

Aristolochia altanii (Aristolochiaceae), a new species from Turkey

Ahmet İLÇİM^{1*}, Lütfi BEHÇET², Aycan TOSUNOĞLU³

¹Department of Biology, Science and Arts Faculty, Mustafa Kemal University, Antakya, Turkey

²Department of Biology, Science and Arts Faculty, Bingöl University, Bingöl, Turkey

³Department of Biology, Science and Arts Faculty, Uludağ University, Bursa, Turkey

Received: 18.07.2014 • Accepted/Published Online: 15.02.2015 • Printed: 30.09.2015

Abstract: *Aristolochia altanii* İlçim & Behçet sp. nov. is described from Turkey and illustrated. The specimens were collected from Kahramanmaraş in South Anatolia. The new species is closely related to *A. guichardii* and *A. brevilabris*. However, this species differs in some important characteristics, such as the length of the pedicel and the perianth, the indument of the perianth limb, and the micromorphology of the pollen and the seeds. The diagnostic characters are discussed and taxonomic comments are presented.

Key words: *Aristolochia*, taxonomy, Flora of Turkey

1. Introduction

According to González et al. (2014), the Aristolochiaceae consist of ca. 550 species in four genera. The genera are grouped in two subfamilies, the Asaroideae and the Aristolochioideae. The current classification within the family is based on molecular phylogenetic evidence that is congruent with inflorescent and floral morphology (Wanke et al., 2006). According to the most recent molecular studies, Piperales are subdivided into two clades that are named according to the presence or absence of a perianth. Piperaceae and Saururaceae belong to the perianth-less clade, whereas Aristolochiaceae, Lactoridaceae, and Hydnoraceae form the perianth-bearing clade (Naumann et al., 2013). Within the latter, the following genera are included: *Aristolochia*, *Asarum*, *Hydnora*, *Lactoris*, *Prosopanche*, *Saruma*, and *Thottea* (Nickrent et al., 2002; Wagner et al., 2014).

Aristolochia, the largest genus, contains almost 500 species and is pantropically distributed, extending to the subtropics as well as to Mediterranean zones with a few species in temperate areas. The diversity, here the number of species, declines sharply from the tropics to temperate regions and few are capable of withstanding freezing temperatures. Geographic areas richest in endemism are China, Mexico, Brazil, and Hispaniola (Pfeifer, 1966; González et al., 2014).

Many species of *Aristolochia* are important in traditional medicine around the world. During the past two decades, this genus has attracted much interest

and has been the subject of numerous chemical and pharmacological studies. *Aristolochia* and related genera contain aristolochic acids, unique to this lineage, as well as terpenoids (Wu et al., 2004). Aristolochic acids have been related to the development of a novel nephropathy and urothelial cancer in aristolochic acid nephropathy patients (Volker et al., 2002). Species of *Aristolochia* are widely used medicinally in many regions of the world and both from an ethnopharmacological and a public health perspective this poses a risk (Heinrich et al., 2009).

In the Mediterranean region the diversity and morphology of *Aristolochia* species have extensively been studied by Nardi (1984, 1991, 1993) by focusing on Greece (Nardi, 1991) and Italy (Nardi, 1984) as well as a revision of the *A. auricularia* group occurring in the Eastern Mediterranean (Nardi, 1993). The extended Mediterranean region, including the Caucasus and the Near East, is a diversity hotspot of *Aristolochia* in the northern hemisphere where about 60 species are documented. In the Flora of Europe only 20 species are listed (Ball, 1964) although for Turkey Davis and Khan (1982) listed 23 species. Since then, the number has increased to 28 (Malyer and Erken, 1997; Tosunoglu and Malyer, 2014).

2. Materials and methods

The specimens on which the new species is based on were collected from the city of Kahramanmaraş, Turkey. Plants were dried and flowers preserved in 70% ethanol

* Correspondence: ailmcim@mku.edu.tr

for further studies. The flower and leaf measurements were performed on fresh and alcohol preserved material. Pollen grains were measured under a light microscope from nonacetolyzed samples after preparation by the Wodehouse method (Wodehouse, 1935). The long axis (A), short axis (B), exine thickness, and intine thickness were measured on at least 50 pollen grains. Mean \pm standard deviation are provided. All measurements were performed using CARNOY 2.0 (Schols et al., 2002). Scanning electron microscopy (SEM) using a Carl Zeiss Evo-40 operated at 20 kV was applied. Pollen grains were transferred directly to a stub with double-sided tape. The pollen terminology follows Faegri and Iversen (1975) and Punt et al. (2007).

