



## *Verbascum faik-karaveliogullarii* (Scrophulariaceae), a new species from southeastern Anatolia, Turkey

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### Abstract

*Verbascum faik-karaveliogullarii* Çingay & Cabi (sect. *Bothrospermae*) is described as new to science from Hâkkari province (SE Anatolia, Turkey). This new species shows affinities to both *Verbascum afyonense* from inner Anatolia and *Verbascum spectabile* var. *isandrum* from N Anatolia. Its connections to and diagnostic differences from these species are discussed. A detailed description including pollen and seed morphologies, map and threat category of the new species are also given.

**Keywords:** Anatolia, endemics, Plantaginaceae, taxonomy, *Verbascum* sect. *Bothrospermae*

### Introduction

The genus *Verbascum* Linnaeus (1753: 177) (excluding *Celsia* Linnaeus 1753: 621) (Scrophulariaceae, vel Plantaginaceae sensu APG 2016) includes approximately 360 species worldwide (Heywood 1993, Mabberley 2008). In Turkey, 251 *Verbascum* species and 130 additional hybrids occur, which have been divided into thirteen partly artificial groups. Among them, 196 are Turkish endemics and the endemism ratio is about 80% (Huber-Morath 1978a, Sutory 2001, 2004, Karavelioğulları *et al.* 2004, 2006, 2008, 2009, 2011, Özhatay 2006, Kaynak *et al.* 2006, Parolly & Tan 2007, Parolly & Eren 2008, Dane & Yılmaz 2005, Yılmaz & Dane 2008, Fırat 2015, Karavelioğulları 2009, 2012, 2015a-b 2016, Karavelioğulları *et al.* 2014a-b, Çingay & Karavelioğulları 2016).

*Verbascum* has been arranged into two sections (Murbeck 1933), *V.* sect. *Aulacospermae* Murbeck (1933: 593) and *V.* sect. *Bothrospermae* Murbeck (1933: 82), mostly based on seed morphology. In sect. *Aulacospermae* seeds are longitudinally corrugated, whereas in sect. *Bothrospermae* they are transversally corrugated and alveolate. All species of *Verbascum* in Turkey belong to *V.* sect. *Bothrospermae* (Murbeck 1925, 1933, Huber-Morath 1971).

As summarised in Çingay & Karavelioğulları (2016), *Verbascum* was previously revised by Huber-Morath (1978a) for the *Flora of Turkey*. Later, five species and six hybrids were described for that country (Davis *et al.* 1988, Vural & Aydoğdu 1993, Ekim 2000). Additionally, in the last decade fifteen new species and six new hybrids were published (Sutory 2001, 2004, Karavelioğulları *et al.* 2004, 2006, Kaynak *et al.* 2006, Karavelioğulları & Aytaç 2008, Karavelioğulları *et al.* 2009b, Dane & Yılmaz 2009, Bani *et al.* 2010, Karavelioğulları *et al.* 2011, 2012, Karavelioğulları *et al.* 2014a, Çingay & Karavelioğulları 2016), and nine species were firstly recorded for Turkey (Dane & Yılmaz 2005, Yılmaz & Dane 2008, Karavelioğulları 2009b, 2014a, 2014b, 2015a, 2015b, 2015c, 2016).

During field work in 2015, some unusual *Verbascum* specimens were collected from Hâkkari province, southeastern Anatolia. At first glance, those plants seemed to be akin to both *Verbascum afyonense* Huber-Morath (1976: 232) from inner Anatolia and *Verbascum spectabile* Marschall von Bieberstein (1819: 158) var. *isandrum* Huber-Morath (1978b: 22) from N Anatolia. However, they exhibited noticeable morphological differences in indumentum, bracts, flowers, and capsules allowing easy differentiation from other known taxa in *Verbascum*. Consequently, in the present study a new Turkish species is described for those Hâkkari plants, which is named *V. karaveliogullarii*.

## Materials and methods

Observations were undertaken on living plants, dried specimens, and digital images from the herbaria GAZI, ANK, G, K, E, W and LD (herbarium acronyms follow Thiers (2018+)). The specimens collected in Hâkkari were cross-checked with the keys provided by Huber-Morath (1978, 1981) and the *Verbascum* accounts were given in various relevant publications such as Feinbrun-Dothan (1978a-b), Meikle (1985), and Boulos (2009).

