

General Overview of the Caryophyllaceae Family in Türkiye

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Abstract

This study describes some of our observations from field studies conducted throughout Türkiye over the years regarding the geographic, ecological, and ethnobotanical characteristics of the taxa of Caryophyllaceae family, as well as the systematic status of some taxa. Ethnobotanical characteristics, systematics, and taxonomy are explained based on herbarium, laboratory studies, literature data, and information obtained from local residents. Taxa of the Caryophyllaceae family are insect-pollinated. They are generally plants of the Irano-Turanian element. They grow well in steppe vegetation from volcanic and limestone. Their populations and taxa numbers increase in the intersection of phytogeographic regions. According to their life form, they are generally chamaephytes, rarely therophytes or geophytes (rhizomed). According to ecological classification, casmophytes and lithophytes (xerophytes) predominate, while mesophytes, ephemerals, and ruderals (cosmopolitans) are in the minority. The most endemic taxa are in the genera *Gypsophila*, *Silene*, *Bolanthus*, and *Dianthus*. All *Bolanthus* taxa in Türkiye are endemic. They are generally distributed in the Lakes Region and its surrounding areas. Its taxa are primarily Mediterranean elements. The genera of *Gypsophila* are Eastern Anatolia, while the genera of *Ankyropetalum* are Southeastern Anatolia (Türkiye). *Gypsophila* originates from the Irano-Turanian phytogeographic region. *Silene* is the largest genus in the family in Türkiye. It is a very taxonomically challenging genus. Therefore, taxonomic problems remain unresolved. A revision of the genus into sections is recommended. It is distributed throughout Türkiye. The most important region for all taxa in the family, but especially for *Silene*, is the area between Erzincan, Tunceli, and Erzurum provinces. The area between Çemişgezek and Arapgir districts is the most important area to study. Tüm Taxa of the family can be seen from sea level to 3500 (-4000) meters, in almost all seasons. Numerous systematic and taxonomic studies have been conducted on the taxa of the family. However, its systematic status has not yet been established on a solid scientific basis. This can be explained by the family's systematic difficulties, the availability of herbaria, and the experience of researchers. The massive work titled "Illustrated Flora of Turkey" cannot adequately introduce the family. Some genera and species are well-defined, but others have been further complicated. Some genera and species are well-defined, but others have been further complicated. The taxa used as synonyms in this book should be reviewed. These genera are better known systematically than others. *Silene* is a large and systematically problematic genus. It contains numerous species complexes (*S. caryophylloides*, *S. odontopetala*, *S. araratica*, *S. caramanica*, *S. sipylea*, *S. armena* etc.). Revisions made without clarifying these problematic species, creating an updated section key, and dividing the genus into smaller groups cannot adequately serve systematics.

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INTRODUCTION

The Caryophyllaceae is one of the largest family in taxon number in Türkiye. They are generally annual or perennial herbaceous plants. This article outlines the status of the Caryophyllaceae family in the country.

The first work written on the plants of Türkiye is "Flora Orientalis" (Boissier, 1865-1888). Later, the book titled "Flora of Turkey and the East Aegean Islands" consisting of 9 volumes was written under the editorship of Davis (1965-1985). Supplementary volumes 10 (Davis et al. 1988) and 11 (Güner et al., 2000), which included new taxa and status changes added to the Flora of Türkiye, were published. Finally, the List of Plants of Türkiye (Vascular Plants) (Güner et al., 2012), prepared by Turkish botanists, aimed to present the plant diversity of the country. This book includes a list of Turkish plants and their distribution within the country. According to this book; The Flora of Türkiye comprises a total of 11,707 plant taxa, including 9,996 species and subspecies taxa, within 167 families and 1,320 genera (Güner et al., 2012). Since this work, new taxa have been added to the country's flora, and they continue to be so. On average, a plant taxon is added to the Turkish flora in every 20 days. Numerous new taxa have been added to the Turkish flora since 1988. It is very difficult to explain the decrease in the number of family in the "Plants of Turkey" book (Güner et al., 2012). Why has the 175 families decreased to 167? However, the richness of Türkiye's biodiversity compared to the floras of neighboring countries is readily apparent.

Türkiye is one of the world's leading countries in biodiversity due to its geography, soil structure, geological, geomorphological, topographical, climatic characteristics, and historical factors. These geographical features are based on the country's location at the intersection of three distinct plant geographies (Mediterranean, Irano-Turanian, and Euro-Siberian) and the presence of the Anatolian Diagonal, a mountain range that begins in the south with the Nur Mountains (Amanos Mountains) and is surrounded by the Eastern Black Sea Mountains in the northeast. Approximately one-third of the plants growing

in the country are relict or endemic plants that formed before the emergence of today's climatic conditions (Çiçek et al., 2017).

The genera *Dianthus*, *Silene*, *Agrostemma*, and *Gypsophila* are important ornamental plants in the family, while *Stellaria*, *Cerastium*, and *Arenaria* are important for landscaping. Some of the genera *Minuartia*, *Arenaria*, *Cerastium*, *Silene*, and *Dianthus* are cultivated as landscape and indoor plants. Some taxa in the genera *Saponaria*, *Ankyropetalum*, and *Gypsophila* are rich in saponin and are of industrial importance. Saponin is an important chemical substance sought after in the chemical industry. The family's economic importance also stems primarily from saponin-rich taxa. Some species of the genera *Ankyropetalum* and *Gypsophila* are also important for food (Özçelik and Yıldırım, 2011). All taxa in the family are more or less toxic; therefore, they also have medicinal importance. They are mostly native plants (Korkmaz and Özçelik, 2012).

