

Original research

Taxonomic resurrection of *Astragalus fodinarum* (sect. *Incana*, Fabaceae)

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Abstract

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Astragalus fodinarum is a species endemic to southeastern Türkiye, first collected in the 1850s in Elazığ province. Due to its morphological similarities in habit, leaves, and floral characteristics, as well as the scarcity of available specimens, *Astragalus fodinarum* had recently been considered a synonym of *Astragalus pendulus*. However, fieldwork conducted in the provinces of Diyarbakır and Bingöl in 2009 and 2018 resulted in the collection of new specimens, which support the recognition of *Astragalus fodinarum* as a distinct species. This study presents a detailed morphological reassessment along with updated data on its distribution, habitat, and ecology.

Keywords: distribution, endemic species, Southeastern Anatolia, taxonomy, Türkiye.

INTRODUCTION

Astragalus L., comprising approximately 3100 taxa worldwide, ranks among the largest genera of angiosperms (Folk et al., 2024). Southwestern Asia, including Türkiye, Iran, and Afghanistan, is recognised as both an evolutionary and biodiversity hotspot for the genus (Podlech & Zarre, 2013; Maassoumi & Ashouri, 2022). Among its infrageneric classifications, *Astragalus* sect. *Incana* DC. is one of the largest, comprising 152 taxa, of which about 82% are distributed in Iran and Türkiye. In particular, of the 35 taxa of this section occurring in Türkiye, 23 are endemic (Maassoumi, 2023).

Astragalus fodinarum Boiss. & Noë ex Bunge remained taxonomically uncertain because the only specimen designated as the type lacked fruits, which

prevented a precise determination of the species identity. It has been treated as a synonym of *Astragalus pendulus* DC. (Podlech & Zarre, 2013; Aytaç et al., 2016; POWO, 2025; WFO, 2025).

The name *Astragalus fodinarum* was first validly published by Bunge in 1868. However, Bunge (1868) did not designate any specimen or holotype for the species. A more detailed protologue was subsequently published by Bunge in 1870 and Boissier in 1872, which cited only a single collection, “Noë pl. exs. no. 879!”, from the locality “in albis ad Bakker Maaden (Maden), May 1852.” Therefore, the original material of *Astragalus fodinarum* consists solely of Noë 879.

The species was later treated by Chamberlain & Matthews (1970), who used the designation “Type: Kotschy 879 (G!)”, assumed to correspond to the same

collection number. However, “Kotschy 879” does not appear in the protologue and represents a different collection. Chamberlain & Matthews (1970) likely misinterpreted the “Ky” annotation in Boissier (1872) “Hab. in alpibus ad Bakkermaaden Armenia merid. (Ky!)” as indicating Kotschy as the collector. Travel notes published by Baytop (2006) suggest that Theodor Kotschy was not present in this locality in 1852. Kotschy’s documented travels in Anatolia occurred in 1836, 1841–1843, 1853, 1856, 1859, and 1862, and there is no record of him being in the region in 1852. Since the collection date of the species is May 1852, it is historically impossible for Kotschy to have collected *Astragalus fodinarum*. The designation “Kotschy 879 (G!)” by Chamberlain & Matthews (1970) cannot be considered a valid lectotype, as it does not correspond to the original material cited in the protologue (ICN, 2025). To ensure the correct application of the name, the specimen preserved at the Conservatoire et Jardin Botaniques de la Ville de Genève (G-BOIS) is here designated as the lectotype.

Floristic explorations conducted in 2009 and 2018 yielded well-preserved specimens from the provinces of Diyarbakır and Bingöl of Türkiye, enabling a thorough morphological reassessment of *Astragalus fodinarum*. These recent collections further substantiate the recognition of *Astragalus fodinarum* as a distinct taxon. The present study offers an expanded and amended species description, updated distribution and ecological data, and a conservation assessment in accordance with the IUCN (2024) Red List criteria and categories.

MATERIALS AND METHODS

Specimens of *Astragalus fodinarum* were collected during botanical field trips conducted over several years from various localities in the Diyarbakır and Bingöl provinces of southeastern Türkiye. The newly collected specimens were deposited at the Herbarium of Dicle University (DUF). The taxonomic identity of *Astragalus fodinarum* was reassessed based on a critical review of relevant taxonomic literature, including Chamberlain & Matthews (1970), Güner et al. (2012), Podlech & Zarre (2013), and Aytac et al. (2016). In addition, available digital images of herbarium specimens housed at DUF, E, JE, G-BOIS, K, MSB, P and W were examined and compared with *Astragalus pendulus* to assess diagnostic differences. Terminology for

morphological descriptions follows standard botanical references used in *Botanical Latin* (Stearn, 2004). The list of examined specimens, including collection data and herbarium accession numbers, is provided in the Appendix. Herbarium abbreviations are sourced from the *Index Herbariorum* (Thiers, 2025).

