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Taxonomic contributions to genus *Gypsophila* in Turkey and a new taxon from Erzurum: *G. venusta* subsp. *staminea*

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Türkiye'deki *Gypsophila* cinsine taksonomik katkılar ve Erzurum'dan yeni bir takson: *G. venusta* subsp. *staminea*

Abstract: *Gypsophila* species in Flora of Turkey had been divided into 4 groups as A, B, C and D. Annuals are in group A. The current key for identification of annuals (A Group) is not able to identify species and subspecies. Moreover, there are new species records in this group. Some *Gypsophila* taxa such as *G. bitlisensis, G. elegans* and subspecies of *G. heteropoda* are confused to each other. In this study, annual *Gypsophila* taxa and confused subspecies were revised, up to date identification keys were prepared and *G. venusta* Fenzl subsp. *staminea* Özçelik and Özgökçe is described as a new taxon from Erzurum (Turkey). The list of Turkey's *Gypsophila* taxa was also updated. Though the existance of *G. gracilescens* and *G. erikii* seem to be doubtfull due to the unavailability of new samples from the determined localities, 63 *Gypsophila* species currently exist in Turkey. Some observations related to taxonomic and geographical characters of the taxa are provided.

Key words: *Gypsophila venusta* subsp. *staminea, G. bitlisensis, G. elegans,* current list.

Özet: Türkiye Florası'ndaki *Gypsophila* türleri A, B, C ve D olmak üzere 4 gruba ayrılmıştır. Tek yıllıklar A grubundadır. Tek yıllıkların (A Grubu) mevcut teşhis anahtarı türleri ve alt türleri ayırt edememektedir. Dahası, bu grupta yeni tür kayıtları vardır. *Gypsophila bitlisensis, G. elegans* türleri ve *G. heteropoda*'nın alt türleri gibi bazı *Gypsophila* taksonları birbiriyle karıştırılmaktadır. Bu çalışmada, tek yıllık *Gypsophila* taksonları ve karışık alt türler gözden geçirilmiş, güncel teşhis anahtarları hazırlanmış ve *G. venusta* Fenzl subsp. *staminea* Özçelik ve Özgökçe Erzurum (Türkiye)'dan yeni bir takson olarak tanımlanmıştır. Türkiye'nin *Gypsophila* takson listesi de güncellenmiştir. Belirlendikleri lokalitelerden yeni örneklerin temin edilememesi nedeniyle *G. gracilescens* ve *G. erikii*'nin varlığı şüpheli olmasına karşın, halihazırda Türkiye'de 63 *Gypsophila* türü vardır. Taksonların taksonomik ve coğrafi karakterlerine ilişkin bazı gözlemler verilmiştir.

Anahtar Kelimeler: *Gypsophila venusta* subsp. *staminea, G. bitlisensis, G. elegans,* güncel liste.

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1. Introduction

The genus *Gypsophila* L. was first described by Linnaeus (1753) and has more than 150 species (Anonymous, 2020a). Sixty three *Gypsophila* species (41 endemic) are currently known in Turkey (Barkoudah 1962; Huber-Morath et al., 1967; Davis et al., 1988; Ataşlar, 2000; Ekim, 2012; Armağan, 2016). Huber-Morath's revision of *Gypsophila* L. in 'Flora of Turkey and the East Aegean Islands'(1967) provides a useful basis for the identification of the genus, but it has some serious shortcomings due to insufficiently studied specimens. Previously, Barkoudah (1962) made a revision of the genus and allied genera i.e. *Phyrana* Pax et Hoff., *Ankyropetalum* Fenzl, *Bolanthus* (Ser.) Rchb. which were separated from *Gypsophila* L. This revision is also important and served as a basis for the revision of Huber-Morath et al. (1967).

Gypsophila includes annuals, biennials and perennial herbaceous or semishrubs. Taxonomically it is related to *Bolanthus* (Ser.) Rchb., *Ankyropetalum* Fenzl and *Acanthophyllum* C.A. Mey. (Davis, 1967; Davis et al., 1988).

More than 50 % of the total *Gypsophila* species currently exist in Turkey. Azerbaijan and Iran, respectively, follow Turkey in terms of *Gypsophila* species diversity (Schischkin, 1936; Rechinger, 1988). According to the Flora of Turkey (Davis, 1967; Davis et al,. 1988; Güner et al., 2000), 60 *Gypsophila* taxa belonging to 56 species had been reported. Thirty five of them are considered to be endemic. The genus is also among the genera to which maximum number of new species have been added after the publication of Flora of Turkey (Davis, 1967; Davis et al., 1988), and most of the *Gypsophila* samples are kept in GUL and VANF Herbarium. New *Gypsophila* taxa have been presented by subsequent studies, increasing the current species number of the genus in Turkey to 63 (Karagüzel and Altan, 1999; Ataşlar, 2000; Korkmaz and Özçelik, 2011a; Budak, 2012; Koç, 2013; Armağan, 2016; Armağan et al., 2017; Anonymous, 2020a).

Since new specimens of *Gypsophila gracilescens* Schischk. and *G. erikii* Yıld. could not be found from the specified localities, the existance of these two species seem to be doubtfull. Though four species, *G. pilosa* Hudson, *G. perfoliata* L., *G. sphaerocephala* Fenzl ex Tchihat., *G. viscosa* Murr., of the genus are quite common, the others are rare or endemics.

Gypsophila is an economically important genus and the members having economic importance are named as "Çöven" by public, and seven species, *G. bicolor* (Freyn. & Sint.) Grossh. (Van çöveni, Tarla çöveni), *Gypsophila arrostii* Guss. subsp. *nebulosa* (Boiss. & Heldr.) Greuter & Burdet (Beyşehir çöveni, Konya çöveni, Helvacı çöveni, Şekerci çöveni), *G. paniculata* L. (Bahar yıldızı), *G. eriocalyx* Boiss. (Çorum çöveni, Yozgat çöveni), *G.*

bitlisensis Barkoudah (Bitlis çöveni), *G. perfoliata* L. (Niğde çöveni), *G. elegans* M. Bieb. (Bebek nefesi), are of economic impotance. Some members are used to make "Tahini Halvah", "Foam Halvah", "Turkish Delight", "Herbal Cheese" and "Çöven Bread". Some are used for the production of detergents, fire extinguisher, liquor and soap. *Gypsophila arrostii* var. *nebulosa* is used for commercial saponin production. *Gypsophila elegans* and *G. paniculata* are produced for floristry purposes (Korkmaz and Özçelik, 2011b). Beside the use of *Gypsophila* species for some health purposes such as diuretic, expectorant, acne remover, they are also used to polish gold at jewellery sector (Özçelik and Yıldırım, 2011).

Though its economic importace, *Gypsophila* is not known sufficiently in Turkish Flora. Thirty five of the 63 taxa were presented from East Anatolian region. Beside being endemic or rare, most of them are known only from type localities or from very few localities (Table 1). It is also the third largest genus in family *Caryophyllaceae* after *Silene* L. (c. 125 species) and *Dianthus* L. (c. 70 species) in Turkey.

Many studies (Özçelik and Özgökçe, 1995; 1999; Korkmaz and Özçelik, 2011a) have been carried out about the *Gypsophila* members of Turkey, and some new species and, new square records and new materials were presented from different regions. Although it is among the most complex genera of Turkish Flora taxonomically, a detailed revisional study related to *Gypsophila* hasn't been conducted.

The study aims to to clarify the problems in the taxonomy *Gypsophila* in Turkey and reveal information about the genus we have obtained during our work in different regions of Turkey.

2. Materials and Method

Research materials were collected from different regions of Turkey between 1988 and 2018, from February to September, both in the flowering and fruiting periods. Specimens were collected from as many different parts of the existing distribution area of the genus as possible to be able to study the variation patterns. The study area included East Anatolian vilayets, such as Van, Bitlis, Muş, Ağrı, Iğdır, Siirt, Şırnak, Bingöl, Erzurum and Hakkari provinces. Type specimens and the collections of herbaria ANK, ATA, E, EGE, FUH, GAZI, GUL, HUB, ISTF, KNYA and VANF were also examined. A range of characteristics that were considered to be taxonomically important in the genus was investigated.