The genera *Silene*, *Arenaria*, *Minuartia*, *Bolanthus* and *Gypsophila*, especially *Silene oligotricha*, *S. leptoclada*, *S. odontopetala*, *S. caryophylloides* etc., are taxonomically problematic. There were many systematically problematic taxa within the genus *Gypsophila*, such as *G. sphaerocephala*, *G. bitlisensis*, *G. elegans*, and *G. heteropoda*. Revision studies were made on these species, and the problem was solved (Fidan and Özgökçe, 2016; Korkmaz and Özçelik, 2011; Muca, 2017; Özçelik and Özgökçe, 1995; 1999; 2023; 2024). There is still no reliable species identification key for the genus *Bolanthus*. In particular, *B. minuartioides* and *B. spergulifolius* cannot be easily identified. *Bolanthus*, *Gypsophila*, *Ankyropetalum*, and *Acanthophyllum*, which were once one genus, were later split into different genera. The systematic characters of these genera are intertwined, and the key to genus identification is unclear. It would have been expected that such systematic problems would also be resolved in the Illustrated Flora of Turkey (Yıldız, 2025)!

Despite being a small genus, *Bolanthus* is a very taxonomically challenging one. Long-term studies are required on each genus. For larger genera such as *Silene* and *Gypsophila*, revisions

should be made not on a genus basis, but on a section basis. The genus *Gypsophila* (Armağan et al., 2017; Korkmaz and Özçelik, 2012; Özçelik and Korkmaz, 2011; Muca, 2017; Özçelik and Özgökçe, 1995; 1999; 2023; 2024) and two sections of *Silene* (Auriculatae Boiss. and Brachypodeae Boiss.) have been revised by us (Özçelik and Kılıç, 2007). Section Hagenia has also been revised (Fidan and Özgökçe, 2016). Performing family-based revisions without section keys for large genera like *Silene* and *Gypsophila* is technically flawed. Therefore, the existing species and genus identification keys are not very effective. The section key for genus *Gypsophila* was prepared by us (Özçelik and Özgökçe, 2024). Furthermore, new studies are constantly underway to provide a more detailed description of Turkish plants. This article aims to draw attention to this issue and provide some information.

MATERIALS AND METHODS

All of Türkiye was explored for scientific purposes as part of various research projects, and observations were made over an extended period. Opinions have been expressed about the ecological factors that cause taxa to grow there. The ethnobotanical information and the process of assigning local names to plants described in this article were obtained from interviews with local people and observations of their economic uses. Literature is also used in the naming of local names (Baytop, 1984).

The GUL Herbarium is a regional herbarium and is very rich in taxa of the Caryophyllaceae family. Its specimens have been collected from across the country for years. Based on these samples, systematic studies have been conducted on the genera *Bolanthus* (Özçelik, 2024), *Ankyropetalum* (Özçelik and Muca, 2010), *Silene* (Özçelik and Kılıç, 2007), *Gypsophila* (Ataşlar and Ocak, 2005; Armağan, 2016; Özçelik, 2023; 2024; Arslan and Güler, 2002), *Bufonia* (Serdaroğlu, 2001), and *Petrorhagia* (Aktaş et al., 2010). Similarly, ecological studies (Korkmaz and Özçelik, 2013) have been conducted. In addition to these, some of the observations made in the field and in the herbarium are described in this article. The

coordinates and altitudes of some important localities are given. Attention is drawn to the mountains or localities that are centers of genotypic differentiation of the plants. Photographs of habitats and plants have been included to facilitate the identification and comparison of some rare species. The majority of the findings are based on field observations. General rules have been applied in presenting systematic information. The article includes findings from some lesser-known taxa or those with questionable systematic status. Most of the laboratory work was conducted in 2025 at the GUL Herbarium.

FINDINGS AND DISCUSSION

General characteristics of Caryophyllaceae family taxa obtained from field observations are described below:

Ecology:

Taxa of the Caryophyllaceae family grow in a wide variety of habitats in Türkiye. Due to the high number of taxa, each taxon may have different ecological requirements. Therefore, the family can spread across a wide variety of habitats. The taxa generally grow in volcanic-rock steppe vegetation. Volcanic-rock areas in Türkiye are generally found within the Irano-Turanian phytogeographic region (Eastern Anatolia, Central Anatolia, and Southeastern Anatolia); the Euro-Siberian phytogeographic region (the entire Black Sea region and Northern Marmara region); and partly within the Mediterranean phytogeographic region, namely the Lakes Region. It is clear that members of the family grow more abundantly in these areas than in other regions. The ecology and geographic distribution of the family's taxa depend on understanding the characteristics of these areas and related taxa in the field.

