

A revision of *Centaurea* sect. *Centaurea* (Asteraceae) from Iran

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Abstract: A taxonomic review of *Centaurea* L. sect. *Centaurea* (Asteraceae) in Iran was carried out. Seven taxa are recognized and 1 of them is described as a new species: *Centaurea joharchii* Ranjbar & Negaresh. This new species has been described and illustrated from Khorasan Province, SE Iran. A new combination is proposed: *C. kermanshahensis* (Wagenitz) Ranjbar & Negaresh. In addition, *C. aggregata* Fisch. & C.A.Mey. ex DC. subsp. *aggregata* is typified and *C. diffusa* Lam. is reported here as a new record for Iran. Finally, a key to all species of the section *Centaurea* in Iran is provided.

Key words: Identification key, lectotypification, new species revision, taxonomy

1. Introduction

Subtribe Centaureinae (Asteraceae-Cardueae), centered mainly in the Mediterranean region (Wagenitz, 1986; Meusel and Jäger, 1992), contains about 31 genera with around 800 species (Hellwig, 2004). A wide array of growth and life forms are known among Centaureinae, ranging from tall shrubs to small annuals, the majority being polycarpic perennial herbs or monocarpic biennials (Hellwig, 2004). Following the progression in taxonomy, numerous taxonomic changes and rearrangements have been proposed in the genera of the subtribe Centaureinae (Garcia-Jacas et al., 2000; Wagenitz and Hellwig, 2000; Greuter, 2003; Hellwig, 2004; Martins and Hellwig, 2005; Garcia-Jacas et al., 2006; Hidalgo et al., 2006; Martins, 2006; Wagenitz et al., 2006; Susanna and Garcia-Jacas, 2007; Ranjbar et al., 2011, 2012a, 2012b; Ranjbar and Negaresh 2012). *Centaurea* L. is the largest genus of subtribe Centaureinae. *Flora Iranica* (Wagenitz, 1980) recognized 28 sections and 70 species for Iran.

The genus *Acrolophus* was described by Cassini (1827) to include species with small capitula, appendages squamous or coriaceous-scarious and decurrent, ciliate, and with short spines. Subsequently, de Candolle (1838) reduced this genus to a section of *Centaurea*, a position followed by subsequent workers (Garcia-Jacas et al., 2000; Garcia-Jacas et al., 2006; Wagenitz et al., 2006). Recently, *Centaurea* sect. *Centaurea* as a new name for the section and *C. paniculata* L. as a new type for the genus *Centaurea* were considered in Greuter's typification system (Greuter et al., 2001), and they are treated by us here for the flora of Iran.

Section *Centaurea* is centered mainly in the Mediterranean region, although several species grow outside this area. The basic chromosome number in sect. *Centaurea* is $x = 9$ (Bakhshi Khaniki, 1996; Garcia-Jacas et al., 1998a, 1998b; Romashchenko et al., 2004; López and Devesa, 2008; Trigas et al., 2008; Uysal, 2008; Martin, 2009).

Section *Centaurea* is still the subject of active research (e.g., Garcia-Jacas et al., 2006; Trigas et al., 2008) and new taxa in section are regularly described (e.g., Wagenitz et al., 2006; Trigas et al., 2008; Uysal, 2008; Strid and Tan, 2009; López et al., 2011). In his account of the section *Centaurea* (sensu sect. *Acrolophus*) for *Flora Iranica*, Wagenitz (1980) described 1 new subspecies (*C. intricata* subsp. *kermanshahensis* Wagenitz) and recognized a total number of 5 species that occur in this area. Taking into account the 2 subspecies common between Iran and Turkey (*C. aggregata* Fisch. & C.A.Mey. ex DC. subsp. *aggregata*, and *C. virgata* Lam. subsp. *squarrosa* (Boiss.) Gugler), Wagenitz (1975) listed 21 species in the section for Turkey. Some of these species are widespread, such as *C. virgata* and *C. aggregata*.

The aim of the present work is to resolve the morphological heterogeneity and synonyms of section *Centaurea* by studying living materials and herbarium specimens and the assignment of doubtful specimens. In addition, full descriptions of all species of the section *Centaurea* in Iran are presented. Finally, we expand the limits of the section *Centaurea* in Iran to include the 7 species enumerated here. As can be seen from recent

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papers in this journal (e.g., Aydın et al., 2013; Aytaç and Duman, 2013; Öztürk and Çetin, 2013; Yıldız et al., 2013; Yüksel et al., 2013), there is considerable active taxonomic research on the family Asteraceae.

2. Materials and methods

The present study includes a total of 39 populations collected from the distributional range of section *Centaurea* in Iran and all vouchers are deposited in the herbarium of the Bu-Ali Sina University Herbarium (BASU). The study also includes 150 herbarium specimens from the herbaria FUMH, E, B, G, G-DC, GOET, H, P, W, and WU. From plants in the field, a preliminary list of the characters that had been or may be useful in delimiting *Centaurea* taxa was developed. A range of taxonomically important characters in the section was investigated. The characters included the life form; the shape and length of leaves; the segmentation and shape of leaves; the shape, size, and number of involucre and appendages; the number, length, and shape of cilia; the length of spines; the color of florets; the size, shape, and color of achenes; and the shape, length, and color of the pappus. The shape of leaves and their segmentation and the shape of involucre, appendages, and the pappus are also important characters (Klokov, 1963; Wagenitz, 1975, 1980). Measurements were obtained from at least 5 replicates of each specimen in BASU and the average value was evaluated. The maximum and minimum values of the measures are given in the descriptions of taxa.

3. Results and discussion

Centaurea sect. *Centaurea* L., Sp. Pl. 2: 909 (1753).

≡ *Centaurea* sect. *Acrolophus* (Cass.) DC., Prod. 6: 581 (1838).

≡ *Acrolophus* Cass., Dict. Sciences Nat. 50: 253 (1827).

≡ *Centaurea* subgenus *Acrolophus* Spach, Hist. Vég. Phan. 10: 11 (1841).

Type: *C. paniculata* L. (Greuter et al., 2001).

= *Acosta* Adans., Fam. 2: 117 (1763).

Biennials, perennials, spiny subshrubs, or suffrutescent, often covered with arachnoid or tomentose hairs; usually copiously branched with many small capitula. Lower cauline leaves lyrate or more often pinnatifid to bipinnatifid, median cauline leaves usually pinnatifid or pinnatilobate, the upper ones usually smaller and simple. Involucre small, 7–13 × 2.5–8 mm, ovoid to fusiform; phyllaries usually herbaceous or herbaceous-coriaceous, often with elevated longitudinal nerves. Appendages ±triangular, scarious, or semicoriaceous, decurrent with a narrow denticulate margin or hyaline auricles, ciliate, ending in a mucro or short spinule. Flowers rose, rose-purple, purple, white, or more rarely yellow, marginal slightly radiant, without staminodes. Achenes

small, usually oblong, brownish, 2.5–4 mm long; pappus double, scabrous, whitish, often shorter than achene and sometimes absent, inner row short.

Key to the Iranian species of *Centaurea* sect. *Centaurea*

1. Flowers white or rarely yellow.
 2. Habit suffrutescent; stem angular, usually subaphyllous in flowering; anther tube rose; pappus 1–1.5 mm long, rarely deficient.
 3. Basal and lower leaves pinnatifid; capitula deciduous; phyllaries glabrous; appendages purplish, the median ones with long mucro; cilia 5–8 on each side, (1.3–)1.5–2.5 mm3. *C. intricata*
 3. Basal and lower leaves entire rarely pinnatilobate; capitula persistent; phyllaries ±densely arachnoid-floccose; appendages pale brown to brown, the innermost ones with short mucro; cilia 3–5 on each side, 0.5–1.2 mm long.....5. *C. kermanshahensis*
2. Habit not suffrutescent; stem cylindrical, not aphyllous in flowering; anther tube white; pappus absent or 0.5–1 mm long.
 4. Plant >20 cm in height; stem upright or ascending at base; median cauline leaves pinnately incised or pinnatisect; capitula solitary at end of branches; phyllaries glabrous; central florets 18–20, ±13 mm long.....2. *C. diffusa*
 4. Plant <20 cm in height; stems diffused at base; median cauline leaves simple or with 1–2 lobes in lower part; capitula single or sometimes 2–3 together at the end of branches or occasionally in clusters; phyllaries arachnoid-floccose; central florets 5–6, ca. 10 mm long4. *C. joharchii*
1. Flowers rose, rose-purple or purple.
 5. Basal and lower leaves lyrate, terminal segment 8–20 mm wide; median cauline leaves lyrate; capitula mostly aggregated at tips of primary branches, in dense clusters of 3–10; phyllaries glabrous.....1. *C. aggregata* subsp. *aggregata*
 5. Basal and lower leaves bipinnatifid or pinnatifid, terminal segment 0.8–2(–5) mm wide; median cauline leaves pinnatifid; single or often 2 together at the end of branches; phyllaries tomentose, arachnoid-hairy, or glabrous.
 6. Capitula persistent after flowering; involucre oblong-ovoid, 5–8 mm wide; appendages pale brown or brown; spine short and ca. 0.5 mm long; 12–20 central florets6. *C. ovina*

