

COMMUNICATIONS

DE LA FACULTÉ DES SCIENCES
DE L'UNIVERSITÉ D'ANKARA

Série C

TOME: 1

ANNÉE: 1983

A Phytosociological Research On The Vegetation Of The Bolu Mountains

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Communications de la Faculté des Sciences de l'Université d'Ankara

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A Phytosociological Research On The Vegetation Of The Bolu Mountains

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(Received June 10, 1983; Accepted August 8, 1984)

SUMMARY

The vast part of the Bolu Mountains is under the influences of Oceanic climate. The study area is situated in the western sector of the Euxinian region.

On the supramediterranean zone of the area the deciduous formations of *Quercus hartwissiana* X *Q. petraea* and *Carpinus betulus* occur while those of *Pinus nigra* subsp. *pallasiana* and *Pinus brutia* are very local.

On the mountainous zone of the region the communities of *Fagus orientalis* and *Abies nordmanniana* subsp. *bornmuelleriana* are seen.

The sylvatic associations and syntaxa in which they are included are:

A- The associations included in the order *Fagetalia sylvaticae*,

1. *Fagus orientalis* – *Castanea sativa* association
2. *F. orientalis* – *Rhododendron ponticum* association
3. *F. orientalis* – *Cicerbita variabilis* association

B- The association and the subassociation included in the order *Vaccinio-Piceetalia*,

Abies nordmanniana subsp. *bornmuelleriana* – *Fagus orientalis* association and *Valeriana alliariiifolia* subassociation.

C- The associations and the subassociations included in the order *Quercetalia* and alliance *Carpino-Acerion*,

- i. *Carpinus betulus* – *Fagus orientalis* association
- ii. *Quercus hartwissiana* X *Q. petraea* – *Erica arborea* association and *Chamaecytisus hirsutus* subassociation
- iii. *Pinus nigra* subsp. *pallasiana* – *Quercus petraea* subsp. *iberica* association and *Anthyllis vulneraria* subassociation

D- The plant formation included in the order *Quercetalia illicis*, *Pinus brutia*.

INTRODUCTION

The study was carried out in 1979 by the financial supports of the Scientific and Technical Research Council of Turkey (Project -440). The investigation is a complementary work of the other studies which have been done before in the north-west Anatolia (Akman et al. 1976, 1978).

In the study, the vegetation of the Bolu Mountains was worked out for the first time by the authors. According to the results of the study and the former studies, the vegetation of the north-west Anatolia has been described rather completely.

The important hindrance which we confronted during the work was the identification of the plants. Therefore, we appreciably acknowledge the help rendered by Dr.A.Baytop and Dr.F.Yaltırık. We are greatly indebted to Dr.P.Quezel who sustained us to the phytosociological classification of the vegetation.

MATERIAL and METHOD

The plants of the study area were collected regularly according to the investigation plan. Most of the specimens were identified by the authors in the herbarium of the Department of Biology, Faculty of Science, University of Ankara (ANK.). Some of them were sent for determination to the authorities.

The climatical data were collected from the records of the nearest observation stations of the area studied and the Bulletin of Extreme Rates (1974) of the State Meteorological Service of Turkey.

The field work was carried out according to Braun-Blanquet's method and thus the abundancy, dominance and sociability of plants were established. The extent of the quadrats was fixed by the "minimal area" method. The following characteristics were established in the quadrats: Altitude, exposition, inclination, size of quadrat, cover percentage of vegetation and other ecological and floristic features.

Association tables were made by grouping in one table all quadrats of identical or very similar floristic composition. Thus, physiognomically striking plant associations in the study area were differentiated by me-

ans of floristic and structural investigations. The floristic composition and structure of plant associations exhibiting a certain physiognomy, was established and they were identified and classified by the aid of differential, dominant and constant species. The other similar or adjacent area studies were taken as a reference, during these operations.

THE STUDY AREA

The Climate

The data of two stations were used in order to determine the climate of the region; one is that of Bolu, in the south of the study area, observing for 42 years and the other is Yiğilca, measuring only the rainfall for 8 years. But it should be noted that Bolu is however the nearest station to the study area, the measurements of rainfall is not enough to reflect the climate of the region.

