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A new species of *Ornithogalum* (Hyacinthaceae) from East Anatolia, Turkey

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Abstract: *Ornithogalum malatyanum* Mutlu is described as a new species from Malatya Province, East Anatolia, Turkey. A description, photographs, and an identification key including related species are given. The International Union for Conservation of Nature threat category and observations on the ecology of the populations are noted. The chromosome number of the new species is 2n = 24. The morphological differences between the new species and related taxa are also discussed.

Key words: Chromosome, geophyte, Ornithogaleae, taxonomy

Türkiye'nin Doğu Anadolu bölgesinden yeni bir *Ornithogalum* (Hyacinthaceae) türü

Özet: *Ornithogalum malatyanum* Mutlu, Doğu Anadolu (Malatya) bölgesinden yeni bir tür olarak tanımlandı. Tanımı, fotoğrafları ve yakın türleri içeren bir tayin anahtarı verildi. Yeni tür için, Uluslararası Doğa Koruma Birliği (IUCN) tehdit kategorisi ve populasyonu üzerinde ekolojik gözlemler değerlendirildi. Yeni türün kromozom sayısı 2n = 24 olarak belirlendi. Yeni tür ile yakın taksonlar arasındaki morfolojik farklılıklar tartışıldı.

Anahtar sözcükler: Kromozom, geofit, Ornithogaleae, taksonomi

Introduction

The genus *Ornithogalum* L. in the tribe Ornithogaleae (Caurel) J.C.Manning & Goldblatt of the subfamily Ornithogaloideae Speta (Hyacinthaceae *Batsch*) comprises about 160 species (Manning et al., 2009) or even 200 according to Martinez-Azorin et al. (2007). There are 14 genera in the subfamily Ornithogaloideae. Among them, *Ornithogalum* is the genus with the most species. This genus has a wide distribution, including Europe, Asia (reaching Afghanistan to the East), Africa (except the Tropic of Cancer band), and Madagascar (Zahariadi, 1965).

Since the first revision of *Ornithogalum* for the Flora of Turkey, 31 taxa have been added to the known species (Cullen, 1984; Davis et al., 1988a; Speta, 2000a, 2000b; Özhatay, 2000; Düşen & Sümbül, 2002, 2003; Düşen & Deniz, 2005; Uysal et al., 2005; Özhatay & Kültür, 2006; Dalgıç et al., 2006; Varol, 2008; Bağcı et al., 2009; Yıldırımlı, 2009; Koca & Yıldırımlı, 2010; Özhatay et al., 2011; Bağcı et al., 2011). The number

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of species increased to 54 in Turkey, together with recent additions.

In June 2010, during an expedition to Tavşan Hill (Malatya), as a part of the project on "Ex-situ Investigations on Geophytes in Malatya Province", the authors collected some interesting *Ornithogalum* specimens whose individuals have long hairs on leaves. The specimens were not referable to any known *Ornithogalum* species. Because of the long hairs on leaves character of the population, indicating that it might be a new species, it was photographed and the population size was estimated. The specimens were examined in detail and compared with related species in ANK, CU, CUFH, HUB, INU, and ISTE, as well as with records in the literature (Boissier, 1881; Zahariadi, 1980; Cullen, 1984; Davis et al., 1988a; Speta, 1991; Müller & Müller, 1996; Özhatay, 2000; Manning et al., 2004). During this study, specimens of this species, which were first collected by B.Yıldız in 1996 and determined as *Ornithogalum pyrenaicum* L. (Yıldız et al., 2004), were detected. Since the first sample collected in 1996, the character hair had not changed, and it was confirmed that the hair feature is distinct and stable. After a thorough study, it was concluded that these plants represent a previously undescribed species with affinities to *Ornithogalum pyrenaicum* L. subsp. *sphaerocarpum* (A.Kern.) Hegi, *O. narbonense* L., and *O. sorgerae* Wittmann.

The chromosome counts were made on root tips. Bulbs were germinated at 4 °C in petri dishes inside the funnel. Actively growing root tips, 1 cm in length, were excised from the bulbs and pretreated with p-dichlorobenzene for 3-4 h at room temperature. They were fixed with Carnoy (1:3 glacial acetic acid–absolute ethanol) for at least 24 h at 4 °C, hydrolyzed in 1 M HCl at 60 °C for 10 min, and stained in acetic orcein.

