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The Phytosociological and Phytoecological investigation of the Gerede-Aktaş forest

by

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ABSTRACT

The aim of the present work was to study the Gerede –Aktaş forest from the phytosociological and phytoecological points of view. The area is situated in the boundaries of Bolu province in the west Black Sea region which is under the influence of a semi-continental climate. Four sylvatic plant associations were described in the area mainly consisted of volcanic (Andesite) massive. The associations are spread out on the brown and noncalcerous brown soils and from two distinct groups; Mediterranean and Eurasiatic ones. Additionally, a meso-hygrophilous plant group was described in the open and wet areas of the forest

INTRODUCTION

The study area, Gerede-Aktaş forest is located in Bolu province in the west part of Black Sea region. It was aimed to describe the vegetation types, plant communities and their relations with the environment.

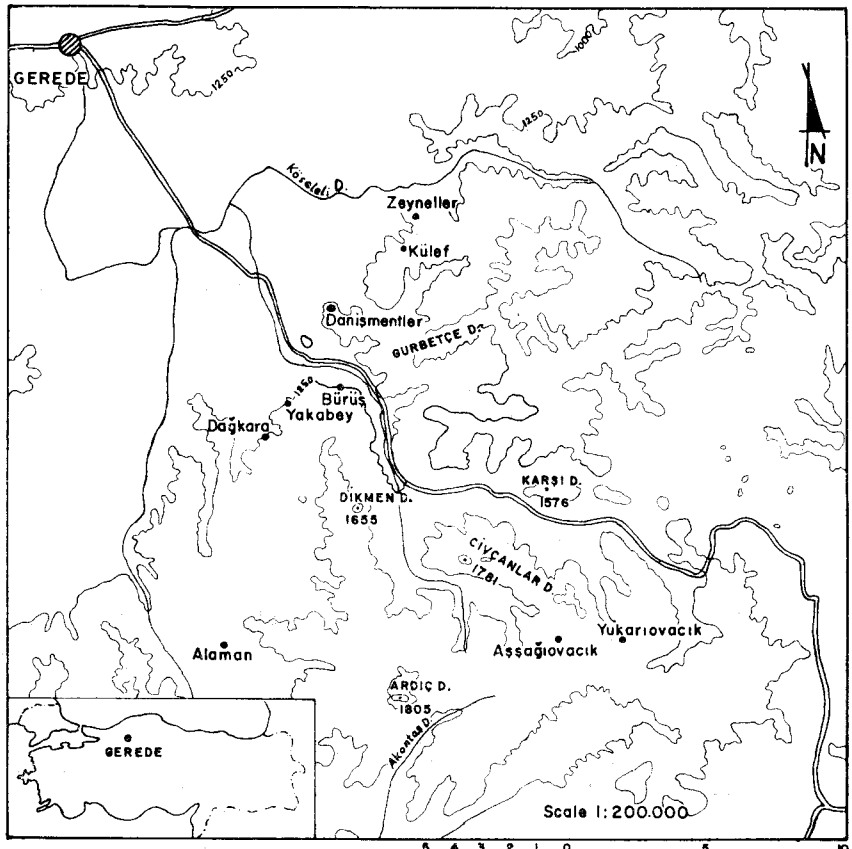
In the area situated within the Euro-Siberian floristic region, four plant communities that are in conformity with the climate were reparts of West Black Sea region were compared with the ones previously described in the Central Anatolia, and the differentiations among them were brought out.

This work forms the first step in the North Anatolia from the viewpoints of phytosociology and phytoecology.

The study was handed over in 1975 and completed in three years as a doctorate thesis under the supervision of Y. Akman to whom I owe a gratitude for his helps.

GEOGRAPHICAL and GEOMORPHOLOGICAL CONDITIONS OF THE AREA

(Map: 1)



Map 1._Topographic map of the study area.

From Harita Gn. Md.

Gerede-Aktaş forest is sitated within the boundaries of Bolu province at a distance of 130 km. on Ankara-İstanbul highway. The situdied site is bordered by Külef village in the north, Aşağıovacık and Yukarıovacık villages in the south, Dağkara village in the west and Kuzgunkaya hill in the east.

The highest point of the area is Erenler hill with an elevation of 1839 m, rising in the west of Aşağıovacık village. It is followed by Ardıç, Civcan and Dikmen mountains with the elevations of 1805 m, 1781 m and 1655 m respectively. The area, mainly composed of volcanic mainrocks, possesses locally quite steep hills.

Stratigraphy

Mesozoic:

Jurassic-Cretaceous: The main outcrop in the study area is situated in the surroundings of Aktaş village, on Gerede plataeu. Here, the chalks of Upper Jura partly mixed with basic erruptives and the yellowish-white chalks of lower cretaceous can be distinguished.

Tertiary:

A serie belonges to Tertiary which is composed of greenish sandstones and conglemerates in present in the vicinities of Mehmetbeyli-Hacılar, Yenecik-Zeyneller-Kazanlar and Köseli, Çalaman in the southeast of Gerde plateau.

Quaternary:

Quaternary formations are mainly composed of allivia in the Dörtdivan and Orta plataeu of the region.

Erruptive rocks:

Erruptive rocks were formed from andesites at the end of Upper Cretaceous. The depressions in the surroundings of Aşağıovacık and Yukarıovacık villages are probably indicators of the last erruptions.

Tectonic:

The tectonic structure in the region is in the form of anticlines, dikes and flexures. It is best seen in the Jurassic-Cretaceous outcrops of Aktaş.

CLIMATE

For determination of the climatic characteristics of the area, the data of Gerede Meteorological Station at an altitude of 1270 m were

used. The observations of the station comprise a period of 18 years for precipitation and 12 years for temperature. The climatic data are shown at the table no: 1 and 2.

Precipitotion

The annual range of precipitation in the area is about 682.6 mm. The minimum rainfall occurs in Autumn and is 134.7 mm while the maximum one is 211.4 mm in spring The amount of rainfall in Summer is 160.6 mm and comprises 23.5 % of total annual rainfall. This amount is quite more than that in Central Anatolia.

Temperature

The mean temperature of the area 7.5 °C. The mean maximum temperature of the hottets month, August, is 23.2 °C, while the mean maximum one in January is -6.0 °C.

Mean relative humidity

The mean annual relative humidity within a time period of 9 years is 60 % .This mean amount falls down to 58 % in July. The highest amount has been recorded as 76 % in December.

