JEB
Journal of Environmental Biology
Journal Home page : www.jeb.co.in
E-mail : editor@jeb.co.in
ISSN: 0254-8704 (Print)
ISSN: 2394-0379 (Online)
CODEN: JEBIDP

Woody vegetation of Şile and its environs (Istanbul/Turkey) and destruction of the area

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Publication Info

Paper received:
02 July 2013

Revised received:
10 November 2013

Re-revised received:
18 June 2014

Accepted:
22 September 2014

Abstract

The woody vegetation of Şile district (Istanbul/Turkey), and its characteristics in conjunction with its environs are presented in this study. The field studies were performed using classic Braun-Blanquet method during 2003-2010 periods. In the present study three associations, two from forest vegetation and one from maquis vegetation, were characterized in the field. One of these associations is new and its description, typification and syntaxonomy was proposed. Phytosociological and phytoecological features of all three associations were compared with their relatives and related discussion was done accordingly. The associations described in the present study were as follows: *Phillyreo-Lauretum nobilis, Smilaco-Castanetum sativae, Fago orientalis-Quercetum ibericae* ass. nova. Furthermore, some soil properties such as saturation, organic matter, pH, $CaCO_3$, K_2O and P_2O_5 were analyzed. Relationship between vegetations, their ecological characteristics and protection of these vegetations against biotic pressures are outlined in the present work.

Key words

Forest vegetation, Phytosociologic, Phytoecologic, Soil analysis

Introduction

Turkey is a large peninsula situated between Europe and Asia and consists of two major parts: Eastern Trace and Anatolia. In Turkey, there are three major phytogeographical regions: Euro-Siberian, Mediterranean and Irano-Turanian (Çolak and Rotherham, 2006). Diverse regions of Turkey are endowed with a wide variety of natural habitats ranging from mountainous regions and plains to an extensive coastal line including deeply incised valleys, expansive steppes, fertile alluvial plains and arid rocky hill slopes (Kaya and Raynal, 2001). Its richness about the climate, geology, topography has led to form a wide variety of natural habitats associated with prosper vegetation systems. As an example, the forests of Turkey are covered naturally by more than 450 species of trees and shrubs (Çolak and Rotherham, 2006). Since 1960s, phytosociological plot sampling methods have been employed for woody vegetation studies in Turkey. A first comprehensive and still authoritative contribution to the diversity of forests in Turkey was published by Mayer and Aksoy in 1986. A number of local studies have been conducted by several researchers on oak forest vegetation (Akman *et al*., 1978–1979; Quézel *et al.,* 1980; Kılınç¸, 1985; Kutbay and Kılınç¸, 1995; Karaer *et al.,* 1999; Yurdakulol *et al.,* 2002; Türe *et al.,* 2005; Kavgacı *et al.,* 2010 and Uğurlu *et al.,* 2012).

Climate, soil conditions, ecological disturbance, and human influence are the factors affecting tree and shrub composition and structure in both rural and urban areas (Pedlowski *et al.,* 2002). Worldwide changes caused by human activities such as intensive deforestation and urbanization are being expanded along with considerable loss of plant communities (Khan, 1960). Clear cutting and extensive use of grasslands for raring animal herds are other factors causing loss of the species richness of plant communities (Johnson *et al.,* 1993). Aridity, soil salinity, soil erosion and acid rain are deteriorating environmental aspects in different parts of the world and as a result, conservation of highly endangered plant communities is becoming an important issue. For this, suitable methods are being considered and taken by the ecologists (Ahmad, 2008). Continuous degradation leads to changes in the natural structure of climax vegetation and due to changes, the climax vegetation is being transformed into steppic or substitute vegetation (Korkmaz *et al*., 2011).

In the present study woody vegetation and its characteristics in Şile district has been investigated and relationship between vegetation and their ecological characteristics are presented.

Materials and Methods

Study area : Şile is located on the Northwest of Turkey on the Asian side of Anatolia (41° 10' 35" N; 29° 36' 46" E). The district is 70 km from Istanbul and covers an area of 755 km^2**.** Neighboring districts are Kandıra (Kocaeli City) to the east, Gebze, Körfez and Derince (Kocaeli City) to the south, Pendik to the south-east and Beykoz and Çekmeköy to the west. Black Sea extends on the north of the district (Fig. 1.) (Tuzlacı and Tolon, 2000; Anonymous, 2013).

