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Contributions to the Syntaxonomy and Ecology of the Forest and Shrub Vegetation in Bithynia, Northwestern Anatolia, Turkey

By

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With 4 Figures

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Summary

TÜRE C., TOKUR S. & KETENOĞLU O. 2005. Contributions to the syntaxonomy and ecology of the forest and shrub vegetation in Bithynia, Northwestern Anatolia, Turkey. – *Phyton* (Horn, Austria) 45(1): 81–115, 4 figures. – English with German summary.

The forest vegetation of the investigated area has been studied using the BRAUN-BLAUNQUET approach. The following associations were described: Two shrub associations, the *Junipero oxycedri-Quercetum pubescentis* ass. nova and the *Hieracio pannosi-Cistetum laurifolii* ass. nova were included in the alliances *Quercion anatolicae* and *Pino-Cistion laurifolii* respectively. They are together with *Carpino-Acerion* united in the order *Quercio-Carpinetalia orientalis*, which comprises the mesophilous forest and shrub vegetation types of NW Anatolia. The forest associations *Argyrolobio biebersteinii-Quercetum cerridis* ass. nova, *Stellario holosteae-Pinetum pallasianae* ass. nova, *Daphno ponticae-Pinetum sylvestris*, and *Fago orientalis-Abietetum bornmuelleriana* were attached to the alliance *Carpino-Acerion*, the *Junipero foetidissimae-Juniperetum excelsae* ass. nova to the alliance *Quercion anatolicae* of the class *Quercetea pubescentis*. Only the *Trachystemo orientalis-Fagetum orientalis* belongs to the order *Rhododendro-Fagetalia orientalis* of the class *Quercio-*

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Fagetea. The manually sorted relevés have been classified on the basis of their floristical and ecological peculiarities. All forest stands in the area develop under a semi-dry and less rainy type of Mediterranean climate and on soils derived from limestone and schistous parent rock.

Zusammenfassung

TÜRE C., TOKUR S. & KETENOĞLU O. 2005. Beiträge zur Syntaxonomie und Ökologie der Wald- und Gebüschgesellschaften in Bithynien, nordwestliches Anatolien, Türkei. – *Phyton* (Horn, Austria) 45(1): 81–115, 4 Abbildungen. – Englisch mit deutscher Zusammenfassung.

Die Waldvegetation des Untersuchungsgebietes ist mit der Methode von BRAUN-BLAUNQUET erfasst worden. Folgende Assoziationen wurden beschrieben: Die Strauchgesellschaften *Junipero oxycedri-Quercetum pubescentis* ass. nova und *Hieracio pannosi-Cistetum laurifolii* ass. nova wurden den Verbänden *Quercion anatolica* bzw. *Pino-Cistion laurifolii* zugeordnet. Zusammen mit dem Verband *Carpino-Acerion* sind sie in der Ordnung *Quercio-Carpinetalia orientalis* vereinigt, die die mesophilen Gesellschaften besonders in NW Anatolien enthält. Die Waldgesellschaften *Argyrolobio biebersteinii-Quercetum cerridis* ass. nova, *Stellario holostea-Pinetum pallasianae* ass. nova, *Daphno ponticae-Pinetum sylvestris* und *Fago orientalis-Abietetum bornmuelleriana* wurden dem Verband *Carpino-Acerion*, das *Junipero foetidissimae-Juniperetum excelsae* ass. nova dem Verband *Quercion anatolicae* der Klasse *Quercetea pubescentis* zugeordnet. Lediglich das *Trachystemofagetum orientalis* gehört zur Ordnung *Rhododendro-Fagetalia* der Klasse *Quercio-Fagetea*. Die manuell sortierten Aufnahmen wurden aufgrund ihrer floristischen und ökologischen Merkmale den einzelnen Einheiten zugeordnet. Alle Waldbestände des Gebietes entwickeln sich unter Mittelmeerklima mit halbtrockenen und weniger feuchten Bedingungen und auf Böden über Kalkgesteinen bzw. Schiefern.

1. Introduction

The geographic position, the different geological structure and the geomorphologic features and as well as the variation of the climatic factors and the different soil types are the reasons for the high biodiversity in Turkey.

The study area is situated in the squares A2 and B2 (see fig. 1, DAVIS & al. 1988) at the intersection of three geographic regions: Aegean, Western Black Sea and Central Anatolia.

For Turkey the study area is interesting from the syntaxonomical and phytogeographical point of view due to the fact that it has many of the characteristics cited above as well as it is located in an area where Euro-Siberian, Mediterranean and Irano-Turanian floristic regions meet. Less is known about the syntaxonomical characteristics of the area because most of the vegetation studies in Turkey were focused on distinct regions and vegetation types.

This study aims to reveal syntaxonomical problems, and to obtain data to the vegetation map of Turkey, which is not available yet.

2. Material and Methods

2.1. Data Collection

The field survey to collect data for analysis of the vegetation was carried out between the years 1992 and 1995. For identification of the phytogeographical designation of the species recorded in the relevés the flora of Turkey and east Aegean Islands by DAVIS P. H. 1965–1985 was used. The localities of relevés are listed in Table 13.

To characterize the soils of the area, three soil samples from each horizon of the profiles from several plots representing eight plant associations are presented in this study. For physical and chemical analysis of the soil samples the following methods were used: Bouyoucus hydrometric method was used to analyse texture, for field capacity centrifuge method was used and pressure membrane extractor was used to determine wilting point. For chemical analyses, Schieber calcimeter for Ca-content, exchangeable K^+ , Na^+ by 1 N ammonium acetate at pH 7 by using Petracourt flame photometer ($\pm 0,01$ ppm sensitivity) and Ca^{++} , Mg^{++} , Fe^{++} , Zn^{++} , Mn^{++} and Cu^{++} by 1 N ammonium acetate at pH 7 by using Perkin Elmer 3030B Atomic Absorption Spectrometer, conductivity bridge equipment for total salt, Walkey-Blade for organic matter and Olsen Method for phosphorus analyses. Cations exchange capacity (CEC) was determined by flame photometer. Beckmen pH meter was used to determine pH (BLACK 1965, Amonymous 1994, GÜLÇUR 1974).

The climatic data were obtained from the General Directory of Meteorological Affairs and the Data for major soil characteristics from the General Directory of Soil-water Affairs of Turkey. For the geological survey, the work of ATALAY 1982 was followed.

The vegetation was analyzed by the BRAUN-BLANQUET's approach 1932. For the cover values of the species, the version suggested by BARKMANN & al. 1964 was used. 109 relevés, the sizes of which were estimated by minimal area method were selected by the authors. The calculation of the constancy values follows DIERSCHKE 1994.

2.2. Data Analysis

For the characterization of the climatic characteristics of the area, Emberger's pluviothermique quotient and Walters's ombrothermique diagrams (WALTER 1956) were used. For the classification of the relevés, they were sorted manually and presented in form of tables for each association separately (see Tabs. 3–10). The phytosociological nomenclature follows the 3rd edition of the international code of phytosociological nomenclature (WEBER & al. 2000).

2.3. Abbreviations

BS: Blueschist	MP: Mesophanerophytes
Ch: Chamaephytes	NP: Nanophanerophytes
CS: Chalk-Schist	Q: Pluviothermique Quotient
G: Geophytes	S: Drought Index
H: Hemicryptophytes	Sch: Schist
LF: Life form	Sh: Shrub
LS: Limestone	T: Tree
Medit: Mediterranean	Th: Therophytes
MIP: Microphanerophytes	

3. Brief Description of the Study Area

The study area is located within in the provincial boundaries of Bilecik-Bursa-Kütahya in Bithynia, the southeastern part of the Marmara region in northwestern Turkey. The altitudinal range varies from 450 to 1250 m. In the investigated areas of the Yirce-Bürmece-Kömürsu and Muratdere, the forests are surrounded by three plateaus: The Pazaryeri plateau in the North, Domaniç plateau in the South and Ynegöl plateau in the Northwest. The forest areas of Yirce-Bürmece and Kömürsu ($39^{\circ} 41' - 39^{\circ} 55' N$ and $29^{\circ} 42' - 29^{\circ} 50' E$) and Muratdere ($39^{\circ} 47' - 39^{\circ} 58' N$ and $29^{\circ} 45' - 30^{\circ} 17' E$) are the parts of Uludağ and Sündiken mountains (Fig. 1).

The geological structure of the area is mainly composed of metamorphic rocks, limestone and schist, originating from mainly Paleozoic

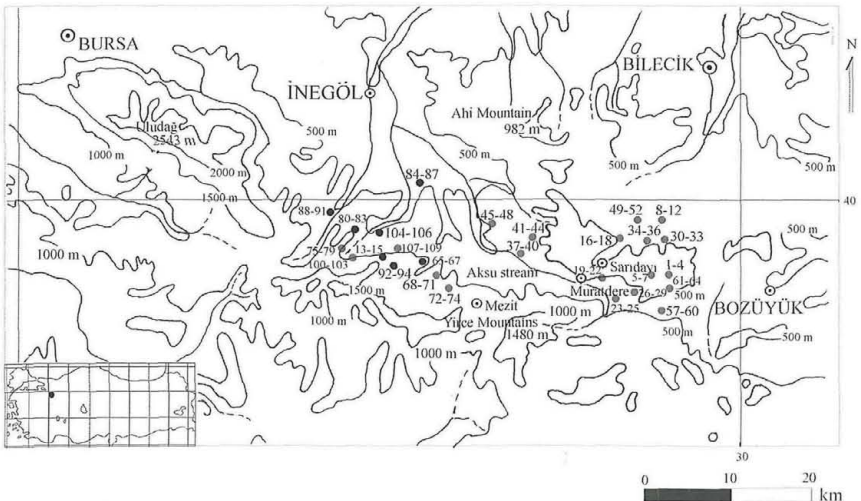


Fig. 1. The study area in NW Turkey. The numbers show the localities of the relevés (For data, see Tab. 13).

