Paracaryum bingoelianum (Boraginaceae), a new species from Turkey

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Abstract: Paracaryum bingoelianum Behçet & İlçim is described as a new species. It is confined to Bingöl in Eastern Anatolia, Turkey. Paracaryum bingoelianum is closely similar to P. cristatum subsp. cristatum and P. kurdistanicum. It mainly differs from them in that it has a shrub-like woody base and numerous stems with sterile shoots, longer corolla, and bigger nutlets. The diagnostic characters are discussed and taxonomic comments are presented. Seed and pollen characteristics were investigated using light and scanning electron microscopy. Notes on its ecology are also presented. A distribution map of the new and related species is provided.

Key words: Paracaryum, taxonomy, Flora, Turkey

1. Introduction

Boraginaceae is one of the largest angiosperm families, comprising approximately 100 genera and almost 2000 species distributed worldwide (Taia, 2006). The species of the family occur in dry, open habitats, mountains valleys, and even in disturbed habitats. Members of the family are annual or perennial herbs, shrubs, or trees. Most of the family members have stiff hairs; inflorescence is cymose, the cymes being scorioid or circinate or rarely thyrsoid (Mill, 1979; Açıçin et al., 2013).

The genus Paracaryum (DC) Boiss. belongs to the tribe Cynoglosseae (Aytaç and Mill, 2005; Hilger et al., 2005). The new species described here belongs to Paracaryum subgenus Modestomattiastrum (Brand) R.R.Mill. The anthers are situated below the scale bases in this new species as in the subgenus Modestomattiastrum (Mill, 1977, 1979).

The first thorough arrangement of the genus Paracaryum was given by Mill (1979), who recognized 27 species, 3 subspecies, and 4 varieties. Since then 1 new species, P. hedgei Aytaç & R.R.Mill of the subgenus Mattiastrum (Boiss.) R.R.Mill., has been identified from Turkey (Aytaç and Mill, 2005). According to Koca and Yıldırım (2010), the genus Paracaryum is represented in Turkey by 28 species, 1 subspecies, and 2 varieties. However, in the recent checklist of Flora of Turkey (Güner et al., 2012), the genus is represented by 28 species, 3 subspecies, and 4 varieties. The distribution of Paracaryum in neighboring countries is as follows: 9 species in the former USSR (Shiskin, 1953), 42 (17 Paracaryum, 25 Mattiastrum) in the Flora Iranica area (Riedl, 1967), 7 in Flora of Syria (Mouterde, 1966), and 1 in Flora Europaea (Ferguson, 1972).

The species described in this paper was collected in Bingöl in Turkey in 2012 by Dr L Behçet. At first glance it resembled P. cristatum (Schreber) Boiss. subsp. cristatum and P. kurdistanicum (Brand) R.Mill. However, it differs considerably from them based on comparative morphological and palynological studies. Therefore, this study aims to describe a new species from Turkey in the genus Paracaryum.

2. Materials and methods

The specimens were cross-checked with the keys provided by Mill (1979) and the Paracaryum accounts given in the relevant literature, including Flora Iranica (Riedl, 1967) and Flora of Syria (Mouterde, 1966). Specimens that were used for cross-checking were deposited at various Turkish herbaria (ANK, GAZI, HUB, and V ANF).

In the course of scanning electron microscopy studies, mature nutlets, seeds, and pollens were mounted using double-sided tape on SEM stubs and coated with gold in a Polaron SC502 sputter coater. They were examined with a JEOL JSM 5500 LV SEM at 5 kV at Mustafa Kemal University.

3. Results

Paracaryum bingoelianum Behçet & İlçim sp. nova (Figures 1–6).
Figure 1. Habit of *Paracaryum bingoelianum* Behçet & İlcım (L. Behçet 8606).

Figure 2. A- Flowering (L. Behçet 8606) and B- Fruiting sample (L. Behçet 8165) of *Paracaryum bingoelianum* C, D- Dissected corolla.

3.1. Diagnoses: Paracaryum bingoelianum is closely similar to *P. cristatum* subsp. *cristatum* and *P. kurdistanicum*. *P. bingoelianum* mainly differs from those in that it has a shrub-like woody base and numerous stems with sterile shoots (not herbaceous and without sterile shoots as found in *P. cristatum* subsp. *cristatum* and *P. kurdistanicum*), longer corolla 11–15 mm (neither 3–6 mm long as in *P. cristatum* subsp. *cristatum* nor 6.5–11 mm as in *P. kurdistanicum*; Fig. 1C), bigger nutlets 15–18 × 15–18 mm (not 8–12.5 × 6.5–10 mm as in *P. cristatum* subsp. *cristatum*, and 10–10.7 × 8.5–9.5 mm as in *P. kurdistanicum*), and styles 6–10 mm (neither 1.3–4.5 mm as in *P. cristatum* subsp. *cristatum* nor 2.3–4.3 mm as in *P. kurdistanicum*).

