

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
Semen Mountains (Bolu)**

by

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Faculté des Sciences de l'Université d'Ankara
Ankara, Turquie

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

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A Phytosociological Research On The Vegetation Of The Semen Mountains (Bolu)

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SUMMARY

The Semen Mountains is situated in the south of the Bolu in the north-west Anatolia. Its northern slopes are under the effects of the Oceanic climate while the southern slopes is under the influence of the Mediterranean climate with a less rain and cold. The vast part of the study area has forestial formations, instead in the small part of the area the grassland vegetation prevails.

1. The sylvatic associations and their syntaxa in which they are included are:

A- The associations included in the order *Fagetalia sylvaticae* and the class *Querc-Fagetea*.

a. *Abies nordmanniana* subsp. *bornmuelleriana*-*Fagus orientalis* association.

b. *A. nordmanniana* subsp. *bornmuelleriana*-*Pinus sylvestris* association.

c. *P. sylvestris*-*A. nordmanniana* subsp. *bornmuelleriana* association.

B- The associations included in the alliance *Carpino-Acerion* of the order *Querc-Carpinetalia*.

i. *Quercus petraea* subsp. *iberica*-*Viola suavis* association.

ii. *Carpinus betulus*-*Scaligera tripartita* association.

C- The association included in the order *Quercetalia pubescentis* and the class *Quercetea pubescentis*.

Pinus nigra subsp. *pallasiana*-*Ligustrum vulgare* association.

2. The grassland association and its syntaxa is:

The association included in the *Hyperico-Verbasicion* alliance.

Festuca varia-*Viola gracilis* association.

INTRODUCTION

The study was carried out in 1980 by the financial supports of the Scientific and Technical Research Council of Turkey (Project-483).

The research is a complementary work of the other studies which had been done before in the northwestern Anatolia (Akman and all. 1972, 1976, 1978).

In the study, the vegetation of the Semen Mountains (Bolu district) was worked out for the first time. The vegetation and flora of the northwestern Anatolia were described by this work and the others.

One of the important obstacles which we confronted during the work, was the identification of plants. Therefore, we appreciably acknowledge the help and assistance rendered by Dr. A. Baytop and Dr. F. Yaltırık.

MATERIAL AND METHOD

The plants of the study area were collected regularly according to the investigation plan. Most of the specimen 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, dominancy and sociability of plants were established. The extent of quadrats was fixed by the "minimal area" method. The following characteristics were established in the quadrats: altitude, exposition, inclination, size of quadrats, cover percentage of vegetation and other ecological and floristic features.

Association tables were made by grouping all quadrats of identical or very similar floristic composition in one table. Thus, physiognomically striking plant association in the study area were differentiated by means 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 studies in similar or adjacent areas were taken as a reference, during these treatment.

THE STUDY AREA

The Geographical Situation of the Study Area

The study area is located in the south of Bolu and it comprises Semen Mountains. The mountain chain stretches to east-west aspect and its length is 40 to 60 km. The bold relief of the area are Koroğlu Hill (2400 m), Karıncalı Hill (1850 m), Çiçekli Hill (1768 m) and Resuldede Hill (1750 m) respectively.

The great part of the studied area which has eruptive main rock is composed of andesites. The vast part of the Semen Mountains is covered by the coniferous forest especially *Abies nordmanniana* subsp. *bornmuelleriana*.

On the southern slopes of the Semen Mountains, there is plenty of high plateau at an altitude of 1600 m. Aladağ is a well known one. Kartalkaya is a winter-sports center in the Aladağ.

The climate of the study area

The meteorological data were collected from the observation station of Bolu to determine of the climate of the study area. As a matter of fact that the meteorological data are valid for the northern slopes of the Semen Mountain. The vegetation changes on the southern slopes depending on the high temperatures and the less rainfall.

1- *Precipitations* (Table I, II)

The annual mean rainfall is 533.7 mm depending on the data of Bolu observation station at an elevation of 742 m. However, it is quite natural that precipitations become rather high at an altitudes of 1600 to 1800 m of the Semen Mountains.

