

# *Dipsacus gmelinii* (Caprifoliaceae), a wetland species new to the Bulgarian flora

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**Key words:** Belene, Danube River, disjunct occurrence, Natura 2000, new record, wetland flora.

**Ključne besede:** Belene, Donava, disjunktno pojavljanje, Natura 2000, novi podatki, mokriščna flora.

## Abstract

*Dipsacus gmelinii* is here reported as a new addition to the vascular flora of Bulgaria. It was recorded on Belene Island, in the Danube River. In the present paper, the species is described morphologically with an emphasis on carpomorphological characters. The distinctive differences from related species of the genus are also highlighted. Additionally, ecological conditions and floristic composition at the localities of the species, and phytosociological relationships of the communities in which it participates are discussed.

## Izveček

V članku poročamo o vrsti *Dipsacus gmelinii*, ki je nova vrsta v flori Bolgarije. Našli smo jo na otoku Belene na Donavi. V članku smo opisali morfološke značilnosti vrste s poudarkom na karpomorfoloških znakih. Izpostavili smo tudi značilne razlike med sorodnimi vrstami znotraj rodu. Razpravljali smo o ekoloških razmerah in vrstni sestavi na rastiščih, kjer se vrsta pojavlja, in o rastlinskih združbah, v katerih smo vrsto našli.

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## Introduction

Belene (Persin) is the largest Bulgarian island in the Danube River. It falls within the borders of Persina Nature Park, it is a Ramsar site, and part of Natura 2000 protected site BG0000396 Persina (MoEW, 2016). There are three big wetlands on the Island covering more than 2000 ha. They were completely drained in the beginning of last century because of riverbank reinforcement. In 2008 connection of the wetlands with Danube River was restored under Lower Danube Green Corridor Initiative by implementing Wetlands Restoration and Pollution Reduction project, financed by Global Environmental Facility (GEF). From then on, the water level in the wetland is managed by Persina Nature Park Directorate, which allows regular flooding of the wetlands. After the restoration of the water regime, the wetland ecosystem started slowly to recover, bringing back typical wetland species like Dalmatian pelican (*Pelecanus crispus*) and other bird species (Cheshmedziev et al., 2022), as well as typical wetland flora.

During botanical trip carried out in the summer of 2022, in the Belene Island, the second and the third authors came across to an unknown representative of the genus *Dipsacus* (*Caprifoliaceae*). The plants were initially identified by the first author as *D. gmelinii* M. Bieb., based on examination of detailed photographs. Later, in the same vegetation season a second field trip to the same site was held in order to insure plant material for reliable identification and preparing herbarium vouchers. Further on, following thorough examination of the collected plant specimens and consulting relevant literature, the initially proposed identity was confirmed. Therefore, our aim is to report the first finding of *D. gmelinii* in Bulgaria. The main distinguishing characteristics that facilitate the identification of the species are presented, as well as ecological peculiarities of the habitat. In conclusion, some initial measures for protection of its single population in Bulgaria are proposed.

## Methods and Methods

Collected specimens were identified according to Hansen (1976). The identification was verified by examination of exsiccates through the virtual herbarium of the Moscow State University (MW) (Seregin, 2023). Dried materials were vouchered in Herbaria of Sofia University (SO) and Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences (SOM) (herbarium acronyms follow Thiers, (2023)). Diagnostic characters were noted from our own gatherings. Mature achenes were further collected and illustrated through photographs created by focus stacking technic. Ecological characteristics were recorded at the field.