The district has a population of 28.847 inhabitants (Anonymous, 2013). The dispersion of population is homogeneous based on the age and gender. Fishing and farming activities are the main source of livelihood for the village. Lately, tourism has become an important source of income for the economy of Şile and on average, the tourist population greatly exceeds the number of permanent residents, especially during summer period (Ayberk *et al*., 2010).

The area shows a low plateau characteristic with an average altitude of 126 m. There are hilly terrains in the area and Kayalıkuyu (411 m), Küpeliler (426 m) and Elmalı (480 m) hills are three of them. Also, Türknil, Kabakoz, Göksu and Ağva are the main streams in the region (Anonymous, 1987).

The geological structure in Şile district consists of the Devonian (first age), Triassic and Cretaceous (second age), Paleocene, Eocene and Neogene (third age) and Pleistocene and Holocene (fourth age) originated sedimentary formations.

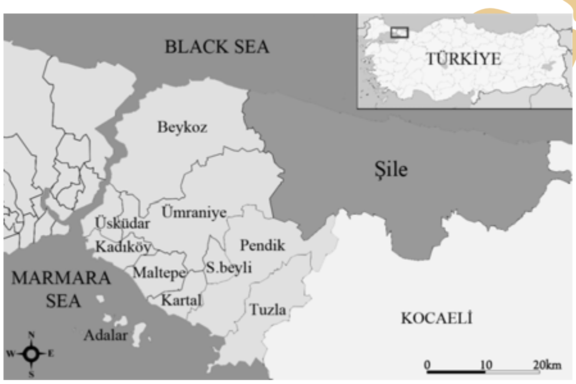

Fig. 1 : The study area (Şile district), its neighboring districts and their location in Turkey during 2003-2010 vegetation periods

Formations were influenced by the movements of Alpine and Hyrcanian. In addition, wide and deep Neogene basin in the west of district is rich with clay-porcelain clay, molding sand, quartz sands and brown coal mining potential (Ertek *et al*., 1998).

Non-calcareous and brown forest soil with good drainage condition cover the largest area in the district. Sand dunes and stretches of beach sands extend from the intrazonal soils. Alluvial soils are widespread in the valley floors (Anonymous, 1987).

A semi-arid Mediterranean climate is dominant in the area with local oceanic climate. The annual average temperature is 14.5 ºC. The lowest and highest temperature is recorded during January (average 2.8ºC) and August (average 29.2ºC). The annual average precipitation is about 771.7 mm and the precipitation is seen all the year around but the highest precipitation is generally observed during December and January (Anonymous, 2006). Raining regime is W.A.Sp.Su. (Winter, Autumn, Spring, Summer). The rain regime is named as "Central-Little Rainfall Mediterranean Regime" (Akman, 1999).

The general vegetation consists of forests, pseudomaquis and littoral formations. The pseudomaquis formation emerges because of destruction or degeneration of the forests. The forests cover 79% of the area. The northern zones of the area are covered by moist forest type. The highest coverage was found with *Quercus* species and *Fagus* (the main taxon of the moist forests). The forest vegetation of the Kocaeli Peninsula including Şile, has been reported as secondary vegetation (Regel, 1963; Dönmez, 1979; Tuzlacı and Tolon, 2000; Ayberk *et al*., 2010).

Data analyses : Plant and soil samples were collected from the Şile district during 2003-2010. Flora of Turkey was followed for taxonomic nomenclature (Davis, 1965-1985). Life form spectra for each association were determined according to the scale of Raunkiaer (1934), and are presented in Tables (1-3). Ecological data was recorded using random quadrate sampling method. For classification of vegetation, the Braun-Blanquet approach was employed (Braun-Blanquet, 1964). The size of quadrats was estimated by minimal area method and it ranged from 400 to 1000 m^2. For syntaxonomic nomenclature, Weber *et al*. (2000) was followed and related references used for the correct classification of syntaxonomic categories in plant associations (Akman, 1995; Yurdakulol *et al*., 2002; Varol *et al*., 2006; Aksoy and Gemici, 2010; Karaer *et al*., 2010; Efe, 2010; Ketenoğlu *et al*., 2010a; Özen, 2010; Altay *et al*., 2012). Sorensen (1948) Index of similarity was used in comparison of associations.