Bioclimatic synthesis

The precipitation regime of the area is Spring-Winter-Summer-Autumn and is of a transitory character between Mediterranean and Continental climates. The effects of the Contienental climate originated from Kastamonu reach to the Gerede-Aktaş forest.

The precipitational continentality (C) in the area is 1 and the temperatural continentality (K) is 25 %. The total continentality in the area indicates the characteristics of a Semi-Continental climate (Akman and Daget, 1971).

The drought indices of De Martonne is calculated as 39.0 and it indicates that the climate of the region may be considered within humid climates. As seen from the Ombro-thermic diagram of Gaussen (Fig. 1), there is not any dry period and the vegetation of the region exhibites a conformity with this type of climate.

Tablo no: 1 – The mean and extreme climatic data of Gerede Meteorological station.

	I+	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
Mean temperature (°C)	–2.4	–1.0	2.0	6.7	11.1	14.3	16.8	16.4	13.6	9.3	4.4	–0.3	7.5
Mean maximum temperature (°C)	1.8	3.1	7.0	11.7	16.3	19.6	22.5	23.2	20.0	15.5	9.4	3.5	12.8
Mean minimum temperature (°C)	–6.0	–4.6	–2.2	2.2	6.1	8.6	10.3	10.2	7.7	4.4	–0.4	–3.4	2.8
Precipitation (mm.)	56.1	46.7	59.2	69.8	82.4	83.8	44.5	32.3	35.4	43.2	56.1	73.1	682.6
Mean relative humidity (%)	75	73	67	61	61	62	58	59	60	61	66	76	65

I,+ II ..... XII : January, February ..... December

Table no: 2 – Seasonal distribution of rainfall (mm).

Station	Winter	Spring	Summer	Autumn	Annual	Precipitation regime
GEREDE	175.9	211.4	160.6	134.7	682.6	Sp., W., Sm., Au.

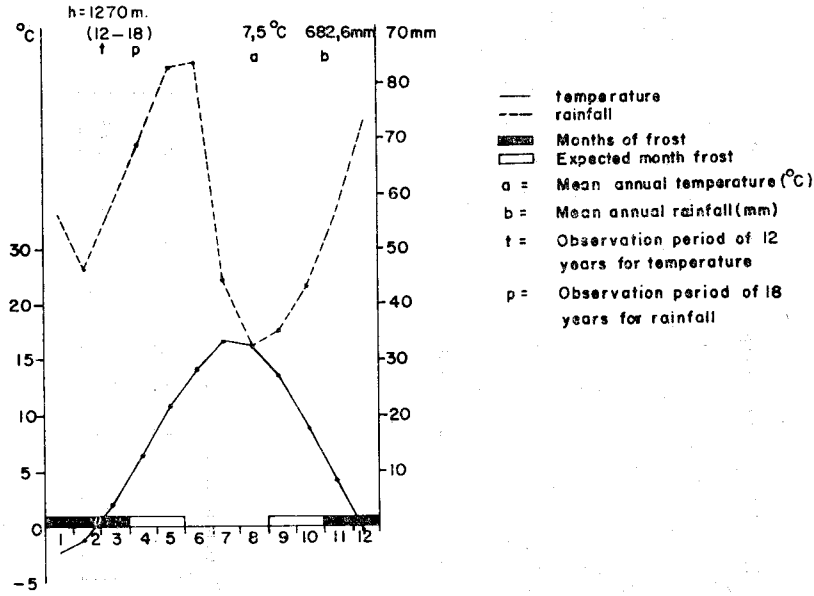


Fig. 1 — Climatic diagram of Gerede Meteorological Station.

METHODS

The plants of the area were collected during the definite periods in the years 1975 and 1976, and were identified in the herbarium of Biology department of Science Faculty, Ankara University. The specimens which I had difficulty in their identification were sent to the other herbaria. The collection has been kept in Ankara Herbarium (ANK.)

The climatic data were taken from the bulletin and archives of the State Meteorological Service of Turkey and the geological data from the reports of MTA institute.

The classic Braun-Blanquet's method has been used for the vegetation analysis. Fifteen quadrats per communities were laid out in order to out the relation of vegetation with its habitat. The size of quadrats were estimated by the "minimal area" method as 1000 m^2 in *Pinus nigra* subsp. *pallasiana-Falcaria vulgaris* and *Abies nordmanniana* subsp. *bornmuelleriana-Pinus sylvestris* associations, as 400 m^2 in *Quercus macranthera* subsp. *syspirensis-Verbascum phoenicum* subsp. *fla-*

vidum association and as 100 m^2 in *Juniperus communis* subsp. *nana-Daphne oleoides* association. In the quadrats at the homogenous area as far as habitat and plant coverage are concerned, the abundancy, dominancy and sociability of plants were established and the vegetation were classified into communities according to the preferential-dominant-constant species.

The information concerning to the major soil groups of the area was collected from Toprak-Su Genel Müdürlüğü, Köy işleri Bakanlığı, Seven soil samples were taken from the distinc places with a good plant coverage in order to reveal the degree of relation between plant communities and the soils as well as to observe the physical and chemical properties. The analysis and evaluation of the soil samples were made in the soil laboratory of the department of Biology, Sicence Faculty of ra University. according to the following methods;

Texture: by Bouyoucos Hidrometer

Field capacity (%): by water held at 1/3 atm.

Wilting point (%): by water held at 15 atm.

Available water: Field capacity-Wilting point

$CaCO_3$ (%): by Scheilber calcimeter

Organic matter and Total Carbon: by Walkley-Black method.

Total N (%): by Kjeldahl method

pH: by glass electrode pH meter

Conductivity: by Conductivity bridge

Exchangeable cations and C.E.C.: by Flame-Photometer and Versenat method

EDAPHIC CHARACTERISTICS

The major soil groups of the region are known and noncalcerous brown forest soils. The first, developed from the calcerous parent material, is included in the Calcimorphic group of Interzonal soils. The latter is with A (B) C profiles and A horizon is well developed with a porodus structure. (B) horizon is not well developed, brown or dark brown, granular or block shaped with circular angles.

The physical and chemical traits of the soils in the region were shown at Table 3 and 4.

Of the plant associations described in the area, *Quercus macranthera* subsp. *syspirensis-Verbascum phoenicum* subsp. *flavidum*, *Abies nordmanniana* subsp. *bornmuelleriana-Pinus sylvestris* and *Juniperus communis* subsp. *nana-Daphne oleoides* associations are well spread on the noncalcerous brown forest soils derived from andesite mainrock. This type of soils have a loamy, sandy clayey loamy characters in texture. In the area, the pH values of these noncalcerous soils range from 5.8 to 6.9. The humid climate in the area sipplying enough water to the soil cause to wash the bases out.