The most droughty season of the study area is Summer (96.0 mm). July and August get less rain than the other months. The rainy season is winter (170.4 mm), spring follows it (155.4 mm). Depending on the sequence of the rainy season, the precipitation regime is East Mediterranean type (W. Sp. Au. Sum.). The precipitation regime is replaced by the Oceanic type in the northern part of the study area. The vegetation structure changes depend on the precipitation regime as we mentioned above.

Table I- Annual and monthly means of the precipitations (mm)

Station	Altitude (m)	Monthly means (mm)												Annual mean
		I	II	III	IV	V	VI	VII	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	47.0	58.3	533.7

Table II-Seasonal means of the precipitations (mm)

Station	Altitude (m)	W		Sp.		Sum.		Au.		Annual mean	Precipitation regime
		Total	%	Total	%	Total	%	Total	%		
Bolu	742	170.4	31.92	155.4	28.74	96.0	17.98	111.8	20.8	533.7	W. Sp. Au. Sum.

2- Temperatures (Table III, IV, V)

The annual mean temperature is 10.2°C in the Bolu station. The mean maximum temperature (M) of the hottest month is 27.9°C in August. Instead, the mean minimum temperature (m) of the coldest month, January is -4.4°C.

3- Bioclimatic synthesis

The pluviothermic quotient of *Emberger* (Q_2) is 60. It means that the study area is under the influence of the semi-arid very cold superior Mediterranean climate. In the following table, the other bioclimatic gradients are given.

Station	P(mm)	M(°C)	m(°C)	Q2	Bioclimatic rank
Bolu	533.7	27.9	-4.4	60	Upper semi-arid very cold type

General characteristics of the vegetation

From the phytogeographical point of view, the Semen Mountains are in the utmost south of the Euxine district of Euro-Siberian region. For this reason, the bioclimatical aspect of the study area shows the transitory characteristics. The vegetation structure changes depending on the climatical variations.

The vast part of the study area is covered by the coniferous forests. The grassland vegetation types are seen in the small stands at the higher parts of the area.

The northern part of the area facing Bolu were occupied by pure *Abies nordmanniana* subsp. *bornmuelleriana* and mixed coniferous forests. *Abies* is dominant and constant species of the mixed coniferous forest appear as if, *Pinus sylvestris* and *Fagus orientalis* complementary species respectively. Around the Ankara-Istanbul high way of Bolu, *Quercus petraea* subsp. *iberica*, *Carpinus betulus* deciduous forests and *Pinus nigra* subsp. *pallasiana* coniferous forest are seen up to 1000 to 1100 m. They have been reduced to patches because of intensive exploitation.

On the higher and eastern parts of the Semen Mountains *Festuca varia* prevails in the grassy vegetation. This type of vegetation appear

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

Station	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

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	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	4.0

in Kartalkaya at an elevation of 1900 m and it goes up to the peak of the Koroğlu Mountain (2550 m).

The phytosociological and ecological aspect of the main plant formations of the Semen Mountains

In this section of the study we shall explain the plant formations of the *Abies nordmanniana* subsp. *bornmuelleriana*, *Pinus sylvestris*, *Quercus petraea* subsp. *iberica*, *Carpinus betulus*, *Pinus nigra* subsp. *palasiana* and *Festuca varia* respectively.

The mixed forest formations in which Abies dominates :

The mixed forest associations of the *A. nordmanniana* were mentioned previously by Czegezott (1938) and Zohary (1973) depending on the co-dominant species.

These plant formations prevail on the northern slopes of the Semen Mountains at an altitude of 1100 to 1200 m and 1600 to 1700 m. Two associations were identified among these formations depending on the dominant species are as follows: *Abies nordmanniana* subsp. *bornmuelleriana*-*Fagus orientalis* and *A. bornmuelleriana*-*Pinus sylvestris*. The first one is rather prevalent than the second formation. Although, these two formations have the same ecologic conditions such as: altitude, aspect and soil factors, their floristic structures are different.

