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A Study on the Floristical, Phytosociological and Phytoecological Structure of Turkish *Astragalus angustifolius* subsp. *angustifolius* Associations

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Abstract

In this study the floristical, phytosociological and phytoecological structure of some Turkish *Astragalus angustifolius* subsp. *angustifolius* associations were investigated. *A. angustifolius* subsp. *angustifolius* associations have 314 taxa floristically. Number of the endemic taxa in *A. angustifolius* subsp. *angustifolius* associations is 59 (18.78 %). Phytogeographically a major part of the taxa in *A. angustifolius* subsp. *angustifolius* associations are Irano-Turanian elements (61) followed by the Mediterranean (43) and Euro-Siberian (25). The biggest five families in the importance order are as follow: "Lamiaceae, Asteraceae, Poaceae, Caryophyllaceae ve Fabaceae". *A. angustifolius* subsp. *angustifolius* associations are usually spreaded between 1050-2350 m. on different bedrocks (limestone, volcanic, volcanic limestone, limestone-dolomite, serpentine, granite, mica schist - flaser gneiss, andesite) and soils (brown soil, brown forest soil, organic soil, brown forest soil without limestone, litozolic soil) in Turkey. The inclination of *A. angustifolius* subsp. *angustifolius* associations is approximately 10^0-60^0 and the general coverage is 30-100 %. The associations usually prefer S-SE and E sides of the mountains. When the studies examined it was seen that, *A. angustifolius* subsp. *angustifolius* associations in Turkey were classified into "Daphno-Festucetae" and "Astragalo-Brometea" lass, "Onobrychido armenae-Thymetalia leucostomi", "Astragalo–Brometalia"and "Daphno–Festucetalia" order, "Phlomido armeniacae-Astragalion microcephali" alliance.

Key Words: *Astragalus angustifolius,* floristical structure, phytoecology, phytosociology, Turkey

Türkiye'nin *Astragalus angustifolius* subsp. *angustifolius* Birliklerinin Floristik, Fitososyolojik ve Ekolojik Özellikleri Üzerine Bir Araştırma

Özet

Bu araştırmada farklı araştırıcılar tarafından tespit edilen *Astragalus angustifolius* Lam. subsp. *angustifolius* birlikleri floristik, fitososyolojik ve ekolojik olarak değerlendirilmiştir. *A. angustifolius* subsp. *angustifolius* birliklerinde 314 adet tür ve tür altı takson yayılış göstermektedir. Bu taksonlardan 60 tanesi (%19) endemiktir. Türlerin fitocoğrafik bölgelere dağılımı İran-Turan 61, Akdeniz 43, Avrupa-Sibirya 25, birden fazla bölgeli ya da bilinmeyen ise 185 takson şeklindedir. En fazla tür ihtiva eden familyalar "Lamiaceae, Asteraceae, Poaceae, Caryophyllaceae ve Fabaceae" şeklinde sıralanmaktadır. *A. angustifolius* subsp. *angustifolius* birlikleri genel olarak 1050-2350 m.'ler arasında; kalker, dolomit, volkanik, granit, gnays ve mikaşist vb. anakayalar ile litozolik toprak; kalkersiz kahverengi topraklar; kahverengi topraklar; kahverengi orman toprakları; kalkersiz kahverengi orman toprakları ve organik topraklar üzerinde yayılış göstermektedir. Birliklerin genel örtüşü % 30-100 arasında olup, birlikler daha çok Güney, Güneydoğu ve Doğu yönleri tercih etmektedir. Birliklerin yayılış gösterdikleri alanlarda eğim 10^0-60^0 arasındadır. Araştırıcılar *A. angustifolius* subsp. *angustifolius* birliklerini "Daphno-Festucetae" ve "Astragalo-Brometea" sınıflarına, "Onobrychido armenae-Thymetalia leucostomi", "Astragalo–Brometalia", "Daphno–Festucetalia" ordolarına ve "Phlomido armeniacae-Astragalion microcephali" alyansına bağlamışlardır.

Anahtar Kelimeler: *Astragalus angustifolius,* floristik yapı, fitoekoloji, fitososyoloji, Türkiye

Introduction

Astragalus L. is the one of the broad genus of vascular plants of the world and it is spreaded on semi-dry steppe areas with 3000 taxa. It is represented in Turkey with 425 species belonging to 62 sections and it is the richest genus regarding to species number in Turkey (Ekici et al., 2008).