3.2. Description: Perennial, woody and branched at base, stems numerous, 11–25 cm, with 10–14-cm-long sterile shoots. Stems erect, simple to branched above. Basal leaves narrowly lanceolate-ovate, 6–8.5 × 0.5–0.8 cm, attenuating into long (1–3 cm) petiole, with sparse simple 0.5–1.5-mm-long hairs. Leaves on sterile shoots 30–81.5 × 2.5–8.5 mm. Stem leaves similar to basal ones, 1–5.5 × 0.3–0.8 cm. Cymes terminal, 8–13-flowered, pedicels 1.5–10 mm in flower, 3–22 mm in fruit, with dense simple hairs, calyx 8–10 mm in flower, 11–13 mm in fruit, triangular-oblong, obtuse, with simple long hairs, divided to 4/5. Corolla violet, 11–15 mm in length, tube whitish-violet, purple or violet, tube to 11 mm in length, limb to 4 mm in length, corolla lobes ovate, scales subquadrate, without appendage, notched, 1–1.5 × 1.5–1.8 mm, apex incurved, densely papillate (2C), filaments 0.5–0.8 × 0.2–0.3 mm, anthers 1.5–2 × 0.5 mm, anthers base borne below the scale bases, linear-oblong, style 6–10 mm in flower, usually included, later somewhat exserted, 9–14 mm in length in fruit. Nutlets suborbicular, 15–18 × 15–18 mm, disc 8–11 × 6–9 mm, ovate, with long and short glochids (Figure 5C). Nutlet wing 3–5 mm broad, dorsal surface with sparse glochids, margin cristate, teeth broad (Figure 5A).

3.3. Distribution and suggested conservation status and ecology

Paracaryum bingoelianum is a local endemic species known in only 2 localities, B8: Genç District (Bingöl Province), East Anatolia (Figure 3). Additionally, it is an Irano-Turanian element. The species is rare in the area. Due to grazing and erosion, the populations of species are threatened by extinction in the wild if protection measures are not taken. Therefore, we recommend that the
threatened categories of *Paracaryum bingoelianum* should be Critically Endangered (CR), because the estimated whole range is less than 10 km² (criteria B2 a b (i, iii) of IUCN 2013).


3.4. Etymology: The specific epithet is derived from the name of the city Bingöl.

4. Discussion

The first thorough arrangement of the genus Paracaryum was given by Mill (1979), who recognized 27 species, 3 subspecies, and 4 varieties. Since then 1 new species, P. hedgei Aytaç & R.R.Mill, has been identified from Turkey (Aytaç and Mill, 2005). The subgenus Modestomattiastrum (Brand) R.R.Mill. is represented by 15 taxa (9 species, 4 subspecies, and 2 varieties) in the Flora of Turkey (Mill, 1979). This new species is similar to the subgenus Mattiastrum with its large nutlet, long corolla, and sterile shoots. However, when we examined the flora of Turkey and Russia, we observed that some species have characters between the subsections Mattiastrum and Modestomattiastrum like P. bingolianum. For example, P. laxiflorum Trautv. has flower and nutlet characters between the subgenus Mattiastrum and the subgenus Modestomattiastrum. Paracaryum bingolianum belongs to the subgenus Modestomattiastrum with its anthers base borne below the scale bases, and the nutlets wings flat. Within the subgenus Modestomattiastrum, the new species is closely similar to P. cristatum subsp. cristatum and P. kurdistanicum. According to Mill (1979), P. cristatum has 2 subspecies in Turkey. This new species clearly differs from the similar species by its branched woody structure and sterile shoots and by its longer corolla 11–15 mm (neither 3–6 mm as in P. cristatum subsp. cristatum nor 6.5–11 mm as in P. kurdistanicum). Paracaryum bingolianum differs from P. kurdistanicum by larger nutlets with dense long and short glochids on disc (not sparsely tuberculate) and larger nutlet wings 3–5 mm with sparse glochids (not always glabrous). A more detailed comparison of the species is given in the Table.