The percentage of water held at field capacity, at 1/3 atm. ranges between 17-26.5 % and the amount of water at permanent wilting point varies between 7.0-8.6 %. The available water content is between 9.6-17.9 %. With respect to the relation between the available water and the organic matter, it is seen that the excess amount of organic matter increases the available water for the plants. Indeed, the amount of organic matter causes to increase the exchangeable cation capacity as well as the capacity of water hold. The quite higher amount of organic matter results from the slow break down of organic matter due to the lower temperature conditions of the region.

The amount of total nitrogen varies between 0.015 and 0.246 % and that of carbon between 2.12-6.91 %. The ratio of carbon to nitrogen, i.e., C/N (14.54-21.93) is convenient to form humus. The excess proportion of Na, K and Mg is due to the nature of andesite mainrock.

Another plant association described in the study area, *Pinus nigra* subsp. *pallasiana-Falcaria vulgaris*, is spread on the brown soils derived from the chalk mainrock. The texture of this type of soils with a very little calcerous content (1.98 %) is clayey loamy and the value of pH is roundabout 7.1. It has a more nitrogen content than the other soil type with acidic character (0.302 %) because the nitrification has been acclerated due to the calcerous content.

VEGETATION

The following associations, each of which is composed of fifteen quadrats, were described in the study area.

Table no: 3 – Physical analysis of the soil samples.

Association	$CaCO^3$ %	Sand %	Loam %	Clay %	Texture	Moisture %	Field capacity (%)1/3At.	Wilting point(%) 1/15 At.	Available water	Depth (cm.)
Quercus macranthera	—	42.58	31.63	25.79	Loam	3.42	20.0	8.0	12.0	0 – 30
subsp.syspirensis I	—	47.66	28.40	24.00	Sandy Clayey Loam	4.80	22.0	7.0	15.0	0 – 30
Pinus nigra subsp. pallasiana II	1.98	33.39	28.57	38.04	Clayey Loam	4.23	25.0	9.0	16.0	0 – 30
Abies nordmanniana	—	49.72	32.65	17.63	Sandy Loam	3.45	20.0	7.8	12.0	0 – 30
subsp.bornmuelleriana - Pinus sylvestris III	—	57.88	30.61	11.51	Sandy Clayey Loam	4.82	26.5	8.6	17.9	0 – 30
Juniperus communis	—	53.80	30.61	15.59	Sandy Loam	3.28	17.0	7.4	9.6	0 – 30
subsp.nana IV	—	53.80	32.65	13.55	Sandy Loam	3.76	23.1	8.0	15.1	0 – 30

Table no: 4 – Chemical analysis of the soil samples.

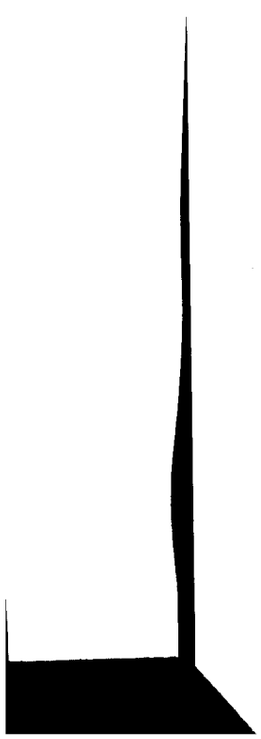
Association	pH	Conductivity	C/N	Organic matter %	Total carbon %	Total nitrogen %	Water soluble cations			Exchangeable cations			C.E.C. meq/100 gr.
							Na	K	Ca+Mg	Na	K	Ca+Mg	
I	6.5	0.299	17.46	5.75	3.33	0.191	0.98	0.11	1.09	0.95	0.60	7.75	5.80
	6.9	0.280	17.71	3.40	2.12	0.121	0.58	0.12	1.80	2.20	0.80	10.00	13.00
II	7.1	0.281	17.76	9.25	5.36	0.302	0.99	0.04	1.36	1.15	0.75	9.25	11.15
III	6.4	0.109	14.56	4.27	2.47	0.170	0.52	0.08	0.24	1.00	0.80	4.35	5.85
	6.8	0.345	21.93	11.92	6.91	0.015	1.52	0.18	0.96	3.24	0.86	7.28	11.38
IV	6.7	0.093	14.54	4.49	2.60	0.179	0.58	0.07	0.31	0.90	0.60	5.15	6.05
	5.8	0.096	15.52	8.28	4.80	0.246	0.31	0.09	0.39	0.82	0.48	5.20	6.50

Table no: 5 – Quercus macranthera subsp.syspirensis - Verbascum phoenicum subsp.flavidum association.

