

ARAŞTIRMA MAKALESİ/RESEARCH ARTICLE

THE STEPPE VEGETATION OF EMIRDAG
(AFYON/TURKEY)

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ABSTRACT

This study was carried out on the vegetation of Emir mountains situated 40 km east of Afyon. The vegetation that is under the influences of semi arid-very cold type of Mediterranean climate was analyzed according to the Braun-Blanquet approach Br.BL. (1932). New alliance *Phlomido nissolii-Onobrychidion tournefortii* Kurt included in the *Onobrychido armenae-Thymetalia leucostomi* Akman et al. (1985) order and *Onobrychido armenae-Thymetalia leucostomi* Akman et al. (1991) suborder, six new associations and one new subassociation are described. Three of these six association and one subassociation belong to the alliance *Phlomido armeniaca-Astragalion microcephali* Akman et al. (1984).

Key Words: Syntaxonomy, Phytosociology, South-West Anatolia, Emir Mountains, *Phlomido nissolii-Onobrychidion tournefortii*, Steppe vegetation, Turkey.

EMİRDAĞ'IN STEP VEJETASYONU
(AFYON/TÜRKİYE)

ÖZ

Bu çalışmada, İç anadolu'nun güney kesiminde, Afyon'nun 40 km doğusunda yer alan Emir dağlarının vejetasyonu ortaya konulmuştur. Yarı-kurak çok soğuk bir Akdeniz ikliminin etkisi altında gelişen vejetasyon Br.BL. (1932) metoduna göre araştırılmıştır. Bu çalışmada *Onobrychido armenae-Thymetalia leucostomi* Akman et al., (1985) ordosu ve *Onobrychido armenae-Thymetalia leucostomi* Akman et al. (1991) alt ordosuna bağlanan yeni bir alyans *Phlomido nissolii-Onobrychidion tournefortii* Kurt ve 6 yeni bitki birliği ve yeni bir alt bitki birliği tanımlanmıştır. Tanımlanan bu birliklerden 3 tanesi ve bir alt birlik *Phlomido armeniaca-Astragalion microcephali* Akman et al. (1984) alyansına bağlanmıştır.

Anahtar Kelimeler: Sintaksonomi, Bitki sosyolojisi, Güneybatı Anadolu, Emir Dağı, *Phlomido nissolii-Onobrychidion tournefortii*, Step vejetasyonu, Türkiye.

1. INTRODUCTION

Steppe vegetation and flora in Central Anatolia are very remarkable in terms of plant ecology and plant sociology. However pure steppe vegetation has decreased very much because of pastures and agricultural uses. Steppe vegetation in Central Anatolia has a changeable structure in short periods due to its different mainstones, microclimates and, interesting topography.

The plant ecology and plant sociology of the Emir mountains located in Afyon province region have not

been investigated before this study. The first researches on the vegetation of Turkey don't date back very far and they were mainly concentrated on the Sylvatic groups in the northern and southern Anatolia. In spite of some recent studies, the evaluation of the steppe vegetation is far from being complete and from the phytosociological point of view, very little is known about the steppe communities (which have anthropogenic influences).

The studies related to synecology and syntaxonomy of steppe vegetation in Turkey are not sufficient.

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The most important studies on the Central Anatolia's steppe vegetation are as follows: Çetik (1985), Birand (1952), Akman (1974) Akman et al. (1976, 1984, 1985, 1991, 1994, 1995, 1996), Ketenöğlü et al. (1983, 2000), Yurdakulol et al. (1990), Kılınç (1974), Aydoğdu et al. (1994, 99) and Hamzaoğlu (1999, 2000), Hamzaoğlu et al. (2000), Kurt et al. (1999) Kurt (2000).

Emir Mountains covered with the remaining species of *Pinus nigra* Arn. subsp. *pallasiana* (Lamb.) Holmboe, *Cedrus libani* A. Rich, *Quercus cerris* L. and *Q. ithaburensis* Decne subsp. *macrolepis* (Kotschy) Hedge et Yalt. under the semi-arid to very cold variations of the Mediterranean climate have been investigated in detail.

The sites on Emir mountains is covered with poor steppe vegetation due to the total destruction of the forests there between 800 and 1100-1200 m. The vegetation between 1400 and 2000 m is a homogeneous shrub formation of no economic value dominated by *Chamaecytisus eriocarpus* (Boiss.) Rothm.

These mountains are mainly covered with secondary "Papilionaceae steppe" as in most part of the Central Anatolia due to anthropogenic effects and the destruction of the forests Akman (1983), İnceoğlu, Pehlivan (1987).

2. METHODS

The vegetation was analyzed and described according to the **Braun-Blanquet's Floristic Association System** Br-Bl. (1932). The sizes of the quadrates were estimated by means of "minimal area" which was 30-40 m² in all steppe associations. The ecological data were placed at the top of each quadrate forming phytosociological tables. Association tables were prepared grouping all quadrates of identical or very similar floristic composition in one table. Thus, apparently striking plant associations in the study area were differentiated by means of floristic and structural investigations. The floristic composition and structure of plant associations exhibiting a certain appearance was established and they were identified and classified by the aid of differential, dominant and constant species Weber et al. (2000).

3. BRIEF DESCRIPTION OF THE STUDY AREA

Emir mountains are located at S of Emirdağ district at 200 km SW of Ankara province. These mountains are approximately 30 to 40 km long. The majority

of these mountains are in the East-West direction. The West point starts at Gömü village and the east side extends to Yunak district. The highest point of these mountains is Emir Baba Tepe with an height of 2064 m estimated.

Emirdağ district is connected with Ankara and Afyon from one side Lake District and Konya from the other with road junctions. There are no big waterways except a few little valleys but they dry in summer periods.

Emir Mountains have been known to be dominated by forests of *Quercus cerris*, *Cedrus libani*, *Quercus ithaburensis* subsp. *macrolepis* a few centuries ago. Nowadays, the majority of these forests have disappeared with exception of small groups at the range of 1400 and 1800 m.

These mountains have volcanic character between 1200 and 2000 m and marly, marly-gypsaceous, gypsum soil structure dominates from 800 to 1200 m (Figure 1).

3.1. The Description of Climate

The climatic data are based on that of the Emirdağ meteorological station, making meteorological evaluations since 1965.

Rainfall: The total amount of annual rain falling of Emir mountains is as 403.4 mm estimated. Afyon district, located at 1034 m 30 km W of Emir mountains has 50 mm more rainfall.

The rainiest season is spring with 145.1 mm and followed by winter with 122.2 mm. The dry seasons are summer and autumn with rainfalls of 70.5 mm and 65.5 mm. The highest amount of rainfall is observed in March and followed by April, May, November, December, January and February, respectively. The dry months are June, July, August and September.

Temperature: The highest temperature is observed in Emir mountains in August with 29.5°C. On the other hand, the lowest temperature occurs January with a temperature of -3,2°C. These temperatures are close to those of Afyon.

Bioclimatic data: According to the data of P, PE, M, m, S and Q₂ from meteorological analyses, Emir mountains area is under the control of semi-arid and superior very cold climate Akman, Daget (1971).

