

Ecological Features of the *Pinus pinea* Forests in the North-West Region of Turkey (Yalova)

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Abstract

In this study, the phytosociological structure and ecological features of the *Pinus pinea* forests in the Fıstıklı village of Yalova province in the north-west region of Turkey was investigated. From the phytogeographical point of view, it is situated in the Europe-Siberian floristic region. The vegetation of the study area was analyzed according to the Braun-Blanquet approach, and the plant associations were classified by considering the characteristic species. In this study, we will describe one plant association belonging to the forest vegetation types.

Association and its higher units are as follows:

Class: *Quercetea ilicis* Br.-Bl. 1947

Order: *Quercetalia ilicis* Br.-Bl. 1947

Alliance: *Quercion ilicis* Br.-Bl. (1931) 1936

Association: *Lavandulo cariensis-Pinetum pineae* ass. nova

Keywords: Ecology, forest vegetation, phytosociology, *Pinus pinea*, Yalova.

Türkiye'nin Kuzeybatısındaki (Yalova) *Pinus pinea* Ormanlarının Ekolojik Özellikleri Özet

Bu çalışmada Türkiye'nin kuzeybatısındaki Yalova ilinin Fıstıklı köyünde bulunan *Pinus pinea* ormanlarının fitososyolojik yapısı ve ekolojik özellikleri araştırıldı. Fitocoğrafik görüş açısından alan Avrupa-Sibirya floristik bölgesinde bulunmaktadır. Çalışma alanının vejetasyonu Braun-Blanquet yaklaşımına göre analiz edildi ve bitki birlikleri karakter türlerine göre sınıflandı. Sonuçta, çalışma alanından orman vejetasyon tipine ait bir bitki birliği tanımlandı.

Birlik ve bağlı olduğu üst kategoriler aşağıdaki gibidir:

Class: *Quercetea ilicis* Br.-Bl. 1947

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Anahtar Kelimeler: Ekoloji, fitososyoloji, orman vejetasyonu, *Pinus pinea*, Yalova.

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INTRODUCTION

Vegetation studies in Turkey started in the 1970's by foreign scientist, and these studies were carried on by Turkish scientist starting from the 1980's. Some of these are the studies are; Akman (1973) and Quezel (1973) Amanus Mountains, Yurdakulol (1981) Pos Forests, Varol and Tatlı (2001) Çimen Mountain, Tatlı et al. (2005) Gümüş Mountain, Varol et al. (2006) Başkonuş Mountain and, Hamzaoğlu and Aksoy (2009) in Central Anatolia. But, the local vegetation studies performed so far are not sufficient for constructing the vegetation map of Turkey. The vegetation map of Turkey can not be

established before the local vegetation studies are completed. *Pinus pinea* L. (stone pine) is a species that is found around the Mediterranean Basin. The total area covered by the Stone Pine woodlands is 380,000 he. (75% in Spain, 9% in Turkey, 9% in Portugal, 5% in Italy, and lower percentages in Greece, Lebanon and France). The Stone Pine seeds are used as nourishment and have both an economic and ecologic importance. Because of that, they were moved to different areas by the people throughout history. Hence, where Stone Pine is natural or introduced has been the subject of debate among plant ecologist. For example, Francini (Mirov 1967)