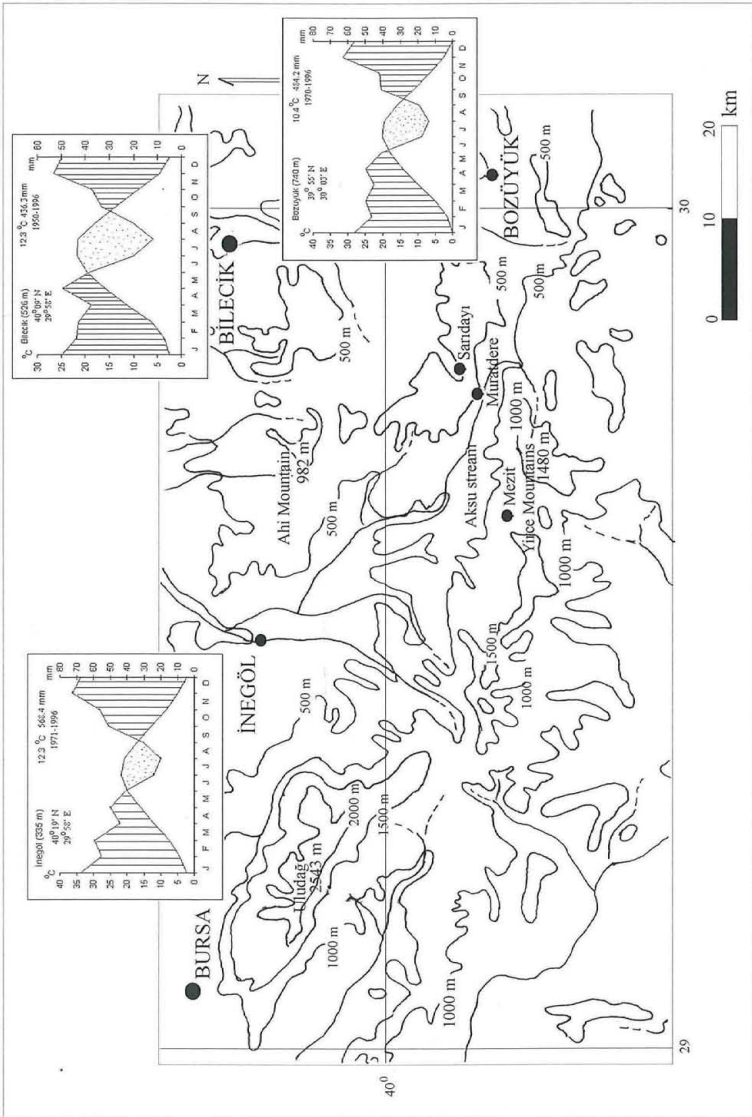


Fig. 2. Study area. Selected climatic diagrams.

Table 1.
Climatic data of the stations in the study area.

a. Mean Precipitation (mm)

	Period (Years)	W		Sp			S			F			W	Mean Annual Sum
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI			XII
Bilecik	62	49.7	43.6	42.7	37.4	49.4	38.4	19.8	11.7	20.1	33.3	37.2	53.1	436.6
Bozüyük	31	56.2	46.3	49.9	45.0	49.7	40.8	17.9	13.6	19.3	40.7	41.9	62.8	484.2
İnegöl	38	67.7	55.0	59.2	44.2	49.7	40.8	24.2	20.0	30.2	50.8	56.1	72.3	568.4

b. Mean Temperature (°C)

	Period (Years)	W		Sp			S			F			W	Mean Annual
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI			XII
Bilecik	53	2.4	3.6	6.2	11.4	15.9	19.6	21.6	21.5	18.0	13.6	9.0	4.5	12.3
Bozüyük	27	0.0	1.6	4.9	10.0	14.3	18.0	20.1	19.6	16.0	11.1	6.5	2.5	10.4
İnegöl	24	2.3	4.4	7.4	12.0	16.1	19.8	21.7	20.8	17.2	12.8	8.3	4.9	12.3

c. Mean Maximum Temperature (°C)

	Period (Years)	W		Sp			S			F			W	Mean Annual
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI			XII
Bilecik	53	5.5	7.5	11.0	16.8	21.5	25.3	27.6	27.7	24.2	18.9	13.5	7.9	17.3
Bozüyük	27	4.4	6.6	11.2	16.8	21.2	24.9	27.2	27.1	24.3	18.9	12.8	6.7	16.8
İnegöl	24	7.3	9.7	13.6	18.7	23.4	27.4	29.2	29.0	26.2	20.9	15.1	9.9	18.2

d. Mean Minimum Temperature (°C)

	Period (Years)	W		Sp			S			F			W	Mean Annual
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI			XII
Bilecik	53	-0.5	0.2	2.1	6.6	10.7	13.9	15.5	15.8	12.7	9.3	5.6	1.8	7.8
Bozüyük	27	-3.8	-2.6	-0.8	3.6	6.8	9.5	11.7	11.4	8.1	5.0	1.6	-0.8	4.1
İnegöl	24	-1.8	-0.2	2.0	5.5	8.7	11.5	13.4	12.4	9.4	6.5	3.1	8.0	5.9

Table 2.
Bioclimatic data of the stations in the study area.

Station	Altitude	S	Q	Prep. Regime	Bioclimate
Bilecik	526 m	2.5	55.9	WSpFS	Semi-dry Medit.
Bozüyük	740 m	2.7	72.6	WSpFS	Less rainy Medit.
İnegöl	335 m	2.9	2.3	WSpFS	Less rainy Medit.

era. Among the major formations in the area, the metamorphic ones, known as Bozüyük metamorphic rocks increasingly extend from northwest to the south. The second important formation are the upper-late Jurassic Bilecik limestones. Lithology of the Yirce-Bürmece-Kömürsu forest series grades into granite masses, semitransparent schist and marble towards Domanıç Mountain (ATALAY 1982).

Brown and red-brown soils are widespread in the area while alluvial and colluvial soils are restricted to small areas.

To determine the climatic characteristic of the area, the data of Bilecik, Bozüyük and Inegöl meteorological stations were evaluated (Tab. 1). According to the Emberger's pluviothermique quotient, the area is under the effective control of a semiarid and less rainy type of Mediterranean climate from the bioclimatic point of view (Tab. 2). The ombrothermique diagrams, on which the arid period can be easily seen, are presented in Fig. 2. The total mean precipitation increases towards the West of the area.

Forests are the dominant formation in the area. The percentage of the forest cover all over Turkey is about 26.8 %. The study area is about one percent of the forested area of Turkey. The main woody species occurring in forest communities are *Fagus orientalis*, *Pinus sylvestris*, *P. nigra* subsp. *pallasiana*, *Carpinus betulus* and *Abies bornmuelleriana*. The deciduous and coniferous forests in the area cover about 80 % of the total area while shrubs occupy the rest. Widespread species of the shrubby vegetation are *Quercus pubescens* and *Cistus laurifolius* in the eastern part (Central Anatolia side) of the area. *Platanus orientalis* is the dominant species along riverbanks. Due to the human impact, the woody riverine vegetation is largely destroyed.

Towards the east, *Pinus nigra* subsp. *pallasiana* and *Quercus cerris* var. *cerris* occupy an altitudinal range between 600 and 1100 m. In the south of the study area above 1000 m, *Juniperus excelsa* and *Juniperus foetidissima* communities show a wide distribution.

Abies bornmuelleriana and broad-leaved forests accompanied by euxinian species accordingly occupy vast areas from Bozüyük towards Inegöl in northwest of the area. The thermophilous areas, where the yearly sum of precipitation decreases, particularly in the Eastern parts, usually are occupied by *P. nigra* subsp. *pallasiana*, *Quercus pubescens* and Juniper species.

4. Results

4.1. Shrub Vegetation

Juniperus oxycedrus-*Quercetum pubescentis* ass. nova (Tab. 3, relevés 1–12)

Holotypus: Tab. 3, relevé 2. South of Aşağy Armutlu Village. Lat: 39°54'18.12" N, Lon: 29°56'16.14" E, 750 m, cover 50 %, 400 m². – Character species: *Quercus pubescens*, *Juniperus oxycedrus* subsp. *oxycedrus*.

