



Astragalus durandianus (sect. *Trachycercis*) as an Iranian endemic species: emended description, distribution, and conservation

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Abstract

An emended description of Iranian endemic *Astragalus durandianus* is provided with illustrations and extra information on several morphological characters not indicated in the protologue, including corolla characteristics, the habit size, peduncle length, bigger fruit size, black hairs on the fruits and several other differences. Based on field observations, a brief description of the habitat and data on ecology and biogeography of the species are provided. The conservation status of all species of *Astragalus* section *Trachycercis* in the Iranian plateau is evaluated.

Keywords: *Astragalus* sect. *Wettsteiniana*, conservation, endemism, Fabaceae, Irano-Turanian, taxonomy

Introduction

Astragalus Linnaeus (1753: 755) is the largest plant genus and alone represents nearly more than one percent of the flora of angiosperms in the world (Ghahremaninejad *et al.* 2020). It is the most diverse genus in Iran with approximately 848 valid species (Ghahremaninejad *et al.* 2022) which makes the country a unique center of endemism and genetic diversity of the genus among the world. Of this number of Iranian species, 565 species (66.63%) are endemic so far.

The majority of taxonomists perhaps believe that completing an incomplete and doubtful description of a species can be even more beneficial than introducing a new species to science. Sometimes it is not possible to find all the necessary characteristics of a species through using the available descriptions, e.g., having only fruit or having only flower; therefore, it is required to study multiple herbarium specimens and recollect and examine them in natural habitats. This situation is usually common in the large genera such as the genus *Astragalus*. The existence of sections as taxonomic ranks is useful for the determination of the species and helps organize very large genera such as *Astragalus*. The huge genus *Astragalus* is split into many small to large sections, but several comprehensive molecular phylogenetic analyses showed that several of these sections are artificial or are not monophyletic (Azani *et al.* 2017, 2019). However, the presence of the sections in the genus *Astragalus* is so useful for identifying the numerous species. These sections are each bounded by a set of characters, such as leaf and stem characteristics, flower components, inflorescence type, number of flowers, fruit characteristics, and trichome shape and indumentum state. It should be added that one of the most important and key features in this genus is trichomes characteristics (Zarre 2003, Ghahremaninejad 2004b).

An example of imperfect description is *Astragalus durandianus* Aitchison & Baker in Aitchison (1888: 54), a rare and endemic Iranian species. This species belongs to the *Astragalus* sect. *Trachycercis* Bunge (1868: 114). The distribution of the section is mostly in steppe vegetation of Eastern Europe and the central and southwestern Asian countries (Podlech & Zarre 2013). It comprises six species in Iran, of which four are endemic. These Iranian species grow at an elevation range of 1340–3500 m (based on distribution data from Ghahremaninejad 2004a, Bagheri *et al.* 2011, Podlech & Zarre 2013). Several recent taxonomic studies have been performed on this section, which refer to the species occurring in Iran (e.g. Ranjbar 2009, Podlech & Zarre 2013, Maassoumi 2018). In the original description of *A. durandianus*, there is not enough data on the petals. In the other works, e.g., Podlech *et al.* (2010) and Podlech & Zarre

(2013), there are detailed descriptions but like the original description without attention to the petal characters due to the lack of specimens with flowers. Although the swollen and very prominent fruit of *A. durandianus* nearly simplifies its determination, the flower-bearing specimens are not easily determined. Therefore, the identified specimens of this remarkable species in all the studied herbaria are exclusively in the fruiting stage. In this paper, we aim to emend the description of this species using the characteristics of the petals and examining the other characters to provide a comprehensive description. We also provide some more data on the distribution pattern and conservation status of the species.

For more information, the original description of *A. durandianus* (Aitchison 1888) is rewritten here to make the need for a more complete description more obvious.

“*Herbaceus, perennis, multiceps, acaulis, foliis imparipinnatis pilis albis rigidulis dense vestitis, stipulis ovatis basi ad petiolum adnatis, petiole brevi, foliolis 7 oblanceolato-oblongis parvis crassis, floribus solitariis breviter pedunculatis, calyce breviter piloso pilis albis paucis nigris multis, tubo oblong post anthesin rupto, dentibus parvis lanceolatis, petalis pallidis glabris calyce sesquialongioribus, legumine sessili ovoideo albo-villoso inflato biloculari, seminibus in loculo pluribus. Herba perennis dense caespitosa. Petioli 3-4 lin. longi; lamina 5-6 lin.; foliola 2-3 lin. Pedunculus foliis brevior. Calyx semipollicaris segmentis tubo 4-plo brevioribus. Petala 8-9 lin. longa. Fructus imperfect matures 6-7 lin. longus, 4 lin. diam.*”

Material and methods

We examined and analyzed the morphological characters of the related specimens of *Astragalus* kept in FUMH, IRAN, LE, T, and W (herbaria acronyms follow Thiers 2021+) using the important literature (Podlech *et al.* 2010, Bagheri *et al.* 2011, Podlech & Zarre 2013, Maassoumi 2018). In addition, we examined and photographed the living plants of *A. durandianus* in their flowering and fruiting stage at some recorded localities. We used the geo-referenced records of *Astragalus* sect. *Trachycercis* in DIVA-GIS 7.5 software (<http://www.diva-gis.org/>; Hijmans *et al.* 2001) to prepare the distribution map of the species in the Iranian plateau. The occurrence data was mapped in the GeoCAT tool (Bachman *et al.* 2011) to assess the threat status of the species based on criterion B (geographic range) of the IUCN Red List categories and criteria (IUCN 2019). The calculation of AOO (Area of Occupancy) is based on auto-value cell width in GeoCAT as the sliding scale of 1/10th of the maximum distance between any pair of points.