RESULTS

Taxonomy and morphology

Astragalus fodinarum Boiss. & Noë ex Bunge, Mém. Acad. Imp. Sci. Saint-Petersbourg, Sér. 7, 11(16): 121 (1868); ≡ *Tragacantha fodinarum* (Boiss. & Noë ex Bunge) Kuntze, in Revis. Gen. Pl., 2: 945 (1891). Fig. 1, Fig. 2.

Lectotype (designated here): Türkiye, Elazığ, in alpibus ad Bakker Maaden (Maden), May 1852, Noë 879, G-BOIS (G00020638)!

Isolectotype: P (P00602650)!

Perennial, acaulescent, erect or ascending herbs, 30–50 cm tall. Plants are glabrous or sparsely covered with bifurcate hairs. Stipules 15–25 mm, membranous, striate, ovate, connate at base, densely white, bifurcately hairy; upper parts lanceolate, acuminate, sparsely hairy. Leaves imparipinnate, 20–40 cm long; petiole 6–10 cm, striate, sparsely white, bifurcate hairy at base. Leaflets 10–14(–18) pairs, 15–35 × 7–10(–18) mm, ovate, glabrous on both surfaces, occasionally bifurcately hairy along margins and dorsal veins; apex obtuse to cuneate, mucronate; upper leaflets smaller, 9–13 × 3–4 mm. Peduncles 30–50 cm, striate, with sparsely white, bifurcate hairs at base, as long as or longer than leaves. Racemes cylindrical, (25–)40–50-flowered, dense at anthesis, later strongly elongated. Bracts lanceolate, 3–4 mm; bracteoles minute, ca. 0.5 mm. Pedicels 1–2 mm, flowers somewhat pendulous, strongly curved in fruit. Calyx tubular, 8–9 mm, purple, with black bifurcate hairs; teeth subulate, 2–3 mm. Petals are dark purple or rarely greenish-purple. Standard 18–22 mm; blade 8–9 mm wide, broadly obovate-elliptic, tongue-like apex ca. 5 mm, slightly emarginate, constricted below the middle, claw distinctly cuneate ca. 6 mm. Wings 17–18 mm, blade narrowly oblong-falcate, 7–8 × 2.5–3 mm; auricle ca. 1.5 mm, claw 8–9 mm. Keel 13–15 mm, blades oblong-narrowly elliptic, 5–7 ×



Fig. 1. *Astragalus fodinarum*: A – habitus, B – inflorescence, C – fruits, D – leaves. Photographs by A.S. Ertekin.

3 mm, claw 7–8 mm. Legume pendulous, stipitate (2–3 mm), broadly ovate to subglobose, $15\text{--}20 \times 8\text{--}10$ mm; with gibbous dorsal veins; beak straight, 2–3 mm long, valves thick-walled, transversely rugose and prominently veined, glabrous or rarely white, bifurcately hairy. Seeds oblong-reniform, $4\text{--}5 \times 3$ mm, dark brown, smooth.

Phenology. Flowers in early May and produces fruits by early June.

Distribution and habitats

Astragalus fodinarum is endemic to the southeastern Taurus Mountains, at elevations between 1000

and 1550 m in oak forests to the north and northwest of Diyarbakır. Its northernmost distribution reaches the Bingöl Mountains. The dominant oak species in its habitat include *Quercus brantii* Lindl. and *Quercus infectoria* subsp. *veneris* (A.Kern.) Meikle. Common co-occurring species include: *Aethionema armenum* Boiss., *Allium asclepiadeum* Bornm., *Astragalus gummifer* Labill., *Astragalus nitens* Boiss. & Heldr., *Euphorbia cheiradenia* Boiss. & Hohen., *Gundelia komagenensis* Firat, *Lathyrus roseus* Steven subsp. *roseus*, *Onosma proballanthera* Rech.f., *Orchis anatolica* Boiss., *Phlomis kurdica* Rech.f., *Rumex acetosella* L. and *Silene laxa* Boiss. & Kotschy (Fig. 3).