The pollen grains of P. bingolianum were studied by light microscopy and SEM. The pollen grains are elliptical in equatorial view and ±hexagonal in polar view, prolate (P/E = 1.52), 6-heterocolpate, and ectocingulate (Figure 4). The aperture margins are strongly thickened. The tectum is psilate, smooth to slightly rugulose. The exine thickness as seen under the light microscope is 0.8–1.02 μm. P. bingolianum shares the same basic pollen morphology with other Paracaryum species. These fall into 2 groups as defined by Bigazzi et al. (2006); the first group, comprising P. artvinense R.Mill, P. cappadocicum Boiss. & Bal., P. polycarpum (Rech.fil.) R.Mill, and P. rugulosum (DC.) Boiss., has very small prolate grains (P/E = 1.62–1.89), while the second comprises P. ancyritanum Boiss., P. laxiflorum Trautv., P. leptophyllum (A.DC.) Boiss., and P. racemosus (Schreber) Britten, which have slightly larger grains with a prolate-spheroidal shape (P/E = 1.13–1.25). The first group of species belong to the subgenus Modestomattiastrum, which has prolate pollen shape as

Table. Comparison of the diagnostic characteristics of Paracaryum bingolianum, P. cristatum subsp. cristatum, and P. kurdistanicum.

<table>
<thead>
<tr>
<th>Character</th>
<th>P. bingolianum</th>
<th>P. cristatum subsp. cristatum</th>
<th>P. kurdistanicum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stem</td>
<td>11–25 cm long, woody and branched at base</td>
<td>12–40 cm long, usually simple, not woody at base</td>
<td>23–30 cm long, simple, not woody at base</td>
</tr>
<tr>
<td>Sterile shoots</td>
<td>present,</td>
<td>sometimes present</td>
<td>absent</td>
</tr>
<tr>
<td>Basal leaves</td>
<td>narrowly lanceolate-obovate, 6–8.5 × 0.5–0.8 cm</td>
<td>obovate (0.8–)2.5–8.5 × 0.3–1.5 cm</td>
<td>narrowly obovate, 2.5–6 × 0.4–0.8 mm</td>
</tr>
<tr>
<td>Cauline leaves</td>
<td>narrowly lanceolate</td>
<td>Obovate</td>
<td>narrowly oblong</td>
</tr>
<tr>
<td>Inflorescence</td>
<td>terminal-paniculate</td>
<td>terminal, bifurcate</td>
<td>cymose terminal and axillary</td>
</tr>
<tr>
<td>Pedicel length</td>
<td>1.5–10 mm in flower, 3–22 mm in fruit</td>
<td>1.5–6 mm in flower, 1.5–13 mm in fruit</td>
<td>3.5–6 mm in flower, 7–12.5 mm in fruit</td>
</tr>
<tr>
<td>Corolla length (mm)</td>
<td>11–15</td>
<td>3–6</td>
<td>6.5–11</td>
</tr>
<tr>
<td>Style length (mm)</td>
<td>6–10</td>
<td>1.3–4.5</td>
<td>2.3–4.3</td>
</tr>
<tr>
<td>Nutlets</td>
<td>suborbicular, 15–18 × 15–18 mm</td>
<td>suborbicular, 8–12.5 × 6.5–10 mm</td>
<td>suborbicular, 10–10.7 × 8.5–9.5 mm</td>
</tr>
<tr>
<td>Nutlets wing</td>
<td>3–5 mm broad, dorsal surface with sparse glochids, margin cristate.</td>
<td>2–3.3 mm broad, dorsal surface always with sparse glochids, margin cristate, teeth large and broad</td>
<td>2.5–3 mm broad, always glabrous, margin shallowly and obscurely muricate-dentate</td>
</tr>
</tbody>
</table>
in *P. bingoeianum*. The seed of *P. bingoeianum* clearly differs by its long beak (Figure 6B) from *P. cristatum* subsp. *cristatum* (Figure 6A).

After the present contribution the total number of *Paracaryum* is 29 species, 3 subspecies, and 4 varieties in Turkey.

4.1. Additional examined specimens

**Paratypes:** Turkey. B8 Bingöl: SE of Genç, Şamdağ, NW rocky slopes, 1950–2000 m, 25.vii.2012 L. Behçet 8165 (in fruit); Bingöl: NE of Çirişli village, stony slopes and steppe, 1750–1850 m, 01.05.2013 L. Behçet 8581 (Mustafa Kemal Univ. Herb. ANK, Bingöl Univ. Herb.).