Measurements were carried out both on the field and in laboratory using calliper and stereo-binocular microscope (Olympus SZ61 with incorporated BAB microscope camera). In the given description, each numerical value is an average of ten measurements from different specimens. We also compared our specimens with *Verbascum afyonense* and *Verbascum spectabile* var. *isandrum* collections in Turkey. Pollen samples were obtained from herbarium specimens and prepared following the standard method of Wodehouse (1935). For pollen measurements, approximately 50 pollen grains were examined by using a light microscope (Leica ICC50). The following measurements were made on 25 pollen grains from each specimen: polar axis (P), equatorial diameter (E), distance between colpi, colpus length, pore length, pore width, and shape index (P/E).

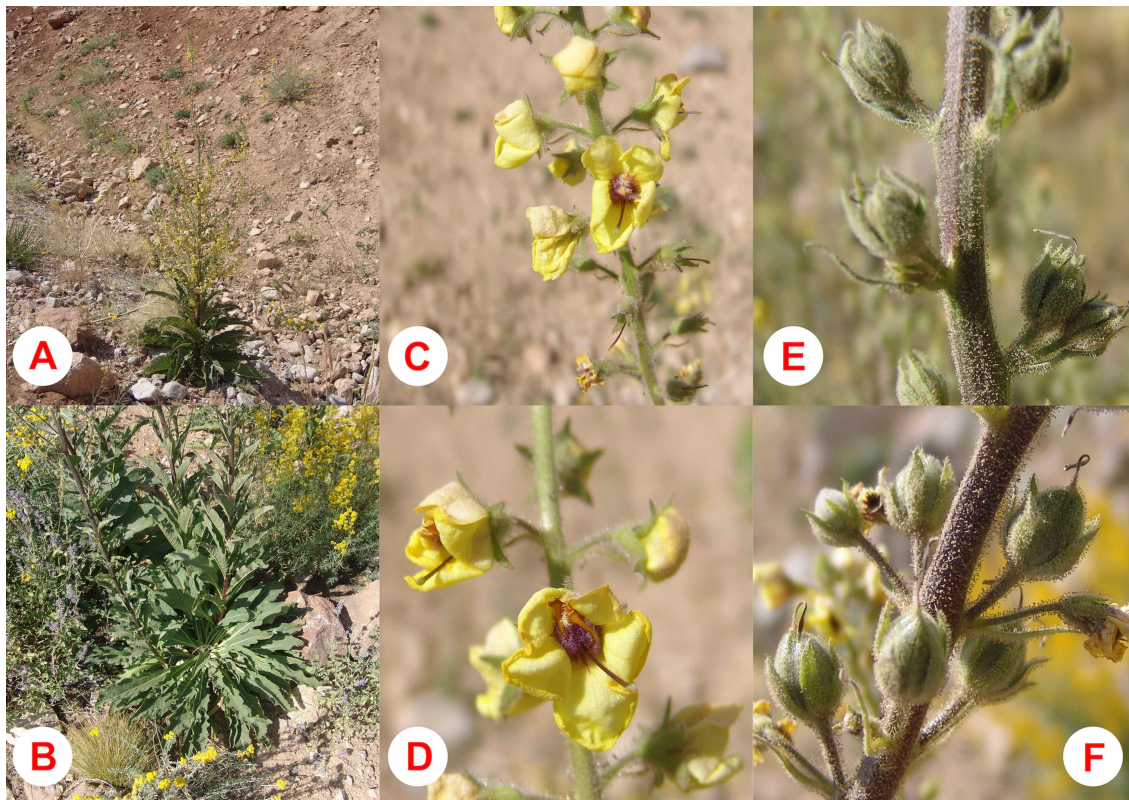
For seed measurements, some 20 ripened seeds were examined under stereo-binocular microscope (Leica EZ4HD). For scanning electron microscope (SEM) observations, selected pollen grains and seeds were placed on aluminium stubs using double-sided adhesive tape, which were gold-coated with Emiteck K550 sputter, and then examined using JEOL Neoscope JCM-5000.

