

## NEW DATA ON THE GENUS *FERULA* (APIACEAE) FOR THE FLORA OF ARMENIA; A NEW RECORD AND A REDISCOVERY

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*Ferula huber-morathii* (Apiaceae), is reported for the first time in the flora of Armenia, where it is found along the dry slopes of the Arpa River valley (Vayots Dzor province). It was previously known to be a rare Turkish endemic. Additionally, after data deficiency from the early 1970s, we report the re-discovery of two populations of *F. glabrifolia* in Armenia. Data on population dynamics and conservation status of both species in Armenia are provided, and a distribution map and images of the species are presented.

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**Keywords:** Apiaceae; *Ferula*; *Dorema*; conservation; new record; Armenia; Vayots Dzor

یافته‌های جدیدی از جنس *Ferula* (Apiaceae)، گزارش جدید و کشف مجدد

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گونه *Ferula huber-morathii* از خانواده چتریان برای اولین بار از فلور ارمنستان از شیبه‌های خشک دره رودخانه Arpa (Vayots Dzor province) گزارش می‌شود. این گونه قبلاً به‌عنوان یک گونه انحصاری از ترکیه شناخته می‌شد. به علاوه بعد از عدم گزارش از گونه بعد از سال ۱۹۷۰، از گونه *F. glabrifolia* دو جمعیت از آن را از ارمنستان گزارش می‌کنیم. هم‌چنین اطلاعاتی در مورد پویایی جمعیت و جایگاه حفاظتی این گونه‌ها از ارمنستان ارائه می‌گردد، نقشه پراکندگی و تصاویری از گونه‌ها نشان داده می‌شوند.

### INTRODUCTION

*Ferula* L. is the second largest genus within Apiaceae, comprising over 220 species (POWO 2024). The genus is widely distributed especially in arid and semiarid regions and mountainous areas of Eurasia and North Africa from the Canary Islands in the West to China in the East. The Irano-Turanian floristic region especially Iran, Turkey, and Central Asia forms the center of biodiversity of the genus *Ferula*, and harbors

a large number of local endemics, many of which are poorly studied (Panahi & al. 2018). So far, 6 *Ferula* species have been validated in Armenia: *F. orientalis* L., *F. persica* Willd., *F. rigidula* Fisch. ex DC., *F. szowitsiana* DC., the recently described *F. dseghica* Nersesian (an Armenian endemic) and *F. glabrifolia* M.Panahi, Piwczynski, Puchałka & Spalik (syn. *Dorema glabrum* Fisch. & C.A.Mey. (Panahi & al. 2015)) as well as a doubtful presence of *Ferula oopoda*

(Boiss. & Buhse) Boiss. (Grossheim 1967; Mandenova 1972a; Mandenova 1972b; Nersesyan 2023). *Ferula glabrifolia* has not been collected since 1971. Therefore, it has been categorized as a critically endangered species in the Red Data Book of Armenia (Tamanyan & al. 2010). This species occurs as small populations mainly along the borderline between Iran, Armenia, and the Nakhchivan Autonomous Republic (Azerbaijan), (Hedge & al. 1987; Mozaffarian 2003, 2007; Takhtajan & Fedorov 1972; Mandenova 1972b; Pimenov 1988).

During studies of the herbarium specimens of the genus *Ferula* in ERE we found an unusual specimen with widely inflated membranaceous leaf sheaths, slightly pointed, obovate mericarps, and creamish-stramineous, shining stems (ERE177600), (Fig. 1). The sample was misidentified as *Ferula orientalis* and collected from the road to Mozrov village in Vayots Dzor province on 30.06.2006. We performed several expeditions to the locality and observed a population of an unusually high (up to 3.5 m) monocarpic *Ferula*. After detailed studies of herbarium specimens (see Results) and literature (Peşmen 1971, 1972; Sağıroğlu 2005) the species was finally identified as *F. huber-morathii* Peşmen. *Ferula huber-morathii* is a rare, endangered species, described from Turkey, previously considered an endemic of East Anatolia. The closest record to the newly described population in Armenia is the locus classicus (see Results) located in the Erzurum province (Turkey) at a distance of over 300 km.