The spine *Astragalus* (*Astracantha*) species which includes *Astragalus angustifolius* is known as "geven" among the people. The glue known as "kitre" is obtained from some of these species

especially from *A. microcephalus* and it is used in textile, food and medicine industry. It is also used as fuel and animal feed when there is shortage. Furthermore, the chamaephytes formed ones have erosion protecting features which is very important ecologycally (Türkiye Çevre Vakfı, 2005).

Astragalus with 250 species is also the richest genus of Turkey regarding to endemic species number. The endemism ratio is around 60 %. Some species of this genus is grown commonly. But, the number of species is localised not less on East Anatolian, South East Anatolian and high altitudes of Black Sea Region Mountains. The dominant genus of mountain steppe (at 1300 m. and higher height in Turkey) is *Astragalus* in spite of showing regional species differences. Especially the spine species of this genus is one of the characteristic plants of this vegetation (Türkiye Çevre Vakfı, 2005).

A. angustifolius Lam. subsp. *angustifolius* is a perennial plant is shrub form, flowering in May-June and spreaded on 1050-2350 m. rocky slopes. *A. angustifolius* species has three subspecies one of which is endemic (subsp. *angustifolius*, subsp. *pungens* and subsp. *longidens* - End.). Furthermore, *A. angustifolius* Lam. subsp. *angustifolius* has two varieties (var. *angustifolius* and var. *violaceus*) (Ekim et al., 2000).

A. angustifolius subsp. *angustifolius* var. *violaceus* Boiss. is seen in Antalya, Burdur and other cities in Mediterranean which shows narrow spread. *A. angustifolius* subsp. *angustifolius* var. *angustifolius* has a broad distribution. Bursa, Ankara, Çorum, Amasya, Tokat, Kütahya, Manisa, Isparta, Sivas, Niğde, Konya etc. can be the other cities where this taxa is widely seen (Davis, 1965-1985; Davis et al., 1988; Güner et al., 2000).

In this study the floristical, phytosociological and phytoecological structure of Turkish *A. angustifolius* subsp. *angustifolius* associations were investigated. *A. angustifolius* subsp. *angustifolius* associations occur especially around İnegöl Mountain-Amasya (Yıldırım, 2009), Sakarat Mountain (Bingöl et al., 2007), Hadim-Konya (Şanda et al., 2000), Alaçam-Gerze and Boyabat-Durağan / Sinop (Özen and Kılınç, 1995), Amasya-Yozgat-Çorum (Ketenoğlu and Aydoğdu, 1994), Karadağ-Karaman (Ocakverdi and Ünal, 1991), Aydos Mountain-Ankara (Akman, 1990), Akdağ / Afyon-Denizli (Gemici, 1988), Central Anatolia-West Black Sea (Kılınç, 1985), Eğrigöz Mountain-Emet (Kütahya) (Görk, 1982), Simav Mountain-Kütahya (Yayıntaş, 1982), Hasan Mountain-Aksaray (Düzenli, 1976), Beypazarı-Karaşar and Nallıhan / Ankara (Akman, 1974).

Material and Methods

In this study the following phytosociological studies; Akman, 1974; Düzenli, 1976; Görk, 1982; Yayıntaş, 1982; Kılınç, 1985; Gemici, 1988; Akman, 1990; Ocakverdi and Ünal, 1991; Ketenoğlu and Aydoğdu, 1994; Özen and Kılınç, 1995; Şanda et al., 2000; Bingöl et al., 2007; Yıldırım, 2009 were evaluated. In evaluated studies, vegetation analyses were performed according to traditional Braun-Blanquet approach by the researchers (Braun-Blanquet, 1965). In this research, the nomenclature, taxonomy and chorology of the taxa in the associations were taken from Davis (1965-1988), Davis et al. (1988), Güner et al. (2000) and the life forms were determined according to Raunkier (Raunkiaer, 1934). The floristical, phytosociological and phytoecological characters of *A. angustifolius* subsp. *angustifolius* associations were determined. The distribution map of *A. angustifolius* subsp. *angustifolius* associations in Turkey was drawn. The syntaxonomic categories of *A. angustifolius* subsp. *angustifolius* associations described in different areas were compared. Furthermore, *A. angustifolius* subsp. *angustifolius* associations mentioned in different research were compared regarding to their spreading altitude, bedrock, soil, general coverage, direction and inclination.