Preparations were made and studied using a Leica DM500 light microscope with an ICC50 HD camera. Electron micrographs were obtained with an EVO 40XVP (LEO Ltd., Cambridge, UK) scanning electron microscope at an accelerating voltage of 20 kV.

Species description

Ornithogalum malatyanum Mutlu **sp. nova** (Figures 1-4)

(Subgen. *Ornithogalum*)

Type: Turkey. B7 Malatya: Venk village, Tavşan Hill, calcareous area, 1500-1600 m, 08.VI.1996, *B.Yıldız* 13368 (holotype: INU; isotypes: HUB). ibid., 1400-1600 m, 7.VII.1996, *B.Yıldız* 13665 (INU); Venk village, north side of Tavşan Hill, 38°19′710′N, 38°23′165′E, 1518 m, mixed forest of *Quercus libani* Olivier and *Quercus infectoria* Olivier subsp. *boissieri* (Reuter) O.Schwarz, calcareous area, 10.VII.2010, *B.Mutlu* 11176 & Ş.Karakuş (paratypes: INU, HUB, GAZI, ANK, KNYA).

Diagnosis: Affinis *Ornithogalo pyrenaico* subsp. *sphaerocarpo*, sed a priore folio hirsuto (non glabro), stylo longiore, 4-5.3 mm longo (non 1.8-3.3 mm) et pedicello fructufero breviore, 10-15 mm longo (non 20-25 mm) differt.

Description: Plant 46-73 cm. Bulbs ovoid-globose, 1.5-2.5 cm in diameter, tunica whitish, papery, without bulblets, scale imbricate. Scape 34-53 cm, glabrous, white. Leaves 5-7, but often withered at anthesis, shorter than scape, linear, (25-) 28-40 × (0.3-)0.4-1.0(-1.1) cm, leaves 2-5.5 mm long hairy, canaliculate, apex obtuse, without white median line, margins hairy. Raceme cylindrical, 12-20 mm, (18-)20-30(-55) flowered. Pedicel 5-10 mm at anthesis, erect and adpressed to main axis, 10-15 cm in fruit, glabrous. Bracts membranous, 7-18 mm, subulate, equal or longer than pedicel, 0-1(-2) teeth on each side, glabrous. Perianth segments 9-12 × 2.2-4 mm, lanceolate, glabrous, elliptic, apex papillate-glandulose, outer surface of tepals with large green fascia, glabrous, inner surface white, glabrous. Androecium 5.5-6 mm, filaments dilated at base, whitish, anthers 2.2-3.2 mm, medifixed, yellowish-light green. Gynoecium 6-8 mm, ovarium 2-3.3 mm, style 4-5.3 mm, stigma punctuate. Capsule (5-)7-11 × (4-)5-7 mm, ovoid or globose, erect, unwinged. Seeds black not shiny, angular, alveolate and papillate surface, (1.8-)1.9-5.2(-5.5) × (1.1-)1.2-2.8(-3.0) mm long. Chromosome number 2n = 24 (*B.Mutlu* 11176 & Ş.Karakuş) (Figure 2).

Distribution: *Ornithogalum malatyanum* is endemic to Turkey and is distributed in the Irano-Turanian phytogeographical region. It is known from the type locality only (Figure 3).

Etymology: The epithet of the new species refers to its type locality in Malatya Province, Turkey.