Quadrat no	89	64	62	63	67	31	84	82	83	88	32	33	65	66	30	
Area of the quadrat (m^2)	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	
Altitude (m)	1250	1250	1250	1250	1250	1300	1300	1300	1300	1200	1200	1250	1250	1250	1200	
Inclination (%)	–	10	–	10	20	10	5	10	5	–	10	10	20	20	10	
Exposition	N	N	E	N	W	N	W	N	W	N	N	E	N	W	N	
Mainrock	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	
Total coverage (%)	80	90	90	90	85	90	80	85	90	80	85	85	70	90	80	Presence
Characteristic and differential species of the association																
Quercus macranthera subsp. syspirensis	44	44	45	45	44	45	44	44	45	44	44	45	33	45	44	V
Verbascum phoenicum subsp.flavidum	.	+1	+1	+1	.	++	.	.	.	.	.	.	.	.	.	II
Filipendula vulgaris	.	.	.	.	.	.	.	.	.	+1	.	.	++	.	.	I
Characteristics of the order QUERCO-CARPINETALIA and the alliance CARPINO-ACERION*																
* Vicia truncatula	11	22	22	.	11	22	+1	11	+1	+1	+1	+1	.	+1	22	V
* Asperula involucrata	+1	+1	.	.	++	+1	+1	++	++	+1	+1	.	.	++	++	IV
* Trifolium caudatum	++	+1	11	+1	++	+1	+1	.	.	.	.	+1	++	++	+1	IV
* Anthriscus nemorosa	.	11	+1	+1	++	11	.	.	++	.	11	+1	.	.	11	III
* Lathyrus czeczottianus	11	.	.	.	+1	.	+1	11	11	+1	.	.	.	+1	.	III
Lathyrus laxiflorus	.	+1	11	+1	.	11	.	.	.	.	11	11	.	.	+1	I
* Asyneuma rigidum	.	.	.	.	.	.	.	+1	.	.	.	.	.	.	.	I
* Crataegus tanacetifolia	.	.	.	.	.	.	+1	.	.	.	.	.	.	.	.	I
Characteristics of the class QUERCETEA PUBESCENTIS																
Pimpinella tragium	+1	.	.	.	+1	.	++	+1	++	++	.	.	.	+1	.	III
Trifolium pannonicum subsp.elongatum	+1	+1	.	11	.	+1	.	.	.	.	.	.	+1	.	+1	II
Coronilla varia	+1	+1	.	.	+1	.	.	.	.	.	.	11	.	.	.	II
Vicia cracca subsp.stenophylla	11	+1	12	.	.	.	.	.	.	11	+1	.	.	.	.	II
Prunus domestica subsp.insititia	++	.	+1	.	.	.	.	.	.	.	.	.	+1	.	.	I
Silene italica	.	.	.	+1	+1	.	.	.	.	.	.	.	.	.	.	I
Pyrus eleagnifolia	.	+1	.	.	+1	.	.	.	.	.	.	.	.	.	.	I
Trifolium medium	.	.	.	.	.	.	.	.	.	+1	.	.	.	.	.	I
Characteristics of the class ASTRAGALO-BROMETEA																
Polygala anatolica	.	.	.	.	.	.	.	.	.	.	.	.	++	.	.	I
Alyssum murale	.	.	.	.	.	.	.	.	.	.	+1	.	.	.	.	I
Characteristics of the superclass QUERCO - FAGEA																
Poa nemoralis	++	.	.	+1	.	+1	.	+1	++	.	+1	+1	+1	+1	.	IV
Lapsana communis subsp.intermedia	.	+1	++	+1	++	+1	.	.	.	.	++	++	++	.	+1	III
Clinopodium vulgare	.	++	+1	++	.	++	.	+1	.	.	+1	+1	.	.	++	III
Geum urbanum	+1	.	.	.	+1	.	+1	++	+1	++	.	.	++	+1	.	III
Campanula glomerata	++	.	.	.	+1	.	++	++	+1	++	.	.	++	.	.	III
Crataegus monogyna	.	+1	+1	+1	.	+1	.	.	.	.	+1	+1	.	.	+1	III
Teucrium chamaedrys	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Companions																
Galium aparine	+1	++	++	+1	+1	11	++	.	+1	++	11	11	.	++	+1	V
Dactylis glomerata	+1	11	.	+1	+1	+1	+1	++	++	+1	.	.	+1	++	.	IV
Galium verum	+1	+1	+1	++	.	+1	+1	+1	++	.	+1	++	.	.	.	IV
Trifolium pratense	.	+1	++	+1	.	++	.	+1	.	.	++	+1	.	.	++	III
Lathyrus pratensis	+1	.	.	.	+1	.	+1	++	++	+1	.	.	.	++	.	III
Muscari racemosum	.	.	.	.	.	+1	.	.	++	.	.	+1	.	.	.	I
Phleum montanum	.	+1	.	.	.	.	.	.	.	.	.	.	+1	.	.	I
Centaurea triumfetti	.	.	.	+1	.	.	.	.	.	.	.	.	++	.	.	I
Potentilla rupestris	+1	.	+1	.	.	.	.	.	.	.	.	.	.	.	.	I

Tablo no: 6 – Pinus nigra subsp.pallasiana – Falcaria vulgaris association.

Quadrat no	21	76	22	34	20	36	75	19	37	58	61	77	35	59	60	Presence
Area of the quadrat (m.)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	
Altitude (m)	1150	1200	1150	1200	1150	1200	1200	1150	1200	1250	1250	1200	1200	1300	1250	
Inclination (%)	20	25	30	30	20	30	30	25	30	30	25	30	25	40	35	
Exposure	N	W	N	E	N	E	W	N	E	E	N	W	W	N	E	
Mainrock	Calc	Calc	Calc	Calc	Calc	Calc	Calc	Calc	Calc	Calc	Calc	Calc	Calc	Calc	Calc	
Total coverage (%)	85	90	80	80	90	80	90	90	85	70	85	75	70	80	80	
Characteristic and differential species of the association																
Pinus nigra subsp.pallasiana	44	44	33	44	44	33	44	44	44	34	44	45	44	45	45	V
Falcaria vulgaris	+1	.	.	++	.	.	++	++	.	.	.	++	.	.	.	II
Anthyllis vulneraria	.	+1	.	.	.	.	+1	.	.	.	.	++	.	+1	.	II
Characteristics of the order QUERCO-CARPINETALIA and the alliance CARPINO - ACERION*																
Aremonia agrimonoides	.	11	.	+1	11	.	.	.	+1	.	11	.	.	.	.	II
Viola sieheana	++	.	+1	+1	++	+1	.	.	.	.	.	.	.	.	.	II
* Cirsium hypoleucum	.	++	.	.	.	.	++	.	.	.	.	+1	.	.	.	I
* Lathyrus czeczottianus	.	.	+1	.	.	.	.	.	.	.	.	.	+1	.	.	I
* Trifolium caudatum	.	.	.	.	.	.	.	.	.	.	+1	.	.	.	.	I
* Asperula involucrata	.	.	.	.	.	.	.	.	.	.	+1	.	.	.	.	I
* Lonicera orientalis	.	++	.	.	.	.	.	.	.	.	.	.	.	.	.	I
* Crataegus tanacetifolia	.	.	.	.	.	.	.	+1	.	.	.	.	.	.	.	I
Chamaecytisus pygmaeus	.	.	+1	.	.	.	.	.	.	.	.	.	.	.	.	I
Characteristics of the class QUERCETEA PUBESCENTIS																
Digitalis ferruginea	++	.	.	++	.	++	.	.	++	++	++	.	+1	++	.	III
Cephalanthera damossonium	++	.	++	++	+1	.	.	.	++	++	.	.	.	.	.	II
Silene italica	+1	.	+1	.	.	.	.	.	.	.	.	.	.	.	.	I
Quercus pubescens	.	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Coronilla varia	.	++	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Juniperus oxycedrus subsp.oxycedrus	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Lamium purpureum	++	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Characteristics of the order QUERCO-CEDRETALIA LIBANI																
Pimpinella tragium	++	++	+1	++	++	.	+1	.	++	.	.	++	.	.	.	II
Berberis crataegyna	+1	.	+1	.	++	.	.	++	.	.	+1	.	.	.	.	II
Characteristics of the superclass QUERCO - FAGEA																
Brachypodium sylvaticum	++	+1	+1	.	.	++	++	++	+1	++	.	.	++	++	.	IV
Viburnum lantana	+1	+1	++	+1	++	.	.	.	.	.	+1	.	.	++	.	III
Teucrium chamaedrys	++	.	+1	+1	+1	.	.	+1	.	.	.	.	.	.	+1	II
Poa nemoralis	22	.	22	22	21	.	.	++	.	.	.	++	.	.	.	II
Lapsana communis subsp. intermedia	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Characteristics of the superclass DAPHNO - FESTUCETALES																
Polygala anatolica	++	+1	+1	.	.	++	++	++	+1	++	.	.	+1	+1	.	IV
Daphne oleoides	+1	++	11	11	+1	.	.	.	.	.	.	++	.	++	.	III
Helianthemum nummularium	+1	++	++	+1	++	.	.	.	++	.	.	.	.	.	.	II
Euphorbia tinctoria	.	++	.	.	.	.	++	.	.	.	.	.	.	.	.	I
Cruciata coronata	.	.	.	.	.	.	.	.	++	.	.	.	.	.	.	I
Veronica multifida	.	.	.	.	.	.	.	+1	.	.	.	.	.	.	.	I
Pilosella hoppeana subsp.troica	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Companions:																
Juniperus communis subsp.nana	++	.	+1	+1	+1	+1	++	.	.	++	.	.	.	.	+1	III
Galium verum	+1	.	.	.	+1	++	.	.	.	++	+1	.	+1	.	++	III
Dactylis glomerata	.	++	.	.	.	+1	.	.	+1	+1	++	.	+1	+1	.	III
Astragalus sigmoideus	+1	.	.	+1	.	++	.	.	.	.	.	.	.	.	++	II
Onobrychis gracilis	.	11	.	.	.	.	+1	.	.	.	.	.	.	11	+1	II
Alyssum repens subsp.trochostachyum	+1	.	+1	.	+1	.	.	+1	.	.	.	.	.	.	.	II
Carex distachya	+1	.	+1	.	+1	.	.	+1	.	.	.	.	.	.	.	II
Veronica orientalis	.	.	.	.	.	.	.	.	.	+1	.	++	+1	.	.	I
Euphorbia stricta	.	++	.	.	.	.	++	.	.	.	.	++	.	.	.	I
Galium album subsp.prusense	.	+1	.	.	.	.	+1	.	.	.	.	++	.	.	.	I
Scrophularia rupestris	++	.	.	+1	.	.	.	.	.	.	++	.	.	.	.	I
Draba verna subsp.verna	.	++	.	+1	.	++	.	.	.	.	.	.	.	.	.	I
[illegible]	.	.	.	.	.	.	.	++	.	.	.	.	.	.	++	I
Veronica gentianoides	.	.	.	.	.	.	.	.	.	++	.	.	++	.	.	I
Conringia perfoliata	.	.	.	.	.	.	.	.	.	++	++	.	.	.	.	I