The stands of this association are usually located west of Bozüyük at the south-facing slopes (750–850 m) with an inclination up to 45 %. They show a structure with shrub and herb layers. The total cover of the shrub layer varies between 60–70 % and the height is about 0.6–2 m while that of

Characteristic species of Cisto-Micromerietea

H	<i>Psoralea bituminosa</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
NP	<i>Cistus creticus</i>	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
Ch	<i>Teucrium polium</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
Th	<i>Trifolium arvense</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Others																				
H	<i>Veronica pectinata</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV
Th	<i>Crupina crupinastrum</i>	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV
Th	<i>Holosteum umbellatum</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV
Th	<i>Alyssum desertorum</i> var. <i>desertorum</i>	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	IV
Ch	<i>Dorycnium graecum</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
H	<i>Onobrychis armena</i>	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
Ch	<i>Globularia trichosantha</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
H	<i>Galium verum</i> subsp. <i>verum</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
Th	<i>Avena barbata</i>	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
Ch	<i>Tymus longicaulis</i> subsp. <i>longicaulis</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
NP	<i>Crataegus monogyna</i> subsp. <i>monogyna</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
H	<i>Dactylis glomerata</i>	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
Th	<i>Onobrychis aequidentata</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	III
Th	<i>Medicago rigidula</i> var. <i>rigidula</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
H	<i>Leontodon asperimus</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
H	<i>Sedum acre</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Th	<i>Xeranthemum annuum</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
H	<i>Koeleria cristata</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
H	<i>Briza media</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
Th	<i>Torilis leptophylla</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
H	<i>Chrysopogon gryllus</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H	<i>Fibigia clypeata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H	<i>Prunella vulgaris</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H	<i>Coronilla cretica</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H	<i>Astragalus cicer</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H	<i>Asyneuma limoniifolium</i> subsp. <i>limoniifolium</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H	<i>Silene vulgaris</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H	<i>Potentilla recta</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H	<i>Euphorbia exigua</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
H	<i>Centaurea urvillei</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I

Total species: 48

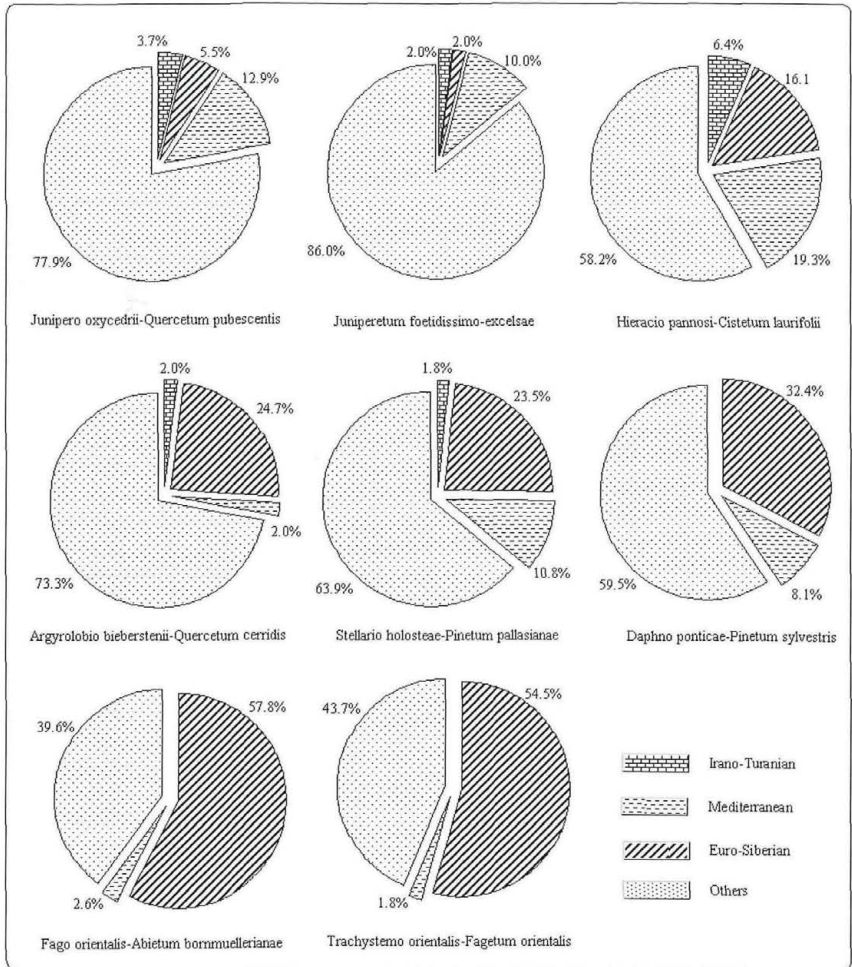


Fig. 3. Phytogeographical distribution of plant species in the associations.

the herb layer is 20–40 % and 5–40 cm respectively. The dominant species within the shrub layer are *Quercus pubescens* and *Juniperus oxycedrus* subsp. *oxycedrus*, which are the diagnostic ones as well.

The floristic composition of the association is mainly formed by the species of Mediterranean origin (12.9%). Others are the components of Euro-Siberian (5.5%) and Irano-Turanian (3.7%) (Fig.3). The ratio of endemism in the presented table is 5.5%. The life-form structure of the association is dominated by hemicryptophytes (44.4%), chamaephytes (15.1%), therophytes (16.9%), phanerophytes (15.1%) and geophytes (1.9%) (Fig. 4). The association is composed of 48 species, the species

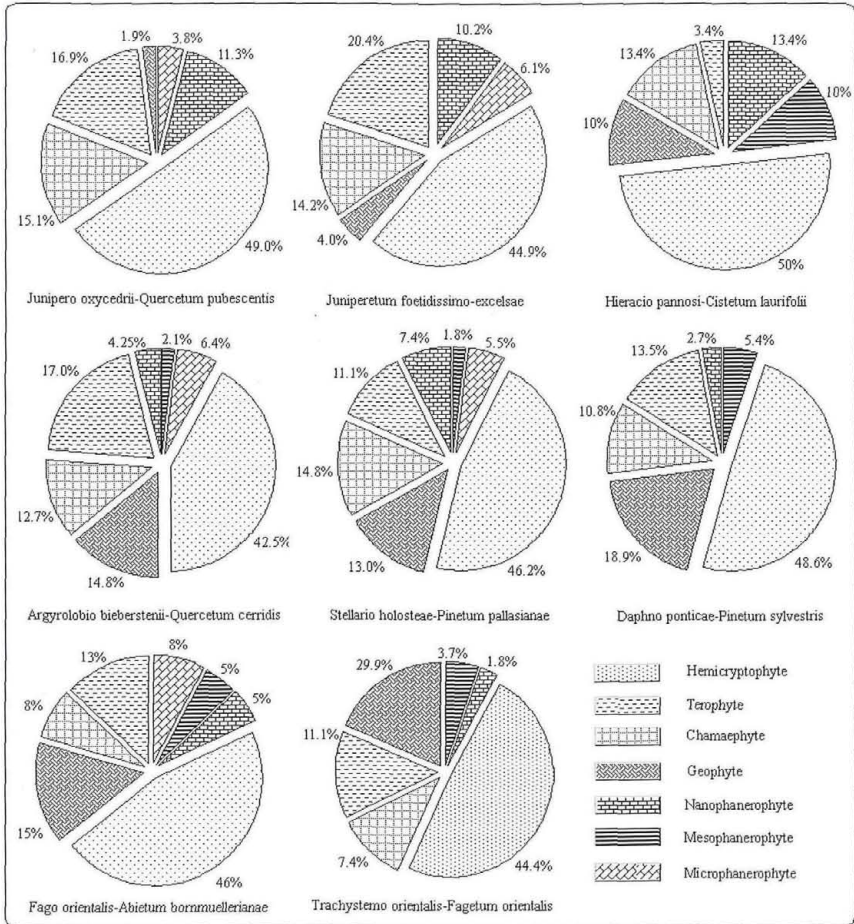


Fig. 4. Life form spectra of the associations.

numbers in the relevés varies between 9 and 22. The relevés recorded on the north facing slopes are not rich in floristic composition due to thermophilous preference of the association. The similar situation also occurs in *Stellario-Pinetum pallasianae*.

The association occupies thermophilous stands extending towards Inner Anatolia, the soils of which were derived from limestone parent rock. The inclination of the slopes, which the association occupied, reaches to 45 %.

The soils of these stands have a sandy-clayey-loamy and clayey loamy texture and shows neutral reactions. The available water in the soil is very poor as well (Tab. 11–12).

Table 4.
Hieracio pannosi-Cistetum laurifolii ass. nova.