## Results and discussion

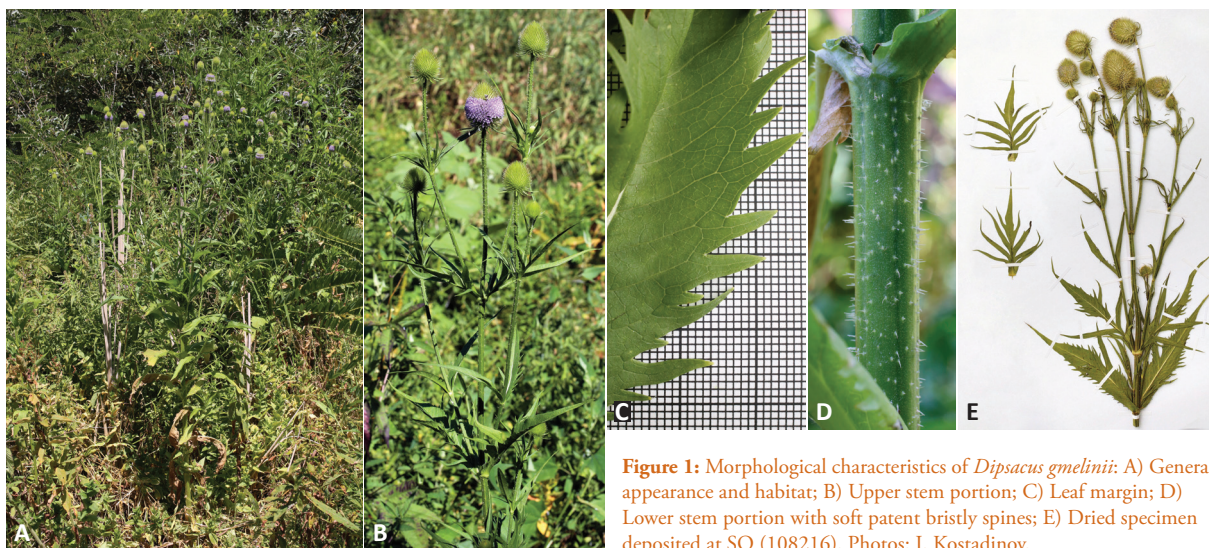
*Dipsacus gmelinii* M. Bieb. Fl. Taur.-Caucas. 1: 92. 1808 (Figure 1)

Plants biennial. Stems 150–180 cm tall, usually multi-branched, upper portion distinctively ridged, with slender prickles along ridges. Rosulate leaves petiolate, spatulate-lanceolate; cauline leaves opposite, sessile or subsessile, lanceolate, lower serrate, upper laciniolate, segments lanceolate-linear. Inflorescences corymbose, composed of 8–30 capitula. Capitula subglobose in pre-flowering stages, ovoid during anthesis, 2–5 cm long. Involucral bracts linear, spreading or slightly curved upwards, margins spinulose, apex acuminate, 10–30 x 1.2–2.5 mm. Bracteoles monomorphic, 8–12 mm long, proximal end obovoid, membranous, 4–7 x 2.5–3.5 mm, gradually tapering into 4–7 mm long awn. Corolla tube whitish, throat and limbs bluish-lilac, 5–6 mm long. Achenes 4-angled in cross-section, longitudinally ribbed, 5–6.5 mm long (see also Carpomorphological examination subchapter).

## Examined specimens

*Dipsacus gmelinii*: 1) **Bulgaria**: Persin island, damp place along abandoned drainage channel, 20 m alt., 43.6625°N, 25.2424°E, coll. date: 01 Aug 2022, leg.: Daniela Karakasheva, det.: Georgi Kunev (SO 108216; SOM 177779); 2) **Bulgaria**: Persin island, 43.6613°N, 25.2419°E, Daniela Karakasheva & Ivan Kostadnov (01 Aug 2022, pers. obs.); 3) **Russia**: Astrakhan Province, Kamyzyakskii region, – 20 m alt., 46.1454°N, 48.2589°E, coll. date: 10 Aug 1951, leg. & det.: Proskuryakova & Vostokova (MW0525513, photo); 4) **Kazakhstan**: coll. date: 9 Aug 1957, leg.: E. Zolotarev (MW0880641, photo); *D. laciniatus*: **Bulgaria**: Sofia, ruderal site near the Central railway station, 42.7162°N, 23.3182°E, G. Kunev (05 Aug 2022, fruit sample); *D. fullonum*: **Bulgaria**: Sofia, ruderal site near the Central railway station, 42.7162°N, 23.3182°E, G. Kunev (05 Aug 2022, fruit sample).