Mature seeds were mounted on SEM stubs using double-sided tape and coated with 40–50 nm of gold in a BALTEC SCD 005 coater. Surface patterns were recorded using the abovementioned SEM. The terminology of seed characters follows Stearn (1985), Corner (1976), Adams et al. (2005), and Tosunoglu and Malyer (2014).

3. Results

Aristolochia altanii İlçim & Behçet sp. nov. (Figures 1–4).

Type: Turkey. C6 Kahramanmaraş; upper parts of Dereboğazi and Hartlap village, 680–700 m, 03 May 2012, (fl), rocky places, A.İlçim 1819 (Holotype: Mustafa Kemal Univ. Herb., isotype: Bingöl Univ. Herb.).

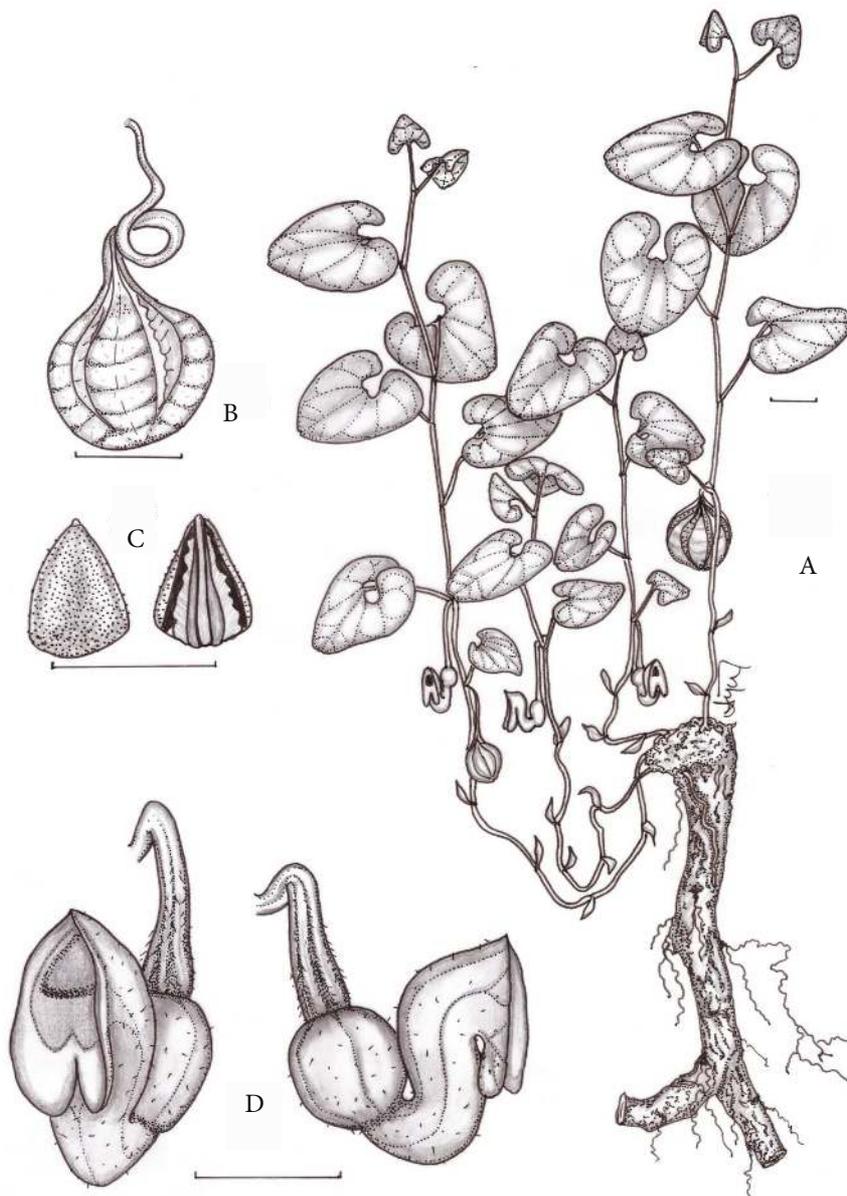


Figure 1. *Aristolochia altanii* A- Habit, B- Capsule, C- Seed, and D- Flowers (scale bars: 1 cm in A, B, D; 5 mm in C).