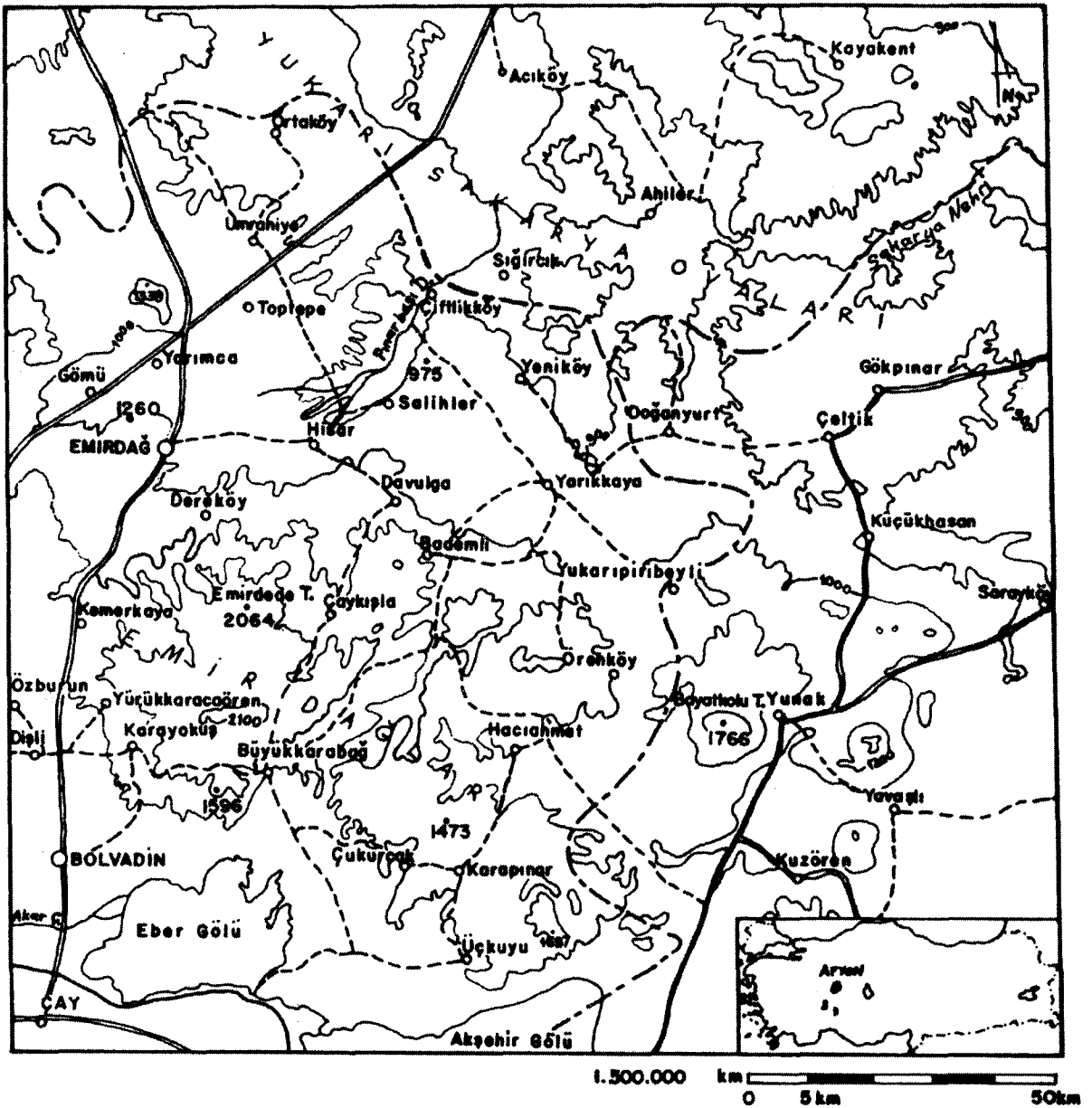


Figure 1. Geographic Map of the Study Area.

4. VEGETATION

The vegetation of Emir mountains can be divided into two parts; Firstly, there is step vegetation that grows up at deep level of soil with marly and marly-gypsaceous structure located at 800 to 1200 m zone. Secondly, a shrub formation (40-50 cm) dominated by *Chamaecytisus eriocarpus* located at the ranges between 1400 and 2000 m.

The recent situation of forest vegetation: Before dwelling upon these two types of vegetation, it will be useful to explain briefly about the remnants of the forest vegetation.

As mentioned above, Emir mountains were once covered with beautiful forest. But almost all of these forests have been destroyed. Today, this area consists of mosaic-structured associations. The number of sheep grazing in the region of 40 km² was approximately 600.000, which comes to 15 sheep per hectare, which is very intensive.

The remaining forests distributed in a mosaic manner in the region are chiefly composed of *Quercus* spp. and *Cedrus libani*.

***Quercus cerris* group:** *Q. cerris* is the most dominant species on Emir mountains. Today the best-preserved forests of these species are encountered in

Çatallı village region at the West of Dona valley ranging from 1450 to 1850 m. They can also be found, on the volcanic rocks in the ranges of 1100-1400 m between Bayat, Derben and Karacalar village in a seldom manner. *Q. cerris* group at the West Dona valley are almost pure species with the exception of a few *Q. pedunculiflora*. These trees are of 6 to 8 m in height (Table 1).

Table 1. *Quercus cerris* Group.

Relevé no:.....	8
Altitude (m).....	1400
Exposure.....	N
Inclination (%).....	40
Square size (m ²).....	400
Substrat.....	Volc.

Characteristic species of the order *Querco-Cedretalia libani*

<i>Quercus cerris</i>	34
<i>Quercus robur subsp. robur</i>	11
<i>Juniperus foetidissima</i>	11
<i>Juniperus excelsa</i>	+1

Characteristic species of the class *Quercetea pubescentis*

<i>Sorbus torminalis</i>	11
<i>Crataegus monogyna</i>	+1
<i>Lathyrus laxiflorus</i>	+1
<i>Silene italica</i>	+1

Companions

<i>Viola suavis</i>	+1
<i>Veronica orientalis</i>	+1
<i>Fragaria vesca</i>	+1
<i>Geranium molle</i>	+1
<i>Myosotis alpestris</i>	+1

***Cedrus libani* group:** The species are located as a destructed group in Çaykışla village at the South of Dandin valley. The group is spread in 4 hectare area on the volcanic mother rocks between 1400 and 1700 m.

***Quercus ithaburensis subsp. macrolepis* group:** This group is found mainly around of Emir, Yüreğil and old Gömü villages. Cover of these trees in the group is 40-60 % and they measure 7 to 9 m. This group was subjected to severe destruction due to floristic grazing. The group is mainly located between 1000 and 1300 m.

***Juniperus* group/formation:** This group is mainly dominated by *J. excelsa* Bieb., *J. foetidissima* Willd. and *J. oxycedrus* L. species originated from Mediterranean. From these species *J. oxycedrus* is generally found as forests. The other two species are located at the ranging 1100-1200 m. The floristic composition of this zone it almost destroyed. Heights of these trees can reach 8-10 m.

The presence of these Mediterranean mountains originated species in Central Anatolia with semi-arid cold and very cold climate is highly important since these regions are mainly covered with steppe vegetation. On the other hand the approach of these Mediterranean vegetation towards Central Anatolia is useful evidence that the Central Anatolia vegetation originated from the Mediterranean region Akman, Quézel (1995).