1. *Precipitation* (Table I and II)

Comparing the data of two station of Bolu and Yiğilca, the Yiğilca region has got a rainfall twice more than that of Bolu. In fact this is normal. Because the town of Bolu is situated on the slopes of the mountain, facing the Central Anatolia. Therefore the amount of precipitation increases in a sensible extent from Bolu towards the north. For example while the annual amount of the precipitation is 533,7 mm, that of Yiğilca which is situated on the lower levels and at a distance of 50 km in the north, is about 1084,1 mm. The increase of the rainfall has an effective control on the vegetation and from the town of Bolu towards the north the mixed forests of *Pinus nigra* subsp. *pallasiana*, *Carpinus betulus*, *Quercus hartwissiana*, *Q. petraea*, *Abies bornmuelleriana*, *Fagus orientalis* and consequently the pure stands of *Fagus orientalis* occur, respectively.

The Bolu station in the south of the region exhibits a transitory character between the Mediterranean climate with a very cold less rainy winter and the Oceanic climate. However, the influences of the Oceanic climate is seen in Yiğilca, on the north of the region. In the other word, while there is a dry period in the months, July and August in Bolu, it is not seen in Yiğilca and the amount of summer rainfall is over 200 mm.

Table I— Annual and monthly means of the precipitation (mm)

Stations	Altitude (m)	Monthly means (mm)												Annual mean
		I	II	III	IV	V	VI	VIII	IX	X	XI	XII		
Bolu	742	58.6	53.5	50.5	48.9	56.0	51.8	25.8	18.4	30.5	34.3	47.9	58.3	533.7
Yığılca	350	128.0	96.6	109.4	89.6	80.1	69.0	72.0	76.5	66.6	58.5	118.0	119.8	1084.1

Table II— Seasonal means of the precipitations (mm).

Stations	Altitude (m)	W		Sp.		Sum.		Au.		Annual mean	Precipitation regime
		Total	%	Total	%	Total	%	Total	%		
Bolu	742	170.4	31.92	153.4	28.74	96.0	17.98	111.8	20.96	533.7	W.Sp.Au.Sum.
Yığılca	350	344.4	31.76	279.1	25.74	217.5	20.06	243.0	22.41	1084.1	W.Sp.Au.Sum.

Although the most rainy season is winter in the region of Yiğilca, it is rainy in almost all season, and this is the characteristic of oceanic climate.

2. Temperatures (Table III, IV and V)

The temperatures has been observed in only Bolu Station. The annual mean temperature of the Yiğilca station was estimated by means of lapse-rate values (Doğan, 1977). There is at least a difference of 4°C between the annual mean temperatures of Bolu and Yiğilca stations, therefore the district of Yiğilca is hotter of 4°C, while the mean annual temperature in Bolu is 10,2°C, that of Yiğilca is 12,8°C. The mean maximum temperature of the hottest month, August (m) is 27,9°C and that of the coldest month, January (m) is -4,4°C, it may be assumed that the same temperatures in Yiğilca is more of 3-4°C.

3. Bioclimatical synthesis

While the environs of Bolu which forms the south boundaries of the region has a character of transitory with the trend of Mediterranean those of Yiğilca is under the influences of Oceanic climate.

General Characteristics of the Vegetation

The flora and vegetation of the study area are in a character of Euro-Siberian. Zohary (1973) considers the north Anatolia within the Euxinian district of the Hyrcano-Euxinian subprovince in the Pontic province. The Euxinian district is divided into three secteurs; the west, the central and the east. The study area, the Bolu mountains is situated in the west secteur. This secteur extends from Bosphorous towards Sinop. Especially the *Fagus orientalis* forests are dominant in this secteur composed of the mountains with the middle altitudes (200-300 m and 1700-1800 m). The communities of *Carpinus betulus* are seen in the lower levels where the euxinian elements are in majority.

