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A new species of *Cirsium* sect. *Epitrachys* (Asteraceae: Cardueae) from the south of Turkey

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Abstract: A new species, *Cirsium bozkirensis* H.Duman, Dirmenci & Tugay (Asteraceae), *Cirsium* sect. *Epitrachys* DC, is described from Konya Province, South Anatolia, Turkey. Diagnostic and morphological characteristics that distinguish it from allied species *C. cephalotes* Boiss. and *C. pugnax* Sommier & Levier. are provided. A description, distribution map, and taxonomic comments on the new species and allied species are given. SEM photograph about setae, stem indumentum, and achene of new and allied species are obtained and characters are discussed.

Key words: *Cirsium*, Compositae, endemic, Konya, Turkey

1. Introduction

The genus *Cirsium* Mill. is one of the largest genera in Asteraceae. It contains about 250 species, which are mainly distributed in Europe, North Africa, East Asia, Central Asia, SW Asia, and North and Central America (Charadze, 1963; Davis and Parris, 1975; Petrak, 1979; Kadereit and Jeffrey, 2007). In addition to the *Flora of Turkey* (Davis and Parris, 1975), nine species belonging to the sect. *Epitrachys* DC. and the sect. *Cirsium* (Daşkın et al., 2006; Yıldız and Dirmenci, 2008; Yıldız et al., 2009a, 2009b, 2011, 2013; Arabacı and Dirmenci, 2011; Fırat, 2016) and two hybrids (Yıldız et al., 2016) were added recently. Finally, the genus *Cirsium* is represented by 67 species (79 taxa, 32 endemic) and two hybrids that belong to *C.* sect. *Epitrachys* (49 species, 51 taxa), *C.* sect. *Cirsium* (17 species, 27 taxa and 2 hybrid), and *C.* sect. *Cephalonoplos* (Neck.) DC. (1 species) in Turkey (Yıldız et al., 2012, 2016).

During revisionary studies of Turkish *Cirsium* and some other floral studies between Bozkır and Hadim in Konya Province, southern Turkey (Figure 1), some interesting specimens belonging to *Cirsium* were collected between 2000 and 2016 by the authors. After these thorough studies, it was concluded that the specimens belonged to the sect. *Epitrachys* and represented a hitherto undescribed species with affinities to *C. cephalotes* Boiss. and *C. pugnax* Sommier & Levier.

The aim of the present study is to describe the new species of the genus *Cirsium* and to determine the morphological differences between the new species and its allied species. Differences of the new species from its allies (*Cirsium cephalotes* and *C. pugnax*) are presented in detail in the Table.

2. Materials and methods

Plant materials belonging to the new species and its allied species were collected by the authors between 2000 and 2016 from Turkey. These specimens were determined using the relevant literature (Boissier, 1875; Sommier and Levier, 1895; Davis and Parris, 1975; Werner, 1976; Huber-Morath, 1980, 1982; Sorger and Buchner, 1983a, 1983b; Davis et al., 1988; Güner et al., 2000; Greuter, 2006; Yıldız et al., 2012) and compared with material found in the herbaria BM, E, G, GAZI, K, KNYA, LE, and W. All of the materials are given under the Examined Specimens, Type, and Paratypes (Appendix).

Stem indumentum, leaf setae, and achenes were studied by scanning electron microscopy (SEM) at the Basic Sciences Research and Applied Center of Balıkesir University. For SEM, small pieces of leaves and stem with achenes were fixed on aluminum stubs using double-sided adhesive tape. The SEM micrographs were taken in a NeoScope JCM-5000 at an accelerating voltage of 10 kV.