Soil samples were collected with a soil borer at a depth of 30 cm from each quadrate and fed through a 2-mm sieve. Soil texture, $CaCO_3$ (%), pH, organic matter (%), plant-available soil phosphorus and total K levels were determined following the method of Tüzüner (1990) and Öztürk *et al*. (1997), respectively.

Results and Discussion

Three different plant associations were found following an evaluation of 30 sampling areas selected from Şile district. The plant groups covering the study area were divided into two vegetation types; forest (two associations) and maquis (one association). Syntaxonomical interpretations of these associations are shown below: Class: Querco-Fagetea (Br.-Bl. & Vliegler 1937) Fuk. & Fab. 1968; Order: Rhododendro-Fagetalia orientalis (Quézel *et al.,* 1980); Association : *Fago orientalis-Quercetum ibericae* ass.nova; Alliance : Casteneo sativae-Carpinion orientalis (Quèzel, Barbèro and Akman, 1980); Association : *Smilaco-Castanetum sativae* (Ketenoğlu, Tuğ and Kurt, 2010); Class : Quercetea ilicis Braun-Blanquet 1947 ex A. and O. Bolòs Y Vayreda 1950; Order : Quercetalia ilicis Braun-Blanquet 1936 em. Rivas Martinez 1974; Alliance : Quercion ilicis Braun-Blanquet (1931) 1936 em. Rivas Martinez 1974; Association : *Phillyreo-Lauretum nobilis* Quèzel, Barbèro and Akman 1980

Castanea sativa Mill. was the dominant taxon of this association and showed wide range of distribution from east Black Sea to Marmara and Aegean regions in Turkey. The association was distributed on the east, south, north, northwest and northeast slopes with 10°-35° inclination, between 100-130 m altitudes. The general coverage ranged from 85 to 90%. *Carpinus betulus* L., *Epimedium pubigerum* (DC.) Moren & Decaisne and *Hedera helix* L. were dominant in the plant physiognomy (Table 1). The result of physical and chemical analysis of the soil samples collected from Şile are presented in Table 4. According to these results the association was capable of growing in clay loam, medium acidic and limeless soils. The soils in which the association grew were poor in K_2O, medium in P_2O_5 and high in organic matter. The largest group of life forms were phanerophytes (44.12%) and hemicryptophytes (32.35%). The percentage of other life forms were as follows: geophytes (17.65%), chamaephytes (2.94%) and therophytes (2.94%) (Table 5). This association was mainly distributed around Sofular, Yeşilvadi and Yeniköy villages.

Dominant taxon in this newly found association was *Quercus petraea* (Mattuschka) Liebl. subsp. *iberica* (Steven ex Bieb.) Krassiln. The association was distributed in the north, south, northeast and southeast slopes with 10°-35° inclination at an altitude of 90 to 190 m. The general coverage ranged between 60-90%. *Q. petraea* subsp. *iberica*, *Fagus orientalis* Lipsky, *Sorbus torminalis* (L.) Crantz and *Pteridium aquilinum* (L.) Kuhn were dominant in the plant physiognomy (Table 2). The soil samples collected from the study area were strongly acidic and rich in P_2O_5, poor in K_2O and high in organic matter. The soil was clay loamy and limeless (Table 4). The largest group of life forms was phanerophytes (44.44%) and hemicryptophytes (29.64%). The percentage of other life forms were as follows: geophytes (18.52%), therophytes (3.70%) and chamaephytes (3.70%) (Table 5), distributed around Yeniköy, Tekeköy and Yeşilvadi villages.

Laurus nobilis L., 'native of Mediterranean region' was the dominant taxon of this association and distributed on the north, northeast and northwest slopes with 20°-35° inclination, at an altitude of 45 to 50 m. The general coverage ranged between 90-100%. *Laurus nobilis*, *Carpinus orientalis* Mill., *Myrtus communis* L., *Arbutus unedo* L. and *Erica arborea* L. were dominant in the plant physiognomy (Table 3). The soil was clay loamy, highly acidic and limeless. The soil was medium in P_2O_5, poor in K_2O and low in organic matter content (Table 4). The life forms were phanerophytes (59.26%), hemicryptophytes (25.93%) and geophytes (14.81%) (Table 5), distributed mainly around Alacalı, Sofular, Yeşilvadi and Yeniköy villages.