Fig. 2. Habitats of *Astragalus fodinarum* (A–B). Photographs by A.S. Ertekin.

Conservation status

Currently, *Astragalus fodinarum* is known from only five isolated populations. Although recent data are available for the Diyarbakır and Bingöl populations, the current status of the populations from Mardin and Hakkâri remains uncertain due to the lack of recent records since 1966. Based on available information, the species' estimated extent of occurrence (EOO) is approximately 2700 km², while its area of occupancy (AOO) is highly restricted, estimated at only 1–2 km². Field surveys conducted in 2009 and 2018 recorded populations with 12 mature individuals near Bingöl–Genç, approximately 20 near Diyarbakır–Lice, and 30 near Diyarbakır–Çüngüş. These findings indicate that the species occurs in highly restricted areas and is represented by very small population sizes.

These populations inhabit oak-dominated com-

munities and are currently experiencing a relatively low level of human impact. However, logging, road construction, and other structural interventions that could degrade habitats are considered to be the main potential threats.

Considering the highly restricted distribution, small population size and habitat decline of the species, *Astragalus fodinarum* is recommended for classification as Endangered (EN B1a + 2a; C2a(i); D) according to the IUCN (2024) criteria.

DISCUSSION

Astragalus fodinarum and *Astragalus pendulus* are morphologically similar in overall habit, leaf, calyx, and corolla characteristics. Due to the lack of fruiting structures in the type specimen of *Astragalus fodinarum* and the lack of recent collections for many years, it had previously been considered a synonym