Relevé No	13	14	15	16	17	18	
Species number	13	14	13	15	17	13	
Size of plot (m ²)	400	400	400	400	400	400	
Parent rock	S	S	S	S	S	S	
Inclination (%)	40	70	50	60	60	40	
Altitude (m)	920	1000	1050	850	1050	1100	
Exposition	N	S	W	NW	SE	S	
Shrub layer height (m)	1	1	1	1.5	1.5	0.7	
Shrub layer cover (%)	30	30	50	50	50	30	
Herb layer height (cm)	20	30	15	15	10	40	
Herb layer cover (%)	20	10	20	20	20	30	
Total cover (%)	50	40	70	70	60	60	
LF							
Differential and Characteristic species of the association							Const.
NP	<i>Cistus laurifolius</i>	3	3	3	3	4	2b V
H	<i>Hieracium pannosum</i>	+	.	1	+	+	+
Characteristic species of Pino-Cistion laurifolii							
Ch	<i>Genista lydia</i> subsp. <i>lydia</i>	+	+	+	+	+	V
MP	<i>Pinus nigra</i> subsp. <i>pallasiana</i>	1	.	.	1	.	II
Characteristic species of Querco-Carpinetalia orientalis							
H	<i>Cirsium hypoleucum</i>	+	+	+	+	+	V
G	<i>Helleborus orientalis</i>	.	+	+	.	+	IV
H	<i>Campanula persicifolia</i>	.	.	+	.	+	II
Characteristic species Quercetea pubescentis							
G	<i>Dryopteris filix-mas</i>	1	.	+	.	+	III
H	<i>Campanula lyrata</i> subsp. <i>lyrata</i>	+	+	.	.	.	+
Ch	<i>Stellaria holostea</i>	.	+	.	.	+	II
Cracteristic species of Cisto-Micromerietea and *Quercetea ilicis							
NP	<i>Cistus creticus</i>	+	.	.	+	+	III
H	<i>Psoralea bituminosa</i>	.	+	.	+	.	+
NP	* <i>Juniperus oxycedrus</i> subsp. <i>oxycedrus</i>	.	.	1	.	+	II
Ch	* <i>Teucrium polium</i>	+	.	.	.	.	+
Characteristic species of Querco-Fagea							
H	<i>Briza media</i>	+	+	.	+	+	+
G	<i>Clinopodium vulgare</i> subsp. <i>arundanum</i>	+	.	.	+	+	.
H	<i>Dactylis glomerata</i>	.	.	+	.	+	.
NP	<i>Crataegus monogyna</i> subsp. <i>monogyna</i>	.	+	.	+	.	.
Others							
H	<i>Campanula olympica</i>	.	+	+	.	+	+
Ch	<i>Helianthemum nummularium</i>	+	.	+	+	.	+
H	<i>Prunella vulgaris</i>	.	+	.	+	+	.
H	<i>Veronica pectinata</i>	.	+	.	.	+	.
Th	<i>Ziziphora capitata</i>	.	.	+	+	.	.
H	<i>Lotus corniculatus</i>	+	.	.	.	+	.
H	<i>Salvia napifolia</i>	.	+	.	+	.	.
H	<i>Leontodon asperimus</i>	.	.	+	.	+	.
NP	<i>Rosa canina</i>	.	.	.	+	.	.
H	<i>Poa bulbosa</i>	.	+	.	.	.	.
H	<i>Anthemis tinctoria</i> var. <i>pallida</i>	.	.	.	.	.	+

Total species: 29

The accompanying species that occur in this community belong to different higher syntaxa such as Quercu-Carpinetalia, Quercetalia ilicis, and Cisto-Micromerietea.

Hieracio pannosi-Cistetum laurifolii ass. nova (Tab. 4, relevés 13–18)

Holotypus: Tab. 4, relevé 15. west of Delielmacik village. Lat: 39°55'28.40" N, Lon: 29°51'52.69" E, 1050 m, cover 70 %, 400 m². – Character species: *Cistus laurifolius*, *Hieracium pannosum*.

The stands of this association are located north of Delielmacik village and its surroundings. It dominates on the degraded sites of black-pine forests. The total cover of the 0,5–1,5 m high shrub layer varies from 40 % to 70 %, the herb layer has a 20–40 % cover and a height of 5–45 cm. *Cistus laurifolius* is the dominant species of the stands. The components of the floristic composition are of Mediterranean (19.3 %) Euro-Siberian (16.1 %) and Irano-Turanian (6.4 %) origin (Fig. 3). The ratio of endemism is 3.2 %. The life-form spectrum of the association is composed of hemicryptophytes (50 %), phanerophytes (23.4 %), chamaephytes (13.4 %) and geophytes (10 %) (Fig. 4).

The stands extend on slopes with an inclination of 40–70 %. The soils, derived from schistous parent rock have sandy loamy texture, show slightly acidic reactions, and never contain CaCO₃ (Tab. 11–12).

The association is the poorest one in floristic composition among all the others presented in the study area due to its occurrence on the eroded steep slopes under the semi-dry conditions and human impact. Accompanying species belong to the Quercu-Carpinetalia, Quercetalia pubescentis, Quercetalia ilicis, Cisto-Micromerietea.

4.2. Forest Vegetation

Stellario holosteeae-Pinetum pallasianae ass. nova (Tab. 5, relevés 45–64)

Holotypus: Tab. 5, relevé 52. Northwest of Saridere village. Lat: 39°58'05.13" N, Lon: 29°53'30.86" E. 1050 m. cover 60 %, 1000 m². – Character species: *Pinus nigra* subsp. *pallasiana*, *Stellaria holostea*, *Dryopteris filix-mas*.

This association shows a homogenous distribution around the villages Saridayi, Kizilpınar, Muratdere and Ormangüzle. The structure is composed of three layers: tree, shrub and herb. Their cover values and heights are 70–90 % and 5–16 m, 10–30 % and 0,5–1,5 m, 10–45 % and 30 cm respectively. The chorological spectrum of the association is composed of Euro-Siberian (23.5 %), Mediterranean (10.8 %), Irano-Turanian (1.8 %) species (see Fig. 3). The endemism rate is 5.4 %. The life-form spectrum shows a dominance of Hemicryptophytes (46.2 %), Chamaephytes (14.8 %),

Therophytes (11.1%), Phanerophytes (14.7%), and Geophytes (13%) (Fig. 4). The dominant and characteristic species, *Pinus nigra* subsp. *pallasiana* has a wide distribution on the peripheral zone of Inner Anatolia and occurs on soils derived from different parent rocks. Particularly it is most extensive in Western Anatolia. The soils on schistous parent rocks have a sandy loamy texture, they show a slightly acidic reaction and free Ca is absent (Tab. 11–12).

The stands of the association are dominated by *Querco-Carpinetalia orientalis* and *Quercetea pubescentis* species.

Daphno ponticae-Pinetum sylvestris KUTBAY & KILINÇ 1995 (Tab. 6, relevés 65–74)

The sites of this association are widespread in the southeast of Kozpinar village between 900–1100 m. The closed canopy shows a total cover between 70–85% and it reaches to 10–15m in height. The shrub layer has a very low cover (5–10%) and a height of 0.6–1 m. The herb layer covers 15–40% and has a height of 5–40 cm. The dominant species, *Pinus sylvestris* characterizes the association along with *Daphne pontica*. Its floristic composition is not so rich. Many of the species composing the floristic structure are of Euro-Siberian (32.4%) and Mediterranean (8.1%) origin (Fig. 3). Among the life-forms physiognomically shaping the association, Hemicryptophytes are 48.6%, Chamaephytes 10.8% Therophytes 13.5%, Phanerophytes 8.1%, and Geophytes 18.9% (Fig. 4).

The association is distributed on carbonate free clayey soils on schistous parent rocks. The pH is neutral (Tab. 11–12).

The accompanying species within the association belong to *Carpino-Acerion* and *Quercetalia pubescentis*.

Argyrolobio biebersteinii-Quercetum cerridis ass. nova (Tab. 7, relevés 30–44)

Holotypus: Tab. 7, relevé 42 Northwest of Muratdere village. Lat: 39°56'37.04" N, Lon: 29°44'13.20" E, 750 m, cover 60%, 800 m². – Character species: *Quercus cerris* var. *cerris*, *Hypericum calycinum*.

The stands of this association are particularly located between Northwest of Aşağımuratlı and Muratdere villages between 510–850 m. They form a deciduous forest type with three vegetation layers. The total cover of three layers, the height of which varies between 3–10 m, is about 50–70%. The cover decreases to 20–30% in shrub layers reaching up to 1.5 m in height. The herbs with a height of 5–45 cm cover an area of 10–20%.

The diagnostic species, *Quercus cerris* var. *cerris* is the dominant element of the tree layer. In the study area it often occupies humid sites. The phytogeographical spectrum of the association is made up of 2% Irano-Turanian, 24.7% Euro-Siberian, and 2% Mediterranean elements (Fig. 3).

Table 6
 Daphno ponticae-Pinetum sylvestris.

