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PHYTOSOCIOLOGICAL INVESTIGATIONS OF *PINUS PINEA* L., FORESTS IN THE NORTH-EAST ANATOLIA REGION (TRABZON AND ARTVİN -TURKEY)

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Abstract

In this study phytosociological structure of *Pinus pinea* L., forests that occurs in Trabzon and Artvin provinces in the East-Black Sea region in Turkey has been investigated. From the phytogeographical view point, it is situated in Euro-Siberian floristic region. The vegetation of the study area was analyzed according to Braun-Blanquet method and the plant associations were typified by considering characteristic species. We describe 1 plant association and 2 subassociations belonging to forest vegetation types in the study area.

Introduction

There is a huge debate on the distribution areas of *Pinus pinea* L., (stone pine). Stone pine seeds are used as nourishment and have both economic and ecologic importance and due to this it has been introduced in different areas by the people along the history. Hence, where stone pine is natural or introduced has been the subject of debate among plant ecologist. For example, Francini stated that the stone pine communities in Italy were planted by Pope IX, Clement in 1666, and they originated from Crete İsland. Yet, Feinbrun claimed that stone pine is natural in Portugal, Spain, Corsica and Turkey, but it was introduced to Crete İsland. However, according to paleobotanical records, cone and pine needle fossils of *Pinus pseudopinea,* which is accepted as forefather of *Pinus pinea,* was found in Pliocene beds, in Southern France and Malay İsland (Mirov, 1967). *Pinus pinea* does not have a widespread distribution on earth-surface because of it's selectivity for parent rock. Distribution areas of stone pine on earth-surface show that this plant species belongs to the Mediterranean river basin. Stone pine is not distributed widely 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 K.Maraş, Artvin and Trabzon in Black Sea region as 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, it is increasingly planted in Turkey.

Some times ago, phytosociological structure of *Pinus pinea* L., occurring in K. Maraş province in the East-Mediterranean region has been investigated and a ***Gastridio ventricosi-Pinetum pineae*** association have been recognised (Varol & Tatlı, 2002). The objective of the present study was to assess the phytosociological structure of the *Pinus pinea* L., forests which is naturally distributed in the Trabzon and Artvin province of north-east Anatolia.

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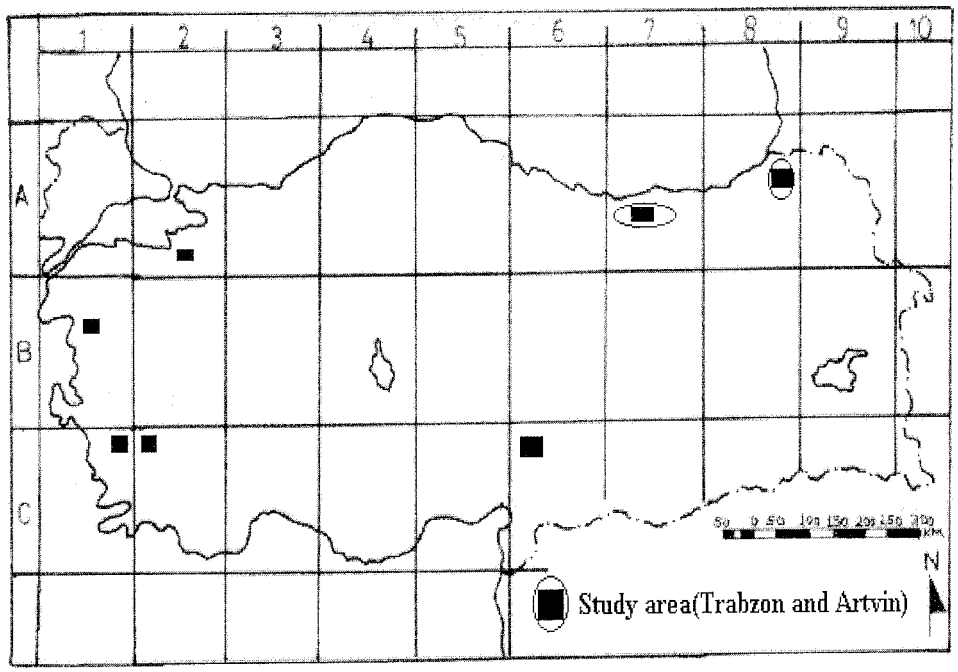