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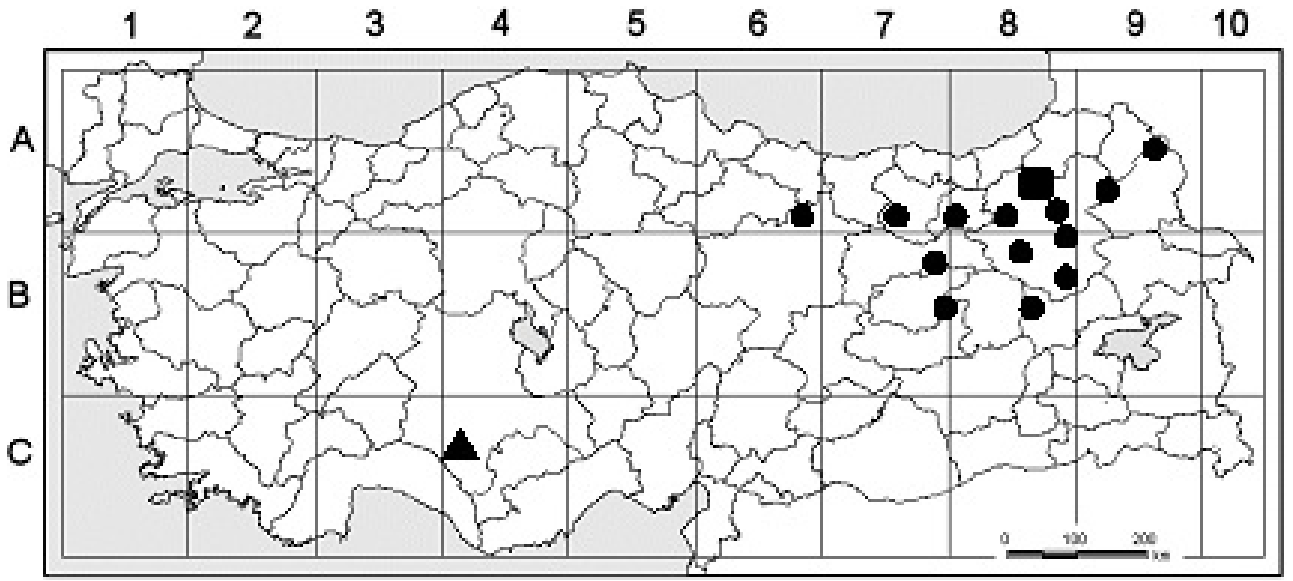

Figure 1. Distribution map of *Cirsium bozkirensis* (▲), *C. cephalotes* (●), *C. pugnax* (■) in Turkey.

Table. Comparison of distinguishing characters of *Cirsium bozkirensis* with those of *C. cephalotes* and *C. pugnax*.

Characters	*C. bozkirensis*	*C. cephalotes*	*C. pugnax*
General view	green to grayish-green	glaucous to purple	glaucous to purple
Stem	single or a few	generally many stemmed from the same root	many stemmed from the same root
Stem indumentum	densely arachnoid to tomentose	sparsely to densely arachnoid	sparsely arachnoid
Median cauline leaves	pinnatifid to pinnatisect	pinnatifid to pinnatisect	pinnatifid
Upper stem leaves	pinnatifid to pinnatipartite	pinnatilobed to pinnatifid	pinnatilobed
Involucral leaves	5-7(-12), shorter or longer than involucre	6-12, equal to longer than involucre	2-3, outer longer than involucre, others shorter
Phyllaries	5-7 seriate, median phyllaries 17-30 mm with 3-7 mm apical spine, recurved	7-8 seriate, median phyllaries 23-29 mm with 4-8 mm apical spine, erecto-patent	7-10 seriate, median phyllaries 19-25 mm with 9-12 mm apical spine, erecto-patent to patent
Corolla	pinkish-purple, 35-40 mm	pinkish-purple,32-37 mm	purple, 25-27 mm
Achene	7-8 mm	c. 5 mm	5.5-6 mm

3. Results and discussion

Cirsium bozkirensis H.Duman, Dirmenci & Tugay **sp. nov**. (Figures 2–4)

Type: Turkey. C4 Konya; Bozkır, between Sorkun District and Dikilitaş Yaylası, 1780 m a.s.l., 28.07.2002, *O.Tugay* 3060 & *Ertuğrul* (Holotype: KNYA; Isotypes: GAZI, KNYA).

Diagnosis: *Cirsium bozkirensis* is distinguished from *C. cephalotes* by its general view grayish-green (not glaucous), single or a few stems on a single root system (not many) densely arachnoid with multicellular hairs to tomentose (not sparsely to densely arachnoid with multicellular hairs), leaf setae more than 10 in 2 mm square (not between 5 and 10), upper stem leaves pinnatifid to pinnatipartite (not pinnatilobed to pinnatifid), involucral leaves mostly 5-7, (not 6-12), and achenes 7-8 mm (not ca. 5 mm). It can be distinguished from *C. pugnax* by its general view grayish-green (not glaucous to purple), single or a few stems on a single root system (not many) densely arachnoid with multicellular hairs to tomentose (not sparsely arachnoid), median cauline leaves pinnatifid to pinnatisect (not pinnatifid), leaf setae more than 10 in 2 mm square (not between 5 and 10), and apical spine of median phyllaries 3-7 mm (not 9-12 mm). (Figures 2–5)

Description: Perennial herbs. Stem stout, single or a few stems on a single root system, branched above, unwinged, striate, densely arachnoid with multicellular hairs to tomentose, green to grayish-green. Basal leaves 15-40 × 10-15 cm (incl. petiole), pinnatisect, spinose-strigose above; setae dense, more than 10 in 2 mm square; lobes

Figure 2. General view of *Cirsium bozkirensis* (drawn by Dr Osman Tugay).