Almost 150 collections from 75 localities were identified by using the second and supplementary volumes of Flora of Turkey and the East Aegean Islands (Davis, 1967; Davis et al., 1988). Twenty five of them belong to *G. bitlisensis* and *G. elegans*. The details about the collection sites of these plants; their direction, distance, biometric measurements, distribution patterns additional characters which were not given in previous revisions were also investigated. The differences from other publications were also noted (Table 1). Recent publications (Barrera and Arenas, 1999; Güner, 2012; Armağan, 2016; Armağan et al., 2017; Anonymous, 2020b) were taken into account in the spelling of the taxa authorities. Except for Table 2 and descriptions of taxa in results section, the authorities of the taxa were not given. Given authors are based on Huber-Morath et al. (1967), Rechinger (1988), Güner et al. (2000) and Güner (2012) with new publications (Budak, 2012; Hamzaoğlu, 2012; Yıldırımlı, 2012; Koç, 2013; Armağan, 2016; Armağan et al., 2017; Anonymous, 2020c).

All species of the genus were investigated by grouping them in four. Annual *Gypsophila* taxa (Group A) and perennials (Group B, C and D).

New identification keys and descriptions were prepared for subspecies and varieties of *G. heteropoda, G. venusta, G. bitlisensis* and *G. elegans*. All hesitant populations between *G. elegans* and *G. bitlisensis* were examined, after their species and populations were distinguished. A revised diagnostic key was prepared for annual members of the genus. A revision was made on Davis' (1967) key. Diagnostic features such as calyx shape, inflorescence and number of flowers, capsule shape and length, number of main stems in the plant, habitus of the plant, body length, leaf shape, size and indumentum, the shape and size of the brackets and the ratio to the calyx, pedicel length, thickness and indumentum, number of ovules in the ovary, indumentum in the calyx, shape, length, and structure of edges of the teeth, type and thickness of the underground organs, were used respectively while preparing the identification keys for Turkish *Gypsophila* members.

Abbreviations in the text and for table 2 are as follows:

*: Only known from type locality, rare; Mt: Mountain, el: Element, Euro-Sib.: Euro-Siberian, Medit.: Mediterranean, Hb: Herbarium/Herbaria; ±: more or less; N: North, S: South; E: East, W: West; Prov: Province (vilayet in Turkish).

Collectors and researchers in the text: Altan: Yasin Altan, Behçet: Lütfi Behçet, Tatlı: Âdem Tatlı, MK: Mustafa Korkmaz, Özgökçe: Fevzi Özgökçe, A.Özçelik: Adnan Özçelik, Özçelik: Hasan Özçelik, A.Ç.: Ali Çelik, Muca: Belkıs Muca Yiğit; K.Aydınşakir: Köksal Aydınşakir.

3. Results

3.1. Taxonomic contributions to some members of *Gypsophila* in Turkey

3.1.1. *Gypsophila venusta* Fenzl subsp. ***staminea*** Özçelik and Özgökçe, subsp. nov.

Differt a subsp. *venusta* floribus minoribus; stamina in serie 2 disposita; flamenta 0.8-1.2 mm vel 2-3.2 mm longa, antherae 0.1-0.2 mm longae, in calyce inclusa, petala breve 5-6(-9) mm.

Type: B8 Prov. Erzurum: Aşkale-Erzincan highway, about 40 km. from Aşkale, steppe, 2200 m, 23 vii 1993, Özçelik 6225 (HOLO in Hb. GUL and ISO in Hb. VANF).

Description: Plant 70-85 cm tall, strong, clearly swollen at nodes, whitish stemmed. Leaves lanceolate, acute to acuminate, 3-5 subveined, 10-60 x 1-10 mm, thin; papillose at margin; Inflorescence large, dense, many flowered paniculate-dichasial. Pedicels capillary, up to 25 mm. Calyx 3-3.5 (-4) mm; petals 5-6(-9) mm; petals milk white, 2-2.5 x longer than calyx; widened cuneate and emarginate -retuse to truncate at the top. Calyx teeth about half of the tube with large scarious intervals. It has two different stamen groups (5 longer + 5 shorter) which are never visible. Filament length of the short stamens 0.8-1.2 mm, the others 2-2.5 (-3.2) mm; anthers 0.1-0.2 mm and style 3-3.5 (-4) mm. long, visible.

Notes: Features related to stamens and petal length bewildered us and provide the most important diagnostic characters. This new subspecies is based on differences in flower size, calyx and petal lengths, ratio of petals to calyx; stamen disposition, filament and anther sizes. At the same time, the region where it spreads, habitat and altitude are very different.

The two subspecies may be distinguished as below:

1. Stamens included in calyx, arranged in two groups as short and long; petals 5-6 (-9) mm, calyx 3-3.5 (-4) mm ..... subsp. *staminea*

1. Stamens visible, apparently longer than calyx, similar one to other; petals 8-12 mm, calyx 3-5 mm …… ..... …… subsp. *venusta*

Subsp. *staminea* is only known from the locus classicus. This taxon is apparently endemic (may probably occur in some areas of Ir.-Tur. region in Turkey) and is geographically isolated from subsp. *venusta*. According to the key in Turkish Flora (Davis, 1967), general characters of the type specimen resemble to *G. venusta.* But only petal length different to *G. silenoides* Rupr. We therefore propose to treat it as subspecies of *G. venusta*. Flower structure is somewhat anomalous, it has both short and long stamens. Thus, it differs from all other Turkish *Gypsophila'*s and cannot be identified by the key given in Flora of Turkey (Fig. 1,2). The anatomical, ecological and palynological features of the species have been studied by us in comparison with other species. In addition, revision of the species and other ones in the Hagenia section were revised and a identification key was prepared (Fidan and Özgökçe, 2016).

Examination and comparison of *Gypsophila venusta* Fenzl. subsp. *staminea* Özçelik & Özgökçe, subsp. nov. showed that it is not only merely an aberrant form of *G. venusta* with a smaller calyx and petals, but also features related to stamens and petal length bewildered us and provide the most important diagnostic characters. This new subspecies is based on differences in flower size, calyx and petal lengths, ratio of petals to calyx; stamen disposition, filament and anther sizes. At the same time, the region where it spreads, habitat and altitude are very different.

Subsp. *venusta* Fenzl subsp. *venusta* is known as "Konya Çöveni in Turkish". There are halva producers in Konya. They mix roots of *G. arrostii* Guss., *G. perfoliata* and *G. venusta* subsp. *venusta* uand also use for halva production (Koyuncu et al., 2008). *G. venusta* subsp. *staminea* is an endemic taxon with local distribution in Eastern Anatolia. There is no information about the use of subsp. *staminea* Özçelik and Özgökçe (Özçelik and Özgökçe, 1995).

Specimens examined: A.Özçelik & K.Aydınşakir Ç.G.G. 140(GUL 13/24/46-1); A.Özçelik & K. Aydınşakir, Ç.G.G. 93(GUL 13/24/46-2); A.Özçelik & K.Aydınşakir Ç.G.G. 20(GUL 13/24/46-3); Özçelik & A.Ç. 13 (GUL 13/24/46-5-13); Özçelik & A.Ç.13(GUL 13/24/46/14-21); A.Özçelik & K.Aydınşakir ÇGG 28(GUL 13/24/46-22); A.Özçelik & K.Aydınşakir 11(GUL 13/24/46-23); A.Özçelik & K.Aydınşakir 22(GUL 13/24/46-24); A.Özçelik & K.Aydınşakir 88(13/24/46-25); Özçelik 12776 (GUL 13/24/46-26).

3.1.2. *Gypsophila elegans* M. Bieb.

A8 Prov. Bayburt: Kop Mountains, steppe, about 2300 m, 23 vii 1993, Özçelik 6229. Erzurum: Erzurum to İspir, between Rizekent and Çıkrıklı villages, steppe, on sandy places, 2100 m, 22 vii 1976, Tatlı 4914. Erzurum to Tortum; 6 km N of Karagöbek, 2200 m, 27 vii 1973, EGE 13595.