Results and discussion

Emended description of *Astragalus durandianus*

The emended description is prepared by using the specimens that are mentioned here (from herbaria FUMH, W, IRAN), and it is broadly based on the detailed description of the species in Podlech & Zarre (2013). The description in Podlech & Zarre (2013) is based on 11 specimens only in fruit status. The extra data in emended description is based on additional observed specimens and fortuitously some specimens in flower status, as well as some living plants.

Astragalus sect. *Trachycercis* Bunge, Mém. Acad. Imp. Sci. Saint Pétersbourg 11(16): 114. 1868. Syn: *A. sect. Borodiniana* B.Fedtsch., *A. sect. Popovianthe* Gontsch., *A. sect. Wettsteiniana* Širj. & Rech.f., *A. sect. Deserta* S.B.Ho, *Ailuroschia* Stev. (Podlech & Zarre 2013).

Brief description: Plants acaulescent or with short stems, covered with bifurcate hairs. Stipules adnate to the petiole, non-connate. Leaves generally with long petioles. Inflorescence sub-sessile to distinctively pedunculate, 1–8(–10)-flowered. Bracteoles absent. Calyx tubular, sometimes slightly inflated in fruiting time. Legumes small, enclosed in calyx or longer and rupturing it, nearly bilocular (Podlech & Zarre 2013, Ghahremaninejad 2004a).

Astragalus durandianus Aitch. & Baker, Trans. Linn. Soc. London, Bot. 3: 54. 1888. Emend. F.Ghahrem. (Figs. 1–6).

Lectotype (Podlech, Sendtnera 6: 179. 1999): Khorassan, on the pass to the south of Bezd, [35.21° / 60.44°], 6000', 18.6.1885, J.E.T. Aitchison 688 (K photo! [K001094452]; iso: BM photo! [BM000885251], C photo! [C10011702], FI photo! [FI010702], G, GH photo! [GH00059546], LE! [LE00013954], P! [P03202941], W! [W19590010612]).



FIGURE 1. Scanned image of the isolectotype specimen of *Astragalus durandianus* kept in P (P03202941).



FIGURE 2. A specimen of *Astragalus durandianus* (Faghiniya & Zangoie 27565-FUMH) collected from Hezar-Masjed Mountains (NE Iran) with a relatively large-sized habit.