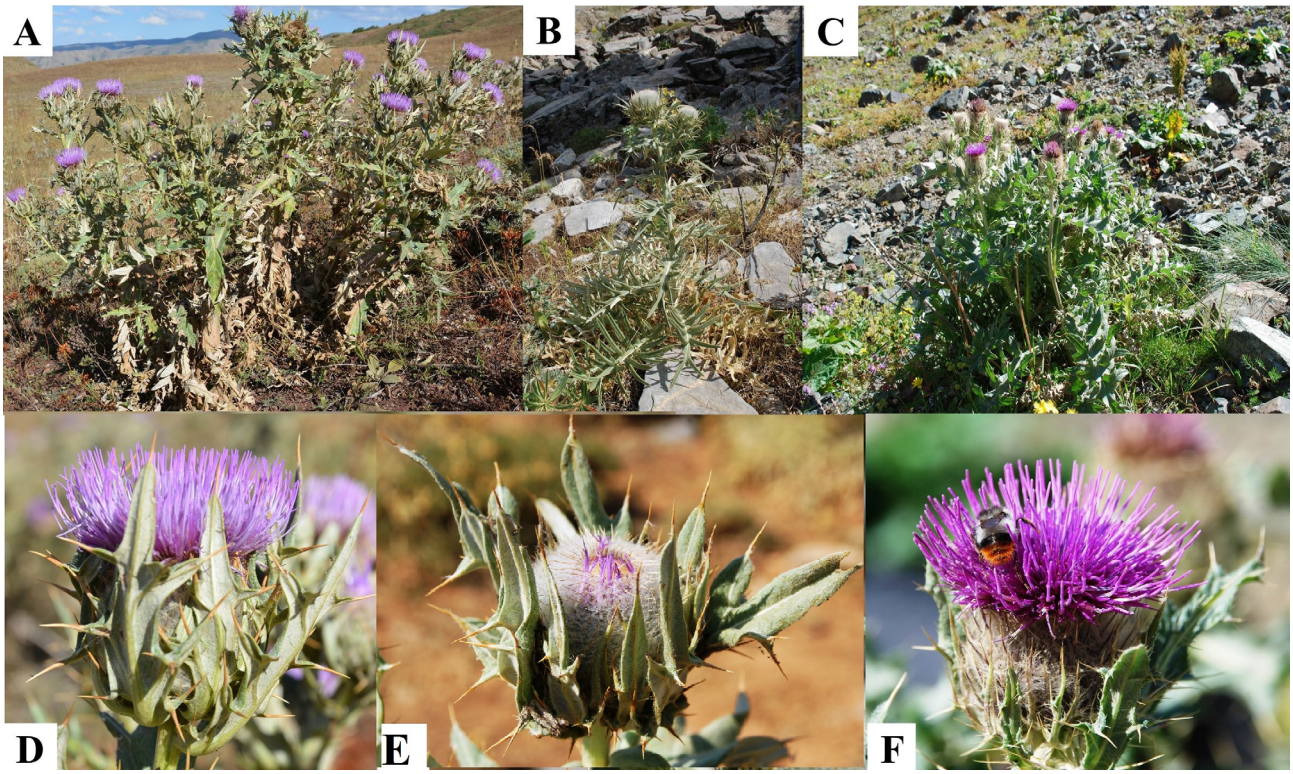

Figure 3. General view of *C. cephalotes* (A), *C. bozkirensis* (B), *C. pugnax* (C) and capitula of *C. cephalotes* (D), *C. bozkirensis* (E), and *C. pugnax* (F) (photos from Dr Tuncay Dirmenci).

