New data on distribution of the endangered species Viola jooi (Violaceae) in Ukraine

Jan Roleček¹,², Pavel Drevojan¹

¹ Department of Botany and Zoology, Faculty of Science, Masaryk University
2 Kotlářská, Brno 611 37, Czech Republic
² Department of Vegetation Ecology, Institute of Botany, Czech Academy of Sciences
25/27 Lidická, Brno 657 20, Czech Republic
honza.rolecek@centrum.cz
pavel.drevojan@seznam.cz

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Abstract. Here we report the third extant site of Viola jooi in Ukraine. The species was found on an open calcareous scree in the valley of the Tlumach stream near Ostrynia village (Tlumach District, Ivano-Frankivsk Region). Vegetation of the scree may be classified to a broadly circumscribed alliance Stipion calamagrostis or to its east-central European counterpart Teucrion montani (class Thlaspietea rotundifolii). Moreover, our survey of Ukrainian and Polish herbaria revealed several specimens collected during the 1930s at two sites not yet mentioned in the literature, with one of the sites situated near our newly found site. We see a need for a thorough field survey of the historical, extant and other suitable sites of the species in the area of its present distribution in the Ukraine. Despite the new finds, Viola jooi remains one of the rarest relicts of the ancient heliophilous flora of the Volyn-Podolian Upland, pointing to its peri-Alpidic biogeographical affinities. Conservation priorities should be in line with this status.

Keywords: endangered species, plant distribution, Podnistrovia, Pokuttia, relict, scree vegetation

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Introduction

*Viola jooi* Janka is a rare species with a narrow distribution range, encompassing mainly the Eastern and Southern Carpathians in Romania. Outside Romania, a single site was reported from Serbia (Homoljske Planine Mts., Southern Carpathians) and two sites from Ukraine (Niketić et al., 2015). The Ukrainian sites are situated in the Pokuttia historical region near Chortovets and Harasymiv villages (Shelyag-Sosonko et al., 1980; Didukh, 2009), about 130 km north of the nearest sites in north-eastern Romania (cf. Niketić et al., 2015). The species is classified as vulnerable in the Red Data Book of Ukraine (Didukh, 2009) and as rare in the Romanian red list (Oltean et al., 1994). Its estimated threat status in Serbia is critically endangered species (Niketić et al., 2015). Habitats of the species in Ukraine include mainly gypsum outcrops with steppe grassland vegetation dominated by *Carex humilis*, *Helictotrichon desertorum* and *Sesleria heufflerana*, where it is accompanied by other rare ecological specialists such as *Draba podolica* (Schivereckia podolica) and *Thalictrum petaloideum* (incl. *T. podolicum*) (Koczwara, 1931; Didukh, 2009; Roleček et al., 2019).

Discovery of *Viola jooi* within the present-day territory of Ukraine has been ascribed to the Polish botanist Tadeusz Wilczyński (Koczwara, 1931; Zablocki, 1947). Koczwara himself reported *V. jooi* from three phytosociological relevés recorded in June 1927 near Chortovets village on gypsum outcrops by the road to Obertyn (Koczwara, 1931; Fig. 1). The place likely corresponds to the Boldy site (also called Zholob) where the species is still present (Didukh, 2009). There are multiple herbarium specimens from this site in Krakow (KRA, KRAM), Lviv (LWS) and Kyiv (KW) herbaria, the oldest one coming from 1928 (see *Overview of the studied herbarium specimens*). Another site reported in the Red Data Book of Ukraine is located 10 kilometres to the north-west, on slopes of a gypsum sinkhole between Zhabokruky, Harasymiv and Zhvachiv villages (Ya.P. Didukh pers. comm.; Fig. 1). A single specimen from this site is present in KW.

The aim of this paper is to report a new site of *Viola jooi* in Ukraine, which was found during a field trip in April 2019, and to provide additional new data on species’ distribution retrieved from the literature and herbaria. These findings change the picture of distribution of *V. jooi* in the country.