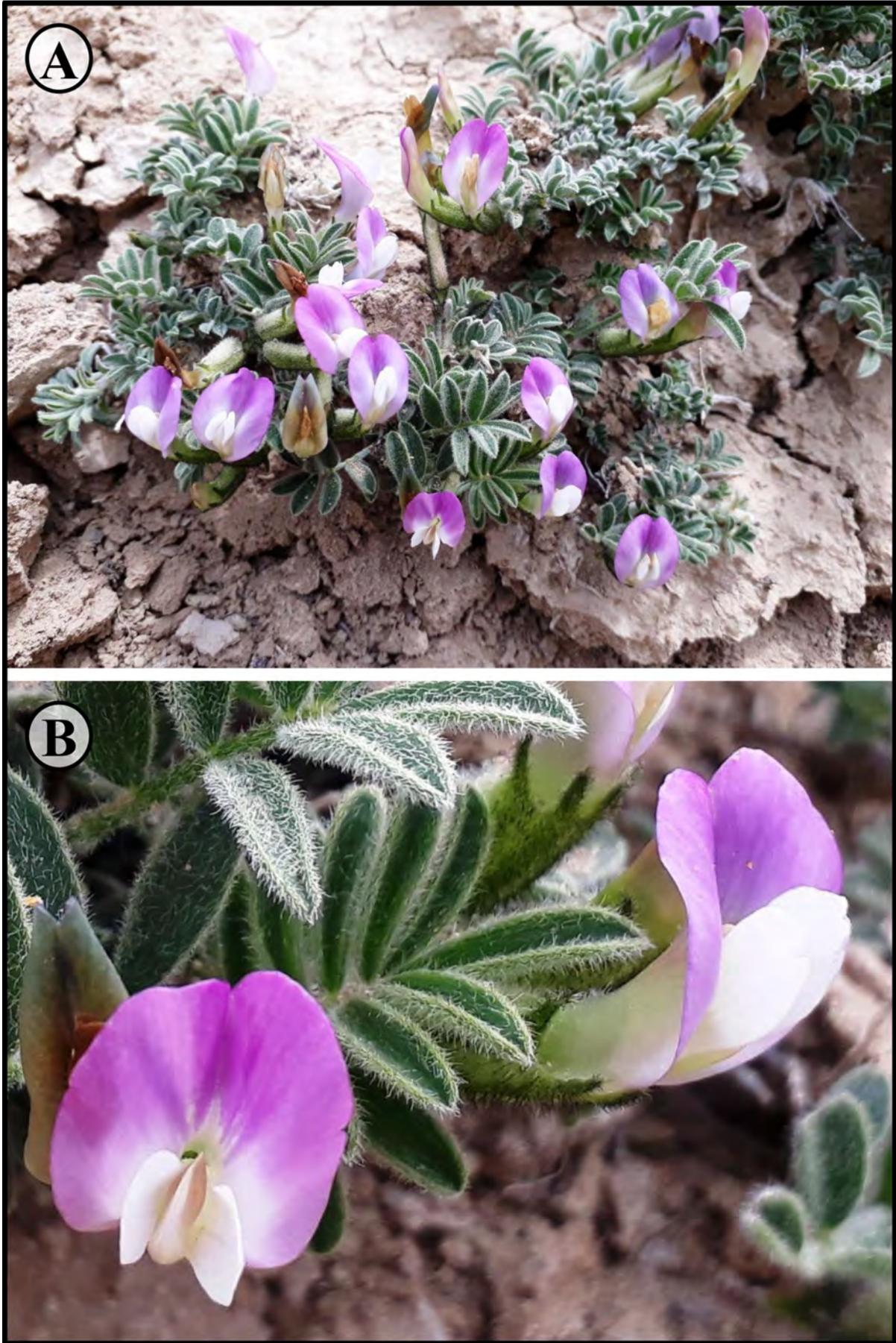


FIGURE 3. A–B) *Astragalus durandianus* in flowering stage (photos by: F. Memariani).

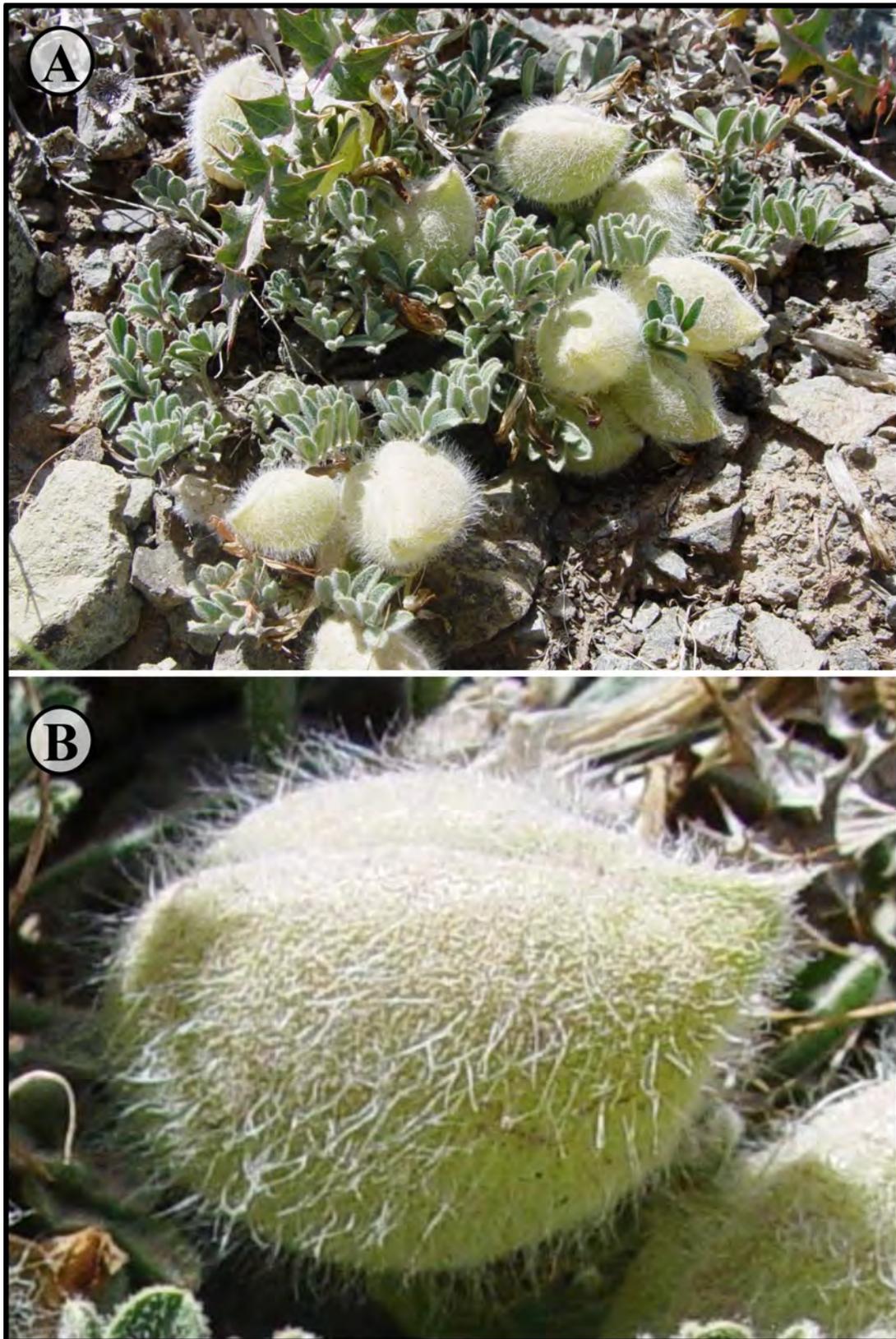


FIGURE 4. A–B) *Astragalus durandianus* in fruiting stage (photos by: M.R. Joharchi).