Biogeographic typology follows Tahktajan (1986), whereas bioclimatic nomenclature matches classification by Thornthwaite (1948) and Köppen (1936). The threat category assessment of the new species was defined according to the IUCN criteria (IUCN 2014).

## Results

*Verbascum faik-karaveliogullarii* Çingay & Cabi *sp. nov.* (Fig. 1–2)

**Type:**—TURKEY. C9 Hâkkari: 11 km north of Hâkkari, Berçelan Yaylası, riverside, limestone rocks, 2779 m elevation, 17 July 2015, B. Çingay 5317, F.A. Karavelioğlu, H. Tek & A. Akbaba (holotype: NGBB 4801!, isotypes: ANK!, CBB!).



**FIGURE 1.** *Verbascum faik-karaveliogullarii* in Hâkkari, southeastern Anatolia, Turkey (type locality). **A)** Plant in habitat, limestone rocks; **B)** Basal leaves; **C)** Inflorescences; **D)** Flowers; **E–F)** Fruits in clusters.



**FIGURE 2.** *Verbascum faik-karaveliogullarii*. **A)** Basal leaves; **B)** Upper surface of basal leaves; **C)** Stem and inflorescence; **D)** Surface of stem leaves; **E)** Seed; **F-G)** Stamens; **H)** Gynoecium; **I)** Cluster of fruits; **J)** Adnation of stamens to corolla. (Drawings by Nihan Şişli).

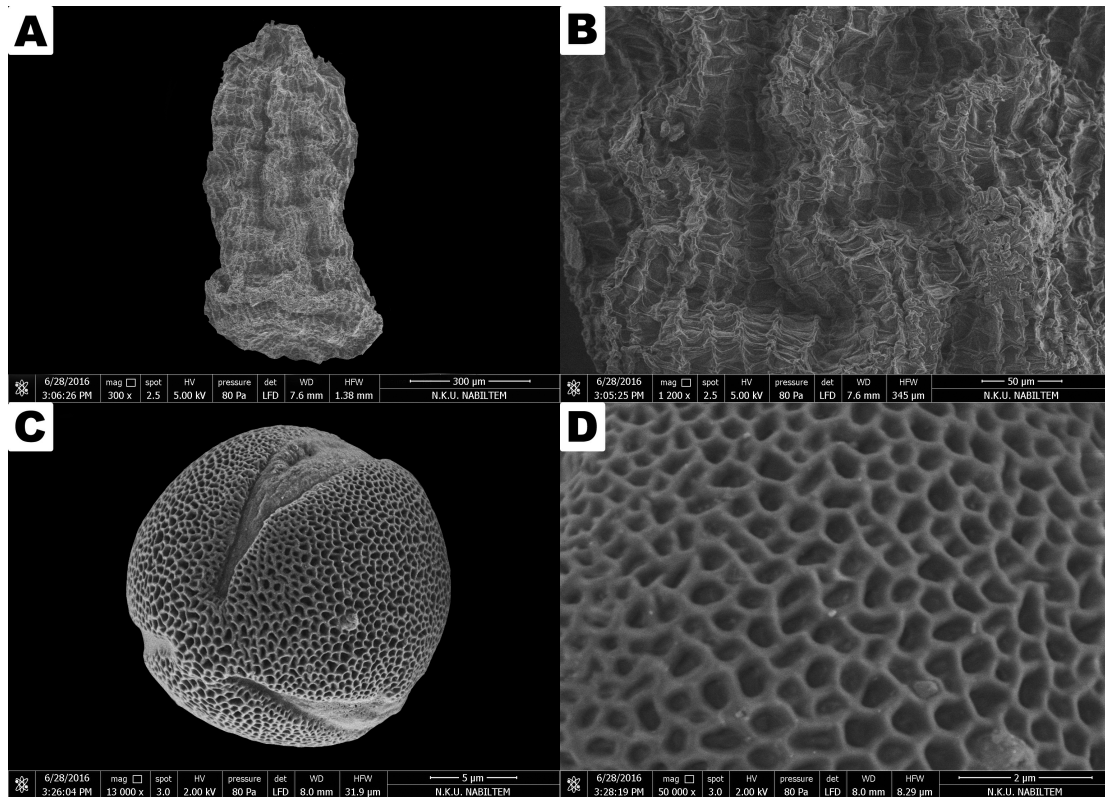
**Diagnosis:**—*Verbascum faik-karaveliogullarii* can be easily distinguished by its inflorescence bearing upper bracts 1-flowered and lower bracts 2–3-flowered (neither all bracts many-flowered nor all bracts 1-flowered); glandular-stellate indumentum all over the stem; upper cauline leaves crenulate-serrate; lower bracts oblong-lanceolate; all anthers reniform, the 2 anterior oblique-inserted, ca. 1–2 mm long; capsule globose with stellate-glandular hairs. This combination of characters is unique among the Turkish species of the genus, and it therefore permits easy identification (Table 1).