Figure 1. *Gypsophila venusta* subsp. *staminea* Özçelik and Özgökçe (a-c: habit; d1: flower; d2: dissected calyx; d3:petal and stamens d4: gynoecium) Özçelik 6225 (HOLO in Hb. GUL

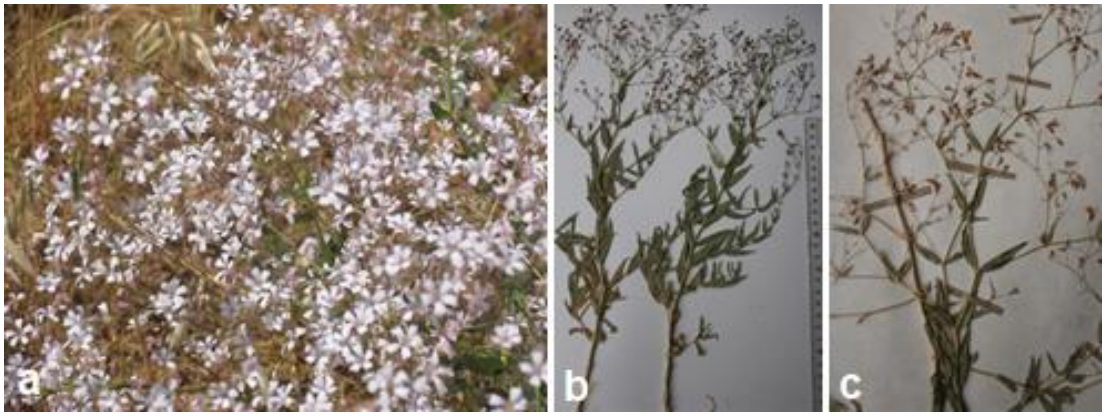

Figure 2. *Gypsophila venusta* subsp. *venusta* (a-c: habit)

A9 Prov. Erzurum: Şenkaya, Gülveren village, Acısu locality, steppe, 2500 m, 26 ix 1984, FUH (Fırat Univ.) Altan 3903.

B9 Prov. Bitlis: Adilcevaz, Aydınlar village, 2200 m, alpinic steppe; Adilcevaz (Bitlis)-Erciş (Van) road, 40-45 km, meadow, 21.05.1995, Özgökçe 2240(13/24/35-09); Özgökçe 2242 (GUL 13/24/35-10); Özgökçe 2243 (GUL 13/24/35-11); Özgökçe 2246 (GUL13/24/35-12); Özgökçe 2247(GUL 13/24/35-13); Özgökçe 2248 (GUL 13/24/35-14); Özgökçe 2249(GUL 13/24/35-15); Özgökçe 2250 (GUL 13/24/35-16); Özgökçe 2252 (GUL 13/24/35-17); Özgökçe 2253 (GUL 13/24/35-18): Özgökçe 2272 (GUL 13/24/35-19); Özgökçe 2273 (GUL 13/24/35-20); Özgökçe 2274 (GUL 13/24/35-21); Özgökçe 2276 (GUL 13/24/35-22); Özgökçe 2278, 2279 (GUL 13/24/35-23); Özgökçe 2280, 2281 (GUL 13/24/35-24); Özgökçe 4148 (GUL 13/24/35-25); Özgökçe 4158 (GUL 13/24/35-26); Özgökçe 2257, 2272, 2276, 2278, 2279, 2280, 2281, 2282(GUL 13/24/35-27).

Notes: Specimens vouchered as Özgökçe 2255, 2256 (GUL 13/24/35-28) are taxonomically problematic. Specimen with the voucher number MK. G. 51 is bottom branched and like biennial. MK. G. 83 seem like perennial.

B9 Prov. Van: Bahçesaray, Kavuşşahap Mountains, around Çatbayır village, field sides, 7 vii 1988, Özçelik 2245. Gürpınar, slopes of Başet Mountain, steppe, 2200 m, 4 vii 1993, Altan & Özçelik 5288. Güzeldere Pass, 2200 m, 21 vi 1986, EGE 33213. Bitlis: Süphan Mountain, around Aydınlar village (Adilcevaz), steppe, 2200 m, 9 vi 1987, Behçet 255; Özgökçe 2240 (in VANF); ATA 620. The distribution area, in Turkey, is Eastern Anatolian region. Therefore, Tatlı 4914: Özçelik 2245, ATA 620, K. Aydınşakir Ç.G.G. 150 (GUL 13/24/35-2).

Notes: Specimens numbered as Tatlı 4914 (GUL 13/24/35/03-05) are hybrids with *G. bitlisensis*.

Specimen examined: A. Özçelik & K. Aydınşakir Ç.G.G. 121 (GUL 13/24/35-1); A. Özçelik & K. Aydınşakir Ç.G.G. 150 (GUL 13/24/35-2); Tatlı 4914-a (GUL 13/24/35/03-05); Özçelik 2245 (GUL 13/24/35-06); A. Özçelik Ç.G.G. 94 (GUL 13/24/35-08); Özgökçe 2240, 2242, 2243, 2246, 2247, 2248, 2249, 2250, 2252, 2253, 2255, 2256, 2257, 2272, 2273, 2274 2276, 2278, 2279, 2280, 2281, 2282; 2249 4148, 4158, (GUL 13/24/35-10-28); MK. G.3, 5, 51, 200, 203, 296, 302, 330, 334, 339, 342, 352, 336, 397; ATA 620.

Notes: The distribution areas of the species mainly fall in Eastern Anatolian region and also spread in Eastern Black Sea region close to this region. Also, in Lakes region etc. Steppe, meadow and arid meadows are important habitats for it. Özgökçe 4158: Inflorescence lax, bract and bracteoles similar in shape, linear and pink. Rare and interesting specimen. Özgökçe 4148: Inflorescence congested, flowers small, bract and bracteoles similar to leaves in colour not pink, scarious (Figure 3).

Gypsophila elegans and *G. bitlisensis* are widely distributed in xerophytic and partially mesophotic habitats in the region. Our field observations indicated that identification of this group have many difficulties. Descriptions of these species have been given using few specimens. They are distinguished in the key as follows:

1. Inflorescence loosely dichasium; petals 2-5 x longer than calyx; calyx 3-5 mm, main stem dominant, seeds bulging and tubers pronounced..... *elegans*

1. Inflorescence densely dichasium, petals c. 1.5-2 x longer than calyx, calyx 2-3 mm, main stem many, seeds long and flat tuberred ..... *bitlisensis*

According to the above key, many specimens of *G. elegans* deviate in qualitative and quantitative characters as well as general appearance, branching, stem number belonging to the same root, petal length and the ratio of petals to calyx. Our results show that even in the same population one can find plants with linear-oblong to linear bract shapes, flowers can be a few or many in number, arranged in dense or loose dichasiums and branched from base or in upper half.

3.1.3. *Gypsophila bitlisensis* Barkoudah

A8 Prov. Erzurum: Tortum, above salt pans, roadsides, 2160 m, 5 vii 1975, Tatlı 2101.

B9 Prov. Bitlis: Süphan Mountain between Ahlat-Adilcevaz cities, steppe, 2200-2800 m, 28 vii 1988, Özçelik 1711; Behçet 1215; Tatvan, Nemrut Mountain, steppe, 1700-2400 m, Aug. 1991, Özçelik 2620; W and N slopes of Yumurtatepe locality, 2250-2350 m, alpinic sandy steppe. 5 vii 1972, Tatlı 717. Por stream, near the centrum; ca. 1500 m, 23 vi 1983, Hb. FUH 7547 (Fırat Univ., Elazığ).

Three types of *G. bitlisensis* occur in the mountains of East Anatolian region. The identification key of these types is prepared as follows:

1. Inflorescence dense and many flowered, only branched from base

   2. Number of main stem many and stems short …… ..... Group suphanis

   2. Number of main stem one or a few and stems long …… ..... Group nemrutis

1. Inflorescence lax or little flowered, branched from base, near base or upper parts ..... Group sarkis

Group.suphanis Özçelik and Özgökçe: Only grow on Suphan Mountain of Bitlis. Naming is new.