The rock types of the Mediterranean phytogeographic region are predominantly limestone, andesite, and marble. Conglomerate, volcanic (pumice), and serpentine (Muğla, Burdur provinces) also occur. Rocks rich in Fe (iron), Zn (zinc) and Cu (copper) and soils formed from these rocks are preferred for most taxa. The largest number of taxa in the family grows at the intersections of these

phytogeographic regions. The districts of Beyşehir and Seydişehir districts (in the Irano-Turanian phytogeographic region), Akseki, İbradı, Gündoğmuş, Yalvaç, and Akşehir districts (in the Mediterranean phytogeographic region); Malatya, Kars, Erzurum, Ardahan, Erzincan, Van, Bitlis, Tunceli provinces (in the Irano-Turanian phytogeographic region); Kahramanmaraş province (in the Mediterranean); Tokat and Gümüşhane provinces, especially the Zigana Pass; Artvin, Rize, Giresun provinces (in the European-Siberian phytogeographic region) and Kop Dağı in Bayburt (in the Irano-Turanian phytogeographic region) are very rich areas. The Iran-Turan region has a continental climate type; the Mediterranean and Euro-Siberian regions have a maritime climate. The Mediterranean climate has hot and dry summers and mild and rainy winters; the Euro-Siberian region has cool and rainy summers and cold and rainy winters. The continental climate has cold and dry winters and cool and dry summers. It is closer to a desert climate. It has the least annual precipitation. Most of the precipitation comes in the form of snowfall, and plants begin to emerge with the melting of the snow. They grow, develop, and die within a short time. The life cycle is short.

Members of the family are generally plants of steppe vegetation. The steppe is the dominant vegetation type in the Irano-Turanian region. Because steppe vegetation in Türkiye is mostly secondary, it exhibits degeneration in natural habitats. Species diversity is high in the steppe, with forest trees and other woody plants found in small amounts. The flora is generally composed of herbaceous plants. Approximately

three of Türkiye's seven political regions are located in the Irano-Turanian phytogeographic region. Therefore, they are less common in the Black Sea region (Europe-Siberian region), as this region is largely covered with forests and is extremely humid. Steppe areas in the Black Sea and Mediterranean regions are secondary, anthropogenic, and are open spaces formed by the destruction of forests.

Taxa of the genus *Gypsophila* are generally distributed in gypsum-bearing rocks, steppes, and partially in debris fields (road and field edges). Populations are strong in the Iran-Turan region (Sivas, Eskişehir, Malatya, Erzincan, Ankara, Kayseri, Konya, Şanlıurfa, Mardin, Gaziantep provinces); they are weak in the Mediterranean region; only the Kütahya region and the Phrygian Valley are relatively rich in gypsum-bearing rocks. Due to these rocks, taxa of the genus *Gypsophila* are distributed in populations in these provinces. Another rock type preferred by members of the genus is volcanic. Volcanic lands are abundant in the Lakes Region (Isparta, Burdur, Antalya) and Eastern Anatolia (Erzincan, Erzurum, Van, Bitlis provinces). *Gypsophila* taxa grow abundantly in these areas in Eastern Anatolia. Casmophyte plants grow abundantly in rock cracks (such as *Gypsophila olympica*, *G. lepidioides*, *G. tenuifolia*, *G. pulvinaris*, *G. simonii*). They are generally xeric steppe plants. Taxa growing in grassland areas such as *G. curvifolia* and *G. heteropoda* are rare. Sometimes weeds such as *G. pilosa*, *G. elegans*, *G. muralis* can also be seen.

The rhizosphere region of *Silene* species, in particular, serves as a nest for the reproduction of insects in nature. **Fig. 1.**



Fig. 1a. *Silene* species form an important habitat for insect reproduction.



Casmpophytes that grows in the alpine zone: **Fig. 1b.** *Gypsophila olympica* (Local endemic: from Bursa, Uludağ). **Fig. 1c.** *Silene brevicaulis* (Regional endemic: from Erkenek, Malatya).

Bufonia species are mostly ruderal. Populations are strong in the areas where they grow. There are several species in Türkiye. The genera *Agrostemma* and *Vaccaria* have the fewest taxa. *Silene* is the largest genus in the family in Türkiye. There are approximately 960 species worldwide and 170 in Türkiye. The large number of taxa reflects the extensive habitat and geographical distribution. Its taxa generally prefer volcanic terrain. Therefore, more species are found in the Irano-Turanian region (Eastern Anatolia, Central Anatolia, and Southeastern Anatolia regions). Rock-bound species such as *Silene odontopetala*, *S. brevicaulis*, *S. azirensis*, *S. akmaniana*, *S. araratrica*, *S. leptoclada*, *S. lycanica*,

S. phrygia, and *S. saxatilis* are numerous. The areas where taxa from the family Caryophyllaceae grow abundantly in Türkiye are described below.

The Lakes Region: Numerous taxa of the family grow in this region. The genera *Bolanthus*, *Ankyropetalum*, *Acanthophyllum*, and *Silene* are generally plants of volcanic terrain. The species of the *Bolanthus* genus are located in the Region. Considering the population size and species diversity, most of the taxa originate from the Lakes Region (i.e. Mediterranean). The Sultan Mountains (Konya-Isparta-Afyonkarahisar), in particular, are the center of differentiation for

the genus. This area extends towards Mersin via the districts of Hadim, Taşkent, and Ermenek. *Bolanthus* taxa exhibit a geographical distribution more dependent on rock structures than other genera. Climate is not the primary factor in the genus' distribution. The primary ecological factors are rock and soil. *B. thymifolia* is concentrated around Lake Salda (Burdur) and Serinhisar district (Denizli province, especially around Köpekbeli); *B. cherlerioides* in the Sultan Mountains (Konya-Isparta); *B. spargulifolius* in the Alma Mountains (Uşak province) and Tavşanlı district (Kütahya province) areas. Davras Mountain, approximately 15 km from Isparta city center, is also an important area for the genera *Silene*, *Cerastium*, and *Saponaria*. Endemic taxa are abundant in its alpine steppe.

