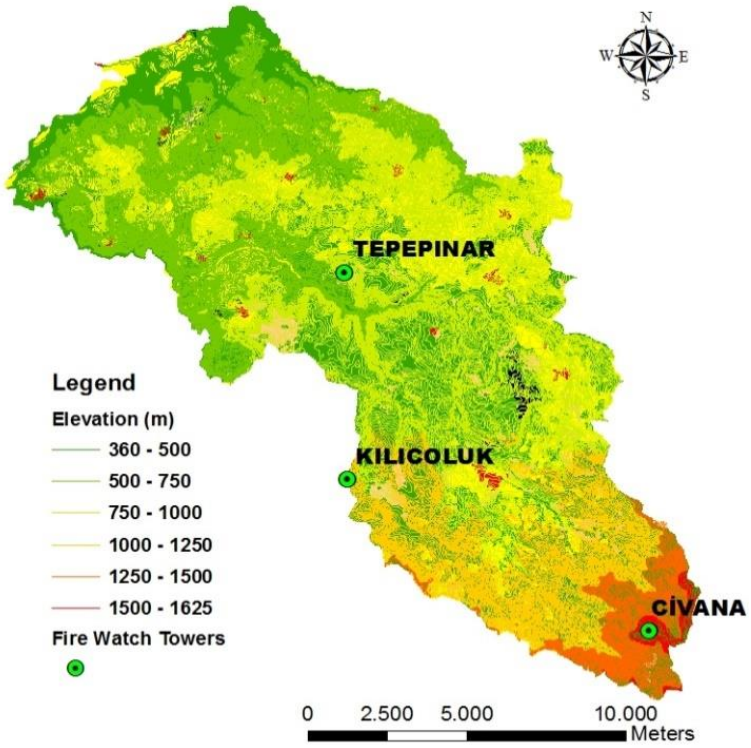

Figure 2. Contour map

2.2.2. Land use types

The land use type map was generated based on forest stand map (1:25000) which was also obtained from Dursunbey FED. Then, land use types (forest, agriculture, open areas, rocky areas, residential area, open areas-rocky areas, mines) within the study area was delineated (Figure 3). Then, a layer was generated representing the forested area and it was used in visibility analysis.

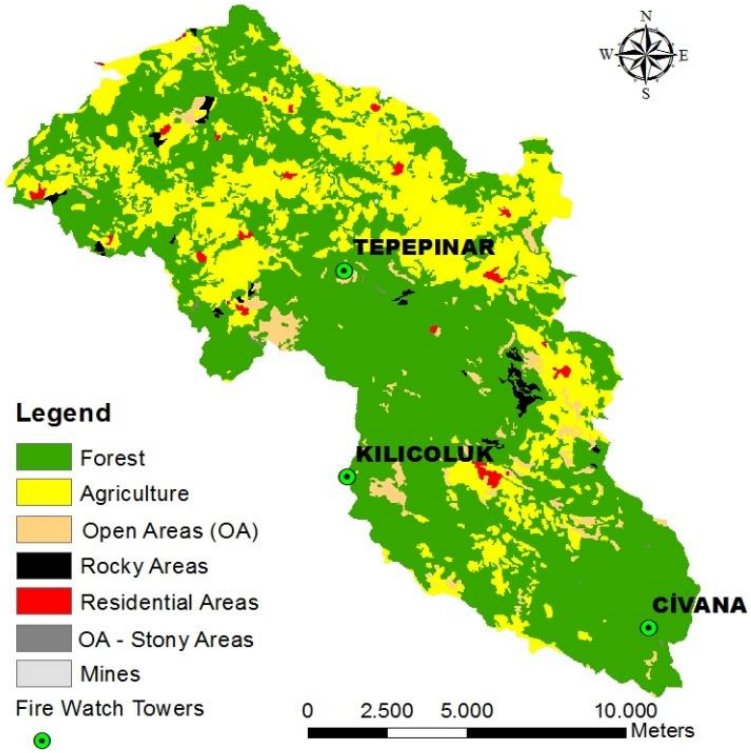

Figure 3. Land use map

2.3. Visibility analysis

Firstly, a data layer indicating fire watch tower locations were generated using UTM coordinates of the three watch towers. Then, Observer Points tool in ArcGIS 10.2 was used to run visibility analysis for the study area. This method requires a specific fields and data inputs in the attribute table of the watch towers. Table 2 indicates these data inputs entered in the attribute table.

In order to observe all of the forested areas around watch towers, horizontal visibility angle was set to 360°. In fire observations, fire smokes that are high above the ground surface are monitored. In this study, the smoke height was estimated as 100 m. Vertical visibility angles were set to +/-90 degrees. The visibility ranges of fire watch towers were also entered into attribute table. In the visibility map, firstly, visible and nonvisible areas from watch tower were indicated for whole Yayla FEC. Then, the map of forested areas was extracted from the map to evaluate visibility of forested areas.

Table 2. The data entered into attribute table of watch towers

Fire Watch Towers	Altitutes (m)	Tower height (m)	Smoke height (m)	Horizontal visibility angle (degree)	Visibility range (m)	Vertical visibility angle (degree)
Tepepınar	912	6	100	360	10000	+/-90
Civana	1622	6	100	360	15000	+/-90
Kılıçoluk	1110	6	100	360	15000	+/-90

3. Results and discussion

3.1. Digital maps

The DEM of the study area was indicated in Figure 4. It was found that the average elevation was about 860 m, with minimum and maximum elevations of 360 m and 1625 m, respectively. The land use type map was generated for the study area. Table 3 indicates the areal distribution of land use types. The results indicated that most of the study area was covered by forests (65.26%), and followed by agricultural lands and open areas. The data layer indicating forested areas was shown in Figure 5.

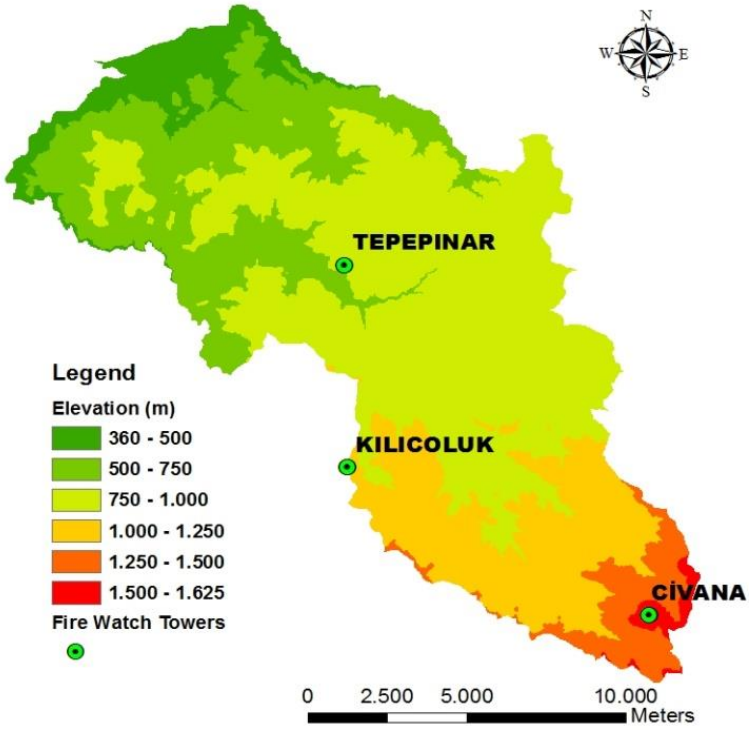

Figure 4. DEM of the study area (10m x 10m)

Table 3. Areal distribution of the land use types

Arazi kullanim tipi	Area (%)
Forest	65.26
Agriculture	29.54
Open Areas (OA)	3.46
Rocky Ares	0.85
Residential Areas	0.81
OA-Stony Areas	0.07
Mines	0.01

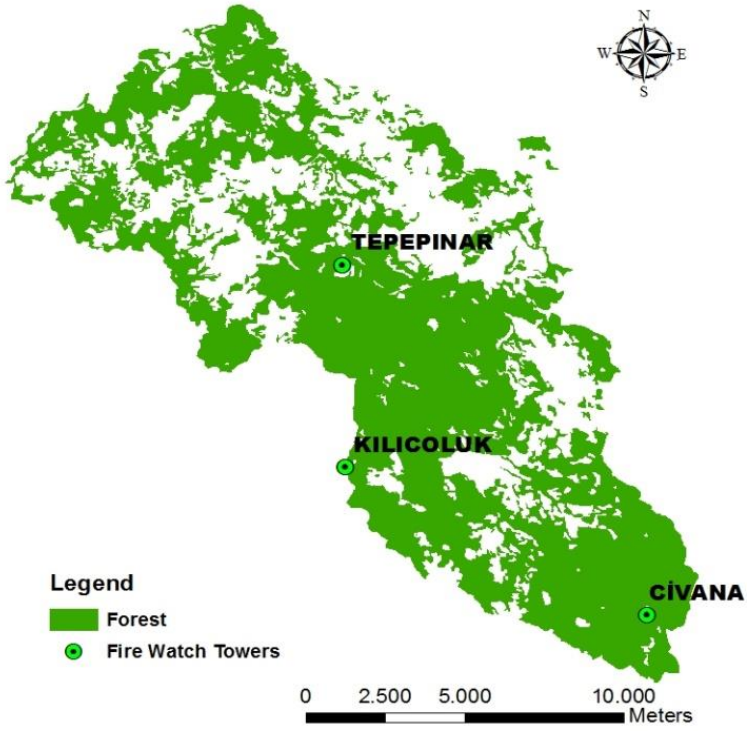

Figure 5. Forested area

3.2. Visibility analysis

The visible forest areas and areas observed by the towers were determined based on the visibility analysis (Table 4). The visible forested areas by the fire watch towers were indicated in Figure 6. It was found that 79% of the whole Yayla FEC was visible from the watch towers, while 81% of the forested area was observed by the towers. The tower with greater visibility was Tepepınar tower, followed by Kılıçoluk and Civana tower. Tepepınar and Civana tower together was able to see 20% of the forest area.

Table 4. The forest areas visible from the fire watch towers

Number of Towers	Watch Towers	Area (%)
-	Not Visible	18.85
1	Tepepınar	16.06
1	Civana	2.23
1	Kılıçoluk	5.72
2	Tepepınar - Civana	20.26
2	Tepepınar - Kılıçoluk	8.22
2	Civana - Kılıçoluk	7.47
3	All Towers	21.18

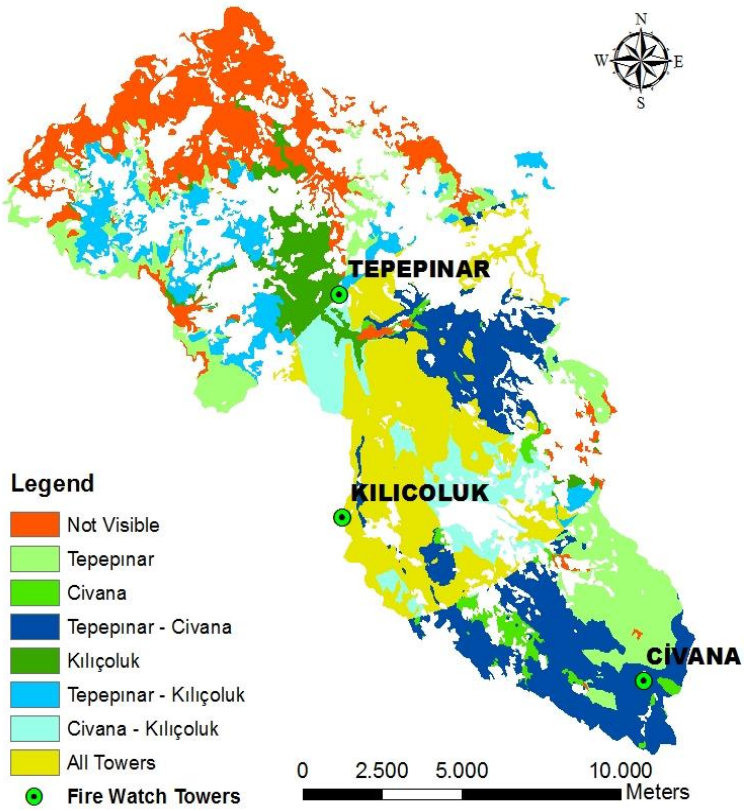

Figure 6. The forest areas seen by the watch towers

It was also found that about 57% of the forest areas was visible from more than one fire watch tower (Figure 7). About 21% of the forest area was visible from all tree towers. On the other hand, 24% of the forest areas was seen by only one fire watch tower.

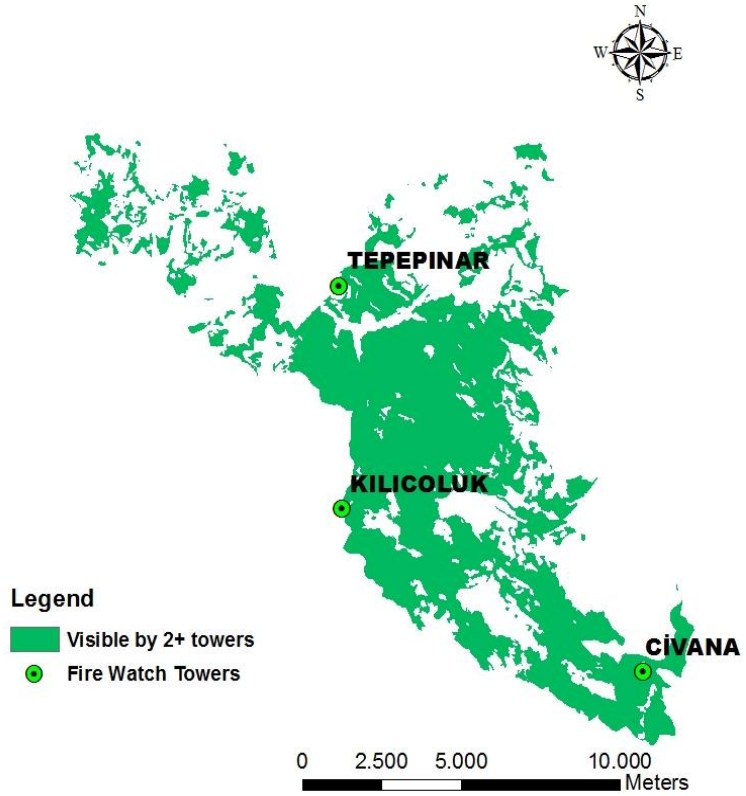

Figure7. The forest areas seen by more than one watch tower

4. Conclusions

GIS based visibility analysis was used to determine visible and nonvisible forest areas from fire watch towers. The visibility of three watch towers was evaluated considering the forest areas in Yayla FEC where two watch towers were within the FEC, while the third one was in the border of nearby FEC. Through the visibility analysis, it was aimed to determine the forest areas that can be seen from each individual watch tower, forest areas visible by more than one tower, and the forest areas that cannot be seen from any of the towers.

The results indicated that 81% of the forested area was visible by available fire watch towers, while rest of the forests (19%) was not visible. Besides, it was found that 57% of the area was seen by more than one tower. Based on these results it can be concluded that watch towers located within the study area was sufficient and their locations were suitable in order to monitor potential forest fires effectively.

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GPS and Google Earth integration; one step further to operational planning

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Abstract: In order to extensively and efficiently manage the forest areas, a well thought and constructed forest road network, "secondary transportation plan", on which the timber will be hauled to log yards or processing mills must first be devised. "Primary transportation plan", which is the initial phase of timber extraction (logging) in any forest operation from stump to forest road side landing, can then be properly executed. Forest roads in Turkey serve multiple functions such as administrative (forest management, conservation, fire suppression, etc.), social and recreational, and get planned and constructed as the management strategies and foresights mandate. Logging which includes felling the timber(s) and removing them out of the stands is the combination of becoming a relatively tough profession and the major player in the environmental adversities examples of which are endless throughout the world as well as in Turkey. Logging, at the same time, is also the part in forest operations, which always surpasses initial cost estimations because Turkish logging operations are still rather rudimentary compared to those of other nations, due to lack of technological advancements. Although relatively well known and used in Turkish forestry, Global Positioning System (GPS) implementation in the profession is only limited to location confirmation by foresters because they do not want to interfere with the administrative boundaries of their fellow neighboring foresters. GPS by itself can be an effective operational planning tool if coupled with the Google Earth. This paper will show with onsite knowledge of how bad an unplanned logging operation would result in an environmentally sensitive area and explain how such mishaps might be avoided if a simple GPS to Google Earth integration can be achieved and put into practice in similar circumstances.
Keywords: Global positioning system, Google Earth, Operational planning, Skidding route planning

1. Introduction

Professional forest management and planning in Turkey started more than a hundred years ago in 1907 with the approval of first ever law dedicated to forest administration. Afterwards, the first forest management plan was put into effect in January 1918 after a group of 10 foresters, 5 Austrian, 5 Turkish, had surveyed an area, near the present day sub-province Hendek, Cam Mountain Forests, in 1917 (Panel, 2017). Modern forest management planning dating back to 1960s produced first comprehensive forest management plans in 1972. Today, Turkish forests are managed according to the principles set towards achieving ecosystem based functional planning (economic, ecologic, social aspects) (Keles et al, 2017) (Figure 1).

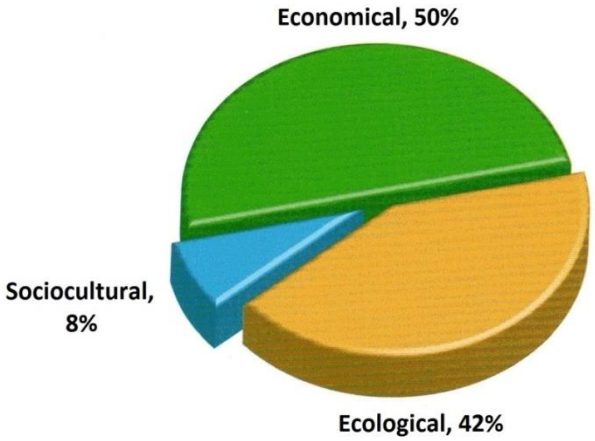

Figure 1. Ratio of main functions to Turkish national forest area, (Bülten, 2015)

Administration structuring is shaped under the governing body, Forest Service, with 28 regional forest directorates including 242 forest enterprises nationwide. Enterprises are also divided into numerous forest directorates, which house a patch of state forests in an approximate acreage of 15000 to 18000 ha. Forest management plans are made for each and every forest directorate depending on the forest stand types with different rotation ages. 10 year management plans are produced for

directorates heavily stocked with shorter rotation species of 50 to 60 years (red pine, pinus brutia) whereas a 20 year interval is used for longer rotation period of 100 to 120 years (other pine variants, coniferous and deciduous species).

Management strategies mandated in management plans of particular forest directorates are applied by state employed forest engineers, so the forests are sustainably managed, depending on the function assigned to them. The professionalism in the management state is at the highest level.

Sylvicultural principles and on-site practices starting from stand initiation via stand exclusion and reinitiation to old growth are applied in every stage of the stands' rotation cycles in accordance with the sustainability principle in utmost priority. The term sustainability, since its inception more than 20 years ago in Rio, dictates the fact that forest resources and forest land must be managed to satisfy the social, economic, ecologic, cultural and spiritual needs of today's and future generations (Cubbage et al., 2007).

The products and services supplied by forests are timber, water, food, fodder, shelter, employment, recreation, natural bio-reserves, landscape variations, carbon storage/pools and other produces. To continue, benefitting from the multi-dimensional advantages of forests, they must be closely guarded against any kind of threat, such as pollution, fires, insects, diseases and so on (Gunn, 1998).

Practices followed in Turkish forestry are rather tender in the early years of stands' establishment. An irregular grid of maintenance tracks, depending upon the slope and tree species is laid out within compartments (Figure 2).

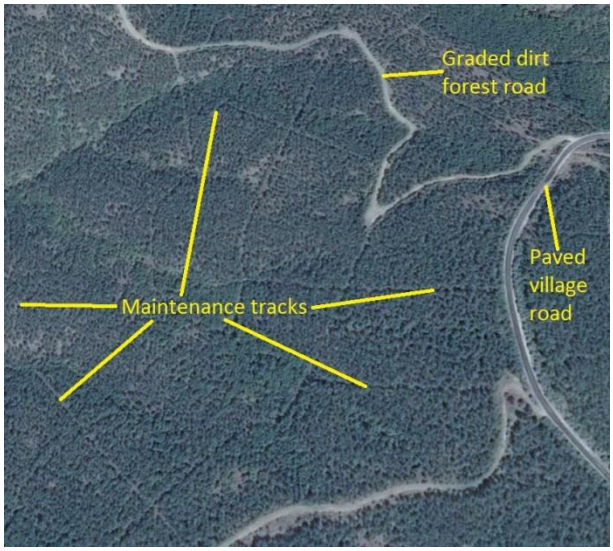

Figure 2. Layout of maintenance tracks in conjunction with other access roads (Daday forest enterprise)

Regenerating stands (predominantly naturally) in the early stages of stands' initiation are furnished with such maintenance tracks to facilitate easy access to any type of tending operations (Figure 3). They provide;

- Convenience during sylvicultural practices
- Extensive stand/compartment tending/maintenance
- Easy access during fire suppression or insect fight
- As skidding roads for longer rotation species

However, this good intension slowly fades away as the stands grow and spacing among individual trees enlarges; as the stands get older, tree trunks start thickening. Competition to reach the upper most canopy is immense in the early ages; this is when the foresters intervene and make thinning according to management plans. Common application to categorize the even aged stands to development classes in Turkish forestry is done in four categories: if 0<stand median diameter (smd) at dbh ≥7.9 cm, then the stand is classified as development class "a", if 8 cm < "smd" ≥ 19.9 cm, "b"; if 20 cm < "smd" ≥ 35.9 cm, "c" and if "smd" ≥ 36 cm, "d". If the stand is composed of uneven aged trees these designations can be paired like "ab", "bc", etc. Crown closure is also attached to the signage as "1" if crown closure is between 11-40%, "2" between 41-70% and "3" >70%. Maintenance tracks laid out and used up until the stands reach development class "c", is no longer needed because the spacing among individual trees are wide enough for skidding machinery to wander in any direction freely. All the good intentions and professional manners brought up in the early stages of stands' development are somewhat undermined when the stands reach maturity for timber harvesting. This is when the pristine forest floor starts getting trampled by heavy machinery while skidding or carrying the harvested timber in every allowable cut period.

Figure 3. Maintenance tracks (courtesy of Bolu Regional Forest Directorate)

In order to efficiently and sustainably benefit from forests, first a planned and constructed forest road network (secondary transport planning) interlinked with village, municipal and intercity roads, must be put to use to provide access to the tracks to be harvested and to enable any type of management activity to be applied inside the forests . Then, a subordinate transport scheme (primary transport planning) must be devised, implementing skidding tracks and roads and yarding possibilities, to move the felled tree(s) from their stump(s) to road side or designated landing.

Today, as the technological improvements and mechanization possibilities are diversified, planning the timber harvesting (logging) has become extremely important in practice. Such plans should be drafted and put into practice by taking all the restricting criteria into consideration as each and every harvesting scenario differ from one another in terms of topographical and ecological sensitivities. Thus, there is no one fits all type of approach in logging.

Logging can be formulated, benefiting from various planning approaches. "*Strategic planning*" is devised in rather large areas, spread over more than one compartment or track. They require topographical map drafting and field survey cross-check on critical issues to be addressed. A hardcopy logging plan is designed, pointing landing locations, haul road and skid road locations, appropriate logging system and yarding patterns. This hardcopy plan is later cross-checked in the field to accordingly address and adjust questionable points such as access locations and major road ways. In this approach, different timber harvesting techniques can be considered for their likely environmental impacts and cost. Following strategic logging plans representing the timber and the terrain that harvesting will take place, patterns, specialized approaches and habits start to develop and lead the way to logging system equipment selection. Another approach "*Tactical planning*" involves unique track(s) with pre-determined logging systems. They are field checked to an extent verifying the fact that the devised plan can be realized as envisioned with minimal environmental impacts, and well within the cost adjusted for the track(s). This is such a plan that specialized logging crew can take to forest with their specific equipment. They build the roads on sides as shown and then, do the harvesting as specified at the cost that has been planned. Knowing what and how to do enables the harvesting crew to program the work efficiently and guard themselves against any unexpected mishaps. As logging system specialization occurs, the track(s) will be further subdivided for other more specialized crews and systems to better fit the timber's and the terrain's needs. By tactically naming logging systems locations, and targeting the specialized system to the forest and the topography, a control in both the logging cost and the possible environmental impacts can be accomplished (Virginia's Forestry BMPs, 2002). The concept of timber production on the other hand is the subject of "*Operational planning*". They can be annually, seasonably, monthly and weekly drafted. For example, an annual operational planning for timber production includes how much allowable cut will be extracted from what compartment(s), using human, animal or machinery at what cost; where and how timber will be transported to what landing/depot, considering topographic, technical, environmental, ergonomical and socio-economical criteria. Planning is the process of decision making, thus the periodical selection of the compartments to be harvested, the preferred logging method or the selection the timber harvesting equipment and their performances, the determination of the compositions to be hauled to log depots, the loading means, the routes over which entire operation will proceed and the selection of the transportation means are the subjects of the operational planning (Eker et al., 2006).

Although expected to be entirely covered with forest vegetation, forest management blocks or planning units can include range and agricultural lands. Such planning units are generally encircled with natural and man-made restrictive phenomenon such as ridges, fissures and waterways, and local roads and links; these can be envisioned as a block including several compartments. The aim of distinguishing and dividing a forest management planning unit into logging planning units is to enable and define sections each of which will be harvested with a different method (Figure 4). Such separation is generally accomplished through available forest roads which are already considered as a transportation boundary, and naturally restrictive barriers.

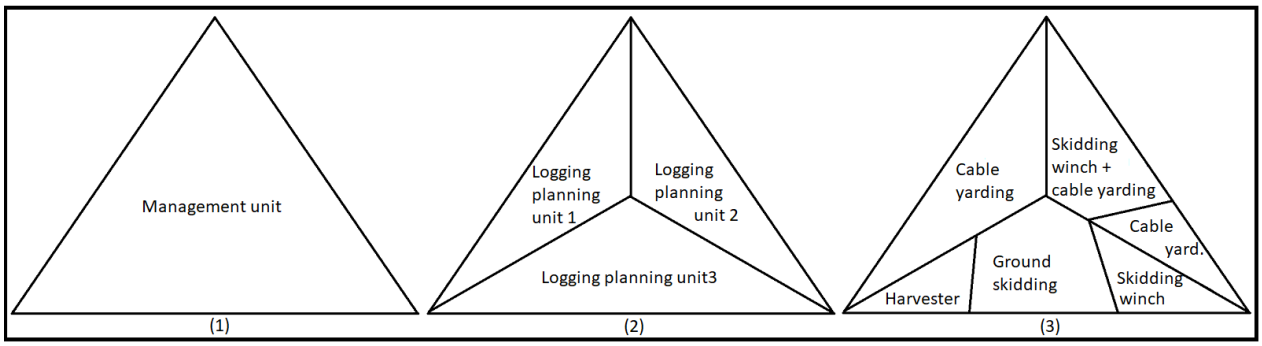

Figure 4. "1" Management block, "2" Logging blocks, "3" Logging methods per condition (Bayoglu, 1996)

All of the above mentioned planning schemes and approaches makes sense as long as the equipment and the people using them are up to date and functions flawlessly. However, mechanization and expertise levels in logging operations in Turkey are rather low (Demir, 2010). Logging is done by the members of forest cooperatives which are formed by the villagers who happened to dwell in or adjacent to state forests. The level of expertise is limited to being reared by the elder generations; no formal training concerning logging and its challenges is available. They are employed by the forest service with a mandatory constitutional decree that "job opportunities must be created for this people by the forest service", so logging has become their main occupation to make a living. Since logging is not providing a steady source of income year round, they also occupy themselves with husbandry, raising livestock and other forest service offered jobs such as sylvicultural tending, nursery and afforestation practices, free range none wood forest products picking, etc.

Forest Service has always procured the service of these cooperatives in timber production, however due to the fact that the rather low level of mechanization these cooperatives can provide (conventional 2x4 or occasional 4x4 farming tractors and attached skidding winches) and the lack of professionalism such "would be" loggers can manifest, there are considerable losses in timber quality and quantity (Yilmaz et al, 2008). Despite all the drawbacks and mishaps, technology is still giving an applicable edge to foresters as long as forest service would opt to implement simple but effective planning tools: Global Positioning System (GPS) and Google Earth geo-portal.

2. Methodology

2.1. Study area

Study was conducted in the "compartment #111" of Aksudere forest directorate in Samatlar Forest Enterprise within Kastamonu regional forest directorate. The standing stock was composed of pure "Corsican Pine_development class-"c"_crown closure 70%". The compartment was due for allowable cut dictated in the management plan. Directorate forester was measuring and marking the individual trees to be selectively harvested, timber cruising. A Garmin Montana 650 hand held GPS devise was used to get a position coordinate from marked trees' stumps, a point cloud including "724" tree positions was generated (Figure 5).

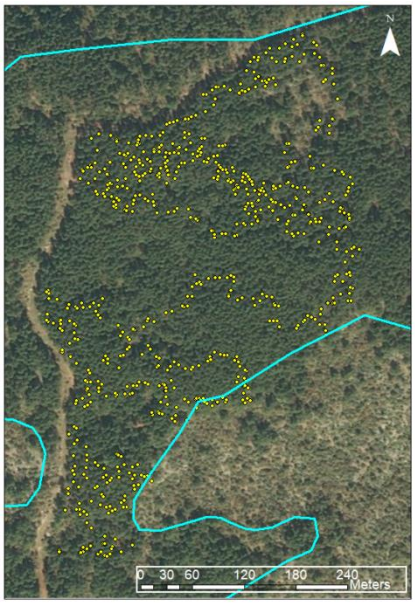

Figure 5. Positions of the marked trees within the compartment

2.2 Data handling

The distribution of the marked tree locations did not seem to deviate from the actual tree locations in the field. To make sure the point cloud was accurate for the task, three Garmin brand hand held GPSs', Montana 650, Etrex 20 and 60csx, generated point locations were compared to that of a Real Time Kinematic (RTK)/ Continuously Operating Reference System (CORS) suitable GPS receiver generated point. Out of 12 comparison points, positions generated by held hand GPSs were well within the manufacturer's assurance of "3 m", even within "1 m" in "x" and "y" directions (Figure 6).

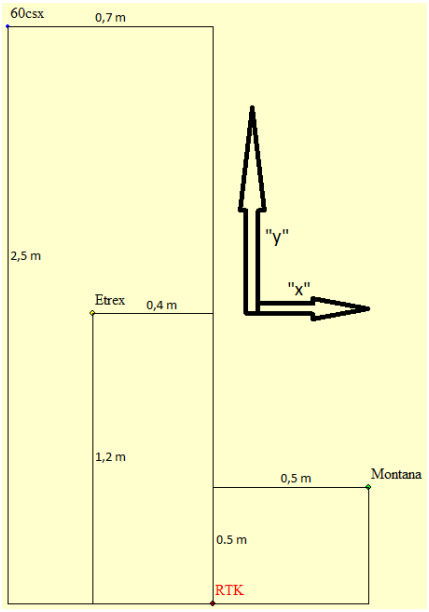

Figure 6. "x" and "y" deviations of different hand held GPS devices from that of RTK

RTK comparison showed that the point cloud was good enough to properly locate the marked tree distribution. Knowing how logging planning was done on topographical maps, knowing only the drafted compartment borders, GPS approach and visualizing it on almost real time imagery can be considered quite an achievement to speed up the process. To designate the skidding trails suitable for timber extraction from the compartment, the GPS generated point cloud was placed on Google Earth geo-portal. It was determined that a total length of 1621 m skidding trails would be needed to extract the timber to be harvested from this 262 m East facing slope (Figure 7).

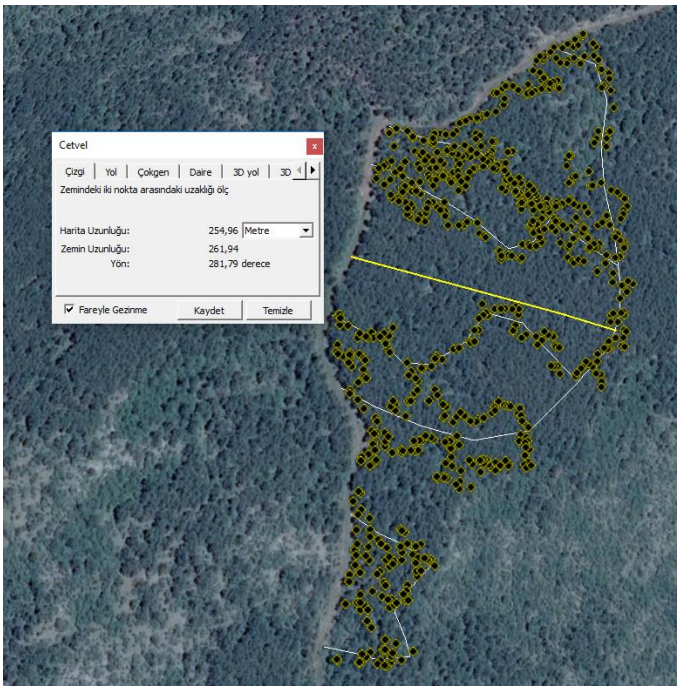

Figure 7. Farthest marked trees from the surrounding forest road

It is possible to evaluate slope on Google Earth, so this particular "logging planning unit" can be related to the specific logging method. 0% gradient as shown on "Figure 8" guarantees the fact that near level forest floor will be suitable for ground skidding with farm tractors on this occasion (Bayoglu, 1996). Slope evaluation is made possible in Google Earth because it shelters Shuttle Radar Topography Mission "SRTM"s global digital elevation model "DEM" underneath the images. This is how three dimensional viewing is achieved in the geo portal (Kennedy, 2010).

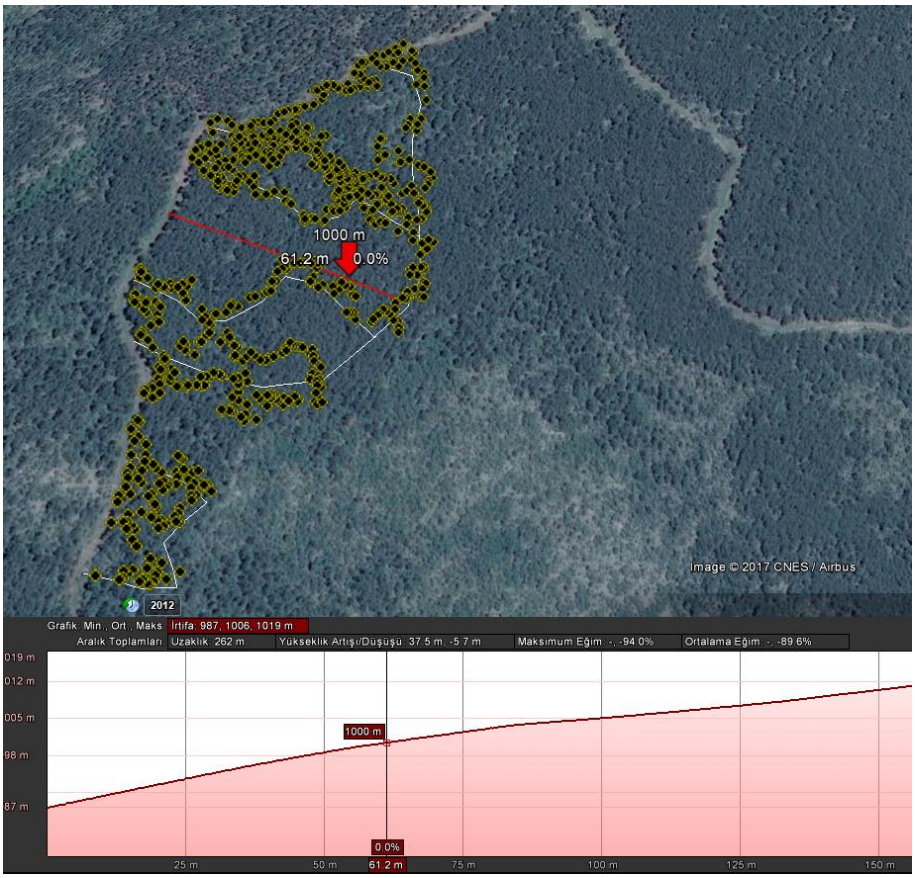

Figure 8. Slope evaluation of possible skid trails

3. Conclusion

Logging is a rather broad, but an unavoidable part of forest management. It deserves meticulous planning, otherwise all those long years of patience and good intentions are jeopardized. Logging planning in operational level involves dealing with many uncertainties many of which can be considered as a subject in itself. Location determination of the cruised timber can be accomplished with a hand held GPS which is widely available in any forest directory in Turkish forestry. GPS enabled hand held terminals will also ease up the clerical work done by a ranger during cruising (Garnett et al., 2014). Skid track designation can be accomplished, using "Google Earth", pending further field verification in the field. Designation of skid trails was proven to lessen the environmental and product damage (Wang et al., 2004). Nearly 40 % of the forest floor might be covered with skidding tracks, impending the taking root of the next generation of trees during a one-time harvesting attempt if no prior work is carried out to plan and place the proposed skid trails on site (Garland, 1997). When felling the trees are still achieved with chain-saws and manual labor, the expertise of the loggers to drop the trees toward the skid trails or cable corridors would considerably increase the production level, even offsetting the cost of expensive yarding operations (Olsen et al., 1984). It is also possible to keep the undesired soil impacts at bay when the initial phase of logging is directed through preplanned skid trails (McNeel, 1997). Two proven and accepted common knowledge can make a difference in logging when they are sincerely embraced and put into practice.

4. Discussion

Planning is the utmost priority in forest management. If it is only limited to the management phase, then harvesting becomes anyone's game. When performed haphazardly, timber harvesting not only decreases the quality of timber, but also leaves deep scars which themselves might need fixing at unnecessary expanses. Timber harvesting requires intricate planning, whereas the situation in Turkish forestry is very far from it. After the strands are timber-cruised by the foresters, forest cooperatives, loggers, come to do the logging. Their only agenda is to extract the timber as in a good enough form as possible, but there is still considerable difference between the standing volume and the extracted volume. Since the priority is on

timber, they do not care much about the remaining stand and the environment. Timber cruising can very well benefit from a GPS. This will enable forest engineer to see if he/she marked his/her stand(s) harmoniously or not. Once the distribution pattern of the cruised timber is visualized on Google Earth, it is then possible to evaluate the situation to further degree. Forest engineer can easily plan, verify, field check and finally peg the skidding trails in his/her stands. This way the most damaging part of logging can be restrictively executed.

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Evaluation of different supervised classification algorithms for crown closure classes: A case study of Yapraklı Forest Planning Unit, Çankırı

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Abstract: Remote sensing and Geographic Information Systems (GIS) provide novel occasions for forest inventory and ecosystem values. Forest inventory has been made by field measurements and remote sensing methods. Field measurements are mostly expensive, cumbersome and time-consuming. Recently, satellite images have been used successfully for large area applications, such as for national forest inventories. The use of satellite images has played significant role in determining forest stand attributes such as crown closures, development stages and land use. However, remote sensing methods have been used to estimate and monitor forest stand parameters with reasonable accuracy levels in large areas. Remote sensing technologies have been successfully used in carrying out of forest inventories and have played a vital role in estimation of forest stand parameters at a low cost and plausible effort with adequate accuracy. There are many algorithms that can be used to classify satellite images. Support vector machines (SVM), highest probability, maximum likelihood (MLC), closest distance, classifier of Mahalanobis, artificial neural networks and decision trees are some of them. The objective of this research was to classify crown closure classes using Landsat TM satellite image with different supervised classification algorithms in Yapraklı Forest Planning Unit. For this purpose, the MLC method and linear, polynomial, radial and sigmoid kernel functions for SVM were used. The SVM method radial function and the MLC gave better results than others did. The result showed that the MLC was estimated with a 0.6002 kappa statistic and 72% overall accuracy assessments, respectively. The SVM radial function for these values was 0.6797 and 80%.
Keywords: Crown closure, Image classification, Landsat TM, Maximum likelihood classification, Support vector machine

1. Introduction

Remote sensing are being investigated in almost every aspect and are being continuously improved especially in the field of forestry. One of the remote sensing techniques researched and developed in forestry is satellite image classification. Some of these techniques such as maximum likelihood, support vector machines, neural network, decision trees are widely used to different criteria such as development stage, crown closure, tree species, land use. Moreover, new techniques are always being investigated for image classification and evaluated for maximum accuracy and ease of use (Günlü et al., 2008; Kavzoğlu and Çölkesen, 2010; Otukei and Blasckhe, 2010; Günlü et al., 2011; Srivastava et al., 2012; Günlü, 2012; Taati et al., 2014; Bulut and Günlü, 2016). We focused on estimating crown closure with remote sensing techniques.

Crown closure is an indicator for productivity of forests. Especially, it is an effective parameter to decide on silvicultural applications. Remote sensing studies are used effectively in estimating this parameter. In this study, we compared performance of image classification techniques (maximum likelihood, SVM linear, SVM polynomial, SVM radial and SVM sigmoid kernel functions) in terms of crown closure.

2. Material and method

2.1. Study area

Our study area, Yapraklı Forest Planning Unit is located in Ankara Regional Forest Directorate with a total area of 29380.30 ha (Figure 1). It is bounded by 563243-572062 on the east longitudes and 4501061-4522167 on the North latitudes (ED 1950, UTM Zone 36N). Average altitude, precipitation and temperature of study area are 1348 m, 397.7 mm and 11.1 C°, respectively. The study area is covered by trees that include Black pine, Scots pine, Fir, Cedar, Oak and Poplar (Table 1).

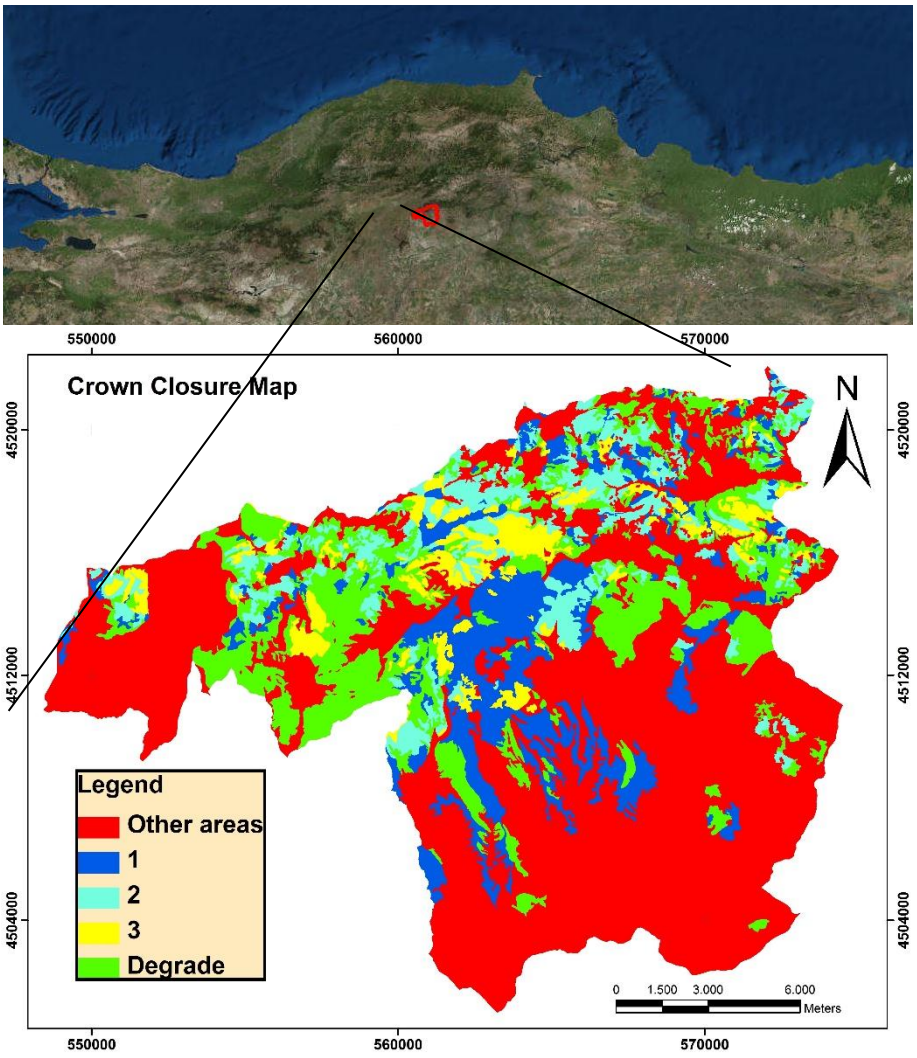

Figure 1. Study area

2.2. Satellite image and classification

The Landsat TM satellite image, which was consisted of six spectral bands (TM1, TM2, TM3, TM4, TM5 and TM7) with 30 m spatial resolution, was acquired on 2010. Stand map of Yapraklı Forest Planning Unit was used as reference data. Supervised classification methods that maximum likelihood, SVM linear, SVM polynomial, SVM radial and SVM sigmoid were applicated with ENVI 5.2 software. Five different crown closure classes were created. These classes are 1 (%11-40), 2 (%41-70), 3 (%71-100), degrade (%0-10) and other areas (settlement, agriculture). Signatures for each classes were taken through stand map and five different supervised classification methods were tested for crown closure. The most accurate parameters for SVM methods were found through trial and error (Table 1).

Table 1. SVM classification parameters

Methods	p	g	r	d
SVM Linear	200			
SVM Radial	1000	0.150		
SVM Polynomial	1000	0.150	1	6
SVM Sigmoid	100	0.150	1	

p: penalty parameter, g: gamma, r: bias and d: degree of kernel polynomial

3. Results and discussion

The most accurate classification was applicated with SVM radial method. It's kappa statistics value was 0.6797 and overall accuracy was 79.6704 %. The lowest result was obtained for SVM sigmoid method. Kappa statistics and overall accuracy of this method were 0.5577 and 72.3290%, respectively. Performance criteria and confusion matrix of all methods were represented (Table 2-7).

Table 2. Performance of supervised classification methods

Classification method	Kappa statistics	Overall accuracy (%)
Maximum likelihood	0.6002	72.1903
SVM linear	0.5933	74.4955
SVM polynomial	0.6792	79.6241
SVM radial	0.6797	79.6704
SVM sigmoid	0.5577	72.3290

Table 3. Confusion matrix of maximum likelihood method

Class	Other areas	Degrade	1	2	3	PA (%)	UA (%)
Other areas	4500	71	94	8	2	76.40	96.26
Degrade	435	1162	94	74	9	63.22	65.50
1	896	353	809	114	18	63.95	36.94
2	59	243	229	572	92	61.31	47.87
3	0	9	39	165	755	86.19	78.00

Table 4. Confusion matrix of SVM linear method

Class	Other areas	Degrade	1	2	3	PA (%)	UA (%)
Other areas	5454	540	325	36	2	92.60	85.80
Degrade	313	961	382	173	25	52.29	51.83
1	118	212	425	105	29	33.60	47.81
2	5	114	122	495	108	53.05	58.65
3	0	11	11	124	712	81.28	82.98

Table 5. Confusion matrix of SVM polynomial method

Class	Other areas	Degrade	1	2	3	PA (%)	UA (%)
Other areas	5475	339	318	22	2	92.95	88.94
Degrade	269	1191	163	140	8	64.80	67.25
1	144	234	685	163	46	54.15	53.85
2	2	73	92	548	118	58.74	65.79
3	0	1	7	60	702	80.14	91.17

Table 6. Confusion matrix of SVM radial method

Class	Other areas	Degrade	1	2	3	PA (%)	UA (%)
Other areas	5505	337	309	24	1	93.46	89.14
Degrade	241	1162	158	130	8	63.22	68.39
1	142	257	695	161	48	54.94	53.34
2	2	81	97	553	128	59.27	64.23
3	0	1	6	65	691	78.88	90.56

Table 7. Confusion matrix of SVM sigmoid method

Class	Other areas	Degrade	1	2	3	PA (%)	UA (%)
Other areas	5416	643	285	46	1	91.95	84.74
Degrade	349	867	463	186	27	47.17	45.82
1	125	195	373	98	16	29.49	46.22
2	0	125	139	456	131	48.87	53.58
3	0	8	5	147	701	80.02	81.42

All classification methods have generally low accuracy for classification of degrade, 1 and 2 crown closure classes. The reason for this, reflectance values of these classes were close to each other in training areas. So, classification methods were not distinguished correctly. The highest accuracy rate was obtained for other areas and 3 crown closure classes. The most accurate methods in terms of producer accuracy were SVM radial (other areas), SVM polynomial (degrade) and maximum likelihood (1,2 and 3 crown closure). The most accurate methods in terms of user accuracy were maximum likelihood (other areas), SVM radial (degrade) and SVM polynomial (1, 2 and 3 crown closure). In addition that all classification maps were displayed (Figure 2).

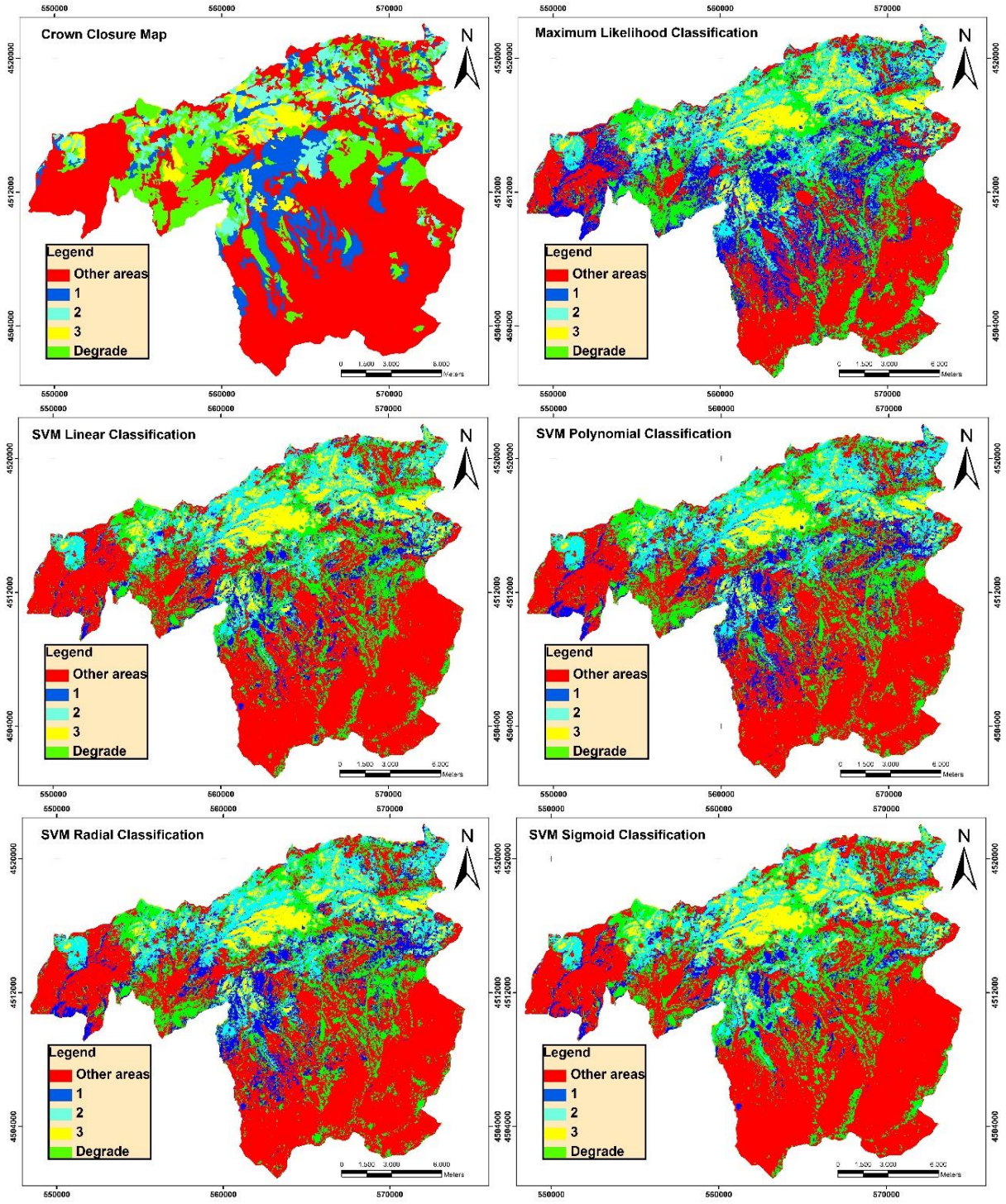

Figure 2. Stand and classification maps

4. Conclusions

In this study, maximum likelihood, SVM linear, SVM polynomial, SVM radial and SVM sigmoid supervised classification methods were compared in terms of crown closure. Landsat TM satellite image was used for classification. Although the most accurate method was SVM radial according to accuracy rate, maximum likelihood, which is the most common classification method, is more suitable for ease of use. In conclusion, it should be applied to different satellite images, fields and parameters so that better comparison of methods can be made.

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Oral presentation

Temporal changes in forest ecosystem dynamics: Borçka planning unit

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Abstract: Forest ecosystem dynamics are substantially influenced by human interventions and other natural processes. This dynamic change is driven by disturbances such as forest fires, clear cutting, insect infestation etc. leading to deforestation. Forest dynamics are also affected in a positive way via natural growth, regeneration, afforestation etc. and result in an increase on forest lands. Management and planning of forest resources in a sustainable manner is only possible by understanding and monitoring the changes carefully. Therefore, there is a need to compare the past and the present composition of the forest ecosystem to detect the spatiotemporal changes. Investigating this trend is of great importance for many fields such as sustainable forest management, climate change, global forest inventory, forest industry and timber supply. The aim of this study is to evaluate the spatiotemporal changes in Borçka Planning Unit (Artvin)'s forests for the last 35 years in terms of land use (ha), tree species composition, growing stock (m^3), crown closure (%), and patches as well. To display the changes over the selected period, forest management plans of the study area from 1972 to 2006 and forest cover maps were used. Geographic Information System software, ArcGIS 10.1^{TM}, was utilized to perform spatial analysis and cartographic representation of the forest structure. The preliminary results show that there is an increase in forest area in the planning unit from 8535 ha in 1972 to 8982 ha in 2006. There is a drastic increase from the beginning of the 1980s in the productive forest areas (having crown closure >%10). Driven factor of this positive trend is the result of decrease in social pressure on forests through migration of population from rural areas to crowded cities. Furthermore, successful rehabilitation activities have also positive effects on improvement of productive forests. The results of this study are expected to help the forest managers and decision makers to understand the trends in forest resources, and sustain goods and services in the ecosystems.
Keywords: Spatiotemporal change, Forest management and planning, Geographic Information Systems (GIS), Borçka-Artvin

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A new approach for the determining EUNIS habitat types with using forest digital management maps in biodiversity surveys: A case study of the Araç State Hunting Grounds

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Abstract: European countries have developed different habitat classification systems to efficiently and regularly utilize natural resources, identify their available resources and build databases. These different systems used by the countries have been combined at the EU level to develop a common classification system which is called the European Nature Information System (EUNIS). According to EUNIS, habitat is the place where plants or animals live naturally and firstly it is described by their physical characteristics (topography, plant or animal physiognomy, soil characteristics, climate and water quality etc) and secondly by their existing species. The smallest EUNIS habitats are at least 100 m^2 and the widest scale has no upper limit. Establishing EUNIS habitat types in biodiversity studies is important in determining where sampling will take place. Completion of habitat maps before biodiversity surveys will provide insight for experts from different subjects. In the contrary case undetected and unexpected habitat types may show up. Forest Management Maps were used for identifying EUNIS habitat types in this study. The codes used in management maps were adapted to EUNIS and "EUNIS Habitat Map" was created based on scanned raster digital maps of 1: 25.000 scale. In the GIS environment, stand types were determined as pure and mixed forests digitally. In addition, canopy closure and age classes of the types forming the stands were taken into consideration. Species compositions of the mixed or pure stands, canopy closure condition, closeness to water communities and elevation from sea level were compared to ecological characteristics in EUNIS habitat codes in order to find corresponding. Codes such as forest land, pasture, stony land, erosion, agricultural land, settlement, dune, mines, water and other foliage in the management maps were corresponded to EUNIS habitat codes then placed in the ArcGIS program in order to make EUNIS habitat type map.
Keywords: EUNIS, Habitat types, GIS, Biodiversity

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Spatio-temporal analysis of forest fire using GIS and remote sensing technologies, the case of Antalya Kumluca forest fire

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Abstract: In recent years considerable increase in the amount and availability of remotely sensed data has enabled the analysis of spatial and temporal changes of the forested areas. In this study spatial and temporal effects of the Antalya Kumluca forest fire evaluated using Geographic Information Systems (GIS) and Remote Sensing (RS) technologies. In the study before the fire event (July 2015) and after the fire event (July 2016) LANDSAT-OLI-TIRS imageries having 30 meter resolution were used. Pre and post event forested areas, surface moisture and post event burned areas were extracted from short wave infrared (SWIR) and near infrared (NIR) bands of LANDSAT-OLI sensors by using Soil Adjusted Vegetation Index (SAVI), Normalized Difference Moisture Index (NDMI) and Normalized Difference Burn Ratio Index (NDBRI) respectively. The differences among pre event and post event NBRI images were used to highlight the burned areas. On the other hand, Land Surface Temperature (LST) of the mentioned years was determined using the thermal infrared (TIR) bands of the TIRS sensors. Pre and post event change on the SAVI, NDMI, NDBRI and LST were quantified using randomly selected 500 points by using Pearson correlation coefficient that were equally spaced and proportionally scaled. According to results of pre and post event Pearson correlation coefficient before the forest fire there is .864 correlations is observed between NDMI and SAVI. However, after the forest fire this correlation decreases to .809. On the other hand, the correlation between NBRI and NDMI before the event is .991 and after the event it decreases the .949. The drastic change is observed between SAVI and LST. Although, before the event SAVI and LST correlation is -.549 this correlation decreases to -270. The result of the analysis reveals that, changes in the forest cover and land surface moisture after forest fire have profound effect on distribution of the (LST) over the forest area. Overall, optic and thermal remote sensing technology was effective approaches for analyzing spatial and temporal effects of forest fire and evaluating its impacts on LST.
Keywords: Soil adjusted vegetation index (SAVI), Normalized difference moisture index (NDMI), Normalized burn ratio index (NDBRI), Land surface temperature (LST)

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Usability of drone for brown bear (*Ursus arctos*) inventory in Artvin Forest, Turkey

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Abstract: Population and habitat inventory are very important for wildlife management. However, there are some difficulties in successfully achieving these inventories with classical methods in especially forest areas. The inventory of large mammal species, especially those with forest habitats, is more complex than species found in open areas. The availability of drones in wildlife inventory has been recently discussed. In this study, the usability of drones in the Brown bear (*Ursus arctos*) inventory has been examined in Artvin forest. The first results of trial flights was showed that detailed and clear images can be taken until approximately 200 meters in distance, because Brown bear were not escape from the drones in this distance. Trial flights have also shown that individuals who are stationary with the drones and difficult to recognize can be seen more easily as they move with drone sounds. Drones can be used with large mammal species such as bear especially when the inventory to be made for the bears is better in the forested areas, especially before the vegetation period starts. However, if the drones are brought closer to the individual for detailed observations, it is also determined that the individual has escaped. Drones are also helping to identify habitats and stands that the target species has used. As a result, this study shows that drones can be used for population and habitat inventory of Brown bear in forested areas. In addition, it is estimated that the use of thermal cameras with drones can provide more healthy results, especially in large predatory species that are active at night. Although the labor cost of inventory with drones is very low, short-term observations are disadvantageous because of the battery problem. In addition, some studies have shown that the drones cause the stress in the bears.
Keywords: Drone, Wildlife management, Habitat inventory, Population inventory

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Forest fire monitoring by using satellite images and information technology

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Abstract: Forest ecosystems are under the pressure of various activities such as forest fires, air pollution, illegal cuts due to agricultural purposes, mining activities, human and climatic or natural causes. Whether for these reasons or not, the forest areas are constantly changing with various farming activities of the Ministry of Forests according to country policies. It is very important to intentionally make new plans for forest areas based on the necessary prediction by monitoring the development and decline of forest ecosystem in short intervals. Satellite images are economical in terms of labor, cost and time when compared to conventional methods, which enable very large areas of forest areas to be monitored at very short intervals. A large part of Turkey is affected by the hot and arid Mediterranean climate in summer, which is why 60% of the forests in these areas are under the risk of forest fire. In 2008, most of the fires were broke out in July, and a large majority of these fires occurred due to neglect and carelessness. On July 31, 2008, fire broke out in four different locations in Manavgat, Antalya. Within the scope of this study, it was aimed to determine the destruction of fire in Antalya Manavgat by the use satellite technology and information technology. Landsat satellite images were taken before and after the fire date for the region on June 19, 2006 and June 19, 2009 then the images were classified and years of classification maps were examined and areas where the fire destroyed were identified. According to the analysis, in 2008 about 13 hectares of area were burned out. The regions were burned out in order to open the agricultural or settlement area or destroyed due to climatic conditions. At the end of the study, information technologies and satellite images were found to be highly effective in monitoring fires and to make plans for future precautionary studies.
Keywords: Forest fire, Landsat, Change detection, Information technology

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GIS based forest cover change detection in the Çamsu Forest Sub-district

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Abstract: Forest management plans are one of the main parts of the forestry activities. In these plans, the choice of optimal goals and explicit objectives makes it possible to ensure that the economic, ecological and social functions expected from the forests are sustainable. In order to make the decision, detailed and accurate spatial data about the forests in the planning units are needed. Detection and monitoring of changes in forest areas provide valuable information for evaluating the spatial and structural state of forests. The assessment of the effects of forestry practices in the past is important with a view to understanding the direction and amount of the change in forest areas. It can also be used in the decision-making process for the future. The aim of the study is to detect the changes in the forest cover from 1990 to 2013 in the Çamsu Forest Sub-district located in the west of Turkey. Approximately 85% of the forests, which consist of usually pure black pine stands and rarely mixed stands of black and red pine species, are productive in this region. The stand type maps produced in 1990 and 2013 were compared by using the Geographical Information System. As a result of the overlay analysis, spatial change maps of the forest cover in the region were produced and the areal changes were calculated. It is suggested that the data on change obtained by using the tools of the geographical information system will provide support for the decision-making process in the planning of the forestry activities of the implementers.
Keywords: Change detection, GIS, Forest cover, Overlay analysis, Çamsu

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Global environmental governance and environmental development: Perspective Bangladesh

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Abstract: This paper has submerged from the thinking on global and its implication in the local level. Global Environmental Governance is the sustainability of environment achieved by collective management and environmental development from the national to international level. Environmental governance as it currently stands is far from meeting one or more of these imperatives. The need to deal with the complex character of environmental issues calls for the adoption of coherent multilateral management by a great variety of stakeholders. "However, the global community has proved incapable of meeting this challenge and environmental governance is currently victim to a great many afflictions." This paper shows that impressive institutional machinery has actually been built, but also that the overall state of the global environment seems not to have improved as a consequence of this. Numerous multilateral environmental agreements have been concluded, many meetings are held each year to advance implementation, and significant amounts of human resources are spent to produce national reports on the efforts undertaken. Yet, as the Millennium Ecosystem Assessment and the work of the Intergovernmental Panel on Climate Change have shown us, ecosystem decline and global warming continue, representing real dangers to our planet. Finally this paper shows if the global environmental governance is possible then what the process will be built environmental development in Bangladesh and shows various environmental development initiatives, strategy, policy and plan by government of Bangladesh and shows the how environmental development is sustain in Bangladesh by the implication of environmental governance. This paper also shows about the various roles and problems of environment in Bangladesh and how can we overcome of those troubles and ensure the peaceful situation in the state of Bangladesh.
Keywords: Global Environmental Governance (GEG), Environmental development, Issues of GEG, Actors of GEG, Environmental development in Bangladesh

1. Preamble

Human induced environmental pressures might seriously affect national and international security (Ullman, 1983: 145). For the Sustainability of political ecology and economic policy environmental governance is the crucial issue. To cope the social, political, economic and cultural phenomena in the environment and ecosystems should be understand and manage as subsets of environmental development. The state of environment is critical for the existence of living creatures as well as for non- living things to exist in the long run. Environmental governance is the protection of global environment which has the sum of organizations, policy instruments, financing mechanisms, rules, procedures and norms that regulated of those environmental problems. Environmental governance often necessitates founding alternative systems of governing for the capturing the diverse range of dynamic forces. If the natural resources and the environment has seen as a global public good and these goods stems from the presence of each of the constituent elements that from an integrated system then it is possible of that everyone can benefit from the atmosphere, climate and biodiversity, to name a few, whilst the entire planet suffers the dramatic consequences of global warming, reduced ozone layer and the disappearance of species. So an approach of collective management is that mean of global environmental governance.

2. World environment movement

The Stockholm Conference on environment is a significant milestone in the world environment movement. The concept of environment was expanded in the larger areas of social, economic and political sectors through this conference held in 1972. The Stockholm conference created the opportunity for advancement in the field of environment. Following the decisions of the conferences, many countries of the world formed environmental institutions and undertook environment management related initiatives (Najam, 2005: 303-321).

Key constitutional movements in the development of environment

- The 1972 United Convention on the Human Environment (UNCHE), held in Stockholm, Sweden.
- The 1987 Brundtland Report, Our Common Future, which coined the Phrase 'Sustainable Development'.
- The 1992 United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil.
- The International Panel on Climate Change (IPCC), coming into existence in 1988 undertaking research on various issues related to changes in the global climatic conditions and arousing public opinion and awareness.

- The Montreal Protocol on Substances that Deplete the Ozone Layer (a protocol to the Vienna Convention for the protection of the Ozone Layer) is an international treaty in September 16, 1987.
- On December 11, 1997, the negotiation on the Kyoto Protocol under the United Nations Convention on Climate Change Framework were completed which was signed to reduce carbon dioxide and greenhouse gas emissions responsible for global warming (Najam, 2005).

3. Definition of global environmental governance

- ☞ Environmental governance has been defined the formal and informal institutions, rules, mechanisms and processes of collective decision-making that enable stakeholders to influence and coordinate their interdependent needs and interests and their interactions with the environment at the relevant scales (Tacconi, 2011: 234-246).
- ☞ All the processes and institutions, both formal and informal, that encompass the standards, values, behavior and organizing mechanisms used by citizens, organizations and social movements as well as the different interest groups as a basis for linking up their interests, defending their differences and exercising their rights and obligations in terms of accessing and using natural resources (Ojeda, 2005: 223).
- ☞ At the international level, global environmental governance is the sum of organizations, policy instruments, financing mechanisms, rules, procedures and norms that regulate the processes of global environmental protection (Najam, Papa & Taiyab, 2006: 254).

4. Characteristics of global environmental governance

1. Multi-level interactions (i.e., local, national, international/global) among, but not limited to, three main actors, i.e., state, market, and civil society, which interact with one another, whether in formal and informal ways
2. In formulating and implementing policies in response to environment-related demands and inputs from the society
3. Bound by rules, procedures, processes, and widely-accepted behavior
4. Possessing characteristics of "good governance"
5. The purpose of attaining environmentally-sustainable development (Gemmill & Bamidele-Izu, 2002: 83).

These are some key principles of environmental governance:

- Embeds the environment in all levels of decision-making and action.
- Conceptualizes cities and communities, economic and political life as a subset of the environment.
- Emphasizes the connection of people to the ecosystems in which they live.
- Promotes the transition from linear systems (like garbage disposal with no recycling) to circular systems.

5. The institutional foundation of environmental governance

Complementary theoretical perspective:

The intricate nature of the interaction between environmental governance regimes/social institutions and ecosystems is duly acknowledged by contemporary environmental scholars. This manifests itself in a variety of forms, notably the concept of cross-regime effects/consequences and the notion of interplay, which refers to the dynamic linkages between the different component parts of the socially-contrived and biophysical architecture (Young, 1998).

6. An evolving system of global environmental governance

GEG refers to the sum of organizations, policy instruments, financing mechanisms, rules, procedures and norms that regulate global environmental protection. Within the context of the evolution of global environmental politics and policy, the end goal of global environmental governance is to improve the state of the environment and to eventually lead to the broader goal of sustainable development.

The major institutional decision coming out of the United Nations Conference on the Human Environment (Stockholm, 1972) was the establishment of the United Nations Environment Programmed (UNEP), which was created to play the lead role in GEG by coordinating environmental activities within the UN agencies and acting as a catalyst for new initiatives. Since then, the world has seen hectic activity in global environmental policy (and, more recently, in sustainable development policy) and a host of treaties, organizations and mechanisms have emerged. The 1992 Rio Earth Summit and the 2002 Johannesburg Summit on Sustainable Development mark just two of the many policy landmarks of this rapid evolution of the GEG system (Najam, 2003).

7. Concerning issues for global environmental governance

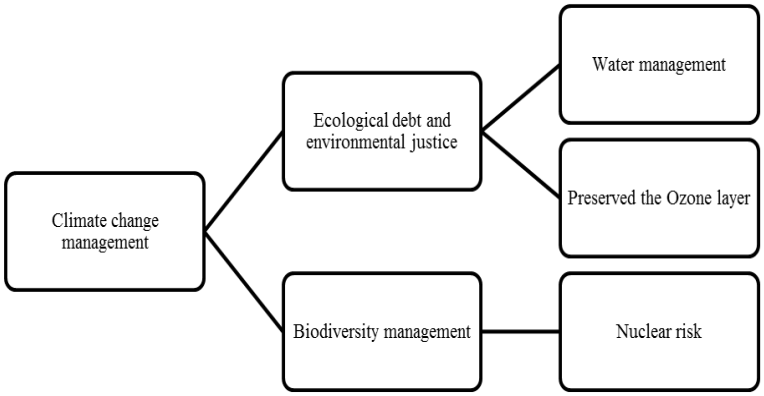

Figure 1: Important issues for global environmental governance

The following discussion will be described on the concerning issues for global environmental change.

7.1 Climate change management

The anthropogenic theory predicts that global warming will continue apace with greenhouse gas (GHG) emissions. The International Panel on Climate Change (IPCC) indicates that "most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations (IPCC, 2007: 16). In the present time global green house gas emission sources (Earth Trends, CAIT, 2008) from the various tools such as

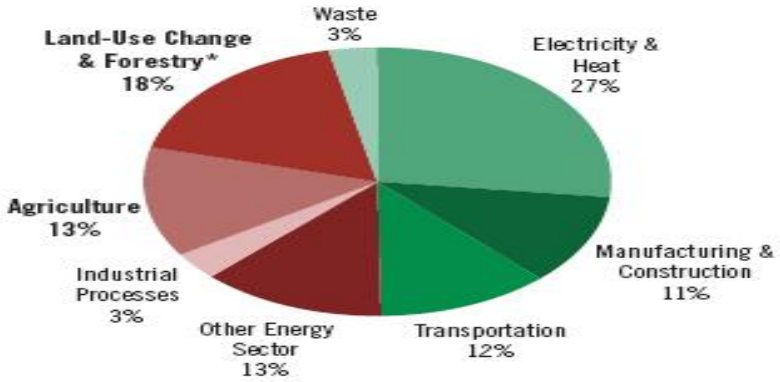

Figure 2: Sources of Global Green House Gas Emissions (GHG).

7.2 Ecological debt and environmental justice

The right to a healthy and safe environment is a fundamental human right that cannot be refused on the basis of race, class, ethnic group or position within the global economic system. The north remains highly dependent on southern countries for maintaining the living standards of its people. Without being able to use the land to pasture their pigs and cows, northern countries would not be able to continue feeding their populations as they have done until now. The same problem applies to fruit and vegetables. However, the question does not hinge solely on an unequal distribution of cultivable land throughout the world, but also on the consequences that monoculture usually has in terms of ecological damage.
The same applies to energy supplies: gas, oil and even the uranium for nuclear energy that are obtained in the southern hemisphere. Mutual dependence is not a bad thing in itself. But what actually happens is that southern countries do not set prices or control the environmental and social conditions that govern the exploitation of their own resources. Worse still, the northern hemisphere continues to dominate the global economy and trade rates. The colonial era is not yet over; a somber page in the history of humanity has not yet been turned (Rijnhout, 2005).

7.3 *Water management*

According to Alliance 21's Organisation, "Water is an unalienable right for every human being. All levels of water supply management are necessary and independent. The integrated approach to the catchment areas must take into account the needs

of irrigation and those of towns, jointly and not separately as is often seen to be the case. Equipment must be sought to bring about water saving and to increase its efficiency in irrigation systems and industrial processes (Alliance21, 2001).
The governance of a water supply must be guided by the principles of sustainable development. Science and technology must be used to meet the requirements of the communities both in the fields of drinking water supplies and sanitation facilities. All governance of a water supply must promote education in connection with water, and make the general public more widely aware of water saving and resource conservation.

7.4 *Biodiversity management*

The Convention on Biological Diversity (CBD) was signed in Rio in 2012 to tackle the loss of biodiversity caused by human activities. The CBD's objectives are: "to conserve biological diversity, to use biological diversity in a sustainable fashion, to share the benefits of biological diversity fairly and equitably." The Convention is the first equitable global agreement that addresses all aspects of biological diversity: genetic resources, species and ecosystems. It recognizes, for the first time, that the conservation of biological diversity is "a common concern for all humanity" and an integral part of the development process. To achieve its objectives, the Convention follows in the footsteps of the Rio Declaration on the Environment and Development and constantly encourages association between countries. Such association is based on measures for scientific and technological cooperation, access to genetic resources and the transfer of clean environmental technologies (CBD, 2012).

7.5 *Preserved the ozone layer*

The disappearance of the ozone layer will result in increased cases of skin cancer, ocular cataracts and damaged immune systems in humans and other species. It will also affect crops sensitive to ultra-violet radiation. If the ozone layer is to be protected, we need to eliminate the use of chemical constituents like chlorofluorocarbons as industrial refrigerants and aerosols and farming fungicides like methyl bromide that destroys the ozone layer 50 times faster than CFCs (UNFCCC, 1992).

7.6 *Nuclear risk*

The nuclear risk began with the rapid development of nuclear reactors used to generate electricity. Another nuclear-related problem is the possibility of environmental pollution by humans using atomic bombs. Regardless of the type of environmental contamination, nuclear pollution causes further damage to human society and the environment, which is rendered unfit for an indeterminate period due to the malformations and congenital diseases that contamination produces in people, animals, plants, water, the land, and so on. A proposed solution for reducing the nuclear risk is to replace the use of nuclear energy with renewable energies such as solar power, wind power, hydroelectric, tidal power, etc (Redgwell, 2005: 178-203).

8. Actors of the global environmental governance: Who deals with the environment?

A measure of the diversity of actors within the United Nations system whose activities somehow impact the environment is the membership of the UN Environmental Management Group (EMG) which was established by the UN Secretary General to "enhance UN system-wide inter-agency coordination" and whose membership consists of "programmers, organs and specialized agencies of the UN system, and all of the secretariats of multilateral environmental agreements." Each of these organizations has a defined environmental mandate and many have specified environmental activities. The membership of this group gives a still incomplete but impressive, picture of the breadth of actors that influence global environmental governance (Bouguerra, 2004). For instances Basel Convention Secretariat Convention on Biodiversity (CBD), Secretariat Convention on International Trade in Endangered Species (CITES), Secretariat Convention on Migratory Species (CMS), Secretariat Economic and Social Commission for Africa (ECA), Economic Commission for Europe (ECE), Economic and Social Commission for Latin America and the Caribbean (ECLAC), Economic and Social Commission for Asia and the Pacific (ESCAP), Economic and Social Commission for West Asia (ESCWA), Food and Agriculture Organization (FAO), Global Environment Facility (GEF), International Atomic Energy Agency (IAEA) International Civil Aviation Organization (ICAO), International Fund for Agricultural Development (IFAD), International Labor Organization (ILO), International Maritime Organization (IMO), International Strategy for Disaster Reduction (ISDR), Secretariat International Trade Center (ITC), International Telecommunication Union (ITU), Office for the Coordination of Humanitarian Affairs (OCHA), Global Environmental Governance: A Reform Agenda Office of the High Commissioner for Human Rights (OHCHR), Ramsar Convention on Wetlands Secretariat Convention to Combat Desertification (CCD), Secretariat UN Conference on Trade and Development (UNCTAD), UN Department of Economic and Social Affairs/ Division for Sustainable Development (UNDESA/DSD), United Nations Development Programmed (UNDP), United Nations Environment Programmed (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Framework Convention on Climate Change (UNFCCC), Secretariat United Nations Population Fund (UNFPA), United Nations Human Settlements Programmed (HABITAT), United Nations High Commissioner for Refugees (UNHCR), United Nations Children's Fund (UNICEF), United Nations Industrial Development Organization (UNIDO), United Nations Institute for Training and Research (UNITAR), United Nations University (UNU), Universal Postal Union (UPU), World Food Program (WFP), World

Health Organization (WHO), World Intellectual Property Organization (WIPO), World Meteorological Organization (WMO), The World Bank World Trade Organization (WTO), World Tourism Organization (WTO) (Biermann & Simonis, 1998).

9. Crisis of the Global Environmental Governance (GEG)

Over the last few years a heated debate has emerged among policymakers as well as scholars on the possible need and potential directions of a reform in the GEG system so that it can keep up with its own rapid evolution. Although the debate on GEG has focused overwhelmingly on reform of the United Nations Environment Programme (UNEP), the issue is far more expansive. This is largely because, since 1972, the business of global environmental governance has grown in many new directions (Von Moltke, 2001: 23-28).

Much of this evolution is, in fact, quite positive and points to an expanded (certainly busier) global system of environmental governance. In particular, the GEG system has expanded in three ways-

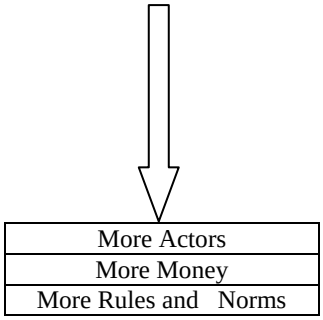

Table 1: Crises in the Global Environmental Governance (GEG)

The increasing scale and gravity of environmental problems in terms of climate change, loss of biological diversity and degradation of ecosystem services threaten to block any possible attempts at a solution by the various stakeholders, and are already restricting the prospect of economic development in many countries and regions. Environmental protection measures remain insufficient in the face of the warnings of the scientific community. The necessary reforms represent a slow process that requires time, energy, money and, above all, diplomatic negotiation. And a serious environmental crisis has proved incapable of generating a unanimous response from all countries. Persistent divisions are slowing down progress towards properly organized global environmental governance (Roussel, 2007).

The question is whether an alternative to the current production system is needed to solve the environmental crisis. Does the current system contain the solutions for its own preservation? Can biotechnology and sustainable development be considered as solutions? The architecture of the regulations for international environmental protection reflects these questions. Rio de Janeiro, The Hague, Nairobi, Stockholm, Montreal, Kyoto, Johannesburg, Cartagena and Bali have all hosted a panoply of international environmental actors and states affected and concerned in one way or another by the environmental crisis. These conferences and agreements and resulting regulations indicate the balance of power within a context containing a multitude of interests and contradictory standpoints.

10. Challenges to Effective Global Environmental Governance (GEG)

Table 2: Key Challenges to Effective Global Environmental Governance (GEG) (Najam, Papa & Tayiba, 2006: 29-62).

- Proliferation of Multilateral Environmental Agreements (MEAs) and
- Fragmentation of Global Environmental Governance (GEG)
- Lack of cooperation and coordination among International Organization
- Lack of Implementation, Compliance, Enforcement and Effectiveness
- Inefficient Use of Resources
- Global Environmental Governance outside the Environmental Arena
- Non- state Actors in a State- centric System

Some of the obstacles and challenges facing environmental governance include:

- Various sources, some of them within the United Nations Environment Programme (UNEP), maintain that lack of political will is at the root of the governance crisis. By persistently showing a lack of political will for solving environmental problems and seeking instead to develop policies in favour of the sustainable use of the earth's resources, environmental regulations produce effects that include lack of funding, imbalance and absence of links with the economy, and the limited application of Multilateral Environment Agreements (MEAs) (UNEP, 2008).
- Financial resources are limited and direct investment in the environment insufficient. In concrete terms, although the UNEP, the main UN body for environmental issues, has obtained noteworthy results during its mandate, the lack of long-term stable financing hinders its chances of tackling new challenges (UNEP, 2008).

- This lack of coordination is not confined to the United Nations system. It also exists in governments, the private sector and civil society. Regional and international cooperation is difficult, since it arises only from occasional action taken by stakeholders without any shared vision or regulation (GMEF, 2002).

11. Elements of a reform agenda for Global Environmental Governance (GEG)

Pulgar Vidal identifies four factors of reform agenda that can be used to develop these processes:

- Formal and informal regulations, procedures and processes, such as consultations and participative democracy;
- Social interaction between participant groups which can arise from external factors such as participation in development programmes proposed by public institutions or from the reaction to certain unjust situations
- Regulating or correcting certain social behaviours to transform an individual question into a public matter and be able to collectively negotiate progress towards sustainable and acceptable agreements
- Horizontality at the level of the social group's structure, decision-making mechanism and mechanisms for relations with external actors (Manuel, 2005).

The International Institute for Sustainable Development proposes a "reform agenda" for global governance. The main argument is that there seems to be a tacit but powerful consensus on the objectives of environmental governance at the international level. These objectives are as follows (Najam, Papa & Tyeeba: 2006).

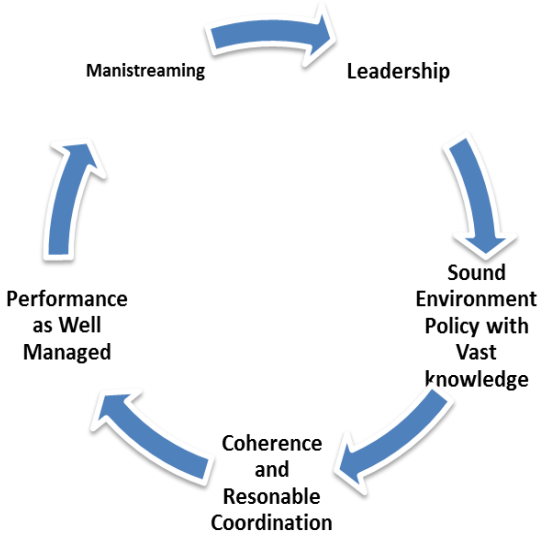

Figure 3: Elements of a Reform Agenda for Global Environmental Governance (GEG)

11.1 Leadership

The GEG system should grasp the attention and visible support of high-profile political leaders. The key institutions within the system should be managed by leaders of the highest professional caliber and international repute; all working together towards the best interests of the GEG system as a whole.

11.2 Knowledge

Science should be the authoritative basis of sound environmental policy. The GEG system should be seen as a knowledge-based and knowledge-producing system.

11.3 Coherence

GEG should operate as a coherent "system" with reasonable coordination, regular communication and a shared sense of direction among its various elements.

11.4 Performance

The institutions that make up the GEG system should be well-managed; they should have the resources they need and should use these resources efficiently; and they should be effective in implementation. The ultimate purpose of the GEG system is to improve the global environmental condition.

11.5 Mainstreaming

The GEG system should seek to incorporate environmental concerns and actions within other areas of international policy and action, and particularly so in the context of sustainable development (Najam, Papa & Tyeeba: 2006).

12. Environmental and Bangladesh

Bangladesh is a developing country in South Asia. It has a border on the west, north, and east with India, on the southeast with Myanmar, and the Bay of Bengal is to the south. Geologically, Bangladesh is a part of the Bengal Basin, one of the largest geosynclinals in the world. Bangladesh has a comparatively low natural resource base, but a high growth rate of population, with almost half of the population below fifteen years of age. Most of the people are among the poorest in the world, and depend mainly on the natural resource base for their livelihood. But now the resource base is under serious threat, as many natural resources are either being over exploited or used sub-optimally. Besides the effects of anthropogenic stresses, the low land-man ratio in the country is often further threatened by natural hazards. Thus, for the survival of Bangladeshis dense population, it is essential to have environmental planning and management that conserves and sustains the ecosystems that support their livelihoods. The high population density, low economic growth, lack of institutional infrastructure, an intensive dependence on agriculture and agricultural products, geographical settings, and various other factors, all contribute to make the country weak in its economic development and quality of life (MOEF, 2003).

12.1 Environmental development in Bangladesh

Environment and development are inextricably linked. The state of environment is critical for the existence of living creatures as well as for non-living things to exist in the long run. The global environment has been changing gradually and it has become a serious concern for all. Industrialization, exponential population growth, tremendous increase in the number of automobiles and indiscriminate felling of trees are some such activities. Bangladesh is recognized to be the worst suffer from the impact of global warming and climate change. The Government is, therefore, giving special emphasis on conservation of environment and development. It has undertaken integrated policies and plans to protect the country from the impact of global warming.

12.2 Environment and sustainable development in Bangladesh

The Environment and Sustainable Development Cluster is dedicated to playing a catalytic role to facilitate mainstreaming sustainable development in Bangladesh by integrating pro-poor environment in policies and development planning. The programmatic interventions of the Cluster fall into four programmed areas: (1) Natural Resource Management and Biodiversity Conservation, (2) Sustainable Land and Water Management, (3) Improved and Cleaner Urban Environment Management and (4) Sustainable Development and Environmental Governance (Rahman, 1994).

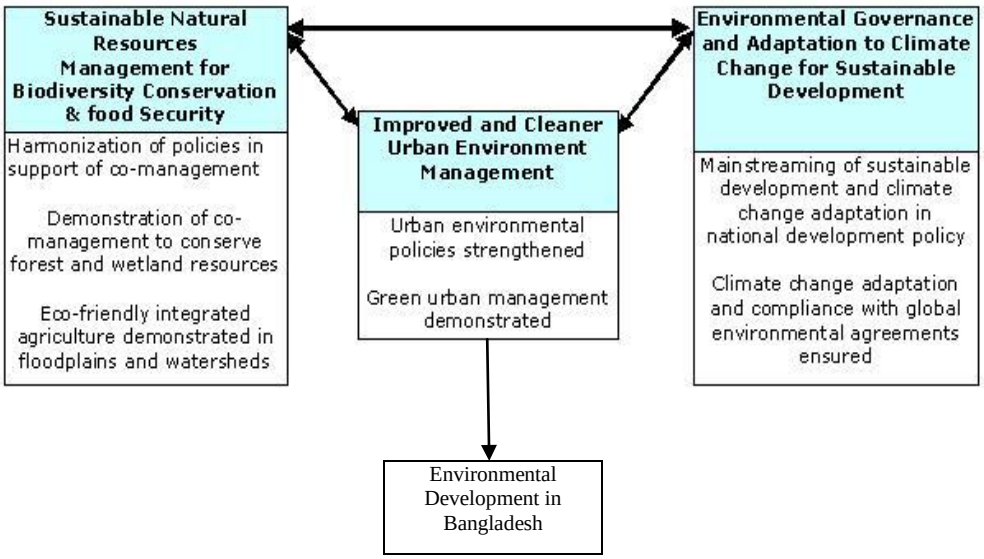

Figure 4: Environment and Sustainable Development in Bangladesh

13. The major environmental problems of Bangladesh

From the geographical location in BD frequencies of hazards arising from drought, flood and other natural calamities are on the increase in Bangladesh. The surface water of the country is being polluted through capricious disposal of untreated industrial effluents and municipal waste water, runoff pollution from chemical fertilizers and pesticides and oil and lubes

spillage in the coastal area from the operation of sea and river ports and ship wreckages. Now in BD, presence of high-level arsenic contamination in ground water is a national problem especially in Chandpur, Shatkhira, Noakhali, Comilla, Gopalgonj and some other countries (Bangladesh Economic Review, 2011: 242). Bangladesh a low-riparian country has 57 trans-boundary rivers, of which 54 are shared with India and 3 with Myanmar. A significant quantity of water flow is withdrawn and diverted upstream by neighboring countries for irrigation and other purposes resulting in reduce flow of waters in the rivers. The Farakka Barrage on the river Ganges is a notable example. Decertification prevails in some area of BD due to the withdrawal of water from the Ganges through the Farakka Barrage (Bangladesh Economic Review, 2011: 242). The depletion of biodiversity is the result of various kind of human intervention that impact on it through destruction and degradation of land, forest and aquatic habits. These activities encompass the sectors of agriculture, forestry, fisheries, urbanization, industry, transport, tourism, energy, chemicals and minerals (Rahman, 1994).

14. The government initiatives to address environment protection and development

There have various initiatives by government of Bangladesh to address environmental problems. Actually BD government pursue to resolve the environment problems applying by national and international plans and policy and taken some strategy, policy to resolve environmental problems and protection of climate and best use of renewable and non-renewable resources in Bangladesh which are as follows-

Table 3: Government initiatives to address environment protection and development

Preparation of National Land Policy
National Water Policy
Air Pollution Control
Control of Industrial Pollution
Control of Noise Pollution
Conservation of Biodiversity
Protection of Ozone Layer
Development of the National Bio-safety Framework
Publication of Dhaka City State of Environment
Natural Disaster Management
NGOs Activities for Conservation of Environment
Social Forestry

14.1 Preparation of national land policy

The govt. has approved National Land Use Policy' Bangladesh. The govt. has adopted various other national policies and measures to prevent land depletion. These include- The National Environmental Policy, National Environment Act and Rules, National Forestry Policy and the National Plan for Agriculture Research (Zahid, 2002).

14.2 National water policy

Water resource is of immense importance for socio-economic development of the nation. Bangladesh is endowed with good number water bodies scattered all over the country. Regional Cooperation is indispensible for water management and protection of water resources and rational use of water (Bangladesh Economic Review, 2010: 244).

14.3 Air pollution control

The Department of Environment is implementing a number of projects to control air pollution. There has been a ban on the plying of two stroke three-wheelers in Dhaka city January 2003. Control of air pollution by-

a) Capacity building for sustainable environment initiative (SEI) in transport and brick industry.
b) Reduction of emissions from brick industry

c) Mitigate acute traffic congestion in Dhaka city
d) Introduction of Bus Rapid Transit (BRT) at the capital city under the government Strategic Transport Plan (STP) and
e) Reduction of emission from vehicles (Rahman, 1994).

14.4 *Control of industrial pollution*

In compliance with the Environment Conservation Act, 1995 and the Environment Conservation Rules, 1997, the mechanism for issuance of environmental clearance certificate has been introduce for new industries or projects after assessing the project area and pollutants to be emitted or discharged by the industries or projects to be set up. Such type of projects is very important to prepare strategy for controlling industrial pollution (Marr, 2009).

14.5 *Conservation of biodiversity*

Under the Bangladesh Wildlife Conservation Act, 1974 which amendment up to 1994, three protected areas have been has been identified as national parks and wildlife sanctuaries with an aim to conserving the biodiversity, preserving and developing natural environment and eco-tourism and facilitating research. Moreover, the government has declared 8 protected areas in different parts of the country Such as Cox's Bazar, Teknaf, Sea beach, St. Martin's Land, Sonadia Island, Sundarban reserve forests, Gulshan-Baridhara Lake, Hakaluki Haor Marjat Baor as Ecologically Critically Area (ECA) (Ecologically Critical Area, 1995).

14.6 *Protection of ozone layer*

Bangladesh has achieved remarkable success in protecting ozone layer. By now, Ozone Depleting Substances (ODS) have been phased out from aerosol sector in Bangladesh. As a result 60 percent use of ODS has been reduced in the country and recycling towards cheeking unnecessary emissions of Chloro-Fluro Carbon (CFCs). With the financial system of multilateral fund such as UNDP complying with the Montreal Protocol, Ozone Depleting Substances Rules, 2004 has been farmed under which import and use of ODS are being controlled through licensing system (Ahmed, 1994).

14.7 *Natural disaster management*

Various government and non-government organizations are working relentlessly in the field of disaster management and mitigation. The focal point for disaster management is the Disaster Management Bureau under the Ministry of Food and Disaster Management. Bangladesh Meteorological Department (BMD) is responsible for forecasting natural disasters like cyclones, droughts, storms and such other disasters. Bangladesh Space Research and Remote Sensing Organization (SPARRSO) provides satellite images while the food forecasting and warning center (FFWC) of Bangladesh Water Development Board is entrusted with the responsibility with the responsibility of forecasting flood (Kafiluddin, 1991: 72).

In various way management the natural disaster such as like-

i. Cyclone Preparedness Programmed Implementation Board (CPPIB)
ii. Disaster Management Training and Public Awareness Building Task Force (DMTATF)
iii. Focal Point Operation Coordination Group of Disaster Management (FPOCG)
iv. NGO Coordination Group on Disaster Management (NGOCC) (Ministry of Disaster Management and Relief, Government of Bangladesh, 1999: 104).

14.8 *NGOs Activities for conservation of environment*

Along with government, a good number of NGOs have been working to face environmental problems and to improve environmental system of the country since 1980s. The NGOs play an important role in motivating people at grass root level to protect environment and to take coordinated efforts in solving environmental problems. Some of the important NGOs are:

- International Union for the Conservation of Nature (IUCN)
- Centre for Sustainable Development (CSD)
- Bangladesh Centre for Advanced Studies (BCAS)
- Environmental Conservation Management Centre, Waste Concern
- Bangladesh Paribesh Andolon (BAPA) and
- Bangladesh Environmental Lawyers' Association (BELA) (Environment and NGOs in Bangladesh, 2012).

14.9 *Policies and laws for the development and protection of environment*

The DoE has been working not only for protection of environment of the country but also formulating requisite laws and responsible the implementation of the conventions, protocols and agreements signed on environmental protection at international and regional level. This calls for creating mass awareness and legal obligation. With this end in view, the following policies and laws have been framed:

- The Environmental Policy, 1992
- The Bangladesh Environment Conservation Act, 1995
- The Environment Conservation Rules, 1997
- The Environment Court Act, 2000 (Rahman, 1994).

14.10 Conservation of ecology

Considering the importance of hills in protecting ecology of the country, the government has issued a notification in March 2002 banning hill destruction. Awareness about the importance of hills in protection of ecology is increasing and the illegal attempts of cutting/razing of hills are on the decline.

14.11 Publication of Dhaka City state of environment report

The DOE has published Dhaka City State of Environment report with financial assistance from UNEP: Beside a report on Bangladesh National Programme of Action for protection of the coastal and marine environment from land based activities have been published.

14.12 Social forestry

Social forestry programme is one of the important programmes of the Forest Department. Since 1981, the Forest Department implemented four social projects with the financial assistance of Asian Development Bank (ADB). Currently along with the social forestry programme for development and management of forest resources, the forest department to also implementing forest development programme for poverty reduction (Sadeque, 1994).

15. Strategy, policy and plan for environmental development in Bangladesh

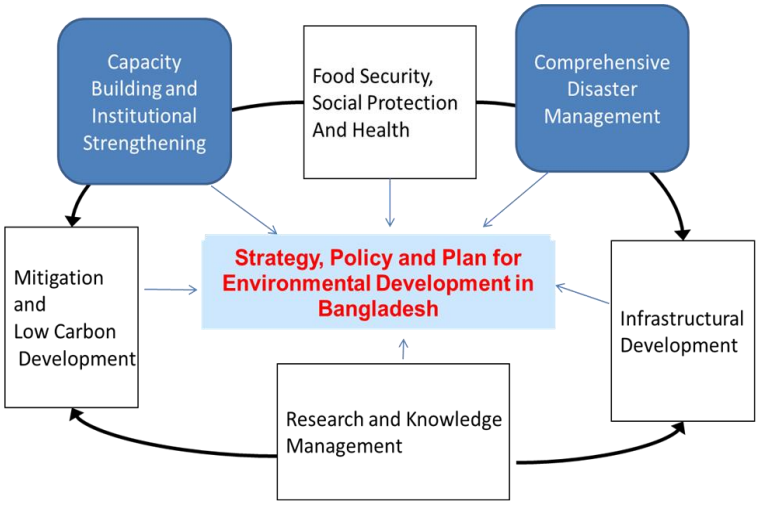

Figure 5: Policy and strategy for environmental development in Bangladesh

15.1 Food Security, social protection and health

- Adaptation against drought
- Adaptation in fisheries sector
- Adaptation in livestock
- Adaptation in health sector
- Development of climate resilient cropping system
- Institutional capacity for research towards climate resilient cultivation and their dissemination.

15.2 Comprehensive disaster management

- Improvement flood forecasting and early warning
- Awareness raising and public education towards climate resilience
- Risk management against loss of income and property

15.3 *Infrastructure*

- Repair and maintenance of existing flood embankments
- Adaptation against floods
- Improvement of urban drainage
- Adaptation against tropical cyclones and storm surges

15.4 *Research and knowledge management*

- Establishing center for knowledge management and training on climate change
- Monitoring ecosystems and biodiversity changes and their impacts
- Macroeconomics and sectoral economic impact on climate change
- Monitoring of impact on various issues related to management of tourism in Bangladesh and implementation in priority action plan

15.5 *Mitigation and low carbon development*

- Improved energy efficiency in production and consumption of energy
- Gas exploration and reservoir management
- Development of coal mines and coal fired power stations
- Renewable energy development
- A forestation and Reforestation programmed

15.6 *Capacity building and institutional strengthening*

- Strengthening human resource capacity
- Strengthening gender consideration in climate change management
- Strengthening institutional capacity for climate change management
- Main-stream climate change in the media (Bangladesh Economic Profile, 2010).

16. Conclusion

This is point out that the emerging forces of environmental governance as like NGOs, scientists, certain international institutions and partnerships between different stakeholders can help to reduce the distance which separates the local and international levels. Nonetheless, the problem, both political and technical, of how to successfully link up the different levels remains unsolved (Kanie, 2004: 86-113). The local level to the global level is important because the way in which local initiatives and best practices, often fragmented, are adapted to the concept of a global system. By which system Bangladesh can develop their environment system. GEG reform cannot be restricted only to a few organizations in the GEG system. It needs to be systemic, even in the short term. That means, at the very least, that it must focus on the key environmental organizations in the system—and especially on the relationships between them. The reform must be designed for—and ultimately evaluated by—the positive impact and it has on actual environmental performance then Bangladesh intractably linked with hoe for pursue of well from the global environmental governance and make a environmental sustainability in Bangladesh.

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Ecological importance and role in carbon sequestration of urban trees (In case of Isparta Anadolu Neighborhood)

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Abstract: As result of human activities, greenhouse gasses include carbon dioxide, methane, water vapor, nitrous oxides etc. in atmosphere have increased. It is called "Global Warming" that greenhouse gasses cause of artificial increase of heat in atmosphere and on the face of the earth. In nowadays, it probably is perceived that it is dangerous and imperceptible about threat of global warming for life. But this problem is slowly and slyly grows up. However it will be effect negative to all of life and cause to become extinct of human. Most of concentrated of greenhouse gasses are be seen (about between 70% and-80%) in urban areas and environment. In nowadays, urban tress which is still under debate and discussed rehabilitation as concept, first approach to consider in C sequestration and rehabilitation of urban ecosystem. In addition, establishment of new urban trees is also very important for urban planning/management and social/environmental functions. The urban road trees have an important effect on carbon sequestrating a decreasing the amount of CO_2 release at the city center. The rapid growth rates of urban trees compared with rural forest trees and the carbon sequestration relationship can be partly explained by the relatively large proportion of leaf biomass. The purpose of this work is to discuss an approach to the determination of urban tree biomass and carbon sequestration values. In this study; the biomass and carbon sequestration values of the trees were determined and interpreted using the tree inventory data obtained from the project of TUBITAK 110Y301 (Gul, et al., 2015). Isparta city Anadolu neighborhood was selected as the study area and the data of the existing urban trees were analyzed. As a result of the study, it has been determined that the number of trees, tree species, leaf surface area, age and height characteristics may increase or affect the biomass and carbon sequestration values in the area. Determination of biomass and carbon sequestration values of urban trees and calculation of their monetary values will be a strategic parameter especially in the case of operational studies against global warming. In particular, the environmental impacts of trees and forests in urban areas will be scientifically demonstrated and will play an important role in raising public awareness.
Keywords: Urban trees, Biomass, Carbon sequestration, Ecology

1. Introduction

In recent years, intensifying human and nature associations have caused factors such as extreme and unconscious consumption of natural resources, environmental problems and distorted urbanization. As a result, unfortunately, the fact that we directly and indirectly affect our world and our living spaces negatively has become a fact accepted by all. The view that global warming and possible effects are one of the important elements threatening the future of humanity and life is widely accepted. "GLOBAL WARMING" is defined as the increase in the amount of greenhouse gases given to the atmospheric environment, which is the result of human activities, and the resultant increase in greenhouse effect, artificial increase of some atmospheric strata and earth temperature. In particular, about 97% of carbon dioxide in the world is naturally released. As a result of human activities, it contributes to greenhouse gases in the atmosphere by about 3%. Although the human effect of total emission has a small percentage, experts have argued that human-made greenhouse gases are in a position to degrade natural balances. Indeed, scientific evidence proves this. Especially in the 20-30 years, the end result of multifaceted human activities is an accepted approach where the greenhouse gases are constantly increasing in atmospheric concentrations. It is widely accepted that this increase leads to the gradual degradation of natural balances or ecosystems (Gül et al., 2009). Global warming, which has become a serious problem on the world scale, can be perceived as a development that is threatening the life cycle but is far too remote or uncertain to worry. However, it is stated that this problem which develops slowly and insidiously may affect the life cycle negatively in the future and may even lead to the extinction of human generation on earth (UNFCCC, 2005b).

Our planet's reserve areas for CO_2 are known to be the atmosphere, oceans and terrestrial biosphere environments. A significant portion of the terrestrial biosphere is forests and has an important role in global warming and climate change. Forests and other green areas as living organisms that photosynthesize absorb the free CO_2 in the atmosphere, stabilize them in more stable complex compounds and contribute to their long-term storage. For this purpose, one of the most important strategies for global warming and climate change in developed countries is to store CO_2 in the forest ecosystem (plant, dead cover and soil). This strategy is generally described as carbon sequestration. Urban trees and urban forests have an important position in order to sequestration CO_2 in the city centers. (Gül et al., 2009).

Urban trees have a very important function in order to increase people's quality of life in the city centers, to improve the aesthetic of the city in terms of visual and ecological aspects, to reduce carbon dioxide emissions and to carbon sequestration.

The open and green spaces that are important for the discipline of landscape architecture play a major role in the improvement of urban ecosystem such as urban heat island effect, carbon sequestration. In this context, the contribution of the urban green areas to the urban ecosystem, has become a need to be determined by scientific research.

The aim of this study is to demonstrate the importance of ecological functions of urban forests on biomass and carbon sequestration, to examine the inventory results of existing trees in Isparta Anadolu Neighborhood, to calculate and interpret the biomass and carbon sequestration values.

2. Material and method

2.1. Material

An effective inventory study is required for this study to take place. For this study, Anadolu Neighborhood, one of the most important neighbourhood of Isparta City, was chosen. The reason for the selection of Anadolu neighborhood as a study area is its proximity to the city center, its borders with intercity roads, the amount of green space is high and the location of the neighborhood. The neighborhood has very favorable conditions for the application of the working method in terms of the amount of green space, number of trees and tree ages (Figure 2.1., Figure 2.2.).

Figure 0.1. The view of Isparta development plan (Gül et al., 2015)

Figure 0.2. The View of Anadolu Neighborhood Borders (Gül et al., 2015)

2.2. Methods

In the study, the inventory data obtained from TÜBİTAK 110Y301 Project were utilized (Gül, et al., 2015). For this purpose, biomass and carbon sequestration of the trees were calculated with the formulas given below by tree inventory data in the Isparta Anadolu Neighborhood. Through this process, some numerical information about inventory of the trees were obtained and individual ecological effects of the trees were determined.

2.2.1. Obtaining tree inventory information by land practices

The following data were obtained from the inventory studies were carried out on the TÜBİTAK 110Y301 (Urban Trees Information System Model) Project by Gül et al. (2015). For this purpose "Urban Trees Inventory Information Form" has been established for the field studies. Inventory studies for forests and trees are very important in terms of sustainable and ecological design (Gül et al., 2014). It was proposed by Form Gül et al., (2015) and is given in

Table 0.1. The required data in the urban tree data sheet were determined in the field studies and the following formulas were used to calculate the biomass and carbon sequestration capacities. The parameters to be used when making structural measurements of trees were also made according to the standards recommended by Gül et al., (2015).

Table 0.1. Urban Trees Inventory Information Form (Gül et al., 2015)

Urban Trees Inventory Information Form								
Date of registration:……..…/……...…/……...….								
Tree sequence number	Latin name:	Turkish name:	Age:	Tree Length(m):	Body Height (m):	Body Diameter (cm). (d: 1.30m)	Crown Width (m)	Percent loss of crown covering (%) (%)
1								

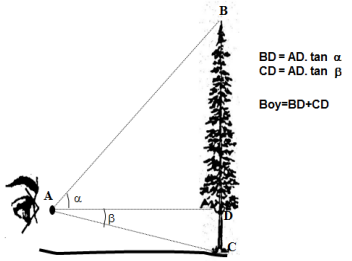

Figure 2.3. Calculation of length according to trigonometric basis

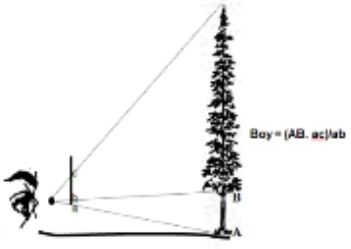

Figure 2.4. Length calculation using ruler

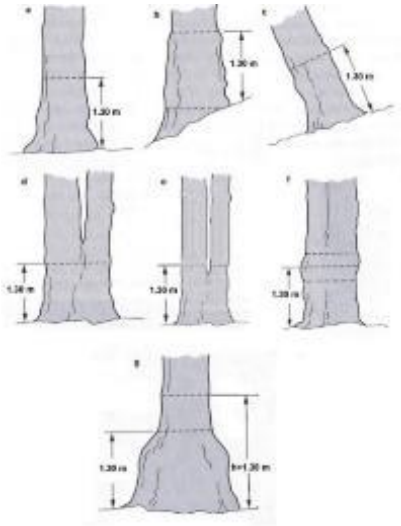

Figure 2.5. Diameter measurement applications in trees (Avery and Burkhart, 1994)

2.2.2. Biomass and carbon sequestration calculations

Leaf surface area and biomass were determined with the help of the following formulas, taking into consideration the tree size, chest diameter, crown top surface area, top diameter, crown height, crown loss ratio and shading factor values of each tree. Calculation of tree leaf surface and leaf biomass were done according to chest diameter. However, sufficient accuracy can not be achieved in the regression equations generated during calculations according to chest diameter. Only 64% of the leaf surface as a function of chest diameter; And 54% of leaf biomass can be explained. However, it has been found that leaf surface and leaf biomass are better explained when some other parameters of the tree participate in the calculation. Accordingly, in calculating leaf area or dry biomass weight, 91% of leaf surface area and 92% of leaf biomass are explained using chest diameter, shading factor, crown top surface area, top diameter and crown length variables. In our study, the equation for the leaf area was used as follows (Nowak, 1996).

$$Y = e^{(-4.3309 + 0.2942H + 0.7312D + 5.7217Sh - 0.0148S)}$$

Since the coefficients of the equation in question are obtained by the linearization of the logarithmic equation, it must be summed with the correction factor. The correction factor for the equation is taken as half of the variance. Thus, the correction term (Correction term=$\sigma^2/2$=0.1159) is obtained. In addition, the equations are used in the following way with the addition of the crown loss ratio.

$$Y = e^{(-4.3309 + 0.2942H + 0.7312D + 5.7217Sh - 0.0148S + 0.1159)} * C$$

- Y: Leaf Area (m^2);
- e: Natural logarithm;
- X: Body diameter (cm);
- Sh: Average shading factor for grown trees. (This value will be taken as 0,83 for broad leaves and 0,91 for needle leaves.)
- S: Outer peak surface area of the tree (π.D(H+D)/2);

- C: Crown loss rate;
- D: Avarege crown diameter (m);
- H: Crown Length (m)

The following equation is used for leaf biomass.

$$Y_b = e^{(1.9375+0.4184*H+0.6218*D+3.0825*Sh-0.0133*S+0.1073)} * C$$

- Yb: Leaf biomass (m2);
- e: Natural logarithm;
- X: Body diameter (cm);
- Sh: Average shading factor for grown trees. (This value will be taken as 0,83 for broad leaves and 0,91 for needle leaves.)
- S: Outer peak surface area of the tree (π.D(H+D)/2);
- C: Crown loss rate;
- D: Avarege crown diameter (m);
- H: Crown Length (m)

For the amount of carbon sequestration; According to Macaroglu (2011), carbon-stock biomass converted to carbon in mass-based carbon determination, Zhang et al. (2009) estimates that the average biomass of single tree is 49.9% 1.3 (mean + se), while carbon stocks vary between 43.7% and 55.6% relative to species. In Lamlom and Savidge (2003) 's study of 41 species, it calculated that it stored between 46.3% and 55.2% carbon. In the annex table 5.2 of the fra-2010 guide, the average coniferous trees were stock 51% carbon and deciduous trees were stock %48 carbon in the geographical climate zone in Turkey. The general acceptance is that the single tree component can be multiplied by the biomass factor of 0.5 to reach the amount of carbon stored (Nowak and Crane, 2002).

In this study, carbon sequestration formulas were used as follows.

- Amount of carbon sequestration for coniferous trees (CSct) = Leaf biomas (Yb) x 0,51
- Amount of carbon sequestration for deciduous trees (CSdt) = Leaf biomas (Yb) x 0,48

3. Results and discussion

3.1. Tree inventory data and analysis in Isparta Anadolu Neighborhood

The Anadolu neighborhood is located in the northeast of Isparta city center. It has an area of 487.798 m^2. At the same time there are 2 small parks in the neighborhood. The population of the Anadolu Neighborhood was 7510 in the year 2016. A total of 1424 trees were planted in 124 neighborhood parks and 1300 roads in Anadolu Neighborhood. When the tree species in the Anadolu Neighborhood are examined; there are *Pinus nigra subsp. Pallasiana (*36,9%)*, Cedrus libani (19,8%*)*, Catalpa bignonioides (9,*3%), *Robinia pseudoacacia 'Umbraculifera* (8,9%) and *Fraxinus excelsior (8,8%)* . When examined in terms of the ages of the trees, 48,88% are in the 6-10 age group and 44,52% are in the 11-20 age group. (Table 3.1., Table 3.2., Table 3.3.).

The total area of the Anadolu Neighborhood is 487.798 m^2, and the crown widths of the trees in the neighborhood are approximately 14.778 m^2. This proportion constitutes approximately 3% of the area (Table 3.4.).