Group.nemrutis Özçelik and Özgökçe: Only grow on Nemrut Mountain of Bitlis. Naming is new.

Group.sarkis Özçelik and Özgökçe: 1-main stemmed, stems long or short (found in several localities of Van, Ağrı, Erzurum). Naming is new.

Specimen examined: Özgökçe 1971(GUL 13/24/37-1-2); Özçelik 5173(GUL 13/24/37-3); Özgökçe 1711 (GUL 13/24/37-04-05); Tatlı 717(GUL 13/24/37-06); Tatlı 2101(GUL 13/24/37-07); A.Özçelik 80 (GUL 13/24/37-08); A.Özçelik 74(GUL 13/24/37-09); Özçelik 2264(GUL 13/24/37/10-11); Özçelik 7206(GUL 13/24/37/12-17); MK.G. 6(10), 19, 32, 34, 88, 150, 162, A.Özçelik (GUL 13/24/37-39); A.Ç., Muca & Özçelik 03(GUL 13/24/37/18-37); Özçelik 12773(GUL 13/24/37-b/01-03); Tatlı 4914, (GUL 13/24/37-38); MK. G. 83(GUL 13/24/37-39); MK. G.296, 318(GUL 13/24/37-38); A. Özçelik ÇGG.108(GUL 13/24/37-38); Özçelik 6487(GUL 13/24/37-39); A. Özçelik Ç.G.G. 106 (GUL 13/24/37-40).

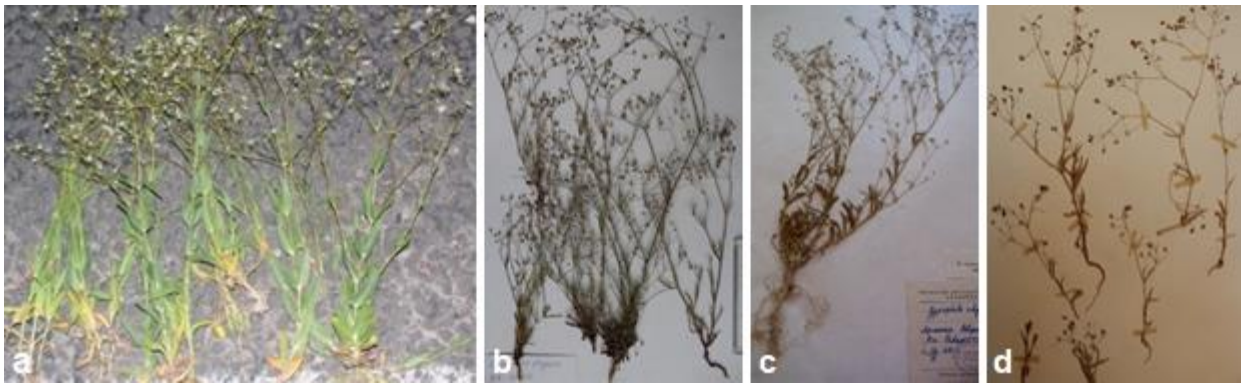

Figure 3. *Gypsophila elegans* (a: habit; b:MK. G. 339; c and d: Tatlı 4914).

Only Group Sarkis of *G. bitlisensis* can't be distinguished clearly from *G. elegans.* It may be a hybrid of *G. elegans* and *G. bitlisensis.* The Lake Van basin is a difference center of these species. For this reason, variation is very high in the species. Though each of the above mentioned types can taxonomically be thought as a variety, such a process has no contribution to systematics. These differences arise from the ecological features of the geography in which it is located. Distributed in Van, Ağrı, Bayburt, Erzurum, Artvin, Ardahan.

Gypsophila bitlisensis and *G. elegans* show a significant distribution. *Gypsophila bitlisensis* often occupies large areas in the Lake Van basin and dominantly grows in the area. A comparison of the two species is given in Table 1.

Among our collections, a large number of the samples belonging to both *G. elegans* and *G. bitlisensis* were observed to grow in the region. These specimens are:

A8 Prov. Erzurum: Tortum, 4 km to Aksu, roadsides, 2250 m, 5 vii 1975, Tatlı 2076. 5 km. from Karakurt to Horasan, roadsides and on moving rough stones, 1600 m., 10 vi 1983, Tatlı 6923. Near Horasan borderland from Ağrı, roadsides and steppe, ±1950 m, 21 vii 1990, Özçelik 2264.

A9 Prov. Artvin: Artvin to Ardahan, 7 km from Yalnızçam pass, 2250 m, 4 viii 1973, EGE 13600. Erzurum: Şenkaya, Gülveren village, steppe, 2500 m, 20 viii 1982, Fırat Univ. 2894. Kars: 8 km from Kars to Ardahan, steppe, roadsides, 1800 m, 10 vii 1975, Tatlı 2680; Ardahan: 32 km from Göle to Ardahan, pastures, 2060 m, 8 vii 1975, Tatlı 2451.

B9 Prov. Ağrı: Eleşkirt, Tahir Mountains, S of Naziktepe, stony steppe, 1940 m, 10 vii 1994, Özgökçe 1970; Özçelik 3151; 3153. Bitlis: Tatvan Nemrut Lake, volcanic rocky places, ca. 2250 m, 5 vii 1986, EGE 33216. Van: W slope of Büyük Erek Mountain, steppe, 2100-2200 m, 6 viii 1989, Özçelik 295; 1113, 1299, EGE 32327. N of Beyüzümü village, sandy-stony steppe, 1750 m, 31 vii 1994, Özgökçe 1971. Özalp, Muhammed valley, steppe and roadsides, 1800 m, 2 viii 1994, Özgökçe 1972.

Gyprosphila bitlisensis: Erzurum-Ağrı; Bitlis/Tatvan, Erzurum/ Aşkale Sivas /Zara Erzurum/Horasan Refahiye, Erzincan; Its roots are perennial; Özçelik 5173 (GUL 13/24/37-3); Bitlis/Ahlat-Adilcevaz. Identification of it is problematic and suspicious. Mixed with *G. elegans.* MK. G. 83 (GUL 13/24/37-39). An interesting example, like perennial and multi-branched from the base. MK. G.296, 318; Erzurum-Ağrı: A. Özçelik (GUL 13/24/37-38); A. Özçelik ÇGG.108(GUL 13/24/37-38); Özçelik 6487(GUL 13/24/37-39); A. Özçelik Ç.G.G.106 (GUL 13/24/37-40); Refahiye, 50 km to Erzincan, 13.7.2007; Bitlis/Ahlat-Adilcevaz; Bitlis/Tatvan, Erzurum/Aşkale.

Notes: Specimens, collected from Sivas/Zara Erzurum/Horasan and vouchered as MK.G.162 had very thin branches and sparsely flowered, a weak plant, a new population. Lower part of the plant is thickened, like a biennial or perennial (Fig. 4).

Table 1. A taxonomic comparison of *G. elegans* and *G. bitlisensis* (Özçelik and Özgökçe 1999)

Characters	*G. elegans*	*G. bitlisensis*
Habit	Up to 80 cm tall, branched from upper part or near it, rarely unbranched; an or a few main stemmed	Up to 50 cm tall, always branched from the base, Often many stemmed
Leaves	10 - 60 x 1-15 mm	10-40 x 1-8 mm
Branching	Often clearly dichotomously branched	Many branched, weakly dichotomously branched
Inflorescence	Often diffuse, lax, less-flowered dichasium finer branched and sparse flowering	Large, dense, many-flowered dichasium Thicker branched and many-flowered
Bracts	Linear-oblong to ovate-triangular	Ovate-triangular
Pedicels	5-20 (-35) mm often longer than *G. bitlisensis*	5-25 mm
Calyx	3-4 mm long	2-3.5 (-4) mm long
Petals	4-8(-10) mm; broadly oblong to cuneate, emarginate	3.5-6 mm; linear-oblong
Seeds	With obtuse tubercles, a little	With minute obtuse tubercles, very much
Habitat	Slopes, steppe, gravel banks, roadsides, open woodland	Steppe, slopes, rarely stream sides
Distribution	East and North parts of east Anatolia in Turkey from sea level to 650-2600 m	Endemic to Van Lake basin and its environs, from sea level to 1650-1800 m

3.1.4. *Gypsophila heteropoda* Freyn & Sint.