Lake Van Basin: Mount Pelli is located on the Gevaş (Van) to Tatvan (Bitlis) highway. *Silene erimicana* grows abundantly on this mountain (N: 38 23 995, E: 0 42 46 637, 2600-2775 m). The rock structure of this area is rich in iron (Fe). The plant forms attractive cushion-like clumps with yellow petals. Its vertical spread begins at 2400 m and continues up to 3000 m. The population is dominant at 2600-2700 m. Flowering decreases above 2700 m. Animals enjoy eating the tops. The plant has sticky stems.

Van-Ağrı provinces: On the Çaldıran district (Van)-Doğubeyazıt district (Ağrı) highway, 30-40 km from Doğubeyazıt, the area around Soğuksu village is covered with volcanic tuff. *Silene araratica* grows abundantly in this area. Differentiated populations of *S. araratica* are found in the steppe at approximately 2000 m, in Van, Gürpınar, Güzeldere Pass, and Kırklar Tepesi (Işıkpınar and Hamurkesen villages). Between Kemah district (Erzincan province) and Pülümür district (Tunceli province) (N: 3820270 E: 04337202 2115-2250 m), *S. araratica* plants form dense cushion-like clumps. Changes in the species' characteristics are observed depending on the rock and the changing region. Plant clumps can vary in size. It is a casmophytic species on rocks and in open areas. Petals initially yellow, later turning whitish and rarely pinkish, and plants are variable in size. These characteristics indicate that the species is polymorphic and strongly influenced by its ecological conditions.

Erzurum, Erzincan and Tunceli provinces: The Dumlupınar Mountains are located on the Tortum highway. 35 km from Erzurum (N: 40 08 930, E: 0 41 26 141, 2035 m). This locality is a derbent (a gorge). This is the area where *S. armena* exhibits the greatest variation. Approximately 10 *Silene* species grow in this area. Their populations are also large. These species also occur in the hills along the Erzurum-Van highway. Palandöken mountain (Tekman district) is alpine steppe. Taxa of *Silene* grow abundantly here. In particular, *S. pungens* is widespread. *Gypsophila vanensis* is also abundant in the area. And its populations show differenties. It is endemic to the region. Most of the eastern endemics are distributed in this center, namely the Erzurum-Erzincan-Tunceli triangle. From here, there is a passage to Doğubeyazıt and Van.

Sivas province: The Sarız and Binboğa Mountains, and the upper reaches of Ziyaret Tepe (Sancakağıl, Tavla, and Çağsak villages) are covered with steppe vegetation at elevations of 2100-2400 m. Tavla village and Ziyarettepe (the spring water area) in Sancakağıl village are limestone rock areas. The bedrock changes locally in the area. The diversity and distribution of species also change depending on this change. Generally, the upper levels are limestone, while the lower levels are conglomerate, serpentine, and sandstone. The soils are mostly clay. Steppe is an important vegetation type for the *Silene* genus. Detailed ecological investigation of this area is recommended.

Kayseri province (Pınarbaşı district: Kavak village vicinity): This is an area under excessive grazing pressure. Because of the abundance of gypsum-bearing land around the town of Pınarbaşı and Kaynar, species of *Gypsophila* with capitulate inflorescences (Group B), such as *G. sphaerocephala*, are widely distributed. From Kaynar town, 5 km before Kavak village, one passes into Şarkışla (Sivas). Hybridization of *Silene* taxa is observed in this area. Hybrid populations similar to *S. akmaniana*, *S. odontopetala*, and even an unidentified *S. akmaniana* are noteworthy. Narrow-leaved and broad-leaved species of the genus grow abundantly in the area. Populations of other genera in the family are also present.

Hatay-Kahramanmaraş provinces: *Silene* and perennial *Dianthus* species grow abundantly in the vicinity of the Atatürk Viaduct (N: 37 10 896, E: 036 42 527). The area is also known as Nurdağı or Nurhak Dağı. *Dianthus* species add a natural appearance to the area with their diverse flowers. An ecological study of this area is also recommended.

Geographic Distribution:

The gene center of the genus *Gypsophila* is the Eastern Anatolia region of Türkiye, which lies within the Irano-Turanian phytogeographic region. This region borders Iran. The genus is monophyletic. In Türkiye, Eastern Anatolia, Central Anatolia, and Southeastern Anatolia belong to the Irano-Turanian phytogeographic region. Members of the genus *Gypsophila* are distributed within these three political regions in Türkiye. In the Mediterranean and Euro-Siberian phytogeographic regions, not many taxa grow. Population diversity and population size increase from west to east. Members of the genus *Ankyropetalum* are prominent as one moves south. This genus is thought to be of Saharo-Arabian origin. In Türkiye, it occurs in Southeastern Anatolia and, to a lesser extent, in Hatay Province.