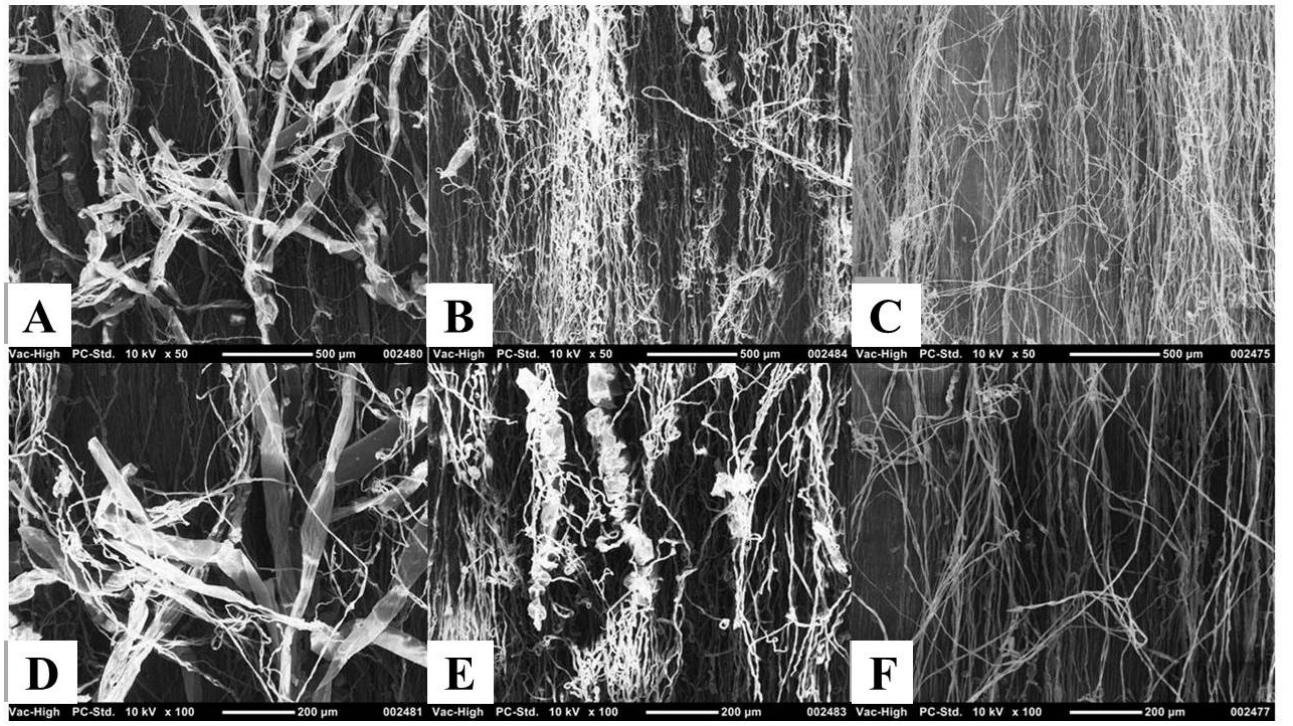

Figure 4. Stem indumentum of *Cirsium cephalotes* (A, D), *C. bozkirensis* (B, E), and *C. pugnax* (C, F).