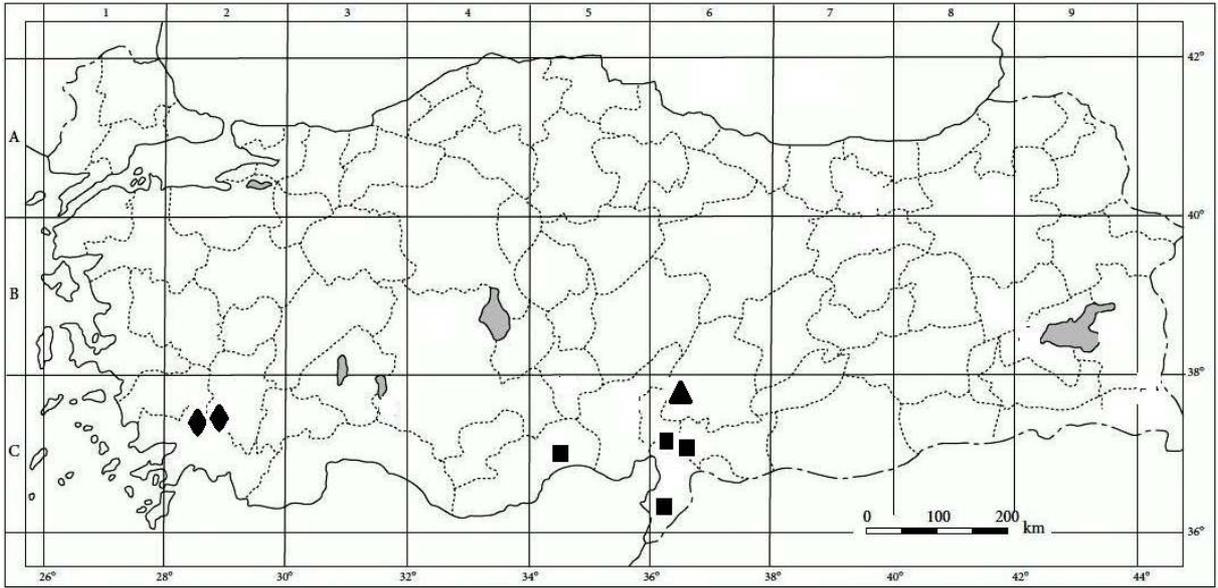


Figure 2. Distribution map of *Aristolochia altanii* in Turkey (▲), *A. brevilabris* (■), and *A. guichardii* (◆).