*Dipsacus gmelinii* is reported to Bulgarian flora for the first time. Morphological features of the Bulgarian specimens were in congruence with the previously published descriptions of this taxon (Marschall von Bieberstein, 1808; Kotov, 1961; Bobrov, 1972; Hansen, 1976) and with the additions of Andrei (1968). According to most recent treatment of the genus *Dipsacus* for the Bulgarian flora (Petrova, 2013), three taxa have been so far known as native to the country: *D. pilosus* L., *D. laciniatus* L., and *D. fullonum* L. The new addition, *D. gmelinii* is morphologically well-separated from the above mentioned taxa by combination of characters as upper leaves not or only slightly connate at base, involucral bracts



**Figure 1:** Morphological characteristics of *Dipsacus gmelinii*: A) General appearance and habitat; B) Upper stem portion; C) Leaf margin; D) Lower stem portion with soft patent bristly spines; E) Dried specimen deposited at SO (108216). Photos: I. Kostadinov.

**Slika 1:** Morfološke značilnosti vrste *Dipsacus gmelinii*: A) splošen izgled in rastišče; B) zgornji del stebila; C) rob lista; D) spodnji del stebila z mehкими, svetlečimi, ščetinastimi bodicami; E) posušen primerek, shranjen v herbariju SO (108216). Fotografije: I. Kostadinov.

shorter than capitula, and short bluish-lilac flowers. The identification of *D. gmelinii* at the field may be quite straightforward if mature individuals are available. It is most similar to *D. fullonum* but it differs from the latter by several conspicuous traits (Table 1).

**Table 1:** Comparative characteristics of *D. gmelinii* and *D. fullonum* based on specimens from wild Bulgarian populations.

**Tabela 1:** Primerjava znakov vrst *D. gmelinii* in *D. fullonum* na osnovi primerkov iz naravnih populacij v Bolgariji.

Character	<i>D. gmelinii</i>	<i>D. fullonum</i>
<b>Leaves</b>	lower cauline leaves sessile, usually free at base, upper cauline leaves lacinate	lower cauline leaves conate, upper cauline leaves usually entire
<b>Leaf margin</b>	serrate-laciniate	crenate-dentate, occasionally irregularly prickly-dentate or entire
<b>Stem</b>	lower portion of stem not or weakly ridged, covered with soft patent bristly spines	lower portion of stem more or less ridged, covered with stiff curved prickles along ridges
<b>Capitula</b>	subglobose to ovoid, 2–5 cm in length	ovoid-cylindrical, 4–8 cm in length
<b>Involucral bracts</b>	normally spreading, similar in length, shorter than capitulum	recurved upwards, very unequal in length, the longest up to 3 times longer than capitulum
<b>Flower bracts</b>	more or less uniform, 8–12 mm in length	dimorphic, lower 15–18 mm, apical 25–30 mm in length
<b>Flower length</b>	5–6 mm	9–11 mm

## Carpomorphological examination

The achenes of *D. laciniatus*, *D. fullonum* and *D. gmelinii* include some common features as rectangular-prismatic shape, sides longitudinally ribbed, covered with minute adpressed bristly hairs, bearing membranous coroniform appendage (corona) at apical end. However, their differences are more pronounced and could be useful for identification at the field, especially late in the vegetation season when leaves and flowers are completely withered. We performed carpomorphological study that showed the achenes of *D. fullonum* (Figure 2A) were 3–4 mm in length, light brown, with three primary ribs, each paired with two slender secondary ribs, fissures narrower than in *D. laciniatus*; corona 0.1–0.2 mm, arcuate, papillate. The achenes of *D. gmelinii* (Figure 2B) were 5–6.5 mm in length, straw colored, ribs broad, fissures narrow, median rib narrow than lateral; corona 1.4–1.8 mm, somewhat membranous, ribs tapering through corona sides as broad branched veins, ending in gradually diminishing from angles to center of achene side spines. The examined achenes of *D. laciniatus* (Figure 2C) were 3.5–4.5 mm in length, dark brown, with three narrow ribs and broad fissures; corona 0.2–0.3 mm, truncate, ciliate, margins irregularly denticulate or lacerate.