Fig. 1. Distribution of *Pinus pinea* L., in Turkey and Study Area

Material and Methods

A brief description of the area

The study areas are within the boundary of Trabzon (Kalenima Deresi) and Artvin (Fıstıklı village) provinces. The research areas falls within A7 and A8 of the grid system adopted by Davis (1965-1988). The study area is in the north-east Anatolia region of Turkey which has a rough topography and ranges in altitude from 100 to 550 m in Trabzon and in altitude from 200 to 600 m in Artvin (Fig. 2).

A vegetation type was described in the field, and association table constructed using the traditional methods of Braun-Blanquet (Braun-Blanquet, 1964). The size of the plots were estimated by means of a "minimal area" that was 400m^2 for all plots. The ecological data were placed at the top of each plot forming phytosociological tables. The unit described was classified according to the system of vegetation nomenclature followed by Barkman *et al.*, (1986). Nomenclature for vascular plants follows Davis (1965-1988). The meteorological climatic data presented in Table 1a, 1b were obtained from Meteoroloji Isl. Gn. Mdl. (1995). Soil characteristics of the vegetation in the study area was taken from other studies (Tüfekçioğlu *et al.*, 2002). The result of the analyses are presented in Table 2. The study area has a microclima-Mediterranean climate. In Trabzon, seasonal precipitation regime during the year is in the order: autumn, winter, spring, and summer, and in Artvin seasonal precipitation regime during the year is winter, autumn, spring and summer (Akman, 1982).