Relevé No	65	66	67	68	69	70	71	72	73	74
Species number	18	14	12	13	11	11	11	16	12	11
Size of plot (m ²)	900	900	900	900	900	900	900	900	900	900
Parent Rock	BS	BS	BS	BS	BS	BS	BS	BS	BS	BS
Inclination (%)	40	45	40	40	60	50	50	40	60	45
Altitude (m)	910	950	900	1000	1040	1100	1050	970	1020	1100
Exposition	N	NW	N	N	N	NW	W	W	NW	N
Tree layer height (m)	10	10	10	15	10	10	10	10	10	15
Tree layer cover (%)	55	55	55	65	55	50	55	55	55	65
Shrub layer height (m)	1	1	1	0.6	1	1	1	1	1	0.6
Shrub layer cover (%)	10	10	10	10	5	5	10	10	10	10
Herb layer height (cm)	30	30	30	20	20	40	30	30	30	20
Herb layer cover (%)	5	5	5	5	10	5	5	5	5	5
Total cover (%)	70	70	70	80	70	60	70	70	70	80

LF

Differential and Characteristic species of the association

MP <i>Pinus sylvestris</i>	4	4	4	4	4	3	4	4	4	4	Const. V
NP <i>Daphne pontica</i>	1	+	.	1	.	.	1	1	.	1	III

Characteristic species of Carpino-Acerion

H <i>Cirsium hypoleucum</i>	+	.	+	+	.	.	+	+	.	+	III
H <i>Lathyrus laxiflorus</i> subsp. <i>laxiflorus</i>	+	.	.	.	+	.	.	+	+	+	III
H <i>Galium longifolium</i>	.	.	+	+	.	.	+	.	.	+	II
G <i>Helleborus orientalis</i>	.	.	.	.	+	.	.	+	+	.	II

Characteristic species of Querco-Fagetea and *Quercetea pubescentis

Ch <i>Stellaria holostea</i>	+	+	.	+	.	.	+	.	+	+	III
G * <i>Cephalanthera rubra</i>	+	.	.	.	+	.	.	+	.	.	II
G <i>Dryopteris filix-mas</i>	.	+	.	.	.	+	.	.	.	.	I
H <i>Sanicula europaea</i>	.	.	+	.	.	.	.	.	.	.	I

Characteristic species of Querco-Fagea

H <i>Brachypodium sylvaticum</i>	+	.	+	+	+	.	.	+	+	+	IV
H <i>Euphorbia amygdaloides</i> subsp. <i>amygdal.</i>	+	.	1	.	.	1	+	+	.	+	III
H <i>Briza media</i>	.	+	.	+	+	+	.	.	+	+	III
G <i>Doronicum orientale</i>	+	+	.	+	.	+	.	.	+	.	III
H <i>Dactylis glomerata</i> subsp. <i>glomerata</i>	.	+	+	.	.	+	.	+	+	.	III
H <i>Melica uniflora</i>	+	.	+	+	.	+	.	.	.	.	III

Others

G <i>Trifolium alpestre</i>	.	+	.	+	+	.	.	+	+	.	III
H <i>Galium paschale</i>	+	+	+	.	.	.	+	+	.	.	III
H <i>Salvia napifolia</i>	+	+	.	.	.	.	.	+	+	.	III
Ch <i>Dorycnium graecum</i>	+	+	.	.	.	.	+	.	.	.	II
H <i>Bellis perennis</i>	+	+	.	.	.	+	.	.	.	.	II
H <i>Poa bulbosa</i>	+	.	.	+	+	.	.	.	.	.	II
H <i>Cynosorus cristatus</i>	.	.	.	.	.	+	+	+	.	.	II
H <i>Viola suavis</i>	+	.	+	.	.	.	.	.	.	+	II
H <i>Campanula olympica</i>	.	.	.	+	+	.	.	+	.	.	I
H <i>Campanula persicifolia</i>	+	.	.	.	.	+	.	.	.	.	I
G <i>Orchis mascula</i> subsp. <i>pinetorum</i>	.	.	+	.	.	.	+	.	.	.	I
Th <i>Myosotis discolor</i>	.	+	.	.	.	.	.	+	.	.	I
Th <i>Agrostemma githago</i>	.	+	.	.	+	.	.	.	.	.	I
Ch <i>Sagina saginoides</i>	.	.	.	.	+	.	.	.	+	.	I
Ch <i>Dianthus calocephalus</i>	.	.	+	.	.	.	.	.	+	.	I
H <i>Silene vulgaris</i> var. <i>vulgaris</i>	+	.	.	.	.	.	.	.	.	.	I
Th <i>Geranium rotundifolium</i>	.	.	.	.	+	.	.	.	.	.	I
H <i>Agrimonia repens</i>	.	.	.	+	.	.	.	.	.	.	I
Th <i>Crepis foetida</i> subsp. <i>foetida</i>	.	.	.	.	.	.	.	.	.	+	I
Th <i>Lamium purpureum</i> subsp. <i>purpureum</i>	.	.	.	.	.	.	+	.	.	.	I

Total species: 36

The ratio of endemism is 2 %. The life form composition is dominated by Hemicryptophytes (42.5 %), Chamaephytes (12.7 %) Therophytes (17.0 %), Phanerophytes (12.7 %), and shows a lower share of vascular parasites (2 %) (Fig. 4).

The association occupies the sites with the soils of clayey loamy texture, developed on blue schistous parent rocks. The soil reaction is mainly neutral (Tab. 11–12).

The species of *Quercus-Carpinetalia*, *Quercetea pubescentis*, *Quercetea ilicis* and *Quercus-Fageteta* usually dominate the herb layer.

Trachystemo orientalis-Fagetum orientalis AKMAN 1995 (Tab. 8, relevés 75–94)

The stands of this association are located on the north facing slopes of Mezit, Sulhiye and Kozpinar villages. The altitudinal range of the stands of this association varies from 550 to 910 m. Total cover and height of tree, shrub and herb layers are between 80–90 % and 10–20 m; 15–30 % and 0.7–1.5 m; 10–25 % and 10–60 cm respectively. The constant and dominant species of the association is *Fagus orientalis*. It is also a diagnostic species along with *Trachystemon orientalis*, *Campanula olympica* and *Cardamine bulbifera*. In the association, the floristic composition is formed by Euro-Siberian (54.5 %) and Mediterranean (18 %) geoelements (Fig. 3). The endemism rate is 1,8 %. The life form spectrum of the association is made up of Hemicryptophytes (44.4 %) Chamaephytes (7.4 %), Therophytes (11.1 %), Phanerophytes (5.5 %), and Geophytes (29.9 %) (Fig. 4).

The stands develop on loamy soils originating from chalk-schistous parent rock. Here, the soils do not contain CaCO_3 and give an acidic reaction. The rate of available water content in this association is much higher due to the fact that the stands are located on humid sites of the region (Tab. 11–12).

The association harbours the elements of *Fagetalia sylvaticae* and *Rhododendro-Fagetalia orientalis* along with those of *Quercetea pubescentis*.

Fago orientalis-Abietetum bornmuellerianae AKMAN, YURDAKULOL & AYDOĞDU 1983 (Tab. 9, relevés 95–109)

This association shows a homogenous distribution on the north and south-facing slopes in the vicinities of Sulhiye, Mezit and Kozpinar villages. Its altitudinal range is from 830 to 1240 m. Total cover of the canopy is between 80–90 % and its height reaches from 10 to 20 m. The cover value of the shrub layer is around 10 %, it reaches up to 1.5 m in height. Total cover of the herb layer is about 10–30 % and their height is about 10–40 cm. The diagnostic taxa of the association are *Abies nordmanniana* subsp. *bornmuelleriana*, *Fagus orientalis* and *Ilex colchica*. The floristic compo-

sition is made up of Euro-Siberian (57.8 %) and Mediterranean (2.6 %) elements (Fig. 3). The ratio of endemism is 2.6 %. Hemicryptophytes (46 %), Chamaephytes (8 %), Therophytes (13 %), Phanerophytes (18 %) and Geophytes (15 %) are the components of the life-form spectrum (Fig. 4).

The soils, originated from schistous parent rock within the association have sandy loamy texture. They do not have CaCO_3 content and show a slightly acid reaction. Available water content is quite high, as in the previous association, due to its extension on mesophilous sites in the study area (Tab. 11–12).

The species belonging to *Quercetea pubescentis*, *Querco-Fagetea* and to their orders are common with in the association. The species numbers in the relevés forming the association, particularly recorded on the south facing slopes decrease.

Junipero foetidissimae-Juniperetum excelsae ass. nova
(Table 10, relevés 19–29)

Holotypus: Tab. 10, relevé 19. South of Ormangüzle village. Lat: $39^{\circ}52'45.37''$ N, Lon: $29^{\circ}51'37.56''$ E. 1000 m, cover 60 %, 400 m². – Character species: *Juniperus excelsa*, *J. foetidissima*, *Phlomis russeliana*, *Lonicera etrusca*.

The stands show a distribution in rocky areas and on shallow soils around Black Pine forests in Ormangüzle village between 1000–1210 m. Physiognomically three layers can be distinguished. *Juniperus excelsa* is the leading dominant species along with *Juniperus foetidissima*. They form the tree layer, the cover of which varies between 50–70 % and the height of which reaches up to 3 m. The shrubs cover an area in the association about 30–40 % and reach to 1 m. in the height. The cover of the herb layer is about 10–30 % and 5–40 cm tall.

The floristic structure is composed of Mediterranean (10 %), Euro-Siberian (2 %) and Irano-Turanian (2 %) elements (Fig. 3). Endemism ratio is 6 %. The life-form structure of the association mainly consists of Hemicryptophytes (44.9 %), Chamaephytes (14.2 %), Therophytes (20.4 %), and Phanerophytes (16.3 %) (Fig. 4). The association develops on the shallow soils, the texture of which is clayey derived from calcareous parent rocks. The pH of soils here is about 7. Moreover, organic matter is lesser than in the other communities in the study area (Tab. 11–12). Vast parts of the stands are covered by rocks.