There were many *C. sativa* associations, which had different codominant species in Turkey (Quézel *et al*., 1980; Bekat and Oflas, 1990; Kutbay and Kılınç 1995; Yurdakulol *et al*., 2002; Ketenoğlu *et al*., 2010 a, b; Öner and Akbin, 2010; Özen, 2010; Altay *et al*., 2012). Floristic resemblance of the associations varied between 4.25 and 44.74% and the highest resemblance was reported by Ketenoğlu *et al*. (2010a) (Table 6).

Till date 8 different *C. sativa* associations were determined (Table 6). Different species were found in *C. sativa* forests. This led to the formation of different associations as a consequence of changing ecological, geological, geographical and climatic conditions from East Black Sea to Marmara and Aegean regions (Ketenoğlu *et al*., 2010b). Nevertheless, chestnut forests comprised of 0.1% of forests in Turkey, while 42% were covered with coniferous, 53.3% were covered with broad leaved forests and 4.5% were covered with mixed forests of both coniferous and broad-leaved species (Mayer and Aksoy, 1986; Ketenoğlu *et al*., 2010a). Additionally, chestnut forests have great importance in Turkey, due to their genetic origin of the species in Turkey (Ketenoğlu *et al*., 2010a).

In the present study, *C. sativa* association was directly included in the order Rhododendro-Fagetalia orientalis and class Querco-Fagetea and *Smilaco-Castanetum sativae* association introduced by Ketenoğlu *et al*., (2010a), since the character species of this association showed high resemblance ratio and includes the same diagnostic species. *Q. petraea* subsp. *iberica* was one of the oak tree species, forming dominant or mixed forests in Turkey. There were many *Q. petraea* subsp. *iberica* associations having different co-dominant species in Turkey (Quézel *et al*., 1980; Akman *et al*., 1983 a, b; Adıgüzel and Vural, 1995; Kutbay *et al*., 1998; Yurdakulol *et al*., 2002; Altay *et al*., 2012). Floristic resemblance of these associations varied between 16.66 and 42.85% and the highest resemblance was seen with Yaltırık *et al*., 1983. Additionally, evaluation of 8 different *Q. petraea* subsp. *iberica* associations has been carried out so far (Table 6).