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stated that the Stone Pine communities in Italy were planted by Pope Clement IX in 1666, and originated from the Island of Crete. Yet, Feinbrun (Mirov 1967) claimed that the Stone Pine is natural to Portugal, Spain, Corsica and Turkey, but it was introduced to the Island of Crete. However, according to paleobotanical records, cone and pine needle fossils of *P. pseudopinea* Sap., which is accepted as, the forefather of *P. pinea*, was found in the Pliocene beds, in Southern France (Mirov 1967). *P. pinea* does not have a widespread distribution because of its selectivity of a parent rock. Distribution areas of Stone Pine show that this plant species belongs to the Mediterranean River Basin. Stone Pine is not widely spread in Turkey, but, it is found in Bergama-Kozak, Aydın-Koçarlı, Antalya-Side, around the Marmara sea, the coast of Gemlik gulf, Önsen and Hacıağalı villages in Kahramanmaraş, Artvin and Trabzon, and Karadeniz region as a Mediterranean enclave. The total area of Stone Pine in Turkey is 30-35 thousand hectares (Fig. 1). Moreover, due to the economic advantage and utility of Stone Pine, its planting has hugely increased in Turkey. First, detailed information related to floristic and phytosociological structure of the *P. pinea* forests in Turkey were provided by Varol and Tatlı (2002), Varol et al. (2003), and Varol (2003, 2004, 2006). In this study, we aimed to determine the vegetation structure and ecological features of the *P. pinea* forests in Yalova. The study area is within the boundary of the city of Yalova. It is in square A2 according to the Davis grid system (Davis 1965-1985, Davis et al. 1988).

MATERIAL AND METHODS

The forests of *P. pinea* were surveyed from 2005-2006 in the province of Yalova. The identification of plants was done with the help of Davis (1965-1985), Davis et al. (1988) and Güner et al. (2000). The vegetation analysis was performed according to Braun-Blanquet's Floristic Unit System Method (Braun-Blanquet 1964). The cover-abundance values were determined according to Barkman et al. (1964). The size of the quadrats were estimated by means of a "minimal area" that was 400 m² in all quadrats. The ecological data was placed at the top of each quadrat forming phytosociological tables. The unit described was classified according to the system of vegetation nomenclature followed by Weber et al. (2000). The names of the syntaxa and their authors were checked and corrected (Akman et

al. 1978, Quezel et al. 1978, 1992). In total, 15 sample plots were taken, and one plant association was distinguished by the analyses of these plots. In order to compare associations, we used Sorensen's (1948) Index of Similarity. The calculation of the constancy values follows Dierschke (1994). The abbreviations used in the list are as follows: Ch: Chamaephytes, G: Geophytes, he: Hectare, H: Hemicryptophytes, Mp: Mesophanerophytes, Np: Nanophanerophytes, Th: Therophytes, End: Endemic, ES: Euro-Siberian region, IT: Irano-Turanian region, Med: Mediterranean region, and Cos: Cosmopolitan.

Brief Description of the Study Area

The study area is in the north-west region of Turkey. The study area is within the boundary of Yalova province in the Fıstıklı Village of Armutlu. The research area falls within A2 of the grid system adopted by Davis (1965-1985). The area has a rough topography and its altitude ranges from 40 to 360 m. The parent rock of our study area is granite. The geological structure of the research area was formed in the Eosen Period and is called Fıstıklı Granite (Akgül and Yılmaz 1991). In the floristic structure of the research area, there are 147 taxon belonging to 36 families. Distribution numbers and rates of the taxon in terms of phytogeographic regions are as follows: Mediterranean elements 36 (24.48%), Euro-Siberian elements 16 (10.88%), and Irano-Turanian 2 (1.36%). The numbers of endemic taxa are 7 and the rate of endemism is 4.76%.

The meteorological climatic data was obtained from the General Directory of Meteorological Affairs (Anonymous 2005) (Table 1). The study area has a Mediterranean climate, the main characteristics of which are: dry summers and warm and rainy winters. The seasonal precipitation regime during the year is as winter, autumn, spring and summer (Akman 1982). In the research area, the annual mean temperature is 14.8°C. The maximum mean temperature (M) is 27.6°C in July and August. The minimum mean temperature (m) is 3.7°C in February. The frost months are from December to March. In the research area, there is a arid period from June to August and there is a precipitation period from September to May. The climatic data is given in Table 1.