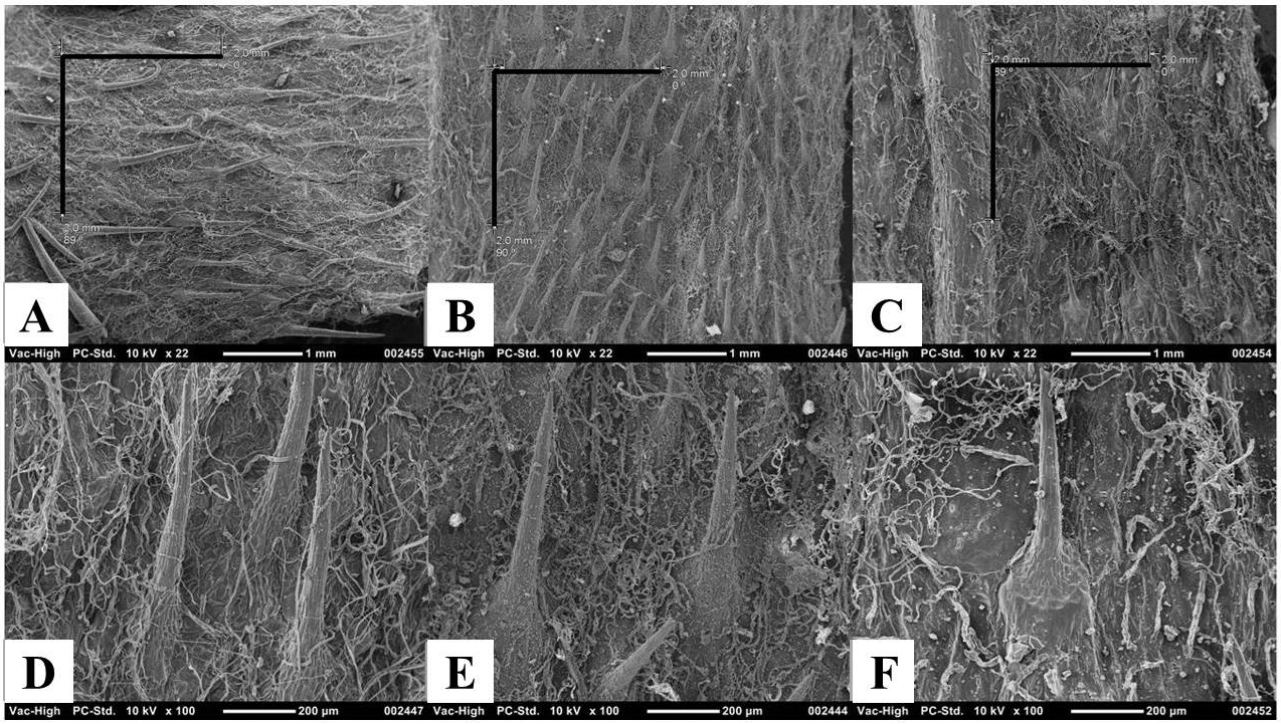

Figure 5. Leaf setae of *Cirsium cephalotes* (A, D), *C. bozkirensis* (B, E), and *C. pugnax* (C, F).

8–10 pairs, 1-5 × 0.4-1 cm, with 5-15 mm apical spine, ±oblong, white arachnoid to tomentose above and densely white tomentose beneath, with upper surface grayish-green, lower surface clearly white; lateral lobes bifid, obtuse, with margins spinulose-ciliate. Cauline leaves oblong in outline, diminishing from base to inflorescence, 8-30 × 4-12 cm; lower and middle cauline leaves pinnatifid to pinnatisect; upper cauline leaves pinnatifid to pinnatipartite; lateral lobes oblong to lanceolate, with stout 5-17 mm apical spine, sparsely to densely tomentose and spinose-strigose above, densely white tomentose below; setae erecto-patent, 0.5-1.2 mm, more than 10 in 2 mm square; middle and upper leaves auriculate. Involucral leaves 5-7(-12), 30-65 mm with to 10 mm apical spine, shorter or longer than capitula; capitula 30-50 mm, ± globose; phyllaries lanceolate, densely arachnoid at apex, imbricate, 5-7-seriate; median phyllaries 17-30 mm with 3-7 mm apical spine, recurved. Corolla pinkish-purple, 35-40 mm, unequally 5-lobed to 1/5-1/8, 4 lobes ± equal c. 5 mm, other lobe c. 8 mm; anthers 9-12 mm, glabrous; filaments densely hairy; style exserted from corolla. Achenes 7-8 mm, blackish to grayish with black striate. Pappus 22-28 mm, dirty white, plumose.

Paratypes: Turkey. **C4** Konya; Hadim, 15 km from Hadim to Beyreli road, steppe, 1700–1800 m a.s.l., 04.10.2000, *H.Duman* 8461(GAZI); Bozkır, Sorkun, Dikilitaş Yaylası, 1850 m a.s.l., 14.07.2001 *Ertuğrul* 2476 & *O.Tugay* (KNYA); ibid., 1780 m a.s.l., 06.10.2016, *O.Tugay* 13613 (KNYA); Bozkır, Sorkun District, 6 km from İsalı village to Dikilitaş Yaylası, 1850 m a.s.l., 23.07.2008, *Yıldız* 16843, *Dirmenci & Arabacı* (GAZI); ibid., 11.09.2007, *Dirmenci* 3657a & *Akçiçek* (GAZI). Bozkır, 10 km from Akseki-Beyşehir main road to Sorkun, 1750 m, 11.09.2008, *Dirmenci* 3658 & *Akçiçek* (GAZI).

Flowering time: July to September.

Etymology: The species epithet is derived from the name of the district (Bozkır, Konya Province) where the type was collected.

Proposed Turkish name for the new species: Bozkır kangalı.

Habitat and ecology: *Cirsium bozkirensis* grows on calcareous open places where the following species appear between 1700 and 1850 m a.s.l.: *Abies cilicica* (Antoine & Kotschy) Carrière, *Juniperus foetidissima* Willd. and *Pinus nigra* J.F.Arnold, *Quercus* sp. forest and *Astragalus* sp. steppe with *Acantholimon ulicinum* (Willd. ex Schult.) Boiss. subsp. *lycaonicum* (Boiss. & Heldr.) Bokhari & Edm., *Acantholimon venustum* Boiss. var. *venustum*, *Astragalus gummifer* Labill., *Berberis crataegina* DC., *Carlina oligocephala* Boiss. & Kotschy subsp. *oligocephala*, *Cirsium*