***Chamaecytisus eriocarpus*:** The group dominates the 1400-2000 m regions of Emir mountains covering approximately 2/3 of the whole area. *C. eriocarpus* characterized as shrub with height of 40-50 cm. This is a typical character of *Adenocarpo-Pinion* Quézel, Barbéro et Akman (1978) alliance reported previously by Akman et al., (1978). The main reason of this species found in this area is that they are poisonous for sheep and not consumed by them.

Investigation of steppe Vegetation

Akman et.al. established the *Onobrychido armenae-Thymetalia leucostomi* order in 1985. It comprises 3 alliances and 15 associations. Two suborders belong to *Onobrychido-Thymetalia leucostomi* Akman et al., (1985).

Suborder 1: *Onobrychido armenae-Thymetalia leucostomi* Akman et al., (1991)

Suborder 2: *Asperulo phrygiae-Thymetalia chaubardii* Akman et al., (1991)

Suborder *Onobrychido armenae-Thymetalia leucostomi* Akman et. al. (1991) located between 800-1200 m, which joins Emir mountains steppe formation to Central Anatolia. On the other hand, *Asperulo phry-*

gae-Thymenetalia chaubardii Akman et al. (1991) sub-order joins the vegetation structure between anti Taurus and Emir mountains.

We described three associations and one sub associations, which belong to *Phlomido armeniacaе-Astragalion microcephali* Akman et al., (1984) alliance on Emir mountains in the Central Anatolia.

In the present study, six new plant associations, one new sub association and a new alliance have been defined on the steppe vegetation of the Emir Mountain, which are classified in the following syntax:

Super class	<i>Daphno-Festucetales</i> Quézel, 1973
Class	<i>Astragalo-Brometea</i> Quézel, 1973
Order	<i>Onobrychido-Thymetalia leucostomi</i> Akman et al., 1985
Suborder	<i>Onobrychido-Thymenetalia leucostomi</i> Akman et al., 1991
Alliance	<i>Phlomido armeniacaе-Astragalion microcephali</i> Akman et al., 1984
Association	<i>Galio floribundi-Nephelochloetum orientalis</i> Kurt ass. nova
Association	<i>Bolantho minuartioidis-Artemisetum santonicii</i> Kurt ass. nova
Association	<i>Nepeto congestae-Salvietum wiedemanni</i> Kurt ass. nova
Sub association	<i>Achilleetosum ketenoglui</i> Kurt subass. nova
Alliance	<i>Phlomido nissolii-Onobrychidion tournefortii</i> Kurt all.nova
Association	<i>Bromo cappadocici-Artemisetum scopariae</i> Kurt ass. nova
Association	<i>Astragaletum mitchelliano-microcephali</i> Kurt ass. nova
Association	<i>Alkanno pseudotinctoriae-Ebenetum hirsutae</i> Kurt ass. nova

4.1. *Phlomido armeniacaе - Astragalion microcephali* Akman et al., (1984)

4.1.1. *Galio floribundi-Nephelochloetum orientalis* Kurt ass. nova

This association is represented by following characteristic species; *Galium floribundum* Sm subsp. *floribundum.*, *Nephelochloa orientalis* Boiss., *Anthemis wiedemanni* Fisch. et Mey. and *Crucianella distachya* Boiss.

The structure and ecology of the association: This type of steppe at the study area is typical found in other parts of Anatolia. It is dominated mainly by a steppe of

Festuca valesiaca Schleicher ex Gaudin. This association is found in ranges 1000 and 1100 m between Emirdağ and Bolvadin districts. The percentage of vegetation coverage changes between 80-90 %. The area has an inclination between 30-35 %. All characteristic species of this association are endemic for South-West metamorphic soil.

Distribution: This association can only grown up at 20 km of Emirdağ-Bolvadin highway direction. So it is represented in only a small area. Holotype: Table 2, quadrate 120.

4.1.2. *Nepeta congestae-Salvietum wiedemanni* Kurt ass. nova

Differential and characteristic species of this association are *Salvia wiedemanni* Boiss., *Gypsophila ericalyx* Boiss., *Nepeta congesta* Fisch. et Mey. subsp. *congesta*, *Allium flavum* L., *Centaurea patula* Dc., *Marrubium trachyticum* Boiss., *Thymus leucostomus* Hauskn. et Velen var. *argillaceus* Jalas.

“Structure and ecology” of the association: This association depends directly to the presence of soil structure with either gypsum or marl-gypsum. This association can be found commonly at between 800-950 m of Emir mountains with 2-3% inclination.

All characteristic species of this association are represented at gypsum soil in Central Anatolia. The association has also a number of endemic species, which belong to only Afyon province and Sivrihisar district.

Distribution: This association sprits out at 150 km point of Ankara-Afyon to Emir mountains. Holotype: Table 2, quadrate 1.

This association contains one subassociations: *Achilleetosum ketenoglui* subass.

Achilleetosum ketenoglui subassociation is characterized by species *Achillea ketenoglui* Duman, *Haplophyllum myrtifolium* Boiss., and *Hedysarum cappadocicum* Boiss. which are also endemic to the Central Anatolia. This sub association is well adapted to the eroded gypsum soil structure. Holotype: Table 2, quadrate 3.

4.1.3. *Bolantho minuartioidis-Artemisetum santonicii* ass. nova

Differential and characteristic species of this association; *Artemisia santonicum* L., *Consolida aconiti* (L.) Lind., *Bolanthus minuartioides* (Jaub. et Spach) Hub.Mor., *Minuartia anatolica* (Boiss.) Woran. subsp. *arachnoidea* Mc Neil, *Moltkia aurea* Boiss., *Scorzonera pseudolanata* Grossheim.

Table 2. Association Within the Alliance Phlomido-Astragalion Microcephali (Akman et al., 1984).

Quadrat :-----	10	120	121	46	3	23	1	2	38	39	41	42	22	125	126	127	19	2	21
Altitude (m)-----	1100	1100	1050	850	850	850	850	850	800	800	800	800	950	1000	950	1000	1000	1000	1000
Exposure-----	N	N	N	W	W	E	-	-	-	-	E	E	N	W	W	W	W	W	W
Inclination (%)-----	35	35	35	10	4	3	-	-	2	-	5	5	5	3	3	3	2	3	3
Square size (m ²)-----	30	30	30	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
Substrat-----	Marl	Marl	Marl	Gyp.	M-G	M-G	M-G	Marl	Marl	Marl	Marl	Gyp.	Gyp.	Gyp.	Marl	Marl	Marl	Marl	Marl

Characteristic species of the associations

*Galio floribundi-Nephelochloetum orientalis**Nepeto congestae-Salvietum wiedemannii**Bolantho minuartioidis -Artemisietum santonici**achilletosum gonioccephali*