The vegetation, as a whole is included into the orders of *F a g e t a l i a s y l v a t i c a e* and *R h o d o d e n d r o - F a g e t a l i a o r i e n t a l i s* of the classes *Q u e r c o - F a g e t e a* and *F a g e t e a s y l v a t i c a e*. The plant group of *Abies nordmanniana* subsp. *bornmuelleriana* in the mountainous zone is included in the order *V a c c i n i o - P i c e e t a l i a* originated from the Middle Europe.

In the study area, the districts of Sünnice mountain and Yedigöller is generally covered by the pure *Fagus orientalis* forest and the ot-

Table III- Annual and monthly means of the temperatures (°C)

Stations	Altitude (m)	Monthly means (°C)												Annual mean
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Bolu	742	0.1	1.4	4.2	9.3	13.9	17.0	19.5	19.7	15.8	11.7	7.2	2.8	10.2
Yığılca	350	4.0	4.5	6.7	11.0	15.3	19.3	21.7	21.8	18.0	14.1	10.5	7.2	12.8

Table IV- Annual and monthly means of the maximum temperatures (°C).

Station	Altitude (m)	Monthly means (°C)												Annual mean
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Bolu	742	5.0	6.4	10.4	16.4	21.2	24.4	27.3	27.9	23.9	19.3	13.5	7.6	17.0

Table V- Annual and monthly means of the minimum temperatures (°C)

Station	Altitude (m)	Monthly means (°C)												Annual mean
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Bolu	742	-4.4	-3.4	-1.3	2.8	7.1	9.5	11.3	11.7	8.6	5.5	2.0	1.5	4.2

her parts by the mixed forests of *Abies nordmanniana* subsp. *bornmuelleriana* and *Fagus orientalis*. However the pure stands of *Abies nordmanniana* subsp. *bornmuelleriana* forests occur on the lower slopes facing Central Anatolia, in the north of Bolu town, and this plant group is located within the boundaries of Prepontic region. The black pine plays a very limited role in this region. In our recent works, the prepontic vegetation was divided into two zones in respect to altitude; one is the Euxinian zone composed of the mountains which are not so higher and affected by the Mediterranean region, the other is a mountainous zone with a character of Eurasia.

The deciduous plant formations of *Quercus hartwissiana* X *Q. petraea* and *Carpinus betulus* occur in the less mountainous or supramediterranean prepontic vegetational zone. The first is encountered as a pure or mixed stand in the vicinities of Karadere-Yığılca and the latter in the surroundings of Dirgine-Devrek and Bolu-Düzce.

In the study area the Mediterranean components are seen either under the black pine forests in Dirgine region or as communities of *Phillyrea media*-*Laurus nobilis* around Devrek. The important features of the Dirgine region are that the black pine communities extend from 150-200 m upwards 600-800 meters and their underlayers are covered by the mediterranean components which belongs to *Quercetalia ilicis*, such as *Arbutus andrachne*, *Phillyrea media*, *Cistus creticus*, *Pistacia terebinthus*, *Rhus cotinus* and *Smilax aspera*. The interesting situation of the black pine is seen in Turkey for the first time.

The geographical, ecological and phytosociological importance of the major sylvatic species.

Here, we shall consider the species of *Fagus orientalis*, *Abies bornmuelleriana*, *Pinus nigra* subsp. *pallasiana*, *Quercus hartwissiana* x *Q. petraea* and *Carpinus betulus* respectively.

The plant group of Fagus orientalis.

The *Fagus orientalis* forests in the Bolu mountains forms its southern boundaries in the western secteur of Pontic region.

Fagus orientalis is a sylvatic species which has a wider distribution in the Euxinian region. The beech also occurs in the mountainous zone of prepontic region and locally on the margins of steppe, in Amanus

mountains and Antitaurus (Pos forest), in the Türkmen mountains and Kaz mountain (Akman, Y. 1973, Yurdakulol, E. 1981).

The important communities of *Fagus orientalis* are seen on the mountain range of Black Sea region. However its distribution in respect to altitude is not the same in all parts of this range. The beech extends towards İnebolu in the western secteur at an altitude of 400–600 m and sometimes going down to the sea level.

Fagus orientalis develops on the various bedrocks, therefore its development does not depend on the type of bedrock.