Table 3.1. Anadolu Neighborhood tree types and percentage distribution

Plant name	Number	Percentage (%)
Abies cilicica	1	0,07
Acer platanoides	5	0,35
Ailanthus altissima	50	3,51
Betula alba	4	0,28
Biota orientalis	5	0,35
Betula pendula	2	0,14
Catalpa bignonioides	133	9,34
Cedrus libani	282	19,80
Cupressus arizonica	12	0,84
Cupressus sempervirens	3	0,21
Eleagnus angustifolia	6	0,42
Ficus carica	1	0,07
Fraxinus excelsior	126	8,85
Lagerstroemia indica	1	0,07
Morus alba	32	2,25
Morus nigra	2	0,14
Pinus nigra subsp, pallasiana	526	36,94
Platanus orientalis	29	2,04
Prunus armeniaca	7	0,49
Prunus avium	14	0,98
Prunus domestica	12	0,84
Prunus dulcis	17	1,19
Robinia pseudoacacia 'Umbraculifera'	128	8,99
Salix babylonica	8	0,56
Tilia tomentosa	18	1,26
Total	1424	100,00

Table 3.2. Anadolu Neighborhood tree age and percentage distribution

Tree Age	Number	Percentage (%)
0-10 Years	753	52,88
10 Years and More	671	47,12
Total	1424	100.00

Table 3.3. Anadolu Neighborhood tree length and percentage distribution

Tree length	Number	Percentage (%)
<3 m Small Tree	77	5,41
3 – 6,9 m Medium Tree	1074	75,42
7 – 20 m Big Tree	273	19,17
Total	1424	100,00

Table 3.4. Anadolu Neighborhood tree crown and percentage distribution

Percentage of Tree Crown	Area (m^2)	Percentage (%)
TA= Total Area (m^2)	487.798 m^2	
TACA= Total tree crown width area ($\prod r^2$) (m^2)	14.778 m^2	
(Percentage of total tree crown density in the area)TACP=100x TACA/TA		3,0%

3.2. Examination of biomass and carbon sequestration rates of trees in Anadolu Neighborhood

The total leaf surface area of 1424 trees is 63861.90 m^2 in Anadolu Neighborhood. The leaf biomass value is 3886 kilograms. The amount of carbon sequestration in total leaf biomass was calculated as 1938 kilograms. Based on the total area of the Anadolu Neighborhood, the amount of carbon sequestration per square meter was 3.97 kilograms. The individual, total biomass, leaf surface area and carbon sequestration capacity of the trees in the Anadolu Neighborhood are given in Table 3.5. In addition, the trees over 10 years old in the Anadolu Neighborhood have been identified. The average leaf surface of these trees was 1358,53 m^2, the mean biomass was 97,49 kilograms and the average carbon sequestration was 47,3 kilograms (Table 3.6.).

Table 3.5. Leaf surface area (m^2), leaf biomass value (gr) and carbon sequestration amounts of trees in Anadolu Neighborhood

Plant name	Number	Leaf Surface Area (m^2)	Leaf Biomass Value (gr)	Carbon sequestration Amounts (gr)
Abies cilicica	1	13,81	644,05	328,47
Acer platanoides	5	156,90	15793,85	7581,05
Ailanthus altissima	50	1864,49	133023,82	63851,43
Betula alba	4	169,61	12690,05	6091,22
Betula pendula	2	84,81	6345,03	3045,61
Biota orientalis	5	86,54	4560,70	2325,96
Catalpa bignonioides	133	2950,20	149741,84	71876,08
Cedrus libani	282	19655,45	1238421,70	631595,07
Cupressus arizonica	12	979,42	60964,79	31092,04
Cupressus sempervirens	3	111,95	5581,57	2846,60
Eleagnus angustifolia	6	265,78	15992,13	7676,22
Ficus carica	1	32,39	1783,49	856,08
Fraxinus excelsior	126	2758,85	183493,44	88076,85
Lagerstroemia indica	1	30,50	1613,03	774,25
Morus alba	32	2526,54	184191,13	88411,74
Morus nigra	2	114,81	5861,98	2813,75
Pinus nigra subsp, pallasiana	526	22329,19	1132310,72	577478,47
Platanus orientalis	29	4322,07	360857,07	173211,39
Prunus armeniaca	7	345,58	21404,47	10274,15
Prunus avium	14	317,09	16836,45	8081,50
Prunus domestica	12	418,03	24940,07	11971,23
Prunus dulcis	17	418,46	26303,23	12625,55
Robinia pseudoacacia 'Umbraculifera'	128	1578,71	102934,80	49408,70
Salix babylonica	8	1164,62	93052,94	44665,41
Tilia tomentosa	18	1166,08	87198,25	41855,16
Total	1424	63861,90	3886540,60	1938813,99

Table 3.6. Average leaf surface area (m^2), leaf biomass value (gr) and carbon sequestration amounts of trees/per aged 10 years and over in the Anadolu Neighborhood

Plant name	Avarage Leaf Surface Area (m^2)	Avarage Leaf Biomass Value (gr)	Avarage Carbon Sequestration Value (gr)
Acer platanoides	31,38	3158,77	1516,21
Ailanthus altissima	63,04	4679,70	2246,26
Betula pendula	46,01	3473,66	1667,35
Biota orientalis	16,43	870,61	444,01
Catalpa bignonioides	38,02	2337,56	1122,03
Cedrus libani	81,53	5287,74	2696,75
Cupressus arizonica	120,34	7512,25	3831,25
Eleagnus angustifolia	57,99	3552,85	1705,37
Fraxinus excelsior	60,51	4297,18	2062,65
Lagerstroemia indica	30,50	1613,03	774,26
Morus alba	101,03	7545,14	3621,67
Pinus nigra subsp, pallasiana	59,11	3105,23	1583,67
Platanus orientalis	158,99	13291,44	6379,89
Prunus armeniaca	44,42	2940,28	1411,33
Prunus avium	37,27	2254,60	1082,21
Prunus domestica	51,40	3180,67	1526,72
Prunus dulcis	49,60	3276,47	1572,71
Robinia pseudoacacia 'Umbraculifera'	88,19	7697,24	3694,67
Salix babylonica	145,58	11631,62	5583,18
Tilia tomentosa	77,18	5780,76	2774,76
TOTAL	1358,53	97486,80	47296,94

3.3. Examination of the relationship of urban trees within biomass and carbon sequestration

There are many positive effects of urban trees on the urban ecosystem and the people of the city with the services and contributions they provide. The most contributing factors to urban trees are increasing air quality, reducing soil erosion, reducing carbon dioxide emissions, reducing greenhouse effect, reducing noise levels, enhancing people's social relations and psychology, creating a habitat for wildlife, and increasing recreational opportunities. Urban trees have an important function in order to reduce CO_2 emissions and to carbon sequestration in the city centers.

In this study, it is predicted that in terms of biomass and carbon sequestration, the number of trees in one area, leaf surface area, tree age, play a determining role. In particular, as a strategic target against global warming, the number of trees per person is considered to be 2 trees. As a matter of fact, the number of trees in Anadolu Neighborhood is total 1424 trees and 0.19 trees per person falls. For this reason, the number of trees per capita was found to be inadequate. In this context, the number of trees in the neighborhood dimension should be increased by 10 times.

To this end, strategies have been developed in 48 cities in the United States to reduce emissions of greenhouse gases under the climate protection campaign. For example, Austin hopes to reduce 33,000 tons of CO_2 emissions after 12 years by planting

between 4,700 and 15,000 trees per year in residential areas of the city (ICLEI, 1997). The proportion of CO_2 that trees consume during photosynthesis while growing actively may be greater than the release rate of gas during respiration. This will reduce the rate of CO_2 in the atmosphere. Trees around the building reduce the need for warming and weather conditions. Thus, they can reduce the CO_2 emissions that can occur with electricity generation. Trees are an important CO_2 sequestration areas in the conservation of energy for weather conditions and warming areas (Larcher, 1980). Carbon sequestration is related to the tree growth and death process, which depends on the tree species composition, age structure and health. The newly planted trees accumulate CO_2 rapidly within 20-30 years, and then the annual increase in CO_2 retained begins to decrease (Harmon et al., 1990). While Urban forests hold average of 4 to 8 tonnes / ha of CO_2, rural forests hold about 2 times more CO_2 than urban forests due to high tree density (Birdsey 1992). However, because urban trees tend to grow faster than rural trees, they have more CO_2 per tree (Jo and McPherson 1995).

In this study, grown trees were found to store much more carbon than trees growing. After reaching grown up, long-lived trees have been found to be more efficient species for carbon sequestration. Even though fast-growing trees keep more CO_2 than slow-growing trees, this advantage is lost because fast-growing trees die at a younger age.

One of the most important factors that affect the carbon sequestration of trees for a long time is the survival time of urban trees. Other factor in carbon sequestration in urban areas is the selection of the most appropriate tree species for the areas to be established.

In this study, it was seen that the appropriate species were not used according to the location properties of urban trees. For example; Needle-leaved species were used in the middle of paved pavements. This situation prevents the growth of trees in a healthy way with the effect of environmental conditions. Failure to reach the sufficient size of the trees will also cause the amount of biomass to be low. This may lead to a lower carbon capture value.

According to Jo and McPherson, (1995); the trees that do not fit the area, grow slowly, display some signs of different pressures, get sick or die early. If the production and consumption in the natural ecosystem are in a balance and complementary, it is necessary to create 'environmentally friendly' cities that meet their own consumption with their own production in urban ecosystem in the context of imitating nature. In this context, the importance of trees which use in urban areas is very large (Gül and Polat, 2009).

4. Conclusion

Nowadays, planning and managing of urban trees have been becoming increasingly important. At the same time, urban trees have been coming to the fore with using, sharing and evaluating of monetary and non-monetary services and contributions. In particular, city administrators, planners and researchers demand that the current state of urban trees and forests be learned, their values provided to the urban ecosystem be explored and applied.

As a result of this study; Biomass and carbon sequestration values were calculated on a species basis and individually by making detailed inventory of urban trees. According to this; The total number of trees in the Anatolian region of Isparta is 1424. The crown area covered by trees is 3% of the total area. There are 0.19 trees per person compared to the neighborhood population. Accordingly, the number of trees are insufficient. It has been determined that there is a mistake in choosing the tree species and that the " the right plant in the right place" usage principle has not been applied. It is estimated that the existing trees in the area have total 3886.5 kg leaf biomass and 1938.8 kg carbon sequestration. The highest values per tree in terms of biomass and carbon sequestration in tree species were*; Platanus orientalis, Salix babylonica Cupressus arizonica, Robinia pseudoacacia 'Umbraculifera'* and *Morus alba* species.

At the end of the study; the number of trees, tree species, leaf surface area, age and height characteristics may increase or affect the biomass and carbon sequestration value in the vicinity. Determination of biomass and carbon sequestration values of urban trees and calculation of their monetary values will be an important strategic parameter in the urban heat island mitigation and operational studies against global warming. It will especially play an important role in raising public awareness. Thanks to this study approach; The environmental effects of the trees and forests in the cities will be scientifically demonstrated and they will be more effective in planning and management of the city.

As a result, a city tree information system should be established for each city in our country and strategic tree management planning should be done. Gul et al., (2015), "Urban Trees Information System Model" should be prepared for each city and a database with detailed tree inventory should be prepared. With the database to be constructed, it will be possible to calculate the urban trees' services and contributions to the urban ecosystem, particularly biomass and carbon storage, in concrete terms. In order to make the cities sustainable, livable and healthy, urban heat island effect and reduction of carbon emissions should be the priority action. For this, it is possible to increase the number of trees with the principle of "the right plant in the right place" to realize the importance of urban trees and forests, to diversify scientific researches and to transform the strategic decisions of city trees into actions.

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Plant diversity variation of pure versus mixed Hyrcanian beech Forests

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Abstract: The Hyrcanian vegetation zone of Caspian forests in Iran is stretching over the northern slopes of the Alborz mountain ranges and covers the southern coasts of the Caspian Sea. In this region herbs account for most of the vascular plant diversity which can be used as an easy tool to measure and evaluate biodiversity in order to ecosystem-based forest management. The study focused on following questions: 1) Whether the herbal vegetation composition and diversity varied from mixed Hyrcanian beech stands to pure ones?, 2) How does increasing beech cover affect the understory species?. 27, 11, 10, 6 samples were respectively recorded in pure beech, beech-hornbeam, beech-hornbeam-maple stands and mixed non-beech sites. Plot size for floristic sampling was 400 m² (20* 20 m) in each site. At each sample, a floristic list of the plot and an estimate of percent cover and abundance of all vascular plants were recorded using the Braun-Blanquet scale. At the center of each vegetation plot, two soil samples were taken of 0–10 and 10–30 cm depth levels for physico-chemical analyses including soil pH, total Nitrogen, available phosphorous, calcium carbonate, organic matter, exchangeable bases and C/N ratio. Cluster analysis was used for classify of samples based on understory vegetation data and Multi-response Permutation Procedure (MRPP) was used to test the hypothesis of no differences between predefined overstory categories in the understory species space. Non-metric multidimensional scaling (NMS) was applied to assess the rate and direction of changes on the understory vegetation in the different stands. For measuring plant diversity for each sample, species richness, Evenness and Shannon diversity index were calculated. The results showed that herb-layer vegetation of more diverse deciduous forest stands appeared to be more diverse than herb-layer vegetation of beech-dominated stands. All diversity indices and understory species frequency were lower in pure beech stands but promoted to higher level while decreasing the proportion of beech towards beech-hornbeam, beech-hornbeam-maple and non-beech stands. Frequency of many species such as *Carex divulsa*, *Calystegia sylvestris*, *Lathyrus laxiflorus*, *Lapsana communis*, *Geum urbanum*, *Brachypodium sylvaticum* increased when proportion of beech in the canopy decreased. NMS analysis clearly indicated that major factors accounting for variations in understory vegetation were organic matter and total nitrogen as well as the proportion of beech in tree layer. All diversity indices and distribution of understory species significantly negatively correlated with beech proportion and positively with soil organic matter and total nitrogen. Therefore, Forest managers should pay attention to the natural composition of forest stands and should not try to replace mixed forest stands by pure ones. For conservation of biodiversity, we need a mixture of (natural) beech forest stands with a more diverse canopy composition.
Keywords: Beech, Diversity, Understory species, Hyrcanian forests, Iran

1. Introduction

The Hyrcanian vegetation zone of Caspian forests is stretching over the northern slopes of the Alborz mountain ranges and covers the southern coasts of the Caspian Sea (Sagheb-Talebi, 2004). Although palynologically not evidenced yet, the presence of many elements of the Arcto-Tertiary flora, such as Parrotia persica, Pterocarya fraxinifolia and Zelkova carpinifolia indicates that the Hyrcanian forest was one of the most important refuges for the temperate deciduous broad-leaved forests during Pleistocene glaciations (Ramezani et al., 2008). In Hyrcanian region woodland herbs account for most of the vascular plants diversity, like the deciduous forests of eastern North America (Whigham, 2004) and Europe (Garcia et al., 2007; Vockenhuber et al., 2011). Herbal vegetation play an important role in ecosystem functioning, especially in nutrient cycling (Anderson and Eickmeier, 2000; Bolte et al., 2004). Besides productivity aspects, forest herb-layer species are well-known indicators of site conditions, overstory regeneration patterns and conservation status (Hutchinson et al., 1999; Small and McCarthy, 2002, Lookingbil et al., 2004, Suchar & Crookston, 2010) and relevant indicators for human impact and evaluate biodiversity in ecosystem-based forest management (Schmidt, 2005). During the two last decades foresters have been trying to develop beech (Fagus orientalis Lipsky) stands by operating single selection system at intermediate elevation levels (800–1800 m a.s.l.) because of productivity reasons and economical value (Mohadjer, 2005). In spite of ecological enormous importance of Hyrcanian forests, the effects of increased proportions of beech trees in the overstory composition on understory species in these forests are still unclear. However, it is illustrated that the species composition of the forest canopy affects the distribution of forest understory species (van Oijen et al. 2005). Moelder et al., 2008 reported that herbaceous understory diversity was indirectly influenced by canopy tree species by altering environmental factors like soil pH and litter layer thickness. Vascular species richness is higher in oak species stands compared to beech ones (Brunet et al.,1996; Skov 1997; Nagaike et al. 2005). On the whole, coniferous species from the Pinus and Larix genera showed to support a diverse understory than some broadleaved species (Barbier et al, 2008). Lenie`re and Houle, 2006 indicated the more diverse tree canopy had a positive effect on vascular species richness because the diversity of the tree layer can influence herb layer diversity by creating environmental conditions suitable to understory vegetation (Vockenhuber et al., 2011). While,

Ampoorter et al., 2014 didn't find a clear relation between tree species richness and understory diversity. According to Tinya et al. (2009), transmitted light from the overstory affects significantly species richness of herbs and cover of ground floor in temperate mixed forests, also the quantity and quality of it alter through tree species composition and stand structure which these factors influence thereby silvicultural management. But, Chen et al. (2004) and Moelder et al. (2008) did not find significant relationship between understory light and herb layer vegetation diversity. In general speaking, it can be supposed that mixed stands are more suitable for species in the herbal layer than pure ones. Nevertheless, these assumptions may not always be sound. Furthermore, the mechanisms involved in the impacts of tree species on understory species are not completely comprehended (Barbier et al, 2008). Hence, insight into the effects of tree species variations on herbaceous diversity can be helpful and essential for forest managers in order to management based on close-to-nature forestry and natural forest dynamics in Hyrcanian forests. So, this paper focussed on following questions:

1) Whether the herbal vegetation composition and diversity varied from mixed Hyrcanian beech stands to pure ones?
2) How does increasing beech cover affect the understory species?

2. Materials and Methods

2.1. Study area

The study was conducted in the experimental forest of the University of Tehran. The experimental forest is located in northern Iran (Figure 1). Latitude range: 36º27′-36º40′ N; longitude range: 51º32′-51º43′E.

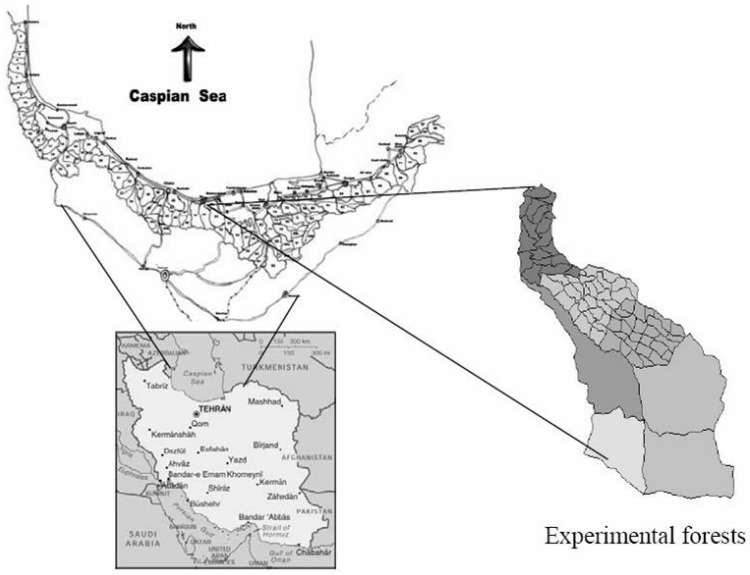

Figure 1. Location of study area

Average annual rainfall is 1300 mm and average annual temperature is 15.3 °C. Relative humidity is also high with an average value of 80 %. The bedrock materials are mainly limestone and soils belong to Inceptisol and Alfisol orders in the study area (Sarmadian and Jafari 2001). The whole study area have been permanently covered by deciduous forest and categorized as ancient forests with multi layers strata (Mohadjer, 2005). In addition to *Fagus orientalis*, major tree species are *Acer velutinum*, *Quercus castanifolis* and *Carpinus betulus*.

2.2. Sampling strategy

For this study, 54 representative sampling plots from 54 research sites were selected based on criteria by experts (according to Moelder et al., 2008). Selection criteria were follows as:

(1) All stands investigated in this study were ancient forests.
(2) Comparable edaphic and climatic conditions. Vegetation composition and habitat conditions within sites should be homogeneous.
(3) No trees have been felled in the plots for at least 10 years;
(4) Tree-layer compositions in pure beech, beech-hornbeam, beech-hornbeam-maple stands. In these, 27, 11, 10 samples were recorded. In order to evaluate the effect of absence of beech from tree layer on understory vegetation, 6 plots were taken in mixed oak, hornbeam and maple stands as mixed non-beech stands.

Nomenclature followed Ghahraman (2001) for all plants observed in the plots.

Plot size for floristic sampling was 400 m² (20* 20 m) in each site (according to Mataji, 2003). Within each plot, the full floristic composition of vascular plants was recorded. Cover classes for each species (using the modified Braun-Blanquet scale, Ellenberg and Mueller-Dombois 1974) were separately estimated for herb and tree layers. As a biotic environmental parameter, the proportion of beech in relation to the other tree species in the tree-layer was calculated for each sample.

At the centre of each sample, two samples were taken from 0-10 and 10-30 cm soil depth from the mineral soil.

Before the laboratory analysis the soil samples were air-dried and sieved with a 2 mm screen. Sand, silt and clay percentages were determined by the hydrometric method. Soil pH (in KCl) was determined by a pH meter. Total N was analyzed by the Kjeldahl method (Zarrinkafsh, 2000). Available P was determined by colorimetry according to Bray-II method (Bray and Kurtz, 1945). Calcium carbonate was determined by calcimetry; organic carbon by the Walkley and Black (1934) method. Organic matter was obtained by multiplying C values by 1.72. Exchangeable bases were extracted with ammonium acetate 1 N and analyzed by atomic spectrometry. Also, C/N ratio was calculated (Zarrinkafsh, 2000).

2.3. Data analysis

In order to recognize understory species groups within predefined overstory categories, cluster analysis was used to classify of samples based on understory vegetation data using a Sørensen distance measurement and flexible beta linkage. Multi-response Permutation Procedure (MRPP) was used to test the hypothesis of no difference between predefined overstory categories in the understory species space (McCune & Mefford, 1999).

Non-metric multidimensional scaling (NMS) was applied to assess the rate and direction of changes on the understory vegetation in different stands. For an ecological interpretation of the ordination result, scores of plots of the first two ordination axes were correlated with corresponding measurements of environmental variables using of Spearman rank correlation (McCune & Mefford, 1999). Before data analysis, species with less than 5% frequency were deleted from the species matrix and the matrix of soil physical and chemical variables was standardized to mean 0 and variance 1 prior to ordination. The cover-abundance-scale for the species was transformed into digital form (for ordination analysis) according to the scale proposed by Van der Maarel (1979).

For measuring plant diversity for each sample, species richness was calculated as the number of species inventoried in the plot. We applied the Shannon diversity index (H') as , where equals the number of species and is the relative cover of ith species And also the Evenness index, E= H'/ H'max with H'max =ln(SR) (Magurran, 2004). The original data was used for calculating the diversity indices.

The computer program PC-ORD for Windows version 4.0 for calculating all diversity indices and the analysis (McCune & Mefford, 1999).

The Spearman correlation was calculated between environmental factors (organic matter, total nitrogen and the proportion of beech) and species with high significant correlation with NMS axis to detect possible relationships.

Mann-Whitney U-test was used to test for significant differences in the species richness, diversity and evenness indices among the different stand types. This analysis was conducted using SPSS 15.0.

Results

Cluster analysis of samples based on understory vegetation recorded in different forest types (Fig. 2) showed that 2 main groups could be separated. The plots of pure beech obtain the first group (in addition to 2 plots of beech-hornbeam stand) and the rest provide the second group in which beech-hornbeam, beech-hornbeam-maple and non-beech samples are included. MRPP analysis (Table 1) detected that there were significant differences between pure beech stands and mixed beech and non-beech stands, also beech-hornbeam versus non-beech and beech-hornbeam-maple versus non-beech stands based on understory species composition but no significant differences observed between mixed beech stands.

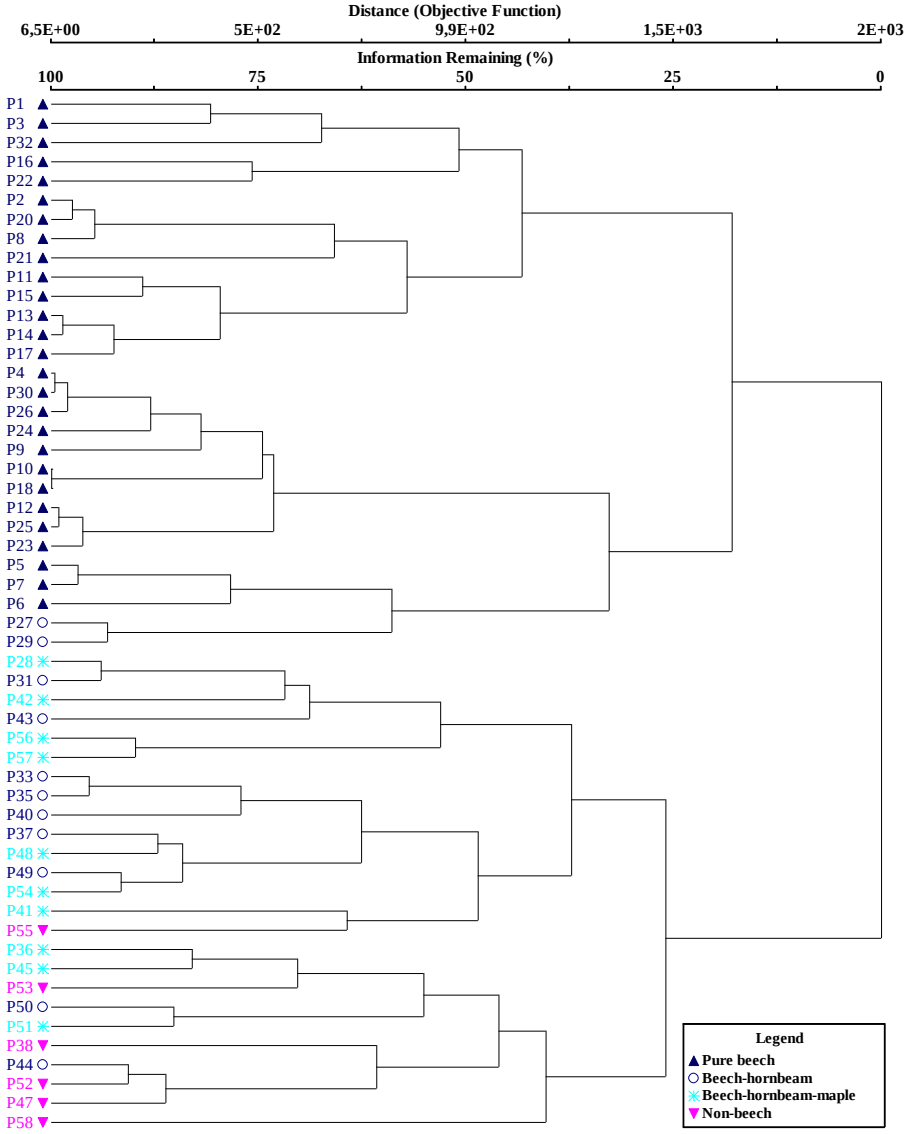

Figure 2. diagram of cluster analyses on 54 sample plots in the study area.

Table 1. multiple pair-wise comparisons of species composition of different stands by MRPP.

	T	A	P
Pure beech *vs.* Beech-hornbeam	-13.312	0.2172	0.00000001
Pure beech *vs.* Beech-hornbeam-maple	-11.041	0.1803	0.00000003
Pure beech *vs.* Non-beech	-12.364	0.2264	0.00000000
Beech-Hornbeam *vs.* Beech-hornbeam-maple	1.386	-0.0411	0.93016211
Beech-Hornbeam *vs.* Non-beech	-3.657	0.1325	0.00263236
Beech-hornbeam-maple *vs.* Non-beech	-2.140	0.0879	0.03019048
Total	-13.799	.2888	0.00000000

The test statistic (T) describes the separation between groups and the chance corrected within-group agreement (A) describes within-group homogeneity compared to random expectation.

Ordination of sampled plots clearly indicated that major factors accounting for variations in understory vegetation were organic matter and total nitrogen as well as the proportion of beech in tree layer (fig 3 & table 2). NMS second axis was significant negative correlated with relative beech proportion. Diversity indices showed a significant positive correlation with this axis. The first axis was positively correlated with soil organic matter and total nitrogen in the first depth. There was no direct relationship between the distribution of understory species with soil texture, exchangeable cations and pH. Correlation analysis showed that understory species diversity indices was significantly positively correlated with soil organic matter and total nitrogen and negatively with relative beech proportion.

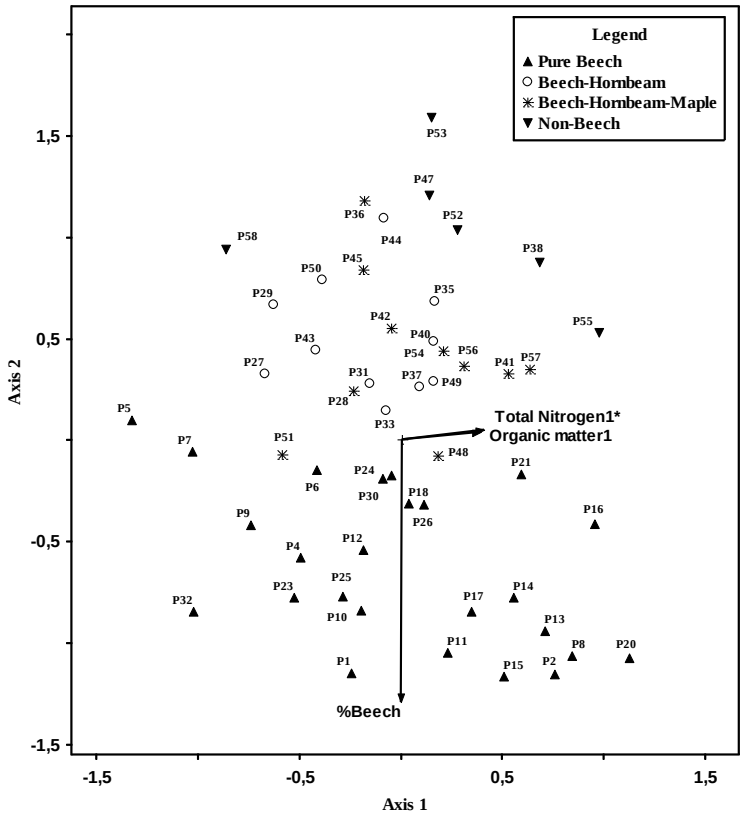

Figure 3. NMS ordination of 54 sample plots in the study area (total organic matter 1 and total nitrogen 1: organic matter content and total nitrogen in the first layer of soil (0-10 cm depth)).

Table 2. Spearman correlations between herb-layer species diversity indices and NMS axis as well as significant environmental parameters

	Oragnic Matter	Total Nitrogen	%Beech	NMS Axis1	NMS Axis2
Oragnic Matter	1	.731**	-.373**	0.250*	.110
Total Nitrogen	.731**	1	-.339*	.274*	-.025
%Beech	-.373**	-.339*	1	.026	-.722**
Species Richness	.303*	.303*	-.821**	-.048	.672**
Shannon-Wiener Diversity index	.336*	.411**	-.839**	.106	.621**
Evennes Index	.350*	.401**	-.825**	.149	.620**

**. Correlation is significant at the 0.01 level.
*. Correlation is significant at the 0.05 level.

NMS first-axis scores were positively correlated with *Cardamine bulbifera, Circaea lutetiana, Mercurialis perennis* and negatively correlated with *Carex sylvatica, Hypericum androsaemum, Epimedium pinnatum* (Table 3, Fig. 4). NMS second-axis scores were significantly positively correlated *with Brachypodium sylvaticum, Calystegia sylvestris, Carex divulsa, Carex sylvatica, Geum urbanum, Hypericum androsaemum, Oplismenus undulatifolius, Scuttellaria tournefortii, Vincetoxicum scandens, Viola odorata, Fragaria vesca* and negatively correlated with *Cardamine bulbifera and Mercurialis perennis*. These species as well as other effective parameters (beech proportion in tree layer, soil organic matter and total nitrogen in the first layer and diversity indices) were tested for significant correlations using of Spearman correlation (Table 3). *Brachypodium sylvaticum and Vincetoxicum scandens* showed significant positive correlation with organic matter and the same for correlation between *Brachypodium sylvaticum, Circaea lutetiana* and total nitrogen. Generally speaking, except for *Cardamine bulbifera* which indicated positive correlation, there were negative correlations between the rests of species with beech proportion. The correlation results for correlations between understory species and diversity indices were vice versa (in most cases) with what were observed to beech proportion.

All diversity indices were significantly negative correlated with beech proportion in the canopy and positively with soil organic matter and total nitrogen (table 2). *Calystegia sylvestris Carex divulsa, Serratula quinquefolia, Sedum stoloniferum, Prunella vulgaris*, *Danae racemosa, Polystichum vulgaris, Lathyrus laxiflorus, Lapsana communis, Geum urbanum, Geranium sylvaticum, Geranium robertianum, Carex remota and Lathyrus vernus* were not recorded in pure beech stands (Table 4).

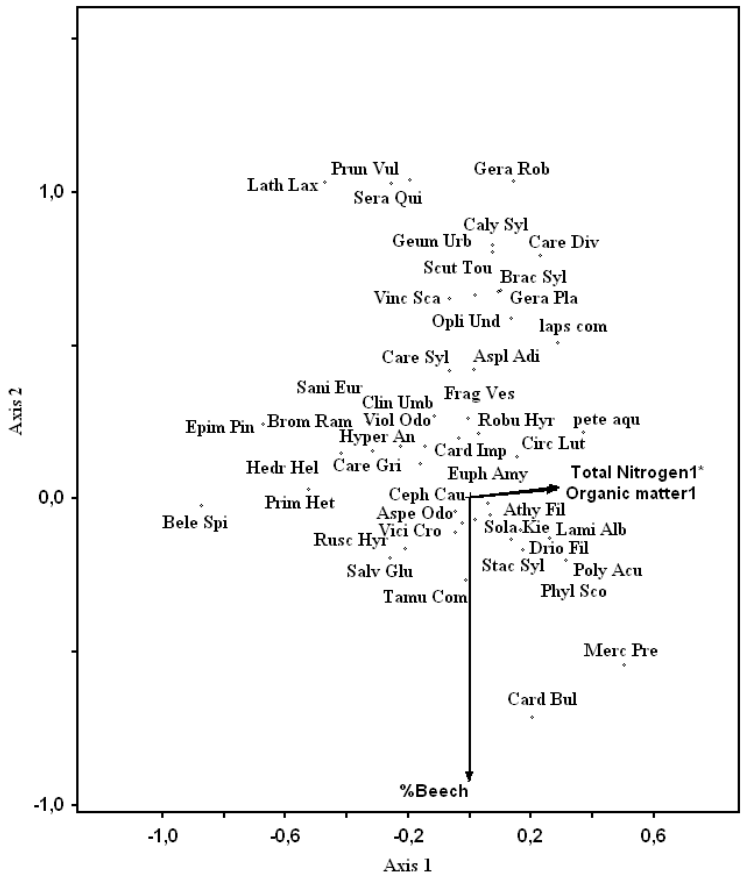

Figure 4. NMS ordination of the understory species (total organic matter 1 and total nitrogen 1: organic matter content and total nitrogen in the first layer of soil (0-10 cm depth); the abbreviations of species scientific name are cited in table 4).

Table 3. Spearman correlations between understory species and environmental parameters as well as diversity indices and NMS axis

	Organic Matter	Total Nitrogen	Species Richness	Shannon-Wiener Diversity index	Evennes Index	%Beech	DCA Axis1	DCA Axis2
Brachypodium sylvaticum	.383**	.310*	.736**	.790**	.803**	-.782**	0.123	.688**
Calystegia sylvestris	0.244	0.113	.574**	.497**	.480**	-.547**	0.007	.555**
Cardamine bulbifera	-0.107	-0.076	-.286*	-.297*	-.314*	.463**	.289*	-.466**
Carex divulsa	0.134	0.246	.500**	.536**	.520**	-.566**	0.179	.473**
Carex sylvatica	0.142	0.137	.583**	.690**	.682**	-.672**	-.275*	.607**
Circaea lutetiana	0.264	.300*	.498**	.530**	.514**	-.418**	.352*	0.265
Geum urbanum	0.273	0.127	.676**	.683**	.722**	-.756**	-0.012	.703**
Hypericum androsaemum	-0.145	-0.213	.323*	.227	0.182	-.311*	-.406**	.455**
Mercurialis perennis	0.104	0.268	-0.240	-.115	-0.133	0.253	.456**	-.525**
Oplismenus undulatifolius	0.158	0.242	.650**	.737**	.749**	-.756**	0.100	.588**
Scuttellaria tournefortii	0.182	0.182	.569**	.538**	.495**	-.567**	-0.066	.454**
Vincetoxicum scandens	.285*	0.209	.489**	.433**	.367**	-.624**	-0.148	.401**
Viola odorata	0.230	0.169	.610**	.605**	.623**	-.652**	-0.263	.622**
Epimedium pinnatum	-0.171	-0.133	0.167	.093	0.011	-0.097	-.573**	0.132
Fragaria vesca	0.130	0.101	.536**	.639**	.643**	-.558**	-0.0003	.618**

**. Correlation is significant at the 0.01 level.
*. Correlation is significant at the 0.05 level.

Table 4. Species frequency percentage in different stands

	Abbreviation	pure beech	beech-hornbeam	beech-hornbeam-maple	non-beech
Euphorbia amygdaloides	*Euph amy*	100	100	100	100
Asperula odorata	*Aspe odo*	100	100	100	67
Rubus hyrcanus	*Rubu hyr*	96	100	90	100
Dryopteris filix-mass	*Dryo fli*	96	82	90	100
Athyrum filix-femina	*Athy fil*	93	91	100	67
Solanum kieseritzki	*Sola kie*	85	100	90	83
Stachys sylvatica	*Stac syl*	81	64	70	17
Viola odorata	*Viol odo*	74	100	100	100
Lamium album	*Lami alb*	74	82	90	83
Circaea lutetiana	*Circ lut*	67	91	100	83
Hypericum androsaemum	*Hyper and*	63	100	90	100
Cephalanthera caucasica	*Ceph cau*	63	64	60	33
Fragaria vesca	*Frag ves*	59	91	100	100
Bromus ramosus	*Brom ram*	56	91	80	67
Mercurialis perennis	*Merc pre*	52	9	30	33
Tamus communis	*Tamu com*	48	27	40	50
Cardamine bulbifera	*Card bul*	48	18	0	0
Vicia crocea	*Vici cro*	41	27	30	50
Carex sylvatica	*Care syl*	37	100	90	100
Salvia glutinosa	*Salv glu*	33	9	40	17
Polystichum aculeatum	*Polys acu*	33	36	40	50
Ruscus hyrcanus	*Rusc hyr*	30	9	30	33
Phyllitis scolopendrium	*Phyl sco*	22	27	30	0
Peteridum aquilinium	*Pete aqu*	22	9	20	33
Clinopodium umbrosum	*Clin umb*	22	82	50	50
Cardamine impatiens	*Card imp*	22	55	20	0
Sanicula europaea	*Sani eur*	19	36	20	17
Carex grioletti	*Care gri*	19	45	30	0
Epimedium pinnatum	*Epim pin*	15	36	20	17
Blechnum spicant	*Blec spi*	11	0	0	0
Vincetoxicum scandens	*Vinc sca*	4	45	30	83
Symphyandra odontosepala	*Symp odo*	4	9	0	0
Scuttellaria tournefortii	*Scut tou*	4	55	40	50
Ptera cretica	*Pter cre*	4	0	0	0
Primula heterochroma	*Prim het*	4	18	0	0
Oplismenus undulatifolius	*Opli und*	4	82	80	83
Hedera Pastuchovii	*Hedr pas*	4	0	10	17
Carex strigosa	*Care str*	4	0	10	0
Brachypodium sylvaticum	*Brac syl*	4	73	80	100
Asplenium adiantum-nigrum	*Aspl adi*	4	18	10	17
Serratula quinquefolia	*Serr qui*	0	0	10	33
Sedum stoloniferum	*Sedu sto*	0	0	0	33
Prunella vulgareis	*Prun vul*	0	9	20	33
Danae racemosa	*Dana rac*	0	9	0	0
Polystichum woronowii	*Poly wor*	0	9	0	0
Carex divulsa	*Care div*	0	27	40	67
Calystegia sylvestris	*Caly syl*	0	36	50	50
Lathyrus laxiflorus	*Lath lax*	0	9	10	33
Lapsana communis	*Laps com*	0	18	30	17
Geum urbanum	*Geum urb*	0	64	70	100
Geranium sylvaticum	*Gera syl*	0	36	40	50
Geranium robertianum	*Gera rob*	0	9	0	17
Carex remota	*Care rem*	0	0	10	0
Mentha aquatica	*Ment aqu*	0	0	0	17
Lathyrus vernus	*Lath ver*	0	0	0	17

All diversity indices increased while the beech proportion decreased so that the lowest amount of all diversity indices were observed in pure beech stands but the highest in non-beech stands (fig.4).

3. Discussion

This study indicated that compositional dissimilarities in the overstory tree types resulted in differences between the understory species except beech-hornbeam versus beech-hornbeam-maple (table1). The cluster analysis (Fig. 2) revealed that pure beech stands was classified quite separately from mixed beech plots with specific understory composition. As NMS analysis (Fig. 3 & Fig. 4) illustrated the variation of ground vegetation in different stands can be explained by a combination of soil organic matter and total nitrogen of upper 10 cm and proportion of beech in the tree layer. Frequency of many species such as *Carex divulsa,*

Calystegia sylvestris, Lathyrus laxiflorus, Lapsana communis, Geum urbanum, Brachypodium sylvaticum increase when proportion of beech in the canopy decreases (table4). Light transmittance from the overstory is related to tree species characteristics (such as leaf area index and spatial arrangement of leaves) and crown structure as well as density of crown (Horn 1971; Planchais & Sinoquet 1998; Jennings et al. 1999). Beech crowns transmit a small amount of light to the forest floor (Barbier et al., 2008).

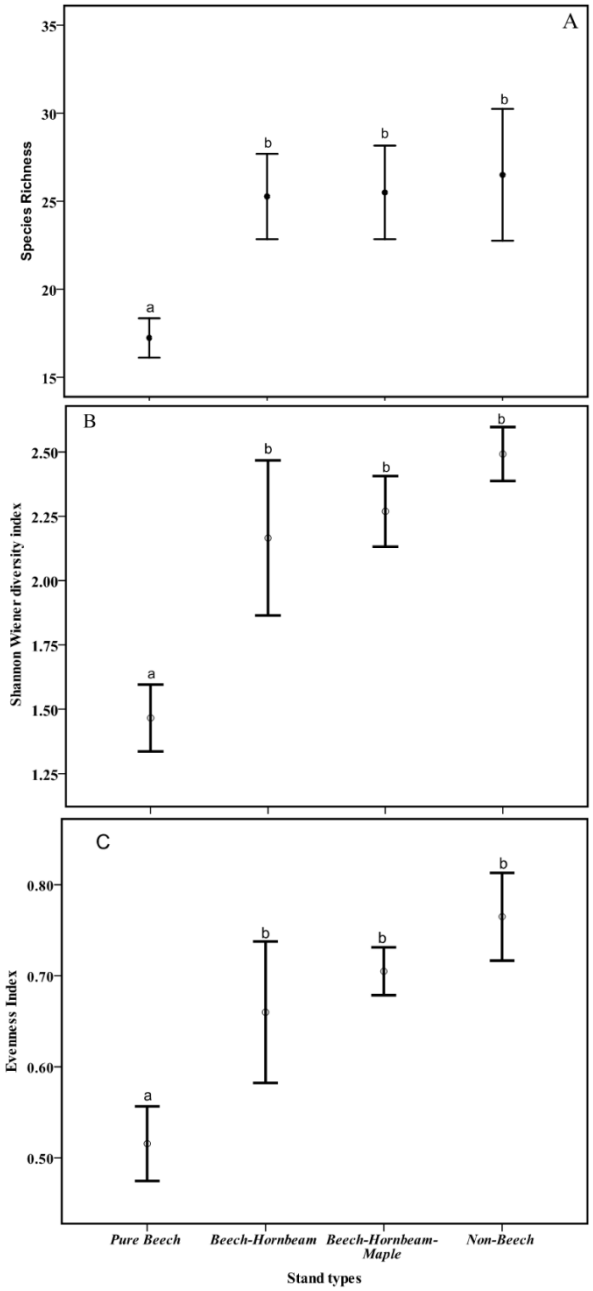

Figure 5. Species Richness (A), Shannon Evenness index (B), Shannon diversity index(C) in the different stand types. Significant differences (at 0.01 level) are depicted by different letters.

Therefore, it can be hypothesized that, lower beech proportion or higher other canopy species result in higher light availability and higher herb-layer diversity (Moelder et al., 2008). Our findings agree with Tinya et al. 2009, who declared that lighter forest patches provide relevant conditions for survive of more herbal species. Also shade-tolerant species which are characteristic for low light condition (e.g. *Cardamine bulbifera* and *Mercurialis perennis*) mainly occur with high frequency in beech stands. Furthermore, all diversity indices significantly positively correlated with soil organic matter and total nitrogen (table2). Fu et

al. (2004) found that soil organic matter content was a suitable index of soil fertility and nutrient availability. Increasing of soil nutrient and equalizing the distribution of it will allow more vascular species to co-exist at small scale (Bruno et al., 2002; Hart, et al., 2003). In a comprehensive study of local and regional trends in the ground vegetation of five ancient beech from northwest France, Lalanne et al. 2010 showed that soil nutrient regime explains a large proportion of the variation in the floristic composition of beech forests. We detected that in addition to beech proportion, organic matter and total nitrogen were major factors for variations of understory vegetation. Haerdtle et al. (2003) indicated in the meso- to eutrophic beech forests (beech forests of the alliance Fagion sylvaticae) that species richness is closely correlated with the nutrient supply. The present study showed no significant correlations between soil pH and herb layer species richness and diversity. However, some other studies such as van Oijen et al. 2005, Moelder et al., 2008 and Vockenhuber et al., 2011 showed herb layer species richness was positively related to increasing soil pH under variety of tree species *including Tilia platyphyllos, Carpinus betulus, Fraxinus excelsior, Fagus sylvatica, Quercus robur* in the Central Europe. The correlation analysis demonstrated that there were significantly negative correlations between soil organic matter and total nitrogen and proportion of beech in the tree layer. Moreover, herb layer diversity indices and species richness were significantly negatively correlation with beech proportion. Litter quality between tree species is different, litter mixtures decompose at a different rate (Seastedt, 1984). Sariyildiz & Kucuk (2009) demonstrated that litter decomposition and nutrient release processes in the pure oriental beech stands (*Fagus orientalis Lipsky*) were lower than mixed ones resulted in greater concentrations of N and net N mineralization rates in the forest floor of the mixed beech stands. In temperate forest, there is a report of the higher organic horizon thickness in the pure beech mature stands in contrast with mixed beech-hornbeam stand that it indicated slower decomposition processes in pure beech forest (Aubert et al., 2004). Furthermore transmission of photosynthetically active radiation in beech canopies is significantly lower than in canopies of other deciduous tree species. This inhibits both the establishment and development of shade-intolerant herb-layer (Schmidt, 2005). In particular, pure beech stands had lower species richness and diversity compared mixed beech stand. Moelder et al., 2008 reported that herb-layer vegetation of more diverse deciduous forest stands appeared to be more diverse than herb-layer vegetation of beech-dominated stands in Hainich National Park (Thuringia, Germany). In the study of Aubert et al., 2004 a pure beech stand had a homogenizing effect on herb-layer composition compared mixed beech-hornbeam stand. Generally, all diversity indices and understory species frequency were lower in pure beech stands but promoted to higher level while decreasing the proportion of beech towards beech-hornbeam, beech-hornbeam-maple and non-beech stands.

Therefore, it can be stated that, tree species significantly influenced herb layer diversity by altering environmental conditions (such as soil variables and light transmittance) and variation of tree species has ecological effects over the time. Concluding, Forest managers should pay attention to the natural composition of forest stands and should not try to replace pure mixed forest stands by pure ones. For conservation of biodiversity, we need a mixture of (natural) beech forest stands, but also a mixture of utilized forest with a more diverse canopy composition.

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Mapping the spatial distribution of mushroom diversity

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Abstract: Mushroom resources are one of the most important non-wood forest products because of food, medicinal, commercial and recreational benefits. Furthermore, wild mushrooms have an important ecological role for forest ecosystems. Therefore it is quite necessary to document of mushroom diversity, spatial distribution and abundance of this resources to conserve of this natural resources. Searching of all mushroom species with observation over the landscape is not a useful method. However, building of a spatial database based on geographical location of mushroom species by using Geographic Information Systems (GIS) would be useful for mapping of mushroom diversity. The objective of the present study is to develop and implement a conceptual approach for creating the thematic map of mushroom diversity in Kemerköprü planning unit of Turkey based on some diversity indexes and GIS. 75 permanent sample plots were installed randomly in nearly pure even-aged stands characterized by *Picea orientalis* and *Fagus orientalis.* The sampling plots cover a square in shaped of 100 m^2. The plots were selected to cover the widest range of aspect, slope, elevation and stand characteristics. The each plots were inventoried from August to November at about ten days interval in 2013. All visible macrofungi were counted and measured fresh weight after harvested from each plot. Some diversity indexes such as Shannon weiner (H') and Simpson diversity index (D) were calculated to compare the abundance and richness of macrofungi from each plot. A point layer showing diversity index of each sample point was created and a scale identifying mushroom diversity was generated using GIS. Then, all points with the same scale for mushroom diversity were combined through Thiessen polygon method. The results showed that the used method is quite useful and practical method for mapping of mushroom diversity.
Keywords: Mapping, Mushroom diversity, GIS, Spatial distribution, Thiessen polygon

1. Introduction

Mushroom resources are one of the most important non-wood forest products because of food, medicinal, commercial and recreation benefits. Furthermore, wild mushrooms have an important ecological role for healthy of forest ecosystems. Therefore, it is quite necessary to document of mushroom diversity, spatial distribution and abundance of this resources to conserve of this natural resources.

Biodiversity is defined as variety of organisms in a space. In other words, biodiversity covers the genes in a region, the species carrying these genes, the ecosystems that contain these species, and the events that link them together. This definition draws attention to many dimensions of biodiversity such as genetic, taxonomic, ecosystem and events diversity (Erten, 2004; Gülsoy and Özkan, 2008).

Diversity indices should be calculated so that the diversity level is expressed as a numerical value and the diversity ratings of the different systems can be statistically compared (Odum ve Barrett 2005). The ability to calculate diversity with this mathematical measure is an especial tool for biologists to understand community structure. Though diversity indices provide important information about diversity, dominancy, richness and evenness of species in a community, there is no single index sufficiently calculating biodiversity concept such as rarity and commonness of species in a community (Hurlbert, 1971; Purvis and Hector, 2000).

The diversity of species in a particular area depends on not only the number of species, but also in their numbers that is relative abundance. While experts determine species richness as the number of species in an area, they determine species evenness as the relative abundance of species in an area. Richness (S) is explained as the number of species and is the most common indication for diversity (Magurran, 2004). Margalef and Menhinicks indices are the some of the common used indexes to characterize species richness in a community. The simplest diversity indices is Berger and Parker diversity indices that reports the proportional abundance of only the most abundant species in a community (Berger and Parker, 1970). Also, Pielou-R indice accounts evenness of the species present. The Shannon-Wiener diversity index (H') and the Simpson index are the most widely used diversity indices to obtain information on species diversity or dominancy in stations and distribution of individuals between species (Jorgensen et al., 2005).

Because natural events and human activities such as forest management practices, fire etc. change stand structures, biological diversity as well as occurrence, abundance and reproduction of mycorrhizal mushrooms can be affected (Pilz and Molina, 2002). Spatial information and mapping of biological diversity can offer several advantages in the planning of forest ecosystems. Especially, determining the state of biodiversity in a unit, obtaining the priority areas in conservation and providing biodiversity strategies can be ensured through mapping of biodiversity. To protect the mushroom diversity in forests accurate information such as spatial distribution maps, productivity models is required. Therefore, developing mushroom diversity maps is essential for conservation and sustainable management of forest ecosystems. This kind of maps are essential

for identification of high priority areas and protected areas (Carrol, 1998; Myers et al., 2000). However, searching of all mushroom species with observation over the landscape is not a useful method. Building of a spatial database based on geographical location of mushroom species by using Geographic Information Systems (GIS) would be useful for mapping of mushroom diversity.

A number of studies obtain the relationship with biological diversity and some stand or ecological variables based on biodiversity indexes and analyze biodiversity (Gülsoy and Özkan, 2008; Bonet et al., 2010; Küçüker, 2017a,b). Although a limited number of studies about mapping of non-wood forest products have been presented (Yang et al., 2006; Franca-Plata et al., 2012; Kucuker and Baskent, 2015; Kucuker, 2017c), there have been very few studies to map the biological diversity (Hernandez-Stefanoni and Ponce-Hernandez, 2004). The objective of the present study is to develop and implement a conceptual approach for creating the thematic map of mushroom diversity in Kemerköprü planning unit of Turkey based on some diversity indexes and GIS.

2. Material and methods

2.1. Study area

This study was conducted in the Kemerköprü Planning Unit, northeastern of Turkey. The study area covers about 18,000 ha area with 174 compartments and 879 sub-compartments. The most common tree species in the study area dominantly characterized by *Fagus orientalis, Picea orientalis, Castanea sativa* and *Abies nordmanniana*. The altitude ranges between 80 m and 2045 m above sea level with an approximately average slope of 26.2%. Mean annual temperature of study area is 9^0C and mean annual precipitation is 1813 mm based on long term measurements from the nearest meteorological station from 1975 to 2005. Of the planning unit, about 60% is forested area. The study area hosts a large variety of edible or nonedible mushrooms.

2.2. Field sampling design

Mushroom surveys were performed in 75 permanent sample plots installed randomly in nearly pure even-aged stands (Fig 1). The plots were selected to cover the widest range of aspect, slope, elevation and stand characteristics. The sampling plots cover a square in shaped of 100 m^2. All plots were visited five times at about ten days interval from August to November in 2013. All visible macrofungus were harvested from each plot. Also, all sporocarp number and fresh weight for each different mushroom species were recorded in each plot.

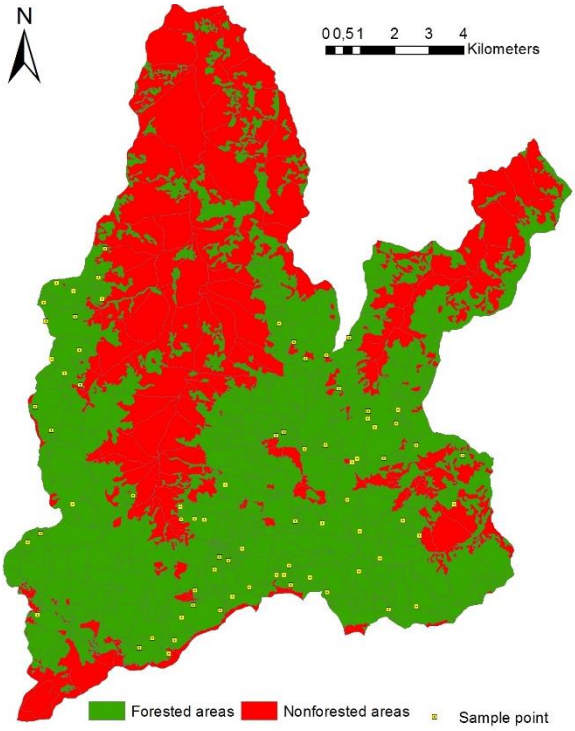

Figure 1. Sampling plots in the study area

2.3. Measures of mushroom diversity

Mushroom diversity was analyzed with the total number of mushroom species in each plot. To measure diversity, abundance and richness of macrofungus in each plot, some diversity indexes such as Shannon Weiner (H'), Simpson index (D), Simpson diversity index (D), Pielou regularity (E), Margalef richness (D), Menhinick's richness and Berger-Parker dominance (BP) were used.

2.4. Mapping method: Thiessen polygon

The diversity indices value of the mushroom species in the each plot were recorded with location through GPS. Spatial database showing the mushroom diversity indexes in the study area was created and then a point layer showing the each mushroom diversity index values in the each sample point was created by using some functions of GIS. Thiessen polygon method was used to allocate all points with the same quality for diversity. Then the created polygon layer indicating mushroom diversity was combined with stand type map of the planning unit.

3. Results and discussion

A total of 293 sporocarp were sampled in 75 sample plots and a total 12 mushroom species belonged to 6 family were recorded. Of the total number of species identified 24.2% are from Cantharellaceae, 22.2% are from Bankeraceae, 18.4% are from Russulaceae, 17.7% are from Boletaceae, 17.0% are from Hydnaceae and 0.3% are from Agaricaceae family (Table 1).

Table 1. Scientific name, family, genus and the number of the mushrooms in the plots

Scientific name	Family	Genus	N	N%
Boletus edulis	Boletaceae	Boletus	52	17.7
Cantharellus cibarius	Cantharellaceae	Cantharellus	71	24.2
Sarcodon imbricatus	Bankeraceae	Sarcodon	65	22.2
Hydnum repandum	Hydnaceae	Hydnum	50	17.1
Lactarius volemus	Russulaceae	Lactarius	35	11.9
Russula delica	Russulaceae	Russula	5	1.7
Lactarius vellereus	Russulaceae	Lactarius	3	1.0
Lactarius deliciosus	Russulaceae	Lactarius	2	0.7
Lactarius sanguifluus	Russulaceae	Lactarius	1	0.3
Lactarius zonarioides	Russulaceae	Lactarius	4	1.4
Macrolepiota procera	Agaricaceae	Macrolepiota	1	0.3
Lactarius glyciosmus	Russulaceae	Lactarius	4	1.4
Total			293	100

The most common mushroom species are *Cantharellus cibarius, Sarcodon imbricatus, Boletus edulis, Hydnum repandum* and *Lactarius volemus* with 24.2%, 22.2%, 17.7%, 17.1% and 11.9% respectivelly. The rest (6.9%) of species are *Russula delica, Lactarius vellereus, Lactarius deliciosus, Lactarius sanguifluus, Lactarius zonarioides, Macrolepiota procera* and *Lactarius glyciosmus* (Table 1).

To understand the mushroom diversity, dominancy, richness or evenness values in each sample plot some alfa diversity indexes such as Shannon-Wiener, Simpson, Simpson Diversity, Berger Parker, Menhinick, Pielou_R and Margalef diversity indices were calculated. Although these all indexes show biodiversity, the results are different due to the difference of mathematical calculation methods. Based on calculation method, index values in the some sample plots are null.

3.1. Mapping of mushroom diversity

Thiessen polygon method was used to allocate all points with the same quality for the mushroom occurrence (Fig 2). Then the polygon layer indicating occurrence of related mushroom species was combined with stand type map of the planning unit. It is important to clarify that this method can create the polygons in a place where the sample plot was included. Thus, one of the big problem with this method is that the sample areas don't completely cover the study area. That is why thiessen polygon could not be created on the stands where the sample plot did not fall. It should be said that in some places don't have any sample plot, all indexes were assumed to be "null". Besides, the results showed that in the combined layer with stand type map the boundaries of the polygons don't coincide with stand boundaries.

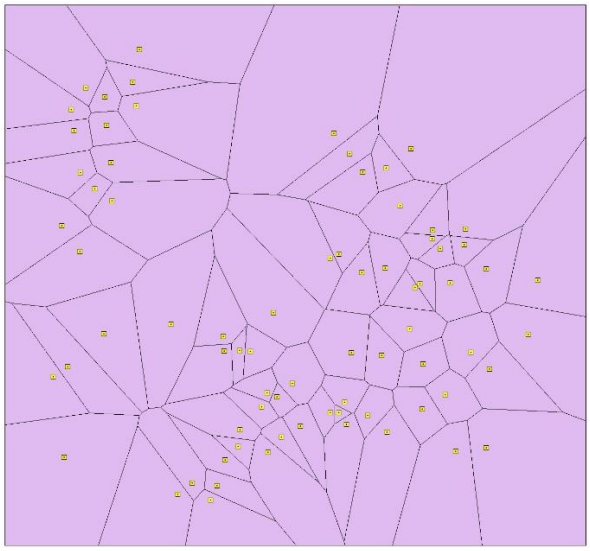

Figure 2. Thiessen polygon created by the sampling plots in the planning unit

Mushroom diversity was analyzed by Shannon-Wiener and Simpson diversity indexes. According to the Shannon-Wiener diversity index value, while the places where the index value close to "1" indicates the greatest diversity, the places where the index value near to "0" have low mushroom diversity (Fig 3a). Based on the maps in figure 3 it can be said that Simpson diversity index also figured out similar results (Fig 3b). The results showed that of the total area just about 3.1% and 2.2% has larger diversity (diversity index is bigger than 0.5) based on Shannon Index and Simpson Index respectively.

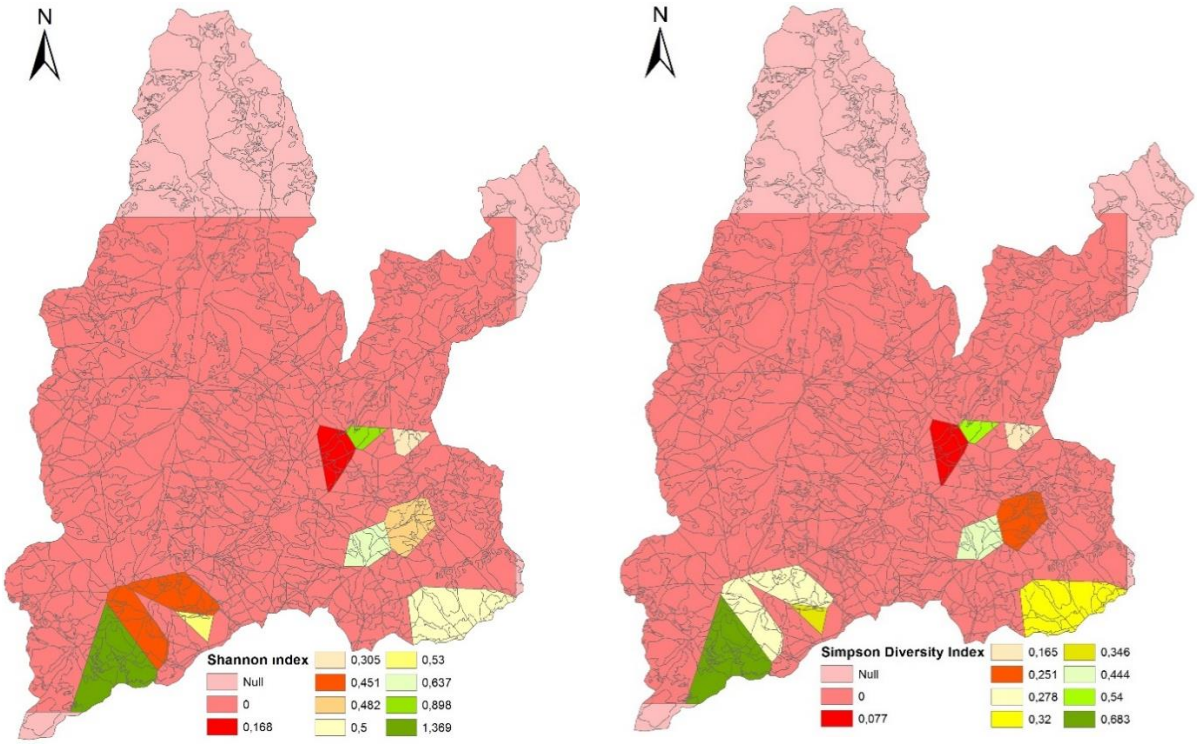

Figure 3. Mushroom diversity maps based on Shannon ındex (a) and Simpson Diversity Index (b)

Dominancy of the mushroom species was analyzed by Simpson D and Berger Parker indexes. The fact that Simpson D index and Berger Parker index value is close to "1" means the mushroom dominancy is high and the value is close to "0" means the mushroom dominancy is low (Fig 4 a,b). The values of two indexes obtained similar results. The results observed that dominancy is low in a unit where diversity is high. According to Simpson Index, about in about 29% of the area mushroom dominancy is very high that is Simpson index value is bigger than 0.5.

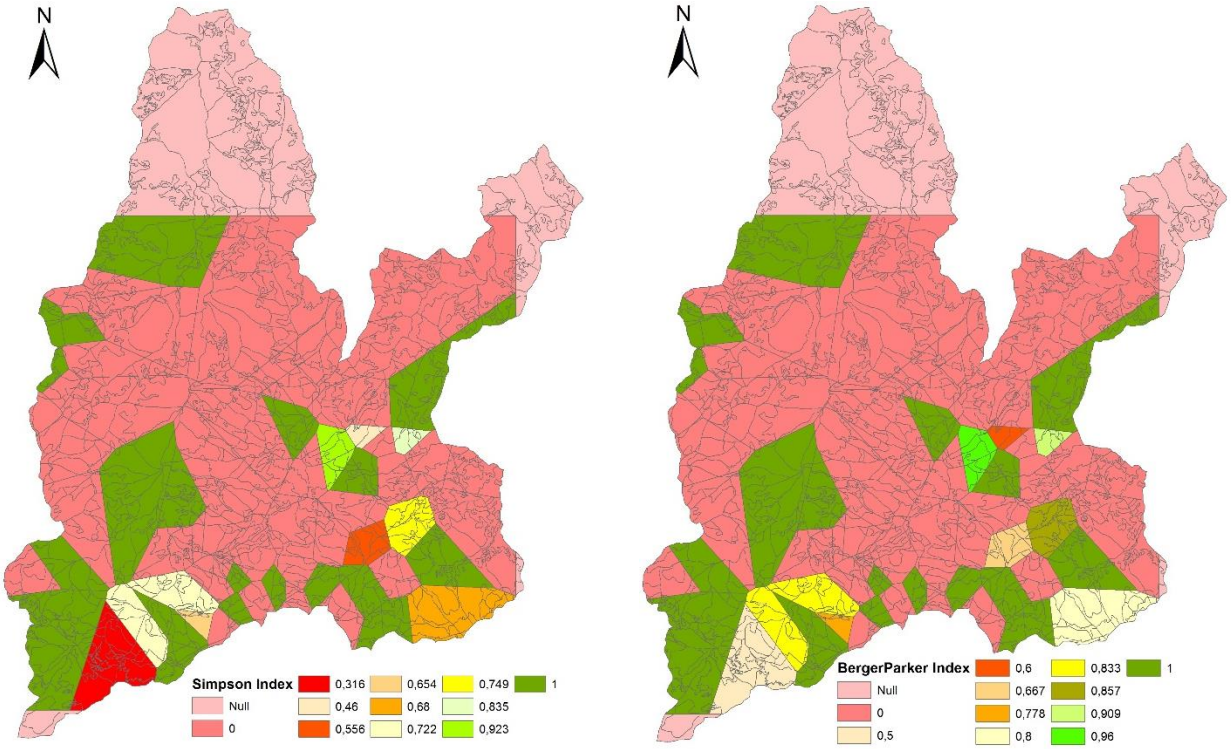

Figure 4. Mushroom diversity maps based on Simpson Index (a) and BergerParker Index (b)

Species richness means the number of species in the community and is the simplest measure of diversity. This measure capture only the number of the species but does not represent the relative abundance of the species in the community. Species richness is measured with Margalef and Menhinick's richness indexes. While high index values indicate high mushroom richness, low values show low mushroom richness (Fig 5a,b). Due to mathematical calculation technique of Margalef index, it could not calculate the index values of some sample plot. These areas are shown as "Null" value in the Margalef index map (Fig 5a).

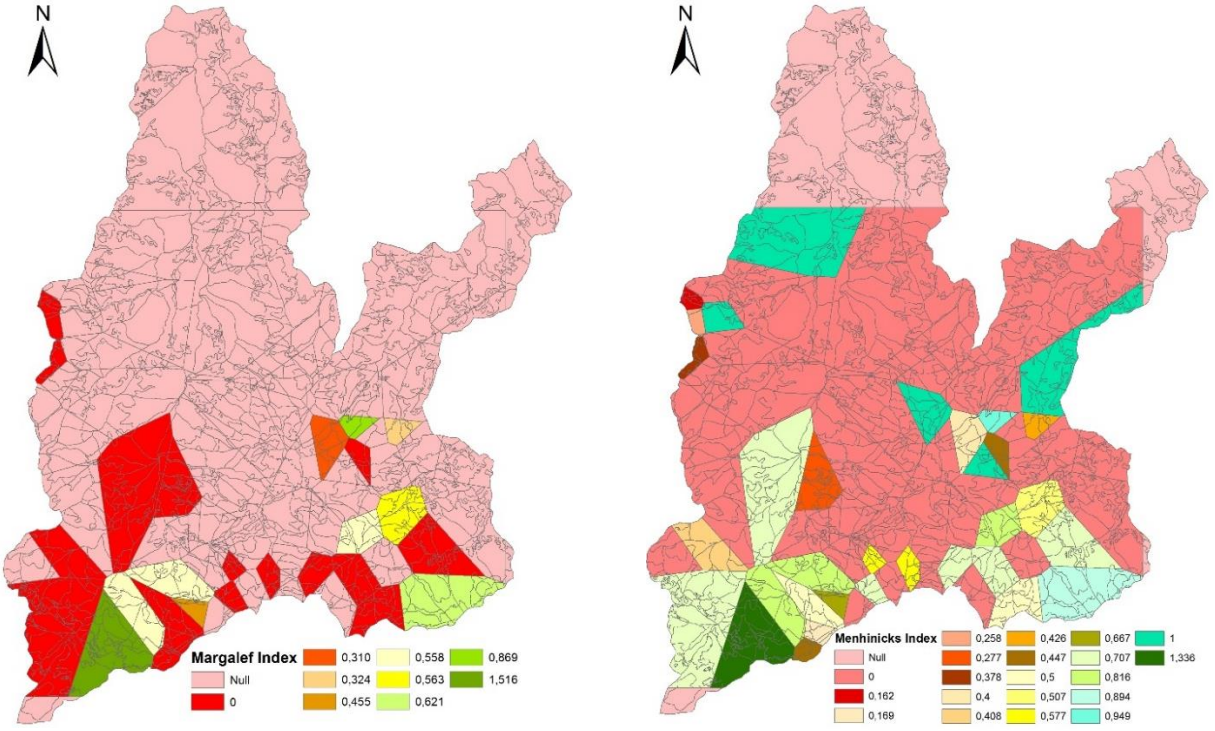

Figure 5. Mushroom diversity maps based on Margalef Index (a) and Menhinick's Index (b)

Pielou-R index -calculated through Shannon index- was used for measure evenness of mushroom species in the planning unit. The values of some places could not estimate because of the mathematical calculation method. The results showed that the high index values show the higher regularity. It means larger values represent more even distributions in abundance among mushroom species. This index indicates if the number of individual between species has a homogeny distribution. The low number of dominant species in the sample plots significantly reduces the Pielou index value.

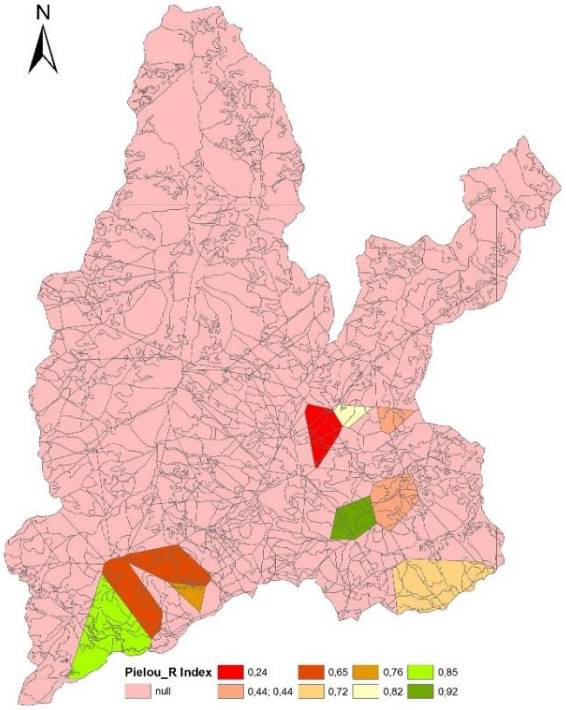

Figure 6. Mushroom evenness map based on Pielou's Index

4. Conclusion

The main objective of this paper was to calculate some diversity indexes for mushroom species and develop an approach for mapping mushroom diversity in the planning unit. In this study, thiessen polygon method was used to map mushroom diversity. The results showed that this method is very useful and practical. However, the accuracy of this map developed by thiessen polygon should be used carefully. This method has some limitations. For example, thiessen polygons can only be created in places where sample plot falls. If a sample plot was not established in any places where the polygon could not be created. In addition the boundaries of this thiessen polygon layer do not overlap with the boundaries of the stand cover type. This situation causes some problems in the implementation of management interventions. Also to improve the accuracy of prediction with these diversity indices, more sampling plots should be established. Besides, all sampling plots should be distributed throughout all the planning unit. Because the right result depends on good inventory data, long term repeated measurements with a short periods on mushroom species should be made for mushroom diversity.

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Effects of different thinning regimes on above ground biomass of young oriental beech (*Fagus orientalis* Lipsky) stands

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Abstract: The study was conducted to investigate the effects of different thinning regimes applied as moderate and heavy on above ground biomass of 25 years old oriental beech (*Fagus orientalis* L.) stand. A total of 9 trial plots, each consisted of 400 m^2 area, were established in Cankurtaran- Hopa region in 2008. In 3 trial plots, heavy thinning was applied (40% of basal area was removed). The other 3 trial plots were moderately thinned (20% of basal area was removed). Remaining 3 plots were allocated as control. The first measurements of tree diameters at basal area were made before the thinning application and the following years of 2008, 2009, 2010 and 2016. Biomass of trunk, branches, leaves and total biomass of trial plots were determined according to the developed biomass equations on dry weight basis. According to the results, biomass values decreased from heavy thinning through the control and biomass of moderate thinning plots located between. Although thinning practices decrease the number of individuals within plots, the increase rate of above ground biomass of the remaining trees found to be higher.
Keywords: *Fagus orientalis*, Oriental beech, Thinning, Above ground biomass

1. Introduction

Thinning is a cutting made in an immature crop or stands primarily to accelerate diameter increment but also, by suitable selection, to improve the average form of the remaining trees (Ford-Robertson, 1971). Thinning, a sustainable management in the forestry sector preserves the health of forests by planned active continual intervention after the sapling stage without permanently breaking stand closure among the trees through the natural regeneration stage (Genç, 2007). While the number of trees and stand closure decrease after thinning application in the stand, mean stand diameter increase. Basal area of the remaining stand decreases after thinning application, but in time basal area increment exceed the value of before thinning. At the same time, rotation age of the stand shorten with increased diameter at breast height and high grade timber might be produced (Kalıpsız, 1982).

Although, in some thinning applications the number of stem per ha are employed as thinning grades, in general, the values of mean diameter at breast height are mostly used. Thinning applications are namely used as light, moderate and heavy depending on the thinning intensity. In general, 10% of the total volume at basal area is removed from overstocked and fully stocked stands, it is called light thinning. If the total volume removal is changed between 10-20%, it is called moderate thinning and the total volume removal is more than 20%, it is called heavy thinning application (Odabaşı, 1985; Nyland, 1996; Smith et al., 1997; Avolio and Bernardini, 2007).

Intensity of thinning makes different gap sizes within the stand that regulates the degree of utilization of land, lateral branch elongation and survival, competition and health of individual tree diameter growth (Nyland, 1996; Smith et al., 1997). Thinning application made periodically as 5 or 10 year intervals which affects basal area of trees (Stefanjik and Stefanjik, 2001; Tüfekçioğlu, et al., 2004), tree heights (Medeiros et al., 2017), crown development (Makinen and Isomaki, 2004; Diaconu, et al., 2015) and enhancing value of the remaining trees' stem quality (Stefanjik, 2013; Kim, et al., 2016). Although some researchers argued that thinning implementations are not significantly affected the total biomass of the stands in the long term (Pesola et al., 2017), the others stated that total biomass of the stand are significantly affected by thinning (Nilsen and Strand, 2008; Verschuyl et al., 2011; Karlsson et al., 2015; Coletta et al., 2016).

This study was implemented to determine the effects of moderate and heavy thinning applications on above ground biomass of 25 years-old oriental beech (*F. orientalis* Lipsky) stand that the species is naturally distributed on the northern part of the Turkey and there is relict distribution areas on eastern Mediterranean region (Yilmaz et al., 2009) and high economic value in Turkish forest species (Talebi and Schütz, 2002; Ertekin et al., 2015).

2. Material and methods

2.1. Study area

The study was conducted on 25 year-old oriental beech plantation located on Hopa-Cankurtaran (41^0 40'N - 41^0 54'S) in Turkey. Plantation was made in 1984 using with 2-0 year-old oriental beech seedlings. Mean altitude of study area is 800 m.

According to interpolated long-term data of Hopa Meteorological observation station, research area receives a total of 2644.0 mm precipitation and the annual mean temperature of the study area is 10.4 ^{0}C, ranging from 3.1 ^{0}C to 18.7 ^{0}C in February and July, respectively (Anonymous, 2017). Soil of the study area is deep acidspodzol with sandy loam and loamy sand.

2.2. Experimental design

In 2008, a complete randomized design was applied to represent the sites and a total of 9 trial parcels were constructed (20x20m: 400 m^2 each). Of these, every 3 trial parcels allocated as heavy thinning, moderate thinning and control. The thinning applications were implemented as crown thinning in September of 2008. About 20% of the total basal area at breast height was removed for moderate thinning and 40% was removed for heavy thinning. No cutting was applied for the control parcels.

2.3. Field and laboratory analysis

In order to determine trunk, branch+leaves and total beech tree biomass, a total of 20 trees were felled from different diameter classes. In every tree, diameter at basal area, fresh weights of branches and leaves and trunk were determined in the field. At the same time, samples were taken in the field to determine oven dry weights. In the laboratory, to determine the oven dry weights of the trunk, branches+leaves and total weight, samples were dried 48 hours at 70 °C. Findings of diameter at basal area (cm), fresh (kg) and dry weights (kg) of trunk, branch+leaves and total biomass are given in Table 1.

Table 1. Average, minimum and maximum values of felled trees for biomass analysis

	Diameter ($d_{1,30}$) (cm)	Fresh weight (kg)			Oven dry weight (kg)		
		Trunk	Branch+leaves	Total	Trunk	Branch+leaves	Total
Average	15.0	89.9	17.87	107.85	49,71	12.70	62,4
Minimum	4.7	6.9	2.43	9.37	4.15	1.76	5.91
Maximum	25.8	231.1	36.86	267.92	121.32	25.84	147.16

2.4. Data analysis

Data was subjected to analysis of variance (ANOVA) with SAS statistical program. Means and differences between means were separated by least significant difference (LSD) analysis.

3. Result and discussion

Average above ground trunk dry biomass for the parcels were measured before the thinning applications that applied in the year of 2008 was 25.64, 25.45 and 25.13 ton/ha for control, moderately and heavily thinned parcels; respectively. The number of trees was 2600, 2417 and 2483 stems/ha for the control parcel, moderately thinned parcels and heavily thinned parcels, respectively. After thinning applications, average above ground dry biomass decreased to 20.98 and 15.68 ton/ha for moderately and heavily thinned parcels, respectively (Figure 1, Table 2).

When comparing the results of above ground trunk dry biomass in the year of 2008 and 2016, increment reached up to 172% in the control parcels, in another saying, dry trunk biomass changed from 25.64 ton/ha to 54.50 ton/ha. Biomass increment was higher for the moderately thinned parcels. Trunk dry biomass reached up to 207%, from 2008 through 2016, which equals to 34.44 ton/ha. The highest dry trunk biomass increment was measured in the heavily thinned parcels. Increment reached up to the 273% from the year of 2008 through 2016. Total trunk dry biomass increment was measured as 42.33 ton/ha between the first and the last measurements (Table 2). Dry matter biomass before and after thinning and according to the application years and types their importance levels were presented in Table 2. In 2008, 2009 and 2010 heavy thinned parcels had the lowest biomass and were statistically different from control and moderately thinned parcels. However, in 2016 the heavily thinned trees had the highest trunk dry biomass while control and moderately thinned trees were grouped together.

Table 2. Above Ground trunk dry biomass and number of trees by years and applications

Treatment	**2008**				**2009**		**2010**		**2016**	
	Before thinning		After thinning							
	N*(ha)	ton/ha	N(ha)	ton/ha	N(ha)	ton/ha	N(ha)	ton/ha	N(ha)	ton/ha
Control	2600	25.64	2600	25.64 ^{a}	2492	28.67 ^{a}	2442	31.64 ^{a}	2233	54.50 ^{b**}
Moderate Thinning	2417	25.42	1908	20.98 ^{b}	1908	23.67 ^{b}	1908	26.77 ^{b}	1783	55.42 ^{b}
Heavy Thinning	2483	25.13	1317	15.68 ^{c}	1317	18.12 ^{c}	1317	21.23 ^{c}	1317	58.01 ^{a}

N*: number of stems

**The values on the same line followed by the same letters are not significantly different at P<0.05.

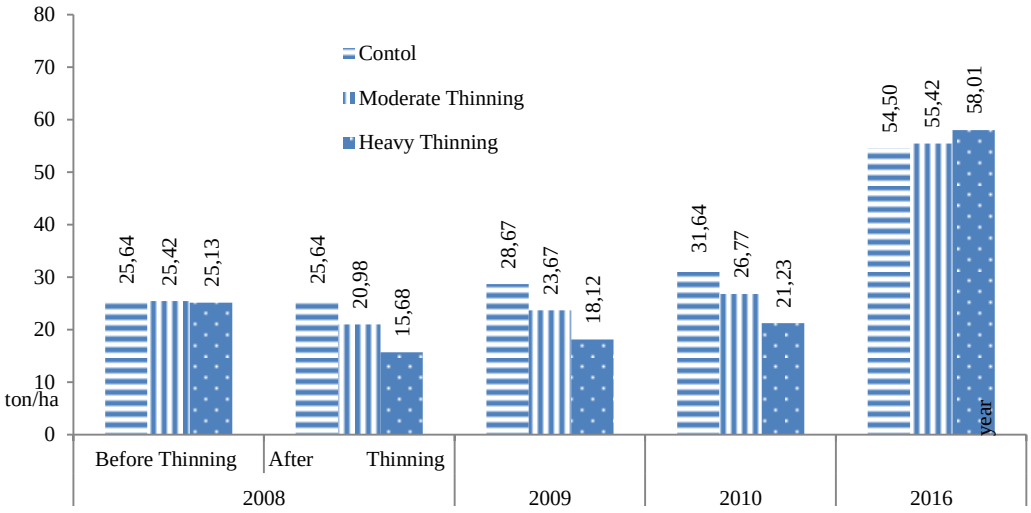

Figure 1. Changes in Trunk Dry Biomass by Years

After 8 years of thinning applications, branch+leaves total dry biomass increment was calculated as 7.45 ton/ha, which equals to 142% raise in the control parcels. Total branch+leaves dry biomass increment for the moderately thinned parcels was 8.44 ton/ha (% 161), reached from 11.23 ton/ha to 17.75 ton/ha from 2008 through 2016, respectively. Heavily thinned parcels showed statistically higher biomass increment comparing to the control and moderately thinned parcels in all years where thinning applications were made. Increment was calculated as 9.65 ton/ha which corresponds to 196% yield from first measurement through the last (Table 3). Dry matter biomass before and after thinning and according to the application years and types were presented in the Figure 2. Throughout the experiment control trees retained the highest branch+leaves biomass and the lowest were observed in the heavy thinned trees.

Table 3. Above Ground Branch+leaves Dry Biomass and Number of Trees by Years

Treatment	2008				2009		2010		2016	
	Before thinning		After thinning							
	N*(ha)	ton/ha	N(ha)	ton/ha	N(ha)	ton/ha	N(ha)	ton/ha	N(ha)	ton/ha
Control	2600	11.49	2600	11.49 [a]	2492	12.49 [a]	2442	13.34 [a]	2233	18.94 [a**]
Moderate Thinning	2417	11.23	1908	9.31 [b]	1908	10.13 [b]	1908	11.02 [b]	1783	17.75 [b]
Heavy Thinning	2483	11.11	1317	6.88 [c]	1317	7.56 [c]	1317	8.42 [c]	1317	16.53 [c]

N*: number of stems

**The values on the same line followed by the same letters are not significantly different at P<0.05.

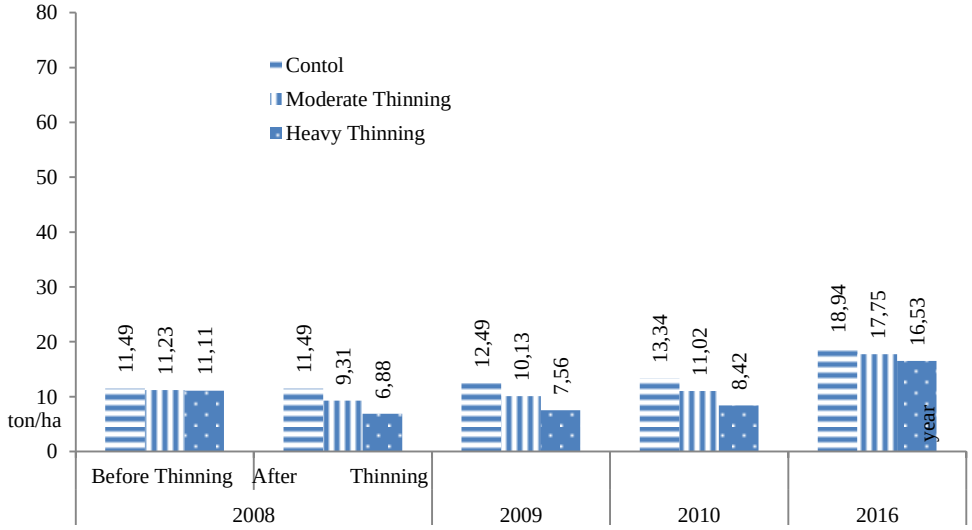

Figure 2. Effect of thinning application on branch and leaves dry biomass

Total dry biomass of trunk and branch+leaves yield was 36.35 ton/ha after 8 years of application on the control parcels which changed from 36.65 ton/ha in 2008 through 73.00 ton/ha in the year of 2016. Biomass yield increment was 164%. On the other hand, moderately thinned plots showed higher increments after 8 years as 197% comparing to the year of 2008. Total yield was calculated as 43.24 ton/ha. As trunk and branch+leaves dry weight biomass, the highest biomass accumulation was measured in the heavily thinned parcels. However, there was no statistically significant differences were detected between the applications and the control parcels. Increment was 35.93 ton/ha at the beginning of the experiment and was found as 74.28 ton/ha at the end of 2016. Biomass accumulation was calculated as 51.88 ton/ha which equals to 253% increase (Table 4). Dry matter total biomass of branch+leaves before and after thinning and according to the application years and types were presented in the Figure 3.

Table 4. Above ground total dry biomass and number of trees by years

Treatment	2008				2009		2010		2016	
	Before thinning		After thinning							
	N**(ha)	ton/ha	N(ha)	ton/ha	N(ha)	ton/ha	N(ha)	ton/ha	N(ha)	ton/ha
Control	2600	36.65	2600	36.65 [a]	2492	40.64 [a]	2442	44.51 [a]	2233	73.00 [a**]
Moderate Thinning	2417	36.20	1908	29.65 [b]	1908	33.12 [b]	1908	37.07 [b]	1783	72.89 [a]
Heavy Thinning	2483	35.93	1317	22.41 [c]	1317	25.41 [c]	1317	29.38 [c]	1317	74.28 [a]

N*: number of stems

**The values on the same line followed by the same letters are not significantly different at P<0.05.

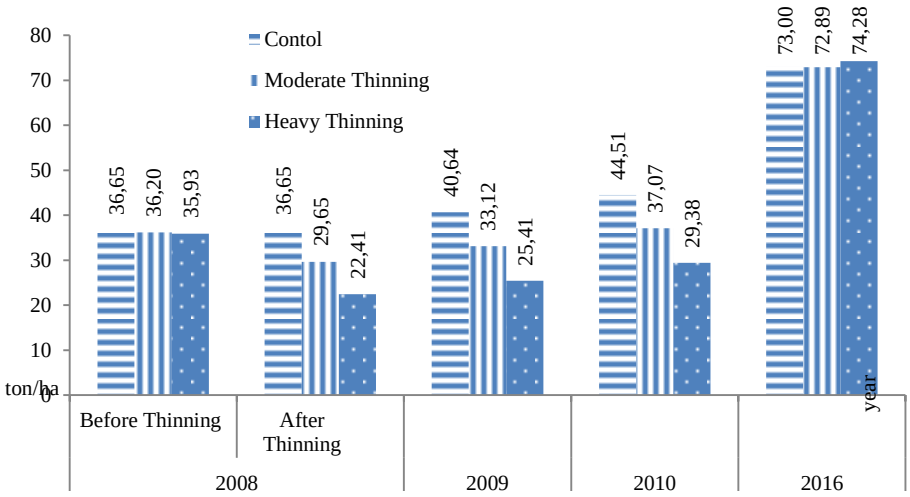

Figure 3. Total Dry Matter Biomass by Years

3.1. Regression equations

Dry matter biomass values of the tree parts were analyzed in MS Excel software program and the highest regression equations were determined. Trunk dry weight (TDW) is expressed as 99% with diameter at breast height of the trees. In other words, beech tree trunk dry weight biomass is dependent with 99% on diameter of the measured tree. Regression equation for the trunk dry weight is given below.

$$TDW = 0{,}2309 \times (d_{1,30})^2 - 0{,}9099 \times (d_{1,30}) + 0{,}7747 \quad (R^2 = 0{,}9918).$$

Regression analysis for branch+leaves dry weight (BLDW) biomass is expressed as 98% with diameter at breast height of the trees. That means, beech tree branches and leaves dry weight biomass are dependent with 98% on diameter of the measured tree. Regression equation for the BLDW is given below.

$$BLDW = 0{,}0151 \times (d_{1,30})^2 + 0{,}7905 \times (d_{1,30}) - 3{,}2807 \quad (R^2 = 0{,}9897).$$

Total trunk and branch+leaves dry weight (TW) is expressed as 99% with diameter at breast height of the trees. Regression equation for the total dry weight is given below.

$$TW = 0{,}246 \times (d_{1,30})^2 - 0{,}1194 \times (d_{1,30}) - 2{,}506 \quad (R^2 = 0{,}9920).$$

Each forest stand has its own growth capacity, depending on the site index of the area. All of the living organisms, particularly forest trees species, are dependent on the availability of light in the stand and organic matter and water in the soil. Usage amounts and limitations of these resources restrict plant growth. As a result of these competitions, vigorous tree species

survive and weak trees die. The current study revealed that in the control parcels where no thinning applications were applied, the average number of trees at the beginning of the study was counted as 2600 stems/ha and 8 years later in 2016 tree numbers was counted as 2233 stems/ha. This result showed that in the control parcels trees died due to increased competition for light, organic matter and water. Similar results were observed for moderately and heavily thinned stands where tree numbers after 8 years were counted as 1783 stems/ha and 1317 stems/ha, respectively.

On the other hand, trunk, branch+leaves and total dry matter biomass showed similar results with tree numbers. This might be expressed as the growing power of the site is gathered in the retained trees in the stand. In other words, biomass production capacity of the forest stand is not affected. The current study results are also supported by Pesola et al., (2017) that carbon accumulation therefore biomass production capacity of the site after thinning applications are not significantly affected. Similarly, Karlsson et al., (2015) stated that in young scots pine stands biomass accumulation is calculated 27% higher than the control parcels where the control parcel had 4000 stems/ha and thinned parcels had 2500 stems/ha. These studies also supported by Nilsen and Strand, (2008) that 10 years after thinning application in young *Picea abies* stands, above ground carbon accumulation, therefore, biomass production capacity of the site was 27% higher than the control sites.

In the current study, despite declining stem numbers in the remaining forest trees after thinning applications, the trees in the site produced higher biomass amounts comparing to the control parcels. This study were supported by Coletta et al., (2016) that 7 different thinning applications applied on Douglas stands yielded higher biomass accumulation than control sites. In addition, the highest biomass and carbon accumulation was observed on heavily thinned stands. Muñoz et al., (2008) stated that *Eucalyptus nitens* stands at the age of 6 year-old are very responsive to thinning applications in terms of biomass accumulation.

Although, increasing rate of thinning applications favor of higher biomass yield, heavy thinning applications to the stands might decrease stem quality due to increase in crown development and negative effect on natural branch pruning (Tonguç and Güner, 2017). Therefore thinning applications should have limitations in order to produce high quality timber and paper pulp. However, to get fully benefit from the biomass potential, it might be necessary to consider alternative management strategies such as increasing interest in biofuels and the generation of renewable energy, in addition to timber and pulp (Karlsson et al., 2015).

4. Conclusion

Moderate and heavily thinned stands yielded higher biomass than unthinned parcels. Diameters at breast height of the stems were also larger and diameter distributions were much uniform. Also, stem quality of the trees were much better in the thinned parcels. Furthermore, thinning and transportation costs, raw materials prices obtained from thinning, damage effects of different thinning regimes on the remaining stand should also be studied in greater details.

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New locality record of anatolian ground squirrel, *Spermophilus xanthoprymnus* (Bennett, 1835) in Isparta-Gencali Province

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Abstract: In this study, a new locality was determined for the Anatolian Ground Squirrel (*Spermophilus xanthoprymnus* Bennet, 1835). Anatolian ground squirrels, one of three species of old world ground squirrels native to Turkey. Species habitat in Egirdir-Gencali province tableland which named "On Kuyular", location altitude at 1592 m. *S. xanthoprymnus* associate with a continental climate and inhabit short-grass steppes. It was found that *Quercus coccifera, Juniperus sp., Astragalus* sp., *Malva sp., Papaver sp., Verbascum sp., Anthemis sp., Elytrigia repens* and *Carduus marianus* have formed the dominant vegetation of the area. Direct observation technique was used at study between wild animals observation tecniques. It was determined that the hibernation period of target species begins in mid-October and ends in March. Species burrows feature, mating season, population behavior and predators study whith this resource in its habitat. With this research result determined the Anatolian ground squirrel get stuck in this province. At target species habitat, have been determined that Gencali villages people practice transhumance and stockbreeding increasing their activity. If the necessary measures are not taken, increasing human influence on habitat have an effect negatively on Anatolian ground squirrel population and therefore species should be extinct in future.
Keywords: Anatolian ground squirrel, *Spermophilus xanthoprymnus*, Ecology, Conservation, Isparta

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Breeding performance of collared pratincole (*Glareola pratincola*) in Boğazkent (South Turkey)

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Abstract: The Collared pratincole (*Glareola pratincola*) that is origin of Africa is a shore bird and distribute summer migratory bird for Turkey. While a part of its population use Turkey as transition zone, some other also stay and breed there. It is globally categorized in "LC" by IUCN but it's locally categorize "VU" for Turkey. Because of this situation, its breeding population and habitats is very important. In this study we were investigate on Antalya/Bogazkent population of Collared pratincole in 2016 breeding season. According to our data, first individuals came to area in 24th April. Totally 370 bird transited pass from area and 32 of those stayed Bogazkent and breed there. We found 16 nest and counted 30 eggs. Totally clutch size 1,88 and incubation periods is 17 days. Hatchling numbers is 26 and fledgling number is 12. We determined two different breeding success for Collared pratincole. According to hatchling breeding success 86,7% and 46,4% for fledgling. All of the population came back to the winter area in first half of the September. Negative factors for breeding success of Collared pratincole were habitat destruction and predators. Predators of Collared pratincole were hooded crow, fox and dogs in Bogazkent.
Keywords: Bogazkent, Breeding success, Collared pratincole, *Glareola pratincola*, Turkey

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Volatile components of *Phlomis bourgaei* Boiss. and endemic taxa *Phlomis leucophracta* P. H. Davis & Hub.-Mor.: Andırın and Gülnar comparison case

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Abstract: *Phlomis* is one of the most important species of the Lamiaceae that is one of the greatest families in the world and, is represented by 52 taxa totaling about 39 taxa and 13 hybrids in Turkey. Many of *Phlomis* species are used in the traditional medicine field as herbal tea for stimulated, tonic, diuretic, ulcer and hemorrhoid treatment. By phytochemical studies on *Phlomis* taxa have shown that it contains intense volatile oils and constituents. In this study that is conducted in vegetation period of 2016, leaf and flower samples of *Phlomis bourgaei* Boiss. and *Phlomis leucophracta* P. H. Davis & Hub.-Mor. were collected in flowering period at Kahramanmaraş-Andırın and Mersin-Gülnar provinces and also volatile components for leaf and flower were determined by gas chromatography mass spectroscopy (GC-MS) after solid phase micro extraction (SPME). Collected leaf and flower samples were placed in paper packages and transported to the laboratory on the same day without being exposed to the sun light. After the plant materials collected were dried at room temperature (25°C), flower and leaf samples were subjected to solid phase microextraction (SPME). 2 g of samples were placed into a 10 mL vial. After incubation for 30 min at 60°C, SPME fibre was pushed through the headspace of a sample vial to adsorbed the volatiles, and then inserted directly into the injection port of the GC-MS (Shimadzu 2010 Plus GC-MS with the capillary column, Restek Rxi®-5Sil MS 30 m x 0.25 mm, 0.25 µm) at a temperature of 250°C for desorption (5 min) of the adsorbed volatile compounds for analysis. Totally 49 components were *P. bourgaei* from Kahramanmaraş-Andırın province and also germacrene-D (15.25 %), (E)-2-Hexenal (12.68 %) and β-caryophyllene (18.60 %) were found main components. 57 components were determined for *Phlomis bourgaei* from Mersin-Gülnar province and germacrene-D (15.66 %), (E)-β-farnesene (14.76 %) and β-caryophyllene (17.63 %) were found as main components. For *Phlomis leucophracta* that is distributed in Kahramanmaraş-Andırın province, 57 components were determined, of them (E)-2-Hexenal (9.74 %), limonene (15.56 %) and β-caryophyllene (22.32 %) were main components. 58 components of *P. leucophracta* were found in Mersin-Gülnar province and (E)-2-Hexenal (7.50 %), limonene (13.64 %) and β-caryophyllene (22.45 %) were main components. For *P. bourgaei*, (E)-2-Hexenal were differ from others in Kahramanmaraş-Andırın and (E)-β-farnesene in Mersin-Gülnar province. Components were found as similar for *P. leucophracta* in both provinces.
Keywords: *Phlomis bourgaei, Phlomis leucophracta,* Volatile components, β-caryophyllene, Andırın, Gülnar

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Comparison of respiration metabolism in some monumental tree species

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Abstract: Monumental trees having any characteristic of historical, folkloric or mystical constitute a bridge from past to future. It is very important to determine the ecological characteristics of tree species, to examine the changes of chemical components in the leaves, and to reveal the growth physiology of the trees in order to determine the aging mechanisms of trees. In this study was compared respiration metabolism of 9 tree species which are *Abies nordmannianna* Stev. (Fir), *Castanea sativa* Mill. (Sweet chestnut), *Cedrus libani* A. Rich. (Taurus cedar), *Cupressus sempervirens* L. (Italian cypress), *Fagus orientalis* Lipsky. (Oriental beech), *Juglans regia* L. (Walnut), *Pinus nigra* Arnold.(Black pine), *Platanus orientalis* L. (Oriental plane) and *Quercus robur* L. (Peduncle oak), varying ages between 300-500 years, in Kastamonu region. For this purpose leaf samples were collected from the tree classes and were measured glucose, pyruvate which is input material of the Krebs cycle, and free amino acid. According to findings, pyruvate, free amino acid, and glucose is found lowest value respectively Beech, Cypress, and Oak leaves. In spite of that, pyruvate, free amino acid and glucose content are the highest values in Chestnut tree leaves. As a result, it was concluded that the aging physiology of the trees changed with respect tree species, and respiration rate of Beech tree was higher than the other tree species. If comparative studies of photosynthesis and respiration metabolism do in more tree species, more accurate results will provide.
Keywords: Growth physiology, Monumental tress, Respiration

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An assesment of potential for coastal ecosystem services in Artvin

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Abstract: Ecosystem services can be defined as benefits provided by ecosystems to people. As a landmark paper about ecosystem services, Millennium Ecosystem Assessment (MEA) report developed an integrated evaluation for researchers working on ecosystem services, including decision makers, scientists, official and non-official organizations, and classified ecosystem services under 4 categories: provisioning services, regulating services, cultural services and supporting services. It is known that, coastal areas are habitats in which sea and land ecosystems meet and affect each other, and with their unique properties distinguishing them from other regions, they are nonrenewable natural resources rendered appealing for economic, social and competitive activities such as urbanization, industry, transportation, tourism, etc. In this context, the aim of this study is to evaluate the potential of ecosystem services in coastal areas. In the study, a GIS-based evaluation for determining spatial usages was implemented. In this context, CORINE 2006 land cover map was reclassified and five ecosystems were determined shore of Artvin province by the Black Sea is 36.2 km, 9.1 km of which is in Arhavi and 27.1 km of which is in Hopa, which was selected as the study area. These ecosystems are urban, forests, cultivated, inland waters and coastal areas. They cover 2100.24 ha of cultivated, 1307.92 ha of forest, 231.69 ha of urban, 401.40 ha of coastal and 120.35 ha of inland waters. Ecosystem services produced by the mentioned ecosystems were identified by considering MEA report. But supporting services were not included in this study because they do not directly influence on human wellbeing. After that, according to the spatial usages and MEA report, coastal areas were evaluated in terms of the producing potential of ecosystem services. Consequently, it is expected that ecosystems and ecosystems services obtained in this study should be constituted baseline for planning of all areas, especially coastal areas.

Keywords: Ecosystem, Ecosystem services, Coastal areas, Artvin

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Applicability of genomic selection on breeding of Turkish red pine

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Abstract: Populating the genome with dense marker coverage and predicting phenotypes from multi-locus genotypes for selection is called genomic selection (GS) or genome wide selection. GS jointly analyzes all markers in a population, attempting to explain the total genetic variance with dense genome-wide marker coverage through summing marker effects to predict breeding values of individuals. GS is the new frontier and a paradigm shift for plant and animal breeding programs. With advancement in DNA sequencing technologies and efficiency in genotyping, GS first has become a reality in animal breeding. Afterwards, it has been implemented for crop breeding. Genomic selection processes start from a training population or reference population. Candidates to establish a next cycle of breeding are selected through GS. Many GS programs routinely use single nucleotide polymorphisms (SNPs) markers to predict the genetic merit of offsprings. SNPs are primarily utilized association genetics and nucleotide differences occurring at specific locations in genome. With application GS, potential to increase genetic gain was estimated to be twofold and savings in logistical costs were estimated to be 92% in cattle breeding. Compared to crop and animal breeding programs, forest tree breeding is still as its infancy. The most advanced programs are in their third or fourth cycle of breeding. Forest trees in general, and conifers in particular take many years to breed (5-15 years) and progeny test (3-15 years). Because of large physical size of trees, it is difficult and expensive to cross trees. With application GS in forest trees, the breeding cycle time can drop almost in half, because selection decision could be made based on markers without phenotype as soon as seeds are available. This can increase genetic gain twofold per year. The tree breeding was started in 1960s in Turkey. A comprehensive Turkish red pine breeding program including progeny test and gene conservation was put into practice in 1994. Since then, totally, 90 ha progeny test was established with about 1850 plus tree/clone between 1998-2014 for each breeding zone. The progeny tests were open pollinated, the trees in the progeny tests were measured once in every four years. Genetic parameters from progeny tests (like heritability, genetic correlation and genotype environment interaction) were obtained. Genetic gains were satisfactory to carry out the Turkish red pine breeding. But, there is no study intending GS. In the light of last advancements, applicability of GS on the breeding of Turkish red pine is discussed in this paper.
Keywords: *Pinus brutia*, Marker assisted selection, Single nucleotide polymorphism, Tree breeding

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The impact of magnetic field applications on photosynthetic pigments of mountain maple seedlings

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Abstract: Maple tree, which increases the "species diversity" for its being a mixed species in general in different forest ecosystems in different regions of Turkey, can grow in different soil and climate conditions ranging from the sea level to the timber line. In this study, *Acer pseudoplatanus*L., which is the object of massive seedling propagation and, therefore, of afforestation practices, was used. In the study, the leaves of the seedlings germinated from cold-wet pretreatment (+4 ºC and 45 dayscold stratification) andfrom non-pretreatment seeds were prepared according to the method of Witham, Blaydes and Devlin (1971).Upon determining the absorption values of 645, 663 and 450 nm wavelength of the extract obtained from the analysis in the spectrophotometer, the amount of chlorophyll (chlorophyll a, chlorophyll b and total chlorophyll) was determined by using the photosynthetic pigment equation. To determine the carotenoid amount, the absorbance values of the extract at 450 nm wavelength in the spectrophotometer were determined, and then the values were calculated according to the carotenoid equation. For magnetic field (MF) treatment, the seeds were exposed to different application durations (20, 60 and 120 min.) and different MF intensities (200 and 400 mT). Seeds subjected to control and different MF applications were germinated on equal conditions. The results of the research revealed that application duration and intensity of magnetic field have a significant impact on photosynthetic pigment contents and carotenoid amounts. While the amount of the chlorophyll a was less in all magnetic field treatments than control treatment in un-stratified groups, in the stratified group, 120 min 400 mT treatment exhibited a positive effect compared to control and other magnetic field application procedures. While chlorophyll b and carotenoid amounts were higher in the unstratified group than in the other treatments, the highest values were found in the stratified group in the 120 min 200 mT procedure. Using magnetic field treatment could be a promising technique for forest tree seedling propagation; however, further and extensive research through the use of different levels of magnetic field doses is required to determine the optimum dose.

Keywords: Chlorophyll, Carotenoid, Seedling, Physiology, Magnetic field, *Acer pseudoplatanus*, Pre-treatment

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How leaf (needle) removal affects the density and flexural properties of *Pinus nigra* Arn. (Anatolian black pine) seedlings

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Abstract: The leaves are one of the important organs in the tree body due to their physiological and biochemical functions – provide light interception, photosynthesis, transpiration, food storage etc. The leaves found to be in two forms between angiosperms and gymnosperms: angiosperms (deciduous) are trees have flat- or broad-leaves and gymnosperms (conifers or evergreens) are trees have needle-shaped leaves. Those trees have different life strategies in dry season to survive harsh weather, although angiosperms shed their leaves in the autumn, gymnosperms keep their leaves year round. This is because, angiosperms have greater leaf surface area than gymnosperms and this could be a disadvantage in harsh and dry weather; that is when water is scarce particularly in dry seasons, angiosperms should need to limit transpiration in order to grow, and thus they drop their leaves to conserve water and energy during dry seasons. However, gymnosperms have needle-shaped leaves which are narrow and thus they do not have a great deal of surface area and do not need to conserve water. Much research therefore concentrated on the structure of leaves to understand their excellent adaptive strategies to the environmental conditions. However, very little is known about the role of leaves to the mechanical properties when tree species at the seedling stage. The aim of this study was to determine how leaf removal affects the density and mechanical properties of small *Pinus nigra* Arn. (Anatolian black pine) seedlings. The seedlings were subjected to four different leaf removal treatments: 0%, 25%, 50% and 75% removal of the existing needles/leaves in order to understand how the amount of leaf removal treatment influences density and flexural properties of Anatolian black pine seedlings. We used three point bend test to investigate mechanical parameters. The morphological and anatomical properties were also determined. The results showed that shoot diameter was greatest in 25% removal needle sample seedlings than that of three seedlings, and so second moment area (I) was also found to be around 1.2 to 2 times greater than other seedlings. Density was found to be between 0.34 to 0.36 g cm^{-3} and higher in 0% and 25% removal of needles than 50% and 75% removal of needles. 25% removal of needles were also stronger than all other seedling, but no difference found in flexural strength (MOE) values between the amount of needle removal.
Keywords: Density, Flexural properties, Leaf removal, Pine needles

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In silico identification and bioinformatics analysis of Hsp90 (Heat shock protein 90) gene family in *Fraxinus excelsior* L.

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Abstract: *Fraxinus excelsior* L. is a common tree in Europe and also considered native in Asia from northern Turkey east to the Caucasus and Alborz mountains. As this aspect, it has great ecological and economic value as a key forest species. "*The British Ash Tree Genome Project*" results have been published in January 2017. Genomes of 37 *F. excelsior* trees from Europe were re-sequenced to indicate long-term decline in population size. As known, the fungus *Hymenoscyphus fraxineus* causes ash dieback. Biomarkers for ash dieback have been also improved based on genome analysis results. So, genome study of ash tree provides a basis for tree breeders for selection of functional genes and proteins. Specific stress proteins activate chaperones which bind to network sequences. Members of the Heat Shock Protein 90 (*Hsp90*) gene family have been conserved thorough evolution. However, no systematic analysis of gene characterization of *Hsp90* proteins has been performed in *F. excelsior* L. *Hsp90* protein domain (PF00183.13) was searched against to ash genome. Then, we have identified 14 *FexHsp90* genes in *F. excelsior* genome. We firstly generated a maximum likelihood phylogenetic tree to examine the phylogenetic clusters among the *FexHsp90* proteins. They were phylogenetically clustered into three major groups. Exon/intron organization of *FexHsp*90 genes were also investigated. All genes were composed of exons. The structural diversity of *FexHsp*90 genes were relatively conserved motif composition. Fifteen distinct motifs were identified among *FexHsp90* proteins. There was a positive correlation between gene structure, motifs and phylogenetic tree. *FexHsp90* genes with similar exon-intron structure and motif composition were found in same branch of phylogenetic tree. For 3D protein homology prediction, Protein Homology/analogY Recognition Engine (Phyre2) was used. A total of twelve *FexHsp90* proteins were modeled at >90% confidence and the percentage residues were varied from 80 to 100. The secondary structure was predominantly constituted of α-helix with having rare incurrence of β-sheets. The amino acid sequences of *FexHsp90* proteins were imported into Blast2GO program and were obtained for GO classification. Binding activity, protein folding and response to stress were main biological processes for *FexHsp90* proteins. Besides, they were mainly located in cytoplasm and organelles. This genome analyses will enable researcher to open new perspectives for further functional investigations of these genes. Additionally, these results will be useful for comparative genomics analysis of forest trees whose genome analyses have been completed.
Keywords: Gene characterization, *Fraxinus excelsior* L., *Hsp*90 gene family, Bioinformatics analysis

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Genome-wide identification of Hsp70 protein family members in European ash trees

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Abstract: Molecular control mechanisms for plant stress tolerance are regulated by specific stress genes. Members of Heat Shock Protein 70 family (*Hsp70*) are one of them and act as molecular chaperones. They are known as regulatory proteins which promote protein folding and prevent misfolding and aggregation of protein structure. Ash trees are the largest native deciduous trees throughout the Northern Hemisphere. The genome of a low-heterozygosity *Fraxinus excelsior* tree was sequenced in 2017. About 39.000 protein-coding genes were determined in ash tree genome. Compared to genomes of other plant species, 25% of these genes appear ash specific. Although some of these genes have been characterized in ash genome, genome-wide analysis of these chaperon proteins has not been studied yet. In this study, we reported identification, molecular and functional characterizations of *Hsp70* family members in ash tree genome. A total of 43 *FexHsp70* genes were detected in genome based on their PFAM search. PFAM accession number of *Hsp70* is PF00012.15 which reveals *Hsp70* family domain. Gene structure and motif analysis of *FexHsp70* genes were performed using Gene Structure Display Server and MEME Suite Server, respectively. Phylogenetic tree was constructed using MEGA 7 program. Exon-intron organization of 43 *FexHsp70* genes were examined. In addition, fifteen conserved motifs were found in *FexHsp70* protein sequences. FexHsp70 proteins were phylogenetically classified as six main clusters. Gene structure analysis and motif compositions were correlated with phylogenetic tree in which *FexHsp70* genes with similar exon-intron structure were found in same clusters. For prediction of Gene Ontology terms of the *FexHsp70* genes, Blast2GO package was used. As a prediction of molecular function of FexHsp70 proteins, binding activity to organic cyclic compounds, ions, proteins and carbohydrates was mainly observed. Besides, oxidoreductase activity was another molecular function of these family members. They were chiefly located in intracellular regions and membrane of the cell. The psRNA Target server was used for *in silico* identification of miRNAs which targeted to *FexHsp70* transcripts. A total of 13 different *FexHsp70* genes were targeted by 11 different plant miRNAs. Among them, the most observed one was miR414. Our results can provide valuable information for further exploration into the functions of this significant gene family members. Additionally, understanding of the evolution and function of these important family members will be useful for comparative and functional genomics studies.
Keywords: Genome-wide identification, Bioinformatics analysis, Hsp70, F. *excelsior* L.