For the characterization of the climatic characteristics of the area, Emberger's "Pluviothermique Quotient" and Walter's "Ombrothermique Diag-

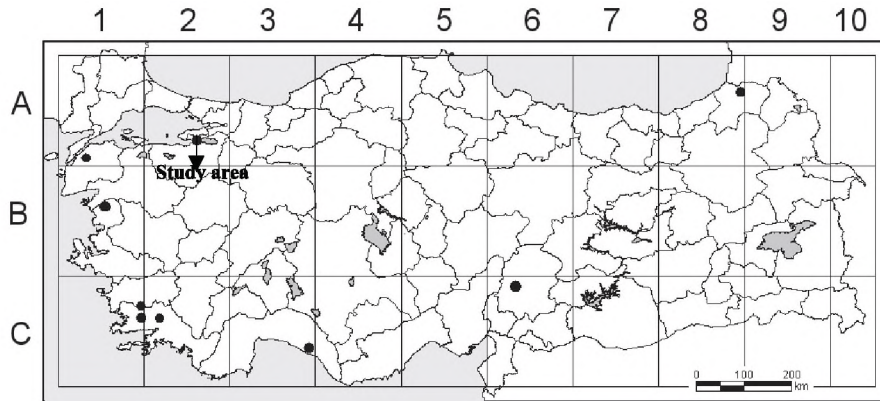


Fig 1. Map showing the provincial distribution of the natural forests of *Pinus pinea* in Turkey and the study area.

Table 1. Climatic data of the study area (Yalova-Çınarcık).

	Period (years)	Winter		Spring			Summer			Autumn		Winter	Mean annual	
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI		XII
Mean temperature (°C)	24	7,1	6,6	8,1	12,5	16,7	21,3	23,6	23,6	20,5	16,3	12,0	9,0	14,8
Mean maximum temperature (°C)	24	10,0	9,7	11,5	16,4	20,8	25,4	27,6	27,6	24,5	19,7	15,2	11,8	18,4
Mean minimum temperature (°C)	24	4,4	3,7	5,1	8,9	12,9	17,3	19,7	20,0	16,9	13,4	9,1	6,2	11,5
Lowest temperature (day) (°C)	24	-5,2	-6,0	-3,9	0,8	3,7	9,8	12,4	14,3	9,7	4,4	0,2	-3,6	-
Mean precipitation (mm)	23	91,8	76,4	77,5	67,9	40,8	53,0	27,3	36,0	45,8	101,3	110,5	121,4	849,7

rams" (Walter 1956) were used (Fig. 2).

The soil samples were collected from the top 30 cm of profile of the vegetation type, where a sociological quadrats was taken. The results of the soil analyses is presented in Table 2. These soil samples were analyzed by the Soil and Fertilizer Research Institute which belongs to The Minister of Agriculture and Village Affairs, in Muğla Province.

RESULTS

Vegetation of the Area

The studied area lies in north-west Turkey. The presence of hemicryptophyte plants were abundant in the study area while the dominant species were *P. pinea* (stone pine), and shrubs such as; *Arbutus unedo* L., *Erica manipuliflora* Salisb., *Pistacia terebinthus* L. subsp. *palaestina* (Boiss.) Engler, *Quercus infectoria* Olivier subsp. *infectoria*, *Lonicera etrusca* Santi, *Phillyrea latifolia* L., *Lavandula stoechas* L. subsp. *cariensis* (Boiss.) Rozeira, *Cistus creticus* L. which is remarkable. The Stone Pine forest forms an unmixed community in the research area. The Stone Pine forest occurs on slopes with an inclination of 5-40% between 40-360 m elevation in the study area, which occurs in the Eu-

