Circaea alpina (Onagraceae) – a poorly known species in the Bulgarian flora

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Received: May 24, 2019 ▷ Accepted: October 30, 2019

Abstract. *Circaea alpina* is already known in the flora of Bulgaria from Yundola, Lokvensko Dere locality (West Rhodope Mts). However, information on it is based only on a single publication 70 years ago, not documented with any herbarium materials. The species has not been confirmed subsequently for Bulgaria and was evaluated as Data Deficient in the *Red List of Bulgarian vascular plants*. This paper offers new data on the second established locality of the species in Bulgaria, as well as some information on its ecology and conservation status in the country. The new locality was found comparatively far from the first one, in the Mt Etropolska Divide – part of Central Balkan Range. The discovered population was very small (about 30 individuals) and inhabited some silicate rocky walls. The new record requires reassessment of the conservation status of *Circaea alpina* in Bulgaria.

Key words: Alpine Enchanter's Nightshade, Boreal relic, Bulgaria, chorology, ecology, new record

Introduction

Circaea alpina L., commonly called Alpine Enchanter's Nightshade or Small Enchanter's Nightshade (Drebna Charovnitsa, in Bulgarian) (Fig. 1), is a 4–20 cm high, rhizomatous perennial herb, with opposite cordate leaves. The petioles have a wing beneath. The leaves are ovate, 1–3.5 cm and coarsely dentate, with sparse falcate cilia on the leaf margins, glabrous on sides. The flowers and fruits are clustered near the top of the fruiting raceme; each raceme bears 15 or less white or pink flowers in July and August. The fruit is pear-shaped, compressed, 2 mm long, setaceous (Ganchev 1979).

The species is a typical circumpolar Boreal-montane element – distributed in the Boreal zone and mountains of the Northern Hemisphere (Preston & al. 2002). In Europe, it was found in most European countries extending southwards to the Pyrenees, N Apennines, Albania, Bulgaria, and Montenegro (Raven 1969; Raab-Straube 2018). No data on intraspecies variability have been published in the European (Raven 1969; Raab-Straube 2018) or national (Stojanov & al. 1967; Ganchev 1979) references. Six subspecies are known at global level, but only C. *alpina* subsp. *alpina* occurs in Europe (Xie & al. 2009).

So far the species has been known only from one location in Bulgaria: Yundola, Lokvensko Dere locality (Western Rhodope Mts) (Stefanov 1950). This locality was not documented with herbarium material in any of the Bulgarian herbaria. Nothing is known about the contemporary distribution and ecology of *C. alpina*, as well as of its threatened status in the country.

During filed work for a PhD thesis in the Etropolska Divide of the Balkan Range, a new locality of *C*. *alpina* was found for Bulgaria. Information on the chorology and ecology of this species in Bulgaria is summarized in the present study.



Fig. 1. *Circaea alpina* L. from Etropolski Zaberi locality (photo: G. Kunev).



Material and methods

The research is based on own collections and field studies in the established locality of *C. alpina*. The ecological features of the species were studied and phytocoenological research was conducted by the classical Braun-Blanquet's methodology (see Braun-Blanquet 1964). The localities are presented on a UTM grid map of Bulgaria (Fig. 2), following the recommendations of Kožuharov & al. (1983). The nomenclature of the vascular plants follows Delipavlov & Cheshemdzhiev (2003). Reassessment of the species was attempted using the IUCN criteria and categories, version 3.1 (IUCN 2001, 2003a), and the available guidelines for application of these categories at regional level (Gardenfors & al. 2001; IUCN 2003b; Petrova & Vladimirov 2009).

Results

Circaea alpina L.

Bulgaria, Balkan Range (*Central*): on the main ridge, above the town of Etropole, Etropolski Zaberi locality, 1715 m, 42°44'16.79"N, 24°01'5.11"E, KH53 (Fig. 2), 04.08.2018, coll. *G. Petrova* & *G. Kunev* (SO 107 990, SOM 176 679).