**TABLE 1.** Diagnostic morphological features of *Verbascum faik-karaveliogullarii*, *V. afyonense* and *V. spectabile* var. *isandrum*.

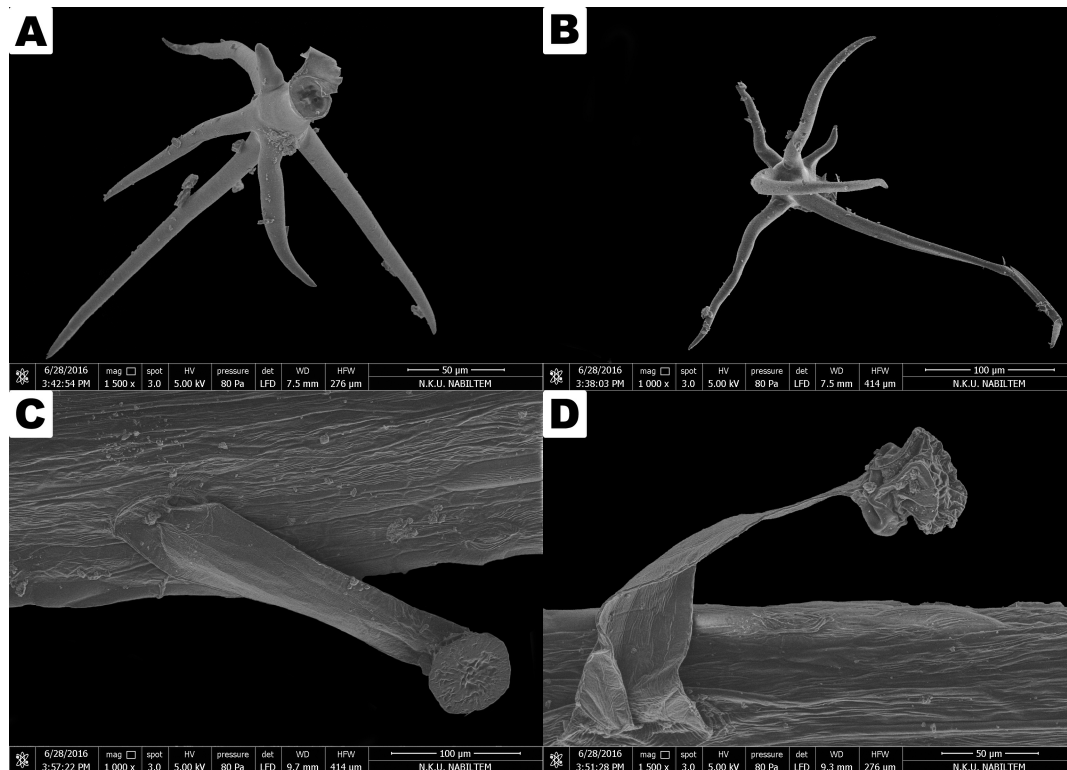
Characters	<i>Verbascum faik-karaveliogullarii</i>	<i>V. afyonense</i>	<i>V. spectabile</i> var. <i>isandrum</i>
Stem indumentum	glandular-stellate indumentum all over stem	woolly-with arachnoid indumentum of branched eglandular hairs from base to first cauline leaves and simple, articulate, eglandular and shorter glandular hairs covered above the branched stems	dense indumentum of branched eglandular hairs below, and simple, articulate, eglandular and shorter glandular hairs above
Upper cauline leaves	lanceolate to ovate, acute to acuminate at apex, crenulate-serrate	lanceolate, acuminate, entire	lanceolate to linear lanceolate, acuminate, finely crenulate
Clusters of inflorescence	bract with a single flower in its axil, rarely lower bracts with 2–3 flowers	bract with a single flowers	bract with a single flowers
Shape of lower bracts	oblong-lanceolate	cordate-auriculate	linear-lanceolate to thread-like
Shape of calyx lobes	oblong-lanceolate	lanceolate	linear or oblong - lanceolate
Corolla indumentum	covered with glandular and stellate hairs outside	covered with hairs only glandular outside	covered with glandular and stellate hairs outside
Anthers	all reniform, 2 anterior glabrous above, oblique-inserted, ca. 1–2 mm long	2 anterior glabrous above, linear-oblong, 3–4 mm, decurrent, posterior reniform, medifixed	all reniform, 2 anterior glabrous above, not decurrent, ca. 2–2.5 mm long
Capsule indumentum	globose, covered with stellate glandular hairs	broadly ovate, with spreading glandular and eglandular hairs	elliptic to broadly ovate, covered with densely tomentose hairs
Distribution	Turkey: Hakkari	Turkey: Afyon, Kırıkkale	Turkey: Zonguldak, Kastamonu
Habitat	Rocky limestone slopes, 1881 m elevation	<i>Quercus</i> scrub, pastures, 1450 m elevation	Rocky limestone slopes, <i>Quercus</i> scrub, pastures, 300–1900 m elevation