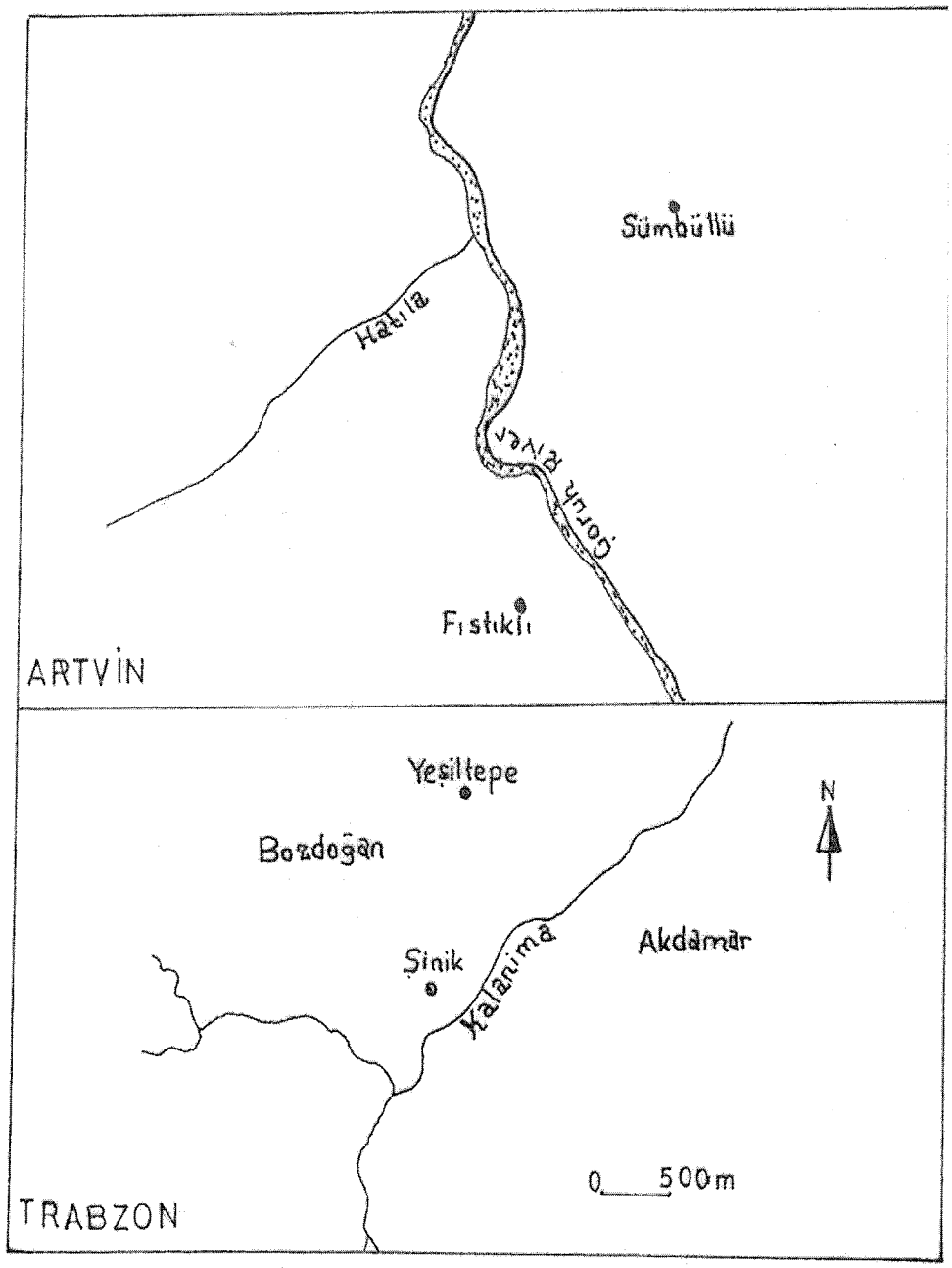

Fig. 2. Geographic map of the study area.

In the research area, the annual mean temperature is 14.6 ^{0}C in Trabzon and 12.3^{0}C in Artvin. The climatic data are given in Table 1.

Table 1. The average climatic values of Trabzon and Artvin.

Meteorological elements	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Mean
							Trabzon						
Mean temperature (C°)	7.6	7.1	8.5	11.6	16.1	20.0	22.5	22.7	20.0	15.6	12.9	10	14.6
Mean rainfall (mm)	83.1	57.1	48.4	41.7	38.4	32.4	30.9	42.9	61.1	104.2	75.4	71.4	687.3
							Artvin						
Mean temperature (C°)	2.7	4.0	7.1	11.7	15.7	18.9	20.8	20.9	17.9	13.6	9.5	4.7	12.3
Mean rainfall (mm)	75.4	73.2	56.3	50.8	47.7	49.0	26.9	28.0	36.0	59.0	71.1	87.5	661.0

Table 2. Soil characteristics of the vegetation in the study area.

Vegetation type	Depth cm	pH	$CaCO_3$	Org. Matter %	Sand % of < 2mm	Silt %	Clay %	Parent rock
Crucianello	0-10	6.60	Absent	4.5	79.55	18.40	2	
Pinetum pineae	10-20	6.75	Absent	3.1	91.78	7.18	1.02	Andesite
	20-50	6.73	Absent	2.8	93.87	2.05	4.08	

Results

Vegetation of the area

The studied area lies in the east-Black Sea region of the north-east Anatolia. The presence of therophyte plants was abundant in the study area while dominant species was *Pinus pinea* L., shurbs such as *Arbutus andrachne, Punica granatum, Spartiun junceum, Cistus salviifolius, Cistus creticus, Calicotome villosa, Pistacia terebinthus* subsp. *palaestina, Juniperus oxycedrus* subsp. *oxycedrus* are remarkable. Stone pine forest forms unmixed community in the research area. Stone pine forest occurs on slopes with an inclination of 30-80 % between 100-600 m elevation in the study area.

***Crucianello ponticae-Pinetum pineae* ass. nova (Table 3)**

Holotype: Table 3, plot no: 9.