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Determination of model maps for the potential distribution of Anatolian black pine (*Pinus nigra* Arnold.) in natural forest areas in the Black Sea region

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Abstract: The main purpose of this study was to determine potential distribution modelling and mapping of Anatolian black pine (*Pinus nigra* Arnold.) in the Vezirköprü district located at inner parts of middle Black Sea region of Turkey. In accordance with this purpose, presence – absence data of the species was collected from 586 sample areas, which are the size of approximately 100 m x 100 m. On the other hands, environmental variables which are elevation, slope, aspect, bedrock, topographic position index and radiation index for each plot were obtained from the digital maps generated by Geographic Information Systems (GIS). In addition, annual mean temperature (BIO1) and annual precipitation (BIO12) as climatic data which are spatial resolution approximately 752x752 m^2 were downloaded from WorldClim database. Two different non-parametric modelling techniques, Generalized Additive Model (GAM) and Classification and Regression Tree (CART) were used for potential distribution modelling of Anatolian black pine. Similar results were considerably detected from both of these models. In both methods, contributions for the model of elevation and bedrock variables were found more significant than other environmental variables for potential distribution of Anatolian black pine in the district. According to the CART method, the areas are potential distribution for Anatolian black pine if the metasandstone does not exist in the sites above 650 m from sea level or if the metasandstone exists, the temperature is between 7.6-11.0 °C and the slope is more than 23%. Also GAM showed that places where gabbro, ophiolitic melange, serpentine, and mixed material were seen as main bedrock type, sloping sites where average elevation was from 600 m to 1150 m and temperature is between approximately 8.5-11.3 °C were found most suitable for the potential distribution of the species. To determine the performance and validation of these models were also calculated by area under the Receiver Operating Characteristics (ROC) curve. Generated model results for potential distribution areas of Anatolian black pine were statistically obtained suitable for ROC threshold value. Finally, mapping of potential distribution models of Anatolian black pine in the district were visualized by using GIS software.

Keywords: Anatolian black pine, Black sea region, Potential distribution model, Generalized additive model (GAM), Classification and regression technique (CART)

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Options for conflict management in protected areas

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Abstract. Because it is considered as a phenomenon that affects not only humans but all living beings that live in communities and use common living spaces, it is often said that conflict is inevitable in every environment where people interact. In order to be able to talk about its presence, it is necessary that conflict is noticed by and disturbs all parties involved. It is observed that the subject of conflict is among the most popular topics that the scientists examine today. It is almost impossible to make a generally-accepted definition of conflict, as scientists study the concept of conflict from different angles. Concepts such as, disagreement, irreconcilableness, opposition, contradiction, incompatibility, frustration, etc. particularly attract attention. The theme of conflict management in protected areas first appeared in a workshop held during "IV. World Congress on National Parks and Protected Areas". As is the case in the world, conflicts are experienced in protected areas, especially with regards to use, preservation, and management of resources such as forests, water, wildlife, pastures etc. in Turkey as well. A variety of methods are utilized globally for managing such conflicts and steps are being taken towards their resolution. In protected areas, conflict is addressed considering its three dimensions (structure, attitude, behavior or position, interest, need) and these are considered as factors that lead to the formation and continuation of the conflict. In addition, the causes of conflict are explained more clearly by analyzing relationships, data, interests, structural factors and values which are dimensions of the source of conflict. Surveys and focus group workshops are frequently used as investigation methods, and, meetings, seminars, and workshops are organized to analyze program outputs and plans are prepared for conflict management and resolution. Concepts such as information about and perception and attitude towards the protected area, public relations in protected area management, participation, reconciliation, communication, and anger management are examined, and, it is ensured that the strategies and actions to manage the conflict are produced more easily. Since the field of conflict management in protected areas is a fairly new subject in Turkey, the number of studies conducted in this regard is low. Although the wildlife-human conflict has become a current issue, it is evident that it has not been analyzed in detail. However, in the protected areas, there are many other conflict issues outside this area, and it is essential to carry out studies in these areas as well. Accordingly, this study has given information about which conflicts are experienced, who are the parties to these conflicts, what are the causes and the consequences of the conflicts, and conflict management approaches and conflict management styles in the protected areas in Turkey, taking into account the examples from around the world.
Keywords: Conflict, Conflict analysis, Conflict resolution, National park, Local community

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Determination of consumer preferences and trends on non-wood forest products in Balıkesir Province scale

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Abstract: Growing in the forests and open spaces, all kinds of plant, animal and mineral products that humans and other living things have used to meet their needs or to provide income are generally defined as "non-wood forest products". Non-wood forest products offer various economic, social and environmental benefits, and also contribute significantly to the socio-economic situation of forest villagers living in and around the forest. Turkey has a very important potential in terms of herbaceous forest products, especially with its rich plant diversity, wildlife resources and different climate. Especially in the fields of medicine, food and cosmetics, the use of many non-wood herbal products has increased, and a great market has been created in the world. For this reason, the aim of this article is to determine the structure, consumption tendency and preference of final consumers in relation to non-wood forest productions in Balıkesir province. A questionnaire consisting of 2 parts and 23 questions was used in the study. In the first part of the questionnaire, it is aimed to determine the demographic and socio-economic characteristics of the consumers. In the second part, it is aimed to determine consumption trends and preferences. 204 questionnaires were taken into consideration in the study. In the analyses, all the questions and answers were digitized according to the sequence statistics, and frequencies and percentages were used according to the characteristics of the questions. Chi-square ($\chi 2$) test to explore the associations between the variables. Statistical Package for Social Science (SPSS) 20.0 program was used in the analyses. According to the results of this research; (1) The consumers use non-wood herbal forest products for general health, therapy and for pleasure, (2) They are consumed as infusion and decoction on large scale, (3) There is a big deficiency by means of using dose and side effect, (4) As the level of education of the consumers increases, they are more careful about the consumption amount (dosage) and side effects, (5) The products are usually purchased from people selling herbal products, (6) The products are generally consumed as they are collected from nature, (7) Products are purchased from places that are thought to be clean and hygienic, (8) Among the factors affecting consumption behaviors, recommendations of family and relatives come first.(9) A large proportion of consumers prefer to consume their products without any treatment. In this regard, traditionality dominates the formation of consumption habits. From the findings, it is suggested that the products should be presented to the consumers in hygienic environments in their natural state, and that they should include promotional forms containing usage information and dosage information with the products.

Keywords: Non-wood forest products, Consumer characteristics, Consumption tendency, Consumption preference, Balıkesir

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Deforestation and human impact around Lake Aktaş (Ardahan-Turkey) during the last 1000 years

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Abstract: The study area is Aktaş Lake, formerly known as Hozapin, is located between 41°14′ 8.98″ - 41°11′ 11.59″ north latitudes and 43°10′ 0.14″ - 43°15′ 21.20″ east latitudes within the boundaries of the Çıldır county of Ardahan province in the Erzurum-Kars section of the Eastern Anatolia Region. The studied lake has a surface area of 24 km square and a shallow water depth varying between 1.5 and 2 meters except for local deeper parts around the islands rising at the central part. Continental climatic conditions of the northeast Anatolian highland of Turkey prevail in the lake areas. Lake Basin is located in Iran-Turan phytogeographic region and anthropogenic steppe has a broad distribution. Using a Kajak Sediment Core Sampler with 6 cm-diameter sampling tubes, a 61 cm-long short core was recovered for fossil pollen analysis and AMS radiocarbon dating at 4 m water depth in the central part of the lake. After completing all the sampling process for all drilling cores they are brought to Istanbul University Faculty of Forestry Department of Forest Botany Palynology Laboratory for fossil pollen analyses and fossil pollen sampling was prepared on every each 1 cm of drilling core according to the classical method. Also, *Lycopodium* spore tablets were added to the each sediment. The identification and counting of pollen and *Lycopodium* spores are performed via Leica DM750 computer assisted light microscope with x40, x100 immersion objective and 10x ocular. Moreover, in each preparation at least 50 *Lycopodium* spore and 250 pollen grains are identified. Pollen concentration as 1 cm^3 is counted for each taxon and the pollen diagrams are drawn with the TILIA program. This study aims to determine the deforestation and human impact on the vegetation around Lake Aktaş from 930-795 cal yr BP to modern times by pollen analysis. The variation of pollen spectra composition reflects vegetation change of *Pinus sylvestris, Picea orientalis, Abies* sp., *Betula* sp., *Fagus* sp., and *Quercus* sp. existed dominantly in this region 930 years ago. According to fossil pollen influx, arboreal plant species had broad distribution around Lake Aktaş about 930 years ago, which conflicts with herbaceous species dominating around the lake at present. Anthropogenic impacts along with climatic changes towards more continental conditions could have profound effects upon shift in the deforestation in this area.
Keywords: Deforestation, Human impact, Ardahan, Lake Aktaş, *Lycopodium*

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A land cover - use change study for Kastamonu Province using NDVI values

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Abstract: Today, Global warming is one of the most important issues all around the world. This problem is basically the result of human activities for the last 100+ years. Altering land cover by means of human influences can be counted as one of those activities. Although such topics have long been studied extensively by scientists, studies on the current statuses of some regions and the improvements which can be acquired by implementing new techniques are popular and important today. NDVI (Normalized Difference Vegetation Index) is a remote sensing measurement technique, which provides us important data about green vegetation. Basically, NDVI values are obtained by dividing the difference between the NIR (Near Infrared) band and the VIS (Visible) band divided by the sum of the two. In this research, a 25 year land use history of Kastamonu province was analyzed to demonstrate the negative and positive changes in several different categories. In addition, this study investigated the accuracy of land cover classification derived through Landsat NDVI. Level 1 Landsat 8, 7 and 4-5 images, obtained at different times and seasons, were used in order to calculate and categorize the NDVI values. Forest management plans, topographical maps and DEMs (Digital Elevation Model) were used to increase the accuracy. As a result of this study, the changes in the Kastamonu province were revealed with high accuracy. Besides, reductions and increases in forest cover, agricultural activities, barren lands and residential areas were well established and mapped. Such work indicates climate change level as a result of land degration, and is an important outcome for decision makers and city planners to interfere and change things for good.
Keywords: Land cover, NDVI, Climate change, Global warming, GIS, Remote sensing

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Aphid pests for forest trees of Malatya province

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Abstract: Aphids can give significant damage to their host plants by direct way or indirect way. They affect their host plant directly by feeding on phloem sap or they infect their host plant via transfer viruses. Aphid management efforts of countries cause important economical loss each year. Therefore early detection and accurate determination of aphids can valuable process for management strategies. This study conducted in Malatya province between November 2015 and September 2016. Approximately 229 of 737 specimens were obtained from forest trees and 32 aphid species were determined with two new entries for Turkish aphid fauna. This study aimed to give information about aphid pest composition that use forest trees as a host plant in Malatya province.
Keywords: Anatolia, Aphid, Forest pest, Malatya, Turkey

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Determination of the relationships between shannon diversity values in different spatial scales derived from satellite data and five wild mammals: A case study of Ağlasun (Burdur) District, Turkey

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Abstract: Topography and vegetation are the most important factors affecting distribution of wildlife species. Although topography changes in any area can take place many years, vegetation changes can be seen even in short time intervals, such as seasonal changes. For this reason, it is important to determine and know the habitats related to vegetation that wild animals prefer. Determination of vegetation changes by traditional field measurement methods is time consuming and costly process. The use of satellite data providing continuous data for over large areas in the detection of vegetation changes will be beneficial in terms of time and cost. This study was carried out on 50 sample areas in Burdur-Aglasun district using indirect inventory techniques. As a result of study, sign and tracks of five different wild mammals (*Sus scrofa*, *Vulpes vulpes*, *Meles meles, Lepus europaeus*, *Martes foina*,) were recorded. The relationships between presence-absence datas of these species and Normalized Difference Vegetation Index (NDVI) and Soil Adjusted Vegetation Index (SAVI) ratio images derived from Landsat-8 OLI (resolution: 30 m) satellite data were investigated. With the Definiens Developer software, multiresolution segmentation was performed and the satellite data were separated into different patches considering color values. Then, the study area was divided into squares with 80, 40, 30, 20, 15, 10 and 5 pixels in different spatial scales. Shannon diversity index (SDI) values were calculated for each cell taking into account the patches within each cell in these spatial scales. The relationships between the SDI calculated at different spatial scales belonging to each sample area and the presence-absence data of wild mammals were analyzed by classification and regression tree (CART) technique. NDVI with 4 species and SAVI with 1 species were found to be associated. As a result of the analysis, it was determined that the different spatial scales of NDVI image were related to be Wild boar (30 pixels), Red fox (30 pixels), Badger (20 pixels), European hare(80 pixels) and SAVI image was related to be with Beech marten(5 pixels). The training and test values obtained with CART technique were recorded as 0.89-0.84, 0.80-0.70, 0.84-0.73, 0.71-0.67 and 0.80-0.68, respectively. Spatial distributions of plants have a low SDI value due to the limited number of different patches entering into small scales, while this value and complexity increases at large scales. When it examined demands of wild animals according to patch diversity in study, the following results were obtained. While Wild boar (SDI>1.99), Red fox (SDI>2.41), Beech marten (SDI>0.59) and European hare (SDI>3.8) prefer areas with high diversity, Badger (SDI<1.82) prefer low-diversity areas. The results show that satellite data can be used to estimate distribution of wildlife species. If future studies carry out in a larger area, in different seasons and with more sample areas, potential of use of satellite data will become clearer in terms of wildlife.

Keywords: Classification and regression tree, Satellite data, Shannon diversity index, Wildlife

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Effects of some auxins on propagation by hardwood cutting of autumn olive (*Elaeagnus umbellata* Thunb.)

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Abstract: Autumn olive (*Elaeagnus umbellata* Thunb.), belonging to Elaeagnaceae family, naturally spreads over Southern Europe and East Asia. It is a deciduous shrub or small tree growing up to 6 m in height and 9 m in width. Its form is rounded, with dense branches. The species can store the nitrogen in its roots. Thus, it has the ability to live even in the most inefficient soil. It is valued for its ability to prevent erosion and to attract wildlife, and has been used to increase certain types of agroforestry. When it is mature, the species has edible fruit with brilliant red or yellow pigmentation, and can be consumed especially as dried fruit. In addition, the greatest benefit of the fruit is the amount of lycopene it has. 100 grams of this fruit contains 7 to 17 times more lycopene than the same amount of tomatoes. Besides having extremely useful fruits, the species which also includes antioxidants can be used in horticulture and landscaping thanks to its leaves and flowers. Therefore, it is necessary to protect and reproduce autumn olive. Within the scope of this study, propagation of the species is carried out by hardwood cutting which is one of the vegetative propagation methods. The objective of the present study is to determine the effects of some auxins (IBA 1000 ppm, IBA 5000 ppm, NAA 1000 ppm and NAA 5000 ppm) were investigated on propagation by hardwood cutting of autumn olive in greenhouse media with air temperature at 20±2°C, rooting table temperature at 25±2°C and perlite rooting media. The first root formation date, rooting percentage, root length and the number of roots were determined. The results showed that the highest rooting percentage occurred as 60% in NAA 5000 ppm treatment. This study will provide a basis for further researches to be made using vegetative propagation methods.
Keywords: Autumn olive, *Elaeagnus umbellata*, Cutting propagation, Auxin

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Determination of the effect of alder use on soil respiration and microbial respiration on forest rehabilitation studies

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Abstract: In this study, we investigated that the effects of microbial respiration and soil respiration on the forest rehabilitation works. For this purpose, degraded beech forest area was selected in Arhavi, Artvin. These were prepared for Beech planting, black alder planting, beech + black alder planting and control (non plantation) fields after clear cutting studies. Soil samples were taken 24 trial sites in these areas. Carbon emission was determined by using soda lime method in the rehabilitation areas. In the same area, soil samples were taken for microbial respiration by using incubation method in the laboratory conditions. Soil respiration studies were conducted between November 2014 and October 2016 and 11 measurements and also microbial respiration were made 6 measurements on time. According to these measurement results, soil respiration has been found that 1,52 g C $d^{-1}m^{-2}$ in beech areas, 1,47 g C $d^{-1}m^{-2}$ black alder areas, 1,67 beech+black alder areas and 1,54 g C $d^{-1}m^{-2}$ control areas in first year. At the end of the second year, soil respiration was found as 1,43, 1,52, 1,40 and 1,53 g C $d^{-1}m^{-2}$ respectively. As a result of the study, there is a linear relationship between temperature and soil moisture. The average soil moisture in the study area was higher in the first year compared to the second year, while the soil temperature was lower .However, as a result of the microbial respiration in the planting areas was higher than in the control areas. The average microbial respiration values in the first year were higher than those in the second year due to changes in soil moisture and temperature.
Keywords: Beech forest, Black alder, Soil respiration, Soil temperature, Artvin

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Landscape character analysis approach in determining protection decisions and strategies

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Abstract: Natural landscapes are important economic and socio-cultural resources which make contributions to the life quality of the public (Brabyn, 2005). Scientific and application studies for the description and evaluation of landscapes have been taking place in the world since the 1950's (Şahin et.al., 2013). European Landscape Convention (ELC) has provided a legal attribute and international recognition to concepts such as landscape and landscape description as well as landscape planning, landscape management, preservation of landscape quality, landscape inventory, landscape repair etc. Today, landscape has become a fundamental research scale in ecological studies as well as a spatial planning – management unit for planning – management purposes (Coşkun Hepcan et.al., 2012). Undoubtedly, landscapes have to be defined (putting forth the landscape character) first in order to plan and manage both natural and cultural landscapes and they should be classified and mapped accordingly. Landscape receives its character by themselves and/or thanks to the interaction over time of both natural and cultural landscape components. The reflection of the interaction over time of these components to the terrain forms the different landscape types. In other words, landscape character is a term that expresses the pattern formed by the different permanent and perceivable elements and processes as well as how these elements are perceived by people. It reflects the different spatial combinations of properties such as geology, soil, plant cover, area usage, settlement areas etc. Landscape elements are overlapped in a certain hierarchy and homogeneous patterns with similar properties are collected under a certain name for determining landscape types. Natural and cultural landscape elements together determine the landscape character (Şahin et.al., 2013). Landscape character is a formation that is determined by abiotic, biotic and cultural functions (Mucher et al., 2003). Processes that appear as a result of the interaction of landscape components are effective in determining the functions of landscape. These functions can be put forth in different means such as habitat value, cultural value, biodiversity etc. (Şahin et.al., 2013). After the landscape characters are determined, their functions are determined and mapped and their primary functions are considered first while making land use and management decisions. The objective of this study was to put forth the relationship of landscape character analysis studies in Turkey with the planning regulations, development plans, national and international strategies.
Keywords: Ecology, Protection, Planning, Landscape Character analysis

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Effects of site characteristics on distribution of oak forests of lakes district of Turkey

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Abstract: Oaks are important tree species for protection of soil and water resources, maintenance of wildlife habitats and rangelands, for production of high quality industrial wood and fuel wood, for its social role in Anatolian folk culture. With its 18 species, oaks cover about 26 % of Turkish forest land. The Lakes District account for a significant portion of Regional Directorate of Forestry in Isparta, and in this region oaks cover 24% of the forest land area. This research was conducted to determine the effects of site characteristics on distribution of oak species in forestlands of Regional Directorate of Forestry in Isparta. The area was in a transitional zone which is under the influence of Mediterranean and continental climates and substantial changes can be seen in local climate depending on the topography. Climate type ranged from semi-arid to very humid according to Erinç method. Mean annual precipitation was 367 - 1395 mm, while mean annual temperature is 11.5 - 17.6 ºC. This research was conducted in 15 different sites where oak stands were abundant. Results showed that two of the most common oak species were *Quercus cerris* and *Q. infectoria* among the 7 oak species (*Q. cerris, Q. infectoria, Q. ithaburensis, Q. trojana, Q. vulcanica, Q. robur, Q. coccifera*) found in this region. Although *Q. coccifera* had a wider distribution area in comparison to these two species, it is usually not in a tree form but appears as shrubs in maquis vegetation. *Q. vulcanica* and *Q. robur* had smallest distribution area. Within the study area, soil texture was mostly loamy clay, while it ranged from heavy clay to sandy clay loam. pH of the soils were between 6.92-7.75 and lime content was between 0 and 36.4 percent. It was determined that *Q. coccifera* preferred protected and sheltered areas which were not exposed to cold northerly winds. Generally, oak species found on heavy soils were distributed according to moisture and temperature characteristics of the site. For example, *Q. cerris* and *Q. infectoria* commonly accompanied each other; however, increased humidity favored *Q. cerris* while increased aridity favored *Q. infectoria*.
Keywords: Lakes district, Oaks species, Site characteristics

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An overview of industrial plantations in Turkey

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Abstract: Over the last century, population of the world quadrupled, which in return raised the demand for wood and increased the pressure on the forest resources drastically. One of the ways to deal with this pressure is to establish new forest lands through plantations, supplying raw material for the forest industry. By the end of the century, the proportion of these plantations reached more than 4 % and rose to 7 % by 2015. Their share in the round wood production is also getting higher, accounting for an average of 46 % in the world as a whole, and reaching as high as 90 % in South America. These plantations are usually even-aged monocultures, set up with fast growing exotic tree species and managed intensively for industrial wood and oil production. While this data shows how important industrial plantations are on the global scale today, it also indicates that its importance will increase in the future. In Turkey, industrial plantation activities started with eucalyptus (*Eucalyptus* spp) plantations in Tarsus in 1930s and accelerated in the 1970s with the establishment of an institute focused on fast growing species in İzmit. Nowadays, species such as poplar (*Populus* spp), eucalyptus and especially maritime pine (*Pinus pinaster* Aiton, Syn: *P. maritima* Lamarck) are the most common in these plantations. In recent years, industrial plantations have regained its popularity in Turkish forestry after General directorate of Forestry (OGM) has initiated the "Industrial Plantation Activities Action Plan (2013-2023)". According to this action plan, it is aimed to establish a total of about 165 thousand hectare plantations in fast growing species such as Turkish red pine (*Pinus brutia* Ten.), maritime pine, ash (*Fraxinus* spp.), alder (*Alnus* spp.), eucalyptus and poplar in somewhat fertile and level grounds suitable mechanical site preparation by the year 2052. The most important part of this plan belongs to Turkish red pine with approximately 145 thousand ha (88%). However, possibility of using mechanical treatments such as disking and ripping is restricted due to steep slopes and rocky, shallow soils in most parts of the Mediterranean region, where Turkish red pine grows naturally. Therefore it is difficult to find ideal sites for productive pine plantations. In some cases, even natural pine forests are converted into industrial pine plantations on suitable sites, and this practice alone creates a serious conflict among decision makers, foresters, forest industry and general public. In this paper, the importance of industrial plantations in the world and Turkey will be emphasized and the problems experienced especially in Turkish red pine plantations will be discussed.

Keywords: Intensive silviculture, Plantation forestry, Turkish red pine, Mediterranean region

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Indicator species analysis of some wild mammals; A case study of Ağlasun

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Abstract: The purpose of natural resource management is to protect components and habitats of wildlife. In Turkey, mammals with 170 species are important part of the wildlife. The coexistence of mammalian species in the ecosystem is an important indicator that the ecosystem is in balance. Therefore, this study was carried out to determine the conditions related to each other of some wild mammals distributed in Burdur-Aglasun district. In this study, absence-presence data based on sign and tracks of wild mammals were collected from 70 sample plots. Statistically, five species were sampled at adequate levels. Sample areas were divided to groups with Cluster analysis (Ward's method of Jaccard indices) using PC-ORD. To see the relationships between groups and mammals, Chi-square test was performed with SPSS. Indicator species and relationship orientation of these species were determined by using interspecific correlation analysis for important ones. A correspondence analysis was carried out with the Past program to see the situation of groups and wild animals with sample areas. Cluster analysis separated sample areas into three groups. As a result of the Chi-square, the group A with Badger, Red fox and Beech marten, the group B with Badger and Red fox, the group C with Badger, Red fox and Beech marten were related ($p< 0.05$). Indicator species of groups A, B and C were determined by interspecific correlation analysis. While the group A showed negative relationship with the Badger (p: 0,000), it showed positive association with Red fox (p: 0,000) and Beech marten (p: 0,000). In addition, direction of relationships of B group's indicators were to negative Red fox (p: 0,005), positive Badger (p: 0.000). Red fox (p: 0,000), Badger (p: 0,000) and Beech marten (p: 0,000) were found as negative indicators of the group C. When the result of the Correspondence analysis was examined, it was seen that the European hare and Wild boar were almost equally distant from the three groups. As a result of this study, it seems that own habitats of species (except for European hare and Wild boar) sharply separated. Since Wild boar and European hare are found in almost all areas, it is possible to say that these species are on a wide scale in terms of their territory and ecological desires. Finally, this study is also important in that it shows the mentioned analysis methods can be used to reveal the relationships of the species with each other.
Keywords: Aglasun district, Correlation analysis, Correspondence analysis, Indicator species, Interspecific correlation analysis, Mammals, Wildlife

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Decay fungi associated with woodpecker nests of oak species in isparta and Mersin Province in Turkey

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Abstract: Woodpeckers generally choose nest and roost sites in dead or partially dead trees, apparently related to the presence of fungal decay. Many woodpeckers excavate cavities in partially decayed wood within two weeks. Most woodpeckers take advantage of softened, but not extensively rotted wood, but many factors influence this balance. In this work we determined the species of decay fungi in wood adjacent to woodpecker nests in old or dead oak trees. Surveys were conducted in oak forests in Isparta- and Mersin provinces. Trees were examined for the presence of 1-2 year-old woodpecker nests. Presence and absence of decay prior to cavity excavation was estimated by visual inspection of the nest trees. Location (co-ordinates) and diameter at breast height of each tree were recorded. Bore cores and saw dust were taken 10 cm below from woodpecker nests from 15 trees. Isolations were made from both cores and saw dust from the nest and at stump height of the tree. Cores were surface sterilized by flaming, cut into 0.5 cm long fragments, and pieces placed on malt extract agar containing streptomycin. Following incubation at 22°C for two weeks, any outgrowing mycelia subcultured to purity, partially classified based on morphology and identified by amplification and sequencing of the internal transcribed spacer (ITS) region of the nuclear ribosomal DNA. To date, 26 morphologically different fungal species were obtained from wood cores and saw dust. Two species were Hymenomycetes. The present work is the first examining woodpecker nests and decay fungi in oak forests in Turkey using DNA-based methods.
Keywords: Fungus, Oak, Woodpecker

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Effects of aspect on some soil properties in oak and beech-hornbeam forest in Western Black Sea Region of Turkey

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Abstract: The aim of this study is to determine effects of aspect on plant community structure and soil chemical and physical properties in an oak and beech-hornbeam mixed stands in Duzce University Campus Forest located in Western Black Sea Region of Turkey. Vegetation period is approximately 6 months and mean annual precipitation is about 800 mm in this temperate broadleaf forest ecosystem. The overstorey of the northern aspect is primarily dominated with a closed canopy of eastern beech (*Fagus orientalis*)-hornbeam (*Carpinus betulus*) mixed forest and the southern aspect is primarily a closed canopy of Oak (*Quercus spp.*) forest. 2 aspects were used for soil sampling. Soil samples collected from the topsoil 0-20 cm depth) from 9 sampling area on each aspect and they were used to determine the soil bulk density, texture, electrical conductivity (EC), cation exchange capacity (CEC), calcium carbonate ($CaCO_3$) and inorganic carbon (IOC) content. Soil texture was in general loam where it ranged from clay loam to sandy loam in this area. Although the mean sand, clay, silt, pH, CEC, $CaCO_3$ and IOC contents were statistically different on south aspects then north aspect, EC did not differ significantly between the aspects. The percentage of sand and clay, CEC, contents of $CaCO_3$ and IOC were 8.4%, 29.4%, 49.8%, 28.7% and 28.7% more on south aspect then those on north aspect, respectively. On the other hand percentage of silt and pH were 11.13% and 5% more on north aspect then south aspect, respectively. According the results of this study it is seen that aspect has varied most of the soil properties and also the plant composition. Descriptive ecological studies' results are very important for the future management decisions so the data obtained from this study can be used for similar deciduous forest ecosystems in this region. Additionally, data obtained from these ecosystems may be stored for long-term monitoring and evaluation.
Keywords: Soil properties, Oak, Beech, Hornbeam, Western Black Sea Region

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Endemic plants of Kahramanmaraş Province (Turkey) along with the IUCN threat categories

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Abstract: Endemic is an expression used for the species unique to a specific region, mountainous chain, a city, a country, a continent, and even an island. This kind of plant species are threatened and are facing the risk of extinction in the future. Endemic plant species can be found on steep rocky slopes, which are difficult to reach, or they can survive even in easily reachable wide spreading areas. In this respect, life strategies of endemic species are also directly related to the living environments and habitat types are very important, because they shelter a wide variety of endemic life forms. There is no comprehensive study of which endemic species are located in Kahramanmaraş. This review share the statistical data of the endemic plant species, derived from Turkish flora and other pertinent works, with the conservation point of view. As a result of the initial evaluations, approximately 657 plant taxa endemic for Turkey (18% or almost one in five of the total 3700 endemic plants) show distribution in the lands of Kahramanmaraş. Systematic list covers 132 threatened plants (20%). The families that are the richest in terms of endemic plants are as follows. *Fabaceae* family has the most endemic plant taxa (107 endemics, 16.3%) among 44 plant families that contain endemic species (31% of totally 144 plant families of Turkey) in Kahramanmaraş. *Asteraceae* family is in the second rank having 87 endemic plants (13.2%). *Lamiaceae* is in the third rank having 64 endemic plants (9.7%). In the assessment of IUCN threat categories, *Asteraceae* is the leading family with the highest taxa numbers in CR, and EN, while *Fabaceae* has the highest number of taxa in VU and LC, and *Lamiaceae* has the highest number of taxa in NT threat category. In the total list of endemics, 20 of which (3.4%) are in CR, 44 of which (7.5%) are in EN, 68 of which (11.6%) are in VU, 162 of which (27.6%) are in NT, 282 of which (48.1%) are in LC, 10 of which (1.7%) are in DD and also the status of 71 plant taxa are remained unverified. Vast majority of endemic plants in Kahramanmaraş (312 plant taxa, 47.5%) belong to Irano-Turanian phytogeographical region. Of the remaining, Eastern Mediterranean region was in the second rank with 134 plant taxa (20.4%). Nearly 27% of the total list (178 taxa) are Pluregional or unknown origin.
Keywords: Endemic plants, Endemism, IUCN, Threat categories, Kahramanmaraş, Turkey

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Preliminary results of litter decomposition and litterfall rates in Eldivan Mountain in Turkey

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Abstract: Chemical, physical and biological breakdown of the falling litter from its organic state to inorganic compounds is called decomposition. In forest ecosystems, knowledge of the amount of litterfall and decomposition presents very important information about the ecosystem functions such as primary production, carbon and nutrient cycles, as well as important processes including global climate change. In forest ecosystems, litterfall constitutes the majority of the source of the organic layer and the humic materials both above and below ground. By this way, vast amounts of organic material and energy go into the soil annually. Depending on chemical composition of organic material, nutrients are formed by means of decomposition and this process affects the soil biota. Litterfall amount is affected by climate, precipitation, vegetation period, growth capacity, water holding capacity, plant composition, and actual evaporation, while tree growth and net primary production are affected by litterfall. Litterfall and leaf litter decomposition are important ecosystem processes that rarely have been quantified for conifer forests in Turkey. That is why this study was aimed to measure amount of litterfall and decomposition in different development ages of black pine (*Pinus nigra* Arnold) forest (40°34'41" - 40°20'38" N latitude and 33°36'00" – 33°25'10" E longitude) in Eldivan Mountain where is a part of semiarid region of Central Anatolia. In this area mean annual temperature is close to 10 °C and mean annual precipitation is about 500 mm. There were three different age classes and 4 sampling area on each age classes. Nine litter traps were placed on each sampling area and totally 108 litter traps were placed in this study area. Litterfall was collected from all litter traps bimonthly for one year and the amount of litter fall was estimated for 1 m^2 where the knowledge of 0.113 m^2 area of litter traps were used. All collected litter samples were carried to the laboratory, air dried, weighed and sorted into six fractions (needle, twigs, male cone and cone, bark, lichen and a rest fraction). Pine needles were then sealed into fiberglass bags with 1 mm mesh size and a surface area of 0.02 m^2 (10 cm *x* 20 cm). 216 litterbags containing 5 g air-dried leaf litter for each site were prepared and placed randomly at three different locations in different development ages of black pine forest. Three litterbags containing decomposed litter were randomly collected at bimonthly interval and then transported to laboratory. The litterbags were opened and the litter materials were air dried initially, brushed to remove adhering soil particles, and finally dried at 75 °C for 48 hours and weighed. According the preliminary results of this study the most litterfall was occurred in young age class black pine forest and that was approximately 70-75% more than those in middle and old age classes were. In all age classes more than 90% of litterfall was accumulated by needles and the rest was a mixture of bark, male cone, twig and cone. Additionally it has been estimated that 40-50% of needles were decomposed according the first year analyses of needle decomposition.

Keywords: Litterfall, Litter decomposition, Black pine, Eldivan Mountain

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A study for assessing the recreation potential of Yozgat Çamlığı National Park

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Abstract: Today, in addition to being a contribution to the conservation of nature, national parks are venues which benefit society for their natural, cultural and esthetic values and counter the people's demand for outdoor recreation where significant interaction in terms of culture and physical environment take place. Yozgat Çamlığı National Park, which is the first national park to gain legal protection status in Turkey, is an important public area that offers the opportunity to experience everyday life practices and has become a common usage area for urban life where city people can spend time and carry out social and recreational activities in parallel with urban development and increasing population. This study has been carried out to determine the present recreational potential of Yozgat Çamlığı National Park with its flora and fauna and its multiple services to the city people which allows daily usage and is preferred by local people as a nearby area for reshaping social relations, strengthening urban relations and dialogue. For this purpose, Inter-forest Recreational Potential has been assessed in terms of the scale value created by parameters such as climate value, accessibility, recreational convenience and negative factors as well as the landscape value of the national park and it has been found to have a medium scale recreational potential. As a result of the study it has been concluded that the national park has a unique potential to add aesthetic, ecological and panoramic values to the urban landscape, to integrate nature and urban people and to contribute to the environmental, psychological and social development of urban people. However, it has been observed that the alternative green areas in the city are inadequate and the national park is close to the city and the recreational demand for this area has increased which has had an adverse impact on the potential of the area from time to time due to picnic and daily use.
Keywords: Yozgat Çamlığı National Park, Outdoor recreation, Recreation potential

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Mycophagous beetles on sporocarps of macrofungi

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Abstract: Sporocarps of macrofungi provide habitat for a wealth of arthropods, especially for a large number of insect species. Diptera (flies) and Coleoptera (beetles) are the most common and important insects attacking fungi. These insects comprise both obligate and facultative user of fruiting bodies. There are also insect species that use sporocarps of macrofungi accidentally. The species composition of mycophagous insect communities varies depending on the characteristics of the fruiting bodies they use as habitats. Aphyllophorales have long-lasted and hard sporocarps while fruiting bodies of Agaricales have fragile and short-lived. There are studies indicating that insects feeding on bracket fungi are monophagous or oligophagous and polyphagous insects feed on Agaricales. Some studies and also have shown that insects can use the sporocarps of Ascomycota as habitat. Our aims in this study identify mycophagous beetles (Coleoptera) from two macrofungi species. This research was carried out in Belgrade Forest in Istanbul. There are more than 400 plant species in the research area, including herbaceous and woody plants. *Quercus* spp., *Fagus orientalis*, *Carpinus betulus* and *Castanea sativa* are the best-known tree species. Approximately 150 species of macrofungi have been identified in Belgrad Forest and some of them cause rotting in trees. Our research was performed on two rotting fungi, *Fomes fomentarius* (L.) Fr. (Basidiomycota), 1849 and *Daldinia concentrica* (Bolton) Ces. & De Not., 1863 (Ascomycota). Brackets *of F. fomentarius* and stromata of D. *concentrica* were collected from dead or dying trees in 2014 – 2017. They were placed in plastic containers separately and left under laboratory conditions. The insects emerging from sporocarps were preserved in the Istanbul University Faculty of Forestry Entomological Museum. It has not been conducted any research on mycophagous insects in Turkey. Some insect species known to be mycophagous have been reported in our country without being associated with fungi. As a result of our study, 9 species *from D. concentrica* and 8 species from *F. fomentarius* were identified. Only one species, *Anaspis (Nassipa) flava* (Linnaeus, 1758), was found both of these fungi. The larvae of the genus *Anaspis* are lignicolous and the species of this genus normally occur on or about rotten wood and *A. flava*'s habitat is not associated with fungi according to current knowledge. *Biphyllus lunatus* (Fabricius, 1787), *Platyrhinus resinosus* (Scopoli, 1763), *Dacne* (*Dacne*) *bipustulata* (Thunberg, 1781), *Orthocis lucasi* (Abeille de Perrin, 1874), *Anthelephila pedestris* (Rossi, 1790), *Olibrus* sp. Erichson, *Stenosis sardoa* (Kuster, 1848) and *Trixagus gracilis* Wollaston, 1854 was obtained from stromata of *D. concetrica*, while *Xylographus bostrichoides* (Dufour, 1843), *Dorcatoma* (*Pilosodorcatoma*) *minor* Zahradnik, 1993, *Dorcatoma (Dorcatoma) robusta* A. Strand, 1938, *Bolitophagus reticulatus* (Linnaeus, 1767), *Neomida haemorrhoidalis* (Fabricius, 1787), *Cis castaneus* Mellie, 1848 and *Rhopalodontus perforatus* (Gyllenhal, 1813) was found on brackets of *F. fomentarius*. All of the insect species from *F. fomentarius* except *A. flava* and also *B. lunatus*, *P. resinosus*, *D. bipustulata*, *O. lucasi* were found on *D. concentrica* are obligate mycetobionts insects. Although is the more research needed on these species, can be said that *A. pedestris*, *Olibrus* sp., *A. flava*, *S. sardoa* and *T. gracilis* are accidentally mycetoxenes. Findings from our study will bring a different perspective to the biodiversity investigations in our country. Due to the dead and dying trees were immediately cut off and removed from the area a small number of sporocarps could be collected. Therefore, the number of species of beetles found in this research remained below the similar studies. We think about that the presence of insects species associated with sporocarps of fungi especially obligate mycetebiont species in our research area is threatened.

Keywords: Mycophagy, Coleoptera, Sporocarp, *Daldinia concentrica*, *Fomes fomentarius*

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Turkey's oak forests are important for biodiversity

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Abstract: The Mediterranean basin exhibits a multitude of forest habitats affected by former and current exploitation and management. Recent afforestation programs have resulted in an increase in the proportion of coniferous trees, while Oak stands (*Quercus* spp), formerly utilized for pollarding, coppicing and grazing, are abandoned or converted into coniferous plantations. The loss of Oak stands might negatively affect birds dependent upon broadleaved forests. Studies confirming or rejecting that statement are scarce, particularly in the eastern part of the region. Old Oaks and its insect fauna are very rare and threatened all over Europe and Turkey. Using six areas in southwestern Turkey we have studied the species richness of wood living beetles on old hollow Oaks and we also investigated how 15 pine and 15 oak stands with various age differ in their capacity to support forest bird assemblages. Our result show that Oak (*Quercus* spp.) forests support a higher species richness of birds than Pine (*Pinus* spp.) forests. The number of bird species clearly increases with the age of the Oak and pine forest habitat. Primary cavity-nesters like woodpeckers prefer old stands of Oak trees while ground-nesters are more indifferent to the factor forest age. Among the 340 identified wood living beetles species, 10 of them are very rare and are on the European ”Red-list”. Some of the beetles found are protected in EU as they are on the Annexes of the Habitat directive in the Natura 2000 system. Many of the beetle species were found for the first time in Turkey and 32 species are also identified as new to science. The result shows the unique species richness of Turkish Oaks and the high endemism among the beetle fauna in Turkey. The conservation value of the Turkish Oak habitats are higher than most of similar areas in Europe.
Keywords: Birds, Woodpeckers, Beetles, Pine, Oak, Forest

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The studies on biodiversity of carabidae family in 3 forest types in Andırın, Kahramanmaraş province of Turkey

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Abstract: In this study, identification of fauna, diversity, and ecology of Carabidae beetles in three forest types (oak, cedar+oak, and beech) were studied. The study was conducted in Kahramanmaras-Andırın province from April to October in 2013 and 2014. Window and pit-fall trap were used to collect the beetles. A total of 1489 adults were collected from the traps. 15 species belonging to 12 genus of Carabidae were determined. Also, information was provided on each track found, ecological characteristics obtained in the field, host plants, phenologies, hazard situations and collection records. As a result, *Aptinus* (*Aptinus*) *creticus*, *Calosoma sycophanta*, *Carabus (Archicarabus) wiedemanni caramanus*, *Carabus (Procrustes) coriaceus ressli*, *Carabus (Lamprostus) mulsantianus, Procerus syriacus, Dinodes* (*Dinodes*) *decipiens, Ophonus* (*Hesperophonus*) *azureus, Lebia scapularis*, *Nebria hemprichi*, *Calathus syriacus*, *Laemostenus* (*Laemostenus*) *venustus*, *Tapinopterus samai*, *Trechus* (*Trechus*) *austriacus* and *Trechus* (*Trechus*) *quadristriatus* were determined.
Keywords: Coleoptera, Carabidae, Cedar, Oak, Andırın, Kahramanmaraş

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An evaluation of a fully mechanized forest harvesting operation in Bursa, Turkey

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Abstract: In recent years, the use of mechanized harvesting technology in forestry has gradually increased in Turkey. There are a number of private contractors who fell and extract timber in state forests by using mechanized harvesting equipment such as: harvesters, feller-bunchers and skidders. Performances of the mechanized harvesting systems are mainly influenced by features such as tree size, tree formations, terrain conditions, operator motivation and skill. In order to implement these systems effectively and efficiently, their applications should be well planned according to the sustainable forestry principles. Therefore, environmental, social and economic dimension as well as operational productivity of these systems should be evaluated. In this study, a single-grip harvesting operation was evaluated by using time and motion study analysis. Also, the main factors that affect harvesting operation were investigated. The study was implemented during a clear-cut operation of Brutian pine (*Pinus brutia*) stands in Osmangazi Forest Enterprise Directorate in the city of Bursa, Turkey. Three stages of harvesting operation were evaluated: a. moving harvester to the trees, b. gripping and felling trees, and processing (i.e. delimbing and bucking) trees. The average time of the work stages was examined and the results indicated that most of the time was spent on tree processing. The productivity of harvesting operation was estimated to be 23.91 m^3/hr. The productivity of mechanized harvesting system was mainly affected by the tree size, which directly influences the total processing time of the felled trees in the study area. The results from this study cannot be generalized but it suggested that mechanized harvesting using a harvester should be well planned and organized ahead of time in order to operate harvester with optimal efficiency. Optimum machine selection and machine combinations should be practiced based on site specifications and stand characteristics. Technical training and field training of the operators are also very important to maximize the harvesters' efficiency and minimize operational costs.
Keywords: Timber extraction, fully mechanized harvesting, time and motion study, single-grip harvester

1. Introduction

In recent years, the usage of mechanized harvesting systems has been increasing in Turkey, especially in Maramara region. The main reason for this trend is that private forest industry demands for large amounts of woods which can be only provided by the logging contractors using mechanized harvesting systems. Appropriately planned and implemented mechanized harvesting operations provide important advantages such as minimizing environmental effects, leaving logging residual as organic matter in the stand, and improving labour efficiency (Akay and Sessions, 2004). However, mechanized harvesting systems can be very costly operations due to very high ownership and operating costs in Turkey. Therefore, mechanized harvesting operations should be efficiently managed in order to ensure profitability (Hiesl and Benjamin, 2013).

The highly mechanized harvesting systems implemented in Turkey currently consist of harvester, feller-buncher, and grapple skidder. Harvested was the first highly mechanized equipment introduced to Turkish forestry in mid 2000s. The use of harvested in forest operations is still new in Turkey and there is only few studies focused on harvester productivity.

Enez and Arıcak (2012) conducted a study where productivity of single-grip harvester was evaluated for different species and tree sizes in Kastamonu region in Turkey. They stated that harvester productivity was maximized in harvesting firs (27.36 m^3/hr), followed by Yellow pine (20.82 m^3/hr), and Black pine (11.82 m^3/hr). For various dimeter classed, the maximum productivity was reached at the DBH of 36-52 cm (25.68 m^3/hr) and followed by 20-36 cm DBH class (23.1 m^3/hr).

Previous studies reported that the productivity of mechanized harvesting mainly depends on ground slope, tree size, tree form, numbers of trees per unit area, operator's motivation and skill (Jiroušek et al., 2007). Thus, the important site factors such as terrain conditions and stand characteristics should be studied and their effects on productivity should be considered during planning stages (Wang et al., 2004).

The productivity of mechanized forest equipment is generally computerized based on the operating time. In the time and motion studies, the duration of recurrent elements of work are measured by time recording devices (i.e. chronometer, watch) directly on a worksite (Szewczyk et al., 2014). There are three common time study methods including cumulative, repetitive, and random sampling (Ovaskainen et al., 2004). In this study, time and motion study analysis using repetitive approach was used to assess the productivity of a single-grip harvesting operation. Also, the main factors that affect harvesting operation were investigated. The study was implemented in Osmangazi Forest Enterprise Directorate in the city of Bursa, Turkey.

2. Material and methods

2.1. Study area

The study was conducted during harvesting operations taken place in Osmangazi Forest Enterprise Directorate within the boarder of Bursa Regional Directorate of Forestry in western Turkey. Study area, mostly covered by Brutian pine (*Pinus brutia*) stands, is located in Osmangazi province of Bursa (Figure1).

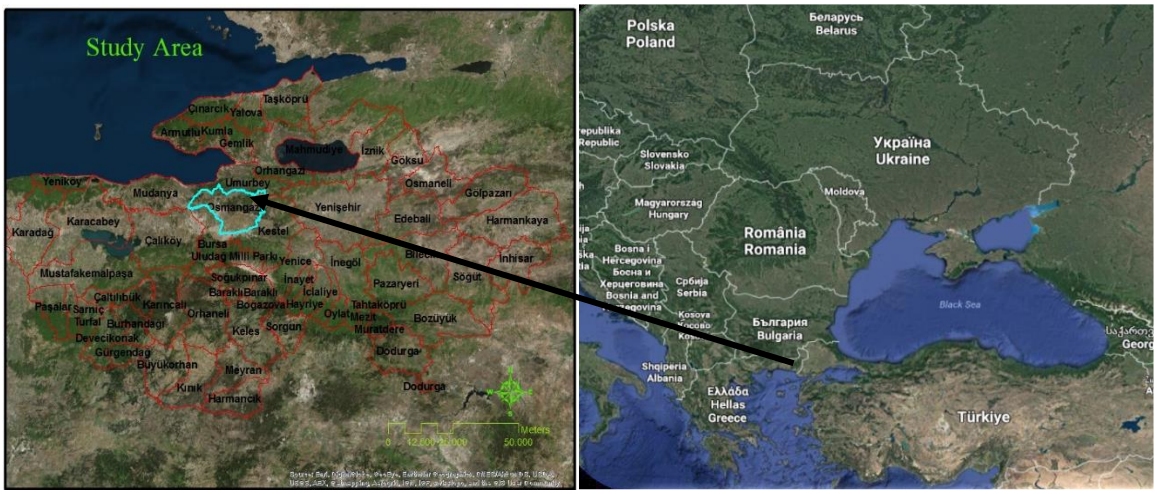

Figure 1. Study area

2.2. Time study

Mechanized cut-to-length (CTL) system was implemented in the field. Trees were cut and bucked by using single grip harvester, and then rubber-tired tractor was used for skidding logs from stump to landing area. The time study was implemented by using repetition approach in which chronometer was run for each work stage separately (Figure 2).

Figure 2. Single-grip harvester

In this study, the harvester operation was evaluated by timing the movement of equipment. The work steps measured include:

1. Moving: Begins when the harvester ends the previous cycle and includes the moving time to the next tree to be cut.
2. Grapping and cutting: Begins when the cutting-head is positioned on the tree and ends when the tree is completely severed from the stump.
3. Processing: Begins when the harvester moves from the stump with the felled tree and ends when movement is stopped.

2.3. Statistical analysis

In statistical analysis, SPSS 22 program was used for statistical analysis where average values and standard deviations were computed. The relation between tree volume and productivity was also analyzed by One-Way ANOVA at 0.05 confidence level. In order to determine if there is a correlation between total cycle time and main decision variable (timber volume), Pearson Correlation Test was implemented. Then, Linear Regression Analysis was used to determine mathematical

models for dependent and independent variable. The potential effects of stand feature (tree volume) on productivity were investigated by the correlation analysis based on the timed data.

3. Results and discussion

A time series analysis was used to assess the productivity of a harvester and the effects of tree size on its performance. The total cycle time was computed by calculating three work steps including moving, grapping and cutting, and processing. The results indicated that that the most time-consuming step was processing stage, followed by grapping and cutting, and then moving the cut trees to the dump roadside area (Table 1, Figure 3).

Table 1. Average time per work steps

Work Steps	Min. (sec)	Max. (sec)	Average (sec)
Moving	5	80	25
Grapping and cutting	8	93	29
Processing	13	98	40
Total cycle time	29	271	95

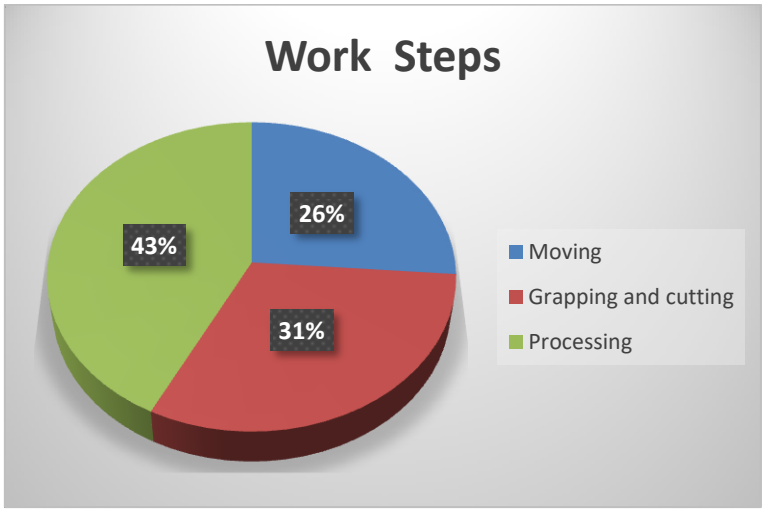

Figure 3. Average time per work steps

Pearson correlation method was used to determine the relationship between productivity and tree size factors (volume), using SPSS 22 program (Table 2). Statistical analysis indicated that there was a significant relationship ($p<0.01$) between productivity and tree size at the confidence interval of 99%.

The significant relation between tree size factors (volume) and productivity was also proven by a One-Way ANOVA at 0.05 confidence level (Table 3). The regression analysis graphic showed a normal distribution (Figure 4). In this study, it was found that there was a significant relationship between tree volume and harvester productivity (Figure 5).

Table 2. The correlation analysis between productivity and tree volume

Correlations			
		Productivity	DBH
Productivity	Pearson Correlation	1	0,479(**)
	Sig. (2-tailed)		0,000
	N	32	32
Volume	Pearson Correlation	0,479(**)	1
	Sig. (2-tailed)	0,000	
	N	32	32

** Correlation is significant at the 0.01 level (2-tailed).

Table 3. The summary table of One-Way ANOVA test

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1655,388	1	1655,388	8,913	0,006(a)
	Residual	5571,794	30	185,726		
	Total	7227,182	31			

a-Predictors: (Constant) volume, b-Dependent Variable: Productivity

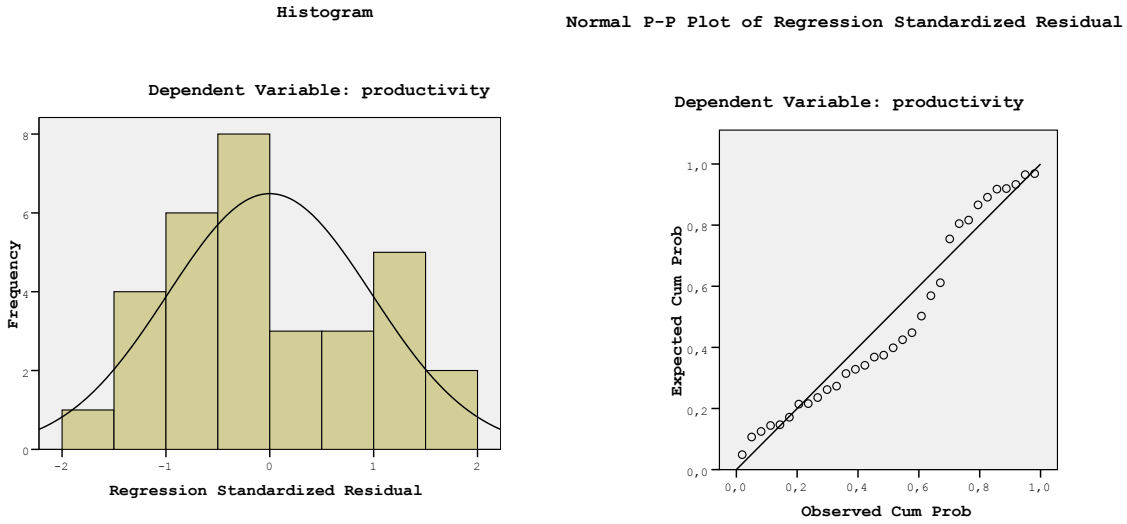

Figure 4. Regression analysis graphics

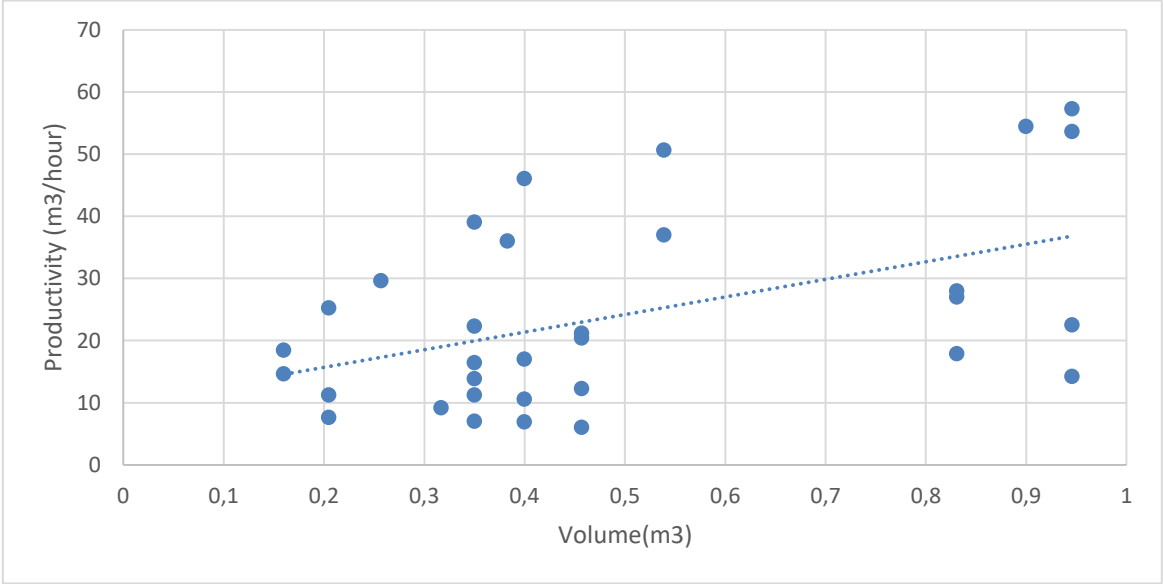

Figure 5. Tree volume vs. productivity

In this study, the average productivity was estimated as 23.91 m^3/hr, ranging between 6.02 m^3/hr to 57.26 m^3/hr. The average timber volume was 0.49 m^3 with the range of 0.16 m^3-0.95 m^3. The productivity was found very close to the values stated in previous works. Andersson (1994) reported a harvester productivity of 22.2 m^3/hr for the average tree volume of 0.34 m^3, which is less compared to Irish conditions. Lanford and Stokes (1996) reported an average harvester productivity of 21.0 m^3/hr using a Valmet 546 Woodstar harvester. Jiroušek et al. (2007) resulted in a productivity of 13.5 to 60.5 m^3/hr with a fairly large stem size (0.1 m^3–1.0 m^3).

4. Conclusions

Mechanized harvesting operations can be very costly especially when dealing with new equipment or the system is implemented for the first time. Thus, newly practiced operations should be well planned based on accurate estimation of the equipment productivity. One of the important factors affecting productivity in previous studies was specified as tree size. Therefore the effect of tree volume on productivity should be carefully examined. Productivity analysis conducted on a single-grip harvester revelaed that there is a meaningful relationship between the volume of tree and productivity. In this study, the effect of tree volume on productivity was studied, thus, other factors that may affect productivity need to be examined in future studies. All factors must be assessed for accurate planning of harvesting systems.

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Ranking of strategic plans with GRA on the basis of recreation and water production; the case of belgrade forest

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Abstract: Forest management plans have been developed to help the contradictions between the number of goods and services demanded by the community and to regulate the time and place of forestry activities. Decisions on the use of forest resources are becoming complicated due to competing uses such as wood production, recreation and water production etc. As the complexity of decisions increases, it becomes more difficult for decision makers to identify a management alternative that maximizes all decision criteria. Planning in forest management are separated strategic, tactical and operational according to the planning time. Strategic plans have plan horizon is more than ten years. Functional planning can be cited as the main reason for strategy changes in forest management. Various studies have been carried out to produce alternative strategic plans for different objectives. Determining the most suitability one from alternative strategies based on various criteria can be accomplished by multi-criteria decision making techniques. This study aims to choose most suitable from six different strategies for water production and recreation purposes for the Belgrade forest. Seven criteria were used to evaluate the suitability of these strategies. Firstly the weights of seven criteria were calculated with AHP method since criteria weights are required for gray relational analysis. Then six strategies were scored according to seven criteria. These strategies were prioritized with Gray Relational Analysis (GRA).
Keywords: Multi-criteria decision making, GRA, Strategies for recreation, Strategic plans

1. Introduction

In general, a number of alternatives are ranked according to various criteria in the decision-making process and the best is selected by the decision-makers. It is necessary to select the criteria that may be influential in the selection relevant to the present problem. For this reason, decision makers frequently use Multi Criteria Decision Making methods (MCDM) in the planning of forest management (Kangas & Kangas, 2005). MCDM contributes to the policy process by solving complex forest management issues and it supports the decision-makers' intuitive decision-making procedures with rational analytical knowledge processes (Ananda & Herath, 2009). When the forestry system is examined, a high-level decision mechanism is required in the source where function priority is considered (Ok, 1999). Additionally, decisions taken within the framework of the Sustainable Forest Management, It is expected to fulfill social, economic and ecological requirements. Due to its ecological and biological qualities, forest resources may have different strengths to obtain product and service (output) on a regional basis.

Criteria setting process in forestry management is a process that is time consuming and requires different disciplinary components, for this reason, the scenarios produced by Zengin (2010) were used as an alternative and the technical components in the scenario were used as criteria. The use of GRA in the field of forestry in Turkey has not been achieved. The purpose of introducing the use of the GRA mathematical method in the study is a priority.

MCDM techniques in the forestry sector, and most of the published studies on forestry were published using two techniques together and about 90% were published after 1989 (Diaz-Balteiro & Romero, 2008). There are studies using different MCDM techniques such as ELECTRE (Ok, Okan, & Yılmaz, 2011), AHP (Daşdemir & Güngör, 2010), TOPSIS (Korkmaz, 2012) in forestry field in Turkey. Unlike the Forestry Administration in Turkey, it can be said that multi-criteria decision making methods are widely used in academic (Daşdemir & Güngör, 2002).

This study aims to choose most suitable from six different strategies for water production and recreation purposes for the Belgrade forest. Seven criteria were used to evaluate the suitability of these strategies for water production and recreation in forest planning. These criteria are periodic wood flows, adjacency restrictions, recreation income in periods, a number of water yields in periods, recreation value fluctuation, water yields fluctuation and harvest area constraints. The weights of seven criteria for calculation in AHP method has acquired from the questions that have been answered by expert since criteria weights are required for gray relational analysis. Then six strategies were scored according to seven criteria and a Preference Matrix was created. These strategies were prioritized with Gray Relational Analysis (GRA).

This paper is organized as follows. Section 2 introduces gray relational analysis and case study for problem description, while Section. 3 defines results of ranking the six scenarios is given. Next, Section 4 presents the discussion and concluding remarks.

2. Material and methods

Gray Relational Analysis (GRA) method was chosen as the basic method in the study. As an effective mathematical approach, GRA the evaluation criteria to be used must be weighted with an other method (Özcan & Tüysüz, 2016). Another multi-criteria decision-making method, AHP, was selected as the criterion weighting method. The AHP method compares criteria in pairs differently than other decision making methods and measures the consistency of the comparison. Because of its superiority, AHP is especially preferred for solving multi-criteria decision-making problems, as well as for determining the criteria weights for many applications. As a result of the literature, GRA and criteria weighting AHP method have been frequently used together (Kaygısız & Girginer, 2014).

The process steps of the AHP method developed by Saaty (1980) were given in the application section of the study, but the methodology was not explained.

2.1. Gray relational analysis

Deng (1982) introduced the "Gray System Theory". There are a number of methodologies developed on the basis of Gray System Theory. These ; Gray System Analysis, Gray Clustering, Gray prediction, Gray combined models, Gray programming, Gray input-output models, Gray control and Gray Decision Making (Gray Relational Analysis) (Wen, 2004). Gray Relationship Analysis is a MCDM technique.

In a MCDM problem where the alternative number is "m" and the number of criteria is "n", the initial decision matrix showing the values of the alternatives according to the criteria is formed primarily.

$$X = \begin{bmatrix} x_1(1), x_1(2), ...x_1(n) \\ x_2(1), x_2(2), ...x_2(n) \\ .... \\ .... \\ x_m(1), x_m(2), ...x_m(n) \end{bmatrix}$$

This $x_i(k)$ i. alternative value according to the criterion *k*. Criterion weights and preference values determined by the decision maker or calculated with objective approaches should be examined (Yang & Chen, 2005).

Table 1: Steps of grey relational analysis (Özcan & Tüysüz, 2016)

Steps	Explanation	No	Equation
In first step of gray relational analysis, data sets of different sizes from different sources are transformed into dimensionless units. After the **normalization phase**, while the best value within the benefit-oriented criteria approaches "1" for the cost-effective criterion, this best value will approach "0".	For benefit-type factor (bigger is better, benefit maximize)	(1)	$x_i(k) = \frac{x_i(k) - \min x_i(k)}{\max x_i(k) - \min x_i(k)}$
	For cost type (smaller is better, cost minimize)	(2)	$x_i(k) = \frac{\max x_i(k) - x_i(k)}{\max x_i(k) - \min x_i(k)}$
	For medium-type or best rated (better than the one with a certain standard value)	(3)	$x_i(k) = \frac{\lvert x_i(k) - x_0(k) \rvert}{\max x_i(k) - x_0(k)}$
Second step is **computing absolute values**	Absolute differences of the comparison series and the reference series should be obtained and maximum and minimum differences should be found.	(4)	$\Delta x_i(k) = \lvert x_0(k) - x_i(k) \rvert$
Third step The gray relational coefficient expressed as ξ calculated.	The separation coefficient *p* is between 0 and 1. In general, the separation coefficient is fixed at 0.5. The distance of the values of each alternate from the reference series.	(5)	$\xi_i(k) = \frac{\Delta \min + p\Delta \max}{\Delta x_i(k) + p\Delta \max}$
Finally, The relationship grade is determined and then alternatives rank by the highest grade.	The gray relational grade gives the relation between the reference series and the comparable series in a problem.	(6)	$r_i = \sum [w(k)\xi(k)]$

2.2. Case study

Scenarios developed by Zengin (2010) are shown in the table 2. Zengin (2010), after developing the main planning model with the mathematical model, six alternative strategies were created to examine the effect on the results.

- Scenario 1 periodic wood flow and adjacency restriction are not controlled. This means that you can produce unlimited wood at any time.
- Scenario 2; wood fluctuation rates (Rwood=0,10) were %10, The recreation income in different periods should not drop down below an actual recreation income (R≥ActR) and The amount of water yields in periods should not drop down below an actual amount of water yields (W≥ActW).
- Scenario 3; Rate of wood fluctuation, recreation income and amount of water yield are the same as scenario 2., There should not be more than three stands adjacent to each other (maxadjacency≤3).
- Scenario 4; periodic wood flows, adjacency restrictions, recreation income and amount of water yields in periods are the same as scenario 3, recreation value fluctuation, water yields fluctuation should not exceed %10 to ensure a water yield and recreation value are generated during each time period.
- Senario 5: periodic wood flow is not controlled, There should not be more than three stands adjacent to each other (maxadjacency≤3). The amount of water yields in periods should not drop down below amount of water yields in the sixth period (W≥ActW6), recreation value fluctuation, water yields fluctuation are not controlled.
- No constraint is checked in the scenario 6 without amount of water yields and The amount of water yields in periods should not drop down below amount of water yields in the sixth period (W≥ActW6)

Table 2: Six alternative plan strategies of forest management plan (Zengin, 2010).

Scenario No	Restrictions	Level
Scenario 1	No control periodic wood flows No control adjacency restrictions	Rwood≥0 maxadjacency≥1
Scenario 2	control periodic wood flows No control adjacency restrictions control recreation income in periods control amount of water yields in periods	Rwood=0,10 maxadjacency≥1 R≥ActR W≥ActW
Scenario 3	control periodic wood flows control adjacency restrictions control recreation income in periods control amount of water yields in periods	Rwood=0,10 maxadjacency≤3 R≥ActR W≥ActW
Scenario 4	control periodic wood flows control adjacency restrictions control recreation income in periods control amount of water yields in periods control recreation value fluctuation control water yields fluctuation	Rwood=0,10 maxadjacency≤3 R≥ActR W≥ActW Rrecreation=0,10 Rsu=0,10
Scenario 5	No control periodic wood flows control adjacency restrictions control amount of water yields in sixth periods No control recreation value fluctuation No control water yields fluctuation	Rwood≥0 maxadjacency≤3 W≥ActW6 Rrecreation≥0 Rsu≥0
Scenario 6	No control periodic wood flows No control adjacency restrictions control amount of water yields in sixth periods No control recreation value fluctuation No control water yields fluctuation No harvest area constraint	Rwood≥0 maxadjacency≥1 W≥ActW6 Rrecreation≥0 Rsu≥0 Maxarea≥0

3. Results

1. Establishing the Pairwise Comparison Matrix : This matrix is created from the average measurement by expert about the Comparison between two criteria. For this design, the Standard Preference Scale with scale 1 – 9 is used. Table 3 shows the Pairwise Comparison Matrix for each criterion for water production.

Table 3: Pairwise Comparison Matrix for Water Production.

		C1	C2	C3	C4	C5	C6	C7
		Periodic wood flows	Adjacency restrictions	Recreation income in periods	Amount of water yields in periods	Recreation value fluctuation	Water yields fluctuation	harvest area constraint
C1	Periodic wood flows	1	4	7	0,33333	5	0,25	0,5
C2	Adjacency restrictions	0,25	1	2	0,2	3	0,2	0,33333
C3	Recreation income in periods	0,14286	0,5	1	0,11111	0,25	0,11111	0,2
C4	Amount of water yields in periods	3	5	9	1	7	0,33333	5
C5	Recreation value fluctuation	0,2	0,33333	4	0,14286	1	0,14286	0,33333
C6	Water yields fluctuation	4	5	9	3	7	1	5
C7	harvest area constraint	2	3	5	0,2	3	0,2	1
	Total	10,5929	18,8333	37	4,9873	26,25	2,2373	12,3667

2. Establishing the Normalized Matrix; the value of each column in Table 3 is summed and for modifying the value into demical value. The result of *Normalized Matrix* for the criteria is shown in Table 4. Next the value of each rows in Table 6 is summed and averaged. Average values are weighted value .

Table 4: Normalization (With AHP).

	C1	C2	C3	C4	C5	C6	C7
C1	0,0944	0,21239	0,18919	0,06684	0,19048	0,11174	0,04043
C2	0,0236	0,0531	0,05405	0,0401	0,11429	0,08939	0,02695
C3	0,01349	0,02655	0,02703	0,02228	0,00952	0,04966	0,01617
C4	0,28321	0,26549	0,24324	0,20051	0,26667	0,14899	0,40431
C5	0,01888	0,0177	0,10811	0,02864	0,0381	0,06385	0,02695
C6	0,37761	0,26549	0,24324	0,60153	0,26667	0,44697	0,40431
C7	0,18881	0,15929	0,13514	0,0401	0,11429	0,08939	0,08086
Total	1	1	1	1	1	1	1

3. Test of Consistency: According to Saaty (1980), a consistency ratio of 0.10 or less is acceptable. If it exceeds 0.1 an inconsistency can be mentioned. In this study Consistency ratio is less then 0.1. So, it is clearly can be said that the results are consistent (Table 5).

Table 5: Consistency Ratio (CR) (With AHP).

	Total	Average (w(k))	Consistancy measure
C1	0,90547	0,12935	7,54861
C2	0,40149	0,05736	7,5143
C3	0,1647	0,02353	7,42468
C4	1,81242	0,25892	8,29952
C5	0,30223	0,04318	7,20113
C6	2,60582	0,37226	8,17774
C7	0,80788	0,11541	7,96795
		Average	7,73342
		CI	0,12224
		RI	1,32
		C.ratio	0,0926

Table 6 shows the original data (preference matrix) for water production. Each scenario was scored according to each criterion by expert.

Table 6: Original Data (Preference Matrix) For Water Production.

Scenario number	C1	C2	C3	C4	C5	C6	C7
Referential series	10	10	10	10	10	10	10
S1	2	2	0	0	0	0	0
S2	8	2	3	9	0	0	0
S3	8	5	3	9	0	0	0
S4	8	5	3	9	3	10	0
S5	2	5	0	5	1	1	0
S6	2	2	0	5	1	1	2

After normalization preference matrix next processes can be perform. Therefore preference matrix is normalized as scale of between 0-1 (Table 6).

Table 7: 0-1 Normalization.

Scenario number	C1	C2	C3	C4	C5	C6	C7
Referential series	1	1	1	1	1	1	1
S1	0,2	0,2	0	0	0	0	0
S2	0,8	0,2	0,3	0,9	0	0	0
S3	0,8	0,5	0,3	0,9	0	0	0
S4	0,8	0,5	0,3	0,9	0,3	1	0
S5	0,2	0,5	0	0,5	0,1	0,1	0
S6	0,2	0,2	0	0,5	0,1	0,1	0,2

In this study all factors are benefit type. Thus Table 8 is created using Eq. 1

Table 8: Benefit Type of Criteria.

Scenario number	C1	C2	C3	C4	C5	C6	C7
Referential series	1	1	1	1	1	1	1
S1	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
S2	1,0000	0,0000	1,0000	1,0000	0,0000	0,0000	0,0000
S3	1,0000	1,0000	1,0000	1,0000	0,0000	0,0000	0,0000
S4	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	0,0000
S5	0,0000	1,0000	0,0000	0,5556	0,3333	0,1000	0,0000
S6	0,0000	0,0000	0,0000	0,5556	0,3333	0,1000	1,0000

Absolute differences of the comparison series and the reference series obtained using Eq. 4 (Table 9).

Table 9: Difference of The Compared Series And The Referential Series.

Scenario number	C1	C2	C3	C4	C5	C6	C7
S1	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
S2	0,0000	1,0000	0,0000	0,0000	1,0000	1,0000	1,0000
S3	0,0000	0,0000	0,0000	0,0000	1,0000	1,0000	1,0000
S4	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	1,0000
S5	1,0000	0,0000	1,0000	0,4444	0,6667	0,9000	1,0000
S6	1,0000	1,0000	1,0000	0,4444	0,6667	0,9000	0,0000

Using Eq.5 “Grey Relation coefficient” table obtained. The weights in this stage was achieved by AHP

Table 10: Grey Relation Coefficient.

Scenario number	C1	C2	C3	C4	C5	C6	C7
w(k)	0,12935	0,05735	0,02352	0,25891	0,04317	0,37226	0,11541
S1	0,33333333	0,33333333	0,333333	0,333333	0,333333	0,333333	0,333333
S2	1	0,33333333	1	1	0,333333	0,333333	0,333333
S3	1	1	1	1	0,333333	0,333333	0,333333
S4	1	1	1	1	1	1	0,333333
S5	0,33333333	1	0,333333	0,529412	0,428571	0,357143	0,333333
S6	0,33333333	0,33333333	0,333333	0,529412	0,428571	0,357143	1

After Grey relation coefficients calculation, all scenario values processed using their weights by Eq.6. Table 11 that given below, shows ranks of each scenarios. It is clearly seen that Scenario 4 is first and Scenario 3 is second ranked according to GRA for “Water Production”.

Table 11: Ranking of Scenario.

Relational degree	Grey analysis of the influence criterias	The ranking of the scenario	
0,333333	6	S4	0,923059
0,607865	3	S3	0,646102
0,646102	2	S2	0,607865
0,923059	1	S6	0,474017
0,435314	5	S5	0,435314
0,474017	4	S1	0,333333

All steps and processes are same for “Recreation” So that following tables (Table 12-17) are given for recreation without explanation.

Table 12: Original Data for Recreation.

Scenario number	C1	C2	C3	C4	C5	C6	C7
Referential series	10	10	10	10	10	10	10
S1	7	1	0	0	0	0	0
S2	3	1	4	3	0	0	0
S3	3	7	4	3	0	0	0
S4	3	7	4	3	8	3	0
S5	7	7	0	2	2	6	0
S6	7	1	0	2	2	6	1

Table 13: 0-1 Normalization.

Scenario number	C1	C2	C3	C4	C5	C6	C7
Referential series	1	1	1	1	1	1	1
S1	0,7	0,1	0	0	0	0	0
S2	0,3	0,1	0,4	0,3	0	0	0
S3	0,3	0,7	0,4	0,3	0	0	0
S4	0,3	0,7	0,4	0,3	0,8	0,3	0
S5	0,7	0,7	0	0,2	0,2	0,6	0
S6	0,7	0,1	0	0,2	0,2	0,6	0,1

Table 14: Benefit Type of Criteria.

Scenario number	C1	C2	C3	C4	C5	C6	C7
Referential series	1	1	1	1	1	1	1
S1	1,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
S2	0,0000	0,0000	1,0000	1,0000	0,0000	0,0000	0,0000
S3	0,0000	1,0000	1,0000	1,0000	0,0000	0,0000	0,0000
S4	0,0000	1,0000	1,0000	1,0000	1,0000	0,5000	0,0000
S5	1,0000	1,0000	0,0000	0,6667	0,2500	1,0000	0,0000
S6	1,0000	0,0000	0,0000	0,6667	0,2500	1,0000	1,0000

Table 15: Difference of The Compared Series And The Referential Series.

Scenario number	C1	C2	C3	C4	C5	C6	C7
S1	0,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
S2	1,0000	1,0000	0,0000	0,0000	1,0000	1,0000	1,0000
S3	1,0000	0,0000	0,0000	0,0000	1,0000	1,0000	1,0000
S4	1,0000	0,0000	0,0000	0,0000	0,0000	0,5000	1,0000
S5	0,0000	0,0000	1,0000	0,3333	0,7500	0,0000	1,0000
S6	0,0000	1,0000	1,0000	0,3333	0,7500	0,0000	0,0000

Table 16: Grey Relation Coefficient.

Scenario number	C1	C2	C3	C4	C5	C6	C7
w(k)	0,097462	0,3115	0,148994	0,06853	0,294561	0,050843	0,028109
S1	1	0,333333	0,333333	0,333333	0,333333	0,333333	0,333333
S2	0,333333	0,333333	1	1	0,333333	0,333333	0,333333
S3	0,333333	1	1	1	0,333333	0,333333	0,333333
S4	0,333333	1	1	1	1	0,5	0,333333
S5	1	1	0,333333	0,6	0,4	1	0,333333
S6	1	0,333333	0,333333	0,6	0,4	1	1

Table 17: Ranking of Scenario.

Relational degree	Grey analysis of the influence criterias	The ranking of the scenario	
0,398308	6	S4	0,890864
0,478349	3	S3	0,686016
0,686016	2	S5	0,677783
0,890864	1	S6	0,488855
0,677783	5	S2	0,478349
0,488855	4	S1	0,398308

After Grey relation coefficients calculation, all scenario values processed using their weights by Eq.6. Table 17 that given above, shows ranks of each scenarios. It is clearly seen that Scenario 4 is first and Scenario 3 is second ranked according to GRA for “Recreation”. Ranking of scenario for “Recreation” is S4, S3, S5, S6, S2, S1.

4. Discussion and conclusions

As a result of the calculations for “Water Production” and “Recreation” ranking of alternative scenarios, first (S4) and second (S3) ranking were similar. The constraints that are set when creating scenarios are suitable for both water production and recreation. For example, the control of wood flow and the adjacency restrictions are wanted constraints in the forest management planning process. Scenario 1 (S1) was selected the worst scenario for both functional objects. Because it is not preferable not to control constraints for recreation and water production which are functional goals.

In multi-criteria decision making techniques, for the same problem is usually more than one method applied and the results are compared. If another method is used, the results could change. Our main aim in this study is to apply the GRA mathematical method, so the results were not compared with a second method. The study results do not include the economic and social measure but only the technical measure.

GRA is a multi-criteria decision-making method that can evaluate both qualitative and quantitative data as AHP, PROMETHEE, ELECTRE etc. GRA should be as widespread as at least another MCDM methods in forest management planning.

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Comparison of some autoregressive models for removing temporal autocorrelation effect in stem analysis data

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Abstract: Some data characteristics (such as cause of heteroscedasticity or autocorrelation problems) can complicate fairly understanding the forest growth behavior. As the stand conditions can change over time, the measurements can be more similar each other in same time period than to measurements from other time periods. Therefore, the data obtained from the forest inventory are temporally dependent, which is called "temporal autocorrelation problem". Nonlinear least square (NLS) regression developed by using diameter increment values ,originating from stem analysis, leads to biased estimates of parameter confidence interval and prediction interval in forest growth models when NLS regression are applied without removing temporal autocorrelation effect. Therefore, this study focus on solving "temporal autocorrelation problem" caused by multiple measurements from individual trees. To overcome this problem, we compared the Negative Exponential, the Gompertz and the Logistic nonlinear models accounting for p-order autoregressive process. The results showed that the AR2 process based on the Gompertz model contributed considerably for increasing the adjusted determination coefficient (0.6545 to 0.9630) and removed the temporal autocorrelation effect (Durbin-Watson test value was 2.0201). AR2 process, also, based on the Gompertz model produced a considerable decreasing for the root mean squared error (69.7048 to 22.8368). The autoregressive model proved that the forest managers may confidently use the diameter increment values obtained from multiple measurements over time in forest ecosystems.
Keywords: Diameter increment, Nonlinear regression, Time series, Autocorrelation, Tree rings

1. Introduction

As developing forest growth models, the forest biometricians should pay more attention to modeling techniques, data characteristics, and statistical assumptions. These are crucial factors affecting model performance and limiting model applicability (Soares, et al. 1995; Thürig, et al. 2005)

In literature, the forest growth models have been developed using regression analysis. Before these models are fitted to forest inventory data, the some statistical assumptions should be ensured, such as the normal distribution of data, the homogeneity of variance, and the independence of observations (Zuur, et al. 2010). If this assumptions do not being considered cautiously, the forest growth model most likely will be inadequate for fitting to real data in a model. The data derived from stem analysis have a temporally hierarchal structure, meaning that the repeated measurements on the same individuals result in correlated data. This leads to violation of independence assumption among the observations. This data structure causes the biased parameter estimations, unexpected results, and consequently misunderstanding inferences (Zuur, et al. 2010; Paine, et al. 2012). Autoregressive modeling approach used for specifying the temporal dependence has been used widely in time-series analysis, and recently it has often been applied in the forest growth studies (Monserud 1986; Huang and Titus 1999; Fox, et al. 2001; Zhao, et al. 2013; Saud, et al. 2016; Kiaei, et al. 2017)

The diameter growth trend may changes over time depending on the plant inner characteristic, the resource availability, and the competition among species (Paine, et al. 2012). Thereby, the diameter growth shows a sigmoid curve, having an inflection point and reaching asymptote after a given time. Nonlinear models are asymptotic and concave-down, allowing to capture rapid increment at the earlier ages and slow increment at the older ages, and consequently to ensure the biological growth trend. Recently, therefore, the forest biometricians prefer to nonlinear models for fitting to diameter data as a function of age or height (Fekedulegn, et al. 1999; Bi, et al. 2012).

In this study, the first purpose is to develop some the nonlinear models as a function of age in order to predict diameter increments at different ages. The second purpose is to remove the temporal autocorrelation effects in stem analysis data by using the first-order and the second-order autoregressive models.

2. Material and methods

The data used in this study were collected from even-aged Scotch pine (*Pinus sylvestris* L.) stands located in the Çankırı, Yapraklı and Yenice (Ilgaz) Planning Unit, Ankara Forest District Directorate, Turkey. In this study, dominant or co-dominat trees being as the 100 trees of greatest height per hectare were sampled for stem analysis in the sample plots. These 106 sampling trees for stem analysis were felled, and also the cross-sectional cuts were made at the first 0.3 m and every 2 m

throughout the tree stem. On each tree the annual rings were counted at 0.3 (m) and the diameter (mm) at different ages were derived from stem analysis measurements. Summary statistics of stem analysis data were shown in Table 1.

Table 1. Summary statistics of the diameters (mm) at 0.3m

Min	Max	Arithmetic mean	Std. Deviation
2.0	1250.0	172.2	120.7

A number of statistical growth functions have been used to model the diameter increment - age relationship in forest literature. In this study, the different three nonlinear models were fitted to stem analysis data using SAS PROC Model procedure. The nonlinear models considered in this study were presented in Table 2.

Table 2. The nonlinear growth models used in this study

Model name	Functional form
Negative Exponential	$d = \beta_0(1 - \exp(-\beta_1 t)) + \varepsilon$
Gompertz	$d = \beta_0 \exp(-\beta_1 \exp(-\beta_2 t)) + \varepsilon$
Logistic	$d = \frac{\beta_0}{1 + \beta_1 \exp(-\beta_2 t)} + \varepsilon$

β_0, β_1 and β_3 are the model coefficients, t is age (year), d is diameter (mm)

To remove temporal autocorrelation effects in the diameter increment prediction, we used the first-order (AR1) and the second-order (AR2) autoregressive models using SAS software (Appendix A).

$$d(t) = c + \phi_1 d_{t-1} + \varepsilon_t \qquad \text{(AR1)}$$

$$d(t) = c + \phi_1 d_{t-1} + \phi_2 d_{t-2} + \varepsilon_t \qquad \text{(AR2)}$$

$$-1 < \phi < +1$$
$$\varepsilon_t \backsim N(0, \sigma^2)$$

Where: d (the diameters at different ages) and t (age) are observations, c and ϕ are determined by nonlinear least square, ε is random with mean zero and serially independent.

Model comparison was carried out based on the root mean squared error (*RMSE*) and the adjusted determination coefficient (R^2_{adj}) in order to identify the best model. Durbin-Watson (DW) test was used for quantifying temporal autocorrelation existing among the error terms. The effects of autoregressive process were evaluated using residual graphics of the best model selected based on model selection criteria.

3. Result and discussion

We developed nonlinear regression models including the Negative Exponential, the Gompertz and the Logistic models and predicted the parameters. Parameter prediction and its significance (at the 5% probability level), model performance criteria and Durbin-Watson statistic results were given in Table 3. For all the models used in this study, the parameter predictions were found to be significant at the 0.05 probability level ($P < 0.05$). The DW test results showed that there was positive autocorrelation ($0 < DW < 2$) among the error terms for all used nonlinear models. The best predictive model was the Negative Exponential model with the second autoregressive process (AR2) having adjusted determination coefficient of 0.9637 and the root mean squared error of 22.5845 mm in terms of the model selection criteria. However, Fekedulegn, et al. (1999) reported that the Negative exponential model was not adequate for describing the biological growth trend because it has not inflection points and is not sigmoid shaped. Thereby, we decided to perform the Gompertz model for describing the diameter increment, which its adjusted determination coefficient was 0.9630 and the root mean squared error value was 22.8368 mm. Tjørve and Tjørve (2010) corroborated the decision, the Richards-model family such as the Gompertz, and the logistic produced a satisfactory result for the organisms (plant or animal) which exhibit a sigmoid growth. Tewari and Kumar (2005) found that the Gompertz model was the proper for diameter prediction in Dalbergia Sissoo plantations.

Table 3. The parameter estimations of the models and model selection criteria results

Model	Parameters	RMSE	R^2_{adj}	Durbin-Watson	Pr<DW	Pr>DW
Negative Exponential		69.2303	0.6592	0.1106	<0.0001	1.0000
	β_0=1819.3150					
	β_1=0.0016					
Negative Exponential (AR2)		22.5845	0.9637	2.0190	0.6755	0.3245
	β_0=1365.5020					
	β_1=0.0023					
	ϕ_1 =1.0345					
	ϕ_2 =-0.0932					

β_0, β_1 and β_2 are the parameter coefficients
Pr<DW was less than 0.05, meaning that there is the autocorrelation among the error terms
DW= 2 means no autocorrelation
0 < DW < 2 means positive autocorrelation
2 < DW < 4 means is negative autocorrelation

Table 3 (Continue). The parameter estimations of the models and model selection criteria results

Model	Parameters	RMSE	R^2_{adj}	Durbin-Watson	Pr<DW	Pr>DW
Gompertz		69.7048	0.6545	0.1170	<0.0001	1.0000
	β_0=444.3968					
	β_1=2.9328					
	β_2=0.0185					
Gompertz (AR2)		22.8368	0.9630	2.0201	0.6797	0.3203
	β_0=511.4391					
	β_1=2.7159					
	β_2=0.0170					
	ϕ_1 =1.0481					
	ϕ_2 =-0.1009					
Logistic		70.2359	0.6492	0.1242	<0.0001	1.0000
	β_0=376.5500					
	β_1=9.8121					
	β_2=0.0340					
Logistic (AR2)		23.0781	0.9621	2.0170	0.6527	0.3473
	β_0=480.1943					
	β_1=6.8316					
	β_2=0.0280					
	ϕ_1 =1.0597					
	ϕ_2 =-0.1000					

β_0, β_1 and β_2 are the parameter coefficients
Pr<DW was less than 0.05, meaning that there is the autocorrelation among the error terms
DW= 2 means no autocorrelation
0 < DW < 2 means positive autocorrelation
2 < DW < 4 means is negative autocorrelation

The temporal autocorrelation impacts greatly the regression model results in terms of the adjusted coefficient of determination (R^2_{adj}) and the root mean squared error (RMSE). In our study, we found that R^2_{adj} was approximately 0.70 for all the considered models when the autocorrelation effects did not remove (table 3). For increasing the models performance, firstly, the first-order autoregressive process (AR1) based on the Gompertz model was applied to remove the positive autocorrelation effects, but this attempt was failed to remove the autocorrelation effects whereas the R^2_{adj} increased considerably (∽45%) and all the parameters were statistically significant (at 5% level, table 3). AR2 process based on the

Gompertz model provided both the solution to eliminate the autocorrelation effects and a significant increase for R^2_{adj} (∽45%). Also, the AR2 process contributed greatly to being reduced RMSE (∽65%, table 3).

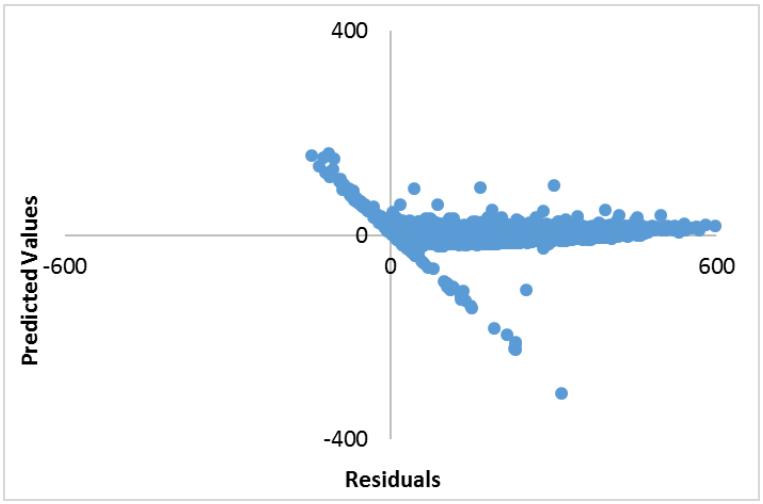

Figure 1. The residual distributions of Gompertz model

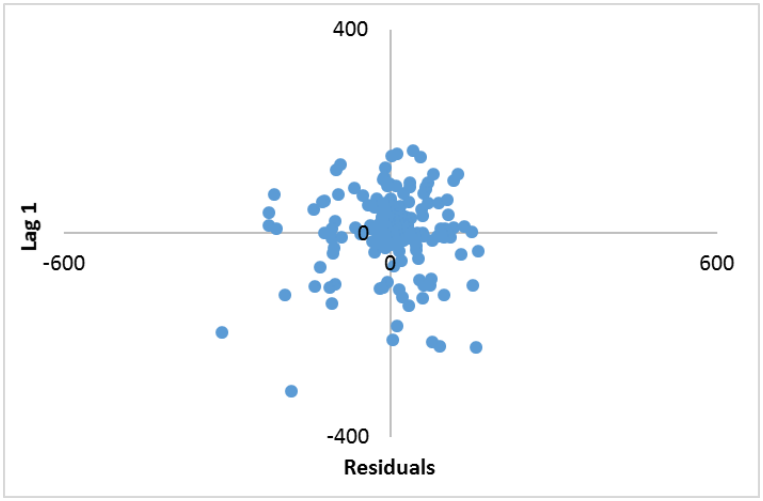

Figure 2. The residual distributions of Gompertz model based on AR1

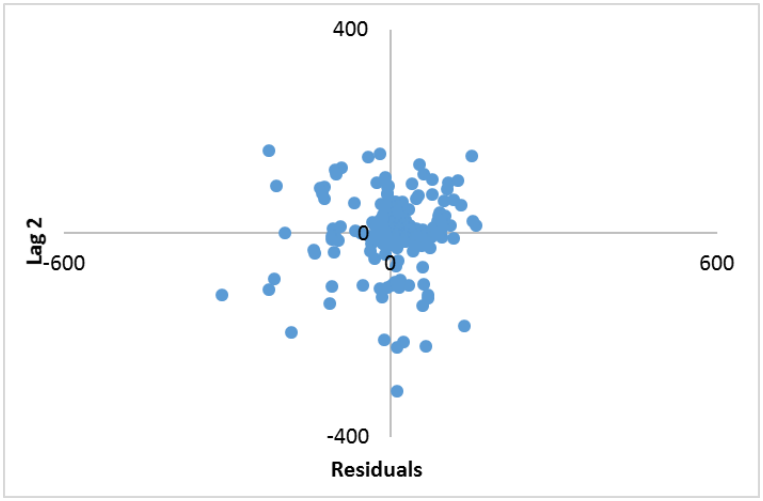

Figure 3. The residual distributions of Gompertz model based on AR2

Zuur, et al. (2010) reported that the parametric statistical analysis assume to be the independent of residuals, but this assumption is often violated in forest populations. Theoretically, if the observations are independent, the model residuals are randomly scattered around zero. In our study, the Gompertz model residuals exhibited a dispersed distribution because the observations were highly correlated (figure 1, table 3). The AR1 process produced a normally residual distribution, which is close to zero, but it could not eliminate the temporal autocorrelation in diameter increments (table 3, figure 2). AR2 process showed a scattered residual distribution about zero (figure 3). The Durbin-Watson (DW) test for AR2 process exhibited to be non-autocorrelation in the residuals (table 3). Monserud (1986) reported that AR1 process was adequately not account for the error variance as it was expected and the higher-order autoregressive process (e.g. AR2, AR3) was better choice in order to removing temporal autocorrelation effects in tree-ring chronologies. In contrast Biging and Gill (1997) reported that AR1 process provided an adequate solution to removal of temporal autocorrelation effects and also to ensured assumption relevant to homogeneity of error variance for describing the tree crown profile. Huang and Titus (1999) found that whereas the nonlinear models including AR1 process contributed slightly a decrease of RMSE, the autoregressive process provided the normal distribution of error terms for tree height predictions.

Consequently, we emphasized that the violation of statistical assumptions had a great effect on nonlinear model fitting to stem analysis data in terms of error variance and model performance. We demonstrated the AR2 process was capable of removing temporal autocorrelation effects in stem analysis data. In next studies relevant to the temporal autocorrelation, forest biometricians should consider the autoregressive modeling techniques.

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Appendix A.

The SAS software interface for the Gompertz model used in this study is given below.

```
data isparta;                    (Write your worksheet name)
input t d;                       (Write your dependent and independent name)
cards;

5     7
15    20
20    30                         (Write your own dependent and independent values)
.
.
.
;
run;

PROC Model data=isparta;

 parameters  b0=380.2443 b1=2.966557 b2=0.022082;      (You should determine proper starting values)

d=b0*exp(-b1*exp(-b2*t));                  (Write equation)

%ar (d, 2;                                 (This means the second-order autoregressive process)

fit d/dw dwprob;

run;
```

NOTE: If you want to print the all predictions and the all residuals, you must add codes expressed as italic;

```
fit artim/dw dwprob out=resid outall ;

run;

  proc print data=resid;


run;
```

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Diameter distribution modeling based on Artificial Neural Networks for Kunduz Forests

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Abstract: The diameter distribution models are tools for providing more detailed knowledge on the forest structure, detailed predictions for stand volume, basal area and number of trees on diameter classes. A wide range of probability density functions have been used in forestry to model tree diameter distributions (e.g., normal, log-normal, gamma, Weibull, beta, Johnson-SB), although the three-parameter Weibull is possibly the most frequently used in forest applications due to their ability to describe flexibly various diameter distributions. Alternative techniques for modelling diameter distributions, Artificial Neural Network Analysis (ANN) has been introduced in forest literature for modeling different individual and stand attributes. Although different statistical modeling techniques based on the probability density functions have been proposed to model the diameter distributions, only a few studies concerning an applications of Artificial neural networks (ANNs) to predict tree frequency in diameter class. The data used in this study were collected by Turkey Forest Management Directorate as a part of local forest inventory works from even-aged pine forest stands located in the Kunduz Forests. In these stands, 637 sample plots were used to model diameter distributions by using the 3-parameters Weibull probability density function based some different parameter prediction methods and various Artificial neural network type such as the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent and NARX network. As application of probability density function, the parameter of Weibull pdf were estimated by using five methods based on 25^{th}, 31^{th}, 50^{th}, 63^{th} and 95^{th} percentiles obtained from data including 637 sample plots. Also, Applications of Artificial neural networks (ANNs) were carried out to model diameter distributions in Kunduz forests. Multiple layer network structures such as the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent and NARX network with training function of Levenberg-Marquardt and transfer function of Log-sigmoid transfer function were used to obtain relative frequency predictions. Also, these artificial neural networks (ANNs) structures such as the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent and NARX network with five Weibull parameter prediction methods were compared based on evaluations of the magnitudes and distributions of models' residual and six goodness-of-fit statistics. As training ANNs using these 25^{th}, 50^{th} and 95^{rd} percentiles, ANN based on the feed-forward backprop gave better fitting ability with AIC (34360.8), RMSE (27.28), R^2 (0.784) than the Weibull parameter prediction methods and the other studied ANNs. This ANNs model based feed-forward backprop accounted for more than 78 % of total variance in number of trees in diameter classes with these diameter percentiles values.

Keywords: Artificial Neural Network, Diameter distribution, Probability density Functions, Weibull function

1. Introduction

The predictions for diameter distribution of trees is important to define forest structure and for different forestry calculations (Loetsch et al., 1973). These predictions can present vital information concerning the size-class distribution of a forest stand, especially in the arrangement of a tabulation of numbers of trees by diameter class (Wang and Rennolls, 2005). The biometricians who studied about diameter distribution modeling have long made effort with the probability density functions (pdfs) to describe diameter distributions of forest stands. At the beginning of literature for diameter distribution modeling, 1883, Gram proposed "the normal distribution" for the distribution oriental beech stands, de Liocourt introduced a technique based on the geometric progression for defining diameter distributions from uneven-aged forests in 1898 (Meyer and Stevenson, 1943). In 1930's, some mathematical series were used to define the diameter distributions. As first probability density function (pdf)'s applications to forestry, different probability density functions (pdf's) such as the log-normal (Bliss and Reinker, 1964), gamma (Nelson, 1964), beta (Clutter and Bennett, 1965), Weibull (Bailey and Dell, 1973), and Johnson's SB distributions (Harley and Schreuder, 1977) were used in literatures. Within these functions, the 3-parameters Weibull probability density function have been favored widely in forestry due to their capability to describe compliantly various diameter distributions (Cao, 2004; Mateus and Tomé, 2011; Lima, et al., 2014). The weibull probability density function has gained importance due to the simplicity in estimating its parameters and it flexibility in fitting wide varieties of unimodal shapes.

Artificial neural network (Ann) has been increasingly used as an alternative method and efficient tools for fitting diameter distributions, which is regardless of any distribution function where a suitable statistical function must first be established. Artificial neural network correspondingly studies to being mathematical model of information processing, which is like to the structure of the synapses of the brain, and it is constituted with a large number of interconnected nodes (or neurons) (Chaoui et. al., 2009; Ghosal and Chaki, 2010). ANN have nonlinear connections of natural systems to have advantage for especially describing the relationships between nonlinear tree and forest attributes in forestry. While several studies have developed the model providing some prediction and forecasting in a number of areas, including finance, power generation, medicine, water resources and environmental science, only a few studies concerning with modeling diameter distributions using Artificial neural network modeling approach exist, e.g. Leduc et. al., 2001; Abbasi et. al. 2008; Cai et. al. (2012); Diamontopoulou et. al., 2015. Therefore, the objectives of the study are (1) to evaluate various artificial neural network type such as the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent and NARX network in prediction of diameter distributions for Kunduz forests and (2) compared these artificial neural network's predictions with the 3-parameters Weibull probability density function based some different parameter prediction methods.

2. Material and methods

The data used in this study were collected by Turkey Forest Management Directorate as a part of local forest inventory works from even-aged pine forest stands located in the Kunduz Planning Unit, Vezirköprü Forest Enterprise, Samsun Forest District Directorate, northeast Turkey (longitude 35°48′–35°01′W; latitude 41°00′–41°19′N). The study area was characterized geomorphologically as a steep terrain land with moderate and steep slopes ranging from 20% to 50%, with an average of 45%. The average annual temperature reaches a maximum of 32.5°C in the summer and a minimum of 6.2°C in winter, with an average annual temperature of 10.6°C. The average annual precipitation of the study area is 500 mm. The climatic regime is a typical Black Sea climate, characterized by a mild winter and a cool summer.

In these stands, 637 sample plots were used to model diameter distributions by using the 3-parameters Weibull probability density function based some different parameter prediction methods and various Artificial neural network type such as the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent and NARX network. These sample plots have circular shape and the size of these were assessed as 400 m^2, 600 and 800 m^2 by considering crown closure. These sample plots are obtained by based on standard Turkey Forest Management Inventory system. In each sample plot, DBH was measured using calipers for every living tree with a DBH > 8 cm and total tree height (h) was not measured.

As application of probability density function, the parameter of Weibull pdf were estimated by using five methods based on 25th, 31th, 50th, 63th and 95th percentiles obtained from data including 637 sample plots. The 3-parameters Weibull probability density function and these five method based on diameter percentiles were given in Equation 1-6, respectively.

The 3-parameters Weibull probability density function:

$$F(x,\alpha,\beta,\gamma) = \frac{\alpha}{\beta}\cdot\left(\frac{x-\gamma}{\beta}\right)^{\alpha-1}\cdot exp\left(-\left(\frac{x-\gamma}{\beta}\right)^{\alpha}\right)$$

The method 1 including 31th and 63rd percentiles:

$$\alpha = 0.5\cdot d_{min} \qquad \gamma = \frac{Ln\left(\frac{Ln(1-0.63)}{Ln(1-0,31)}\right)}{Ln(d_{\%63}-\alpha)-Ln(d_{\%31}-\alpha)} \qquad \beta = \frac{d_{\%63}-\alpha}{(-Ln(1-0.63))^{\frac{1}{\gamma}}}$$

The method 2 including 50th and 95rd percentiles:

$$\alpha = 0.5\cdot d_{min} \qquad \gamma = \frac{Ln\left(\frac{Ln(1-0.95)}{Ln(1-0,50)}\right)}{Ln(d_{\%95}-\alpha)-Ln(d_{\%50}-\alpha)} \qquad \beta = \frac{d_{\%50}-\alpha}{(-Ln(1-0.50))^{\frac{1}{\gamma}}}$$

The method 3 including 25th, 50th and 95rd percentiles:

$$\alpha = 0.5\cdot d_{min} \qquad \gamma = \frac{Ln\left(\frac{Ln(1-0.95)}{Ln(1-0,25)}\right)}{Ln(d_{\%95}-\alpha)-Ln(d_{\%25}-\alpha)} \qquad \beta = \frac{d_{\%50}-\alpha}{(-Ln(1-0.50))^{\frac{1}{\gamma}}}$$

The method 4 including 31th, 50th and 63rd percentiles:

$$\alpha = 0.5\cdot d_{min} \qquad \gamma = \frac{Ln\left(\frac{Ln(1-0.63)}{Ln(1-0,31)}\right)}{Ln(d_{\%63}-\alpha)-Ln(d_{\%31}-\alpha)} \qquad \beta = \frac{d_{\%50}-\alpha}{(-Ln(1-0.50))^{\frac{1}{\gamma}}}$$

The method 5 including minimum, quadradic mean diameter (dg), 25th, 50th and 95rd percentiles:

$$\alpha = \frac{n^{0.3333}\cdot d_{min}-d_{\%50}}{n^{0.3333}-1} \qquad \gamma = \frac{2.343088}{Ln(d_{\%95}-\alpha)-Ln(d_{\%25}-\alpha)} \qquad \beta = \frac{\alpha\cdot\Gamma_1}{\Gamma_2}+\sqrt{\left(\frac{\alpha}{\Gamma_2}\right)\cdot\left({\Gamma_1}^2-\Gamma_1\right)+\left(\frac{{d_g}^2}{\Gamma_2}\right)}$$

In the neural network model building, both training, verification and testing data sets that randomly partitioned into training (75% of all data), verification (15% of all data) and test (the remaining 10% of all data) data sets were used for taking general relationships between input variables and target variable. In ANN training process, input variables were diameter

central value for each diameter class, best predictive percentiles values within these five method and number of tree for sample plots. Target variable is relative frequencies calculated as ratio of number of trees in diameter classes to total number of trees in each sample plots. Multiple layer network structures such as the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent and NARX network with training function of Levenberg-Marquardt and transfer function of Log-sigmoid transfer function were used to obtain relative frequency predictions. In ANNs training process, the number of neurons is used as 10 with number of two layers including hidden and output layers, since this structure are the most frequently chosen values in ANNs. All these applications for ANN was carried out using MATLAB-nntool module. Also, these artificial neural networks (ANNs) structures such as the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent and NARX network with five Weibull parameter prediction methods were compared based on evaluations of the magnitudes and distributions of models' residual and six goodness-of-fit statistics: sum of squared errors (SSE), Akaike's information criterion (AIC), Bayesian information criterion (BIC), Root Mean Square Error (RMSE), Mean Squared Error (MSE) and Adjusted Coefficient of Determination (R^2_{adj}).

3. Result and discussions

The values of goodness-of-fit statistics, such as SSE, AIC, BIC, RMSE, MSE and R^2_{adj}, for these ANNs, including the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent and NARX network types, and five Weibull parameter prediction methods based on diameter percentiles were given in table 1. The AIC was between 35677.2 and 36349.1, RMSE between 30.97 and 33.04, and R^2 between 0.684 and 0.722 in Weibull parameter prediction methods. However, The AIC was between 34360.8 and 35167.2, RMSE between 27.28 and 29.48, and R^2 between 0.748 and 0.784 in ANNs. Within Weibull parameter prediction methods, the method 3 with 25^{th}, 50^{th} and 95^{rd} percentiles produced more predictive results than other methods. As training ANNs using these 25^{th}, 50^{th} and 95^{rd} percentiles, ANN based on the feed-forward backprop gave better fitting ability with AIC (34360.8), RMSE (27.28), R^2 (0.784) than the Weibull parameter prediction methods and the other studied ANNs. This ANNs model based feed-forward backprop accounted for more than 78 % of total variance in number of trees in diameter classes with these diameter percentiles values.

Table 1. The goodness-of-fit statistics of number of trees predictions for the ANNs types and Weibull parameter prediction methods

Technique	SSE	AIC	BIC	RMSE	MSE	R^2_{adj}
The method 1 with 31^{th} and 63^{rd} percentiles	5337121	36033.9	36049.0	32.05	1027.16	0.702
The method 2 with 50^{th} and 95^{rd} percentiles	5670836	36349.1	36364.2	33.04	1091.38	0.684
The method 3 with 25^{th}, 50^{th} and 95^{rd} percentiles	4983020	35677.2	35692.3	30.97	959.01	0.722
The method 4 with 31^{th}, 50^{th} and 63^{rd} percentiles	5355450	36051.7	36066.9	32.10	1030.69	0.701
The method 5 with minimum, quadradic mean diameter, 25^{th}, 50^{th} and 95^{rd} percentiles	5227325	35925.9	35941.0	31.72	1006.03	0.709
ANN based on the feed-forward backprop	3867748	34360.8	34375.9	27.28	744.37	0.784
ANN based on Cascade Correlation	4325355	34941.8	34956.9	28.85	832.44	0.759
ANN based on Elman backprop	4517125	35167.2	35182.3	29.48	869.35	0.748
ANN based on Layer Recurrent	4000311	34535.9	34551.0	27.75	769.88	0.777
ANN based on NARX	4279939	34886.9	34902.0	28.70	823.70	0.761

4. Conclusions

These results underlined that the ANN are able to predict the number of trees in diameter classes describing diameter distributions, and to generate more accurate predictions than parameter prediction method for the 3-parameters Weibull probability density function. These empirical results for ANN helped to develop successfully for modeling diameter distributions. Based on the results obtained from the research, forest managers could use ANN for predicting number of trees in diameter classes and this information would also be beneficial for evaluating different management strategies and developing forest management plans. It may produce unbiased diameter distribution predictions using different ANN structure in specific sample plots. However, these predictions will be improved by the addition of permanent sample plots comparing alternative silvicultural treatments and alternatives. However, these results should be generalized to outside the studied forest area was further analyzed and evaluated at other forest sites since the results of this tree growth predictions are specific to this species and the type of forest structure that was studied. It is expected that this study will make a valuable contribution to forestry literature.

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Modelling of growth for pure, even-aged and natural Calabrian pine (*Pinus brutia* Ten.) stands in Burdur-Ağlasun Region

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Abstract: In this study, a variable density yield table is constructed for pure, even-aged and natural Calabrian pine (*Pinus brutia* Ten.) in Burdur-Ağlasun region. The data are obtained from 139 sample plots. Stand age is 21-112, site quality class I.-III. and stand density degree 1.189-6.851. The dependent volume table being functions of stand age, site quality class and stand density degree. The findings are obtained from stand density degree dependent yield table are in agreement with the known rules and laws. In this study, the results are obtained as follows; 1) As number of trees decreases according to age progression for the same site quality class and stand density degree but stand basal area, stand volume, mean diameter and mean height are increases, 2) The same site quality class and for stand ages, the density of the stands is decreasing, while the basal area, volume, number of trees and mean height are increases, 3) As the same stand density degree and stand age; stand basal area, stand volume, mean diameter, mean height is increase while the number of trees is decrease, 4) The number of trees in the stand, the basal area and the volume increase while the mean diameter decreases as the stand density degree increases for the same stand age and site quality class, 5) The number of stand trees is increasing according to the number of trees although it decreases due to the age and the site quality class, 6) Decreased stand volume decreases as stand age and site quality class improve and stand density degree ratings decrease, summarized in this way.
Keywords: Calabrian pine, Age, Density degree, Site quality class, Density dependent volume table

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Integrating soil erosion prevention activities into forest management plans: A review

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Abstract: Forest ecosystems offer many ecological and socio-cultural services such as erosion prevention, climate regulation clean water production, and recreation as well as economically beneficial products such as industrial raw wood materials. The sustainable use of these products and services is required forest management plans (FMPs) that are prepared for a specific period of time and can be updated periodically. Along with the understanding of how valuable the ecological and socio-cultural services of forests are in the international public opinion, the forest management planning approaches in the developed countries have also evolved and changed. For that reason, the Ecosystem Based Functional Planning (EBFP) systems which the multiple use of economical and non-economical values of a forest are emphasized in accordance with international processes has been officially adopted in today's Turkish Forestry Services, instead of only wood production oriented classical planning approach. In practice, however, planners in Turkey are faced with many difficulties in reflecting the conservation and regulatory services of the forest into the FMPs, such as not being able to easily adopt the values of the forest outside wood production, their criteria and indicators not being clearly displayed, or these indicators being not measurable, reportable, or verifiable. The present study, therefore, aims to review the research conducted on adaptation of the criteria and indicators related to integration of the soil erosion prevention functions into sustainable FMPs. In this context, the soil erosion prevention functions in the current FMPs of Turkey were examined and the problems and deficiencies were identified. Then, any erroneous decision making processes that these deficiencies could cause were reported. Any worldwide adaptation of integrating the soil erosion prevention functions into the FMPs were searched, summarized and the feasibility of integrating these studies into Turkey's forestry is discussed. At the end of the study, a new and practical integrating methodology that balances the needs of the planning team and the requirements of the scientific approach was emphasized and some suggestions were made. In conclusion, connecting the two different disciplines will close an important gap between the erosion control and forest planning studies carried out by different institutions independently for many years in Turkey. Thus, it is considered that integrating the soil protection functions of the forest ecosystem into every level of the sustainable forest management plans as a more effective control mechanism will reduce million tons of valuable topsoil lost every year.