As to phytosociological structure of the *Fagus orientalis* communities, they were included in the alliance *Fagion orientale* so far (De Soo 1964, Horvat, Glavac and Ellenberg, 1974). But according to this work and those formerly carried out, the beech communities are not included in this syntaxon owing to their ecological and phytosociological features. The beech forests in the western secteur may be included in the order *Fagetalia sylvaticae* and partly that of *Rhododendro-Fagetalia orientalis* of the class *Quercus-Fagetea*.

According to this, in the phytosociological frame the all units in the Euxinian region are included in the class *Quercus-Fagetea* and especially in the order *Fagetalia sylvaticae*.

It shows that while the vegetation of the eastern secteur, as a whole, is included in Euxinian phytogeographical region, the affects of Europe are seen on particularly beech forests in the western secteur. But the components of the order *Rhododendro-Fagetalia orientalis* is quite rich.

The beech communities in the Bolu mountains may be divided into two types:

The firsts are the mixed forests at the lower level composed of *Castanea sativa*, *Fagus orientalis*, *Carpinus betulus*, *Ostrya carpinifolia* and *Quercus hartwissiana*.

The second are the forests of *Fagus orientalis* on the middle and upper levels of the mountainous zone.

The mixed deciduous formations (Fagus orientalis - Castanea sativa association) (Table 1).

These forests are formed of mainly *Fagus orientalis*. It is highly successful between 400–600 m in the district of Bolu mountain. But it was destructed in the vicinities of Düzce by men activities. The association can be encountered between Düzce and Akçakoca as well. It is also seen very locally between the region of Karadere-Aksu and Yiğilca.

The deciduous species in the association such as *Castanea sativa*, *Carpinus betulus*, *Ostrya carpinifolia*, *Acer campestre* and *Cornus mas*, are rich in number.

These formations occupy large areas as the communities of *Carpinus betulus* - *Castanea sativa* in the eastern Black Sea secteur. Therefore the two species develop well in the eastern Black Sea region and form the alliance *Castanea-Carpinion*.

On the other hand, the association of *Fagus orientalis* - *Castanea sativa* is described in lower levels of the Bolu mountain in the western secteur as a vicariant of the alliance mentioned above.

It should be noted that there isn't any special alliance in the lower levels of the less mountainous zone of the Bolu mountains, while the alliance *Carpino-Acerion* and the order *Quercu-Carpinetalia* were described in the upper levels of preontic region in the central secteur.

Some mediterranean components such as *Erica arborea* and *Carpinus betulus* occurs in the association along with the species which reflect the temperateness of the climate.

As to beech forests in the middle and upper levels of the Bolu mountains, we distinguished two associations here. One of them is the association of *Fagus orientalis* - *Rhododendron ponticum* which is seen around the Sünnice mountain in the region and the other is the association of *Fagus orientalis-Cicerbita variabilis* in the vicinities of Yedigöller.

Fagus orientalis - *Rhododendron ponticum* association (Table 1)

The association forms pure stands in surroundings of Sünnice mountain and Yedigöller at an elevations of 600–700 and 1000–1600 meters. These communities are rather homogeneous in floristic composition and develop well. The influences of Euxinian region and the Middle Europe are markedly felt here. Therefore the most of the species in the quadrats belong to the order *Fagetalia sylvaticae*. For

example; *Festuca sylvatica*, *Asperula odorata*, *Cardamine impatiens*, *Cardamine bulbifera*, *Calamintha grandiflora*, *Dryopteris filix-mas*, *Polygonatum multiflorum* can be cited. Therefore, this plant group can be included in the order *Fagetalia sylvaticae*.

In this region the beech are highly successful and reaches to 30 m in height. Especially in the region of Bolu the shrub layer is too dense to penetrate and the widespread components of this layer are *Rhododendron ponticum* and *Vaccinium arctostaphylos*.

It is quite hard to chose the characteristics due to the absence of the differential species though the community develops well. However the transgressives of the order *Fagetalia orientalis* especially *Rhododendron ponticum* and *Vaccinium arctostaphylos* were chosen as characteristics.