6. Capitula deciduous after flowering; involucre fusiform, 3–4 mm wide; appendages often purple-maculate; spine hamate or squarrose, (1–)1.5–2 mm long; 5–8 central florets
7. *C. virgata* subsp. **squarrosa**
1. ***Centaurea aggregata*** Fisch. & C.A.Mey. ex DC., Prodr. 6: 585 (1838).
 subsp. **aggregata** (Figures 1 and 2).
 = *Centaurea virgata* Lam. subsp. *aggregata* (DC.) Gugler, Ann. Hist.-Nat. Mus. Hung. 6: 248 (1908).
 = *Acosta aggregata* (DC.) Soják, Čas. Národ. Muz. 140: 133 (1972).
 Lectotype (designated here): Iran. Azerbaijan, 27.7.1828, Szowits s.n. (G-DC! isoelectotypes: K! H!).
 = *Centaurea pauciflora* C.Koch, Linnaea 24: 433 (1851).
 Ind. loc.: im Gebirgsane Pertakrek auf Kalk und Prophyr, 5000–6000 hoch. (typus non vidi)
- = *C. chrysolopha* Boiss. & Kotschy in Diagn. Pl. Or. ser. 2, 3: 75 (1856).
 Holotype: Frequens in rupestribus calcareis aquiloni obversis in monte Gisyl Deppe. alt. 8000 ped., 6.1853, Kotschy 184 (G! duplicate: G!).
 = *C. amani* Post in J. Linn. Soc., Bot. 24: 434 (1888); et in Bull. Herb. Boiss. 1: 23 (1893).
 Lectotype (designated here): Syria, Amanus, 8.1891, Post 95 (G! isoelectotypes: G! B!).
 = *C. aggregata* var. *argyrea* Bornm., Beih. Bot. Centrbl. 60B: 210 (1939).
 Holotype: Iraq. Prov. Arbil: Rawandiz, Handren mountains, 1300 m, 21.6. 1893, Bornmüller 1472 (B!).
 Perennial plants, whole usually green, with long woody rhizome, with sterile leafy rosette, (20–)40–80(–100) cm tall; remains of stems and leaf bases of the previous year present. Stems 2 to 8(–13), erect or upright or almost

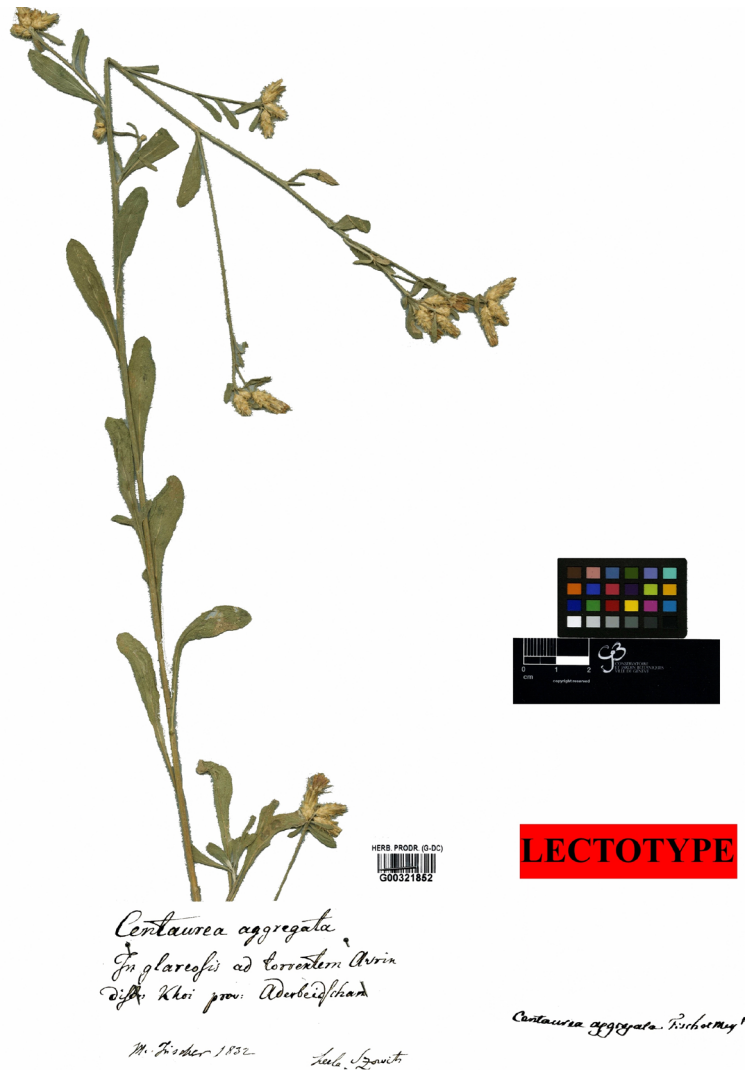


Figure 1. Lectotype of *Centaurea aggregata* subsp. *aggregata* (Szowits s.n., G-DC).



Figure 2. *Centaurea aggregata* subsp. *aggregata*. A- Habit, B- ramification, C- clusters of capitula, D- indumentum of stem and leaves, E- basal leaves (Ranjbar & Negareh 29449 BASU). Scale bars: A = 10 cm, B = 3 cm, C and E = 1 cm.

ascending, sometimes ascending from the base, ribbed-sulcate, almost branched in median to upper parts, 2–6 mm in diameter at the base; branches rigid, unequal in length, \pm densely covered with floccose-arachnoid hairs. Leaves usually divided, \pm loosely covered with arachnoid-tomentose mix of scabrous and densely minutely sessile glands, sometimes subglabrous. Basal and lower leaves petiolate, lyrate, segments in 2–5 pairs, terminal segment larger, lanceolate, 8–20 mm wide, lateral segments much smaller, narrowly lanceolate, acute or acuminate at apex.

Median cauline leaves sessile, almost lyrate, segments in 1–3 pairs, terminal segments larger, 3–8(–10) mm wide, lateral segments much smaller, acuminate or acute at apex. Upper cauline leaves increasingly smaller, sessile, simple, smooth, oblong or lanceolate or oblanceolate, sometime with a pair of lobes near the base, mucronate at apex. Capitula numerous, persistent, mostly aggregated at tips of primary branches, in dense clusters of 3–10, and then sessile, sometimes with short peduncles. Involucres subcylindrical, narrowed at the base, 10–13 \times 3–4(–5)

mm. Phyllaries multiseriate, herbaceous, pale green, with 3–4 prominent longitudinal nerves or elevated, glabrous. Outer phyllaries ovate or ovate-oblong, 0.8–2 × 0.6–1.2 mm; appendages 1–2.6 × 2.5–3 mm (including cilia and spine). Median phyllaries oblong, 2.8–4.8 × 1.3–2 mm; appendages 2–2.3 × 3–3.5 mm (including cilia and spine). Inner phyllaries oblong-linear or linear, reddish above, with distinct nerves, 8.5–10 × 1–1.5 mm; appendages entire or lacinate, membranous, 1–1.5 × 0.8–1.1 mm. Appendages small, concealing a major part of phyllaries, with spreading tip, triangular, brown, ±patent; cilia numerous, 6–8(–9) on each side, 1.5–2.5 mm long; spine short, 0.5 mm long, shorter than the adjacent cilia. Flowers rose-purple or purple; central florets hermaphroditic (8–)10–13, (11–)14–15 mm long, corolla ca. 8 mm long; peripheral florets 14–16 mm long, rarely radiant. Achenes 2.5–3 mm long, 1.3–1.4 mm wide, light reddish-brown or brown, with whitish ribs. Pappus 2.5–3.5 mm long, scabrous, inner shorter.

Taxonomic and distribution remarks: *C. aggregata* subsp. *aggregata* is distributed in W and NW Iran (Figure 3), and also in Turkey, Iraq, and the Transcaucasia region. It occurs on dry rocky and stony slopes, forests, and meadows in the midmountain zone, at 700–2600 m elevation. *C. aggregata* subsp. *aggregata*, in most cases, can

be easily recognized by the congested heads with small brownish appendages and very short terminal mucro, and the fresh green lyrate leaves (Wagenitz, 1975). The taxon is related to *C. austro-anatolica* Hub.-Mor. from Turkey in the arrangement of capitula (clusters), size of involucre, and length of achenes and pappus. However, *C. aggregata* subsp. *aggregata* differs from it by having basal and lower leaves lyrate (vs. pinnatifid), median cauline leaves lyrate (vs. simple), capitula persistent (vs. easily deciduous), involucre subcylindrical, narrowed at the base (vs. ±fusiform), cilia 6–8(–9) (vs. 10–15) on each side, and also spine 0.5 mm (vs. 1–2 mm) long. *C. aggregata* subsp. *aggregata* grows at higher elevations (700–2600 m) than *C. austro-anatolica* (50–460 m).

Specimens examined: Iran. Prov. Azerbaijan: in valley Qutor W Khoy, 1600–1900 m, *Rechinger* 49535 (W); neck Zamziran S Mahabad, 1200 m, *Rechinger* 49081, 49093 (W); Chalil Kuh N Razhan, 1800–2000 m, *Rechinger* 48755 (W). Prov. Kurdistan: Paveh to Bayangan, 5 km to Bayangan, 1525 m, 30.5.2012, *Ranjbar & Negaresh* 29449, 32980 (BASU); Sanandaj to Marivan, 5 km to Sarv Abad, Langeriz village, 1350 m, 20.6.2012, *Ranjbar & Negaresh* 32198 (BASU); Marivan to Saqqez, Kani-Kan, 1970 m, 23.6.2012, *Ranjbar & Negaresh* 32963 (BASU); 5 km after Dezeli village, 20.6.2012, *Ranjbar & Negaresh*

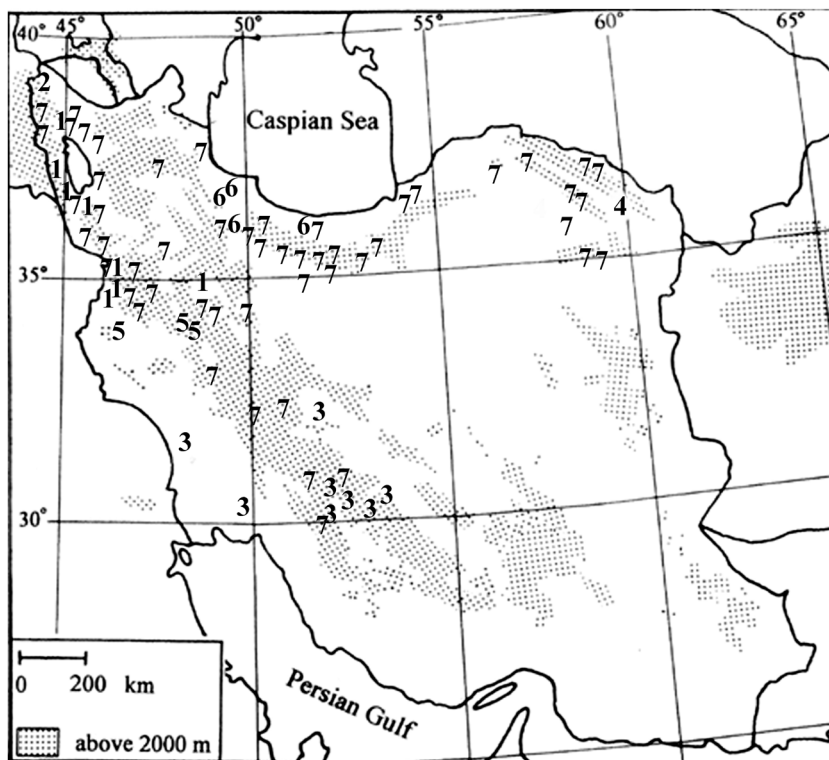


Figure 3. Distribution of *Centaurea aggregata* subsp. *aggregata* (1), *C. diffusa* (2), *C. intricata* (3), *C. joharchii* (4), *C. kermanshahensis* (5), *C. ovina* (6), and *C. virgata* subsp. *squarrosa* (7) in Iran.