From the phytosociological point of view, the formations could be put into the *F a g e t a l i a s y l v a t i c a e* order. The associations that belong to these formations spread mainly in the north-western Anatolia, Bolu and Kastamonu.

Abies nordmanniana subsp. *bornmuelleriana*-*Fagus orientalis* association (Table 1).

The association spreads on the northern slopes of the Semen Mountains at an altitude of 1200 to 1700 m. It is found in the mountainous layer of the Pre-Pontic region from the phytogeographical point of view.

The characteristics which differentiate the association from the second are the floristical richness and the hygrophilous species are more in number (See table 1 and 2)

These forests have a high crown cover percentage and the trees in 20 to 25 m height. In the tree layer, *Fagus orientalis* is a co-dominant species, but it has the lower height than the *A. bornmuelleriana*. Therefore, it is not seen from the far off, so the formation seems to be a pure stand of *Abies*. Although, herb layer is rich in floristic respect, the shrub layer is rather poor.

From the phytosociologic point of view, the plant group belongs to the *Fagetalia sylvaticae* order due to the majority of the order's species. The association has the species of the *Vaccinio-Piceetalia* order besides the order *Fagetalia sylvaticae*. This characteristic could be seen in the other studies which have been done so far in the west Black Sea region. This reveals that, the components of *Fagetalia sylvaticae* order are dominated in the Black Sea region resulting of their penetration from the Central Europe.

In the plant formation, the characteristic species of the order *Fagetalia sylvaticae* occur at an altitude of over 1000 m and, the species are as follows: *Sanicula europea*, *Galium rotundifolium*, *Polygonatum multiflorum*, *Asperula odorata*, *Cardamine bulbifera*, *Oxalis acetosella*, *Calamintha grandiflora* and *Actea spicata*.

The bedrock is andesite where the association occurs. The soil derived from the mainrock is in medium depth and pH is acidic in character. Humus type is mull.

The characteristic and differential species of the association are as follows: *Hieracium medianiforme*, *Cicerbita variabilis*, *Asarum europaeum*, *Valeriana alliarifolia*, *Lathrea squamaria*, *Pirola media* and *Cardamine hirsuta*.

Orthilia secunda and *Monoses uniflora* which belong to the *Vaccinio-Piceetalia* order, were considered as characteristic species for the mixed *A. nordmanniana* subsp. *bornmuelleriana* forests.

Abies nordmanniana subsp. *bornmuelleriana*-*Pinus sylvestris* association (Table 2)

The association consists of the same characteristic species by the previous one, but these species are very poor in the floristic structure

because the co-dominant species is pine. So that, the pine needles make a thick mat on the surface of the soil therefore, a few species grow.

Thus, the same situation can be seen in the characteristic species of the order *Fagetalia sylvaticae* and *Vaccinio-Piceetalia*. For instance, *Asperula odorata*, *Galium rotundifolium*, *Polygonatum multiflorum* and *Calamintha grandiflora* are seen in the lower cover percentage.

The association occurs preferably on the sunny northern slopes of the Semen Mountains. The other ecologic situations are same with the previous association such as: bedrock, soil, soil depth, pH and humus type.

From the phytosociological point of view, the association could be informed to the *Fagetalia sylvaticae* order and class of the *Querc-Fagetea*.

The characteristic and differential species of the association which occur on the andesite bedrock in the north-western Anatolia are as follows: *Hieracium medianiforme*, *Valeriana alliariifolia*, *Pirola media* and *Lathrea squamaria*.

The occurrence of the species of the *Querc-Carpinetalia* order and *Carpino-Acerion* alliance are rather high in the floristic composition of the association. Instead, the species that belong to the *Quercetea (etalia) pubescentis* order are poor in the floristic structure. These are important phytosociological features of the association, this shows that the study area is situated in the transitory region.

On the other hand, the hygrophilous species were diminished in the floristic composition of the association when we compared the previous one. Of course, this case shows that the moisture of the soil becomes less.

Pinus sylvestris-Abies nordmanniana subsp.

bornmuelleriana association (Table 3).