Taxa of the family are generally steppe vegetation plants. Because they prefer volcanic and limestone rocks, most of the taxa are elements of the Irano-Turanian region, in proportion to the distribution of these rocks in Türkiye. Elements of the Mediterranean phytogeographic region come second. Field weeds and other ruderal plants are abundant in the genera *Bufonia*, *Arenaria*, *Minuartia*, *Silene*, *Agrostemma*, *Vaccaria*, and *Gypsophila*. Therefore, cosmopolitan plants also occupy a significant place in the family. The most cosmopolitan taxa are in the genera *Silene*, *Spergularia*, *Holosteum*, *Stellaria*, *Minuartia*, *Arenaria*, *Gypsophila*, *Saponaria*, *Telephium*, *Vaccaria*, *Petrorhagia*, *Bufonia*, *Polycarpon* and, *Moehringia* respectively. There are no cosmopolitan taxa in the genera *Bolanthus*, *Thurya*, *Phryana*, *Acantophyllum*, *Allochrysa*, *Lychnis*, *Cucubalus*, *Loeflingia*, *Lepyrodiclis*, and *Velezia*. While endemic and narrowly distributed taxa are known in Türkiye, cosmopolitan taxa are less well-known. *S.*

spergulifolia, *S. vulgaris*, *S. fabaria*, *S. dichotoma*, *S. conoidea*, and *S. colorata* are cosmopolitan plants. They are abundant in fields, roadsides, and along walls. Annual taxa are more cosmopolitan than perennial. There are a few biennial species, such as *Gypsophila silenoides*. *Myosoton*, *Sagina*, *Moenchia*, and *Cerastium* taxa grow more dependent on humidity than others.

S. armena, *S. araratica*, *S. acaulis*, *S. oligotricha*, *S. ruscifolia*, *S. brevicaulis*, *S. tunicoides* are steppe plants that are distributed depending on the geographical region. **Fig. 1, 2.**

Similarly, although *Silene leptoclada* grows abundantly in the marble and limestone cliffs of Antalya and Isparta provinces, it has not been observed elsewhere. It is a rare and endemic species.

***Silene ruscifolia*:** A strong population is only found in an eroded area in Bahtiyar village, Yalvaç district (Isparta province). Very weak populations have been observed in some localities in Van province. The Tecer Mountains (Sivas province) is its type locality, but it has not been observed there. It is a rare species. **Fig. 2.**

The family still contains numerous taxa whose geographic range, i.e., their phytogeographical region, is unknown. More fieldwork and geographic information are needed. Endemic taxa in genera such as *Bolanthus*, *Gypsophila*, *Silene*, *Dianthus*, *Cerastium*, *Arenaria*, *Velezia*, and *Petrorhagia* are important. For example, *Dianthus zonatus*, *Bolanthus sertavulus*, *B. cherlerioides*, *Gypsophila heteropoda*, *G. lepidioides*, etc., can be used as indicators for determining geographic boundaries.

***Silene oligotricha*:** This rare and endemic species has only been recorded from Pülümür district (Tunceli province). We found it under bushes in a military area at the summit of Pülümür. It has not been seen elsewhere. This finding confirms the species' presence in Turkey, demonstrating that its habitat is steppe and protected among thorny shrubs.

***Silene azirensis*:** This species grows on the extremely steep and eroded slopes of Keşiş Mountain in Erzincan province. It is only found in this locality, between 2700 and 3000 meters. In this area, the rocky and debris-covered areas are mobile in alpinic steppe vegetation. Its red flowers are easily recognized in July. Its leaves

are glandular hairy; the flowers are solitary or in dicasias of 3-5. Its flowering and seed setting occur in the 7th-8th months. It produces few seeds. For all these reasons, the taxon is quite poorly distributed throughout its range. Grazing pressure also threatens the species' extinction.

S. azirensis is a local endemic. Goats and sheep consume this species extensively, literally picking them off one by one. The urine of the animals that eat it is oily and sticks to the animal. **Fig. 3.**



Fig. 2. *Silene leptoclada* (Regional endemics: from Akseki, Erenyaka village), *S. ruscifolia* (from Yalvaç, Bahtiyar village). **Fig. 3.** *Silene azirensis* (Local endemic: from Keşiş mount, Erzincan).

***Silene pungens*:** With its spiny leaves and clump-forming forms, it is very common in the alpinic steppe. This species is an important plant of the alpine steppe vegetation on Palandöken Mountain near Tekman district, Erzurum province, as well as on Keşiş Mountain in Erzincan province and around the Güzeldere Pass in Van province. It is a characteristic plant

of the Irano-Turanian region. It grows abundantly on volcanic rock and gravelly slopes between 2600 and 3000 m. Morphologically, it resembles *S. erimicana* and *Silene oligotricha*. The main distribution center of these three related species is the Erzurum-Erzincan-Tunceli triangle, and also, to a lesser extent, Van. **Fig. 4.**



Fig. 4. *Silene pungens*: It is an Irano-Turanian element. Its populations are strong in Keşiş Mountain (left side) and Palandöken Mountain (right side).

Economic Importance:

Most genera in the family are not economically important. The most economically valuable are

Dianthus and *Gypsophila*. Five species of the *Gypsophila* genus are economically important (*G. arrostii* var. *nebulosa*, *G. bicolor*, *G. paniculata*, *G.*

ruscifolia, *G. sphaerocephala*, etc.). Root extracts of these species are used in halva, as a fire extinguisher, and as a polish for precious metals. *G. paniculata* is valued by florists. Larger inflorescences of *G. sphaerocephala* are also important in floriculture. Saponin content in *Gypsophila* ranges from 13% to 28%. The lowest saponin is found in *G. ruscifolia* and *G. arrostii*, and the highest in *G. bicolor* roots. *G. bicolor* populations are very strong in Iran and Azerbaijan because it is not used economically in these countries and is not collected. Saponin is a raw material for the soap industry. It is also used for medicinal purposes and to flavor foods. Its extract is used as a fire extinguisher and to clean precious metals such as gold.