Table 1 : Characteristic of *Smilaco-Castanetum sativae* association

	Quadrate Number	7	8	9	10	11	12	13	14	15	16	
	Altitude (m x 10)	10	10	11	13	13	10	13	12	10	10	
	Size of the quadrate (m^2 x 1000)	1	1	1	1	1	1	1	1	1	1	
	Direction	NW	NE	NE	NW	E	E	S	N	N	N	
	Inclination (º)	30	30	15	20	30	30	35	35	10	10	
	Coverage (%)	90	90	90	90	85	85	85	90	90	90	
	Mainrock	A N D E S I T E										
Ph	*Castanea sativa*	44	54	44	44	44	44	54	54	54	44	V
G	*Smilax excelsa*	.	23	23	33	12	12	.	13	13	13	IV
	***Carpino-Acerion* (*) Alliance, *Querco-Carpinetalia* (**) Order and *Quercetea pubescentis* Class**											
H	***Cirsium hypoleucum*	+1	.	.	+1	.	+1	.	+1	+1	.	III
Ph	*Clematis vitalba*	+1	.	+1	.	+1	.	.	.	.	+1	II
H	***Dorycnium pentaphyllum*	.	.	+1	.	+1	.	+1	+1	.	.	II
H	***Viola sieheana*	+1	.	.	+1	.	+1	.	.	.	.	II
H	**Helleborus orientalis*	.	.	.	+1	.	.	+1	.	.	.	I
Ph	***Mespilus germanica*	.	.	.	.	+1	.	.	.	.	+1	I
Ph	*Cornus mas*	.	+1	.	.	.	.	.	.	.	.	I
Ph	*Sorbus torminalis*	.	.	.	.	.	+1	.	.	.	.	I
	***Castaneo-Carpinion* (*) Alliance, *Rhododendro-Fagetalia* Order and *Querco-Fagetea* (**) Class**											
Ph	**Carpinus betulus*	33	22	33	22	22	23	12	+1	12	+1	V
H	*Epimedium pubigerum*	12	12	12	12	23	.	32	12	12	12	V
Ph	*Quercus petraea* subsp. *iberica*	.	22	.	22	.	.	+1	+1	12	.	III
Ch	*Hypericum calycinum*	.	.	.	.	12	12	.	12	+1	+1	III
G	*Trachystemon orientalis*	+1	.	+1	.	.	.	.	+1	+1	+1	III
Ph	*Daphne pontica*	.	+1	+1	.	.	.	.	13	13	13	III
G	***Ruscus hypoglossum*	.	.	.	12	12	.	.	.	.	22	II
	***Quercetea ilicis* Class**											
Ph	*Erica arborea*	.	.	+1	.	23	23	33	23	23	23	IV
G	*Ruscus aculeatus*	.	.	.	.	+1	+1	23	+1	+1	+1	III
Ph	*Arbutus andrachne*	.	12	+1	.	.	.	+1	12	12	12	III
H	*Rubia tinctorum*	+1	.	.	+1	.	.	+1	.	.	.	II
Ph	*Laurus nobilis*	.	.	+1	.	.	+1	.	.	.	.	I
Ph	*Arbutus unedo*	.	.	11	.	.	.	+1	.	.	.	I
Ph	*Phillyrea latifolia*	11	.	.	.	.	.	.	.	.	.	I
	***Cisto-Micromerietea* Class**											
Th	*Psoralea bituminosa*	.	+1	+1	.	.	.	.	+1	+1	.	II
	***Querco-Fagea* Super Class**											
Ph	*Hedera helix*	23	12	12	12	+1	+1	12	12	22	22	V
G	*Tamus communis*	+1	+1	.	.	.	+1	+1	+1	.	.	III
H	*Brachypodium sylvaticum*	.	+1	.	+1	.	+1	+1	.	+1	.	III
H	*Geum urbanum*	.	.	.	+1	.	+1	.	.	+1	+1	II
Ph	*Corylus avellana*	12	.	.	12	+1	12	.	.	.	.	II
H	*Fragaria vesca*	.	+1	.	.	+1	.	.	+1	.	.	II
H	*Primula vulgaris*	.	.	.	.	+1	.	.	+1	.	.	I
G	*Teucrium chamaedrys*	.	.	.	.	.	.	+1	.	.	+1	I
H	*Geranium robertianum*	+1	.	.	.	.	.	.	.	.	.	I

Fago orientalis-Quercetum ibericae ass. nova was defined as a new association, owing to both low resemblance ratio (except *Quercus petraea* ssp. *iberica-Lathyrus niger* association defined by Yaltırık *et al*. (1983) and differentiation of character species with other associations. The greater number of species belonging to *Fago orientalis-Quercetum ibericae* ass. nova were placed in the Rhododendro-Fagetalia orientalis order and Querco-Fagetea class. Therefore, the present association was included in these syntaxa units.

In the present study, *Phillyreo-Lauretum nobilis* association was mainly observed on the coastline of Şile district. There were many *P. latifolia* L. and *L. nobilis* associations, which have different codominant species in Turkey (Quézel *et al*., 1980; Ketenoğlu *et al*., 1983; Kutbay and Kılınç, 1995; Vural *et al*., 1995; Özen, 2010; Altay *et al*., 2012). Floristic resemblance of the associations varied between 14.41 and 51.02% and the highest resemblance was observed by Quézel *et al*. (1980). Additionally till 2013, seven different *P. latifolia* and *L. nobilis* associations

Table 2 : Characteristic of *Fago orientalis-Quercetum ibericae* ass. nova (*Holotypus Quadrat Number: 25)