Keywords: Soil erosion prevention, Sustainable forest management plans (SFMP), Forest ecosystem services

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Effects of forest roads on wildlife

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Abstract: Forest roads are the most important infrastructural facilities to exploit forests that are renewable natural resources. A road network that leads us to our goals needs to be established in order to plan forestry activities sustainably. Despite the benefits of forest roads, they have great potential to cause degradation and fragmentation effects on ecological. Ecological impacts of forest roads are effects during the construction, short term or long term effects. For example: loss of habitat and biota, accidental animal deaths by traffic. The loss of habitat and change in habitat extends beyond the edge of the road. The roads affect the wild animals in four ways; (1) reducing the quantity and quality of habitats, (2) causing deaths, (3) not reaching the remaining habitat resources on the other side of the road, and (4) causing smaller populations of animal populations and cutting off gene flow. Big mammals are at the forefront of the species that are adversely affected by their path because of their ecological needs. Emissions, litter, noise and other physical disturbances may extend into the roadside vegetation for varying distances and result in changes in species composition. The aim of the current study is to carry out effects of forest roads on wildlife. It was made observations by wildlife camera traps from fixed points the forest roads. The image ratio (DR) ((Number of images / Number of view days) x100) was calculated from images obtained from camera traps points. The number of species at each spot and the rate of display of species were classified according to the time of the month and forestry activity. Minimizing negative effects of the ways was specified at forest roads planning and construction process.
Keywords: Roads, Big mammals, Aksu Region, Düzce

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The effects on trees and stream beds of forest road construction on soil and loose rock grounds in south region of Turkey

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Abstract: Forest roads are necessary to provide access to the forest for general management, maintenance, timber extraction, recreation, regeneration, production, fire and pest control. Building forest roads involves removal of vegetation and soil, thus favoring run-off, pollution of streams, the risk of erosion and mass movement on steeper terrain. Besides, the stream beds can fill with excavated materials and this situation is very important in terms of aquatic habitat, fish and changed of stream beds. In this study, environmental damages and forest road construction techniques by using bulldozer were investigated in forested regions in Antalya region in Turkey. Also, the productivity of bulldozer was found on soil and loose rock areas. Along the 1575 m of the road section, decision variables were collected from 52 cross sections. Along the forest road construction area, the number of damaged trees and undamaged trees were determined between two cross sections as gradient groups. Another damages type, stream beds were investigated filling with excavation materials during forest road construction operation. The slope in this research area was changed between 25 – 80%. Besides, maximum length and minimum length of fill on different cross sections was found to be between 2 and 16 meters, approximately. In this study, 26.3% of trees below the forest road construction were bending for 25-80% ground slopes and 6.1% of trees were wounding. The number of damaged trees regarding with various gradient classes were also determined in study area. Along the forest road section, some areas were determined fill of stream bed. The wounding of the tree barks is very important for this forest region.
Keywords: Road construction, Environmental damages, Cross section, Stream bed, Bulldozer

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Comparison of some segmented taper equations for Brutian Pine

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Abstract: Brutian pine (*Pinus brutia* Ten.) forests are economically and ecologically one of the most important forests in Turkey, where they constitute large forest areas and occupy approximately 5.9 million ha, with a current standing volume of approximately 270 million cubic meters (GDF, 2012). In this context, knowing the state and limitations of growth and yield of Lebanon cedar forests in the Taurus Mountains is necessary for improving future management and planning strategies of timber resources. However, information regarding growth and yield is currently lacking in Turkey. Taper models are one of several necessary components in modern forest inventory and/or management planning systems, giving information on diameter at any point along the tree stem. This information can be used to estimate stem volume and to assort the structure of the tree. This study aimed to assess the performance of segmented taper equations for predicting tree diameter at a specific height, height to a specific diameter, merchantable volume and total tree volume for Brutian pine (*Pinus brutia* Ten.). Ten commonly used and well-known segmented taper functions were evaluated: Max and Burkhart (1976), Clark et al. (1991), and Fang et al. (2000) models. Appropriate statistical procedures were used in model fitting to account for the problems of autocorrelation and multicollinearity in the hierarchical data that are associated with the construction of taper models. The compatible segmented model of Clark et al. (1991) was superior to the other equations in describing the stem profile, estimating height to a specific diameter, and merchantable volume for Lebanon cedar when upper stem diameter measurements were available, while the taper equation of Fang et al. (2000) performed well when those measurements were unavailable. The equations developed in this study are fundamental tools for use in forestry practices and can be help forest managers in the area of study.
Keywords: Taper model, Segmented model, Volume systems, Brutian pine

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Just time for implementing operational harvest plans

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Abstract: The growing concerns about forest ecosystem, worker safety and health, managing of material, process, and products dictate that the forestry operations should be effectively carried out in environmentally soundly manner. The development on tactical level and multi functional forest management plans recent decades indicates that it is time to implement operational plans that can be integrated into the management plans. This study aimed to introduce the conceptual framework of operational harvest planning model from stand to storage. In this concept, it was exposed how a planning strategy was to be developed targeting cost minimization subject to technical, environmental and socio-economical constraints. So, it was exemplified a planning procedure based on quantitative and qualitative data belonging a forest planning unit through operations management methods. To test the planning model, it was used the data about stand, budget, employment, machinery, and local harvesting technology of a forest district. Operational decisions focused on which compartment should be harvested, when it should be harvested, which harvesting system should be used, where the landing should be located, where the products should be stored, which forest road should be used, etc. In case of using an operational plan, it was calculated that this model could minimize the annual average unit cost from %4 to % 30 as directly and indirectly, as well. Thus, the planning methodology could represent an operational harvest plan that was technically available, economically acceptable, environmentally sensitive, and societal utilizable.
Keywords: Operational planning, Wood harvesting, Modelling, Operations research

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Planning process of forest resources in Turkey from inventory to silvicultural planning

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Abstract: Since 2008, forest resources in Turkey have been planned and managed according to ecosystem based multi-purpose planning principles. The planning process begins with forest ecosystem inventory of eight titles. The data obtained from the inventory are entered into the computer and the geographic database is established using the geographic information systems (GIS). Participatory meetings are organized and the main requests and demands of the people are determined. Forest function maps are prepared according to the inventory data and the demands of the people. Then goals and conservation targets are defined and the planning unit is divided into management units. The optimal forest structure is determined for each management unit. The silvicultural treatments to be applied to each sub-compartment is shown in the relevant table and cutting map. The planning process of forest management is ended with calculation of allowable cut and preparation of maps and outputs in the forest management plan format. When the process of preparing the silvicultural plan starts after this stage, firstly the ecological conditions in the regeneration areas are examined and the existence of the seed tree is determined. Then, silvicultural treatment methods and times to be made for reforestation and regeneration areas are determined and related tables are arranged. In this study; In particular, the forest management planning process will be examined in terms of legal and application from the inventory to silvicultural planning. The process of preparing the silvicultural plan integrated into forest management plans over the last five years; measurements and evaluations in forest area, establishment of database and preparation of silvicultural prescriptions, calculation of allowable cut (to be taken from tending and regeneration areas), and finally preparation of cutting or silvicultural maps. Sample applications; Erzurum Forest Regional Directorate Oltu Forest Management Enterprise consists of forest management planning process and silvicultural planning process. The research area is generally composed of pure Pinus sylvestris and the year of abundant seed is every two years. In preparing the silvicultural treatments prescriptions, artificial and natural regeneration methods, taking into consideration the biological characteristics of Pinus sylvestris, clear cutting and shelter wood method are recommended. The method applied in the tending areas is low thinning and weeding, release cutting, weak, moderate or heavy low thinning are suggested according to the development stage. Planning period is between 2015-2034.
Keywords: Forest management plan, Silviculture plan, Ecosystem-based multiple use management

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Predicting breast height diameter from stump diameters of crimean pine stands in CAKU Research Forest

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Abstract: The diameter cannot be measured at breast height in some forest applications, such as illegal timber cut studies or unrecorded data from harvested stands. In these forest applications, the stump diameter, which is measured at 0.3 m, remains as an indicator or tree size. It is common practice that the dimeter at breast height initially is predicted from the stump diameters, which are directly measured at the logged trees, and then the tree volume and other tree attributes can be estimated from these DBH predicted. In this study, some the linear and nonlinear models predicting diameter at breast height from stump diameter were developed and evaluated for Crimean pine stands located in the forest region of Çankırı, TURKEY. In these studied stands, 61 sample plots were randomly selected to guarantee that various stand conditions with the variability of site qualities, ages, stand density occurred in these Crieman Pine stands. In each sample plot, the diameter at breast height (DBH) and stump diameter at 0.3 m stump height were measured to 0.1 cm precision with calipers for every living tree with its DBH of greater than 4 cm. The allometric models used to develop to statistical models for predicting DBH from stump diameter were some linear (simple and quadratic model) and nonlinear models (power and compound model). These linear regression models were fitted by ordinary least squares using PROC REG procedure and nonlinear models were fitted by the non-linear regression analysis with the Marquadt algorithm using PROC NLIN procedure of the SAS/ETS V9 software. These linear and nonlinear models predicting DBH from stump diameter were evaluated in their accuracy and precision by using five statistical criteria: Akaike's Information Criterion (AIC), Schwarz's Bayesian Information Criterion (BIC), the Root Mean Square Error (RMSE), the Absolute Bias, and the Adjusted Coefficient of Determination $\left(R^2_{adj}\right)$ using the following equations. These models developed in this study is applicable to forest managers for predicting unmeasured tree diameter at breast height in certain circumstances, e.g. illegal timber activities or unrecorded data from harvested stands, and then the volume or biomass estimation of these cut trees can be carried out by using the predicted DBH for these studied stands.
Keywords: Stump diameter, Dimeter at breast height, Regression analysis, Prediction

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Evaluation of ORKÖY's heat insulation and stove heating project (Case study: Zonguldak Forest Regional Directorate)

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Abstract: The General Directorate of Forests and Village Affairs (GDoFVA) has been providing services to forest villagers with its various organisations for over 40 years. It is aimed to raise the life quality of forest villagers with individual and cooperative loan support of social and economic content. By these means, the objective is to reduce the pressure on forests by forest villagers. Since the Solar Powered Water Heating Systems Project began in 2005, it rapidly became widespread and the project reached approximately 40,000 families. The project, which lead to the increase of life quality among forest villager families, became an example of good practice. It was seen that families benefiting from the project had an average annual saving of 30% on firewood. Starting in 2012, GDoFVA began to implement a new project that aimed to further reduce the firewood consumption of forest villagers. The project undertakes the approach of installing the stove heating system and insulation for homes of forest villagers. The project has three main components: i) heating insulation (sheathing) for homes of forest villager families; ii) stove heating system for houses with insulation, and iii) utilisation of heating insulation and solid fuel heating system. The aim of the study is to determine the level of savings in amounts of firewood consumption in households in forest villages that have heating insulation or stove heating systems, or both. The study includes the households that have taken advantage of the GDoFVA project support in forest villages within the boundaries of the Zonguldak Forest Regional Directorate in the Western Blacksea Region. The sample of the study is all families that have taken part in this new project of GDoFVA between the years 2012-2014. Data for the study was collected from families benefiting from project support by means of face-to-face questionnaires. As a result of investigations and observations conducted in the scope of the study, it was found that heating insulation and solid fuel consuming heating systems practices were considerably successful. It was also found that the levels of savings were lower if the household had only stove heating or only insulation. It was observed that in some of the forest households, families had only solid fuel heating systems or stove heating systems. In such households, it was found that annual firewood consumption increased instead of becoming lower. The study found the project to be successful in contributing to family budgets and reduction of firewood consumption by implementation of the heating insulation and solid fuel heating systems of the project.
Keywords: Forest villages, Fuelwood, New policies of GDoFVA

1- Introduction

The establishment of the General Directorate of Forests and Village Affairs (ORKÖY) and its provision of services is a reflection of the rural development approach of the governments in power in the 1960's. One of the ministries founded by the 28th Government, the İnönü Government in power between 1963-1965, was the "Ministry of Village Affairs". With the transition to a planned system, the Ministry (which was established in 1963) carried out work aimed towards the rural sectors and also the forest villages. Together with the establishment of the General Directorate of Forests and Village Affairs in 1970, the activities aimed to the forest villages gained quality. Activities for the regulation of public-forest relations especially found a niche in the forestry sector (Coşgun, 2008). This was strengthened with the establishment of the Ministry of Forestry in 1973 and the founding of the General Directorate of ORKÖY. Since the 45 past years, the Ministry of Forestry and the General Directorate of ORKÖY continues to carry out its responsibilities within a variety of different organisational structures. Today, the "Departments" within the General Directorate of ORKÖY continues to carry out its activities and responsibilities. The ORKÖY continues to provide social and economic support to forest villages by means of cooperative and individual loans.

The main function of ORKÖY is to regulate the public-forest relations with the aim of reducing the pressure of forest villagers on forests. Since its establishment, the organisation has provided social and/or economic related support. Projects implemented as cooperative or individual loans have varied according to the economic political processes at the national level. In the scope of this process, research conducted by Directorates of Forestry Research and Faculties of Forestry of universities (including other faculties), have sought to regulate public-forest relations, to determine the characteristics of rural communities, to assess the place of forest villagers in society and to ascertain socio-economic situations (Sakman, 1974; State Planning Organisation, 1970; State Planning Organisation, 1971). The organisation of forest engineers have open to discussion the policies for forest villagers. The activities of ORKÖY have been assessed in general terms with the aim to shed light on the processes so far (OMO, 1974). The early practices/activities of ORKÖY, up to the 1980's, have been reviewed and data was attempted to be produced to contribute to the field studies and actions of ORKÖY on the basis of a variety of examples of field studies (Anıl, 1973; Duruöz, 1975; Duruöz et al., 1976).

The 1980's comprises the second phase of the ORKÖY. In this period, studies concerning forest villages increased and it was aimed to contribute to the activities of ORKÖY by conducting studies regarding the urbanisation and forest-village

relationships were conducted by taking samples of the population in the scope of the socio-economic structures of forest villages were conducted, evaluations regarding the development of forest villages were made and, in regards to the ORKÖY district development plans, studies were conducted to determine the optimum enterprise plans by carrying out linear programming techniques for the forest villages-agricultural enterprises economic analysis for the districts (Geray & Acun, 1980; Acun, 1983; Taraklı, 1982). Important data for ORKÖY was determined regarding the impact of energy consumption by forest villagers (İstanbullu, 1978). The 1960-1980 period was reviewed with an attempt to determine the levels of Village, Town and City Social Transformation. By the end of the second phase of ORKÖY since its establishment, The ORKÖY activities were investigated and new ORKÖY models were discussed concerning the activities for the development of forest villages and the future of ORKÖY (Akşit, 1985; Çağlar, 1986).

The third phase of ORKÖY is the period of the 1990's where a variety of studies were conducted on the activities of ORKÖY. The socio-economic problems of forest villages were determined and recommendations for district or regional level solutions for the development of the forest villagers were developed (Özkurt, 1998; Coşgun, 2005). The global concept of Social Forestry was discussed and new opportunities for ORKÖY were considered (Tolunay, 1992; Tolunay, 1998; Tolunay et al, 2007). During this period, the reflection of the ORKÖY plans and implementations on the forest villagers were investigated (Gümüş, 1993). Especially the level of use of firewood by forest villagers and its impact on the forest eco-system and its impact on the socio-economic situation of forest villagers were determined. By doing so, the ORKÖY practices were evaluated in a different light (Türker & Toksoy, 1992; Türker, 1992).

In the fourth phase of ORKÖY, two main areas of activity of ORKÖY were given emphasis. The first of these was to establish the measures and criteria to be used in the scope of individual and cooperative loan provisions (Coşgun et al., 2007; Coşgun et al., 2009; Alkan & Demir, 2013; Tolunay et al., 2002). The second was the studies to evaluate the impact of the ORKÖY projects implemented to date on the forest villagers (Tolunay & Korkmaz, 2005; Uzun, 2008; Önal, 2010; Önal & Bekiroğlu, 2011; Ay & Tolunay, 2012; Okutucu et al., 2012; Korkmaz & Alkan, 2014; Coşgun et al., 2015, Coşgun & Güler, 2015).

It can be seen in the National Forestry Programme that there is priority given to ORKÖY and forest villagers. The priority areas in the National Forestry Programme are: i) legislation to be developed concerning the principles and procedures regarding the development services for forest villagers, ii) development of the capacity of forest villagers in regards to organisation, production, marketing, iii) realisation of joint initiatives and activities by related groups to strengthen the allocation of public resources for rural development programmes for disadvantaged mountain and forest villages. In addition, the second area of priority was identified as: i) determining the contributions, problems and development needs for the preservation forests, forest-village relationships and development of forest villagers in light of the policies, strategies and practices of past forest organisations, ii) with the aim of improving the struggle and life conditions of forest villagers, to determine the opportunities and conditions of wide spreading appropriate integrated-holistic rural development models (Eastern Anatolian Basin Development Project, etc.) (Anon, 2004).

Aim: The aim of the study is to identify the level of savings on fuelwood in the scope of heat projects implemented in forest villages by ORKÖY, such as heat insulation in houses, stove heating systems or where both practices were applied simultaneously. The sample of the study was obtained by the total area sampling system of families taking advantage of the new project implementations of ORKÖY between 2010-2015. Data was obtained from families participating in the project, by the method of face-to-face questionnaires.

The scope of the study was i) solar energy systems (SES), ii) stove heating and iii) sheathing projects were implemented for the forest villagers by the ORKÖY Branch of the Zonguldak Forest Regional Directorate.

2. Materials and method

The literature of the study was obtained from other studies conducted on the subject matter. In this scope, the data from the General Directorate of Forestry ORKÖY Department, the ORKÖY Branch of the Zonguldak Forest Regional Directorate and the Provincial Forestry Departments of Zonguldak, Bartın, Karabük and Yenice was used. Local data from the forest villages in the region was obtained by means of face-to-face questionnaires administered to forest villagers who had taken advantage of the ORKÖY investments. The sample of the study was obtained by the total area sampling system of families taking advantage of the new project implementations of ORKÖY between 2010-2015. The scope of the study included the forest villagers for which i) solar energy systems (SES), ii) stove heating and iii) sheathing projects were implemented by the ORKÖY Branch of the Zonguldak Forest Regional Directorate (Table 1, 2, 3).

In regards to the number of enterprises/families which took advantage of the ORKÖY Stove Heating and Sheathing projects, all such enterprises/families were included in the sample. When going to the field to conduct the questionnaires, it was that case that some families could not be interviewed, as they are living both in the village and in the city and had not yet returned to their village. A total of 24 families had implemented the stove heating practice in the region (Table 3). Of these, a total of 21 face-to-face questionnaires were administered to a total of 21 families. 133 families took advantage of the sheathing practices. Of these families, a total of 103 (77.44% sampled) face to face questionnaires were administered to families. 80.00% of those included in the sheathing project in Bartın, 84% in Karabük and 72.60% in Zonguldak was included in the sample. Of the total 154 families who took advantage of both projects, 80.52% (124 families) were included in the sample. In this way, the fuelwood saving for both practices were attempted to be determined. It was found that some families implemented both the SES project and the sheathing project or stove heating project, while some families implemented the sheathing or stove heating project and then implemented the SES with their own means. In order to obtain information on the level of savings on fuelwood in the scope of the ORKÖY SES practices, face-to-face questionnaires were conducted in the

same villages or neighbouring villages. Thus, interviews were conducted with 124 families who had taken advantage of the ORKÖY SES project. In this way, the amounts of fuelwood savings were determined for each of the three projects.

3. Findings and discussion

3.1. Distribution of the ORKÖY SES, sheathing and stove heating projects

3.1.1. Distribution of the ORKÖY SES Projects in the region

The investigation of the Zonguldak Forest Regional Directorate ORKÖY practices were conducted under three main headings: i) Sheathing, ii) Stove Heating and iii) Solar Energy Systems. ORKÖY SES practices for forest villagers were conducted by the Zonguldak Forest Regional Directorate between 2010-2015 for 2,590 families (Table 1).

Table 1: Zonguldak Forest Regional Directorate ORKÖY SES Practices

Row Titles	2010	2011	2012	2013	2014	2015	General total
Amasra	33	0	0	21	0	0	54
Kurucaşile	20	6	17	0	0	0	43
Merkez	178	77	40	62	0	16	373
Ulus	67	53	9	0	0	13	142
Bartın	298	136	66	83	0	29	612
Eflani	75	37	0	0	0	0	112
Eskipazar	0	11	0	0	0	0	11
Merkez	14	0	12	0	20	0	46
Ovacık	56	0	0	0	3	0	59
Yenice	22	23	0	0	0	0	45
Karabük	167	71	12		23	0	273
Alaplı	0	9	0	0	0	0	9
Çaycuma	106	50	77	80	0	0	313
Devrek	63	210	42	87	37	0	439
Dirgine	0	0	7	1	0	0	8
Ereğli	74	55	59	103	153	0	444
Gökçebey	124	81	0	0	10	0	215
Kozlu	44	64	23	0	0	0	131
Merkez	61	54	31	0	0	0	146
Zonguldak	472	523	239	271	200	0	1705
General Total	937	730	317	354	223	29	2590

The ORKÖY SES practices were 23.63% in Bartın, 10.54% in Karabük and 65.83% in Zonguldak. It can be seen that in Bartın, 60.95% of the implementation was in the forest villages of the Central District, 23.20% was in Ulus, 8.82% was in Amasra and 7.03% was in Kurucaşile. The implementation in the forest villages of the districts of Karabük was as follows: 41.03% in Eflani, 21.61% in Ovacık, 16.48% in Yenice and 4.03% in Eskipazar. In the case of Zonguldak, the implementation for the families in the forest villages in the districts as follows: 26.04% in Ereğli, 25.75% in Devrek, 18.36% in Çaycuma, 12.61% in Gökçebey, 8.56% in the Central district, 7.68% in Kozlu, 0.53% in Alaplı and 0.47% in Dirgine (Table 1).

3.1.2. Distribution of the ORKÖY sheathing projects in the region

ORKÖY Sheathing practices for forest villagers were conducted by the Zonguldak Forest Regional Directorate between 2010-2015 for 133 families (Table 2). It can be seen that the distribution of the ORKÖY sheathing practice was 23.63% in Bartın, 10.54% in Karabük and 65.83% in Zonguldak.

Table 2: Zonguldak Forest Regional Directorate ORKÖY Sheathing Practices

Province	District	Number of projects implemented
Bartın	Ulus	5
Bartın	Merkez	5
Bartın Total		10
Karabük	Merkez	45
Karabük	Ovacık	2
Karabük	Yenice	3
Karabük Total		50
Zonguldak	Ereğli	60
Zonguldak	Çaycuma	13
Zonguldak Total		73
General Total		133

The ORKÖY Sheathing practices were conducted in forest villages as 7.52% in Bartın, 37.59% in Karabük and 54.89% in Zonguldak (Table 2). It can be seen that in Bartın, 50.00% of the implementation was in the forest villages of the Central District and 50.00% was in Ulus. For Karabük, the implementation was 90.00% of forest villages of the Central district, 6.00% in Yenice and 4.00% in Ovacık. In the case of Zonguldak, the implementation of sheathing in forest villages in the districts are as follows: 82.12% in Ereğli and 17.88% in Çaycuma.

3.1.3. Distribution of the ORKÖY stove heating projects in the region

There were 24 cases of the ORKÖY loan provision for stove heating practices for forest villagers with the aim of saving on fuelwood was conducted by the Zonguldak Forest Regional Directorate between 2010-2014 (Table 3). This was only implemented in the Yeşilöz Village in Dirgine District of Zonguldak (Table 3).

Table 3: Zonguldak Forest Regional Directorate ORKÖY stove heating practices

Province	District	Village	Year	Number Implemented	Loan Type
Zonguldak	Dirgine	Yeşilöz	2014	24	Stove Heating

3.2. Contribution of the ORKÖY SES, sheathing and stove heating projects to savings on fuelwood

The investigation of the ORKÖY practices of the Zonguldak Forest Regional Directorate showed that the average annual fuelwood consumption was 18.28 stere and 2.31 tonnes coal for use for cooking, showering, etc. for families who took advantage of the loan opportunities for the i) sheathing, ii) stove heating and iii) solar energy systems. According to Coşgun (2005), the annual fuelwood consumption was 35.8 stere in the early 1990's in the Western Blacksea Region. According to the 2015 data for forest villages of the Western Mediterranean Region, the annual fuelwood consumption was 11.74 stere (Coşgun & Güler, 2015).

3.2.1. Contribution of the ORKÖY SES projects to savings on fuelwood in the region

The ORKÖY SES project implementation was made widespread to the forest villages in the Western Blacksea Region by the Zonguldak Forest Regional Directorate. It was stated that the families who took advantage of the SES project generally benefitted from the project in the summer months. It is generally used following the work concerning the farming and husbandry work. It was stated that the fuelwood saving of families who had received the SES support in region was 32,0%. The annual fuelwood saving of families taking advantage of the SES support in the Western Mediterranean Region is 30% (Coşgun & Güler, 2015).

3.2.2. Contribution of the ORKÖY sheathing projects to savings on fuelwood in the region

It was determined that the annual fuelwood saving of the families who had received the sheathing support was 52.78%. An attempt was made to determine which of the practices (sheathing together with the SES project or SES practices implemented by families own mean) brought about the most saving on fuelwood. It was found that the annual fuelwood saving of families who had both the sheathing and SES practices together was higher when compared with the saving incurred by just the sheathing practice. The sheathing project practices saved more than 52.50% on average in comparison with the SES project practices. Similarly, families who had sheathing together with the stove heating system saved on average 61.57% more fuelwood than families who had only the stove heating practices.

3.2.3. Contribution of the ORKÖY stove heating projects to savings on fuelwood in the region

In the forest villages (Yeşilöz and Tohumlar villages) of Eğerci Village of Dirgine District in Zonguldak, 24 cases of the Stove Heating Project was implemented (Table 3). In practice, this was implemented in two ways. The first was to establish

"stove heating" in the houses and the second was to establish "room heating". The observations showed that the "room heating" was more effective. This means of heating generally uses coal for fuel. Wood is most commonly used as kindling. The practice of "stove heating" generally uses wood as fuel. In the interviews held, the families receiving the support for the "stove heating" stated that they mostly used wood as fuel. Prior to the project, there were heaters in both of the rooms; after the project implementation, the stove is used in only one room. Radiators are placed in the other rooms. As the fuel chamber of the stove heater is larger, larger sized wood can be used. During the winter months, the stove is always kept alight in order to heat the other rooms. In the case where there is a heater in each room, the second heater is only fired at certain times. In the majority of the houses in the region which are using either the "room heating" or the "stove heating" do not have exterior sheathing. Therefore, there is a large amount of energy/heat loss. This leads to a heating problem, resulting in the need to consume more fuel. If there is no sheathing, the aim of saving on the consumption of fuel cannot be reached. It was also observed that some enterprises/families who had received the sheathing support had also implemented the "room heating" system with their own means. Thus, when these two approaches are combined, there is a significant chance for saving on fuelwood as this is a more efficient practice.

A comparision of "room heating" and "stove heating" has showed that, coal is most often used as fuel for the former and wood for the latter. Thus, it is important to encourage the wider use of "room heating".

Another factor which effects fuelwood consumption in the "room heating" and "stove heating" practices is the number of members of the household. In households were there a 2-3 persons and homes which are used all year round, this practice is less efficient. It is stated that it is more efficient if the members of the family are 4 persons or more.

Within the sample, there were families who had received ORKÖY support for "room heating" or "stove heating" and also the Solar Energy System (SES) to be used for hot water. To be able to Access hot water in a short period of time has increased the quality of life for the villagers, especially in the summer months following the laborious farming and husbandry work. However, this has not had an impact on the annual fuelwood saving. When considering the annual fuelwood consumption of families, the "room heating" or "stove heating" project practices leads to 25.45% more saving than the SES project practices. The reason for this is that there percentage of exterior sheathing is low among households. On the other hand, families who have taken advantage of the ORKÖY "room heating" or "stove heating" project has saved an average of 31.25% fuelwood annually.

4. Conclusion

This study has determined the probable contribution of the ORKÖY Zonguldak Forest Regional Directorate loan support projects of i) sheathing, ii) stove heating and iii) solar energy systems on fuelwood saving. The annual fuelwood consumption of villagers in the region has shown a significant reduction in comparison to the 1990's. It was observed that forest villagers has also began consuming coal as fuel, instead of firewood. It was found that the average annual fuelwood consumption had reduced to 18.28 stere and 2.31 tonnes coal was also used as fuel. Considering that an annual consumption of 2.5 tonnes of coal is on average equitable to 10 stere fuelwood, the annual fuelwood consumption is at the amount of 28.28 stere. This amount is below the amount of 35.8 stere annual fuelwood which was found to be consumed on average in the Western Blacksea Region in the first half of the 1990's. The reduced amount of fuelwood consumption is also thought to be the result of the reduced forest village population and lower members of households in the last 20 years.

It was seen that the average fuelwood saving was 32.00% as a result of the ORKÖY SES Project, a saving of 52.78% as a result of the sheathing project and an average of 31.25% as a result of the "room heating" and "stove heating" project.

Families stated that their coal consumption increased with the room heating practices, while fuelwood consumption increased with the stove heating practices. Of the two approaches, the room heating practice should be preferred and the villagers should be encouraged to implement this project. However, in both cases, the lack of appropriate exterior sheathing for the majority of houses means that the impact of the practice is not effective on the consumption of fuel. Therefore, the families who are to implement the "room heating" or "stove heating" projects should consider the condition of their housing. It is important for the housing to have at least a common approach insulation.

The ORKÖY sheathing project was the project which resulted in the most saving of fuelwood on average, annually. It is recommended for this practice to become was widespread as possible. However, the cost involved in this approach is a limitation for its widespread practice. Forest villager families expressed doubts as to whether they could meet the costs of sheathing. It is not easily accepted and practiced. For this reason, the ORKÖY should develop long term policies for provision of loans for this practice. As with the momentum gained since 2005 with the ORKÖY SES practices, it could be a possibility to ensure a longer term in loan repayment to ensure the practice can be an option.

It was seen that the most significant impact on the reduction of fuelwood was to implement two projects in combination. However, the costs involved in the combined approach has an effect on the rate of implementation in such way. It is recommended that policies be developed for special loan opportunities for sheathing and also to implement the sheathing and room heating practices together.

Technology of heat insulation is rapidly developing. The use of boron based materials are increasingly becoming widespread. Materials such as polystyrene, fiberglass, etc. in sheathing practices should no longer be used. A recent fire in England has led to the discussion of using materials which have a higher level of fireproofing in the insulation of buildings. According to studies, there are materials manufactured under various trade names in Turkey which boron based, are more fireproof and can provide sound insulation. Thus, policies need to be developed to encourage the use of boron based materials in sheathing practices.

The architectural characteristics of housing in forest villages are more preserved than that of urban housing and are thus have heritage/traditional value. In this light, the sheathing practices should be applied in a manner which preserves the architectural design of the housing. It is recommended to take special consideration when developing new policies to make changes to the project concerning the interior insulation of the houses.

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Evaluating some artificial neural networks and multiple linear regression model for predicting carbon of pure oriental beech stand in Göldağ forests

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Abstract: Forest ecosystems provide timber and non-timber products, recreation; water and soil protection, biological diversity conservation as well as they decreased a huge amount of CO_2 in the atmosphere. As stated in some international agreements and acts like "Kyoto Protocol", the simplest, easiest and cheapest way for decreasing climate change is protection of forest ecosystems, reforestation and afforestation. Recently, many scientific studies have been conducted for determining carbon quantities of forest trees in the World's forest ecosystems. On the other hand, remote sensing methods have been used to estimate aboveground carbon. Many prediction models based on linear regression analyze for stand attributes and stand carbon have been developed in forest literature. However, this analyze based on some statistical assumptions, normally distributed residuals and homoscedastic trends in predictions, and if these assumptions are violated, these predictions can be biased and erroneously obtained in forest applications. As remedy for this problem in predictions, Artificial Neural Network Analysis (ANN) has been successfully introduced in forest literature for modeling different individual and stand attributes. In this study, stand carbon storage were firstly calculated from BEF coefficients of Tolunay (2013) for 70 sample plots in Göldağ Forests. Vegetation indices values were obtained from Landsat 7 ETM. To model the relationships between stand carbon and vegetation indices, the multiple linear regression analysis and some artificial neural networks such as the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent, NARX network and Radial basis with training function of Levenberg-Marquardt and transfer function of Log-sigmoid transfer function were used in this study. These artificial neural networks (ANNs) structures such as the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent, NARX network and Radial basis network with multiple linear regression model were compared based on evaluations of the magnitudes and distributions of models' residual and six goodness-of-fit statistics: sum of squared errors (SSE), Akaike's information criterion (AIC), Bayesian information criterion (BIC), Root Mean Square Error (RMSE), Mean Squared Error (MSE) and Adjusted Coefficient of Determination (R^2_{adj}). The ANN based on the Cascade backprop produced better predictive ability with SSE (28353.36), AIC (424.280), RMSE (20.126), R^2 (0.510) than the regression model and the other studied ANNs. These fit statistic results in the ability of ANN to predict stand carbon values by using vegetation indices from satellite image and producing more precise predictions than multiple linear regression models.
Keywords: Stand carbon, Remote sensing data, Artificial neural network, Prediction

1. Introduction

Forest biomass is cursor of carbon sequestration. Nearly 50% of forest dry biomass is carbon (Brown, 1997). The greater part of biomass evaluations is performed for the above ground biomass (AGB) of trees. Traditional biomass and carbon evaluation technique depend on ground measurements are the most accurate technique; however, but it is an extremely time overwhelming and destructive method, generally limited to minor areas and minor tree sample sizes (Attarchi and Gloaguen, 2014). Recently, remote sensing technique have been used to gather data regarding the AGB and carbon on large forest areas (Maynard et al., 2007). Remote sensing technique has been applied to the AGB evaluate in many revisions (Maynard et al., 2007; Wannasiri et al., 2013). Investigators have used different modelling technique such as linear regression models, multiple regressions models, artificial neutral networks and so on. The aim of this study is to evaluate the relationships between band reflectance values and vegetation indices obtained from Landsat 7 ETM satellite image and the stand carbon storage from field measurements by using multiple regression analysis and some artificial neutral networks for pure beech forests in north of Turkey.

2. Material

2.1. Study area

The research area, a part of Göldağ Forest Planning Unit is located in Kastamonu Regional Forest Directorate with a total area of 600 ha. It is bounded by 647000-650000 on the east longitudes and 4629000-4632000 on the North latitudes (ED 1950, UTM Zone 36N). Average altitude, precipitation and temperature of research area are 775 m, 677.3 mm and 17.6 C°, respectively (Günlü et al., 2008). The study area is covered by trees that include unmanaged, even-aged, pure stands of oriental beech (*Fagus orientalis* Lipsky.). In this study, required data were obtained from 70 temporary sample plots ranging crown closure. In the field survey, the size of circular plots ranged from 400 to 800 m2, depending on crown closure. The

diameter at breast height (dbh) of each tree and spatial coordinates of sample plots were measured. Dbh was considered for every trees greater than 8.0 cm. Stand volume was calculated for each plot and converted to values in hectare. In addition to, The Landsat 7 ETM satellite image, which was consisted of six spectral bands (ETM1, ETM2, ETM3, ETM4, ETM5 and ETM7) with 30 m spatial resolution, was acquired on May 3, 2000 used as the remote sensing data.

3. Method

3.1. Carbon estimation through standing volume

Prediction of forest biomass are required for monitoring changes in Carbon stocks. Investigators use different methods such as allometric biomass equations or Biomass Expansion Factors (BEFs) to forest inventory in biomass estimations. A common method is the use of BEFs. In fact, BEFs is simple method of converting from forest tree stem volume to total forest biomass (Brown et al. 1999; Hu and Wang 2008; Keleş et al. 2012; Kadıoğulları and Karahalil 2013; Karahalil 2013). In this study, above ground biomass of each sample plot was calculated. The aboveground biomass for each sample plot was calculated using BEFs by developed Tolunay (2013).
The amounts of above ground carbon of each sample areas were calculated using the above ground biomass values calculated for each sample area.

3.2. Estimation vegetation indices values

Some vegetation indices (NDVI, SR, DVI, TVI, NLI, SAVI, ND53, ND54, ND57, ND32 and ND73) were calculated using bands of Landsat 7 ETM satellite imagery.

3.3. Analyzed models

To model the relationships between stand carbon and vegetation indices, the multiple linear regression analysis was used in this study. This multiple linear regression models based on stepwise variable selection method was developed though Ordinary Least Squares (OLS) Technique using vegetation indices as independent variable, which dependent variables in models were stand carbon values. The multiple stepwise regressions were performed using SPSS version 12.0 (SPSS Institute, 2004). The stepwise regression technique was used to select the best vegetation indices variables that are significant ($p<0.05$) with the highest value of coefficient of determination adjusted by number of parameters (R^2_{adj}), also called adjusted the coefficient of determination. In this study, the following linear relationship was assumed:

$$SC = \beta_0 + \beta_1 \cdot X_1 + \beta_2 \cdot X_2 + ... + \beta_n \cdot X_n + \varepsilon \quad (1)$$

where SC is the stand carbon values, X_1 …… X_n are variable vectors corresponding to vegetation indices values, β_1…… β_n represent model coefficients and ε is the additive error term (Corona et al., 1998) as other technique to model the relationships between stand carbon and vegetation indices, the neural network model building and multiple linear regression model were used in this study. both training, verification and testing data sets that randomly partitioned into training (75% of all data), verification (15% of all data) and test (the remaining 10% of all data) data sets were used for modeling the relationships between input variables (vegetation indices, independent variables in regression analysis) and target variable (stand carbon values dependent variables in regression analysis). In ANN training process, input variables were some vegetation indices that gave the best predictive results in regression analysis. Target variable is stand carbon values calculated as sum of individual tree carbon in each sample plots at hectare. The ANNs selected for predicting stand carbon are multiple layer network structures such as the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent, NARX network and Radial basis with training function of Levenberg-Marquardt and transfer function of Log-sigmoid transfer function. In ANNs training process, the number of neurons is used as 10 with number of two layers including hidden and output layers, since this structure are the most frequently chosen values in ANNs. All these applications for ANN was carried out using MATLAB-nntool module. These artificial neural networks (ANNs) structures such as the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent, NARX network and Radial basis network with multiple linear regression model were compared based on evaluations of the magnitudes and distributions of models' residual and six goodness-of-fit statistics: sum of squared errors (SSE), Akaike's information criterion (AIC), Bayesian information criterion (BIC), Root Mean Square Error (RMSE), Mean Squared Error (MSE) and Adjusted Coefficient of Determination (R^2adj).

4. Results and discussions

The values of goodness-of-fit statistics, such as SSE, AIC, BIC, RMSE, MSE and R^2_{adj}, for these ANNs, including the feed-forward backprop, Cascade Correlation, Elman backprop, Layer Recurrent, NARX network and Radial basis network and multiple regression model were given in table 1. In this regression model for stand carbon values, the F statistics and coefficients were significant at a probability level of 95 percent ($p<0.05$). The stand carbon model based on the vegetation indices were developed by NDVI and SAVI as independent variables with SSE (36207.78), AIC (441.397), RMSE (22.743), R2 (0.374). Table 1 showed that ANN based on the Cascade backprop produced better predictive ability with SSE (28353.36),

AIC (424.280), RMSE (20.126), R2 (0.510) than the regression model and the other studied ANNs. Using the Cascacade backprop neural network model building, the explanatory in stand carbon predictions determined as Adjusted Coefficient of Determination (R^2adj) increased by % 13.6 and prediction's error determined as RMSE decreased by % 11.51.

Table 1. The goodness-of-fit statistics of number of trees predictions for the ANNs types and regression model.

Prediction Methods including the ANNs and regression model	SSE	R^2_{adj}	MSE	RMSE	AIC	BIC
ANN based on feed-forward backprop	31879.25	0.449	455.418	21.341	432.485	436.982
ANN based on Cascade backprop	28353.36	0.510	405.048	20.126	424.280	428.777
ANN based on Elman Recurrent	31350.12	0.458	447.859	21.163	431.313	435.810
ANN based on Layer Recurrent	31790.74	0.451	454.153	21.311	432.290	436.787
ANN based on Radial Basis	29615.53	0.488	423.079	20.569	427.329	431.826
Linear Regression	36207.78	0.374	517.254	22.743	441.397	445.894

These fit statistic results in the ability of ANN to predict stand carbon values by using vegetation indices from satellite image and producing more precise predictions than multiple linear regression models. This empirical relationship between vegetation indices from satellite image and stand carbon helped to develop successfully for mapping stand carbon. Based on the results obtained from the research, forest managers could use satellite images data for estimating stand carbon and this information would also be beneficial for generating maps and developing forest management plans. It is probable that this study will present appreciated contribution to the literature indicated that ANN scan be utilized in various stand attributes such as stand biomass, carbon, volume others. However, these fitting results should be further examined and assessed at different forest areas meanwhile this modeling consequences of this carbon values from satellite images are specific to this type of forest structure and areas that was studied.

5. Acknowledgment

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To understand maquis biomass spreading in Eastern Mediterranean Region

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Abstract: The "shrubs, which are generally always-green and dominated by hard-leaved species, that are 2-5m in length in Mediterranean Basin" are named maquis. Scrub populations called maquis have significant role in agro-silvo-pastoral systems having limited water potential, and they have also potential to reduce the effects of climate change by acting as a carbon pool because of their high portion within the vegetation in places, where they spread over. The aim of our study is to determine the aboveground and belowground biomass storage capacities of maquis spreading over Eastern Mediterranean region and to reveal the change in amount of biomass stored depending on certain vegetation and habitat conditions. Thus, it was aimed to understand the biomass of maquis populations and to provide useful data. In determining the plot areas, in order to ensure the standard firstly, the regions, where the maquis flora covers 70% or more, were selected. In order to reduce the slope-related errors, the study was started on the lands with 5-10% slope, and the study areas were distributed in accordance with the aim of this study (in dimensions of 10m x 10m) to various altitude, exposure and vegetation height levels. The belowground sampling was carried out in 2 m x 2 m sample areas in same plot. In addition, the mean age determined in the sample areas is treated as another variable. While designing, in order to reveal the maquis' biomass, 4 groups of samples, which were believed to have effect on the biomass, were established, and then they were divided into sub-groups. And then, by using t-test and variance analysis, it was examined if there are differences between these sub-groups.
According to the data obtained in our study, the mean aboveground biomass amount was found to be 24,183 ton/ha. Moreover, it was determined that the belowground biomass contains approximately 41,062 ton/ha of root. Of the total fresh biomass amount, approximately 63.98% consists of dry matter. In accordance with the obtained results, the root/shoot ratio was found to be 1.7. In statistical evaluations, there was no relationship between group and subgroups and biomass quantities with sufficient confidence level. The reason is that the data obtained from the sample plots show a very wide variation. On the other hand, correlating the subsequent studies on determining the maquis biomass with the mean vegetation heights is the most acceptable approach.
Keywords: Biomass, Maquis, Altitude, Exposure, Height, Age

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Land use effects on soil physical properties in semiarid region of Turkey

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Abstract: The conversion of cultivated and grasslands areas to forest has been occurring in Black Sea backward region of Turkey for decades. The legacy of management activity during this transition is reflected in soil physical and chemical properties years after abandonment. The purpose of this research is to compare the soil properties in four adjacent land uses including the cultivated area, the grassland area, the plantation area and the natural forest area in semi-arid region of Black Sea backward region of Turkey. Some of soil properties, including texture, pH, total nitrogen, soil organic matter (SOM), and bulk density were measured at a grid with 50 m sampling distance on the surface soil (0 - 20 cm depth). Disturbed and undisturbed soil samples were taken from one hundred sampling points. According to the results dry bulk density (BD), SOM, and total nitrogen (TN) significantly change with land use. Soil characteristics negatively affected by tillage practices and grazing are BD and SOM. Finally, the findings indicated that tillage and grazing, in semi - arid region, affected adversely on soil properties. On the other hand, success afforestation works have been developing and protecting the surface soil properties.
Keywords: Land use, Semiarid, Desertification, Turkey

1. Introduction

Several semi-arid areas of the world are vulnerable to environmental changes (Warren *et al.*, 1996) and are degraded (UNEP, 1992), partly due to reduction in the permanent plant cover (Le Houe´rou, 1995). This degradation includes reduced SOC levels, lower soil nutrient content, lower water holding capacity and increased risk of erosion (Batjes, 1999). These degraded areas have a large potential to sequester C in the soil, which may be preferable to storage in vegetation due to their longer residence times and less risk of a rapid release (Lal et al., 1999). Batjes (1999) estimated that between 0.6 and 2 PgC/ year could be sequestered by the large-scale application of appropriate land management in the world's degraded areas. This accounts for 18– 60% of the annual increase of CO2 in the atmosphere. Squieres (1998) estimated the potential sink of dry lands to be 110 PgC / year over the next 50 years. In addition to the removal of atmospheric CO2, increased soil organic matter (SOM) in semi-arid environments could be beneficial to food productivity and erosion control in poor and degraded areas (Ringius, 1999).

Land use change can cause a change in land cover and an associated change in carbon stocks (Bolin and Sukumar, 2000). The change from one ecosystem to another could occur naturally or be the result of human activity, such as for food or timber production. Each soil has a carbon-carrying capacity, i.e. equilibrium carbon content depending on the nature of vegetation, precipitation and temperature (Gupta and Rao, 1994). The equilibrium carbon stock is the result of a balance between inflows and outflows to the pool (Fearnside and Barbosa, 1998). The equilibrium between carbon inflows and outflows in soil is disturbed by land use change until a new equilibrium is eventually reached in the new ecosystem. During this process, soil may act either as a carbon source or as a carbon sink according to the ratio between inflows and outflows. Some studies have reviewed the effects of certain land use changes on soil carbon stocks, such as forest clearing (Allen, 1985), tropical forest clearing (Detwiler, 1986), disturbance and recovery (Schlesinger, 1986), cultivation (Davidson and Ackerman, 1993), deforestation for pasture (Neil and Davidson, 2000), and from cultivation and native vegetation into grasslands (Conant et al., 2001). The main objective of this study was to determine the relationships between LUTLC and soil properties in the semiarid climate zone of Turkey.

2. Material and method

2.1. Study location

This study was conducted in the Karataşbağ River stream catchment located Eldivan district of Çankırı province found on in transition zone Black Sea climate to Inner Anatolia semiarid mezzo - thermal climate. Coordinated of study area between 40° 38' - 40°20' N and 33°36' - 33° 25' E (Fig. 1). The study area consists of various topographic features. Due to high slope degree and misuse and mismanagement of fragile natural structure of the study area, severe soil erosion and landslide had been occurred which leads to economic and ecologic destruction on agricultural areas and settlements until 1961. After this phenomenon, catchment was rehabilitated and reforested from 1961 to present.

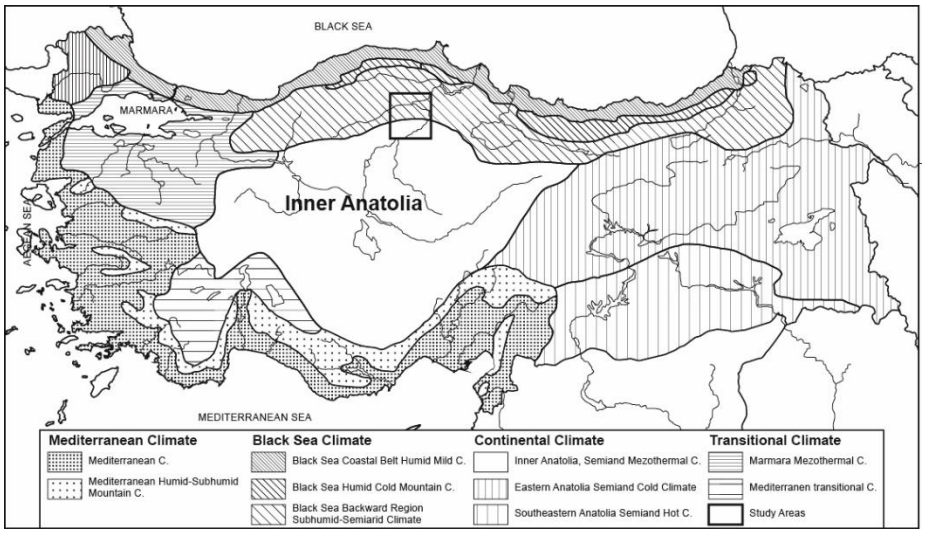

Figure 1. Location of study area in transition zone Black Sea climate to Inner Anatolia semiarid mezothermal climate

The climatic type of the region was determined by using the data from the Eldivan Climate Station (Anonymous, 2016) according to the Thornthwaite method. Climate type at the research area was "arid - subhumid, mesothermal, moderately excessive water during winters, close marine" climate type. The north and south Anatolia mountains ranges block the moist air flow from the sea. Therefore, Central Anatolia receives the least rainfall in Turkey and is the most arid regions. The forests in this region are generally located above 1000 m altitude. These forests are under the pressure of aridity, shallow and unproductive soil characteristics, human activities, and grazing. This situation results in a fragile ecosystem of high mountain forests in Central Anatolia. Grazing fields have created by transforming agricultural lands in steeper hill slopes when soil productivity decreased as intensively crop production. The main ecological factors that determine the soil properties of different land use type and land cover (LUTLC).

The mean annual precipitation of the region is 500 mm, while the mean temperature is 10.4 ^{o}C. According to the Thornthwaite method research area "semi - dry - moist, mesothermal, in excess of water in the dead of winter, the marine climate in the near influence" with a climate that has emerged on the type. The north and south Anatolia mountains ranges block the moist air flow from the sea. Therefore, Central Anatolia receives the least rainfall in Turkey and is the most arid regions. The forests in this region are generally located above 1000m altitude. These forests are under the pressure of aridity, shallow and unproductive soil characteristics, human activities, and grazing. This situation results in a fragile ecosystem of high mountain forests in Central Anatolia. When the general land use in Central Anatolia is considered, it could be observed that low altitude regions are used for dry farming and dry steppe grassland. High altitude regions are formed of forests, rangeland, plateaus, and marginal agricultural lands.

Research area was formed of Tertiary Oligo - miocene gypsum series. That formation starts with thick and red bottom conglomeras followed by light color clay and marl, stratified with gypsum. Top strata of the gypsum series may include Miocene at many locations. This sequence implies marine regression and replacement of desert climate (Ketin, 1962). Catchment soils were classified as Entisols and Inceptisols according to Soil Survey Staff (1999), (Göl and Dengiz, 2007).

The natural tree species of the sample area are Anatolian Black Pine (*Pinus nigra* subsp. *Pallasiana* var. *Pallasiana* (Arnold*)*), Cedar (*Cedrus libani* A. Richard), oak (*Quercus* sp.), juniper (*Juniperus* sp.), hornbeam (*Carpinus* sp.), willow (*Salix* sp.), linden (*Tilia* sp). The woodland comprises of black pine (Pinus nigra Arn. subsp. nigra var. caramanica (Loudon) Rehder) and Oak. (Quercus cerris L., Q. pubescens Willd). Principal tree species of the plantation, which was replaced by the original woodland forty eigth years ago, is Pinus nigra, which is also principal tree species of the natural forest in the site. (Göl et al., 2010).

2.2. Soil sampling and Laboratory analyses

The investigations were carried out within four different adjacent LUTLC namely; natural forest (Anatolian black pine), plantation forest (Anatolian black pine, 57 year - old plantation), grassland, and cultivated land (dry farming).

The distributions of sampling plots in the grid system (50 x 50 m) are total 120 soil samples (4 land use types x 30 surface soil samples) for all three different adjacent LUTLC. Soil samples were collected at surface soil (0 - 20 cm depth) (because of effective depth of soil organic matter accumulation in the study areas). The undisturbed soil samples were taken by a steel core sampler of a 100 cm^3 volume for dry bulk density analysis (120 samples). Sampling method was systematic with equal distances between soil samples in this study. Random sampling can generate (Fig. 2).

Soil samples were taken only from the surface soil (0-20 cm depth) and analyzed for particle size distribution (Bouyoucous, 1951), Dry bulk density (BD) was calculated by dividing the oven dry mass at 105°C by the volume of the core (Cassel and Nielsen, 1986). Soil pH and was measured on a 1:5 soil to water ratio suspensions by a pH/conductivity meter (Rhoades, 1996). Carbonate ($CaCO_3$) was determined by pressure calcimeter method (Richard and Donald, 1996). The

concentration of soil organic matter (SOM) was determined by using the Walkley and Black method (Nelson and Sommer, 1996). Total nitrogen (TN) was determined by Kjeldahl method (Bremner, 1996).

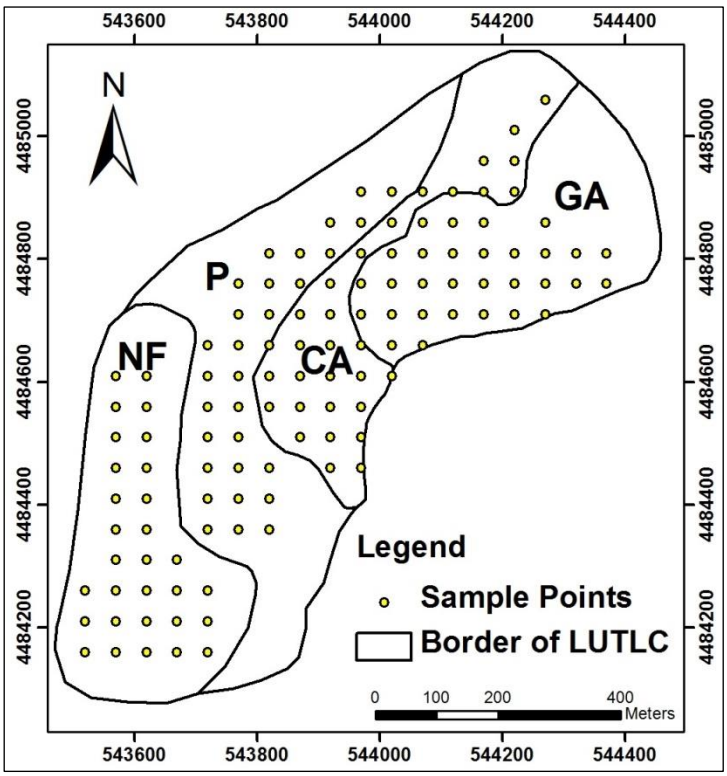

Figure 2. Sampling points in different Land Use Type / Land Cover (NF - natural forest, P -plantation forest, CA - cultivated area, GA - grassland area)

2.3. Statistical analysis

The descriptive statistics (mean, maximum, minimum, standard deviation (SD), coefficient of variation (Cv), skewness, kurtosis coefficient for soil properties in terms of LUTL were calculated using the SPSS® 20.0 (IBM corporation software). Before geostatistical analyze, normality test with Kolmogorov-Smirnov analysis was implemented using SPSS® 20.0 software. The log-transformation was made for providing constant variance because SOM values in our data set showed a non-normal distribution, and the spatial analysis of SOM content were made based on log-transformed values in this study (Webster, 2001). Mean differences between soil organic carbon values of land use types were compared using one-way ANOVA by followed LSD test ($p < 0.05$).

3. Result and discussion

The descriptive statistics including mean, min., max., standard deviation (SD) and coefficients of variation (CV) of some observed soil properties are presented in Table 1. On the other hand, soil properties of different LUTLC were determined (Table 2). Soil pH was not significantly different between soils under the all the LUTLC. The results showed that SOM and TN in the soils of cultivated area were significantly lower than in the soils of forest and the grazing areas. LSD analysis revealed that the difference ($p < 0.05$) was due to the variance among all LUTLC. In recent years, many studies have shown that cultivation practices increased soil organic matter decomposition rate and caused the loss of SOC from the soils of the agricultural ecosystem (Abbasi et al., 2007; Watson et al., 2000). Conversion of the natural forest into continuous cultivation had resulted in statistically significant decreases of both the concentration and stock of SOM and TN (Göl, 2009).

Soil properties change directly according to land use types. Therefore, SOM content, especially in surface soils alters within a quite wide range. This usually leads to a heavy-tailed distribution. In our data set, the skewness was quite high. Therefore, log-transformation was applied to the data to decrease effect of extreme values (Webster, 2001). Soil texture classes are clay loam, sandy clay loam, sandy loam, silt clay loam and clay in all land uses. The pH values of the forest, grassland and cultivated lands varied significantly from 7.05 to 7.69 (Table 1).

The descriptive statistics for soil organic carbon (SOM) at 0 - 20 cm under different land uses are presented in Table 2. The SOC values vary between 0.26% and 5.34%. The highest and the lowest SOM content in surface soils were found in natural forest and cultivated, respectively. Coefficient of variation (Cv) (%) varied from 33.51 - 46.76% for SOM, and for whole area it was 31.31% (Table 1). Kolmogorov-Simirnov normality test showed that the SOM content distribution deviated from normality ($p < 0.01$). In our study, SOM content in surface soils is statistically different in terms of land use types ($p <$

0.05). The similar results were found in relevant studies. For instance, Abegaz et al. (2016) reported that differences in organic carbon content among land use types including cropland (Zheng et al., 2016), brush land (DeMarco et al., 2016), grassland (Conant et al., 2016), and forestland (Were et al., 2015) were statistically significant ($p < 0.01$), and greater amounts of carbon were stored in forest soil compared to other land use types in smallholder farming systems, at highlands of Ethiopia. Vågen and Winowiecki (2013) found that the greatest SOM values (0 - 30 cm) were in grassland, while the lowest values were in brush lands and woodlands (croplands to forest) in semi-arid ecosystems. SOM plays a key role in nutrient cycling and can help improve soil structure. SOM is an important source of nutrients for plants.

Table 1. Descriptive statistics of soil properties sampled to a depth of 20 cm in adjacent different LUTLC (Nt = 120).

Land-use and cover types	Soil Properties		N	Min.	Max.	Mean	SD	Skewness	Kurtosis	Cv (%)
Dry Farming	Clay	%	30	22.00	53.00	40.73	8.96	-0.60	-0.47	22.00
	Silt	%	30	17.00	35.00	24.63	3.65	0.95	2.43	14.83
	Sand	%	30	23.00	53.00	34.63	6.71	0.67	0.56	19.38
	BD	$gr.cm^{-3}$	30	0.95	1.44	1.13	0.13	0.73	-0.16	11.13
	pH		30	7.21	7.75	7.40	0.12	0.89	1.42	1.62
	SOM	%	30	0.26	2.20	1.15	0.50	-0.01	-0.65	43.60
	TN	%	30	0.01	0.11	0.06	0.03	0.00	-0.65	43.57
Grassland	Clay	%	30	20.00	49.00	35.80	10.93	-0.07	-1.76	30.52
	Silt	%	30	5.00	36.00	25.50	6.04	-0.82	3.66	23.70
	Sand	%	30	26.00	55.00	38.70	8.57	0.24	-1.07	22.15
	BD	$gr.cm^{-3}$	30	0.85	1.99	1.11	0.21	2.53	10.12	18.96
	pH		30	7.33	7.63	7.47	0.08	0.54	-0.40	1.08
	SOM	%	30	0.26	2.75	1.23	0.47	0.93	2.99	38.36
	TN	%	30	0.01	0.14	0.06	0.02	0.93	3.00	38.37
Plantation Forest	Clay	%	30	24.00	55.00	36.03	8.99	0.72	-0.68	24.96
	Silt	%	30	12.00	35.00	25.57	4.19	-0.87	3.07	16.39
	Sand	%	30	26.00	49.00	38.73	6.71	-0.16	-1.16	17.32
	BD	$gr.cm^{-3}$	30	0.74	1.16	0.98	0.12	-0.42	-0.92	12.43
	pH		30	7.05	7.69	7.29	0.13	0.63	2.05	1.76
	SOM	%	30	1.03	4.86	2.44	1.14	0.65	-0.76	46.76
	TN	%	30	0.04	0.24	0.12	0.06	0.57	-0.81	48.88
Nature Forest	Clay	%	30	17.00	49.00	33.23	7.69	0.12	-0.37	23.13
	Silt	%	30	18.00	31.00	23.73	4.08	-0.13	-1.15	17.18
	Sand	%	30	29.00	62.00	43.03	9.61	0.46	-1.14	22.33
	BD	$gr.cm^{-3}$	30	0.71	1.13	0.92	0.09	-0.35	0.60	10.01
	pH		30	7.06	7.46	7.26	0.12	0.05	-1.32	1.65
	SOM	%	30	1.17	5.34	2.87	0.96	0.63	0.03	33.51
	TN	%	30	0.06	0.27	0.13	0.05	1.04	0.89	38.13

Results of one-way ANOVA test showed that SOM and TN mean values were different by land use types ($F = 28.462$, $p < 0.05$), ordering as natural forest = plantation > grassland = cultivated area (Table 2).

When the dry bulk density (BD) values under different land use types are compared, the lowest value (0.71 g cm^{-3}) was measured in natural forest soils and the highest value (1.99 g cm^{-3}) was measured in agricultural lands. The differences in BD values of all LUTLC were found to be statistically significant with respect to the land use type ($p < 0.05$).

Bulk density of a soil is a dynamic property that varies with the soil structural conditions. In general, it increases with profile depth, due to changes in organic matter content, porosity and compaction. The bulk density depends on several factors such as compaction, consolidation and amount of SOM present in the soil but it is highly correlated to the organic material content (Chaudhari et al., 2013). Many researchers (Morisada, 2004; Leifeld et al., 2005; Chaudhari et al., 2013) obtained the relationship between organic matter and bulk density of soils and showed strong correlation between them.

Table 2. Comparison of types of land use in terms of soil properties according to one-way ANOVA by followed LSD

LUTLC	N	Sand (%) M ± Std. Error	BD ($gr.cm^{-3}$) M ± Std. Error	pH M ± Std. Error	SOM (%) M ± Std. Error	TN (%) M ± Std. Error
Dry Area Farming	30	34.63 ± 6.71^{a}	1.13 ± 0.1263^{b}	7.39 ± 0.11^{b}	1.14 ± 0.50^{a}	0.05 ± 0.02^{a}
Grassland	30	38.70 ± 8.57^{a}	1.10 ± 0.2103^{b}	7.46 ± 0.08^{c}	1.22 ± 0.47^{a}	0.06 ± 0.02^{a}
Plantation	30	38.73 ± 6.71^{a}	0.97 ± 0.1213^{a}	7.25 ± 0.12^{a}	2.44 ± 1.14^{b}	0.12 ± 0.05^{b}
Natural Forest	30	43.03 ± 9.60^{b}	0.92 ± 0.0922^{a}	7.28 ± 0.11^{a}	2.86 ± 0.96^{c}	0.12 ± 0.04^{b}
F		5.518**	15.341**	21.911**	33.314**	24.495**

Abbreviations: BD – dry bulk density, SOM – soil organic material, TN – total nitrogen

** Significant at $p \leq 0.05$, c > b >a, Different letters show that means have statistically significant different ($p < 0.05$)

Conclusion

LUTLC led to changes in some of the physical chemical and hydro - physical properties of soils especially. Soil characteristics affirmatively affected by changes of LUTLC are SOM, TN, and BD. Effect of LUTLC on SOM was found to be higher than that of the other soil properties. There was high degree reverse relationship between LUTLC and SOM storage of soil. The results indicate converting grassland or cultivated areas to plantation forest improve soil properties. In our study showed strong relationship between soil properties and LUTLC. Our results demonstrate that, within the 57 - year time frame, both land - use type and forest type have an influence and long - term effects on soil physical properties.

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Changing of Vegetation properties on the grazed and protected rangeland sites (Kocapınar Rangeland/Isparta)

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Abstract: Rangelands are wide and open areas where grasses and other herbaceous plants are dominant. Rangelands have many benefits, such as the provision of forage for livestock, protection and conservation of soil and water resources, provision of wildlife habitat, and contribution to the attractiveness of the landscape. The objective of this study is to determine the some vegetation properties in Kocapınar Rangeland of Kozağacı Highlands of Davraz Mountain (Isparta) during 2011-2012. The measurements were carried out for a period of two years during the months of June and September of the grazed and protected rangeland areas. "Line intercept (transect)" method was used for the determination of plant-covered area whereas "quadrate method" was used to determine dry forage yield. Aim of the study was collect the data which will form a basis to the rangeland improvement works in the region and to provide the required information about the rangeland vegetation. The results obtained were summarized as follows. A total of 30 families and 140 plant species were identified in the rangeland areas. The families that have the most taxa in the site are Asteraceae with 25 taxa, Lamiaceae with 14 taxa, Brassicaceae and Fabaceae with 12 taxa. With respect to the botanic composition of the vegetation of the research area, total ratio of Poaceae family, Fabaceae family, and the plant species belonging to the other families were found as 60.9 % and 58.7 %, 14.4 % and 18.0 %, 24.7 % and 23.3 % in the grazed and protected areas, respectively. The ratio of plant covered area was found as on average 24.3 % in the grazed area and 30.5 % in the protected area. Besides, the range quality degree, which was on average 3.478 in the grazed areas, was found as 3.787 in the protected ones. Above-ground biomass proved to be on average 208.24 kg/da in the grazed area and 256.49 kg/da in the protected area, while the under-ground biomass was determined to be 347.88 kg/da and 454.41 kg/da, respectively. The grazing capacity for an area of 1 ha was found as on average 0.39 animal units in the grazed areas and 0.48 animal units in the protected ones. Current grazing management practices leads to overgrazing pressure on the rangeland; therefore, developing a suitable grazing management plan are necessary to provide sustainable use of these rangelands.
Keywords: Rangeland vegetation, Range condition, Botanical composition, Grazing capacity, Isparta.

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Determination of some soil properties in black pine, beech and fir stands

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Abstract: The soil is the three dimensional entity one of the most important natural resources on earth and one of the basic elements of life, which is the result of physical fragmentation and chemical decomposition of the main rock, food source for plants, containing water and air. The soil properties, which are composed of different minerals, affect the composition of the forest and the growth rate significantly. In the well-developed forest soils, the dead cover layer covering the soil surface ensures that the soil surface maintains the structure and the surface flow decreases, whereas the infiltration increases the amount of water entering the soil. The aim of this study is to determine the rates of colloid-humidity which has an erosion tendency index, the amount of available water, pH, organic matter and texture (sand, clay, dust) for black pine, beech and fir stands. Soil specimens taken from the cylinders at depths of 0-20 cm were became dried and then sifted through 2 mm sieves. The differences and similarities between these properties were analyzed. As a result of the study, it was determined that the highest pH and dust values are in Black pine, the highest sand value is in Beech, and the highest clay, organic matter and available water value are in Fir. The low colloid-humidity ratio indicates that the stands soils are not resistant to erosion.
Keywords: Black pine, Beech, Fir, Soil properties, Kastamonu, Turkey

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Rainfall-runoff interactions of Göksu River Basin

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Abstract: The existence of any trend for the monthly and seasonal rainfall and runoff data between 2005-2015 acquired from the two runoff gauge station and one meteorological station at the Göksu River basin in Mersin province, were analyzed based on the Mann-Kendall Rank Correlation test. Prior to the trend analysis, initially, water yields were obtained dependent upon the basin sizes and flow rate data belonging to the runoff stations with the codes of E17A020 (Hamam) and E17A014 (Karahacılı). Then, flow coefficient percentages were determined for each station, based on the water yields and total rainfall ratios. The increase in the flow coefficient parameter that is an indicator of the water yield deficiency, implies the low total water deficiency within basin whereas the decrease emphasizes the much total water deficiency or the water is trapped as soil moisture or the natural flow is restricted by any structural means such as dams and etc. Considering the annual total flow and rainfall data, the runoff coefficient of the station with the code of E17A020 was 43.49% while it was 41.28% for the E17A014. In order to determine the rainfall-runoff interactions within the basin, the trend analyses for each 12 months revealed the inexistence of trend for the all months at the E17A020 station whereas revealed the increase for the July and September at the E17A014. On the other hand, no trend was determined for the other months. When the four seasons were separately evaluated, the increase in the summer season rainfall for long-term time series was observed only at the E17A014 station, yet it did not occur for the other seasons. According to the rainfall trend for the E17A020 station, it was concluded that the inexistence of any monthly and seasonal trend may be due to the artificial storage structures such as dams and etc.
Keywords: Rainfall, Runoff, Göksu, Water yield

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Effects on watersheds rehabilitation projects and rural development

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Abstract: East Anatolian Watersheds Rehabilitation Project implemented from 1992 to 2001 which permitted to Turkey to obtain important gains and Anatolian Watersheds Rehabilitation Project implemented afterwards from 2005 to 2012 accelerated development goals to be achieved by Turkey about collective based rural forest, agriculture and pasture management. Determination of global goals as adoption of the watershed based sustainable land management model taking population participation as a principle, necessity of the development of the rural population in-place, including forest inhabitants, forest resources degradation, Development Programs as One Thousand Years Development Program, beside increase of rural development importance, increase of food security importance, demographic increase, because of causes as resources decrease, Watershed Rehabilitation Projects importance is increased because they are efficient in rural development. This work is related to World's and Turkey's experiences about watershed rehabilitation and rural development subjects. Watershed rehabilitation projects relation with rural population/inhabitants will be treated taking advantage of project cycle. Anatolian Watershed rehabilitation Project implemented in Turkey (ASHRP) will be mentioned, and with the use of the Final Evaluation Report its effects to the goals for "Ensuring Development to Rural Population" taking place in ASHRP Ninth Development Program, will be discussed. After having discussed ASHRP effects to rural development, assessment will be carried out in the conclusion part related to watershed rehabilitation projects effects to rural development.
Keyworld: Watershed, Rehabilitation, Rural, Development, Forestry

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Comparing fabrika and Hatila Creek watersheds with respect to some water quality parameters and total suspended sediment (TSS) amounts

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Abstract: As a hydrological unit, a watershed plays vital roles on both sustainability and quality of water resources and protection of soil resources against erosion depending on its land use (e.g. forest, grassland, agriculture, settlements, etc.). However, it is known that large-scaled land use changes caused by anthropogenic interferences particularly affecting water quality and sediment yield of watersheds. The Coruh River Watershed is one of the watersheds where the mentioned effects are needed to be determined since it has been facing important changes due to large dams, road constructions, mining, and urbanization. For this purpose, Fabrika Creek Watershed (FCW) and Hatila Creek Watershed (HCW), two of the sub-watersheds with different land uses were chosen as the research area. In total of 10 sampling points, 7 within the FCW and 3 within the HCW, water quality parameters of pH, dissolved oxygen (DO), total dissolved substance (TDS), ammonium (NH4-N), ammonia (NH3-N), nitrate (NO3-N), salinity, conductivity, and temperature were determined in the field using YSI (Professional Plus) portable instrument. In addition, monthly measurements of water discharge and TSS values for both watersheds were done for a year. Preliminary results indicated that all the values of water quality parameters measured for both creeks were below the standards set by the Turkish Water Quality Control Regulation. However, when considering the average amounts detected only at the outlet point of each creek, it was clear that FCW had poor quality of surface water compared to HCW for all the parameters. For example, the values of TDS (230 and 120 mg/l), conductivity (280 and 130 µS/cm), ammonium (0.41 and 0.02 mg/l) and nitrate (0.20 and 0.04 mg/l) were much higher in FCW than HCW, respectively. Similarly, the average amount of TSS was also higher from the outlet of FCW with 47.86 than the outlet of HCW with 11.71, as expected. This outcome can be associated with the fact that while HCW is located within the Hatila Valley National Park with limited human interaction, the FCW is affected by relatively high rate of urbanization, particularly the lower section of the watershed, causing more domestic wastewater discharge into the creek.
Keywords: Water quality, Total suspended sediment, Land use, Fabrika Creek, Hatila Creek, Artvin

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Modification of wood by chemical processes: A review

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Abstract: Very important developments in the area of wood modification have been made during the last five decades. These developments can be attributed to the increased environmental concerns, the escalating demand for a high quality of wood products, and the rising prices of the durable tropical timbers, as affected by the illegal logging. As a consequence, a number of wood modification techniques such as chemical and impregnation modifications, by chemical processes, have been introduced, and some of these technologies have reached the industrial level. This review paper discusses the most important chemical processes of wood modification as of today.
Keywords: Wood modification, Acetylation, Furfurylation, Resin impregnation, Impregnation modification of wood, Monomer impregnation

1. Introduction

Wood has been utilized by humans for many centuries, mainly for fuel, shelter, weapons, tools, and furniture. As a material, wood is considered to be easy-to-work, renewable, readily available, and sustainable. For the most part, it has been used without any modification (Rowell 2014). Solid timber and lumber long have been treated for decay and fire resistance, as recorded in ancient, historic sources. Nonetheless, most modern applications of wood involve little treatment, mostly limited to coatings or finishes (Rowell 2016).

Humans have learned to use wood, accepting that it changes dimensions with changing moisture content, or in contact with water (Mantanis *et al.* 1994). It can be degraded by a wide variety of microorganisms, it burns, and it is decomposed by ultraviolet energy (Stamm 1964; Rowell 1983). With an increased awareness of the fragility of the environment and the need for durability in wood products, new technologies have been developed to increase the service life of wood without the use of toxic chemicals (Rowell 1983, 1984; Militz 1991; Westin 1996; Hill 2006; Rowell *et al.* 2009; Rowell 2012; Gérardin 2016). Issues of sustainability and carbon sequestration converge in this search for new 'green' technologies to improve durability, stability, and performance of wood, especially in exterior applications (Rowell 2016).

In addition, the progress of regulations in Europe, North America, and elsewhere, on the use of biocide products, has led to novel developments in the field of wood modification (Gérardin 2016). This has led to an increasing attention for non-biocide treatments including chemical modification, thermal modification, or impregnation modification, in an attempt to face the forthcoming prohibition of biocide-treated products (Hill 2006; Rowell 2012). Through chemical modification of wood, low-durability species can be upgraded to new modified wood products with advanced properties, without any deleterious effects to the natural environment or to the human beings (Hill 2006; Rowell 2014).

It should be noted in here that most of the processes developed, or today being under experimentation, in the area of wood modification have full or partial origins based upon the pioneering research and seminal work of Dr. Alfred J. Stamm and his co-workers of the Forest Products Laboratory at Madison, Wisconsin, back in the '40s and '50s.

This work reviews on the present technologies of wood modification by chemical processes and focuses mostly on the two processes which have reached in the industrial-scale level.

2. Modification of wood by chemical processes

Chemical modification of wood takes place when a chemical reaction of a reagent occurs with the polymeric constituents of wood (lignin, hemicelluloses, or cellulose), resulting thus in the formation of a stable covalent bond between the reagent and the cell wall polymers (Rowell 1982, 1983; Hill 2006).

In general, chemical modification of wood can be regarded as an active modification because it results in a distinct chemical change in the macromolecules of the cell wall. Currently, much is known about the modes of action of modified wood, which includes the following: i) the equilibrium moisture content is lowered in modified wood, and hence it is harder for fungi to obtain the moisture required for decay; ii) there is a physical blocking of the entrance of decay fungi to micropores of the cell walls; and/or, iii) inhibition of the action of specific enzymes (Hill 2006; Rowell *et al.* 2009; Rowell 2012). These three are only parts of the whole mechanism (Mantanis 2017).

Several chemical technologies of wood modification are reviewed, and briefly discussed in the following sections.

2.1. Acetylation of wood

The first recorded experiment of wood acetylation was carried out in Germany by Fuchs (1928) using the chemical agent acetic anhydride, with sulphuric acid as a catalyst. Horn (1928) also acetylated beech wood, but in order to remove hemicelluloses in a similar lignin isolation procedure. Tarkow was actually the first scientist who described the use of acetylation process in an attempt to stabilize wood from swelling in the water (Tarkow 1946; Tarkow *et al.* 1946). Since the '40s, many laboratories worldwide have performed experiments on the acetylation of wood in a variety of different ways, and by using various wood species and agricultural resources (Rowell 1983, 1984).

Early attempts to commercialise the process of wood acetylation failed in the USA (Koppers Inc. in 1961), Russia (1977), and Japan (Daiken Inc. in 1984) due to the high production costs involved (Rowell 2012). Pioneering work in scaling-up laboratory acetylationto the semi-industrial level, was successfully carried out at Stichting Hout Research (SHR, The Netherlands) by Prof. H. Militz and his coworkers during the '90s (Militz 1991; Beckers and Militz 1994; Beckers *et al.* 1994).

Wood acetylation, using primarily acetic anhydride, has been initially carried out as a liquid phase reaction (Rowell 1983, 1984). The early work was initiated using acetic anhydride catalyzed by zinc chloride or pyridine (Tarkow 1946). Through the years, many other catalysts have been evaluated, both with liquid and vapour systems. Some of the catalysts used include sodium acetate, potassium acid, urea-ammonium sulphate, magnesium persulfate, anddimethylformamide (Rowell 1983). Most acetylation reactions today are realized without the use of a catalyst (Rowell 2012; Larsson-Brelid 2013).

The reaction of acetic anhydride with wood polymers results in the esterification of the accessible hydroxyl groups in the cell wall (Rowell 1983), with the formation of a by-product, acetic acid (Fig. 1). The by-product is, for the most part, removed from the final modified material (Lankveld 2017) as the human nose is quite sensitive to the odour of acetic acid. Like untreated wood, acetylated wood is comprised only of carbon, hydrogen, and oxygen, and it contains absolutely nontoxic constituents (Hill 2006). In fact, acetylation of wood is a single-addition chemical reaction (Rowell 1984; Rowell *et al.* 1994) which means that one acetyl group is on one hydroxyl group without any polymerisation (Fig. 1).

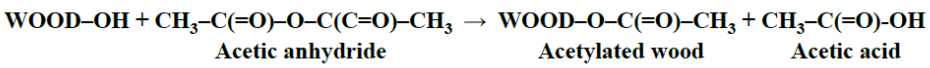

Figure 1. The main acetylation reaction of wood with acetic anhydride (Rowell 1983)

Many scientists today believe that wood acetylation reduces the number of hydroxyl groups (-OH) that can sorb moisture by hydrogen bonding so the equilibrium moisture content and fibre saturation point are largely reduced. Hence, the dimensional stabilisation of wood increases with increasing weight gain due to acetylation reaction (Rowell et al. 1994, Rowell et al. 2009, Larsson-Brelid 2013, Rowell 2016). Other scientists like Prof. Hill and others (Papadopoulos and Hill 2003, Hill 2006, Jones and Hill 2007, Papadopoulos 2010) favour another mechanism, that is: by modifying wood with acetic anhydride, it is observed that the dimensional stabilisation is related closely to the weight percentage gain (WPG) or bulking of the cell wall. As a consequence, the extent of OH- substitution is rather irrelevant.

As far as it concerns the biological resistance, several theories have been proposed to explain the high resistance of acetylated wood to fungal attack. One theory, that has gained large acceptance, is based on the fact that enzyme penetration is prevented by physical blocking of the cell-wall micropores (Papadopoulos and Hill 2002, Hill 2006, Hill 2009). In an agreement with the above, Highley et al. (1994) have showed that the smallest enzyme of a brown-rot fungus is too large to penetrate the cell wall of wood.

On the contrary, Prof. Rowell has postulated that the mechanism of decay resistance in acetylated wood is clearly based on 'moisture exclusion' owing to the fact that the equilibrium moisture content of a highly modified wood is too low to support fungal attack, i.e., there are no enough water molecules at the site of a glycosidic bond, which the fungal enzymes need for hydrolysis (Rowell 2006, Rowell et al. 2009). Rowell (2014) in his recent review, supports the idea that in the case of brown-rot fungal attack, the reduced moisture of acetylated wood prevents the fungus from initiating the breakdown of the hemicelluloses as an energy source. Mohebby (2003) in his interesting doctorate work, speculated a third possible mechanism, that is: there are possibly very small regions in the cell wall that are not acetylated owing to the size of the acetate group itself. In consequence, these regions are accessible to the free radicals generated by the fungi. Hill (2009) in his review concluded that the substrate recognition effects were very unlikely to be of importance given the inherent lack of enzyme accessibility; thus, the reduced cell-wall water content was considered to be the most likely mechanism for the high biological resistance of acetylated wood.

However, recent research works (Ringman et al. 2015, Alfrendsen et al. 2015) have demonstrated that the mechanism of substrate recognition by the fungus should be considered as very important, in combination with the lowered moisture content as distributed within the wood matrix.

According to Prof. Rowell, during the acetylation process, wood material at 100 to 120°C reacts with acetic anhydride in the absence of catalyst, and at an acetyl weight gain of 16% to 19%, approximately 90% of the lignin is esterified and 25% of the holocellulose (Rowell *et al.* 1994; Rowell 2012). As expected, 100% of the hydroxyl groups in the hemicelluloses, which are readily accessible, are substituted. It has been shown that lignin is the most reactive constituent of the cell wall during the acetylation reaction (Rowell *et al.* 1994).

Acetylated wood is presently commercialised by the company Accsys Technologies in Arnhem, The Netherlands. It is marketed under the commercial name Accoya®, utilizing mainly the species radiata pine (*Pinus radiata*) and alder (*Alnus* sp.), and technically, on the average, has a 20% acetyl weight gain. Annually, approximately 40,000 m^3acetylated timber is produced by Accsys (2017), while the company will increase its capacity to 60,000 m^3 in the year 2018 (Mantanis 2017). Accoya wood is today available in many countries, and its main uses are for exterior windows and doors, decking, cladding, andcivil construction mainly in outdoors, above- and in-ground contact (Mantanis 2017).

Today, the acetylation process, as applied in liquid phase, yields chemically modified timber that has considerably improved physical, mechanical, and biological material properties (Hill 2006; Jones and Hill 2007; Rowell *et al.* 2009; Larsson-Brelid 2013; Alexander *et al.* 2014; Gérardin 2016), which are presented below.

- The biological durability of wood (EN 350: 2016) is improved to the highest durability class ('class 1'), which corresponds to the very durable tropical species teak (*Tectona grandis*) and merbau (*Intsia* spp.), as originating from the natural tropical forests. Acetylated wood exhibits considerably increased biological resistance to brown- and white-rot fungi (Larsson-Brelid*et al.* 2000; Papadopoulos and Hill 2002; Mohebby 2003; Mohebby and Militz2010; Rowell 2012; Larsson-Brelid 2013; Alexander *et al.* 2014; Rowell 2016).
- Acetylated wood, at *ca.* 20% loading, obtains a fiber saturation point below 15%; thus, the cell wall becomes highly hydrophobic (Papadopoulos and Hill 2003; Hill 2006; Rowell 2012). Consequently, swelling and shrinkage properties are reduced by 70% to 75% as compared to untreated wood (Jones and Hill 2007; Rowell 2012). The reason for that is simply because the cell wall is filled with chemically bonded acetyl groups that take up space within the cell wall (Rowell 1983; Rowell *et al.* 1994; Hill 2006; Jones and Hill 2007).
- Accoya wood at high acetyl loading is very resistant to subterranean and Formosan termites (Alexander *et al.* 2014). This field study against termites verified the high resistance of acetylated material to attack by termites.
- Acetylated pine wood with high acetyl loading (>20% acetyl weight gain) has been shown to provide excellent resistance to borer attacks even after 11 years of field exposure; *i.e.*, in better order than chromium copper arsenate (CCA) impregnated pine wood (Westin *et al.* 2016). It is believed that acetylated wood at high loading can be confirmed as marine-borer resistant timber for long periods of time.
- An increase of 15% to 30% of hardness of the material can be reached (Rowell 2012).
- The acetylation treatment has no negative impact on the strength properties of wood (Jorissen and Luning 2010; Bongers *et al.* 2013; Larsson-Brelid 2013).
- Acetylated wood is marketed today as a 'green' product with several environmental benefits (Jones and Hill 2007; Lande*et al.* 2008; Van der Lugt*et al.* 2016). According to a recent study of Van der Lugt*et al.* (2016), acetylated wood has considerably lower carbon footprint than steel, concrete, and unsustainably sourced azobé. In fact, Accoya wood does have CO_2 negative life-cycle-analysis over a full-life cycle.

Recently in Germany, Accoya wood has gained acceptance for use in exterior windows by the German Association of Windows and Facades (VFF).

2.2. Furfurylation of wood

Research relating to chemical modification of wood with furfuryl alcohol ($C_5H_6O_2$), which has beenreferred to in the literature as 'furfurylation of wood', was initiated by Goldstein and Stamm (Goldstein 1959; Stamm 1977). By using cyclic carboxylic anhydrides, mainly maleic anhydride, as key catalysts, furfurylated wood, having properties superior to those produced with the early developed systems, was achieved by Prof. M. Schneider (1995) in Canada. Novel research was also carried out by Dr. M. Westin and his coworkers (Westin 1996; Westin *et al.* 1998; Lande *et al.* 2004a, 2004b) at SP Sweden, which led to a new technology based on stable solutions with good impregnating capacity, as well as some promising properties such as resistance to decay.

Furfuryl alcohol is a liquid produced from agricultural wastes such as sugar cane and corn cobs. Furfurylation is accomplished by impregnating the wood with a mixture of furfuryl alcohol and catalysts, and then heating it to cause polymerization (Schneider 1995; Westin 1996). The purpose of furfurylation is to improve some physical, mechanical, and biological properties of the lignocellulosic material (*e.g.*, resistance to biological degradation, dimensional stabilization, resistance to weathering, and hardness) by applying a proprietary furfuryl alcohol polymer, which notably is nontoxic (Lande *et al.* 2004b, 2008).

The polymerization of furfuryl alcohol polymer in the wood is a rather complex chemical reaction. The question of whether wood furfurylation is a true chemical modification of the cell wall remains unanswered by the scientific community. Some scientists believe that it comprises a chemical modification process, since the furfuryl alcohol polymer reacts with itself and possibly reacts with lignin in the cell walls (Nordstierma *et al.* 2008; Lande*et al.* 2008; Li *et al.* 2016; Gérardin 2016). Hence, the furfuryl alcohol complexes are predominantly deposited in the wood cavities, and also in the cell walls (Fig. 2). Polymerization takes place in the microscopic cell cavities, which is easily detected using several microscopic techniques (Thygesen *et al.* 2010). The study of Thygesen *et al.* (2010) also revealed that when higher amounts of catalyst were added to the impregnation liquid, a red-shift in the fluorescence from the furfurylated wood was seen, corresponding to an increased conjugation length of conjugated poly-(furfuryl alcohol) formed within the cell wall of wood.

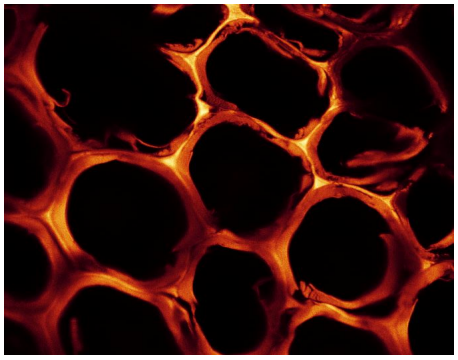

Figure 2. Cross section of radiata pine (Pinus radiata) wood with cell walls containing furan polymer. Image through fluorescence microscopy (courtesy: L. Garbrecht Thygesen, RVAU, Copenhagen)

Recent nanoindentation studies demonstrated improvements in indentation modulus and hardness of furfurylated wood cells demonstrated. The work indicated that furfuryl alcohol indeed penetrated wood cells during the modification process (Li *et al.* 2016). Another perception is that furfurylation leads to permanent 'bulking' of cell wall, meaning that the cells are swollen in a permanent way. One possible explanation is that the furfuryl alcohol polymer inside the cell wall occupies some of the space normally filled with water molecules, when wood is under swelling in humid conditions (Lande*et al.* 2008).

On the contrary, other scientists insist that furfurylation of wood is an impregnation modification process in which the properties of the furfurylated material appear more like those of a polymer-filled cell wall rather than a reacted cell wall (Rowell 2012; Larsson-Brelid 2013). However, it may be possible that a branch from the polymer chain forms a connection to the wood polymers *via* the lignin hydroxyls (Thygesen *et al.* 2010; Gérardin 2016).

The technology for industrially producing furfurylated wood is presently applied by the Norwegian company Kebony AS (formerly Wood Polymer Technologies). The industrial process of wood furfurylation consists of the following production steps (Lande*et al.* 2004a):

- ✓ Storage and mixing of chemicals: The treating solutions are mixed in a separate mixing tank where different chemicals (furfuryl alcohol, initiators/catalysts, buffering agents, surfactants, water) are added. The mixed solution is pumped to one of the buffer tanks.
- ✓ Impregnation: The wood material (i.e. treatable softwoods or hardwoods) is vacuum pressure impregnated with the treating solution by a full-cell process with a vacuum step, a pressure step, and a short post-vacuum step.
- ✓ Reaction/curing: In-situ polymerisation of the chemicals and grafting reactions with the wood polymeric components occur during this step. The curing chamber is heated with direct injection of steam, where the temperature achieved depends on the product use. The chamber is operated as a closed system during the curing period except for a ventilation period at the end. The ventilation gas is cooled, and the condensate is separated from the gas. Condensate goes back to the condensate tank for re-use.
- ✓ Drying: Final drying of the wood material in a kiln dryer is essential to minimize emissions and to obtain desirable final moisture content.
- ✓ Cleaning: The emissions during the process are managed by cleaning the ventilated gases.

By using cyclic anhydrides as catalysts, the impregnation solution is stable at room temperature. The polymerization reaction is initiated by heating. In the initial phase of polymerization, there are two competing condensation reactions (González *et al.* 1992). The possible cross-linking patterns of furfuryl alcohol polymer chains have been proposed by González *et al.* (1992), who demonstrated that the high amount of permanent wood cell-wall bulking in the furfurylated wood is evidence of the grafting reactions at early polymerization stages. In addition, it has been concluded (González *et al.* 1992; Lande*et al.* 2004b) that with the catalytic systems used for furfurylation of wood it is more likely that grafting to hemicelluloses and most of all to lignin is dominant. As a consequence, a possible grafting reaction between the furfuryl alcohol and a guaiacyl unit of lignin (the predominant unit in softwood lignins) is evidently probable. Gérardin (2016) in his recent review work reported that the furfurylation of wood as a process is based on the *in-situ* polymerization of furfuryl alcohol, with the main chemical reactions demonstrated in Fig. 3.

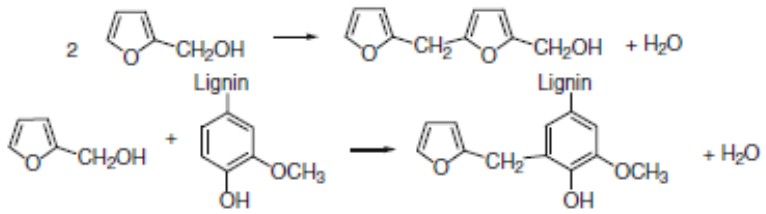

Figure 3. Main reactions involved in the polymerization of furfuryl alcohol (Gerardin 2016)

According to the literature (Lande*et al.* 2004a; Lande 2008; Lande *et al.* 2008; Rowell 2012; Larsson-Brelid 2013; Mantanis and Lykidis 2015), the furfurylation process results in a modified wood product that has significantly improved material properties and characteristics, which are summarized below.

- The biological durability of wood is upgraded to 'class 1' (Gérardin 2016) according to EN 350 (2016). Results from decay resistance test ongoing for 9 years, have shown that furfurylated wood of moderate loading, *e.g*., at 30to35% of weight percentage gain (WPG), has comparable biological resistance with that of pine wood treated with copper chromium arsenate (Lande *et al.* 2008; Larsson-Brelid 2013).
- The mechanical properties of wood, except for impact resistance, are enhanced when wood is treated with the furfuryl alcohol polymer. As a matter of fact, furfurylated wood is characterized by greater hardness, elastic and rupture moduli, as compared to untreated wood but, on the other hand, it is more brittle (Larsson-Brelid 2013).
- Furfurylated wood at a loading>35% exhibits very good dimensional stability (Lande*et al.* 2008), and resistance to weathering (Mantanis and Lykidis 2015). It was reported that furfurylation leads to an anti-shrink efficiency of 60%, at a WPG of approximately 35% (Lande*et al.* 2008).
- Furfurylated wood is resistant to marine borers (Westin *et al.* 2016) only when the WPG is very high (>50%). Not really satisfactory results were obtained after 16-year exposure at reasonable loadings of 30to35% (*i.e*., slight or moderate wood failure to marine borers was observed at these levels of WPG or lower).
- Recent studies regarding ecotoxicology of furfurylated wood and leachates from furfurylated wood have shown no significant ecotoxicity, while its combustiondid not release any volatile organic compounds or polyaromatic hydrocarbons above the normal levels of wood combustion (Pilgård*et al.* 2010a, 2010b).
- Furfurylated wood is a 'green' wood product that holds an ecological label in the Scandinavian market, named '*Swan'*. Furfurylation of wood is, therefore, believed to be a safe process for the environment (Gérardin 2016).

At present, the company Kebony AS in Norway produces two distinct furfurylated wood products, namely:

i) 'Kebony Clear': a highly-loaded, dark, hard furfurylated wood currently used for flooring that simulates tropical hardwood. The wood species used for this are radiata pine (*Pinus radiata*), southern yellow pine (*Pinus sp*.), and maple (*Acer sp*.). Typically, the mean WPG of this product is approx. 35%.
ii) 'Kebony Character': a more lightly-loaded furfurylated wood presently used as decking, siding, roofing, and outdoor furniture mainly sold in the Scandinavian markets. This wood material is produced today from Scots pine *(Pinus sylvestris)* wood; it has an average WPG of ca. 20% (Mantanis 2017).

In addition, Kebony wood has been recently used in the production of exterior windows. Following a series of extensive quality tests in Germany (Bollmus*et al.* 2012), furfurylated wood has been recommended by the German Association of Windows and Facades. Results from a project, entitled 'Winfur', indicated that the use of furfurylatedwood in windows has not caused any problems, fulfilling the criteria for the Scandinavian *P-mark* and the German *RAL* certificates (Bollmus *et al.* 2012).

Today, the company Kebony AS (Norway) produces the above-listed modified products at approximately 22,000 m^3 annually (as in 2017). It is expected to increase its production capacity by building a new factory in Belgium (Mantanis 2017).

2.3. Modification of wood with thermosetting resins

Historically, the first experiments on impregnation modification of wood using formaldehyde-based resins were carried out by Dr. A. Stamm and co-workers during the 1940s. Their initial research work included impregnation of wood with phenol-formaldehyde resins to up to 100% resin addition, which resulted in an improved dimensional stability (anti-shrink efficiency, ASE up to 58%) and improved resistance to biodeterioration against fungi, termites, marine borers. Initial experiments using wood veneers by applying impregnation with phenol-formaldehyde (PF) resins, and also heat and compression, have been made by Stamm and Seborg (1955) leading to the production of products called *Compreg* and *Impreg*.

Manufacture of *Compreg* is currently taking place in a number of industrial sites in the USA, Pakistan and India under different brand names. *Compreg* and related products (Fibron*, Permali, Dymonwood, C-K Composites*) have very good dimensional stability, and high strength properties like hardness, abrasion resistance and compression strength (Hill 2006). Products resulting from these impregnation treatments have been used in the manufacture of knife and tool handles, musical and electrical instruments but not directly for preservation purposes (Gérardin 2016). The volumes of these products are today very low (Hill 2006).

Research on the impregnation modification of wood with melamine-formaldehyde (MF) resins has been increased in the recent decades, especially in Europe, with positive results in respect to dimensional stability and biological resistance to brown-rot fungi (Kielmann et al. 2012). Main drawbacks still remain are the high production cost and the tendency of such wood products to cracking under humid-dry cycle conditions. In nowadays, none of these impregnation modification methods has reached the full scale level.

2.4. Modification of wood with DMDHEU

This technology was transferred from the treatment of non-wood systems. As a matter of fact, it involves the impregnation of pine wood, a known highly porous species, with the reagent 1,3-dimethylol-4,5-dihydroxyethyleneurea (DMDHEU). This reagent (Fig. 4) was well utilised in the industry of textiles until the 1980s in an attempt to manufacture wrinkle-free fabrics. Wood modification with DMDHEU has been shown to improve dimensional stability and durability, and to slightly reduce the moisture uptake of wood (Militz 1993).

Militz (1993) was the first scientist to successfully report on the use of DMDHEU in treating wood, with very positive results. Prof. Militz tested beech wood treated with DMDHEU and demonstrated its effectiveness by using a variety of catalysts. It was finally found that temperatures of 100°C were necessary for the effective curing of the resin system. Noticeably, the anti-shrink efficiency (ASE) value of DMDHEU-treated wood was found to be ca. 75%.

Since then, the process has been undertaken considerable improvements by Militz and co-workers (Krause et al. 2003, Xie et al. 2005), from which commercial application has been finally achieved in Germany. This impregnation modification process is marketed today by the German company BASF under the commercial name *Belmadur*® (Fig. 4).

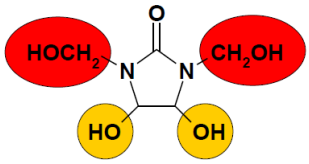

Figure 4. The reagent 1,3-dimethylol-4,5-dihydroxyethyleneurea (DMDHEU).

This technology is considered to be an innovative modification process under which pine wood, typically Scots pine, is impregnated under high pressure (12-14 atm) and polymerised by curing. The whole process is based on simple production stages. The first stage consists of penetrating the wood with a proprietary DMDHEU solution, that is, an aqueous solution of a chemical agent (Militz 1993). The air is removed from the cell structure by applying a vacuum to ensure that the agent can reach the innermost cells when the solution is applied under pressure. The next stage consists of the drying of impregnated wood at a slow rate at a temperature of 100-120°C under humid conditions. This causes the agent molecules to cure by polycondensation, and water is released (Krause et al. 2003, Krause & Militz 2009).

The modified product has highly reduced hygroscopic properties (Krause & Militz 2009, Papadopoulos and Mantanis 2012, Larsson-Brelid, 2013). The ASE values of up to 70% can be achieved (Krause and Militz 2009), but normally is in the range of 30-40% (Krause et al. 2003). The mechanisms of the reaction between DMDHEU and the cell wall polymers are still not clear (Hill 2006, Larsson-Brelid 2013). It has been shown that the modification of wood with DMDHEU produces a bulking effect, while results from Dieste et al. (2009) have shown indications that DMDHEU reduces the pore size of the samples by occupying the void space present in the cell walls.

Belmadur wood production is still very small in Germany. The producing German company, Münchinger, belongs to the BASF group, and until today is focusing on the German market. Key applications so far have been decking and garden furniture. However, a laminated Belmadur product has gained acceptance by the German association of Windows and Facades (VFF) for use in exterior windows. The resistance of Belmadur wood to marine borers is very good (Larsson-Brelid 2013). However, the drawbacks are brittleness, tendency to cracking and high emissions of formaldehyde from the product. As a matter of fact, the present technical and market developments of Belmadur technology are not known.

2.5. The indurite process

The so-called 'Indurite process' has been developed from a comprehensive survey of possible reactions of wood cell walls with polymer systems. The technology was scaled-up by the company Engineered Wood Solutions in New Zealand (Hill 2006), and afterwards, it has been obtained by the company Osmose. The original concept for Indurite was undertaken to upgrade home-grown radiata pine *(Pinus radiata)* by impregnation of wood with a water-soluble polysaccharide solution (soy and corn starch).

The impregnated material is held in a covered area for some hours, and then the curing step takes place in a temperature-controlled conventional kiln with the use of certain catalysts in the solution (Hill 2006). Major advantage is that there is no need of significant equipment investment. This modified wood is claimed to be used presently in exterior applications such as cladding and decking. However, the present developments of this technology are not clear.

2.6. The keywood process

According to Larsson-Brelid (2013), a new product named *KeyWood*, that resembles furfurylated wood, was developed within an EU funded project ('Ecobinders'). The reactant that contains small amounts of tri-hydroxy-methyl furan (THMF) and furfuryl alcohol is more water soluble than furfuryl alcohol itself, and easily penetrates the cell wall. After curing of the THMF-impregnated wood, the polymer formed within the cell wall resembles the polymer formed by the Kebony process. However, unlike furfurylated wood, no covalent bonds to the cell wall polymeric constituents (lignin, hemicelluloses, cellulose) were detected in the analytical studies within the project 'Ecobinders'.

Furthermore, due to the higher amount of remaining hydroxyls in the polymer as well as to no bonds to the lignin, the *KeyWood* product has higher equilibrium moisture contents than furfurylated wood at the same level of relative humidity. Furthermore kiln drying temperatures of 125°C are necessary for sufficient curing; consequently, this temperature causes problems with cracking and brittleness. As of today, the technology was sold to the company Arch SA in 2009, but the production volumes seemed to be very small. Meanwhile, the present market developments of the *KeyWood* process are not clear and have not been disclosed publicly.

2.7. Modification processes of wood using monomers

Vinyl monomer impregnation of wood, followed by in situ polymerization, represents another promising way to enhance mechanical, dimensional and thermal stability as well as fungal and insect resistance to wood species of poor natural durability. Different commercially available vinyl monomers such as acrylonitrile, glycidyl methacrylate, methyl methacrylate, hydroxyethylene methacrylate, ethylene glycol, dimethacrylate, butyl acrylate, butyl methacrylate, styrene, acrylamide or acrylonitrile have been investigatedby several scientists (Hill 2006, Rowell 2012).

According to the nature of the monomer used, polymerisation can take place either in the cell lumens, in the cell wall, or in both (Schneider 1995). Polymerisation can be initiated by different means using either thermal free radical initiator, or gamma radiation. X-rays, derived from a high-energy, high current electron beam can be also used to initiate in situ polymerisation of vinyl monomers. X-rays initiated polymerisation and penetrated through thick pieces of wood, where polymerisation took place allowing polymerisation of the monomers in the cell walls of wood. Having entered the cell walls and then being polymerised within the cell walls, these radiation-cured treatments increased the dimensional stability of treated wood (Gérardin 2016). Nevertheless, all of the above mentioned techniques have not resulted in commercial applications up to date.

3. Conclusions

This work briefly reviewed the most known wood modification technologies based upon chemical processes, up to date. These technologies have given rise to new modified products with, more or less, improved physical, mechanical, and biological properties. This fact can gradually change the mistaken perspective of customers about wood being a fragile, instable, and easily degraded construction material. For each of them, as disclosed in the literature, a very large number of quality tests have been carried out worldwide, demonstrating the technical advantages and enhanced durability of the modified timber products.

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This review paper acknowledges the most respected wood scientist, namely, the late Dr. Alfred J. Stamm (Forest Products Laboratory, Madison, Wisconsin, USA) for his pioneering scientific contributions on the modification of wood in general.

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Physical and thermal properties of injection molded HDPE based composites reinforced with waste tire powder and red pine wood wastes

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Abstract: The number of vehicles produced is increasing day by day with developing technology and population growth. Parallel to this, the numbers of tires are also increasing. The tires have ten years lifetime without using. Life expectancy of tires on use reduces less than 5 years. There will be great amount of waste tires in the future. In this study, waste tire powder was used as filler in the manufacturing of HDPE based wood-plastic composites. Waste tire micronized powder (WTP) was used as received from the plant. Retained on 200 mesh size sieve red pine wood wastes flour (RPWF) was also used as lignocellulosic filler. High-density polyethylene (HDPE) was pulverized in Pulverizator with cooling capabilities into the flour form. Maleic anhydrite grafted polyethylene (MAPE) and paraffin wax were utilized as coupling agents and a lubricant, respectively. The blends included HDPE, WTP, RPWF, MAPE and wax were compounded in a single-screw extruder at 40 rpm screw speed in the temperatures of 170-200 °C. After extruded blends were injection molded using an HDX-88 Injection Molding Machine (pressure: 100bar; injection speed: 80mm/sec; screw speed: 40rpm) to produce standard test samples. Water absorption, thickness swelling and thermal (TGA and DSC) properties of produced composites was investigated. With the addition of RPWF, water absorption and thickness swelling properties were increased. In addition, tensile properties, flexural properties, impact properties, harness properties, density and morphology of composites were determined in our previous study. Density of composites increased with addition of both fillers.
Keywords: HDPE, Waste tire powder, Red pine wood wastes, Thermal and physical properties, Injection molded

1. Introduction

About 318.4 million tires were produced in The United States in 2016 (Rubber Manufactures Association (RMA), 2017). At the end of December 2014, there are 18 million 828 thousand 721 vehicles on roads (Turkish Statistical Institute Report, 2015). The number of vehicles produced is increasing day by day with developing technology and population growth and as well as the number of tires are also increasing. The tires have ten years lifetime without using. With using that time reduces less than 5 years. It was reported that there was 10 million of waste tires all over the Brazil (Marques et all, 2008). Inaddition, approximately, 25.918 tons of the scrap tires are generated for a year in Algeria (Bekhiti et al., 2014). According to The Ministry of Environment and Urbanization of Turkey, 315.000 tons of waste tires were sold in renovation market in 2015 (LASDER, 2017). There will be occurred great resource for waste tires. However, most of the wastes are burned or abandoned to nature. These methods causes to some environmental problems such as air pollution. There are also some uses for waste tires such as into tire-derived fuel, used by the civil engineering applications, recycled by the ground rubber applications, land disposed and etc. (Lin et all, 2008). That great resource can be utilized in the production of lignocellulosic polymer composites as a filler material.

In previous studies, polystyrene (PS), polypropylene (PP), polyethylene (PE), polyvinyl chloride (PVC), etc. as thermoplastic materials and wood flour, agricultural residue and industrial lignocellulosic waste were used in polymeric composites. In previous studies, 40-80 mesh size lignocellulosic materials were used by researchers (Karakuş, 2008; Mengeloglu and Kabakcı, 2008; Dönmez Cavdar, 2011; Avcı, 2012; Acar, 2014). Red pine wood wastes flour (RPWF) is also great resource for lignocellulosic material and it might be utilized in production of wood composite materials.

In this study, RPWF and WTP were used as filling material in pulverized high-density polyethylene-based thermoplastic composites. Thermal and physical properties of the produced composite were determined.

2. Materials and methods

2.1. Materials

High-density polyethylene (HDPE) was pulverized in Pulverizator with cooling capabilities into the flour form. Pulverized high-density polyethylene (HDPE) was used as thermoplastic matrix and red pine wood wastes flour (RPWF) and waste tire powder (polybutadiene)(WTP) were used as fillers. Waste tire powder (WTP) was used as received from the plant. The plant was manufactured four different size of WTP (micronized powder, 0-1mm, 1-3 mm and 3-4 mm). Micronized waste tire powder was used for this study. Red pine wood wastes flours (RPWF) were screened and retained on 200 mesh size sieve were used. Maleic anhydrite grafted polyethylene (Licocene PEMA 4351 by Clarient) was utilized as coupling agents.

Paraffin wax (K.130.1000) was used as a lubricant. RPWF were collected from timber plant in the city of Kahramanmaraş, and also waste tire powder (WTP) was obtained from the ORBAY PLASTIK KAUÇUK GERİDÖNÜŞÜM SANAYI in the city of İzmir, TURKEY.

2.2. Methods

2.2.1. Composite manufacturing

The experimental design of the study was presented Table 1. Depending on the formulation given HDPE, RPWF, WTP, MAPE and paraffin wax were dry-mixed in a high-intensity mixer to produce a homogeneous blend. These blends were compounded in a single-screw extruder at 40 rpm screw speed in the temperatures (barrel to die) of 170-180-185-190-200 °C. Extruded samples were cooled in water pool and then granulated into pellets. The pellets were dried in oven at 103 °C (±2) for 24 hours. Dried pellets were injection molded using an HDX-88 Injection Molding Machine (pressure: 100bar; injection speed: 80mm/sec; screw speed: 40rpm) to produce standard test samples.

Table 1. Manufacture schedule

ID	Pulverized HDPE (%)	RPWF (%)	WTP (%)	MAPE (%)	WAX (%)
TP 1	94.0	0	0.0	3.0	3.0
TP 2	86.5	0	7.5	3.0	3.0
TP 3	79.0	0	15	3.0	3.0
TP 4	71.5	0	22.5	3.0	3.0
TP 5	79.0	15	0.0	3.0	3.0
TP 6	71.5	15	7.5	3.0	3.0
TP 7	64.0	15	15	3.0	3.0
TP 8	56.5	15	22.5	3.0	3.0
TP 9	64.0	30	0.0	3.0	3.0
TP 10	56.5	30	7.5	3.0	3.0
TP 11	49.0	30	15	3.0	3.0
TP 12	41.5	30	22.5	3.0	3.0

2.2.2. Thermal property testing

Thermal properties of the composites were investigated with thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). TGA of the samples was performed in a Shimadzu TGA-50 thermal analyzer at a heating rate of 10°C/min under nitrogen with 20 mL/min flow rate. 10 mg of powdered test samples were used for the analysis. The samples were heated from room temperature to 800°C. DSC analysis was performed by Shimadzu DSC-60. The samples were heated from room temperature to 500°C at a heating rate of 10°C/min under a dry nitrogen atmosphere with a 30mL/min flow rate. Degree of crystallinity (X_c %) was determined from the second melting enthalpy values using the fallowing equation:

$$\text{Xc}\ (\%) = \frac{\Delta\text{Hm}}{(1-\alpha) * \Delta\text{Hc}} * 100$$

ΔHm (J/g) : Melting enthalpy of the specimens
ΔHc (286.7 J/g) : The enthalpy value of melting of a 100% crystalline form of high-density polyethylene (HDPE)
(1-α) : The weight fraction of polymer into the composite material.

2.2.3. Physical property testing

Water absorption (WA) and thickness swelling (TS) of the thermoplastic composites were determined according to ASTM D 1037 (1996) and EN 317 (1993), respectively. Test samples were conditioned in an acclimatized room at 20°C and 65% relative air humidity before testing. The weight and thickness of samples were measured. The measured samples were dipped into water and their weight and thickness were measured periodically. Five samples were tested for each composite group.