This association occurs on andesite bedrock. The soils of the association are sandy and loamy in texture (SL), and have a slightly acidic character. Organic matter is medium. This association is characterized by the *Pinus pinea, Crucianella gillani* subsp. *pontica.* The association consist of three vertical layers. The tree layer of the association consists of *Pinus pinea.* The coverage of tree layer is between 40-70 % and the height 8-15 m. The common species in the shrub layer are *Arbutus andrachne, Punica granatum, Spartiun junceum, Cistus salviifolius, Cistus creticus, Calicotome villosa, Pistacia terebinthus* subsp. *palaestina, Juniperus oxycedrus* subsp.*oxycedrus.* The coverage of shrub layer is between 50-70 % and the height 1-2 m. The coverage of herb layer is between 50-60 % and the height 30-50 cm.

Crucianello ponticae-Pinetum pineae association separated into a*lyssietosum murale* subassociation and *chamaecytisetosum hirsutae* subassociation.

a. alyssietosum murale subass. nova (Table 3, plots 1-6)

Holotype: Table 3, plot no: 5.

This subassociation occurs in Kalenima stream of Trabzon. The characteristic species of this subassociation are: *Alyssum murale* var. *murale, Spartium junceum* and *Satureja spicigera.*

b. chamaecytisetosum hirsutae subass. nova (Table 3, plots 7-11)

Holotype: Table 3, plot no: 7.

This subassociation occurs in Fıstıklı village of Artvin. The characteristic species of this subassociation are: *Chamaecytisus hirsitus, Punica granatum, Sempervivum glabrifolium* and *Silene armeria.*

The characteristic species of classes QUERCETEA-ILICIS, and CISTO-MICROMERIETEA in the ***Crucianello ponticae-Pinetum pineae*** association are found. The presence of characteristic species of the class CISTO-MICROMERIETEA in this association shows that this association suffers from heavy antropogenic impact. *Crucianello ponticae-Pinetum pineae* association in our research is included in the class QUERCETEA-ILICIS

Table 3. Crucianello ponticae-Pinetum pineae ass.nov.

Quadrat no	1	2	3	4	5	6	7	8	9	10	11	
Area (m^2)x10	40	40	40	40	40	40	40	40	40	40	40	P
Altıtude (m)x10	45	43	41	41	35	35	35	35	33	33	35	R
Exposition	S	S	S	SE	SE	SE	E	SE	E	E	E	E
Inclination(°)	45	40	30	30	40	45	50	50	60	60	80	S
Tree cover (%)	40	45	55	55	65	65	60	60	70	70	4 0	E
Shrub cover (%)	60	60	70	70	60	50	60	60	70	70	50	N
Herb cover (%)	60	60	60	50	60	60	50	50	50	50	50	C
Parent rock (Andesite)	An.	An.	An.	An.	An.	An.	An.	An.	An.	An.	An.	E
Characteristic species of association												
Pinus pinea	23	23	23	23	33	33	23	23	33	33	22	V
Crucianella gillani subsp. *pontica*	21	21	21	.	22	.	11	11	11	11	11	V
Characteristic species of subassociation												
Alyssum murale var. *murale*	22	+2	22	12	12	12	.	.	.	.	.	III
Spartium junceum	12	.	12	.	12	12	.	.	.	.	.	II
Satureja spicigera	+2	+2	.	+2	+2	.	.	.	.	.	.	II
Characteristic species of subassociation												
Chamaecytisus hirsutus	.	.	.	.	.	.	+1	+1	+1	+1	+1	III
Punica granatum	.	.	.	.	.	.	+1	.	+1	+1	+1	II
Sempervivum glabrifolium	.	.	.	.	.	.	+1	+1	.	.	+1	II
Silene armeria	.	.	.	.	.	.	+1	.	+1	.	+1	II
Characteristic species of Quercetea Ilıcıs												
Arbutus andrachne	+2	+2	+1	+2	.	+2	22	22	12	12	+1	IV
Rhus coriaria	.	+1	+1	+1	+1	+1	+1	.	+1	.	+1	IV
Juniperus oxycedrus subsp. *oxycedrus*	.	+2	+2	.	+1	+2	+1	.	+2	+1	+2	IV
Pistacia terebinthus subsp. *palaestina*	.	+1	+1	.	+1	+1	.	.	+1	+1	.	III
Cistus salviifolius	.	+2	+2	+2	.	.	+2	.	12	+2	.	III
Ruscus aculeatus	+2	.	+1	.	+1	.	+1	+2	.	.	.	III
Euphorbia rigida	.	.	.	.	.	.	+1	+1	.	+1	+1	II
Vitis sylvestris	.	.	.	.	.	.	.	.	+1	+1	+1	II
Characteristic species of Cısto-Micromerietea												
Cistus creticus	22	22	32	22	22	21	23	23	23	22	22	V
Origanum vulgare	+1	+1	+1	+1	+1	+1	+1	+1	.	.	+1	V
Psorolea bituminosae	.	+1	+1	+1	+1	+1	+1	+1	.	.	+1	IV
Fumana arabica	+1	+1	+1	.	.	+1	+1	+1	.	.	+1	IV