	Quadrate Number	1	2	23	24	25*	26	27	28	3	4	5	6	
	Altitude (m x 10)	9	10	10	19	10	18	15	12	11	11	10	9	
	Size of the quadrate (m^2 x 1000)	1	1	1	1	1	1	1	1	1	1	1	1	
	Direction	S	S	N	N	S	S	S	N	N	S	SE	NE	
	Inclination (^{0})	30	35	10	10	30	25	35	10	15	15	15	15	
	Coverage (%)	90	90	90	80	80	80	90	80	80	60	80	60	
	Mainrock	A	N	D	E		S	I	T	E				
Ph	*Quercus petraea* subsp. *iberica*	54	54	12	54	54	54	44	44	44	34	44	34	V
Ph	*Fagus orientalis*	.	11	44	22	22	+1	11	+1	+1	12	+1	12	V
	Rhododendro-Fagetalia orientalis **Order and** ***Querco-Fagetea*** **(*) Class**													
G	*Smilax excelsa*	23	12	23	+2	12	33	22	23	22	12	22	33	V
Ch	*Hypericum calycinum*	23	12	+1	+2	12	+1	12	+1	+1	12	12	+1	V
Ph	*Daphne pontica*	.	+1	+2	+1	+1	12	+1	.	+1	23	22	+1	V
H	*Epimedium pubigerum*	.	23	12	.	.	.	22	.	.	23	12	23	III
G	**Ruscus hypoglossum*	.	.	.	+1	+1	+1	.	.	.	.	.	.	II
H	**Stellaria holostea*	.	.	.	+1	+1	+1	.	.	.	.	.	.	II
G	*Trachystemon orientalis*	.	+1	.	.	+1	.	.	.	.	.	.	.	I
Ph	**Crataegus monogyna*	.	.	.	.	.	.	.	22	.	.	.	.	I
	Querco-Carpinetalia orientalis **(*) Order and** ***Quercetea pubescentis*** **Class**													
Ph	*Sorbus torminalis*	23	+1	+1	12	12	22	+1	+1	12	+1	+1	+1	V
Ph	**Mespilus germanica*	.	11	12	+1	+1	+1	.	.	+1	.	.	.	III
H	**Viola sieheana*	.	.	.	+1	+1	.	.	.	.	.	.	.	I
Ph	*Cornus mas*	.	.	.	.	.	.	.	+1	.	.	.	.	I
	Quercetea ilicis **Class**													
Ph	*Erica arborea*	.	22	.	33	33	33	23	+1	+1	22	33	12	V
Ph	*Arbutus unedo*	.	+1	.	.	.	.	+1	.	.	.	+1	.	II
H	*Rubia tinctorum*	+2	+1	.	.	.	.	.	.	.	+1	.	.	II
Ph	*Arbutus andrachne*	.	+1	.	.	.	.	.	.	.	.	.	.	I
Ph	*Phillyrea latifolia*	+1	.	.	.	.	.	.	.	.	.	.	.	I
G	*Ruscus aculeatus*	.	.	.	.	.	.	.	.	.	.	+1	.	I
	Cisto-Micromerietea **Class**													
G	*Pteridium aquilinum*	33	33	12	23	33	22	33	22	22	33	33	33	V
	Querco-Fagea **Super Class**													
Ph	*Hedera helix*	.	.	+2	13	12	23	.	11	11	.	22	.	III
H	*Fragaria vesca*	.	.	+1	+1	.	.	.	.	.	.	.	.	I
H	*Brachypodium sylvaticum*	.	.	.	.	+1	.	+1	.	.	.	.	.	I
H	*Lapsana communis*	.	.	.	+1	+1	.	.	.	.	.	.	.	I
	Companions													
Th	*Galium aparine*	12	+1	.	.	+1	.	+1	.	+1	+1	+1	+1	IV
H	*Campanula rapunculus*	+1	.	+1	.	.	.	.	.	.	.	.	.	I

have been determined (Table 6). The species mentioned above originated from Mediterranean, belonging to the Quercetea ilicis class, together with other characteristic and identifying species, dominant in this group. Thus, this association was included under Quercetea ilicis class, Quercetalia ilicis order and Quercion ilicis alliance (Yurdakulol *et al*., 2002).

Soil analysis showed that all three associations prefered similar texture (clay loamy, limeless, and poor in K_2O) characteristics. However, pH, P_2O_5 and organic matter requirements showed some difference (Table 4). It was observed that ground flora was very poor in strongly and/or moderately acidic soils, in the study area. Higher soil acidity negatively affected the activity saprophytic microorganism and litter layer dissociated slowly (Whittaker, 1975). Organic matter content in the soil influences buffering capacity of the soil and soil reaction. High cation exchange capacity carried out by the plant associations was noticed in the research area because of rich or very rich organic matter content in the soil (Kutbay and Kılınç, 1995).