Quercus macranthera subsp. syspirensis-Verbascum phoenicum subsp. phoenicum association
(Table no: 5)

The association which is described for the first time is located in the vicinities of Külef and Bünüş villages with the altitudes of 1200-1300 meters.

The total coverage of the association varies between 70-90 %. It is rich in floristic composition and comprises of two vertical layers. The first is tree layer dominated by *Quercus macranthera* subsp. *syspirensis* shrubs of 2-5 m. The type species. *Q. macranthera* subsp. *syspirensis* is the constant and dominant species of the association and mixed with the other shrubs in various abundancy. The second layer is formed from herbaceous species of 20-50 cm and its coverage varies between 20-60 %.

Verbascum phoenicum subsp. *flavidum* and *Filipendula vulgaris* are distinguished as the characteristic and diffrential species of the association.

As seen on the table no: 5, from the phytosociological respect, the majority of the species in the association are the characteristics of the alliance Carpino-Acerion, the order Querco-Carpinetalia and the class Quercetea pubescentis. The association, therefore should be considered within these higher units.

Pinus nigra subsp. pallasiana-Falcaria vulgaris association
(Table No: 6)

The association is locally spread around the Gerede-Aktaş forestry office at an altitude of 1150-1300 m. It prefers the alkalin soils derived from the calcerous mainrock.

The total coverage of the association ranges between 70-90 %. It exhibites a more dry apperance than the other soil types due to lack of permanent moist.

The frequencies of the species in the association is not so high. *Pinus nigra* subsp. *pallasiana* is the constant and dominant species and forms the tree layer. The coverage of the species forming the herbaceous layer with a height of 10-20 cm varies between 20-50 %.

Falcaria vulgaris and *Anthyllis vulneraria* were chosen as characteristic species which differentiates the association from the others.

The species constituting floristic composition of the association belong to the alliance Carpino-Acerion of the order Quercо-Carpinetalia and the class Quercetea pubescentis as in the previous association.

Abies nordmanniana subsp. bornmuelleriana- Pinus sylvestris association

(Table no: 7)

Abies nordmanniana subsp. *bornmuelleriana* is an endemic Euxinian elements is widespread from Kızılırmak basin to Uludağ in the west Black Sea region. It forms a mixed formation together with *Pinus sylvestris* and their pure stands are are in the study area. In this case, they share the same species within their floristic compositions. Therefore, it will be more convenient to describe an association mixed with both.

The association located at an altitude of 1500-1800 m is spread on the brown forest soils with a sandy loamy and sandy clayey loamy texture.

Abies nordmanniana subsp. *bornmuelleriana* is the constant and dominant species of the association and forms the three layer with *Pinus sylvestris* which is co-dominant of the association. The abundancy of *P. sylvestris* increases at the lower altitudes. Although the shrub layer is not well developed, the young shoots of *Abies* and *Pinus* and the some shrubs of *Juniperus* species are spreas throughout this layer.

The total coverage of the association varies between 80-90 %. The coverage of the herbaceous layer with an average height of 20-40 cm. ranges between 30-70 %.

Such as the species *Pyrola chlorantha*, *Moneses uniflora*, *Orthilia secunda* which are the components of the order Fagetalia syl-

Table no: 7 – Abies nordmanniana subsp.bornmuelleriana – Pinus sylvestris association.