Study area

The study area (Fig. 1) is situated in the northern part of the historical region of Pokuttiya, which is a part of a physiographic region of the Pokutian-Bessarabian Upland (IEU, 2019). It is predominantly built of calcareous sediments of the Neogene and Cretaceous age, mainly gypsum and marlstones (Vashchenko et al., 2007). The landscape is mildly undulating and largely used as farmlands. Incised valleys of the Dniester and its tributaries provide suitable habitats for the remnants of natural and semi-natural non-forest vegetation, such as steppe grasslands, vegetation of rocky outcrops and scree (Koczwara, 1931; Didukh, Korotchenko, 2000; Didukh, Vashchenko, 2018; Roleček et al., 2019). Karst features, particularly sinkholes, developed in the Neogene gypsum deposits, provide additional habitats for these vegetation types (Didukh, Pavliuk, 2008).

Methods

Taxonomic concepts and nomenclature of vascular plant taxa follow *Euro+Med PlantBase* (2006–onward), with the exception of *Ligularia glauca*, for which we use the concept of *Flora Europaea* (Tutin et al., 1976). Syntaxonomic nomenclature follows Mucina et al. (2016); full references are provided for syntaxa not included in this source. Vegetation composition was recorded using 2 × 2 m plot and standard phytosociological methodology, with the extended Braun-Blanquet scale used for species cover-abundance estimation (Dengler et al., 2008). Acronyms of herbaria follow *Index Herbariorum* (Thiers, 2006–onward).

Results

A new site of *Viola jooi* was found during a survey of steppe vegetation on steep slopes of the valley of Tlumach stream near Ostrynia village (Tlumach District, Ivano-Frankivsk Region, Western Ukraine; Fig. 1). Herbarium vouchers are deposited in the Herbarium of the Masaryk University (BRNU) in Brno. Several dozens of individuals were found on the south-west facing open marlstone scree (Fig. 2) and in adjacent dry grasslands. Species composition of the scree vegetation was recorded using the following phytosociological relevé.

Ukraine, Ivano-Frankivsk Region, Tlumach District, Ostrynia village, steep slope above right bank of the Tlumach stream, latitude 48°55′40.9″ N, longitude 24°59′12.3″ E (WGS-84), altitude 250 m a.s.l., plot size
4 m², slope inclination 40°, slope aspect 200°, cover of herb layer 5%, cover of moss layer < 1%. Authors: J. Roleček & P. Dřevojan. Date: 17 April 2019.

Herb layer: *Teucrium montanum* 1, *Allium lusitanicum* +, *Asperula cynanchica* +, *Bupleurum falcatum* +, *Euphorbia cyparissias* +, *Ranunculus breyninus* +, *Salvia verticillata* +, *Securigera varia* +, *Teucrium chamaedrys* +, *Viola jooi* +, *Arrhenatherum elatius* r, *Daucus carota* r, *Echium vulgare* r, *Sanguisorba minor* r.

During our subsequent survey of botanical literature and herbaria we identified two additional sites not yet reported in the relevant Ukrainian and Polish literature (Zabłocki, 1947; Shelyag-Sosonko et al.; 1980; Didukh, 2009):

i) Suchodół [= Sukhodil] village, Dniester valley near Brzezina grange (J. Mądalski, 1934, KRAM);

ii) slopes above Pałahicze [= Palahychi] village (J. Mądalski, 1936, KRAM).

Detailed information on the herbarium specimens are provided in Appendix 1. Summary data of the known past and present localities of *Viola jooi* in Ukraine is provided in Fig. 1.

**Discussion**

**New finds**

While the latest overview of the distribution of *Viola jooi* in Ukraine (Didukh, 2009) mentions two historical sites (both reported as still existing), we discovered three additional sites. The extant site near Ostrynia, which was found during a field trip in 2019, represents the northernmost point of species’ known distribution (cf. Niketić et al., 2015).