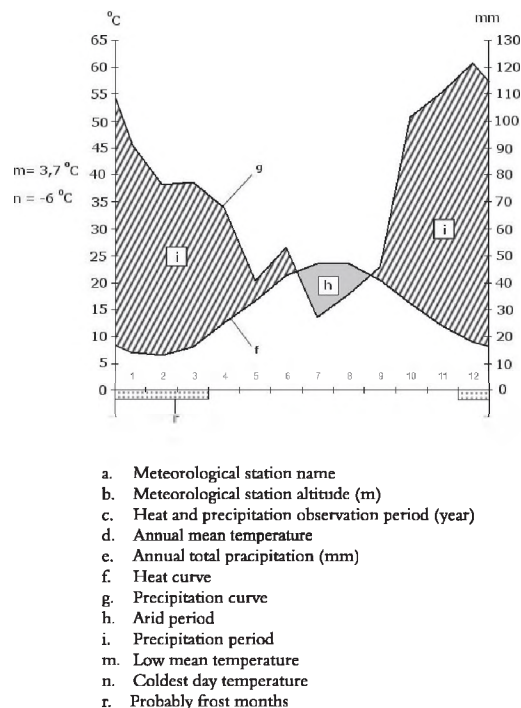


Fig 2. Climatic diagram of Yalova.

Table 2. Chemical analysis and characteristics of the soil profiles.

İstasyonlar	Quadrat no	Depth (cm)	pH	Salt (microS/cm)	CaCO ₃ (%)	Organic matter %	Total N (%)	Useful P (ppm)	Useful K (ppm)	Useful Ca (ppm)	Useful Mg (ppm)	Useful Fe (ppm)
Yalova-Muftüçiftliği	6	0-7	5.33	189	1.05	4.14	0.207	3.90	147.7	1798	280.7	111.68
Yalova-Muftüçiftliği	6	7-30	5.46	101	1.05	1.14	0.057	0.10	109.5	815.9	160.3	33.68
Yalova-Yılanlıdere	13	0-3	5.28	152	1.05	0.56	0.028	2.0	62.5	935.9	179.6	41.2
Yalova-Yılanlıdere	13	3-30	5.28	34	1.05	0.56	0.028	0.0	25.0	783.8	134.8	16.18