32379 (BASU); mountains Chehel Chashmeh, 44 km NE Marivan (Dezh Shahpur), 2000 m, *Rechinger 43044* (W). Prov. Hamedan: Hamedan to Avaj, 20 km to Abgarm, Pole-e Arvan, 1835 m, 10.6.2012, *Ranjbar & Negaresh 29929* (BASU). Prov. Kermanshah: Kermanshah to Paveh, 5 km before Shahu city, 1545 m, 30.5.2012, *Ranjbar & Negaresh 29925* (BASU).

Iraq. Prov. Arbil: mountains Qandil above Pushtashan, 1300 m, *Rechinger 15819* (W); in valley above Nowanda, 2000–2600 m, *Rechinger 11352* (W). Prov. Mosul: between

Radziem and Sharanish, 900 m, *Rechinger 10808* (W); mountains Ouraman near Tawilla, 1300 m, *Rechinger 10203* (W). **Turkey.** C5 İçel: S of Pozanti Forest HQ, toward Gülek Bogazi, 21.7.1998, *Reeves s.n.* (E)

2. *Centaurea diffusa* Lam., *Encycl. 1: 675* (1785) (Figure 4).

= *Acosta diffusa* (Lam.) Soják in *Čas. Nár. Muz., Odd. Přir. 140* (3–4): 133 (1972).

Type: Western Europe. [Turkey?] ‘*Carduus orientalis calcitrapae folio, flore minimo*, *Tournefort s.n.* (P!).

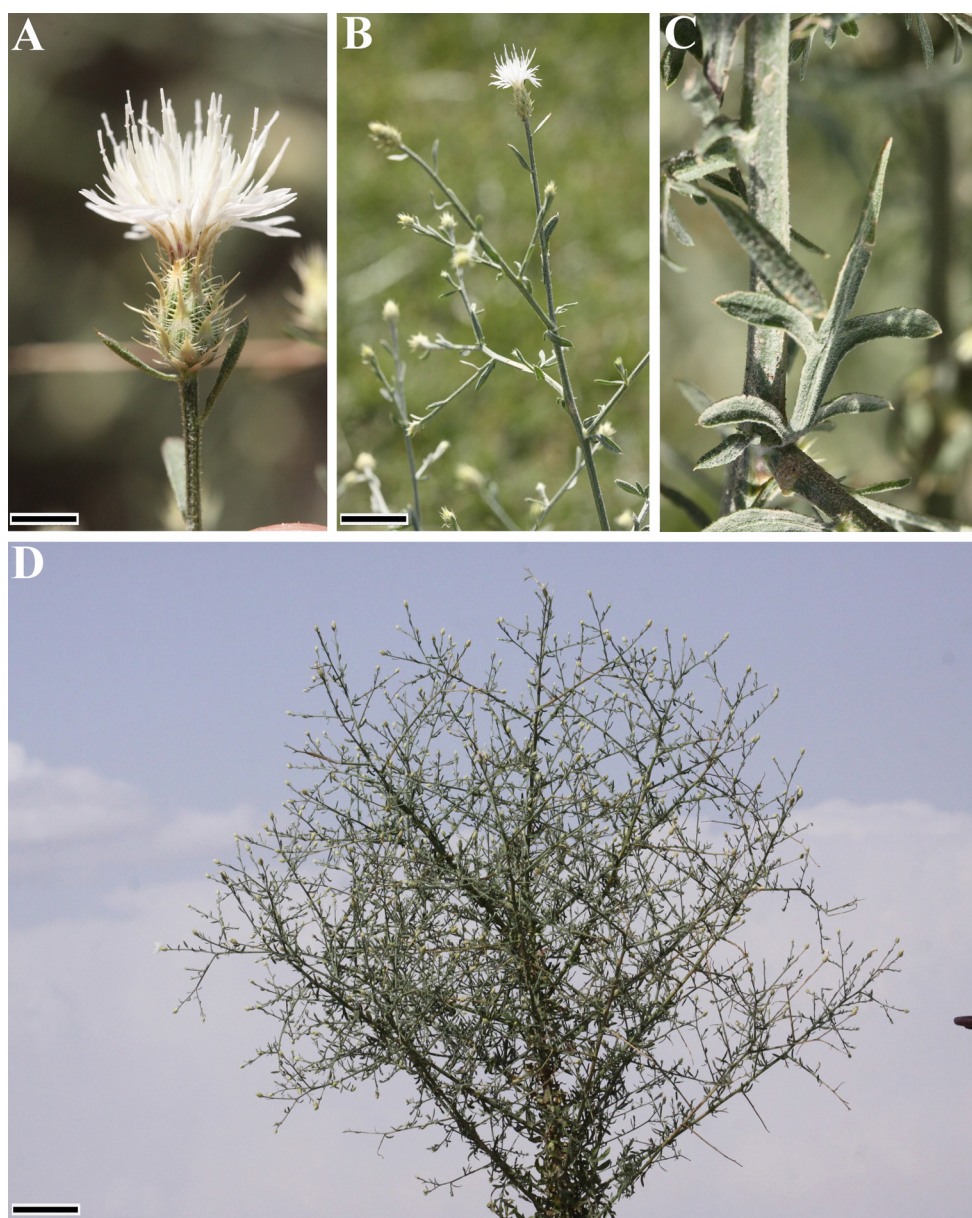


Figure 4. *Centaurea diffusa*. A- Close-up of capitulum, B- branches with capitula, C- indumentum of stem and leaves, D- habit (*Ranjbar & Negaresh 28925*: BASU). Scale bars: A = 5 mm, B = 2 cm, D = 8 cm.

Biennial plant, usually green all over, often 20–50(–90) cm high. Stems upright or ascending at base, ribbed-sulcate, strongly branched from base to upper part, up to 5 mm in diameter at the base, branches numerous, divaricated, unequal in length, densely arachnoid mix of pilose hairs, and sessile glands. Leaves usually all divided, covered with slightly scabrous or with weakly arachnoid-hairy. Basal and lower leaves petiolate, 10–12 cm long, pinnatipartite or bipinnate, segments in 8–16 pairs, 2–4 mm wide, narrowly linear or narrowly lanceolate, acuminate at apex. Median cauline leaves pinnately incised or pinnatisect, 5–7 cm long, segments in 5–10 pairs, 1–6.5 mm wide, linear or narrowly lanceolate or narrowly oblong, acuminate or cuspidate at apex. Upper cauline leaves undivided, linear-lanceolate, (0.5–)1–3 mm wide, acuminate or mucronate at apex. Inflorescence usually paniculate. Capitula persistent, solitary at tips of many branches, peduncles 1–3.5 cm long. Involucres ovoid-cylindrical, 8–10 × 2.5–5 mm. Phyllaries multiseriate, herbaceous, imbricate, glabrous. Outer phyllaries oblong-ovate, 0.3–1.2 × 1–1.2 mm; appendages 3–3.3 × 3–4.5 mm (including cilia and spine). Median phyllaries oblong, 1.8–2.8 × 1.4–1.8 mm; appendages 4–4.2 × 4–4.2 mm (including cilia and spine). Inner phyllaries oblong-linear, 5.2–7.5 × 1–1.6 mm; appendages 2.5–4 × 0.8–4 mm (including cilia and spine). Appendages medium-sized, totally concealing phyllaries, spreading, straw-colored (rarely dark brown), triangular, with (4–)5–7 cilia (1.5–2 mm) on each side, ending in a spine of (1.5–)2.5–3.5(–4) mm. Flowers whitish, rarely light purple; central florets hermaphroditic 18–20, ±13 mm long, corolla around 7 mm long. Achenes 2.5–3.0 mm long, brownish, glabrous. Pappus absent, or very rarely 0.5–1 mm long, or consisting of fewer hairs.

Taxonomic and distribution remarks: *Centaurea diffusa* (Figure 4) is cited here as a new record for Iran. It occurs on clay mountains and hills around Bazargan of W Azerbaijan Province (Figure 3). *C. diffusa* can be expected to grow in open places and on stony slopes, coastal sands, and roadsides at 900–1700 m. This homogeneous and easily recognizable Mediterranean element (Wagenitz, 1975) is widespread in the Mediterranean area. According to Klokov (1963), *C. diffusa* has been introduced to many regions of southern and central Europe, and is also native to Asia Minor. It is similar to *C. sivasica* Wagenitz by ramification of stem, single and persistent capitula, and the length of the cilia and spine. *C. sivasica* is endemic to Turkey and is an Irano-Turanian element. However, *C. diffusa* differs from it by some important characters, such as plant 20–50(–90) cm (vs. 15–25 cm) in height, basal and lower leaves pinnatipartite or bipinnate, segments in 8–16 pairs, narrowly linear or narrowly lanceolate (vs. pinnatisect, segments in ca. 5 pairs, lanceolate-ovate),

appendages straw-colored (vs. straw-colored and usually with purple spots), flowers white, rarely light purple (vs. rose-purple), and central florets 18–20 (vs. 5–6) in number.

In addition, *C. diffusa* shares some characters such as ramification of stem, dissection of basal and lower leaves, and size of involucre with *C. calolepis* Boiss., but differs from it by having (4–)5–7 (vs. 9–13) cilia on each side, flowers white, rarely light purple (vs. rose-purple), central florets 18–20 (vs. 4–6) in number, and achenes 2.5–3.0 mm (vs. 3.5–4 mm) long.