Perennial, 4–17(–20) cm tall undershrub, caespitose, covered in vegetative parts with warty, \pm medifixed, ascending to partly spreading white hairs up to 1 mm. Rootstock up to 10 mm thick, repeatedly divided, with short subterranean branches, in upper part covered with blackish remnants of old stipules. Stems of the current year, if present, up to 4 cm, very densely covered with subappressed to ascending, tangled white 0.6–0.8 mm hairs, at the nodes sometimes mixed with black hairs. Stipules whitish, green to yellow, 3–5 mm, narrowly triangular, adnate to the petiole for 1–2 mm,

loosely to densely covered with subappressed to slightly ascending white 0.4–0.7 mm hairs, at the base sometimes with loosely black hairs mixed in. Leaves 2.5–6.0 cm; petiole 0.8–30.0 mm, like the rachis rather densely to densely hairy. Leaflets in 3–5 pairs, obovate, or rarely elliptic, 4–14 × 2–6 mm, rounded to emarginate, on both sides rather densely covered with ascending to nearly spreading hairs up to 1 mm, mostly flat. Peduncles very short to 7 cm, white hairy to white hairy at the lower part and black hairy at higher part, loose to dense, subappressed to ascending. Raceme 1–3-flowered. Bracts 1.5–3.0 mm, narrowly triangular, densely covered with white, predominantly white or completely black hairs, ciliate with white hairs. Pedicels 1.0–3.5 mm, black hairy. Calyx 10.0–18.5 mm, tubular, at the base slightly gibbous, rather densely covered with asymmetrically bifurcate, ascending, often flexuose, tangled white and black hairs or completely black hairs, 0.5–1 mm; teeth narrowly triangular, 1–4 mm, densely white hairy on inner side. Petals purple and white. Standard 24–33 mm; blade ovate to obovate, 9.5–13.0 mm wide, emarginate, narrowed into the narrow claw. Wings 23–28 mm; blades narrowly oblong, obliquely emarginate, 9.0–10.5 × 2.5–3.5 mm; auricle c. 1 mm, claw 14–18 mm. Keel 20.5–25.0 mm; blades obliquely elliptic to obliquely elliptic–triangular, subacute, 6.5–8 × 3–4 mm; auricle c. 0.4–0.5, claw 14–17 mm. Stamen-tube 16–22 mm, truncate at the mouth. Ovary stipitate (stipe c. 1 mm), 5.5–7.5 mm, linear, appressed white hairy; style 14.5–18.0 mm, hairy only at the base, with minutely papillose stigma (0.4–0.5 mm). Legumes sessile, or with a stipe to c. 0.8 mm, ovoid-inflated, 18–35 mm long, 10–20 mm high, 12–28 mm wide, shallowly grooved ventrally and dorsally, subacute, nearly fully bilocular; valves thin, straw-colored to pale brownish, densely covered with ± medifixed, ascending, flexuose, tangled white to rarely together with black hairs 0.1–0.3 mm and loosely with white extremely asymmetrically bifurcate, straight, ascending to spreading hairs 2–3 mm. Seeds 2.5–2.8 × 2.8–3.2 mm, pale brown, with darker dots.

Specimens examined

A list of all specimens of *A. durandianus* examined in this paper (from several herbaria) or recorded in related literature (i.e., Podlech *et al.* 2011, Podlech & Zarre 2013, Maassoumi 2018) is indicated here. All recorded specimens of this species are collected from Iran. Three specimens from the list below have not been seen (no. 4, 28, 29: BG, G) by the authors of this article, and therefore they are not marked with “!” sign in front of the herbarium acronym; but some of their data such as elevation, phenology, and the locality have been used in our analysis. Among these 31 specimens, only five (no. 22 to 26: all deposited in FUMH) are collected in flowering time and the rest are in the fruiting stage.