All of the forests researched in the Bolu mountains have rainfall more than 1000 mm and the fog is frequently seen. The soils are locally deeper and forest mull is dominant. The tree layer developed well but the abundance of *Rhododendrons* in the shrub layer prevents the beech to grow well.

The association has a wider distribution in the Bolu Mountains and resembles the association of *Fagus orientalis* - *Ilex colchica* described in the western secteur of Black Sea region. But however the components of the order *Fagetalia sylvaticae* are more successful here.

On the other hand, many of the components of the order *Quercocarpinetales* occur here. For example; *Lathyrus laxiflorus*, *L. aureus*, *Cirsium hypoleucum*, *Galium longifolium*, *Viola sieheana*, *Quercus petraea* subsp. *iberica*, *Helleborus orientalis* and *Asperula cymulosa* can be cited.

Fagus orientalis-*Cicerbita variabilis* association (Table 1)

This association is mostly seen around Yedigöller in the Bolu mountain and characterized by the richness of *Cicerbita variabilis*. The association is sometime accompanied by the transgressives of the order *Rhododendro-Fagetalia orientalis* as characteristic species, such as *Staphylea pinnata*, *Tilia rubra* subsp. *caucasica* and *Aristolochia pontica* in the lower levels.

The soils are as deeper as in the former one and the brown forest soils are dominant. The type of humus is mull.

In the association occupying quite large areas at the altitudes of 500–1600 m around Yedigöller, the species such as *Vaccinium arctostaphylos* and *Rhododendron ponticum* which are abundant in the previous association, are lessened or absent here.

The association is included in the order *Fagalia sylvatica* due to well-development of the order's components well here.

The beech forests in the region of Aksu-Pınar were also included in the same order owing to the resemblance of their floristic composition to those in Yedigöller. But however *Circea lutetiana* plays enough distinctive role here.

The communities of beech-fir and fir

The community has a distribution between 800–1200 m around Ayıkaya, Aksu and Karadere. The exhibits an appearance of an attractive mixed forest composed of both deciduous and evergreen species. The fir is always dominant in the community though the beech locally grows well. On the other hand, the firs rarely have an appearance of pure forests. We deemed convenient to include the community in order *Vaccinio-Piceetalia* though the components of the order *Fagalia sylvatica* are as much as in the plant group of *Fagus orientalis*. We distinguished an association and a subassociation in this plant group.

Abies nordmanniana subsp. bornmuelleriana - Fagus orientalis association (Table 2)

The association ecologically has a continuous distribution from the altitude of 900 m up to 1600 m, in the other word it shows a wider distribution on the mountainous zone of Prepontic region. Here, the forests having a high coverage degree are under consideration; the heights of the trees reach to 20–25 m; the shrub layer is scattered but the herbaceous layer is fairly rich.

Phytosociologically this forest group can be included in the order *Vaccinio-Piceetalia*, because it contains numerous differential species belonging to this order. On the other hand, the Euxinian

components are lesser than the group of *Fagus orientalis*. But however, the order *Fagetalia sylvaticae* was represented well.

In the eastern sector of Black Sea region, the order *Pino - Piceetalia* is individuated on the same zone.

The fir stands within this plant group are rich in number of the components of the order *Vaccinio - Piceetalia* above 1000 m as in the Ilgaz mountains of the region Kastamonu. For example *Orthilia secunda*, *Monotropa hypopithys*, *Doronicum orientale*, *Pyrola chlorantha*, *Saxifraga rotundifolia* and *Monoses uniflora*. But should be noted that *Doronicum orientale* and *Saxifraga rotundifolia* have a local value here.

The association has some similarity with the subassociation *Abies bornmuelleriana* of the association *Pinus sylvestris - Orthilia secunda* in the Işık mountain and Eğriova-Beypazarı (Akman 1974, 1976; Akman, Quezel, Barbero, 1978). But however, the fir stands are fairly different from the view point of phytosociology; a less rainy climate in conformity with this different floristic structure is affective.

Although the mainrock shows a slight variation it doesn't an important role in the structure of the association. The amount of the rainfall increases above 1000 m, the summer temperature is lower and snowfall is affective between 5-6 months.