<i>Galium floribundum</i> subsp. <i>floribundum</i>	22	22	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
<i>Nephelochloa orientalis</i>	11	+1	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
<i>Anthemis wiedemannii</i>	11	12	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
<i>Crucianella distachya</i>	+1	+1	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
<i>Salvia wiedemannii</i>	.	.	.	+1	+1	+1	12	11	34	.	34	34	34	.	.	.	.	.	.	9
<i>Gypsophila eriocalyx</i>	.	.	.	+1	.	11	+1	+1	.	+1	11	11	.	.	.	.	.	.	.	7
<i>Nepeta congesta</i> subsp. <i>congesta</i>	.	.	.	.	.	.	+1	+1	+1	+1	+1	.	+1	.	.	.	.	.	.	6
<i>Allium flavum</i>	.	.	.	+1	+1	.	+1	+1	.	.	.	+1	.	.	.	.	.	.	.	6
<i>Centaurea patula</i>	.	.	.	+1	+1	+1	+1	+1	.	.	.	.	.	.	.	.	.	.	.	5
<i>Marrubium trachyticum</i>	.	.	.	.	.	.	.	+1	+1	+1	.	.	.	+1	+1	.	.	.	.	5
<i>Thymus leucostomus</i> subsp. <i>argillaceus</i>	.	.	.	.	.	11	11	12	11	+1	.	.	.	.	.	.	.	.	.	5
<i>Achillea ketenoglu</i>	.	.	.	.	12	.	.	+1	+1	.	.	.	.	.	.	.	.	.	.	3
<i>Haplophyllum myrtifolium</i>	.	.	.	.	+1	.	.	+1	+1	.	.	.	.	.	.	.	.	.	.	3
<i>Hedysarum cappadocicum</i>	.	.	.	+1	+1	.	.	.	+1	.	.	.	.	.	.	.	.	.	.	3
<i>Consolida aconiti</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
<i>Bolanthus minuartioides</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	+1	+1	+1	+1	+1	5
<i>Minuartia anatolica</i> var. <i>arachnoidea</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	+1	+1	+1	+1	5
<i>Moltkia aurea</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	+1	+1	+1	4
<i>Scorzonera pseudolanata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	+1	+1	+1	4

Characteristic species of the alliance *Phlomido-Astragalion microcephali*

<i>Paronychia kurdica</i>	+1	.	+1	+1	.	.	.	.	.	.	+1	.	+1	11	+1	+1	+1	+1	.	+1	11
<i>Alyssum pateri</i>	.	.	.	.	11	+1	+1	11	.	+1	.	+1	.	.	.	.	.	11	11	+1	9
<i>Helianthemum canum</i>	.	.	.	+1	+1	.	+1	+1	.	.	.	+1	.	.	.	.	12	11	12	8	
<i>Dianthus zonatus</i> subsp. <i>zonatus</i>	.	.	+1	.	.	.	.	.	.	.	+1	.	.	.	+1	+1	.	+1	11	11	7
<i>Phlomis armeniaca</i>	12	12	12	.	.	.	.	.	+1	.	11	+1	.	.	.	.	.	.	.	.	6
<i>Marrubium parviflorum</i> subsp. <i>oligodon</i>	.	.	.	.	.	.	.	.	12	11	+1	11	.	.	.	.	.	.	.	.	4
<i>Astragalus lycius</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	.	+1	.	+1	.	3
<i>Teucrium chamaedrys</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	+1	+1	3

Characteristic species of the suborder *Onobrychido-Thymenetalia leucostomi*

<i>Thymus leucostomus</i> subsp. <i>leucostomus</i>	11	12	12	34	34	22	.	.	.	.	.	.	22	.	.	12	12	12	33	23	22	13
<i>Stipa holosericea</i>	11	.	11	.	.	+1	.	.	.	.	.	.	+1	12	.	11	11	11	.	.	.	8
<i>Cousinia birandiana</i>	.	.	.	+1	.	+1	.	.	.	.	+1	+1	.	.	.	.	+1	+1	.	+1	.	7
<i>Astragalus lydius</i>	.	.	.	.	.	.	.	12	.	.	.	.	+1	.	.	.	.	.	22	22	22	5
<i>Hedysarum varium</i>	.	.	.	.	12	.	.	.	+1	.	.	.	+1	.	.	.	.	.	.	.	.	4
<i>Thymelea passerina</i>	+1	.	+1	.	.	.	.	.	.	.	.	.	.	.	.	+1	.	+1	.	.	.	4
<i>Bungea trifida</i>	.	.	.	.	+1	.	+1	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	3
<i>Stachys cretica</i> subsp. <i>anatolica</i>	+1	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
<i>Salvia cryptantha</i>	.	.	.	.	12	.	.	.	.	.	.	+1	.	.	.	.	.	.	.	.	.	2

Cont. Table 2.

Characteristic species of the order *Onobrychido armenae-Thymetalia leucostomi*

<i>Artemisia santonicum</i>	.	.	.	23	.	33	33	33	12	23	12	.	12	44	44	44	44	44	44	44	14
<i>Scabiosa argentea</i>	+1	+1	+1	.	+1	.	+1	.	.	+1	.	+1	.	.	.	.	.	.	.	.	7
<i>Centaurea virgata</i>	+1	+1	.	.	.	.	+1	+1	.	.	.	.	.	+1	+1	.	.	.	.	.	6
<i>Globularia orientalis</i>	.	.	.	+1	.	+1	+1	.	.	+1	+1	.	.	.	.	.	.	.	+1	.	6
<i>Bupleurum boissieri</i>	+1	+1	.	.	.	.	.	.	.	.	.	.	.	+1	+1	+1	.	.	.	.	5
<i>Alyssum sibiricum</i>	.	.	.	.	+1	+1	+1	+1	.	.	+1	.	.	.	.	.	.	.	.	.	5
<i>Moltkia coerulea</i>	.	.	.	11	.	+1	.	+1	.	+1	.	+1	.	.	.	.	.	.	.	.	5
<i>Onobrychis armena</i>	.	.	.	.	.	.	.	.	.	+1	.	.	.	.	+1	+1	.	.	.	+1	4
<i>Ziziphora tenuior</i>	.	.	.	.	.	.	.	.	+1	.	.	.	.	+1	+1	+1	.	.	.	.	4
<i>Asyneuma limonifolium</i> subsp. <i>limonif.</i>	.	.	.	.	+1	.	.	+1	.	.	+1	+1	.	.	.	.	.	.	.	.	4
<i>Helianthemum nummularium</i> subsp. <i>num.</i>	.	.	.	+1	.	.	.	.	.	.	+1	+1	.	.	.	.	.	.	.	.	3
<i>Polygala pruinosa</i>	.	.	.	.	.	.	+1	+1	.	.	.	+1	.	.	.	.	.	.	.	.	3
<i>Anthemis tinctoria</i>	.	.	.	.	+1	.	.	+1	.	.	.	.	.	.	.	.	.	.	.	+1	3