**Description:**—Hard and rough biennial herbs. *Stem* 30–150 cm tall, purplish, robust, single or usually with a few short branches above middle, terete, angular-striate, covered all over with glandular-stellate hairs. *Leaves* alternate, mostly condensed at base in a dense persistent rosette, upper and lower surface covered with dense white stellate hairs; *basal leaves* with petiole 2–6 cm long, blade 5–25 × 1–6 cm, dark green when fresh, purplish brown when dried, lanceolate, indistinctly crenulate-serrate, acute, cuneate at base; *cauline leaves* decreasing in size toward flowering part of stem; *lower cauline leaves* sessile or with petiole up to 1 cm long, blade 5–8 × 1.5–2 cm, lanceolate, acute, crenulate-serrate, *upper cauline leaves* sessile, blade 0.5–1.5 × 2.5–4.5 cm, lanceolate-ovate, acute to acuminate at apex, crenulate-serrate. *Inflorescence* with numerous branches, forming lax, pyramidal panicle, with clusters 1–2 (–3) flowers. *Upper bracts* lanceolate to linear, acuminate, 3–10 mm long, 1-flowered. *Lower bracts* oblong-lanceolate, 2.5–6 cm long, 2–3-flowered. *Pedicels* 5–15 mm long, ebracteolate. *Calyx* 3–5 mm long, lobes oblong-lanceolate, mucronate. *Corolla* yellow, 10–15 mm in diameter, without pellucid glands, glandular-stellate outside. *Stamens* 5,

fertile, all anthers reniform, 2 anterior ones oblique-inserted, ca. 1–2 mm long; 2 anterior filaments covered with purple-violet wool, glabrous near apex, 3 posterior ones with purple-violet wool in the lower  $\frac{3}{4}$ , whitish above. *Pollen grains* radially symmetrical, isopolar, prolate- spheroidal, and tricolporate (Table 2, Fig. 3C–D). *Capsule* globose, 5–7 × 4–6 mm, covered with stellate glandular hairs (Fig. 4). *Seeds* rod-shaped, ca. 0.7 × 0.9 mm, reddish-brown to brown, transversally corrugated (Fig. 3A–B).



**FIGURE 3.** *Verbascum faik-karaveliogullarii*. **A)** Seed rod-shaped; **B)** Transversally corrugated textured; **C)** Equatorial view of pollen grain; **D)** Exine ornamentation.



**FIGURE 4.** *Verbascum faik-karaveliogullarii*. **A–B)** Stellate hair of capsule indumentum; **C–D)** Glandular hair of capsule indumentum.

**TABLE 2.** Quantitative analysis of the pollen morphology of *Verbascum faik-karaveliogullarii*. All dimensions are in  $\mu\text{m}$ . Mean value is shown in brackets.