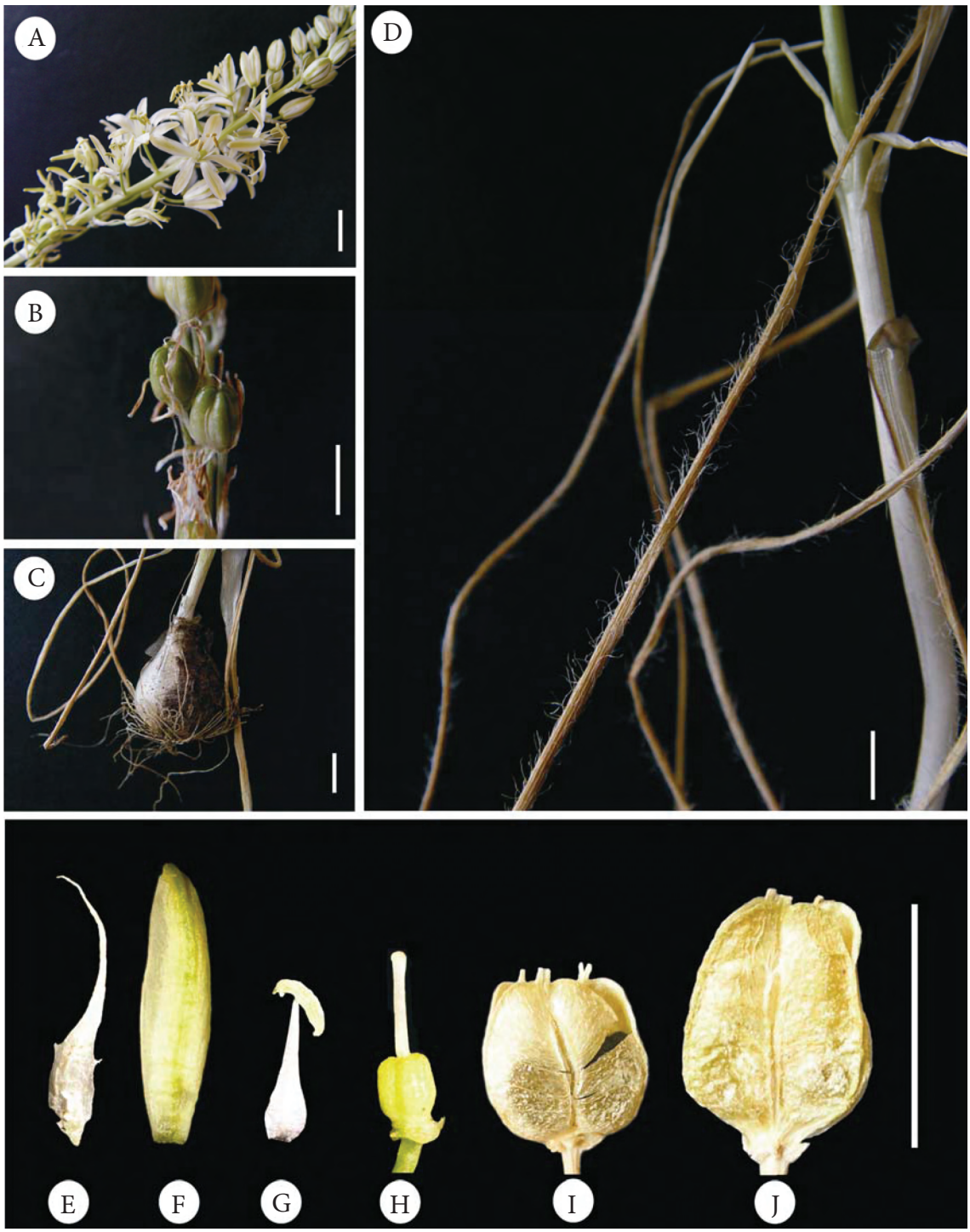

Figure 1. *Ornithogalum malatyanum* (from *B.Mutlu* 11176 & Ş.Karakuş). **A**-inflorescence, **B**-fruits, **C**-bulb, **D**-leaves, **E**-bract, **F**-tepal, **G**-androecium, **H**-gynoecium, **I** and **J**-capsules after dehiscence (from *B.Yıldız* 13665). Scale bar: 1 cm.