**Paracaryum cristatum:** B9 Bitlis: Tatvan, Nemrut Mountain, 2400–2900 m, volcanic slopes, 07.1973, A.Tatlı (HUB), B7 Erzincan: Rabat stream, moving stony slopes, 860 m, 03.07.2007, M.N. Özbek 2524 (HUB), A7 Gümüşhane: 10 km to Şirán, after Aksaray village, stony places, 1300 m, 17.06.2007, A.D. Koca 3284, (HUB), A7 Gümüşhane: Alucra, Şirán, 2 km to Sarıca village, steppe and rocky slopes, 1295 m, 02.07.2008, A.D. Koca 3527 (HUB), B9 Bitlis: Tatvan, Şöürt to Nemrut Mountain, 2200 m, 22.06.2007, A.D. Koca 3351 (HUB), B9 Ağrı: Eleşkirt, Güneykaya to Sancan village, rocky places, 1900 m, 22.06.2007, A. D. Koca, 3352 (HUB), C6 Kahramanmaraş: Engizek Mountain, Aksu neighborhood, 1000 m, 02.06.1986, Duman 3008, (GAZI), B8 Muş: 15 km to Muş, limy rocks, 26.vi.1983, T. Ekim, 7776 (GAZI), C6 Kahramanmaraş: Ahürdağ, around TV mast, Ulucak hill, Bakacak ridges, 1200–1500 m, 21.v.1992, oak clearings, Aytaç & Duman 4603 (GAZI), C6 Malatya: around Erkenek 3 km, Deveyatağı area, limy rocks, 28.v.1989, B. Yıldız 8653 (GAZI), B6 Kayseri: Sarız, Yalak, Binboğa Mountain, around Tekke kayası, rocky steppe, 2000–2400 m, 18.vii.1992, Aytaç & Duman 5268 (GAZI), C6 Kahramanmaraş: Ernine Mountain, 1300–1500 m, 22.v.1987, oak clearing, H. Duman 2795 (GAZI), C9 Şırnak: Beytüşşebap, Mezra district, 1797 m, 15.05.2010 water edges, L. Behçet 3783 (VANF), B9 Van: Erçiş, east of Doğancık village, 2250 m, 18.06.2007, steppe, O. Karabacak 6402 (VANF), B9 Van: Gürpinar, between Zernek dam and Üçgen village 1700–1900 m, steppe, 10.06.2007, I. Demir 448 (VANF), B9 Muş: Malazgirt, around Yapraklı village, 1591 m, steppe, 29.05.2006, L. Behçet & LFEM 564 (VANF), B9 Bitlis: A. Nabat mountain, 1700 m steppe, L. Behçet 2416 (VANF), B9 Bitlis: Tatvan, Kesän creek, 20 km, 1500–1800 m, rocky slopes, 29.05.2005, T. Çelik 479 (VANF), B9 Van: Muradiye, west of Akçadağ visit, 2300 m steppe, 12.06.2001 O. Karabacak 1708 (VANF), B9 Bitlis: Adilcevaz, Kef castle, slopes of Ziyaret hill, 1300 m, steppe, 14.07.1988, L. Behçet 1173 (VANF), B10 Van: Özlâp, upper parts of Y. Turgutlu village, 2250 m, steppe, 10.06.1997, F. Özgökçe, 5874 (VANF), B9 Van: Muradiye, between Adakl Lake and Lake Süphan, 2500 m, steppe, 28.06.1998, M. Ünal 4201 (VANF), B9 Bitlis: Hızan, Karbaštı village, Yamaç hamlets, 1600 m, road edges, 26.06.1990, Y. Altan & L. Behçet, Y. Altan 2251 (VANF), B7 Elazığ: Başkılık, Meydancık village, 900–1700 m forest clearing, 02.06.1998. L. Behçet 5855 (VANF), B7 Elazığ: Başkılık, Haroğlu village around TV mast, 1700–1900 m, 23.06.1995. L. Behçet 4886 (VANF), B7 Elazığ: North of Başkılık, Daşanın village 1200–1800 m rocky places, 15.05.1995. L. Behçet 4808 (VANF).

**Paracaryum kurdistanicum:** C7 Şanlıurfa: Karacadag, Kollubaba hill, 1950 m, rocky slopes, 28.05.2005, Ö.F. Kaya 1745 (HUB), C7 Şanlıurfa: Siverek, north of Karacadag, 1250 m, 19.05.1957, Davis & Hedge (ANK).

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References