The new locality was restricted narrowly to the Etropolski Zaberi locality on its northern slope, close to the upper treeline of the beech forest belt. The estab-

lished new population of *C. alpina* was not numerous and consisted only of 30 individuals. It occupied an area of about 0.30 m². The habitat was silicate rocky walls, where the individuals grew mainly in the rocky crevices, together with other shade-tolerant species (ferns) and many mosses.

A phytocoenotic relevé of 1 m^2 (Fig. 3) was set in the locality. The macro-slope was about 70°, with north exposition, 60% of the vegetation coverage. The following species were discovered in

Fig. 2. Map of distribution in UTM grid (10×10 km) of *Circaea alpina* in Bulgaria.

the sample plot: **Vascular plants** (50%): *Circaea alpi*na (25%), *Polypodium vulgare* (15%), *Oxalis aceto*sella (5%), *Asplenium viride* (3%), *Cystopteris fragilis* (2%), *Homogyne alpina* (+), *Campanula velebitica* (+), *Adoxa moschatellina* (+); **Bryophytes** (30%): *Dicranum scoparium* (20%), *Racomitrium lanuginosum* (10%); **Lichens** (8%): *Cetraria islandica* (4%), *Thamnolia vermicularis* (2%), *Cladonia* sp. (2%).

Vegetation on the surrounding rocks (Fig. 4) in the locality included also other species of Boreal and Arctic-Alpine origin (glacial relics) from the Bulgarian flora, namely *Juncus trifidus*, *Rhodiola rosea*, *Homogyne alpina*, *Pleuropteropyrum undulatum*, etc.



Fig. 3. Community with participation of Circaea alpina (photo: G. Kunev).



Fig. 4. General view of the locality on the northern slopes of Etropolski Zaberi Peak (photo: G. Kunev).

Discussion

Circaea alpina was first published for Bulgaria by Stefanov (1950), from the shadowy places along small rivulets, in a mixed spruce-fir forest, on wet and hummusrich soils in the area of Yundola (Western Rhodope Mts), Lokvensko Dere locality, above Yundolska Polyana, at 1450 m a.s.l. According to same author, the plant was flowering in August. It formed large groups but Stefanov (1950) emphasized its invisibility. The author determined it as a northern circumboreal and polar species, with single locality in Bulgaria. As accompanying species in the same habitat and locality he mentioned

> also *Corallorhiza trifida* and *Epipogium aphyllum* from *Orchidaceae*. However, all our attempts in the summer of 2018 to confirm the species distribution in the formerly known site – Yundola and especially Lokvensko Dere – have failed.

> On the grounds of above-mentioned publication, the species was included in *Flora of Bulgaria* (see Stojanov & al. 1967; Ganchev 1979). However, its description there was probably based on materials from abroad, because no material from Bulgaria existed in any registered Bulgarian herbaria (SO, SOM and SOA) in the Index Herbariorum.

> Generally, the habitat of this species is in dark spruce thickets, often hidden under ferns, on rather damp northern slopes, in hollows (amongst boulders and screes, along streams and waterfalls), in broadleaved forests (dominated by Fagus and Quercus), and occasionally in rich mixed swamps, amongst Sphagnum or coastal ferns. The plant itself is rather modest: low-growing, green, thinleaved and small-flowered (Preston & al. 2002; Hokkanen 2004). According to Mucina & al. (2016), the species was determined as occurring both in mesic deciduous (Carpino-Fagetea) and dark coniferous (Vaccinio-Piceetea) forests. The species is present in similar habitats in Bulgaria.

> The flowers of *C. alpina* lack nectar so it does not attract many insects.

The pollen is often released, while the flower is still a bud, so it falls into its own stigmas, i.e. the species is self-pollinated. Most often the plant spreads vegetatively through its rhizomes and stolons. It forms a great number of clones of a single plant. The fruit has hooked hairs and drops easily onto passing animals or people (Boufford 1982, 1987). The discovered plants were flowering and fruiting properly but their ability to disperse was very restricted, since the newly found location was very isolated and barely accessible. The plants grew in a deep niche under the cliffs, so they were sheltered from the wind and could not be reached by grazing stock. The mature fruits fell close to the parent individuals, therefore reproduction most probably was effected both vegetatively and by seeds. Circaea alpina could hybridize with the similar congeneric species C. lutetiana. They produce a sterile hybrid species Circaea ×intermedia Ehrh. which persists in the vegetative colonies of both parent individuals (Raven 1969). The discovered plants though were morphologically uniform and showed no features of hybrid origin.