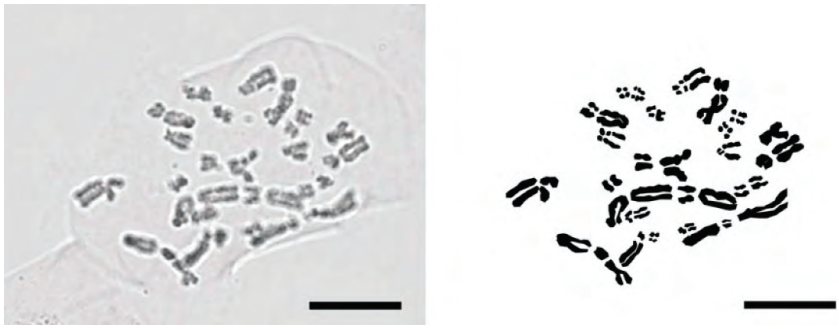

Figure 2. Somatic metaphase chromosomes of *Ornithogalum malatyanum* (2n = 24) (from *B.Mutlu* 11176 & Ş.Karakuş). Scale bar: 10 µm.

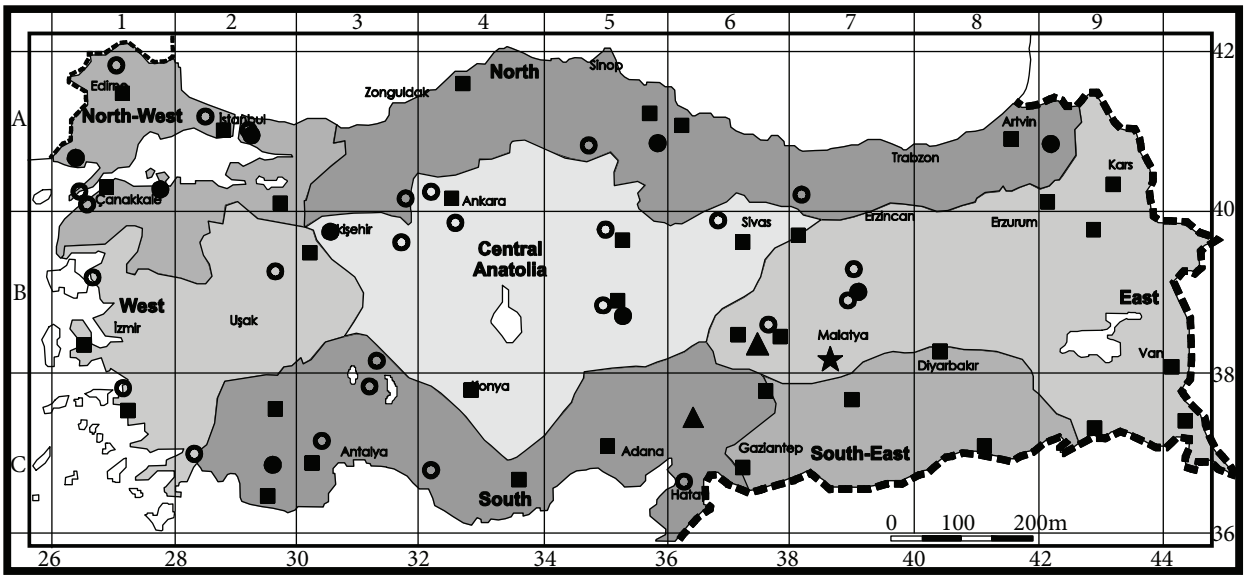

Figure 3. Distribution map of *Ornithogalum malatyanum* (★), *Ornithogalum pyrenaicum* subsp *pyrenaicum* (●), *O. pyrenaicum* subsp *sphaerocarpum* (❍), *O. narbonense* (■), and *O. sorgerae* (▲) in Turkey.

Phenology: Flower and fruit in May-June.

Habitat: *Ornithogalum malatyanum* grows under the mixed forest of *Quercus libani* Olivier and *Quercus infectoria* Olivier subsp. *boissieri* (Reuter) O.Schwarz on the north side of the calcareous slopes of Tavşan Hill at 1500-1600 m. Associated species at the type locality include: *Amygdalus communis* L., *Pistacia terebinthus* L. subsp. *palaestina* (Boiss.) Engl., *Umbilicus erectus* DC., *Chaerophyllum crinitum* Boiss., *Ferula orientalis* L., *Tanacetum argenteum* (Lam.) Willd. subsp. *argenteum*, *Thymus sipyleus* Boiss. subsp. *rosulans* (Borbas) Jalas, *Bellevalia sarmatica* (Pallas ex Georgi) Woronow, *Sternbergia clusiana* (Ker-Gawl.) Ker-Gawl. ex Spreng., *Fritillaria imperialis* L., *Aethionema capitatum* Boiss. & Balansa, *Dianthus zonatus* Fenzl var. *zonatus*, and *Hypericum lydium* Boiss.