Specimens examined: Iran. Prov. W Azerbaijan: Bazargan, 1860 m, 25.6.2012, *Ranjbar & Negaresh 28925* (BASU) (Figure 4). Austria. Arsenal, beim Objekt 12, 20.7.2012, *Adler s.n.* (W); Arsenal, beim Objekt 12, bei den abgestellten Panzern, 3.7.2004, *Adler s.n.* (W). Germany. Ingelheim/Rheinhessen, 10.7.1993, *Hecker s.n.* (W); Neckauer bei Neckarstadt, 26.7.1973, *Diehl s.n.* (W); östlich Mannheim-Schönau, 5.7.1973, *Diehl s.n.* (W); Bingen-Stadt, Bahnhof, 18.7.2012, *Schmalz s.n.* (W). Italy. In ditone Illyrico-Litorali, in agro Tergestino, in “Campo Martio”, date s.d., *Marchesetti s.n.* (W). Russia. Europäisches Russland, Provinz Tambov, distr. Uwarowo, Eisenbahnstation Oblowka (Stadt Uwarowo), 20.8.2008, *Suchorukov s.n.* (W). Greece. Prope Volena Macedoniae, *Orphanides 1090* (W). France. Schweizer Jura, Delemont, kultiviert in Garten des CIBC, stammt aus Apt in S.-Franckr, 28.7.1965, *Schlatte s.n.* (W).

3. *Centaurea intricata* Boiss., *Diagn. Pl. Orient. ser. 1*, 6: 130 (1846).

Holotype: Iran. Esfahan, *Aucher-Eloy 4853* (G; isotypes: P, K) (Figure 5).

Perennial plant, suffrutescent, many stemmed, usually green or gray all over, 20–30 cm tall. Stems erect, branched from base to upper part; branches intricate, with weak structure, densely covered with canescent-tomentose hairs, angular. Basal and lower leaves withering in flowering, evanescent, in juvenile ±densely covered with arachnoid-tomentose hairs, later glabrescent, pinnatipartite, segments in 2–4 pairs, linear or linear-lanceolate, segments entire or dentate, terminal segments rarely wider or lanceolate, acuminate or acute at apex. Median cauline leaves sessile, simple, rarely lyrate, 10–15 × 1–15 mm, narrowly linear or linear to linear-lanceolate, acuminate or mucronate at apex. Upper cauline leaves increasingly smaller, sessile, simple, small filiform. Capitula numerous, very deciduous, solitary at tips of many branches, 0.3–1.3(–1.5) cm long leafy to capitula. Involucres subcylindrical, 8–10 × 2.5–3.5 mm. Phyllaries multiseriate, green, imbricate, glabrous. Outer phyllaries ovate-oblong, 0.8–1 × 0.8–1 mm; median phyllaries oblong, sometimes with prominent longitudinal or elevated nerves, 2.5–3(–4) × 1–1.2 mm; inner phyllaries oblong-linear or linear, almost with prominent longitudinal or elevated nerves, 4.5–6(–7)

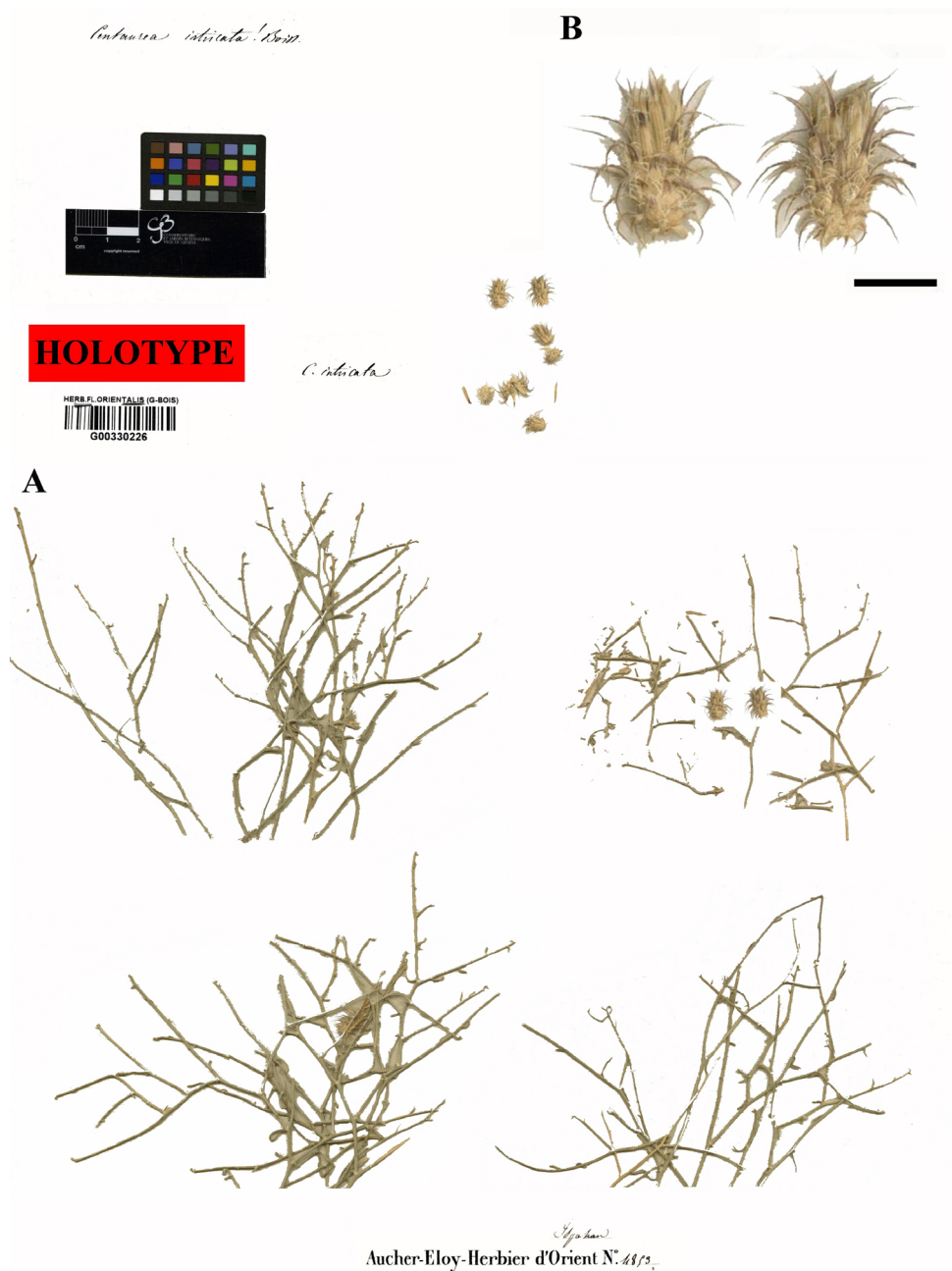


Figure 5. Holotype of *Centaurea intricata*. A- Habit, B- close-up of capitula (Aucher-Eloy 4853 G). Scale bar: A = 5 mm.

× 0.5–1 mm. Appendages small, concealing pro part of phyllaries, narrowly triangular, purplish, rarely brown, in base 0.6–0.8 mm wide (excluding cilia), the median ones almost with long mucro (mucronate); cilia numerous, scabrous, 5–8 on each side, (1.3–)1.5–2.5 mm long; spine arcuate-patent or recurved, 2–3(–4) mm long. Flowers white; central florets hermaphroditic 7–8, ±11 mm long, anther tube rose; peripheral florets not radiant, shorter

than central floret. Achenes oblong-lanceolate, brownish, shiny and smooth, glabrous, approximately 3 mm long. Pappus 1–1.5 mm long, rarely deficient.

Taxonomic and distributional remarks: *C. intricata* generally occurs in S and SE Iran, and also Iraq (Figure 3). It is a Zagrosian element known only from the dry-steppe zone. *C. intricata* can be expected to grow on clay hills and calcareous land in midmountain zones, at 700–1800 m.

Wagenitz (1980) recognized 2 subspecies of *C. intricata* in Iran. The study of the type specimen, fresh material, and field observations indicated that both subspecies (subsp. *intricata* and subsp. *kermanshahensis*) have many morphological differences, which are reported in Table 1. With this consideration, we recognize them as separate species.

Specimens examined: Iran. Prov. Fars: 108–160 km SE Shiraz, 980–1200 m, *Pabot s.n.* (W); Takht-e-Jamshid (Persepolis), above the ruins, 22.7.1959, *Wendelbo 772* (B); Fasa, Azad University, 1450 m, 27.4.2012, *Ranjbar & Negaresh 29967* (BASU); Darab to Bandar Abbas, 275 km to Bandar Abbas, 1193 m, 30.4.2011, *Ranjbar & Negaresh 23826* (BASU); Fasa-Estahban bifurcate, 1566 m, 29.4.2011, *Ranjbar & Negaresh 23965* (BASU); Darab, 25 km after Darab, on the road to Larizangan village, 1424 m, 30.4.2011, *Ranjbar & Negaresh 24086* (BASU); Darab, 1226 m, 29.4.2011, *Ranjbar & Negaresh 24005* (BASU); Abolhayat canyon, 95 km from Kazerun toward Shiraz, 1167 m, 28.4.2012, *Ranjbar & Negaresh 23144* (BASU); hillside on the road to Isfahan, 21 km from Shiraz, 25.6.1972, *Alava 10618* (E). Prov. Shahr Kord: Chashmehghirin, *Koelz 15272* (E). Prov. Khuzistan: N Dezful 15 km to Andimeshk, *Pabot 1097* (W); 36 km SE Hamidieh, *Pabot 861* (W); 30 km E Behbahan, in faucibus Marun, *Pabot 515* (W). Iraq. Prov. Diyala: 10 km E Mandali, 2.6.1957, *Rechinger 9655* (E); Mandali, *Hadač et al. s.n.* (E).

4. *Centaurea joharchii* Ranjbar & Negaresh sp. nov. (Figure 6).