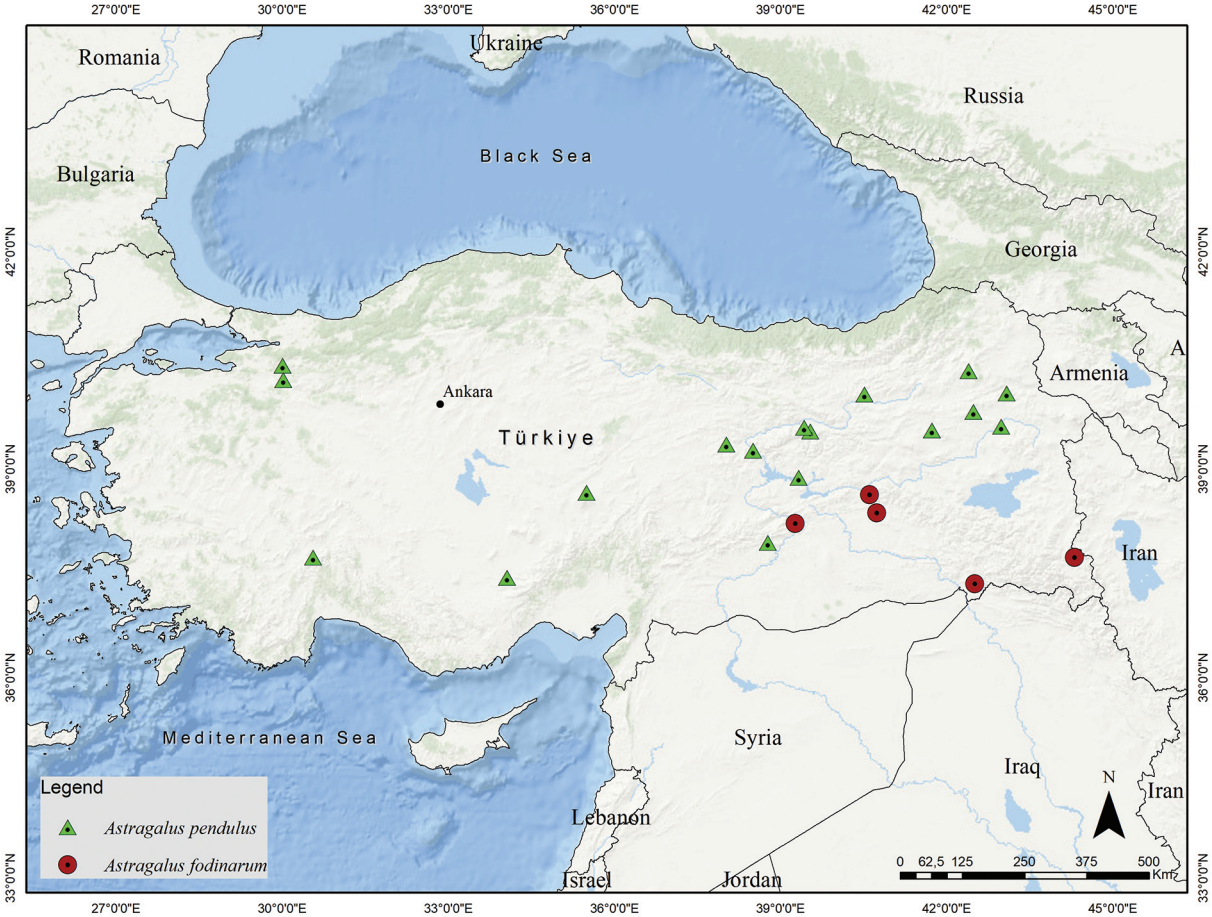


Fig. 3. Geographical distribution of *Astragalus fodinarum* and *Astragalus pendulus* in Türkiye.

Table 1. Comparative diagnostic traits of *Astragalus pendulus* and *Astragalus fodinarum*. * – characteristics were prepared following Chamberlain & Matthews (1970) and examined specimens

Characters	<i>Astragalus pendulus</i> *	<i>Astragalus fodinarum</i>
Stipules	ca. 10 mm long	15–25 mm long
Leaflets	8–14 mm; ovate to broadly elliptic; bifurcate-sericeous; 6–12 pairs	15–35 × 7–10(–18) mm; ovate; glabrous or bifurcately hairy along the margins and dorsal veins; 10–14(–18) pairs
Standard	Lamina attenuate toward the apex	Lamina tongue-like at the apex, ~ 5 mm long
Bracts	2–3 mm long	4–5 mm long
Legume	Pendulous, sessile; linear-oblong, straight or slightly curved; 12–18(–20) × 3 mm	Pendulous, stipitate; broadly ovate to subglobose; 15–20 × 8–10 mm

of *Astragalus pendulus*. However, newly collected specimens exhibit consistent morphological distinctions, particularly in leaf and fruit morphology. *Astragalus fodinarum* has longer leaves, larger leaflets (15–35 mm), and stipitate, broadly ovoid to subglobose legumes. In contrast, *Astragalus pendulus* has shorter leaves, smaller leaflets (8–14 mm), and sessile, linear-oblong legumes (Table 1).

Characters of the indumentum vary considerably

between the two taxa. In *Astragalus fodinarum*, vegetative parts (except stipules and calyx) are glabrous or sparsely villous; legumes are glabrous or sparsely white-villous. *Astragalus pendulus* exhibits a denser, more uniform villous covering across all organs.

The specimens collected from Mardin, Cudi Mountain (E00341522, E00341523) and Hakkâri (E00341521) have been identified as *Astragalus fodinarum*. However, these specimens differ from *Astra-*

galus fodinarum in having smaller stipules (7–9 mm long), fewer (5–8 pairs) and smaller leaflets (10–22 mm long) with a dense indumentum. Morphologically, the specimens appear to be more closely related to *Astragalus elongatus* subsp. *nucleifer* and *Astragalus pendulus*.

These findings support the taxonomic reinstatement of *Astragalus fodinarum* as a valid and distinct species. Future molecular studies are recommended to further clarify the phylogenetic relationship between *Astragalus fodinarum* and *Astragalus pendulus*.

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APPENDIX

The list of examined samples of *Astragalus* species

Astragalus fodinarum

1. Mardin, Cudi dağı, above Hessana (district Si-lopi), 1200–1400 m, rocky limestone slopes in *Quercus aegilops-infectoria* forest, 11 May 1966, Türkiye, P.H. Davis 42844A, E00341522 (E).
2. Mardin, Cudi dağı, above Hessana (district Si-lopi), 1200–1400 m, rocky limestone slopes in *Quercus aegilops-infectoria* forest, 11 May 1966, Türkiye, P.H. Davis 42844A, E00341523 (E).