*Ferula glabrifolia* is a monocarpic species restricted to NW Iran, Central Armenia, and the Nakhchivan Autonomous Republic (Azerbaijan), (Takhtajan & Fedorov 1972). This species has not been recollected in Armenia since 1977 (MW0700586) and has been included in the Red Book of Armenia (Critically Endangered: CR) (Tamanyan & al. 2010). As a result of extensive search two small populations of *F. glabrifolia* were discovered and their conservation status and population dynamics evaluated.

## MATERIALS AND METHODS

We organized expeditions to locate and study *F. huber-morathii* according to the location data available from the herbarium specimens in ERE. At least 9 expeditions have been undertaken between 2022-2024 to study the population size, dynamics, and threats. In a time frame between 2015-2022, expeditions have been conducted by the first author to locate populations of *Ferula glabrifolia*. Study areas were chosen based on literature (Takhtajan & Fedorov 1972) and herbarium

data (see Results), additionally climatically and edaphically similar areas in the surrounding areas have been monitored. Altogether an area of 210 km<sup>2</sup> has been covered (45 km<sup>2</sup> in Vayots Dzor Province and 165 km<sup>2</sup> in Ararat Province and the surroundings of Yerevan). After the rediscovery of existing populations of *F. glabrifolia*, yearly expeditions were organized to study threats, population size, and dynamics. Herbarium vouchers are stored at ERE. Mapping data were retrieved from virtual herbarium specimens (see Results), published data (Takhtajan & Fedorov 1972; Borodin 1984; Mozaffarian 2007; Talibov 2010), and expedition data (A. Rudov personal communication). The herbarium abbreviations are as follows: ERE (Herbarium of the Institute of Botany NAS RA, Yerevan, Armenia), GAZI (Herbarium of the Gazi University, Ankara, Turkey), MW (Moscow State University Herbarium, Moscow, Russia).

## RESULTS & DISCUSSION

### New record

*Ferula huber-morathii* Peşmen, 1971, Notes Roy. Bot. Gard. Edinburgh 31:71

**Holotypus:** Turkey, Erzurum: 29 km from Hınıs to Pasinler, 1800 m, Meadows on chalky slopes, flowers yellow, 1 m, 12.07.1966, Davis 46387.

Tall, monocarpic perennial. Stems solitary (rarely 2-3), 1.8-3.5 m tall, cylindrical, glabrous, slightly corrugated, 2.0-4.0 cm diameter at the base, glaucescent during flowering, shining creamish-stramineous during fruiting. It forms a thickened, turnip-like taproot (4-11 cm in diameter) with a fibrous collar of petiole remnants from previous years surrounding the leaf rosette and stem. Basal leaves triangular-ovate, ca. 30-40 × 17-20 cm, 4-5 pinnate, soft, petioles corrugated; 9-15 cm long, hairy pubescent, last segments linear-oblong, 0.5-2 × 0.3-0.6 mm, smooth, densely puberulent hairy, obtuse. Sheaths are semi-membranaceous, widely inflated, drop-shaped, greenish-glaucous during growth, creamish-stramineous during fruiting. Inflorescence extended in length, sparsely paniculate-corymbose. All umbels proliferating; rays 2-8 (12), unequal, ascending. Umbellets 8-16 flowered, raylets 4-10 mm. Petals glabrous, 1.5 mm, with a curved tip. Mericarps elliptical to obovate, 8-14 × 4-7 mm, greyish-cream colored, 3 filiform dorsal wings, lateral wings 0.8-1 mm wide; stylopodium conical; on the ventral side with 2-6 resin canals; 3 dorsal vittae; 2-6 commissural vittae; Flowering time May-June; Fruiting time July-August.



Fig. 1. ERE177600 herbarium specimen of *Ferula huber-morathii* Peşmen erroneously determined as *Ferula orientalis* L.