—IRAN. **Khorassan Provinces:** ⁽¹⁾On the pass to the south of Bezd, 1830 m, 18.6.1885, *Aitchison 688* (BM photo!, C photo!, FI photo!, G, GH photo!, K photo!, LE!, P!, W!); ⁽²⁾27 km S Bejestan [Bajestan] versus Ferdows, 1700–1750 m, 10.5.1975, *Rechinger 51516* (M, W!); ⁽³⁾Between Birjand and Torbat, 3.7.1950, *Manuchehri 5590–E* (W!); ⁽⁴⁾Inter Assadabad et Zaidan, 33°10' N, 60°05' E, 1600–1700 m, 1.6.1977, *Rechinger 56103* (G); ⁽⁵⁾N Kashmar, 12 km NE Rivash, 35°25' N, 58°25' E, 2000 m, 5.5.1975, *Rechinger 51281* (W!); ⁽⁶⁾27 km S de Bajestan, 1700–1750 m, 10.5.1975, *Iranshahr 44159* (IRAN!); ⁽⁷⁾NW Qayen, Dehestan, 6 km on the road towards Karqand, 1700 m, *Rafeie 17162* (FUMH!); ⁽⁸⁾NW Qayen, Grimonj to Bihood, km 12, 1750 m, *Rafeie 27115* (FUMH!); ⁽⁹⁾18 km from Qayen to Birjand, 1930 m, *Maassoumi et al. 83335* (TARI!); ⁽¹⁰⁾Gonabad, Seno, Darre Nakhoo, 16.5.1991, 1600 m, *Faghihnia & Zangoie 19572* (FUMH!); ⁽¹¹⁾42 km from Kashmar to Neishabur, Akbarabad pass, 2000–2100 m, *Amirabadi & Abbasi 4377* (TARI!); ⁽¹²⁾W Gonabad, Boghchir (Black Mt.), 2500 m, 17.5.1995, *Rafeie & Zangoie 25108* (FUMH!); ⁽¹³⁾NW Qayen, Khezri, Piremardanshah, 1700 m, 13.5.2003, *Joharchi 34466* (FUMH!); ⁽¹⁴⁾N Kashmar, SE Rivash, the mountains of S Tanurcheh, 1962–2000 m, N 35°23'7.4" E 58°37'28.6", 27.5.2012, *Joharchi 44816* (FUMH!); ⁽¹⁵⁾Qayen–Gonabad road, near Khezri, Piremardanshah, 1700 m, 19.5.1986, *Ayatollahi & Zangoie 14380* (FUMH!); ⁽¹⁶⁾26 km from Kakhk to Ferdows, 1900 m, 21.5. 1997, *Rafeie & Zangoie 28682* (FUMH!); ⁽¹⁷⁾Between Gonabad and Ferdows, Tangale Mahvid, 1850 m, 11.5.1998, *Rafeie & Zangoie 30651* (FUMH!); ⁽¹⁸⁾30 km from Qayen to Birjand, 17.5.1986, *Ayatollahi & Zangoie 14221* (FUMH!); ⁽¹⁹⁾Qayen to Birjand, after Khunik pass, 1850 m, 11.6.1989, *Joharchi, Zangoie & Alvani 17640* (FUMH!); ⁽²⁰⁾95 km N of Mashhad, NW Mareshk, Hezar-Masjed Mts., 2500 m, 24.6.1996, *Faghihnia & Zangoie 27565* (FUMH!); ⁽²¹⁾S Gonabad, elevations around Boskabad dam, 2000 m, 3.5.1999, *Hojjat & Zangoie 32262* (FUMH!); ⁽²²⁾N Kashmar, NE Chelpeo village, on serpentine and gypsum hills, N 35°37'28.8" E 58°33'05.5", 1940–2100 m, 26.4.2017, *Joharchi & Memariani 46031* (FUMH!); ⁽²³⁾30 km south of Gonabad, Kalat Mts., 1700 m, 15.4.1985, *Joharchi & Zangoie 11950* (FUMH!); ^(24,25)NW Qayen, Khezri, mountains around of Boskabad dam, 1900 m, 2.5.1995, *Faghihnia & Zangoie 25256, 25270* (FUMH!); ⁽²⁶⁾21 km from Gonabad to Ferdows, 2200 m, 25.4.1995, *Rafeie & Zangoie 25045* (FUMH!); ⁽²⁷⁾E Birjand, 90 km on the road towards Darmian, 2000 m, 15.4.1981, *Zokaei & Ghoreshi 478* (FUMH!).—**Mazandaran Province:** ⁽²⁸⁾Nezva Kuh, at the western top, northern side, 53°10' E, 35°59' N, 3200 m, 8.7.1959, *Wendelbo 1288* (BG).—**Semnan Province:** ⁽²⁹⁾Declivia austr. montis Shahvar supra Nekarman (supra Rahé), 3500 m, 20.–26.7.1948, *Rechinger 5963* (G); ⁽³⁰⁾Kuh–i Nezva, 3000 m, 29.8.1948, *Behboudi & Aellen 5593–E* (W!); ⁽³¹⁾30 km NW Shahrud, Mt. Shahvar above Tash, 3000 m, 11.7.1976, *Assadi & Maassoumi 21074* (TARI!).



FIGURE 5. Some details of morphological characters in *Astragalus durandianus*. **A)** Relatively long terminal branches in fruiting stage (Rafeie & Zangooei 30651-FUMH); **B)** Floral bracts with black and white hairs (Joharchi & Memariani 46031-FUMH). Scale bars: A=10 mm; B=2 mm.