Quadrat no	81	8	6	7	9	5	25	41	53	80	24	42	54	43	23	
Area of the quadrat (m^2)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	
Altitude (m)	1750	1600	1600	1550	1800	1600	1700	1600	1650	1750	1700	1550	1500	1500	1700	
Inclination (%)	–	10	10	10	30	10	20	30	40	–	20	25	40	30	–	
Exposition	E	N	N	N	N	N	E	N	E	E	N	N	N	E	N	
Mainrock	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	
Total coverage (%)	90	85	90	90	85	85	90	90	90	85	90	85	80	80	90	
Characteristic and differential species of the association																
Abies nordmanniana subsp.bornmuelleriana	45	44	44	44	45	44	45	34	45	45	45	44	33	34	45	V
Pinus sylvestris	.	33	33	34	.	33	.	44	.	.	.	34	44	45	32	III
Pyrola chlorantha	+1	++	.	.	.	.	.	++	11	++	.	++	12	+1	.	III
Monoses uniflora	++	.	.	+1	+1	.	++	++	+1	.	.	.	.	++	.	III
Draba muralis	.	++	+1	+1	.	+1	++	+1	++	.	.	.	.	.	.	III
Orthilia secunda	+1	.	++	11	11	12	.	.	.	.	+1	.	+1	.	.	III
Geranium pusillum	.	.	.	.	.	.	+1	.	.	.	.	++	.	.	.	I
Hieracium medianiforme	+1	.	.	.	+1	.	.	.	.	.	.	.	.	.	.	I
Characteristics of the class QUERCO - FAGETEA and the order FAGETALIA SYLVATICAE*																
Galium rotundifolium	.	.	++	.	+1	.	12	22	++	11	12	+1	.	++	+1	IV
* Rubus ideaeus	+1	+1	.	.	+1	.	.	.	.	+1	+1	+1	.	.	.	II
Daphne pontica	+1	+1	.	.	.	.	.	.	.	11	.	.	.	.	.	I
Veronica officinalis	.	.	.	.	.	.	.	.	.	.	.	.	++	.	11	I
Saxifraga rotundifolia	.	.	.	.	.	.	22	.	.	.	.	.	.	+1	.	I
* Moehringia trinerva	.	.	.	.	.	.	.	.	.	.	11	11	.	.	.	I
Characteristics of the order QUERCO-CARPINETALIA and the alliance CARPINO-ACERION*																
Viola sieheana	++	++	++	++	++	++	.	.	.	+1	.	.	.	+1	.	III
* Trifolium caudatum	+1	+1	+1	.	.	+1	.	+1	12	.	.	.	.	+1	.	III
Dorycnium graecum	.	+1	11	12	.	+1	.	+1	.	12	.	.	.	.	.	II
Genista lydia	+1	.	.	.	+1	.	.	.	.	.	+1	+1	.	.	.	II
* Asperula involucrata	.	+1	.	.	.	++	+1	+1	.	.	+1	.	.	11	.	II
* Cirsium hypoleucum	+1	.	.	.	.	.	.	.	.	.	.	.	++	.	.	I
* Vicia truncatula	+1	.	.	.	.	.	.	.	.	+1	.	.	.	.	.	I
Chamaecytisus pygmaeus	.	.	+1	.	.	.	.	.	+1	.	.	.	.	.	.	I
* Lathyrus czeczottianus	.	.	.	.	+1	.	.	.	.	.	.	.	.	.	.	I
* Cyclamen coum	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Characteristics of the class QUERCETEA PUBESCENTIS																
Lamium purpureum	11	+1	+1	.	.	+1	++	.	11	11	++	++	.	+1	.	IV
Myosotis stricta	.	11	11	++	.	11	.	11	++	.	.	.	++	.	.	III
Poa persica	.	.	+1	.	.	.	.	.	.	+1	+1	.	+1	.	.	II
Doronicum orientale	+1	.	.	.	.	.	.	.	+1	+1	.	.	++	.	.	II
Campanula rapunculoides	.	.	.	.	.	.	+1	.	.	.	.	.	.	.	.	I
Juniperus oxycedrus subsp.oxycedrus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	I
Characteristics of the class ASTRAGALO-BROMETEA																
Cynoglossum montanum	++	.	.	++	.	.	.	.	.	+1	.	.	.	.	.	I
Pilosella hoppeana subsp.troica	.	.	.	.	.	.	.	.	.	.	.	.	++	.	++	I
Astragalus squalidus	.	+1	.	.	.	.	.	.	.	.	.	+1	.	.	.	I
Characteristics of the superclass QUERCO - FAGEA																
Luzula forsteri	11	+1	+1	+1	.	+1	.	22	.	11	22	22	.	.	++	IV
Lapsana communis subsp.intermedia	21	+1	++	+1	+1	++	.	11	.	.	11	.	.	.	.	III
Fragaria vesca	++	12	+1	++	11	+1	+1	.	.	++	.	.	.	.	.	III
Veronica chamaedrys	.	22	11	12	+1	+1	.	+1	.	.	.	.	.	.	.	III
Primula vulgaris subsp.vulgaris	+1	+1	+1	11	+1	11	.	.	.	+1	.	.	.	.	.	III
Brachypodium sylvaticum	11	.	.	.	+1	.	+1	.	.	.	+1	11	.	.	+1	II
Epilobium montanum	+1	.	++	.	.	.	.	.	11	+1	.	.	.	.	+1	II
Poa nemoralis	+1	.	11	.	+1	.	.	.	.	.	.	.	+1	.	11	II
Euphorbia amygdaloides	+1	.	.	.	+1	.	.	.	.	.	+1	.	.	+1	.	II
Geranium robertianum	+1	+1	.	.	.	.	.	.	.	++	.	.	.	.	.	I
Companions:																
Juniperus communis subsp.nana	+1	+1	++	++	.	+1	.	.	.	+1	.	.	+1	.	.	III
Cardamine hirsuta	.	.	++	.	.	.	++	++	.	.	+1	+1	.	+1	.	II
Dactylis glomerata	+1	.	.	.	+1	.	+1	.	+1	.	.	.	.	+1	.	II
Poa bulbosa f.vivipara	+1	.	.	+1	+1	++	.	.	.	.	+1	.	.	.	.	II
Moenchia mantica subsp.mantica	.	+1	++	+1	.	++	.	.	.	.	.	.	.	.	.	II
Poa trivialis	.	.	.	+1	.	.	+1	.	.	.	.	.	.	.	+1	I
Sedum pallidum	+1	.	.	.	+1	.	.	.	.	.	.	.	+1	.	.	I
Campanula rapunculus	.	.	.	.	.	.	.	.	+1	.	.	+1	+1	.	.	I
Valeriana alliariifolia	.	.	.	.	.	.	.	.	.	.	.	+1	.	.	+1	I
Trifolium pratense	.	.	.	.	+1	.	.	.	.	.	.	.	.	.	+1	I
Luzula campestris	+1	.	.	.	.	.	.	.	.	.	.	.	+1	.	.	I
Geranium pyrenaicum	.	.	.	.	.	.	.	+1	.	.	.	.	.	.	.	I
Veronica orientalis	.	.	.	+1	.	.	.	.	.	.	.	.	.	.	.	I
Petrorhagia alpina subsp.olympica	.	.	.	.	.	.	.	.	+1	.	.	.	.	.	.	I
Epilobium lanceolatum	.	.	.	.	.	.	.	.	++	.	.	.	.	.	.	I
Veronica hederaefolia	.	.	.	.	.	.	++	.	.	.	.	.	.	.	.	I
Trifolium hybridum subsp.anatolicum	.	.	.	++	.	.	.	.	.	.	.	.	.	.	.	I
Veronica serpyllifolia	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.	I