Characters	<i>Verbascum faik-karaveliogullarii</i>
Polar axis (P)	17.96–[22.42]–28.1
Equatorial diameter (E)	16.71–[20.51]–23.49
Distance between colpi	4.28–[6.24]–8.39
Colpus length	16.15–[18.71]–20.9
Colpus width	4.99–[6.75]–8.09
Pore length	2.66–[3.7]–5.91
Pore width	2.24–[3.54]–6.46
Shape index (P/E)	ca. 1.09

**Eponymy:**—The new *Verbascum* species honours Dr. Faik Karavelioğulları, who passed away on 5 January 2018 at the age of 50, as a consequence of brain haemorrhage. He was an eminent scholar and researcher of the flora of Turkey and a world authority on the genus *Verbascum*. The Turkish name of the newly described species is given as “Yadigâr sığırkuyruğu”, according to the guidelines of Menemen *et al.* (2013).

**Habitat and ecology:**—*Verbascum faik-karaveliogullarii* grows on deep limestone rocky slopes (Fig. 1A), at 2700–2800 m elevation near Hâkkari, where it endures harsh climate conditions. Hâkkari province has a continental climate (Köppen 1936). Winter is cold and snowy with an average of  $-5\text{ }^{\circ}\text{C}$ ; summer is hot and dry with an average of  $25\text{ }^{\circ}\text{C}$ . Climate classification of this province according to Thornthwaite (1948) method is B1 (humid), B'1 (mesothermal), s2 (summer deficient in rainfall), b'2 (Summer PE concentration % 61).

The new species occurs on calcareous limestone rocky slopes with chasmophytic vegetation, whereas the morphologically similar *V. afyonense* is found in *Quercus* scrub and pastures, and *V. spectabile* var. *isandrum* occurs in rocky limestone slopes, *Quercus* scrub and pastures. Species growing in the near vicinity of *V. faik-karaveliogullarii* include *Thymus pubescens* Boiss. & Kotschy ex Čelakovski (1883: 152), *Tanacetum kotschyi* (Boissier 1846: 88) Grierson (1975: 435), *Campanula glomerata* Linnaeus (1753: 166), *Cephalaria sparsipilosa* Matthews (1972: 596), *Papaver setiferum* Goldblatt (2011: 182), *Consolida orientalis* Schrödinger (1909: 27, 62), and *Silene chlorifolia* Smith (1789: pl. 13).

**Phenology:**—The new species flowers in June, and fruits are produced in August.

**Distribution and biogeography:**—*Verbascum faik-karaveliogullarii* is a local endemic limited to calcareous, rocky areas of Berçalan Plateau in Hâkkari, southeastern Anatolia (Fig. 5), which together with other representatives of the genus can be regarded as representative of the Southeastern Anatolian province, Irano-Turanian region (Takhtajan 1986). Therefore, further prospective effort is to be developed on high plateau and limestone rocky palace areas of the surrounding territories in the cited biogeographical region in order to locate eventual new populations of the new species.

**Suggested conservational status:**—*Verbascum faik-karaveliogullarii* Çingay & Cabi is known only from Hâkkari in southeastern Anatolia, Turkey (Fig. 5). To our current knowledge, the area of occupancy of the new species can be estimated to be less than  $10\text{ km}^2$ , in which about 600 individuals are estimated to occur. Overgrazing by sheep and goat herds on individuals nearby to soil level was observed. Therefore, it should be classified as “Critically Endangered” (CR), on the basis of criterion [CR B2a(ii)+b(iii)] of the IUCN threat categories (IUCN 2014) on account of its restricted distribution and anthropogenic effects on the population.