The southern slopes of the Semen Mountains over an altitude of 1600 to 1700 m show an aspect of a high plateau. The Oceanic climate decreases in these part of the study area. Thus, the pure and mixed

forests of the *Pinus sylvestris* are seen in the stands. The situation could be explained ecologically by the decrease of soil moisture and increase of the light periods of the communities in the utmost south of the study area. But, the mean minimum temperature of the coldest month (m) is the same with this and the previous associations, its around -8°C degree. Snow lies on the ground for 4 to 6 months.

The association is spread on the andesite mainrock at an elevation of 1600 to 1700 m in the mountainous layer of the area.

The table shows that the association is similar to the previous one from the floristic respect. The species in the order rank are very poor in the association. In broad sense, the association could be put into the *Quercus-Fagetea* classis, because the species of the *Fagalia sylvaticae* order were decreased.

The association is floristically similar to the *Pinus sylvestris-Orthilia secunda* association formerly described in the Beypazarı-Eğriova region (Akman, Y. Ketenoğlu, 0. 1976).

It is difficult to separate the characteristic and differential species of the association. The community is poorer in the floristic structure than that of the previous associations. *Hieracium medianiforme* is the striking one among the differential species. Of the characteristic species, *Daphne pontica* is the prominent one as usual. *Orthilia secunda* and *Monoses uniflora* could be mentioned in the characteristic species.

Quercus petraea subsp. *iberica*-*Viola suavis* association (Table 4)

In the study area, *Quercus petraea* subsp. *iberica* is a prevalent species in the deciduous forest formations. It build up a belt around the Bolu Basin at an altitude of 800 to 1300 m.

The altitude of the association is a distinctive ecological factor from the other associations. The association occurs on the lower levels of the Semen Mountains. The cover percentage of the tree layer reaches 80 to 100 percent in many places.

The soil depth of the association varies from 20 to 30 cm. The soil moisture changes depending on the topography particularly it is rather high in the plain areas and the Bolu-Abant road junction. In these places, *Periploca graeca* grows abundantly.

The plant formation can be included in the *Carpino-Acerion* alliance and *Quercocarpinetalia* order indisputably. It is difficult to consider the characteristic species of the community. Although, the oak species can be seen in accompany with the *Pinus sylvestris*, *Fagus orientalis* and *Carpinus betulus*; but it appears in the pure stands. *Viola suavis*, *Periploca graeca*, *Lathyrus rotundifolius* var. *minuatus*, *Festuca pratensis* and *Trifolium diffusum* are considered as the characteristic species of the association. In fact, *Periploca graeca* is an element of the *Poppuleta* order but, it is rather prevalent on the damp places and especially in this plant formation.

Pinus nigra subsp. *pallasiana*-*Ligustrum vulgare* association (Table 5)

The association is not a common plant formation in the Semen Mountains. Thus, it can be seen around the east of the Cement Factory, forming a belt at an altitude of 850 to 1100 m. The community shares the same altitudes with the *Carpinus betulus* plant group which occupies in the small stands.

In ecologically, the association is located in the transitory region of the oceanic and semi-arid climates.

In the recent studies (Akman, Quezel, Barbero 1978) we mentioned that the *Pinus nigra* subsp. *pallasiana* forests which formed a zone around the Anatolia, have a different floristic structure and it is included in the *Quercetalia pubescentis* and the *Quercocedretalia libani* phytosociological orders.

As can be seen in the table 5. black pine forests can be considered in the *Quercetea (alia) pubescentis* order phytosociologically so that, they have many species of the order. But, the plant formation has some species of the *Carpino-Acerion* alliance at the same time. For instance; *Helleborus orientalis*, *Pyracantha coccinea*, *Viola siehana*, *Chamaecytisus hirsutus*, *Lathyrus laxiflorus*, *Cirsium hypoleucum*, *Carpinus betulus* and *Quercus petraea* subsp. *iberica*.

Ligustrum vulgare, *Lithospermum purpureocaeruleum* and *Anthyllis vulneraria* are given as the characteristic and differential species of the association.