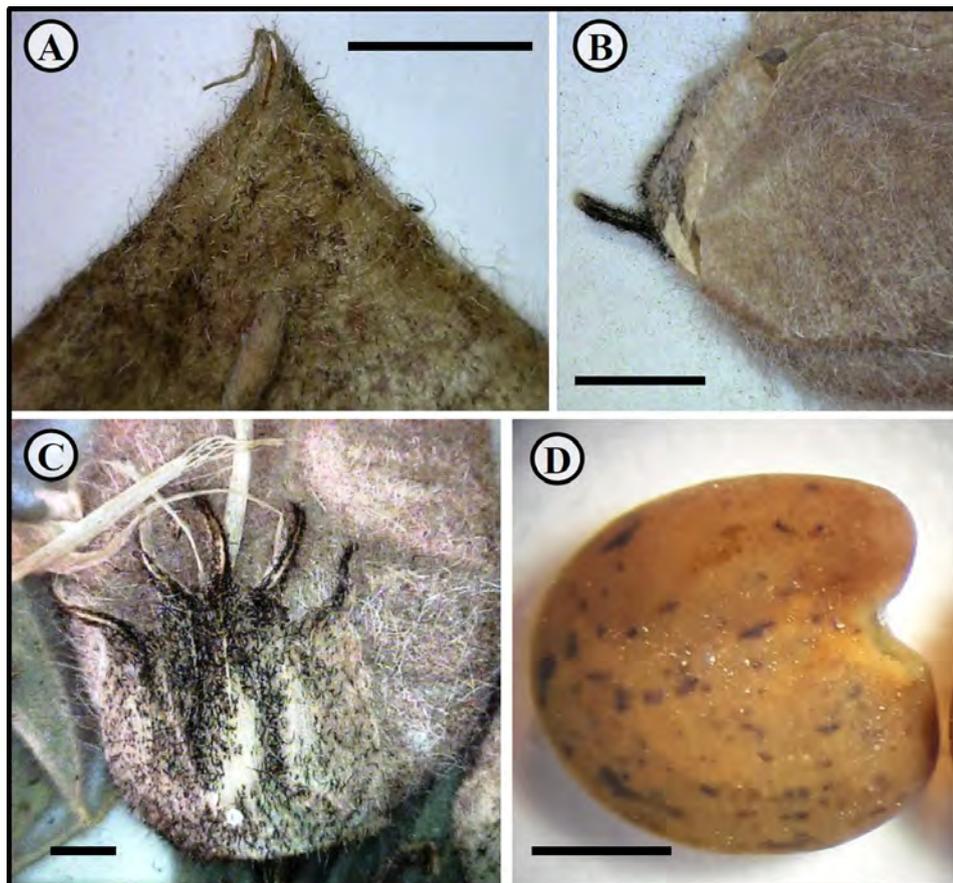


FIGURE 6. Some details of morphological characters in *Astragalus durandianus*. **A–B)** Fruits densely covered by a mixture of black and white hairs (A: Hojjat & Zangooei 32262-FUMH) or wholly by white hairs and on stipe by black hairs (B: Ayatollahi & Zangooei 14380-FUMH); **C)** Calyx in fruiting stage covered by black hairs (Rafeie & Zangooei 30651-FUMH); **D)** Seed. Scale bars: A–B=5 mm; C=2 mm; D=1 mm.

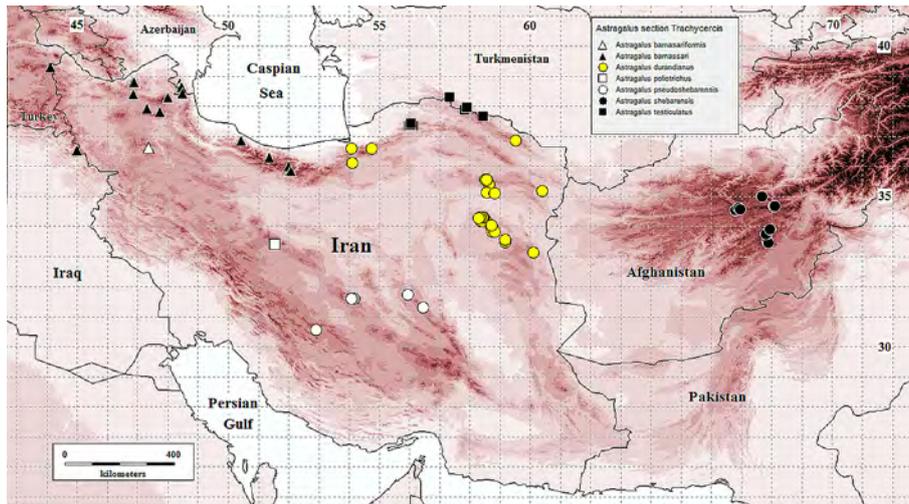


FIGURE 7. Distribution map of seven species of *Astragalus* sect. *Trachycercis* in the Iranian plateau based on confirmed identification of the herbarium specimens.

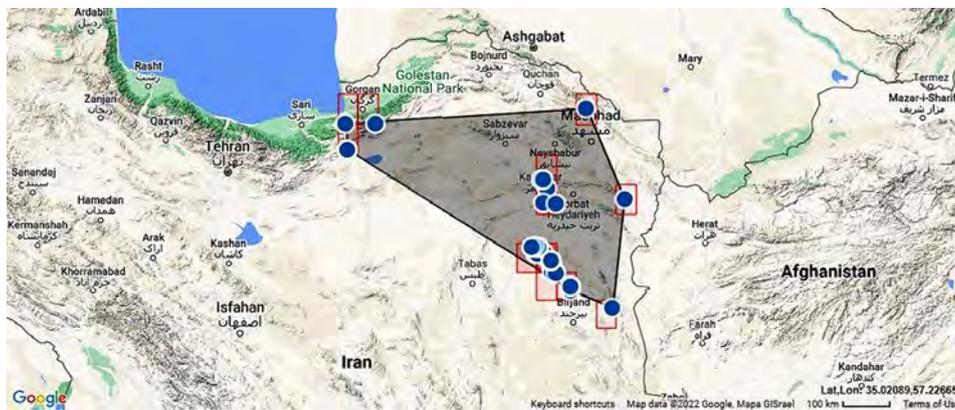


FIGURE 8. GeoCAT distribution map of *Astragalus durandianus* and estimation of Extent of Occurrence (EOO) and Area of Occupancy (AOO) based on IUCN Red List Criteria.



FIGURE 9. GeoCAT distribution map of *Astragalus barnassari* and estimation of Extent of Occurrence (EOO) and Area of Occupancy (AOO) based on IUCN Red List Criteria.