Conservational status: The known population is confined to an area less than 10 km^2, and the total number of individuals is approximately 50-100. Therefore, this new species should be regarded as 'Critically Endangered' (CR) according to the IUCN threat categories (IUCN, 2001).

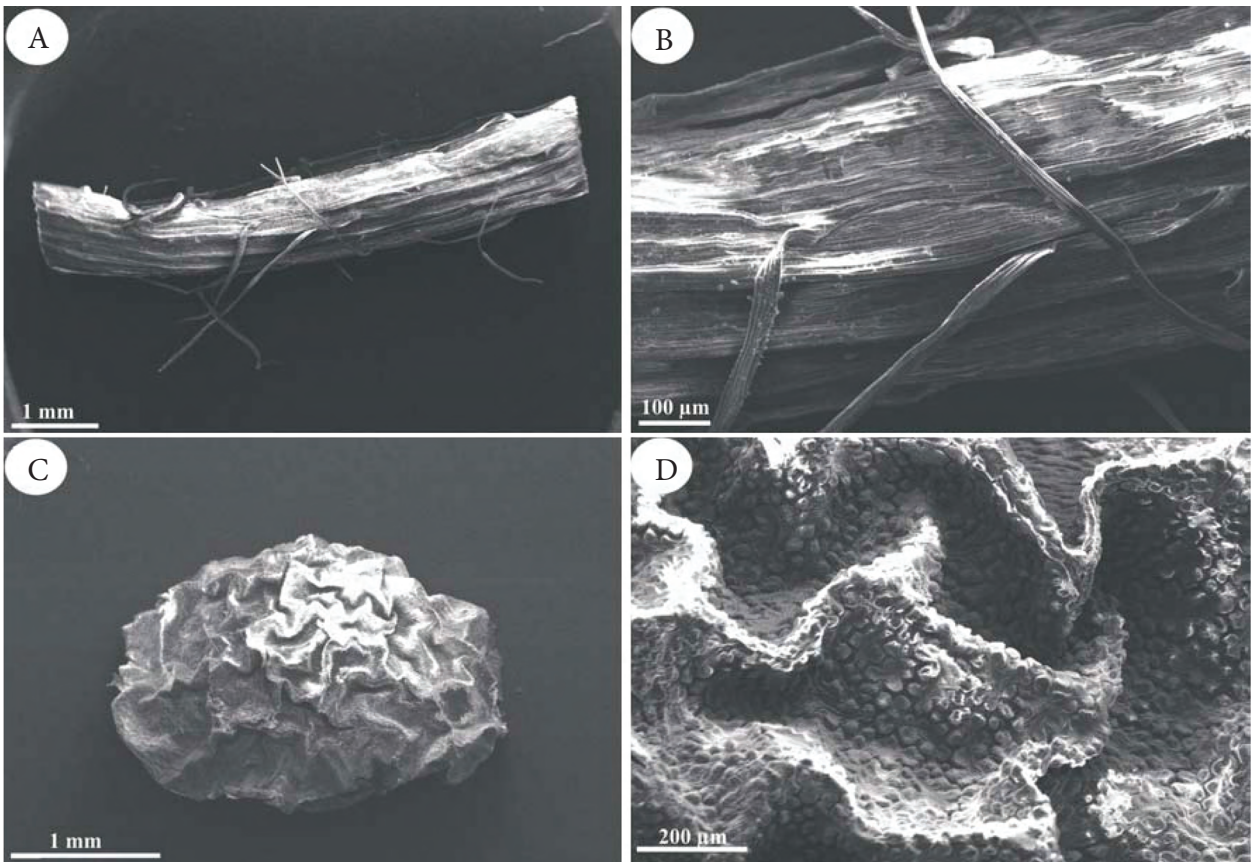

Figure 4. SEM photographs of *Ornithogalum malatyanum*. **A** and **B**-leaf hairs (from *B.Mutlu* 11176 & Ş.Karakuş), **C** and **D**-seed coat (from *B.Mutlu* 11235 & Ş.Karakuş).