Characteristic species of the class *Astragalo-Brometea*

<i>Bromus tomentellus</i>	22	12	22	.	12	12	12	11	.	12	34	.	11	11	12	22	22	22	22	22	16
<i>Festuca valesiaca</i>	33	33	33	.	11	11	11	.	22	11	11	.	11	.	11	+1	22	22	22	22	15
<i>Teucrium polium</i>	12	12	11	.	.	+1	.	.	12	+1	.	+1	+1	+1	+1	+1	+1	+1	+1	+1	13
<i>Anthemis cretica</i> subsp. <i>anatolica</i>	.	.	.	.	+1	+1	.	.	.	+1	.	.	.	.	.	.	.	.	.	.	8
<i>Minuartia anatolica</i> subsp. <i>anatolica</i>	.	.	.	+1	+1	.	+1	+1	+1	.	+1	.	+1	.	.	.	.	.	.	.	7
<i>Convolvulus lineatus</i>	.	.	.	.	+1	.	+1	+1	+1	.	.	.	.	.	.	.	+1	+1	+1	+1	7
<i>Eryngium campestre</i>	+1	+1	.	.	.	.	.	.	.	.	.	.	.	.	+1	+1	.	.	.	+1	6
<i>Filago eriocephala</i>	+1	.	+1	.	.	.	.	.	+1	+1	.	.	+1	.	.	.	.	.	.	+1	6
<i>Erysimum crassipes</i>	+1	.	+1	.	.	.	.	.	.	+1	.	.	.	.	.	.	+1	+1	+1	+1	6
<i>Botriochloa ashaemum</i>	+1	+1	+1	.	.	.	.	.	.	.	.	.	.	+1	+1	12	.	.	.	.	6
<i>Koeleria cristata</i>	.	.	.	12	.	+1	.	.	.	.	.	.	.	.	.	.	+1	11	+1	5	5
<i>Jurinea pontica</i>	.	.	.	.	.	+1	.	.	.	.	+1	.	.	.	.	.	+1	+1	+1	5	5
<i>Euphorbia macroclada</i>	.	.	.	+1	.	.	.	.	.	+1	.	.	+1	+1	.	.	.	+1	.	5	5
<i>Convolvulus compactus</i>	.	.	.	.	+1	+1	+1	+1	.	.	+1	.	.	.	.	.	.	.	.	.	4
<i>Ziziphora taurica</i>	.	.	.	.	.	.	+1	.	.	.	.	.	.	.	.	.	.	.	+1	+1	4
<i>Bromus cappadocicus</i>	.	.	.	.	.	.	.	+1	.	.	.	.	.	.	.	.	.	+1	+1	+1	4
<i>Ajuga chia</i>	.	.	.	.	+1	.	11	.	.	.	.	+1	.	+1	.	+1	.	.	.	.	5
<i>Scutellaria orientalis</i>	.	.	.	.	+1	.	.	+1	.	.	.	.	.	.	.	.	.	.	.	.	3
<i>Stipa lessingiana</i>	.	.	.	.	12	.	.	.	.	.	.	+1	.	.	.	.	.	+1	.	.	3
<i>Centaurea urvillei</i>	.	.	.	.	.	.	.	.	.	.	+1	.	.	.	.	.	+1	.	+1	.	3
<i>Apera intermedia</i>	.	.	.	.	.	.	.	.	.	12	.	.	.	.	.	.	.	.	.	+1	2
<i>Phleum exaratum</i> subsp. <i>exaratum</i>	.	.	.	.	+1	.	.	.	.	.	+1	.	.	.	.	.	.	.	.	.	2
<i>Linaria corifolia</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	+1	.	.	.	.	.	2
<i>Lappula barbata</i>	.	.	.	.	.	.	+1	.	.	.	.	.	.	.	.	.	.	.	+1	.	2

Companions

<i>Xeranthemum annum</i>	+1	.	+1	.	.	.	.	.	.	.	.	.	.	+1	.	.	+1	.	.	.	4
<i>Fumana procumbens</i>	.	.	.	.	+1	.	+1	+1	.	.	.	.	.	.	.	.	.	.	.	.	4
<i>Bromus japonicus</i>	11	11	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	+1	.	.	.	4
<i>Iris attica</i>	.	.	.	.	+1	.	+1	+1	.	.	.	.	.	.	.	.	.	.	.	.	3
<i>Sideritis montana</i> subsp. <i>montana</i>	.	.	.	.	.	+1	.	.	.	+1	.	.	.	.	.	.	.	.	.	.	2
<i>Bromus tectorum</i>	.	.	.	11	.	.	.	.	.	.	.	+1	.	.	.	.	.	.	.	.	2

Not: Gyp.=Gypsum, M-G.=Marly-Gypsaceous

Structure and ecology of association: This association makes real chamaephyte steppe. It is covered by 90 % percent with *Artemisia santonicum*. This species is followed by second common species *Astragalus lydius* Boiss. This species produce nice view with their purple color at the beginning of summer season.

This association expands to the large area from 900 m to 1000 m of Emir mountains. It prefers little inclination of 2-3 % as the previous association. The association grows up on deep marly soil structure.

Distribution: This association expands in lower level of Emir mountains mainly at junction of Emirdağ-Afyon. Holotype: Table 2, quadrate 19

Syntaxonomy: The three associations (*Galio floribundi-Nephelochloetum orientalis*, *Nepeto congestae-Salvietum wiedemannii*, *Bolantho minuartioidis-Artemisietum santonici*) belong to *Phlomido-Astragalion microcephali* alliance of *Onobrychido armeni-Thymetalia leucostomi* order under classes *Astragalo-Brometea*.

4.2. *Phlomido nissolii-Onobrychidion tournefortii* Kurt all. nova.

This alliance spreads in Bolvadin, Çay, Senirkent and Uluborlu regions at South-west of Emir mountains. However, it is necessary to determine geographical distribution of this alliance. This alliance grown up on the chalk, marly chalks and agglomerates. It can be found deeply on more or less eroded soil. It is ranges from 900 m to 1000 m.

Characteristic species of this alliance are; *Hypericum avicularifolium* Jaub. et Spach. subsp. *depilatum* Freyn et Bornm. var. *depilatum*, *Phlomis nissolii* L., *Onobrychis tournefortii* (Wild) Desv., *Eryngium bithynicum* Boiss. (Table 3). *Astragaletum mitchelliano-microcephali* Kurt ass. nova. is the type association of the alliance. Holotype: Table 3, quadrate 10.

4.2.1. Association *Bromo cappadocici-Artemisietum scoparii* Kurt ass. nova.

It is difficult to isolate characteristic species of association. It may be identified as; *Artemisia scoparia*, *Bromus cappadocicus* Boiss. et Bal., *Centaurea urvillei* DC., *Teucrium orientale* L.

Structure and ecology of the association: This steppe is dominated by biannual species *Artemisia scoparia*. This steppe grows up on deep and marly soil with good drainage. Association is growth at between 900 and 1000 m but sometimes this can be found up to at

1500 m. This association mainly prefers the area with 5-15 % inclination.

Artemisia scoparia usually can be found with *Artemisia santonicum* in a large area at South-west of Anatolia. Association coverage varies by 50-60 %.

Distribution: This association spreads particularly between Emirdağ district and Karacalar village. Holotype: Table 3, quadrate 29.

4.2.2. *Astragaletum mitchelliano-microcephali* Kurt ass. nova.

Differential and characteristic species of this association are; *Astragalus microcephalus* Wild., *Astragalus mitchellianus* Boiss., *Alyssum strigosum* Banks et Sol. subsp. *cedrorum* (Schott et Kotschy) Dudley, *Elymus lazicus* (Boiss.) Melderis subsp. *divaricatus* Boiss. et Bal.) Melderis, *Astragalus micropterus* Fischer.