Table no: 8 – Juniperus communis subsp.nana – Daphne oleoides association.

	Quadrat no	12	73	26	52	13	27	28	14	45	51	72	46	74	44	29	
	Area of the quadrat (m^2)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
	Altitude (m)	1800	1700	1750	1700	1800	1750	1750	1800	1650	1700	1700	1700	1750	1650	1700	
	Exposition	N	W	N	W	N	N	N	N	W	W	N	W	N	W	E	
	Inclination (%)	5	2	–	2	5	–	–	5	2	2	–	2	–	2	–	
	Mainrock	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	Adst	
	Total coverage (%)	85	90	90	85	90	80	95	85	70	85	90	70	70	75	95	Presence
	Characteristic and differential species of the association																
	Juniperus communis subsp.nana	34	44	44	44	44	34	44	45	34	44	44	45	44	45	44	V
	Daphne oleoides	++	.	++	.	+1	++	+1	++	.	.	.	.	.	.	.	II
	Arum conophalloides	11	.	.	+1	.	.	.	.	+1	+1	.	.	.	.	.	II
	Characteristics of the order QUERCO - CARPINETALI and the alliance ACARPINO - ACERION*																
	Geranium asphodeloides	.	.	+1	.	++	+1	+1	++	.	.	.	+1	.	.	.	II
	Viola sieheana	.	+1	.	++	.	.	.	.	.	+1	+1	+1	.	.	.	II
*	Cirsium hypoleucum	.	+1	.	+1	.	.	.	.	.	+1	++	.	++	.	.	II
	Characteristics of the order QUERCO-CEDRE TALIA LIBANIand the c'ass QUERCETEA PUBES CENTIS*																
*	Myosotis alpestris	.	.	+1	++	+1	11	+1	11	12	.	.	.	.	.	.	III
	Myosotis stricta	+1	.	.	.	+1	.	.	.	.	.	.	+1	.	12	12	II
	Pimpinella tragium	.	+1	.	+1	.	.	.	.	.	+1	.	.	++	.	.	II
*	Coronilla varia	.	++	.	++	.	.	.	.	.	.	11	.	.	.	.	I
*	Geum urbanum	.	.	+1	.	.	.	.	.	.	.	.	++	.	.	.	I
	Geranium tuberosum	++	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
	Characteristics of the class QUERCO - FAGETEA																
	Daphne pontica	.	+1	+1	++	+1	+1	+1	+1	++	.	++	.	++	++	.	IV
	Festuca drymeja	.	+1	.	11	.	.	.	.	.	11	11	.	+1	.	.	II
	Lamium album	11	.	+1	.	.	11	++	+1	.	.	.	.	.	.	.	II
	Rubus idaeus	+1	.	.	.	+1	.	++	.	.	.	.	.	.	.	.	I
	Characteristics of the class ASTRAGALO-BROMETEA																
	Cynoglossum montanum	.	++	.	+1	++	.	.	.	.	+1	+1	.	.	.	.	II
	Bromus erectus	.	++	.	+1	.	.	.	.	.	.	++	.	+1	.	.	II
	Marrubium parviflorum	.	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	I
	Sanguisorba muricata	+I	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
	Characteristics of the superclass QUERCO - FAGEA																
	Fragaria vesca	++	+1	++	+1	.	.	.	.	+1	.	+1	++	+1	++	.	III
	Teucrium chamaedrys	.	11	.	++	.	.	.	.	.	12	++	.	+1	.	.	II
	Poa nemoralis	.	.	11	.	.	+1	+1	+1	++	.	.	.	.	.	.	II
	Geranium robertianum	.	.	.	.	.	.	.	.	++	.	.	+1	++	.	+1	II
	Epilobium montanum	.	.	.	.	.	.	.	.	+1	.	.	.	.	+1	+1	I
	Clinopodium vulgare	.	.	.	.	+1	.	.	.	.	.	.	.	.	.	.	I
	Companions:																
	Galium aparine	+1	.	11	+1	++	11	11	11	++	.	.	.	.	++	.	III
	Urtica dioica	+1	.	22	.	++	12	+1	22	+1	.	.	11	.	.	.	III
	Datctylis glomerata	11	.	.	.	.	.	.	.	+1	.	.	.	.	++	++	II
	Rosa canina	.	++	.	++	+1	.	.	.	.	++	.	.	.	.	.	II
	Veronica orientalis	+1	.	+1	.	.	.	.	.	++	.	.	.	.	.	.	I
	Galium album subsp.prusense	.	.	++	.	.	.	.	.	.	+1	.	.	.	.	++	I
	Agropyron intermedium	.	.	.	.	.	.	.	.	.	+1	.	.	.	.	+1	I
	Vincetoxicum tmoleum	.	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	I
	Galium verum	.	.	.	.	.	.	.	.	.	.	.	+1	.	.	.	I
	Poa pratense	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
	Phleum paniculatum var. ciliatum	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I

v a t i c a e, *Draba muralis*, *Geranium pusillum* and *Hieracium medianiforme* were conveniently chosen as the characteristic and differential species of the association.

From the viewpoint of phytosociology, even if the both species after which the association is named seem to form two independent associations, they harbour the common component. The majority of the species constituting the floristic composition belong to the order F a g e t a l i a s y l v a t i c a e and the class Q u e r c o – F a g e t e a.

Juniperus communis subsp. nana-Daphne oleoides association

(Table no: 8)

The association, densely covering the open places and timberline of the forest locally forms pure stands between 1650 and 1800 m in the region.