Table 3. *Lavandula cariensis-Pinetum pineae* ass. nova. typus: Quadrat no.13*

L I F E F O R M	Quadrat No	1	2	3	4	5	6	7	8	9	10	11	12	13*	14	15	C O N S T A N C Y	C H O R O T Y P E S
		Size of plot (m ²)x10	400	400	400	400	400	400	400	400	400	400	400	400	400	400		
	Altitude (m)x10	320	350	350	350	340	350	360	90	120	130	140	150	60	50	40		
	Exposition	W	W	W	W	W	E	W	SSW	S	S	SSW	S	NW	NW	NW		
	Inclination (°)	15	10	10	5	5	5	5	30	40	40	40	40	20	20	20		
	Tree layer cover (%)	60	60	60	60	70	70	60	50	60	50	60	50	75	70	90		
	Shrub layer cover (%)	60	80	70	30	80	70	60	90	90	90	90	80	70	80	70		
	Herb layer cover (%)	70	30	80	80	70	80	90	20	20	10	10	10	10	10	15		
	Parent Rock (Granite)	Grn	Grn	Grn	Grn	Grn	Grn	Grn	Grn	Grn	Grn	Grn	Grn	Grn	Grn	Grn		
	Species number	33	22	22	29	35	27	36	20	21	20	25	23	26	22	29		
	Differential and Characteristics species of association																	
Mp	<i>Pinus pinea</i>	33	33	33	33	44	44	33	33	33	33	33	33	44	44	55	V	Cos.
Np	<i>Erica manipuliflora</i>	23	33	33	-	-	33	22	33	33	33	44	3	33	33	33	V	Med.
Np	<i>Lavandula stoechas</i> ssp. <i>cariensis</i>	12	+2	-	+2	-	12	+2	22	22	22	22	22	+2	-	+2	IV	End-Med.
	Differential and Characteristics species of the <i>Quercion ilicis</i>																	
Np	<i>Arbutus unedo</i>	+2	33	22	-	22	22	22	22	33	22	33	33	33	33	33	V	Cos.
Np	<i>Pistacia terebinthus</i> ssp. <i>palestina</i>	-	-	-	-	-	-	-	-	+2	+2	22	+1	22	+2	+2	III	Cos.
Np	<i>Lonicera etrusca</i>	-	-	-	-	-	-	-	-	-	-	-	-	+2	+2	+1	I	Med.
	Differential and Characteristics species of the ordo <i>Quercetalia ilicis</i>																	
Np	<i>Phillyrea latifolia</i>	-	+2	+2	+2	22	-	-	22	+2	+2	33	33	22	+2	22	IV	Med.
G	<i>Ruscus aculeatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	+1	+1	+1	I	Cos.
	Differential and Characteristics species of the class <i>Quercetea ilicis</i>																	
G	<i>Asparagus acutifolius</i>	-	-	+2	-	+1	-	+1	-	-	+1	+1	-	+1	+1	+1	III	Med.
Np	<i>Oxyris alba</i>	-	-	-	-	-	-	-	-	-	-	-	-	22	+2	+2	I	Med.
	Differential and Characteristics species of the class <i>Quercetum pubescens</i>																	
Np	<i>Quercus infectoria</i> ssp. <i>infectoria</i>	22	22	22	22	33	+2	22	22	22	22	22	22	+2	+2	+2	V	Cos.
H	<i>Campanula lyrata</i> ssp. <i>lyrata</i>	-	-	-	+1	+1	-	+1	-	-	+1	+1	-	+1	-	+1	III	End.
Np	<i>Crataegus monogyna</i> ssp. <i>monogyna</i>	-	-	+1	-	-	-	-	-	-	-	-	-	-	-	-	I	Cos.
	Differential and Characteristics species of the class <i>Cisto-Micramerietea</i>																	
Np	<i>Cistus creticus</i>	23	33	22	22	22	33	33	44	44	44	33	33	22	44	22	V	Med.
Th	<i>Aira elegantissima</i> ssp. <i>ambigua</i>	-	12	+2	-	-	12	12	+1	+1	-	+2	+2	12	-	-	III	Med.
Ch	<i>Trifolium arvense</i>	+1	+1	-	+1	+1	-	+1	-	+1	+1	+1	+1	-	-	-	III	Cos.
Ch	<i>Trifolium cherleri</i>	+1	-	-	-	-	-	-	-	-	-	-	+1	-	-	-	I	Cos.
Np	<i>Spartium junceum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+1	I	Med.
H	<i>Calicotome villosa</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+1	I	Med.
	Companions																	
H	<i>Stipa bromoides</i>	+1	12	+2	22	22	12	-	12	12	12	+2	+2	+2	+2	12	V	Med.
Th	<i>Briza maxima</i>	+2	+2	12	12	+1	22	-	+1	12	-	+1	+2	+1	+2	12	V	Cos.
H	<i>Dactylis glomerata</i> ssp. <i>hispanica</i>	12	+2	-	22	12	12	22	12	+2	+2	+2	-	+1	+1	+2	V	Cos.
G	<i>Muscari neglectum</i>	-	+1	+1	-	+1	+1	-	+1	+1	-	+1	+1	+1	+1	-	IV	Cos.
H	<i>Gallium verum</i> ssp. <i>verum</i>	+1	11	+1	+1	+1	11	12	-	-	+1	-	-	-	-	-	III	ES
G	<i>Poa bulbosa</i>	-	12	-	-	-	12	-	+2	+2	+2	-	12	-	12	12	III	Cos.
Th	<i>Crucianella angustifolia</i>	+1	+1	-	-	-	-	-	+1	+1	+1	11	+1	-	-	-	II	Med.
H	<i>Cynosurus echinatus</i>	12	12	12	12	-	12	12	-	12	-	-	-	-	-	-	III	Med.
H	<i>Inula oculus-christi</i>	-	-	+1	-	+1	+1	+1	-	-	-	-	-	-	+1	+1	II	FS
Th	<i>Logfia arvensis</i>	-	+1	-	+1	-	-	+1	+1	+1	-	-	+1	-	-	-	II	Cos.
H	<i>Pilosella piloselloides</i> ssp. <i>megalomastix</i>	+1	-	-	+1	-	-	+1	-	-	-	-	+1	-	+1	+1	II	Cos.
Ch	<i>Teucrium chamaedrys</i> ssp. <i>chamaedrys</i>	-	-	+1	+2	+1	12	-	-	+2	+2	-	-	-	-	-	II	FS
H	<i>Hypericum calycinum</i>	-	+2	22	+1	-	-	-	-	-	-	-	-	+2	-	22	II	ES
H	<i>Oryzopsis hymenoides</i>	-	-	-	22	12	-	12	-	-	-	-	-	+2	-	+2	II	Cos.
G	<i>Phalaris arundinacea</i>	-2	-	-	12	12	12	22	-	-	-	-	-	-	-	-	II	Cos.
Np	<i>Rubus canescens</i> var. <i>canescens</i>	-	-	+1	+1	+2	+2	+2	-	-	-	-	-	-	-	-	II	Cos.
Th	<i>Trifolium campestre</i>	+1	+1	-	-	-	-	-	-	-	+1	+1	+1	-	-	-	II	Cos.
H	<i>Hypericum perforatum</i>	+1	+1	-	-	+1	+1	-	-	-	-	-	-	-	-	-	II	Cos.
H	<i>Lolium rigidum</i> var. <i>rigidum</i>	+2	-	-	12	12	-	12	-	-	-	-	-	-	-	-	II	Cos.
Th	<i>Oryza daucoides</i>	+1	-	-	-	-	-	-	+1	+1	-	+1	-	-	-	-	II	Cos.
G	<i>Limodorum abortivum</i>	-	-	-	-	-	-	-	+1	-	+1	-	-	+1	-	+1	II	Cos.
G	<i>Allium guttatum</i> var. <i>guttatum</i>	-	-	-	-	-	-	-	+1	-	+1	+1	+1	-	-	-	II	Cos.
Ch	<i>Rubia tinctorum</i>	-	-	-	-	-	-	-	-	-	-	+1	-	+1	+1	+1	II	IT
Np	<i>Rosa canina</i>	+1	-	+1	-	+2	-	-	-	-	-	-	-	+2	-	-	II	Cos.
Th	<i>Avena barbata</i> ssp. <i>barbata</i>	12	-	-	12	-	-	22	-	-	-	-	-	-	-	-	I	Med.