#### Identification key to *Verbascum faik-karaveliogullarii*

1	Anthers of 2 anterior stamens elongate, longitudinally inserted .....	2
–	Anthers all reniform, transversely medifixed .....	6
2	Corolla violet purple .....	<i>V. wiedemannianum</i>
–	Corolla yellow .....	3
3	Filament hairs white or yellow .....	<i>V. subnivale</i>
–	Filament hairs purple-violet .....	4

4	Corolla indumentum glandular and stellate hairs outside .....	5
–	Corolla indumentum glandular .....	<i>V. spectabile</i> var. <i>isandrum</i>
5	Shape of lower bracts oblong-lanceolate .....	<i>V. faik-karaveliogullarii</i> sp. nova
–	Shape of lower bracts linear-lanceolate .....	<i>V. afyonense</i>
6	Corolla glabrous outside .....	
	.....( <i>V. eriocarpum</i> , <i>V. lanchnopus</i> , <i>V. germaniciae</i> , <i>V. eleonora</i> , <i>V. leiocladum</i> , <i>V. laetum</i> , <i>V. rubricaula</i> , <i>V. adenocaulon</i> , <i>V. tunaekimii</i> )	
–	Corolla (at least in bud) with glandular or eglandular hairs outside .....	7
7	Corolla with simple hairs only .....	( <i>V. biscutellifolium</i> , <i>V. pseudoholotrichum</i> )
–	Corolla with branched eglandular hairs outside, often mixed with glandular hairs .....	8
8	Plants perennial, woody at base not typically “Verbascum-like” habit .....	
	.....( <i>V. helianthemoides</i> , <i>V. pestalozzae</i> , <i>V. dumulosum</i> , <i>V. inulifolium</i> , <i>V. pterocalycinum</i> )	
–	Plants biennial, with typical “Verbascum-like” habit .....	9
9	Calyx lobes lanceolate .....	( <i>V. isauricum</i> , <i>V. chrysorrhacos</i> , <i>V. gracilescens</i> , <i>V. alepence</i> )
–	Calyx lobes linear, oblong, obovate, oblong-lanceolate .....	10
10	All filaments hairy up to anthers .....	<i>V. pyramidatum</i>
–	Two anterior filaments glabrous near apex .....	11
11	Filaments with purple-violet hairs .....	12
–	Filaments with yellowish or whitish hairs .....	15
12	Capsule ovate .....	13
–	Capsule oblong-elliptic to broadly ovate .....	14
13	Basal leaves oblong .....	<i>V. leuconeurum</i>
–	Basal leaves lanceolate .....	<i>V. kurdistanicum</i>
14	Pedicel to 15 mm .....	14a
14a.	Stamens decurrent, 4–6 mm .....	<i>V. spectabile</i> var. <i>spectabile</i>
–	Stamens not decurrent, 2–2.5 mm .....	<i>V. spectabile</i> var. <i>isandrum</i>
–	Pedicel to 26 mm .....	<i>V. cicekdagensis</i>
15	Capsule ovate .....	<i>V. mecit-vuralii</i>
–	Capsule globose .....	<i>V. faik-karaveliogullarii</i>