3. Hakkâri, 2800 m., Vadinasor Tepe, 22 km N.E. of Yüksekova, sharp W slope of gully of SE exposure. Rock outcrops and *Ferula*-dominated herbage, 15 June 1966, Türkiye, Cheese & Watson 1596, E00341521 (E).
4. Diyarbakır, Lice, Tapantepe, in *Quercus* forest, 1000 m, 7 June 2009, Türkiye, Ertekin 2009-62 (DUF).
5. Bingöl, Genç, Bulgurluk village, in *Quercus* forest, 1530 m, 7 June 2009, Türkiye, Ertekin 2009-78 (DUF).
6. Diyarbakır, between Çüngüş and Hindibaba village, slopes in *Quercus* forest, 1100 m, 1 May 2018, Türkiye, Ertekin 2018-136 (DUF).
- 5 km N unter der Passhöhe, 1950–2000 m, 28 June 1951, Türkiye, A. Huber-Morath 11418, G00000022 (G).
9. Tunceli, Pertek-Tunceli, 1000 m, N slope in oak scrub, 6 June 1957, Türkiye, P.H. Davis & Hedge 29153, E00370802 (E).
10. Ağrı, 2 km SW of Hamur (Murat valley), 1680 m, sloping meadow, 1 June 1966, Türkiye, P.H. Davis 44083, E00341435 (E).
11. Erzurum, 29 km from Hınıs to Pasinler, 1800 m, chalky slopes, 12 July 1966, Türkiye, P.H. Davis 46383, E00370801 (E).
12. Kars, Mountains E of Kağızman, c. 20 km from Akçay to Cumaçay, 2200 m, dry pastures, 17 July 1966, Türkiye, P.H. Davis 46690, E00340992 (E).

Astragalus pendulus

1. Isparta, in planitie Isbarta (Isparta) Pisidiae, May 1845, Türkiye, Heldreich s.n., G00020577. Isolectotype (G).
2. Kayseri, ad Argaeum ad Yachjaile pagum, in solo graniticis fragmentis mixto alt. 1290 m, 27 May 1859, Türkiye, Kotschy 183, JE 00007822 (JE).
3. Erzincan, Egin, Kyl-Maghara-dagh, in declivibus saxosis, 5 July 1890, Türkiye, Sintenis 2879, E00340988 (E).
4. Egin, Kota, in herbis, 6 June 1890, Türkiye, Sintenis 2568, MSB-163500. Isolectotype (MSB).
5. Konya, Eregli, 1450 m, June 1912, Türkiye, W Siehe 260, E00370797 (E).
6. Bithynia, in ditone oppiduli Vesir-Han, in pinetis (*Pinus pityusa*) et *Arbuti macchiis* montis Tepaja, 3–400 m, 25 May 1929, Türkiye, J. et F. Bornmüller 14099, W1931-0001135. Lectotype (W).
7. Bithynia, in ditone oppiduli Vesir-Han, in pinetis et *Arbuti macchiis* montis Tepaja, c. 3–400 m, 25 May 1929, Türkiye, J. et F. Bornmüller 14099, MSB-163501. Isolectotype (MSB).
8. Gümüşane, Bayburt, Kop Dag, Aşkale-Bayburt, 1680 m, sloping meadow, 1 June 1966, Türkiye, P.H. Davis 44083, E00341435 (E).
13. Ağrı, E side of Tahir pass, 19 km from Eleşkirt to Horasan, 2400 m, sloping meadows in gully, 23 July 1966, Türkiye, P.H. Davis 47220, K003517875 (K).
14. Erzincan, Munzur Silsilesi, Mercan Dağları; Tayran Dağ (N side), 2150 m, mountain slopes, limestone, 15 July 1967, Türkiye, Watson et al. 3323, E00340990 (E).
15. Erzincan, Munzur Silsilesi, Mercan Dağları, Tayran Dağ, Kizil Tepe, mountain cliff, limestone, ledges, 15 July 1967, Türkiye, J.M. Watson AC&W 3323, K003517867 (K).
16. Sivas, Divriği, Dumlucadağ, 30 April 1968, Türkiye, T. Baytop 12852, E00340989 (E).
17. Gümüşhane, Bayburt-Soğanlı dağ, ca. 1300 m, 1 June 1975, Türkiye, Y. Akman 6092, E00340983 (E).
18. Sakarya (Adapazarı), by the road Iznik-Geyve c. 4 km W of Mekece (c. 34 km SW of Geyve), c. 330 m, 23 May 1990, Türkiye, Raino Lampinen 7788, E00340995 (E).
19. Adıyaman, Nemrut dağı, 2 km NW of Karadut, slopes in *Quercus* forest, 1180 m, 12 May 2005, Türkiye, Ertekin 2005-87 (DUF).

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