Table 3. Continued.

Th	<i>Bromus sterilis</i>	12	*	*	*	*	.	*	+1	+2	.	.	.	.	.	.	I	Cos.
H	<i>Cichorium intybus</i>	.	.	.	+1	+1	.	+1	.	.	.	.	.	.	.	.	I	Cos.
Th	<i>Milium pedicellare</i>	.	.	+2	.	.	.	.	.	.	.	12	+2	.	.	.	I	Cos.
H	<i>Poa nemoralis</i>	.	.	.	.	22	12	.	12	.	.	.	.	.	.	.	I	Cos.
Ch	<i>Thymus longicaulis</i> ssp. <i>chaubertii</i> var. <i>chaubertii</i>	+2	+2	.	.	+1	.	.	.	.	.	.	.	.	.	.	I	Cos.
Th	<i>Torilis leptophylla</i>	+1	.	.	.	+1	.	.	.	.	.	.	.	+1	.	.	I	Cos.
H	<i>Calamintha nepeta</i> ssp. <i>glaberrima</i>	.	.	.	.	+2	+2	+1	.	.	.	.	.	.	.	.	I	Cos.
H	<i>Clinopodium vulgare</i> ssp. <i>vulgare</i>	.	.	.	.	+1	+1	+1	.	.	.	.	.	.	.	.	I	Cos.
Ch	<i>Dorcnium gracium</i>	+1	+1	+1	I	Cos.