The soils are quite deeper and humus is in the form of mull. The litters quickly decomposes and moss layer is fairly thick.

Since the characteristics of the association are not developed well, the species characterizing the association are absent except for *Fagus orientalis* and *Valeriana alliariifolia*. That is why it was mixed with the trees of firs and beeches.

Another feature of the floristic composition is that the order *Quercu - Carpinetalia* has much representatives while those of *Rhododendro - Fagetalia orientalis* are not.

The subassociation of *Valeriana alliariifolia* is seen around Gurbet taşı, Yasanoç plateau and Sarımustan in the way of Yedigöller.

Carpinus betulus - Fagus orientalis association (Table 3)

Here the forest communities included in the alliance *Carpino - Acerion* are under consideration. These formation form a part of

prepointic vegetation. This type of vegetation is seen around Borozanlar plateau, Yiğilca and Maziçam-Gebelek. The quadrats laid out in these three region are gathered in the same table.

These formations are spread between 250-1000 m on the less mountainous zone of the region, in the Maziçam, region exposing the Devrek valley, the mediterranean species belonging to the order *Quercocarpinetalia* such as *Cornus mas*, *Phillyrea latifolia*, *Quercus cerris* subsp. *austriaca*, *Ostrya carpinifolia*, *Lithospermum purpurocaeruleum* and *Campanula rapunculoides* are seen.

The components of the orders *Fagetalia sylvaticae* and *Rhododendro-Fagetalia orientalis* such as *Daphne pontica*, *Salvia forskahlei*, *Fagus orientalis*, *Sanicula europea* and *Asperula odorata* are abundant especially above 800 m in surroundings of the Bolu mountains situated on the right of Sünnice and Düzce-Istanbul highway, on the other word, the Euxinian effect is conspicuous as the altitude increases.

This deciduous forests are rich in floristic composition and comprise numerous components of the syntaxa *Quercocarpinetalia* and *Carpino-Acerion* in which they are included. The components of the order *Rhododendro-Fagetalia orientalis* become rich in number depending on the increasing altitude.

These forests are fairly denser and their heights reach to 15 m where they were less affected by the human activity. The coverage percentage is quite high and reaches to 70-80 %.

Although the association has a wider distribution in the region it may be characterized by the species, *Carpinus betulus*, *Quercus hartwissiana*, *Q. petraea*, *Periploca graeca*, *Glechoma hederacea* and *Phillyrea latifolia*. The two latters have a local value.

Quercus hartwissiana x *Q. petraea* plant group (Table 4)

This hybrid formations are spread on the lower levels of the *Fagus orientalis* and *Abies nordmanniana* subsp. *bornmuelleriana* plant group at an altitude of 450-800 m especially on the southern slopes in the vicinities of Belengölcük of Dirgine region and from the scots pine region towards Yiğilca in the Bolu mountains. Here in develops on the schist and chalk bedrocks which are Silurian-Devonien aged.

Although the communities have not any distinctive differential features, *Erica arborea* which is a transgressif of the alliance *C a s t a - n e o - C a r p i n i o n*, *Chamaecytisus pygmaeus*, a transgressif of the alliance *Q u e r c i o n f r a i n e t t o* and some species of mediterranean origin such as *Chamaecytisus hirsutus*, *Dianthus carthusianorum*, *Cistus creticus*, *Sorbus aucuparia* can be taken as characteristics.

From the view point of phytosociology, these communities are included in the alliance *C a r p i n o - A c e r i o n*. As glanced at the table 4, it is seen that the components of the orders *F a g e t a l i a s y l v a t i c a e* and *R h o d o d e n d r o - F a g e t a l i a o r i e n t a l i s* decreases in a considerable extent; besides, any component of the order *V a c c i n i o - P i c e e t a l i a* is not seen.

Since this plant group is replaced by the *Quercus pubescens* communities belonging to *Q u e r c i o n a n a t o l i c a e* in Anatolian plateau in the further south, the number of the components of the syntaxon *Q u e r c e t a l i a (e a) p u b e s c e n t i s* increases.