Perhaps even bigger surprise was a discovery of two historical sites of *Viola jooi* in the herbarium of the W. Szafer Institute of Botany, Polish Academy of
Sciences, Krakow (KRAM), kindly checked by Agnieszka Nikel. Respective specimens were collected by the Polish botanist Józef Mądalski in the 1930s, when the whole area of interest was a part of Poland. Mądalski worked at Jan Kazimierz University in Lviv. After the expulsion of Poles from the region by the end of World War II he moved to Wrocław, but later he handed over his personal herbarium to Krakow (see https://pl.wikipedia.org/wiki/Józef_Mądalski).

The site near Palahychi is located just about 1 km south-west of the extant site found by us and thus may be considered as a single larger site. However, site conditions of the two places may differ, as the area provides outcrops of not only Cretaceous marlstones, but also of Neogene gypsum. The other site near Sukhodil is the first known place of occurrence of Viola jooi in the Dniester valley, which has been recognized as an important refugium for non-forest species (Didukh, Vashenjak, 2018). Additional habitats suitable for V. jooi still occur in the surroundings of both historical sites and we assume that a focused field survey might bring new interesting findings. The search in other relevant herbaria in Ukraine and Poland (KRA, KW, LW, LWS) brought no new information on distribution of the species. It should also be noted that V. jooi was repeatedly reported from the Ukrainian Carpathians (Klokov, 1955; Tzvelev, 1996; Novikoff, Hurdu, 2015) listed it among doubtful taxa for this region. However, the respective record is surely erroneous, because it was based on an incorrect geographical interpretation of the Pokuttia region by Klokov (1955), which was probably followed by Tzvelev (1996).

We hope that the new find reported here will stimulate interest in the species and that nature conservation priorities will meet its status and needs.

**Biogeography**

Despite the new finds, Viola jooi remains one of the rarest relicts of the ancient heliophilous flora of the Volyn-Podolian Upland. This flora includes various biogeographical and ecological elements, among which the continental steppe element and Central European...
(in a wide sense) montane element belong to most characteristic ones (Szafer, 1923; Gajewski, 1937; Zaveryukha, 1985; Didukh, Vasheniak, 2018). Viola jooi clearly belongs to the latter, showing dealpine ecological features and peri-Alpidic (in this case, peri-Carpathian) distribution. In this respect, the co-occurring Teucrium montanum and Ranunculus breyninus show certain similarities.

Although some authors (e.g. Szafer, 1923) suggested the Tertiary age for these relics, we assume that extensive climatic fluctuations connected with multiple Pleistocene glacial-interglacial cycles (Ehlers, Gibbard, 2011) led to profound changes of species’ distribution ranges. Therefore, the current distribution patterns of Viola jooi and other heliophilous relics were probably determined rather by the extent of their ranges during the last Ice Age (Late Pleistocene) or early Holocene and by the rate of their retreat during the Holocene forest spread. Admittedly, in some cases (e.g. the species with extremely disjunct ranges such as Ligularia glauca and Thalictrum petaloideum) earlier events might have played more important roles.

Vegetation

Vegetation of the scree with Viola jooi in the Tlumach valley may be classified to a broadly circumscribed alliance Stipion calamagrostis (class Thlaspietalia rotundifolii), which according to Mucina et al. (2016) includes the alliance Teucrietalia montanum. The latter alliance is an alternative option for the classification of vegetation of low-altitude calcareous scree in east-central Europe (Valachović et al., 1997). None of these alliances has been reported from Ukraine yet (Solomakha, 2008, Dubyna et al., 2019).