The elements of *Quercetalia pubescentis* and *Querco-Carpinetalia* play an important role.

Phlomis longifolia and *Lonicera etrusca* along with the Juniper species characterize the association.

Table 9.
Fago orientalis-Abietetum bormmuellerianae.

Relevé No	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109
Species number	20	16	15	18	14	10	10	18	15	14	9	13	11	12	9
Size of plot (m ²)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Parent Rock	BS	BS	BS	BS	BS	BS	BS	BS	BS	BS	BS	BS	BS	BS	BS
Inclination (%)	50	60	50	60	50	50	70	60	50	60	60	60	50	70	50
Altitude (m)	900	940	100	1070	900	1200	1100	1100	830	1050	1200	1200	1240	1100	1000
Exposition	N	N	NW	N	N	NW	NW	N	N	N	N	W	W	W	N
Tree layer height (m)	15	15	15	15	15	15	20	20	15	15	15	10	15	20	15
Tree layer cover (%)	70	70	70	70	70	70	80	80	70	70	70	50	70	80	70
Shrub layer height (m)	1	1	1	1	1	1	0.8	0.8	1	1	1	1.5	1	0.8	1
Shrub layer cover (%)	5	5	5	5	5	5	5	5	5	5	5	10	5	5	5
Herb layer height (cm)	30	30	30	30	30	30	20	20	30	30	30	40	30	20	30
Herb layer cover (%)	5	5	5	5	5	5	5	5	5	5	5	10	5	5	5
Total cover (%)	80	80	80	80	80	80	80	90	80	80	80	70	80	90	80

LF

Differential and Characteristic species of the association

MIP *Abies nordmanniana* subsp.MP *Fagus orientalis*NP *Ilex colchica*

Characteristic species of Carpino-Acerion

G *Helleborus orientalis*H *Lathyrus laxiflorus* subsp. *laxiflorus*H *Cirsium hypoleucum*MIP *Carpinus betulus*

Characteristic species of Rhododendro-Fagetalia orientalis

NP *Daphne pontica*G *Trachystemon orientalis*H *Sabia forskaletii*H *Hypericum calycinum*

Const.

V

V

III

III

II

II

III

III

II

II

III

III

II

II

II

Characteristic species of Quercetea pubescentis

H *Hypericum perforatum*H *Coronilla varia* subsp. *varia*H *Digitalis ferruginea* subsp. *ferruginea*Ch *Argyrobolium biebersteinii*

Characteristic species of Quercro-Fagetea

H *Sanicula europaea*Ch *Sambucus ebulus*G *Cardamine bulbifera*G *Gallium rotundifolium*MP *Pinus sylvestris*

Characteristic species of Quercro-Fagea

H *Euphorbia amygdaloides* subsp. *amygd.*MIP *Hedera helix*H *Fragaria vesca*H *Epilobium montanum*H *Brachypodium sylvaticum*G *Primula vulgaris* subsp. *vulgaris*

Others

H *Prunella vulgaris*G *Pteridium aquilinum*H *Centaurium erythraea* subsp. *turcic.*H *Bellis perennis*Th *Senecio vernalis*H *Salvia napifolia*Ch *Scutellaria orientalis* subsp. *alpina*Th *Lamium purpureum* var. *purpureum*Th *Euphorbia helioscopia*Th *Orobancha* sp.Th *Myosotis arvensis*

Total species: 37

Table 10.
Junipero foetidissimae-Juniperetum excelsae.

Relevé No	19	20	21	22	23	24	25	26	28	29
Species number	20	17	21	20	17	22	23	19	18	16
Size of plot (m ²)	400	400	400	400	400	400	400	400	400	400
Parent Rock	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS
Inclination (%)	45	50	40	60	45	30	40	70	50	45
Altitude (m)	1000	1100	1020	1000	1150	1070	1200	1210	1060	1210
Exposition	N	NW	S	W	E	SE	S	E	N	E
Tree layer height (m)	3	2	3	3	3	2	3	2	2	2
Tree layer cover (%)	30	20	30	40	40	20	40	30	30	20
Shrub layer height (m)	0.8	1	0.6	0.6	0.8	1	0.8	0.8	0.8	1
Shrub layer cover (%)	20	20	10	10	20	10	20	10	20	10
Herb layer height (cm)	20	40	30	30	20	40	20	30	30	20
Herb layer cover (%)	10	10	20	20	10	20	10	10	10	20
Total cover (%)	60	50	60	70	70	50	70	50	60	50

LF

Differential and Characteristic species of the association

MIP	<i>Juniperus excelsa</i>	3	2b	3	3	2	3	3	3	2b	Const.
MIP	<i>Juniperus foetidissima</i>	3	2a	.	2a	.	2a	2b	2a	2a	V
Ch	<i>Phlomis russeliana</i>	+	.	+	.	+	.	.	.	.	II
NP	<i>Lonicera etrusca</i>	.	+	.	.	.	.	.	.	.	II
Characteristic species of Quercion anatolicae											
Ch	<i>Genista lydia</i> subsp. <i>lydia</i>	+	+	.	.	.	+	+	+	.	III
MIP	<i>Quercus pubescens</i>	1	.	2a	.	2a	+	.	.	.	II
H	<i>Coronilla varia</i> subsp. <i>varia</i>	.	.	.	.	+	+	.	.	.	II
NP	<i>Colutea ciliata</i>	.	.	+	.	.	+	.	.	.	I
Characteristic species of *Quercetea pubescentis and Quercetea ilicis											
H	* <i>Campanula lyrata</i> subsp. <i>lyrata</i>	+	.	+	.	+	+	.	+	+	IV
NP	<i>Jasminum fruticans</i>	.	+	.	+	.	+	.	.	.	III
NP	<i>Juniperus oxycedrus</i> subsp. <i>oxycedrus</i>	.	.	1	.	.	1	.	.	.	II
H	<i>Hypericum perforatum</i>	+	.	.	.	.	.	.	.	+	I
Characteristic species of Cisto-Micromerietea											
Ch	<i>Teucrium polium</i>	+	+	+	+	+	+	.	+	+	IV
H	<i>Psoralea bituminosa</i>	.	+	.	.	+	+	+	+	+	III
H	<i>Meica ciliata</i>	.	+	+	.	.	.	.	.	.	II

Characteristic species of Quercio-Fagea

Th	<i>Holosteum umbellatum</i>	+	+	+	+	+	+	+	+	+	V
NP	<i>Crataegus monogyna</i> subsp. <i>monogyna</i>	.	.	.	.	.	.	.	.	.	II

Others

H	<i>Veronica pectinata</i>	+	+	+	+	+	+	+	+	+	V
Th	<i>Alyssum desertorum</i> var. <i>desertorum</i>	+	+	+	+	+	+	+	+	+	IV
Th	<i>Torilis leptophylla</i>	.	.	.	.	.	.	.	.	.	IV
H	<i>Onobrychis armena</i>	+	+	+	+	+	+	+	+	+	IV
Th	<i>Coronilla scorpioides</i>	.	.	.	.	.	.	.	.	.	III
H	<i>Onosma tauricum</i> var. <i>tauricum</i>	.	.	.	.	.	.	.	.	.	III
H	<i>Galium verum</i> subsp. <i>verum</i>	+	+	+	+	+	+	+	+	+	II
H	<i>Dianthus leptophylla</i>	.	.	.	.	.	.	.	.	.	II
Th	<i>Hippocrepis unisiliquosa</i>	+	+	+	+	+	+	+	+	+	II
H	<i>Phleum montanum</i>	+	+	.	.	.	.	.	.	.	II
G	<i>Brunnera orientalis</i>	.	1	.	.	.	.	.	.	.	II
H	<i>Thymus sibthorpii</i>	.	+	.	.	.	.	.	.	.	II
H	<i>Cononculus cantabrica</i>	.	.	.	.	.	.	.	.	.	II
Th	<i>Pterocarpus plumosus</i>	+	+	+	+	+	+	+	+	+	II
Ch	<i>Aubrieta pinardi</i>	.	.	.	.	.	.	.	.	.	II
Ch	<i>Cerastium banaticum</i>	+	+	+	+	+	+	+	+	+	II
H	<i>Anthyllis vulneraria</i> subsp. <i>pulchella</i>	+	+	+	+	+	+	+	+	+	II
H	<i>Astragalus cicer</i>	.	.	.	.	.	.	.	.	.	I
Ch	<i>Phlomis longifolia</i>	+	+	+	+	+	+	+	+	+	I
H	<i>Echinops ritro</i>	.	.	.	.	.	.	.	.	.	I
Th	<i>Medicago polymorpha</i> var. <i>polymorpha</i>	.	+	.	.	.	.	.	.	.	I
H	<i>Polygala anatolica</i>	.	.	.	.	.	.	.	.	.	I
H	<i>Salvia sclarea</i>	.	.	.	.	.	.	.	.	.	I
H	<i>Potentilla recta</i>	+	.	.	.	.	.	.	.	.	I
G	<i>Muscari armeniacum</i>	.	.	.	.	.	.	.	.	.	I
Ch	<i>Minuartia anatolica</i>	.	.	.	.	.	.	.	.	.	I
Th	<i>Scandix pecten-veneris</i>	.	.	.	.	.	.	.	.	.	I
Th	<i>Sideritis montana</i>	.	+	.	.	.	.	.	.	.	I
H	<i>Sanguisorba minor</i> subsp. <i>muricata</i>	.	.	.	.	.	.	.	.	.	I
H	<i>Papaver lacerum</i>	.	.	.	.	.	.	.	.	.	I

Total species: 47

Table 11.
Physical analyses of the soils belonging to the associations.