Structure and ecology of the association: The association is covered with *Astragalus microcephalus* by 90 % so it forms a close steppe. This kind of steppe does not expand in a large area and prefers an area with 5-25 % inclination. The preferred soil is the one with well drainage and more less deep. Association grows up on chalky or marly-chalky soil between 1000 and 1100m. This association has got many similar characteristics with the order *Onobrychido-Thymetalia leucostomi* and class *Astragalo-Brometea* in view of floristic structure.

Distribution: This association mainly expands between Emirdağ district and Karacalar village. Also the destroyed type of association can be found around of Ekizce village. Holotype: Table 3, quadrate 11.

4.2.3. Association *Alkanna pseudotinctoriae-Ebenetum hirsutae* Kurt ass. nova.

Differential and characteristic species of this association: This association is represented by a large number of species. *Ebenus hirsuta* Jaub. et Spach., *Allium cupani* Rafin subsp. *hirtovaginatatum* (Kunth) Stearn, *Achillea monocephala* Boiss. et Bal., *Alkanna pseudotinctoria* Hauskn et Hub-Mor., *Helichrysum arenarium* (L.) Moench subsp. *aucheri* (Boiss.) Davis et Kupicha, *Astragalus condensatus* Ledeb., *Lotononis genistoides* (Fenzl) Benth.

Structure and ecology of the association: This association grows up on a deep and marl soil has many endemic species of Central Anatolia. It is dominated mainly by two species. These are *Ebenus hirsutus* and *Onobrychis tournefortii*. The association has a very rich floristic structure. It prefers middle to high altitudes with a little inclination as previous association. Its coverage ranges from 80 to 100 %.

Table 3. Associations Within the Alliance *Phlomido nissolii-Onobrychidion Tournefortii* all. nova

Rquadrate:	16	32	37	45	13	29	31	17	18	43	44	10	11	15	30	33	34	35
Altitude (m)	950	1000	950	1000	1100	1000	1000	1000	1000	1000	1000	1100	1100	1050	950	1000	1000	1000
Exposure	E	W	E	N	-	-	W	E	E	W	N	E	E	E	W	W	W	W
Inclination (%)	5	15	5	10	3	3	10	5	5	25	30	20	20	20	20	50	10	10
Square size (m ²)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20
Substrate	Marl	Marl	Marl	Marl	Marl	Marl	Marl	chalk	chalk	chalk	chalk	chalk	chalk	chalk	chalk	Marl	Marl	Marl

Characteristic species of the associations

Bromo cappadocici-Artemisietum scoparii *Astragalum mitchelliano-microcephali* *Alkanno pseudotinctorii*
Ebenetum hirsui

<i>Bromus cappadocicus</i>	+1	.	.	+1	+1	+1	.	.	.	.	.	.	.	.	.	.	.	.	4
<i>Teucrium orientale</i>	.	+1	.	+1	.	+1	11	.	.	.	.	.	.	.	.	.	.	.	4
<i>Centaurea urvillei</i>	.	.	+1	+1	+1	+1	.	.	.	.	.	.	.	.	.	.	.	.	4
<i>Astragalus microcephalus</i>	.	.	.	.	.	.	.	12	12	44	34	45	44	34	34	.	.	.	8
<i>Astragalus mitchellianus</i>	.	.	.	.	.	.	.	+1	+1	+1	.	+1	+1	.	+1	.	.	.	6
<i>Alyssum strigosum subsp. cedrorum</i>	.	.	.	.	.	.	.	+1	+1	.	+1	+1	.	+1	.	.	.	.	6
<i>Elymus lazicus subsp. divaricatus</i>	.	.	.	.	.	.	.	+1	.	+1	.	+1	.	+1	.	.	.	.	5
<i>Astragalus micropterus</i>	.	.	.	.	.	.	.	.	+1	.	.	+1	+1	.	11	.	.	.	4
<i>Ebenus hirsuta</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	34	34	34	4
<i>Allium cupani subsp. hirtovaginatam</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	11	11	4
<i>Achillea monocephala</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	11	11	3
<i>Alkanna pseudotinctoria</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	+1	+1	3
<i>Helichrysum arenarium subsp. aucheri</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	12	11	3
<i>Astragalus podperae</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	+1	+1	3
<i>Lotononis genistoides</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	+1	+1	3

Characteristic species of the alliance *Phlomido-Onobrychidion tournefortii*

<i>Hypericum avicularifolium subsp. depilat.</i>	+1	.	+1	+1	+1	.	.	+1	11	+1	+1	11	11	+1	.	+1	.	+1	13	
<i>Eryngium bithynicum</i>	.	+1	.	+1	+1	+1	+1	+1	+1	.	.	.	.	+1	11	.	+1	.	11	
<i>Phlomis nissolii</i>	+1	.	.	.	.	+1	+1	+1	.	.	.	+1	+1	+1	.	+1	11	11	12	11
<i>Onobrychis tournefortii</i>	.	+1	+1	.	.	.	+1	.	+1	.	.	+1	+1	+1	.	.	22	22	22	10

Characteristic species of the suborder *Onobrychido-Thymenetalia leucostomi*

<i>Artemisia scoparia</i>	23	33	34	33	44	44	33	22	22	+1	+1	12	11	+1	.	.	.	+1	15
<i>Thymus leucostomus subsp. leucost.</i>	23	33	.	.	+1	22	33	22	22	.	11	.	.	12	.	33	.	+1	11
<i>Artemisia santonicum</i>	34	+1	.	.	.	.	+1	34	34	.	.	+1	.	+1	+1	11	11	11	11
<i>Astragalus lydius</i>	+1	.	.	.	+1	.	.	+1	+1	+1	.	+1	+1	+1	.	12	11	12	11
<i>Salvia cryptantha</i>	.	11	.	.	+1	.	+1	.	11	11	.	.	.	.	.	22	22	22	8
<i>Stipa lessingiana</i>	+1	11	.	.	.	.	+1	+1	11	.	+1	.	.	+1	.	.	.	.	7
<i>Cousinia birandiana</i>	+1	.	+1	.	.	+1	.	+1	+1	.	.	.	.	.	+1	.	.	.	6
<i>Thymus leucostomus subsp. argillaceus</i>	.	.	+1	+1	.	+1	.	.	.	.	.	.	.	.	11	.	12	12	6
<i>Bungea trifida</i>	.	.	.	.	.	.	.	.	.	.	+1	.	.	.	.	11	11	11	4
<i>Stipa holosericea</i>	.	.	11	.	+1	.	.	.	.	.	.	.	.	.	+1	.	.	.	3

Characteristic species of the order *Onobrychido-Thymetalia leucostomi*

<i>Onobrychis armena</i>	11	+1	+1	.	+1	.	.	11	+1	+1	+1	+1	+1	+1	.	+1	+1	+1	14
<i>Marrubium parviflorum subsp. oligodon</i>	.	+1	.	+1	.	.	+1	.	.	.	.	+1	.	.	+1	11	+1	+1	9
<i>Paronychia kurdica</i>	+1	.	+1	.	+1	.	.	+1	.	.	.	+1	.	.	+1	11	11	.	9
<i>Dianthus zonatus subsp. zonatus</i>	.	11	+1	.	.	+1	11	.	.	.	+1	.	.	.	.	+1	+1	+1	8