leucocephalum (Willd.) Spreng. subsp. *leucocephalum*, *Daphne oleoides* Schreb. subsp. *oleoides*, *Digitalis ferruginea* L. subsp. *ferruginea*, *Euphorbia kotschyana* Fenzl, *Festuca valesiaca* Schleich. ex Gaudin, *Echinops pungens* Trautv. var. *pungens*, *Eryngium campestre* L., *Erodium cicutarium* (L.) L'Herit. ex DC. subsp. *cicutarium*, *Marrubium parviflorum* Fisch. & C.A.Mey. subsp. *parviflorum*, *Micromeria myrtifolia* Boiss. & Hohen., *Picnomon acarna* (L.) Cass., *Teucrium polium* L., *Xeranthemum annuum* L., and *Velezia rigida* L.

Distribution and proposed conservation status: *Cirsium bozkirensis* is endemic to Konya Province, South Turkey, and is a Mediterranean element (Figure 1). The new species is known from four locations. Its distribution area is less than 10,000 km^2. The total number of individuals is approximately 100–150. Although the new species being perennial is a crucial advantage for its future, destruction of the forests by local people, forest fires, and deterioration of habitats may cause some threats to the future of the species. Because of all these reasons (B2abi-vCaiD), *C. bozkirensis* should be regarded as an Endangered (EN) species (IUCN, 2016).

Key to related *Cirsium* species

1. Apical spine of median phyllaries stout, 9-12 mm; lower and median cauline leaves pinnatifid (NE of Turkey) ..... **pugnax**

1. Apical spine of median phyllaries weak, 3-9 mm; lower cauline leaves pinnatisect, median cauline leaves pinnatisect to pinnatifid **2**

2. Stems and leaves glaucous; sparsely to densely arachnoid; leaf setae not more than 10 in 2 mm square, upper stem leaves often pinnatilobed; involucral leaves 6-12, ... (E and NE of Turkey) **cephalotes**

2. Stems and leaves grayish-green to green; densely arachnoid to tomentose; leaf setae more than 10 in 2 mm square; upper stem leaves often pinnatifid; involucral leaves mostly 5–7 .. (S of Turkey) **bozkirensis**

Cirsium bozkirensis is similar to *C. cephalotes* and *C. pugnax*. It shares some characteristics with them such as stem, leaf, and capitula sizes (Figures 3A–3F), but it is distinguished from *C. cephalotes* by its general view green, single or a few stems on a single root system, stem and leaf indumentum, leaf fragmentation, and achene micromorphology (Figures 3A, 3B, 3D, and 3E). It differs from *C. pugnax*, by its stem indumentum, lower and median cauline leaf fragmentation, median phyllary, corolla size, and achene micromorphology (Figures 3B, 3C, 3E, and 3F). Differences of the new species from its allied species (*Cirsium cephalotes* and *C. pugnax*) are presented in details in the Table and the key.

Although stem indumentum is similar between the species, there are some differences (Figures 4A–4F). *C. bozkirensis* is different from *C. cephalotes* by its stem indumentum arachnoid with a few multicellular hairs to tomentose hairs (not many multicellular hairs) (Figures 4A, 4B, 4D, and 4E) and it differs from *C. pugnax* by its stems densely arachnoid to tomentose with a few multicellular hairs (not only sparsely arachnoid) (Figures 4B 4C, 4E, and 4F). Furthermore, the setae on the leaf are different in terms of density (Figures 5A–5F)

The morphological characters of the cypsela are quite useful for the delimitation of different taxa at both the generic and species level within the genera of Asteraceae, such as *Scorzonera* L., *Lactuca* L., *Cicerbita* Wallr., *Prenanthes* L., *Achillea* L., and *Carduus* L. (Akçin and Akçin, 2014; Köstekçi and Arabacı, 2014; Abid and Qaiser, 2015; Coşkunçelebi et al., 2015, 2016; Aytaç et al., 2016). In addition, the macro- and micromorphological features of the cypselae of *Cirsium* taxa can be used as distinguishing characteristics. In previous studies on the cypsela morphology of *Cirsium* species, the examined species were divided into 7 main types (Köstekçi and Arabacı, 2011). Our results show that *Cirsium bozkirensis* is Type I (ornamentation; scalariform, cells: 4–5-angled), *C. pugnax* is Type II (ornamentation: ribbed, cells: linear and hollow), and *C. cephalotes* shows both Type I and Type II characteristics according to Köstekçi and Arabacı (2011).