The most attractive ecological conditions of this plant group are their localization on the lower altitudes and generally on the southern slopes.

The soils on which the communities are spread, are quite deeper brown forest soils. The humus forms a good mixture in the upper horizons of the soils.

Pinus nigra subsp. pallasiana plant group (Table 5)

The black pine forests in the Bolu mountains form their northern borders in the north-west region of Turkey. The black pine forests practically aren't seen towards the north of Bolu province. But, however the black pine stands in Dirgine region have a very special situation.

The black pine forests are spread in two distinct part of the Bolu mountains. One is the districts of Çakmaklar village and Hızar woodyard in the north of Bolu province. The other is the Dirgine region having a different ecological and floristic structure. The former is under the influences of a Continental climate while the latter a type of Mediterranean climate.

Pinus nigra subsp. pallasiana communities in the districts of Çakmaklar village and Hızar woodyard:

These communities on the slopes exposing the Central Anatolia are usually homogenous and occur in fragments reaching to 1200 m. The community near Hızar woodyard has some similarities with the subassociation described in Mudurnu-Uluhan region, the climate of which is relatively drier, and it harbours numerous steppe species.

The black pine communities in the vicinities of Çakmaklar village occur in a more humid environ and it is not usually associated with the steppe species. But however, the components of the alliance *Carpino - Acerion* increases in number. For example *Viola sieheana*, *Pyracantha coccinea*, *Helleborus orientalis*, *Asperula cymulosa*. Although the euxinian components are not rich, those of *Quercetia pubescentis* are quite rich.

Here, of the association of *Pinus nigra* subsp. *pallasiana* - *Quercus petraea* subsp. *iberica* and a subassociation of *Anthyllis vulneraria* are distinguished and the mediterranean elements such as *Ligustrum vulgare*, *Lithospermum purpurocaeruleum* and *Viburnum lantana* play a distinctive role. It is obvious that the association is ecologically closer that of *Carpinus betulus* and is characterized by decrease of the xerothermic traits.

The black pine communities in the district of Dirgine

These communities are ecologically and floristically more different than those formerly worked out in Turkey and spread from 150-200 m to 800-900 m.

The underlayer of the forest is covered by the mediterranean species such as *Phillyrea latifolia*, *Pistacia terebinthus*, *Arbutus andrachne* and *Smilax aspera* which belongs to the order *Quercetalia ilicis*. Therefore the features seperating the community from the previous one is presence of the mediterranean components. The presence of the black pine forest in an environment under the effects of oceanic climate and occurrence the mediterranean elements are of interest from the view point of floristic structure and biogeography it is of course difficult to explain this. However it can be said that the effects of the Devrek valleys with a lower altitude cause the mediterranean elements to occupy here. On the other hand the continental effect in Mengen region is in confirmity with the presence of black pine here. In fact, within the tree and shrub layer of the black pine forests in this region, there are

some species such as *Juniperus oxycedrus*, *Quercus pubescens*, *Chamaecytisus pygmaeus* and *Cotoneaster nummularia* belonging to the syntaxon *Quercetalia (ea) pubescentis*.

The great part of the quadrats were laid out on the schist and chalk bedrock which are Precambrian aged. The soils are quite deeper and generally brown forest soils are widespread. Humus shows a good mixture with the soil.

Pinus brutia plant group (Table 6)

Along Devrek stream towards to the north from the district of Dirgine the mediterranean components become dominant. For example *Pinus brutia* communities are seen in the district of Maziçam-Kurdeşe but they are fairly exploited. However, we tried to explain its floristic structure by means of three quadrats.

As understood from the table 6 the community is rich in the components of the order *Quercetalia illicis*. i.e., *Phillyrea latifolia*, *Arbutus unedo*, *Pistacia terebinthus* and *Juniperus oxycedrus*. Therefore the community can be included in the order mentioned above. The presence of the *Pinus brutia* communities under the effects of oceanic climate is quite interesting.

DISCUSSION and CONCLUSION

The west part of the Bolu mountains is under the influences of Oceanic climate. The Bolu province shows a character of transitory type of climate. From Bolu province towards the north, beech and beech-fir forests become dominant. In the lower levels *Carpinus* and black pine forests are locally seen.