Sönmez (2005) mentioned that species such as *Fagus orientalis*, *Carpinus* sp. and *Q. petraea* subsp. *iberica* generally showed distribution on brownish soils without lime. This situation showed consistency with distribution of *Fago orientalis-Quercetum ibericae* ass. *nova* in the research area. Additionally, this association affected the ground flora since its dominant species *Q. petraea* subsp. *iberica* had lobed leaves, which

Table 3 : Characteristic of *Phillyreo-Lauretum nobilis* association

	Quadrate Number	17	18	19	20	21	22	29	30	
	Altitude (m)	50	50	45	45	45	45	50	50	
	Size of the quadrate (m^2 x 100)	4	4	4	4	4	4	4	4	
	Direction	NE	NE	N	NW	N	N	N	NW	
	Inclination (^{0})	20	20	35	35	30	30	30	20	
	Coverage (%)	100	95	100	100	95	90	100	100	
	Mainrock	A N	D	E	S	I	T	E		
Ph	*Laurus nobilis*	22	32	22	22	33	23	23	22	V
Ph	*Phillyrea latifolia*	12	12	12	12	32	12	12	12	V
	***Quercetalia (etea) ilicis* Order and Class**									
Ph	*Myrtus communis*	32	32	32	32	22	22	23	32	V
Ph	*Arbutus unedo*	32	32	32	32	22	22	23	32	V
G	*Ruscus aculeatus*	12	+1	12	+1	22	12	12	12	V
Ph	*Erica arborea*	32	32	32	32	.	23	32	32	V
G	*Smilax aspera*	+1	+1	12	12	.	12	23	+1	V
G	*Asparagus acutifolius*	+1	+1	+1	+1	22	+1	.	.	IV
Ph	*Osyris alba*	+2	.	+2	+2	+2	+2	.	+2	IV
Ph	*Juniperus oxycedrus*	.	+1	+1	.	+1	+1	+1	+1	IV
Ph	*Arbutus andrachne*	12	.	.	12	.	12	.	12	III
	***Carpino-Acerion* (*) Alliance, *Querco-Carpinetalia orientalis* (**) Order and *Quercetea pubescentis* Class**									
Ph	***Carpinus orientalis*	22	22	22	22	32	22	12	.	V
Ph	*Acer campestre*	+1	+1	+1	+1	.	+1	+1	+1	V
Ph	*Clematis vitalba*	+1	.	.	+1	+1	.	+1	.	III
Ph	*Cornus mas*	.	+1	.	+1	+1	+1	.	.	III
H	***Dorycnium pentaphyllum* subsp. *herbaceum*	.	+1	+1	+1	.	.	+1	.	III
H	**Helleborus orientalis*	+1	.	.	.	+1	.	.	.	II
H	***Polygala supina*	.	.	.	.	.	.	+1	.	I
	***Rhododendro-Fagetalia* (*) Order and *Querco-Fagetea* Class**									
Ph	**Daphne pontica*	12	+1	12	12	22	12	.	+1	V
Ph	*Crataegus monogyna*	.	+1	+1	.	+1	+1	+1	+1	IV
H	**Epimedium pubigerum*	+1	+1	+1	+1	.	+1	+1	.	IV
	***Querco-Fagea* Super Class**									
Ph	*Hedera helix*	22	22	23	23	23	23	23	22	V
G	*Tamus communis*	+1	+1	+1	+1	+1	+1	.	+1	V
H	*Fragaria vesca*	.	+1	+1	+1	+1	+1	.	.	IV
H	*Geranium robertianum*	+1	.	.	+1	.	+1	.	.	II
H	*Geum urbanum*	.	.	.	.	+1	.	.	+1	II
	Companions									
Ph	*Vitis vinifera*	.	.	.	+1	+1	.	.	.	II

provided light penetration to the ground. Nevertheless, only some distinct plant species such as *P. aquilinum*, *E. arborea* and *Hypericum calycinum* L. were located in the under forest flora and their presence prevented development of other plant species (Kantarcı, 2008; Öner and Akbin, 2010; Altay *et al.*, 2012).