Diagnosis: *C. joharchii* is similar to *C. virgata* subsp. *squarrosa* in the size of involucre, number and length of cilia, and number of central florets, but differs from it by having some important characters such as plant up to 17 cm (vs. 30–70 cm) tall, stems diffuse (vs. erect), basal and lower leaves pinnatipartite with 2–4 pair segments, sometimes pinnatifid or with a few coarse teeth (vs. pinnatipartite or pro part bipinnatipartite, segments in 4–10(–12) pairs), median cauline leaves simple or with 1–2 lobes in lower part (vs. pinnatipartite), appendages pale brown (vs. purplish-maculate, sometimes straw-colored), flowers white (vs. rose or rose-purple), anther tube white (vs. rose-purple), achenes ovate or ovate-oblong, striate-costate, sparsely hairy (vs. oblong, striate, glabrous), and pappus deciduous and 0.5–0.8 mm long (vs. persistent and 1–2 mm) long (see Table 2).

Type: Iran. Prov. Khorasan: Kalat-e Naderi, Kuh-e Babakamar, 1200 m, 16.7.1990, *Faghiniha & Zangui 18948* (holotype: FUMH!, isotype: BASU!).

Perennial with woody base, many-stemmed, whole usually grayish, with many heads, 10–17 cm tall; remains of leaf base of the previous year present. Stems diffuse, densely covered with arachnoid-tomentose and sessile glands hairs, branched at the base and often from median to upper parts, upward with spreading rigid branches, ca. 2 mm in diameter at the base branches often short, almost

Table 1. Diagnostic morphological characters of *Centaurea kermanshahensis* and *C. intricata*.

Characters	<i>C. kermanshahensis</i>	<i>C. intricata</i>
Branches	Slightly intricate	Intricate
Basal and lower leaves: dissection	Entire rarely pinnatilobate	Pinnatipartite
Basal and lower leaves: indumentums	Glabrous or subglabrous	In juvenile ±densely covered with arachnoid-tomentose, later glabrescent
Capitula	Persistent	Deciduous
Involucre: shape	Ovoid-oblong	Subcylindrical
Phyllaries: indumentums	±Densely arachnoid-floccose	Glabrous
Appendages: width (mm)	0.2–0.6	0.6–0.8
Appendages: color	Pale brown to brown	Purplish
Appendages	Innermost ones with short mucro	Median ones with long mucro
Cilia	3–5 on each side, 0.5–1.2 mm long	5–8 on each side, (1.3–)1.5–2.5 mm long
Central florets: number	5–7	7–8

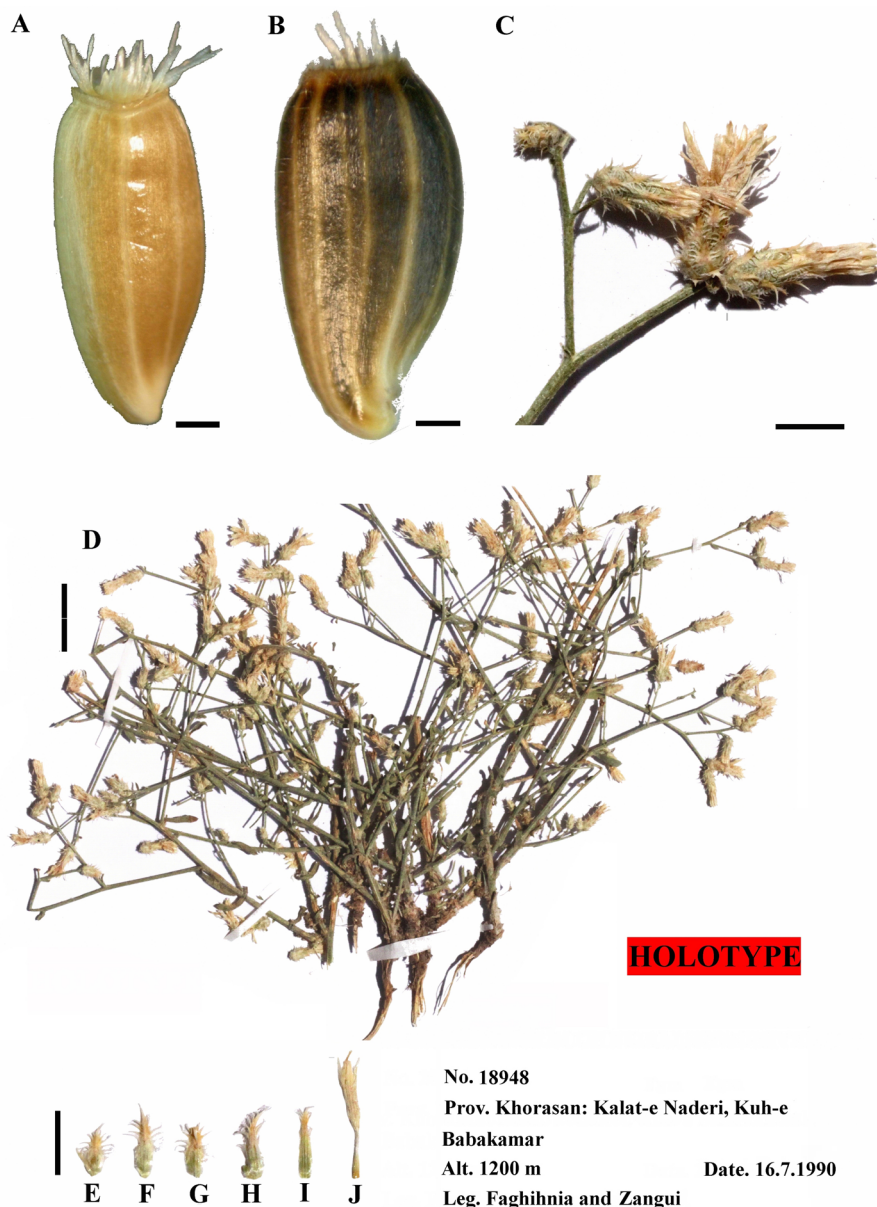


Figure 6. *Centaurea virgata* subsp. *squarrosa*: A- Close-up of achene with pappus. Holotype of *Centaurea joharchii*; B- Close-up of achene with pappus, C- branches with capitula, D- habit, E- outer phyllaries, F and G- median phyllaries, H and I- inner phyllaries, J- central floret (*Faghinia & Zangui* 18948 FUMH). Scale bars: A = 1 mm; B = 0.5 mm; C, E-J = 5 mm; D = 2 cm.

branched, unequal in length, cylindrical, loosely leafy. Leaves very small, coriaceous, without venation, densely covered with tomentose hairs, margins entire. Basal and lower leaves at flowering time evanescent, sometimes withered, sessile, pinnatipartite, segments in 2-4 pairs, linear or narrowly lanceolate-linear, ca. 1.5 cm long, 0.1-0.2 cm wide, sometimes pinnatifid or with coarse teeth, acute at apex. Median cauline leaves sessile, 10-15 × 1-12 mm, simple or with 1-2 lobes in lower part, linear or

narrowly lanceolate-linear, acute at apex. Upper cauline leaves small, sessile, 3-10 × 0.8-1 mm, simple or with 1-2 lobes in lower part, short linear or filiform, acute at apex. Capitula small, single, or sometimes 2-3 together at the end of branches, occasionally in clusters, mostly persistent after flowering. Involucres fusiform-oblong, 7-8 × 3-4 mm. Phyllaries multiseriate, herbaceous, pale green, with prominent longitudinal nerves or elevated, loosely covered with arachnoid-floccose and sessile glands hairs. Outer

Table 2. Diagnostic morphological characters of *Centaurea joharchii* and *C. virgata* subsp. *squarrosa*.

Characters	<i>C. joharchii</i>	<i>C. virgata</i> subsp. <i>squarrosa</i>
Habit tall (cm)	up to 17	30–70
Lower cauline leaves	Pinnatipartite with 2–4-pair segments, or pinnatifid or with few coarse teeth	Pinnatipartite or pro part bipinnatipartite, segments in 4–10(–12) pairs
Median cauline leaves	Simple or with 1–2 lobes in lower part	Pinnatipartite
Capitula	Persistent	Deciduous
Appendages: color	Pale brown	Purple-maculate, sometimes straw-colored
Flowers: color	White, in dry state yellow	Rose or rose-purple
Anther tube: color	White	Rose-purple
Achenes	Ovate or ovate-oblong, striate-costate, sparsely hairy	Oblong, striate, glabrous
Pappus	Deciduous and 0.5–0.8 mm long	Persistent and 1–2 mm long

phyllaries elliptic, ca. 2 × ca. 1.5 mm; appendages ca. 2 × ca. 3 mm (including cilia and spine). Median phyllaries elliptic, 2.5–3 × 1.2–1.3 mm; appendages 2.5–3 × 3.2–3.5 mm (including cilia and spine). Inner phyllaries oblong-linear or linear, 3–3.5 × 1–1.6 mm; appendages 1.5–2.2 × 1.8–2.8 mm (including cilia and spine). Appendages small, concealing a major part of phyllaries, rigid, pale brown, not decurrent; cilia scabrous, slightly whitish, mostly spreading or reflexed, numerous 3–8 on each side, 0.5–1.5 mm long; spines subsquarrose, 1–1.8 mm long, whitish, ±equal to or longer than the adjacent cilia. Flowers white, in dry state yellow; central florets hermaphroditic 5–6, ca. 10 mm long, corolla ca. 6 mm long, 5-lobed, lobes ±2.5 mm long, anther tube white; peripheral florets not radiant, 4-lobed, limb lobes lanceolate-linear. Achenes ovate or ovate-oblong, 2.8–3.5 mm long, ca. 1.5 mm wide, dark brown or blackish, striate-costate (with 6–10 yellowish line), rounded at the apex, sparsely hairy; hilum ca. 0.5 mm long, yellowish. Pappus scabrous, whitish, 0.5–0.8 mm long, deciduous.

Etymology: Named in honor of the Iranian botanist Dr Joharchi, who is director of the herbarium of Ferdowsi University of Mashhad.

Habitat and ecology: It grows on a stony slopes in a mix of clay soil and calcareous soil. In addition, some other plants that occurred in the area were *Alhagi maurorum* Medik., *Anchusa arvensis* Tausch, *Chondrilla juncea* L., *Cousinia verbascifolia* Bunge, *Eryngium bungei* Boiss., *Euphorbia bungei* Boiss., *Falcaria vulgaris* Bernh., *Gastrocotyle hispida* (Forssk.) C.B. Clarke, *Gypsophila pilosa* Huds., *Heliotropium europaeum* L., *Sisymbrium loeselii* L., and *Sisymbrium septulatum* DC.