Table 3 (Cont'd.)

Characteristic species of Astragalo-Brometea												
Teucrium polium	+2	+2	+2	+2	+2	+2	.	+2	+2	+2	+2	V
Teucrium chamaedrys	+2	+2	+2	+2	+2	+2	+2	+2	.	.	+2	V
Trifolium stellatum	+1	+1	+1	+1	.	+1	+1	.	+1	+1	.	IV
Pilosella hoppeana	+1	+1	+1	+1	.	.	+1	.	+1	+1	.	IV
Helianthemum nummularium	.	+1	+1	+1	.	.	+1	.	+1	+1	.	III
Onobrychis armena	.	.	.	+1	+1	+1	.	.	+1	+1	.	III
Sanguisorba minor	+1	+1	.	.	+1	.	+1	+1	.	.	.	III
Characteristic species of Quercetea-Pubescentis												
Dorycnium graecum	+1	+1	+1	+1	+1	+1	+1	+1	.	.	.	IV
Coronilla orientalis	+1	+1	+1	.	+1	+1	.	.	+1	+1	.	IV
Cotinus coggyria	.	+1	+1	.	.	.	+1	+1	.	.	+1	III
Cotoneaster nummularia	.	.	.	.	+1	.	+1	+1	.	.	+1	II
Dorycnium pentaphyllum	.	+1	+1	+1	.	.	.	.	.	+1	.	II
Carpinus orientalis	.	.	.	.	+1	.	+1	.	+1	.	.	II
Companions												
Petrorhagia saxifraga	+1	.	+1	+1	+1	+1	+1	+1	+1	+1	+1	V
Sedum pallidum	+1	+1	+1	+1	+1	+1	+1	.	+1	+1	.	V
Trifolium campestre	+1	.	+1	+1	+1	+1	.	+1	+1	+1	+1	V
Galium odoratum	+1	.	+1	+1	+1	+1	+1	+1	.	.	+1	IV
Brachypodium pinnatum	11	.	+1	+1	+1	+1	+1	+1	.	.	+1	IV
Arceuthobium oxycedri	.	+2	+2	.	+2	+2	+2	.	+2	+2	+2	IV
Dactylis glomerata	+1	.	+1	+1	+1	+1	.	.	+1	+1	.	IV
Scabiosa columbaria	+1	+1	+1	+1	+1	.	+1	+1	.	.	.	IV
Medicaga xvaria	.	+1	+1	+1	+1	+1	.	.	+1	+1	.	IV
Trifolium arvense	.	+1	.	+1	+1	.	.	.	+1	+1	+1	III
Convolvulus cantabrica	+1	11	11	.	+1	+1	.	.	.	.	+1	III
Rosa canina	.	.	+2	+2	+2	.	.	+2	.	+2	.	III
Bothriochloa ischaemum	.	.	.	.	+2	+2	.	.	+2	+2	+2	III
Crepis micranthum	+1	.	.	.	+1	.	.	+1	+1	+1	.	III
Tripleurospermum oreades	+1	.	+1	.	.	+1	+1	+1	.	.	.	III
Cynosurus echinatus	.	.	+1	.	+1	.	.	+1	.	+1	+1	III
Anthemis tinctoria	.	+1	.	+1	+1	.	.	.	+1	+1	.	III
Trifolium pratense	+1	.	.	+1	+1	.	.	.	.	+1	+1	III
Astragalus sp.	.	.	+2	+2	+2	+2	.	.	.	.	.	II
Hypericum perforatum	+1	.	.	+1	.	+1	.	.	.	.	.	II
Paliurus spina-christi	+1	.	.	+1	.	.	+1	+1	.	.	.	II
Inula ensifolia	.	+1	+1	.	.	+1	+1	.	.	.	.	II
Orobanche alba	.	.	+1	.	+1	.	+1	+1	.	.	.	II
Clinopodium vulgare	.	+1	.	.	+1	.	.	+1	+1	.	.	II
Inula vulgaris	.	.	+1	.	.	+1	+1	.	.	+1	.	II
Medicaga minima	.	.	.	.	.	+1	.	+1	+1	+1	.	II