The species of double frequency:
 (H)(Cos.) *Cirsium vulgare*: +1(1), +1(4); (Th)(Cos.) *Euphorbia taurinensis*: +1(1), +1(7); (Np)(Cos.) *Pyrus amygdaliformis* var. *amygdaliformis*: +2(4), +2(6); (H)(Cos.) *Rumex obtusifolius* ssp. *alpinus*: +1(4), +1(7); (H)(Cos.) *Sanguisorba minor* ssp. *muricata*: +1(3), +1(6); (H)(Cos.) *Sonchus arvensis* ssp. *uliginosus*: +1(3), +1(4); (Th)(Cos.) *Trifolium leucanthum*: +1(1), +1(5); (Th)(Cos.) *Trifolium striatum*: +1(1), +1(7); (Th)(Cos.) *Trifolium chertleri*: +1(1), +1(12); (Ch)(Cos.) *Teucrium lamifolium* ssp. *lamifolium*: +2(5), +1(6); (H)(Med.) *Digitalis viridiflora*: +1(5), +1(6); (H)(Cos.) *Dianthus leptocladus*: +1(6), +1(7); (H)(Med.) *Origanum vulgare* ssp. *hirtum*: +1(7), +1(11); (H)(Cos.) *Hypericum montbreti*: +1(13), +1(14); (H)(Cos.) *Pimpinella humilis*: +1(13), +1(15).

The species of single frequency:
 (Th)(Cos.) *Aegilops biuncialis*: +2(1); (Th)(Cos.) *Geranium robertianum*: +1(1); (H)(ES) *Luzula sylvatica*: +1(3); (H)(ES) *Onopordum tauricum*: +1(4); (G)(ES) *Phleum alpinum*: 12(4); (Th)(Med.) *Sherardia arvensis*: +1(1); (H)(Cos.) *Carex flacca* ssp. *serrulata*: +1(3); (H)(Cos.) *Oenanthe pimpinelloides*: +1(5); (H)(Cos.) *Plantago lanceolata*: +1(5); (G)(Cos.) *Hordeum bulbosum*: 12(5); (Ch)(Med.) *Dorcnium hirsutum*: +1(5); (Ch)(Cos.) *Agrimonia eupatoria*: +1(5); (H)(Cos.) *Euphorbia rigida*: +1(5); (H)(ES) *Hypochoeris radicata*: +1(6); (Th)(Cos.) *Trifolium glomeratum*: +1(7); (Th)(Med.) *Gastridium phleoides*: +2(7); (Th)(Cos.) *Artemisia tinctoria* ssp. *pallida*: +1(7); (H)(Cos.) *Herschfeldia incana*: +1(7); (H)(Cos.) *Reichardia picroides*: +1(7); (Mp)(Cos.) *Pinus brutia*: 22(8); (H)(Med.) *Micromeria myrsinifolia*: +1(11); (H)(Med.) *Psorelea butiminosa*: +1(11); (H)(Cos.) *Melica ciliata* ssp. *ciliata*: +2(14); (H)(Med.) *Galium paschale*: 12(15); (H)(End-ES) *Lathyrus undulatus*: +1(15).

Mediterranean zone.

Association *Lavandulo cariensis-Pinetum pineae* ass. nova (Table 3, Quadrat 1-15)

Holotypus: Tab. 3, quadrat no.13, Yılanlıdere locale, 60 m, cover 75%, 400 m².-Character species: *P. pinea*, *E. manipuliiflora*, *L. stoechas* subsp. *cariensis*.