Discussion and conclusion

Taxonomic and nomenclatural confusion regarding the species *Ornithogalum pyrenaicum* has been recognised since it was firstly published. This species was described originally by Linnaeus in *Species Plantarum* (Linnaeus, 1753). Later Desfontaines (1798) published this name for the second time in *Flora Atlantica*. Rafinesque (1837) incorrectly transferred this species to the genus *Loncomelos* Raf. (as *Loncomelos pyrenaicum* (L.) Raf.) because the species name is given there only by its specific epithet corresponding by its genus to *Ornithogalum* (neuter) and not to *Loncomelos* (masculine). This name was correctly published by Holub (1988) as *Loncomelos pyrenaicus* (L.) L.D.Hrouda ex Holub.

The species *Ornithogalum sphaerocarpum* was described firstly by Kerner (1878). Later Hegi (1909) regarded it as a subspecies of *Ornithogalum pyrenaicum* L. (*O. pyrenaicum* L. subsp. *sphaerocarpum* (A.Kerner) Hegi). This taxonomic situation was accepted in a revisional study on the *Ornithogalum* by Wittmann (1985). Holub (1988) transferred this taxon to the genus *Loncomelos* (as *L. pyrenaicus* (L.) L.D.Hrouda ex Holub subsp. *sphaerocarpus* (A.Kerner) Holub).

Recently phylogenetic analysis on Ornithogaloideae of molecular data, in combination with *matK*, *trnL* intron, *trnL-F* spacer, and *rbcL* plastid DNA sequence data, has established that the genus *Loncomelos* Raf. is a synonym of the genus *Ornithogalum* L. in the section *Ornithogalum* (Manning et al., 2009).

Ornithogalum malatyanum is closely allied to *Ornithogalum pyrenaicum* subsp. *sphaerocarpum*, *O. narbonense*, and *O. sorgerae*, especially because of

its cylindrical inflorescence and flowers numbering more than 15 (Cullen, 1984). However, it is clearly different from them by its hairs on the leaves' surface (not glabrous) (Figures 1, 4), pedicel 10-15 mm in fruit (not 15-40 mm), and style more than 3 mm (Figure 1).

Three types of seed were described by Moret et al. (1990) on the basis of the ornamentation pattern of testa cells. Although these types were thought to characterise different subgenera of *Ornithogalum*, a direct relationship has not been demonstrated as shown by Coşkunçelebi et al. (2000), Bednorz and Czarna (2008), and Moret et al. (1990), who found more than one seed type in various sections of the genus. Regarding seed shape, the primary and secondary sculpture of *O. pyrenaicum* was described as angular, rugose, and undulate-partly reticulate by Bednorz and Czarna (2008), whereas the seed morphology of *O. malatyanum* was characterised in our study as angular, alveolate, and tuberculate (Figure 4).

The chromosome number of *Ornithogalum malatyanum* was 2n = 24 (Figure 2), while different chromosome counts were reported in *O. narbonense* (2n = 14, 14 + 1B, 14 + 2B, 14 + 5B, 16, 18, 22, 24, 28, 36, 46, 52, 52 + 2B, 52 + 11B, 54, 88), *O. sorgerae* (2n = 18), and *O. pyrenaicum* subsp. *sphaerocarpum* (2n = 16, 16 + 2B, 17, 18, 24, 32) (Lungeanu, 1972; Capineri et al., 1978; Murin & Majovsky, 1979; Wittmann, 1985; Tornadore, 1986; Moret, 1987; Galland, 1988; Davis et al., 1988b; Druskovic & Lovka, 1995; Markova & Goranova, 1996; Özhatay et al., 2000).

A more detailed comparison of the new species with relevant species is given in the Table. Considering all these results, *Ornithogalum malatyanum* was evaluated as a new species. Consequently the total number of *Ornithogalum* species in Turkey is now 54. Given the number of species all over the world, Anatolia is an important distribution area for the genus *Ornithogalum*.