Bolu mountains are situated in the western secteur of the Euxinian region and Euxinian elements are dominant. The vegetation of this region are usually included in the order *Fagetalia sylvaticae* and partly in the order *Vaccinio-Piceetalia* and *Rhododendro-Fagetalia orientalis*.

On the supramediterranean zone of the region the deciduous formations of *Quercus hartwissiana* x *Q.petraea* and *Carpinus betulus* occur while those of *Pinus nigra* subsp.*pallasiana* and *Pinus brutia* are very local.

On the mountainous zone of the region the communities of *Fagus orientalis* and *Abies nordmanniana* subsp. *bornmuelleriana* are seen.

Within the *Fagus orientalis* plant group, the associations of *Fagus orientalis*-*Castanea sativa* were described in the lower levels, while those of *Fagus orientalis* - *Rhododendron ponticum* and *Fagus orientalis* - *Cicerbita variabilis* in the upper levels. They all are included in the order *Fagetalia sylvaticae*, were described.

The association of *Carpinus betulus* - *Fagus orientalis* included in the syntaxa *Quercio-Carpinetales* and *Carpino-Acerion* were described within the *Carpinus betulus* plant group.

Another plant group of *Quercus hartwissiana* x *Q.petraea* which is included in the alliance *Carpino-Acerion* is a hybrid formation. Here the association of *Quercus hartwissiana* x *Q.petraea* - *Erica arborea* and the subassociation of *Chamaecytisus hirsitus* were described.

Consequently the plant group of *Pinus nigra* subsp. *pallasiana* shown two different structures, one is an association of *Pinus nigra* subsp. *pallasiana* - *Quercus petraea* subsp. *iberica* and its subassociation *Anthyllis vulneraria* in the vicinities of Çakmaklar village and Hızır woodyard under the effects of a continental climate and it is included in the alliance *Carpino-Acerion*. The other is a black pine group included in the order *Quercetalia ilicis* mediterranean type of climate. On the other hand the *Pinus brutia* community which was considered in the order mentioned above, was locally described in the district of Dirgine-Devrek.

ÖZET

Bolu Dağlarının büyük bir kısmı Oseyanik iklimin etkisi altındadır. Çalışma alanı, Öksin Bölgenin batı sektörü içinde yer almaktadır.

Araştırma bölgesinin Supramediterranean katında; *Quercus hartwissiana* x *Q.petraea*, *Carpinus betulus* yaprak döken ormansal toplulukları ile *Pinus nigra* subsp. *pallasiana* ve çok yerel olarak *P.brutia* iğne yapraklı bitki grupları gelişmektedir.

Alanın dağ katında ise *Abies nordmanniana* subsp. *bornmuelleriana* ve *Fagus orientalis* birlikleri görülmektedir.

Ormansal birlikler ve onların dahil olduğu sosyolojik birimler şöyledir:

A- *Fagetalia sylvaticae* takımına ait birlikler

1. *Fagus orientalis* – *Castanea sativa* birliđi
 2. *F.orientalis* – *Rhododendron ponticum* birliđi
 3. *F.orientalis* – *Cicerbita variabilis* birliđi
- B- Vaccinio – Piceetalia takımına ait birlik ve altbirlikler: *Abies nordmanniana* subsp. *bornmuelleriana* – *Fagus orientalis* birliđi ve *Valeriana alliariifolia* alt birliđi.
- C- Quercu – Carpinetalia takımı ve Carpino – Acerion alyansına ait birlik ve altbirlikler:
- i- *Carpinus betulus* – *Fagus orientalis* birliđi
 - ii- *Quercus hartwissiana* x *Q.petraea* – *Erica arborea* birliđi ve *Chamaecytisus hirsutus* altbirliđi.
 - iii- *Pinus nigra* subsp. *pallasiana* – *Quercus petraea* subsp. *iberica* birliđi ve *Anthyllis vulneraria* altbirliđi.
- D- Quercetalia ilicis takımına giren bitki grubu, *Pinus brutia*.

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