It is Ardıç Mountain (1805 m) where the species is highly successful and appears like a subalpin land. The soils of the association have a sandy texture, a lower water-content and a less depth as compared to those of *Abies nordmanniana* subsp. *bornmuelleriana-Pinus sylvestris* association.

The height of the species in the association is between 40-60 cm and the coverage varies from 70 % to 90 %.

Daphne oleoides and *Arum conophalloides* were chosen as the characteristics of the association. The species constituting the floristic composition mostly belong to the class Q u e r c r t e a p u b e s c e n t i s as in the other associations in the study area.

Themeso-Hygrophilous Meadows

This type of vegetation is developed in the forest range at an altitude of 1500-1600 m and the soils it spread on is deeper and wet in a long period of the year. The existance of such a type of vegetation depends on the temporary or permanent water current.

It is widespread on the open places among the Fir and Scots pine forest and is destructed due to overgrazing. Such type of meadows have a uniform structure and is not rich in floristic composition.

Pedicularis comosa var. *sibthorpii*, *Melampyrum arvense* subsp. *pseudobarbatum*, *Rhinanthus rumelicus*, *Ranunculus constantinopolitanus*, *Ranunculus arvensis*, *Euphrasia tatarica*, *Hordeum bulbosum*, *Zingeria trichopoda*, *Alopecurus arundinaceus*, *Calamagrostis pseudophragmites*, *Ranunculus repens* are the chief components of such type of meadows in the study area.

DISCUSSION

In the study area which is under the influence of a semi-continennental climate, four plant associations were described at different altitudes and they were phytosociologically analized according to the Braun-Blanquet's method. At the same time, their relations with the environment were tried to reveal. Most of the associations being in conformity with the climate of the region are spread on the noncalcerous brown soils derived from the colcanic mainrock, except for the association of Black Pine which is successful on the brown soils with an alkalin character.

The associations described in the area form two groups with respect to both climate, geographical distribution and floristic compositions;

Plant groups of Mediterranean origin

1- The oak association

2- The Black pine association

Plant groups of Eurasia origin

1- The Fir and Scots pine association

2- The Juniper association

The study area is located in the Subeuxinian zone of North Anatolia according to biogeographical division of ZOHARY (1973). From the phytosociological point of view, such classes of D a p h n o - F e s t u c e t e a and A s t r a g a l o - B r o m e t e a which include the steppe groups have been, to some extent, represented in the associations due to the connection of the area with the steppe formations of İnner Anatolia. The amount of steppe species is lesse than in steppe-forest comminities of Xero-Euxinian zone owing to more higric conditions of the study area.

The great majority of the species forming the floristic compositions of three associations described in the area, belong to the class Quercetea pubescentis. This class is mostly represented in the area by the components of the order Quercо-Carpinetalia and the alliance Carpino-Acerion. However, the order Fagetalia sylvaticae and the class Querco-Fagetea is well represented in the *Abies* and *Pinus* association, the unit cited above have some components among the characteristic and differential species of the association.

Quercus macranthera subsp. *syspirensis*, after which the association is named, is spread on the sub-euxine zone of the North Anatolia. This sociation has been described for the first time. As seen on the phytosociological table no: 5, the association should be considered in the class Quercetea pubescentis due to the fact that the species constituting floristic composition belong to this syntaxonomic unit.

The association of *Pinus nigra* subsp. *pallasiana* which form the great part of Coniferous forest in Turkey was described before in Beynam forest (1972), in the vicinities of Beypazarı-Nallıhan (1974), in the Işık Mountain (1976) by AKMAN and in the surroundings of Çubuk-Karagöl by ERİK (1975) and in the Ayaş Mountains by AKMAN and KETENOĞLU (1976). There are differencies amoung the floristic compositions of the associations described here and the localities cited above due to the climatic conditions and the different mainrocks.

The widespread association in the area is that of *Abies nordmanniana* subsp. *bornmuelleriana-Pinus sylvestris*. The two Euxinian species exhibite a similiar floristic structure characterized by the common species. Therefore, an association formed in consequence of mixture of both species was described here.

The similiar associations were described before under the different titles in the disrinct regions. *Abies nordmenniana* subsp. *bornmuelleriana-Pinus sylvestris* association was described before in the vicinities of Beypazarı-Nallıhan (1974) and Işık mountain (1976) by AKMAN as two different associations formed from only *A. nordmanniana* subsp. *bornmuelleriana* and *P. sylvestris*. That of *P. sylvestris* was described in surroundings of Çubuk-Karagöl by ERİK (1975) and in the localities cited above as well.

There are similarities, to a considerable extent, between the associations described here and in especially Işık Mountain due to the regional proximity and same climatic conditions, while the similarity ratio with the ones described in the Central Anatolia and adjecents decreases.

The *Juniperus communis* subsp. *nana-Daphne oleoides* association starts to be spread out from the lower level of forest zone and forms pure stands at the open places of the forest after an elevation of 1600 m. It exhibities a resemblance with the one worked out in Işık Mountain by AKMAN (1976) while very poor similarity with the one described in Çubuk -Karagöl by ERIK (1975).

The plant groups such as Meso-Hygrophilous meadows in the study area were also described in Beypazarı (1974) and in Işık Mountain (1976) by AKMAN before. It is impossible for now to determine the distribution area of this type of communities due to the fact that there is not enough work except for the ones cited above.

ÖZET

Bu çalışma ile Batı-Karadeniz bölgesinde Bolu il sınırları içersinde Kastamonu kökenli yarı-karasal bir iklimin etkisi altında bulunan Gerede-Aktaş ormanı bitki ekolojisi ve bitki sosyolojisi yönünden araştırılmıştır.

Esas itibariyle volkanik (andezit) kütlelerin oluşturduğu bu alanda tanımlanan bitki grupları kalkersiz kahverengi ve kahverengi orman topraklarında yayılma göstermektedir.

Floristik açıdan Euro-Siberian floristik bölgesinin Euxine eyaleti sınırları içerisinde bulunan bölgede Braun-Blanquet metoduna göre dört bitki birliği tespit edilmiştir.

a– Akdeniz yanlısı bitki grupları

1– *Quercus macranthera* subsp.*syspirensis* birliği

2– *Pinus nigra* subsp.*pallasiana* birliği

b– Örazyatik bitki grupları

1– *Abies nordmanniana* subsp.*bornmuelleriana* birliği

2– *Juniperus communis* subsp.*nana* birliği

Ormansal bitki birliklerine ilâveten, ayrıca orman açıklıklarında, nemli ve sulak yerlerde meso-higrofil bir bitki grubu da tanımlanmıştır.

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