Diagnosis:—The closest species to *A. durandianus* are *A. shebarensis* and *A. pseudoshebarensis*. However, it differs with its relatives in having leaflets with 4-10 mm long (not 2–5 mm long), leaf covering with ascending to nearly spreading hairs (not covering with appressed hairs), peduncles length from very short to 7 cm long (not 0.2- 3 cm long), legumes with 18–35 mm long (not 15-25 cm long).

Phenology:—The elevation range for *A. durandianus* is from 1600 m (South Khorassan Province) to 3500 m (Semnan Province). At the elevation of 3000–3500 m in Mazandaran and Semnan Provinces, the fruiting time is late, i.e. early July to late August. Therefore, the fruiting time range is estimated around July to September. In 1600–2500

m elevation and probably lower elevations in Khorassan Provinces, the fruiting time is earlier, i.e. early May to July. Therefore, the fruiting time range can be estimated around late April to September.

Taxonomic relationship:—Our follow-accepted list of the Iranian species of *Astragalus* sect. *Trachycercis* is almost entirely consistent with Podlech and Zarre (2013). The only difference is that there is one more species in our list, i.e. *A. barnasariformis* Maassoumi, F.Ghahrem. & Bagheri in Bagheri *et al.* (2011: 178): 1) *A. barnassari* Grossheim (1940: 32), 2) *A. barnasariformis* (endemic to Iran), 3) *A. durandianus* (endemic to Iran), 4) *A. poliotrichus* Bornmüller (1914: 379) (endemic to Iran), 5) *A. pseudoshebarensis* Podlech (2004: 594) (endemic to Iran), and 6) *A. testiculatus* Pallas (1800: 82, t. 67).

A triplet species group in this section, including *A. durandianus* (endemic to Iran), *A. shebarensis* Podlech (1973: 274) (endemic to Afghanistan), and *A. pseudoshebarensis* Podlech (endemic to Iran) have swollen fruits with completely distinct separated (not overlapped) habitats; however, they are morphologically related and similar to each other and with somewhat overlapping characters. These species grow in a restricted area and can be considered vicariant species. Thus, here it is proposed, two species, i.e. *A. shebarensis* and *A. pseudoshebarensis*, may be synonyms as subspecies of *Astragalus durandianus*. Proof of this claim requires the study of several specimens of these species in flower and fruit states and perhaps additional complementary studies such as molecular researches. The petals characteristics of *A. pseudoshebarensis* are not included in the descriptions (like *A. durandianus* in the original description), but the petal characteristic of *A. shebarensis* (based on Podlech & Zarre 2013, Maassoumi *et al.* 2005) is so similar to *A. durandianus* based on the observed flowers in some specimens in FUMH that is mentioned in this paper.

TABLE 1. The comparing of the characters of *A. durandianus* in the emended, Podlech & Zarre (2013), Maassoumi (2005, 3018), and the original description (Aitchison 1888).

Character	Emended description	Podlech & Zarre (2013)	Maassoumi 2005, 2018	Original description
Habit	4–17(–20) cm tall	4–6 cm tall	4–6 cm tall	-
Stems of the current year	up to 4 cm long	up to 2 cm long	up to 2 cm long	-
Leaflet's pairs	3–5 pairs	3–4 pairs	3–4 pairs	3 pairs
Leaflets dimension	4–14 × 2–6 mm	4–10 × 2–4 mm	2–10 × 1.5–4 mm	4–6 mm
No. of flowers in raceme	1–3	1–2	1–3	1
Peduncle length	up to 7.0 cm	up to 1.5 cm	1.5–3 cm	very short
Bracts length	1.5–3.0 mm	1.5–2 mm	1.5–2 mm	-
Pedicels length	1.0–3.5 mm	1–2 mm	1–2 mm	-
Calyx length	10.0–18.5 mm	10–12 mm	10–12 mm	-
Calyx teeth length	1–4 mm	c. 2 mm	2 mm	-
Petals color	purple & white	-	violet-pale violet	-
Standard dimension	24–33 × 9.5–13.0 mm	-	-	Petals: 16–18 mm
Wings length	23–28 mm	-	-	-
Wing's blade dimension	9.0–10.5 × 2.5–3.5 mm	-	-	-
Wing's claw length	14–18 mm	-	-	-
Keel length	20.5–25.0 mm	-	16 mm	-
Keel's blade dimension	6.5–8.0 × 3–4 mm	-	-	-
Keel's claw length	14–17 mm	-	-	-
Stamen-tube length	16–22 mm	-	-	-
Ovary's stipe length	c. 1 mm	-	-	-
Ovary length	5.5–7.5 mm	-	-	-
Style length	14.5–18.0 mm	-	-	-
Legume	18–35 × 10–20 × 12–28 mm	18–25 × 10–13 × 12–15 mm	15–25 × 8–13 × 12–15 mm	Immature: 12–14 mm
Hairs color of legume	white (rarely together with short black hairs)	white	white	white
Seeds size	2.5–2.8 × 2.8–3.2 mm	-	-	-

So far, no photos of flowering specimens of *A. durandianus* have been published in the form of articles, books, or even at virtual herbaria. The photos in this paper are from both herbarium specimens and natural individuals (Fig. 3). In addition, flower components are also shown here, and photos of the plants that bear flowers in their natural habitat are unique and presented for the first time.