MK.G.314 (GUL 13/24/32-1); MK. 49 (GUL 13/24/33/2-09).

Two varieties of this species exist in Turkey. However, in Flora of Turkey (Davis 1967), the key is inadequate to identify these two varieties. Korkmaz (2011a) made a revision of annual *Gypsophila* species in Turkey, but the taxonomic problems of this species could not be adequately resolved, and a detailed study is necessary about this species. These variants can be distinguished with the key given below:

1. Plant densely branched and stems viscose with sessile glands .....var. *heteropoda*

1. Plant delicate, sparsely branched and glandular hairy, never viscose with sessile glands .....var *minutiflora*

Gyprosphila heteropoda Freyn & Sint subsp. ***heteropoda***: A9 Prov. Iğdır and B10 Prov. Ağrı: This taxon was collected by us from many localities. Taxonomically confused with *G. parva.*

Gyprosphila heteropoda Freyn & Sint subsp. ***minutiflora*** Barkoudah: It is known only from the collections made from Prov. Sivas. It is seen in rocky, arid areas. In the Flora of Turkey (Davis, 1967), it recorded as subsp. *minutiflora* Bark. Obviously, it is rare endemic and Ir.-Tur. el. (Figure 5).

3.2. Revision of *Gypsophila* in the Group A of Turkey's Flora

Group A comprises only annuals. During preparation of the illustrated Flora of Turkey, this grouping might very important. However, for most species, some important diagnostic characters such as inflorescence type, fruit shape, and number of ovules are still missing. Some of these shortcomings have been completed in this study. The definition of the sections will remain weak without removing these deficiencies. After that, species identification keys related to the sections should be made and the group key in Flora of Turkey (Davis, 1967) should be abandoned.

3.2.1. Revised grouping of *Gypsophila* members in Turkey

1.Annual herbaceous, without woody roots and vegetative stems..... Group **A**

1.Biennial or perennial herbaceous, with woody roots and vegetative stems..... Groups **B, C, D**

Figure 4. Variations in *Gypsophila bitlisensis* (a-c: habit)

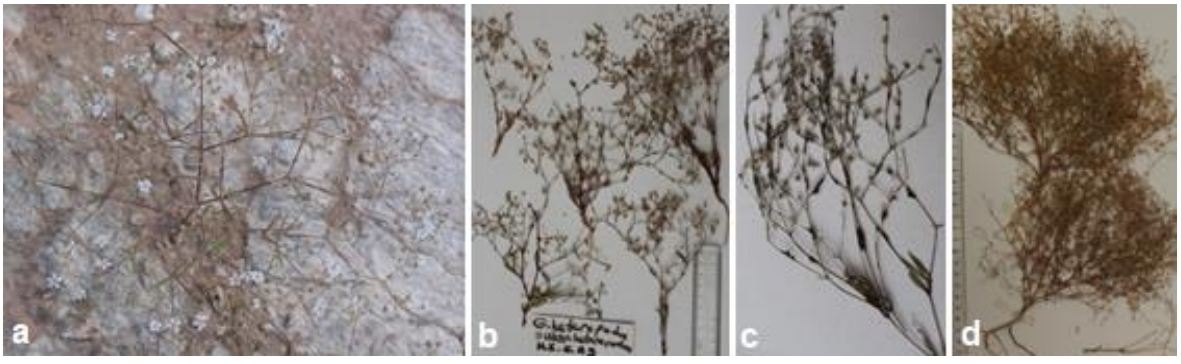

Figure 5. *Gypsophila heteropoda* (a: subsp. *minutiflora*; b and c: subsp. *heteropoda*; d: *G. parva*)

3.2.2. Revised identification key for annual *Gypsophila* members (Group A) in Turkey by taking advantage of Davis (1967).

1. Stem (at least at the base) and calyx hairy

2. Calyx pilose hairy (stem and leaves densely pilose-villose), leaves lanceolat, 10-30(-40) mm wide..... ***pilosa***

2. Calyx pilose not hairy, leaves linear, oblanceolate, up to 4 mm wide

3. Calyx tubulate, 4-8 mm, petals 5-10(-12) mm long

4. Pedicels 5.0-15.0 mm, inflorescence lax, bracts not leaf like ..... ***tubulosa***

4. Pedicels 1.0-2.0 mm, inflorescence densely globose, bracts leaf like ..... ***confertifolia***

3. Calyx campanulate, up to 4.0 mm, petals 2-5(-6) mm long

5. Bracts foliaceus, linear or oblanceolate, petals linear, cuneate, emarginate to bilobed

6. Pedicels 5-10 mm, petals 3-6 mm, cuneate, whitish or pink.....***torulensis***

6. Pedicels 10-20 mm, petals 2-3.5 mm, linear, white.....***linearifolia***

5. Bracts scarious, triangular, petals oblanceolate, acute to obtuse

7. Seeds obtus to acute tubercles; bracts and calyx glandular pubescent ..... …… ..... ***heteropoda*** subsp. ***minutiflora***

7. Seeds sharply echinate (prickly), bracts and calyx glabrous.....***parva***

1. Stem (at the base) and calyx never hairy or viscous

8. Pedicels not capillary, leaves ± oblanceolate rarely linear-lanceolate,

9. Whole plant viscous, leaves 3-5 non-apparent veined .....***viscosa***

9. The plant never viscous, leaves 1-3 distinctly grained

10. Petals oblanceolate to cuneate, bracts triangular, acute ..... ***heteropoda*** subsp. ***heteropoda***

10. Petaller linear-oblong, bracts ovate-triangular, obtuse

11. Seeds obtuse bulging prominent tubercles, main stem dominant, 1 (-2), inflorescence loose dichasium .....***elegans***

11. Seeds long flat tubercles, main stem usually numerous, inflorescence frequent dichasium ..... ***bitlisensis***

8. Pedicels capillary, leaves linear to lanceolate

12. Bracts linear to lanceolate, leafy, calyx 2.5-4.8 mm

13. Seeds flat tubercles, petals cuneate, calyx 2.5-4.0 mm

14. Pedicels 5-10 mm (show only distributed in Tekirdağ for Turkey ..... ***muralis***

14. Pedicel 10-25 mm (only shows distribution in Şanlıurfa in Turkey..... ***antari***

13. Seeds acute tubercles, petals linear-oblong, calyx 3.0-4.8 mm .....***munzurensis***

12. Bracts triangular, scarious, calyx 1.5-2.5 mm…..... ……***heteropoda*** subsp. ***heteropoda***

4. Conclusions and Suggestions

In this study, it has been tried to solve taxonomic problems of some Turkish *Gypsophila* members.

1. Actual list of Turkey *Gypsophila* taxa and their sections have determined and correctly named taxa and sections (Table 2). While preparing this list in the light of observations and literature, contributions to solve of taxonomic problems, examined voucher specimens and important results are mentioned. In addition, all *Gypsophila* taxa have ranked on sections on the basis of kinship. Table 2 will not only be a check list of studies on *Gypsophila* taxa, but also it will be a scientific infrastructure showing the systematic location and correct naming of taxa.

2. In the all Floras books, large genera mainly are classified into sections. In the Flora of Turkey (Davis, 1967; Davis et al., 1988) too, this is the case. However, this principle was not applied in *Gypsophila* genus. Because the sections were not defined at the time of writing the Flora of Turkey (1967), the taxa could not be placed in the sections. Many new taxa have been recorded since then. These taxa had to be placed in their sections before starting the revision. For this reason, all *Gypsophila* taxa are classified in 4 large groups. It is an artificial but practical classification. Annual *Gypsophila* taxa were collected in Group A. B, C and D Groups include the perennial taxa.