Previously, the species was reported from Ukraine only from dry grasslands on gypsum bedrock (Koczwar, 1931; Didukh, 2009). These have been classified to the association Ranunculoo zapalowiczi-Helictotrichonetum desertori described by Kukovitsia et al. (1994). The association has been assigned to different higher syntaxa by different authors (Kukovitsia et al., 1994; Didukh, Korotchenko, 2000; Didukh, Vasheniak, 2018). Based on its species composition, physiognomy and ecology, we prefer its original assignment to the order of rocky steppes Stipo pulcherrimae-Festucetalia pallentis and the alliance Galio campanulati-Poion versicoloris or to its more broadly conceived analogue Bromo pannonici-Festucion ciscohegynsis (see Mucina et al., 2016).

In Romania Viola jooi occupies mainly colline to alpine rock grasslands, outcrops and scree on calcareous bedrock, often dominated by Festuca pallens, Helictotrichon decorum, Sesleria heufleriana, S. rigida, Teucrium montanum or Thymus comosus (Csűrös, Pop, 1965; Doniţă et al., 2005; Šmarda, 2005). The new site by Ostrynia therefore fits well the ecological amplitude of the species.

Overview of the studied herbarium specimens

Tlumach Region: Ostrynia: SW-facing open marlstone scree and adjacent dry grasslands on the steep slope above the right bank of the Tlumach stream 1.2 km ENE from the church, 250 a.s.l., 48°55′40.9″ N & 24°59′12.3″ E (P. Dřevojan & J. Roleček, 17.04.2019, BRNU). – Pałachic. K. Tłumacza, na haluwie na pd. stoku wzgórza na pd. od koty 331 (J. Mądalski, 16.04.1936, KRAM). – Suchodół, folwark Brzezina, na ścianie pr. brzegu Dniestru w jasnych zaroślach wśród lasu (J. Mądalski, 20.07.1934, KRAM). – Suchodół koło Tłumacza, na lesistej ścianie prawego brzegu jaru Dniestru w miejscach jasnych, stepowych koło dawnego folw. Brzezina (J. Mądalski, 07.08.1936, KRAM). – Ivanovo-Frankovskaya obl., Tłumachskiy r-n. s. Gerasimov, severnye krutyye sklyony, form. Seslerieta heufleriana [Ivanovo-Frankovskaya obl., Tłumachskiy r-n, s. Gerasimov, severnye krutyye sklyony, form. Seslerieta heufleriana] (Ya.P. Didukh, 18.05.1979, KW).

Horodenka Region: Czortowiec – step (J. Dobrzańska, 29.05.1928, KRA). – Podole: Czortowiec koło Winogradu. Skalki stepowe (Anonymous [Wycieczka Inst. Bot. U. J.] 29.05.1928, KRAM). – Pokucie stepowe. Czortowiec, step z Avena Besseri na stromem wzgórza gipsowem (B. Pawłowski, 29.05.1928, KRAM). – Pokucie stepowe. Step z Avena Besseri na stromem zboczu gipsowem (B. Pawłowski, 29.05.1928, KRAM). – Pokucie stepowe. Czortowiec (pow. Horodeński). Step z Avena Besseri na gipsowem, stromem zboczu (B. Pawłowski, 29.05.1928, KRA). – Pokucie; Czortowiec (A. Kozłowska, 30.05.1928, KRAM). – Czortowiec koło Obertyna, na stromych halawach na pd. zach. od wsi (J. Mądalski, 25.04.1934, KRAM, KW). – Ivanovo-Frankovskaya obl. Gorodenkovskiy r-n. s. Chortovets. Boldy. Kamienistyye obnasheniya i stepnye sklyony [Ivanovo-Frankovskaya obl. Gorodenkovskiy r-n. s. Chortovets. Boldy]. Kamenistyie obnashesienia i stepnye sklyony (Yu.R. Sheleyag-Sosonko & Ya.P. Didukh, 31.07.1977, KW). – Ivanovo-Frankovskaya obl., Gorodenkovskiy r-n. s. Nazarenkovo [= Chortovets], ur. Galdy [= Boldy]. Severnye krutyee sklyony, formatsiya Helictotrichoneta bessieri [Ivanovo-Frankovskaya obl., Gorodenkovskiy
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