In the north-western Anatolia, there is a floristical resemblance within the black pine forests, so that the association is similar to the other communities which have been done in the Mudurnu town, Çakmaklar village and Hızar woodyard around the northern part of Bolu.

Carpinus betulus-Scaligera tripartita association (Table 6)

In the Semen Mountains, *Carpinus betulus* forest occur at the same level of the black pine forests at an elevation of 900 to 1100 m. It prevails in the eastern part of the area, particularly in the vicinities of Yeniçağ.

The association is similar to those of determined in Mezit Valley of the Marmara Region. The community which is a deciduous plant formation has nearly hundred percent of cover percentage of the crown. The heights of the trees arise to 6 to 9 m.

Floristically, these forests have many species of the order *Q u e r c o - C a r p i n e t a l i a* and *C a r p i n o - A c e r i o n* alliance so that, they can be included in these syntaxa.

As were determined in the Mudurnu, *Carpinus betulus-Scaligera tripartita* association is found out around the Yeniçağ of Semen Mountains. Although, in the stands a few quadrats were laid out, the representation of the characteristic species of the association is quite well. These species are as follows: *Scaligera tripartita*, *Polygonatum multiflorum* and *Lonicera orientalis*. On the other hand, occurrence of the species of the *C a r p i n o - A c e r i o n* alliance is also distinctive (Table 6).

The species of the *Q u e r c e t e a (e t a l i a) p u b e s c e n t i s* classis are included in the association, because it has the same altitudinal level with the black pine plant group and the bioclimatic characteristics. The species of the *Q u e r c e t e a (e t a l i a) p u b e s c e n t i s* are as follows: *Coronilla varia*, *Cornus mas* and *Lithospermum purpureocaeruleum*.

Grassland Vegetation

Festuca varia-Viola gracilis association (Table 7)

The plant formation occurs prevailently on the utmost south of the study area at an elevation from 1900 m up to 2300 m where the climate became arid.

The plant group has a Mediterranean Orophytic character, therefore it is spread on the southern part of the area from the climatical point. In the area, rather thick snow cover lies for 4 to 6 months.

The soils have been formed on the eruptive bedrocks and its structure is loam or loamy-sand. pH is around 5.5 to 6. The soil depth varies from 25 to 50 cm.

The plant formation was determined for the first time in the Köröğlü Mountains (Akman and Ketenöğlü 1979). The community was put into the *Hyperico-Verbascion* alliance in the former study. In the study 28 quadrats were laid out in the association. We should point that, the floristical structure of the quadrats are similar with the former study which were laid out on the Köröğlü Mountains. Phytosociologically, it is difficult to explain the plant formation, because the high mountain steppe vegetation has not been studied in the Central Anatolia yet. Therefore, we utilized the study which was worked out in Greece by Quezel (1967) for comparison with ours.

We determined the *Festuca varia-Viola gracilis* association on the Kartalkaya for the first time. The characteristic and differential species of the association are as follows: *Thymus callieri*, *Viola gracilis*, *Festuca varia* and *Helictotrichon pubescens*. The characteristic species of the *Hyperico-Verbascion* alliance are as follows:

<i>Verbascum armenum</i>	<i>Arenaria acerosa</i>
<i>Astragalus squalidus</i>	<i>Stachys iberica</i>
<i>Hypericum linarioides</i>	<i>Cerastium purpurescens</i>
<i>Jasione supina</i> subsp. <i>akmanii</i>	<i>Euphorbia stricta</i>
<i>Marrubium astracanicum</i>	<i>Genista tinctoria</i>
<i>Pilosella hoppeana</i> subsp. <i>troica</i>	
<i>Stachys germanica</i> subsp. <i>bithynica</i>	
<i>Sideritis germanicopolitana</i>	

In fact, some species of the alliance are adaptable to live on the silic bedrock so that they could be seen in the high mountainous zone of the Central Anatolia.

The species of the high mountain steppe are also seen in the plant formation. These belong to the *Astragalo-Brometea* class.

For instance, *Euphorbia myrsinites*, *Centaurea triumfettii*, *Phlomis armeniaca*, *Galium coronatum* and *Teucrium chamaedrys*.