As seen as Figures 6A–6F, *Cirsium bozkirensis* has scalariform ornamentation. The epidermis cells are 4–5-angled, smooth, with conspicuous walls that are flat, angular, flexuous, or ± concave (Figures 6B and 6E). The ornamentation of *C. cephalotes* is scalariform-ribbed. The epidermis cells are 4–5-angled, flat, with inconspicuous, straight, or angular-anticlinal walls. Some of them are linear, hollow, with inconspicuous to conspicuous and flat anticlinal walls. The periclinal cell walls are distinct, straight or concave (Figures 6A and 6D). The ornamentation of *Cirsium pugnax* is ribbed, the cells are linear, hollow, with inconspicuous to conspicuous and flat anticlinal walls. The periclinal walls are very distinct, ± flat or concave (Figures 6C and 6F).

Cirsium bozkirensis is ecologically and geographically isolated from its allies. It grows in calcareous habitats in open places in coniferous and *Quercus* sp. forest between 1700 and 1850 m in the south of Turkey and is a Mediterranean element. In contrast, *C. cephalotes* grows on steppe up to 2500 m in east and northeast Turkey and is a Euxine element and *C. pugnax* grows on granite and dioritic screes in alpine steppes up to 3200 m in northeast Turkey and is also a Euxine element.

Cirsium bozkirensis is different from its allied species in the macro- and micromorphological characters mentioned above and is geographically isolated. Finally, with this new