3. Results and discussion

3.1. Thermal properties

Thermal properties of all groups were determined with thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). The thermographs of the TGA and DTGA analysis of the composites were given in Figure 1 and 2, respectively. Six different groups were given in the thermographs. When the manufacture schedule was examined, TP1 group did not include any filler, just has coupling agents and paraffin wax. To mention on that group, thermal degradation was observed single-stage and it was started at 425 °C and finished at 510 °C. Maximum thermal degradation was occurred at 492.8 °C with 93.2% amount of decomposition. Residue amount was 0.8% at 520 °C for TP1.

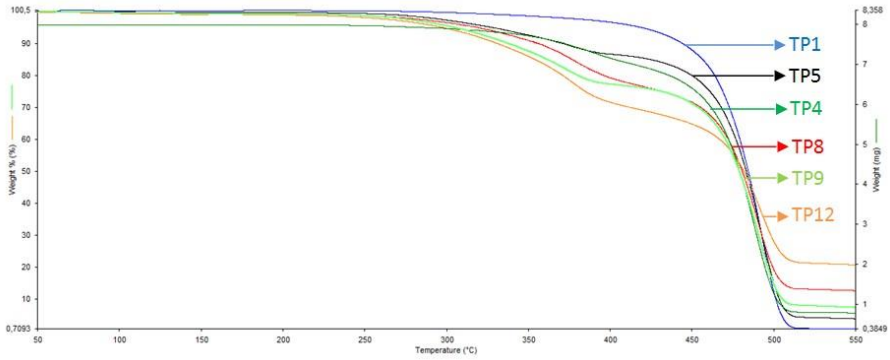


Figure 1. TGA Thermographs of Composites

Thermal degradation occurred in two stages for TP4 composite group produced with maximum waste tire powder rate (22.5%) (WTP) and without red pine wood wastes flours (RPWF). In the first stage, a small amount of thermal degradation occurred, while high amount in the second stage. The first decomposition temperature range was determined between 300 and 430 °C in first stage. Maximal degradation was observed at 351.4 °C with 13.6% rate. Second degradation began at 430 °C and finished 510 °C. Maximal degradation was observed at 487.9 °C with 75.2% rate. Residue amount was 10.04% at 520 °C for TP4. When TP1 and TP4 were compared, residue amount at 520 °C was increased with loading of the maximum WTP rate in HDPE matrix.

Thermal degradation occurred in two stages for TP3 and TP5 composites groups. They were produced with the same filler rate but TP3 included 15% WTP, while TP5 15% RPWF. Thermal degradation occurred in two stages for TP3 and TP5 composites groups. They were produced with the same filler rate but TP3 group included 15% WTP, while TP5 group 15% RPWF. The first decomposition temperature range was determined between 360-435 °C and 275-430 °C for TP3 and TP5 groups in first stage, respectively. In addition, maximal degradation was observed at 400.7 °C with 7.32% rate for TP3 group, while at 375.9 °C 14.4% for TP5 group in the first stage. To mention on the second stage of degradation, both composites were decomposed at closed temperature range. It was between 435-510 °C for TP3 group, while between 440-510 °C for TP5 group. Maximal degradations were observed at 490.7 °C with 79.6% rate and 492.6. °C with 78.6% rate for TP3 and TP5 groups, respectively. That second decomposition temperature peak for HDPE based composites was identical with the decomposition temperature of TP1 group which produced without filler (492.8°C). It was also reported that decomposition temperature of neat HDPE was 470 °C (Mengeloğlu and Karakuş, 2008). Moreover, first decompositions started with WTP and RPWF for TP3 and TP5 groups in the first stage, respectively. They degraded closed temperature range. However, WTP was more thermal stability than RPWF. Degradation started at 275 °C for RPWF, while at 360 °C for WTP. Residue amounts at 520 °C were 6.9% for TP3 group and 4.3% for TP5 group. When usage rates were same for WTP and RPWF, residue amount at 520 °C was higher while WTP used.

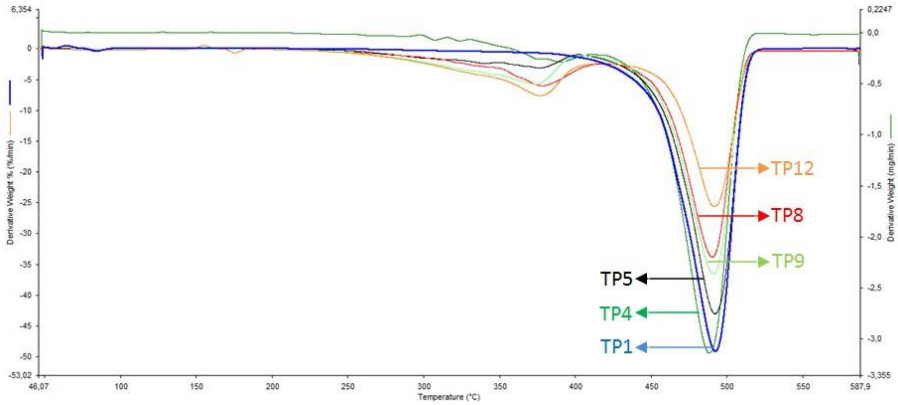


Figure 2. DTGA Thermographs of Composites

If the DTGA thermographs of composites were examined (Figure 2), It could be said that the thermal decomposition started earlier in the groups produced with maximum RPWF rate than produced with maximum WTP rate. Maximum residue amount at 520 °C was observed from TP12 group produced with maximum WTP rate (22.5%) and maximum RPWF rate (30%).

Results of Differential Scanning Calorimetry (DSC) analysis was presented in Table 2. When Table 2 was examined, melting temperature was same for all composites. However, the crystallinity ratio of polymer (Xc) which calculated by the help of energy for melting (ΔHm) shown variety. With the loading of the both fillers in HDPE matrix, melting temperature of composites and crystallinity ratio of polymer was slightly changed. DSC results of the composites were similar to control group. More precise results might be reached through XRD analyses.

Table 2. Results of Differential Scanning Calorimetry (DSC) analysis

ID	Tm	ΔHm (J/g)	ΔHc (neat HDPE) (J/g)	Xc(%)
TP 1	132.7	151.6	286.7	52.88
TP 2	132.7	142.8	286.7	53.85
TP 3	132.8	126.9	286.7	52.07
TP 4	132.6	118	286.7	53.11
TP 5	132.7	124	286.7	50.88
TP 6	132.7	119	286.7	53.56
TP 7	132.4	105	286.7	52.32
TP 8	132.5	91.8	286.7	51.23
TP 9	132.4	103.9	286.7	51.77
TP 10	132.4	94.3	286.7	52.63
TP 11	132.4	72.3	286.7	45.85
TP 12	132.3	69.9	286.7	51.33

3.2. Physical properties

High-density polyethylene (HDPE) based red pine wood wastes flour (RPWF) and waste tire powder (WTP) filled composites were produced in the density range of 0,94-1.07 g/cm^3. Mean density values are presented in Table 3. Both WTP and RPWF filed composites had slightly higher densities than neat HDPE. Compared the WTP filling, RPWF filling increased the density twice as much. This increase was believed to be due to the higher cell wall density of lignocellulosic materials (Mengeloglu and Karakus 2008).

Table 3. Density of the manufactured composites

ID	Density (g/cm^3)	ID	Density (g/cm^3)	ID	Density (g/cm^3)
TP 1	0.94 (0.008)*	TP 5	0.97 (0.003)	TP 9	1.04 (0.002)
TP 2	0.95 (0.006)	TP 6	0.99 (0.003)	TP 10	1.06 (0.001)
TP 3	0.96 (0.005)	TP 7	1.02 (0.002)	TP 11	1.07 (0.005)
TP 4	0.98 (0.003)	TP 8	1.03 (0.002)	TP 12	1.09 (0.002)

* The numerical value in the parenthesis is standard deviation.

In this paper, water absorption and thickness swelling properties of all samples were determined for physical properties. The graphs of water absorption and thickness swelling properties are given in Figure 3-4. When Fig.3 and 4 examined, some of the composites did not reach the maximum water sorption and thickness in 113 days of testing. The results are ambiguous and it is hard to interpret with available data. However, the following conclusion can be reached with the available data;

- ✓ With the increasing of RPWF rate in the polymer matrix, water absorption properties were getting worse,
- ✓ Usage of WTP as filler in the composites provided better water absorption properties than usage of RPWF,
- ✓ It was hard to establish exact result for thickness swelling properties but it might be understood from Fig 4 thickness swelling properties of composites were shown parallel results with water absorption properties

Moreover, further study needs to be done to understand variety in behavior of produced samples.

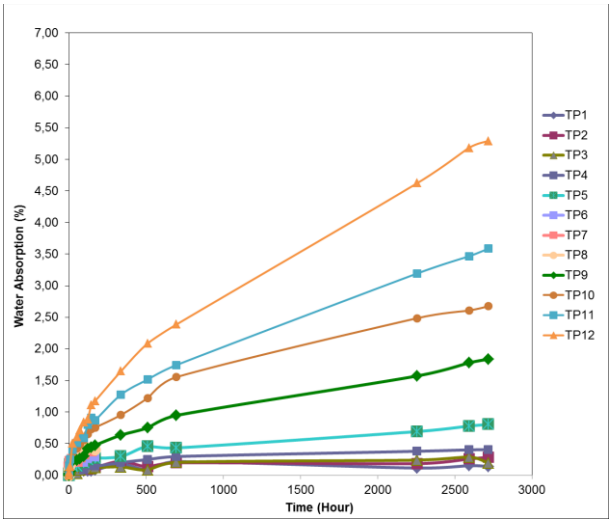


Figure 3. Water absorption properties

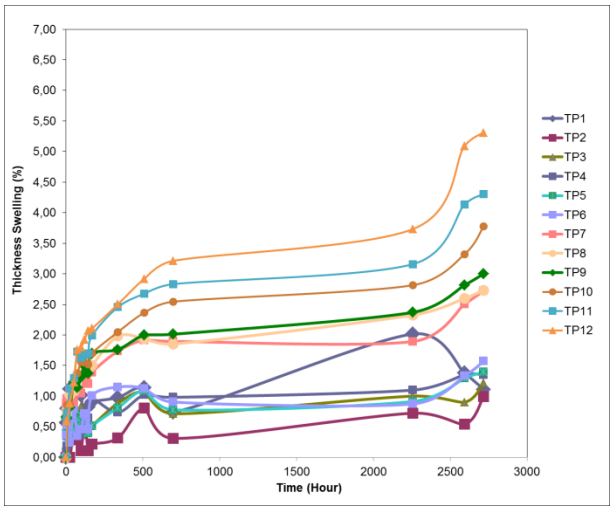
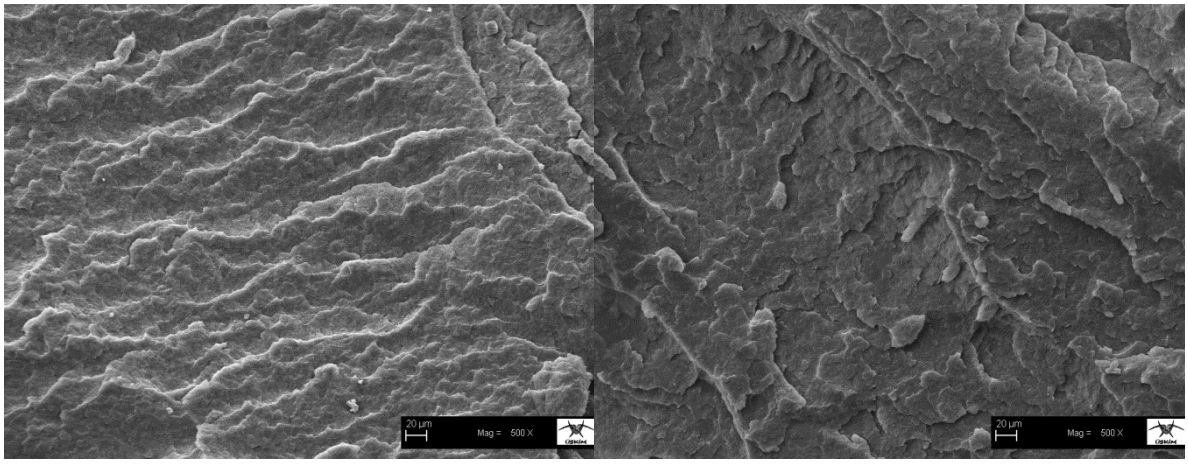


Figure 4. Thickness swelling properties

Morphology of the some of the produced samples was also studied. SEM images of neat HDPE samples (sample ID: TP1) and with highest WTP filler rate without RPWF (sample ID: TP4) was presented in Fig 5. SEM images of composite with 0% WTP and 15% RPWF content samples (sample ID: TP5) and with highest WTP and 15% RPWF rate (sample ID: TP8) was shown in Fig 6. SEM images of composite with 0% WTP and highest rate of RPWF content samples (sample ID: TP9) and with highest WTP and RPWF rate samples (sample ID: TP12) was shown in Fig. 7.



a b

Figure 5. SEM images of a- TP1; b- TP4

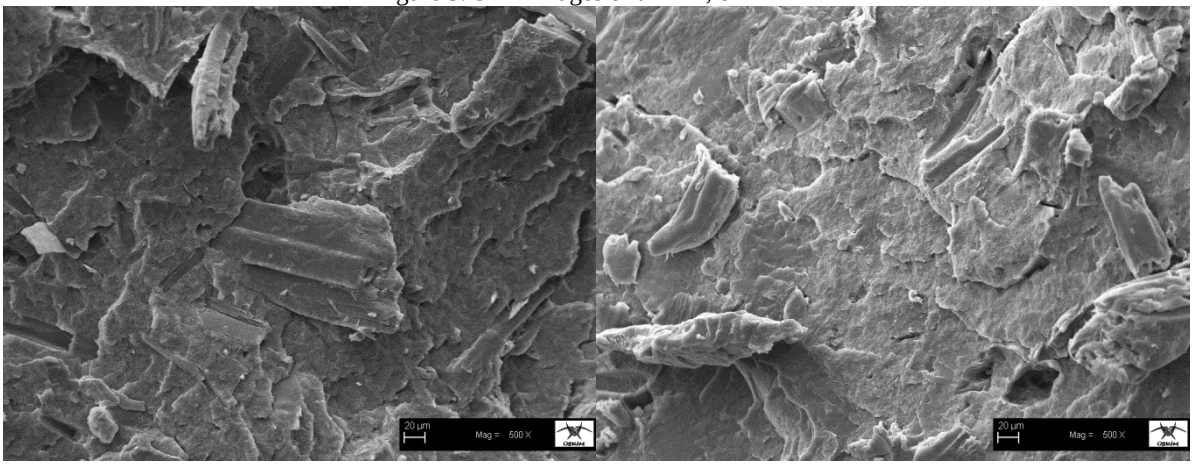


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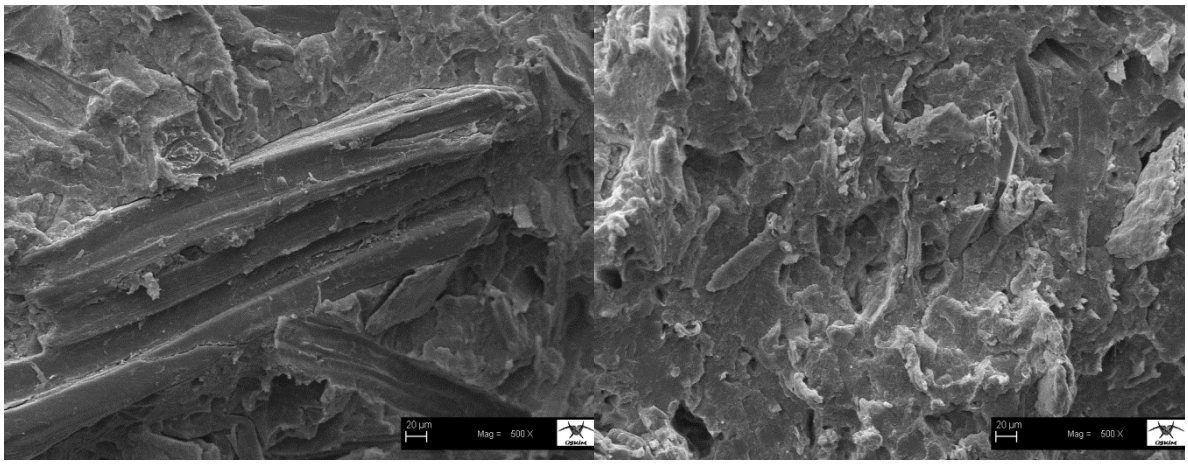
Figure 6. SEM images of a- TP5; b- TP8



a b

Figure 7. SEM images of a- TP9; b- TP12

From these images, it is clear that polymer matrix, red pine wood waste flour (RPWF) and waste tire powder (WTP) were successfully mixed. In all composites, there are individual lignocellulosic fibers and tire powder pull out of the matrix indicating the lack of adhesion between the fillers and polymer matrix.

4. Conclusion

In this study, Red Pine Wood Wastes Flour (RPWF) and Waste Tire Powder (polybutadiene) (WTP) were successfully utilized in the manufacturing of HDPE based composites as filler. Thermal (TGA and DSC), water absorption and thickness swelling properties of produced composites were determined and the following conclusions were reached;

Loading of the both fillers was raised residue amount at 520 °C. However, with the same usage rate, residue amount at 520 °C was higher while WTP used. WTP was more thermal stability than RPWF. With the loading of the WTP and RPWF fillers in HDPE matrix, crystallinity ratio of polymer was slightly changed. However, XRD analyses might be used for more precise results. Loading of the RPWF was more effective than loading of the WTP on the physical properties.

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Durability of a natural flavonoid inserted wood against various fungi

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Abstract: Wood has excellent mechanical properties, however outdoor utilization of this renewable resource as an engineering material is limited by unfavorable properties such as low dimensional stability upon moisture changes and a low durability against decaying organisms and insects. However, some wood species are known to produce wood of higher quality by inserting phenolic compounds in the already formed cell walls which is called heartwood formation. In the present study, we transferred the principles of heartwood formation in black locust (*Robinia pseudoacacia*) as a bio-inspiration modification to improve durability of Siberian pine wood by a chemical treatment with commercially available extractable flavonoids. Tosylation treatment was carried out before flavonoid impregnation for hydrophobization of cell walls. The effect of natural flavonoid insertion into wood was studied to improve it's durability by using various fungi. Wood samples including un-treated controls were exposed to brown rot fungi, *Coniophora puteana* and *Postia placenta* attack according to the EN 113 standard, and mold fungi, *Penicillium chrysogenum* and A*spergillus niger* according to the ASTM D4445-10 standard. Flavonoid inserted samples showed higher decay resistance of 50-84% against brown rot fungi but lower resistance against mold fungi than controls. The weight loss results clearly demonstrated modified samples did not have sufficient protection against *P. placenta* according to EN 113 standard since the modified samples had more than 3% weight loss in decaying test but they were found efficacious in suppressing *C. puteana* attack. Mold growth in modified samples was not inhibited by flavonoid insertion. Especially, growth of *A. niger* was very aggressive on both modified and control samples in petri dishes from the first week to the end of the incubation period. Consequently, it is suggested that more successful biomimetic modifications may lead to alternative cell wall modification procedures and improve durability of wood as an engineering material.
Keywords: Brown rot fungi, Decay resistance, Durability, Heartwood, Natural flavonoid, Mold fungi

1. Introduction

The low durability of wood limits its utilization especially in outdoor fields (Rowell, 2000; Hill, 2006). It is known that the wood cell wall determines the main structural properties of wood. Cell walls are composed of bio-synthesized cellulose fibrils embedded in hemicellulose and lignin matrix (Fengel et al, 1984; Salmen et al, 2009). Due to specific chemical structure of wood, its unprotected application in the presence of high moisture results in biodegradation of cell walls by fungi and insects.

Producing durable wood timber by chemical treatment and cell wall modification has been a common application to protect wood from bio-organisms. Anhydrides, carboxylic acids, acid chlorides, isocyanides, epoxides, aldehydes, silicon-containing compounds, graft polymerization methods etc. have been used so far for wood property improvement (Rowell, 2000; Mai et al, 2004; Hill, 2006; Cabane et al, 2016). These chemical treatments are mainly aiming to make covalent bonding between related chemical and cell wall polymers or making cross-links. Such chemical modifications increase hydrophobicity of wood, so reduce water and humidity uptake.

Another treatment model is filling the nano and micro-voids of cell walls which again limit humidity entrance inside cell walls of wood. Thus possible fungi attack can be limited, because fungi can grow inside wood at certain humidity level (Rowell, 2000). Flavonoids which are polyphenolic chemicals found in heartwood of some wood species, can affect wood quality and characteristics significantly, especially durability and color (Magel, 2000; Taylor et al, 2002; Pallardy et al, 2008).

In this study, we bio-inspired from the heartwood formation in black locust to improve the durability of Siberian pine wood, an economically valuable wood species, which has a low durability. Similar wood modification approaches have been reported with different molecules such as simple or polycyclic phenolic compounds (Sakai et al, 1999; Matsunaga et al, 2000; Obataya et al, 2000; Ermeydan et al, 2012). However, a new method of modification with a natural hydrophobic flavonoid has been used for the first time in the study, and there is no literature found that reports fungal resistance of modified wood with flavonoids. In this study, fungal resistance of modified wood with a natural flavonoid, Chrysin, exposed to brown rot fungi, *Coniophora puteana* and *Postia placenta* according to the EN 113 standard, and mold fungi, *Penicillium chrysogenum* and A*spergillus niger* according to the ASTM D4445-10 standard was evaluated.

2. Materials and methods

2.1. Modification process

Para toluene sulfonyl chloride, pyridine, 5,7-Dihydroxyflavone (Chrysin) were bought from Sigma-Aldrich and used as received. Siberian pine (*Pinus sibirica*) wood samples were cut parallel to grain direction and sawn into blocks of 0.5 × 1.5 × 3.0 cm^3 (tangential x radial x longitudinal). Tosylation reaction of pine wood cell walls was carried out as follows. The Siberian pine sapwood samples were dried at 60 °C for 1 day. 25 replicates were weighed (25,7 g, 0,158 mol, calculated as a glucopyranose (MW:162 g/mol)equivalent). 300 mL of pyridine was added to the samples in the flask for swelling for 1 day. The flask was stored in an ice bath with the reactants. P-toluenesulfonyl chloride (45 g, 0,238 mol) was added to the solution and reacted for 1 day at 5 °C.

Before impregnation of flavonoid in the cell walls, 3 g of Chrysin was dissolved in 340 ml acetone (7,5:1) ethanol mixture. Tosylated pine wood samples were washed with pyridine for 3h to leach out the unreacted tosylates before Chrysin process. Chrysin solution was poured onto the swollen and tosylated samples. Acetone was evaporated harshly by heating the flask to 80°C under vacuum to remove acetone. After evaporation of acetone, samples were washed with distilled water by stirring to leach out pyridine and flavonoid molecules that had not been impregnated in the cell walls but precipitated in the lumen.

2.2. Decay-resistance test

Decay performance was determined using the mini-block agar plate test according to principles EN 113 standard with some modifications. Samples were sterilized in an autoclave by steaming, and then placed into petri dishes inoculated with the brown-rot fungi, *Coniophora puteana* (Schumach.) P. Karst. (Mad-515) and *Postia placenta* (Fr.) Lars. & Lombard (Mad-698-R). After 8-week-exposure period at 20°C and 65% RH, weight loss that had occurred in the samples during fungal exposure was calculated.

2.3. Mold-resistance test

Modified and control samples were evaluated for resistance to mold fungi according to the ASTM D4445-10 standard method with slight modifications. Two mold fungi, *Aspergillus niger* ATTC 16434 and *Penicillium chrysogenum* ATTC 101016 were grown on 4% malt agar at 25°C and 80% RH. Spore suspension was prepared by adding 10mL to petri dishes and rubbing the surface of culture. Suspensions were diluted to yield $1.42x10^7$ spores for *A. niger* and $1.52x10^7$ spores for *P. chrysogenum*. Spore suspensions of 0.25 mL were leaved along the length of one flat side of each sample in the petri dishes. All samples were then incubated at 25°C and 80% RH for four weeks. Following incubation, specimens were visually rated every week on a scale of 0-5 with 0 indicating the specimen is completely free of mold growth and 5 indicating the specimen was completely covered (0: no growth, 1: 20%, 2: 40%, 3: 60%, 4: 80%, 5: 100% coverage with mold fungi). At the end of the test weight loss of samples was also calculated.

3. Results and discussion

3.1. Modification process and physical changes

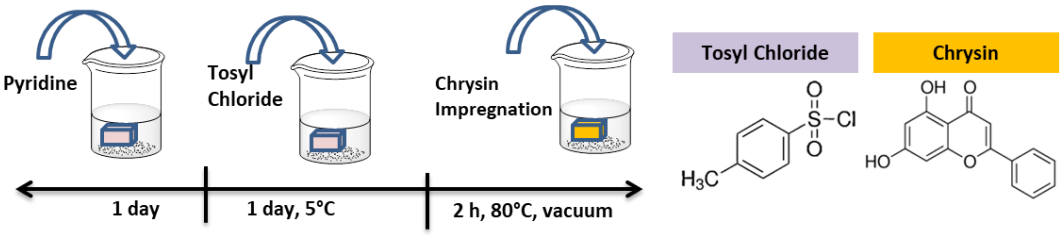


Figure 1. Left: Schematic representation of modification process. Right: Chemical structure of tosyl chloride and chrysin molecules.

Siberian pine samples were first activated by tosylation treatment to increase hydrophobicity of wood cell wall (Ermeydan et al, 2012). Then wood was impregnated with Chrysin molecules (see methods part and Figure 1). Success of modification was observed by simple weight percentage gain (%) and volume change (%) calculations (Table 1). P-toluen sulfonyl chloride (tosyl chloride) is a reactive reagent and can establish covalent bonds with hydroxyl groups of cell wall polymers. Thus, due to the chemistry of tosyl chloride and blocking of hydroxyl groups onto the cell wall polymers, wood cell walls can be hydrophobized (See Figure 1). The aim of hydrophobization of wood cell walls is to be able to insert hydrophobic Chrysin molecule to increase durability of wood.

The reaction process of tosylation step was successful as shown in Table 1. WPG% of wood after tosylation is around 15%, which means there is a certain amount of tosyl groups entered and boned in wood structure. However, after impregnation of chrysin into wood, WPG% of the initial material reduced to 7,7% which means during chrysin impregnation,

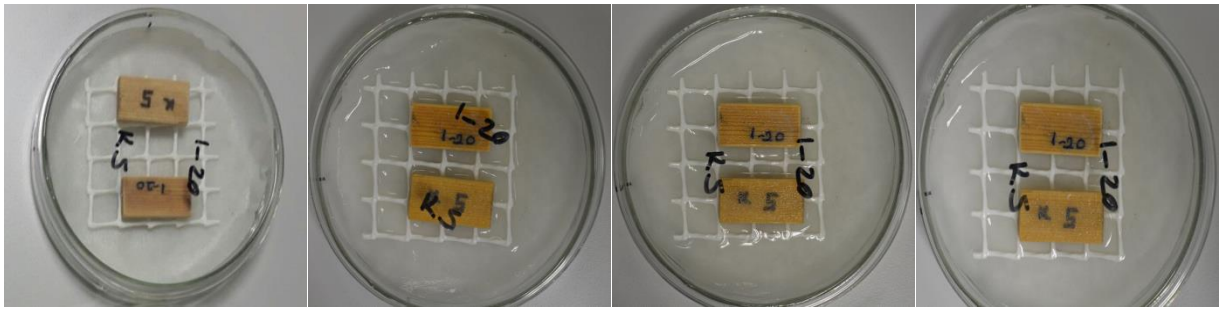
wood lost weight about 7%. This is probably due to the removal of tosyl groups and wood constituents, because a harsh process carried out during the acetone leaching after impregnation (80°C and vacuum). Volume change is another important parameter that shows chrysin or tosyl groups still inside cell walls, and swell them to make a volume increase about 4%. Another observation to prove existence of chrysin in wood is color change of wood after chrysin impregnation. Color of wood become yellowish after chrysin impregnation as can be seen in Figures 2 and 3.

Table 1. Weight Percentage Gain (WPG%) and Volume Change% of wood after tosylation treatment and chrysin modification

	WPG%	Volume Change%
tosylation only	15±1,4	N/A
after chrysin mod.	7,7±1,7	4,3±1,5

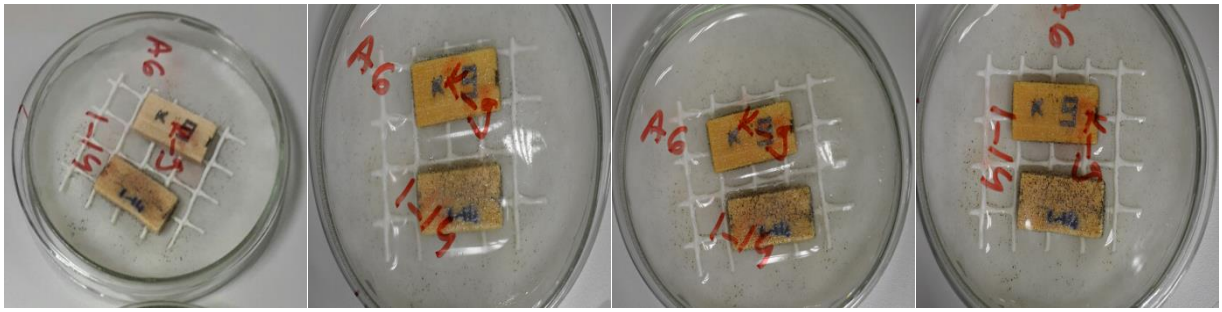
3.2. Decay resistance

Growth and average rating of mold fungi on the wood surfaces is shown in Figures 2-5. In mold-resistance tests, average rating of mold fungi was found to be lower in controls than in chrysin modified samples. Chrysin modification did not enhance mold resistance of wood samples. These results may suggest that concentration level of chrysin is not enough to protect wood against mold growth, and higher concentration levels of chrysin are needed for better performance. Among the mold fungi, growth of *A. niger* was very aggressive on the wood from the first week to 4 weeks. Growth of *A. niger* on the surface increased as the incubation period increased. The molds and soft rot fungi tolerate high levels of some toxicants. These include *Penicillium (cyclopium) aurantiogriseum* on mercury compounds, *Scopulariopsis brevicaulis* on arsenic compounds, *Hormoconis (Cladosporium) resinae* on creosote, and *Trichoderma* sp. on sodium fluoride. The roles of these fungi and the significance of their detoxification abilities on treated wood in the natural environment remains unknown, but under ideal conditions, they could detoxify preservative treatments, permitting decay fungi to colonize the treated wood (Zabel and Morell 1992). *Aspergillus niger*, *Cephalosporium* sp., *Penicillium frequentens* and *Cladosporium elatum* was resistant to high copper levels (Sharp 1975). Some studies also showed nano-CuO, nano-ZnO, nano-B_2O_3, nano-Ag (Kartal et al. 2009), nano-CeO_2, nano-TiO_2 and nano-SnO_2 (Terzi et al. 2016) known as effective chemicals against basidiomycetes failed to provide sufficient protection against mold growth (*Antrodia* sp., *Aspergillus niger*, *Trichoderma harzianum* and *Penicillium pinophilum*) on the wood surfaces.



1 week 2 weeks 3 weeks 4 weeks

Figure 2. Pictures of samples exposed to *P. chrysogenum*.



1 week 2 weeks 3 weeks 4 weeks

Figure 3. Pictures of samples exposed to *A. niger*.

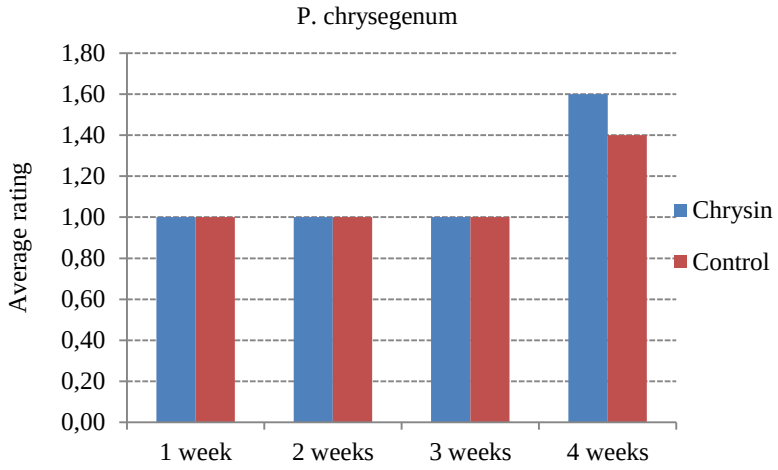


Figure 4. Average rating of *P. chrysogenum* growth on wood samples

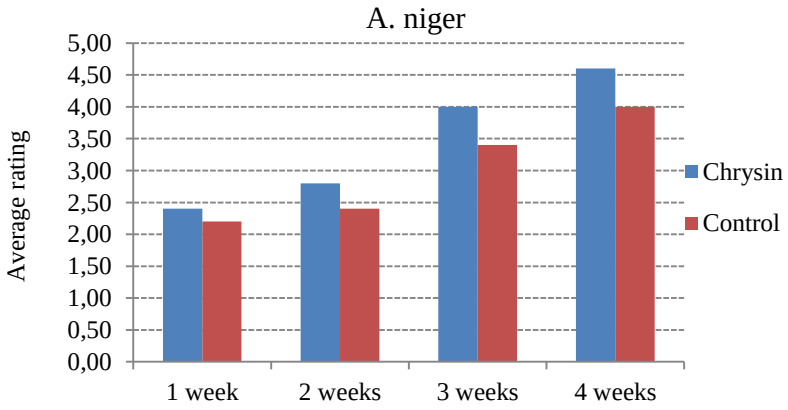


Figure 5. Average rating of *A. niger* growth on wood samples

Figure 6 shows the weight loss of samples by fungi attack. Chrysin modified samples exhibited lower weight loss than controls for both basidiomycetes fungi. Decay resistance in modified samples was found as 50 and 84% for *P. placenta* and *C. puteana* attack, respectively. *P. placenta* was more aggressive than *C. puteana*. This is probably due to the degradation of the cell wood attacked by *C. puteana* occurs firstly on the wall surface, but in the case of *P. placenta* the destruction of cellulose proceeds deep inside the wall even after 1 month of fungal attack (Irbe et al, 2006; Tomak 2014). The weight loss results clearly demonstrated modified samples did not have sufficient protection against *P. placenta* according to EN 113 standard since the modified samples had more than 3% weight loss in decaying test but they were found efficacious in suppressing *C. puteana* attack. Surprisingly, quite high weight loss was observed on the modified samples after mold fungi attack. It has been stated that the mold fungi do not affect the strength of wood; however, in this study mold fungi covered the wood surface and caused weight loss of around 5%. Salem (2016) reported that mold fungi affected significantly the surface elemental composition and showed different degrees of hyphal penetrations. The mold fungi metabolize the carbon-rich constituents of wood and produce large fruiting structures (Salem 2016). Weight loss findings by mold fungi were in accordance with the average rating of fungi growth on surfaces. Control samples exhibited lower weight loss (0.6 and 0.9%) than modified samples (5.16 and 5.4%). Chrysin might support mold growth on the samples, and mold fungi might digest the chemical. Both weight loss of wood components and chrysin due to decay, could be possible reasons for higher weight loss in modified samples than control samples. Wood extractives are commonly degraded by mold decay (Zabel and Morell 1992). *Aspergillus niger* is a producer of many pectinases and hemicellulose degrading enzymes, like xylanases and arabinases (Salem et al, 2016). Hydrolytic enzymes of *Aspergillus* spp. also cause cellulose hydrolysis. *Penicillum* species are known for their ability to produce extracellular enzymes including cellulose. Some species of *Penicillum* can also degrade pectin and xylan (Mansour et al, 2015). Certain molds such as *Aspergillus* or *Penicillium* have been observed to grow on the surface of liquids of tannery pits and tannery wastes since they have tannin-degrading systems. *Aspergillus* and *Penicillium* species have been used biodegradation of polyphenols (Bhat et al, 1998). Chrysin is a natural flavonoid and is belonging to the polyphenols family. That's why it is thought that Chrysin may be consumed by the mold fungi.

In this study, it was expected to obtain greater decay resistance with chrysin modification of wood for both basidiomycetes and mold fungi. Low concentration level of chrysin and a harsh leaching process of acetone after impregnation process which caused 7% weight loss in wood components could be possible reasons for the low efficiency in decaying tests. This study clearly showed more studies are needed for better understanding the fungal resistance of chrysin in wood. Higher concentration levels of chrysin, more moderate leaching process and different decaying organisms should be studied. Studying of these parameters to obtain optimum modification process is still under progressive by the authors.

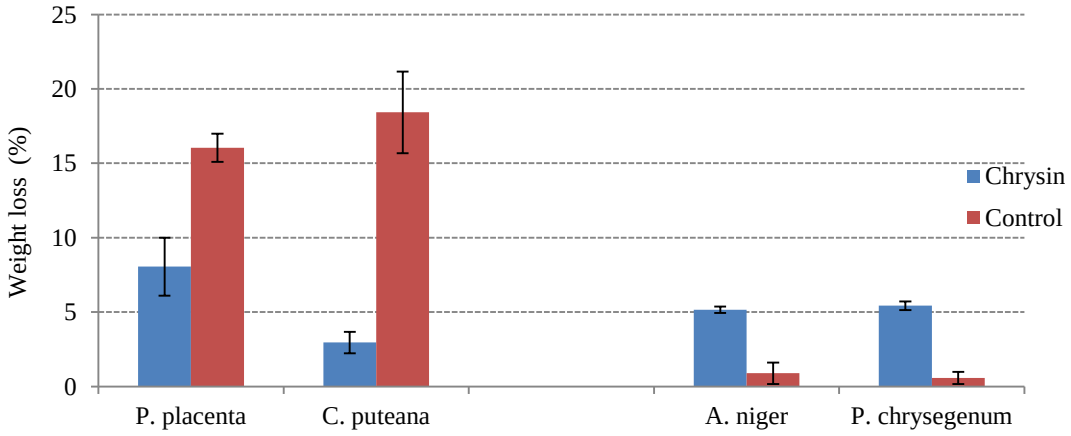


Figure 6. Weight loss (%) of wood samples after fungal decay.

4. Conclusion

In this study, the chemical modification method reported by Ermeydan et al. (2012) was upgraded. A natural hydrophobic flavonoid, chrysin, has been impregnated into the wood to improve durability of wood material. We inspired from heartwood formation and one step more used a natural hydrophobic flavonoid instead of hydrophilic flavonoids. Chrysin molecule contributed to a significant enhancement of the durability against brown rot fungi however the chemical did not have sufficient protection against mold fungi. The study which is the first part of the Tubitak project clearly showed more studies are needed by using different microorganisms since the chemical seemed to have not a broad spectrum of activity against wood decaying organisms.

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Surface properties of biopolymer nanocomposites coated wood and wood panels

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Abstract: The aim of this study was conducted to determine the effects of biopolymer nanocomposite films on the surface properties of the wood based substrates. Today, many resins or paints with different chemical contents and allergic effects are used on surfaces of wood panels to obtain more aesthetic furniture. This status had led people to be affected by these surface coating components on products. In this study, the biopolymer nanocomposite films were prepared by solvent casting method with using polyhydroxybutyrate (PHB), a biodegradable and non-allergenic polymer. In order to improve the combustion and UV resistance of the PHB, 1% of nanobor nitride (BN) and nano titanium dioxide (Nano-TiO_2) were added to the biopolymer matrix, separately. The all blends were prepared in chloroform medium at 90°C for 30 min with speed mixer. SEM characterization, color changes of the coated wood and wood panels, and thermal analysis with TGA of the biopolymer coating solutions were determined. The obtained results showed that pure polyhydroxybutyrate and their composite films with TiO_2 and BN are suitable for using as coating solutions. The addition of fillers such as TiO_2 and BN was found to improve adhesion among the filler and the polymer matrix.
Keywords: Biopolymer, Nanocomposite films, Polymer coating, Polyhydroxybutyrate (PHB), Nanoparticles

1. Introduction

Surface coating for wood and wood panels are generally based on petroleum based or synthetic polymers due to low-cost and easy availability. These polymers have a significant barrier against water and oxygen permeation, and exhibit high mechanical properties. However, they are disfavored by limitations in petroleum reserves, difficult recyclability toxic and allergic effects, and lack of biodegradation (Rastogi and Samyn, 2015). Therefore; bio-based polymers have been widely studied as alternative to petroleum polymer. The replacing the petroleum coatings with biopolymer films and solutions might provide both a competitive advantage and more sustainable/greener image (Vartiainen et al., 2014; Vieira et al., 2011). Bio-based coatings for wood and wood panel have high potential to replace petroleum based coating. Bio-based coatings obtained from renewable resources also have the numerous advantages such as biodegradability, easy recyclability, non-toxicity and biocompatibility, etc (Cha and Cinnas, 2004; Tang et al., 2012; Khwaldia et al. 2010; Uzun and Aydemir, 2017). Some bio-based polymers have used as coatings for wood panels, such as starch and cellulose derivatives, casein, soya, gluten, carnauba wax, fatty acids, polyhydroxyalkanoates (PHA) and polylactic acid (PLA) (Schaller and Rogez, 2007; Khwaldia et al., 2010; Kugge and Johansson, 2008). Moisture resistance of bio-based polymers is the most important issue because poor barrier properties of many biopolymers, thus excessive water vapour transmission can diminishes the hardness and strength of the coatings. Thermal behavior and UV-resistance also other important issues for bio-based coatings thus various fillers can be added to improve the disadvantages (Johansson et al., 2012; Vartiainen et al., 2010). This study investigated feasibility of bio-based coatings on the surface of the wood and wood panels to their potential for use in the sustainable and green coating applications. The effects of nano sized BN and TiO_2 on the thermal properties were also determined.

2. Materials and methods

2.1. Materials

Polyhydroxybutyrate (PHB), which is a biodegradable and bio-syntheses polymer was used as polymer matrix for preparing of coating solution (PHB was supplied from GoodFellow, UK). Nano sized boron nitride (BN) (Bortek Inc., Turkey) and nano sized Titanium dioxide (TiO_2) (MKNano, Canada) were added to polymer matrix for improve the thermal properties and UV-resistance. The sizes of BN and TiO_2 were 85 nm and 15-35 nm, respectively. In this study, particleboards, fiberboards, heat-treated and un-treated ash wood were used, and the panels and woods were bought from a market.

2.2. Preparation of the biopolymer nanocomposite films

5 g Polyhydroxybutyrate (PHB) pellets dissolved in 100 mL chloroform was mixed to 30 min at 25±2◦C with a magnetic stirrer. The melted PHB were applied to the surface of wood and wood panels, and all samples were dried at room temperature for a day. In the preparation of the PHB nanocomposites; BN and TiO_2 at 2% loadings were suspended in chloroform under magnetic stirring for 15 min. The blends were then sonicated for 15 min at room temperature with an ultrasonic mixer at 50 W

and 50% frequencies. The solutions containing 2 wt% of BN and TiO_2 were added to the prepared PHB solution and then stirred vigorously for 15 min. with a magnetic stirrer. The blends were sonicated for another 15 min, and the blends were applied with a brush on the surface of the samples, respectively. The rest of the coating solutions with BN and TiO_2 were put to petri, respectively to determine the thermal behavior. Both the coating solution and the coated samples were put to the climatic chamber for curing

2.3. Methods

The coating thickness and particle dispersion on the surface the coated samples were determined with scanning electron microscopy (Tescan, Poland). The color changes of the coated samples were measured with Minolta color device, and the results were exhibited with ΔEab. Thermogravimetric analysis of the coating solutions also were performed with Perkin Elmer TGA-DTG analyzer. The TGA analyses were conducted from 25°C to 900 °C with 25°C heating rate.

3. Results and discussion

3.1. Surface Characterization of the Samples Covered with Coating Solutions

The SEM images of the samples coated with pure PHB, PHB-TiO_2, and PHB-BN blends were given in Fig. 1, 2 and 3. The each coating solutions were applied with a brush the surface of the samples for 3 times. After coating with the blends, the surface of the samples were provided to white layer. Thickness of the layer generally was found to be different according to the SEM images. The surface of the samples was determined to be wavy for all samples, and some porous layers found to the samples coated with pure PHB and PHB+TiO_2 blends. The roughness of the layer were found to be similar to all samples. According to particle dispersion analysis, some aggregates was determined on the surface of the coated samples. EDAX analysis exhibited that TiO_2 and BN were dispersed on the surface of the samples. In a study, PHB was used to cover the surface of the paper with solvent casting, and the obtained results showed that the origin and distinctive molecular weight and their composite films with various fillers proved to be suitable for coating formation and the requested thickness. Addition of fillers to polymer matrix was found to improve adhesion among the filler and the polymer matrix and formation of a homogeneous structure of the obtained films, and also the surface of the materials (Erkske et al., 2006).

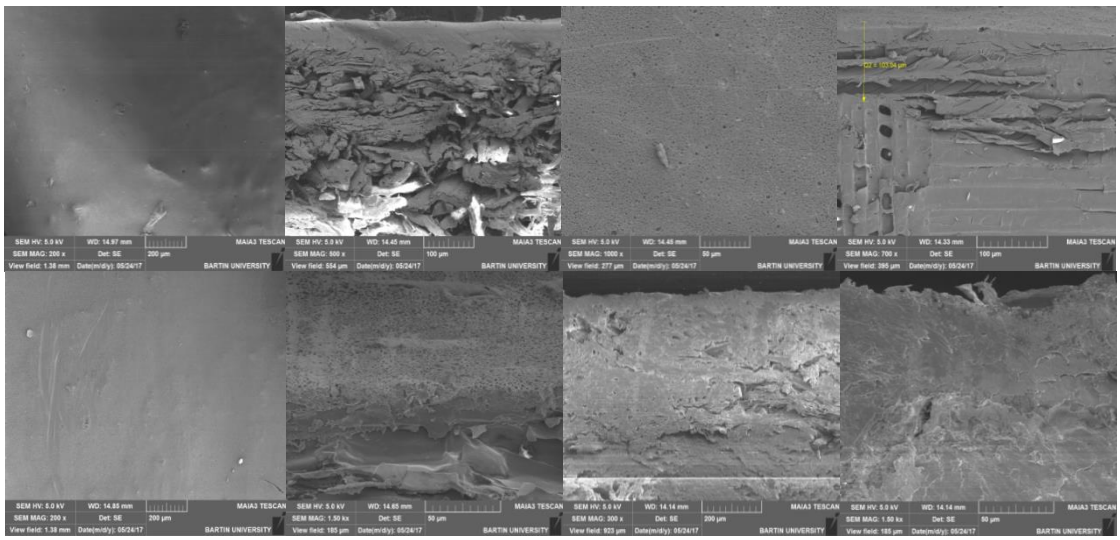

Figure 1. SEM images from surface and cross-section of the samples coated with pure PHB.

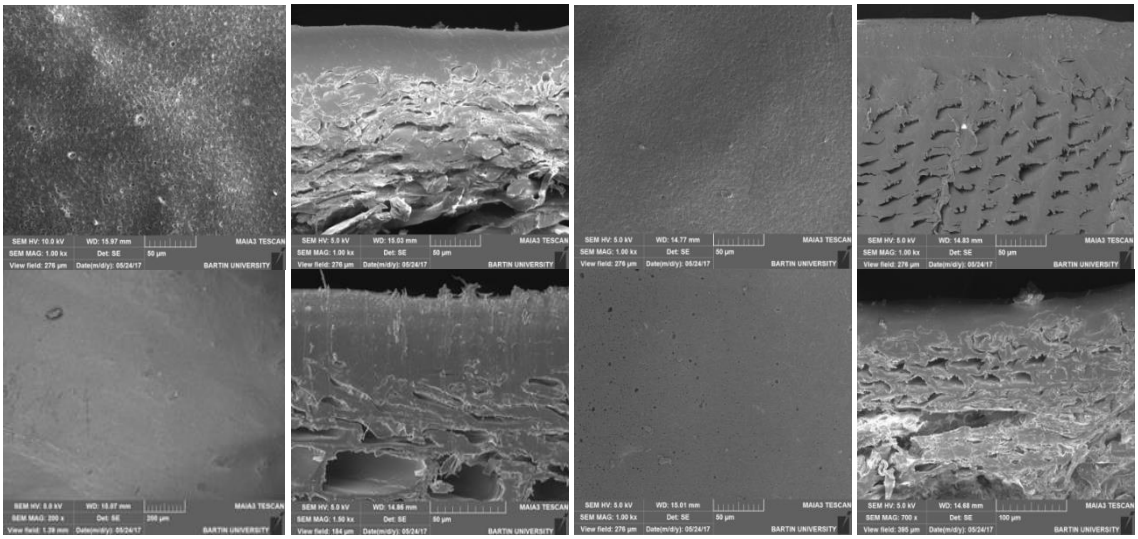

Figure 2. SEM images from surface and cross-section of the samples coated with 1%TiO_2-PHB blends.

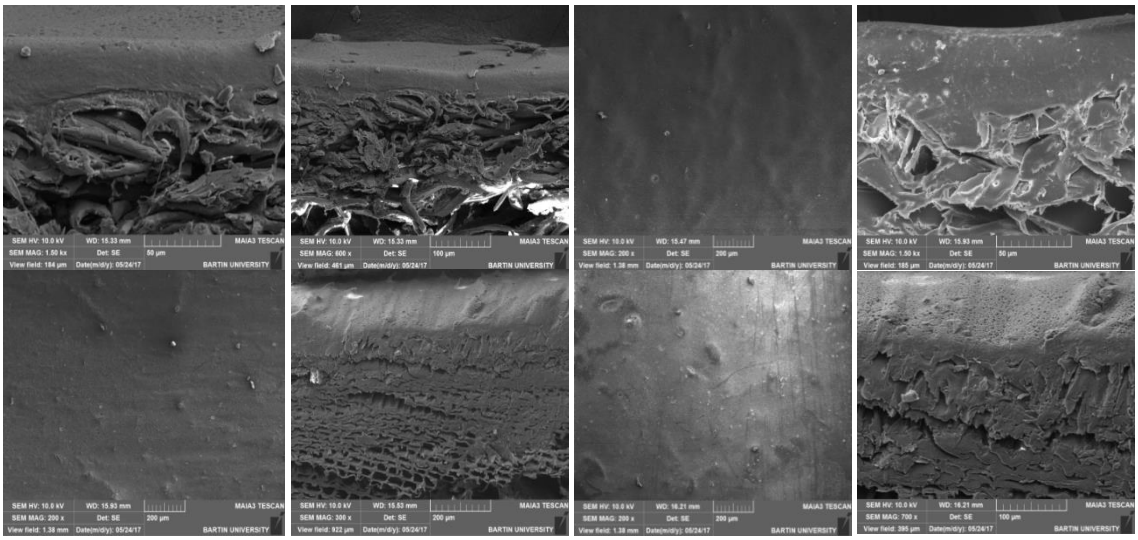

Figure 3. SEM images from surface and cross-section of the samples coated with 1%BN-PHB blends.

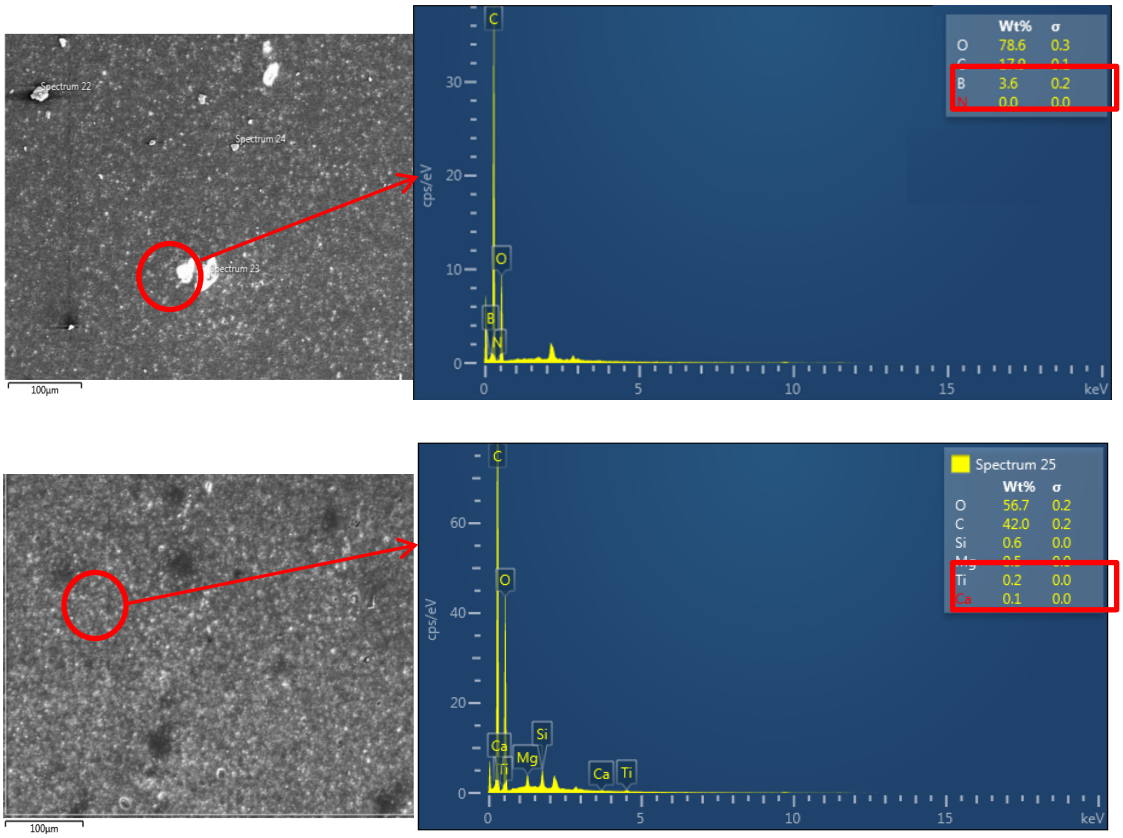

Figure 4. SEM Mapping on the surface of the samples coated with TiO_2/BN-PHB Blends.

The color changes of the coated samples were given in Fig. 5. According to Fig. 5, the ΔEab values were generally found to be lower than the samples coated with pure PHB. The addition of the fillers such as BN and TiO_2 generally decreased to the ΔEab.

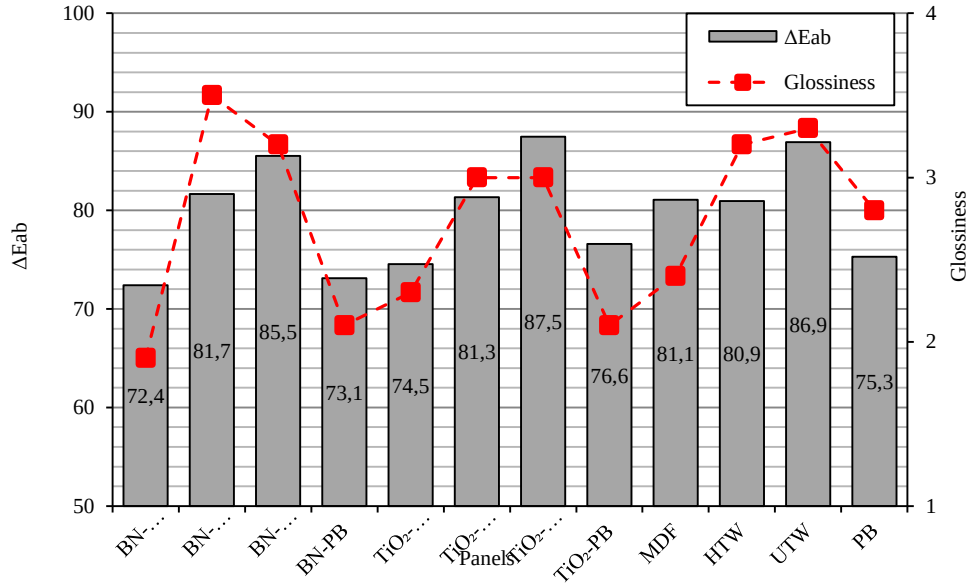

Figure 5. Color values of the samples covered with coating solutions.

3.2. Thermogravimetric analysis of the coating solutions

The thermogravimetric analysis of the coating solution were determined with TGA-DTA device, and the curves and the summary of the all TGA data were given in Fig. 6, 7, 8, and Tab. 1.

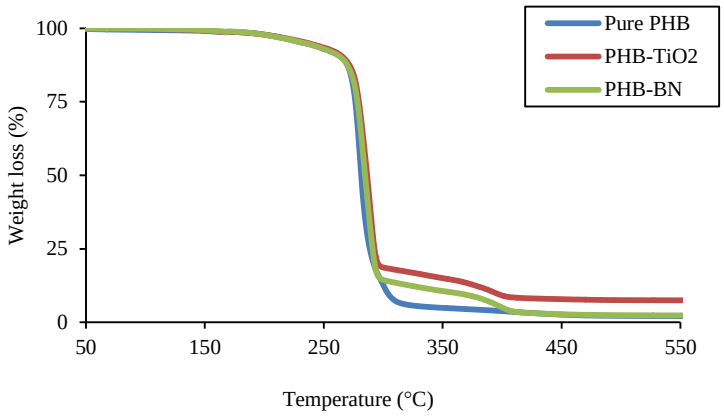

Figure 6. TGA Graph of the Coating Solutions.

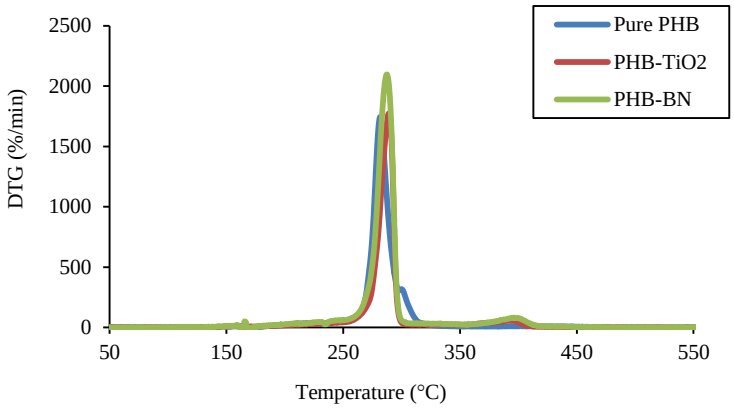

Figure 7. DTG Graph of the Coating Solutions

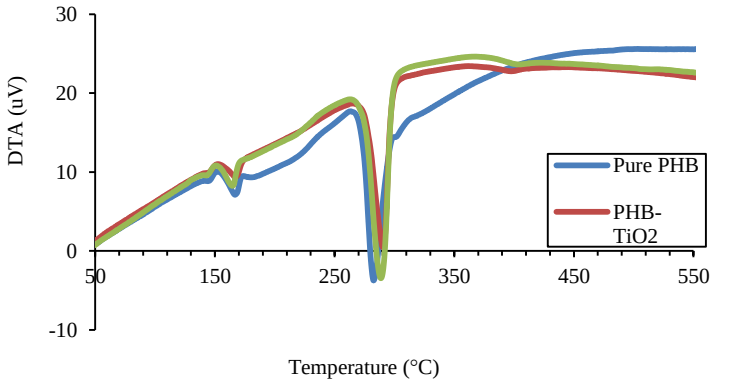

Figure 8. DTA Graph of the Coating Solutions.

Table 1. Summary of the Curves of Thermogravimetric Analysis of the Coating Solutions.

Coating Solutions	T_{onset} (°C)	$T_{10\%}$ (°C)	$T_{50\%}$ (°C)	$T_{85\%}$ (°C)	DTG_{max} (°C)	Residue (%)	Tm (°C)	Td (°C)
Pure PHB	274.4	266.5	281.5	297.8	281.4	99.8	166.2	281.4
PHB-TiO_2	276.5	267.8	286.5	357.7	288.0	92.9	166.9	286.3
PHB-BN	277.3	266.0	284.9	299.4	288.3	98.9	165.7	286.0

As seen as TGA curves of the coating solutions in Fig. 6, all curves for the coating solutions were found to be similar and near to each one. Tonset was found at 274.4°C for pure PHB, 276.5 °C for PHB-TiO_2, and 277.3 °C for PHB-BN. Fig. 7 showed the DTG peaks of the coated samples, DTG max peaks were determined at 281.4°C for pure PHB, 288.0°C for PHB-TiO_2, and 288.3°C for PHB-BN. Fig. 8 exhibited the DTA curves, which obtained to the melting temperature (Tm) and the degradation temperature (Td). Tm and Td values were found as 166.2°C and 281.4°C for pure PHB, 166.9°C and 286.3°C for PHB-TiO_2, and 165.7°C and 286°C for PHB-BN. According to Tab. 1, the maximum temperature was determined to $T_{10\%}$, $T_{50\%}$ and $T_{85\%}$ for PHB-TiO_2 blends. Uzun and Aydemir (2017) found that the addition of the fillers to polyhydroxybutyrate polymer matrix improved the thermal properties.

4. Conclusion

In this work, the feasibility of use of the PHB biopolymer films to the coating of the surface of the wood and wood panels, and also the effects of the fillers such as TiO2 and BN on the thermal properties were investigated. The coating performance of the PHB films on the surface of the wood and wood panels were characterized with SEM, EDAX, and SEM-mapping. SEM analysis showed that PHB layers were determined on the surface of the all samples, and especially the thickness layer were seen the cross-section of the all samples, but the thickness of the PHB layers were found to change at 50-100μm for all the samples. The addition of the fillers improved the thermal behavior, and improving effect of TiO2 was found to be higher than those of the BN. Tm and Td values increased with incorporation of the both fillers into PHB.

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Effect of acetylated furniture wastes on the mechanical properties of HDPE composites

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Abstract: In this study, it is aimed to evaluate Medium Density Fiber Board (MDF) flour from furniture wastes in the production of thermoplastic composite materials. For this purpose, unlike previous studies, MDF flour were chemically modified with acetic anhydride at two different molar levels. Milestone brand microwave device assisted reaction system was used for the acetylation reaction. The microwave device was adjusted to 200 watts for the reaction. FTIR analyzes of acetylated and non-acetylated (Control group) MDF flour at two different molar levels, 5 and 20 mmol respectively, were performed. According to the results of FTIR analysis, the esterification of MDF flour showed an increase in the carbonyl peak at 1720 cm^{-1} compared to the control group. Also, at 900 and 1370 cm^{-1} C-H stretching vibrations of the methyl groups were observed. Then the acetylated and non-acetylated MDF flour were mixed with High Density Polyethylene (HDPE) at a ratio of 40%. And then composite pellets were obtained from these mixtures. Gülnar brand co-rotating twin-screw extruder was used for the obtain composite pellets. Composites were produced by press molding technique using Carver brand presses from the pellets obtained later. After, a comparison was made between the non-acetylated composites and the mechanical properties of the acetylated composites. In the mechanical tests made, the flexural and tensile strengths of the modified composites increased by approximately 14-15% and the impact resistance decreased by approximately 22%, respectively, compared to the control group. In addition, for the dimensional stability test of the produced composites, water uptake and contraction-expansion percentages at different temperature levels were determined. Dimensional stabilization was found to be less than the control group of contraction expansion percentages of acetylated composites compared to the test result. Besides, Scanned Electron Microscope (SEM) images were taken to examine the morphological properties of the composites. Thermo Gravimetric Analyzes (TGA) were also performed to determine the thermal properties of composites. According to the results of thermal analysis, some improvements were observed in the thermal properties of the acetylated composites compared to the control groups.

Keywords: Acetylation, Medium density fiber board flour, Microwave-assisted reaction, High density polyethylene, Thermoplastic composite

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Investigations on chemical composition of willow bark (*Salix Alba* L.)

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Abstract: Willow tree is often used for in parks, gardens and landscape designs over 300 around the world in Turkey is a species of the 22 taxon. Willow tree is a forest tree that chooses wetlands and riversides. Industrial-size willow wood is a kind of soft tissue which is preferred in paper, fibreboard and flake board making. However, the crust of this tree species is considered waste and is not evaluated in any usage area. Nevertheless, it is known that the crust of willow tree has significant chemical content. Salicin, the active ingredient of aspirin used especially as a pain reliever and fever reducer, is produced from this tree species. Willow tree are spread over a wide are a significant amount in Göller Bölgesi (Region of Lakes) in this regard it is preferred as working material. Samples has taken from the Burdur region and cut as a shape of discs from the bottom billet (0,50 m), the middle section (1,30 m) and the top section by 5 cm and this samples will be provided to represent the entire tree. In the next step, the wood and bark parts will be separated from one another and shredded to smaller sizes and the bark parts will be evaluated in this study. The crust samples will be shrunk with the help of sharp garden scissors, knife and hammer and dried in a freeze-dryer. Subsequently, the specimens will be milled in a laboratory-type Willey mill with a particle size of 1 mm. After this step, crushed bark samples will be extracted with hexane in a Soxhlet device to dissolve oily (lipophilic) extractive substances and the structure and amount of these chemical groups will be determined by means of chromatographic devices. The quantity of fatty acids present in the willow barks will be determined by Supelco's 37 fatty acid mixture in the GC-MS device available at SDU Central Laboratory. For this purpose, bark samples will be derivatized after hexane extraction and injected into GC-MS under appropriate conditions. Then, the fatty acids in the willow barks will be compared with the fatty acid standard mixture of 37, and the structure and amount of the fatty acids in the samples will be compared. Suggestions will be made on methods of utilizing willow bark in different industries especially pharmacy, chemistry, etc.
Keywords: Willow, Bark, Fatty acid, Extraction

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Research on the effect of sepiolite on combustion characteristics of wood plastic composites materials

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Abstract: In this study, the effect of sepiolite mineral on the fire resistance of polypropylene based wood plastic composite materials was investigated. The pellets were produced with twin screw extruder and plastic composites were obtained. The Limit oxygen index (LOI) and combustion tests of the produced plastic composites were performed according to the standards of ASTM 2863-09 (2006) and ASTM D 635 (1997) respectively. It has been found that the density of sepiolite mineral used as fire retardant in composite materials increases due to the increase of fill amount. Limit oxygen index and horizontal combustion test results have shown that combustion characteristics are positively affected. All the tests also found that the samples with 20% sepiolite had the most positive effect.
Keywords: Sepiolite, Polypropilen, LOI, Combustion

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Acoustic properties of boards made from mixtures of wood and recycled waste paper fibers

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Abstract: Typically, sound absorption relates to the percentage that effectively decreased when the sound wave hits a surface. Hence, the sound absorption is evaluated by measuring the reverberation time. If the reverberation time is long then the material could be acoustically uncomfortable for most activities. If the reverberation time is too short the material could be acoustically comfortable. In this study, the post-consumer waste papers (office and newspaper) and old corrugated containes (OCC) products were obtained from local waste paper trader, Isparta, Turkey. All the chemicals used in this study were used as received from chemical company. The waste papers separately converted to pulp using a 5 L. capacity, laboratory type standard disintegrator in water. The repulping process was take 30-40 minutes to convert pulp. Then the pulps washed with fresh water and screened on a 100 mesh screen to remove excess water. Then the pulps air dried at 24 hours. After that the pulps was refined a stone mechanical refiner to final fibrillation. The pulps were then dried at 105 °C (± 3); until at least a 3.0% moisture content was obtained. In the production of panels, commercially available urea-formaldehyde (UF) resin was used as binder. After spraying the adhesive on the fibers in a drum blender, the board mat was manually formed inside a wooden box on a metal caul plate. After experimental boards manufactured, then the boards were conditioned at 20 ºC and 65% relative humidity and samples were cut to determine the insulation properties. There are a number of techniques for measuring the acoustic properties of materials. However, the measurement of air flow through a material is a physical property useful in evaluating its performance as an acoustic absorber. The sound absorption properties (Acoustic) of boards were determined according to TS EN 10534-2 standard that at least 12 samples tested with Brüel&Kjaer Tube Type 7758 instrument. With microphones in a pod, 125, 250, 500, 1000, 2000, 4000, 5000, 6300 Hz in the frequency range, sound absorption coefficient of the samples with sound pressure level measured (T).

$$T = (P_1 - P_2)/P_1$$

Where, P1=incoming sound wave pressure, P2=outgoing sound wave pressure.

Keywords: Waste paper, Secondary fibers, Acoustic properties, Composites, cellulose

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Evaluation possibilities of growing in turkey some agricultural resources and wastes in production of microfibrillated cellulose (MFC)

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Abstract: Every year millions of ton agricultural residues outcrop in Turkey. Storage and disposal of such large quantities of wastes is very difficult and costly. Therefore, in recent years agricultural resources and wastes have been preferred to produce micro/nanofiber and micro/nanocrystalline cellulose with varied chemical and mechanical methods. These micro/nano particles can be thought as new generation polymeric reinforcement agents for composite materials. Besides they progress physical, mechanical, thermal and optical characteristics of varied composite products. These products can be used in sectors such as electronics, medical, constructional works, pulp and paper production, coating etc. In this study, some morphological and characteristic properties of microfibrillated cellulose (MFC) obtained from corn stalk, sunflower stalk, sesame husk and reed with chemical-mechanical method were revealed and MFC production opportunities were investigated. As a result, MFC production can be thought as a method to evaluate agricultural resources and wastes in bio-based composite materials. Besides, it is thought that this study will be a new source to literature.
Keywords: Agricultural residues, Microfibrillated cellulose, Composite materials

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Wooden sculptures in Garden: Art in landscape designs

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Abstract: Wood was one of the earliest materials to serve as a source for humans. However, wood as a feature used in the landscape can be found in nearly all cultures throughout history. Even in very early times (i.e., stone and masonry cultures), it was used in the construction of some garden sculpture structures. Its wide range of versatility includes: warmth and richness, light weight, and workability takes people back to the landscape. Thanks in part to its natural origin with aesthetic features, wood is also well suited to apply in many landscape implementations. Landscape architects have been using wood-based elements in many ways. They could be enjoyed more when the garden is surrounded by wooden structures. However, wooden sculptures could be exhibited identity of specific area and sometimes the culture of a city. In this study, the available wood based garden sculptures and alternative utilization of wood based elements in gardens have been examined in worldwide. The use of these elements on gardens and impacts on people have been studied in detail. The aesthetic and functional properties of those elements have presented in the view of landscape architecture discipline.
Keywords: Wood, Sculpture, Garden, Landscape elements

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Staining of wood using natural dye obtained by lichen extractives and determination of color values

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Abstract: Recently, demand on natural dyes emerged due to some health problems that occur by common use of synthetic dyes. Dyeability of wood material using Maritime sunburst (*Xanthoria parietina* (L.) Th.Fr.) Lichen extractive, one of the non-wood forest products, was investigated in this study. Lichen was collected from Isparta region and air-dried. Turkish pine (*Pinus brutia* Ten.) and Oriental beech (*Fagus orientalis* Lipsky) were used as wood material. Dyeing extractives which obtained by Maritime sunburst lichen were mixed with Aluminum Sulfate ($Al_2(SO_4)_3$) and Iron tri-chloride ($FeCl_3$) mordant to obtain dyeing material. And then, dyeing material applied to wood materials by dipping method. Stained test samples were dried in the shade and conditioned at 20 ± 2°C ve % 65 ±5 RH to obtain 12% Moisture Content (MC) when through-dry state of staining were achieved. Color values of samples were measured using Chroma Meter CR-400. Obtained values were classified according to CIELAB-76 coordinates of ISO 2470 standard. According to results, Maritime sunburst lichen can be used to staining of wooden and wood-based furniture or accessories. Also, it is seen that use of this lichen type can provide aesthetical appearance on applied material.
Keywords: Lichen, Natural dye, Wood

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Using whey protein for producing MDF

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Abstract: Todays, wood based composites (WBC) industries generally use the synthetic resins such as urea-formaldehyde (UF), phenol formaldehyde (PF), melamine formaldehyde (MF), etc., which are petroleum-derived and environmentally harmful adhesives. However, in the near future; it was estimated that, petroleum-derived productions price will be more expensive from the price of raw material supply. For this reason, last decade natural-based adhesives has been become more interested research subject. In this study, it has been determined that the potential utilization of proteins, waste product of cheese factories and called as whey protein, as an UF adhesive additive in the production of MDF are getting important year by year. Consequently, WP can be evaluated in MDF production as a natural resource with petroleum-derived additives.
Keywords: Whey protein (WP), Urea formaldehyde (UF), MDF

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Evaluating of some plastic wastes in HDF production process

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Abstract: Using plastic wastes in forest product industry is an attractive subject for evaluating the wastes and also for decreasing the environmental pollution. In this study; different types of plastic wastes, polyethylene terephthalate (PET), polypropylene (PP) and polystyrene (PS), etc., various characteristics, were determined the potential usability as a mixture material for wood fibers in the HDF boards. It is important that some values, especially water absorption (%) , thickness swelling (%), modulus of elasticity (MOE), and bending strength (MOR) of producing boards , determine for the using areas. Consequently, it is possible to easily say that, the some plastic wastes will be usable in HDF production process for some mixture ratios and for some usage areas.
Keywords: HDF, Plastic wastes, Physical and mechanical properties

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Volatile components of *Salvia tomentosa*

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Abstract: In this study, it was aimed to determine volatile components of *Salvia tomentosa* which can commonly find Mediterranean, Marmara and Black Sea region in Turkey. Our plant materials were collected in Isparta, Atabey province at 1050 m altitude in the year of 2013. Materials were stored in dark room and at standard room temperature until they became air dry condition. For determination of volatile components firstly headspace solid phase micro extraction (HS-SPME) was used for collecting volatile components. After that gas chromatography mass spectroscopy (GC-MS) device was performed to determine components and their percentages. 48 components were detected in the sample of *Salvia tomentosa*. Camphor was the first major component with 21.45%. α-pinene (15.63%), Camphene (10.99%), Limonene (10.11%), 1.8-Cinoele (8.70%) and n-Hexanal (7.36%) were followed Camphor. Result showed that *Salvia tomentosa* has a potential use of antibacterial, antienflamatuar and antibiotic applications in medicine as well as in food applications.
Keywords: *Salvia tomentosa*, Volatile components, HS-SPME-GC-MS

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Effect of acetylation on the thermal properties of cellulose nanocrystals

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Abstract: Cellulose is one of the most abundant bio-polymer on the Earth. Cellulose nanocrystals are obtained from cellulose by acid hydrolysis. Sulfuric and hydro-chloric acids are mostly used for cellulose nanocrystals production by hydrolysis reactions. The potential application of cellulose nanocrystals is as reinforcing materials in thermoplastics polymer composites. There are some drawbacks using cellulose nanocrystals as reinforcement in the thermoplastic composites. The first drawback is the low compatibility between the hydrophilic cellulose nanocrystals and the hydrophobic polymer. The second drawback is the low thermal stability of cellulose nanocrystals due to sulfate groups. During the hydrolysis reactions with sulfuric acid treatment, sulfate groups are created on the surface of cellulose nanocrystals. Several previous studies reported that these residual sulfate groups had detrimental effect on the thermal stability of cellulose nanocrystals. When cellulose nanocrystals are used as reinforcement in the thermoplastic composites, they are exposed to high temperatures (180°C and above) during the manufacturing process. In earlier studies, it was reported that acetylation of lignocellulosic fibers improved thermal stability of the fibers and the compatibility between hydrophilic lignocellulosic fibers in hydrophobic thermoplastic matrices. In this study, in order to understand the effect of acetylation on the thermal properties of cellulose nanocrystals, thermal degradation of cellulose nanocrystals and acetylated cellulose nanocrystals have been investigated using thermo-gravimetric analysis (TGA) between room temperature and 700°C. It was found that acetylated cellulose nanocrystals were more thermal stable than untreated cellulose nanocrystals and the chemical modification played an important role in the thermal decomposition process.
Keywords: Acetylation, Cellulose, Cellulose nanocrystals, Thermo-gravimetric analysis

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Effect of mistletoe (*Viscum album* L.) on some physical properties on *pinus sylvestris* wood

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Abstract: In this study ; some physical properties of Scoth pşne (Pinus sylvestris L.) wood were investigated, that was parasited by mistletoe (*Viscum Album l.*). Test samples were obtained from Gümüşhane –Torul area . Then they were prepared according to standarts. İn this study physical properties of scoth pine (Pinus sylvestris L.) wood were studied air and oven dry specific gravities, volüme density, shrinking/swelling values determined. According to the results, the highest air dry density value of control samples (0./85 g/cm^3), the lowest value (0.40 g/cm^3) ; the highest air dry density (Mistletoe) value (0./68 g/cm^3), the lowest value (0.43 g/cm^3); the highest oven dry density value of control samples (0./77 g/cm^3), the lowest value (0.38 g/cm^3) ; the highest oven dry density (Mistletoe) value (0./66 g/cm^3), the lowest value (0.37 g/cm^3); the highest volumetric shrink,ng value of control samples (% 13.757) , the lowest value (% 6.061) ; the highest volumetric shrink,ng (Mistletoe) value of control samples (% 15.368) , the lowest value (% 6.168) ,the highest volumetric swelling value of control samples (% 13.581, the lowest value (%6.032) ; the highest volumetric swelling (Mistletoe) value of control samples (% 13.790) , the lowest value (% 6.004) were determined.

Keywords: Scoth pine wood, Mistliture, Physical properties, Furniture

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Applicability of thermography and increment coring for the determination of juvenile wood zone of Turkish red pine (*Pinus brutia* Ten.)

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Abstract: Utility and uniformity of wood within species vary depending on the differences between juvenile and mature wood. Juvenile wood shows different characteristic than mature wood and proportion of juvenile wood is an important topic for usage. The study was mainly carried out to investigate the applicability of thermography, as an efficient and a practical technique, for the determination of juvenile wood part in Turkish red pine (Pinus brutia Ten). In a standing tree moisture content is higher than fiber saturation point and the moisture content of wood varies with location from pith to bark depending on different wood parts such as heartwood, sap wood, juvenile wood, and mature wood. The main assumption was that any difference in moisture should cause differentiation of surface temperatures and these differences may be used as a practical way to separate juvenile wood zones. For this purpose increment core samples were collected from different age and type of Pinus brutia stands from Mediterranean region of Turkey. After removing increment cores from living trees, they placed into plastic tubes and stored in cooler bag to keep their moisture stable. Increment cores surfaces was monitored using FLIR I7 thermal camera at laboratory conditions. Thermal images were evaluated via image analysis system. The rings of the transition from juvenile to mature wood were determined by visual interpretation of cambial age profiles of ring density trait. Ring densities measured on increment cores via x-ray densitometry method. The juvenile period, which was separated according to x-ray density data, was compared to the findings of IR images. The thermal properties (thermal conductivity, and capacity) of juvenile and mature wood were different and, consequently the surface temperatures differed. The difference determined 85% of all investigated cores for 7-10 rings from pith. This was parallel to identified juvenile part with x-ray densitometry profiles. Results showed that thermography can be applied as a very promising and practical technique to separate juvenile period of investigated species. It is possible to apply this technique not only laboratory condition but also in the field with a portable IR camera.
Keywords: Pinus brutia, Thermography, Juvenile wood

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Effect of TiO_2 nano particles on mechanical and thermal properties of wood plastic nanocomposites

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Abstract: Effect of TiO_2 nano particles on mechanical and thermal properties of wood polymer nanocomposites was investigated. To meet this objective, pine wood flour, polypropylene with and without coupling agent (maleic anhydride grafted polypropylene), and TiO_2 were compounded in a twin screw co-rotating extruder. The mass ratio of the wood flour to polypropylene was 50/50 (w/w) in all compounds. Test specimens were produced using injection molding machine from the pellets. The mechanical properties, and thermal analysis (thermogravimetric analysis and differential scanning calorimetry) of the nanocomposites were investigated. The flexural and tensile properties of the wood polymer nanocomposites increased with increasing content of the TiO_2 and maleic anhydride grafted polypropylene (3 wt%). The mass loss rates of the wood polymer nanocomposites decreased with increasing amounts of the maleic anhydride grafted polypropylene and TiO_2. The differential scanning calorimetry analysis showed that the melt crystallization enthalpies of the wood polymer nanocomposites increased with increasing amount of the TiO_2. The increase in the Tc indicated that the TiO_2 were the efficient nucleating agent for the wood polymer nanocomposites.
Keywords: TiO_2, Nanocomposites, Wood, Plastic, Characterization

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Effects of sodium hydroxide treatment of particles on the quality properties of particleboard

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Abstract: The purpose of this study was to determine the effects of treatment of wood particles with sodium hydroxide (NaOH) (for 12 and 24 h) on the mechanical (modulus of rupture, modulus of elasticity and internal bond strength), physical (thickness swelling) and surface quality (roughness and contact angle) properties, and formaldehyde emission of particleboard composite. *Ailanthus Altissima* (Mill.) Swingle trees were used as a raw material for manufacturing of the test panels. Urea formaldehyde resin was applied as an adhesive. Ammonium chloride was added into the urea formaldehyde resin as a hardener. Mechanical and physical properties and formaldehyde emission of the panels were determined according to European standards. The surface properties of the samples were determined by employing a fine stylus profilometer. The wetting behavior of the samples was characterized by the contact angle method (goniometer method). Contact angle measurements were performed using a CAM 101 Optical Contact Angle Meter. Alcohol-benzene, hot and cold water and dilute alkali (1% NaOH) solubility's and lignin content were determined according to TAPPI standards. Hemicellulose and cellulose contents were determined by chlorite and nitric acid methods. Amount of condensed tannin was determined according to the method developed by Tisler and friends. Analysis of variance was conducted to evaluate the effects of sodium hydroxide treatment and adhesive amount on the quality properties of the panels. NaOH treatment positively affected the surface roughness, adhesion and mechanical strength properties of particleboards. However, this application increased the thickness swelling and formaldehyde emission of the panels. NaOH treatment statistically decreased the amounts of extractives and hemicelluloses. Positive effects of NaOH treatment on the surface quality and mechanical properties of the test panels are increased related to the treatment time. The results showed that particleboards made from particles treated with NaOH for 24 h had the required levels of mechanical strength properties for general purposes and furniture manufacturing. Decreasing adhesive amount in the particleboard negatively affected the surface quality, mechanical and physical properties of particleboard except for formaldehyde emission. Panels made from treated particles with NaOH for 24 h at 8-10% adhesive usage had the required levels of mechanical strength properties for general purposes.
Keywords: Particleboard, Sodium hydroxide Treatment, Mechanical and physical properties, Formaldehyde emission, Surface quality properties, Chemical properties.

1. Introduction

Particleboard is an engineered wood product manufactured from wood particles and synthetic resins at high temperature and pressure. It is widely used in the furniture, floor underlayment, cabinets, housing, interior decoration, shelving, vanities, bulletin boards, structural sheathing, electronic game consoles, table tennis, sliding doors, pool tables, lock blocks, displays, speakers, counter tops, stair treads, paneling, kitchen worktops, interior signs, wall and ceiling panels, packing materials, insulators, educational establishments, building and other industrial product applications. The demand and consumption of particleboard composite show an increase in the wood sector due to its stability and low price. The manufacturing of particleboard has positive effects on the environment and economy, due to using waste materials and residues.

Many studies have been performed on the effects of manufacturing factors and parameters on the quality properties of particleboard. Among these factors are log position (Muhcu et al., 2015), bark extractives (Nemli et al., 2004), residue type and tannin content (Moubarik et al., 2013), permeability of wood (Lynam, 1969), density of wood and particleboard, pressing conditions (Maloney, 1977), dimensions of particles (Mottet, 1967), anatomical and chemical properties of wood (Baharoglu et al., 2013), resin type (Sari et al., 2012), moisture content of wood (Baharoglu et al., 2012), moisture content of particles (Kollmann et al., 1975), additives (Heebing, 1967).

The objective of this investigation was to evaluate the effects of sodium hydroxide treatment of particles on the mechanical (modulus of rupture, modulus of elasticity and internal bond strength) and physical (thickness swelling) properties, formaldehyde emission, surface roughness of particleboard, and chemical properties (solubility's, amounts of cellulose, hemicellulose and lignin) of wood.

2. Materials and methods

Five *Ailanthus Altissima* (Mill.) Swingle trees were felled from a private forest in Rize, Black Sea region of Turkey. The age and diameter of the trees were 18-years-old and 25 cm, respectively. The bark of logs was removed before chipping. After the foliage was trimmed, all the trees were chipped using a ring type flaker. The chips were then reduced into smaller particles using a hammer mill. The particles were classified into two sizes using a 3.0–1.5–0.5 mm openings vibrating screen for the core and face layers. Some of the screened particles were immersed in 1% NaOH solution for 12 h and 24 h. The particles were dried to 3% moisture content in a dryer. In the next process, resin was applied with a pneumatic spray gun. Urea formaldehyde resin (formaldehyde/urea mole ratio: 1.25) with a solid content solid content of 65% was applied as an adhesive. Shelling ratio was 0.35 for all samples. Ammonium chloride (concentration: 20%) was added into the urea formaldehyde resin by about 1% based on the solid amount of adhesive as a hardener. No wax or any other additives were used for the panel manufacture. Mats formed manually in a frame with a size of 550 x 600 mm pressed in a hot press at a temperature of 150°C using a pressure of 2.5 N/mm^2 for 6 min. All panels were pressed to a nominal thickness of 12 mm and an average target density of 0.65 g/cm^3. A total of 10 experimental panels, 2 panels for each type of particleboard, were produced.

The panels were kept in a conditioned room with a relative humidity of 65% and a temperature of 20 °C until they reached equilibrium moisture content. Mechanical properties- modulus of rupture (MOR), modulus of elasticity (MOE) and internal bonding (IB)- and physical property- thickness swelling (TS) after 24 immersion- of the panels were determined according to European standards (EN 310, 1993; EN 317, 1993; EN 319, 1993). Twenty samples were used for each type of property. Formaldehyde emission (FE) was determined according to perforator method based on EN 120-1 standard (EN 120-1, 1993). Three samples were used for determining FE.

The samples used for surface roughness tests were sanded with a sequence of 100 and 150 grit sand papers. The surface properties of the samples were determined by employing a fine stylus profilometer (Mitutoyo SJ-301). Ten samples were used from each type of the particleboard for the surface roughness measurements. Three roughness parameters characterized by ISO 4287 standard, respectively, average roughness (R_a), mean peak-to-valley height (R_z), and maximum peak-to-valley height (R_y) were considered to evaluate the surface properties of the boards (ISO 4287, 1987). The wetting behavior of the samples was characterized by the contact angle method (goniometer method). Contact angle (CA) measurements were performed using a CAM 101 Optical Contact Angle Meter (KSV Instruments Ltd., Helsinki), equipped with a video camera, which collected one image per second. Ten samples were taken from each type of panel for contact angle measurements.

Determination of the chemical properties of the wood particles and preparation of the test specimens were carried out according to TAPPI standards (TAPPI T 11 M-45, 1992). Alcohol-benzene, hot and cold water and dilute alkali (1% NaOH) solubility's and lignin content were determined according to TAPPI standards (TAPPI T 207 om-88, 1988; TAPPI T 204 cm-97, 1997; TAPPI T 212- om-98, 1998; TAPPI T 222 om-02, 2002). Hemicellulose and cellulose contents were determined by chlorite and nitric acid methods (Wise and Karz, 1962). Amount of condensed tannin was determined according to the method developed by Tisler and friends (Tisler et al., 1986). Three samples were used for determination of chemical properties.

ANOVA (analysis of variance) was conducted to evaluate the effects of sodium hydroxide treatment and adhesive amount on the quality properties of the panels. Significant differences between the average values of each type of particleboard were determined employing Newman-Keuls test. The experimental design is shown in Table1.

Table 1. Experimental design of the study.

Panel Types	NaOH Treatment Time (h)	Adhesive Amount for Core Layer (%)*	Adhesive Amount for Surface Layers (%)*
A	-	9	11
B	12	9	11
C	24	9	11
D	24	8	10
E	24	7	9

Note: * Based on oven dry weight of particle weight

3. Results and discussion

The average values of chemical properties of wood particles are presented in Table 2. Treatment of wood particles by sodium hydroxide for 12 and 24 h was found to be effective on the chemical properties of wood except for amounts of cellulose and lignin. NaOH impregnation statistically decreased the solubility values and amount of hemicellulose.

Table 2. Chemical properties.

Chemical properties	Untreated particles	Particles immersed for 12 h	Particles immersed for 24 h
Solubility in 1% NaOH (%)	22.48 (0.24) a	17.73 (0.45) b	11.16 (0.38) c
Solubility in alcohol-benzene (%)	2.78 (0.04) a	2.51 (0.07) b	2.15 (0.14) c
Solubility in cold water (%)	4.78 (0.06) a	4.32 (0.09) b	3.95 (0.05) c
Solubility in hot water (%)	5.25 (0.08) a	4.88 (0.03) b	4.17 (0.10) c
Amount of condensed tannin (%)	5.73 (0.11) a	5.12 (0.07) b	4.59 (0.14) c
Hemicellulose (%)	26.38 (0.18) a	22. 56 (0.15) b	16.32 (0.16) c
Cellulose (%)	48.75 (0.14)a	48. 56 (0.24) a	48. 35 (0.32) a
Lignin (%)	22.12 (0.27) a	22.07 (0.15) a	21.93 (0.31) a

Note: Numbers in the parenthesis are standard deviations. Different letters in the same line represent statistical differences at 95% confidence level.

The surface roughness and contact angles, physical and mechanical properties, and formaldehyde emission of the test panels are presented in Tables 3 and 4, respectively.

Table 3. Average surface roughness and contact angles of the particleboards.

Panel Types	R_a (μm)	R_y (μm)	R_z (μm)	C (°)
A	8.48 (0.18) a	47.33 (1.75) a	39.88 (1.01) a	100.87 (1.87) a
B	6.24 (0.11) b	40.52 (1.06) b	34.42 (1.74) b	89.13 (1.22) b
C	4.53 (0.15) cA	32. 65 (1.14) cA	25.02 (1.34) cA	74.04 (1.09) cA
D	5.23 (0.32) B	35. 04 (0.92) B	28.48 (1.05) B	78.37 (1.20) B
E	6.08 (0.21) C	39. 48 (1.03) C	34.29 (1.17) C	87. 49 (1.35) C

Note: Numbers in the parenthesis are standard deviations. Different letters in the same column represent statistical differences at 95% confidence level.

The surface roughness and contact angles were improved by treatment of wood particles with sodium hydroxide. The meaning of decreasing solubility values is revulsion of extractives from wood. The adhesive has to wet, flow and penetrate the cellular structure of wood in order to establish intimate contact between molecules of wood and adhesive. Revulsion of extractives from wood increases the wettability of wood particles (Ayrilmis, and Winandy, 2009).

Table 4. Physical and mechanical properties, and formaldehyde emission of particleboards.

Panel Types	MOR (N/mm^2)	MOE (N/mm^2)	IB (N/mm^2)	TS (%)	FE ($mgCH_2O$)
A	10.34	1443.58	0.214	28.43	8.14
	(1.84) a	(104.22) a	(0.031) a	(0.42) a	(0.04) a
B	12.85	1718.06	0.341	32.56	8. 82
	(1.08) b	(116.45) b	(0.045) b	(0.28) b	(0.07) b
C	15. 28	2145.54	0.492	38.74	9.64
	(1.12) cA	(120.02) cA	(0.056) cA	(0.62) cA	(0.05) cA
D	12.64	1700.56	0.301	42.13	7.78
	(1.34) B	(100.03) B	(0.028) B	(0.51) B	(0.08) B
E	10.02	1412.38	0.205	46.38	6.94
	(1.05) C	(103.48) C	(0.61) C	(0.38) C	(0.03) C

Note: Numbers in the parenthesis are standard deviations. Different letters in the same column represent statistical differences at 95% confidence level.

The treatment of wood particles with 1% NaOH improved the mechanical strength properties of the test panels. The one reason of this is decreasing hemicellulose amount in the wood with NaOH impregnation. Hemicelluloses are weak wood components. Their polymerization degree is lower than cellulose. The low polymerization degree causes poor mechanical strength properties (Panshin and Dreweuw, 1980). Higher solubility values of untreated particles could be another reason for the poorer mechanical strength properties. The meaning of high solubility values is high amount of extractives in wood. Extractives cause poorer mechanical properties due to breaking down the adhesive linkage. They negatively affect adhesive bonding and adhesion. Decreasing contact angle and roughness increase the adhesion and wettability of the wood particles. Increasing adhesion causes high adhesive bonds and mechanical properties (Wasniewski, 1989; Chritiansen, 1990). Some extractives are translated to the wood surfaces by the water during the drying and pressing processes. When the water is vaporized, these extractives stayed in solid form on the particle surfaces. This condition negatively affects quality of gluing and adhesion (Huang et al., 2011).

Treatment of particles with NaOH negatively affected the thickness swelling and formaldehyde emission of particleboard. This can be explained by the chemical changes in the wood particles due to NaOH treatment. As could be seen in Table 2, NaOH treatment decreased the solubility values and amount of condensed tannin. The extractives, such as wax, phenolic compounds and liphophilic, and condensed tannin positively affect the dimensional stability and formaldehyde emission. They make the particleboard more waterproof. Higher amount of condensed tannin is related to higher amount of polyphenolic extractive content in the wood. Tannin and phenolic extractives fix the formaldehyde as a formaldehyde scavenger. Acetyl groups in the wood play a major role in formaldehyde emission. These groups change to acidic acid and fix the formaldehyde during hot pressing. Hemicelluloses contain a higher amount of acetyl groups than celluloses. Decreasing hemicelluloses due to NaOH treatment of particles (Table 2) could be increased the formaldehyde emission (Ayrilmis and Buyuksari, 2011; Marshall et al., 1974).

As it would be expected, decreasing adhesive amount in the particleboard negatively affected the surface quality, mechanical and physical properties of particleboard, and improved the formaldehyde emission.

Based on EN 312 (2010) standard, 12.5 N/mm^2 and 13 N/mm^2 are the minimum requirements for MOR of particleboard general uses and interior fitments (including furniture), respectively, while the minimum MOE for interior fitment is 1800 N/mm^2. The minimal requirements of IB strength for general purpose and furniture manufacturing are 0.28 N/mm^2 and 0.40 N/mm^2, respectively (EN 312, 2010). The panel type C had higher MOR, MOE and IB for general purposes and furniture manufacturing. Panel types B and D had the required levels of MOR, MOE and IB only for general purposes. Panel types A and E did not have the required levels of mechanical strength properties. According to the test results, the test panels did not have the required level of TS property according to EN 312 standard due to no usage of water-repellent agents, such as paraffin, in the manufacturing process. The maximum permissible formaldehyde content for E_1 quality particleboard is 8 mg CH_2O/100 g dry particleboard sample (EN 120-1, 1993). Panel types D and E met the required level of FE for indoor applications.

4. Conclusions

Formaldehyde emission, dimensional stability, mechanical and surface properties of particleboards, and chemical properties of particles were significantly affected by the treatment of wood particles with 1% NaOH. Treatment of wood particles with 1% NaOH decreased the solubility values (extractives) and amount of hemicelluloses. NaOH treatment improved the mechanical strength properties and surface quality of particleboards. However, this application negatively affected the dimensional stability and formaldehyde emission. Particleboards made from particles treated with NaOH for 24 h had the required level of mechanical strength properties for general purposes and furniture manufacturing. The results showed that particleboards made from particles treated with NaOH for 12 h could be used for general uses. Decreasing adhesive amount negatively affected all of the quality properties of particleboards except for formaldehyde emission. However, panels made from treated particles with NaOH for 24 h at 8-10% adhesive usage had the required levels of mechanical strength properties for general purposes.

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Effects of different starch applications on the properties of test liner paper

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Abstract: In this study, test liner papers were manufactured by using starch in pulp preparation unit and at size press in order to determine the effects of starch application on the properties of the papers. Firstly, 8, 10, 12, and 15% starch were applied in the pulp preparation unit and the physical and optical properties were determined. Likewise, starch was applied at size press in 15, 18, 22, and 26% rates. Then, papers were produced in different grammages using rates that gave the best results in the physical properties. The physical and optical properties of these papers were measured to determine effects of different starch applications on these properties. According to results, starch application at size press improved the physical and optical properties of test liner papers when compared with pulp preparation unit. Besides, the strength values of the papers produced by using size press were higher than the specified standards.
Keywords: Starch, Size press, Test liner, Physical and optical properties

1. Introduction

Starch has been used in many industrial applications for many years. It's used extensively in various applications in the paper industry. Besides, food industry is uses the starch for viscosity control while the pharmaceutical industry uses starches as fillers and carrier materials (Wurzburg, 1986). In paper industry, starch is the third largest component after cellulose fibers and fillers (Maurer, 2001). Its main application areas are coating, surface sizing, effluent treatment, furnish preparation, and conversion of paperboard to packing grades. Starch is generally used to increase paper strength both in internal and surface sizing (Smook, 1994; Muller et al.,, 2000).

Two or three layered liner paper produced by adding dark or white primary or secondary fibers onto secondary fibers is called a test liner. In recent years when recycling has become important, test liner papers are widely used. It is used in top and bottom layers in corrugated cardboard making. Their appearance must be clean and their colors are free of ripples due to their use on the outside of the packaging. The weights range from 90-350 $gr.m^{-2}$ and resistance to moisture can be increased by using additives. Starch and coloring agents can be used to improve strength properties and to provide surface smoothness (Onen, 2002).

Paper used in the packing paper production is subject to less deformation and the products it contains should be less exposed to internal and external effects in the transfer process. For this reason, the materials used in paper production must have maximum strength (Casey, 1960). Almost all of the packaging paper is produced by recycling in Turkey, and the strength of the fibers obtained from recycling is lower than virgin fibers. Some searches are being done to increase the strength values; and one of these is starch application on the surface of papers.

Starch application on paper surface process can be considered in three types. These are film size press, classic size press, and spray size press. Classic size press has also three types; horizontal, vertical, and angled size press (Tunca, 2010). Many important paper qualities can be improved by surface application. The sizing process is generally used to improve the strength properties of papers, while reducing penetration of the aqueous solutions. As mentioned before, there are two different sizing methods as internal and surface sizing (Smook, 1994). Surface sizing is commonly used for the fine papers, coated base papers and paper boards (Knowpap, 2013).

The aim of the study was to determine effects of the different starch applications on the test liner paper properties. For this purpose, test liner papers were manufactured by adding starch at size press and in pulp preparation unit. Angled size press which is one of the classic size press method was used to apply starch in this study. The optical and physical properties of the test liners produced with different starch application were analyzed and the differences between them were examined.

2. Materials and methods

Test liner paper production was performed in Kayseri Parteks Paper Mill. Fluting, test liner, white liner and kraft wastes were used for test liner paper production. Test liner papers were produced in ten different grammages as 90, 100, 110, 125, 130, 140, 150, 160, 170, and 175 $gr.m^{-2}$.

Firstly, in pulp preparation unit, test liner papers with 100 $gr.m^{2}$ were produced with adding starch in different dosages (8, 10, 12 and 15 kg/ton) in order to determine the best dosage. The best strength values were obtained with adding 15 kg / ton starch in test liner paper production (data not shown). Then, test liner papers with ten different grammages were manufactured

with adding starch as 15 kg/ton. Likewise, papers were produced with adding 15, 18, 22, and 26 kg/ton starch at size press. Paper produced using 26 kg/ton starch gave the best result in the strength properties and papers with ten different grammages were manufactured with adding this dosage. In order to decrease COBB (water absorptiveness) values of the papers, 8 kg/ton AKD (Alkyl ketene dimer) was added in pulp preparation unit.

The physical and optical properties of the papers were analyzed in accordance with applicable standards given in Table 1.

Table 1. Standards used to determine the physical and optical properties.

Physical and Optical Pro.	Standards	References
Grammages	TS 3122 EN ISO 536	Anon., 1998
Breaking Length (M. D.)	TS 3121-2 ISO 1924-1	Anon., 1997a
Breaking Length (C. D.)	TS 3121-2 ISO 1924-2	Anon., 1997a
CMT	TS 6717 EN ISO 7263	Anon., 2002
CCT	TS 12735	Anon., 2001a
RCT	TS 12734	Anon., 2001b
Burst Index	TS 3123 EN ISO 2759	Anon., 2004
Tear Index	TS 4423 EN 21974	Anon., 1996
ISO Brightness	ISO/DIS 2470	Anon., 1997b
ISO Opacity	ISO/DIS 2471	Anon., 1997b

The important required physical properties of the packaging papers are RCT, CCT, CMT, and bursting strength (Levin and Söderhjelm, 1999; Marin et al., 2009). Corrugated Medium Test (CMT): measures the crushing resistance of a laboratory-fluted strip of a corrugating medium. Corrugated Crush Test (CCT): measures the edgewise compression strength of a laboratory-fluted strip of a corrugating medium. Ring Crush Test (RCT): measures the resistance of a short cylinder of paper in the axial direction. Bursting strength: maximum pressure that the paper can resist without breaking with pressure applied perpendicular to the plane of the test piece.

3. Results and discussion

The physical and optical properties of the test liner papers produced using 15 kg/ton starch added in pulp preparation were presented in Table 2.

Table 2. The physical and optical properties of the test liner papers with different grammages produced using 15 kg/ton starch added in pulp preparation unit

Grammages (gr/m²)	90	100	110	125	130	140	150	160	170	175
Tensile Index (C.D.) (Nm/g)	18.53	20.27	21.35	19.04	18.66	17.39	21.36	22.48	21.92	25.78
Tensile Index (M.D.) (Nm/g)	43.01	43.06	43.91	44.20	44.21	44.24	43.63	41.15	38.92	37.96
CMT Index (Nm²/g)	149	151	190	174	186	179	198	184	176	175
CCT Index (Nm/g)	12.22	11.30	10.73	10.00	10.62	10.07	10.13	9.13	9.41	9.43
RCT Index (Nm/g)	5.67	5.70	5.69	5.36	6.62	5.60	6.07	6.5	6.76	6.57
Burst Index (kPam²/g)	2.07	2.06	2.07	1.96	2.04	2.23	2.16	2.08	1.99	1.96
Tear Index (C.D) (mNm²/g)	9.04	9.25	9.01	8.4	8.38	8	7.8	7.41	7.03	6.97
Tear Index (M.D) (mNm²/g)	8.69	7.63	7.23	6.44	6.5	6.52	6.61	6.7	6.5	6.64
Brightness (%ISO)	14.76	17.63	19.04	19.47	18.30	18.52	18.28	18.96	19.20	19.00
Whiteness (%ISO)	24.85	27.80	29.91	30.33	28.98	29.23	28.90	30.31	29.54	29.72

CD: Cross direction, MD: Machine direction

According to the table, the findings were found at the intervals specified in the standards. The effects of the grammages on the physical and optical properties of the papers can be also clearly seen in Table 2. With increases in grammages, it was observed that the brightness, whiteness, CMT, RCT, tensile (CD) indices were increased and CCT, tensile (MD), burst and tear indices were decreased.

The physical and optical properties of the test liner papers produced using 26 kg/ton starch added at size press were presented in Table 3.

Table 3. The physical and optical properties of the test liner papers with different grammages produced using 15 kg/ton starch added at size press

Grammages (gr/m²)	90	100	110	125	130	140	150	160	170	175
Tensile Index (C.D.) (Nm/g)	26.22	24.71	23.18	21.55	21.07	19.52	15.98	17.66	24.23	24.28
Tensile Index (M.D.) (Nm/g)	52.30	51.78	51.12	46.92	46.77	44.46	42.73	40.14	40.08	40.15
CMT Index (Nm²/g)	180	185	238	250	247	242	226	217	213	210
CCT Index (Nm/g)	13.33	13.00	13.18	16.80	16.77	16.79	16.42	16.58	16.00	15.77
RCT Index (Nm/g)	10.1	9.8	9.18	8.24	8.23	8	7.62	7.52	7.24	7.14
Burst Index (kPam²/g)	2.62	2.55	2.41	2.39	2.35	2.28	2.17	2.08	2.02	2.02
Tear Index (C.D) (mNm²/g)	9.89	10.6	10.5	9.42	9.41	9.05	8.77	8.41	8.1	7.99
Tear Index (M.D) (mNm²/g)	8.98	8.51	7.96	7.06	8.46	8.21	7.91	7.68	7.39	7.4
Brightness (%ISO)	17.05	18.70	17.37	17.19	17.94	18.02	18.52	18.64	18.76	18.29
Whiteness (%ISO)	26.80	29.18	26.97	27.11	27.63	28.06	29.57	28.43	28.56	29.18

When Table 2 and 3 compared with each other, the effect of size press application appears quite obviously. The use of starch at size press improved the physical and optical properties of papers with low grammages. But, these improvements have been ineffective with increasing grammages. The important physical properties CCT, CMT, RCT, and burst indices of the papers with different grammages were compared with each other in order to determine differences illustrated in Fig. 1

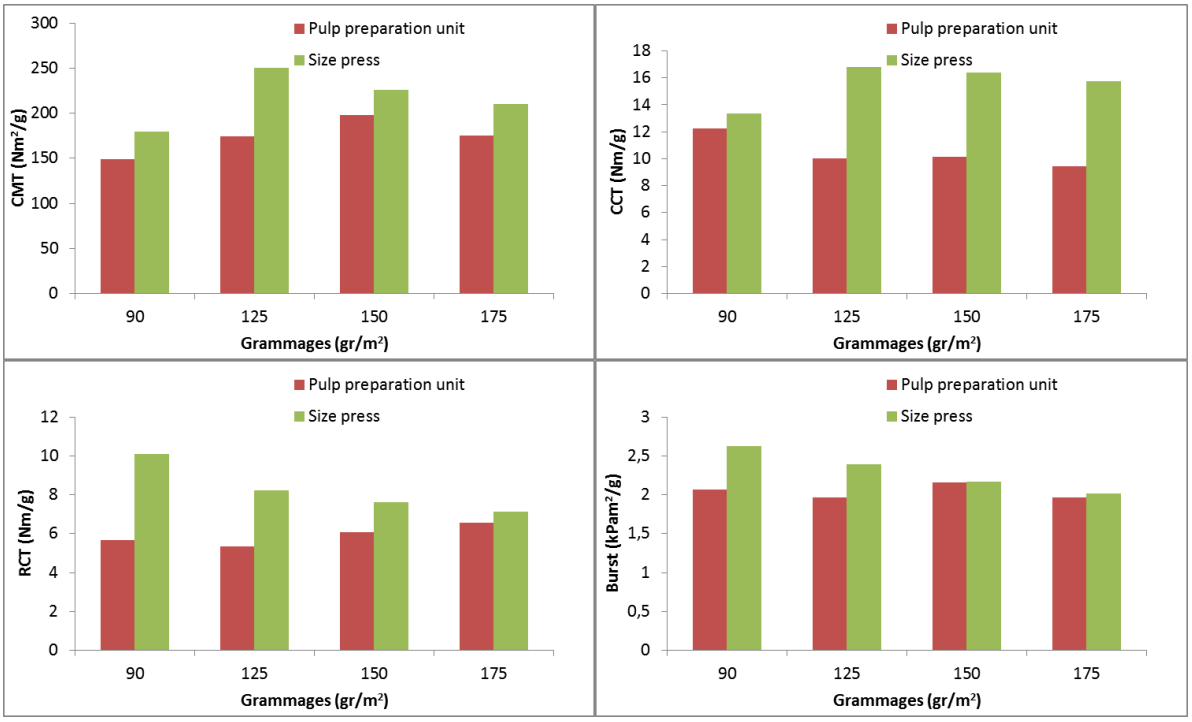

Figure 1. The physical properties of the papers with different grammages produced using starch in pulp preparation unit and at size press

As can be seen in the figure above, the papers (SP) produced using starch added at size press have better physical properties. CMT, CCT, RCT, and burst index of SP with 90 gr.m^{-2} were increased about 20.80%, 9.08%, 78.13%, and 26.57%, respectively, when compared with the papers produced using starch added in pulp preparation unit (PP). The most significant increases for physical and optical properties were obtained on test liner papers with 90 gr.$^{-2}$ after size press application. Kuusisto (2014) reported that tensile strength increased up to 108 kN/m, compared to tensile strength of 97-100 kN/m for base paper from same run without sizing. In a study, Biricik et al., (2011) have found that the physical properties of the papers applied starch to surface improved. Besides, the optical properties were increased by using starch added at size press. As a result, adding starch at size press improved significantly the physical and optical properties of the test liner papers.

4. Conclusion

In this study, the effects of different starch application on the test liner paper properties were investigated and the physical and optical properties of the papers produced using starch added in pulp preparation unit and at size press were determined. The conclusions obtained from this study were given below:

- Application starch at size press were improved the important physical properties such as CCT, CMT, RCT, and burst indices for test liner papers. In particularly, CCT values have shown a large increase about 78.13% compared to PP.
- The physical properties are considered to be more important for packing papers. Starch application at size press has an important role to improve the physical properties of the test liner papers.

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Waste management in the industry of small and medium sized Turkish furniture enterprises (SMEs)

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Abstract: Urbanization, population growth, rising living standard, the demand for furniture in Turkey, there is a significant increase. In this regard, the sector is fundamentally understands the requirements of the age and development, and in this context re-shaping a new perspective. In this context, as well as the rapid progress of productions in furniture factories that are established due to the need for big businesses based on furniture, it is required to maximize the recycling despite the low level of wastages and wastes. Occurring in the wood products industry waste is not to be underestimated. There are many advantages of wood as a renewable resource. Processed wood residues can be used as secondary raw material for other products. Wood products can be mostly recycled or re-used. Or used products can not be recycled or reused waste incinerated in order to be a source of energy. Furniture enterprises, set up to produce goods. Objectives is to make a profit. As is known, a number of factories producing goods wastage, waste occurs. In this study, the goods producing wastes, discharges to profit by minimizing the factory, how to resolve it, and recycling of waste will be provided investigates how. Survey technique was used in this study. One to one business managers of conducted the survey and face to face interviews. In the survey, about 20 questions directed at businesses of waste, in Turkey cities provinces of random sampling method involving a simple questionnaire was applied to 120 furniture operation. The work of furniture enterprises are still high rates of fire and waste recycling rate of assessment concluded that low-level. In addition, technological developments in the enterprise parallel machines need to be replaced with new ones. Where provided, properly recycling of waste, the plant margin has improved, the damage to the environment goes down to the lowest level. Thus, in the plant ecology of the environment and the world will be preserved.
Keywords: Waste, Furniture industry, Productivity, SMEs, Environment, Wood

1. Introduction

Waste wood can be a potentially valuable resource for the manufacture of various materials and products (Lykidis and Grigoriou, 2008). The type and volume of wastes generated during the manufacture of forest products have changed over time depending on various factors. One of these factors is the reduction in the amount of wood resources available (Lu et al., 2006).

To make a profit in order to meet the needs of individual businesses and economic activities are located to produce goods and services. Businesses are required to use environmental resources due to the activities of creating added value. With outputs produced during the production of goods and services, solid and liquid waste, gaseous waste and hazardous waste occurs. Reduce the amount of waste, prevent the loss of business value of raw materials and reduces operating costs (Kirlioglu and Fidan, 2011).

Turkey is a major manufacturer of industrial wood. Forest products industry is a relatively advanced features can be considered. Turkey's forest industry by using their own raw timber, particle board and plywood-based products. Pulp and paper industry, currently working for the domestic market. Unfortunately, significant amounts of wood as fuel is still used (Konukcu, 2001).