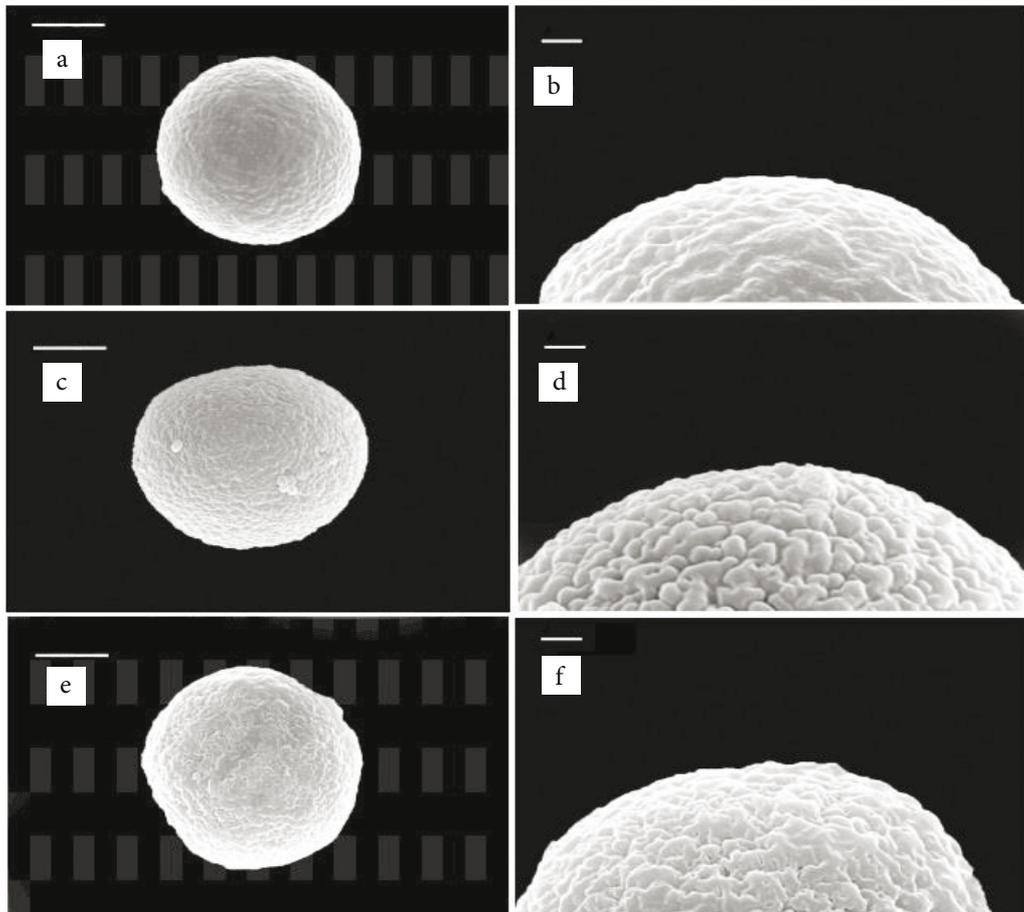


Figure 3. SEM photographs of pollen grains of *Aristolochia guichardii* (a, b), *A. altanii* (c, d), and *A. brevilabris* (e, f). Scale bars: 10 μ m in a, c, e; 2 μ m in b, d, f.

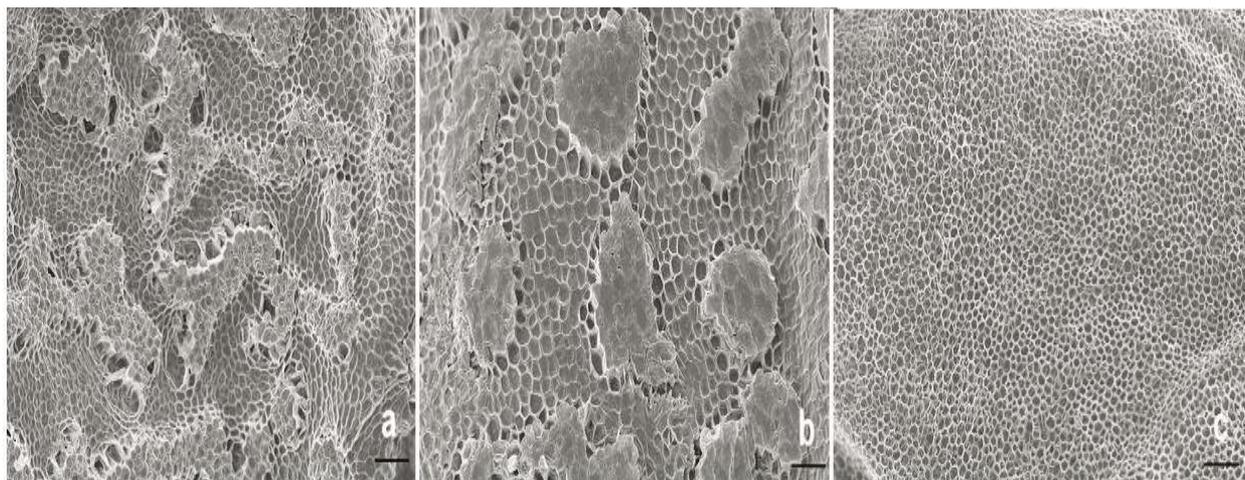


Figure 4. SEM photographs of the seed surface of *Aristolochia guichardii* (A), *A. altanii* (B), and *A. brevibras* (C). Scale bars: 100 μ m.

Paratype: C6 Kahramanmaraş, upper parts of Dereboğazi and Hartlap village, 680–700 m, 08 Jun 2012 (fr), rocky places, *A. İlçim* 1834 (isotype). BULU and Mustafa Kemal Univ. Herb.

3.1. Diagnosis

Aristolochia altanii resembles *A. guichardii* P.H.Davis & Khan and *A. brevibras* Bornm. It clearly differs from them by a smaller perianth, 12–20 mm long (versus 20–35 mm in *A. guichardii* and 34–56 mm in *A. brevibras*). In addition, *A. altanii* differs from *A. guichardii* by the glabrous inner surface of the perianth limb (versus densely hirsute in *A. guichardii*), and by the distinctly bi-auriculate (cordate) base of the perianth limb (versus limb oblong, auricles indistinct in *A. brevibras*).