**Specimens examined:** Armenia, Vayots Dzor region, ascent towards Mozrov village, 1190 m a. s. l., [Armeniya, obl. Vayots Dzor, podyem k s. Mozrov, vdol dorogi, 1190 m nad ur.m.], 30.06.2006, E. Gabrielyan, A. Nersesyan, M. Aghababyan, M. Sarkisyan, ERE 177600; Ibid, 1184 m a. s. l., 15.07.2022, A. Rudov, A. Nersesyan, A. Danielyan, H. Kosyan ERE202533; Ibid, 1180 m a. s. l., A. Rudov, A. Nersesyan, 07.06.2022, ERE202534: Armenia, Vayots Dzor region, Between Arpi and Areni villages, dry slopes, 1030 m a. s. l., 12.10.2023, A. Rudov, ERE202535.

**Additional specimens examined:** Turkey, Erzurum: 29 km from Hınıs to Pasınler, 1800 m, Meadows on chalky slopes, flowers yellow, 1 m, 12.07.1966, Davis 46387 (holo.: E); Erzurum: 28 km from Varto to Hınıs, 1700 m, stony slopes, 2-2.5 m, monocarpic? Only 1 ft. stem per plant, 11.07.1966, Davis 46266 (E); Bingöl: Elazığ-Bingöl road, between Kuruca and Yolçatı villages, 1300 m, 29.08.2002, M. Sağıroğlu 2250 (GAZI); Bingöl: Elazığ-Bingöl road, between Kuruca and Yolçatı villages, 1300 m, 08.06.2002, M. Sağıroğlu 1991 (GAZI).

**Karyology:** The chromosome number  $2n=22$  has been reported for the Turkish populations (Sağiroğlu 2005). Currently, no data are available on the Armenian population.

**Distribution and Habitat in Armenia:** *F. huber-morathii* grows on rocky, chalky slopes with NNW

exposition and 45-50° inclination, located along the Arpa River in the mountain steppe of the middle mountain belt (1300-1800 m a.s.l.) in between oak clearings in the proximity of the Arpi village (Vayots Dzor Province). Accompanying species are *Acer monspessulanum* subsp. *ibericum* (M.Bieb.) Yalt., *Agropyron cristatum* (L.) Gaertn., *Artemisia fragrans* Willd., *Asyneuma pulchellum* (Fisch. & C.A.Mey.) Bornm., *Atraphaxis spinosa* L., *Bassia prostrata* (L.) Beck, *Centaurea daralagoezica* (Fomin) Greuter, *C. virgata* subsp. *squarrosa* (Boiss.) Gugler, *Ferula orientalis* L., *Ferula rigidula* Fisch. ex DC., *Galium verum* L., *Gypsophila bicolor* (Freyn & Sint.) Grossh., *Pistacia atlantica* subsp. *mutica* (Fisch. & C.A.Mey.) Rech.f., *Poa bulbosa* L., *Prangos lophoptera* Boiss., *Prunus incana* (Pall.) Batsch, *Rhamnus erythroxylodes* Hoffmanns., *Stachys inflata* Benth., *Tanacetum polycephalum* Sch.Bip.

**General Distribution:** *Ferula huber-morathii* is an endemic of the Armeno-Iranian Province of the Irano-Turanian Floristic Region (Takhtajan 1986). It is distributed in Turkey/E Anatolia (Bingöl, Erzurum, and Mush Provinces) and Armenia (Vayots Dzor Province), (Fig. 2). In Turkey, the species can be found at an altitude range of 1300-1800 m a.s.l. in grasslands, on stony and chalky slopes and between oak clearings (Sağiroğlu 2005).