The following key, an excerpt from the *Flora of Turkey*, contains those species thought related to *Ornithogalum malatyanum*

Table. Comparison of diagnostic characters of *Ornithogalum malatyanum* and related species.

Characters	*O. malatyanum*	*O. pyrenaicum* subsp. *sphaerocarpum*	*O. narbonense*	*O. sorgerae*
Presence of hairs on leaves	+	-	-	-
Margin of leaves	entire	entire or denticulate	entire or denticulate	denticulate
Capsule shape	ovoid or globose	ovoid or obconical	ovoid or ovoid-cylindrical	ovoid
Bract teeth number	0-1(-2)	0	0	0
Fruiting pedicel length (mm)	10-15	20-25	15-40	7-23
Filament length (mm)	5.5-6	3-5.5	5-7.5	4.5-5.5
Style length (mm)	4-5.3	2.5-3.3	(3.5-)4.2-5.5	(1.8-)2-2.7(3)
Flower number	(18-)20-30(-55)	25-40	25-75	(15-)17-23(-28)
Leaf width (mm)	(3-)4-10(-11)	2-5	5-16	4-15
Chromosome number (2n)	24	16, 16 + 2B, 17, 18, 24, 32	14, 14 + 1B, 14 + 2B, 14 + 3B, 14 + 5B, 16, 18, 22, 24, 28, 36, 46, 52, 52 + 2B, 52 + 11B, 54, 88	18

1. Stylus up to 3.3 mm.....2
1. Stylus more than 3.3 mm.....3
2. Perigon rolls itself during the anthesis in the longitudinal direction.....*O. pyrenaicum*
2. Perigon either without each longitudinal rolling, or this begins only after the anthesis....*O. sorgerae*
3. Leaves glabrous, margins entire or denticulate; bract teeth absent.....4
3. Leaves hairy, margins entire; fruiting pedicel length 10-15 mm; bract teeth number 0-(-2).....*O. malatyanum*
4. Leaves linear-filiform, 1-4 mm broad, without a white line on upper surface, raceme 3-25 flowered; fruiting pedicel length 6-12 mm...*O. pamphylicum*
4. Leaves , linear, to 16 mm broad, with a white line on upper surface, raceme 25-75 flowered; fruiting pedicel length 15-40 mm.....*O. narbonense*