ASSOCIATIONS	DEPTH (cm)	SAND (%)	SILT (%)	CLAY (%)	SOIL TEXTURE CLASS
<i>Junipero oxycedri- Quercetum pubescentis</i>	0-5	52.43	22.68	24.89	Sandy-clay loam
	5-25	46.12	22.73	31.15	Sandy-clay loam
	>25	44.54	16.39	39.07	Clay loam
<i>Hieracio pannosi- Cistetum laurifolii</i>	0-5	65.95	23.30	10.75	Sandy loam
	5-25	59.79	27.40	12.81	Sandy loam
	>25	56.60	26.77	16.63	Sandy loam
<i>Junipero foetidissimae- Juniperetum excelsae</i>	0-5	26.70	20.45	52.10	Clay
	5-25	21.35	20.90	52.75	Clay
	>25	0.20	29.16	72.25	Clay
<i>Argyrobio biebersteinii- Quercetum cerridis</i>	0-5	40.17	31.97	27.86	Clay loam
	5-25	42.89	27.42	29.69	Clay loam
	>25	43.75	24.94	31.31	Clay loam
<i>Stellario holostea- Pinetum pallasianae</i>	0-5	64.34	20.89	14.77	Sandy loam
	5-25	66.85	14.44	18.71	Sandy loam
	>25	67.08	16.38	16.54	Sandy loam
<i>Daphno ponticae- Pinetum sylvestris</i>	0-5	32.29	24.77	42.94	Clay
	5-25	29.17	6.84	63.99	Clay
	>25	17.23	26.79	55.98	Clay
<i>Trachystemo orientalis- Fagetum orientalis</i>	0-5	40.99	47.52	11.49	Loam/Silt loam
	5-25	43.99	41.67	14.74	Loam
	>25	41.59	42.19	16.22	Loam
<i>Fago orientalis- Abietetum bornmuellerianae</i>	0-5	41.45	48.50	12.20	Sandy loam
	5-25	44.30	40.99	16.15	Sandy loam
	>25	42.10	42.70	18.70	Sandy loam

5. Discussion

Syntaxonomical survey of the described associations

Quercetea pubescentis (OBERDORFER 1948) DOING, KRAFT 1955.

Quercu-Carpinetalia orientalis QUÉZEL, BARBÉRO & AKMAN 1980

Quercion anatolicae AKMAN, BARBÉRO & QUÉZEL 1979

Junipero oxycedri-Quercetum pubescentis ass. nova

Junipero foetidissimae-Juniperetum excelsae ass. nova

Pino-Cistion laurifolii AKMAN, BARBÉRO & QUÉZEL 1978

Hieracio pannosi-Cistetum laurifolii ass. nova

Carpino-Acerion QUÉZEL, BARBÉRO & AKMAN 1980

Argyrobio biebersteinii-Quercetum cerridis ass. nova

Stellario holostea-Pinetum pallasianae ass. nova

Daphno ponticae-Pinetum sylvestris KUTBAY & KILINÇ 1993

Fago orientalis-Abietetum bornmuellerianae AKMAN, YURDA-
KULOL & AYDOĞDU 1983

Quercu-Fagetea (BR.-BL. & VIEGER, 1937) FUK. & FAB. 1968

Rhododendro-Fagetalia orientalis QUÉZEL, BARBÉRO & AKMAN 1980

Trachystemo orientalis-Fagetum orientalis AKMAN 1995

Table 12.
Chemical analysis and characteristics of the soil profiles.

ASSOCIATION	Depth (cm)	pH	CaCO ₃ (%) Total	Organic Matter (%)	Total N (%)	Ca++ Mg++ K+ N+	Exchangeable cations (me./100 gr. soil)	C.E.C Me/100 gr soil	P ₂ O ₅ ppm	EC.10 ³ mmhos/cm at 25°C	Field capacity (%) 1/3 Atm.	Wilting Point (%) 1/3 Atm.	Available water (%) 1/3 Atm.
<i>Junipero oxycedri-Quercetum pubescens</i>	0-5	7.50	0.75	6.582	0.329	19.77	0.99	0.44	47	0.51	20.19	14.47	5.72
	5-25	7.65	0.75	4.033	0.202	15.14	1.017	0.44	28	0.34	19.27	14.65	4.62
	>25	7.45	0.74	2.505	0.125	13.56	1.40	0.37	28	0.29	20.71	17.81	2.90
<i>Hieracio pamosi-Cistetum laurifolii</i>	0-5	6.15	0.0	14.12	0.706	12.19	3.10	0.78	70	0.31	33.03	26.82	6.21
	5-25	6.00	0.0	8.670	0.434	10.00	3.05	0.57	55	0.27	37.94	17.89	20.05
	>25	6.00	0.0	3.539	0.177	4.53	1.43	0.33	68	0.15	20.16	13.57	6.59
<i>Junipero foetidissimae-Juniperetum excelsae</i>	0-5	7.70	40.67	3.420	0.151	30.52	4.90	0.75	66	0.44	31.21	20.88	12.01
	5-25	7.20	42.45	3.400	0.178	33.52	4.00	0.75	72	0.45	28.08	21.20	6.69
	>25	7.20	50.90	5.680	0.321	42.41	5.22	0.80	55	0.40	30.45	18.80	8.88
<i>Argylobio Biebersteini-Quercetum cerridis</i>	0-5	7.80	17.07	7.397	0.370	29.31	1.05	0.98	78	0.36	32.31	19.39	12.92
	5-25	7.95	31.13	4.564	0.228	29.80	0.65	0.21	48	0.32	26.24	19.19	7.05
	>25	8.00	31.59	3.429	0.171	26.93	0.58	0.13	48	0.31	27.12	17.36	9.76
<i>Stellario holostea-Pinetum pallasianae</i>	0-5	6.00	0.0	11.09	0.554	9.88	2.53	0.45	36	0.29	25.88	17.56	8.32
	5-25	6.10	0.75	5.522	0.276	7.31	1.75	0.29	28	0.34	19.51	13.41	6.10
	>25	5.75	0.0	2.067	0.103	5.10	1.55	0.20	35	0.18	17.97	11.74	6.23
<i>Daphno ponticae-Pinetum sylvestris</i>	0-5	7.20	1.63	14.22	0.711	39.10	4.29	0.92	59	0.52	45.81	31.25	14.56
	5-25	7.40	0.0	3.491	0.175	30.43	1.58	0.32	65	0.29	41.48	30.26	11.25
	>25	7.20	0.0	1.891	0.094	23.29	4.40	0.17	44	0.25	40.97	23.26	17.71
<i>Trachystemo orientalis-Fagetum orientalis</i>	0-5	6.55	0.0	21.17	1.059	27.23	3.10	1.09	212	0.57	81.29	43.26	38.03
	5-25	6.20	0.0	5.366	0.288	12.29	9.62	0.27	154	0.35	37.16	14.60	55.56
	>25	6.20	0.0	4.594	0.230	11.75	11.45	0.10	53	0.23	39.98	15.31	24.67
<i>Fago orientalis-Abietum bonmuellerianae</i>	0-5	6.50	0.50	20.96	0.965	28.32	4.21	1.14	201	0.45	83.24	44.25	40.01
	5-25	6.30	0.0	5.524	0.325	11.96	10.32	0.35	170	0.39	38.12	15.32	59.32
	>25	6.30	0.0	4.698	0.321	10.95	12.24	0.15	62	0.24	40.23	15.78	25.21

Forest types with dominating *Quercus pubescens* represent stages of degraded *Pinus nigra* subsp. *pallasiana* woodlands in Inner Anatolia and occupy particularly the heliophilous stands. Some associations were described by KETENOĞLU & AKMAN in the vicinities of Kizilcahamam-Kargasekmez (1974) and on the Ayaş Mountains (1976), Ankara (Pyro eleagnifoliae-Quercetum anatolicae AKMAN & KETENOĞLU 1976 em. AKMAN, BARBÉRO & QUÉZEL 1979). The association described here, the Junipero oxycedri-Quercetum pubescentis (Tab. 3), shows a similar floristic composition compared with the stands under xeric conditions of Inner Anatolia but in the study area, it exceptionally harbours the elements of Cisto-Micromerietea and Quercetelia ilicis. Due to its distribution in the transitional zone, Euxinian species decrease in number.

The association was considered to be included in Quercion anatolicae, in spite of that, its stands in the study area are more humid and contain the mesophilous species of Querco-Carpinetalia. The Quercetalia pubescentis KLIKA 1933 extending towards Northwest Europe, the West Mediterranean basin and North Africa in Anatolia is replaced by Querco-Carpinetalia. Quercion anatolicae, therefore has been included in the order cited above (QUÉZEL & al. 1980).