Etymology: The specific epithet is named in honor of the Turkish botanist Prof Dr Yasin Altan.

3.2. Description

Rootstock elongated, cylindrical, 8–12 cm long, woody, 1–2 cm thick (Figure 1). Stems up to 40 cm long, 1 mm in diam., puberulous when young but glabrous at maturity. Leaves with 0.7–4 cm long petiole, shortly puberulous, blade cordate-ovate, 2–4.4 \times 2–4.5 cm, basally cordate-auriculate, auricles slightly shorter than broad, attenuate at its junction with the petiole, apex mucronate or emarginate, glabrous to sparsely puberulous on both sides. Flowers develop at the lowermost leaves, the earliest from the scarious scale-like or reduced leaves, 5–6 \times 4–4.5 mm; pedicels, (ovary included) 13–40 mm long, sparsely and shortly puberulous. Entire perianth 12–20 mm long, puberulous, utricle and tube whitish to brown, 5–7 \times 4.5–7 mm, subglobose to ovoidal, tube U-curved, gradually dilated to 4 mm above, limb reddish-purple to brown, 7–7.5 \times 2–2.2 mm, cordate-auriculate at base, auricles 2.5 mm, apex rounded, sparsely and shortly puberulous

outside, glabrous inside. Gynostemium coroniform, sessile, to 1 \times 1.5 mm, whitish. Ovary 7–8 mm long, densely shortly puberulous. Capsule pyriform, brownish-maroon, 15–25 \times 12–15 mm (Figure 1). Seed ovate to ovate-deltoid, brown, 8–9 \times 6–7 mm, flattened, wingless, raphe prominent.

3.3. Distribution and suggested conservation status

Aristolochia altanii is only known from the type locality at the city of Kahramanmaraş (Figure 2) and a few localities nearby, at elevations between 680 and 700 m. The species is very rare in the area, and the population size is small. The species is strongly threatened by extinction if protection measures are not taken to stop grazing and increasing habitat destruction. Therefore, we recommend classifying *A. altanii* as “Critically Endangered (CR)” because the estimated distribution range is less than 10 km² (criteria B2 ab (i,iii) of IUCN 2010).

Given that the flowers of *A. altanii* develop at the base of the stems, they remain hidden among the rocky substrate. *Aristolochia altanii* grows in clearings of *Pinus brutia* forest, along with other herbaceous elements, such as *Anacamptis pyramidalis* (L.) J.C.M.Rich., *Anagallis arvensis* L. var. *caerulea* (L.) Gouan, *Anarrhinum orientale* Benth., *Bromus sterilis* L., *B. tomentellus* Boiss., *Brunnera orientalis* (Schenk) Johnst., *Buglossoides arvensis* (L.) Johnston, *Cruciata taurica* (Pallas ex Willd.) Ehrend., *Crupina crupinastrum* (Moris) Vis, *Fritillaria alfredae* Post subsp. *glaucoviridis* (Turrill) Rix, *Fumaria asepsala* Boiss, *Geranium molle* L. subsp. *molle* L., *Gynandris sisyrinchium* (L.) Parl, *Helianthemum nummularium* (L.) Mill. subsp. *ovatum* (Viv.) Schinz & Thell., *Helleborus vesicarius* Aucher, *Knautia integrifolia* (L.) Bert. var. *integrifolia*, *Lagoecia cuminoides* L., *Lathyrus variabilis* (Boiss. & Ky.) Maly, *Linaria chalcipensis* (L.) Mill., var. *chalcipensis* (L.)

Miller, *Orchis syriaca* (E.G.Camus) Boiss. ex H.Baumann & Künkele, *Ranunculus arvensis* L., *Sanguisorba minor* Scop, subsp. *minor*. *Saxifraga sibirica* L. subsp. *mollis* (Sm.) Matthews, and *Styrax officinalis* L.

4. Discussion

The habit and floral shape of the new species resemble those of *Aristolochia brevilabris* and *A. guichardii*, but it clearly differs from them by the smaller perianth, which is 12–20 mm long (versus 34–56 mm in *A. brevilabris* and 20–35 mm in *A. guichardii*). In addition, *A. altanii* differs from *A. guichardii* by the glabrous perianth limb on the inside (not densely hirsute). It also differs from *A. brevilabris* by the distinctly bi-auriculate base of the perianth limb. A more detailed comparison of these species is given in Table 1.