The geographical position, geological history and surrounding vegetation of the discovered new locality of C. alpina in Bulgaria have provided good evidence of its relic origin and primary restricted species range. The same was valid for the origin and ecological features of the locality in the Western Rhodope Mts (Stefanov 1950). Probably, the closest localities of the species are now situated in the eastern parts of Serbia: Belan Peak in the Stara Planina Mts (Diklić 1973) and Resava Gorge (Mijatović & al. 2007), where there existed certain phytogeographical connections with the new Bulgarian locality of the species along the main ridge of the Stara Planina (Balkan Range) mountain system. These data prompt an assumption that there are probably more locations of the species in Western Stara Planina Mts, which further field work may reveal.

Circaea alpina is listed in Annex 3 under the Bulgarian Biodiversity Act and, therefore, it is a protected species at national level. It has been also included in the first edition of the Red Data Book of Bulgaria in the category Rare (Peev 1984). Lack of any recent information was the main reason to assess it as 'Data Deficient' in the *Red List of Bulgarian vascular plants* (Vladimirov 2009). The newly established locality is very significant for preservation of the species in the south-easternmost part of its European range. Considering the results of the present study, a reassessment is suggested of the national conservation status of the taxon. The currently available data indicate that the species would meet the criteria of a 'Critically Endangered' taxon in Bulgaria, based on its small and severely fragmented population in the country and projected decline of the habitat and area of occupancy (Criterion B). The newly recorded very small, relic locality raises the serious question of preservation of this protected species in Bulgaria. The locality is very close to one of the largest open mines in Bulgaria: Elatsite. Therefore, declaring Etropolski Zaberi locality a protected area will contribute to the preservation not only of *C. alpina* but also of some other rare and relic species in Bulgaria, such as *Rhodiola rosea*.

Acknowledgements: The authors extend their thanks to the Scientific Fund of Sofia University St. Kliment Ohridski, because part of this study was made during the PhD thesis work of Gabriela Petrova, under Contract № 80-10-151/25.04.2018 for the project "Syntaxonomical research of the grassland vegetation in the Etropolska Stara Planina Mountain". They also extend special thanks to Dr. Anna Ganeva from the Institute of Biodiversity and Ecosystem Research for determination of mosses and to Dr. Bojan Zlatković from the University of Niš for the provided literature sources and information.

References

- Boufford, D. 1982 The systematics and evolution of *Circaea* (*Onagraceae*). Ann. Missouri Bot. Gard., **69**: 804-994
- Boufford, D. 1987. Pollination biology of *Circaea* (*Onagraceae*). Acta Phytotax. Geobot., **38**: 133-154.
- Braun-Blanquet, J. 1964. Pflanzensoziologie, 3rd ed. Springer-Verlag, Wien.
- **Delipavlov, D. & Cheshmedzhiev, I.** (eds). 2003. Handbook of Plants in Bulgaria. Acad. Publ. House of Agr. Univ. Plovdiv (in Bulgarian).
- Diclić, N. 1973. *Circaea* L. In: Josifović, M. (ed.), Flora of SR Serbia. Vol. 5, pp. 32-35. Serbian Academy of the Sciences and Arts, Beograd (in Serbian).
- **Ganchev, I.** 1979. *Onagraceae* Juss. In: **Jordanov, D.** (ed.), Fl. Reipubl. Popularis Bulgaricae. Vol. 7, pp. 447-479. Aedibus Acad. Sci. Bulgaricae, Serdicae (in Bulgarian).
- Gärdenfors, U., Hilton-Taylor, C., Mace, G. & Rodríguez, J.P. 2001. The application of IUCN Red List Criteria at regional levels. Conservation Biol., 15(5): 1206-1212.
- Hokkanen, P. 2003. Vascular plant communities in boreal herbrich forests in Koli, East Finland. – Ann. Bot. Fenn., 40: 153-176.