Results and Discussion

13 plant associations were determined in 13 various researches carried on *A. angustifolius* subsp. *angustifolius* associations in Turkey (Figure 1).

5 of these associations were found in Central Anatolia Region, 2 of them in between Central Anatolia and Black Sea Region (Amasya-Yozgat-Çorum / Central

Anatolia-West Black Sea), 3 of them in Black Sea Region and 3 of them in Aegean Region. As shown *A. angustifolius subsp. angustifolius* associations are mostly spreaded in Central Anatolia and Central Anatolia-Black Sea transition regions.

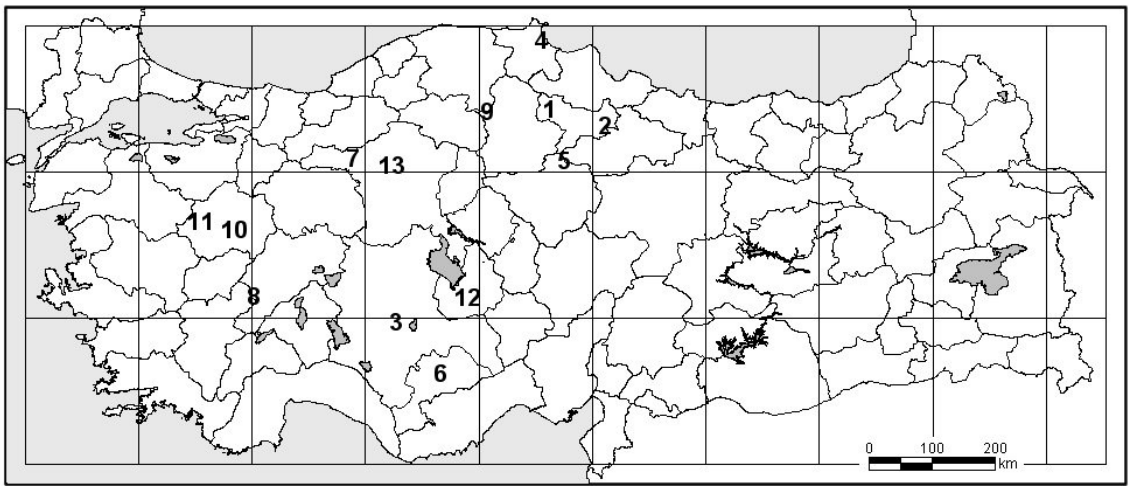

Figure 1. The distribution of *A. angustifolius subsp. angustifolius* associations in Turkey

A. angustifolius subsp. angustifolius is represented by the following associations in Turkey (Fig. 1):

1.*Convolvulo assyrici - Astragaletum angustifoli* (Yıldırım, 2009): İnegöl Mountain-Amasya, 1500-1750 m, Limestone, Brown Soil-Brown Forest Soil.

2.*Thymo rosulei - Astragaletum angustifoli* (Bingöl et al., 2007): Sakarat Mountain-Amasya, 1187-1595 m, Volcanic Limestone

3.*Onobrychido fallaxi - Astragaletum angustifoli* (Şanda et al., 2000): Hadim-Konya, 1700-1800 m, Serpentine, Brown Forest Soil.

4.*Sideritido - Astragaletum angustifolii* (Özen and Kılınç, 1995): Alaçam-Gerze and Boyabat-Durağan / Sinop, 1050-1250 m.

5.*Astragaletum angustifolio - leucothrichis* (Ketenoğlu and Aydoğdu, 1994): Amasya-Yozgat-Çorum, 1100-1400 m.

6.*Acantholimo-Astragaletum angustifoli* (Ocakverdi and Ünal, 1991): Karadağ-Karaman, 1500-1900 m, Volcanic, Brown Soil without limestone.

7.*Veronico - Astragaletum angustifolii* (Akman, 1990): Aydos Mountain-Ankara, 1500-1700 m, Volcanic.

8.*Astragalus angustifolius subsp. Angustifolius - Festuca punctoria* (Gemici, 1988): Akdağ / Afyon-Denizli, 2000-2170 m, Limestone –Dolomite, Litozolic Soil.

9.*Astragalus angustifolius - Poa alpina subsp. fallax* (Kılınç, 1985): Central Anatolia-West Black Sea, 1500-2000 m.