In our study, a very fine powder was obtained by boiling soapwort roots and removing the water with a spray dryer. Approximately 1000 kg of water was evaporated to obtain 1 kg of powder. High saponin levels were expected in this powder. This powder was used in the manufacture of soap, surfactants, etc. However, its foaming and surface cleaning properties were found to be weak. In other words, the evaporated water also reduced the saponin content. Therefore, in recent years, efforts have been made to obtain pure saponin using chemical solvents (Herold & Henry, 2001). Due to its economic importance, cultivation and mass production efforts are ongoing (Gribble, 1999). *G. sphaerocephala* is being cultivated in Konya province for the reclamation of degraded and unproductive agricultural lands; the land can be made productive within a few years (Babaoğlu et al., 2004). Only *A. gypsophiloides* (Helva kökü) of the genus *Ankyropetalum* is known to be used economically and as a food additive. Most species in the family are poisonous. Although *Silene vulgaris* is used as a food additive (flavoring), domestic mammals grazing *Silene azirensis* experience kidney damage, and blood appears in the animal's urine. This indicates that the plant is causing kidney damage. Generally,

Silene taxa are not used widely by the public or industrially. They are of minor importance in floriculture. Mammals do not graze much.

Genera of *Dianthus* and *Cerastium* are attractive plants in the genus. Therefore, *D. caryophyllus* (Turkish Yabani Karanfil) and *D. barbatus* (Turkish Hüsnüyusuf) are important in horticulture and as indoor plants. The most important species in floriculture is *Gypsophila paniculata*. *Gypsophila* 'Perfecta' is cultivated in Türkiye (Karagüzel, 2003). Landscapes such as *Cerastium tomentosum* (Turkish Farekulağı) are important in landscaping. The flowers of the genus *Saponaria* are very showy. Therefore, *S. officinalis* is used for ornamental purposes in landscaping and home gardens. Its extract has medicinal value and can be used in cleaning products. All members of the genus in Türkiye are showy. Because they can grow in a wide variety of environments and often prefer degraded areas, they can be preferred for rehabilitating degenerated land. They produce abundant seeds, have a high germination rate, and are particularly good groundcovers. After planting soapwort seeds in fields, the roots can be harvested three years later. If not desired, they can be harvested after 8-10 years. They significantly accumulate heavy metals in fields, decompose rocks, and deepen the soil layer. Those growing on eroded slopes (such as *G. simulatrix*) prevent landslides. Casmophytes or lithophytes of the genera *Arenaria*, *Minuartia*, *Gypsophila*, *Silene*, and *Cerastium* can be important in establishing rock gardens. Although not widely known, an experimental trial of diabetes mellitus has been conducted on *Bolanthus spergulfolius*, (Derici et al., 2021), *B. turcicus* (Özdaş et al., 2024) with significant success. This success is believed to be due to the essential oil in the hairs of the substance ethene. It has been revealed that some species in the family can be used in cancer treatment (Houshdar Tehrani et al., 2021). **Fig. 5.**



The ornamental plants of the family: **Fig. 5a.** *Saponaria officinalis*, *Agrostemma gracilis* and *S. kotschy*. **Fig. 5b.** *Gypsophila bicolor* is rich in saponin. *Gypsophila* species with globular inflorescences are important in floriculture.

Local and Turkish Names:

Gypsophila taxa are known locally as ‘Çöven, Çögen, Çavan and Çevgen’ (Baytop, 1984; Öztürk and Özçelik, 1991; Özçelik, 2016). *A. gypsophiloides*, belonging to the genus *Ankyropetalum*, is known as ‘Helva kökü’ or ‘Çöven’ in the Siirt region. *A. reuteri* and *A. arsusianum* have no local names or usage. Scientists have named *A. arsusianum* ‘Arsuz çöveni’, for *A. gypsophiloides* ‘Azçöven’ and for *A. reuteri* ‘Ahırçöveni’ (Güner et al., 2012).

Silene vulgaris is well known to the public and is called "Gıvışkanotu" (Baytop, 1984). The local name and use of other *Silene* species are unknown. In recent years, scientists have named them ‘Nakil’ (Güner et al., 2012). Members of the *Bolanthus* genus have no local use or name. In recent years, scientists have named them ‘Havaotu’. Some species of the *Dianthus* genus have been cultivated. Those produced as ornamental flowers are called ‘Hüsni Yusuf’. Wild species and those with less fragrance are called ‘Karanfil’.

Taxonomy and Classification

The first work on the flora of Türkiye was Flora Orientalis by E. Boissier (Boissier, 1865-1888). This work was in Latin. The most important work since then was Flora of Turkey and the Aegean Islands (Davis, 1965-1985; Davis et al., 1988). In the early 2000s, Turkish botanists wanted to publish in Turkish the plants of Türkiye. Vascular plants is an encyclopedic work prepared by numerous authors (Güner et al., 2012). ‘The Illustrated Flora of Turkey’ began

publication in 2018. Although planned for 35 volumes, it is estimated to be around 60. The Caryophyllaceae family has been published in 17 volumes (Yıldız, 2025). This book published some genera of the Caryophyllaceae family (*Gypsophila*, *Silene*, *Ankyropetalum*, *Bolanthus*, etc.). However, this work contradicted some classical taxonomic approaches, bringing previous taxonomies and their work into question. Such contradictions were rare in previous publications. However, this contradiction does not apply to all genera; it encompasses some genera. *Silene* is one such genus.