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Appendix

Examined specimens: – *Ornithogalum narbonense*: **Turkey**. A1 İstanbul: Belgrad forest, 19.VI.1967, *N.Touken s.n.* (ISTE); Tekirdağ: Hayrabolu, Şalgamlı village, Yörgüç area, 13.VI.1992, *E.Akalın s.n.* (ISTE); A2 Bursa: İnegöl, Cerrah village, field side, 15.VI.1987, *A.Baytop s.n.* (ISTE); A4 Ankara: Çubuk stream 18.V.1939, *B.Kasaplıgil s.n.* (ANK); A9 Kars: Kağızman, between Paslı and Çilehane village, 1500-1650 m, 15.VI.1980, *V.Güneş* 1605 (HUB); B1 İzmir: Çamlıhisar roadside, Çamlık, 19.VI.1974, *G.Entem s.n.* (ISTE); B5 Kayseri: Ürgüp roadside, Başköy, 11.VI.1971, *A.Baytop s.n.* (ISTE); B6 Malatya: Darende, N side of Gürpınar waterfall, 1300 m, 18.V.2008, *Ş.Karakuş* 329 (INU); Venk village, North side of Tavşan Hill, E side, 1500-1600 m, 9.VI.2010, *B.Mutlu* 11137 & Ş.Karakuş (INU); Sivas: Bingöl to Akpınar, 1700 m, gypsum area, 26.VI.1986, *N.Çelik* 4529 (CUFH); Kayseri: Pınarbaşı, Kavak village, Hınzır Mountain, 1850 m, 16.VII.1981, *N.Çelik* 1984 (CUFH); B7 Sivas: 4 km from Sincan to Divriği, garden side, 1323 m, 01.VI.2002, *A.A.Dönmez* 10875 & *B.Mutlu,* (HUB); B9 Ağrı: Balık Lake, 12.VII.1979, *A.Baytop s.n.* (ISTE); C1 Aydın: Kuşadası, Söke, 6 km from Kuşadası, field side, 30.V.1972, *A.Baytop s.n.* (ISTE); C2 Antalya: between Antalya and Kaşkale, 22.VI.1978, *A.Baytop s.n.* (ISTE); C3 Antalya: Elmalı, Çığlıkara, 5 km S of Kabakçılar, clearing in forest, 1760 m, 26.VI.1975 *R.Çelik* 1567 (ANK); C4 Konya: between Karaman and Bucakkışla Meraatan area, 1200 m, 07.VI.1978, *M.Vural* 823 (ANK); C5 Adana: Pozantı, 750 m, 1986, *Sche s.n.* (ANK); C6 Malatya: 3 km from Erkenek to Sürgü, Deveyatağı, limestone slopes, 1400 m, 28.V.1989, *E.Aktoklu* 1613 & *B.Yıldız* (INU); Erkenek, E of Büngüldek, steppe and slopes, 1550-1650 m, 14.V.1989, *E.Aktoklu* 1613 & *B.Yıldız* (INU); C7 Adıyaman: between Kahta and Çaylarbaşı, 14.V.1976, *B.Baytop s.n.* (ISTE) - *Ornithogalum pyrenaicum* subsp. *sphaerocarpum*: **Turkey**. A1 Edirne: Kalkansöğüt, 14.V.1989 *G.Dalgıç s.n.* (ISTE); A2 İstanbul: Çatalca, Hadımköy, 60 m, 25.VI.2002, İ.Genç 1429 (ISTE); A3 Ankara: between Beypazarı and Kıbrıscık, Yiğerler village, 1300 m, 01.VI.2001, *A.A.Dönmez* 8956 (HUB); A4 Ankara: Güdül, Kimir stream, Çerçininkaya site, SE slopes, 750 m, 16.VI.2001, *B.Tarıkahya* 1236 (HUB); A5 Yozgat: Çekerek Yavıhasan-Çalınpınar, 1500 m, 28.VI.1979, *R.İlarslan s.n.* (ANK); B1 Balıkesir: Ayvalık, Alibey Island, 07.V.1995, *K.Alpınar s.n.* (ISTE); B2 Eskişehir: 14 km from Eskişehir to Kütahya, rocky area, 06.VI.1973, *A.Baytop s.n.* (ISTE); B3 Isparta: Şarkikaraağaç, Kızıldağ National Park, N side of Küçüksivri Hill, 1250-1300 m, *C.libani* forest, 25.VII.1994, *B.Mutlu* 864 (INU-HUB); B4 Ankara: Küçükesat, 31.V.1942, *H.Bağda s.n.* (ANK); Ankara: Beytepe, 1000 m, *Erik s.n.* (HUB 10866). B5 Yozgat, Akdağmadeni, *T.Ekim s.n.* (ANK); B6 Sivas: Divriği, Dumlucadağ, 30.V.1968, *B.Baytop s.n.* (ISTE); Malatya: Darende, Irmaklı village, near side of Tohma Stream, 940 m, 28.V.2009, *Ş.Karakuş* 1230 (INU); B7 Erzincan: Kemaliye, between Venk bridge and Salihli village, *Quercus* forest, 912 m, 14.V.2006, *non leg. (*HUB); C1 Aydın: Söke, Sazlıköy, Sugözü, 13.V.1983, *K.Alpınar s.n.* (ISTE); C3 Burdur: 6 km from Burdur to Antalya, 25.V.1966, *A.Baytop s.n.* (ISTE); C4 Antalya: Alanya, Göksu Valley, Dikmetaş village, *Quercus* forest, 1478 m, 12.V.2006, *A.A.Dönmez* 13346, *B.Mutlu* & *T.Ağar* (HUB); C6 İskenderun: Arsuz, Ilıca, Amanos Mountain, 700 m, 09.VI.1967, *Y.Akman s.n.* (ANK) - *Ornithogalum sorgerae*: **Turkey**. B6 Malatya: Darende, 2 km from turn to Irmaklı village, 21.VI.2009, *Ş.Karakuş* 1514 (INU).