<i>Scabiosa argentea</i>	.	+1	.	+1	.	+1	.	.	.	+1	.	.	+1	.	+1	+1	+1	8
<i>Stachys cretica subsp. anatolica</i>	.	+1	.	.	.	+1	+1	.	.	+1	+1	.	.	.	+1	11	.	7
<i>Centaurea virgata</i>	.	+1	.	+1	.	.	.	.	.	.	.	.	.	.	+1	+1	+1	6
<i>Ziziphora tenuior</i>	.	.	+1	-1	+1	.	.	.	.	.	.	.	+1	.	.	.	.	5
<i>Bupleurum boissieri</i>	.	.	.	.	+1	.	.	.	.	+1	.	.	.	.	.	.	+1	3
<i>Helianthemum nummularium ssp. num.</i>	.	+1	.	.	.	.	.	.	.	.	.	.	+1	.	+1	.	.	3
<i>Polygala pruinosa</i>	.	.	.	.	.	.	.	.	.	.	+1	.	+1	.	.	.	.	2
<i>Anthemis tinctoria</i>	.	+1	.	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	2
<i>Asyneuma limonifolium subsp. limoni.</i>	.	.	+1	.	.	.	.	.	.	.	.	.	.	+1	.	.	.	2

Characteristic species of the class *Astragalo-Brometea*

<i>Bromus tomentellus</i>	11	12	11	12	11	22	12	11	11	11	11	11	12	12	22	22	22	18
<i>Festuca valesiaca</i>	22	11	22	.	12	12	11	12	22	.	22	11	12	11	11	33	33	16
<i>Teucrium polium</i>	11	22	+1	.	.	22	11	+1	+1	+1	+1	11	11	+1	.	.	+1	13
<i>Alyssum pateri subsp. pateri</i>	.	+1	+1	.	+1	+1	11	11	11	+1	+1	11	11	+1	11	.	.	13
<i>Koeleria cristata</i>	.	11	.	.	+1	12	11	11	11	11	+1	12	12	+1	+1	.	11	13
<i>Minuartia hirsuta subsp. anatolica</i>	12	.	+1	.	.	.	.	+1	11	+1	+1	+1	11	11	+1	.	.	12
<i>Anthemis cretica subsp. anatolica</i>	.	.	.	+1	+1	+1	.	.	+1	.	11	11	11	+1	11	+1	11	12
<i>Phlomis armeniaca</i>	.	+1	+1	.	11	12	11	.	.	+1	.	+1	.	.	11	+1	+1	10
<i>Ziziphora taurica subsp. taurica</i>	+1	.	.	.	.	.	.	.	+1	.	+1	+1	+1	.	+1	.	+1	7
<i>Jurinea pontica</i>	.	.	.	.	+1	.	+1	.	.	.	+1	+1	+1	.	.	+1	.	7
<i>Helianthemum canum</i>	.	+1	.	+1	.	+1	.	.	.	+1	.	.	.	+1	.	+1	.	7
<i>Teucrium chamaedrys</i>	.	.	.	.	+1	.	.	.	.	+1	+1	+1	.	+1	.	+1	.	6
<i>Echinaria capitata</i>	.	.	+1	.	+1	.	.	+1	+1	.	+1	.	.	+1	.	.	.	6
<i>Globularia orientalis</i>	.	+1	.	.	.	+1	.	.	.	+1	+1	.	.	.	.	.	+1	5
<i>Apera intermedia</i>	.	.	12	.	.	+1	.	+1	+1	.	.	.	.	.	.	.	.	4
<i>Phleum exaratum subsp. exaratum</i>	.	.	.	22	.	.	.	.	.	+1	.	.	+1	.	.	.	.	4
<i>Euphorbia macroclada</i>	.	.	.	.	.	.	.	.	.	.	+1	.	.	.	.	12	12	4
<i>Linum hirsutum subsp. anatolicum</i>	.	.	.	.	+1	.	.	.	.	+1	+1	.	+1	.	.	.	.	4
<i>Veronica multifida</i>	+1	.	.	.	.	.	.	+1	+1	.	.	.	+1	.	.	.	.	4
<i>Leontodon asperrimus</i>	.	.	+1	.	+1	+1	.	.	.	.	.	.	.	.	.	.	.	4
<i>Filago eriocephala</i>	.	.	+1	.	+1	.	.	.	.	.	+1	.	.	.	.	.	.	4
<i>Ajuga chia</i>	.	.	.	.	+1	.	.	.	.	+1	.	.	.	+1	.	.	.	3
<i>Convolvulus lineatus</i>	+1	.	.	.	.	.	.	+1	+1	.	.	.	.	.	.	.	.	3
<i>Galium coronatum</i>	.	.	.	.	.	+1	.	.	.	.	.	.	.	+1	+1	.	.	3
<i>Linum austriacum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+1	+1	3
<i>Erysimum crassipes</i>	.	.	.	.	.	.	.	+1	.	+1	.	.	.	.	.	.	.	2
<i>Lappula barbata</i>	.	.	.	.	+1	.	.	.	.	.	.	.	.	+1	.	.	.	2

Companions

<i>Fumana procumbens</i>	+1	.	.	.	.	.	.	+1	+1	.	.	+1	+1	.	+1	.	.	6
<i>Sideritis montana subsp. montana</i>	.	.	.	.	+1	+1	.	+1	.	.	.	.	.	.	.	.	.	3
<i>Xeranthemum annuum</i>	.	.	+1	.	+1	+1	.	.	.	.	.	.	.	.	.	.	.	4
<i>Asperula lilaciflora subsp. phrygiae</i>	+1	.	.	.	.	.	.	.	.	.	+1	.	.	.	.	.	.	2
<i>Echinops ritro</i>	.	.	+1	.	.	+1	.	.	.	.	.	+1	.	.	.	.	.	3
<i>Bromus japonicus</i>	.	.	.	.	+1	+1	.	.	.	.	+1	.	.	.	.	.	.	3
<i>Anthemis wiedemannii</i>	.	.	+1	.	.	.	.	.	.	.	+1	.	.	.	.	.	.	2
<i>Bromus tectorum</i>	.	.	+1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
<i>Herniaria incana</i>	.	.	.	.	+1	.	.	.	.	.	+1	.	.	.	.	.	.	2

Distribution: This association spreads out a local area particularly around Bolvadin district. Holotype: Table 3, quadrat 33.

The association has only a few characteristic species, due to its very high location. The characteristic species of association are: *Verbascum cheiranthifolium* Boiss. subsp. *obtusiusculum* Hub-Mor., *Veronica cuneifolia* D. Don subsp. *cuneifolia* and *Dianthus leptopetalus* Willd.

The association described here as an upper level vegetation belongs to the suborder **Asperulo-Thymenetalia chaubardii** Akman et al., (1991) and alliance **Verbascum-Astragalion flavescens** Akman et al., (1991) (Table 4).

4.3. The Upper Level Vegetation of Emir Mountains

The steppe vegetation is replaced with shrub vegetation dominated by *Chamaecytisus eriocarpus* at the upper levels, which start at 1400-1500 m of Emir mountains and continue up to 2100 m.

This formation covers particularly volcanic mother rock without limestone on upper level of Emir Mountains with a poor and homogenous appearance. It is dominated by *C. eriocarpus* with an average height of 30-40 cm.