10.*Astragalus angustifolius subsp. angustifolius* (Görk, 1982): Eğrigöz Mountain-Emet (Kütahya), 1500-1700 m, Granite, Brown Forest Soil without limestone.

11.*Astragalus angustifolius subsp. angustifolius* (Yayıntaş, 1982): Simav Mountain-Kütahya, 1400-1700 m, Mica Schist - Flaser Gneiss, Organic Soil.

12.*Astragalus angustifolius subsp. angustifolius* (Düzenli, 1976): Hasan Mountain-Aksaray, 1900-2350 m, Andesite.

13.*Astragalus angustifolius* (Akman, 1974): Beypazarı-Karaşar and Nallıhan / Ankara, 1350-1500 m, Limestone.

The taxa of *A. angustifolius* subsp. *angustifolius* associations are in the form of 62 shrubs and 252 herbs (total 314). 59 of these are endemic (18.78 %). 59 endemic taxa composed of the floristical composition of the *A. angustifolius* subsp. *angustifolius* associations according to threatened categories are as follows: 2 of them are belonging to "CR (Criticaly Endangered)" category (*Nepeta nuda* subsp. *glandulifera*, *Thymus proecox* subsp. *proecox*), 5 of them are "EN (Endangered)" category (*Festuca punctoria*, *F. ustulata*, *Verbascum*

rubricaule, *Paronychia chionaea* subsp. *chionaea*, *Erysimum pallidum*), 4 of them are "VU (Vulnerable)" category (*Pimpinella isaurica*, *Dianthus erinaceus* var. *erinaceus*, *Dianthus erinaceus* var. *alpinus*, *Centaurea bourgaei*). 4 of endemic species are belonging to "LR-cd (conservation dependent)" category (*Sideritis condensata*, *Dianthus zederbaueri*, *Carduus nutans* subsp. *trojanus*, *Olymposciadium caespitosum*), 6 of them are "LR-nt (near threatened)" category (*Thymus leucostomus* var. *leucostomus*, *Astragalus strictispinis*, *Asyneuma compactum*, *Minuartia corymbulosa* var. *corymbulosa*, *Sempervivum brevipilum*, *Crocus speciosus* subsp. *ilgazensis*) and 38 of them are belonging to "LR-ıc (least concern)" category (Ekim et al., 2000).

The distribution ratio of taxa in *A. angustifolius* subsp. *angustifolius* associations according to the Raunkiaer (1934) Life Forms can be listed as follows: Hemicryptophytes 181 (57.6 %), Chamaephytes 58 (18.5 %) and Terophytes 48 (15.3 %) (Figure 2).

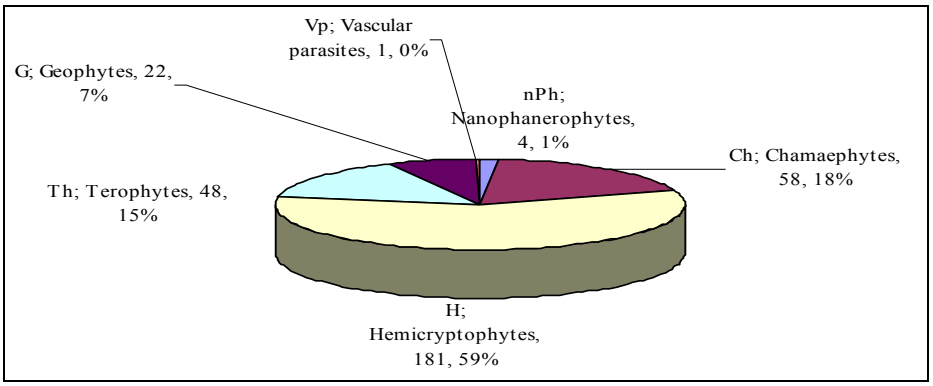

Figure 2. Life forms of taxa in *A. angustifolius* subsp. *angustifolius* associations

According to the phytogeographical region of species, Irano-Turanian origin plants are the most with 61 taxa in *A. angustifolius* subsp. *angustifolius* associations (19%) (Figure 3). In these associations, Mediterranean origin taxa are represented with 43 taxa (14 %) and Euro-Siberian with 25 (8 %). It is inevitable to reach this result as *A. angustifolius* subsp. *angustifolius* associations are highly distributed in Mid-Anatolia and the transition zone of Mid-Anatolia.