Taxonomic and distribution remarks: *Centaurea joharchii* is a rare endemic to NE Iran and is known only

from the dry-steppe zone of the Babakamar mountains around Kalat-e Naderi in Khorasan Province, NE Iran (Figure 3). The new species can be expected to grow on stony residual, at elevations of 1100–1400 m. *C. joharchii* shares some characters such as height of stem, shape of appendages, and color of flowers with *C. intricata*, but differs from it by having habit perennial (vs. perennial and suffrutescent), stems diffuse and cylindrical (vs. intricate and angular), capitula single sometimes 2–3 together at end of branches or occasionally in clusters (vs. solitary at end of branches), involucre 7–8 mm (vs. 8–10 mm) long, spine 1–1.8 mm (vs. 2–4 mm) long, cilia 0.5–1.5 mm (vs. (1.3–)1.5–2.5 mm) long, anther tube white (vs. rose-violet), and pappus 0.5–0.8 mm (vs. 1–1.5 mm) long.

This species is also related to *C. aggregata* subsp. *aggregata*, especially because of the indumentum, habit, and number of cilia. However, *C. joharchii* differs from it by having plants up to 17 cm (vs. 40–75 cm) tall, capitula single or sometimes 2–3 together at the end of branches or occasionally in clusters (vs. mostly aggregated at tips of primary branches, in dense clusters of 3–10), involucre 7–8 × 3–4 mm (vs. 10–13 × 3.5–5 mm), appendages pale brown (vs. brown), cilia 0.5–1.5 mm (vs. 1.5–2.5 mm) long, spine subsquarrose, 1–1.8 mm long (vs. short, ca. 0.5 mm long), flowers white (vs. rose-purple), central florets 5–6 (vs. (8–)10–13 mm) number, and pappus 0.5–0.8 mm (vs. 2.5–3.5 mm) long.

Suggested conservation status: The new species is endemic to the Babakamar mountains in Kalat-e Naderi, Iran. The specimens were collected in Khorasan Province, where the species is apparently very rare and local. *Centaurea joharchii* is known only from 1 population in the type locality occupying an area of 50 m². The population

was not in good condition at the time of our fieldwork, numbering approximately 50 to 100 plants. According to IUCN Red List criteria (IUCN, 2001), it should be assigned to the Critically Endangered (CR) category because of its local distribution and small population size.

5. *Centaurea kermanshahensis* (Wagenitz) Ranjbar & Negaresh, **comb. & stat. nov.** (Figure 7).

Basionym: *Centaurea intricata* subsp. *kermanshahensis* Wagenitz, Flora Iranica, 139b: 339 (1980).

Type: Iran. Prov. Kermanshah: between Qasr Shirin and Kermanshah, 50 km E Qasr Shirin toward Karand,

28.8.1957, *Rechinger 14611* (holotype W! isotypes: E! G! B!) (Figure 7).

Perennial plant, suffrutescent, many-stemmed, usually grayish all over, with long woody rhizome, 10–30 cm tall; many remains of leaf and stems base of the previous year present. Stems erect, woody, branched from base to upper part; branches slightly intricate, loosely covered with canescent hairs, angular. Basal and lower leaves withering in flowering, evanescent, glabrous or subglabrous, entire rarely pinnatifid, narrowly lanceolate or lanceolate to oblanceolate, 40–60(–70) × 5–8 mm, long-petiolate.



Figure 7. Isotype of *Centaurea kermanshahensis*. A and C- Habit, B- close-up of involucre (*Rechinger 14611*, B). Scale bar: B = 5 mm.

Median cauline leaves sessile, entire, sometimes lyrate, 10–30 × 1–1.5 mm, narrowly linear or linear to linear-lanceolate, acuminate or mucronate at apex. Upper cauline leaves increasingly smaller, sessile, simple, short filiform. Capitula numerous, persistent, solitary at tips of many branches, peduncles 0.5–2(–4) cm long (0.5–2(–4) cm long leafy to capitula). Involucres ovoid-oblong, 8–10 × 3–4.5 mm. Phyllaries multiseriate, yellowish or yellow-greenish, imbricate, ±densely covered with arachnoid-floccose hairs. Outer phyllaries ovate-oblong, 1.5–2 × 1–1.6 mm; median phyllaries oblong, 3–4 × 1.2–1.8 mm; inner phyllaries oblong-linear or linear, 5–6 × 0.5–1 mm. Appendages small, concealing pro part of phyllaries, narrowly triangular, pale brown to brown, in base 0.2–0.6 mm wide, the innermost ones with short mucro, cilia 3–5 (0.5–1.2 mm long) on each side; spine recurved, (1.5–)2–3 mm long. Flowers white; central florets hermaphroditic 5–7, ±12 mm long, anther tube rose; peripheral florets not radiant, shorter than central floret. Achenes oblong-lanceolate, brownish, shiny and smooth, glabrous, ca. 2.5 mm long; pappus ca. 1.5 mm long, rarely deficient.

Taxonomic and distribution remarks: *C. kermanshahensis* is distributed exclusively in Kermanshah and Hamedan provinces, W Iran (Figure 3). It possesses a narrower distribution than other species of the section *Centaurea* in Iran. It is a Zagrosian element and known only from the dry-steppe zone. *C. kermanshahensis* can be expected to grow on clay hills and in calcareous areas of the midmountain zone, at elevations of 900–1700 m. It seems that the assignment of it as a subspecies of *C. intricata* may be wrong, because there are many distinct differences between *C. kermanshahensis* and *C. intricata* (Table 1). *C. kermanshahensis* is far from the main distribution area of *C. intricata* (Figure 3). Both species have different geographical ranges in Iran. *C. kermanshahensis* is only distributed in W Iran, while *C. intricata* is mainly distributed in S Iran (Figure 3).

Specimens examined: Iran. Prov. Kermanshah: 5 km after Rijab, 920 m, 27.5.2012, *Ranjbar & Negaresh 30134* (BASU); between Khanaqin and Kermanshah, *Davis 701* (E). Prov. Hamedan: Hamedan to West Eslam Abad, 15 km to West Eslam Abad, 1682 m, 24.6.2011, *Ranjbar & Negaresh 27360* (BASU).

6. *Centaurea ovina* Pall. ex Willd., Sp. Pl., ed. 4, 3(3): 2292 (1803).

= *Acrolophus ovinus* (Willd.) Löve & Löve, Bot. Not. 114: 44 (1961).

Lectotype: Habitat ad Caucasum, *B-Willd. 16563/3* (B!) (Figures 8 and 9).

= *Centaurea intacta* Ledeb., Fl. Ross. 2: 705 (1845) fide Fl. URSS.

Type: Caucasus, Kachetia, *Hehn s.n.* (LE!).

= *C. hohenakeri* Stev., Bull. Soc. Nat. Mosc. 29, 2: 395 (1857).

Type: in saxosis Georgiae Caucas, *Hohenaker s.n.* (K!).

Perennial plant, whole usually green, 30–70(–80) cm tall; remains of leaf base of the previous year present. Stems 1 to 5, upright, sharply ribbed, deeply sulcate, lower parts densely covered with tomentose-arachnoid gray hairs, other parts loosely to sparsely tomentose or subglabrous mix of short scabrous hairs, branched at the base to upper part; branches numerous, upward with divaricated branches, almost branched, unequal, and cylindrical. Leaves loosely to sparsely covered with arachnoid-tomentose hairs or subglabrous, usually divided. Basal and lower leaves with short-petiolate, bipinnatifid, segments in 5–10 pairs, terminal segments oblong-linear to oblong-obovate, up to 15 × 0.8–2 mm, acuminate at apex. Median cauline leaves sessile, pinnatifid, segments in 2–6 pairs, terminal segments shortly linear or narrowly oblong, 3–4 mm wide, lateral segments 1–2 mm wide, acuminate or mucronate at apex. Upper cauline leaves increasingly smaller, sessile, undivided, linear, up to ca. 20 × 1 mm wide. Floriferous branches 2–14 cm long. Capitula persistent, solitary at tips of branches. Involucres oblong-ovoid, 9–11 × 5–8 mm. Phyllaries multiseriate, greenish, imbricate, in immature state densely tomentose, later glabrescent, with longitudinal nerves. Outer and median phyllaries ovate or oblong, 3–7 × 1.5–2.5 mm, with 3–5 veins; appendages 2–3 × 2.5–4 mm (including cilia and spine). Inner phyllaries linear or narrowly linear, 7.5–9 × 0.7–1.7 mm; appendages 1.5–2 × 1–1.5 mm, entire or lacerate. Appendages small, concealing a major part of phyllaries, triangular, pale brown or brown, ciliate; cilia numerous, 5–7 on each side, 1–2 mm long, with auricles hyaline in base; spine short, ca. 0.5 mm long, shorter than the adjacent cilia. Flowers rose; 12–20 hermaphroditic central florets ca. 12 mm long; peripheral florets few radiant, ca. 15 mm long. Achenes oblong, dark brown, (2.5–)3.0–3.5 mm long, 1–1.3 mm wide, sparsely hairy; hilum lateral, yellowish, ca. 0.8 mm long. Pappus persistent, whitish, (0.5–)1–2 mm long.

Taxonomic and distributional remarks: *C. ovina* is distributed in N Iran and the Transcaucasia region (Figure 3). It occurs on stony and rocky mountain slopes at 250–1500 m. Little is known about the species as related to *C. virgata* subsp. *virgata* in color of flowers, number and length of cilia, or length of achenes and pappus. However, *C. ovina* differs from it by having basal and lower leaves bipinnatifid (vs. pinnatifid, pro part bipinnatifid), capitula persistent, solitary at tips of branches (vs. deciduous, single or often 2 together at end of branches), involucres oblong-ovoid, 9–11 × 5–8 mm (vs. fusiform, 7–9 × 3–4 mm), appendages pale brown or brown (vs. purple-maculate, sometimes straw-colored), spine short, ca. 0.5 mm long (vs. hamate or squarrose, (1–)1.5–2 mm long), and 12–20 (vs. 5–8) central florets.