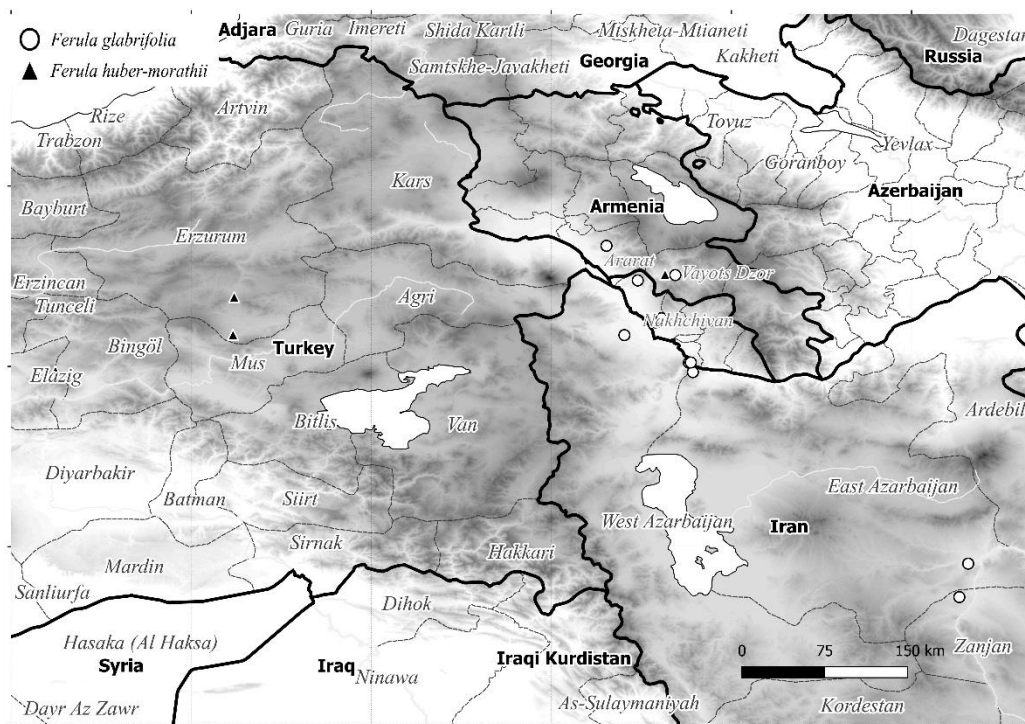


Fig. 2. Distribution of *Ferula huber-morathii* (black triangles) and *F. glabrifolia* (white circles).



**Conservation status**

*Ferula huber-morathii* was considered a rare Turkish species. Although it has been collected from several locations in E Anatolia, it is considered rare in Turkey and is categorized as endangered (EN), (Sağiroğlu 2005; Ozhatay 2009).

We screened the whole area with similar habitat types in the Vayots Dzor Region of Armenia. However, just one fragmented population could be detected (Fig. 3). This population occupies an area of ca. 110 ha, which is divided by a ground road in two parts. An area of 90 ha is located in the proximity of a recreational area, that recently expanded and thus presents a threat to the population. The second part of 20 ha is surrounded from three sides by road and subjected to road fortification and reconstruction measures, which may pose a serious threat to the vegetation of this area. The chalky slopes in the area are unstable, with the shifting substrate making them prone to movement (e.g. recent road fortification works). In the Armenian population, the number of flowering individuals is

relatively low and is subject to annual fluctuations depending on the duration and quantity of spring precipitation. According to our 3-year observations, 60-140 individuals bear flowers each year, while only 65 % of the plants develop mature seeds. Based on IUCN criteria (2024), *Ferula huber-morathii* is considered Critically Endangered (CR: A4cd+B1, B2abc (ii+iv) +C2b) in Armenia, given the small Extent of Occurrence (EOO=4km<sup>2</sup>) and Area of Occupancy (AOO=4km<sup>2</sup>), its small population size, low reproduction rate, slow reproductive cycle, as well as habitat destruction. Accordingly, *F. huber-morathii* should be included in the upcoming 3rd edition of the Red Data Book of Armenia, and its population to be protected and monitored. Seeds from the Armenian population are stored for long-term conservation in the Seed Bank of Armenian Flora of the A. Takhtajan Institute of Botany. A global assessment of the species extinction risk based on IUCN criteria is crucial in implementing effective conservation measures.