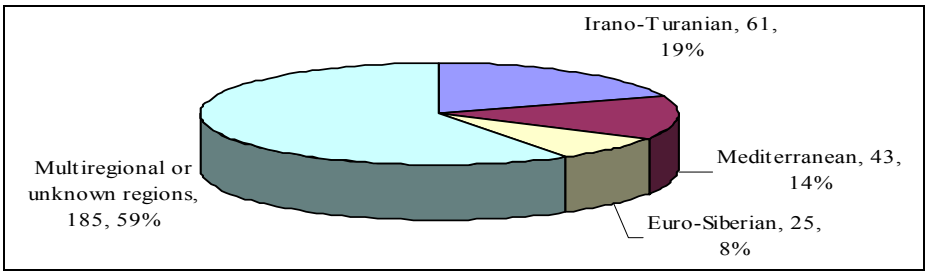

Figure 3. Phytogeographical origins of taxa in *A. angustifolius* subsp. *angustifolius* associations

The dispersion and the ratios of the species gathered from the *A. angustifolius* subsp. *angustifolius* associations according to the biggest five families in the importance order are as fallow: Lamiaceae 44 (14 %), Asteraceae 43 (14 %), Poaceae 28 (9 %), Caryophyllaceae 26 (8 %), Fabaceae 22 (7 %) (Figure 4).

The biggest four genera which are determined according to the taxon numbers in the *A. angustifolius* subsp. *angustifolius* associations are as follows: *Thymus* (9), *Astragalus-Centaurea-Minuartia* (8), *Sedum-Veronica-Dianthus-Euphorbia* (7), *Alyssum-Hypericum* (6), *Allium-Bromus-Erysimum-Festuca-Trifolium* (5).

A. angustifolius subsp. *angustifolius* associations are usually spreaded between 1050-2350 m. (Table 1).

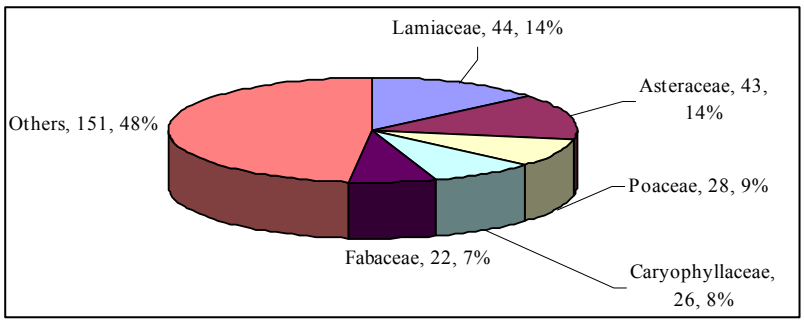

Figure 4. The distribution of families in *A. angustifolius* subsp. *angustifolius* associations

Table 1. The comparison of *A. angustifolius* subsp. *angustifolius* associations defined in various regions relating to distribution height, bedrock and soil

Research	Study Area	Association	Altitude (m.)	Bedrock	Soil Type
Yıldırım, 2009	İnegöl Mountain	*Convolvulo assyrici - Astragaletum angustifoli*	1500-1750	Limestone	Brown Soil and Brown Forest Soil
Bingöl et al., 2007	Sakarat Mountain	*Thymo rosulei - Astragaletum angustifoli*	1187-1595	Volcanic Limestone	-
Şanda et al., 2000	Hadim (Konya)	*Onobrychido fallaxi - Astragaletum angustifoli*	1700-1800	Serpentine	Brown Forest Soil
Özen and Kılınç, 1995	Alaçam-Gerze and Boyabat-Durağan	*Sideritido -Astragaletum angustifolii*	1050-1250	-	-
Ketenoğlu and Aydoğdu, 1994	Amasya-Yozgat-Çorum	*Astragaletum angustifolio - leucothrichis*	1100-1400	-	-
Ocakverdi and Ünal, 1991	Karadağ	*Acantholimo - Astragaletum angustifoli*	1500-1900	Volcanic	Brown Soil without limestone
Akman, 1990	Aydos Mountain	*Veronico -Astragaletum angustifolii*	1500-1700	Volcanic	-
Gemici, 1988	Akdağ (Afyon-Denizli)	*Astragalus angustifolius subsp. angustifolius - Festuca punctoria*	2000-2170	Limestone - Dolomite	Litozolic Soil
Kılınç, 1985	Central Anatolia-West Black Sea	*Astragalus angustifolius - Poa alpina subsp. fallax*	1500-2000	-	-
Görk, 1982	Eğrigöz Mountain	*Astragalus angustifolius subsp. angustifolius*	1500-1700	Granite	Brown Forest Soil without limestone
Yayıntaş, 1982	Simav Mountain	*Astragalus angustifolius subsp. angustifolius*	1400-1700	Mica Schist - Flaser Gneiss	Organic Soil
Düzenli, 1976	Hasan Mountain	*Astragalus angustifolius subsp. angustifolius*	1900-2350	Andesite	-
Akman, 1974	Beypazarı-Karaşar and Nallıhan	*Astragalus angustifolius*	1350-1500	Limestone	-