Harvested and processing of solid wood material for extraction of logs to the final product consists of all stages of production losses, due to many reasons. This is necessary to minimize wastage as well as the country's economy will benefit greatly from base of business economics (Sofuoglu, 2001).

In the production of timber work, predicted sizes of round wood to work. During this process, next to the wood sawdust, chip, cover, lumberjacks, chock-called waste and scrap of goods occurs. Some of them are, for example, cover boards, the stave is cut hacks evaluated as smaller in size. Others also account for the industry's raw materials, waste or losses are recognized in the timber industry (Ozen, 1978).

Waste in accordance with TS 654, bud timber recycling, timber processing and repair during and outside of class size and features throwaway goods, wood shavings, cover, debris, lumberjacks, wedge part or particle of waste is called. Throwaway goods, specified in standard sizes, but which aren't carried by any of the classes specified in standards in terms of appearance features pieces. Wood shavings, issued by the particles when mowing blade teeth. Crumb, during collection and processing of timber sides and small goods, paquet, there is no possibility lath production piece. Cover, bud is cut out on one side of the timber appraisal stub. Wedge, round or square logs and lumber occurring during the cutting head piece (Fig, 1-2).

Figure 1. Abrasive waste

Figure 2. Chip waste.

Langendorf and his friends are given the following values for the valuation bud timber (Ozen, 1978; Sofuoglu, 2001):

Timber	: % 71
Wood shavings	: % 12
The share of the Authority	: % 4
Evaluated other residues	: % 13
Total	: % 100

Kurz according to the,	
The main product	: % 42
Wood shavings	: % 12
Slab	: % 8
Wedge	: % 3
Firewood	: % 12
By-product	: % 23
Total	: % 100

Ozen 1978; Sofuoglu, 2001 has been determined as 65% of the total timber yield.

Figure 3. Part of waste.

Lumber and veneer mills ends, cover boards, timber production edges of the pieces, chips, sawdust, wood chips and covering some of the main processing waste residues. Although different sizes of these wastes chip board, fiber board, competitive raw materials for pulp and paper sectors. Widely used in most European countries, the source of raw materials (Engur and Kartal, 2002).

Maisenbacher according to 450 the number of factors on yield due to impress wastage rates. These are the most important (Ozen, 1982):

1- Intersect method
2- Timber cross-section
3- Harvested timber edge nature of the
4- Diameter of the log
5- Log length
6- Log form
7- Growth characteristics and defects
8- Mowers
- Circular saw
- Block band saw machine and block multi-bladed machine
- Vertical multi-bladed machine
- Combination machines

9- Blade Thickness
10- Harvesting errors

Forest products industry polluting substances are divided into four main groups (Engur and Kartal, 2002):

1- With or without solids, gases: the best examples of this, sulfur and nitrogen oxides, non-condensable organic gases and sulfur. Most of them, particularly fossil fuels is used, the plant given to the atmosphere through the chimneys.
2- Water-soluble substances: these are sodium salts, acids, alkalis, various additives, bark and timber waste substances from the extractives and impregnation. May be toxic or non-toxic.
3- Suspended in liquid (suspended) solids: fibers, paper fillers and growing small particles of different actions.
4- Solid wastes: tree bark, wood chips, wood shavings, clay and coal ash from water and solutions.

Purpose of The Study; Turkish furniture industry, often working in most of the traditional methods of job shop, has a view dominated by small-scale enterprises. Today, Turkey is in the furniture industry, large and small, with all manufacturers and retail stores with about 60,000 companies and 260 000 people are employed. Process, especially in the last 15-20 years, as well as medium and small-sized enterprises has increased the number of large-scale enterprises. On the other hand, The Union of Chambers and Commodity Exchanges of Turkey capacity reports, according to the number of firms 40 250 or more workers are employed, the number of businesses that employ one hundred or more employees in the 155 (TSI, 2012).

2. Materials and methods

Turkish furniture industry, the market concentration, and/or forest products collected are concentrated in certain regions. Important furniture production areas according to their share of total production in Istanbul, Ankara, Bursa (Inegol), Kayseri, Izmir and Adana are listed as (Spo, 2007).

The primary forest products industry wastes include the timber industry wastes (wood shavings, crumbs, covers, lumberjacks, wedges and discard goods), wastes of wooden panel products, sand, cardboard, packaging wastes, paint, varnish, and water wastes. Reuse of these wastes that are left in the hands of businesses by exposing them to various processes and formation of this cycle have become an economic and political target for both developed and developing countries.

Furniture enterprises, set up to produce goods. Objectives is to make a profit. As is known, a number of factories producing goods wastage, waste occurs. In this study, the goods producing wastes, discharges to profit by minimizing the factory, how to resolve it, and recycling of waste will be provided investigates how.

Survey technique was used in this study. One to one business managers of conducted the survey and face to face interviews. In the survey, about 20 questions directed at businesses of waste, in Turkey cities provinces. Random sampling method involving a simple questionnaire was applied to 120 furniture operation.

3. Findings

The data obtained in the study, the frequency, percentage values were calculated. This statistical package for the evaluation of results using the datas given in Table 1, Table 2, Table 3.

Table 1. Demographic properties of enterprises

	Frequency	Percentage (%)
The number of employees in the enterprise		
0-9	54	45
10-19	3	2.5
20-49	33	27.5
50 or more	30	25
Production type of business		
Discrete manufacturing	66	55
Mass production	54	45
The enterprise workspace		
Kitchen furniture	36	30
Seating furniture	15	12.5
Baby furniture	7	5.8
Bedroom furniture	20	16.7
Children furniture	13	10.8
Others	29	24.2
Do you have a CNC machine in enterprice?		
Yes	84	70
No	36	30
Do you have a dust extraction system in enterprice?		
Yes	93	77.5
No	27	22.5
Total	120	100

Table 2. Assessment of waste wood in enterprises

	Frequency	Percentage (%)
In enterprises chip tailings		
Particle board and MDF sent to factories	27	22.5
Chicken farms sending	12	10
Used as fuel	54	45
Other	27	22.5
In enterprises assessment of waste water		
Using purified varnish and paint shops	18	15
Using purified in WC	18	15
Garden irrigation use	18	15
Other	66	55
In enterprises piece tailings		
Use as firewood	72	60
Decorative furniture making	9	7.5
Finger Joint machine	24	20
Other	15	12.5
Paint waste recycling in enterprises		
Whether the disposal of the relevant organizations	75	62.5
Whether the relevant organizations to ensure the storage of	12	10
Other	33	27.5
In enterprises evaluation of packaging waste		
Nylon waste whether the relevant Organizations destruction of	51	42.5
Whether the relevant organizations cardboard wastes for storage	45	37.5
Other	24	20
In enterprises paper waste recycling		
Whether to provide the recycling of paper mills	68	57
Whether the relevant organizations to ensure the storage of	8	6
Other	44	37
In enterprises varnish waste recycling		
Whether the disposal of the relevant organizations	60	50
Whether the relevant organizations to ensure the storage of	-	-
Other	60	50
In enterprises sanding etc. of waste		
Firewood material	18	15
As waste	90	75
Other	12	10
In enterprises waste and waste rate		
%0-5	15	12.5
%6-9	84	70
%10-14	21	17.5
%15 or more	-	-
Total	120	100

Table 3. Demographic properties of the respondents

	Frequency	Percentage (%)
Educational status of the respondents		
Primary school	21	17.5
High school	60	50
University	39	32.5
Of respondents working in the enterprise		
0-5 years	9	7.5
6-8 years	18	15
9-10 years	12	10
11 or more	91	67.5
Department of the respondents		
Process	70	58
Accounting	10	8
Marketing	12	10
Others	28	24
Years old of the respondents		
21-30	30	25
31-40	50	42
41-50	25	21
51 and more	15	12
Gender of the respondents		
Male	100	83
Female	20	17
Total	120	100

4. Results and discussions

According to this study the majority of level of education is high school level, high school level of individuals, business owners, masters and appear to be the foreman. Furniture factories, administrative and management emphasizes the importance of education at the university level pruning that the majority of people.

In terms of yearsYears of working in this sector, the majority of people who fill out the survey 77.5% and over 9 years observed. This shows that the industry experienced people who know the job.

All of the surveyed small to medium-sized enterprises, 45% of production and 55% of batch production. All enterprises engaged in mass production, batch production makers in 32.5% of dust extraction system. Absence due to dust extraction system in the field of discrete manufacturing enterprises to be small or the cost is high. Dust extraction system, a clean environment, the collection of waste easier, as there are many benefits to reduce the possibility of dust. In this context the importance of the system appears to be how big.

The study area outside of the other choices in the poll of businesses, office, bathroom, garden furniture are included. All businesses are working more than one area. More space to cater to more than one area of study so as to increase the size of enterprise and profit.

CNC machines are all medium and large-sized enterprises. The main reason is due to the mass production that makes the. CNC benefit from the use of manpower and time, use of less importance. Recycling of waste sawdust, 55% of enterprises, and 45% are considered as firewood. These ratios is given that recovery is still insufficient observed levels.

Waste water back to the work of transformation is carried out by medium-sized enterprises. Varnish and paint shops to meet both environmental and water used in the waste water plant will profit. Garden watering will be environmentally friendly by using the business. There are no studies on the recycling of waste water in small businesses. Small enterprises, water, sewer goes to waste.

Part of the waste timber production enterprises, and the fence are used to make decorative decoration. Some of the parts of waste in the finger joint In enterprises combining machine are made available again. Some enterprises are considered as firewood.

The upper surface processes and solvents used in the paint-varnish is flammable. Upper surface treatment and not as waste disposal businesses prefer to storage. Paint-varnish cans stored for recycling. In addition, environmental officers of all waste in accordance with waste regulations under the supervision of the ministry of the environment are evaluated.

Storage of waste nylon provides businesses by giving the relevant organizations. Other option under the auspices of the ministry of the environment assessed marks the businesses. Cardboard and paper waste sent for recycling the majority of businesses and send their paper mills. Some businesses are marked other option for upholstery use.

Grinding and so on. waste "fuel material (fuel briquettes, etc.) using the" and "waste" using options, sanding, etc. markings reason is the difficulty in collecting waste. "Other" option is the use of the process of the upper surface markings reason for using some of the mixtures.

As a result of the survey 120 and over 15% did not waste any business. This is because over 15% and profits by stopping fire the event that the company can not obtain a huge loss. A rate of 6-9% in the vast majority of enterprises and the waste is waste.

Conclusions

Timber production and the bud of the factors that will minimize wastage rates in accordance with the valuation technique is required. Evaluation of the wood material with a minimum of wastage of raw materials, as well as the need of wood processing enterprises is extremely important for the economy. In order to reduce fire, remains smaller cross-section than the valuation Parts and bud is required with minimal losses. Lumber mills are capable of employees and their work, there should be thorough maintenance of machinery and equipment.

Part of waste recycling work for gain, to some extent cut off parts of the finger joints can be used in combination with the camera so that the desired dimension. Using waste as fuel to heat the factory parts can help.

For recycling of waste wood shavings to gain work, send chipboard factories, poultry farms, sending fuel to use, as using the recycling of cork production can provide. Examined the upbringing of fuel briquettes from chips and mushrooms can be used.

Recycling of waste water cleaning can be achieved. In addition, emerging water waste; garden irrigation varnish and paint shops, toilets can be used. Thus, water saving is achieved in terms of the factory.

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Determination of some properties of particleboards produced with two different adhesives

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Abstract: In this study, particleboards were produced with two different adhesive and two different lignocellulosic materials. Urea formaldehyde and PMDI were used as adhesive. Wheat straw and mixture of pine and poplar particles were utilized as lignocellulosic material. The aim of the study was to determine the effects of type and amount of adhesive, type of lignocellulosic materials on the particleboards properties. In addition, effects of usage layers of the lignocellulosic materials were investigated. For this purpose, sixteen particleboards with single or three layers were produced. Test samples were prepared and their mechanical and physical properties including bending strength, modulus of elasticity in bending, tensile strength perpendicular to the plane of the board, swelling in thickness, water absorption and density of the samples were determined according to EN 310, EN 319, EN 317 and EN 323/1 standards, respectively. As results of this study, the particleboards produced with PMDI adhesive were provided better bending strength, modulus of elasticity, internal bond strength than urea formaldehyde adhesive. Mechanical strength values were increased with rising of adhesive amount. The particleboards produced with urea formaldehyde were absorbed more water and more swelled than PMDI. All the boards manufactured with PMDI adhesive provided standard requirements.
Keywords: Particleboard, Urea formaldehyde, PMDI, Wheat straw, Wood particle

İki farklı tutkal kullanılarak üretilen yonga levhaların bazı özelliklerinin belirlenmesi

Özet: Bu çalışmada iki farklı tutkal ve iki farklı hammadde kullanılarak yonga levhalar üretilmiştir. Hammadde olarak odun yongası ve buğday sapı, tutkal olarak üre formaldehit ve PMDI kullanılmıştır. Çalışmanın amacı üretilen yonga levhaların kalite özellikleri üzerine tutkal türü, tutkal miktarı, hammadde türü ve hammaddelerin yonga levha içerisindeki kullanım yerlerinin etkisinin belirlenmesidir. Bu amaç doğrultusunda tek ve üç tabakalı olmak üzere 16 adet yonga levha üretilmiştir. Üretilen levhaların eğilme direnci, eğilmede elastikiyet modülü değerleri, yüzeye dik çekme direnci, kalınlık artışı, ağırlık artışı (su alma) oranları ve yoğunluk değerleri sırasıyla EN 310, EN 319, EN 317 ve EN 323/1 standartlarına göre belirlenmiştir. Elde edilen istatistik sonuçlarına göre PMDI tutkallı levhalar üre formaldehitli levhalara göre daha yüksek çekme direnci, eğilme direnci, eğilmede elastikiyet modülü değerlerine sahip olduğu görülmüştür. Üretilen levhalarda kullanılan tutkal oranı artıkça mekanik değerlerde artış olduğu belirlenmiştir. Üre formaldehit tutkalı ile üretilen levhalar PMDI tutkalı ile üretilen levhalardan daha çok su alıp şiştiği tespit edilmiştir. PMDI tutkalı ile üretilen yonga levhaların tamamı standartta istenen değerleri sağlamıştır.
Anahtar kelimeler: Yonga levha, Üre formaldehit, PMDI, Buğday sapı, Odun yongası

1. Introduction

The particle board is usually a large surface plate produced under the heat and pressure with the help of glue of small pieces of wood. In the production of particle board, materials such as forest waste, firewood, branch wood, industrial waste wood, timber waste and annual plant stalks are used as wood raw materials. Wood of a type tree can be used as a raw material or woods of different type tree can be used by mixing in the production of particle board. (Akyıldız, 2003; Başyiğit vd, 2000; Bozkurt ve Göker, 1990; Kalaycıoğlu ve Özen, 2012).

Our country is also an important agricultural region, especially because plants such as wheat and cotton are grown in abundant quantities. The stalk of cotton planted in this area is renewable and forms a significant fiber source. Kalaycıoğlu ve Özen (2012) stated that it will be possible to evaluate these wastes as raw materials in the production of chipboard.

Due to its low cost, ease of use and some technical advantages, urea formaldehyde is used in 90% of the production of chipboard industry. Urea formaldehyde can be obtained in both dry and liquid form. (Bozkurt ve Göker, 1990; Kalaycıoğlu ve Özen, 2012). Another adhesive used in the production of chipboard is Polymeric Diphenyl Methane diisocyanate (PMDI). This glue has many advantages such as high resistance to moisture, low pressing time and resistance properties over FF glue, as well as disadvantages such as the sticking of the particle board to the press plates in the first years of use and the price being expensive (Schmidt, 1998).

In a study by Grigoriou (2001), wood chips and wheat stalks were mixed at different rates to produce chipboard. Urea formaldehyde and polymeric diphenyl methane diisocyanate adhesives were used at different rates in the production. As a

result of the tests made, the produced particle boards with PMDI and PM / PMDI adhesives had higher values than the produced particle boards with UF.

The aim of this study was to produce three layered particle board using two different glue and two different raw materials and to determine some properties of them. Tests have been carried out in accordance with the standards. The values obtained are compared with the standard values.

2. Material and method

In this study, wood particle with wheat stalk as raw materials and urea formaldehyde with polymeric diphenyl methane diisocyanate as adhesives were used. Wood particles and urea formaldehyde (UF) were supplied by Kastamonu Integrated industry and trade limited company. Wheat stalks were provided by the local farmers in Kahramanmaraş/Turkey. Polymeric diphenyl methane diisocyanate (PMDI) was supplied microkim chemical and machinery Industry and trade limited company in Turkey. Properties of UF and PMDI were shown Table 1 and Table 2, respectively.

Table 1. Properties of urea formaldehyde

Properties	UF
Solution (%)	65+- 1
Density (g/cm^3)	1.27-1.29
PH (25^{0}C)	7.5-8.5
Viscosity Dın/cPs 25^{o}C	150-200
Gelling time (s, 100^{0}C)	25-30
Usage time (day)	60
Flow time (s, 25^{0}C)	20-30
Free CH_2O (max.) %	0.19

Table 2. Properties of polymeric diphenyl methane diisocyanate (URL 1)

Physical appearance	Sticky liquid
Color	Brown
Smell	Light Mold
Specific weight	At 200 ^{0}C 1,24
Water Solubility	İnsoluble in water
Boiling Point	300 ^{0}C
Freezing point	5-10 ^{0}C
Reaction	Water, Alcohol, Acids, Bases

The composition of manufactured particle boards is shown in Table 3. Wheat straws and wood particles were first dried in an oven to about 2%. Dried particles and glue were mixed in the mixer machine according to the determined ratios. Glued particles were laid in the mold. First, cold press was applied to the prepared draft board. It was then pressed at 200 ° C at 120 bar pressure for 6 min. 14 groups were successfully produced, but M3 and M7 groups were not produced. The produced particle boards were allowed to cool down in room conditions. The particle boards were cut to standard test sizes. All tests samples were conditioned in a climatic room with the temperature of 20 °C and the relative humidity of 65%. Values of tensile strength perpendicular to the plane of the board, bending strength, modulus of elasticity in bending, swelling in thickness and density were determined according to EN 319, EN 310, EN 317 and EN 323/1, respectively.

Table 3. The composition of manufactured particle boards

Specimen ID	Glue type and ratio (%)		Amount of glue	Particle type and ratio (%)		Amount of particle (gr)		Number of layers and Particle type (WP, WS)
	UF	PMDI	(gr)	WP	WS	WP	WS	
M_1	5	0	139*	100	0	2,685	0	Surface layer WP
M_2	10	0	265*	100	0	2,685	0	Surface layer WP
M_3	5	0	139*	0	100	0	2,264	Surface layer WS
M_4	10	0	265*	0	100	0	2,264	Surface layer WS
								Surface layer WS
M_5	5	0	140*	67	33	1,867	920	Inner layer WP
								Surface layer WS
								Surface layer WS
M_6	10	0	266*	67	33	1,782	878	Inner layer WP
								Surface layer WS
								Surface layer WP
M_7	5	0	140	33	67	878	1,782	Inner layer WS
								Surface layer WP
								Surface layer WP
M_8	10	0	266*	33	67	878	1,782	Inner layer WS
								Surface layer WP
M_9	0	5	139	100	0	2,803	0	Surface layer WP
M_{10}	0	10	265	100	0	2,679	0	Surface layer WP
M_{11}	0	5	139	0	100	0	2,948	Surface layer WS
M_{12}	0	10	265	0	100	0	2,687	Surface layer WS
								Surface layer WS
M_{13}	0	5	140	67	33	1,879	920	Inner layer WP
								Surface layer WS
								Surface layer WS
M_{14}	0	10	315	67	33	1,908	945	Inner layer WP
								Surface layer WS
								Surface layer WP
M_{15}	0	5	140	33	67	948	1,883	Inner layer WS
								Surface layer WP
								Surface layer WP
M_{16}	0	10	315	33	67	965	1,918	Inner layer WS
								Surface layer WP

WP: Wood particle, WS: Wheat stalk

3. Results and discussion

In this study, on the physical and mechanical properties of the chipboard were investigated the effect of glue and raw material type as well as being single or three layered of particle boards. The density values of the particle boards produced using the UF and PMDI glues are given in Table 4 and Table 5. According to test results, it was seen that the lowest density value (0.60gr/cm^3) is the M4 board produced with 10% urea formaldehyde glue and 100% wheat stalks. The highest density value (0.75gr/cm^3) was appeared the M11 board produced using 5% PMDI glue and 100% wheat stalks. It was seen that the density values of the produced particle boards are close to the target density values.

Table 4. The density values of the particle boards produced using the UF

Specimen ID		M1 (gr/cm^3)	M2 (gr/cm^3)	M4 (gr/cm^3)	M5 (gr/cm^3)	M6 (gr/cm^3)	M8 (gr/cm^3)
Glue type	No						
	1	0,71	0,73	0,57	0,73	0,73	0,64
	2	0,70	0,75	0,58	0,73	0,72	0,69
UF	3	0,67	0,74	0,61	0,70	0,73	0,71
	4	0,66	0,74	0,61	0,72	0,74	0,71
	5	0,63	0,74	0,61	0,70	0,73	0,70
Average (%) (X)		0,67	0,74	0,60	0,72	0,73	0,69
Standard deviation (S)		0,03	0,01	0,02	0,02	0,01	0,03

Table 5. The density values of the particle boards produced using the PMDI

Specimen ID		M9	M10	M11	M12	M13	M14	M15	M16
Glue type	No	(gr/cm^3)	(gr/cm^3)	(gr/cm^3)	(gr/cm^3)	(gr/cm^3)	(gr/cm^3)	(gr/cm^3)	(gr/cm^3)
	1	0,62	0,63	0,73	0,71	0,65	0,71	0,70	0,75
	2	0,63	0,71	0,74	0,69	0,67	0,70	0,69	0,73
PMDI	3	0,63	0,70	0,78	0,68	0,66	0,69	0,71	0,73
	4	0,63	0,62	0,76	0,68	0,67	0,67	0,72	0,71
	5	0,62	0,63	0,74	0,70	0,69	0,69	0,70	0,75
Average (%) X		0,63	0,66	0,75	0,69	0,67	0,69	0,70	0,73
Standard deviation (S)		0,00	0,04	0,02	0,01	0,01	0,01	0,01	0,02

The values of swelling in thickness of the samples which are kept in water for 24 hours are given in Table 6 and Table 7.The highest thickness increase value (68,9 %) was appeared the M8 board produced using wheat stalk in the middle layer and 10% UF glue. It was seen that the lowest thickness increase value (8,4 %) is the M10 and M14 board produced with wood particle in the middle layer and 10% PMDI glue .

Table 6. The values of swelling in thickness of the particle boards produced using the UF

Specimen ID		M1 (%)	M2 (%)	M4 (%)	M5 (%)	M6 (%)	M8 (%)
Glue type	No						
	1	34,1	17,6	62,1	47,0	29,4	69,2
	2	34,5	17,4	65,6	49,9	29,3	67,7
UF	3	32,1	17,4	64,6	50,1	30,4	68,7
	4	31,7	15,2	62,4	47,5	31,1	70,5
	5	32,6	18,1	59,7	47,2	31,5	68,4
Average (%) (X)		33,0	17,1	62,9	48,3	30,3	68,9
Standard deviation (S)		1,2	1,2	2,3	1,5	1,0	1,0

Table 7. The values of swelling in thickness of the particle boards produced using the PMDI

Specimen ID		M9 (%)	M10 (%)	M11 (%)	M12 (%)	M13 (%)	M14 (%)	M15 (%)	M16 (%)
Glue type	No								
	1	11,7	8,2	11,4	8,2	10,9	7,8	12,7	8,3
	2	12,0	8,4	9,4	8,1	10,7	8,7	12,8	8,7
PMDI	3	11,5	8,5	10,2	6,5	12,7	8,6	11,7	8,7
	4	12,0	7,9	9,8	8,1	11,0	8,6	11,7	8,8
	5	11,	9,0	10,3	7,8	10,9	8,3	11,6	8,3
Average (%)		11,7	8,4	10,2	7,7	11,2	8,4	12,1	8,5
Standard deviation (S)		0,3	0,4	0,8	0,7	0,8	0,4	0,6	0,2

The bending strength values of test samples are shown in Table 8 and Table 9. As a result of the tests, the highest bending strength value (26,64 MPa) was identified the M12 board produced using PMDI glue while the lowest bending strength value (3,6 MPa) was appeared the M4 board produced using UF glue. The bending strength values of the particle boards increased as the glue use ratio raised. Standard value was provided by only the M2 from boards produced using UF while were supplied by M10, M11, M12, M13, M14 M15 and M16 from boards produced using PMDI. In the study conducted by Bektaş et al. (2005), it was shown that the swelling value of the boards produced by using sunflower stalk particles and UF glue is 25.5%. Topbaşlı (2013) determined that the swelling values of medium density particle boards produced from banana shell wastes are between 17.7% and 44.8%.

Table 8. The bending strength values of the particle boards produced using the UF

Specimen ID		M1 (%5)	M2 (%10)	M4 (%10)	M5 (%5)	M6 (%10)	M8 (%10)
Glue type	No						
	1	10,2	18,6	3,7	7,9	10,2	4,8
	2	9,2	19,3	3,7	8,5	10,8	4,5
UF	3	8,5	18,2	3,6	7,6	9,7	4,5
	4	7,2	16,7	3,5	6,2	12,2	5,8
	5	6,7	16,8	3,5	6,5	11,0	5,1
Average (X)		8,4	17,9	3,6	7,3	10,8	4,9
Standard deviation (S)		1,4	1,1	0,0	1,0	0,9	0,5

Table 9. The bending strength values of the particle boards produced using the PMDI

Specimen ID		M9 (%5)	M10 (%10)	M11 (%5)	M12 (%10)	M13 (%5)	M14 (%10)	M15 (%5)	M16 (%10)
Glue type	No								
	1	10,62	12,48	25,17	27,02	19,14	24,48	16,42	21,87
	2	9,63	12,71	25,11	26,78	19,88	23,21	16,66	21,30
PMDI	3	10,01	12,24	23,52	24,51	20,99	22,28	16,41	20,93
	4	9,12	11,23	26,22	28,47	17,81	22,79	17,76	24,03
	5	8,98	11,90	23,67	26,43	18,17	18,70	14,90	21,48
Average (X)		9,67	12,11	24,74	26,64	19,20	22,29	16,43	21,92
Standard deviation (S)		0,67	0,58	1,13	1,42	1,29	2,17	1,02	1,23

The values of modulus of elasticity in bending of test samples are shown in Table 10 and Table 11. According to tests performed, the highest flexural modulus value (4221,6 MPa) was identified the M12 board produced using PMDI glue while the lowest flexural strength value (1156,4 MPa) was appeared the M8 board produced using UF glue. Flexural modulus values of PMDI based boards were determined higher than UF based boards. In addition, higher flexural modulus values were found in the single-layer produced particle boards. The flexural modulus value of Only the M4 and M8 from the test samples did not provide the standard value. Grigoriou (2001) determined as 11,58-32,66 MPa the bending strength values of particle boards produced using in different percentages of wood particles and wheat stalks with 10% UF, 8% PMDI, 10% UF / PMDI glues.

It was shown that bending strength values of particle boards produced using PMDI and UF/PMDI glues were higher than bending strength values of particle boards produced using UF.

Table 10. The values of modulus of elasticity in bending of the particle boards produced using the UF

Specimen ID							
Glue type	No	M1 (%5)	M2 (%10)	M4 (%10)	M5 (%5)	M6 (%10)	M8 (%10)
	1	2047,5	3046,5	1248,4	2208,4	2477,2	1167,0
	2	2042,9	3181,5	1310,1	2308,9	2601,9	1170,8
UF	3	1816,8	2982,1	1268,4	2231,6	2443,1	968,3
	4	1683,8	2728,7	1210,8	1756,7	2705,6	1235,2
	5	1502,4	2786,5	1250,8	1935,0	2603,3	1240,9
Average (X)		1818,7	2945,1	1257,7	2088,1	2566,2	1156,4
Standard deviation (S)		234,9	186,7	36,0	232,9	106,2	110,7

Table 11. The values of modulus of elasticity in bending of the particle boards produced using the PMDI

Specimen ID									
Glue type	No	M9 (%5)	M10 (%10)	M11 (%5)	M12 (%10)	M13 (%5)	M14 (%10)	M15 (%5)	M16 (%10)
	1	1850,9	2048,0	4144,3	4290,4	3535,4	3703,1	2517,0	2865,5
	2	1772,4	2100,6	4232,0	4300,2	3571,4	3656,0	2576,1	2894,2
PMDI	3	1701,0	1979,7	4258,1	4072,7	3482,3	3517,8	2488,6	2815,6
	4	1617,2	1895,9	4132,1	4210,7	3357,3	3524,7	2431,1	2885,5
	5	1592,7	1933,7	3937,6	4234,2	3418,6	3431,0	2320,9	2828,4
Average (X)		1706,8	1991,6	4140,8	4221,6	3473,0	3566,5	2466,7	2857,8
Standard deviation (S)		107,4	83,2	125,9	91,3	86,5	110,8	96,8	34,6

In Table 12 and Table 13 showed the tensile strength values of test samples. When the test results are examined, the highest tensile strength value (2,46 MPa) was determinated the M10 board produced using PMDI glue while the lowest flexural strength value (<0,xx) was appeared the M1, M4 and M5 board produced using UF glue. The increase in the amount of glue and the use of PMDI glue have increased the tensile strength value. Tensile strength values of boards produced using UF glue did not provide the standard value while tensile strength values of boards produced using PMDI glue provide the standard value.

Table 12. The tensile strength values of the particle boards produced using the UF

Specimen ID							
Glue type	No	M1(%5)	M2(%10)	M4(%10)	M5(%5)	M6(%10)	M8(%10)
	1	*	0,24			0,06	0,02
	2	*	0,33			0,03	0,03
UF	3	*	0,74			0,03	0,03
	4	*	0,25			*	0,01
	5	*	0,20			*	0,02
Average (X)		*	0,35			0,04	0,02
Standard deviation (S)		*	0,22			0,02	0,01

Table 13. The tensile strength values of the particle boards produced using the PMDI

Specimen ID									
Glue type	No	M9 (%5)	M10 (%10)	M11 (%5)	M12 (%10)	M13 (%5)	M14 (%10)	M15 (%5)	M16 (%10)
	1	1,51	2,7	0,73	0,58	1,27	1,8	1,31	2,4
	2	1,46	2,3	0,79	1,29	1,55	2,45	1,25	2,2
PMDI	3	1,40	2,7	0,49	1,30	1,12	1,7	1,36	2,7
	4	1,35	2,5	0,66	1,12	1,50	1,91	1,10	2,4
	5	1,32	2,1	0,62	1,22	1,49	2,1	0,95	2,1
Average (X)		1,41	2,46	0,66	1,10	1,41	2,00	1,20	2,4
Standard deviation (S)		0,08	0,26	0,12	0,30	0,20	0,30	0,17	0,23

In Wu (2001) study, it was measured that the tensile strength values of the boards produced by using sugar cane stalk and PMDI glue were 1,63-2,70 MPa. Furthermore, It has been shown that the perpendicular tensile strength values of the boards produced using PMDI are increased.

4. Conclusion

In this study, particle boards were produced using two different glue and two different usage rates. Furthermore, some properties of single and three layered particle boards produced by using wood particles and wheat stalks as raw materials have been examined. PMDI glue gave better results than UF glue. Physical and mechanical properties of particle boards produced using PMDI glue provided the standard values. Both the physical and mechanical properties of the particle boards increased as the amount of glue used rising.

It has been shown in this study that wheat stalks and PMDI glue can be used in particle board production. Most of the samples produced provided standard values.

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Effects of different drying environments on the dimensional stability of eucalyptus wood

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Abstract: Due to its hygroscopic properties, the wood material reach a certain equilibrium moisture content at various usage areas according to the existing relative humidity and adapting the weather conditions considering the temperature. For this reason, there could be shrinkages and swellings in wood material dimensions if it is not dried enough with respect to its intended purpose and place of use. Therewith, a number of deformations occur in wood material such as cracking, warping and split-up at joints. Because of the high amount of water found in eucalyptus, which is the subject of the study, it is known that it is one of the most late-drying trees and difficulties occur during its drying process. In this study, the effects of natural drying methods performed at different environments upon eucalyptus (*Eucalyptus camaldulensis*) timber' density and dimensional stability were investigated. Within this scope, sample timbers were stacked under two different atmospheres being open - closed environments and dried during a year. Then, measurements made on samples prepared according to standards showed that oven dry density, volume weight value, volumetric shrinkage and swelling percent of timbers dried at open environment (OE) were found averagely as 0.674 g/cm^3, 0.56 g/cm^3, 11.91%, 18.90%, while values of timbers dried at close environments (CE) were found as 0.737 g/cm^3, 0.63 g/cm^3, 10.89%, 17.14%. When evaluating the results of data using Independent-Samples T test analysis, it was determined that drying environment has formed significant differences at a level of ($p<0.05$) on density, swelling as well as volume weight value however, it has not significant effect on volumetric shrinkage.
Keywords: Natural drying, Eucalyptus, Dimensional stability, Volumetric shrinkage, Swelling, Density

1. Introduction

The eucalyptus tree planted with the aim of drying the bogs in Turkey is a fast growing species and therefore an important raw material used in the forest products industry nowadays. Eucalyptus, which is considered to be a packaging box in the past, is importantly now used in building constructions, railway traverses, coatings, furniture, chests, turning, agricultural tools, musical instruments, sports equipment, sandal and buckets. Despite many advantages, Eucalyptus wood has some disadvantages such as high swelling, low dimensional stability, and several drying problems limiting its use (Unsal et al., 2003; Bektas et al., 2008; Korkut et al, 2008; Kilic Ak, 2016).

Before final products are obtained, the water present in newly cut trees should be evaporated from wood. For this reason, the rough and fresh lumber sawn from the log must be dried. Depending on species, local weather conditions, dimensions and time of year when the material piled, natural-drying times vary widely. Temperature, rainfall and relative humidity all contribution to the drying process of wood piles. Also water loss slows down as wood water content decrease. Additionally, different log diameters and lengths, debarking and piling specifications may strongly affect natural-drying times (Simpson and Wang, 2004; Bown and Lasserre, 2015). The drying process has several important advantages such as reduces wood weight, stains, and decays, increases some strength properties, improves the application of adhesives and other chemicals. Besides, it improves dimensional stability of wood reducing shrinkage and swelling (FPL, 1999).

Wood normally shrinks as it dries and swells as it absorbs moisture. These changes in its dimensions are important to final usage area. The dimensional changes in wood are brought about by the shrinkage or swelling of the cells, or fibers, of which the wood is composed. The timber drying process should be well managed to ensure dimensional stability. For example, collapses are formed on the wood as a result of rapid drying. Therefore, shrinkage and swelling values can be varied.

The aim of this study was to determine differences between open-closed drying on the dimensional stability of eucalyptus woods grown in Turkey. For this reason, the shrinkage and swelling values of the wood samples dried in different environment were determined and compared with each other.

2. Material and methods

2.1. Drying process

The freshly sawn materials were obtained in Mersin-Karabucak Forest Sub-district Directorate. When the timbers were brought to environments, their starting moisture content (MC) varied between 57 to 72%. All the material consists in boards 3 m long, 15 cm width and 6 cm thickness. Air drying method was applied to the timbers stacked in Kahramanmaraş Province. Timbers were piled in two different environments: Open (OE) and Closed (CE). Drying process was began in summer period

(effective drying) on June and followed during one year. The data were taken from meteorological station for OE and Geratech DT-172 was used to measure temperature and relative humidity of CE.

2.2. Determining dimensional stability

When drying process ended, thirty specimens having a dimension of 20 × 20 × 30 mm were prepared for the each test. In order to determine dimensional stability, volumetric swellings and shrinkages in tangential and radial, and longitudinal directions were performed accordance with TS 4083-4084-4085-4086 standards. Also volume-weight value was calculated based upon TS 2472. The specimens were dried at the temperatures of 103± 2°C until they reached 0% moisture content. Then, in order to determine oven-dry density, they were weighed and their dimensions were measured. Changes in the cell wall thickness of the fibers was examined in order to determine effects on the dimensional stability.

2.3. Statistical analysis

The independent samples T-test was performed to determine the effect of different environments drying on the dimensional stability of eucalyptus wood.

3. Results and discussion

The temperature and relative humidity values, which are effective parameters in the drying process, were measured throughout a year and are given seasonally in Fig. 1 below. As can be seen in the figure, throughout drying process, average temperature in CE and OE were measured 19 and 20 °C, and relative humidity were 58 and 43%, respectively. In addition, the average annual rainfall and wind velocity values that are effective on OE were 2.70 mm and 2.10 m/sec, respectively. At the end of the effective drying period (summer), the moisture content of CE and OE were 12% and 9.8% whereas after one year, respective values were 13.3% and 14.5%, respectively.

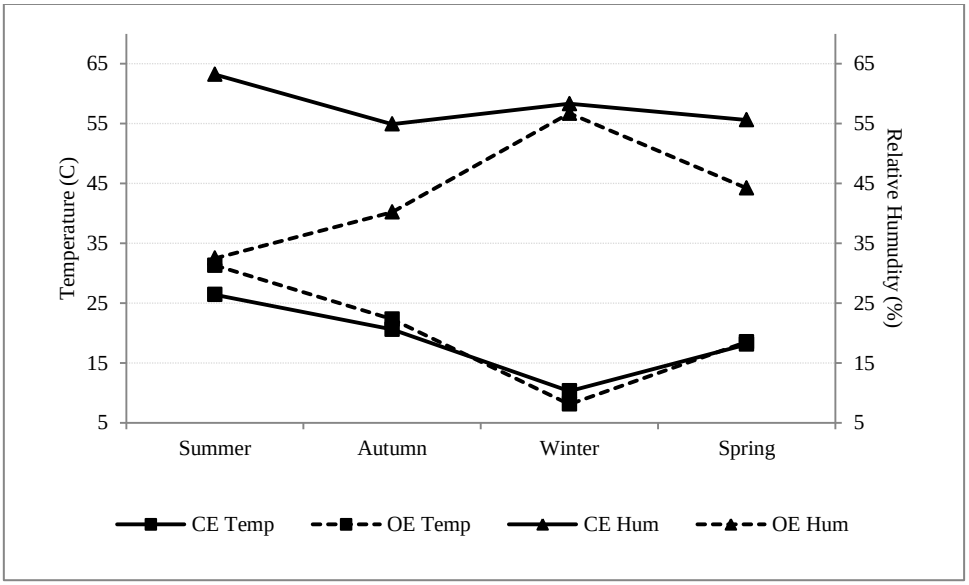

Figure 1. Temperature and relative humidity values of CE and OE

The findings obtained in the tests were analyzed by grouping according to drying environments, and evaluated below. Table 1 demonstrates the mean values of oven dry density, volumetric shrinkage - swelling and volume-weight values of Eucalyptus wood dried in two different environments obtained from T-tests.

It is obviously seen that the difference drying environment has a significant effect on the properties of eucalyptus wood except for volumetric shrinkage. It was determined that the density and volume weight values of the samples taken from timbers dried in CE were higher than those dried in OE, while the volumetric swelling and shrinkage percentages were lower. Also, it can be seen that the shrinkage percentage values were not significantly affected from differences open-closed environments. Commonly, low swelling and shrinkage values as well as high density in wood material are desirable characteristics (Schulgasser and Witztum, 2015).

Table 1. The T-test analysis results of the findings

Physical properties		Mean	Standard deviation	Standard error	Coefficient of variation	t_{value}	Sig. (2-tailed)
Oven dry density (g/cm^3)	CE	0.737	0.062	0.010	8.41	3.033	0.003
	OE	0.674	0.114	0.018	16.91		
Volume weight value (g/cm^3)	CE	0.63	0.062	0.010	9.84	3.660	0.000
	OE	0.56	0.091	0.014	16.25		
Volumetric shrinkage (%)	CE	10.89	5.224	0.826	47.97	-1.169	0.246
	OE	11.91	1.724	0.273	14.48		
Volumetric swelling (%)	CE	17.14	2.801	0.443	16.34	-2.217	0.030
	OE	18.90	4.153	0.657	21.97		

Under normal conditions, it is known that has more density trees are more shrinkages; but due to the collapse, hysteresis and deformations on the wood, resulting from open-closed drying factors (relative humidity, temperature, etc.), density-shrinkage relationship have not been completely linear. When compared to previous studies, the findings show that the swelling and shrinkage values were consistent with the literature (Unsal et al., 2003; Bal et al., 2012).

As known, in high relative humidity and low temperature conditions, the wood dries more slowly and has more quality and thus less collapse is occurred. The high temperature increases the collapse formation because of reduces the strength of the cell wall (Bozkurt and Goker, 1996). Meanly, the effect of collapse formation on wood stability is mentioned. In our previous study, the cell wall thicknesses of the timber dried in CE (3.98 µm) were found to be significantly different from those dried in OE (3.56 µm), statistically (Bektas et al., 2017). It can also be said that the precipitation and the wind velocity also influential on the results for samples dried in OE. In other words, timbers dried in CE have more dimensional stability than timbers dried in OE.

4. Conclusion

In this study, it has been investigated the effects of different drying environments on the wood dimensional stability properties. The dimensional stability properties of eucalyptus timbers' dried two different environments (open-closed) were determined. The results show that the drying environment has an effect on the dimensional stability of the eucalyptus woods. There were significant differences between oven dry density, volume weight, and volumetric swelling values except for volumetric shrinkage value in different environments. It is thought that this is caused by the severity of drying conditions in OE. Besides, the cell wall thickness of timbers dried in CE was measured higher than that of timbers dried in OE. Consequently, it can be said that drying eucalyptus timbers in CE gives more suitable results.

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Wood preservatives potential of geothermal energy resources from some regions of Turkey

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Abstract: Geothermal energy sources have been used in different application areas all over the world. In order to be answer of the needs, various institutions and organizations has active on the geothermal energy technologies. Geothermal energy production has an activity that provides high value-added socio-economic positive contributions for national and regional economic development without damaging the geothermal resources and geothermal activities. Therefore, it is important to evaluate the utilization process of geothermal energy for different industrial uses and to make recommendations for this process. Turkey is an important country with geothermal energy resources containing rich chemical or mineral substances. In order to be use economically, it must also be determined the wood preservatives potential of these resources. The purpose of this study is to discuss from the perspective of wood preservatives potential of different geothermal energy resources from some regions of Turkey. Geothermal energy resources whose analyzed hydrogeochemical content from geothermal fields where hot water + steam resources are dominant in Afyonkarahisar, Kutahya and Sakarya regions of Turkey were studied especially for this study. The study used as materials the data obtained from current standards, literature documentation and relevant institutions or organizations. After analysis of the data, for these geothermal waters, a data table was created by using different variables such as temperature, flow rate, depth and pH values, chemical contents, concentrations. The table was investigated from wood protectants perspective, and the wood preservatives contents of geothermal waters were determined. Total numbers and concentrations were detected for chemical or mineral objects which compatible with the standards and literature. The findings were discussed in the context of water-based impregnants at the scale of the chemical or mineral substances added to classic wood preservatives. At the present time, the forest products industry provides employment by making significant contributions to national and regional economic development. However, both there are problems in the import of wood preservatives and the use restrictions of chemicals threatening human and environmental health has increased increasingly. For this reason, in out country, determination of potential as a alternative reference origin of an renewable natural resource for wood impregnants production has important in terms of developmen of human and environmentally friendly chemicals and reducement of import burden and external dependency.
Keywords: Geothermal energy, Wooden, Wood preservatives

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Determination of seasonal impacts on log prices in auctions and future log price forecast

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Abstract: Seasonality refers to periodic fluctuations that occur regularly in certain business areas based on a certain season. Forestry activities are influenced by the seasons because of its ability to be open to external factors. Some forestry activities, such as the increase in firefighting activities in summer, the increase of spring afforestation activities, and the increase of wood production activities in spring and summer months, are examples of seasonal effects. Because of the dependence of production on seasonal conditions, the effects of seasonality are also seen on log sales prices. In this study, the seasonal effects on the auction log sales prices of third-class normal sized Fir (*Abies nordmanniana subsp. bornmülleriana Mattf*), Black pine (*Pinus nigra subsp.pallasiana*), Beech (*Fagus orientalis*) and Scots pine (*Pinus silvestris*) in the Kastamonu Regional Directorate of Forestry, which provides the largest log product supply in Turkey, has been determined and the log prices for the next year were estimated. For this purpose, 103060 auction sales figures were used in the Kastamonu Regional Directorate of Forestry between 2009-2016. For this purpose, time series analysis was used and analyzes were performed using Microsoft Excel. According to the results of the study, it was determined that all of the third-class normal height Fir, Black pine, Beech and Scots pine logs had a seasonal effect on the auction selling prices. It was determined that winter and spring seasons are positive on log prices and summer and autumn seasons are negative effects.
Keywords: Auction log sales prise, Seasonality effect, Fir log, Black pine log, Beech log, Scots pine log, Kastamonu Regional Forest Directorate, Turkey

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Oral presentation

The tensile shear strength comparison of the unprotected exterior conditions plywood produced from fir, alnus, pine and poplar wood

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Abstract: Forest products are at the forefront of services provided by nature. Forests are natural resources that meet the needs of human. Moreover, because of its superior properties, it still maintains its importance in many applications today. One of these applications of wood is plywood production. With the production of plywood, wood material can be used more efficiently also, it is possible to obtain large surface materials with high strength properties, less dimensional changes, free from various defects. In this study, plywood samples were obtained from fir, alder, pine and poplar rotary cut veneers with combinations of poplar-pine, poplar-fir, poplar-alder and simple poplar. It is aimed to determine the tensile-shear strength values of these unprotected outdoor plywood's produced by using phenol formaldehyde resin and to determine the effect of wood species on adhesion quality. Generally, Phenol formaldehyde (PF) resins are preferred as adhesives for water resistant plywoods to be used in outdoor environments. For this purpose, test samples were provided by TKS Tosya Veneer and Particle Board Company. In accordance with the instructions of adhesion class 3 and according to TS EN 314-1 and TS EN 314-2, the test specimens were firstly allowed to cool in water for at least 1 hour at (20 ± 3) ° C. Secondly they were immersed in boiling water for 4 hours, then dried at 60 ± 3 ° C for 16-20 hours in an air-circulating drying oven. Thirdly, they were immersed in boiling water for 4 hours. After this process, samples were allowed to cool down in water for at least 1 hour at (20 ± 3) ° C, and the excess water on them was gently wiped off and then tested for adhesion quality in a Shimadzu ™ brand universal tester. The test speed was adjusted so that the sample was separated in 1 minute. The obtained data were analyzed statistically by using SPSS 22 statistical program. As a result of the study, the plywood produced from the poplar wood had the lowest tensile-shear strength. The highest tensile-shear strength was determined in poplar-alder and poplar-fir plywoods. Statistically, no difference was found between these plywoods in terms of tensile-shear strength value. In order of the test results, the second highest degree of tensile-shear strength was determined in poplar-pine plywood. The obtained tensile-shear strength values were determined to be higher than the minimum value of 1N/mm2 determined for the unprotected exterior conditions plywoods specified in TS EN 314-2. These plywoods are thought to be used in outdoor conditions.

Keywords: Plywood, Tensile-shear strength, Adhesion quality, Wood veneers, Unprotected exterior conditions plywood

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Oral presentation

Effects on retention by applying liquid nitrogen to some woods

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Abstract: The wood materials are a material which uses in almost every area of daily life, such as decoration, landscape, construction and furniture. They have some disadvantages like flammable and affected by biological factors. For increase service life of wood materials against to these factors are treated coated or impregnated materials. Many methods are being studied to improve the permeability of wood. But, alternative methods are still researched to increasing amount of retention. In this study, Scots pine and Oriental spruce wood materials impregnated with Firetex and before impregnation exposed to liquid nitrogen for 15 minutes. According to research results increased the retention amounts of applying liquid nitrogen. The liquid nitrogen treatment can use as a new method to improve the permeability of the wood.
Keywords: Retention, Liquid nitrogen, Scots pine, Oriental spruce

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A topsis-based performance assessment study in wood panel industry

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Abstract: One of the important elements of economic and social development is production activities. Wood panel sector which is a leading producer of byproducts in forest products sector has an important place especially in the development and competition of the furniture sector. Performance analysis is defined as the collecting, analyzing and reporting process of data on a regular and systematic basis, In order to follow resources used, product and services produced and results obtained by an company. The aim of this study is to assess performance of 3 wood panel manufacturers taking place among the best 500 firms explained for the year 2015 in the Journal of FORTUNE Turkey. These companies have superiority in terms of different performance factors. However, to make a holistic assessment, it was used TOPSIS method which is one of the multi-criteria decision making techniques. TOPSIS approach includes all criteria (performance factors) into the solution, in order to provide a single result. In order to evaluate the performance of these manufacturing companies; financial performance factors such as equity, active assets, leverage ratio, number of employees, net sales and operational profit margin factors were analyzed. The financial performance scores of the companies were calculated and were evaluated based on their score proximity to the positive value and negative value range (ideal values) according to the TOPSIS method. As a result of study, the findings suggest that Yıldız Sunta MDF Company (ideal value: 0.7861) is first place in terms of performance in wood panel industry. Other companies were determined as Çamsan Company (ideal value: 0.6549) and AGT Company (ideal value: 0.2526) respectively. The TOPSIS method provides an objective evaluation opportunity for decision makers by evaluating a large number of evaluation criteria. Thus, these results provide information about the financial performance of companies to managers and facilitate decision-making for existing or potential investors.
Keywords: Wood panel industry, Performance analysis, TOPSIS method

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Thermogravimetric analyses and decay resistance of wood-cement composites with silica fume and different chemical additives

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Abstract. Pozzolanic materials can partially substitute Portland cement in order to enhance the properties of wood-cement composites such as durability and mechanical properties. The interaction between additions and cement can be investigated by various techniques such as thermal analysis, X ray diffraction, cement calorimeter and physico-mechanical tests ect. Thermogravimetry (TGA) and derivative thermogravimetry (DTG) are considered important tools to evaluate the hydrated products of cement according to different stages of cement hydration, in addition to quantifying the different phases. The purpose of this paper is to investigate the effects of silica fume and different chemical additives on TGA/DTG and decay resistance of cement bonded particleboards from Douglas fir wood. For this purpose, the three-layer cement bonded particleboards with a target density of 1200 kg/m^3 and a dimension of 45*45*1 cm were produced by using 1/2 -1/3 wood-cement ratio, 10%, 15%, 20% silica fume as cement replacement materials and three different chemical additives [$AI_2(SO_4)_3$, $CaCI_2$, $FeCI_3$] to improve the compatibility between wood and cement. All the boards were pressed using a pressure of 18-20 kg/cm^3 for 24 hrs. In the first 8 hours of the pressing process, a temperature of 60 °C was applied and then pressing was continued for 16 hrs in ambient temperature. TGA/DTA analyses was done on a DTA-TG apparatus, Shimadzu DTG –60 simultaneous with samples heated over the temperature range of 30 °C – 900 °C at a constant rate of 10 °C/min under nitrogen atmosphere. Decay resistance was performed using brown-rot fungi according to EN 113 standards. The results demonstrated that, the decay test specimens had weight gains in contrast to the loss of weight due to carbonation reaction of cement. Silica fume and $CaCI_2$ led to decrease the weight gain compared to the reference sample. According to the results of TGA/DTA, the most weight loss was obtained from the boards with 15% silica fume while the least weight loss was obtained from the reference board with %0 silica fume. This means that there were more hydration products [C-S-H gel and $Ca(OH)_2$] of cement at the board with %15 silica fume than the reference boards with %0 silica fume and the boards with %15 silica fume had more mechanical and physical properties than the reference board.

Keywords: Silica fume, Chemical additives, Thermogravimetric analyses, Decay resistance, Cement bonded particleboards

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Oral presentation

5S applications in furniture manufacturing environment

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Abstract: Turkey's forest products sector grows continuously and is a sector that seeks to gain a significant share in international markets. While Turkey is the largest producer of wood based board industry in European markets, the furniture industry is growing more and more every year with an average growth of around 13%. It is necessary for the sector to increase its efficiency and effectiveness so that these advantages can continue and improve. And it also necessary to use advanced production systems applied in manufacturing sectors more effectively in global markets. The 5S system is a key component of a Japanese original philosophy known as the Toyota Production System (TPS) or the lean manufacturing system, based on eliminating all the wastes in the production area. The 5S application is a systematic approach aimed at creating a regular work environment and making sustainable management style. It is the whole of the (sort, set in order, shine, standardize, sustain) activities expressed by the combination of the English initials activities that should be repeatedly applied in 5 steps in order to enable the work and production to operate in a certain system and in certain flow and order. This system also introduces a corporate culture created a regular and organized work environment in organizations. This culture offers opportunities for improving the quality, efficiency and efficiency levels of the business by combining motivation and discipline in the working environment. The purpose of this study is; to observe the activities that 7 enterprises applying lean manufacturing system in Turkish furniture industry as 5S applications and to determine good practices by exemplifying ones selected from these activities. Thus, for the furniture industry enterprises that want to increase their efficiency and effectiveness, a road map was created to follow in 5S applications Under this road map, the steps of sorting, set in order, sweep, standardize and sustain have been examined by photographing with good practices from different enterprises. Obtained gains are expressed by post-pre-analysis. Observational data obtained as a result of the study will contribute not only to furniture industry enterprises but also increase efficiency and effectiveness, to provide competitive advantage and to spread these gains for small and medium scale production workshop type manufacturing enterprises.
Keywords: 5S, Toyota production system, Furniture industry, Productivity

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Oral presentation

Evaluation of lignocellulosic and plastic wastes in composite production by using flat press method

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Abstract: The aim of study was to evaluate the wastes generated from sawdust in the composite production. Five different compositions were used in production of composites. For production of composites, polystyrene (PS) as polymer matrix and maleic anhydrite grafted polypropylene (MAPP) as binding agent were chosen. Composite samples were produced at the size of 250 mm x 25 mm x 5 mm by hot press with the compression molded technique. The several mechanical tests, (e.g., tensile strength, bending strength, young modulus tests), physical tests (water uptake, swelling etc.) of PS-based composite were investigated in the case of using flat press. The results showed that the mechanical and physical properties of the composite sample added the coupling agent (3%) was better that composite without MAPP. When amount of lignocellulosic fibers in composites was increased, mechanical and physical properties of composite samples slightly decreased. The results showed that the PS-based composites could be used for the production of composite material to be used in several field.
Keywords: Waste sawdust, Flat press, Wood plastic composites

POSTERS

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Poster presentation

Flora of Dedegül Mountains and its effects to agricultural production of lakes region

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Abstract: It is known that the ancestors of agricultural plants and the agricultural plants grown in a geographical area.are closely related to the wild flora. As a parallel to the Turkish Flora, the Lakes Region also has an important plant diversity. Although the flora of Antalya is not fully known, 2500 taxa; It is known that Isparta carries 2,300 (600 endemic) and Burdur carries 1600 (450 endemic) taxa. On the other hand, it is stated in the scientific sources that the mediterranean region is the center of the differentiation of some genera from the four important groups of medicinal and aromatic plants: Lamiaceae / Labiatae, Apiaceae / Umbelliferae, Rosaceae and Papaveraceae families. Production and diversity of coriander, cumin, fennel in Burdur; carrot in Isparta; Dill, radish, turnip; Poppy, apple, fat rose, strawberry, blackberry, quince, quince, deer apple, hawthorn in Lakes Region are very high. They also have a significant potential in wild plants that have been harvested. Sütçüler thyme, rose hip, sage are some of these. The secret of this success in the agricultural products of the Region is many ecological factors besides belonging to Dedegül Mountain and Bozburun Mountain which is the extension of this mountain; Beyşehir Lake National Park, Kızıldağ National Park, Köprülü Kanyon National Park; Kovada Lake National Park and Eğirdir Lake. The Lakes Region has an important gene center and microclimatic effects. The most effective factor in formation of these features is seen as the floristic richness and topographical structure of Dedegül mountain. This report emphasizes the relationship between the Dedegül Mountain and the agricultural production in the region.

1. Introduction

Dedegül Mountains are a mountain range 5-8 km wide between the Beysehir and Eğirdir Lakes to the east of the Lakes Region, extending about 60 km in the north-south direction. Beyşehir is the eastern border of the area and it forms Büyükçay's arms, which are poured into this Lake. The west border is Davras Mountain, Aksu Creek and the basin. To the east, Beyşehir Lake, Kurucaova town, Dumanlı village and Yeşildağ city; to the north is Şarkikaraağaç, Sultan Mountains, Eğirdir Lake, Aksu in the west, Sarp Mountain; in the south it is surrounded by Köprüçay valley and Emerdin mountain, Sütçüler city, Kesme and Derebucak towns. Bird flight in north-south direction the field is generally mountainous and rugged. It is tectonic. The rocks are generally serpentine, volcanic and limestone. The area: 138568 ha, Coordinates: 31,25 'D, 37,74 ° K, altitude. It is 820-2992 m. It is mostly located in Isparta (Şarkikaraağaç, Gelendost, Eğirdir, Beyşehir, Yenişarbademli, Aksu, Sütçüler cities) and partially in the province of Konya (Beyşehir district); No protection status. May be harmed.

"Dedegül" is the name of a mountain range between Yenişarbademli, Aksu, Eğirdir, partly Sütçüler (Isparta) and Beyşehir (Konya) districts. Beysehir Lake on one side and Kızıldağ National Park and Eğirdir Lake on the other. It is the highest mountain in the world. Dedegül Tepe is at the height of 2992 m altitude. Other peaks; Kartal peak is 2983 m, Karçukuru peak is 2932 m high (Güner, 2005; Eken et al., 2006).

Zindan Cave (in Aksu city), Pinargözü Cave (in Yenisarbademli, 16 km in length) are the most attractive caves of Türkiye. Rock type and karstic structure have been very influential in the formation of caves and boulders. It is the richest area of the Lake District in terms of vegetation and animal diversity. The mountain was selected as one of Türkiye's 122 Important Plant Areas (Özhatay, 2006). At the same time, it is the Important Nature Areas of Türkiye (Eken, 2006). These names are international project and book names. The important fresh water resources of the region are the effects of this mountain or mountain. Especially Karagöl (2350 m) is an interesting karst formation. This lake, which is fed with snow water, has its base paved and its edges are clay. The waters leaking from the bottom of this lake are transformed into important rivers on the side of Antalya and these waters are mainly used for agricultural production.

Dedegül peak is integrated with the Anamas mountains. Cedar and larch forests dominate up to 2000 m. It is one of the areas where the nomads are settled and lived their migratory traditions. The Çayır plateau, the Barak plateau, the Sorkun plateau and the valleys are important pedestrian precincts. Mountaineering festivals are being held on the Melikler plateau for 18 years (Anonymous, 2017).

2. Material and method

The herbal materials of the work have been collected by the author at various dates since 1994. Almost 1000 specimens were collected from the area. After being made according to the techniques of addition, pressing and drying, the author was

put on herbarium cartons and placed in **GUL Herbarium** which is in the Department of Biology (Isparta) of Süleyman Demirel University Science and Literature Faculty. Diagnosis was made by the authors (Davis, 1965-1988; Davis et al., 1988; Güner et al., 2000) from the works of Flora of Turkey and the East Aegean Islands. Findings were obtained within the scope of scientific projects carried out on various dates. These projects were later transformed into scientific publications (Özçelik and Öztürk, 1999; Özçelik and Korkmaz, 2002; Özçelik et al., 2004; Özçelik et al., 2012; 2016; Özçelik and Özhatay, 2005; Serin et al., 2008; Ünüvar et al. 2016). The flora and vegetation taxa that should be monitored and endangered are determined for these studies. the floristic, topographical, climatic and geological structure of the area has been interpreted in order to explain the effects on the agriculture of the local people. The satellite image of the study area is shown on Map 1.

No record of plants collected from the field. A list of the taxa threatened on a global scale, on a European scale or throughout the country, and the hazard categories were determined according to the literature (Özhatay et al., 2005; Eken et al., 2006). However, the collection of plants has been done by us and from general diagnosis books (Davis, 1965-1988; Davis et al., 1988; Güner et al., 2000) of the diagnosis country. The endangered taxa with little or no distress in the danger category have not been added to the list of mountains.

The author's interpretation of the agricultural production effects in the region of Dedegül Mountain. After the flora and vegetation of the mountain and the region were revealed, the geological and geomorphological structure was compared with the plants dominant in the agricultural production of the Lake Region and the results were interpreted.

The flora of the mountain, the vegetation and the threats on its natural geological and topographic structure have been determined by observations. Some suggestions have been made to protect this mountain against the identified threats.

Map 1. View from SATellite of research area (from https://earth.google.com/web).

3. Findings and discussion

There are different ecological habitats in Dedegül Mountain. These habitats have been an important factor in the development, spread and diversification of various plants. Dedegül is the richest mountain in terms of floristics of the Lake District. Flora of it is not exactly known. According to our work called "Flora of Isparta"; this mountain is home to at least 900 vascular plant taxa. Approximately 350 of these are endemic. 30 of the endemic are only grown on the mountain of Dedegül. So this mountain is the only address in the world of about 40 plants.

Pinus brutia as a local community, *Platanus orientalis* and *Tilia platyphyllos* along the Aksu stream are widely distributed near the village of Kasımlar. The high sections of the Dedegül Mountains are quite rich in terms of plants. Approximately 40 plant taxa are endemic to the area and its environment.

Plant taxa specialised to the mountain and its environs: *Aubrieta anamasica, Alyssum cephalotes, Hesperis ozcelikii, H. pisidica, Ranunculus gueneri, Delphinium gueneri, Geranium cinareum* subsp. *subcaulescens* var. *pisidicum, G. glaberrimum, Erodium pelargoniflorum, Minuartia umbellifera* subsp. *salbacica*, *Silene guerbuezii, S. caramanica, S. caryophylloides* var. *echinus*, *S. cariensis, S. isaurica, S. phrygia, S. ruscifolia, S. lycaonica, S. oreades, S. pharmaceifolia, S. capillipes, S. akmaniana, S. deliculata* var. *pisidica*, *Minuartia anatolica* var. *phrygia, Herniaria pisidica Astragalus sorgerae, Trigonella polycarpa, Sempervivum ispartae, S. pisidicum, Rosa dumalis* subsp. *boissieri* var. *antalyensis, Eryngium trisetum, Centaurea kizildaghensis, Helichryssum chasmolycicum, Ballota cristata, Nepeta plinux, Lamium pisidicum, Polygala pruinosa* subsp. *megaptera, Verbascum adenocarpum, V. sorgerae, V. pumilum, V. spodiotrichum, Rindera dumanii, Valeriana oligantha* and *Crocus asumaniae.*

The narrow-spread taxa that grow on the Dedegül mountains but also grow in other areas: *Hesperis matronalis* subsp. *cilicica, Thlaspi papillosum, Papaver strictum, Matthiola montana, Isatis cappadocica* subsp. *alyssifolia, Hypericum monodenum, Silene amana, S. sipylea, S. leptoclada, S. tunicoides, S. cryptoneura, S. cariensis, Dianthus eldivanus, Saponaria syriaca, Paronchia davisii, Geranium lasilopus, Genista burdurensis, Trigonella lycica, Astragalus barbarae, Astragalus panduratus, A. sparsipilis, Cephalaria lycica, Sempervivum brevipulum, Sedum hispanicum* var. *planifolium, Kundmanniana syriaca, Helichryssum heywoodianum, Centaurea germanicopolitana*, *Euphorbia isaurica, Verbascum pinardii, V. cilicicum, Sideritis leptoclada, Lamium lycium, Thymus samius* and *Asyneuma isauricum.*

Although *Silene ruscifolia* were registered, from Kayseri (Pinarbasi) and Sivas provinces they were not found by us, but there was a small area in Gelendost(Isparta).

Silene caryophylloides have very good variation in the mountain.

Sedum hispanicum var. *planifolium* was registered from Kütahya. Dedegül Mountain is the area of second spread. In the mountain, it is growing the best. It is spread by birds.

Minuartia umbellifera subsp. *salbacica* was registered from Denizli. However, varieties of the species are growing abundantly in the mountain.

Plant taxa in the VU (at risk) category in the mountain: *Acer hyrcanum* subsp. *sphaerocaryum, Asphodeline turcica, Bupleurum davisii, Echinops onopordum, Eremopoa attalica, Erodium pelargoniiflorum, Gaudiniopsis macra* subsp. *micropyroides, Glycyrrhiza asymetrica, Hypericum ternatum, Iris pamphylica, Muscari muscarimi, Omphalodes ripleyana, Ricotia varians, Silene deliculata* subsp. *pisidica, Stachys antalyensis, Trigonella pamphyllica, Valeriana oligantha, Veronica panormitana* subsp. *baradostensis, Ranunculus gueneri* and *Rosa dumalis* subsp. *boissieri* var. *antalyensis.*

Plant taxa in the CR (Critical) category in the mountain: *Stachys chasmosericea.*

Plant taxa in the EN (Endangered) category in the mountain: *Campanula antalyensis, Cerastium pisidicum, Crocus asumaniae, Globularia trichosantha* subsp. *longisepala, Herniaria piscida* and *Stefanoffia insoluta.*

It is a field where the Mediterranean enclaves (vegetation with foreign origin,) are seen in the region. For this reason, it is a mountain that has links to other regions in terms of geological structure and plant formations. There are a large number of monumental trees in the area (registered Beyçamı by the ministry), and even 600-800-year-old larch forests or remains. *Quercus vulcanica* and *Abies cilicica* subsp. *isaurica* are also present as enclaves. Most of these trees are monumental trees. It is a rare plant from Tertiary (3 rd time) that can reach the day-to-day. For this reason, they are both a relite and an endemic. Along the canyon (Kapiz) is an enclave of European Siberian taxa. There are small remains from these enclaves in the upper parts of the canyon.

Dedegül mountains are the gene center of the rose genus. According to our work; rose genus and *Rosa dumalis* subsp. *boissieri* var. *antalyensis. R. dumalis* in the area, a rosehip species, is the highest quality rosehip species in Türkiye. Vitamin C in R. dumalis growing the mountain is above of world standards. Dedegül mountain shows a lot of species variation. There are almost 60 rose genotype belonging to 12 species in the mountain. This route must be produced for economic gain (Özçelik vd., 2012; Özçelik, 2013).

We have to think the Dedegül mountain together its surroundings. Especially from Bozburun Mountain and Köprülü Canyon National Park, we can not think separately from the Beysehir Lake National Park. Among the other bulbous and tuberous plants that we have cultivated, there are Şakayık, Ayıgülü (*Paeonia mascula*), Kardelen (*Galanthus gracilis, G. elwesii*), Boynubüküк, Gölsoğanı (*Leucojum aestivum*), Ağlayangelin (*Fritillaria* spp.), Çiğdem (*Crocus, Colchicum* spp.) and Lale (*Tulipa* spp.) are also abundant and varied in this mountain. Members of the Crassulaceae family are particularly important for the *Sedum* and *Sempervivum* genera, as well as *Populus* and *Salix* genera. *Origanum minutiflorum* is one of the endemic species of the region and is known as Sütçüler kekiği, Aş (Çorba) kekiği, Tota kekiği. We have to think about the Dedegül mountains with its surroundings. Especially from Bozburun Mountain and Köprülü Canyon National Park, we can not think separately from the Beysehir Lake National Park. Among the other bulbous and tuberous plants that we have cultivated, there are Şakayık/ Ayıgülü (*Paeonia mascula*), Kardelen (*Galanthus gracilis, G. elwesii*), Boynubüküк/ Gölsoğanı (*Leucojum aestivum*), Ağlayangelin (*Fritillaria* spp.), Çiğdem (*Crocus* and *Colchicum* spp.),) and Lale (*Tulipa* spp.) are also abundant and varied in this mountain. Members of the Crassulaceae family are particularly important for the *Sedum* and *Sempervivum* genera, as well as *Populus* and *Salix* genera. *Origanum minutiflorum* is one of endemic species of the region. It is the most important of Turkey's export. The volatile oil content is about 3% and the use of oil components is very convenient. Türkiye's export is the most important. The volatile oil content is about 3% and the use of oil components is very convenient.

The floristic characteristics of the area are given in Table 1 as a comparison with their surroundings.

Table 1. A comparison of the floristic studies performed in and around the study area.

Research Areas	Total Taxa	Endemism Ratio %	The biggest 3 families*	The biggest 3 genera**	Med. el. %	Ir. Tur. el. %	Avr.-Sib. el. %
Kasnak Meşesi Nature Protection Area (Isparta) (Özen and Fakir, 2015)	442	15,61	Fabaceae, Asteraceae, Lamiaceae	*Trifolium, Astragalus, Silene*	27,38	9,28	6,33
Yaylabel (Isparta) (Şenal, 2011)	271	13,65	Asteraceae, Fabaceae, Lamiaceae	*Silene, Astragalus, Centaurea*	25.46	8.86	5.54
Dedegül Mountains (Isparta-Konya) (Peşmen and Güner, 1976)	824	18,69	Asteraceae, Fabaceae, Caryophllaceae	*Silene, Astragalus, Ranunculus*	18,57	10,92	4,73
Sütçüler (Isparta) (Özçelik and Korkmaz, 2002)	587	26,20	Fabaceae, Asteraceae, Caryophyllaceae	*Silene, Trifolium, Ranunculus*	% 29.0	%15.6	% 6.2
Aksu (Isparta) (Özçelik and Öztürk, 1999)	658	25,20	Asteraceae, Lamiaceae, Caryophyllaceae	*Silene, Veronica, Astragalus, Centaurea*	% 23,1	% 11,4	% 9,2
Barla Mountain (Isparta) (Bekat, 1987)	645	17.05	Asteraceae, Fabaceae, Lamiaceae	*Astragalus, Centaurea-Trifolium- Silene-Euphorbia, Veronica*	21.65	11.92	3.71
Bozburun Mountain (Antalya-Isparta-Burdur) (Fakir, 2006)	645	16,12	Fabaceae, Asteraceae, Lamiaceae	*Silene, Trifolium, Ranunculus*	32.1	7.9	5.1
Burdur (Özçelik et all., 2016)	1580	25,31	Asteraceae, Fabaceae, Lamiaceae	*Astragalus, Verbascum, Centaurea*	-	-	-
Kızıldağ National Park (Isparta) (Mutlu and Erik, 2003).	786	15,72	Asteraceae, Fabaceae, Rosaceae-Poaceae	*Ranunculus, Allium, Veronica*	16.76	17.56	4.59
Davras Mountain (Isparta) (Özçelik et all., 2001)	415	25,80	Fabaceae, Asteraceae, Brassicaceae	*Silene, Veronica, Astragalus*	35.0	15.6	5.5
Kovada Gölü National Park (Isparta) (Fakir, 2007)	367	15,25	Fabaceae, Asteraceae, Brassicaceae	*Silene, Trifolium, Astragalus*	21.52	10.62	4.90
Gölcük Lake (Isparta) (Fakir and Dutkuner, 1999)	227	28,20	Fabaceae, Carypophyllaceae, Asteraceae	*Astragalus, Silene, Vicia*	21.1	17.6	6.2
Kovada Arboretum (Çetinkaya, 2005)	350	12.3	Asteraceae Fabaceae Lamiaceae	*Galium Silene, Ranunculus*	28.8	14.4	6.8
Beyşehir Lake and its Environs (Konya) (Küçüködük, 1988)	-	10.12	Fabaceae, Poaceae, Asteraceae	*Trifolium, Astragalus, Trigonella*	18.32	12.40	5.06
Köprülü Kanyon National Park (Antalya-Isparta) (Özçelik et all., 2002)	707	32.50	Lamiaceae, Fabaceae, Asteraceae	*Ranunculus*, *Veronica*, *Geranium*	30.97	10.46	07.07
Yeşildağ-Kurucuova (Konya) (Serin and Çetik, 1984)	512	11.52	Poaceae, Asteraceae, Brassicaceae	*Astragalus, Trifolium, Silene*	20.89	15.13	4.48
Sultan Mountains (Afyon-Isparta-Konya (Ocakverdi, 1984; Özçelik and Özhatay, 2005)	587	14.0	Asteraceae, Fabaceae, Poaceae	*Astragalus, Silene, Hypericum*	12.50	13.0	5.70
Yandağ (Isparta) (Kargıoğlu and Ertuğrul, 1995)	729	13.80	Fabaceae, Asteraceae, Poaceae	*Salvia, Astragalus, Trigonella*	19.80	16.30	3.80
Akşehir (Konya) (Küçüködük and Çetik, 1984)	-	0.80	Asteraceae, Poaceae, Fabaceae	*Ranunculus, Juncus, Polygonum, Potamogeton*	11.20	25.60	8.80
Derebucak-İbradı-Akseki (Demirelma and Ertuğrul, 2009).	960	17.3	Asteraceae, Caryophyllaceae, Liliaceae	*Sideritis, Astragalus, Silene*	-	-	-
Isparta (Özçelik and Serdaroğlu, 2000)	2280	28.50	Asteraceae, Fabaceae, Poaceae	*Astragalus, Silene, Verbascum*	-	-	-

*: The order of three families involving the most taxa; **The order of three genera involving the most taxa; ***: It has been determined by removing it from the related publication. **Med. el.:** Mediterranean element ratio; **Ir.-Turan el.:** Irano-Turanian element ratio; **Avr.-Sib. el.:** Euro-Siberian element ratio.

According to the information received from the people in the region, especially shepherds and forestry; the public believes that Dedegül Çiçeği (*Centaurea bornmuelleri* or *Jurinea* sp.) will bring good luck, and it keeps some of it at home for a while. For many illnesses, tea is brewed and drunk. It is short-lived, rhizomatic, perennial, light blue, whitish-flowering, and even pleasant-smelling. In the place where the tomb of Dedegül is located, it is a rare endemic growing on the rocky slopes between Karagöl and the peak.

There is also Dedegül Çayı (*Cyclotrichum origanifolium*) at the mountain. This plant gives Senirkent the name "Kafaotu, Kafasüpürgesi or Karabaşotu". It grows on damp bare rocks and at high altitudes. The Yaka villagers sells locals from the tops of the village and sells them in Pınar Pazarı of Eğirdir. It is used against diabetes, infectious diseases; it is brewed and drunk for a delicious fragrant tea.

It is a very important economic value and must be cultured. Marsuvan otu / Herdemtaze / Altınotu (*Helichryssum plicatum*) is also an important medical plant in the mountains. Tea is drinking against the urinary tract disorders. It is sold in the neighborhood markets.

This mountain is very important in local agriculture. It is known that the plant geography, ecological conditions and floristic structure of the mountains are important in the selection of the plant to be cultivated. Lakes Region is the center of rose and fruit production in Türkiye. More than 50 % of the fruit trees in Türkiye belong to the family of roses. This success is due to the fact that the Dedegül mountains. It is a genetic center for the rose genus. Almost all of the fruit trees have a few wild forms in this mountain flora.

Some plants that grow naturally on Dedegül Mountains and have high economic importance:

Mushrooms: There are edible mushroom taxa in the mountain. Kuzugöbeği (*Morchella* spp.), Çayır mantarı (*Agaricus campestris*), İstiridye mantarı (*Pleurotus ostreatus*), Domalan / Türüf mantarı (*Tuber* sp.).

Herbaceous plant taxa:

For medical and aromatic purposes: Dedegül çiçeği *(Centaurea bornmuelleri* or *Jurinea* sp.), Altın otu / Marsuvanotu *(Helichryssum plicatum* and other *Helichryssum* spp.), Rezene *(Foeniculum vulgare),* Kekik *(Thymus, Thymbra, Corydothymus, Origanum, Satureja* spp.), Bayır çayı/ İncir kekiği (*Origanum majorana)*, Acı yavşan *(Artemisia absinthium),* Isırgan otu *(Urtica dioica, U. urens),* Şalba/ Bozot *(Salvia tomentosa),* Oğlanotu *(Teucrium polium),* Yarpuz/ Nane (*Mentha spicata, M. longifolia*), Adaçayı / Eşekotu / Dağçayı (*Sideritis* spp.), Yılan burçağı (*Arum* spp.), Su teresi /Gerdeme (*Nasturtium officinalis*), Karağan/ Laden (*Cistus* spp.), Salep (*Orchis, Ophyris, Cephalanthera* spp.), Kantaronotu (*Hypericum* spp.), Ayvadana / Civanperçemi (*Achillea* spp.), Papatya (*Anthemis, Tripleurospermum* spp.), Ebegömeci (*Malva neglecta, M. sylvestris*), Yabani soğan (*Allium* spp.), Çöğen (*Gypsophila arrosti* var. *nebulosa*), Sümbül (*Muscari* spp.), Yakı otu (*Epilobium* spp.), Çiğdem (*Crocus* spp.), Gelincik (*Papaver, Glaucium* spp.), Sirken (*Chenopodium* spp.), Eşek marulu (*Taraxacum, Sonchus* spp.), Güneğik, Karakavuk (*Cichorium intybus*), Topuzluk (*Echinops* spp.), Oğul otu (*Melissa officinalis*), Siğil otu (*Chrysophora tinctoria*), Böğürtlen (*Rubus* spp.), Sığırdili otu (*Anchusa* spp.), Deve dikeni (*Onopordum* spp.), Hardal (*Sinapis arvensis*), Sakız otu (*Chondrillea juncea*), Menekşe (*Viola* spp.), Yabani turp (*Raphanus sativus*), Demir dikeni/ Deveçökerten (*Tribulus terrestris*), Bıtırak (*Arctium tomentosum*), Ayrık otu (*Cynodon dactylon*), Yayla çayı/ İnce çay/ Dağ çayı (*Sideritis libanotica)*, Balotu (*Onosma isauricum),* Gelincik (*Papaver rhoeas*)*,* Sinirotu/ Sinirliot / Kırkdamarotu (*Plantago major* subsp. *intermedia*), Abdestbozan (*Sacopoterium spinosum*) etc.

Ornamental plants: Şakayık/Ayıgülü (*Paeonia mascula*), Menekşe (*Viola* spp.), Dağ lalesi (*Anemone* spp.), Sarmaşık (*Hedera helix*), Dağ karanfili (*Dianthus* spp.), Keçi biciği (*Michauxia campanuloides*), Erkek Eğreltiotu (*Dryopterix filix-mas*), Kartal eğreltisi (*Polypodium vulgare*)*,* Acı çiğdem (*Gladiolus italicus*), Süzen/ Zambak (*Iris* spp.), Nergiz (*Stenbergia lutea*), Kardelen (Galanthus spp.), Ağlayangelin (*Fritillaria* spp.), Lale (*Tulipa* spp.), Gül/ Kuşburnu (*Rosa* spp.).

Food plants: İlabada/ Kuzukulağı/ Evelik/Efelek (*Rumex* spp.), Böğürtlen (*Rubus* spp.), Horozibiği (*Amaranthus retroflexus)*, Isırgan (*Urtica dioica),* Tokmekan/ Tokmakan/ Semizotu (*Portulaca oleracea),* Acı çiğdem (*Gladiolus illyricus*), Çiğdem (*Crocus biflorus, C. chrysanthus*) Sığır dili (*Anchusa azurea)*, Çoban çantası (*Capsella bursa-pastoris),* Çakır dikeni (*Eryngium campestre, E. billardieri),* Ebegümeci (*Malva neglecta, M. neglecta),* Hardal *(Sinapis arvensis),* Yabani bakla (*Vicia sativa),* Gıvışganotu *(Silene vulgaris* var. *vulgaris),* Yemlik/ Tekesakalı *(Tragopogan latifolius* var. *angustifolius, Scorzonera cana),* Madımak (*Polygonum cognatum, P. aviculare),* Körmen *(Allium scorodoprasum* subsp. *rotundum),* Salep *(Orchis laxiflora; O. tridentata),* Dağ Eriği/ Çakal eriği (*Prunus divaricata* subsp. *ursina),* Turşu otu *(Echinophora* spp.), Çöven (*Gypsophila arrostii*).

Woody taxa: Essential oil plants and aromatics: Sumak/ Mavru (*Rhus coriaria*), Ihlamur (*Tilia argentea*), Yağlı ardıç/ Kokarardıç (*Juniperus foetidissima*), Murt/ Mersin *(Myrtus communis),* Kebere *(Capparis spinosa* var. *spinosa; C. ovata),* Karaçalı *(Paliurus spina-christi),* Defne *(Laurus nobilis),* Karağan/ Laden *(Cistus* spp.), Tesbih çalısı/ Ayıfındığı (*Styrax officinalis*).

Wild fruit trees: Doğan ağacı/ Çitlembik (*Celtis australis*), Elma (*Malus sylvestris*), Armut/ Ahlat (*Pyrus* spp.), kiraz (*Prunus* spp.), Dağmuşmulası (*Cotoneaster* spp.), Üvez (*Sorbus* spp.), Payam / Badem (*Amygdalus* spp.), Kuşburnu/ İtburnu (*Rosa dumalis, R. canina, R, horizontalis, R. pulverulenta, R. horrida* etc.), Alıç/ Kızılcık/ Geyikelması (*Crataegus* spp.), Kızılcık/ Ergen (*Cornus mas*), Menengiç / Çıtırık (*Pistacia terebinthus*), Çakal eriği (*Prunus spinosa* subsp. *dasyphylla),* Kuşkirazı *(Prunus* spp.).

Forest trees: Karaçam (*Pinus nigra*), Katran/ Sedir (*Cedrus libani*), Dikenardıç (*Juniperus oxycedrus*), Yağlı ardıç/ Kokarardıç (*Juniperus foetidissima*), İledin/ Göknar (*Abies cilicica* subsp. *isaurica*), Şimşir/Akçaağaç (*Acer* spp.), Dişbudak (*Fraxinus* spp.).

Plants for ornamental / landscaping purposes: Papazkülahı (*Eunymus latifolius*), Karaçalı *(Paliurus spina-christi),* Şimşir/ Akçaağaç (*Acer* spp.), Dişbudak (*Fraxinus* spp.) Karamuk (*Berberis vulgaris, B. crataegina*), Kara Çam (*Pinus nigra*), Çınar/ Kavak (*Platanus orientalis*), Pırnal meşesi / Piynar (*Quercus coccifera*), Kasnak meşesi (*Quercus vulcanica*), Söğüt (*Salix* spp.), Kavak (*Populus* spp.), Sandal/ Kocaağaç *(Arbutus andrachne*).

Fruit (apple, cherry, apricot, strawberry, quince, new world, mediterranean / pearl, pear, hawthorn etc.), wild deer, fruits), cutting roses (in Antalya) and oil rose production (in Burdur, Isparta, Afyon) are belonging to microclimatic effects produced by this mountain in the region. Strawberry (especially produced in Şarkikaraağaç in recent years successfully), the apple of Isparta (from Isparta, 22 % of Türkiye's apple production) and Isparta's leader in the production of oil roses. In recent times lily production has also been increased and turned into an industrial product.

Iris germanica (Zambak in Turkish) is produced on the side of Keçiborlu for this purpose. The production of lavender (*Lavandula intermedia, L. angustifolia*) is around 300 da in the vicinity of Keçiborlu. Isparta oil rose (*Rosa damascena*) is produced in the region since the time of the Ottoman period. In recent years rose production has reached 35000 da. area. *Papaver somniferum* (Haşhaş in Turkish) has also been produced for medicinal purposes since the Ottoman period. Its production is supervised.

Sugar beans (Akçabelen bean) which is a high quality and brand-name produced in the related area is a result of microclimate that flows around the Akçebelen neighborhood of Beyşehir. There is a project that is protected by the World Bank for the protection of this bean. Protein value is around 18% in normal beans and about 30% in this bean (Özçelik et al., 2016).

Beans, Ilgın, Seydisehir, Yalvaç, Şarkikararac, Yenişarbademli, Eğirdir, especially in the region are produced a lot of sugar bean(Şeker fasülye) varieties. Sugar beans carry a geographical sign for the region. Not only sugar beans, but also many kinds of vegetables such as chickpea, cowpea, red kidney beans are produced. This success is thought to be due to the fact that Leguminosae family is from large families in the mountain flora and that microclimate is effective.

Honey production in the region is important as economic. There are varieties such as lavender honey, Yaylabalı(plateau honey, Karakovan honey. It is known that honey quality and production are related to floristic variety and vegetation. The rose honey and pine honey can be produced in the future. The quality of the products in the region is high and therefore there is no sales problem. Honey is also produced in lavender, rose, lily, thyme fields and fruit gardens.

There are many kinds of medical and aromatic plants collected or raised from the mountain. Significant revenues are gained from these crops both in Türkiye and abroad. Most of these plants are herbaceous and geophyt plants, which are commercial values and sold abroad from Türkiye (Özhatay et al., 1997)

Zindan Cave (in Aksu), Pinargözü Cave (in Yenisarbademli, 16 km in length) are the most attractive caves of Türkiye. Especially Karagöl (in 2350 m) is an interesting karst formation. Rock type and karstic structure have been very influential in the formation of caves and boulders. In here, the local people can store the food for a long time. This tradition is still maintained in some parts.

Dedegül mount is the richest area of the Lakes Region in terms of vegetation and animal diversity. It was selected as one of Türkiye's 122 Important Plant Areas At the same time, It is one from an Important Nature Field (Özhatay et al., 2005; Eken et al., 2006).

The rock variety of Dedegül Mountains have been an important factor in the soil diversity of agricultural areas. It is known that after the climate, the soil factors are effective in the growth of plants, and in some plants it is the first factor. The diversity of volcanic rocks in the region has been influential in the formation of fertile agricultural lands.

The main rock in the area is limestone. Locally small blocks of serpentine are visible in the area. It is known that the rock variety is effective in the chemical composition of the water. There are underground lakes in Dedegül mountains. The rivers that come out of the mountain go out with the increase of the water level there, decrease and increase. Because it is the highest mountain and big in the region. It receives the highest rainfall and these rains descend inferior in time. Dungeon cave such as Karagöl, Pınargözü is also nourished by the precipitation. Başpınar, Beyşehir Lake and Eğirdir Lake's water resources from the bottom of this mountain is the extensions of the mass of water to the earth. This wet and damp structure have been influential in the formation of wetlands, meadows and marshes around the mountain. An important part of these mers are the shores of Beysehir Lake and Yalvaç, Hüyüklü, Şarkikarağaç Göksöğüt, Çiçekpınar; It's around Senirkent Trotter. In these areas, pastures management was projected with the works of the Provincial Directorate of Food, Agriculture and Livestock (Serin et al., 2008) to improve the animal husbandry and to distribute the facilities equally to the people in the rural areas. Significant distances have been taken in these studies. This success is due to the fact that there is microclima and water source which is formed by the related mountain.

4. Conclusion and recommendations

Since the area is located between Central Anatolia and the Mediterranean, the flora and vegetation reflect the characteristics of the Mediterranean and Iran-Turan regions. Mediterranean forests, alpinic steppe, stony slopes and steep rocky vegetation cover vast areas. In the lower parts, maquis communities, plains steppes, red pine (*Pinus brutia*), river-coastal plant communities, agricultural areas; mixed forests of cedar / tar (*Cedrus libani*) and larch (*Pinus nigra* subsp. *pallasiana*), up to 2000 m in height; On the tree border (2000 m), it consists of mountain steppes, juniper (*Juniperus excelsa*), fragrant juniper (*J. foetidissima*) communities and steep rocky vegetation cover.

Plant taxa endemic to the area and its environment: approximately 40,

Plant taxa in the VU (at risk) category in the mountain: 20,

Plant taxa in the CR (Critical) category in the mountain: 1,

Plant taxa in the EN (Endangered) category in the mountain: 6,

Rare and endangered plant taxa in the area; 52,

Number of endangered species on a global scale 1 (*Acer hyrcanum* subsp. *sphaerocarium*); Number of endangered species on European scale 49,

According to the Bern Convention, the number of endangered natural habitats is 5 (West Taurus *Abies cilicica* forests, *Pinus nigra* subsp. *pallasiana* forests, South Anatolian *Pinus brutia* forests, Taurus *juniperus excelsa* forests, Taurus cedar (*Cedrus libani*) forests) (Güner, 2005).

Farming, animal husbandry and forestry are made in the mount. Foliage and vegetable cultivation are carried out in the covered districts. Apple, rose, strawberry is one of the important income sources of Isparta and the region. This success is due to the floristic structure of the Dedegül mountains and the effect of microclimate on the environment.

The area has been the scene of many civilizations throughout history. B.C. Etiler (Hittites) in 4000 BC, Phrygians in 1500 BC Ions in 800 BC Lydians in 600 BC, BC Persians in 450 BC In 190, the Romans, M.S. In 395 the Byzantines were dominant in the region. The dungeon of Aksu is one of these ancient cities (Anonymous, 2017).

After the Malazgirt Victory of 1071, he joined the Seljuk lands in 1142, beginning with the domination of Anatolia and consequently of the locally Türks. During the Seljuk period, Sultan Alaaddin Keykubat built the Kubat-Abad city and made the second capital, saying: "Heaven is here or under this place". This word is still valid for this day and indicates the uniqueness of the area (Anonymous, 2017).

Wild plants have been used as important food in prehistoric communities. B.C. The transition to plant and animal breeding between the years 6000-7000 (Cilalitaş period) reduced the importance of wild plants, but during the famine period wild plants were used as food. In Anatolia, wild apples (*Malus sylvestris* subsp. *orientalis*), Hibiskus (*Malva sylvestris*), Kasnak meşesi (*Quercus ithaburensis* subsp. *macrolepis*) and many other plant foods were used as raw or cooked. The role of these civilizations is great in the cultivation of the region and in agricultural plants.

Today, around 3000 plants are cultivated for food purposes in the world. The number of natural plants used as food is more than 10.000 (Baytop, 1999). According to the 11th volume of Flora of Turkey, the number of plant species in our country is 11.014 and 3.708 is endemic (Güner et al., 2000). Dedegül Mountains are an important center for bulbous, medicinal and aromatic purposes as well as fruit trees.

Mount Dedegül is the highest mountain in the region. It is also linked to other mountains. Thus microclimate was formed in the region and ecosystems came to the foreground. Every ecosystem has its own plants and animals that feed and shelter those plants. In Lakes Region, most of the plants are grown in this mountain. People around the area are more likely to benefit from the flora than other places. Thyme, sage, caravan etc. It is collected and sold for commercial purposes. Boynubüküк / Gölsoğanı (*Leucojum aestivum*) only grows in an area on the edge of this mountain and is protected by the Nature Conservation and National Park Directorate. In MAREM, located in Eğirdir, experiments on reproduction of this plant have been made. The symbol of the EXPO 2016 Fair held in 2016, Ayıgülü / Şakayık (*Paeonia mascula*) grows best and best on this mountain. The people of the region depend on agriculture for the first time. Almost all of the plants produced in agriculture grow naturally in this mountain. Therefore, this seedling / breeding, rootstock etc. is obtained. In addition, the presence of the wilds of agricultural plants to be produced on a mountain is an indication of the success of the cultivation of that plant group in the relevant area. Irrigation and water features are very important in agriculture. In both drinking water and agricultural irrigation, the water reserve of the mountain concerned is quite significant and important. It is known that the freshwater resources are increasingly decreasing in our country and the importance of it is increasing.

The sources of the floristic richness in the area is due to its microklima, soil and rock properties. The fact that our study area is mainly influenced by the Mediterranean phytogeographical region, although the endemics of Türkiye are mostly in the range of 1000-2000 m, the fact that most of the cultivation is carried out at these heights is the most important factor in the low rate of endemism. The excessive number of taxa may be another factor that reduces the endemism rate.

Although the Long Period Development Plan (UDGP) of the Beysehir Lake National Park exists, the plan is not implemented. Our idea is that; the private company that prepared the plan probably drafted the plan depending on the literature to reduce the cost and the experts in the field did not review it. Therefore, the plan has no provisions.

Categories of Hazard and Status of Protection: Only a small part of Dedegül Mountains are protected because it is included in the scope of Beysehir Lake National Park. There is no protection status for the other part. Despite the fact that the area is very important, it is very unfortunate that there is no protection status. For this reason, the destruction has been made clear in recent years. Marble and mines are opened by taking advantage of legal space and wildlife is damaged. The change of topography and the alteration of microclimate due to vegetation is a threat to agricultural production, underground and super fresh waters and biodiversity on the ground. It is suggested that state and national care should be taken to protect all natural structures, especially topographic changes, up to the taking of the area protection status.

Local people living in or around protected areas such as National Park, Nature Conservation Area, and Protected Area are opposed to areas that are protected by complaints from their restrictions on their movement. While maintaining biodiversity in the local population, it is widely believed that the human needs of the people are not considered enough. However, biodiversity is health, education, economy. The only way to overcome this misconception and protect biodiversity is again education, project, skilled human power.

The area is the target of biotools.

Every year, there are aliens who smuggle in this area. Local guides should be given to foreign tourists and the aims of the tourists should be well established. Especially in ecotourism, the danger of biofuels is higher. Consciousness of the local people is important.

Excessive grazing and cutting trees are other important threats. But the above threats are of higher priority. The cut is usually carried out by the General Directorate of Forestry. It is very damaging to the area. The removal of the historic larch

forests in this way causes a new structure in the ecological structure. It changes the flora and vegetation. It is estimated that the number given in Table 1 is increased by at least 50 species and 20 endemic taxa in the mount.

The effects on the local agriculture of Dedegül Mountains can be summarized as follows:

There are many medical and aromatic plants growing in the mountains. These plants are collected from nature or produced and contribute to the economy and health of the local people. The most important of these is undoubtedly the Milking Cane.

Fruit farming is leading in local agriculture. Especially strawberry, apple, quince, quince, rose, rosehip, cherry, plum, pear etc. It grows wild in the mountains. In the same way grape (grape), fig (nut) also naturally grows in the relevant area. This situation indicates that such fruit plants are the natural spreading area and ecologically the most suitable growing area in the region.

There are many wetlands around the mountain. The importance of wetlands is increasingly understood. Some of these areas are considered meadow-pasture. This situation is also an important contribution to local animal husbandry.

Source streams such as Aksu, Başpınar and Pınargözü are important services in both drinking water, agricultural irrigation and fishing. Fish farms in Aksu are fed from this source.

The knowledge and experience inherited by the ancient civilizations in the region are also important in the food and agriculture culture. When all the features are combined, the Seljuk Sultan reminds the words of Alaaddin Keykubat: "Heaven is here, or underneath." Protecting the area is very important for this reason.

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Investigation of visitor characteristics within the scope of park management planning studies: Uşak-Ulubey Canyon Nature Park example

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Abstract: Today, with the change of consumption preferences, tourism concept has also changed. Previously, while the demand was mostly for sea, sand and sun containing tourism activities, and now people prefer to go to natural and unspoiled places and spend cultural time with the local people. This trend has increased the interest in ecotourism and nature tourism. In this context, the Ulubey Canyon Nature Park, located within the boundaries of the Ulubey District of Uşak, is one of the most remarkable areas in recent times due to its natural characteristics. The Canyon is the world's second largest canyon after the Grand Canyon, which is also found within the Arizona State borders of the United States. The nature park is 119 ha and is 30 km away from Uşak-Ulubey highway. The source values of the area are horizontal layered natural rock formations, canyon valleys, forest and river ecosystem and thermal water resources. Recently, it is being discuss whether the area will be declared as a national park due to its natural characteristics. One of the key factors for the sustainable management of Ulubey Canyon Nature Park and protected areas is the visitors who use these areas. For this reason, in this study, the effects of visitor characteristics, preferences and perceptions on the planning of protected areas and sustainable management were investigated. Literature analysis, questionnaire-interview and field observations were used as data collection methods. The factor analysis method was used to determine the factors affecting visitor perceptions and chi-square ($\chi 2$) test to explore the associations between the variables. According to the results of the study, the natural park is highly demanded due to its natural characteristics and landscape structure. In general, visitors come from the Aegean region. Familiar recommendations are highly effective in the choice of the area and visits are usually held together with family members. Associating the socio-demographic characteristics, preferences and perceptions of visitors with each other gives the decision makers important clues that can be used to protect the park and manage it effectively. In the plans to be made in the study area and other protected areas, ecological, biological, geological, etc. As well as user features, will contribute to the development of behavioral patterns that will best understand the perception and understanding of the wider area. A management approach that will be developed in these frameworks will also help to protect the resource value of the area and transfer it to future generations.

Keywords: Protected areas, Visitor characteristics, Visitor management, Ulubey Canyon Nature Park, Uşak

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Harvest amounts and ethnobotanical uses of the juniper (*Juniperus* sp.) seed in Turkey

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Abstract: Juniper (Juniperus) is one of the important breeds of the Cupressaceae family with a wide distribution area in Turkey. The junipers, especially those who find their habitat on the coastline, tend to form mixed mounds with the species Pine and Fir. It is very difficult to obtain fertile forests with this genus, which contains important essential species. Because germination of seeds is prohibited. Various methods have been developed to overcome this situation and it has been aimed to use juniper seeds in the laboratory environment for germination and reforestation. Junipers are often preferred in soil remediation work because they are resistant to difficult weather conditions and because their root systems are strong. Juniper species are also individuals with visually impressive body forms. It is also preferred in the field of landscape thanks to these features. Thanks to the volatile oils and active substances (limonene, β-myrcene, Sterols, α-pinene, p-benzoquinone, Lignans, Monoterpenes etc.) that the plant contains various organs, the woods are very valuable and there are many fields (cosmetics, perfumery, medicine, food , Etc.) are used. Thanks to these substances, the düğse are used in the treatment of lung, stomach and skin cancer. In recent years, It is also used in the treatment of diabetes mellitus. Thanks to the oils and carbohydrates found in cones, it is preferred for fattening. It is very important to determine the yields of the essential oils of juniper conch, leaves or other plant organs, and to determine the proportions of their constituents. Various methods have been used for this and studies have been done. In this context, the present data of the Directorate General of Non-Wood Products and Services Department of Forestry between 1989-2015 has been examined and it is aimed to show harvest quantities of juniper seeds according to years, to show the income obtained and to emphasize the use areas of the plant and the active substances it contains. According to the data received from General Directorate of Forestry, Department of Non-Wood Products and Services. First record belongs to year 2000 in the period of 1989-2015. In 2000, for the first time, 16,830 kg juniper seed collected and gained 67,32 TL incomes in the territory of The Forest Regional Directorate Isparta. Acorn was harvested from The Forest Regional Directorate Balıkesir, Isparta, Kahraman Maraş, Kütahya and Eskişehir until now. Maximum amount of juniper seed harvested while performing from The Forest Regional Directorate Eskişehir (in 2015) with 23,145 kg, and minimum amount of harvest was carried out from The Forest Regional Directorate Isparta (in 2002) as 520 kg of juniper seed harvested.
Keywords: Juniper seed, Essential oils, Harvest data, Turkey

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Harvest amounts and ethnobotanical uses of the acorn in Turkey

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Abstract: The oaks are an important genus of the Fagaceae family and show wide spread in Turkey. Fruit called as acorn has an important place in various usage fields and economy. *Quercus ithaburensis* Decne *subsp. macrolepis* (Kotschy) Hedge-Yalt, *Quercus robur* L., *Quercus cerris* L. are species with economic value. In Turkey, *Quercus ithaburensis* Decne *subsp. macrolepis* has an area of 142,293 hectares. Quercus (Oak), a member of the Fagaceae family, is known to 18 natural species in our country. Both wood and fruit have wide use areas. It is the purpose of studying and explaining the place and usage of this gender in the literature which is very important far Turkey. Utilizing the data obtained from the General Directorate of Forestry Department of Non-Wood Products and Services, the production of acorn and income will be revealed and the materials and usage areas of acorn will be emphasized. Tannin, which is found especially in *Quercus ithaburensis* Decne *subsp. macrolepis* (Kotschy) Hedge-Yalt and shows its ability to be hydrolyzed, is often used in sepsis (tanning). Tannin is different in each organ of the plant. Gallic tannins are found in the nails on the goblet of oak**,** while tannins in the pellet are lower. The rate of tannins in the goblet of oak is quite high. This ratio is shaped by the characteristics of the plant and the characteristics of the growing environment. It is also known to be used in textile to give fabrics a black color. At the same time, the mixture obtained by crushing the nails and the goblet of oak with powder and mixing with water and honey is consumed especially to prevent child diarrhea. According to the data received from General Directorate of Forestry, Department of Non-Wood Products and Services. First record belongs to year 1989 in the period of 1989-2015. In 1989, for the first time, 9,000 kg acorn collected and gained 360 TL incomes in the territory of The Forest Regional Directorate Balıkesir. According to the same data, nail and goblet of the acorn were collected for the first time from Mersin Forest District Directorate and 1,000 kg and 260 TL were obtained. Occasionally it appears that oak leaf and tanbark are found in the economy. Acorn was harvested from The Forest Regional Directorate Bursa, Balıkesir, Konya, Antalya, İzmir and Isparta until now. Maximum amount of acorn harvested while performing from The Forest Regional Directorate Isparta with 746,000 kg, and minimum amount of harvest was carried out from The Forest Regional Directorate Bursa as 500 kg of acorn harvested.
Keywords: *Quercus* sp., Acorn, Harvest, Turkey

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Harvest amounts and ethnobotanical uses of the rhododendron (*Rhododendron* sp.) in Turkey

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Abstract: *Rhododendron sp.* that is forest roses, one of the important species of family Ericaceae. In the temperate regions, it spreads in the southern and northern hemisphere. The rhododendrons have wide spread species in all areas except Africa and South America. Rhododendrons, which are generally bushy, are rarely seen in tree sizes. In acidic soils, organic matter is growing very well in rich and moist soil. Generally from the sea level up to 3,500 - 4,000 m high. It is frequently seen in Turkey, particularly in the coastal area of the Black Sea. We have five natural species: *Rhododendron smirnovii*, *R. ponticum, R. ungernii, R. caucasicum* and *R. luteum*, there are 12 taxa related to them. At the same time, it is known among different people such as Komar and Ağur or Ağu among the people. In the species belonging to the Ericaceae family, grayanotoxin is usually present in high concentrations. Rhododendron luteum and Rhododendron ponticum species are mentioned. The pollen of these plants contains a toxin called grayanotoxin (andromedotoxin). This honey, which is fed with toxins, is consumed by humans, and the 'honey poisoning' is seen. Since they have wide distribution in the Black Sea region, poisoning cases in the region are frequent in June and July. This condition, which has negative effects on health, is known due to heart rhythm deterioration and hypotension. It may result in death on a more serious scale. The purpose of working in this context is; The General Directorate of Forestry uses harvest data to tell the location of forest roses in our country and to emphasize the results by referring to the usage areas among the people. According to the data received from General Directorate of Forestry, Department of Non-Wood Products and Services. First record belongs to year 1996 in the period of 1989-2015. In 1996, for the first time, 16,830 kg forest roses collected and gained 67,32 TL incomes in the territory of The Forest Regional Directorate Adana, Mersin and Antalya. After the first harvest in 1996, the total harvest amount was recorded as 21,800 kg and the total income was recorded as 14,504 TL. Forest rose was harvested from The Forest Regional Directorate Bolu, İstanbul, Adapazarı, Adana, Mersin and Antalya until now. Maximum amount of forest rose harvested while performing from The Forest Regional Directorate Bolu (in 2008) with 77,400 kg, and minimum amount of harvest was carried out from The Forest Regional Directorate Mersin (in 1996) as 600 kg of forest rose harvested.

Keywords: *Rhododendro*n sp., Ericaceae, Harvest, Ethnobotanical use, Turkey

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Income generation from bay leaves (*Laurus nobilis*) in forested areas

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Abstract: Bay leaves *(Laurus nobilis)* with leaves and seeds is one of the most important non-wood forest products. Over many years interest in harvesting of bay leaves has increased considerably due to its importance for food, medicine and cosmetic industries. Statistics of international trade indicate that Turkey is one of the most important bay leave suppliers. For example, it exported about 12 million kg bay leaves with worth 36 million $ based on 2014 statistics. Harvesting of bay leaves provide an important supplementary income for forest villagers. Rural communities can collect this product in case of payment of the stumpage price determined as quite low to support rural development by General Directorate of Forestry. This study documents the emergence of commercial bay leaves harvesting in Bursa and describes the its supply chain and assesses its contribution to rural development in the area. The analysis concentrates particularly on commercial harvesters who gather the products from the forest due to their vast majority in the value chain. The first step of the study is to find out socio-economic and demographic structure of rural dwellers harvesting bay leaves in the planning unit and document the economic importance of this product for them. For this purpose, a survey was conducted with the commercial harvesters. The survey aimed to come out some information about collection activity such as the number of days picked, duration of picking, amount of harvest, percent of sold and socio-economic characteristics such as sex, age, education, income from their sales, primary source of income, being qualitative grading when selling of the products and who are the costumers. The second stage of the study is to seek the price change of bay leaves in supply chain from the harvesters to the retailers via the different questionnaires prepared for each actors in the distribution channels. All used questionnaires for each supply chain (pickers, processer, wholesaler and retailer) in this study were prepared under the European Union, Startree project. The sample actors were selected through snowball sampling technique in the field. In addition face to face interview technique was used for data collection. The primarily results showed that the villagers collecting this products are comparatively less-educated, older than 30 years old and male. In addition while harvesting activity can differ from one picker to another, on average, a picker spent about 195 hours in 24 days at 6 km far in the collection season. Besides, a picker sold about 12.5 ton bay leaves to the cooperatives which with at 2014 price would be worth 1500 Euros. Also the results figure out that although this activity is secondary income source for them, mean harvest for a picker is about 64 kg/h with worth 7.7 Euro/h which is more than five times of the minimum wage 1.4 Euro/h in Turkey. Also the results showed that the price of dry leave significantly increased from pickers to retailers.
Keywords: *Laurus nobilis*, Supply chain, Distribution channels, Rural development

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Identification of wildlife (Mammalia)-vehicle collision on Ankara-Samsun highway

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Abstract: Adverse impact of motorways on wildlife has been an increasing worldwide. The effects of traffic on motorways are not only limited with wildlife-vehicle collisions (WVC), but also give harm to wildlife in various ways such as habitat fragmentation, traffic noise, pollution, creation of new human settlements. Accidents with human death and injury and financial damage also take place in wildlife-vehicle collisions. Necessary measures should be taken by planners during the construction of motorways in order to reduce the negative effects of traffic on wildlife such as ecological underpasses and overpasses, signalization, warning signs. The number of wild animals that died as a result of accidents on Ankara-Samsun Highway was recorded between 15 March 2016 and 15 March 2017. The records were collected in three days on average. The carcasses were taken to roadsides after record to prevent double count and the coordinates of the spots where the dead of the wild animals were located (UTM) were taken with Garmin GPS, which had 5 m accuracy. Eight photos were taken with 45 degree angle from the point where collision occurred and 1 photo was taken from nearly 50 m distance on the direction the collision occurred. The speed limit, elevation, road width, curve feature of the road were recorded. The biological features of the wild animals couldn't be taken because of smash, squeeze and disintegration. During study time, 44 accidents with casualties, from five species of mammals most of which were foxes and hedgehogs, were recorded. It was seen that most of the casualties were from hedgehogs *Erinaceus concolor* with 21 and from marten *Martes foina* with 12. Additionally, 9 foxes *Vulpes vulpes*, 1 wolf *Canis lupus* and 1 rabbit *Lepus europaeus* died in consequence of wildlife-vehicle collision. The death rate for all of the mammals along the road was 0.83 ind/km/year. For hedgehogs, which were the mostly killed mammal, the death rate all along the road was 0.23 ind/km/year. Ecologists working on highways use statistical models according to the characteristics about the landscape, the effect and density of animal distribution, what kind of habitat distribution is present around the roads, traffic density of these roads, road and road side topography. That information can be used as a guide in building wildlife overpasses, underpasses and barriers and in taking precautions like periodical wildlife signals, decelerator wildlife reflectors, roadside wildlife management and speed bumps.
Keywords: Wildlife, Vehicle, Collision, Ankara-Samsun highway, Hedgehog

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Trophy hunting in the world

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Abstract: Trophy hunting is defined as killing wild animals for their body parts, such as head and hide, for display but not primarily for food or sustenance. Trophies include, but are not limited to, parts—such as elephant ivory tusks, rhino horns or deer antlers—to entire heads that can be mounted on walls or complete bodies that can be formed into life-like poses by a taxidermist. Trophy hunters display their trophies in their homes or offices. Throughout history, hunting has been a sport for royalty and the elite. In 1887, President Teddy Roosevelt founded the Boone & Crockett Club, which established the Boone & Crockett Trophy Scoring System in 1930 for North American mammals. The International Council for Game and Wildlife Conservation (CIC) established the CIC trophy formula in 1930. All three of these systems focus on comparative analysis and the achievements of individual trophy hunters. Each of these three record books also already have required or are contemplating requiring trophy owners who wish to enter the records to sign an affidavit confirming that the trophy was taken under "Fair Chase." In the mid-1970s, Safari Club International (SCI) established its own international record book, accessible only to its members. The development of record books and record keeping systems does not merely record kills, but also evidences the rising popularity of trophy hunting over time. A recent study that examined the motivation for trophy hunting found that hunters glamorize the killing of an animal so as to demonstrate virility, prowess and dominance. Trophy hunters are also motivated by the competitions sponsored by trophy hunting organizations. The world's largest trophy hunting advocacy organization is U.S.-based Safari Club International (SCI) which reportedly has 50,000 members. SCI gives hunting awards in dozens of categories, including the Africa Big Five, for which a hunter must kill an African lion, an African elephant, an African leopard, an African rhino and an African buffalo. Other competitions include Bears of the World, in which a hunter must kill four of eleven types of bears; Cats of the World, in which a hunter has to kill four of seven types of cats; and Spiral-horned Animals of Africa, in which a hunter has to kill 17 different types of animals. "Inner Circle" awards recognize various hunting achievements, such as killing animals with a handgun, killing animals on each continent and getting the most entries into the SCI record book. To win the highest SCI award, known as "World Hunter of the Year," a hunter must kill more than 300 animals across the globe. More than 1.26 million wildlife trophies, which is on average more than 126,000 trophies every year. Trophies of more than 1,200 different kinds of animals, including nearly 32,500 trophies of the Africa Big Five species (including approximately 5,600 African lions, 4,600 African elephants, 4,500 African leopards, 330 southern white rhinos and 17,200 African buffalo.
Keywords: Hunting, Trophy, Wildlife

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Daily activity of large carnivore in northeastern Turkey

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Abstract: It is supposed that large carnivore activities are shaped with especially prey and human activities. But the habitat use and prey activities may be changed from vegetation to weather conditions. The aim of the study is determine the daily activity of large carnivore, relationship and conflict with large carnivore and human in Şavşat / Artvin, North-eastern Turkey. The large carnivore was Brown bear (*Ursus arctos*), Gray wolf (*Canis lupus*) and Eurasian lynx (*Lynx lynx*) in the region. In addition, Brown bears are giving conflict to local people and making it harder to manage. Camera trap is one the method to capture the abundance of especially elusive species that are not directly observable during daytimes and are very active at night times. These species averaged captured density with camera trap was 25.8 Brown bear, 5.7 Gray wolf and 1.9 Eurasian lynx individuals in 100 camera trap days. The daily activity of Brown bear was ranged from two hour before sunset and two hour after sunrise. The Gray wolf and Eurasian lynx activity was shaped nearly one hour before sunset and one hour after sunrise. It was estimated that the activity of Brown bear was mainly figured out according to human activity, but Gray wolf and Eurasian lynx was focused on the prey activity. Also large carnivore activity changed with season and local weather condition in the region. There should be managed the human activity to large carnivore activities to decrease the conflict between the human and large carnivore, especially Brown bear.
Keywords: Large carnivore, Camera trap, Human activity, Prey activity, Human-brown bear conflict

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Rural women in community&economic life

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Abstract: In order to evaluate, within the scope of social life, the problems women face in rural settlements and to carry out the works of gender-balanced development, the roles the women have undertaken must be defined first. In terms of level of development as socio-economic and cultural structures between the rural settlements, the studies qualified as scientific towards defining the roles the women in rural areas have undertaken, in most underdeveloped forest villages, are very few. In this context, the purpose of the proceeding is to make some determinations on the roles that the rural women living in forest villages have on economic, social and cultural life. The main focus on the proceeding were as follows: women in everyday life, women in economic life, time utilization, status of women in terms of education, health and social security, women's participation in decision making, women's expectations for the future, women's level of relationship with the forest resources, etc. in Isparta-Turkey. According to the findings, it was defined that the women have a so an important role and heavy workload in communal-economic life. However women's education level and participation in decision processes of both economic and social contexts is at a very low level. A large portion of women have worked forestry activities. And they consider forest labor to be an appropriate work group for them. Besides, the presence of positive perception towards environmental forest resources is very important in terms of the relationships the women have with natural resources. On the other hand, a significant portion of women in the Isparta region being satisfied with their lives is another important result of the study.
Keywords: Forest villages, Rural women, Community life, Isparta

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The first important outbreak of *Clostera anastomosis* Linnaeus 1758 (Lepidoptera; Notodontidae) on *Populus* plantations in Turkey

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Abstract: *Clostera anastomosis* Linnaeus 1758 is considered a dangerous pest of poplars and willows but this species first prefer is poplars in Turkey. *C. anastomosis* is elements of terrestrial Palearctic ecozone. Its distribution area includes from Europe, the north of Asia and Africa and the northern and central parts of the Arabian Peninsula. *C. anastomosis* has known in north and northwest Turkey since 1987. *C. anastomosis* larvae feed on leaves while severe infestations can lead to almost complete defoliation of the host plants. *C. anastomosis* is a univoltine species and has four generations per year in the Marmara region, in northwest Turkey. Emergence was seen in the first generation in May and June, the second in July and August, the third in August and September, and the last generation from September to the following May. The eggs are laid on leaf back and the number of eggs laid per female is from 350 to 650. It is noticed a mass breeding of the species *C. anastomosis* on the poplar plantations located in Bilecik and Sakarya provinces, in Marmara region, in northwest Turkey in mid-July 2015. On only this year, there were registered total defoliations over 250 ha, produced by *C. anastomosis* within the different poplar plantations. Up to now, outbreak of *C. anastomosis* hasn't been reported from Turkey. This paper is first reported of outbreak of *C. anastomosis* from Turkey.
Keywords: *Clostera anastomosis*, Poplar plantations, Turkey, Notodontidae

1. Introduction

Forest ecosystems are a system formed in a balance of animals, plants, soil, and climate. But the change in one of these elements can ruin all the stability. Insects are very important positions in animals. Insect play an important role in the deterioration of stability.