## Phytosociological notes

*Dipsacus gmelinii* has been observed in two microsites (Figure 3) with overall 20 individuals. The plants participated in plant communities developed in wet depressions along drainage channel. The vegetation at the localities



**Figure 2:** Carpomorphological comparison of achenes: A) *Dipsacus fullonum*; B) *D. gmelinii* and C) *D. laciniatus*. Photo: I. Kostadinov.

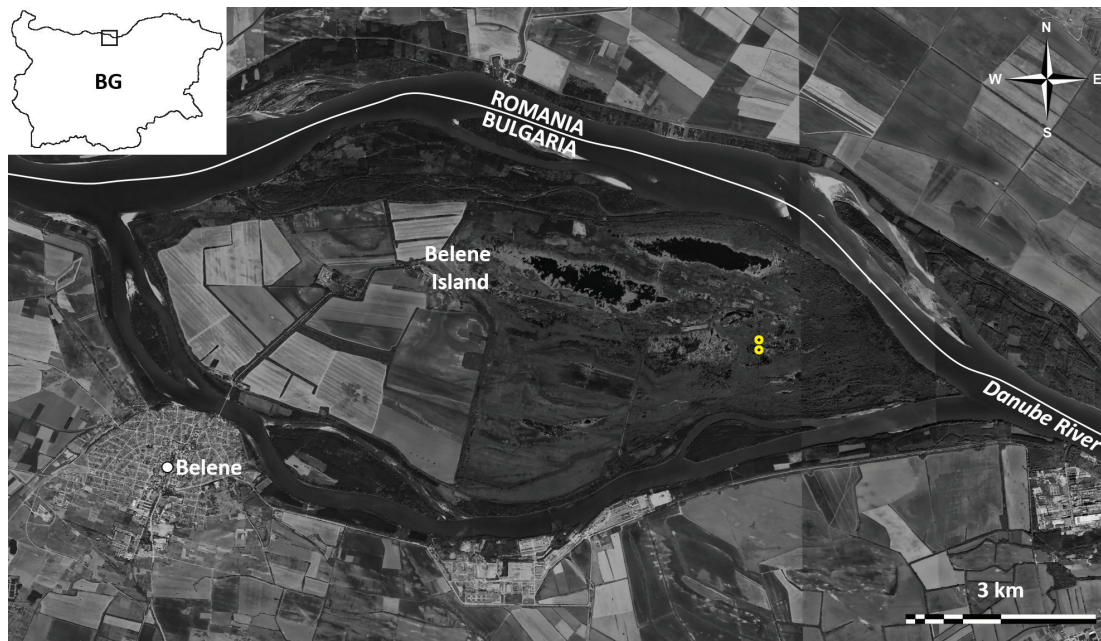
**Slika 2:** Primerjava karpomorfoloških znakov rožk: A) *Dipsacus fullonum*; B) *D. gmelinii* and C) *D. laciniatus*. Photo: I. Kostadinov.

were composed of mostly mesophilous and hygrophilous species, typically tall herbs and reeds as *Lythrum salicaria* L., *Chaiturus marrubiastrum* (L.) Ehrh. ex Rchb., *Lysimachia vulgaris* L., *Glycyrrhiza echinata* L., *Stachys palus-*

*tris* L., *Thalictrum flavum* L., *Carex* cf. *buekii*, *Euphorbia lucida* Waldst. & Kit., *Phalaris arundinacea* L., *Sonchus arvensis* subsp. *uliginosus* (M.Bieb.) Nyman, *Bidens* sp., *Chenopodium ficifolium* Sm., *Echinocystis lobata* (Michx.) Torr. & A.Gray, *Xanthium orientale* subsp. *italicum* (Moretti) Greuter, *Typha latifolia* L., *Allium angulosum* L., *Salix alba* L., and *Amorpha fruticosa* L.