3. We have been studying on the *Gypsophila* revision since 1993 (Özçelik and Özgökçe, 1995; 1999; Korkmaz and Özçelik, 2011a; Özgökçe et al., 2012; Fidan and Özgökçe, 2014; Armağan et al., 2017; Armağan and Özgökçe, 2018). We started from annual *Gypsophila* which a group of clear boundaries, and in this study, we prepared an identification key for annual members of the genus. To make this key, we were identified firstly problematic species, after their taxonomic problems were solved. Then species identification key was made.

4. There are two subspecies of *G. heteropoda*. These are *G. heteropoda* subsp. *heteropoda* and *G. heteropoda* subsp. *minutiflora. G. heteropoda* subsp. *minutiflora* appears to be a taxon far from the other taxon (subsp. *heteropoda*). For this reason, it should be increased to the statu of species category. However, its status has not been changed. Because it mixes with *G. parva*. If more detailed studies are conducted, if the difference can be clearly distinguished from *G. parva,* it can be promoted to the species category.

5. Another problem group is complex of *G. elegans* with *G. bitlisensis.* This complex group is partially mixed with *G. viscosa.* This confusion was fixed with the new key. All hesitant populations between *G. elegans* and *G. bitlisensis* were examined, after their species and populations were distinguished. Three groups of *G. bitlisensis* have been appeared. These groups might be called varieties or they might be called new species. But for now it has been called the group and the diagnostic key has been made. *G. munzurensis* is close to *G. elegans*, not to *G. pilosa*. The reason for the author to make this mistake is that *G. elegans* is not clearly defined.

6. Although a large number of *Gypsophila* taxa have been studied, revision of annuals is given in this study. A new subspecies of *G. venusta* species (subsp. *staminea* Özçelik and Özgökçe) have been added from perennial *Gypsophila* members.

7. The *Gypsophila* list of Turkey was updated. It has 63 *Gypsophila* species.

8. *Gypsophila erikii* Yild. (Yıldırımlı, 2012) and *G. gracilescens* Schischke's presence (Davis 1967) in Turkey is doubtful. The existence of *G. laricina* Schreb. (Sin.: *Gypsophila sphaerocephala* Fenzl ex Tchihat. Asie Min., Bot. 1: 205 (1860)) was confirmed. Some taxa of it are still known from type collection and some are relict. Some observations about taxonomic and geographical characters of all taxa are stated in a list of them.

Taxonomical and distributional data are unsatisfactory for Turkey. For floristic studies, few collections (of which some are new species or records) have been made from some mountains in the region by other botanists (Güner, 1983; Vural and Tan, 1983; Tan, 1984; Alpınar, 1994; Barrera et al., 1999; Yıldırımlı, 2012; Armağan, 2016;

Table 2. Updated *Gypsophila* species of Turkey and their investigated collections and some characteristics

Taxon	Endemism	Distribution area	Phytogeogra-phical region	Taxonomic situation, distribution and investigated collections
1. Sect. **Excapae** Williams				
*1. ***G. serpylloides*** Boiss. & Heldr.	Endemic	C4 Antalya	E. Medit.Mt. el	It is easily distinguished by its short creeping stems. Özgökçe 3173, 3175.
2. G. peshmenii Güner	Endemic	B9 Bitlis	Ir.-Tur el.	-
3.*G. adenophylla* Barkoudah	Endemic	B7 Erzincan ?; B9 Bitlis, Van; C9 Hakkari	Ir.-Tur el.	Recorded from Erzincan (Kandemir and Türkmen, 2008) suspect.
4. *G. pulvinaris* Rech. f.		A10 Ağrı		-
5. G. hakkiarica Kit Tan	Endemic ?	C10 Hakkari	Ir.-Tur el.	-
6. *G. briquetiana* Schischk.	Endemic	B7 Erzincan, Tunceli; B8 Erzurum	Ir.-Tur el.	-
2. Sect. **Gypsophila**				
7. G. davisii Barkoudah	Endemic	C2 Muğla	E. Medit.Mt. el.	-
3. Sect. **Ensifoliae** Bark.				
8. G. graminifolia Barkoudah	Endemic	A8 Erzurum; B9 Van	Ir.-Tur. el.	Local endemic Başkale (Van) city and its environs. Erzurum record of it is new.
4. Sect. **Corymbosae** Barkoudah				
9. G. patrinii Seringe		B10 Ağrı	Ir.-Tur. el.	It is written as a new record for Turkey. *G. patrinii* is the synonym of this species (Armağan et al., 2017).
10. G. brachypetala Trautvetter	Endemic	A9 Kars	Euro.-Sib. el.	It was written as Blacksea Mt. el. (Güner 2012) and *G. brachypetala* Trautv. (Davis, 1967). Özçelik & A.Çelik 23 (GUL 13/24/6/1-4); Özçelik & A.Ç. 27 (GUL 13/24/6-5).
11. *G. guvengorkii* Armağan, Özgökçe & Çelik	Endemic	A4 Karabük	Euxine (Mt.) el	-
12. *G. yusufeliensis* Budak	Endemic	A8 Artvin	Ir.-Tur. el.	-
13. *G. transcaucasica* Barkoudah		B9 Ağrı	Ir.-Tur el.	Only recorded in Doğubeyazıt (Ağrı). Detailed research is required to deduct taxonomic status.
14. *G. tenuifolia* M.Bieb.		A8 Artvin, A9 Ardahan	Euxine (Mt.) el	It's a rare species. Taxonomically very problematic.
5. Sect. **Capituliformes** Williams.				
15. *G. glomerata* Pall. ex Adams		A1 Tekirdağ	Euxine (Mt.) el.	It was written as *G. glomerata* Adams by Güner (2012). It is rare in Turkey. *G. glomerata* Pall. ex Adams is considered as a valid name by the international websites (Anonymous, 2020a,b). New record is a species, very narrow range in Turkey, rare. Edirne, from Süloğlu to Lalapaşa, Süloğlu exit, MK. 1971, 1978; A.Ç. 88.
16. *G. syriaca* Schischk.	Endemic	C6 Adana	E.Medit.Mt. el.	It was a variety of *G. sphaerocephala*. It had been removed from the synonym, but the synonym made valid again as the species. It was more appropriate to have a subspecies. According to Davis (1967), it is an element of Ir.-Tur. region.
17. G. pilulifera Boiss. & Heldr.	Endemic	B5 Kırşehir, Nevşehir; B7 Erzincan; C3/ C4 Antalya	E. Medit.Mt. el.	The distribution area of this species tends to expand over time. Özçelik 1002, 1003(GUL 13/24/9/3-4); A.Özçelik (GUL 13/24/9/1-2; Özçelik 1001(GUL 13/24/9-5); Özçelik & Muca 2013(GUL 13/24/9-6); Dönmez 13754 B. Mutlu T. Ağar (İnönü Univ. Hb. 728); A. Özçelik (GUL 13/24/9/1-2; Özçelik 1002, 1003(GUL 13/24/9/3-4; Özçelik 1001(GUL 13/24/9-5; Özçelik & Muca 2013(GUL 13/24/9-6); A. Özçelik ÇG.18 (GUL 13/24/9-7); MK. 2104(GUL 13/24/9/8-10); Muca 15(GUL 13/24/9/11-12; A.Ç.01 (GUL 13/24/9/13-20).
18. G. olympica Boiss.	Endemic	A2 Bursa	E. Medit.Mt. el	-
19. *G. pinifolia* Boiss. & Hausskn.	Endemic	B6 Malatya, K. Maraş; B7 Malatya, Elazığ; B8 Erzurum	Ir.-Tur. el.	It can be distinguished by its leaves being pointed and stinging.
20. G. leucochlaena Hub.-Mor.	Endemic	B6 Malatya, Sivas	Ir.-Tur. el.	Between Gürün and Darende is the most important habitat area of the species.