Poplar cultivation is widely performed in the Marmara region. So largest poplar plantations of Turkey are common in the Marmara region. *Clostera* (=Pygaera) *anastomosis* Linnaeus 1758 (Lep.; Notodontidae) is the indigenous species of Turkey. It is important harmful insect of poplars. This paper has been dealt with in order to report the epidemic of *C. anastomosis* in the private property poplar plantations in Sakarya province (Akyazı, Erenler and Hendek) in 2015 July.

2. Material and methods

Farmers were stated attacked, who raised poplar in private property in the vicinity of Bedirkadirbey and Bedirtahirbey villagers of Akyazı district of Sakarya province, by an unknown species of caterpillars fed on leaves of poplars in about 50 ha (500 da) poplar plantations on 27.07.2015. We started to work effected plantations area and addition to this the aerial images of the poplar plantations, taken by small-sized unmanned aerial vehicle (drone) have been obtained. During research, eggs, larvae and pupa samples of this pests were collected and transferred to the laboratory. The samples were cultured under suitable conditions. We used CAN, (1988) and ÖZAY et al. (2000), Anonymous (2017) for identificaion and taxonomy.

3. Results and discussion

It has been seen that the adults, which collected pupas on 27.07.2015, starting from July 31, 2015. We made identification this insect *Clostera anastomosis* Linnaeus 1758, (Lepidoptera Notodontidae). The wing opening of the adults was measured between 29-36 mm and the females 37-44 mm (Figure-1.A, B, C).

C. anastomosis is a native to Turkey, but its presence is known in North and Central Europe, northern Italy, the Balkans, the Scandinavian countries, Siberia, Korea, Pakistan, China and Japan. *Betula sp., Populus sp., Salix sp. and Crataegus oxyacanth* host plants for *C. anastomosis* (Arru 1965, Chararas 1972, Chaudhry and Ahmad 1974, Schwenke 1978).

C. *anastomosis* was first recorded on poplars in Bursa-Mustafakemalpaşa Turkey in 1987. Researches on this species in Turkey have been dealt mainly distribution level. *C. anastomosis* were recorded Adapazarı (Akyazı, Karasu and Söğütlü), Bursa (Mustafakemalpaşa and Yenişehir), Edirne (Edirne and İpsala), Kocaeli (Gölcük and İzmit) and Samsun (Bafra) In these studies (Can, 1988, Yüksel, 1988; 2000). Özay et al. (2000) researched biology of *C. anastomosis* in the Marmara Region. In this research, *C. anastomosis* have 4 generations in one year in Marmara region. The first generation of *C.*

anastomosis is in May-June (duration of adulthood = 37-40 days), the second generation in July-August (34-38 days), the third generation in August-September (32-37 days), the fourth generation in September- 255-258 days). There was no report on the outbreak of C. *anastomosis* in Turkey until 2015.

C. anastomosis made first important effect and strong damage on *Populus deltoides* Bartr., which in 5-35 m length, between 2-10 years of age, extending along the Mudurnu Stream around Bedirkadirbey and Bedirtahirbey neighborhood of Akyazı district of Sakarya province, in Turkey. Other effected host plant is *Populus* x *euramericana* "I-214" (Salicaceae) clone of different size plantations in research area. Later on, *C. anastomosis* extented damage from the Mudurnu river to the poplar plantations in the inner regions (Figure-2).

Female of *C. anastomosis* lays its eggs in groups on the top surface leaf or tree bark of the poplar (Figure-1.D). The number of eggs in the egg packages counted between 312-593. Özay *et al.* (2000) reported that this figure was between 350 and 650, and in Croatia it was reported as 700-800 (Tomescu and Neţoiu, (2011).

Larvaes of *C. anastomosis* feed on poplar leaves. First instar larvae fed only on leaf surface, but mature larvae fed with buds on shoot as well as whole leaf. Almost all of the poplars attacked by *C. anastomosis* were observed to be leafless in the epidemic areas (Figure 1.G). Colonys of larvaes of *C. anastomosis* was observed to meet on stem of trees that do not have leaves in the epidemic areas (Figure 1.H).

Mature larvae has been observed into the pupae in tree bark, leaves and shoots of the plants and the living cover on ground in (Figure 1.E, F).

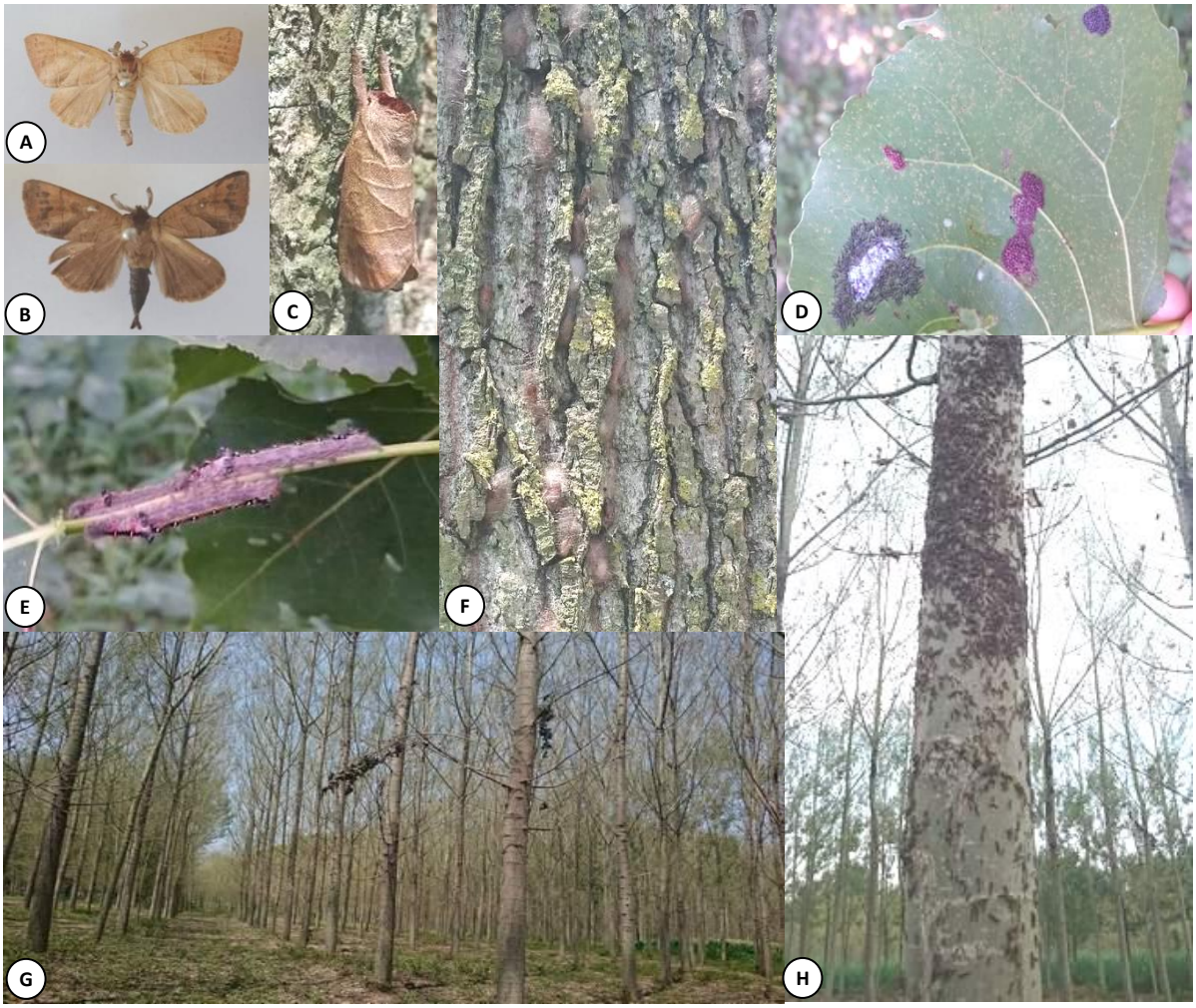

Figure-1. *Clostera anastomosis* **A)** Adult female, **B)** Adult male, **C)** Adult female, repose position, **D)** eggs on leaves, **E)** Mature caterpillars, **F)** Pupa, **G)** Its damage, **H)** caterpillar's colony on the bark in epidemy areas.

In survey performed, outbreaks of *C. anastomosis* were determined in poplar plantations, in the neighborhoods of Bedilkazancı, Gebeş, Kumköprü, Türkorman köyü, Yahyalı, Uzunçınar of *Akyazı district* and Çaykışla, Hasanbey, Şeyhköy of *Erenler district* and Beyköy, Kargalı, Uzuncaorman of *Hendek district* in Sakarya Province. In addition, outbreaks of *C. anastomosis* were identified in the poplar plantations which is throughout the Sakarya River in Vezirhan and Osmanlı districts of Bilecik province. On the other hand, expcept for epidemic areas, numerous adults and larvae of *C. anastomosis* were found on the poplars in Izmit of Kocaeli province and Altınova and Çiftlikköy districts of Yalova provinces.

Before the outbreaks, samples of the eggs, larveas, pupa and adults of of *C. anastomosis* were noticed by farmers and the outbreaks of *C. anastomosis* were suddenly occurred in the epidemic areas. It is estimated that the outbreaks of *C.*

anastomosis were based on from the ownerless *Populus* sp. and *Salix* sp. along the Sakarya and Mudurnu riverbed. The outbreak, as of August 26, 2015 (in 2500-3000) is estimated to occur in the area. The epidemic has been found to occur entirely on private ownership in the poplar plantation (Figure 2).

Figure-2. General views of epidemy of *Clostera anastomosis* in populus plantations in Akyazı and Erenler district in Sakarya province.

4. Conclusions

We need the new research bio-ecological and natural enemies for the management of *C. anastomosis*. This will avoid to loss of biomass in populus plantations in the region.

On the other hand, many insects have been documented to undergo changes in their phenology due to climate change (Logan and Powell 2001). In this context, it would be appropriate to investigate whether there are deviations in the biology of *C. anastomosis*.

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Poster presentation

Three new epidemic areas of *Tomicus destruens* (Wollaston 1865) (Coleoptera: Curculionidae, Scolytinae) in Eastern Mediterranean part of Turkey

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Abstract: The species of *Tomicus* genus, which are noteworthy for their damage in pine forests in Europe, North America, Asia and North Africa, also cause significant damages in pine forests of Turkish forests. The *Tomicus* is represented by 3 different species which are defined in Turkey throughout. It was recently believed that *Tomicus piniperda* (Linnaeus 1785) attacked to *Pinus brutia* and rarely to *P. nigra* trees in the Mediterranean basin of Turkey. For this reason, *T. piniperda* was reported as responsible for epidemic that occurred in the Mediterranean basin of Turkey. However, recent studies have determined that species as *T. destruens* which is very similar with *T. piniperda* as morphologically. By the way, *T. destruens* has shown biologically significant differences from *T. piniperda.* In this study, three different epidemics of *T. destruens* were evaluated in 3 different *P. brutia* forest stands of Adana (Ceyhan, 30 m, 30 ha), Mersin (Anamur, 600 m, 42 ha) and Osmaniye (Hasanbeyli, 780 m, 50 ha), in the Eastern part of Mediterranean region of Turkey. This outbreak occurred in 122 ha. It has been observed that beetle predominates *P. brutia* in the whole area. At both 30 m and 780 m altitudes, it is observed that the young adult exits still continued on the last week of March, and the adult entrances were still continuing in the prepared trappings. *Aulonium ruficorne* (Col.: Colydiidae), *Corticeus fraxini* (Col.: Tenebrionidae), *Cylister elongatus* (Col.: Histeridae), *Raphidia ophiopsis* (Neur.: Raphidiidae), *Temnochila coerulea* (Col.: Trogossitidae) and *Thanasimus formicarius* (Col.: Cleridae) were determined as natural enemies of *T. destruens* in outbreak stands. Most abundant predator species was *T. formicarius*. On the other hand, these samples were found first time in the Çamlıyayla-Belçınarı village (790 m), Çamlıyayla-Kızılkaya (950 m) village, Çamlıyayla-Boztepe village (900 m), Erdemli-Karahıdırlı village (532 m), Mut (350 m) and Silifke-Çandırlı village (613 m) of the Mersin province.
Keywords: Eastern Mediterranean, Epidemic, *Tomicus destruens*, Turkey.

1. Introduction

Bark beetles are among the most harmful species of coniferous forests through the World. Many species have secondary characteristic. Adults prefer weakened trees by physiologically. The plant materials are suitable materials by constituted abiotic conditions like snow broken, fallen trees by wind and forest fires. Aggressive species can make epidemics and also change the situation and functions of forests in range areas.

The species of *Tomicus* genus, which are noteworthy for their damage in pine forests in Europe, North America, Asia and North Africa. *Tomicus* genus is represented by 8 species in the world. These species are *Tomicus piniperda* (Linnaeus, 1758), *T. minor* (Hartig, 1834), *T. destruens* (Wollaston, 1865), *T. puellus* (Reitter, 1894), *T. pilifer* (Spessivtsev, 1919), *T. brevipilosus* (Eggers, 1929), *T. yunnanensis* (Kirkendall ve Faccoli, 2008) and *T. armandii* (Li and Zhang, 2010; Kirkendall et al., 2008, Li et al., 2010).

The *Tomicus* is represented by 3 different species which are defined in Turkey. This species are *T. piniperda*, *T. minör* and *T. destruens* (Sarıkaya and Avcı, 2010). In 1865, *T. destruens* was described as a different species by Wollaston (Wollaston, 1865). After the studies of Schedl, who rejected this species status (Schedl, 1932; Schedl, 1946), *T. piniperda* and *T.destruens* species were considered to be synonyms for many years (Faccoli, 2006). However, as a result of the studies of Lekander (1971) on the morphologic characters of larvae, and the morphologic and genetic studies of Gallego and Galián (2001); Kohlmayr et al. (2002) and Kerdelhue et al. (2002), *T. piniperda* and *T. destruens* were described as different species.

It was recently believed that *Tomicus piniperda* (Linnaeus 1785) attacked to *Pinus brutia* and rarely to *P. nigra* trees in the Mediterranean basin of Turkey. For this reason, *T. piniperda* was reported as responsible for epidemic that occurred in the Mediterranean basin of Turkey. However, recent studies have determined that species as *T. destruens* which is very similar with *T. piniperda* as morphologically. By the way, *T. destruens* has shown biologically significant differences from *T. piniperda.*

The numbers of drying trees in *P. brutia* and *P. nigra* forests in the Western Mediterranean region in Turkey have increased in recent years because of *T. destruens* damage (Sarıkaya and Avcı, 2007). This situation is also seen in the *P. brutia* forests in the Eastern Mediterranean region of Turkey. In this presentation, outbreaks by *T. destruens* in three different regions of the Eastern Mediterranean region in 2017 were discussed and the findings were shared.

2. Material and methods

This study was conducted in epidemic stands of *T. destruens* in pine forests that are situated in Eastern Mediterranean region between 2016 and 2017 (Fig.1). Standing trees that were attacked by *T. destruens* and trap woods were investigated. Biological terms, flight periods of adults and natural enemies were recorded.

Figure-1. Study area, Eastern Mediterranean region of Turkey (Map:produced from GoogleMap, 2017)

3. Results and discussion

As the results of study, three different epidemics of *T. destruens* were evaluated in 3 different *P. brutia* forest stands of Adana, Mersin and Osmaniye provinces of the Eastern part of Mediterranean region of Turkey in 2017.

3.1. Turkish red pine forest of Ceyhan

Turkish red pine forest of Ceyhan district in Adana province is first epidemic area of *T. destruens.* The forest is 45 years old and includes pure Turkish red pine. This forest is on 30 m above from sea level. This forest is an independent stand in the form of an island in the middle of the Ceyhan plain. The closest forest area is 17 km away from stand. The damages of *T. destruens* were observed on 30 ha area of 45 ha totally (Fig.2).

Figure-2. Epidemic area of *Tomicus destruens* in Ceyhan district in Adana province (Map:produced from GoogleMap, 2017)

It was observed in 31.03.2017, adults emerging were almost finished on trap trees which were set in November 2016. Young adults were light yellowish color. Mature larvae of *T. destruens* and also white color pupae that settled mostly in bark were observed under bark of trap trees which were set in 16.02.2017 (Fig.3).

During the observations on trap trees that were set in 18.03.2017, a few number *T. destruens* adults who have just arrived were seen. Also, young larvae were observed under bark of same trap trees. The observation of the adults of *T. destruens* still have on the main gallery of the same nest, is another finding.

Natural enemies in Ceyhan stand

Cylister elongatus (Col.:Histeridae), *Raphidia ophiopsis* (Neur.: Raphidiidae) (Fig.3E) and *Thanasimus formicarius* (Col.: Cleridae) were determined as natural enemies of *T. destruens* in outbreak stands.

C. elongates and *T. formicarius* were caught in the mature larval stage of *R. ophiopsis* despite being caught as adults. The adult of C. elongates and also mature larvae of *R. ophiopsis* were found on the Turkish red pine trap trees that were set in November 2016. By the way, the adults of *T. formicarius* were found on yet set trap trees (16.02.2017 and 18.03.2017). The most abundant predator species were found as *T. formicarius* in this stand.

Figure-3. *Tomicus destruens* A) young adult, B) older adult, C) pupae, D) Adult and larval galleries in the bark of Turkish red pine, E) Larvae of *Raphidia ophiopsis* in adult galleries.

3.2. Turkish red pine forest of Anamur

Turkish red pine forest of Anamur district in Mersin province is second epidemic area of *T. destruens* for Eastern part of the Mediterranean region of Turkey. The forest includes pure Turkish red pine and situated above 600 m from sea level. The damage of *T. destruens* was including approximately 42 hectares (Fig.4). During the observation which conducted in 07.04.2017, larvae were seen under bark of trap tree that was set on 12.03.2017

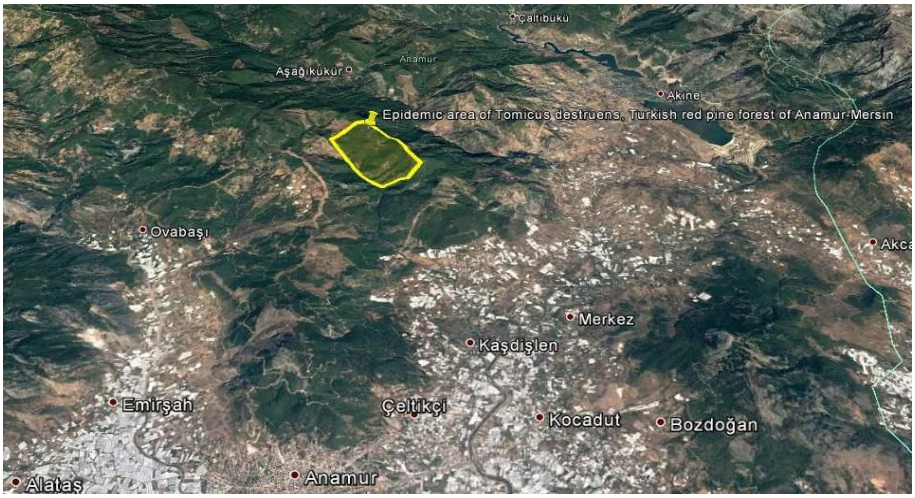

Figure-4. Epidemic area of *Tomicus destruens* in Anamur district in Mersin province (Map:produced from GoogleMap, 2017)

Natural enemies in Anamur stand

The adults of *Aulonium ruficorne* (Col.: Colydiidae) and *Corticeus fraxini* (Col.: Tenebrionidae) and also mature larvae of *R. ophiopsis* were observed on the larva galleries of *T. destruens*. The adults of *Temnochila coerulea* (Col.: Trogossitidae) and *T. formicarius* (Col.: Cleridae) were recorded as natural enemies on bark and crevices. *T. coerulea* and *T. formicarius* were found as most common species.

3.3. Turkish red pine forest of Hasanbeyli

Turkish red pine forest of Hasanbeyli district in Osmaniye province is third epidemic area of *T. destruens* (Fig.5). The forest is 37 years old and includes pure Turkish red pine. This stand was established by plantation in 1980. It was recorded that *T. destruens* have caused outbreaks since 4 years. It was stated that it could not get a successful result against these outbreaks. On official records it was reported that the species name of the harmful species is *T. piniperda*. It is estimated that the controlling has not been successful due to the application of the control methods specific to the field *T. piniperda.*

Figure-5. Epidemic area of *Tomicus destruens* in Hasanbeyli district in Osmaniye province (Map:produced from GoogleMap, 2017)

During the observations in 31.03.2017 on trap trees that were set in 16.03.2017, adults that were opening main galleries and larvae were hatching. The adults were seen on main galleries yet. Further, young adults that were coming on to barks were seen.

Natural enemies in Hasanbeyli stand

A lot of *T. coerulea* and *T. formicarius* adults were found among bark crevices. A few number *A. ruficorne* and C. *fraxini* adults were seen under bark. Also, only one young larva was found near *T. destruens* nest.

3.4. Other observations

T. destruens specimens were found the first time in Çamlıyayla-Belçınarı (790 m), Çamlıyayla-Kızılkaya (950 m), Çamlıyayla-Boztepe (900 m), Erdemli-Karahıdırlı (532 m), Mut (350 m) and Silifke-Çandırlı (613 m) villages during the survey studies which were conducted in 2017. Among these stands, the populations of *T. destruens* were observed in high levels. For this reason, it is estimated that *T. destruens* outbreaks could occur in these areas if adequate measures are not taken

4. Conclusions

It is necessary to investigate the presence of *T. destruens*, including the larch forest zone where this moult over 1000 m starting from the shoreline where Turkish red pine has spread in the Eastern Mediterranean region. This will also confirm the records of *T. piniperda* in the previous years, which will ensure the formation of healthier data for both cadaver distributions. And it will also help to identify the potential epidemic areas of *T. destruens*.

In previous studies, Sarıkaya and Avcı (2007) stated that *T. destruens* is univoltine in Turkey. Saide et al. (2016) reported that also this species has one generation in Balıkesir region. Similarly, *T. destruens* was found as univoltine in Israil, Algaria, Tunusia and Italy (Masutti 1969; Dajoz, 1980; Mendel et al. 1985; Chakali, 1992; Ben Jamâa et al., 2000; Faccoli et al., 2005). By the way, Russo (1940); Nanni and Tiberi (1997) and Masutti and Zangheri (2001) stated that it has two generations and also Davis et al. (2013) mentioned that it can be up to three times a year.

In this context, a detailed investigation of the biology information of *T. destruens* in the Eastern Mediterranean region will be the basis for the control methods against it. This will contribute to the prevention of the deaths of predominantly Turkish red pine and rarely Anatolian Black pine trees in the region.

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Poster presentation

The important pest insect species on forest trees of Akdağ Nature Park

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Abstract: Protected areas, as a result of long years of knowledge and experience at international and national levels, are now present as an indispensable element of nature conservation. Pest insects are among the various factors that affect the health of forests in Turkey. Some of the insect species that are harmful to Protected Areas are periodically harmful, as is throughout the Turkish forests. As the research area Akdağ Nature Park (Denizli) which was declared as Nature Park in 2000 in terms of its resource values, is a valuable area in terms of its flora and fauna. By the way, there is no detailed study on pest insect species of this protected area. This study was carried out in 2015 in order to determine important insect species which are harmful on forest trees in Akdağ Nature Park. Samples were taken from the trees throughout the field and also red winged sticky traps (by an attractive mixture of 96% ethyl alcohol and 1% toluene) and funnel type pheromone traps were settled for determining pest species and adult flight periods of important species. Traps were established on two different experiment sites in the research area. These areas are located on Koca Yayla (1500 m) and Kızlar Alanı (1120 m) provinces. While *Pinus nigra* and P. *sylvestris* communities are exist in Koca Yayla province, as deciduous trees *Quercus cerris* is spread in Kızlar Alanı province. The traps were hunged on the branches of the trees at a height of 2-2.5 m at a distance of at least 80-100 m from each other. Controls were performed weekly in visual traps, once every two weeks in pheromone traps, and trap controls were continued until the end of adult catching. As result, *Anisandrus dispar* (Fabricius, 1792), *Carphoborus henscheli* (Reitter, 1887), *Xyleborinus saxesenii* (Ratzeburg, 1837), *Ips sexdentatus* (Boern), *Lymantria dispar, Pityogenes bistridentatus* (Eichhoff, 1878), *Rhyacionia buoliana, Thaumetopoea wilkinsoni* and *Tomicus minör* (Hartig, 1834) were determined as pest insect species in Akdağ Nature Park.
Keywords: Akdağ Nature Park, Forest, Pest insect, Flight period

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Ambrosia and bark beetles on relict oriental beech (*Fagus orientalis* Lipsky) trees in the southeastern part of Turkey

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Abstract: Oriental beech (*Fagus orientalis* Lipsky) is known as one of main tree species for Turkish forests. The main distribution area of oriental beech is in the northern region of Turkey. By the way, approximately 40,000 ha of isolated relict oriental beech forest exist in south-eastern Turkey especially Adana, Osmaniye, Hatay, and Kahramanmaraş. In this study, ambrosia beetle species which distribute on oriental beech forests of Andırın (Kahramanmaraş) were determined. The survey was carried out in Andırın-Akifiye province (37° 44' N, 36° 22' E) in the south-eastern part of Turkey. Field studies were conducted from March to October in 2015 and 2016. For this aim, the red winged sticky traps (by mixed of ethyl alcohol 96% and toulen 1%) were set in stand and checked periodically. Also, specimens were collected from weaken trees and also broken and fallen trees by snow. Traps consist of two red-colored and crosswise mounted sticky plates with a 1 liter white colored plastic bottle hanging just below and each wings of oblong sticky plates with adhesive glue has 15x21 cm size. Total 20 traps were placed on beech trees and checked. They were placed 2-2,5 m above the ground and positioned 50-80 m from each other. Mix attractant which contains 96% alcohols and 1% toluen were used in traps. Checking was made monthly and traps were replaced with new ones at each controlling period. Specimens were examined under microscope and species were determined. Based on the material collected from Oriental Beech forests in Andırın between 2015 and 2016 by red winged sticky traps and by examination on 1224 individuals during 2 years, a total of 7 Ambrosia beetle species belonging to 6 genera of 3 tribe were identified. These species are; *Taphrorychus ramicola* (Reitter, 1894), *T. villifrons* (Dufour, 1843), *Scolytus intricatus* (Ratzeburg, 1837), *Anisandrus dispar* (Fabricius, 1792), *Trypodendron signatum* (Fabricius 1787), *Xyleborinus saxesenii* (Ratzeburg, 1837) and *Xyleborus monographus* (Fabricius, 1792). Among those, *X. saxesenii* was the more abundant species than the others. The species of *A. dispar*, *T. ramicola* and *T. signatum* were followed it respectively.
Keywords: *Fagus orientalis*, Ambrosia beetle, Andırın, Red winged sticky traps, Turkey

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Research on the possibility of using thermography for the determination of insect activity in wood

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Abstract: Wood, as a sustainable and renewable natural resource, has been used for packaging material for years. As a biological material, although wood has many advantages, it has also some disadvantages. Biodegradability is the major disadvantage of the material in use. Although the role and importance of international trade on the development of countries is well known, there is a general argument on their negative environmental effects. There has been increasing concern about spread of harmful organisms (fungus, insects etc.), from one country to another one via international trade of wooden materials. In order to protect their forests, a number of countries and trading blocs have taken regulatory action against to harmful organisms' movements. To take precautions some international phytosanitary standards (ie: ISPM 15) have been accepted and implemented in many countries including Turkey. Wood packaging material must be heated in accordance with a specific time–temperature schedule that achieves a minimum temperature of 56 °C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including at its core). Theoretically, materials and products which treated and stamped in these contexts (ie: heat treated wood packages) are thought to be safe. But, in practice exporters have been faced many problems mainly because of unsuitable treatments, illegally stamped materials without any treatment etc. The common control mechanism of these materials is the evaluation of visual signs (or evidence) of infestation. Since tunneling and development of the larvae takes place entirely below the wood surface, the only signs of infestation are the emergence holes made by the adults and the powder-like frass sifting from the holes. It is quite difficult to distinguish insect activity in wood with naked eye or normal imaging techniques, especially at the early stage of insect growing. Actually there is no quick and practical way for inspectors to determine biological activities in wood at field. The main purpose of this work was to find a quick and practical way to separate infected wood materials even at early development phase of insects. As it well known, insects are cold-blooded organism. From this point of view, different (lower) temperature zone would occur on wood surface parallel to organism presence. Although insect activity in wood is not visible at early stage of the activity, it may be possible to determine the infected area using a thermographic technique. For laboratory experiments pine (*Pinus brutia*) wood which was commonly preferred for wooden package material production in Turkey and insect species which are belong to Buprestidae, Curculionidae and Cerambycidae families were used as experimental materials. Experiments applied at laboratory temperature but, because of the fact that insects are cold-blooded organisms, thermal images obtained also at 0 ^{0}C which is the lower than minimum temperature of important Turkish customs. Presence of species in different growth period was monitored using FLIR I7 thermal camera. IRimages were evaluated via FLIR QuickReport software and Süleyman Demirel University Forestry Faculty image analysis system. Although positive results achieved with this preliminary laboratory work, further research including outdoor experiments should be considered.
Keywords: NDE, Thermography, Wood, Quarantine, Harmful organism

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A microsporidian pathogen of *Crysomela populi* (Coleoptera: Chrysomelidae)

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Abstract: Microsporidia are mostly very small, intracellular parasites reported from major group of animals. Insects are one of the most widespread distributed hosts for these pathogens. The members of this group infecting insects is called as entomopathogenic microsporidia. Many entomopathogenic microsporidia cause chronic infections in insects and their effects appear as reduced fertility and pupal weight, fecundity and shortened longevity. Therefore such infections caused by microsporidia in insects are mostly desireble for biological control. In the present study, a microsporidian pathogen, infecting *Crysomela populi* is recorded from Turkey for the first time. Morphology and infection locality is given with the infection rates. During the study microsporidian infection was observed in one population (Kırşehir) in Turkey. The infection was found in adult. Infection rate was 0.7%. Hemolymph and midgut was the infection site.
Keywords: Microsporidia, Biological control, *Crysomela populi,* Chrysomelidae

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A study on chestnut blight in Kastamonu chestnut forests

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Abstract: Turkey has an important potential for biodiversity because of its geographical position. Chestnut (*Castanea sativa* Mill.) Is one of the important tree species of our country benefiting from the production of firewood and firewood, as well as its fruit and honey production. In this study, it was aimed to investigate the health conditions of chestnut forests in Kastamonu in point of chestnut blight. Chestnut blight is one of the most important diseases in chestnut forests and is an important fungal disease that is common in chestnut fields in the world and in Turkey and often causes the trees to death. The study was carried out in the chestnut forests of the provinces of Kastamonu, İnebolu and Bozkurt. In the study, necrosis or wounds were seen on cambium and bark of the stumps and branches. In diseased trees, the rate of cancer in the stumps was 6.25% in İnebolu and 40% in Bozkurt. The rate of cancer seen in branches was 37.5% in Inebolu and 14.29% in Bozkurt. In addition to the active cancer tissues, the rate of recovered cancer tissues in these areas were 81.25% in İnebolu and 51.14% in Bozkurt. According to the elevation, the active cancer tissues in the stumps are mostly found at 800-1000 m. and the recovered cancer tissues are found at between 500 and 800 m. In addition to *Cryphonectria parasitica,* pathogenic *Phytophthora* spp. and *Fusarium solani* and saprophytic *Aspergillus niger* and *Penicillium* species were also identified as a result of examining the cancer tissues collected from the fields.
Keywords: *Castanea sativa, Cryphonectria parasitica,* Kastamonu

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Pathogenicity of *Diplodia sapinea* isolates on endemic and exotic pine species

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Abstract: *Diplodia sapinea* has a worldwide distribution in temperate and tropical regions and causes the disease known by the common name of Diplodia tip blight of pine. Some of the most severe damage from Diplodia shoot blight has occurred in the southern part of Turkey. The pathogen was first noted on dead twigs or canker samples of *Pinus brutia* var. *eldarica* and *Pinus brutia* in Kahramanmaraş. Soon after, *D. sapinea* was shown to be the main causal agent of shoot blight of *P. brutia* in the Isparta region, in the western part of Taurus Mountains. Similar symptoms were reported in *Pseudotsuga menziesii* (Mirb.) Franco plantations in İzmit province and the same pathogen were suggested as the causal agent. The aims of the work reported here was to investigate pathogenicity, host specialization and virulence of *D. sapinea* isolates.
Host specialization and virulence of isolates were tested on 30-cm-long twigs of *P. sylvestris*, *P. nigra*, *P. taeda*, *P. radiata* and *P. pinaster*. Totally 25 isolates grown on PDA were inoculated on twigs. Inoculated twigs were kept at 20°C in a growth chamber. After one month, lesion length in the inner bark and fungal growth in the sapwood were examined. Analysis of variance (ANOVA) was performed on lesion lengths using the SPSS GLM procedure and differences among mean values assessed using Duncan's multiple range test. As a results, most of the isolates used in the inoculation trial induced lesions on the twigs of the five host species. In general, the isolates obtained from *P. taeda* caused longer lesion length on *P.radiata* twigs. *P. radiata*, *P. sylvestris* and *P. nigra* twigs seemed to be susceptible to all isolates compared to seedling inoculations.
Keywords: Virulence, Host specialization, Shoot blight, Inoculation

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Emerging tree diseases in Turkey

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Abstract: Over the last century, the number of reports of new tree diseases, as well as increasing severity of known tree diseases increased in most parts of the world. Increased disturbance by humans, establishment of monoculture forests and planting of exotic species, intensified trade in especially live plants are among main reasons for the increased incidence of diseases in forests and urban environments. Additionally, climate change is also influencing the distribution of pathogens by altering the balance between host, pathogen and environment. The main impacts of forest diseases include reduced value of forestry products, the costs of disease management such as removal of dead and dying trees and control measures to eradicate or reduce diseases. On the other hand, the balance within whole ecosystems can be altered due to loss or reduction in numbers of trees through impact of diseases, which would lead to further ecological damage. Especially if an alien invasive pathogen is causing the disease, the ecological impact can be more severe and irreversible. In urban environment, diseases can affect trees in the streets and parks as well as trees of significant cultural value thereby also posing social impacts, either through creating public safety risk or through causing social pressure on management activities. In Turkey, many forest diseases cause moderate damage in forest ecosystems, although these problems usually remain unrecognized by the forestry authorities for long periods. Chestnut blight, one of the most well-known forest tree diseases, is the only tree disease subject to intensified management practices so far. In contrast, Dutch elm disease, first introduced into Turkey in the 1940s has never been subjected to control measures, nor have the causal agents been determined on a comprehensive scale. While the impact of the disease resulted in the loss of elms (*Ulmus* spp.) in many regions, the ecological impact of these losses on Turkish forest ecosystems remains unknown. Numerous pathogens still seem to be entering urban areas and forests, amongst which boxwood blight and canker stain of plane (*Platanus* spp.) are recent examples. Canker stain of planes is currently affecting trees in urban amenity, heritage and many other situations in İstanbul. Despite the significant cultural values, all infected planes and nearby healthy trees must be removed in order to slow disease spread. Emerging tree/forest diseases in Turkey, however, are not limited to introduced alien pathogens. Heterobasidion and Armillaria root and butt rots, Dothistroma needle blight, Lophodermium needle cast and Diplodia shoot blight diseases are becoming more prominent, with expanding distributions and increasing damage in the last 25 years.
In this paper, we will summarize the forest diseases emerging in Turkey, in forest ecosystems and urban environments, discussing the possible reasons for the emergence and the likely consequences.
Keywords: Alien invasive forest pathogens, Climate change, Dothistroma needle blight, Armillaria root rot, Native plant pathogens

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Isolation experiments fungi from bark beetles

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Abstract: Bark beetles (Coloeptera: Curculionidae: Scolytyinae) are among the most destructive insects in boreal and temperate regions especially conifer forest ecosystems in northern hemisphere and may cause huge economic losses. Bark beetles are completed the majority of their lives under the bark or phloem of coniferous and deciduous trees. It is known that the bark beetles are vector to some fungal species during the transition from tree to tree for reproduction. These fungal species are ecologically different. Some of them are nutrient resource for bark beetles, while others are important pathogenic species for woody plants. The most known plant pathogenic fungi that associated with bark beetles are *Ophiostoma* species. The aim of our research is to isolate the fungus associated with bark beetles. In the study, bark beetles were obtained from the black pines in the forests of Balıkesir Reginoal Directorate in 2014. Our research was conducted on 4 different black pine (*Pinus nigra* J. F. Arnold.) stands where bark beetle damage was determined. Wood traps were established to the experiment area at the end of February. Wood traps had been checked regularly from March. Fungal isolates were grown from *Ips sexdentatus*, *Orthotomicus erosus*, *Hylurgus ligniperda* and *Hylurgus micklitzi*. The bark beetles were surface sterilized with 0.5% sodium hypochlorite. While some of them were placed individually into petri dishes containing about 25 ml 1% MEA (Malt Extract Agar), the others were transferred separately into petri dishes containing 1% MEA added 100 µg/ml streptomycin to inhibit bacterial growth and 500 µg/ml cycloheximide for inhibit some fungal growth. Petri dishes were incubated at 20 °C and checked daily for two months. Out growing fungal mycelia were sub-cultured in new petri dishes with fresh 2% MEA. The fungal cultures were divided into the groups according to their morphology to be subjected to DNA sequence analysis for species identification. Fungal species growing on first type medium are known as contaminant species; *Aspergillus*, *Penicillium*, *Rhizopus* and also *Trichoderma* spp. In addition, in some petri dishes, different colonies immersed into medium were observed but pure cultures were not obtained. Bacterial contamination occurred in some of those petri dishes. On the other medium 8 different types of colony morphology were determined. Each group representing the fungus was extracted using the NucleoSpin Plant II - Macherey-Nagel Mini Kit. Genomic DNA samples of each isolate were identified by amplifying elongation factor primers. The findings will shed light on the fungus-insect relationship that can cause deaths on black pine in Balıkesir region.
Keywords: Bark beetles, Fungi, blAck pine, Balıkesir

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An invasive fungal pathogen threatening plane trees in Turkey; *Ceratocystis platani*

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Abstract: *Ceratocystis platani* (*C. fimbriata* f. *platani*), is a wound pathogen causing canker stain that leads to wilting and eventually death of plane (*Platanus* spp.) trees. *Platanus occidentalis* is more resistant to the fungus than *P. orientalis* and their hybrid *P.* x *acerifolia*. Infected trees die within 3 to 7 years. *C. platani*, which originates from United States, caused serious damage and deaths on *P. acerifolia* along the Atlantic coast. The disease was introduced into European ports in wood or wooden packaging material during the Second World War. Canker stain of plane was detected in mainland Italy and France in 1940s, in Switzerland in 1983, in Sicily and Armenia in 1994, in Greece in 2003, in Spain, Turkey and Albania in 2010, 2011 and 2014, respectively. However, the disease is stated to have been eradicated from Spain. In the spread of the disease agent, injuries in branches or the trunk of the tree play an important role. Pruning of the diseased trees can initiate infection in neighboring healthy trees, even if only very small quantities of wood dust reach injured trees. The fungus in soil, contaminated pruning tools, or any machinery and equipment used in the transfer of trees are among the elements that spread the disease. In addition, the fungus is known to pass from one tree to another via root grafts. Also the fungus is transported long distances in infected seedlings and wood. In some studies it was shown that canker stain becomes epidemic principally in areas where plane trees require human tending. Once the fungus has grown into the wood via a wound, it quickly invades the heartwood. The first symptoms are the rapid wilting and death of the affected branch or the foliage in general. Crown infection proceeds from the top of the crown towards the lower branches resulting in a dieback that spans the entire tree. Crown of diseased trees is sparse, and have yellow leaves in the spring. The fungus, causes long, oblong cankers, which affects and prevents water transfer. These can be recognized on the bark. In addition, vector insects have significant effect on spreading of the pathogen. The ambrosia beetle *Platypus cylindrus* was very common in stands of *P. orientalis* trees in Greece, infesting trees already infected by *C. platani*. In most of the cases, the beetles had bored tunnels in the stem, where abundant perithecia of *C. platani* were observed. *P. cylindrus* adults regularly visited artificially wounded *P. orientalis* trees in a natural stand. Although this ambrosia beetle normally infests stressed or dead trees, it appears to play a role as a vector of *C. platani*. It is probable that *P. cylindrus* is involved in transmission of *C. platani* on plane trees in Istanbul where the disease was detected in 2011. The aim of this study was to diagnose one of the alien invasive species, to reveal the effective conditions of transmission of plane canker, to prevent national and international spread of the disease and emphasize the importance of controlling the disease.
Keywords: *Platanus* spp., Plane canker, Alien invasive species, Canker stain of plane, Disease epidemic

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Forest pathogens under plant quarantine regulations in Turkey

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Abstract: Quarantine pests and diseases are harmful organisms, defined under legislation. We addressed the harmful organisms that are capable to cause disease on forest plants and listed for regulation as quarantine pests in regulation on plant quarantine of Turkey and by EPPO (European and Mediterranean Plant Protection Organisation). We also examined the fungi listed under a recent regulation entered into force in 2016 in order to regulate the authorization of marketing the plant propagative materials and Phytosanitary Certificates only for forest plants. A remarkable number of harmful fungal organisms take place under legislations as quarantine pests causing diseases on forest trees or other plants in forests. More than half (52%) of the harmful fungal organisms listed in the EPPO's A1 list (absent in EPPO region, including Turkey) are either directly causing disease on forest trees and on fruit trees in orchards or pose threat to wild hosts in forests. On the other hand, according to the current regulation on plant quarantine in Turkey (Annexes 1-A and 2-A), a total of 32 fungi were recommended for regulation as absent in the country, among which 73% (19 fungi) are capable of causing diseases on forest trees or pose threat to other plants in forests. the number of fungal pathogens present in EPPO region but not in Turkey according to these lists were 17. *Phytophytora ramorum* and *Fusarium circinatum* are among very destructive forest pathogens reported from Europe but not from Turkey. However, some of the organisms listed in EPPO A1 list were not accounted in the Turkish plant quarantine regulation; for example, the fungal causal agent of thousand canker disease of Walnuts (*Juglans* spp.) *Geosmithia morbida* which recently detected within EPPO region (Italy). On the other hand, some harmful fungal pathogens not listed in currently in EPPO, but present almost all around Europe, such as *Hymenoscyphus fraxineus*, the causal agent of destructive Ash dieback disease, is not included as a harmful organism in the Turkish regulation even though not present in Turkey but pose high risk for forestry. Another drawback in the current legislations is the usage of synonyms of the organisms which also lead to repetitive listing of the same fungus in different categories (i.e. both in annex 2A as absent in county and in annex 2B as present). Interestingly, the recent regulation for authorization of marketing the plant propagative materials and phytosanitary certificates for forest plants also doesn't include, for example, the above mentioned dangerous forest pathogens, even though the regulation meant to regulate marketing of propagative materials used in forestry. Nevertheless, this regulation also lists some plant pathogens such as *Ophiostoma ulmi* and *O. novo ulmi* in the list of harmful organisms that are not present in Turkey. However, the presence of Dutch elm disease caused by *O. ulmi* and *O. novo-ulmi* is known in Turkey since 1940s and 2000s respectively. As fungi are the main disease agents of forest trees or shrubs, in this review we focused on the harmful fungal organisms. However, there are also a number of nematodes, viruses, prokaryotes and parasitic plants which also can cause disease in forest plants and pose important risk to forests. For example, *Xylella fastidiosa* is one of the most dangerous plant bacteria worldwide, causing a variety of diseases on woody plants including elms, oaks and many other forest trees. A revision for the harmful organisms especially those capable to cause disease on forests trees or on other forest plants listed in legislations is definitely needed. Especially the forestry authorizations should consider the high risks posed by this organism and be more careful while planning new legislations. While our study revealed some drawbacks on current regulations but only on fungal pathogens, a comprehensive revision on the lists for all harmful organisms as well as plant products would provide a wider opinion on requirements.
Keywords: Plant quarantine, harmful organisms, forest pathogens, Tukey

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Antifungal activities of juniper berry oil (*Juniperus oxycedrus* L.) against *Trichoderma* sp. a causal agent of green mold disease on mushroom (*Agaricus bisporus*)

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Abstract: Juniper berries are used commercially for the preparation of essential oil, gin, and as a spice . The Juniper berry (*Juniperus oxycedrus* L.) essential oil has been known since ancient times as a very strong antiseptic, diuretic properties, gastrointestinal irritant properties. In this study, the antifungal activities of different doses (10, 20, 30, 50, 100, 200, 300, 400 and 500 µg/ml) of juniper berry oil were investigated against *Trichoderma* sp., a causal agent of Green Mold disease on mushroom by using volatile and dilution methods. The volatile effect of different doses of juniper berry oil were investigated against *Trichoderma* sp. *in vitro*. Sterile distilled water was used as a control. Antifungal effect of Juniper berry oil was compared with that of *Thymbra spicata* var. *spicata* essential oil (50 µg/ml) which is known a very strong antifungal essential oil. Juniper berry oil had a strong antifungal effect on *Trichoderma sp.* It was thought that this antifungal effect can be result from the presence of some main components as a □- and □-pinene, myrcene, sabinene, thujone, limonene, etc. This study is the first report on antifungal effect of Juniper berry oil against the fungal pathogen *Trichoderma* sp. a causal agent of Green Mold disease on mushroom.

Keywords: *Juniperus oxycedrus*, Juniper berry oil, Green mold, *Trichoderma* sp., Antifungal activity

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Effects of traditional goat farming on forest fire control in Turkey

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Abstract: Turkey is a country with an area of 78.004.644 hectares. This asset is 22.342.935 hectares of forest area and represents 28.6 percent of the country's area. Forest fires have an important role in threatening forests. The Mediterranean climate is on the south of the country and the Mediterranean region is the region where forest fires are most visible due to the characteristics of this climate type. Summer drought, which is one of the characteristics of the Mediterranean climate, is the most important factor in causing forest fires. When the summer drought is over, the annual plants that keep the annual life at the end are dried up after the seeds have matured. On the other hand, as a result of leaf and branch casting of trees, and shrubs, dry material that is ready for burning in forests and agricultural areas can easily accumulate and forest fires can easily come into contact with fire for any reason. In short, the presence of dry grass and woody material suitable for burning during the summer drought, and the fact that it cannot be removed from the forest areas in some way, especially because the forest fires in the Mediterranean region are both high in area and numerically high. Today, the General Directorate of Forestry is spending a large amount of money in order to prevent forest fires and to extinguish the forest fire that is needed. However, it is possible to reduce these monetary expenditures by introducing herbs and leaves to be converted into flammable material by putting small animals in forest areas in short periods at certain periods. In the prevention of forest fires, goats have important functions. Every year thousands of miles of fire safety strips and roads are set up to keep forest fires in small areas and prevent them from spreading. Passengers opened by patrons, natural fire safety path and patrol. It is expensive and difficult for mankind to open and construct these patios. By doing this, goats contribute to preventing fires. If the goats are grazed in high forest areas, it is not harmful to the forest. Because, goats eat the whole plant cover around the trees. Thus, main factors that increase the risk of fire spread are eliminated. When a fire breaks out, flames cannot spread because there are no plant remains in the ground. Thus, the fire on the scene where the adult trees are found will not be able to spread. In this lecture effects of traditional goat farming on forest fire control in Turkey were analyzed and discussed.
Keywords: Forest fires, Silvopastoral systems, Traditional goat farming, Forest fires control, Turkey

1. Introduction

Forest fires are a recurring phenomenon in, and have always had a pervasive influence on Turkish forests. In the period 2003-2013 a total of 36,724 fires burned a total of 150,100 hectares of forest land. On the other hand domestic goats are blamed for much of the destruction of the forests in Turkey. There is hardly a single study on deforestation in the Mediterranean Basin which does not specify goats as a primary cause. Over the last few years, however, it has been realized that it is not goats per se that are the real culprit but the continuous, uncontrolled overgrazing for which humans are responsible. Although uncontrolled goat grazing has contributed to the destruction of Mediterranean forests, their controlled grazing can be beneficial. The benefits may be ecological. Because of low temperatures in winter and the lack of sufficient moisture in the summer, decomposition is slow, resulting in the accumulation of organic material on the ground. This can lead to devastating wildfires. Grazing animals can reduce this material and thus prevent forest fires. In this lecture the role of goats and goat husbandry for forest conservation and wildfire control in Mediterranean and Aegean region of Turkey were analyzed and discussed.

1.1. Forest fires in Turkey

Forest fires are a recurring phenomenon in, and have always had a pervasive influence on Turkish forests. In the period 1937-1996, a total of 60,434 fires burned a total of 1,464,928 hectares of forest land. This represents 1007 fires on 24,414 hectares annually with an average area burned of 24 hectares per fire. In recent years, there has been a gradual increase in the number of fires, but due to the increased and effective use of technology in transportation, communication and fire suppression, the area burned has been cut in half and kept at a range of 12,000-14,000 ha (Mol and Kucukosmanoglu, 1997) on average. The distributions of fires to different regions are as follows: 41% of the fires occur in Aegean; 24% in Mediterranean; 22% in Marmara; and 13% in other regions (Anonymous, 1989).

In the Mediterranean and Aegean regions, every place has a unique fire regime or pattern of fire activity resulting from the interaction of many natural and cultural influences. In the past, one of the major causes of forest fires was the use of fire to clear land for agricultural purposes. Although very little effort has been made to determine the fire regime (e.g., Neyisci, 1985) in Turkish forests, many areas that are now covered by maquis formation (of mainly shrub species) were created by

repeated fires set by people. Typically, there is very little winter activity, followed by an increase in May as the rain activity decreases and fuels start to dry up, a peak in the number of fire starts in August, followed by decreasing activity in the fall. Another but less recognized fire season is the spring/fall fire season. This type of fire season is seen in the spring and fall in broad-leaved forests in fire prone regions and in the eastern Black Sea region, one before leaf-out when the last years surface fuels are dried up before the new vegetation period starts and one in the fall after the vegetation period has ended and leaves fallen. Here, surface fuels are the only fuel component that becomes available for combustion, thus all fires spread as surface fires.

The majority of forest fires in Turkey are caused by people. People-caused fires account for 98% of all fires, while lightning is responsible for the remaining 2%. Of the people-caused fires 23% was classified as arson, 27% as negligence and carelessness, and 50% as unknown (Mol and Kucukosmanoglu, 1997). "Unknown" fires are the fires for which no known cause could be determined. However, it is very likely that the shares of the first two categories of fire causes (i.e., arson, negligence and carelessness) in unknown causes are similar to that of the known causes. In this case, arson accounts for about 35% of all fires, which is a little over the average value (32 %) found in temperate forests of the northern hemisphere (Mol and Kucukosmanoglu, 1997). This is definitely a very large proportion and is seriously taken into account in the process of fire prevention, pre-suppression and suppression planning.

Arson fires are set for several reasons. About 7.7 million people live in 20 293 villages in or near forests (Anonymous, 1991). Socio-economic life standards of most of these people are well below the national average.

People with low income and low life standards see the forests as an earning ground for their sustenance. So, people set fire in the forest to create jobs that will earn them some provision or manipulate vegetation to improve and produce useful plants for their animals to graze. Personal conflicts between people and forestry officials or between shepherds or different villagers have also been reported to have been a cause for fires.

1.2. Goat and goat husbandry in Turkey

1.2.1. Traditional goat breeding in Turkey

The areas in Turkey where pure hair goat breeding is most widely conducted are the Aegean, Mediterranean and Southeast Anatolian Regions. Nomads who live in these areas have been breeding pure hair goats in the upper basins of that region for centuries (Boyazoglu et al., 2005; Ocak et.al., 2007). Pure hair goat breeding symbolizes a cultural value for nomads, in addition to being a breeding system (Guney and Darcan, 2005).

There are similarities between the borders of the regions where pure hair goats are bred and natural distribution borders of some types of trees and shrubs within the Mediterranean scrub vegetation. This similarity is demonstrated clearly in Kermes Oak *(Quercus coccifera* L*.)*, Boz Pirnal Oak (*Qercus aucheri* Jaub.&Spach.) and Holm Oak (*Quercus ilex* L.) species. These three types of shrubs are woody types, the leaves of which are eaten fondly by the pure hair goats. Pure hair goats have selected as their habitat the natural distribution area of these these shrubs. Pure hair goat raising is conducted in the form of transhumance in Turkey. Villagers are specialized in pure hair goat raising and do not avail of any other sources of income. The number of goats in the flocks ranges between 75-600. Flocks of goat are being grazed by women and children. They climb to the grazing land at the end of March and return in November. Villages have built simple accommodation facilities within the areas where they graze their pure hair goats.

The addition of male goats to the flocks for the purpose of impregnating females occurs during the month of September and they are kept within the flock for approximately 10 months. The rate of male goats/female goats is 1/25 during the breeding period. Kids are fed with their mother's milk for a period of 2 months after their birth. The milking period lasts for 3 months and the milking is performed once a day by women. The total milk yield per goat is 55 kg. A pure hair goat has a live weight of up to 20 kg at 1 year of age. The hair of the goats is only sheared once a year in August. As free range breeding is conducted, the manure of pure hair goats cannot be collected, thus it is not possible to use manure in agricultural production.

The milk and products obtained from pure hair goats are consumed by the families owning the herds and also placed in the markets of villages. The milk they obtain is converted into products such as cheese and/or butter upon being used purely or by being mixed with cattle milk. There is no marketing mechanism for providing goat milk and products to the consumers on a regular basis.

The per household income obtained from pure hair goats on an annual basis is US $3,500. Given that the average number of members in a household is 4.9, it is seen that the annual income per capita is US $715. As the annual income per capita is US $9,333 in Turkey, it can be concluded that economic status of the villagers is rather bad (SPO, 2008).

1.2.2. Problems on goat breeding in Turkey

Some traditional agroforestry practices used by the inhabitants of rural areas in Turkey are not given importance by institutional and academic circles and efforts are aimed at reducing or eliminating these practices. One of these practices relates to pure hair goat (*Capra hircus* L.) breeding by forest villagers (Avcı, 2005; MEFO, 2008). Various investigations have been conducted regarding grazing at in-forest meadows and forage yield in Turkey (Defne, 1955; Alpay, 1972). Furthermore, there are also studies regarding utilization of leaf fodders of forest trees (Mol, 1982; Sevimsoy and Sun, 1987). In these researches, the damage done by pure hair goats on the forest and the trees have been highlighted and they request has been made for keeping them away from forests. Yet, in the countries located in the Mediterranean Region have noticed the importance of the woody species in goat breeding and tried to develop their breeding system (Aldezabal and Garin, 2000; Boyazoglu and Morand, 2001; Ainalis and Tsiouvaras, 2004; Ainalis et al., 2006; Zarovali et al., 2007).

2. Role of goats for wildfire control in Turkey

There is hardly a single study on deforestation in the Mediterranean and Aegean region of Turkey which does not specify goats as a primary cause in Turkey. Over the last few years, however, it has been realized that it is not goats per se that are the real culprit but the continuous, uncontrolled overgrazing for which humans are responsible (Papanastasis, 2009). Although uncontrolled goat grazing has contributed to the destruction of Mediterranean forests, their controlled grazing can be beneficial (Papanastasis, 1985). The benefits may be ecological. In discussing livestock grazing in the forests, domestic animals are instrumental to the functioning of these ecosystems because they contribute to nutrient cycling and thus to an increase of their productivity (Liacos, 1980). Because of low temperatures in winter and the lack of sufficient moisture in the summer, decomposition is slow, resulting in the accumulation of organic material on the ground. This can lead to devastating wildfires. Grazing animals can reduce this material and thus prevent forest fires. The role of goat in reducing fuel has received special attention in the last few years in Turkey.

3. Conclusion

Goats play an important socio-economic role in many rural areas of the world. These animals adapt easily to intensive production systems and convert their feed into highly nutritious milk and meat very efficiently (Castel et al., 2010). Therefore, goat farming is a traditional occupation and an important activity for nomadic societies, especially in the Mediterranean region of Turkey (Tolunay et al., 2014). Goat breeders living in these areas obtain a means of subsistence by selling high value products such as meat, milk and dairy products to urban consumers. Goats need nutrients derived from grazed forage in order to enhance extensive production systems so that goats may produce high value products.

Traditional goat production is quite profitable in Turkey. The economic value of hair goat production has been ignored for a long time; whereas, this production system is the cheapest and most ecological production system so that the goats utilize the maquis and bushes where the other livestock animals could not consume. In conclusion goat grazing at the forestry and maquis areas would be useful for not just forest but the raising of goat number and production as well (Türkoğlu et.al., 2016).

In Turkey, pure hair goat breeding had been conducted in an undisciplined and irregular manner until 2011. This was mainly due to the banning of pure hair goat breeding in forest areas by the state. A grazing plan was prepared by the state and conditions have changed pursuant to the government's permission of grazing goats in state forests. Thus, the number of the pure hair goats has increased dramatically in recent years. Currently, pure hair goat breeding is conducted in the form of free-range animal husbandry in scrublands. In line with these developments, it has become critical to develop a sustainable goat farming and benefitting optimally from the rich feed sources in Turkey.

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Environmental controls of litter decomposition dynamics in Turkish forests

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Abstract: Concerns over the potential effects of increased atmospheric CO_2 have spurred research on topics as different in scale and process as plant leaf/litter quality and litter decomposition, global climatology and forest carbon storage. Decomposition is central to ecosystem functionality and recent studies have shown that decomposition in forest ecosystems contribute significantly to global carbon studies. Plant litter decomposition has long been recognized as an essential process for nutrient cycling and organic matter turnover within ecosystems that are important determinants of plant productivity and ecosystem carbon (C) storage. Decomposition rate and nutrient release patterns of plant litters are influenced by environmental conditions, the nature of the microorganisms and soil fauna active in the decomposition process, and by substrate quality or litter quality. In general, climate (especially temperature and moisture) governs decay rates on broad regional scales, whereas initial litter quality variables (carbon:nitrogen (C:N) ratio, lignin, N, and lignin:N ratio) are of more importance in controlling decay rates at small scales, i.e. within site. Interest in the role of litter decomposition in the global carbon cycle has increased recently since (1) increased atmospheric carbon dioxide will probably affect the chemical quality of litter (especially nitrogen content), and (2) global warming may enhance decomposition rates. In this present study, we have reviewed and discussed the four main site factors influencing litter decomposition dynamics in Turkish forests. In general, in Turkish forests, a number of site factors such as topographical landforms (especially different aspects and slope positions), gap size classes, stand type (pure or mixture) and understorey species can create different environmental conditions which can retard or accelerate litter decomposition through negative or positive effects on the activity of organisms. The results have generally indicated that the litters on north-facing site decomposed faster than those on the south-facing site. The litters placed at the top slope position decompose slower than at those at either the bottom or middle positions. Large forest gaps significantly reduce litter decomposition rates by changing environmental conditions, especially by decreasing soil temperature and soil pH which reduce soil respiration rates. Litter decomposition is highest under mixed beech/spruce forest, following by pure beech and spruce forest. Beech and spruce litter decompose much faster in mixed bags (beech–spruce) than they do separately under each stand type. Purple-flowered rhododendron significantly reduces litter decomposition of Oriental beech and spruce.
Keywords: Litter decomposition, Topography, Gap sizes, Stand types, Rhododendron, Site factors

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Global climate change and forest fires

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Abstract: Today, it is accepted by almost all climate scientists that there is a deterioration in the world climate system. In the event that the people who cause the natural balance disruption continue their various activities without taking the necessary precautions, it is stated that these deteriorations in the climate will increase and the climate change due to the global warming will be very negative. Because of anthropogenic causes, the increase in the accumulation of greenhouse gases and particulates in the atmosphere, the destruction of the natural environment, the thinning of the ozone layer, will cause to rise the temperature in the global dimension. Photosynthetic fixation of carbon dioxide (CO2) by green plants and other autotrophs sustains life on Earth by moving carbon from atmospheric to terrestrial pools, and by helping to mitigate the global climate. Forest fires, however, play an important role in the atmospheric release of stored terrestrial carbon. As forests store about 45% of terrestrial carbon and can hold 25% of annual anthropogenic carbon emissions, forest fires are a critical link in the global carbon cycle. Many climate models have predicted significant climate change over the past century due to the greenhouse effect, including increase in temperature worldwide and the tendency to dry in many subtropical and mid-latitude regions. Turkey is one of the countries most affected by a climate change that can be seen in the complex climate structure. Although there are differences in scenarios and models, almost all of the simulations predict a temperature increase from 10 ° C to 3.5 ° C for Turkey's general and decrease in precipitation for southern and western Turkey by 2100. In the case of global warming continuing, extreme high temperatures, widespread and severe drought events for some regions are predicted at a very high level of reliability. A natural consequence of these, shrub and forest fires will cause some serious potential changes, including human health and ecosystem function. Especially hot weather waves and drought; Forest fire risk, fire intensity, number of fire, burning area together with the fire frequency will increase. In addition, new vegetation and fuels community that may arise under a changing climate regime may affect fire potential, burning area, combustion efficiency, and available fuel load, and fuel consumption.
Keywords: Global climate change, Global carbon cycle, Forest fire regime

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Importance of forest ecosystems in global climate change

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Abstract: Global warming is the increase of Earth's average surface temperature due to effect of greenhouse gases, such as carbon dioxide emissions from burning fossil fuels or from deforestation, which trap heat that would otherwise escape from Earth. Climate change is the change of the normal weather patterns around the world over an extended period of time, typically decades or longer. Human induced climate change is expected to continue in the coming decades, with considerable effects on the environment. Consequences of climate change include an increased risk of floods and droughts, losses of biodiversity and damage to economic sectors such as agriculture and forestry. Forest ecosystems play a very important role in maintaining natural processes. Forests are one of the biggest reservoirs of carbon, so they help to keep the carbon cycle and other natural processes working and help reduce climate change. Forest ecosystems are major contributors to the Earth's ability to maintain its climate, by the global impact of their photosynthesis. They are a natural defense against climate change, removing the greenhouse gas carbon dioxide and generating oxygen. This assists in purifying the atmosphere and controlling rising temperatures. However, forest ecosystems are important in the global carbon cycle because they store large quantities of carbon in vegetation and soil, exchange carbon with the atmosphere through photosynthesis and respiration. Also forest ecosystems keep carbon by increasing of living biomass and participation of fallen leaves to soil carbon reservoir. Large portion of carbon goes to developing biomass when trees are planted. By this way, during the first 30–40 years of development of the tree are large amounts of carbon. The vast majority of carbon sequestration takes place within the first 60-100 years. A well developed, 100-year-old beech tree can absorb 40 million m^3 airs and also it can bind 6 tones carbon from 1200 m^3 carbon dioxide. On the other hand, forest ecosystems bind about three billion tons of carbon which emitted as a result anthropogenic effects every year. This also constitutes 30% of CO_2 from fossil fuels. The aim of this study is to present the current state of knowledge about the role of forest ecosystems in the global climate change and carbon cycle, with respect to the potential role of forests to mitigate carbon dioxide emissions and thus affect climate change.
Keywords: Global warming, Climate change, Forest ecosystems, Carbon cycle

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Effects of global climate change on arab countries

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Abstract: Global climate change due to greenhouse gasses and aerosols and changes in the Earth's surface resulting from various human activities, which leads to increased concentrations of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs) and Water vapor in the atmosphere. Which caused global warming since the industrial revolution in 1975 and it has become a global problem on the environment. The aim of this study is to provide general information on climate change and its impact on the environment in Arab countries and to find appropriate solutions to reduce of the causes these climate changes and mitigation on the environment. In this study, effects of global climate change on Arab countries evaluated according to impacts of climate change in terms of the impact of sea-level rise (SLR). Through the results of the study, it has found that the land area of Qatar is witnessing a significant reduction ranging from 2.6% at SLR of 1m to 13 % at SLR of 5m. And we found that the GDP of Egypt is witnessing a reduction approximately ranging from 3% at SLR of 1m to 8 % at SLR of 5m. And where find that the agricultural extent of Egypt is witnessing a reduction approximately ranging from 11% at SLR of 1m to 22 % at SLR of 5m. And Where find that the urban extent of Mauritania is witnessing a reduction approximately ranging from 4% at SLR of 1m to 31 % at SLR of 5m. Also, it has found that the wetlands of Qatar are witnessing a reduction approximately ranging from 21% at SLR of 1m to 73 % at SLR of 5m.As well as this study has indicated to the impact of global climate change on freshwater sources and most of the Arab countries do not have adequate water sources. The total water resources are the compilation of the total renewable water for each of the internal surface water, the external surface water and groundwater. where the countries of Iraq, Sudan and Egypt have the largest amount of water resources of 75, 65 and 58 billion m3/year, respectively. As well each of Lebanon Tunisia. Yemen, Mauritania. Algeria, Somalia, Syria, and Morocco come in the second region in terms of the amount of water resources between 5 to 30 billion m3/year. As well as this study has indicated to the impact of increasing drought. Some semi-arid and subhumid regions of the Arab countries have suffered from more intense and multi-annual droughts.Previous studies indicate an increase in drought through the last 20-40 years in Morocco, Tunisia, Algeria and Syria where the average drought in Morocco has changed from one year of drought in each five-year period before 1990 to a full year for each two-year period. The problem of global climate change in the Arab countries needs much attention and study by integrating the effects of climate change and adaptation into development plans and strategies and policies that strengthen these strategies and increases their efficiency.

Keywords: Global warming, Climate change, Arab countries

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Assessment of the carbon footprint mass balance in the context of global climate change; a case study for Isparta Province

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Abstract: After the industrial revolution in the world, especially in the last 20 years, due to the increase in population and technology, energy consumption has also increased in very serious quantities. The industrial revolution has started with the intense use of fossil fuels, which is a process of millions of years of human creation. As a result of the use of fossil fuels in energy consumption, the atmospheric carbon emissions have increased and the concept of global climate change has formed. The concept of carbon footprint has been established in the United Kingdom to create awareness of global carbon emissions and the adverse effects of global climate change. In this study, the emissions of the main carbon sources in Isparta Province were calculated. A calculation was also made from the carbon respiration of forest areas in the Isparta Province and the results were compared. In this context, four main sources were taken into account in the carbon footprint calculation for Isparta Province. These were electricity consumption, heating, number of cars and socioeconomic preferences. The calculation tool used at the carbon footprint calculation is located at www.carbonfootprint.com, which is based in the United Kingdom and aims to raise awareness about global warming and centers in different countries. Within this scope, it was accepted that 4 people living in 1 household in order to calculate the carbon emissions per household. The population of Isparta Province was 427 324 people in 2016 according to Turkish Statistical Institute and about 106 800 households were found (1 household with 4 people accepted). The consumption for heating purposes of Isparta Province was accepted about 40% natural gas and 60% coal. The average annual natural gas and coal consumption per household was accepted as 360 m^3 and 1 ton, respectively for Isparta Province. The annual average total energy consumption for Isparta Province was assumed to be 1000 kWh per household. According to Turkish Statistical Institute, 160 000 vehicles have been determined in Isparta Province as of 2016. However, some assumptions were made from the socioeconomic situation of the people living in Isparta Province such as the preference for food (meat consumption), the recycling rate of the formed garbage (some being recycled) and the furniture and electronic goods preferences (generally taking new products and using them for at least 5 years). The amount of carbon footprint per capita for Isparta Province was calculated to be about 5.2 tons by the carbon footprint calculation. It was seen that the average value of Turkey is about 4 tons per capita and slightly above the average for Isparta Province. The total carbon footprint of Isparta Province was calculated approximately as 2 220 000 tons (427 324 people * 5.2 tons). The forest area of Isparta Province was 386 048 hectares according to taken data from Isparta Regional Directorate of Forestry for 2016. The amount of carbon sequestration per hectare by forests is 3-5 tons per year in literature. This value was chosen as 4 tons in order to stay safe in this study. The amount of carbon sequestration per year was calculated to be approximately 1 544 000 tons for Isparta Province (386 048 ha * 4 tons). It was found that 676 000 tons of carbon to be released in atmospheres from Isparta Province when carbon mass balance was made in the light of the abovementioned acceptances. In this case, it is recommended that decreasing of the use of fossil fuels and increasing of the use of renewable energy resources and the area of productive forests for reducing the adverse effects of climate change.

Keywords: Carbon emissions, Carbon footprint, Climate change, Forest areas, Fossil fuels

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Socio-economic effects of forest fires: Antalya Serik Taşağıl region case

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Abstract: Forest fires are among the major problems for Mediterranean countries. The south and west of Turkey is at risk from forest fires. Especially large forest fires negatively affect forest villages. The aim of this paper is to determine the socio-economic impacts of the forest fire in Antalya Serik-Taşağıl Turkey in 2008. Within the scope of the study, survey studies were conducted to determine the perceptions of the villagers who suffered from fire and the size of the damage and forest fires. As a result, the damage to the forest villages of fire is great in economic and social terms. House, tools, equipment, animals etc. were damaged by fire in the region. From the social point of view, most children are affected by fire. After the fire there has been a migration from the region.
Keywords: Forest fire, Socio-economic effects, Antalya, Turkey

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Application potentiality of lidar derived DEM and DSM data in forestry

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Abstract: Remote sensing techniques and technologies are used extensively in forestry as well as in many other disciplines. There are certain reasons why remote sensing techniques are so widespread and widely used. The most important of these are the efficiency of the technology reducing the time, cost and labor. In addition, they are also useful in establishing the possibility of working in large areas and determining the invisible properties of objects. Light Detection and Ranging (LIDAR) is an important instrument that has been used in remote sensing studies since the early 1960's. As the name implies, LIDAR measures the distance to the targeted object(s) by calculating the time differences for the light pulses hitting the object(s) and returning from them. Besides, the change in the wavelength gives users other important information about the properties of the object(s). Basically, LIDAR data gives us 3D point cloud of the object/area, which includes elevation and other structural properties of them. Digital Elevation Models (DEMs) and Digital Surface Models (DSMs) are the most important outputs obtained through LIDAR data. While DEM gives us the elevation data of the world's bare surface, the DSM gives us elevation data of all elements (trees, buildings, etc.) on the earth's surface. In this study, the usage and capacity of high resolution DEM and DSM data obtained through LIDAR data in forestry activities were examined and discussed. Results were obtained by using many different studies in the literature. Accordingly, DEM and DSM data derived by LIDAR have been used for calculating and estimating the 3D stand parameters such as canopy height, above–ground biomass, mean steam diameter, vertical foliage profiles, canopy volume, tree density, open areas and stream/road paths within forests. In these studies, it was seen that the calculation of the elements of forest components obtained with LIDAR data validated and exceeded the expectations and saved both labor and time. It has also been demonstrated that LIDAR was far superior then the other remote sensing techniques. The success achieved in forestry activities with LIDAR data is important in the future development, production and use of such techniques.
Keywords: LIDAR, DEM, DSM, Remote sensing, Forestry

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Comparison of Sentinel-2 and Landsat 8 OLI satellite imagery for vegetation cover and land surface moisture monitoring

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Abstract: The availability of new generation multispectral sensors of the Landsat 8 and Sentinel-2 satellite platforms provides opportunities for certain time intervals and at certain frequencies vegetation and land surface moisture monitoring. In this study, success of Landsat 8 and Sentinel-2 satellite images are evaluated for determining the vegetation cover and land surface moisture in areas where the vegetation cover is dense and less dense. Sentinel-2 satellite carries a single multi-spectral instrument (MSI), which provides 13 bands in the visible, near infra-red, and short wave infra-red part of the spectrum, at different ground resolution.

On the other hand, Landsat 8 carries two push-broom instruments: The Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS). The Operational Land Imager (OLI) measures in the visible, near-infrared and shortwave infrared portions of the spectrum. Its images have 15-meter panchromatic and 30-meter multi-spectral spatial resolutions. In our S2 data assessment, vegetation cover and land surface moisture were produced at 10 m spatial resolution by pansharpening the low resolution Sentinel 2 spectral channels with 10 m pixel size. On the other hand, in our Landsat 8 assessment, vegetation cover and land surface moisture were produced at 15 m spatial resolution by pansharpening low resolution Landsat OLI spectral channels with 15 m pixel size. In the study vegetation cover is extracted from near-infrared and red spectral bands of Landsat OLI and Sentinel 2 satellites by using Normalized Difference Vegetation Index (NDVI). High NDVI values correspond to areas that reflect more in the near-infrared spectrum. Higher reflectance in the near-infrared corresponds to denser and healthier vegetation. On the other hand, land surface moisture extracted from the near infrared and short wave infrared spectral bands of Landsat OLI and Sentinel 2 satellites by using Normalized Difference Moisture Index (NDMI). NDMI is used in combination with other vegetation indexes, which is associated with vegetation moisture. The resulted NDVI and NDMI that are extracted from Landsat 8 and Sentinel-2 are compared at randomly selected points. The results of the study reveals that, although spectral signatures similar to each other's, the spatial accuracy of Sentinel 2 derived indices is slightly higher than Landsat 8 OLI derived indices.

Keywords: Normalized difference moisture index (NDMI), Normalized difference moisture index (NDMI), Sentinel-2, Landsat 8 OLI

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A framework for the afforestation information system in Burdur Region

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Abstract: Afforestation, which plays an important role in forestry practices, is necessary for sustainable forestry. Afforestation is realized not only for the establishment of the future forest areas but also for reducing erosion in severely eroded areas or rehabilitating the degraded areas. In order to evaluate the success of the afforestation activities, field works should be recorded and long term monitoring and measurement should be performed for these areas. Geographical information system is necessary in order to carry out these activities in a permanent, controllable and accountable way. To this end, a digital database that consists of graphical and text data about the activities is created under the afforestation information system. Spatial data such as soil characteristics, geological structure, climate data about the afforestation areas can be added to this system as a layer. The relationships between the data can be examined with the help of the analysis functions offered by the geographical information system. This system is a dynamic structure with features that can be updated and edited on a continuous basis. The purpose of this study was to produce the afforestation geodatabase and to describe a framework for the afforestation information system in Burdur region. While creating the geographical database, the necessary physical infrastructure was provided to enable the data input and feature codes were developed. The graphical data derived from afforestation, erosion control and rehabilitation projects in this region were uploaded to the geodatabase. Furthermore, text data such as tree species, soil tillage method and plantation year were also recorded. The maps of afforestation works were also created. The data obtained in this study show that the operations performed in the area are not recorded in details. These gaps make it difficult to interpret the results of data analysis. It is suggested that creation of a multi-dimensional afforestation information system and uploading detailed data will provide support in decision-making process for the planners.
Keywords: Afforestation information system, GIS, Burdur, Afforestation, Erosion control, Rehabilitation

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The effects of catchment melioration on land cover case study: Tatlıçay catchment

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Abstract: The objective of this study was to investigate the effects of catchment melioration studies on land use types and land cover (agriculture-forest-grassland) changes between 1975 and 2016. Tatlıçay catchment has been the subject of flood and erosion control studies for many years. Catchment melioration studies were initiated in 1960. Grazing control, terracing, afforestation and conservation work were carried out in the scope of the studies. In this study, the success of catchment melioration studies carried out between the years 1975 and 2016 and changes in the land use type/land cover (LUTLC) in the catchment were assessed. Tatlıçay catchment covers the mountains north of the city of Çankırı, crosses Acıçay at the city center, and flows into Kızılırmak River southeast of the city. As the catchment located within the transition zone from the humid Black Sea climate to the arid Central Anatolia climate, the land cover becomes poorer towards the south. Climate, soil and topography are the main ecological factors that directly affect land use types of the catchment. Remote Sensing (RS) data and Geographical Information System (GIS) were used to evaluate the usefulness of RS/GIS data to determine the effects of catchment melioration studies in semi-arid region in this study. RS/GIS data can provide more reliable and, low-cost data compared to conventional field and lab analysis methods. The field research was conducted in Tatlıçay Catchment, in Central Anatolia. Land use types in downstream are generally dry farming and degraded grasslands, in upstream are pasture, forests and cultivate area. The properties of soils in these areas are salty, dry, gypsum. Sloped and arid areas are only convenient for being used for dry farming with degraded grassland. Forest areas are mostly located north and northeast (upstream) of the catchment.
Keywords: Remote sensing, Land use, Melioration, Semi-arid, Turkey

1. Introduction

Changes in land use result from the complex interaction of many factors including policy, management, economics, culture, human behavior, and the environment. Inappropriate land use is one of the main reasons for land degradation. Afforestation plays an important role in many semi-arid regions all over the world as a permanent plant cover in terms of preventing erosion, sustainable use of land and water resources, defense against desertification and settling population in rural areas. Therefore, determining the trend and the rate of land cover conversion are necessary for the development planner in order to establish rational land use policy. For this purpose, the temporal dynamics of remote sensing data can play an important role in monitoring and analyzing land cover changes.

The objectives of this study are; to evaluate the effects of catchment amelioration studies on land cover types and land cover changes that have taken place in the last 41 years, to integrate visual interpretation with classification using GIS and to examine the capabilities of integrating remote sensing and GIS in studying the spatial distribution of different land over changes.

2. Material and methods

2.1. Field description

Tatlıçay catchment covers the mountains north of the city of Çankırı, crosses Acıçay at the city center, and flows into Kızılırmak River southeast of the city. The catchment is located at latitude of 40° 33'- 40° 51' north and a longitude of 33° 17'- 33° 46 east (Fig. 1). Its total area is 65468 hectares.

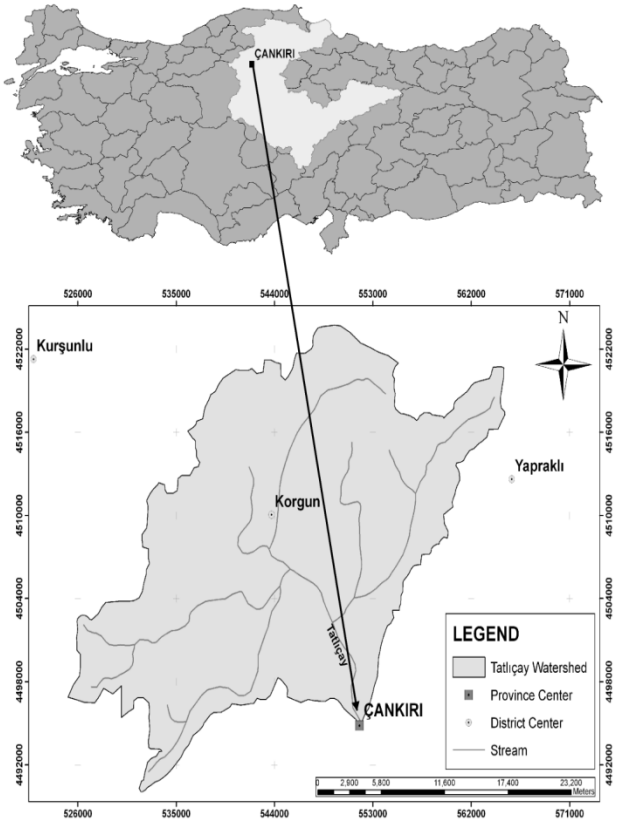

Figure 1. Location of Tatlıçay catchment within Kızılırmak basin

Topographic structure is diverse and shows an ever changing characteristic. Topographic structure and elevation are the two main determinants of the diverse land usage and land cover in the catchment. In the upper portion of the catchment, land types are not suitable for agricultural production. Land cover is of degraded forest type and bovine breeding is prevalent. In contrast, dry farming, degraded pasture and ovine breeding are common in the lower catchment. The catchment has a sloped structure and 50 % of it consists of steep and vertical fields. This has significant effects in terms of type of land usage, land cover, erosion and distribution of settlement areas.

There are two meteorological stations within the catchment and five more outside it. The long term measurement results collected by these stations show that the catchment has three main climate zones. The catchment is within the transition zone from the humid climate of Black Sea to Central Anatolia continental climate. While in 21 % of the catchment semiarid climate is dominant, sub-humid and continental arid - semiarid climates are dominant in the other 16 % and 63 % of the catchment respectively.

In the northern part (upstream) of the catchment, a place which is under the influence of Black Sea climate and which reflects the characteristics of sub-humid climate, mean daily temperature is 9.1 ^{o}C and mean annual rain fall is 530.8 mm (Anonymous, 201a - 2010b)). In the sections where water surpluses are observed in winter season, best forests and grassland of the catchment are situated. In this section, forest villages and villages, where irrigated farming is carried out, are present (Göl et al., 2010). Middle of catchment with semiarid climate, mean daily temperature is 10.7 ^{o}C and mean annual rain fall is 500 mm (Anonymous, 2010a). Downstream with arid-semiarid climate, mean daily temperature is 11.1 ^{o}C and mean annual rain fall is 417 mm (Anonymous, 2010b). Mean annual rain fall of the catchment is 391 mm and shows that Tatlıçay is generally under the influence of a semiarid and arid climate.

Bedrock and soil properties are the main factor that directly affects water quality and vegetation structure of the catchment. There are two different geological formations (Oligo-Miosen gypsum, Miocene series) (Doğan, 2002; Ketin, 1962; Yuksel et al., 2001) in the catchment. Geological structure should be taken into account in the catchment management planning.

As the catchment located within the transition zone from humid Black Sea climate to arid Central Anatolia climate, is examined from north to south, the farther we go south, land cover becomes poorer. Climate, soil and topography are the main ecological factors that affect land use of the catchment and change in its land cover. Areas with arid, salty and gypsum bearing soils form degraded pasture grounds with poor land cover. Sloped and arid areas are only convenient for being used for dry farming with degraded pasture grounds. Sloped and semiarid areas, on the other hand, are convenient for being used as forests and in-forest pasture grounds.

Forestlands within the catchment are mostly located north and northeast of the catchment. The forest intensity in these areas originates from the fact that the influence of the humid Black Sea climate is strong in these areas. In the upper catchment part there are forests and rich alpine pasture lands. Soil of this area is salt and gypsum free. On the other hand, the lower catchment section consists of extensive degraded pasture grounds and farming areas. No bodily forests exist in the lower

catchment section but bushes that need little water and herbaceous type of vegetation. There is strong erosion in the lower catchment section due to human pressure and over herding.

Digital elevation model-DEM, geological maps and meteorological data were used to prepare land use-land cover map and characteristics of catchment. All these data were analyzed using of ArcINFO software ArcGIS 9.2 program. Remote Sensing (RS) data and Geographical Information System (GIS) were used to evaluate the usefulness of RS/GIS data to determine the effects of catchment melioration studies on land use changes. In order to determine those effects, satellite images (1975 and 2016), forest maps and some local information were used to evaluate of the changes of land uses in study area. The database (developed around 1976 from satellite images) was used as the source of land use data in this study. Digital topographic maps digitized from hardcopy topographic maps with scale of 1 : 25,000 were used mainly for geometric correction of the satellite images and for some ground truth information. In this study, post-classification change detection technique was applied. Post classification is the most obvious method of change detection, which requires the comparison of independently produced classified images. Post-classification comparison proved to be the most effective technique, because data from two dates are separately classified, thereby minimizing the problem of normalizing for atmospheric and sensor differences between two dates. Cross-tabulation analysis was carried out to analyze the spatial distribution of different land cover classes and land cover changes.

3. Result and discussion

3.1. Effects of catchment melioration on LUTLCC

In this study, multi-temporal land use types and land cover changes (LUTLCC) were determined by integrating GIS and remote sensing data. Specifically, Landsat 7 ETM+ (Enhancement Thematic Mapper Plus) satellite images from 1976 to 2016 with approximately 30 m resolution were employed as base data.

Imagery for use in land use type and land cover (LUTLC) should be prepared so that the “before and after” images match each other as closely as possible spatially, spectrally and radio metrically. In this way, the only differences detected should be those that have actually occurred on the ground. All images were rectified to UTM zone 36N, WGS 84 using the rectified Landsat images as the reference source for image to image registration. In addition, 1:25,000 scale digital topographic maps were used in that process.

Post-classification change detection technique was carried out, through cross-tabulation GIS module, for the classification results of 1975 and 2016 images in order to produce change image (Fig. 2 - 3) and statistical data about the spatial distribution of different land cover changes and non-change areas (Table 1).

Changes among different land cover classes were assessed. During the study period, a very severe land cover change has taken place as a result of catchment melioration projects. These changes in land cover led to increased forest areas (10%) and decreased grassland areas (-18%) in part of the study area (Table 1).

Table 1. Land use types and land cover changes

Land use type and land cover	1976 year		2016 year		Change (+/-)	
	Area	%	Area	%	Area	%
Forest	10499.3	15.9	17299.7	26.2	6800.4	10.3
Water	49.7	0.0	90.9	0.1	41.2	0.1
Cultivated Area	12361.9	18.7	13709.7	20.7	1347.8	2.0
Settlement	3735.2	5.7	5257.4	7.9	1522.2	2.2
Plantation Forest	378.9	0.6	2788.3	4.2	2409.4	3.6
Grassland	39002.8	59.1	26881.6	40.9	-12121.2	-18.2
Total	66027.8	100	66027.8	100		

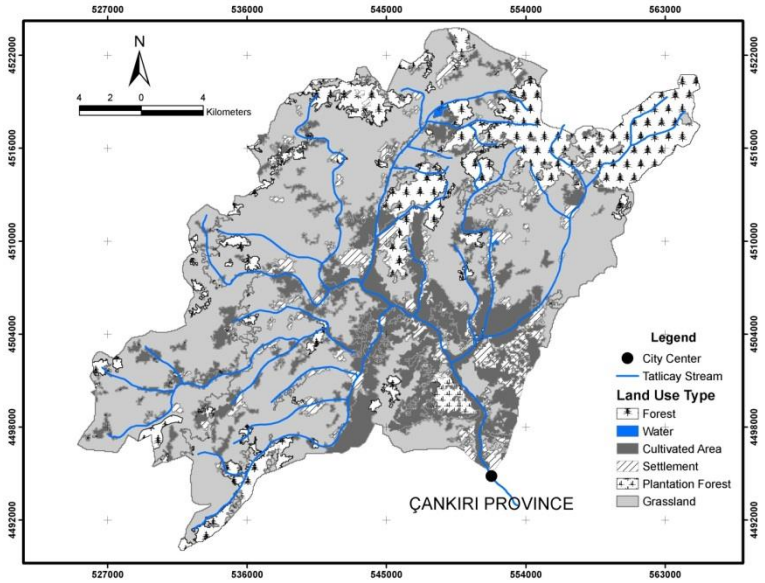

Figure 2. Land use types and land cover in 1975 year

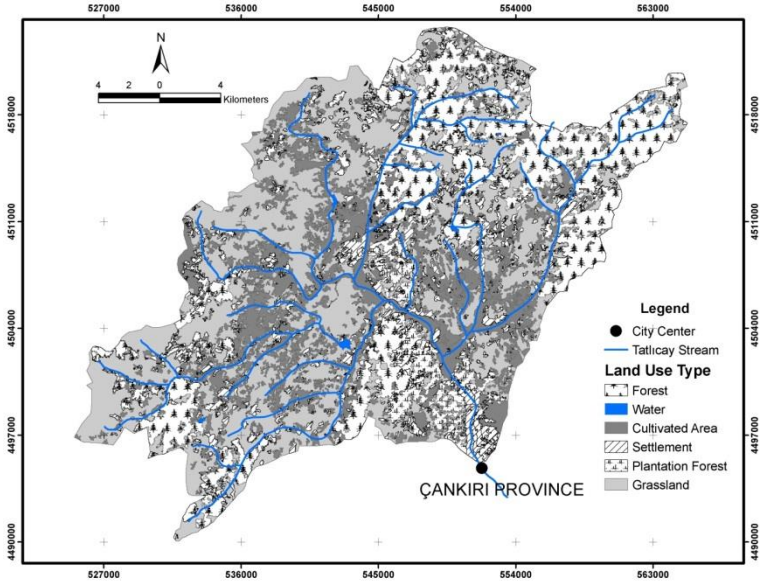

Figure 3. Land use types and land cover in 2016 year

Conclusion

Geographic Information System and Remote Sensing (GIS/RS) contribute to the speed and efficiency of the overall planning process and allow access to large amounts of information quickly. It is also very easy to update or modify data involved in GIS database in future. Water scarcity and low precipitation are major constraints at the research area, which is located in the north of the Central Anatolia. GIS/RS systems may help and guide planners and other technical staff in determination of proper land use management systems.

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Determination to volatile components of endemic taxa *Phlomis armeniaca* Willd. in Seydişehir province of Konya

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Abstract: Most plants of the Lamiaceae family, which are usually fragrant or perennial herbaceous plants, rarely work or have trees, are plants used in the treatment of various diseases as well as food, food industry, perfumery and cosmetics since ancient times. One of the important taxa of the Lamiaceae family is *Phlomis*. Leaves and flowers of this taxa are used as an appetizing, antiallergic, diuretic, diarrhea cutting, degaussing, stomach ailments, pain reliever, antidiabetic herb tea and tonic, represented by 52 taxa with approximately 39 taxa and 13 hybrids in total in Turkey. Also, they are used against to respiratory tract diseases and hemorrhoids. *Phlomis armeniaca* is a perrennial herb in the genus *Phlomis* endemic to Turkey. It is a herbaceous plant with yellow flowering which can be dated up to 60 cm. Infusions of flowers and leaves, especially in villages, are used as stimulants, gas expectorants, appetizers and cutting stomach pain. Flowers and leaf samples of *Phlomis armeniaca* collected during the flowering period of 2016 from the Seydişehir district of Konya constitute the material to study. Leaf and flower volatile components were determined by gas chromatography mass spectroscopy (GC-MS) after solid phase micro extraction (SPME). Totally, 47 different volatile components were determined, of them (E)-2-Hexenal (17.33 %), Limonene (14.95%), Germacrene-D (14.71%) ve β-caryophyllene (14.15%) were main components. It is very important for the people consciously to collecting, consuming and using of *Phlomis armeniaca*.
Keywords: *Phlomis armeniaca*, Seydişehir, Volatile component, (E)-2-Hexenal

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Some non-wood herbal forest products has commercial importance in Isparta province and their usage areas

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Abstract: Products that are produced from trees, shrubs, woody and herbaceous plant species growing in forests and their leaves, flowers, seeds, stems and roots and also products from balsam contents are called as none wood forest products (NWFP). Recreation, hunting, animal grazing etc. other benefits from forest resources are also considered as non-wood forest products. NWFP also has an important place within the scope of sustainable forest management. In recent years, the demand for NWFP has increased significantly, and for this reason forest resources have gained a new awareness. Non-wood herbal forest products use traditional and modern medical as medicines to prevent diseases, maintain health and improve diseases. At the same time, nutritional supplements, herbal tea, taste, flavoring are utilized as food products. In addition to being used in perfumery and cosmetics as perfumes and body care products, like insecticides, they are used in the different parts of the industry. By this study, some important non wood forest products that are distributed in Isparta region and also have commercial prescription like thyme, lavander, mentha were determined and information were given related to their usage fields and evaluation. Also, distributions in Isparta and cultivation applications of important herbal plants were evaluated. As a result, non-wood forest products that have commercial importance are used in industries as medicine, food, cosmetic etc. Since there is no standardization in plants collected from nature, not all plants collected are of the same quality, and the active substance is in different proportions. Cultivation of these plants will not only create an alternative income gate to the producers but will also avoid the excessive collection of nature that threatens these valuable plants.
Keywords: NWFP, Isparta, Tyhme, Lavander, Food industry

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Bioinformatics analysis of stress-induced Hsp20 protein family members in ash tree genome

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Abstract: Small heat shock proteins are characterized by a conserved sequence which acts as molecular chaperones. They can bind to denatured substrates of proteins and result in preventing unfolding and denaturation of proteins. They are associated with different abiotic stress tolerance such as regulation of salinity, drought and extreme temperature changes. *Fraxinus excelsior* L. is one of the important forest tree whose genome project was completed in 2017. Maintaining of protein conformation is extremely important for protecting plants against severe stresses. Although some of important protein family genes have been identified in ash tree genome, there is a limited study on genome-wide identification and characterizations of *Hsp20s* in both *F. excelsior* as well Oleaceae family members. Using various bioinformatics methods, we have analyzed ash genomes to find out *Hsp20* protein family members. PFAM analysis, motif analysis, gene structure analysis, phylogenetic tree construction and Gene Ontology (GO) analysis have been performed to characterize Hsp20 proteins. PFAM accession number of *Hsp20* is PF00011.16 which reveals *Hsp20*/alpha crystalline family domain. Based on PFAM analysis, a total of 43 *FexHsp20* genes were found in ash tree genome. According to phylogenetic analysis, *FexHsp20* proteins could be classified into five main groups. A good number of the internal branches were observed with higher bootstrap values because of performing bootstrap analysis with 1000 replicates. It was also examined gene structure profile and motifs of *FexHsp20* genes to check the reliability of the phylogeny analysis. Protein sequence motifs were determined using the multiple EM for motif elicitation tool (MEME). MEME analysis identified 15 motifs according to their domain compositions of *Hsp20* proteins. All identified *FexHsp20* genes have no intron regions. The different phylogenetic tree was also drawn according to exon-intron organization of *FexHsp20* genes. Both phylogenetic trees were correlated each other. In addition, motif structures were variable among phylogenetic tree groups. Besides, we performed the GO analysis of *FexHsp20* proteins which had mainly binding activity and played significant roles in cellular process. In addition, they were found in different cellular localizations such as cell, cell-part, organelle, organelle part, membrane and lumen. Characterization of *FexHsp20* proteins could be used for improving stress tolerant forest plants for further studies. Additionally, results could provide detail information for comparative genomics studies for different plant species.
Keywords: Small heat shock protein, Genome analyses, Ash genome, Bioinformatics methods

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The pollen atlas of some important plant species of Turkey

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Abstract: The plant diversity of Turkey is quite large with approximately 12,000 different plant taxa. In this study, a total of 88 taxa were selected from plant species that differ in pollen morphology from this rich flora, and their microscopic photographs were taken to reveal morphological characteristics of pollen. The aim of the study is to make a pollen atlas of these 88 taxa of Turkey. 16 gymnosperms and 72 angiosperms (44 arboreal and 28 non-arboreal) were studied under the light microscope. The Gymnospermae taxa studied are *Abies nordmanniana* subsp. *nordmanniana*, *Abies nordmanniana* subsp. *bornmulleriana*, *Cedrus libani, Picea orientalis, Pinus nigra* subsp. *pallasiana, Pinus brutia, Pinus halepensis, Pinus pinea, Pinus sylvestris, Juniperus oxycedrus, Juniperus excelsa, Juniperus communis, Juniperus foetidissima, Juniperus drupacea, Cupressus sempervirens* and *Taxus baccata*. The Angiospermae taxa are (arboreal ones) *Carpinus betulus, Corylus avellana, Betula pubescens, Betula medwediewii, Alnus glutinosa, Castanea sativa, Fagus orientalis, Quercus ilex, Quercus coccifera, Quercus frainetto, Quercus robur, Quercus petraea, Acer monspessulanum, Acer campestre, Acer sempervirens, Acer tataricum, Acer cappadocicum, Acer trautvetteri, Acer platanoides, Acer hyrcanum, Hedera helix, Buxus sempervirens, Laurus nobilis, Fraxinus excelsior, Fraxinus ornus, Ligustrum vulgare, Olea europa, Osmanthus* sp., *Phillyrea latifolia, Juglans regia, Platanus* sp., *Prunus spinosa, Crataegus monogyna, Laurocerasus officinalis, Ulmus minor, Ulmus glabra, Celtis australis, Erica arborea, Arbutus unedo, Rhododendron ponticum, Populus alba, Populus tremula, Populus euphratica* and *Salix* sp. and (non-arboreal ones) are *Carlina vulgaris, Cirsium* sp., *Cichorium intybus, Senecio* sp., *Pulicaria dysenterica*, *Carduus nutans, Tanacetum balsamita, Centaurea* sp., *Galium palustre, Rubia peregrina, Echium plantagineum, Symphytum tuberosum, Trachystemon orientalis, Anchusa* sp., *Epimedium pubigerum, Campanula persicifolia, Dianthus* sp., *Mesembryanthemum* sp., *Stellaria* sp., *Chenopodium* sp., *Calystegia sepium, Convolvulus arvensis, Potentilla reptans, Geranium asphodeloides, Geranium dissectum, Poa pratensis, Zea mays* and *Malva sylvestris* were taken in the light microscope. The features of the pollen studied are type of apertures, shape and numbers of colpus, porus and colporus, and surface characteristics (ornamentation). These features are showed in the microphotographs for each taxon.
Keywords: Pollen atlas, Pollen morphology, Angiospermae, Gymnospermae

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The effect of pre-treatments on the germination speed of common hornbeam (*Carpinus betulus* L.) seeds in the Eastern Black Sea Region, Turkey

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Abstract: The objective of the present study is to determine the germination speed of seeds of the common hornbeam (*Carpinus betulus* L.) naturally spread in Turkey according to different populations and pre-treatments. The germination speed indicates seed strength and the high-strength seed germinates faster than the low-strength seed. Common hornbeam is found in the Black Sea Region, which is the whole European-Siberian flora region in Turkey. It is also spread locally in Amanos Mountains. Mature trees can generally reach a height of 20-25 m and live for average of 150 years. The seed material used in the present study was obtained from 12 populations in different altitudes in the watersheds of Trabzon-Maçka, Trabzon-Çaykara, Rize-Çamlıhemşin and Giresun-Espiye. In order to represent the population and to minimize the likelihood of kinship during sampling, there was at least 150 m between the sample trees in the selection of trees within each population. The common hornbeam seeds have dormancy being seed coat and embryo. Therefore, seeds were subjected to 22 different pre-treatments in different doses and durations including cold stratification, gibberellic acid (GA_3), citric acid, sulfuric acid (H_2SO_4), seed tip cut, steep in hot water. In all treatments, filled seeds identified through floatation in 96% alcohol were used. As a result of the study, germination speeds in among populations and among pre-treatments of each population were determined. The highest germination speed among the populations was observed in Çamlıhemşin-1 population, followed by Çamlıhemşin-2, Maçka-2, Çaykara-1 and Espiye-1 populations. It was also determined that the germination speed of the populations decreased as the altitude increased in each watershed. Furthermore, the highest germination speed was generally observed in GA_3 pre-treatment in terms of germination speed between pre-treatments in each population. This is followed by seeds treated with sulfuric acid.
Keywords: Hornbeam, *Carpinus betulus*, Germination speed, Seed pre-treatment

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Surface morphology and micro morphometric measurements using SEM-EDX on seeds of some *Fagus orientalis* Lipsky. population

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Abstract: In Turkey, *Fagus orientalis* Lipsky is one of the important broadleaves tree species. The species is distributed in Black Sea Regions of Turkey. However, relict oriental beech forests are distributed in the Eastern Mediterranean region of Turkey. Conservation of oriental beech genetic resources is an important issue for sustainable forestry and afforestation strategies. The seed is a very important material for outdoor plantation conditions, regeneration, rehabilitation and conversion to high forest practices for oriental beech stands. In order to reveal some characteristics of seeds, selected the three different oriental beech population from Sinop, Kastamonu-Cide and Kastamonu-Bozkurt respectively. In this study, it has been investigated the seed surface morphology characteristics and some micro morphometric characters using SEM (Scanning Electron Microscope) – EDX (Energy Dispersive X-ray Microanalysis) and SM (Stereo Microscopes). Particularly, it has been examined seed coat size, seed surface size, seed color, lengths and widths of seed wing, hilum and micropyle on these analysis. Additional it was detected of seed coat ornamentation and elemental analysis. The elemental analysis of C, O, N, Na, Mg, Si, K, P, N, Ca, S and Cl elements have also tried to obtain. According to the results 12 different element were detected in seed coat surface Bozkurt (%57 C, %21 O, % 11,8 Ca), Cide (%65 C, %22 O), Sinop (%53 C, %42 O). The elemental analysis Kastamonu-Bozkurt, Kastamonu-Cide and Sinop provenances of seed coat surface generally C and O elements were found whereas in the Bozkurt were detected Ca. As a result of all the data it can be said that these different *Fagus orientalis* L. seed population characterization and surface morphology analysis are similar.
Keywords: Seed coat, Surface morphology, SEM, EDX, Stereo microscopes, Oriental beech

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Water stress and degradation rates in different populations seeds of oriental beech (*Fagus orientalis* Lipsky.)

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Abstract: Many factors that affecting the seed quality and vitality are influential on seed characteristics in ecological conditions, where the population is exposed.Seed characteristics can also provide practical and theoretical information about the population that it represents. In this study, it was aimed to examine the water stress (proline level) and deterioration rates (MDA and H_2O_2) of *Fagus orientalis* L. seeds collected from six different localities (Sinop, Sinop-Türkeli, Sinop-Ayancık, Kastamonu-Bozkurt, Kastamonu-İneboluandKastamonu-Cide). Proline, lipid peroxidation (malondialdehyde-MDA) level and hydrogen peroxide (H_2O_2) concentration were measured in the seeds. To do this, the coat of the seeds are removed, milled and powdered. Then in samples; the experiments carried out for proline, MDA and H_2O_2 assays were carried out in three replicate. At the end of the study, the highest proline amount was found in the populations od seed collected from Sinop-Ayancık (239.6 µmol), Kastamonu-Bozkurt (202,71 µmol) and Kastamonu-Inebolu (129,63 µmol),while the lowest proline was detected in seeds collected from Sinop (81,27 µmol), Kastamonu-Cide (93,62 µmol) and Sinop-Turkeli (127,69 µmol); the highest MDA levels were found in seed samples collected from Kastamonu-Bozkurt (2,14 µg), Kastamonu-Inebolu (2,12 µg) and Sinop-Ayancık (1,98 µg), the lowest MDA levels were found in seed samples representing Sinop (1,69 µmol), Kastamonu-Türkeli (1,81 µmol) and Kastamonu-Cide (1,83 µmol) populations. While the highest H_2O_2 concentrations values were measured in samples taken from, Kastamonu-Cide (2.78 µmol), Kastamonu-Inebolu (2.46 µmol) and Sinop (2.36 µmol), the lowest values were determinedin samples taken from Sinop-Türkeli (2,19µmol), Kastamonu-Bozkurt (2,19 µmol) and Sinop-Ayancık (2,35 µmol). From the obtained data, seed samples collected from Sinop, Kastamonu-Cide and Sinop-Turkeli according to proline values and seed samples collected from Kastamonu-Bozkurt, Kastamonu-İnebolu and Sinop-Ayancık according to the amount of MDA and depending on the concentration of H_2O_2, it was concluded that structural deterioration occurred in seed collected from Kastamonu-Cide, Kastamonu-Inebolu and Sinop. In the light of on the data all values, it is suggested that the chemical components of the seed vary according to their growth conditions and seed characteristics are affected by many factors. In addition, the high level of proline found in the seed content against the stress factors of the growing environment suggests that the osmotic regulatory role of Sinop-Ayancık and Kastamonu-Bozkurt populations is therefore more capable of adaptation.
Keywords: Bean seeds, Prolin, MDA, H_2O_2

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Spatial planning approach based on ecosystem services

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Abstract: Increase in population and intensive urbanization at both the global scale and in our country results in an increase in damages to the basins in our day thus resulting in loss of ecological functions as well as the disruption of life quality and social dimension especially in urban basins. When effects of changes in rain regime and vaporization due to climate change as well as the effects on moisture in both the soil and the air, agricultural efficiency are considered; spatial planning practices that give priority to ecological sensitivity towards basin areas come to the forefront. However, no approach has been developed as of yet which gives priority to the multidimensional benefits provided by the ecosystems as well as the related processes and products in spatial planning processes. No content that is associated with the ecological functions of basins is present in the distance based protection zone approach that is frequently used in our country for the management of basin areas. The generation of basin management systems has taken its place among the significant issues in EU Water Framework Directive policies and similar global policies. The generation of basin management systems is a very important tool that will enable the protection of water resources and their sustainable use. Distance based basin management approach is used in Turkey. Preparation and application of basin planning approaches and managements based on ecosystems that take into consideration the water resources management together with ecosystem approach will provide a more effective protection and use which is vital for the future of our water resources. The term “ecosystem services” indicates the different means with which nature supports the welfare of people – it can be defined as all cases, processes, functions, benefits and products presented by the ecosystems for the sustainment of human life. Healthy ecosystems provide countless benefits for human lives. The benefits obtained from ecosystems can be listed as food, water, clean air, medical raw materials, recreational and cultural values. These benefits provided by nature are vital for people as well as for other living things. Hence, factors that affect the services obtained from ecosystems as well as those that change the way the ecosystems function should be determined in order to better understand the effects of human beings on nature. Planning approach based on Ecosystem Services (ES) related with the relationship between humans and nature take into consideration the ecological processes and functions that take place in ecosystems as well as understanding how the produced services are used by people while trying to benefit from their multiple benefits effectively. The objective of this study was to put forth the approach by which the “multi functionality” approach which is an important application strategy for landscape design and spatial planning may contribute as a rational tool for planning and management applications based on ES.
Keywords: Basin, Spatial planning, Ecosystem services

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Evaluation of developments in the understanding of management of non-wood forest products in Turkey

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Abstract: In recent years, there has been an increasing interest in non-wood forest products due to sustainable forest management principles, Turkey's rich biological diversity, broad cultural heritage and economic potential. NWFP both contribute to country's economy and provide to rural development of people that living in rural areas. In 1987, General Directorate of Forestry published "Diagnosis and Presentation Guide of Some Important Forest Products in Turkey" for the diagnosis of non-wood forest products. At the Rio Conference held in 1992, with drawned attention to biological diversity NWFP were started to be used as a parameter in forest management plans. In 1995, the harvesting, transporting and selling process of non-wood forest products determined by general instructions which is named of "production and sales principles of forest wood products". Since 2000, instead of forest secondry products concept, non wood forest product (NWFP) has been used. Together with the international processes in the world, GDF was restructured with the taking importance of NWFP in Turkey. In addition, an online inventory tracking system was established to determine the distribution areas, production quantity and wealth of NWFP in 2013. International symposiums, congresses and meetings were held in order to examine and develop the social, technical and economic dimension of NWFP's in Turkey, with the participation of academicians from various parts of the world. Thus, awareness for NWFP's was tried to be established. Today, studies on NWFP contribute to the development of our forestry, and it is very important to open new study areas for our people that living in rural areas. As a result of this, an independent Non-Wood Products and Services Department was established within GDF. In this study, the developments experienced in NWFP were evaluated in the historical process in Turkey. In terms of forestry sector, the importance of NWFP business is emphasized. Also, within the scope of NWFP business, experienced bottlenecks have been handled from administrative, tecnical and economic aspects and solutions were proposed for these problems.
Keywords: NWFP, Sustainable forest management, Bottlenecks, Online inventory tracking system, Secondry product

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Comparison of respiration metabolism in some tree species at the different age groups

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Abstract: Growth in trees denotes the increase in diameter, size and volume of the tree over time. These formations are completed in three different stages, namely as formative, maturity and old age phases. The formation phase is the stage in which the anabolic reactions occur at a high rate due to rapid growth. In the second phase (maturity) metabolic activity slow down but wood morphology and chemistry start to change. In the old age anabolic reactions convert into catabolic reactions. However growth and development in trees occur due to the collective influence of environmental conditions such as the speed of metabolic reactions working in genetic structure, age, growth and development processes of the tree as well as senescence, climate and others abiotic and biotic factories. In this study was compared respiration metabolism in some forest trees at different ages. These are *Abies nordmannianna* Stev. (Fir), *Fagus orientalis* Lipsky. (Oriental beech), *Pinus nigra* Arnold.(Black pine), and *Quercus robur* L. (Peduncle oak) in the Kascılar village of Kastamonu; *Juglans regia* L. (Walnut), in the Esen village of Kastamonu; *Cupressus sempervirens* L. (Italian cypress), in the central of Kastamonu. For this purpose leaf samples were collected from these trees and were measured glucose, pyruvate, and free amino acid. According to the findings, the highest values were found in leaves of oak tree over 30 aged for pyruvate, in leaves of cypress tree over 35 aged for free amino acid, and in leaves of fir tree over 100 aged for glucose content. According to age groups of trees, the high pyruvate value was found in leaves of fir, cypress and beech at over 300 and 500 aged and in leaves of walnut and black pine at over 100 aged. The high free amino acid value was found in leaves of walnut at over 400 aged and black pine and fir at over 100 aged. Glucose content was found high value in leaves of cypress at over 100 aged, in leaves of walnut at over 400 years aged and in leaves of black pine at over 100 aged. As a result, it was concluded that the aging physiology of the trees changed according to tree species and trees's ages. However, pyruvate, from the criteria of catabolic activity, is higher in older treess and lower in younger trees. This situation is signaled that environmental factors and harmful effects also are important on respiration rate.
Keywords: Age-groups, Growth physiology, Kastamonu, Respiration

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The effect of stand characteristics on flammability as spatially and temporally

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Abstract: The composition of plant species in the fire prone ecosystems, the season of fire, the type of fire and the size of the burning area play an important role in the frequency and the spread of forest fires. The topographical features and seasonal differences as well as the effects of combustible material (plant) properties on flammability are very important in predicting fire behavior. *Pinus nigra* Arnold (Anatollian black pine), which is most affected by forest fires and has the widest distribution area in Turkey after *Pinus brutia*, has a wide distribution area in Kastamonu. In this study, it was aimed to determine the needle moisture contents, ignition temperatures and total ash amounts after burning depending on the slope, elevation, stand characteristics and seasonal differences in the *Pinus nigra* stands. *Pinus nigra* needle samples were taken from different stands ($Çka_3$, $Çkab_3$ and $Çkc_3$) types in April, June, July, August and October, as well as different elevation (700m - 800m and 1000m - 1200m) steps as well as sunny and shady slopes. The moisture content of needles was calculated based on the owen dry weights. Experiments were carried out in a laboratory and total ash amounts, ignition times and ignition temperatures were obtained and correlated with topographical, seasonal and stand characteristics.
Keywords: Forest fires, Stand characteristics, Flammability

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Estimating density of large mammals in Devrekani Region

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Abstract: It is crucially important to monitor and conserve the populations of wild animals, for assessing the successful management of wildlife. Monitoring dynamics of wildlife helps to understand ecological processes better. Estimating the population size and density of animals is also fundamental to understand the status, distribution and encounter rate of animal species and their management. Transect sampling is a practical and efficient way to estimate biological populations by using on indirect and direct methods. In this study density of large mammals in Devrekani region, which is located in Kastamonu, were estimated by using line transect method. Study was executed between the period of January 2017 – July 2017. Camera trapping method was also used to determine the existing animals in the area.
Keywords: Line transect method, Animal density, Wildlife, Devrekani, Kastamonu

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Bird fauna of Kastamonu University Kuzeykent Campus

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Abstract: Birds play an important role in ecosystems due to their roles in the food chain, biodiversity, biocontrol and pollination. Bird populations have been slumped drastically in 600 years. For this reason, it is significantly important to record bird species systematically. Kastamonu University Kuzeykent Campus is surrounded by forests. This situation makes the area to an important place for birds. In this study, bird fauna of Kastamonu University Kuzeykent Campus were determined by using direct observations. Study were executed between the years of 2015 – 2017. 32 Bird species were recorded.
Keywords: Bird, Kastamonu, Ornithology, Direct observations, Inventory

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Food preferences of red deer (*Cervus* elaphus) in Kastamonu Ilgaz Mountains National Park

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Abstract: Diets of wild animals are useful tools for researching and understanding their ecology, behaviour and the management of wildlife. Ruminants are the mammals that are one of important species of wildlife and game. The red deer (*Cervus elaphus*) is one of the largest deer species of Europe. Red deer (*Cervus elaphus*) is an important species that can influence vegetation of forest with its food preferences, anther rubbing and grazing. In this study diet of red deer (*C. elaphus*) which distributed in Kastamonu Ilgaz Mountains National Park were determined. A combine of camera traps, direct observations of red deer were used as methods of researching the diet of red deers. Plants which are eaten by red deer, were collected from the field and species were identified in the Herbarium. Due to results of study, suggestions on management and conservation strategies were discussed.
Keywords: Red deer, Diet, Wildlife, Kastamonu, Ilgaz

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The importance of wildlife crossing in roads

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Abstract: The effects of roads on wildlife populations have been the focus of many studies in the last decade and increasing concern for transportation and natural resource management agencies. Roads affect populations in numerous ways, from habitat loss and fragmentation, to barriers to animal movement, and wildlife mortality. The impact of roads on wildlife populations is a significant and growing problem worldwide. Wildlife crossing structures are intended to increase permeability and habitat connectivity across roads and reduce wildlife–vehicle collisions. These are above-grade (wildlife overpasses) or below-grade (wildlife underpasses) structures designed to facilitate movement of animals and connections among populations. Like landscape corridors, the conservation value of wildlife crossing structures are gaining attention as applied measures to help adapt changes in species ranges and animal distributions to climate change. The siting of wildlife crossing structures is equally as important as their design. Identifying the proper location of crossing structures is critical for designing effective mitigation of the barrier effect caused by roads. The number of methods used to determine these key locations on roads has increased in recent years. However, few attempts have been made to critically review the techniques that are currently available to transportation agencies.