When different researchers examined, the lowest altitude is 1050 m. in Alaçam-Gerze and Boyabat-Durağan (Sinop) (Özen and Kılınç, 1995). The highest distribution is in Hasan Mountain (Aksaray) with 2350 m. height (Düzenli, 1976). Average altitude of *A. angustifolius* subsp. *angustifolius* associations spreaded at 1050-2350 m. is generally around at 1600 m. Therefore the

ecological tolerance of this species is not broad regarding to the elevation.

A. angustifolius subsp. *angustifolius* associations are spreaded on different bedrocks (limestone, volcanic, volcanic limestone, limestone-dolomite, serpentine, granite, mica schist - flaser gneiss, andesite). That is to say, *A. angustifolius* subsp. *angustifolius* associations do not show selectivity related to the soil types. They prefer brown soil, brown forest soil, organic soil, brown forest soil without limestone and litozolic soil.

Moreover, *A. angustifolius* subsp. *angustifolius* associations were evaluated as syntaxonomic (Table 2). When the studies examined it was seen that, Kılınç classified *A. angustifolius* subsp. *angustifolius* associations into "Daphno–Festucetae" class (Kılınç, 1985) and other into "Astragalo-Brometea" class (Akman, 1974; Düzenli, 1976; Yayıntaş, 1982; Görk, 1982; Gemici, 1988; Akman, 1990; Ocakverdi and Ünal, 1991; Ketenoğlu and Aydoğdu, 1994; Özen and Kılınç, 1995; Şanda et al., 2000; Bingöl et al., 2007; Yıldırım, 2009). Akman (1990), Ocakverdi and Ünal (1991), Ketenoğlu and Aydoğdu (1994), Şanda et al. (2000), Bingöl et al. (2007), Yıldırım (2009) classified *A. angustifolius* subsp. *angustifolius* associations into "Onobrychido armenae-Thymetalia leucostomi" order.

Tablo 2. The syntaxonomic categories of *A. angustifolius* subsp. *angustifolius* associations described in different areas

			Syntaxonomic Categories			
Research	**Study Area**	**Association**	**Superclass**	**Class**	**Order**	**Alliance**
Yıldırım, 2009	İnegöl Mountain	*Convolvulo assyrici - Astragaletum angustifoli*		Astragalo-Brometae	Onobrychido-Thymetalia	Phlomido–Astragalion microcephali
Bingöl et al., 2007	Sakarat Mountain	*Thymo rosulei - Astragaletum angustifoli*	Daphno - Festucetales	Astragalo-Brometae	Onobrychido-Thymetalia	Phlomido–Astragalion microcephali
Şanda et al., 2000	Hadim (Konya)	*Onobrychido fallaxi - Astragaletum angustifoli*	_	Astragalo-Brometae	Onobrychido-Thymetalia	Phlomido–Astragalion microcephali
Özen and Kılınç, 1995	Alaçam-Gerze and Boyabat-Durağan	*Sideritido - Astragaletum angustifolii*	_	Astragalo-Brometae	_	_
Ketenoğlu and Aydoğdu, 1994	Amasya-Yozgat-Çorum	*Astragaletum angustifolio - leucothrichis*	_	Astragalo-Brometae	Onobrychido-Thymetalia	Phlomido–Astragalion microcephali
Ocakverdi and Ünal, 1991	Karadağ	*Acantholimo - Astragaletum angustifoli*	_	Astragalo-Brometae	Onobrychido-Thymetalia	Phlomido–Astragalion microcephali
Akman, 1990	Aydos Mountain	*Veronico - Astragaletum angustifolii*		Astragalo-Brometae	Onobrychido-Thymetalia	-
Gemici, 1988	Akdağ (Afyon-Denizli)	*Astragalus angustifolius subsp. angustifolius - Festuca punctoria*	_	_	Daphno-Festucetalia	_
Kılınç, 1985	Central Anatolia-West Black Sea	*Astragalus angustifolius - Poa alpina subsp.fallax*	_	Daphne-Festucetae	Daphno-Festucetalia	_
Görk, 1982	Eğrigöz Mountain	*Astragalus angustifolius subsp. angustifolius*	_	Astragalo-Brometae	Astragalo-Brometalia	_