The genus *Gypsophila* L. is closely related to the genera *Ankyropetalum* Fenzl and *Bolanthus* (Ser.) Rchb. *Gypsophila* and *Ankyropetalum* originate from the Irano-Turanian region, while the genus *Bolanthus* originates from the Mediterranean phytogeographic region. An identification key is insufficient. Experience is required to identify the genera.

Species in Group A of the Flora of Turkey (Davis, 1967), such as *Silene caryophylloides*, *S. odontopetala*, *S. rhyncocarpa*, *S. fenzlii*, *S. caramanica* and *S. sipylea*, are highly problematic. We have revised this group. However, the subspecies of *S. caramanica* remain controversial. *S. caryophylloides* is also a highly problematic species. Population-level biosystematic studies should be conducted for *S. fenzlii*, *S. leptoclada*, *S. muradica*, *S. armena*, and *S. odontopetala*, and their systematic characteristics should be clarified. Superficial studies only pollute the literature.

S. odontopetala: Dedegöl Mountain (N: 3741175, E: 03117881, 2200 m), limestone cliffs, valleys, and the upper reaches of Cukkapınarı, along stream beds, from the foot of the mountain to its summit. Populations are large and diverse: polymorphic, with yellowish petals, yellow calyx, indistinct veins, and short calyx in

Group 1; and long calyx, pink with purple veins, and purple petals. Even within the same mountain, population differences are observed. This variation is seen in Isparta, Davras Mountain (N: 3746111, E: 03045034; vertical distribution up to 2060-2300 m). Morphological differences are also noteworthy. **Fig. 6.**



Fig. 6a. *Silene odontopetala* shows morphological differences depending on the habitat in which it grows. **Fig. 6b.** *Silene araratica* (Regional endemic: from Çiçekpınar village, Gürpınar/Van).

Silene argaea: Caespitose, perennial, ascending, herbaceous. Plant height 1.5-5.4 cm; crispate-pubescent; pubescence increases towards the top. Nodes are few; internodes 3-12 mm, 1 (-2) flowered. Calyx slightly swollen in fruit, not suffocated around the anthophore. Petals auriculate. It is an endemic that grows in rocky

places and rock fragments between 2700-3000 m (-32000) m in the area between Kayseri and Yozgat provinces. To better understand this species, Mount Erciyes (Kayseri) and its surroundings should be examined thoroughly. **Fig. 7.**



Local endemics:

Fig. 7a. *Silene argaea* (from Erciyes Mountain). **Fig. 8b.** *Silene fenzlii* (from Pınarbaşı district, Kayseri).

Silene lucida subsp. *lucida*:

Perennial, suffused (cushion-forming), herbaceous plants with erect stems, 10-20 cm tall. Inflorescence a single flower or a 2-flowered dichasm. Calyx 11-15 mm; 13.73 ± 0.87 , puberulent, rarely glandular, venation reticulate,

more or less unsuppressed around the anthophore. Petals auriculate, 9-12 mm. Capsule oblong-ovoid, within the calyx; teeth triangular. Anthophore sparsely puberulous. It is endemic to the Irano-Turanian and Mediterranean phytogeographic regions, growing in rocky

areas at an altitude of 1500-3000 (-4000) m, flowering in the 7th-8th months.

S. l. subsp. *glandulosa* is an endemic species that grows shorter, blooms earlier, and grows on the rocky outcrops of Davras Mountain (Isparta province) at an altitude of 2000-2300 m. According to field observations, *S. lucida* subsp. *glandulosa* should be a separate species. Based on morphological characteristics, it is closer to *S. rhynchocarpa* than to *S. lucida*. In this case, this taxon should be called *S. glandulosa*. Davras Mountain is within the distribution area of *S. lucida* and does not meet the conditions for subspecies formation. *S. lucida* subsp. *glandulosa*, included in the 11th volume of the Flora of

Turkey (Güner et al., 2000), was considered a subspecies of *S. lucida*. This taxonomic problem has not been solved in the work titled Illustrated Flora of Turkey (Yıldız, 2025).

Silene caryophylloides: Its spiny, cushion-forming form attracts attention in rocky areas. Numerous taxa with varying flower colors, calyx length, anthophore length, and leaf size and shape are grouped under this species name. It is abundantly found in rocky areas throughout Turkey. In our opinion, the taxa here are not the same species. Biosystematic and DNA studies will further clarify the differences. **Fig. 8.**



Fig. 8. *Silene caryophylloides* (from different localities of Türkiye).

The genus *Bolanthus* is represented by 13 species in Türkiye. All taxa are endemic. It is a taxonomically challenging genus. Some researchers have attempted to create a species identification key (Özçelik, 2023). However, none are suitable. *B. minuartioides* and *B. spergulifolius*, in particular, are closely related species. The inadequacy of the keys produced is due to the intertwining of morphological characters and the lack of clear boundaries. Therefore, other characteristics, not just morphological ones, must be used.

CONCLUSIONS AND RECOMMENDATIONS

The Aegean and Mediterranean regions in Türkiye have received the most floristic research. The Eastern Anatolia, Southeastern Anatolia, and Central Anatolia regions are less

well-known from a floristic perspective. Because most taxa of the Caryophyllaceae family grow in regions of Türkiye that are less well-known from a floristic perspective, much research remains to be done on their geographical characteristics. This situation leads to constant changes in the conservation categories in the Red Book of Turkish Plants (Anonymous, 2001; Ekim et al., 2000). Specimens found in herbaria generally consist of plants collected during floristic and, in part, vegetation studies. The number of specimens collected for revision or systematic studies is smaller. Therefore, specimens collected for flora or vegetation purposes may be insufficient for systematic and taxonomic studies. This is because either the specimens are few in number or, due to not being collected in a timely manner, may be missing taxonomically important organs.