Fig. 3. A, flowering *Ferula huber-morathii*, and B, its habitat in autumn; C, flowering *F. glabrifolia*; D, ca. 3-5 years old plant of *F. glabrifolia* in their habitat

### Rediscovery of *Ferula glabrifolia*

*Ferula glabrifolia* is endemic to a relatively narrow area between NW Iran, the Nakhchivan Autonomous Republic, and Armenia (Rechinger, 1987; Mozaffarian 2007). For almost five decades, no data for any living population of *F. glabrifolia* were available for the Republic of Armenia. The species has been suggested to be a gypsophile (Takhtajan & Fedorov 1972). In Iran, the species is present in scattered populations in East Azerbaijan Province and bordering areas of the West Azerbaijan Province (Mozaffarian 2007; A. Rudov personal communication). A relatively large population is present on steep slopes along the Aras River valley between the Saint Stepanos Monastery and the Nakhchivan Dam. In the Nakhchivan Autonomous Republic, *F. glabrifolia* has been reported around the Velidag, Duzdag, Dahnadag, and Daridag mountains and along the Aras River, between Nehram and Darasham and is considered endangered based on older collections (Borodin 1984; Pimenov 1988; Talibov 2010), (Fig. 2). Data in the Red Book of Armenia are referring to older collections of the plant from the Karaburun hill on the borderline between Armenia and the Nakhchivan Autonomous Republic in 1933 and 1959 (ERE24361-24362; ERE77900-77902; ERE77564) and from the hill areas to the north of Zovashen/Lanjazat village in 1971 (ERE102693), both in the Ararat Province of Armenia. The latest collection from Armenia was performed in 1977 by Pimenov & al. around Agarakadzor (Vayots Dzor Province) (MW0700586).

After a year-long search in the area of Zovashen village and the Azat Dam Lake, the dry alleys and foothills of Yeranos, Yerakh, and Urts mountain ranges and the proximity of the Armenian side of the Karaburun hill, finally in 2022 searches two small populations of *F. glabrifolia* were found. The first is located along the Barakaghbyur valley about 8 km to the N of Vedi town (Ararat Province), (Fig. 3). This population is the biggest currently known in Armenia with about 46 individuals. Observations between 2022-24 in this area (45 km<sup>2</sup>) did not result in the finding of any further plants. Most individuals in this area are 3-5 years old with only 4 older plants, that flowered in 2024 (no flowering was observed in 2022 and 2023). A second population has been found on steep slopes of a hard-to-access dry valley about 3 km to the SW of Agarakadzor village (Vayots Dzor Province). Here, just 15 older plants have been found. No further plants were found in the surroundings in the following years of observation. Only 3 flowering individuals were observed for the first time in 2024. One plant was affected by mites and dried up without producing seeds. Our data confirm the existence of *F. glabrifolia* in

Armenia. The species is Critically Endangered in the country (CR): (A4cd+B, B2abc(ii+iii+iv) +C2b+D+E), given the small number of individuals, big annual fluctuations with total lack of reproducing individuals for several years, the long reproduction cycle of the species and the small Area of Occupancy (AOO=8km<sup>2</sup>) and Extant of Occurrence (EOO=14km<sup>2</sup>). Additionally, the population near Vedi City is affected by the consequences of human activity (dam construction, establishment of new gardens, grazing, mining) around the foothills of the Yerakh range. *Ferula glabrifolia* shares its habitat with a series of other rare and endangered taxa for the flora of Armenia, such as *Astragalus polyanthus* subsp. *vedicus* (Takht.) Zarre, *Klasea serratuloides* (Fisch. & C.A.Mey. ex DC.) Greuter & Wagenitz, *Kaviria aucheri* (Moq.) Akhani, *Kaviria tomentosa* (Moq.) Akhani, *Lactuca takhtadzhanii* Sosn., *Limonium carnosum* (Boiss.) Kuntze, *Noaea minuta* Boiss. & Balansa, *Plocama szowitzii* (DC.) M.Backlund & Thulin, *Reseda microcarpa* Müll.Arg., etc. None of the two populations are included in any protected area.

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