1955—First wildlife crossing built in United States: Black bear underpass, Florida
1974—First wildlife crossing built in Europe: Badger tunnel, The Netherlands
1975—First wildlife overpass built in United States: Interstate 15, Utah
1982—First wildlife crossing built in Canada: Trans-Canada Highway wildlife underpass, Banff National Park
1982—First wildlife overpass built in Europe: Le Hardt, France
1990—First wildlife overpass built in Canada: Coquihalla Highway, British Columbia

Planning and designing wildlife crossings will often be focused on a certain species of conservation interest (e.g., threatened or endangered species), a specific species group (e.g., amphibians) or abundant species that pose a threat to motorist safety (e.g., Deer, Elk). Their ecological requirements and how roads affect them are described along with some sample wildlife species for each group.

- Large mammals (ungulates [Deer, Goat, Mouflon], carnivores [Bears, Wolves]) – Species with large area requirements and potential migratory behavior; large enough to be a motorist safety concern; traffic-related mortality may cause substantial impacts to local populations; susceptible to habitat fragmentation by roads.
- High mobility medium-sized mammals (Lynx, Coyote, Fox) – Species that range widely; fragmentation effects of roads may impact local populations.
- Low mobility medium-sized mammals (Raccoon, Skunk, Hare, Groundhog) – species with smaller area requirements; common road-related mortality; relatively abundant populations.
- Semi-arboreal mammals (Marten, Red Squirrel, Flying Squirrel) – Species that are dependent on forested habitats for movement and meeting life requisites; common road-related mortality.
- Semi-aquatic mammals (River Otter, Mink, Muskrat) – Species that are associated with riparian habitats for movement and life requisites; common road-related mortality.
- Small mammals (Ground Squirrels, Voles, Mice) – Species that are common road related mortality; relatively abundant populations.
- Amphibians (Frogs, Toads, Salamanders, Turtles) – Species with special habitat requirement; relatively abundant populations at the local scale; populations are highly susceptible to road mortality.
- Reptiles (Snakes, Lizards) – Species with special habitat requirement; road environment tends to attract individuals; relatively abundant populations.

Keywords: Wildlife crossing, Passage, Road, Wild animals

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The impact of maintenance and pruning practices on health of urban trees; a case study from Çankırı Province

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Abstract: Unarguably, trees growing in urban environments are strongly stressed by both abiotic and biotic factors. To mitigate the adverse effects of stress, trees should be handled with specific care. In this sense, maintenance and pruning practices represent the backbone of growing vigorous, healthy as well as attractive trees. The maintenance practices for ornamental and shade trees include planting suitable trees, irrigation, fertilization and restoration or removal of trees if necessary. On the other hand, pruning has been treated amongst the most prominent practice in maintenance of urban trees. While the objective of maintenance and pruning practices are to produce strong, healthy and attractive trees, if not implemented properly, they also can lead trees to lose their vigour, health as well as aesthetical values. Moreover, trees those have not been subjected to any or proper practices would eventually pose threat to public safety. Improper pruning practices can have a number of adverse impacts on trees. For example, pruning wounds serve as main entrance doors for many canker as well as decay causing plant pathogenic organisms. Once an improper pruning practice has been applied, the probability of the tree to be attacked by this kind of pathogenic organisms would increase. Infected trees would pose threat to public safety through prompting failure of branches or trunks. Even so, safety prunings can help to reduce these adverse impacts. However, a special care should be paid to avoid spread of the disease agent via infected pruning materials or pruning residues such as infected branch pieces or saws. In this study, the impact of maintenance and pruning practices on the health, safety and aesthetic value of street trees in Çankırı province were evaluated. Visible signs; indicating type, intensity or severity of previous pruning practices, were visually assessed on the trees along main streets of the city. The health, safety and aesthetic value of trees were found to be strongly affected by improper punning practices, especially through topping or pollarding. Decay fungi were also very common on deformed trunks of topped trees. Host tree species was another factor effecting the likelihood of a tree to be infected with a decay fungus. Along with the impact of improper pruning practices, the lack of proper maintenance practices was also evident with the presence of decay fungi as well as dead branches on trees in streets or even in children playgrounds which pose a high risk for public safety. In this context, appropriate pruning practices were introduced which improve tree architecture and health. The preliminary results from Çankırı, a relatively small city, revealed a negative impact of improper pruning and lack of sufficient maintenance practices. Detailed studies for further evaluations on tree defects and tree risk analysis would be beneficial to put forward and set an example on the importance and necessity of tree risk management plans.

Keywords: Urban trees, Pruning, Wood decay fungi, Hazard trees, Tree risk analysis

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Methods to determine service quality and customer satisfaction level in protected areas

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Abstract: In Turkey, the current experience has shown that despite the prohibition of various benefits from natural protected areas, these areas are not adequately protected. Because, natural resources managers and users have different target about these areas. While the managers might be concerned about the protection of the resources; customers may be more concerned about the socio-economic benefits. In order to protect these areas more effectively, expectations of customers benefiting from these areas need to be met. In this context, it will be useful to present and diversify some services for customers. According to the 2873 numbered national park law, various services are offered to the customers in the national parks and the protected areas of the nature, from the protected areas established. In response to these services, it will be necessary to measure service quality in order to determine the satisfaction level of the customers and to take necessary measures. Because the quality of the services provided is possible by measuring the quality correctly and different measurement models have been developed for this. In this proceeding, the status of service quality and customer satisfaction in national parks and nature parks is addressed in protected areas. The methods used to measure the quality of service and to determine the level of customer satisfaction were examined within the scope of the study. Some of these methods are as follows:

- Servqual Service Quality Measurement Method,
- Servperf Service Quality Measurement Method,
- Total Quality Index Service Quality Measurement Method,
- Benchmarking Service Quality Measurement Method,
- Critical Events Method (CIT), *etc.*

In this proceeding, the information about customer perception and expectation in the measurement of the quality of service provided in the protected areas was evaluated and the advantages and disadvantages of the methods used were determined.
Keywords: Protected areas, Customer satisfaction, Corporate marketing

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Ornamental plant production in forest nursery in Turkey

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Abstract: In Turkey, there are totally 37 state forest nursery directorates and 93 nurseries affiliated to them. These nurseries operate to meet the seedling needs of many parts of the society, on the local and national level. In recent years, the amount of seedlings produced in these nurseries has increased rapidly, reaching 509 million in 2011. Common forest tree species such as cedar, pines and black locust account for up to 70 % of the total seedlings production. Besides these species, significant amounts of ornamental plants are also produced and take place in the national market. The majority of the ornamental plants are woody perennials such as cypress, oriental arborvitae, privet, blue spruce, catalpa, honey locust, bead tree, Japanese pagoda tree, firethorn, golden raintree, barberry, rose of Sharon, "silk tree and crape myrtle. In this respect, forest nurseries offer wide product range and play an important role in ornamental plant production in local markets. However, the forest nurseries' active role in the ornamental plant sector can have both positive and negative effects on the private sector. On one hand, they can share know-how with local investors and create driving force in the market. On the other hand, they can have a lower price policy and create unfair competition for private investors, since they already have existing infrastructure and trained staff for plant production. For this reason, keeping ornamental plant production at the minimum levels in the forest nurseries is extremely important in areas where the private sector is already developing, so that these state agencies do not diminish the opportunities of the private sector enterprises.
Keyword: Forest trees, Ornamentals, Nursery, Private enterprise

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Stomatal conductance in plant leaves

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Abstract: The stomata formed by the differentiation of the epidermis cells are one of the most important parts of the plant leaves and they regulate the gas exchange on the leaves. Through stomatal openings, the carbon dioxide (CO_2) required for photosynthesis enters the intercellular space from the air, and the water taken up by the roots from the soil is evaporated into the atmosphere. While the stoma makes up only 1% of the leaf area, they account for 90% of the total transpiration. This way, not only mineral nutrients from the soil reach the leaves through xylem, but also the leaf temperature is controlled. Stomatal conductance is a measure of gas exchange and transpiration through the leaf stomata. The rate of the stomal conductance depends on the density, size and opening of the stomata. The size and density of the stomata vary according to the species of the plant and the growing conditions. Stomatal conductance varies both seasonally and diurnally. Drought stress is one of the main factors that trigger the opening and closing of stomata. Stomata close to reduce the rate of transpiration when atmospheric vapor pressure deficit and evaporative demand are high. Consequently, it is essential to understand plant-water relationships according to plant species and environmental conditions. In this study, stomatal conductance was discussed with examples from various plant species and environmental conditions.
Keywords: Plant, Stomata, Transpiration

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Food preferences of fallow deer (*Cervus dama* Linnaeus, 1758) spreading in Antalya/Düzlerçamı Wildlife Development Area

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Abstract: Düzlerçamı Wildlife Development Area which is one of the important living areas of fallow deer populations in the world and in Turkey. Although it is not endangered in the world, the last natural population lives in our country and this species is endangered. In the western Mediterranean region, The total area within the boundaries of the District of Korkuteli, Döşemealtı, Kepez and Konyaaltı is 29,033 hectares. Although the area is very close to the city center and settlements, the area is quite rich in flora and fauna. In the study area, 398 genera and 714 plant taxa belonging to 94 families; 6 order, 15 families and 17 mammal species; 53 bird species from 24 families; 2 order, 9 families and 19 reptile species were identified. Fallow deer is a species of the deer family(Cervidae). It is one of the important herbivorous species that spread in our country, and it uses many plant species in its diet. In this review study, the feeding distribution of fallow deer during the year is as follows: 42,08% of meadow grasses, 15.18% shrub, 12.42% coniferous trees, 12.42% of leafy trees, 9.42% blackberry, etc., 8,48% fruit and seeds spreading in Antalya/Düzlerçamı Wildlife Development Area. Among the meadow grasses, members of the Fabaceae family occupy an important place and followed by the families Poaceae, Asteraceae and Caryophyllaceae etc. This study is a survey of fallow deer food preferences in Düzlerçamı Wildlife Development Area where it is the only natural area of deer populations. The obtained data will be compared with diet analyses of fallow deer that spread throughout the world. This study is the first and only one research on food preference of fallow deer in our country.
Keywords: Fallow deer (*Cervus dama*), Düzlerçamı, Food preference, Herbivor, Türkiye

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Determination on essential oil rate and composition of Sarıcapisik (*Nepeta conferta* Hedge & Lamond)

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Abstract: The genus *Nepeta* L. (Lamiaceae) comprises nearly 300 species that are distributed all over the world. The genus *Nepeta* L. is represented in Turkey by 39 species including 18 endemic plants. In this study; it was aimed to determine the essential oil percentage and assign composition of *Nepeta conferta* that is in the family of Lamiaceae which are endemic species of Turkey. It is assessed as critically endangered (CR) in the Red Data Book of Turkish plant. The material of the study consisted of *Nepeta conferta* that grow naturally in Muğla-Ula area. It, which is the material of the study, was collected from Muğla Yayla Söğüt village (1215 m). At least 1 kg leaved shoots of plant were collected to be used in essential oil analyses. The data like the collection time, place, and elevation were written on the label on each bag. These plants were then dried in a semi-shadowy and airy place at room temperature to be used in essential oil analyses. The plant materials that were collected were dried at room temperature (25ºC) and 200 g plant samples were distilled for 3 hours in hydro-distillation device with Clevenger apparatus. After the essential oil yields of the samples were determined, they were kept at +4oC to determine the components of the essential oil. The components of the essential oils were determined with the Perkin Elmer Autosystem XL Gas Chromatography (with MS Detector) in Suleyman Demirel University, Central Laboratories. A colon that was at the size of CP WAX 52 CB, 50 m. x 0,32 mm (1,2 µm film thickness) and Helium (10 psi flow rate) was used as the carrier gas. The temperature program reached 220ºC from 60ºC with an increase at a rate of 2ºC/minutes, and waited for 20 minutes at 220ºC. The injection block temperature was 240ºC and detector temperature was 250ºC. 7.5 mg was taken from the essential oil samples and diluted in 1.5 ml dichloromethane, and 1 µL was taken from this sample and was injected to the device. At the end of the study, the essential oil rates, colors and components of *Nepeta conferta* species was determined in 200-gram samples. The essential oil rates of *Nepeta conferta* was determined as 2,4 % and the color of the oil was determined as light yellow. It was found that the essential oil yield and the most abundant components of *Nepeta conferta* were Cineole 25.22%, Caryophyllene oxide 21.78%, trans-caryophyllene 12.91%, β-pinene 4.26% ve Germacrane D 3.67%, which were determined according to GC-MS analysis results.
Keywords: *Nepeta conferta*, Endemic, Essential oil, Muğla, Turkey

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Volatile components of *Arbutus andrachne* L. in Isparta and Burdur provinces

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Abstract: The Ericaceae family has two evergreen *Arbutus* L. species with edible fruits. *Arbutus andrachne* L. and *A. unedo* L. are two members of the Ericaceae. *Arbutus andrachne* is the strawberry tree and it is native to the Mediterranean region and southwestern Asia. Its small trees are usually less than 4 m high and also the wood is used for several purposes including making carved spindles, stools and small furniture. *A. andrachne* trees are found growing on dry rocky slopes and hillsides or in pine forests, particularly in the Taurus Mountains of Turkey from just above sea level to 800 m. Infusion form of the leaves is being used as an urinary antiseptic, especially in the western and southern Anatolian traditional medicine. In this study that is conducted in vegetation period of 2015, leaf samples of *A. andrachne* were collected from Isparta (Aşağıgökdere and Çandır) and Burdur (Melli) provinces. Collected leaves were dried at room temperature (25°C). Samples were subjected to solid phase microextraction (SPME). 2 g of samples newly hand-picked was put into a 10 mL vial. After incubation for 30 min at 60°C, SPME fibre was pushed through the headspace of a sample vial to adsorbed the volatiles, and then inserted directly into the injection port of the GC-MS (Shimadzu 2010 Plus GC-MS with the capillary column, Restek Rxi®-5Sil MS 30 m x 0.25 mm, 0.25 µm) at a temperature of 250°C for desorption (5 min) of the adsorbed volatile compounds for analysis. Totally 37 components of *A. andrachne* were determined from Isparta (Aşağıgökdere and Çandır) and Burdur (Melli) provinces, of them (E)-2-Hexenal, (E)-3-Hexenol, and limonene were found main components. For Aşağıgökdere province (300 m), (E)-2-Hexenal (26.48%), (E)-3-Hexenol (15.52%) and Limonene (10.68%) were found as in order and also similarly same components were determined as 31.08%, 14.10% and 10.07% for Çandır province (350 m) and 32.11%, 15.12% and 10.33% for Melli province respectively. Despite the regional variability, the main components were found as the same.
Keywords: *Arbutus andrachne,* volatile components, (E)-2-Hexenal, (E)-3-Hexenol, Limonene, Isparta, Burdur

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Investigation of drainage works on forest roads

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Abstract: Forest roads are indispensable infrastructures for carrying out forestry operations sustainably, effectively and economically. However, they encounter some problems such as erosion, when they are not constructed in required engineering standards. Doubtless, forest roads should not be routed over where drainage problems are common. Nevertheless, forest roads need mandatorily to be planned over such areas. Accordingly, water-runoff over the road platform cause degradation in their stability. That's why, surface and subsurface water flow over the road platforms need to be avoid by drainage works. Drainage should carefully be taken into account during whole road construction. In the present study, drainage problems and related works on forest roads were investigated in Gölyaka Forest District. For this aim, the effectiveness of application of open top wooden culverts for mitigation of water runoff-induced problems on forest roads were studied. Because, application costs of these structures are comparable with other complex drainage structures. Wooden culverts can be used as simple, cheaper structures in drainage regulation of forest roads.
Keywords: Drainage, Erosion, Forest road, Wooden culverts

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Assessment of bark debarking using axe

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Abstract: In Turkey, the work stages of timber production involve cutting and felling, delimbing, bucking, debarking, hauling, loading, transport and stacking. The felled trees are, initially, bucking and then debarking in cutting sites. Because the barked trees, which remain in stands, may face with the high risk of beetle damage. Debarking activities are generally performed by villagers using axe or chainsaw mounted debarking tool. In this study, we evaluate productivity of debarking works using the axe, considering Brutian Pine (*Pinus brutia* Ten.) and Lebanon cedar (*Cedrus libani* A. Rich.) timber. The study performed in Brutian Pine and Lebanon Cedar stands where locate in the border of Andırın and Çınarpınar Forest Enterprise Chief of Kahramanmaras Forest Enterprise Directorate in Kahramanmaras Regional Forestry Directorate. To investigate of productivity of axe using for debarking was carried out with time study methods using chronometer. Beside diameter, length and bark thickness of timber were measured. As a result of obtained measurements, mean diameter, length and bark thickness of timbers are figured out as; 18,53 cm, 3.04 m and 0.57 cm of Brutian Pine and 27.123 cm, 2.05 m and 2.62 cm of Lebanon Cedar. The mean volume and productivity are determined as 0.11 m^3 and 1.25 m^3/hour of Brutian Pine, and 0.08 m^3 and 0.86 m^3/hour of Lebanon Cedar, respectively. During the timber debarking, workers spend more time of cedar debarking than pine due to knots on cedar. Hence, which caused low mean productivity compare to pine debarking.
Keywords: Debarking activity, Chainsaw mounted debarking tool, Debarking productivity, Brutian Pine (*Pinus brutia* Ten.), Lebanon cedar (*Cedrus libani* A. Rich.)

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Analysis of forest public relations and forest crimes in forest district directorate

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Abstract: The most important reason of forest destruction and damage is the irregularity of forest and public relations. Much of the damage caused by human interventions to forests is focused on forest villagers living in rural areas and in terms of land, wealth and increment, these actions, which are called forest crime, cause the destruction of our forests. In order to ensure the continuity of land, wealth and increment in the forests of our country and to establish a good forest-people relation, determining results and causes of forest crimes committed for different purposes and the relationship between economic and social conditions of regions, which have excess of crime potential, and forest crimes must be investigated. The situations and causes of forest crimes committed in the last 6 years were determined and Forest-village associations and crime rates evaluated in Muğla forest district directorate (MOBM), which has a high potential for forest crime.
Keywords: Forest public relations, Forest crime, District directorate

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Regional height-diameter model for Taurus cedar using nonlinear mixed-effects approach

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Abstract: Lebanon cedar (*Cedrus libani* A. Rich.) is significant from historical, cultural, aesthetic, scientific, and economic perspectives. It is presently found primarily in the Taurus Mountains of Turkey. Presently, Lebanon cedar forests cover an area of about 463521 ha with a current standing volume of approximately 27.4 million m^3. Because of its valuable wood properties, it is the most important conifer species from an economic point of view for the forest products industry in Turkey. Furthermore Lebanon cedar forests play a key role in providing important benefits and environmental services such as protection of soil and water resources and conservation of biological diversity in the Taurus Mountains. In this context, knowing the state and limitations of growth and yield of Lebanon cedar forests in the Taurus Mountains is necessary for improving future management and planning strategies of timber resources. However, information regarding growth and yield is currently lacking in Turkey. The relationship between diameter at breast height and tree height is an important in growth and yield models, carbon budget, stand description, damage appraisals, and timber volume models. In this study, a diameter-height model for natural Taurus cedar stands was developed in Western Mediterranean Region of Turkey. For this aim, data were collected in 88 sample plot and about 50% of plots were randomly selected for model development and the reminder (50%) used for model validation. The diameter-height model was based on an allometric model, which was linearized to include both fixed- and random-effects parameters using mixed effects modeling technique. Based on goodness-of-fit criteria, the model including random-effects in all parameters was the best. In this study, different calibration alternatives were tested and an example of model calibration is provided. Accordinlgy results of model calibration based on independent data, the use of three trees for a particular species from a plot to calibrate the model will likely provide a reasonable compromise between predictive ability and field sampling times. The results of this study support previous findings indicating that If calibrated at the stand level, three trees could be used.
Keywords: Height-diameter, Taurus cedar, Mixed-effects, Calibration

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Comparative study of some standard and modern methods for volume estimation of standing trees

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Abstract: Brutian pine (*Pinus brutia* Ten.) is one of the most important ecological and economical tree species in Turkey. Presently, Brutian pine forests cover an area of about 5.9 million ha with a current standing volume of approximately 270 million m^3. Brutian pine is the most important conifer species from an economic point of view for the forest products industry in Turkey. Furthermore Brutian pine forests play a key role in providing important benefits and environmental services such as protection of soil and water resources and conservation of biological diversity in the South and West Regions of Turkey. Therefore, the information is necessary about growth and yield of the species for developing future management and planning strategies. The one of the essential building blocks in forest growth and yield prediction models is the equations for estimating individual tree volume. Volume estimation is an important issue to forest management and planning, to projecting regarding future of forest products industry, to monitoring the forest health and productivity and to estimating biomass and carbon stocks. Therefore, there is a need for volume estimation methods to accurately estimate standing tree volumes and combination with growth and yield models. In the present, tree volume of 250 standing trees estimated for brutian pine in the southwestern Turkey using two modern methods, Centroid and Paracone methods, and Hossfeld's Method. These estimates were compared with "true" volume of each tree bole which was determined by aggregating the volumes of measured short sections (average 1 m) using Smalian formula. The modern methods have been shown to be accurate approaches for obtaining the volumes of trees and logs when taper models are unavailable. On the other hand, although Hossfeld's method is older method, it is nearly identical to that for modern methods. Moreover, Hossfeld's method may be slightly simpler to implement in the field and like the modern methods, it can be used either for whole trees or for unmerchantable tops. However, in practice, convenience and economics play an important a role in the decision whether to use given estimation methods.
Keywords: Centroid method, Paracone method, Tree volume, Dendrometry

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Extraordinary cuts in Çanakkale Regional Directorate of Forestry (Five-year period)

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Abstract: Annual allowable cut is defined as the amount of periodic or annual yield obtained depending on stand parameters as; stand age, tree volume in hectare, annual tree volume increase, development stage and crown closure. Yield which is obtained from forest products is defined by three different allowable cut concepts. The first one is final yield annual allowable cut which is taken from forest that reached cutting age or reached target diameter; the second one is intermediate yield annual allowable cut which consists of trees from tending areas or the ones that are taken for tending. The last one is extraordinary cut which is taken from natural events such insect harm, fire and storm. Main subject of this paper are extraordinary cuts and the factors that cause them. Çanakkale Regional Directorate of Forestry and its planning units were chosen as the study area. In this study, extraordinary cut reports were examined according to years between 2011-2015 and they were evaluated in terms of forestry enterprises, planning units and, tree types and causes of extraordinary cuts. Extraordinary cuts are recorded by organizing extraordinary cut reports in Forest Planning Units and extraordinary cut tables that are numbered as 35. Forest Planning Units report the extraordinary cut amounts to the Forest Enterprises and the tables are sent to Regional Directorates of Forestry and General Directorate of Forestry. The reasons of obtaining extraordinary cuts are; fire, storm, snow, harms of insects and mushroom, road constructions and other constructions or harms. Analyzing the extraordinary cut reports of Çanakkale Regional Directorate of Forestry for five years period, the most extraordinary cut is reported to be done in 2012. In this amount, road constructions has the highest ratio (65 %); harms of mushroom has the least ratio. Analyzing the general situation of extraordinary cut in five years period, road constructions has the highest ratio (55 %) of total amount, second highest ratio (19%) belongs to permit and access. The least ratio of total extraordinary cut consist of harms of mushroom which is similar to 2012. The most extraordinary cut was taken from black pine and red pine.
Keywords: Extraordinary cut, Annual allowable cut, Forest management plan

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A Practical approach toward better tending the stand class "BC" in pine stands; cleaning and considering the understory stand class "A" into consideration: A case study of Kocanli Forest Directorate of Taşköprü, Kastamonu

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Abstract: Turkish forests are managed according to professional forest management practices. Different rotation cycles are applied to deciduous and coniferous species as experienced thorough a long lasting familiarity with the indigenous tree species such as pine, fir, spruce, cedar, oak and beech. Forest management-wise, stands are categorized in four stages, depending upon the stand diameter at breast height "dbh" in centimeter. When "dbh" is between 0-7.9 cm, a development class sign, "a", "stand initiation" is designated; between 8-19.9 cm "b", "stem exclusion" is designated; between 20-35.9 cm "c", "understory reinitiation" is designated, and ≥36 cm "d", "mature/multi age stand" is designated,. Stands having either pure or mixed tree species with these or in any following double signage, i.e. "ab", "bc", "cd" are named using the acronym(s) of the species along with the development sign and crown closure. Crown closure is categorized in three classes; %11-40 closure is designated as class"1", %41-70 designated as "2" and >%70 designated as "3". Starting from the development age "b", an amount of allowable cut, tending, in "m^3" as prescribed in forest management plans, is assigned to compartments within the administration units, forest directorates. Tending procedures are implemented by responsible foresters in 10 year rotations. This study showed within stands, designated as "bc", in which Anatolian Black and Scotch Pine species are dominant, there is a stiff competition coming from the understory class "a" to reach the crown. As a result of this competition, understory young trees behave like whiplashes damaging the crown and foliage of the"would be future trees". Besides, fallen, broken and leaned young trees of class "a" litter the forest floor and form ladders against such promising trees so bad that the situation create serious fire hazard during fire seasons. In order to eliminate such risks, tending works are performed by the forest service. However, since the amount of allowable cut, assigned to such a "bc" compartment within the stand(s), is filled with such understory trees, < 8 cm, the actual dominant trees are lightly tented than what it has actually been prescribed in forest management plans. This might create problems in the long run because such stands are very lightly thinned out, which will probably limit or reduce the further development of the trees.
Keywords: Stand tending, Allowable cut, Fire risk, Understory reinitiation

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Growth and increment of Oak (*Quercus* L.) stands in Bursa

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Abstract: Most of the forests, managed as coppice forest, are composed of pure oak or mixed oak stands over the country. Oaks (Quercus L.) which has a very wide distribution area in Anatolia and Thrace, is divided into three. White Oak, Red Oak and Evergreen Oak are very different from each other in their growth, development and silvicultural properties. Despite these differences, it has not been studied enough and almost all the forestry work that was done by the oaks, was carried out based on the genus. Research area which is the oak stands of the Bursa Forest District Directorate is 22.1% of the general forest area, according to 2012 data. In this study, increment and growth relationships of oak (Quercus sp.) forests of Bursa Forest District Directorate in same ages, densities and site indexes were examined. Results indicate that differences in growth and increment patterns between oak species have been identified. In this way, it is recommended that forest inventory and planning, yield and volume tables, should be done on oak species.
Keywords: Growth, Increment, Quercus, Site quality, Yield tables

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Time cycle to wood from tree in Turkey

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Abstract: Harvesting of a tree is a process to difficult and time consuming. The harvesting process is occurred different stages. The stages are cutting of tree, delimbing, skidding, landing and transporting. This stages are be up to as a chain. The production plans are done for every stages. In this study was done Şile and Adrasan Forest Enterprises regions. The tree types are *Pinus maritima* and *Pinus brutia*, respectively. The stand in Şile Forest Enterprise is *Pinus maritima* plantation area and another stand is forest fire area. The time measurements in every areas were investigated for harvesting stages as cutting, delimbing etc. Firstly, the average of tree length and tree diameter (dbh) was found for every areas. Then, the harvesting stages were investigated with time measurements. The equipment was investigated of use to every stages in study areas. For cutting and delimbing, skidding and transporting were used motor chain, tractor and truck, respectively. As a result, production time of a tree is revealed. The delay times were found for every stages and the various suggestions were revealed. Besides, environmental impacts were investigated to every stages for harvesting operations.
Keywords: Time measurement, Cutting, Delimbing, Skidding, Landing, Transporting

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Life cycle assessment for wood harvesting in Turkish forestry conditions

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Abstract: The aim of the study was to expose the energy expenditure of human and machine power and to calculate the CO_2 emission of harvesting operations. In this concept, timber harvesting operations was analyzed according to time and motion analysis method, thus, the average time consumption was determined in clear felling and tending operations within Ağlasun Forest Planning Unit located in Isparta Regional Directorate of Forest District. Human and machine power energy consumed in logging process was fixed through measurement method with metabolic holter and/or calculation method with standardized model. The exhaust gases (CO_2) emission amount resulted from the chainsaws used in cutting operations, the agricultural tractors used in skidding and loading operations, and trucks used in hauling, were estimated by means of relationship between fuel consumption and emissions. The calculation of the energy expenditure was also based on the fuel consumption of the machines and working time. As result, in the harvesting operations, it was determined that the average time consumption was amount 74,56 minutes in cutting process with chainsaw and axe; 17,77 minutes in ground skidding with rolling; 5,17 minutes in loading with grapple loader and 3,78 minutes in truck hauling for one cubic meter of brutian pine wood procurement. Thus, the total time consumption was calculated as 1,69 hour/m^3 for logging operations and 1,87 hour/tour for two way hauling. The energy expenditure amount was 23237,48 kcal/m^3 through whole harvesting process. The exhaust gas emission was estimated as 6,82 kg CO_2/m^3 and the noise level 81,33 dB(A) in working environment. The total energy content/equivalent of the unit product was calculated as 2878350 kcal/m^3 and embodied CO_2 content was 988,2 kg/m^3 for the products. The energy balance ratio, input to output, was calculated as 0,8 % per unit cubic meter.
Keywords: Wood harvesting, Energy consumption, Time and motion analysis, Exhaust emission, Noise effect, Technology level

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Calculating carbon sequestration via different methods a sample of Bartın Forestry Operation of Directorate

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Abstract: "Global warming", recently added to the major environmental problems, occupies the agenda of the entire world. It is necessary to lower the level of carbon dioxide in the atmosphere, which is considered to be the most important reason for global warming. The most practical way to do this is to absorb and store carbon dioxide in the atmosphere through woody plants. The amount of carbon stored in forests is calculated from the biomass they have. In this study, the amount of carbon stored in the field which Bartın Forestry Enterprize is responsible for was examined comparatively with 3 different methods. In the study, the volumes and areal data obtained from the forest management plans of the 8 sub-district directorates affiliated to Bartın Directorate were utilized. For this purpose, carbon calculation was carried out by the method recommended by ASAN, by the method of calculation in the FRA-2010 guide and by the method in the principles and procedures of Ecosystem-based Functional Forest Management Plans (ETFOP). As a result of the study, it was determined that 4,493,913.64 tons of carbon was stored in Bartın Forestry Enterprize via the method of ASAN while it was 4,615,243,57 tons by EFTOP and 5,222,648,52 tons by FRA-2010. The amount of carbon stored in the Bartın Forestry Enterprize including forest soil, litter and living cover and dead wood carbons was calculated as 8.744.668,32 tons with FRA-2010, 9.940.536,98 tons with ASAN's method and 10.416.550,90 tons with ETFOP. Based on the ETFOP method, which is of the highest total carbon value in total, the ASAN method bears a 4.5% lower value than that of the ASAN Method and The FRA 2010 method gives a 16% lower value.
Keywords: Carbon sequestration, Bartın, Biomass

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Variation of carbon content in the soil of red pine plantations area at different ages

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Abstract: Forest ecosystems have a considerable influence on the storage of CO2 from greenhouse gases, which play an important role in global climate change. Carbon deposits are made not only by forest trees, but also by forest soils. In forest soils, more carbon accumulation occurs compared to agriculture and pasture lands. Factor such as leaves, litter, climate, stand type, soil properties, tree species, landform and processing of land are influential in this carbon accumulation that occurs in forest soils. In this study, changes in the amount of carbon in the soil in different depth layers were determined in the red pine plantation areas of different ages. As a result of this study the value of the average amount of carbon at top soil layer (0-10 cm); for a age class 62,18 t/ha; b age class 61,63 t/ha; c age class 71,42 t/ha and for control parcel 56,4 t/ha. In the lower soil layer (10-20 cm); for a age class 64,55 t/ha; b age class 66,21 t/ha; c age class 72,67 t/ha and for control parcel 52,69 t/ha.
Keywords: Red pine, Soil organic carbon, Sinop, Turkey

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Contribution of black alder to oriental beech on biomass increase

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Abstract: Black alders enrich the poor soil with nitrogen by the bacteria in their roots. Because of these characteristics, alders might be evaluated as a natural fertilizer. In this study, it was investigated that whether or not there would be an important beech (*Fagus orientalis* Lipsky) while oriental contribution of black alder to development of oriental beech and black alder were grown together in afforestation sites. For this purpose, 15 sample plot of 200 m^2 were established in 2014. Arhavi is the country of Artvin which was located in the eastern Black Sea Region of Turkey. Five of the sample plots were planted with 2-year-old eastern beech, five with 1-year-old bearded alder, five mixed with 1-year old alder and 2-year old eastern beech. Seedlings were planted with 1m x 1m spacing distance. Biomass measurements were made on 30 seedlings representing each group prior to planting in 2014 and at the end of the vegetation period of 2015 and 2016. Within the scope of biomass measurements, fresh root weight (FRW), fresh body weight (FBW), fresh seedling weight (FSW), root dry weight (RDW), body dry weight (BDW) and seedling dry weight (SDW) values of seedlings were measured. In this study, according to the results obtained between 2014 and 2016, it was determined that beech grown with alder have more biomass.
Keywords: Red alder, Oriental beech, Seedling, Biomass

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The possibilities of woody biomass harvesting for bioenergy in Turkey

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Abstract: In this study, it was aimed to introduce (i) perceptions and expectations of stakeholders, especially forest villagers, about the procurement and utilization of logging residues, (ii) biomass potential of logging residues which can be utilized as a resource of raw material for production of bioenergy, (iii) the ways to sustainable procurement of logging residues, (iv) the cost of procurement of logging residues, (v) the effect of utilization of logging residues on forest ecosystems in respect to nutrient reserves. The documentation analysis, field surveys and interviews were conducted to determinate the expectations of stakeholders. In order to determine the biomass potential of Brutian pine (*Pinus brutia* Ten.) forests, biomass measurements and calculations were conducted after taking sample plots from stands of different stages within the areas of Isparta Regional Directorate of Forestry. Trails were carried out about the handling, collection, removal, transportation and chipping of logging residues during the production, and costs were calculated with time and motion studies through a model system design. Results showed that available biomass potential of logging residue in Brutian pine forests were 6-14 green tons per ha; logging residues could be removed from the stands, provided that materials with high nutrient contents, such as needles, twigs and barks, were left on site; the available biomass is just about 4% of the total biomass in mature stands; forest villagers will support this action if the fuel wood demands were met and new employment opportunities were created. Besides, it was put forwards that it is possible to acquire logging residues with the traditional labor intensive methods and chipping is a key factor for reduction of production costs.

Keywords: Forest biomass, Logging residues, Harvesting residues, Bioenergy, Chipping, Procurement, Systems analysis, Cost analysis, Nutrient budget

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Water resources potential and the factors effected on water consumption

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Abstract: Water is one of the most important vital resources for all lives. It is also used for many purposes including agricultural, industrial, household, recreational and environmental activities. However, the majority of human uses require fresh water which the quantity of potable water is very limited Only 2.5% of water on the Earth is fresh water, and over two thirds of this is frozen in glaciers and polar ice caps as known. Surface water is in a river, lake or fresh water wetland. It is naturally replenished by precipitation and naturally lost through discharge to the oceans, evaporation, evapotranspiration and groundwater recharge. For instance, rainfall varies according to seasons and regions in Turkey and average annual precipitation is 643 mm. This is equal to 501 billion m^3 water for a year. 274 billion m^3 of this amount returns to the atmosphere through evaporation from the surfaces of water and land; 41 billion m^3 of this amount feeds underground water reserves by seeping into earth from surface; 186 billion m^3 of this amount ejaculates into the seas and lakes in closed basins through the stream of rivers in various sizes. In addition, considering that 7 billion m^3 water from the rivers arising from our neighbor countries flows into our water supplies, gross total renewable fresh water supply is 234 billion m^3 in Turkey. However, human activities can have a large and sometimes devastating impact on these factors. Humans often increase storage capacity by constructing reservoirs and decrease it by draining wetlands. They often increase runoff quantities and velocities by paving areas and channelizing the stream flow. Due to this situation and population increasing and global warming, it is obvious that the quantity of potable water would be more important and valuable. In this context, protection, conscious consumption and management of current water resources are getting importance. Thus, nowadays billions of people are unable to access water of desired quality and quantity. According to the annual amount of water per capita, our country is a country with water shortage. The annual amount of usable water per capita is around 1519 m^3 in Turkey. Phenomena and contaminations of current surface and underground waters, consumption, insufficient water supply network, competition in water use and frequent droughts call for development of alternative plans in an integrative policy for management of water resources. One of these plans is to develop water consumption consciousness and awareness through determination of factors that affect water consumption of families and individuals. This study was conducted to determine water resources potential, using of people, quantities of water consumption, their attitudes and behaviours towards water saving methods and factors influencing them and their behaviours and attitudes towards water consumption.
Keywords: Water resources, Water consumption, Water saving

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Environmental problems in watershed management

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Abstract: A watershed is defined basically the geographic area through which water flows across the land and drains into a common body of water, whether a stream, river, lake, or ocean. Watersheds are important because of main resource of water supply for living. It is essential to consider watershed improving for quality, quantity and sustainability of the water resource. Improving of watershed is one of the main target of watershed management included many biotic and abiotic factors. Landowners, land use agencies, storm water management experts, environmental specialists, water use surveyors and communities all play an integral part in the management. The management mainly focused on specific issues such as air, land, and water. Most of these focusisng have resulted in decreasing pollutant emissions to air and water, improved landfills, remediation of waste sites and contaminated groundwater, protection of rare and endangered species, design of best management practices to control water and contaminant runoff, and much more. However, an integrated watershed management approach needs to be adopted and the soil and water conservation technologies and approaches need to be applied in field situations by the officer-trainees. It could be said that there are many factors effective on watershed problems shifting cultivation, forest destruction, fire, over-grazing, poor road construction and maintenance, uncontrolled mining, soil erosion, landslides, heavy sedimentation, water pollution, floods and droughts, etc. But, the problems and their solutions can change for watersheds and countries. These may include land tenure, poverty, education, low acceptance of innovations, seasonal shortages of labour, socio-economic etc. For instance Turkey has 25 watersheds, and different management strategies are applied for the watersheds because of their local problems and duty. In this study; the environmental problems encountered in the basins is tried to determine to contribute watershed management.
Keywords: Improving, Watershed management, Pollution, Environmental problems

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The effects of forestry activities on soil properties

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Abstract: Forests are habitats where combinations of complex communities with different kinds of flora and fauna exist together. The need for forest products, brought forests to a such position that not just in the means of visual sense but one that produces wood raw material. Production planning is being done in order to obtain raw wood. Production activities in forestry; consists of cutting, skidding, loading and transport phases. In the examination of our country's historical development of forestry production activities, there is a tendency towards machine power instead of human and animal power. Nevertheless, especially in the chamber of removing works, human and animal power is still widely used. Forestry practices are having an impact on forest flora and fauna because it is practicing in the forests which are living entities. In particular, the ongoing forestry production activities in various parts of the forest are primarily a negative impact on the environment, including the physical and biological properties of soil. Production activities in forest areas affects soil properties both directly and indirectly. The direct effects found with the reduction of biomass per unit area are associated with a decrease in organic carbon. Indirectly, on the other hand, applied production methods have played a massive role in the compaction of soil also affecting the general physical features of soil. During the friction of raw material of wood upon the ground, soil compaction takes place. According to the researches that have been made, it was put forth that this situation decrease the soil porosity on the ground and affects the water infiltration, soil humidity, aeration of the soil and stem volume. Soil compaction is one of the physical factors that prevent the evolution of plant in the galenic production. The studies that have been done revealed that 80 kPa and more soil compaction prevent the evolution of the stem of plants. The compaction effects can be much more in the clay soil. When the organic matter of the soil increases, the damage of compaction decreases. The production activities should be made when the humidity levels are the lowest in compaction of soil with the good timing and not at the humid conditions of the soil. Forestry production activities may have many negative effects. On the other hand, in order to meet the wood needs of the society, the production in forest is inevitable. However the matter that needs caution is, in the production activities in forestry, environmental damages may stay out of sight. As for that, at the production activities in forest, a sustainable and economic method which gives the least harm to human health, the product and the ecosystem, should be adopted.
Keywords: Production in forestry, Production activities, Forest soil, Soil features

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Determination of vegetation properties of the Karaören Village rangeland (Seyitgazi-Eskişehir)

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Abstract: Rangeland is the basis of any livestock operation that purports to be truly sustainable. Rangelands in the semiarid regions are diversified ecosystems that have adapted to natural conditions and human activities for a long time. Recently, global climate change and deterioration of the land in these regions have become matters of concern. Furthermore, the rangelands of the Turkey support a wide variety of rare and endangered species. This research was conducted in Karaören Village Rangeland, in the vegetation period of 2016. The study area is located within Eskişehir/Seyitgazi district boundaries and its average altitude is about 1050 meters and also slopes about 5%. The aim of this study is to determine to the plant-covered area, botanical composition, aboveground biomass, underground biomass and rangeland condition. Transect and quadrat methods were used in order to determine the rangeland flora of the case study area. The main soil characteristic of the research area has been examined and texture class has been found as a sandy loam texture. It has been figured out that soil is in average level with the following features; slightly alkaline with the amount of pH 7.66, low chalky with the rate of 1.16%, with 0.98% of organic matter. In the study area, 89 plant taxa, belonging to 49 families, were identified; and 10, 8, and 71 of these belonged to the poaceae, fabaceae, and other families, respectively. The plant-covered area was found as nearly 51.2%. Additionally, the botanical composition of rangeland consists of 44.28% Poaceae, 22.56% Fabaceae and other families 33.16%. The aboveground and underground biomass yields were calculated as 351.6 kg/da and 560.7 kg/da, respectively. The rangeland condition was established as good. On the other hand the investigation, it was concluded that vegetations of the rangeland were big part of composed of invader plants. There is an immediate need to improve the plant cover on these rangelands to protect soil resources.
Keywords: Eskişehir, Vegetation structure, Plant-covered area, Botanical composition

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Integrated watershed management of water resources based on the water framework directive

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Abstract: The main purpose of this article is to describe the importance of integrated watershed management of water resources and defining the current state of the country's water resources in relation to integrated management in the aspect of Water Framework Directive. Watershed can be defined as an area surrounded by natural borders that control the basin hydrological system on the bases of integrated water management. The correct and easy understanding of the relationships between the processes affecting the hydrological system can be achieved by knowing the reactions of the system to different effects. In the determination of these reactions, it is important to examine watershed scale, which is considered as a whole determined by natural boundaries. In this context, our country has started to implement an integrated solution model specified in the European Union Directives. Within this scope, many different national and international projects are carried out for the harmonization studies of the European Union Water Framework Directive by the Ministry of Forestry and Water Affairs, Turkey. Based on the results of the mentioned projects, the Regulations are revised and integrated management of water resources is carried out on watershed basis. The Water Framework Directive is a key directive on the use and management of water resources under the EU Water Quality Sector. The main objective of this directive is to ensure that all water bodies in Europe reach good water status by 2027 at the latest due to the conservation, improvement and justification of the quality of aquatic ecosystems. Good water status is the improvement of water quality and ecological criteria based on integrated watershed management. Integrated Watershed Management is a plan in which the sustainable management, planning of natural resources in a river basin is coordinated and water resources are addressed at the basin scale with the participation of interest groups. Integrated watershed management can also be described as an integrated approach that takes into account the use of all stakeholders in the planning and management of surface and underground water resources in the basin and takes the necessary precautions to define and protect the status of waters. This approach is based on the implementation of a planning, organization and control mechanism that will balance the views, expectations and objectives of all segments. As a result, the problems in terms of water resources suggest that water management is important not only of water resources planning but also integrated watershed management should be adopted for the rational use of limited water resources.

Keywords: Integrated watershed management, Pollution, Water framework directive, Water resources, Surface and ground waters

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Using machine learning methods in order to classify watershed land use type

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Abstract: Machine learning is a system that studies the construction of algorithms that can be learned as structural functions and can be predicted from data. Such algorithms work by constructing a model to make database estimates and decisions from sample entries rather than alphabetically tracking static program instructions. There are many research has gone into the application of neural network classifiers to land use classification. However, none of them focus on Bayesian view. In our study, we included the research area (Tatlıçay and Acıçay) is located in the Kizilirmak basin of the north of the central district of Çankırı. The central district includes some of the Yaprakli and Korgun districts. The location of the area is between 40 ° 52 '11 "- 40 32' 58" northern latitudes and 33 ° 18 '19 "- 34 ° 3' 43" east longitudes. 15 different parameters were determined that can affect the land use type by taking expert opinions. The data collection has been made based on those parameters. Some parameters were collected as continuous variables but they were modified as categorical variable at the end. In statistical analyses part, Watershed land use type was classified with selected machine learning algorithms (k-nearest neighbor algorithm, naive bayes algorithm and c4.5 classifier algorithm) and artificial neural networks. For this purpose, hydro-morphological observations and water quality parameters such as Rosgen type, salinity, sinuosity, ph, salt, oxygen etc. were considered in order to predict the watershed land use type. In addition, the *k*-nearest neighbor algorithm (kNN), Naive Bayes classifier, c4.5 classifier and artificial neural networks (ANN) were used as classifier machine learning methods. Analyzes were performed with R statistical software. In conclusion, the classification results for each algorithm are underlined and the classifier which has revealed the best performance was determined.
Keywords: Rosgen, Machine learning, Watershed land, Classification

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Effects of grazing on soil compaction and some soil properties in rangelands case study: Kahramanmaraş Ahır Mountain

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Abstract: Soil compaction which has highly impact on soil erosion, runoff and productivity is one of the common problems in rangelands under uncontrolled and intensive grazing pressure. In this study, effects of soil compaction on some soil properties in rangelands of Ahır Mountain under intensive grazing pressure are revealed. With this aim, 3 different factor including exclosure, grazed and pathway (transition routes of livestock) areas are selected. 3 plots, each one is 1000 m^2, are established in each factor area. Homogeneously distributed 360 penetrometer measurements are performed to determine soil compaction in these plots. Soil compaction is measured in depths of 5, 10, 15 and 20 cm. In order to calculate soil properties such as bulk density, permeability and water holding capacity, 10 undisturbed soil samples are taken from each plot. Soil compaction values in depth of 5 cm are determined as 845.6 kPa, 1739.3 kPa and 1928.1 kPa in exclosure, grazed and pathways areas respectively. In study area, it is determined that soil compaction increases as soil depth increases. It is found that soil compaction in pathways known as route used by livestock to arrive grass and grazed areas is higher compared to exclosure areas. According to soil properties of pathways and grazed areas, it is observed that bulk density is higher, whereas pore volume, permeability and water holding capacity are lower due to livestock pressure.
Keywords: Soil compaction, Permeability, Water holding capacity, Grazing

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Chemical properties of pine cones

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Abstract: The cone is an organ of conifers that contains the reproductive structures. There is growing interest products from natural materials in worldwide. However, the chemical compounds from cones are great interest because of its residue products. A number of studies on conifer cones hava available in literature. Majority of these studies are on morphological, chemical and materials properties of cones. All these findings have contribute to better utilization of materials from conifer cones as new medicinal plant products. However, it was consistently reported that the chemical constituents of cones changed depend on geographical, seasonal, genotypic and environmental situations. It was reported that conifer cones have similar chemical constituents like wood but in various proportion. They markedly contain rich of phenoloic compunds and some extractives. They consists cellulose, lignin, and hemicelluloses as major constituents. They have also some condense tannins, resin acids, stilbenes, flavonoids, etc. Many of researchers have already reported that these extracts, which have various proportions in different species may offer some advantages in terms of utilization from waste materials and may show exceptional medicine properties.
A number of different approaches have also applied with cone to find alternative and economical. It has also used for manufacturing various kinds of composite and paper material as substituent of wood. It has already tried to use for particleboard, fiberboard and plastic composite process aiming to without lowering properties. The results reported in that area is poromising. It has also utilized for prufying of waters as bioabsorbent or scavengers for heavy metals from waste streams. It has also found to be useful for producing cellulose with its intrinsic viscosity and molecular weight. However, it has already well explained that some extracts from cones show antioxidant, antifungal, antimicrobial properties and may cure some disorders of humans. The utilization of these constituents from forest residue material (i.e. conifer cone) may offer many possible applications as raw material.
Keywords: Pine cone, Utilization, Cellulose, Chemical properties

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The characterization of biochars obtained from waste bagasse of licorice (*Glycyrrhiza glabra* L.) root

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Abstract: The licorice plant (*Glycyrrhiza glabra* L.) is distributed in Eastern Mediterranean and Southeast Anatolia regions of Turkey. The fibers obtained from roots of the plant are used for the production of a very popular local beverage/juice called as "Mayam" in these regions in the summer time. After maceration of roots into the water, they remained in the form of fibers as a waste bagasse. Biochar, which is a charcoal type obtained via carbonization of biomass sources, can improve the soil quality and structure, and increase the crop yield contributing a perennial carbon sequestration due to its high carbon stability. In this study, licorice root wastes were evaluated for the production of biochar. The carbonization experiments were carried out in a tubular furnace at different temperatures (i.e. 450, 550, 650 °C), heating rates (i.e. 10, 20, and 40 ˚C/min), and nitrogen flow rates (i.e. 50, 100, 200 and 300 mL/min) for 1 h. The fibers were ground and sieved into different particle sizes (i.e. 40, 60, 80 mesh) before the experiments. The yield of produced liquid bio-oil, biochar and gases were separately calculated to determine the best production parameters. The obtained biochar samples were analyzed using various spectroscopic (i.e. FTIR, EDX, XRF, XRD), microscopic (SEM) and calorimetric methods. The highest biochar yield (i.e., 45.52%) was obtained at 450 °C pyrolysis temperature and 10 ˚C/min heating rate with a nitrogen flow rate of 50 mL/min for 40 mesh size waste fibers. The heating value of the obtained biochar samples varied between 21-23 MJ/kg. The heating value of biochar is close to lignite and can be preferred to fossil fuels because they can be used for cleaner energy production compared to coal. The amount of ash in the produced biochar samples varied about from 16% to 25%, while the amount of sulfur is found as very low in the range of 0.016-0.039%. Most of the peaks formed in the FTIR spectrum of biochar samples were seen in the fingerprint region. In the structure of samples, some peaks belonging to the carbon bonds (e.g. C=O, C=C, C-O) were identified as well as the characteristic peaks of the CO_3 which is one of the major inorganic compounds in the chemical structure of glycyrrhizic acid of licorice root. The SEM/EDX results showed that fibers in the licorice root wastes were converted into a porous structure with a high yield of carbon after carbonization process. In particular, many of the plant cells were clearly observed on the fiber surface with the wall structures. According to the XRF analysis, the structure of biochar samples relatively consisted of the high content of carbon over 90%. Moreover, in the structure of all samples, the elements such as Si, Ca, Na, Mg and K were found in considerable amount as well as trace elements such as Al, Fe, P etc. Finally, XRD results indicated the crystalline regions of cellulose in the lignocellulosic root wastes disappeared due to high-temperature treatment and the structure were transformed into a more amorphous and carbonaceous state.
Keywords: Licorice, *Glycyrrhiza glabra* L., Maceration, Root, Carbonization, Bio-char

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The density and bending strength of Turkish red pine wood treated with geothermal waters with different temperature: A case study from Sakarya, Turkey

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Abstract: Geothermal resources waters containing various chemical substances are used in different application areas. In order to make a rational use from these sources, the effects on some important technical propeties of wood material in practice need also to be determined. The purpose of this study is to investigate the properties of density and bending strength **of** pine wood treated with geothermal resource water with different temperatures. The study used the geothermal resource waters of Geyve, Kuzuluk and Tarakli from geothermal fields of Sakarya region of Turkey, hot-cold dipping method (thermal method) and sapwood samples of Turkish red pine (*Pinus brutia* Ten.) as experimental materials and methods. The hot geothermal waters were taken from the geothermal resources, and cooled to normal environmental conditions. For each geothermal resource, the treatment fluids with four different temperature (23°C, 48°C, 69°C, 92°C) were prepared with ±2°C degrees of precision. The density and bending strength tests were carried out separately on wood samples impregnated with treatment liquids according to thermal method technique. Findings obtained from tests were analyzed and evaluated statistically. According to this, in treatment with different temperature geothermal water, for sapwood samples of Turkish red pine, the values of density varied between 0.53 g/cm^3 and 0.57 g/cm^3 while the values of bending strength ranged from 76.82 N/mm^2 to 118.94 N/mm^2. For three geothermal resources, the geothermal water temperature affected significantly the bending strength, but did not important effect on density. In this treatment, according to untreatment control wood specimens, the density values of test wood specimens increased while the bending strength values decreased. Statistically, the density value increasements were found insignificant while the bending strength value decreasements were found significant. However, due to the increasement in temperature of geothermal resource water, the density values of wood samples increased while their bending strength values decreased. For density value, while the highest increment was found to be 0.57 g/cm3 in treatment with Kuzuluk geothermal water at 92°C, the lowest increment was found to be 0.53 g/cm3 in treatment with Tarakli geothermal water at 48°C. For bending strength value, the lowest reduction was 76.82 N/mm^2 in treatment with Geyve geothermal resource water at 92°C, while the highest reduction was 122.87 N/mm^2 in treatment with Tarakli geothermal resource water at 48°C.
Keywords: Geothermal, Wood impregnation, Density, Bending strength, Sakarya

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Effects on properties of hardness and surface roughness properties of aging test applied to heat treated MDF boards

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Abstract: The purpose of this study will be to investigate the effects of aging test on the hardness and surface roughness of the MDF boards subjected to heat treatment for a certain temperature and time. MDF boards were heat treated at 150, 170 and 190 ^{o}C for 15, 30 and 45 minutes, respectively. Then, the boards were subjected to a 4-week aging test. The aging test was carried out in a UV aging cabinet depending on temperature and relative humidity according to ASTM26 / 95 standards. It has been determined that the hardness values and surface roughness values of the test specimens decrease at a certain rate with aging. The hardness and surface roughness of the test specimens subjected to heat treatment of 190 ^{o}C and 45 minutes were the most adversely affected specimens.
Keywords: Aging, MDF, Hardness, Surface roughness

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The effect of sodium borohydride on the crystallinity of hemp cellulose

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Abstract: In this study, it was aimed to obtain high crystallinity cellulose from hemp fibers without damaging the raw material structure during the production of cellulose. For this purpose, hemp fibers obtained from Kastamonu Taşköprü district were cut to lengths of 10-15 mm and shorten to standard sizes for chemical paper pulp production. And then, chemical analysis of hemp fibers was carried out to determine the amounts of cellulose, hemi-cellulose, alpha-cellulose and inorganic materials. Then, paper pulp was produced from hemp fibers, according to the produce method of closed system paper pulp for 150 minutes at 160 °C. Sulfate (kraft) method was used for the production of paper pulp. Sodium borohydride was added to the cooking solution according to the completely dry fiber weight of 0,3-0,5-0,7% respectively. For cooking, a total of four cooks were made, one without sodium borohydride (control group) and three with sodium borohydride. And then, the pulp obtained after cooking was washed on the sieve with plenty of water until the black solution was removed. Then, obtained from chemical analyzes of the pulp were carried out to calculate the amounts of cellulose, hemi-cellulose, and alpha-cellulose. As a result of the calculations made, an increase of about 9% in the amount of alpha-cellulose of the celluloses obtained from the sodium borohydride added pulp according to the control group was observed. Then, X-Ray Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FTIR) analysis of paper pulp, cellulose and alpha-cellulose were performed. According to the XRD and FTIR analysis results, the cellulose crystal cell structure of hemp fibers was found to be monoclinic. It was also found that the crystallinity index of sodium borohydride celluloses increased with respect to the control group. According to XRD analysis results, it was also observed that the crystallinity of pulp and alpha-cellulose obtained from hemp fibers increased with sodium borohydride added to the cooking solution. In addition to these, Thermo Gravimetric Analyzes (TGA) of pulp, cellulose and alpha-cellulose from hemp fibers were made. According to the TGA analyzes made, the addition of sodium borohydride to the cooking solution resulted in an increase in the degradation temperatures of the pulp. Consequently, to the results of the studies made, the crystallinity of cellulose obtained by the addition of sodium borohydride to the cooking solution increased.
Keywords: Hemp fiber, Sodium borohydride, Cellulose, crystallinity

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Physical properties of nanocomposites produced by using speloite nanofibers

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Abstract: Effect of speloite nanofibers on physical properties of wood polymer nanocomposites was investigated. To meet this objective, pine wood flour, polypropylene with and without coupling agent (maleic anhydride grafted polypropylene), and speloite nanofibers (0, 1, 3, 5wt%) were compounded in a twin screw co-rotating extruder. Water absorption and thickness swelling properties of the nanocomposites were investigated. Water absorption and thickness swelling rates of the wood polymer nanocomposites improved with increasing content of the speloite nanofiber (from 1 to 5 wt%) and maleic anhydride grafted polypropylene (3 wt%).
Keywords: Speloite nanofiber, Nanocomposites, Physical properties

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Elementel chorine free bleaching of wood: A case study of spruce kraft pulp

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Abstract: The bleaching of chemical pulps is necessary to remove residual lignin and improve pulp cleanliness to produce high grade paper products. With bleaching process, not only residual lignin, extractives and bark fragments removed but also fiber bundles and shives are also reduced to achive high grade pulp. However, the removal of lignin from pulp have positive effects on fiber flexibility and strength that suitable for paper manufacturing. However, if multistage bleaching is not controlled well or too severe to fibers, this can be effects lowering paper strength. A typial bleaching of pulps consists of a number of stages, each of which has a specific function. However, unless large proportion of lignin removal, high level of pulp brightness can not be achieved. Hence, in broad sense, the bleaching can be aimed to two target; -Remove lignin as much as possible to brighten, -Remove chromophere to stabilize and improve brightness. In a typical bleaching of chemical grade pulps, the following sequences and chemical are utilized. However, the number of stages and used chemical determined by the mill that best results for them. The clorine (Cl_2) is very effective chemical for lignin removal especially early stages of bleaching. But it has causes very toxic chemical formation (Dioxin; 2,3,7,8-tetrachlorodibenzo-p-dioxin) in bleaching effluents. For eliminating the use of chlorine (Cl_2) based chemicals and reducing toxicity to environment, the *Elemental Chlorine Free* (ECF) belaching stages have been developed. In this approach, molacular chlorine (Cl_2) is replaced with chlorine dioxide (ClO_2). Hence, the term of ECF usually referring bleaching with chlorine dioxide as the only chlorine containing chemical in bleaching stages. So it has reported that the substitution of chlorine dioxide instead the chlorine in first stage, very effective reducing dioxin and AOX. Pulp bleaching have been changed since coventional chemials have very toxic effleunts to environment. After reviewing bleaching stages, extensive researchs have been done and new approaches applied on pulp bleaching sequences. In this study, the kraft method were used to produce pulp from spruce chips. The pulps were refined in PFI mill until the specified level of freeness (= 300 ml CSF) was reached according to Tappi standard No. 248. The bleaching of the kraft pulp produced from spruce wood was done by an ECF process which involves O-E-D-P (Oxygen-Alkali extraction-Chlorine dioxide-Hydrogen peroxide) sequences. The result found in this study promosing and high brightness level of pulp (93%) with acceptable strength properties of pulps.
Keywords: Kraft pulp, Bleaching, Paper brightness, Elementel chlorine free belaching

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Is it time for using wood or wood based materials for electromagnetic radiation shielding?

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Abstract: The aim of this paper is to summarize past studies of improving electromagnetic radiation shielding of wood or wood based materials. Wood is a porous material and has almost no effect to electromagnetic radiation yet this property could be improved. In this paper, using an extra layer, coating or impregnating techniques are considered. Studies mentioned in historical order. Results will be given as dB decrease and/or conductivity in respective frequencies. Improving the properties of wood or wood based materials will be benefical to wood industry but there are very few studies in this interdisciplinary subject.
Keywords: Wood, Wood based, Electromagnetic, Shielding

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Effect of chemical modification or compatibilizers on the mechanical properties of WPC

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Abstract: Wood Plastic Composites (WPC) are defined as composite materials that contain thermoplastics and lignocellulosic fibers. The main problem of using lignocellulosic fibers as reinforcement in a thermoplastic matrix is the compatibility of the lignocellulosic material with the matrix. Interfacial adhesion between lignocellulosic fibers and polymers is very poor. Lignocellulosic materials are hydrophilic due to OH functionality, while thermoplastic polymers are hydrophobic. Lignocellulosic fibers show a tendency of forming large aggregates, which cause poor dispersion of the fibers in the polymer matrix. The compatibility between the reinforcing material and the matrix plays an important role in determining the mechanical properties of a composite material. Various methods may be employed to improve the compatibility of hydrophilic lignocellulosic materials with a hydrophobic matrix. Two methods are generally used for improving the compatibility of lignocellulosic fibers and thermoplastic matrix which are utilization of compatibilizers or chemical modification of the lignocellulosic fibers. In this study, the effects of these treatments on the mechanical properties of the composites have been compared. Maritime pine (*Pinus pinaster*) wood flour samples were pretreated with acetic anhydride (AA) to achieve three different weight percent gain levels (5%, 10% and 16% WPGs) or adding various amount of maleated polyethylene (MAPE) (1, 2, 3, 5 and 10%) then compounded with high density polyethylene (HDPE) by using twin screw extruder. The influence of acetyaltion levels or compatibilizers amount on the mechanical properties of 30 wt% Maritime pine wood flour reinforced HDPE composites was determined.
Keywords: Maritime pine, Wood plastic composites, Acetylation, MAPE

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Tannin, flavonoid and terpenoid contents of some wood Barks' extracts

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Abstract: In this study, solid extracts of some barks of deciduous and coniferous species were obtained through Soxhlet extraction method using water (hot), methanol and chloroform as solvents. eight wood species were selected such as oriental beech (*Fagus orientalis*), olive (*Olea europaea* L.), pedunculate oak (*Quercus robur*), sweet chestnut (*Castanea sativa*) as deciduous species, and also, scots pine (*Pinus sylvestris*), black pine (*Pinus nigra*), calabrian pine (*Pinus brutia*), Nordmann fir (*Abies nordmanniana* subsp. bornmulleriana) as coniferous species. Moreover, tannin, flavonoid and terpenoid contents were determined by phytochemical screening methods in obtained extracts. As a result of extraction process, the highest yields were found as 25,40%, 19,69% (in calabrian pine extract) and 37,69% (in black pine extract) in hot water, chloroform and methanol, respectively. Tannin presence in hot water extracts, flavonoid presence in methanol extracts, terpenoid presence in chloroform extracts were investigated. According to phytochemical experimental results, tannin was determined in all hot water extracts apart from Nordmann fir. Flavonoids were detected In the methanol extracts of sweet chestnut, oriental beech, scots pine and olive barks. Finally, in the chloroform extracts, terpenoids were detected in the bark of Nordmann fir, oriental beech, scots pine, calabrian pine and black pine. As a result, it was found that the yields of bark extraction process yields were high and the content of the extracts was very rich.
Keywords: Wood Bark, Extract, Tannin, Flavonoid, Terpenoid

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Natural weathering of biomaterials' surface: mechanisms and implications

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Abstract: Recent developments in materials science lead to discoveries on novel bio-based building materials, offering wide range of outlooks, starting from traditional rustic to modern design products. Their functional performance is usually improved by a proper selection of the raw resources, treatments, impregnations or other modifications. Unfortunately, biomaterials will deteriorate during service life due to several processes, such as weathering, oxidation, biodegradation, wear or decay. As a consequence, biomaterials may loss visual appeal leading to a perceived need for replacement even if the material is far from reaching functional failure. The research reported here was dedicated to understand mechanism of the material deterioration exposed to natural weathering in different locations in Europe. Several surface properties, including color, gloss, roughness, as well as chemical composition and erosion rate were monitored with dedicated sensors. The resulting data were used for modeling of the weathering mechanisms. An original approach for determination of the aesthetical appearance of the deteriorated surface was also developed. The model bases on the dose-response approach, being able to simulate different climate conditions, locations and architectural solutions. Even if the weathering itself does not affect functional performance of products, it highly influences the customer perception and therefore should be considered when designing products or structures.
Keywords: Biomaterials for buildings, Aesthetics, Service life, Weathering, Surface characterization

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Incorporating wood quality traits into tree breeding programs: Usability of Fractometer for the purpose of a preliminary assessment of wood strength and density of *Pinus brutia* (Turkish red pine)

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Abstract: In tree breeding programs there is a need to assess large numbers of trees and families for traits of economic importance. However, traditional methods of assessment for wood strength and density are expensive and restrict the numbers of samples that can be processed. In addition, traditional strength measurement methods involve cutting of the sample trees. There is an increasing interest in developing and using cost-effective non-destructive/semi-destructive technologies to evaluate the strength of standing trees all around the World. The Fractometer is a device that breaks increment core (5mm in diameter) to measure fracture strength. The advantages of the device are that it is relatively fast, easy to use in the field, and it can perform direct strength measurements using small diameter cores. The main purpose of the study (Project No: TUBITAK 110-O-560) was to evaluate the usability of Fractometer as a preliminary evaluation tool for the wood quality of standing trees. Relationship between density and bending strength values were evaluated to determine the possibility of using the device in predicting density. X-ray densitometry technique used for density measurements. Depending on high correlation between two traits, a model was built using linear regression. Fifty tree sampled for building up statistical model (r^2: 0.74), and fifty trees used to test the model. The density value obtained from the model was 0.546 g / cm^3, and the density value averaged by the x-ray method for the same group was 0.543 g / cm^3. In terms of mean values, the model seems to have made a successful prediction. Depending on our experience and research results some trees have superior growth, stem form and wood quality traits and breeding from these trees could offer gains in timber production and performance for Pinus brutia. Therefore, Fractometer can be used for Turkish red pine tree breeding program for the purpose of a preliminary assessment of wood strength and density performance in the field. Required sample for the device also give a chance to see and compare growing performance of the investigated trees. Consequently, by adopting this technique in a tree improvement program, it is possible to select plus-trees, superior populations to achieve the highest gains in productivity and timber quality.
Keywords: Pinus brutia, Fractometer, NDT, Wood density

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Changes in the chemical and physical properties of aged WPC with high wood filler

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Abstract: The aim of this study is to examine changes in the Chemical and physical properties of aged wood plastic composites. For production of composites, sawdust as lignoselulosic filler, high density Polyetilene (HDPE) were chosen. Composite granules produced using a twin screw extruder were pressed at the size of 250 mm x 25 mm x 5 mm by hot press with the compression molded technique. Aging test applied to composites samples were prepared in accordance with ASTM standards. The wood plastic composites were subjected to aging test for a total of 720 hours. Measurements made every 240 hours were recorded for the aging test. The chemical (Fourier Transform infrared spectroscopy (FTIR)), physical tests (water uptake, hardness (Shore D)) of HDPE-based composite boards were investigated. It was understood that the aging test had an effect on the chemical and physical properties of the composites.
Keywords: Waste sawdust, Flat press, Wood plastic composites

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The anatomical characteristics of hot compressed poplar wood boards

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Abstract: The goal of this study was to investigate the influences of thermal modification by hot pressing on the anatomical characteristics of poplar wood boards. The boards were thermally modified by hot pressing method under different temperature stages. After that samples were cut in cube shapes for microtome. Very thin samples were taken from cross section of wood blocks and the slides were prepared with them. In consequence of microscopic analyses, it was seen that lumens shrank due to removing of water in the cell gaps and some of cell walls disintegrated. Besides it was determined that rays moved and had cracks while they were passing from late wood to early wood and it was seen separations in annual ring borders. Thanks to this study, anatomical characteristics can be regarded when other characteristics (mechanical, physical and surface characteristics) of thermal modified wood are researched.
Keywords: Thermal modification, Hot pressing, Anatomical characteristics

1. Introduction

It is thought that physical, mechanical and discoloration properties of thermal modified wood and wood boards with hot press can be improved (Yeo et al., 2010). Various thermal processes like Retification Process, Thermowood Process, Plato Process, Oil-Heat Treatment Process and Boise Perdure are used in the wood product sector (Militz, 2002). Seborg et al. (1945) stated as *Staypak* wood boards pressed and modified with hot press. Tarkow and Seborg (1968) performed studies related to surface density of modified wood thermally. After 1980s because of their low density and cost, modified wood boards as thermal attained a big market in Asia (Norimoto, 1994; Wang et al. 2000). The thermal modified wood and wood boards exhibit advanced physical and mechanical properties. For instance thermal modified wood boards can be preferred in furniture production, roof panelling, flooring materials, window and door carpentry, environmental planning and architectural construction, interior and exterior planking of structures, light and sound barrier (Korkut et al. 2008; Korkut and Kocaefe, 2009).

There are wide range of researches in terms of anatomical properties of hot compressed wood boards in the literature (Boonstra et al. 2006; Awoyemi and Jones 2010; Dogu et al. 2010; Icel and Simsek 2016). It was aimed investigation of influences on anatomical properties of wood boards of varied temperatures, times and pressures in these studies. In this study, it was researched anatomical properties of modified poplar wood boards as thermal with different temperatures.

2. Material and method

The samples obtained from boards produced with different thermal processes were used in this study. Poplar wood (*Populus* spp) timber without defects and with dimensions of 500 by 100 by 25 mm were compressed by using a laboratory hot press at 130^{o}C, 150^{o}C, 170^{o}C, 190^{o}C and 210^{o}C and for 45 min under 1 atm pressure. Before hot pressing, average moisture contents of the boards were 14.74%, yet after process it was determined that average moisture content of the hot-compressed boards diminished to 7.22%. 6 for each treatment group, totally 36 boards were used.

To carry out anatomical analyses, after hot press and acclimatization, the cubic samples were cut from wood boards. The cubes were soften by boiling during 6 hours/5 days. Thin samples were slivered from cross section of the cubes with a Thermo Shandon Finesse 325 microtome and the slides were prepared. The slides were stained with safranin to achieve brilliant images which indicate early and late wood zones in the wood structure. The images were observed under a Leica DM3000 light microscope.

3. Results and discussion

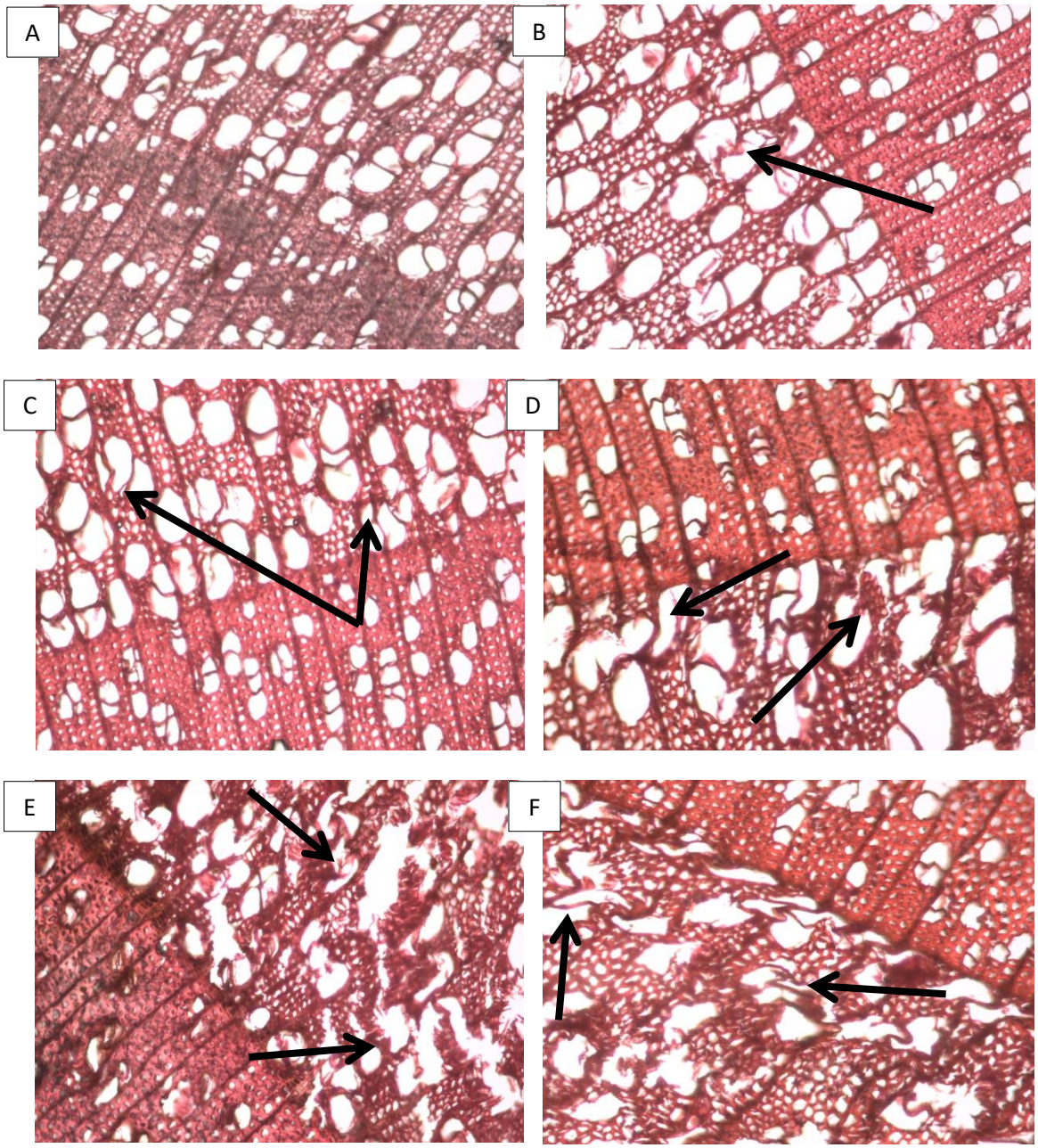

Figure 1. The microscopic pictures of hot compressed wood samples A)Control, B)130^{o}, C)150^{o}, D)170^{o}, E)190^{o}, F)210^{o}

Microscopic analyses were performed in cross sections of control and thermal modified samples to see the effects of hot pressure on the anatomical structure of the wood. Anatomic images of untreated and hot-compressed wood samples were shown in Figure 1. Collapses in lumens and disintegrations in cell walls of earlywoods of hot-compressed samples with 170^{o}, 190^{o} and 210^{o} were seen in images. Besides, it was noticed that rays weaved in earlywoods of these samples. Because latewood zone is denser and tighter than earlywood zone, any disintegration and collapse didn't occur in latewood zone. Disintegration of lumens in earlywood zone led to a fluctuant structure in this zone, but latewood of hot-compressed samples remained smoothly. It wasn't observed any disintegrations in control samples and treated samples in 130^{o} and 150^{o}, however very little deformations happened compressed samples in 130^{o} and 150^{o}. Dogu et al. (2010) attained the similar results in their anatomic studies conducted with hot compressed Scotch pine (*Pinus sylvestris* L.) boards and they confirmed anatomical changes in earylwood zone and latewood zone depending pressure and temperature. In a similar way, Icel and Simsek (2016) were utilized from ash (*Fraxinus excelsior*) and spruce (*Picea abies*) woods in their study. They determined that hot press led to any deformations in anatomic structures of wood boards.

4. Conclusions

The effect of varying temperature (130^o, 150^o, 170^o, 190^o and 210^o) and stable pressure (1 atm) as well as time (45 min) on the anatomical structure of thermal modified wood boards were researched in this study. Consequently, it was seen that if the press temperature increases in the event of the press pressure is stable, anatomic deformation of hot-compressed wood increased during process. It was noticed that cell walls of the samples started to warp in 130^o and 150^o, whereas they splintered in 170^o, 190^o and 210^o according to microscopic images. Furthermore microscopic images indicated that hot-press didn't affect borders of growth rings excessively, however deformations in earlywood cells increased step by step as press temperature increased.

This study revealed that there are some important relations between thermal modification and anatomical structure of wood. Specification of alterations in anatomical structure of thermal modified wood is very significant in respect to end-usage place of these materials. Within this framework, different thermal modification methods should be developed to implement the wood types in varied anatomical structure. Thus, manufacture of novel products can be supplied for different sectors in industry.

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The effects of lean manufacturing set-up time reduction efforts on productivity in North America's secondary wood products industry

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Abstract: Since lean manufacturing's emergence onto the world stage in the 1970s and in its later evolutions, many industries and companies of different sizes and specializations have tried to adapt lean tools and techniques with varying success. Most often, lean manufacturing has been concentrated in large manufacturing firms. Yet, lean manufacturing tools and techniques are also suited for small enterprises. This study investigated how a firm's productivity is affected by lean set-up time reduction efforts needed to achieve "one-piece flow" in secondary wood products manufacturing facilities on four woodworking machines (moulder, shaper, table saw, and band saw) based on firm size. As part of this study, surveys were administered to firms in North America's secondary wood manufacturing industry which had adopting lean manufacturing from 2015 to 2015. This ten-year period was chosen since some of the companies involved might not have undertaken any set-up improvement activities on their woodworking machines in recent years. This survey targets industries which widely use moulders, band saws, table saws, shapers, and require frequent changes in set-up of these machines. Thus, the survey looks at members in the wood products manufacturing and furniture manufacturing as identified by the U.S. Census Bureau. Survey questions asked about the company's set up times and experience with lean to the hypothesis that smaller firms would achieve lower productivity gains through set-up time reduction than larger firms. Both small and large firms surveyed reported productivity gains from reduced set-up times, with several companies citing productivity improvements over 15 percent. In addition to firm size, results are broken down as they related moulders, band saws, table saws, and shapers. However, the sample size of responses was small such that no statistically significant difference could be found. This study adds to the research around how lean manufacturing has been applied across the wood products industry by firm size by providing a unique survey instrument and by highlighting initial findings into this subject.
Keywords: Lean manufacturing, Set-up time, Productivity, Wood products industry, Survey

1. Introduction

To better compete in today's global economy, manufacturing firms seek to decrease the time needed for setting up their manufacturing machinery. Set-up time refers to the amount of time between the production of the last time and the production of the first good item after set-up of a new production batch (Trevino et al., 1993). Set-up time can be affected either internal or external set-up activities. Internal set-up means the activities and time it takes to stop a machine, while external set-up time means set-up time spent on activities performed while the machine continues its production run (Cakmakci, 2009; Monden, 2011). Some set-up efforts aim to change internal set-up to external set-up activities. Monden (2011) highlights the improvements achieved when changing internal set-up activities to external set-up activities, a machine can continue producing during the time that was switched from internal to external set-up activities. For example, liners/spacers can be used to standardize the die heights of a punch press or a molding machine to eliminate stroke adjustment so that the process can continue to produce without stopping the machine (See Figure 1).

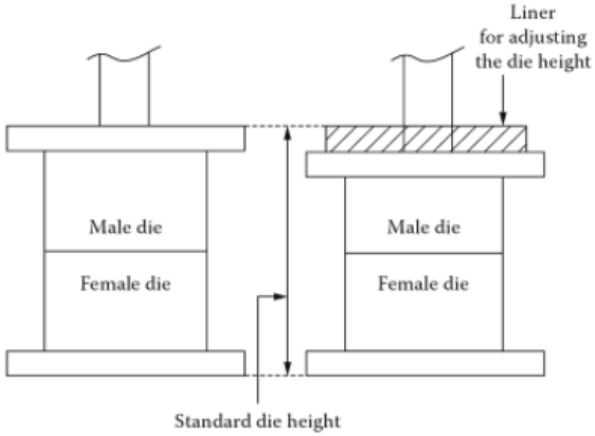

Figure 1**:** Using a liner to standardize die height (source: Monden 2011).

Benefits of reduced set-up time include increased flexibility and capacity; reduced lead-time, batch sizes, inventory, and waste; and improved customer responsiveness (McIntosh et al., 2007; Wadhwa, 2012; Zammori et al., 2011). These advantages can help companies increase their competitiveness including an ability to diversify their product lines and/or increase their production capacity.

According to Enginarlar (2003), increasing production capacity is the main goal of set-up time reduction efforts. By minimizing set-up time, machine downtime is decreased and more products can be produced, so as to minimize any losses in production capacity.

Reducing set-up time is one component of "Lean" manufacturing strategies. Here "Lean" can be defined as making manufacturing and other systems more effective and more efficient (Womack et al., 1990). Lean manufacturing techniques were first widely used in Toyota Motor Company's invention of the Toyota Production System (TPS) for its automobiles in the 1950s. The driving force behind Lean is the desire to increase productivity and reduce costs by eliminating unnecessary tasks from work areas (Monden, 2011). As mentioned, start-up reduction activities are one tool used as part of Lean manufacturing techniques. While other manufacturing industries have successfully adopted Lean methods through set-up time reduction, the implementation of Lean techniques in other industries needs further exploration. One of these industries is the wood products industry.

Still, a small number of studies have examined the wood products manufacturing area. Fricke (2010) analyzed on lean manufacturing in Virginia's wood products industry. More recently, Erdogan (2015) used original survey data research the use of Lean tools by the wood products industry in the U.S. This study seeks to expand these efforts by focusing the investigation within the U.S. secondary wood products industry and firms' ability to successfully implement set-up time reduction efforts. The secondary wood products industry is especially suited for the study of set-up time efforts because manufacturing facilities in this industry produce various types of products on the same equipment and therefore require frequent set-ups for the production of new products.

Specifically, this study examines these set-up time efforts on four common basic woodworking machines in the secondary wood products manufacturing firms: band saw, moulder, table saw, and shaper. Advanced machines such as CNC (computer numerical control) wood routers, are not of primary interest in this study due to their complexity and the variability in set-up requirements. This variety makes it difficult to compare the set-up time reduction performance on CNC-routers between different facilities.

With these considerations in mind, in addition to exploring the use of Lean techniques in another objective of this study is to investigate how a firm's productivity is affected by set-up time reduction efforts as related to firm size. As many small manufacturing firms have a limited financial and other resources, and may lack certain expertise among its small staff, this study will examine whether small firms achieve lower productivity gains through set-up time reduction than do large firms. Another objective of this study is to examine how any productivity changes vary by the type of wood products manufacturing equipment used.

2. Material and methods

The primary methods of this study for gaining insights into common set-up time activities in the wood products industry was a web-based survey among readers of one of the leading wood products industry trade magazines. The results of this study were used to describe current trends and successes of set-up time improvement efforts among secondary wood manufacturing firms in North America from 2005 to 2015. This ten-year was chosen to increase the number of usable responses from the survey and help highlight trends and successful practices in set-up time reduction efforts in the industry.

This survey targets members in the wood products manufacturing (NAICS 321) and furniture manufacturing (NAICS 337) industry segments, as defined by the U.S. Census Bureau (2012). However, not all the sub-categories of these two industries are within the scope of this study. For example, sawmills (NAICS 321113), wood preservation (NAICS 321114), and metal household furniture manufacturing (NAICS 337124) manufactures, among others, are of no interest to this study.

Possible respondents from the U.S. wood products industry were identified by consulting the trade publication FDM&CM (http://www.fdmcdigital.com/). The decision to cooperate with a trade magazine allowed access to the magazine's wide network of industry professionals, with the hope that this would increase the number of survey responses for this study. Obtaining a higher survey response rate can be important because it increases the statistical validity of the findings of the study by collecting expanding the population from which data are drawn from (Great Book n.d.; UMEX 2002).

The survey gathers information related to the objective the study, basic company information, set-up time reduction efforts, and General Questions. The web-based survey conducted was accessible online for 73 days (October 06, 2015 – December 17, 2015). During this (approximately) two and a half months surveying period, 24 completed responses were received. 23 of these responses were considered valid and analyzed.

3. Results and discussion

3.1. Respondent characteristics

Respondents held a variety of positions within manufacturing firms (Table 1). The largest categories of respondents were plant managers (8) and owners (7). Additional responses came from continuios improement staff, production managers, along with one CEO and one process engineering manager.

Table 1: The statistics on respondents' job descriptions.

Job Descriptions	Number of Participants
Plant Manager	8
Continuous Improvement Person	4
Operations / Production Manager	2
Owner	7
Process Engineering Manager	1
Pres/CEO	1
TOTAL	23

When asked about the main product produced by their facilities, six respondents indicated that they are Wood Kitchen Cabinet and Countertop Manufacturers (NAICS 33711), followed by four Household, Institutional Furniture Manufacturer (NAICS 33712), four Millwork Manufacturers (NAICS 32191), and one Office Furniture (including Fixtures) Manufacturer (NAICS 3372). Additionally, eight respondents selected Other product types manufacturing (Table 2). Respondents who selected the Other product types manufacturing specified their main product types one of the following:

- Store fixtures,
- All of the above (note: means all the standardized answers of the question),
- Custom cabinets, furniture, millwork,
- Wood moulding,
- Cabinet Components,
- Custom wood products to customer specs,
- POP display, and
- Custom AV related furniture.

Table 2: Main product category produced in respondents' facilities.

The main product category		Number of Response
Millwork		4
Wood Kitchen Cabinet and Countertop Manufacturing		6
Household, Institutional Furniture Manufacturing		4
Office Furniture (Including Fixtures) Manufacturing		1
Other		8
Other	1. All of the above 2. Store fixtures 3. Custom cabinets, furniture, millwork 4. Wood moulding 5. Cabinet Components 6. Custom wood products to customer specs 7. POP display 8. Custom AV related furniture	
Total		23

In addition to a geograpically diverse group of U.S. companies, one respondent indicated that their wood products manufacturing firm was from Canada (Table 3).

Table 3: Locations of the facilities of respondents.

	States/Province	Number of Facilities
United States	CA California	2
	GA Georgia	1
	IL Illinois	1
	IN Indiana	1
	ME Maine	1
	MN Minnesota	2
	NC North Carolina	3
	NE Nebraska	1
	NJ New Jersey	1
	NY New York	2
	OH Ohio	2
	PA Pennsylvania	2
	TX Texas	1
	VA Virginia	1
	WA Washington	1
	Total	22
Canada	AB Alberta	1
	Total (USA & CANADA)	23

The survey also asked respondents to specify the employment sizes of their manufacturing facilities. Of those surveyed, 14 firms indicated that they employeed between 1 and 19 employees, 6 facilities with between 20 and 99 employees, 2 facilities with betwen 100 and 499 employees and one facility with 500 or more employees (Table 3).

Table 4: Employement sizes in facilities of respondents.

Employment Size	Number of Facilities
1 to 19 employees	14
20 to 99 employees	6
100 to 499 employees	2
500 or more employees	1
Total	23

Firms surveyed used a variety of manufacutring machines, but the most common were the table saw (15), followed by moulder (11). In contrast few respondents reported using shapers (2) and or band saws (2) (Figure 2).

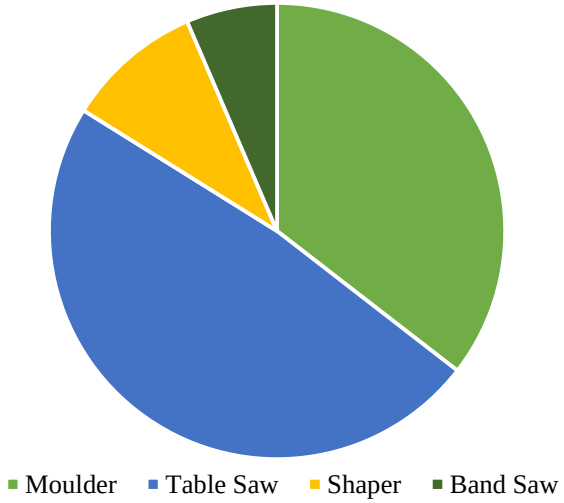

Figure 2: Numbers of specified machine types.

3.2. Set-up time

The survey gathered information on what activities wer most time-consuming and impeded set-up reduction efforts. Four of the 11 (36%) answers relating to the moulder were *Mounting and adjusting cutterheads (knives, cutter etc.)*, qhilw for table saws seven of the 13 (54%) answers chose *Mounting and adjusting a circular saw or a combination cutter.* Of thethe four different types of woodworking machines specified in this study (moulder, table saw, shaper, band saw), respondents indicated that *Mounting and adjusting* is the most time consuming activity during their set-up for 13 out of a total of 28 machines (Table 5). One possible reason for this being the most commonly reported *Mounting* time consuming set-up activity may be related to qualifications of the employees and the condition of the machines used and their level of technology.

Table 5: The most time consuming areas for their machine set-ups in respondents' facilities.

The most time consuming activity	Moulder	Table saw	Shaper	Band saw	Total
Adjusting cutting depths and widths	2	2	2	0	6
Cleaning activities	1	1	0	0	2
Mounting and adjusting cutterheads	4	7	1	1	13
Searching for tools and equipment while doing set-up	1	1	0	0	2
Trial runs	2	2	0	0	4
Other	1	0	0	0	1
Total	11	13	3	1	28

When participants were asked if they do have a machine that creates a production bottleneck in their facilities, seven respondents (44%) answered *Yes* while nine respondents (56%) answered *No.* Such bottlenecks hinder set-up time reduction, and therefore can affect productivity. Follow up questions gathered information on bottleneck machines, reasons for bottlenecks, and solutions for the specified bottleneck (Table 6).

Table 6: Bottleneck machines, reason for and solution to the specified bottleneck.

Bottleneck Machine	Reason	Solution
Drum Sander	Set up time required	Not specified
Ripsaw	Machine failures	Manufacturer engineered better parts
Door and panel clamp machines	Glue drying	Fans, and leave gaps between products for air flow
Moulder	Production needs	Overtime
Auto Drilling	Set up time required	SMED set-up reduction
Costa Sander	Speed of the machine	Purchased another machine
CNC	Speed of the machine	Highly scheduling issues, obtained second CNC

3.3. Set-up Time Reduction efforts

Respondents reported a variety of beneficial set-up time reduction efforts. The most frequently cited results were in the areas of *New equipment technology* (28%), followed by *Moving internal activities into external ones* (16%) and Searching for tools and equipment while doing set-up (16%). Table 7 outlines the full range of responses for what respondents found most rewarding in their set-up reduction efforts.

Table 7: The most rewarding set-up time reduction effort in respondents' companies.

The Most Rewarding Set-Up Time Reduction Effort	Number of Responses
Moving internal activities into external ones	4
Adjusting cutting depth and width	3
Searching for tools and equipment while doing set-up	4
Cleaning activities	3
Mounting a blade in a machine	1
New equipment technology	7
Other	3
Total	25

For moulders, only one out of a total of 11 respondents indicated that they had no set-up time improvement, while all the other respondents indicated that they achieved some set-up time improvement in their facilities because of their set-up time reduction efforts. Set-up time improvements raned from a 0 to 4.9% reduction in time for in three facilities, 5 to 9.9 % reduction in four facilities of respondents, and more than 15 % reduction in three facilities responding. When respondents were asked about how they would rank the productivity gains (increasing throughput) related to the set-up time improvement on their moulder, seven respondents rated the gain as *Little,* while another four respondent rated the gains as *A lot.* All respondents who undertook set-up time reduction efforts on their moulders therefore reported improved productivity throughput.

For table saws, 11 of the 13 respondents (85%) using such machines reported that that their set-up time improvement efforts resulted in reduced time, while two respondents reported no reductions. Of those indicating reduced set-up time, set-up time improvement ratings ranged from 0 to 4.9% set-up time reduction in six facilities, 5 to 9.9 % in two facilities, and, more than 15 % in three facilities. When respondents were asked how they would rank the productivity gains based on the set-up time improvement achieved on their table saw (twelve responses were obtained), two respondents indicated *None* was achieved, while four respondents responded that *Little* improvement was gained, while another four respondents indicated that *Some* improvement was achieved and two respondents rated their improvement as *A lot*. Overall, a majority of respondents concerning their table saw set-up time reduction efforts (ten out of total twelve responses) indicated productivity improvements (in terms of increasing output) related with the set-up time improvement efforts on their table saws.

3.4. Productivity improvements

For shapers, all three firms using shapers participants indicated their firms achieved at least some reductions in start-up time. Two out of the total of three respondents rated the set-up time *improvement between 5 and 9.9% while the other respondent rated their firm's improvement as more than 15%.* When respondents were asked to rate the productivity improvement achieved, one respondent indicated that *Some* productivity was gained while another two respondents indicated that *A lot* of productivity improvement was achieved.

Finally, for bands saws, one of the two respondents rated their set-up improvement as *None* while the other respondent rated their set-up time improvement result as *More than 15%.* When respondents were asked to rate the productivity improvement depending on the set-up time improvement achieved on their band saw, the respondent who acheived set-up time reducdtions answered *A lot.*

Respondents using molders ranked the productivity improvement (in terms of increasing throughput) from reducing set-up time as either *Little* (64%) or *A lot* (*36%*). When respondents answerd which moulder's set-up requirements had been reduced, the most common answer was *Searching for tools and equipment while doing set-up* (four answers), followed by *Mounting and adjusting cutterheads* (three responses), *Converting internal set-up time to external set-up time (three responses), Adjusting cutting depths and widths* (two responses), *Cleaning activities* (two responses), and *Other*.

For respondents using the table saw, four ranked their productivity improvement from decreased set-up times responded either *Little* (27%) or *Some* (27%) while two participants responded *None* (13%) and another two responded *A lot* (*13%*). When asked about the single most important outcome from reducing the set-up time for the table saw, five participants (39%) answered *Increasing productivity/capacity*, followed by two participants (15%) citing *More frequent set-ups/improve flexibility*, two participants chose (15%) *Reduced batch sizes*, one participant (8%) *Reduced maintenance due to shorter cycles*, one participant selected (8%) *Improved responsiveness to customer demands*, while two participants (15%) selected *Othe*r. One of the *Other* respondents elaborated: "We run all parts on a nested based CNC now. much faster" while the other one did not specified any response."

Two-thirds of respondents using a shaper in their firm ranked the resulting change in productivity (increasing throughput) from set-up time improvements as either *A lot*. The other third of respondents reported Some productivity improvements. When participants were asked in which area set-up time has been reduced, the most frequent response was Adjusting cutting depth and width (two answers) while the other participant indicated *Mounting and adjusting a cutterhead*.

For those respondents using band saws, when asked how they ranked the productivity increases achieved from reduced set-up time for their bandsaws, one participant answered *A lot* while the other respondent did not provide an answer. When participants asked which activity most reduced set-up time, one respondent wrote "Fixturing for cutting different components" while the other respondent did not provide an answer.

3.5. Limitationsand suggestions for future research

Although only a limited number of participants participated in the survey (twenty-three participants), respondents were mostly employees in the targeted job positions (plant or production managers, continuous improvement persons), assuring that the responses obtained have been given by knowledgeable professionals. Thus, despite the low response rate, the findings from this study can be considered relevant. However, the conclusions drawn from this study only apply to the facilities of the survey participants and they do not represent the general North American secondary wood manufacturing population or subscribers of FDM&CM. Similary, the low response meant the study was unable to test the relationship between set-up time improvements and firm size with statistical reliability or validity.

Future reserach could expand upon this study's investigation of Lean tequniques such as start-up time reduciton in the wood products industry by seeking to answer some of the following questions: 1) To what extent do secondary wood manufacturing firms use other Lean techniques beyond those related to start-up time? If so, which other techniques? 2) Do companies provide appropriate training to their employees to improve implementation of Lean techniques in their facility? If so, what is the type and content of such training? 3) How have bottleneck and other oproblems affected wod products manufacturing firms' production, and how have they worked to solve bottleneck issues? In addition to these questions, future reserach may benefit from comparisions between the production of similar versus different types of wood products.

4. Conclusions

This study is among a small but growing body of research aiming to understand the application of Lean techniques to the wood products industry and its production processes. Specifically, this study focused set-up time reduction efforts and the benefits obtained thorough these reduction efforts in North American enterprises. Even though comparatively few responses were collected, too few for most rigorous statistical tests to be conducted, the survey responses gathered still provided valuable insights. For instance, respondents indicated that Lean techniques aimed at reducing set-up time can be successfully implemented in the wood products industry. Respondents cited up to 15% savings time and higher for certain pieces of equipment. Survey respondents also highlighted also improved productivity (as measured by throughput) as a result of set-up time reduction activities. As this study shows, the large majority of secondary wood products manufacturers experienced considerable benefits from their set-up time reduction efforts, including increasing productivity and capacity, among other improvements.

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Poster presentation

The importance of maintaining machinery in forest products industry

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Abstract: Organizations, maintaining their existence depends on their profiting by marketing in an economical manner. Moreover, the organization should compete with their rivals. As such, organizations need to keep their production systems continuously functioning and this requires repair and maintenance activities to be conducted in a planned way and to keep the unexpected breakdowns at minimum. In this way, reliability of the organization will increase. The advancements seen in the field of technology and organizational changes enhance the importance of effectively working machine. Moreover, the increasing competition forces the organizations to use their facilities and machine more efficiently.

1. Introduction

One of the most important issues in organizations, either producing service or good, is what to do in case the equipment possessed and used in the production breaks down. Some organizations deal with the issue by purchasing one more machine than the required so that they can use the spare ones in case of malfunctioning. This approach is not economically viable because when the broken machine is repaired, the number of the machine will increase and the organization will have more machine than required in its machine park [1].

The purposes of repair and maintenance activities can be listed as follows [2];

- Increasing the quality of machine and its parts,
- Developing a design to make the maintenance and renewal of the machine easier,
- With the inactive capacity available, minimizing the losses resulting from the breakdowns,
- Establishing the system and having the equipment required for fast maintenance and renewal,
- Through regular inspections, critically damaged parts are changed and so doing, breakdowns to lead big losses can be hindered,
- Preventing machine and the personnel operating it from being inactive,
- Enabling to timely provision of the customer demands and preventing sales from dropping,
- Allowing losses to be low.

Repair And Maintenance Methods Used In Organizations

Types of maintenance to be used in an organization are divided into three:

1. Corrective maintenance
2. Preventive maintenance
3. Corrective and improving maintenance

These are the maintenance activities going up to design of all the original parts of a machine.

If the maintenance activities are not carried out on time, this may result in some adverse effects on efficiency, production increase, and costs. Some of the negative effects are listed below [2]:

1. Leaving the machines and the personnel operating them inactive,
2. Increase in indirect labor and production expenses,
3. Not meeting customers' demands and decrease in sales,
4. Other units remaining inactive due to the unit where the breakdown has occurred,
5. Decrease in quality and increase in the rate of the discarded,
6. Compensations paid to the customers due to delays in the delivery of orders,
7. Increase in the ratio of breakdowns due to deficient maintenance.

The main point to be emphasized here is that when machine and equipment are used for production, maintenance is an indispensable part of the process.

2. Results

As a result, export development has been stifled, resulting in a national foreign trade balance deficit in this sector. In addition, government investment strategies have resulted in a rapid increase in the number of forest product enterprises, but technology, scale and establishment location placement have developed haphazardly. Deficiencies in technology and finance, lack of qualified employees and their rapid turnover, bureaucratic obstacles, and insufficiency in demand are the main problems in the Turkish forest sector [3].

Timely prevention of breakdowns is possible only when all the factors involved function to a certain extent as planned before. If some factors do not function as planned before, loss of productivity may appear.

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The influence of sapwood and heartwood usage on the quality properties of particleboard

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Abstract: The impact of heartwood and sapwood usage on the physical, mechanical, and surface properties and formaldehyde emission of particleboard was investigated. European Larch (*Larix decidue* Mill.) trees were used as a raw material. The logs were divided into three segments: sapwood, heartwood and soundwood (heartwood and sapwood). Segments were chipped reduced into smaller particles. Urea formaldehyde was used an adhesive for the manufacturing of the test panels. Ammonium sulphate was added to the adhesive as a hardener. Mechanical properties (modulus of rupture (MOR) and modulus of elasticity (MOE), and internal bond (IB)), physical property (thickness swelling (TS)), and formaldehyde emission (FE)) of particleboards were determined according to European standards. Alcohol-benzene, hot and cold water and dilute alkali (1% NaOH) solubility's, lignin content and amount of ash were determined according to TAPPI standards. Holocellulose and cellulose contents were determined by chlorite and nitric acic methods. A Mitutoyo SJ-301surface roughness tester, a stylus type profilometer, was employed for the surface roughness tests. Contact angle (CA) measurements were performed using a CAM 101 Optical Contact Angle Meter (KSV Instruments Ltd., Helsinki). One-way analysis of variance was conducted to evaluate the effect of sapwood and heartwood usage on the quality properties of the panels. Significant differences between the mean values of the panel types were determined using Newman–Keuls's test. The highest amounts of cellulose, hemicelluloses and lignin were found in the sapwood, followed by soundwood, and the heartwood, respectively. The highest solubility values were obtained from heartwood, followed by soundwood, and the sapwood, respectively. While the lowest pH values were found in heartwood, the highest values were obtained from sapwood samples. The highest ash content and amount of condensed tannin were found in heartwood, followed by soundwood, and sapwood, respectively. The test panels manufactured from sapwood had the smoothest surface and the lowest contact angles, while the roughest surface and highest contact angle were obtained from the panels manufactured from heartwood. The panels made from sapwood had the required levels of MOR, MOE and IB for general purposes and furniture manufacturing. Particleboards made from soundwood met the required levels of MOR, MOE and IB only for general purposes. Panels made from heartwood did not have the required levels of mechanical strength properties. The test panels did not have the required level of TS property. Panels made from heartwood met the required level of FE for E_1 quality. The thickness swelling and formaldehyde emission values of the panels manufactured from heartwood significantly lower than the panels manufactured from the soundwood and sapwood. The highest mechanical strength values (modulus of rupture, modulus of elasticity and internal bond strength) were obtained from sapwood, followed by soundwood, and the heartwood, respectively. Surface smoothness and wettability of the particleboards manufactured from sapwood were better than those of soundwood and heartwood.

Keywords: Particleboard, Thickness swelling, Mechanical and chemical properties, Roughness, Contact angle, Formaldehyde emission

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Risk assessment for Kahramanmaraş paper mill

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Abstract: In this study, the hazards and risks that can occur in the paper industry in terms of worker health and work safety were analyzed and measures to be taken were described. Thus, the application of risk analysis in a sector related to forest products were performed to give an idea of how accomplished, and it is intended to serve as an example which will work in the related field further. Kahramanmaraş Paper Mill which belongs to Kahramanmaraş Paper Industry and Trade Joint Stock Company was selected as the application area depends on the was selected. In this study, based on the No. 6331 Occupational Health and Safety Act and technical staffs and employees which work in Kahramanmaraş Paper Mill in addition to concerning the health and security, and in terms of occupational health and safety which are important in the work environment; noise, light intensity, temperature, relative humidity, vibration, and indoor gas (nitrogen dioxide-NO2, sulfur dioxide-SO2, O2 and hydrogen sulfide-H2S) were measured. As a result of measurements, the average noise level and the light intensities of the factory were found as approximately 85.3 dB(A) and 207.92 lux, respectively. When evaluated based on the U.S. ASHRAE standards, enterprise's operating environment was found to be appropriate for the temperature. In addition, the relative humidity of the work section was at the desired level. According to regulation, hand-arm vibration measurements were at the desired level. Hydrogen sulfide was not observed except for the refining section. The oxygen level of the work area was within the accepted limit values (%19-25) in terms of worker health and safety. Sulfur dioxide was not observed in the any sections of factory.
Keywords: Risk analysis, Paper mill, Occupational health and safety

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The influence of pre-treatment on bonding strength of wood

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Abstract: Bonding performances of laminated veneer (prepared from chestnut and poplar woods) were determined by using urea formaldehyde and phenol formaldehyde adhesives which have widely usage in the furniture industry. The laminated veneer were investigated bonding strength after hold by 96 hours in water vapor, 1 week in water and 2 hours in 60 ° C, 103 ° C, -20 ° C temperatures. According to test results of chestnut was observed to be higher than poplar for all pretreatment implement bonding strength. Generally results showed that applied pretreatments had caused a decrease in bonding strength for in both types of adhesive. The lowest bonding strength was determined when exposed to water vapor. When all pretreatments are considered, laminated veneers which are manufactured from chestnut and PF adhesive are proposed to use under different environment conditions.
Keywords: Chestnut, Poplar, Water vapor, Water holding, Bonding strength

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Increasing refiner plates efficiency with SPC techniques in a fiberboard manufacturing plants

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Abstract: In the medium density fiberboard (MDF) product market, Asian countries, especially China, Indonesia, where labor costs and energy and raw material costs are low, provide a significant competitive advantage. Turkey and many developed European countries can only compete with more efficient and effective production processes. In this case, it is vital to use existing resources more efficiently, to reduce costs by constantly monitoring production processes that generate high costs. With this study, it was aimed to increase for working life of the refiner plates and the efficiency of the system by monitoring the energy consumption in the refinery unit. The working life of the refiner plates is of significance to the fiber board manufacturing plant. It may affect refining quality, productivity, and power consumption. In the analyzed process of production considered; although the target life for refiner plates use was 21 days, when historical data were examined the average was determined 11.7 (s=6.34) days. This indicates that an average of 55% of refiner plates life time can be used. The reason why the refiner plates are out of use in a short time is the presence of hard particles such as stone and iron in the dimensions smaller than the wood chips, which can not be detected by scanning in the process with the wood fiber. Extracting these materials before entering the production process requires expensive investments, but in many cases it is impossible. In this study, energy consumption in the refinery unit was monitored every hour and daily distributions in energy consumption were analyzed using regression control chart which are SPC techniques. As known, control charts are used extensively to detect and control various sources of variation in manufacturing environment. Control charts provide signals for the quality and consistency of the system's performance. For example; If for some reasons, the defibrator is more energy consumption in the same conditions, then sample information about energy consumption collected to monitor the process may point out to unexpected performances and states and therefore attract special attention. Thus, the presence of the common (also called random or chance) or special (also called assignable) causes affecting the system can be monitored, and when a signal out of the control limits is detected, it is interfered to the system. Eventually, the refiner plates are avoid from prematurely blunted over the foreseen use period..
Keywords: Medium density fiberboard (MDF), Refinery efficiency, Statistical process control (SPC), Regression control chart, Energy consumption

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