Astragalo - Brometea class is represented better than Daphno - Festucetea class consisting of only two species as: *Daphne oleoides* and *Koeleria cristata*.

As we mentioned in the fore part of the section, the studies which have been done on the high mountain steppe of the Central Anatolia are a few. Therefore, the species which were given in the association table as the companions, it should be chosen in some alliance or orders in the future.

In the *Festuca varia* grassland vegetation, small streams can be seen where the snowdrifts melt. Beside such streams, the hygrophile vegetation and its luxuriant species occur such as: *Nardus stricta*, *Veronica gentianoides*, *Gentiana sempemfida* var. *coridifolia*, *Ranunculus dissectus* subsp. *sibthorpii* and *Allium orientale*.

Around the peak of the Koroğlu Mountain, the Rupicol vegetation is spread on the stable rocks or in between their crevices. *Saxifraga exerata* subsp. *adenophora* and *Allium wiedemanniana* are striking species of the vegetation.

DISCUSSION and CONCLUSION

The semen Mountains are the great mountain ranges in the north-western Anatolia. It is located in a transitory region of the oceanic and semi-continental climates, from the climatic respect. The northern part of the semen mountain is under the effect of the oceanic climate, instead the southern part of the mountains is under the influence of the semi-continental climate. Of course, this situation also affects the vegetation so that, the northern and southern slopes have different floristic structure.

The study area is situated in the western secteur of the Euxinian Region. The vast part of the mountain range conifer forests of the *Abies nordmanniana* subsp. *bornmuelleriana*, *Pinus sylvestris* and *P. nigra* subsp. *pallasiana* are prevail. But, the *Fagus orientalis*, *Carpinus betulus* and *Quercus petraea* subsp. *iberica* deciduous forests are located like a belt in the lower level of the slopes facing to the Bolu Basin.

In the study area, *Abies nordmanniana* subsp. *bornmuelleriana* and *Pinus sylvestris* forestrial communities belong to the *Fagetalia sylvaticae* order among the others. Somehow, *Vaccinio Piceetalia* order's species which are derived from the Central Europe are also seen in the floristic structure. These mean that, there is the influence of the Central Europe on the forestrial vegetation of the north-western Anatolia.

Carpinus betulus and *Quercus petraea* subsp. *iberica* formations are included in the *Carpino-Acerion* alliance and the *Quercoco-Carpinetalia* order. The black pine formation occurs in the limited areas. It belongs to the *Quercetalia pubescentis* order and *Quercetea pubescentis* class.

Today it is difficult to explain phytosociologically of the *Festuca varia-Viola gracilis* grassland communities which are located on the eastern and the highest mountainous parts of the Semen Mountains. We determined the new *Hyperico-Verbascion* alliance, depending on the comparison of the results of the floristic tables of today's and foregone studies. But it is early to say something about the level of the order and the class. It would be possible to explain after the exact distribution of the formation was investigated.

ÖZET

Semen Dağları kuzey-Batı Anadolu'da Bolu'nun güneyinde yer alır. Kuzey yamaçları Oseyanik, güney yamaçları ise; az yağışlı, soğuk Akdeniz ikliminin etkisi altındadır. Bölgenin geniş bir kısmında ormansal topluluklar, küçük bir parçasında ise çayırlar egemendir.

1. Bölgede tespit edilen ormansal birlikler şunlardır:

- a- *Abies nordmanniana* subsp. *bornmuelleriana*-*Fagus orientalis* b.
- b- *Abies nordmanniana* subsp. *bornmuelleriana*-*Pinus sylvestris* b.
- c- *P. sylvestris*-*A. nordmanniana* subsp. *bornmuelleriana* b.
- d- *Quercus petraea* subsp. *iberica*-*Viola suavis* b.
- e- *Carpinus betulus*-*Scaligera tripartita* b.
- f- *Pinus nigra* subsp. *pallasiana*-*Ligustrum vulgare* b.