Figure 8. Lectotype of *Centaurea ovina* (16563/3 B-Willd).

Specimens examined: Iran. Prov. Mazandaran: 8 km after Tab village or Nikoyeh village, 1512 m, 14.6.2012, *Ranjbar & Negaresh* 29715 (BASU). Prov. Qazvin: Kuhin neck, Tarum Sofla, 30 km to Lowshan, 1020 m, 14.6.2012, *Ranjbar & Negaresh* 32737 (BASU); Qazvin, 10 km to Lowshan, 620 m, 14.6.2012, *Ranjbar & Negaresh* 29733 (BASU). Prov. Gilan: in valley Sefid Rud S Rasht, *Pabot* 3606 (W); N Rudbar, 250 m, *Pabot* 3642 (W). **Armenia.** Inter pagos Diližan et Idževan, in later laevo vallis rivi Agstef infra pontem Krasnoselsk, 920 m, 12.7.1975, s.c. 12770 (E). **Georgia.** Tbilisi: hillside near the Dabahane gorge, opposite the Tbilisi Botanical Institute, 550–650 m, 29.6.1959, *Davis* 33687 (E).

7. *Centaurea virgata* Lam., Encycl. [J. Lmarck & al.] Meth. Bot. 1: 670 (1785) (Figures 6 and 10).
Centaurea virgata Lam. subsp. *squarrosa* (Boiss.) Gugler [family Compositae], Ann. Hist.-Nat. Mus. Natl. Hung., 6: 248 (1907).
Centaurea virgata var. *squarrosa* Boissier [family Compositae], Fl. Orient., 3: 651 (1875), based on *C. squarrosa* Willd., Sp. Pl. 3: 2319 (1803), not Roth 1800.
 = *Centaurea squarrosa* Willd., Spec. Plant. 3(3): 2319 (1803), nom. illegit. non *C. squarrosa* Roth, Catal. Bot. 2: 118, (1800).
 = *C. virgata* Lam. var. *squarrosa* Boiss., Fl. Or. 3: 651 (1875).

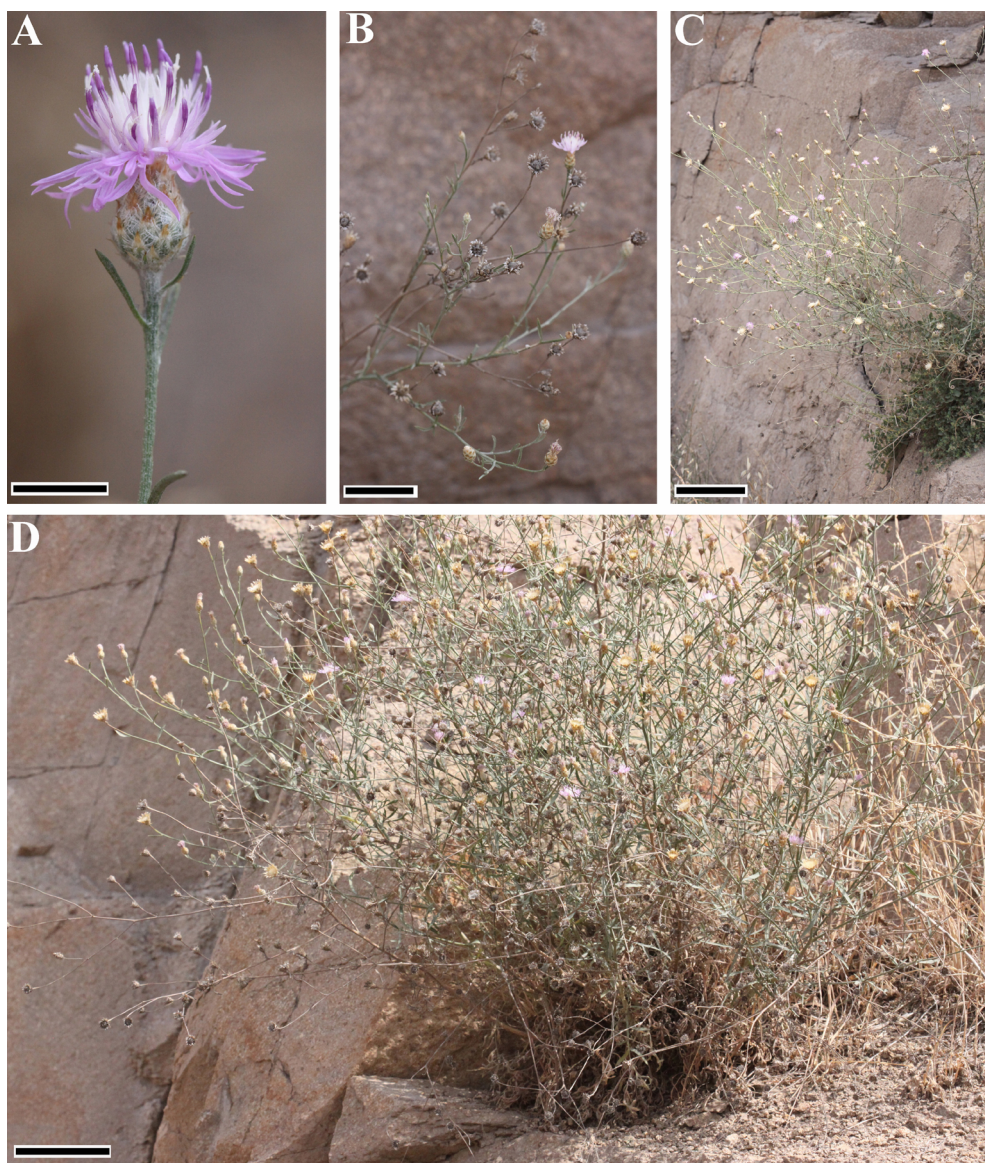


Figure 9. *Centaurea ovina*. A- Close-up of capitulum, B- branches with capitula, C and D- habit and habitat (Ranjbar & Negaresh 29715 BASU). Scale bars: A = 1 cm, B = 5 cm, C = 20 cm, D = 10 cm.

Type: In Oriente, Tournefort & Gundelsheimer ? 16635 (B-Willd!).

= *C. squarrosa* Willd. var. *colensis* C.Koch, in *Linnaea* 24: 434 (1851).

Type: Unknown country, *C.Koch s.n.* (GOET!).

= *C. squarrosa* Willd. var. *rubella* Schultz Bip., in *Exsicc. Pl. Aleppo*. Th. Kotschy, nr. 303 (1843).

Type: Iraq. Prov. Mosul: Chiya-e Gara, *Kotschy 303* (GOET!).

= *C. virgata* Lam. Variante A, Wagenitz, *Willdenowia* 6: 483 (1972).

Holotype: Turkey, Pontisches Gebirge. 1843-1845, *K. Koch s.n.* (B!).

Perennial plants, with woody base, whole usually greenish, many-stemmed, 30–70 cm tall; sometimes remains of leaf base of the previous year present. Stems 1 to 12, erect, ribbed-sulcate, branched in upper part or often near base or from base; branches cylindrical, almost divaricately branched, rigid, densely to loosely covered with arachnoid-tomentose hairs. Leaves usually divided, loosely covered with arachnoid to thin tomentose hairs. Basal and lower leaves petiolate, sometimes withered at flowering time, pinnatipartite or pro part bipinnatipartite, segments in 4–10(–12) pairs, linear rarely narrowly lanceolate, terminal segment 0.8–2(–5) mm wide, acute at apex. Median cauline leaves sessile, pinnatipartite,



Figure 10. *Centaurea virgata* subsp. *squarrosa*. A and B- Capitula, C- branches with capitula, D- habit (Ranjbar & Negaresh 31832 BASU). Scale bars: A and B = 5 mm, C and D = 3 cm.

segments in 1–5 pairs, linear to oblong-lanceolate, 2–18 mm long, 0.05–0.22(–0.3) mm wide, acuminate or cuspidate at apex. Upper cauline leaves increasingly smaller, sessile, undivided, narrowly oblong-linear to linear or narrowly linear, 5–22 × 1–3.7 mm, acuminate or mucronate at apex. Capitula numerous, single or often 2 of them together at end of branches, mostly deciduous after flowering, at tips of short branches to 1.5–4 cm long or partly often sessile and crowded at tips of branches. Involucres small, fusiform, 7–9 × 3–4 mm. Phyllaries multiseriate, herbaceous, imbricate, arachnoid-hairy or

glabrous, greenish or yellowish or purplish, with prominent longitudinal nerves or elevated. Outer phyllaries shortly ovate, 1–3 × 0.5–1 mm; median phyllaries oblong-linear, 3–5 × 1–1.5 mm; inner phyllaries linear or narrowly linear, 6–8 × 0.5–1 mm, often purplish. Appendages concealing pro part of phyllaries, patent or reflexed, triangular, in base excluding cilia 0.5–1 mm wide, often purple-maculate, sometimes straw-colored, ciliate, the innermost ones often entire; cilia numerous, 5–8(–10) on each side, 1–1.5 mm long; spine hamate or squarrose, (1–)1.5–2 mm long, nearly equal the adjacent cilia. Flowers rose or rose-

purple; 5–8 hermaphroditic central florets ca. 13–14 mm long; peripheral florets scarcely radiant. Achenes oblong, glabrous, 3–4 mm long, 1.3–1.5 mm wide, striate with yellowish stripes on ribs. Pappus persistent, whitish, 1–2 mm long, rarely absent.

Taxonomic and distribution remarks: *C. virgata* subsp. *squarrosa* is a widespread element. It is widely distributed in Iran (Figure 3), and also in Bulgaria, Turkey, Lebanon, N Iraq, the Transcaucasia region, Afghanistan, Pakistan, and Turkmenistan. *C. virgata* subsp. *squarrosa* is widely distributed in comparison to other species of the section *Centaurea*. It occurs on dry hills, dry waste ground, stony slopes, weedy places, and roadsides, at elevations of 100–3000 m. *C. virgata* subsp. *squarrosa* is similar to *C. calolepis* in dissection of leaves and color of flowers, but differs from it by having some important characters such as capitula single or often 2 of them together at the end of branches, mostly deciduous after flowering (vs. often 2–3 together, persistent), appendages small, patent or reflexed, often purple-maculate, sometimes straw-colored (vs. large, spreading, straw-colored (upper usually with purple spots)), cilia 5–8(–10) on each side, 1–1.5 mm long (vs. cilia 9–13 on each side, 1.5–2(–2.5) mm long), spine hamate or squarrose (vs. erect or spreading), 5–8 (vs. 4–6) central florets, and pappus 1–2 mm long, rarely absent (vs. absent) (Figure 6a).