The *Quercetea ilicis* class was represented by few taxa (*Arbutus andrachne* L., *Rubia tinctorum* L., *A. unedo*, *R. aculeatus* L. and *P. latifolia*) in the forest vegetation of the area. It is known that distribution of this class was observed in most parts

Table 4 : Soil characteristics of the sampling sites, where plant associations are distributed

	Phillyreo-Lauretum nobilis	***Smilaco-Castanetum sativae***	***Fago orientalis-Quercetum ibericae* ass. nova**
Saturation (%)	53.80	61.20	54.40
pH	3.00	6.00	5.00
$CaCO_3$ (%)	0.00	0.00	0.00
Organic matter (%)	4.70	5.16	5.20
P_2O_5 (kg da^{-1})	3.26	2.75	3.30
K_2O (kg da^{-1})	62.83	77.69	33.30

Table 5 : The percentages of the life forms in different plant associations

Associations	**Ph**	**H**	**Th**	**G**	**Ch**
Phillyreo-Lauretum nobilis	59.26	25.93	-	14.81	-
Smilaco-Castanetum sativae	44.12	32.35	2.94	17.65	2.94
Fago orientalis-Quercetum ibericae ass. nova	44.44	29.64	3.70	18.52	3.70

Ph: Phanerophytes; H: Hemicryptophytes; Th: Therophytes; G: Geophytes and Ch: Chamaephytes

Table 6 : A comparison of the associations with other studies using Sorensen's (1948) similarity (%) index

	Phillyreo-Lauretum nobilis	***Smilaco-Castanetum sativae***	***Fago orientalis-Quercetum ibericae* ass. nova**
Quézel *et al.*, 1980	51.02	27.64 – 38.20	21.78
Akman *et al.*, 1983a	-	-	20.56
Akman *et al.*, 1983b	-	-	22.47
Ketenoglu *et al.*, 1983	28.98 – 39.39	-	-
Yaltırık *et al.*, 1983	-	-	42.85
Bekat and Oflas, 1990	-	4.25	-
Adıgüzel and Vural, 1995	-	-	16.66
Kutbay and Kılınç, 1995	16.09 – 26.67	22	-
Vural *et al.*, 1995	14.41	-	-
Kutbay *et al.*, 1998	-	-	31.17
Yurdakulol *et al.*, 2002	-	32.18	29.17
Ketenoglu *et al.*, 2010a	-	44.74	-
Öner and Akbin, 2010	-	18.70	-
Özen, 2010	18.75	37.11	-
Altay *et al.*, 2012	27.12	43.81	26.67

of the shores of the Mediterranean and northwest Anatolia (some parts are influenced by the Mediterranean climate). Thus, the study area included both Mediterranean and Black Sea vegetation types (Atalay and Efe, 2010).

The residential population in the Şile district was not very high. However, there were many summer houses and seasonal hotels, and when people from other cities moved to Şile for touristic purposes, the population reached up to 250.000. This increase exerts a great pressure on the vegetation. Recently, the vegetation has been damaged severely in the area due to human activities. The local people living in Şile, summer residents and the people visiting the area for touristic purposes cause detrimental damage to the natural vegetation willingly or unwillingly. As stated by Öztürk *et al*. (2010), major threats facing the forest vegetation in Turkey are; over and illegal tree cutting, fires, climate change, agricultural land development and clearance, over-grazing, harmful insects and fungi, wind, snow, unsuccessful regeneration attempts and infrastructure establishments. Additionally, overgrazing also resulted in reduced vegetation cover when livestock density became high (Mayer and Aksoy, 1986; Çanakçıoğlu, 1993). The number of *C. sativa, F. orientalis* and *Q. petraea* subsp. *iberica* trees have reduced due to deforestation activities, and under forest flora has vanished from most of the habitats. There is a need for strong sanctions by the local municipal authorities in order to save the vegetational cover of Şile and its environs in order to overcome the negative effects. Also, attempts should be taken to make people conscious about the problem.

Acknowledgment

We would like to thank Dr. Ilhan Dogan from Institute of Technology, Department of Molecular Biology and Genetics, Izmir, for linguistic improvement.

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