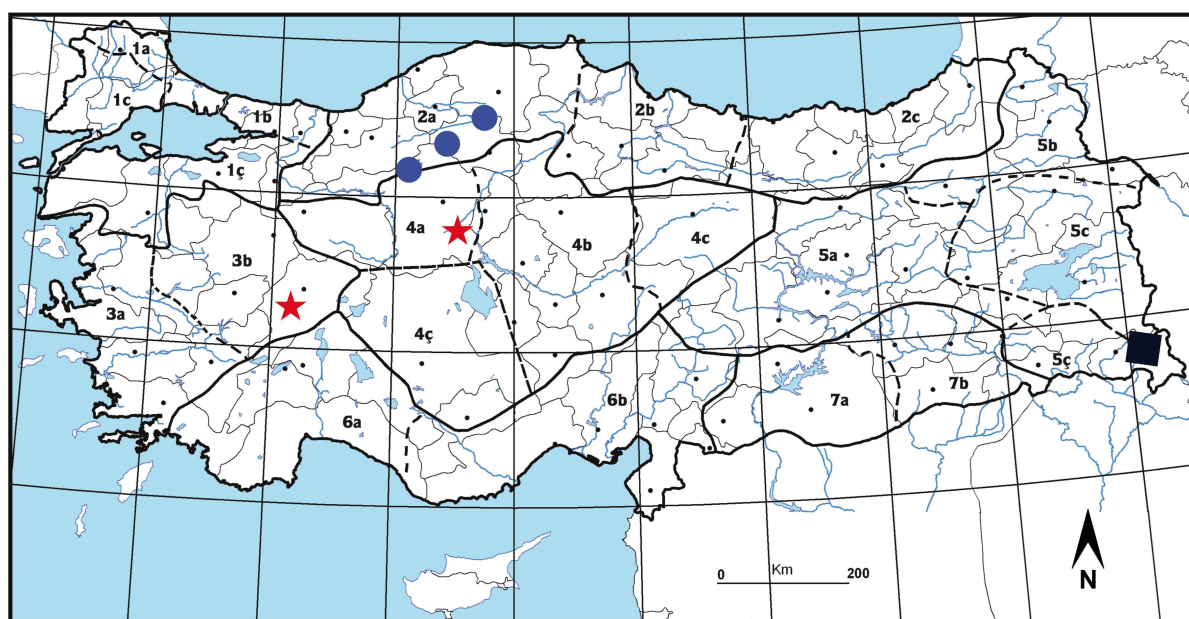


FIGURE 5. Distribution of *Verbascum faik-karaveliogullarii* (square), *V. afyonense* (stars) and *V. spectabile* var. *isandrum* (circles) in Turkey.

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## APPENDIX 1. Additional specimens examined.

*Verbascum afyonense*.—TURKEY. **B3** Afyon: Bayat, Köroğlu tepe - Yongalı tepe arası. ca. 1450 m elevation, 27 June 1975, *M. Vural 173* (holotype: ANK!). **A4** Kırıkkale: Koçubaba kasabası, Enikçayı Mevkii, ca. 1300 m elevation, *Quercus pubescence* çalılığı içi, 28 July 1994, *A.A.Dönmez 4100* (HUB 23869!).

*Verbascum spectabile* var. *isandrum*.—TURKEY. **A4** Kastamonu: İnebolu: Özlüce, Cevizliyanı Köyü, ca. 1000 m elevation, 30 May 1978, *O. Ketenoğlu 700, 701* (ANK!). **A4** Karabük: Keltepe üst seviyeler, ca. 1950 m elevation, 12 July 1984, *M. Demirors 1939* (ANK!). **A5** Kastamonu: Tosya - Yağcılar Köyü, Karanlık Dere mevkii, Tensil sahası, ca. 1500 m elevation, *A. Huber-Morath* (1976), (ANK!).

*Verbascum macrocarpum* Boiss.—TURKEY. **C9** Hâkkari: Between Karabey - Yüksekova, 2 km from Nehilsazlığı, meadows, 2700 m elevation, 05 June 2015, *F.A. Karavelioğlu 4100*. IRAN. Bors: Elymais, in humid, August 1886, *H.C. Haussknecht* (K000975886 [digital image!]).

*Verbascum blattaria* L.—TURKEY. **B7** Erzincan: Kemah, Beşikli village, steppe, 11.06.2013, *F.A. Karavelioğlu 3009*. —UNITED KINGDOM [cultivated]. Kew Gardens: North Arboretum, ought to grass in semi-shade at the edge of the \*Paddock (zone 104, OS monad 18.77), 11 July *T.A. Cope* (RBG 151) (K000914359 [digital image!]).

*Verbascum wiedemannianum* Fisch & C.A.Mey.—TURKEY. **B7** Erzincan: Tercan, Mercan, Yeşilyaka village, steppe, 06 June 2016, *F.A. Karavelioğlu 4272* (GAZİ!).

*Verbascum cicekdagensis* Karavel. & Vural.—TURKEY: **B5** Kırşehir: Çiçekdağı, between Küçükteflek and Sekili, 900 m elevation, roadside, 18 May 1995, *F.A. Karavelioğlu 2365* & *H. Polat* (holotype: GAZİ!; isotype: ANK!). **B5** Kırşehir: Çiçekdağı, between Küçükteflek and Sekili, 900 m elevation, calcareous stony slopes, roadside, 18 May 1994, *F.A. Karavelioğlu 2103* & *H. Polat* (GAZİ!) **B5** Kırşehir: Çiçekdağı, between Ömeruşağı and Kalevci, 900–950 m elevation, calcareous stony slopes, road-side, 19 May 1995, *H. Polat 1994* & *F. A. Karavelioğlu* (GAZİ!)