The pollen grains provide important diagnostic characters for distinguishing *A. altanii* from closely related species. They are smaller than the grains of *A. guichardii* (Table 2) and the exine thickness and exine/intine ratio are also different between these three species. The exine

thickness of *A. altanii* is 1.440 μm versus 1.231 μm in *A. guichardii* and 0.925 μm in *A. brevilabris*.

The pollen ornamentation of *A. altanii* is microareolate-granulate versus granulate in *A. guichardii* and sparsely granulate and densely perforate in *A. brevilabris* (Figure 3).

The seeds in all three species are flattened, ovate to ovate-deltoid, but they are smaller in *A. brevilabris* and *A. altanii*. The seed surfaces of all studied species are reticulate, but in *A. altanii* and *A. guichardii* the reticulate surface shows verrucate ornamentation.

Unlike the seed surface of *A. altanii*, shallow foveae are observed on the seed surface of *A. guichardii* (Figure 4).

4.1. Additional specimens examined

Aristolochia guichardii: C2 Muğla: Muğla–Köyceğiz road, between Gökova and Dövüşbelen protected area, 100 m, 01.05.1982, T.Ekim & M.Koyuncu 10570 (AEF); Ula, between Gökova and Ula, Sakar pass ramp, right side of road, under *Quercus* shrubs, 600 m, 03.05.1984, H. Malyer & M.Öğütveren 6317 (ESSE); Between Muğla and Köyceğiz, 15–20 km, 50 m, 16.04.1992, M.Koyuncu 17096

Table 1. Comparison of the diagnostic characteristics of *Aristolochia altanii*, *A. guichardii*, and *A. brevilabris*.

Characters	<i>A. altanii</i>	<i>A. guichardii</i>	<i>A. brevilabris</i>
Stem indumentum	glabrescent	hirtellous	sparsely pubescent
Leaf size and indumentum	2–4.5 × 2–4.5 cm glabrous to sparsely and shortly puberulous on both sides	3.5–5.6 × 3–5.5 cm hirtellous, more densely so on the lower surface	2.3–5.2 × 2.8–5.3 cm, hirtellous, more densely so on the lower surface
Flowers	formed on the proximal portion, at axillary to scarious scale-like or reduced leaves	formed on the distal portion of the twigs, at leaf axils	formed on the distal portion of the twigs, at leaf axils
Perianth length	12–20 mm	20–43 mm	34–56 mm
Shape, size, and indumentum of the perianth limb	cordate, 7–7.5 × 2–2.2 mm, glabrous inside	cordate, 12 × 12 mm, densely hirsute inside	narrow, reduced to a mucro. 15–25 × 7–11 mm
Utricle	5–7 × 4.5–7 mm	7–10 × 4–6 mm	6–(7)–9 × 4–6

Table 2. Measurements of pollen grains: A, Long axis; B, Short axis; A/B, Long axis/short axis ratio; E, Exine thickness; I, Intine thickness; E/I, Exine/intine ratio; \pm : Standard deviation.

Species (N > 50)	A (μm)	B (μm)	A/B	E (μm)	I (μm)	E/I
<i>A. guichardii</i>	38.769 \pm 3.666	38.141 \pm 3.726	1.02	1.231 \pm 0.226	1.138 \pm 0.189	1.08
<i>A. altanii</i>	33.252 \pm 2.335	31.952 \pm 2.264	1.04	1.440 \pm 0.195	1.280 \pm 0.190	1.14
<i>A. brevilabris</i>	32.196 \pm 1.313	30.927 \pm 1.394	1.04	0.925 \pm 0.105	0.912 \pm 0.135	1.01