Taxonomical and geographical distributional data are unsatisfactory for Türkiye (Dönmez et al., 2013). For floristic studies, few collections (of which some are new species or records for Türkiye) have been made from some mountains (Koç, 2013; Armağan, 2016; Armağan et al., 2017; Budak, 2012; Muca, 2017). General literatures (Rechinger, 1988; Kandemir and Türkmen, 2008; Özçelik and Yıldırım, 2011) which are still available are those primarily meant general systematic and taxonomy. For most of the plants described appears to us as invalid. In view of this, we have started investigation on the genus based on personal observations and wider collections on population basis.

Numerous taxonomic studies have been conducted on the genera and species of this family. However, the systematic basis remains weak in Türkiye. This can be explained by attempts to make decisions based on a small number of herbarium specimens without sufficient field examination of relevant taxa. *Arenaria kotschyana* subsp. *stenophylla*, *Gypsophila graminifolia*, and *Minuartia asiyeae* are considered extinct taxa (Ekim et al., 2001). We have specimens of *G. graminifolia* collected recently in Başkale/Van province (Özçelik and Özgökçe, 2023). There are taxonomic issues, but there is no doubt that the species continues. We have no information on the other two taxa.

Protecting biodiversity and passing it on to future generations is as important as identifying it. To this end, 'Species Action Plans' are being prepared for taxa requiring protection, and they are supported and implemented by the relevant ministry. An example of this species is the 'Species Action Plan' prepared for the protection of the Denizli Transplant (*Silene denizliensis* Aytaç). This implementation is expected to be implemented for other species in the family classified as CR. Another example was prepared for *Saponaria karapinarensis* (Durukan Öçalan et al., 2020-2024).

A species action plan is also necessary for rare endemic species such as *Silene oligotricha*, *S. guerbuezii*, *S. eminentis*, *S. azirensis*, *S. brevicaulis*, *S. leptoclada*, and *S. ruscifolia*. These action plans not only serve to protect the species but also to

raise public awareness and provide a better understanding of the species' taxonomic and ecological aspects.

According to the literature on *Silene oligotricha* (Davis, 1967), It was known to be inadequate from a collection and taxonomic perspective. Its mature capsule, anthophore length, and structure were unknown. In an artificial classification of this species (Davis, 1967), this taxon was included in Group A even though the characteristics of the mature capsule and anthophore were unknown. It is inevitable that such a classification is incorrect and that a new key needs to be made. This creates many problems. In other words, a new section key needs to be made for the genus *Silene* in Türkiye. When preparing a section key for the genus *Silene*, the auriculate petal structure of taxa is a primarily considered character. Although there are numerous studies on the genus, there is no revision study that produces a section key. This situation causes taxonomic confusion in the genus *Silene* and its taxa. The studies of Greuter and Barkoudah provide important and reliable information on this subject (Greuter, 1995; Barkoudah, 1967; Huber-Morath et al., 1967).

In recent years, studies supporting systematic studies under the name DNA fingerprinting and DNA sequence analysis have been conducted. Previously, anatomical, palynological, ecological, and even serological characteristics were utilized in addition to morphological features. Gene sequence analysis has recently been considered a scientific tool supporting taxonomy. However, these analyses can yield findings that differ from those in other research fields. According to classical taxonomy, species distantly related to each other can be considered closely related, while species considered closely related can be considered distinct or distantly related. This discrepancy stems from the necessity of a scientist to know several fields and their inability to be proficient in each. Multidisciplinary studies involving experts in each field will yield more reliable results. If someone conducting revisions using classical taxonomy also conducts DNA, pollen, and anatomy studies, this undermines the reliability of the results. Taking numerous DNA samples and submitting them to experts, and errors in

recording or identification, can also lead to inaccurate results. Classical taxonomy and DNA analyses must be mutually consistent.

Silene caryophylloides, *S. araratica*, *S. armena*, *S. lucida*, *Gypsophila sphaerocephala*, and *Bolanthus minuartioides* are complex species. Biosystematic studies should be conducted on these species. For *S. armena* and *S. araratica*, the Van province, Güzeldere Pass, Tunceli province, and Kemah district, as well as Erzurum, the Dumlu Mountains, Tortum district, and Uzundere, should be thoroughly studied from Yusufeli district (Artvin province). For *S. armena*, the Sivas, Şarkışla and Sarız districts, as well as the Dumlu Mountains (in Erzurum province) should be thoroughly studied, and population transitions should be noted in the field. The most important area for the *Silene* genus is the Erzincan, Erzurum, and Tunceli provinces. The Pülümür, Kemaliye, Çemişgezek, Üzümlü, and Arapgir districts should be thoroughly studied. This area may be the genetic center of the *Silene* genus. Some taxa of the family are of economic importance. Saponin levels are particularly high in five species of the *Gypsophila* genus. However, for this saponin to be commercially available, it must be isolated (Çevrimli et al., 2007; Koyuncu et al., 2008). This article is written to describe the general status of this family in Türkiye. Our research on this topic is ongoing.

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