				Özçelik 12209 (GUL 13/24/12/ 1-5).
21. *G. osmangaziensis* Ataşlar & Ocak	Endemic	B2 Kütahya, B3Eskişehir	Ir.-Tur. el.	-
22. *G. laricina* Schreb.	Endemic	B6 Tokat, B8 Erzurum	Ir.-Tur. el.	*G. sphaerocephala* Fenzl ex Tchihat. var. *cappadocica* Boiss. was made synonym to this species. Detailed taxonomic study required. The spread of var. *cappadocica* is also spreading area of this species.
6. Sect. **Rokejeka** (Forssk.) A. Braun.				
23a. *G. paniculata* L. var. ***araratica*** Hub.-Mor.	Endemic	A9/A10 Iğdır, Ağrı	Ir.-Tur. el.	Endemic to Mount Ağrı. A rare species.
23b. *G. paniculata* L. var. ***paniculata***		Culture form	-	This subspecies is being recorded for the first time for Turkey. It is produced by florists in Izmir, Istanbul, Yalova and Antalya for ornamental and landscape purposes. Its origine is unknown.
24. *G. bicolor* (Freyn. & Sint. Grossh.		A8 Artvin; B8 Erzurum; B9 Van, Bitlis, Iğdır, Kars	Ir.-Tur. el.	The population has weakened due to excessive collection. Van lake Basin is an important spread area. It is abundant in parts of Azerbaijan near Iran and Turkey.
25. *G. arrostii* Guss. var. ***nebulosa*** (Boiss. & Heldr.) Greuter & Burdet	Endemic	B2 Manisa; B3 Afyonkarahisar; B4 Ankara; C2 Burdur, Uşak, Denizli; C3 Konya/ Isparta/ Burdur	Ir.-Tur. el.	It is endemic to the Lakes Region. It is endemic to the Lakes Region (Isparta, Burdur, Konya, Afyonkarahisar, Denizli).
26. *G. simulatrix* Bornm. & Woron	Endemic	A8 Erzurum; A8/A9 Artvin; A9 Kars/Ardahan; B5 Niğde; B6 Sivas; B6/B7 Malatya C4 Konya; C3 Afyonkarahisar	Ir.-Tur. el.	The phytogeographic region is specified for the first time. It is the endemic of the Eastern Black Sea Region and its environs. Its spread in Central Anatolia is interesting. Thus, the area of soaking has expanded. These examples and their land should be examined in detail.
27. *G. baytopiorum* Kit Tan	Endemic	C9 Hakkari	Ir.-Tur. el.	-
28a. *G. perfoliata* L. var. ***perfoliata***		B3 Afyonkarahisar; B4 Ankara/ Konya, Kayseri; B5 Kayseri; B6 Sivas; B7 Erzincan; C2 Denizli; C4 Konya	Ir.-Tur. el.	This taxon was newly created for Turkey. Before, there was only *G. p.* var. *araratica*. Its habitus is variable. It is a very polymorphic species. Their forms could be seen between Afyonkarahisar, Eskişehir and Ankara. It is easily distinguished by its large layers of flowers and strong plant. It is also produced by florists in Antalya, Izmir, Manisa vilayets etc. There are culture and wild forms.
28b. *G. perfoliata* L. var. ***araratica*** Kit Tan	Endemic ?	A9 Erzurum-Ağrı B9/10 Iğdır	Ir.-Tur. el.	It is endemic to the Ağrı mountain Its endemicity to Turkey section of Mount Ağrı is controversial. It is unknown presence in the part that does not belong to Turkey of the mount. The accuracy of the taxon is questionable. It purchased from the Real Market/flower section.
29. *G. simonii Hub-Mor.	Endemic	A4 Çankırı; B5 Yozgat/ Kayseri/ Ankara; B6 Sivas; B7 Erzincan/ Malatya; B9 Van/ Kars/ Iğdır; C4 Konya.	Ir.-Tur. el.	It spreads depending on gypsum rock. It is one of the indicator plants of gypsum rocks. It is an endemic specific to salty, gypseous areas around Çankırı. Rare endemic. A.Özçelik ÇGG. 61(GUL 13/24/18-1); A.Özçelik ÇGG.46 (GUL 13/24/18-2); A.Özçelik ÇGG.99(GUL 13/24/18-94); MK.48 (GUL 13/24/18/95-96.
30. *G. oblanceolata* Barkoudah	Endemic	B4 Niğde/Aksaray/ Konya	Ir.-Tur. el.	The fleshy structure and oblanceolat shape of the leaves is distinctive. It is peculiar to salty marshes in the Middle Anatolian region. It mixes with *G. germanicopolitana* in the identification key. Only the leaves differed from *G. germanicopolitana* it may be distribution. M.K. 67 (GUL 13/24/18/01-02).
31. *G. germanicopolitana* Hub.-Mor.	Endemic	A4 Çankırı; B5 Yozgat, Kırşehir; B5/B6 Kayseri; Sivas	Ir.-Tur. el.	It is grown on stony, loamy, sandy soils. It was a local endemic known only from Çankırı. The distribution area has been extended with new records. A.Özçelik 116(GUL 13/24/20-1); A.Özçelik 207(GUL 13/24/20-2); A.Özçelik 43(GUL 13/24/20-3); A.Özçelik & K.Aydınşakir 03(GUL 13/24/20-4).
32. *G. nabelekii* Schischk.		B10 Iğdır; C9/10 Hakkari	Ir.-Tur. el.	Endemicity of it is controversial. Its spread can also be found in Iraq. Its type specimen from Turkey.
33. *G. curvifolia* Fenzl	Endemic	C3 Antalya, Isparta, Burdur;	E. Medit. Mt. el.	It grows in swamps and wetlands or on their edges. It is an endemic to Lakes region.