2. Çayır vejetasyonuna ait birlik ise:

Festuca varia-*Viola gracilis* birliğidir.

Table 5. *Pinus nigra* subsp. *pallasiana* - *Ligustrum vulgare* association

Quadrat no	56	59	60	58	57	48	47	49	Presence
Area of the quadrat (m ²)	1000	1000	1000	1000	0000	1000	1000	1000	
Altitude (m)	1100	850	850	1100	1100	1100	1100	1100	
Exposition	35	35	30	35	35	30	35	10	
Inclination	NW	NE	N	NW	N	SW	SW	NW	
Bedrock	Marn	Marn	Marn	Marn	Marn	Marn	Marn	Marn	
Characteristic and differential species:									
<i>Pinus nigra</i> subsp. <i>pallasiana</i>	45	45	45	44	44	34	34	34	V
<i>Ligustrum vulgare</i>	11	11	12	+1	.	+1	.	.	IV
<i>Lithospermum purpureoaceruleum</i>	.	12	+	22	23	.	.	.	III
<i>Anthyllis vulneraria</i>	.	.	.	.	++	++	11	.	II
Characteristics of the QUERCETEA PUBESCENTIS:									
<i>Quercus pubescens</i>	.	22	22	12	12	21	11	.	IV
<i>Cornus mas</i>	.	11	.	+	+	.	+	+	IV
<i>Juniperus oxycedrus</i> subsp. <i>oxycedrus</i>	.	11	11	+	12	.	.	.	III
<i>Dorycnium pentaphyllum</i> subsp. <i>anatolicum</i>	.	.	.	.	.	+	22	+	II
<i>Acer campestre</i> subsp. <i>campestre</i>	11	.	.	.	+	.	+	.	II
<i>Trifolium pannonicum</i> subsp. <i>elongatum</i>	.	.	.	.	.	+	+	+	II
Characteristics of the CARPINO - ACERION and QUERCO - CARPINETALIA:									
<i>Helleborus orientalis</i>	12	12	+	+	+	+	+	.	V
<i>Pyracantha coccinea</i>	.	+	.	.	+	11	+	21	IV
<i>Viola sieheana</i>	.	+	.	.	+	+	+	.	III
<i>Chamaecytisus hirsutus</i>	.	.	+	.	.	+	+	+	III
<i>Tanacetum poteriifolium</i>	.	+1	+1	12	+1	.	.	.	II
<i>Lathyrus laxiflorus</i> subsp. <i>laxiflorus</i>	.	.	.	.	+	+	+	.	II
<i>Cirsium hypoleucum</i>	11	.	.	+	+	.	.	.	II
<i>Argyrolobium biebersteinii</i>	.	.	.	.	.	+	+	21	II
<i>Carpinus betulus</i>	11	.	.	11	+1	.	.	.	II
<i>Quercus dschorchensis</i>	12	.	12	.	.	.	.	.	II
<i>Digitalis ferruginea</i>	12	.	.	+	.	.	.	.	II
<i>Dorycnium graecum</i>	.	.	.	+	+	.	.	.	II
Characteristics of the QUERCO - FAGEA:									
<i>Brachypodium sylvaticum</i>	.	12	12	.	.	34	21	11	IV
<i>Clinopodium vulgare</i>	.	+	+	.	.	+	+	.	III
<i>Fragaria vesca</i>	11	.	.	.	+	+	.	.	II
<i>Euphorbia amygdaloides</i>	11	.	.	+	+	.	.	.	II
<i>Hedera helix</i>	+	.	.	11	11	.	.	.	II
Characteristics of the QUERCO-FAGETEA and FAGETALIA SYLVATICAE:									
<i>Daphne pontica</i>	23	.	+	23	22	+	+	.	IV
<i>Sanicula europaea</i>	12	.	.	12	11	.	.	.	II
Companions:									
<i>Pteridium aquilinum</i>	34	.	.	23	22	.	32	22	IV
<i>Dactylis glomerata</i>	.	+	.	.	.	+	11	+	III
<i>Briza media</i>	.	.	.	.	.	+	+	+	II
<i>Helianthemum nummularium</i>	.	+	.	.	.	+	+	.	II
<i>Juniperus communis</i> subsp. <i>nana</i>	.	.	.	.	.	.	22	22	II
<i>Pilosella hoppeana</i> subsp. <i>troica</i>	.	.	.	.	.	12	+	.	II
<i>Anthemis tinctoria</i>	.	.	+	.	.	.	.	.	II
<i>Medicago lupulina</i>	.	.	.	.	.	+	+	.	II
<i>Salvia grandiflora</i>	.	.	.	.	.	12	22	.	II
<i>Origanum hirtum</i>	.	.	+	.	.	21	.	.	II
<i>Onobrychis armena</i>	.	.	+	.	.	+	.	.	II