Yet, Görk (1982) classified *A. angustifolius* subsp. *angustifolius* associations into "Astragalo–Brometalia" order. On the other hand, Gemici (1988) and Kılınç (1985) classified them into "Daphno-Festucetalia" order. All the Mid-Anatolia steppe vegetation communities in Turkey were included into "Astragalo-Brometea" class and "Onobrychido armenae-Thymetalia leucostomi" order as well (Kurt et al., 2006).

In this study, *A. angustifolius* subsp. *angustifolius* associations which spreaded both in Mid-Anatolia and Mid-Anatolia – Black Sea transition zones were also included into "Astragalo-Brometea" class and "Onobrychido armenae-Thymetalia leucostomi" order except "Mid-Anatolia – West Black Sea (Kılınç, 1985).

When the *A. angustifolius* subsp. *angustifolius* associations defined in different areas were determined it was seen that the general coverage changes between 30 % - 100 %. But, average of general coverage is about 75 %. *A. angustifolius* subsp. *angustifolius* associations can be spreaded S, SE, SW, N, NE, NW, W, E sides of the mountain.

However, these associations usually prefer S, SE and E sides. The inclination of *A. angustifolius* subsp. *angustifolius* associations is approximately 10-60 degrees. When the extreme values extracted, it is seen that this associations are generally spreaded on the inclination 25^0-30^0 (Table 3).

Table 3. The comparison of *A. angustifolius* subsp. *angustifolius* associations defined in different regions relating to the general coverage, direction and inclination

Research	Study Area	Association	General Coverage (%)	Direction	Inclination (%)
Yıldırım, 2009	İnegöl Mountain	*Convolvulo assyrici - Astragaletum angustifoli*	70-75	S-SE	25-30
Bingöl et al., 2007	Sakarat Mountain	*Thymo rosulei - Astragaletum angustifoli*	95-100	S-SE	20-45
Şanda et al., 2000	Hadim (Konya)	*Onobrychido fallaxi - Astragaletum angustifoli*	90-95	S-SE-E	15-45
Özen and Kılınç, 1995	Alaçam-Gerze and Boyabat-Durağan	*Sideritido - Astragaletum angustifolii*	65-95	S-SW-SE	20-40
Ketenoğlu and Aydoğdu, 1994	Amasya-Yozgat-Çorum	*Astragaletum angustifolio -leucothrichis*	80-100	NE-SW-SE-E	15-30
Gemici, 1988	Akdağ (Afyon-Denizli)	*Astragalus angustifolius subsp. angustifolius - Festuca punctoria*	50-70	N-NW-SW	20-60
Ocakverdi and Ünal, 1991	Karadağ	*Acantholimo - Astragaletum angustifoli*	90-100	N-S-W-E	15-50
Akman, 1990	Aydos Mountain	*Veronico - Astragaletum angustifolii*	70-80	E-SE-W-S	10-60
Kılınç, 1985	Central Anatolia-West Black Sea	*Astragalus angustifolius - Poa alpina subsp.fallax*	80-100	E-N-W-NW-SE	5-30
Görk, 1982	Eğrigöz Mountain	*Astragalus angustifolius subsp. angustifolius*	30-50	W-NW-E	10-20
Yayıntaş, 1982	Simav Mountain	*Astragalus angustifolius subsp. angustifolius*	35-50	_	10-20
Düzenli, 1976	Hasan Mountain	*Astragalus angustifolius subsp. angustifolius*	50-90	N-NW	10-40

In this study, the *A. angustifolius* subsp. *angustifolius* associations determined by various researchers were evaluated regarding to their floristical, phytosociological and phytoecological structures. It is hoped that this study on the general structure of these associations which distributed in Mid-Anatolia and Black Sea transition zones having ecological importance of protecting

the erosion will contribute to the future studies on the Turkish steppe vegetations.

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