Hieracio pannosi-Cistetum laurifolii (Tab. 4) extends on the schiostous parent rocks and develops after the degradations of Black Pine stands. The dominant species, *Cistus laurifolius* often appears after *Pinus nigra* forests have been destroyed by fire and shows a peripheral distribution surrounding Inner Anatolia from three sides. *Cistus laurifolius* communities in Anatolia represent the last arboreal stage of the regressive succession of black pine forests. The degradation process of *Pinus nigra* forests often ends in *Cistus laurifolius* communities on shallow soils while open arboreal formations of *Juniperus excelsa* or *J. oxycedrus* occur on deeper soils (AKMAN & al. 2001). The associations of *Cistus laurifolius* with different co-dominant taxa in distinct regions were also described by several authors in some previous works. (AKMAN & KETENOĞLU 1976, ÇETİK & OCAKVERDI 1982). All the associations of *Cistus laurifolius* exhibit similar floristic composition due to the ecological conditions except for some accompanying Mediterranean species in this association presented here. However, it should be attached to Pino-Cistion laurifolii owing to its well representation within the association.

Quercus cerris has a wide distribution particularly in the western half of Turkey. It forms pure or sometimes mixed stands with other *Quercus* species, *Carpinus*, *Fagus*, *Pinus nigra*, *P. brutia* from sea level up to 1500 meters. The association presented here, Agyrolobio-Quercetum cerris (Tab. 7) harbours many components of Querco-Carpinetalia and Quercetea pubescentis. Some similar associations were described before from different regions under peculiar ecological conditions by EKIM & AKMAN 1991

Table 13
Localities of the relevés.

Relevé No.	Locality of the relevés	GPS-data
1-4	Southwest of Aşağı Armutlu village	Lat: 39°54' 18.12"N, Lon: 29°56' 16.14"E
5-7	West of Aşağı Armutlu village	Lat: 39°54' 24.19"N, Lon: 29°54' 30.88"E
8-12	West of Çamyayla village	Lat: 39°38' 00.43"N, Lon: 29°55' 55.43"E
13-15	West of Delielmacık village	Lat: 39°55' 28.40"N, Lon: 29°51' 52.69"E
16-18	North of Delielmacık village	Lat: 39°56' 32.37"N, Lon: 29°51' 43.87"E
19-22	South of Ormangüzle village	Lat: 39°52' 45.37"N, Lon: 29°51' 37.56"E
23-25	West of Ormangüzle village	Lat: 39°52' 39.14"N, Lon: 29°50' 25.64"E
26-29	East of Ormangüzle village	Lat: 39°52' 47.47"N, Lon: 29°52' 55.24"E
30-33	North of Aşağıarmutlu village	Lat: 39°56' 26.53"N, Lon: 29°56' 05.45"E
34-36	West of Aşağıarmutlu village	Lat: 39°52' 23.88"N, Lon: 29°54' 25.49"E
37-40	East of Muratdere village	Lat: 39°55' 39.44"N, Lon: 29°43' 03.77"E
41-44	Northwest of Muratdere village	Lat: 39°56' 37.04"N, Lon: 29°44' 13.20"E
45-48	North of Delielmacık village	Lat: 39°57' 47.64"N, Lon: 29°40' 27.47"E
49-52	Northwest of Saridere village	Lat: 39°58' 05.13"N, Lon: 29°53' 30.86"E
53-56	South of Kizilpınar village	Lat: 39°62' 23.27"N, Lon: 29°56' 34.56"E
57-60	Southwest of Revnak village	Lat: 39°51' 25.68"N, Lon: 29°55' 17.77"E
61-64	South of Ormangüzle village	Lat: 39°53' 05.91"N, Lon: 29°56' 25.51"E
65-67	Southeast of Kozpınar village	Lat: 39°55' 24.65"N, Lon: 29°34' 33.12"E
68-71	South of Kozpınar village	Lat: 39°54' 22.68"N, Lon: 29°35' 48.44"E
72-74	North of Köşk forest product storage	Lat: 39°53' 02.30"N, Lon: 29°56' 25.20"E
75-79	North of Mezit village	Lat: 39°56' 33.66"N, Lon: 29°27' 43.82"E
80-83	Northwest of Mezit village	Lat: 39°57' 35.68"N, Lon: 29°28' 52.31"E
84-87	East of Güneykestane village	Lat: 40°01' 09.46"N, Lon: 29°33' 31.35"E
88-91	East of Sulhiye village	Lat: 39°56' 06.62"N, Lon: 29°27' 08.11"E
92-94	East of Tanpınar village	Lat: 39°54' 58.83"N, Lon: 29°32' 04.35"E
95-99	Northwest of Mezit village	Lat: 39°56' 28.49"N, Lon: 29°29' 35.28"E
100-103	Northeast Sulhiye village	Lat: 39°55' 39.64"N, Lon: 29°28' 36.63"E
104-106	North of Kozpınar village	Lat: 39°57' 39.73"N, Lon: 29°31' 01.14"E
107-109	Northeast of Kozpınar village	Lat: 39°56' 16.41"N, Lon: 29°32' 22.67"E

(Sündiken Mountains), AKMAN & al. 1983 (Ilgaz Mountains) and ÇETİK & OCAKVERDİ 1982 (Sultan Mountains). The association described here was included in Carpino-Acerion of Querco-Carpinetalia due to better representation of Euro-Siberian mesophilous species compared with other stands in different localities.

Pinus nigra subsp. *pallasiana* is a wide spread pine species in Turkey particularly in the peripheral zone of Inner Anatolia. Its stands show different ecological situations due to its wide distribution. Some stands occupy dry and thermophilous localities while some extend to the humid regions. Its dry stands are very species poor. AKMAN 1995 divides the black pine communities into three regional groups: northwest Anatolia, Aegean part of Turkey and those on Taurus range and he shows that black pine forests in north Anatolia are spread on various parent rocks particularly metamorphic and volcanic ones. In the study area located in northwest Anatolia, it harbours many Euxinian (Euro-Siberian) species due to higher soil humidity of the stands. The association described here, *Stellario holosteae-Pinetum pallasianae* (Tab. 5) contains many species of Carpino-

Acerion and Querco-Carpinetalia. It therefore was considered to be included in the alliance cited above.

Various associations of Black pine have been described with different co-dominant species so far in Turkey. They all have peculiar floristic composition due to the regional ecological conditions. In the study area, it occupies the soils derived from blueschistous parent rock. We include it into Carpino-Acerion of Querco-Carpinetalia.

Pinus sylvestris has a limited distribution in the north-west Anatolia. In the study area, it forms stands with *Daphne pontica* and occupies almost the same altitudinal range as black pine. It spreads on the same parent rock with black pine and shows many common species with *P. nigra* subsp. *pallasiana* stands. Here, the Euro-Siberian elements are also rich in number. It therefore should be included into Carpino-Acerion of Querco-Carpinetalia orientalis. The associations of *Pinus sylvestris* were previously described by several authors particularly in North Anatolia; AKMAN 1974, 1976, AKMAN & al. 1978, DEMİRÖRS 1986. The association described here (Tab. 6) is very similar in floristic composition to that one described by KUTBAY & KILINÇ 1995 in Nebyan Mountain, Bafra.

Fagus orientalis, which is the main component of the deciduous forests in Turkey extends throughout Pontic range including the preponctic zone. Particularly at lower altitudes it forms pure stands partly mixes with coniferous species towards higher elevations. Trachystemo-Fagetum orientalis (Tab. 8) generally shows a distribution in north-west Anatolia. Many associations from different localities of the pontic range in north Anatolia with other co-dominant species were described in various papers. Their floristic composition includes many common species due to its homogenous distribution in north Anatolia and are made up of mainly Euxinian species. The floristic composition of the association described here is similar to that described by AKMAN & al. 1983 and was included in Rhododendro-Fagetalia orientalis.

The Fago orientalis-Abietetum bornmuellerianae (Tab. 9) is distributed on various geological substrates up to 1900–2000 m in the western Black Sea region. It occupies the montane altitudinal belt and both species usually form a mixed stand particularly in the western part of pontic range. Above 1100 m, the association shows a wide distribution on metamorphic flysch and brown forest soils. Similar associations were described by AKMAN 1976; AKMAN & al. 1980. The one described by AKMAN has many common species with the one described here. This association, the floristic structure of which is mainly composed of Euxinian (Euro-Siberian) species is included in Carpino-Acerion.

The association formed by different species of Juniper (Tab. 10) occupies the rocky areas with shallow soils at higher elevations. It has a poor floristic structure composed of the species belonging to Quercetea pub-

escentis and other companions. Most of the accompanying species are elements of the Mediterranean floristic regions. Various similar associations of these two Juniper species were described before in different regions such as Konya by ÇETİK, 1985; Sündiken Mountain, Eskişehir by EKİM 1977; Akdağ (Afyon-Denizli) by GEMİCİ 1988. Only one of these Junipers formed most of the associations previously described. The associations were considered to be included in Quercion anatolicae of Quercetea pubescentis because of the higher representation of accompanying species belonging to these syntaxa.

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