It should be noted here that in RBGE virtual herbarium, two flowering specimens are determined as *A. durandianus*. These two specimens were determined by Podlech (year 1996) as *A. durandianus*. Both specimens were collected from Afghanistan: (1) Bamian: Top of Hajigak pass, 3550 m, 25.6.1962, Hedge & Wendelbo 4619 (BG, E photo! [E00341210] (<https://data.rbge.org.uk/herb/E00341210>)), and (2) Ghazni: In monte Saperlebuli ad marginem austro-orientalem altoplanitiei Dasht-i-Nawar, 3200–4200 m, 19.7.1967, W.Rechinger 37321 (E photo! [E00341209] (<https://data.rbge.org.uk/herb/E00341209>), G, M). Some years after these determinations, *A. shebarensis* Podlech was introduced as a new species (Podlech 1973). These two RBGE specimens are mentioned as specimens examined for *A. shebarensis* in Podlech & Zarre (2013). Therefore, it is recommended that these determinations be changed in E Herbarium.

Distribution:—In the original description, *A. durandianus* was recorded from Bezd Mountains which is located in NE Iran. However, Aitchison (1888) described this species among several species collected from Afghanistan and on the label of type specimen in Paris herbarium “P”, it is noted as “*Plantes de l’Afghanistan*”. A label affixed to this specimen by F. Ghahremaninejad in 2013 indicates that this plant specimen belongs to the Iranian territory (Fig. 1). Based on current data, *A. durandianus* is a Central Irano-Turanian species known as an Iranian endemic plant. Its distribution range covers mainly the eastern and northeastern Iranian mountains in the South Khorassan Province and Khorassan-Kopet Dagh (KK) floristic province in the Razavi Khorassan Province (28 specimens), with few localities in the alpine zone of eastern Alborz Mountains (three specimens) (Fig. 7).

Based on current data, *A. barnasariformis*, *A. poliotrichus*, and *A. pseudoshebarensis* are the other Iranian local/narrow endemic species of the sect. *Trachycercis* restricted to the central Iranian highlands; however, *A. shebarensis* is endemic to east-central Afghanistan. *A. barnassari* is a sub-endemic species restricted to the Caucasian (Atropatene) and Alborz Mountains. It is distributed mainly in the northwestern and northern Iran with few localities in the south of Azerbaijan, northeast of Iraq, and east of Turkey near the borders to Iran (Fig. 7). *A. testiculatus* is a widespread species distributed from eastern Euro-Siberian to the eastern Irano-Turanian regions. It occurs in its southernmost distribution range in Khorassan-Kopet Dagh floristic province (*sensu* Memariani *et al.* 2016, Memariani 2020).

TABLE 2. Conservation status of *Astragalus* species (sect. *Trachycercis*) in the Iranian Plateau.

Species	Chorotype ¹	No. of records ²	EOO ³ (km ²)	AOO ³ (km ²)	10% of maximum distance (km)	Red list categories and criteria
<i>A. barnasariformis</i>	IT ^C	1 (1)	-	-	-	DD
<i>A. barnassari</i>	IT ^{Cauc.-Alborz}	22 (22)	145951	25000	50	LC
<i>A. durandianus</i>	IT ^C	31 (29)	132371	30000	50	LC
<i>A. poliotrichus</i>	IT ^C	1 (1)	-	-	-	DD
<i>A. pseudoshebarensis</i>	IT ^C	5 (5)	19367	4819	35	VU B1ab(iii)
<i>A. shebarensis</i>	IT ^C	13 (13)	10529	2107	18	VU B1bc(iii)
<i>A. testiculatus</i>	ES ^E - IT ^E	10 (10)	9866	3314	22	VU B1ab(iii)

¹The phytogeographical units are based on Memariani *et al.* (2016). IT: Irano-Turanian; ES: Euro-Siberian; C: Central; Cauc.-Alborz: Caucasian-Alborz; E: Eastern.

²The numbers in brackets indicate the records which can be localized for geo-referencing in order to produce distribution maps

³EOO: Extent of Occurrence; AOO: Area of Occupancy.

Conservation:—The conservation assessment of *A. durandianus* based on available data on the geographic range in the form of either extent of occurrence (EOO=145951 km²) or area of occupancy (AOO=25000 km²) shows that it does not belong to any threatened category and it is evaluated as Least Concern (LC) (Fig. 8). Although it is a relatively widespread species based on geographic criteria for Red Listing (IUCN 2019), it is not an abundant species in the natural habitats and may be qualified for a threatened category in the future. So, it is recommended to monitor and measure the population size over time and to check the current occurrence of the old collections, especially for the peripheral localities across its distribution range to re-evaluate the conservation status. It may be a potential ornamental

plant due to its growth form, flowers, and fruits (Figs. 3–4). So, cultivation in botanical gardens may be an important *ex-situ* conservation practice to guarantee protection to the remaining populations of this rare plant species.

The GeoCAT distribution maps (Figs. 8–9) and details of Red List categories and criteria for all species of *Astragalus* sect. *Trachycercis* in the Iranian plateau (Table 2) indicate that the conservation status of *A. barnassari* is also Least Concern (LC), however, *A. shebarensis* and *A. pseudoshebarensis* are evaluated as Vulnerable (VU). Both of *A. barnasariformis* and *A. poliotrichus* are known only from their type locations with no data on their populations, so they are categorized as DD (Data Deficient). Globally, the widespread *A. testiculatus* does not belong to any threatened category; however, it is a regionally vulnerable species because it is restricted to the west-central parts of Khorassan-Kopet Dagh Mountains in the Iranian plateau.

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