Specimens examined: Iran. Prov. Azerbaijan: Maku, Dashtak, 1555 m, 24.6.2012, *Ranjbar & Negaresh 31832* (BASU); Zonus, 1630 m, 25.6.2012, *Ranjbar & Negaresh 29284* (BASU); Khoy, 3 km after Balajock, 2100 m, 23.6.2012, *Ranjbar & Negaresh 29847* (BASU); Oshnavieh, 1700 m, 23.6.2012, *Ranjbar & Negaresh 32685* (BASU); Goja Bel, 1800 m, *Rechinger 14863* (W); 5–17 km S Maku, 1500 m, *Rechinger 14592* (W); 13–19 km SW Mianeh to Qezel Owzan, 1200 m, *Rechinger 42265* (W); 20–30 km NE Tabriz, 1600 m, *Rechinger 43591* (W); 94 km N Khoy, 1000 m, *Rechinger 32726* (W); between Oshnavieh and Naqadeh, 1500 m, *Rechinger 49028, 49029* (W); 38 km NW Bonab, 1550 m, *Rechinger 43170* (W); between Balanaj and Rashkan, 1350 m, *Rechinger 42112* (W); SW Rezaieyeh, 1500 m, *Rechinger 49113* (W); Khanian, *Rechinger 14811* (W). Prov. Ardebil: Meshkinshahr to Ardebil, 6 km after Shahryari, 52 km to Ardebil, 1260 m, 25.6.2012, *Ranjbar & Negaresh 30469* (BASU). Prov. Hamedan: neck Asad Abad, 19.6.2012, *Ranjbar & Negaresh 32981* (BASU); Nahavand, Gamasiab, Garin mountain, 15 km from Nahavand, 1840 m, 14.6.2012, *Ranjbar & Negaresh 29088, 29115* (BASU); mountains Karaghan, 2000–2200 m, *Rechinger 2121* (W). Prov. Kurdistan: 8 km to Tekab, above the neck, 1750 m, 13.6.2012, *Ranjbar & Negaresh 30215* (BASU); Sanandaj to Kamyaran, 32 km to Kamyaran, 1405 m, 30.5.2012, *Ranjbar & Negaresh 29681* (BASU); Sanandaj to Marivan, 105 km to Marivan, before Darmala village,

2057 m, 20.6.2012, *Ranjbar & Negaresh 29223* (BASU); 14 km N Saqqez, 1550 m, *Rechinger 43098* (W); 15 km E Dez Shahpur (Marivan), 1400 m, *Rechinger 42986* (W). Prov. Arak: Komeijan to Arak, 1830 m, 14.6.2012, *Ranjbar & Negaresh 29108* (BASU); Gargan to Tafresh, 16 km to Tafresh, 2120 m, 14.6.2012, *Ranjbar & Negaresh 29145* (BASU). Prov. Zanjan: Bijar to Zanjan, 115 km to Zanjan, 1630 m, 14.6.2012, *Ranjbar & Negaresh 29451* (BASU); 10 km to Lowshan, 620 m, 14.6.2012, *Ranjbar & Negaresh 29732* (BASU). Prov. Qazvin: ca. 80 km to Moallem Kalayeh, 1620 m, 10.6.2012, *Ranjbar & Negaresh 30064* (BASU); Kuh-e Dashteh, 2400–2500 m, *Rechinger 57295* (W); Kuh-e Sefid near Karaj, 1500 m, *Rechinger 620* (W); between Qazvin and Takestan, 1200 m, *Rechinger 42314* (W). Prov. Kermanshah: Kamyaran-Ravansar road, 5 km after Alak village, 1428 m, 14.6.2012, *Ranjbar & Negaresh 30556* (BASU); 76 km N Taq-i Bustan, *Rechinger 14681* (W). Prov. Lorestan: Bisheh, 1200–1400 m, *Rechinger 5725* (W). Prov. Khorasan: SE Soltan Abad, Sabzavar, Emamzadeh Asghar, 1950 m, 11.7.1989, *Faghihnia & Zangui 17935* (FUMH); 10 km road Kashmar, Ghaleh Ghogh village, 1300 m, 27.5.1981, *Zokaei 970* (FUMH); Ghochan, first entry to Khosravieh, 1550 m, 18.6.1981, *Ghorashialhosseini 1059G* (FUMH); Shirvan, Malakanlu, 1600 m, 8.7.1990, *Faghihnia & Zangui 18844* (FUMH); 19 km to Ghochan, after Zobaran, 1600 m, 17.6.1981, *Ghorashialhosseini 913G* (FUMH); Shirvan, Ghenat between Khanlagh and Shirvan, 1000 m, 30.6.1981, *Ghorashialhosseini 1096G* (FUMH); Bajgiran, 1600 m, 17.6.1981, *Ghorashialhosseini 783G* (FUMH); Norozi 9 km to S Ghochan, mountains of Norozi valley, 1500–1600 m, 17.6.1981, *Ghorashialhosseini 938G* (FUMH); Chehelmir, 25 km SW Dargaz, 1000–1200 m, 4.6.1981, *Ghorashialhosseini 632G* (FUMH); neck Badranlu, 900 m, 19.8.1984, *Ayatolahi & Zangui 11653* (FUMH); Dargaz, 500 m, 3.6.1984, *Ghorashialhosseini 597G* (FUMH); 6 km to W Dargaz, 1050–1200 m, 1.7.1987, *Ayatolahi & Zangui 15501* (FUMH); mountains Kopet Dagh infra Alam Ali, 1600 m, *Rechinger 1684* (W); NE Mozduran, 900–1000 m, *Rechinger 55630* (W), *55631* (W); near Torbat-e Heydarieh, 1300 m, *Rechinger 4334* (W); Sepid between Bojnord and Maraveh Tappeh, *Rechinger 32451* (W); Kuh-e Neyshahpur above Akhlamad, 1600–1800 m, *Rechinger 4589* (W); 20 km N Sabzvar, 1750 m, *Rechinger 53651* (W); Jowzak, 74 km W Bojnord toward Gorgan, 1100 m, *Rechinger 53771* (W); Sepid, between Bojnord and Maraveh Tappeh, 1350 m, *Rechinger 32541* (B). Prov. Tehran: mountains Tuchal near Darband, 1500–2000 m, *Rechinger 1080* (W). Iraq. Prov. Arbil: mountains Qandil, Pushtashan, 1100 m, *Rechinger 11033* (W); Hajji Omran, 1700 m, *Rechinger 11298* (W). Prov. Suleymanieh: 18 km W Penjwin, *Rechinger 10400* (W); near Tawilla, 1300 m, *Rechinger 10203* (W). Prov. Mosul: above Suwara Tuka, 1500 m, *Rechinger 11561* (W). Pakistan. Prov. Kurram:

between Amal Kot and Sadda, 1400 m, *Rechinger 30965* (W). Afghanistan. Prov. Farah: 32 km N Gulestan to Viam toward Parjuman, *Podlech 21726* (W). Prov. Ghorat: Qala Shahrak, 2000 m, *Rechinger 19136* (W); infra Parjuman, 1850 m, *Rechinger 19020* (W); Qala-i Ghor (Taiwara), 2100 m, *Rechinger 19125* (W). Kabul: Kabul, 1800 m, *Rechinger 17052-a* (W); between Kabul and Charikar, *Podlech 11628*, *12868* (W); Baba Qashqar, 2000 m, *Podlech 15881* (W); Band-e Kharghak, 2000 m, *Rechinger 19293-a* (W); Sar-i Chashmeh, 3000 m, *Rechinger 18554* (W). Prov. Panjshir: above Safed Jir, 2800 m, *Podlech 12522* (W). Prov. Logar: 3 km S Pul-i Alam, 1955 m, *Podlech 18484* (W). Prov. Maidan: Shibar, 2200–2500 m, *Rechinger 36909* (W). Prov. Ghazni: between Kabul and Ghazni, 1900 m, *Rechinger 17220* (W); Bozghalak 24 km NE Ghazni, 2400 m, *Rechinger 17289* (W); Sang-i Masha, 2500–2700 m, *Rechinger 17486* (W); 9 km ENE Malestan, 2850 m, *Podlech 19302* (W); Sardalu W Qarabagh, 2300–2500 m, *Rechinger 17317* (W). Prov. Bamian: 14 km S Waras, 2400 m, *Rechinger 36710* (W); Jare sare Nil, 2850 m, *Podlech 18979* (W). Deh Kundi: in saxosis et arenosis graniticis 3–30 km NE Shahrestan, 2200 m. 1–2.7.1967, *Rechinger 36732* (B). Turkey. C5 Niğde: Aladağar, 2000 m, 7.8.1999, *Döring & Tolimir 1358* (B);

1700 m, 12.8.1999, *Döring, Parolly & Tolimir 1526* (B); d. Ulukişla, Bolkar Dağları above Meydan, 2350 m, 29.7.1999, *Döring, Parolly & Tolimir 1067* (B); d. Ulukişla, Bolkar Dağları, upper Arpalik (Maden) Deresi, slopes along the road from Darboğaz to Meydan, 2350 m, 30.7.1999, *Döring, Parolly & Tolimir 1058* (B); d. Ulukişla, Bolkar Dağları, upper Arpalik (Maden) Deresi, slopes along the road from Darboğaz to tarn Karagöl, 2360 m, 29.7.1999, *Döring, Parolly & Tolimir 936* (B). B9 Van: Bendimahi, 1700 m, 15.7.1981, *Raus 4050* (B). Ad Angora Galatiae, 1892, *Bornmüller 3056* (B); 1600 m, 17.8.1938, *Ellenberg 77* (B). Turkey. Szandschak Gümüşkhane, *Frey 7407* (B).

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