		C4 Antalya, Konya		Özçelik 7335(GUL 13/24/22-1-5); MK. 897(GUL 13/24/20-6); Özçelik 8038 (GUL 13/24/22/7-8)
34. *G. festucifolia* Hub.-Mor.	Endemic	B6 Sivas, Kayseri	Ir.-Tur. el.	-
35. *G. turcica* Hamzaoğlu	Endemic	B6 Sivas	Ir.-Tur. el.	It is a new recorded species known from type gathering (Hamzaoğlu, 2012).
36. *G. libanotica* Boiss.		B6 Niğde; C5 Konya, Niğde; C6 K. Maraş, Osmaniye	E. Medit. (Mt.) el.	-
37. *G. ruscifolia* Boiss.		B7 Elazığ, Tunceli; B8 Erzurum, Muş; B9 Van, Bitlis, Ağrı; C6 Gaziantep; C8 Diyarbakır, Mardin	Ir.-Tur. el.	It is easily distinguished by the perfoliate leaves. It is common in East and South East Anatolian regions. Its rhizomes are very flexible.
38. *G. pallida* Stapf.		B6 Kahramanmaraş, Malatya, Elazığ; B9 Van; C9 Hakkari	Ir.-Tur. el.	_
39. *G. tuberculosa Hub.-Mor.	Endemic	B7 Erzincan	Ir.-Tur. el.	Its identification is very difficult to make from the current key. It mixes with *Bolanthus*, but it is annual.
40. *G. aucheri* Boiss.	Endemic	B7Sivas/Erzincan/ Tunceli, Malatya, Adıaman; B8 Erzurum	Ir.-Tur. el.	It spreads in environment peculiar to rock.
41. *G. eriocalyx* Boiss.	Endemic	A4 Çankırı; A9 Kars/Ardahan; B3 Eskişehir; B4 Ankara; B5 Kayseri/ Çorum; B6 Sivas; C5 Niğde	Ir.-Tur. el.	Hair features in the stem, leaves, and calyx provide important diagnostic characters.
42. *G. lepidioides Boiss.	Endemic	B7 Erzincan	Ir.-Tur. el.	It develops depending on gypsum rock, it shows local distribution. It is endemic to Erzincan environment. It is close to *G. eriocalyx*. is easily distinguished by its inflorescence stalk and indumentum characters. Özçelik 12876 (GUL 13/24/30/1-13).
7. Sect. Heterochroa (Bunge) Fenzl.				
43. *G. glandulosa* (Boiss.) Walp.	Endemic ?	A7 Trabzon; A8 Erzurum, Rize; A9 Artvin	Euxine Mt. el.	It may be not endemic. Type specimen of it from Turkey (Güner, 2012).
8. Sect. **Dichoglottis** (Fisch. & Mey.) Fenzl				
44a. *G. heteropoda* Freyn & Sint. subsp. ***heteropoda***		A9 Kars; B10 Ağrı	Ir.-Tur. el.	In identification, 2 subspecies seems to be impossible with the existing key. A new key was made by us. Subsp. *heteropoda* can be easily distinguished by presence of viscous structures in stems and inflorescences. But subsp. *minutiflora* is very difficult to define. Detailed studies are needed. Subsp. *minutiflora* may be a separate species. The taxon is mixed with *G. parva*. The plant is completely hairless and not viscos, it should be studied in detail, it does not go from 1st to 1st, not from 2nd to 1st. Some have viscosity, some do not.
44b. *G. heteropoda* Freyn & Sint. subsp. ***minutiflora*** Barkoudah	Endemic	B6 Sivas	Ir.-Tur. el.	
45. *G. parva* Barkoudah	Endemic	A4 Çankırı; A5 Çorum	Ir.-Tur. el.	-
46. *G. linearifolia* (Fisch. & C.A. Mey.) Boiss.		B5 Nevşehir and its environs	Ir.-Tur. el.	Taxonomic features are not safe. It is particularly confused with *G. elegans.*
47. *G. bitlisensis* Barkoudah	Endemic	B6/7 Sivas; B7 Erzincan; B8 Erzurum; B9 Bitlis, Van	Ir.-Tur. el.	-
48. *G. viscosa* Murr.		A9 Kars; Iğdır; B3 Eskişehir; B4 Konya, Ankara; B5 Kayseri; B6 Sivas; C3 Konya, Isparta; C6 Şanlıurfa	Ir.-Tur. el.	-
49. *G. elegans* M. Bieb.		A7 Gümüşhane, Bayburt; A8 Erzurum; B7 Erzincan, Diyarbakır; B9 Van, Bitlis; B10 Kars, Iğdır, Ağrı; C3/C4 Konya	Ir.-Tur. el.	The distribution area of the species is mainly in the Eastern Anatolia region and it also spreads in the Eastern Black Sea region close to this region. Steppe, meadow and arid meadows are important habitats for it.
50. *G. silenoides* Rupr.		A7 Giresun, Gümüşhane, Trabzon; A8 Trabzon, Rize, Artvin; A9 Artvin; Ardahan	Euxin el.	It is usually biennial, rarely perennial. In the first year, rosette leaves are formed, in the 2nd year there is flowering. If this condition is unknown, its identification is difficult. The spreading area of the species is essentially the Eastern Black Sea region. It is

				the Kashgar mountains between Trabzon and Rize. It grows abundantly on gravelly slopes.
51. *G. polyclada* Fenzl. ex Boiss.		C10 Hakkari	Ir.-Tur. el.	It is rare species.
52. *G. antari* Post. & Beauverd.		C7 Şanlıurfa	Sahara Arabian el.	It is rare species. Especially in Akçakale, which is the border of Syria, it has spread.
9. Sect. **Marcrorhizaea** Boiss.				
53. *G. muralis* L.		A1 Edirne	Euro.-Sib. el.	Its general appearance is similar to *Arenaria* genus. It was recorded from Çörekköy (Davis 1967). Today, Çörekköy is within the borders of Greece, 13 km away from the Customs Gate of Pazarkule. It has been revealed with the subsequent research that it has spread in Tekirdağ / Silivri-Çorlu. It's a rare species. Sammel 02.284(EGE); A.Özçelik (GUL 13/24/40-2
54. *G. torulensis M.Koç		A7 Gümüşhane	Euro.-Sib. el. ?	It resembles to *G. muralis* (Koç 2013)
55. *G. tubulosa* (Jaub. & Spach) Boiss.	Endemic	B1 İzmir; B2 Uşak; C1/C2 Aydın	E. Medit. el.	It leaves from genus *Bolanthus* as it is annual. There is also an example in IZEF Hb. (İzmir). It is a difficult species to identification.
56. *G. confertifolia* Hub.-Mor.	Endemic	C2 Muğla, Burdur	E. Medit. el.	This kind of short, dense flowered inflorescence looks like *Velezia*. MK. 16 (GUL13/24/42-1)
57. *G. hispida* Boiss.		A8 Gümüşhane, Erzurum; A9 Kars, Iğdır; B7 Erzincan, Tunceli; B8 Erzurum; B10 Iğdır, Kars	Ir.-Tur. el.	Type sample from Turkey. This species has not been seen by us.
10. Sect. **Hagenia** A. Braun.				
58. *G. pilosa* Hudson		A2 İstanbul, Bilecik; A9 Kars; B2 Kütahya; B3 Afyonkarahisar; B4 Ankara; B5 Kayseri; B7 Elazığ; C2Antalya; C3 Isparta; C4 Konya; C5 Niğde; C6 Şanlıurfa	Ir.-Tur. el. ?	It is a species widespread throughout Turkey. It doesn't choose many habitats. It must be a cosmopolitan species. Özçelik & Muca 05(GUL 13/24/44/02-09); Özçelik & Muca 12(GUL 13/24/44-10); Özçelik & Muca 04(GUL 13/24/44/11-16); Özçelik 12877(GUL 13/24/44-17); Özçelik 12877(GUL 13/24/44-18); MK. 704(GUL 13/24/44-19); MK. 700.
59. *G. munzurensis* Armağan	Endemic	B7 Tunceli	Ir.-Tur. el.	It is seem like *G. elegans* not *G. pilosa*. (Armağan 2016)
60. *G. nodiflora* (Boiss.) Barkoudah	Endemic	B7 Elazığ; C6 Malatya	Ir.-Tur. el.	This species has not been seen by us.
61a. *G. venusta* Fenzl subsp. ***venusta***		A4 Çankırı; A7 Sivas; B3 Afyonkarahisar; B4 Ankara, Konya; B5 Yozgat, Kayseri; B6 Sivas; B7 Malatya; B8 Erzurum, Erzincan; C3 Isparta, Konya, Karaman; C5 Niğde; C6 Gaziantep, Adana; C7 Şanlıurfa	Ir.-Tur. el.	The most distinctive feature of the length of the petals and the high ratio of calyx. Subsp. *venusta* was named for the first time. Although it is seen in the same region with subsp. *staminea*, its main spreading area is the Lakes Region and Central Anatolia Region. It is very rare in Eastern Anatolia.
61b. *G. venusta* Fenzl subsp. ***staminea*** Özçelik and Özgökçe	Endemic	Erzurum	Ir.-Tur. el.	It is a rare endemic known from type gathering. Its stamen characters is distinguished from subsp. *venusta*.
62. *G. gracilescens* Schischk. (Davis 1967) and **63. *G. erikii*** Yild. (Yıldırımlı, 2012) are suspected of being in Turkey. Their samples are not seen.				

Armağan et al., 2017). General literatures (Rechinger, 1988; Karagüzel et al., 1992; Kandemir and Türkmen, 2008; Özçelik and Yıldırım, 2012; Anonymous, 2020c) which are still available are those primarily meant for the 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.

Most of the investigated collections are dated after the publication of the Flora of Turkey, and some of them could not be distinguished from each other with the help of the Flora (Davis, 1967). Those taxa included in Güner (2012) were prepared more accurately. However, there is no identification key and also their Turkish names and geographical regions are dream, does not meet to the reality of Turkey in general. Some members of the genus show a great variation in indumentum, branching and flower number, due to polymorphism, hybridisation, polyploidy and habitat differences. As such, their taxonomical status has not been revealed fully.

While visiting the area, we came to conclusion that the region between Ağrı and Van, Bitlis especially Tahir, Tendürek, Süphan, Nemrut and Ağrı Mountains, Başkale environs appear to us as center of great diversity for the genus. The mountains and their environs are very rich in *G. bitlisensis* and *G. elegans*. The area should therefore be investigated in detail.

Conflict of Interest

Authors have declared no conflict of interest.

Authors' Contributions

The authors contributed equally.

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