At present, we could not identify the phytosociological affinities of *D. gmelinii*. The vegetation at the localities is complex and composed of species characteristic for various high-ranked syntaxa. According to Golub et al. (2015), *D. gmelinii* is a diagnostic taxon for the association *Calystegio-Phragmitetum* Golub et Mirkin 1986 of the alliance *Phragmition communis* Koch 1926 and the class *Phragmito-Magnocaricetea* Klika in Klika et Novák 1941 described from the lower Volga Valley, SE Russia. At Belene Island the species shows similar affinities. The species pool was influenced by surrounding vegetation, generally reed communities dominated by *Typha* sp. and *Phragmites australis* (Cav.) Steud. and stands of the association *Amorpha-Salicetum albae* Tzonev 2009 nom. prov. of the class *Salicetea purpureae* Moor 1958 (Tzonev, 2009; MoEW, 2016).

However, due to the hydrological regime of seasonal floods, the vegetation at the sites of *D. gmelinii* was additionally influenced by taxa characteristic for tall herb fringe communities; for example, such are some taxa of the alliance *Veronico longifoliae-Lysimachion vulgaris* (Passarge 1977) Balatová-Tulačková 1981 of the class



**Figure 3:** Distribution map of *Dipsacus gmelinii* in Bulgaria. Yellow dots showing the two microsites observed on Belene Island in 2022.

**Slika 3:** Karta razširjenosti vrste *Dipsacus gmelinii* v Bolgariji. Rumeni točki prikazujeta lokaciji mikrorastišč, ki smo ju zabeležili na otoku leta 2022.

*Molinio–Arrhenatheretea* Tuxen 1937 already reported from the same region (see Tzonev, 2009).

## Geographic range

The geographic distribution of *D. gmelinii* includes Eastern Europe and Western Asia: Romania, Ukraine, Eastern Russia, Northern Caucasus, Western Siberia, Kazakhstan, and Altay (POWO, 2023). According to our knowledge, its closest occurrence lies near Jijila, Tulcea County, Northern Dobrudzha, Romania (Andrei, 1968). It has been known also from the Danube Delta Biosphere Reserve (Doroftei et al., 2011).

We assume that *D. gmelinii* is recently introduced to Belene Island since the flora and vegetation of the island has been extensively studied in the last 20 years and this particular location was visited repeatedly for monitoring of the critically endangered in Bulgaria *Allium angulosum* (Tzonev, 2009, 2015; MoEW, 2016). However, up to now, only *D. laciniatus* has been registered at the studied area.

*D. gmelinii* inhabits damp shores of lakes and rivers and moist depressions across its range (Bobrov, 1972; Hansen, 1976). The species produce abundant number of seeds that fall mostly close to the parent plants and has great expansion potential (Andrei, 1968), in the same way as *D. laciniatus* and *D. fullonum*. The latter two species are dispersed mostly through anthropochory, including outside their native range (Daddario et al., 2017). However, *D. gmelinii* is more restricted globally and has narrow habitat range, so its dispersal strategy is most probably different. Belene Island, as an important bird area, is connected with the Danube Delta through migratory pathways of many waterfowl birds. Therefore, we assume that most probable way of introduction of *D. gmelinii* to the Belene Island is through migratory waterfowl, similarly to many wetland plant species inhabiting temporary flooded habitats (Salisbury, 1970; Deil, 2005).

The finding of *D. gmelinii* on the island of Belene is interesting and significant from biogeographical point of view because it is the westernmost disjunct occurrence of the species within its global range. In Romania, it was evaluated as Vulnerable (Dihoru & Negrean, 2009) and it is possible to show same trait also in Bulgaria. Due to its single locality in the country and relatively distant (approximately 300 km in NE) neighboring populations of the species in Romania, we assume there is a high extinction risk for of its Bulgarian population. Therefore, some measures should be taken in this regard as regular monitoring of its population, search for new localities in available suitable habitats, and control of some aggressive competitors as *Amorpha fruticosa*, *Phragmites australis* and *Phalaris arundinacea* at the known localities.

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