Conclusion

Pinus pinea L., (Stone pine) is not widespread in Turkey, besides in other Mediterranean Countries. The common distribution of stone pine in Turkey is found in Bergama, Aydın, Muğla, Antalya-Side, East Taurus and Black Sea region as Mediterranean enclave (Davis, 1965; Akman, 1995). Moreover, due to the economic advantage and utility of stone pine, its plantation is greatly increasing in Turkey. In Italy stone pine *(Pinus pinea* L.) has been used for fixing sand-dunes where the agricultural plants are grown to prevent these plants from the sea winds (Selçuk, 1964). This study attempts to classify the phytosociological features of *Pinus pinea* forests vegetation in north-east Anatolia. From the point of view of plant geography, study area is situated in the Euro-Siberian floristic region which is under the effective control of the Oceanic climate (Akman, 1982).But, there is a microclima of mediterranean climate in the study area. Annual rainfall is very important in 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 soil. In those soils originating from granite, sand proportions were found minimum 60% and maximum 93%. The stone pine groves in Turkey are mostly observed over granite, besides andesite, quartzite, mica schist and sandstone (Akgül & Yılmaz 1991). However, the parent rock of our study site is andesite. Although the physionomical aspect of the landscape is quite homogeneous, its floristic composition exhibits a heterogeneous structure. Characteristic species of phytosociological units are not well represented in this association. This may be due to heavy overgrazing and floristic poverty which is associated with the parent rock. In this association, some characteristics of *Cisto-Micromerietea* class such as *Cistus creticus, Psorolea bituminosa, Fumana arabica and Origanum vulgare,* show that this association stays under the anthropogenic effects which is heavy to over-grazing. In the research area, for this reason, young generation of stone pine is very poor. *Pinus pinea* forms pure population at altitudes between 800-1000m in Aydın province and it forms mixed stands with *Pinus brutia* on sand-dunes in Manavgat (Antalya)-Side (Akman *et al.*, 1978; Akman, 1995). According to Zohary (1973), *Pinus pinea* forest in Black Sea region is a Mediterranean relict. Characteristic species of class QUERCETEA-PUBESCENTIS is mostly found in the *Pinus pinea* community in Aydın. Moreover, characteristic species of class QUERCETEA-ILICIS exists in the *Pinus pinea* association which occurs in Side (Antalya). Therefore, this association is included in the alliance *Oleo-Ceratonion* (Akman *et al.*, 1978; Akman, 1995). In our previous study, *Gastridio ventricosi-Pinetum pineae* association which is present in the east Taurus was included in the class QUERCETEA-ILICIS (Varol & Tatlı, 2002). In the same way, ***Crucianello ponticae-Pinetum pineae*** association which is present in the north-east Anatolia was also included in the class QERCETEA-ILICIS.

As a result, there is a heavy continuous degradation in the area. Day by day the structure of *Pinus pinea* forests in the research area is degraded. To prevent this destructive effect, the inhabitants should be alarmed and the destroyed areas should be restored.

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