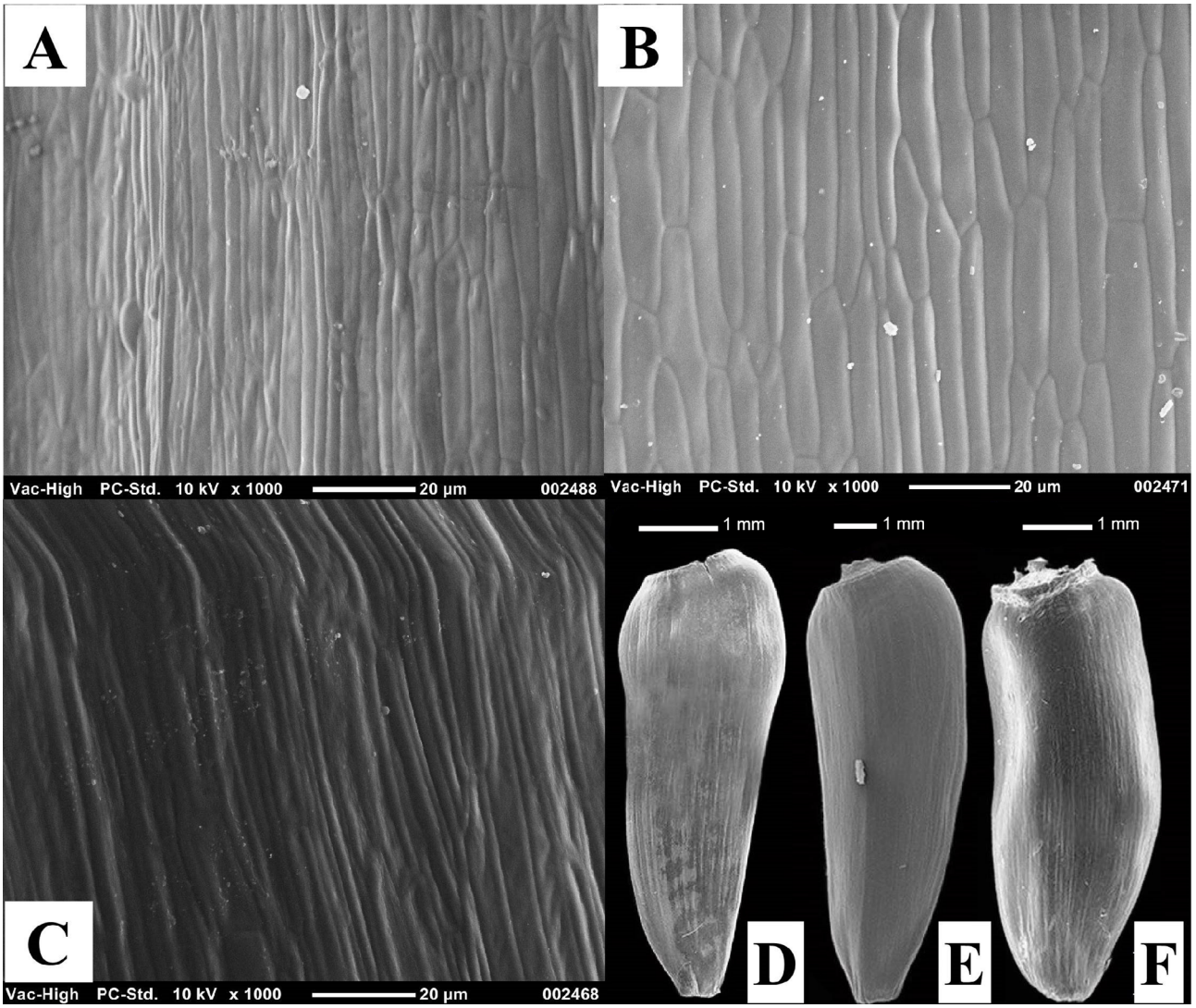

Figure 6. Achenes: general view of *C. cephalotes* (A), *C. bozkirensis* (B), and *C. pugnax* (C); micromorphology of *C. cephalotes* (D), *C. bozkirensis* (E), and *C. pugnax* (F).

species, the number of *Cirsium* species growing in Turkey reached 68 (80 taxa), 33 (41%) of which are endemic.

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Appendix

***Cirsium cephalotes* Boiss.:** A7 Giresun: Tamdere, South of Eğribel pass, Hozanlı Yaylası, 1900 m a.s.l., 22.08.2006, *Yıldız* 16386 *& Dirmenci* (GAZI). A7 Gümüşhane: Stavri, 2286 m a.s.l., 20.08.1934, *Balls* 1997 (G); Szandschak, Tempede, in harbidis, 22.08.1894, *Sintenis* 7443 (G, K, BM); Erzurum: in jugo Kop Dagh inter Askale et Bayburt, 2300-2500 m a.s.l., 18.08.1967, *Rechinger* 37698 (W); A8 Gümüşhane: North of Bayburt, 1500 m a.s.l., 03.08.1957, *P. H. Davis* 31986 *& Hedge* (E, K); Szanchak Gumuschkhave, Gumuschkane: in declivibus supra Istavros, 09.08.1889, *Sintenis* 1801 (G); A8 Bayburt: North of Bayburt, 1500 m a.s.l., 03.08.1957, *P. H. Davis* 31986 & *Hedge* (K); Bayburt: Kop Mountain pass, 8000 ft, 10.08.1962, *Furse* 3836 (K); Kop Mountain, environs of pass, 2400-2500 m a.s.l., mountain steppe, 12.08.2006, *Yıldız* 16263 & *Dirmenci* (GAZI). Kop Mountain, between Aşkale and Bayburt, 2000–2450 m a.s.l., *Rechinger* 32889 (W); B7 Erzincan: on road to Kelkit, South of Pöske pass, steppe, 1800-1900 m a.s.l., 12.08.2006, *Yıldız* 16256 & *Dirmenci* (GAZI). Asia minor, prope Erzincan, 1858, *Tchihatchef* (G); Erzincan: Sipikör Mountain, *Sintenis* 1890: 3337, 337b (G); Tunceli: Sultanbaba Mountain, 1700–2900 m a.s.l., 20.08.1982, *Sorger* 82-130-16 & *Buchner* (W); B8 Erzurum: Erzerum, *Aucher-Eloy* 3525 (type of *C. cephalotes*, holo. G, iso. K); Erzurum: 31 km from Çat to Bingöl (137 km) c. 8 km south of Karir village, 2260 m a.s.l., *Buttler* 15960 (K).

***C. pugnax* Sommier & Levier:** in Caucasi iberice alpine incultis circe Kasbek, ad torrentum Terek frequens, type of *C. munitum* (Birb.) Fisch. (LE); A8 Rize: d. İkizdere, Cermanin Hill above Cimil, 3200 m a.s.l., 29.08.1952, *P.H.Davis* 21090 & *Dodds* (E, K); Baltaş Hill, 3200 m a.s.l., 30.08.1952, *P.H.Davis* 21121 & *Dodds* (E, K); upper Cimil valley, *Balansa* 583 (K) İkizdere, Başköy, Çiçekli Yaylası, 2100–2300 m a.s.l., stony places, 15.09.2007, *Yıldız* 16664 & *Arabacı* (GAZI). Başköy, Kılıçgaç Yaylası, 2400–2600 m a.s.l., 04.09.2008, *Dirmenci* 3656 & *Akçiçek* (GAZI) İkizdere, Cermanin Hill, above Cimil, 3200 m a.s.l., 29.08.1952, *P.H.Davis* 21090 & *Dodds* (E, K, BM); İkizdere, Baltaş Hill, 3200 m a.s.l., 30.08.1952, *P.H.Davis* 21121 & *Dodds* (K, BM).