Table 4. Association Within the Alliance *Verbascum-Astragalion Flavescens*.

Quadrat	4	5	6	7	12	24	25	26	27	28	Presence
Altitude (m)-----	1650	1500	1450	1900	1600	1600	1900	2000	2000	1750	
Exposure-----	N	N	N	N	N	N	NW	NW	W	W	
Inclination (%)-----	40	40	20	20	30	50	30	35	53	20	
Square size (m ²)-----	60	60	60	60	60	60	60	60	60	60	
Substrat.-----	Volc.	Volc.	Volc.	Volc.	Volc.	Volc.	Volc.	Volc.	Volc.	Volc.	
<i>Verbascum-Chamaecytisetum eriocarpii</i>											
<i>Chamaecytisus eriocarpus</i>	34	44	34	44	45	44	44	45	45	44	10
<i>Verbascum cheiranthifolium</i> subsp. <i>obtusiuscul.</i>	.	22	12	11	+1	11	22	12	12	12	9
<i>veronica cuneifolia</i> subsp. <i>cuneifolia</i>	.	11	.	11	.	11	+1	11	+1	.	6
<i>Nepeta nuda</i> subsp. <i>nuda</i>	+1	.	.	+1	+1	+1	.	.	+1	.	5
<i>Ranunculus isthmicus</i> subsp. <i>stepporum</i>	+1	+1	+1	+1	+1	.	.	.	.	.	5
<i>Dianthus leptopetalus</i>	.	.	.	.	.	+1	+1	+1	+1	+1	5
Characteristic species of the alliance <i>Verbascum-Astragalion flavescens</i>											
<i>Astragalus flavescens</i>	+1	.	+1	.	.	+1	11	11	11	11	7
<i>Pimpinella tragiium</i> subsp. <i>polyclada</i>	.	+1	.	.	.	.	+1	+1	+1	+1	5
<i>Verbascum phrygium</i>	.	12	.	.	.	11	.	.	.	+1	+1
Characteristic species of the order <i>Asperulo-Thymenetalia chaubardii</i>											
<i>Thymus longicaulis</i> subsp. <i>chaubardii</i>	+1	+1	22	33	11	11	12	11	11	12	10
<i>Achillea teretifolia</i>	.	.	.	.	+1	11	+1	+1	+1	+1	6
<i>Plantago lanceolata</i>	+1	.	.	+1	.	.	+1	+1	+1	.	5
<i>Lotus corniculatus</i> subsp. <i>alpinus</i>	.	.	.	.	+1	+1	+1	+1	+1	.	5
<i>Dianthus zontaus</i> subsp. <i>zonatus</i>	.	.	.	.	.	.	+1	+1	+1	.	3
<i>Asperula lilaciflora</i> subsp. <i>phrygiae</i>	.	.	+1	.	.	.	+1	.	.	.	2
<i>Fumana procumbens</i>	.	.	.	+1	.	.	+1	.	.	.	2
Characteristic species of the class <i>Astragalo-Brometea</i>											
<i>Marrubium astracanicum</i>	11	11	11	11	11	+1	+1	+1	+1	+1	10
<i>Festuca valesiaca</i>	11	.	11	11	.	.	11	.	11	11	6
<i>Centaurea triumfetti</i>	.	.	+1	+1	.	+1	+1	+1	+1	.	6
<i>Bromus tomentellus</i>	11	.	.	.	.	+1	11	11	.	11	5
<i>Minuartia hirsuta</i> subsp. <i>anatolica</i>	.	.	.	+1	.	.	+1	+1	+1	+1	5
<i>Apera intermedia</i>	.	.	.	.	.	11	12	12	11	+1	5
<i>Phleum exaratum</i> subsp. <i>exaratum</i>	.	.	.	+1	.	+1	+1	.	+1	+1	5
<i>Koeleria cristata</i>	.	.	.	.	.	.	11	11	11	+1	4
<i>Phlomis armeniaca</i>	.	+1	+1	.	.	+1	.	+1	.	.	4
<i>Papaver apokrinomenon</i>	.	.	.	.	.	.	+1	+1	+1	+1	4
<i>Allium coronatum</i>	+1	.	+1	+1	.	.	.	.	.	.	3
<i>Senecio pseudo-orientalis</i>	.	.	.	.	+1	+1	.	+1	.	.	3
<i>Anthemis cretica</i> subsp. <i>anatolica</i>	+1	.	.	.	.	.	.	.	+1	.	2
<i>Teucrium chamaedrys</i>	.	.	.	.	.	+1	.	.	.	+1	2
Companions											
<i>Myosotis sylvatica</i> subsp. <i>sylvatica</i>	+1	+1	+1	+1	+1	.	+1	.	+1	.	7
<i>Lamium garganicum</i> subsp. <i>reniforme</i>	.	.	.	12	11	+1	.	.	+1	+1	5
<i>Allium pusillum</i>	+1	+1	.	.	+1	+1	.	.	.	+1	5
<i>Vernica orientalis</i>	.	.	+1	+1	.	.	+1	+1	+1	.	5
<i>Legousia pentagonia</i>	.	.	.	.	.	12	12	+1	11	11	5
<i>Achillea nobilis</i> subsp. <i>heldreichii</i>	.	.	.	+1	.	+1	.	+1	+1	+1	5
<i>Alyssum minutum</i>	+1	+1	+1	+1	.	.	.	.	.	.	4
<i>Campanula cymbalaria</i>	.	.	.	.	.	.	+1	+1	+1	.	3

Not: Volc.= Volcanic bed rock

5. CONCLUSION

Emirdağ region were occupied by *Quercus cerris*, *Q. ithaburensis* subsp. *macrolepis* and *Cedrus libani* forests in the past. Today, these groups are seldom found in destroyed forms. It is quite difficult to identify the floristic structure of this formation due to continuous effects of biotic factors.

As a result of comparison of the regional quadrates areas, one alliance *Phlomido nissolii-Onobrychidion tournefortii* and six associations have been identified.

The alliance *Phlomido nissolii-Onobrychidion tournefortii* has a little role in view of plant geography and is characterized particularly by species, which are endemic for South-West Anatolia. This alliance grows between 900-1200 m with more or less deep, eroded soft soil.

This alliance consists of three new associations with dominated by endemic species.

The alliance *Phlomido-Astragalion* has 3 new associations and 1 sub associations. This alliance grows up on marl, marl-gypsum and gypsum soil with slightly inclination.

The climate of this area is semi-arid cold and very cold Mediterranean type with annual rainfall between 360 and 410 mm, $Q_2=43$, $m=-3$ and -4°C .

The associations under the alliance of *Phlomido-Astragalion microcephali* are mainly *Artemisia santonicum* with seldom *Artemisia scoparia* steppes with 25 to 30 cm in height.

Emir mountains are well represented by suborder *Onobrychido-Thymenetalia leucostomi* Akman et al., (1991) and its superordinate unit *Astragalo-Brometea* Queze (1973) class. However, the association found on the upper level of Emir mountains included into the suborder *Asperulo phrygiae-Thymenetalia chaubardii* Akman et al., (1991).

All associations identified in our study area show Irano-Turanian plant geography originated rich floristic structure.

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