This association occurs on granite bedrock and the soils of the association have an high-asidic character. In the Yılanlıdere locale, organic matter is very poor between 0-3 cm and 3-30 cm. The association consist of three vertical layers. The tree layer of the association consist of *P. pinea*. The coverage of the tree layer is between 50-90% . The common species in the shrub layer are as *E. manipuliiflora*, *L. stoechas* subsp. *cariensis*, *A. unedo*, *Q. infectoria* subsp. *infectoria*, *C. creticus*, *P. latifolia*, and *P. terebinthus* subsp. *palaestina*. The coverage of the shrub layer is between 30-90%. The coverage of the herb layer is between 10-90%. The life form structure of the association is dominated by hemicryptophytes (41.93%), therophytes (21.50%), nanophanerophytes (15.05%), chama ephytes (9.67%), geophytes (9.67%), and mesophanerophytes (2.15%). The association is composed of 93 species, the species numbers in the quadrats varies between 20 and 36. The accompanying species that occur in this community belong to different higher syntaxa such as *Quercetea pubescentis* and *Cisto-Micromerietea*.

DISCUSSION

P. pinea isn't widespread in Turkey as in other Mediterranean Countries. The common distribution of stone pine in Turkey is found in Bergama, Aydın, Muğla, Antalya-Side, and eastern Taurus and Karadeniz region as a Mediterranean enclave

(Akman 1995, Varol et al. 2003). Moreover due to the economic advantage and utility of Stone Pine, its plantations have hugely increased in Turkey. This study attempts to classify the phytosociological structure and ecological features of the *P. pinea* forest vegetation in north-west Anatolia, and the classification of the was also attempted. From the point of view of plant geography, the study area is situated in the Euro-Siberian floristic region which is under the effective control of a rainy-cool Mediterranean climate (Akman et al. 1979, Barbero et al. 1981). Annual rainfall is very important in the growing of stone pine. The annual rainfall must be at least 600 mm, since the loss of water is quite high due to the sandy and porous characteristics of the soil. The expand of Stone Pine in Turkey is mostly observed on granite, besides andesite, quartzite, mica schist and sandstone (Akgül and Yılmaz 1991). However, the parent rock of our study field is granite. Although the physionomical aspect of the landscape is quite homogeneous, its floristic composition exhibits a heterogeneous structure. The Stone Pine forests in Yalova not have been protected very seriously by the local people, when compared with other Stone Pine forests in other regions of Turkey. This association has a floristic structure which consists of trees, shrubs and herbs. In this association, some characteristics of *Cisto-Micromerietea* class such as *C. creticus*, *Aira elegantissima* Schur subsp. *ambigua* (Arcang.) M. Doğan, *Trifolium arvense* L., *T. chertleri* L., and *Spartium junceum* L. show us that this association stays under the anthropogenic effects which is heavily over grazed. In Aydın province, *P. pinea* forests forms a pure population at altitudes between 800-1000 m and, it

grows mixed with *P. brutia* on the sand-dunes in Manavgat (Antalya-Side) (Akman et al. 1978, Akman 1995). Furthermore, it forms a *Crucianella-Pinetum pinea* association around Trabzon and Artvin in Karadeniz Region (Varol et al. 2003). According to Zohary, *P. pinea* forest in the Karadeniz Region is a Mediterranean relict (Zohary 1973). Characteristic species of class *Quercetea pubescentis* is mostly found in the *P. pinea* community in Aydın. Moreover, characteristic species of class *Quercetea ilicis* exists in the *P. pinea* association which occurs in Side (Antalya). Therefore, this association is included in the alliance *Oleo-Ceratonion* (Akman et al. 1978, Akman 1995). The *P. pinea* association in the Karadeniz region (Trabzon & Artvin) is included in the class *Quercetea ilicis* (Varol et al. 2003). In our previous two studies, the *Gastridio ventricosi-Pinetum*

pineae association which is present in the eastern Taurus Region (Kahramanmaraş) (Varol and Tath 2002) and *Diantho tripunctati-Pinetum pineae* association which is present in the south-west Anatolia Region (Muğla) were included in the class *Quercetea ilicis* (Varol 2004).

In the same way, the *Lavandulo cariensis-Pinetum pineae* association which is present in the north-west Anatolia Region (Yalova-Armutlu) was also included in the alliance *Quercion ilicis* of order *Quercetalia ilicis* of class *Quercetea ilicis*.

We hope that this study will contribute to the vegetational studies of Turkey.

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