- IUCN. 2001. IUCN Red List Categories and Criteria: Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland & Cambridge, UK.
- IUCN. 2003a. Guidelines for Using the IUCN Red List Categories and Criteria. Prepared by the Standards and Petitions Subcommittee of the IUCN SSC Red List Programme Committee. IUCN, Gland, Switzerland & Cambridge, UK.
- **IUCN.** 2003b. Guidelines for Application of IUCN Red List Criteria at Regional Levels: Version 3.0. IUCN Species Survival Commission. IUCN, Gland, Switzerland & Cambridge, UK.
- Kožuharov, S., Peev, D. & Nikolov, N. 1983. Conservation, representation and use of the current chorological information. – Fitologiya, 22: 61-66 (in Bulgarian).
- Mijatović, M., Karadžić, B., Jarić, S., Pavlović, P., Mitrović, M., Popović, Z. & Đurđević, L. 2007. Contribution to knowledge of the vascular flora of the Resava Gorge, East Serbia. – Arch. Biol. Sci., Belgrade, 59(1): 75-80.
- Mucina, L., Bültmann, H., Dierßen, K., Theuriat, JP., Raus, T., Čarni, A., Šumberová, K., Willner, W., Dengler, J., Gavilán García, R., Chytrý, M., Hájek, M., Di Pietro, R., Iakushenko, D., Pallas, J., Daniëls, F., Bergmeier, E., Santos Guerra, A., Ermakov, N., Valachovič, M., Schaminée, J., Lysenko, T., Didukh, Y., Pignatti, S., Rodwell, J., Capelo, J., Weber, H., Solomeshch, A., Dimopoulos, P., Aguiar, C., Hennekens, S. & Tichý, L. 2016. Vegetation of Europe: Hierarchical floristic classification system of vascular plant, bryophytes, lichen, and algal communities. – Appl. Veg. Sci., 19(1): 3-264.

Peev, D. 1984. Circaea alpina L. - In: Velchev, V. (ed.), Red Data

Book of the People's Republic of Bulgaria. Vol. 1, Plants, p. 243. Publishing House of the Bulgarian Academy of Science, Sofia (in Bulgarian).

- Petrova, A. & Vladimirov, V. (eds). 2009. Red List of Bulgarian vascular plants. Phytol. Balcan., 15(1): 63-94.
- Preston, C., Pearman, D. & Dines, T. 2002. New Atlas of the British and Irish Flora. Oxford Univ. Press, Oxford.
- **Raab-Straube, E. von.** 2018. *Onagraceae*. In: Euro+Med Plantbase the information resource for Euro-Mediterranean plant diversity. http://ww2.bgbm.org/EuroPlusMed/query.asp (accessed May 2019).
- Raven, P. 1969. Circaea L. In: Tutin, T. & al. (eds), Flora Europaea. Vol. 2. From Rosaceae to Umbeliferae, pp. 305-306. Cambridge Univ. Press, Cambridge.
- Stefanov, B. 1950. Notes: Lepidium sativum L., Circaea alpina L., Cephalanthera pallens Rich. – Izv. Bot. Inst., 1: 475-476 (in Bulgarian).
- Stojanov, N., Stefanov, B. & Kitanov, B. 1967. Flora Bulgarica. Vol. 2 (Leguminosae–Compositae). Nauka i Izkustvo, Sofia (in Bulgarian).
- Vladimirov, V. 2009. Circaea alpina L. In: Petrova, A. & Vladimirov, V. (eds), Red List of Bulgarian vascular plants. – Phytol. Balcan., 15(1): 90.
- Xie, L., Wagner, W., Ree, R., Berry, P. & Wen, J. 2009. Molecular phylogeny, divergence time estimates and historical biogeography of *Circaea* (*Onagraceae*) in the Northern Hemisphere. – Molec. Phylogen. Evol., 53: 995-1009.