(AEF); Muğla–Marmaris road, between Gökçe village and Marmaris, 2 km, 03.05.1984, *H.Malyer* & *M.Öğütveren* 6318 (ESSE); Marmaris, Gökova, 50 m, 19.04.1965, *P.H.Davis* 41444 (E); Marmaris, Çetibeli opposite of forest store, under trees, 15.05.1987, *K.H.C.Başer* 7468 (ESSE); Marmaris peninsula, *Pinus brutia* forest, 50 m, 17.04.1965, *P.H.Davis* 41280 (E); Köyceğiz, Hamitköy, Domuzdireği hill, macchie, 15–50 m, 15.04.1981, *A.Güner*, *M.Vural*, *A.A.Dönmez* & *B.Mutlu* 8662 (HUB); (GAZI); around Ortaca, Dalyan, Marmarlı, macchie, calcareous area, 30 m, 19.04.1991, *A Güner*, *M.Vural*, *A.A. Dönmez* & *B.Mutlu* 8916 (HUB); (GAZI); Between Fethiye, Eşen and Babadağ, 19–20 km, above 9 lake local, under *P. brutia* forest, 01.05.1984, *H.Malyer* & *M.Öğütveren* 6313 (ESSE), Fethiye, Babadağ, under *P. brutia* forest, 600–800 m, 01.05.1984, *H.Malyer* & *M. Öğütveren* 7314 (ESSE).

References

- Adams CA, Baskin JM, Baskin CC (2005). Comparative morphology of seeds of four closely related species of *Aristolochia* subgenus *Siphisia* (Aristolochiaceae, Piperales). *Bot J Linn Soc* 148: 433–436.
- Ball PW (1964). *Aristolochia* L. In: Tutin TG, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA, editors. *Flora Europaea*, Vol 3. Cambridge, UK: Cambridge University Press, pp. 73–74.
- Corner EJH (1976). *The Seeds of Dicotyledons*. vols 1 and 2. Cambridge, UK: Cambridge University Press.
- Davis PH, Khan MS (1982). *Aristolochia* L. In: Davis PH, editor. *Flora of Turkey and the East Aegean Islands*, Vol. 7. Edinburgh, UK: Edinburgh University Press, pp. 552–565.
- Faegri K, Iversen J (1975). *Textbook of Pollen Analysis*. New York, NY, USA: Hafner Publishing Co.
- González F, Wagner ST, Salomo K, Symmank L, Samain MS, Isnard S, Rowe NP, Neinhuis C, Wanke S (2014). Present trans-Pacific disjunct distribution of *Aristolochia* subgenus *Isotrema* (Aristolochiaceae) was shaped by dispersal, vicariance and extinction. *J Biogeogr* 41: 380–391.
- Heinrich M, Chan J, Wanke S, Neinhuis C, Simmonds MSJ (2009). Local uses of *Aristolochia* species and content of nephrotoxic aristolochic acid 1 and 2 – a global assessment based on bibliographic sources. *J Ethnopharmacol* 125: 108–144.
- IUCN (2010). IUCN Standards and Petitions Subcommittee. Guidelines for using the IUCN Red List Categories and Criteria. Version 8.1. prepared by the Standards and Petitions Subcommittee.
- Malyer H, Erken S (1997). A new species from Turkey *Aristolochia baseri* (Aristolochiaceae). *Turk J Bot* 21: 381–383.
- Nardi E (1984). The genus *Aristolochia* L. (Aristolochiaceae) in Italy. *Webbia* 38: 221–300.
- Nardi E (1991). The genus *Aristolochia* L. (Aristolochiaceae) in Greece. *Webbia* 45: 31–69.
- Nardi E (1993). Systematic revision of the *Aristolochia auriculata* group (Aristolochiaceae). *Fl Medit* 3: 223–232.
- Aristolochia brevilabris*: C6 Adana: Osmaniye, Haruniye, Gaziantep–Haruniye around Kanlı pass, slopes, 200 m, 11.05.1985, *H.Malyer* 6841 (ESSE); Bahçe, Haruniye–Fevzipaşa, ca. 700 m, 18.04.1957, *Davis* & *Hedge* 26915 (ANK); Adana dist., Bahçe (W. Amanos), Haruniye–Fevzipaşa, 700 m, 18.04.1957, *Davis* & *Hedge* 26815 (E); Osmaniye–Fevzipaşa, 41 km E of Gazipaşa, 760 m, 08.04.1986, *Föhrenwald* 41089 Herbarium Max. Nydegger (GAZI); Hatay: Arsuz, Amanos mountains, *Pinus brutia* forest, ca. 350 m, 19.04.1968, *Y. Akman* 222 (ANK).

Acknowledgments

We are indebted to the curators of ANK, GAZI, HUB, and E for providing access to *Aristolochia* specimens, and to Prof Dr Hulusi Malyer for comments on the paper.