Table 6. *Carpinus betulus* - *Scaligera tripartita* association

Quadrat no	29	28	85	84	Presence
Area of the quadrat (m ²)	1000	1000	1000	1000	
Altitude (m)	1000	1000	950	800	
Exposition	25	25	40	45	
Inclination (%)	N	N	NW	N	
Bedrock	Marn	Marn	Marn	Marn	
Characteristic and differential species:					
<i>Carpinus betulus</i>	44	44	44	44	V
<i>Scaligera tripartita</i>	.	+	.	+	III
<i>Polygonatum multiflorum</i>	+	+	.	.	III
<i>Lonicera caucasica</i> subsp. <i>orientalis</i>	+	+	.	.	III
Characteristic species of the QUERCO-CARPINETALIA and CARPINO-ACERION:					
<i>Helleborus orientalis</i>	11	11	11	+	V
<i>Asperula involucrata</i>	.	+	II	+	IV
<i>Laser trilobum</i>	11	11	.	11	IV
<i>Lathyrus laxiflorus</i> subsp. <i>laxiflorus</i>	+	.	+	.	III
<i>Dorycnium graecum</i>	.	+	.	+	III
<i>Viola sieheana</i>	.	+	.	+	III
<i>Cirsium hypoleucum</i>	.	+	.	+	III
<i>Lathyrus aureus</i>	+	.	:	.	II
Characteristic species of the QUERCO-FAGETEA and FAGETALIA SYLVATICAE:					
<i>Crataegus microphylla</i>	+	+	11	12	V
<i>Ranunculus brutius</i>	.	+	+	+	IV
<i>Cardamine bulbifera</i>	+	.	.	+	III
<i>Doronicum orientale</i>	+	.	+	.	III
<i>Hieracium medianiforme</i>	.	+	+	.	III
<i>Sanicula europaea</i>	+	.	.	.	II
Characteristic species of the QUERCETEA PUBESCENTIS:					
<i>Coronilla varia</i> subsp. <i>varia</i>	12	12	+	+	V
<i>Cornus mas</i>	12	12	12	12	V
<i>Lithospermum purpureocaeruleum</i>	.	11	12	.	III
<i>Quercus pubescens</i>	.	.	+	.	II
<i>Ligustrum vulgare</i>	.	.	+	.	II
Characteristic species of the RHODODENDRO - FAGETALIA ORIENTALIS:					
<i>Trachystemon orientale</i>	.	.	+	12	III
Characteristics of the QUERCO - CEDRETALIA LIBANI:					
<i>Sorbus umbellata</i> var. <i>cretica</i>	+	.	.	+	III
Characteristics of the QUERCO-FAGEA:					
<i>Corylus avellana</i>	32	32	12	+	V
<i>Clinopodium vulgare</i>	11	11	.	11	IV
<i>Veronica chamaedrys</i>	.	+	11	+	IV
<i>Primula vulgaris</i> subsp. <i>vulgaris</i>	.	+	11	11	IV
<i>Euphorbia amygdaloides</i>	+	.	+	.	III
<i>Poa nemoralis</i>	+	.	+	.	III
<i>Melica uniflora</i>	+	.	+	.	III
Companions:					
<i>Spiraea filipendula</i>	.	.	+	+	III
<i>Polygala anatolica</i>	.	+	.	+	III

