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Short communication

Cardamine fialae Fritsch (Brassicaceae) a new species in Croatian flora

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Abstract – During a floristic survey of the northern slopes of Matokit Mountain in the surroundings of Vrgorac in central Dalmatia, a peculiar population of *Cardamine* belonging to the *C. maritima* complex was found. Because of its morphology, general habit, type of leaves and fruits, the collected plants were recognized as *C. fialae* hitherto know only from Bosnia and Herzegovina. Morphologically, *C. fialae* is similar to the Serbian endemic *C. serbica* with which it shares following characteristics: auricules at the base of lower cauline leaves, stem and rosette leaves bipinnate, margin of leaflets serrate with hairy main stem and sepals, although it differs in having bigger petals and sepals, longer filaments and 1–2 lateral stems. *C. fialae* grows on lower altitudes in rocky ground within the vegetation of forest fringes of the sub-Mediterranean zone. This is the first report of the endemic species *C. fialae* in Croatian flora.

Key words: *Cardamine maritima* complex, Dalmatia, flora, Matokit Mountain, taxonomy, Vrgorac

Introduction

The genus *Cardamine* L. is one of the largest in the family Brassicaceae and consists of approximately 200 species of annual to perennial herbs distributed on all continents except for mainland Antarctica (Kučera et al. 2005, 2010). In the European flora the genus is represented by ca. 54 species (Lihova and Marhold 2006), while in the Croatian flora 26 taxa are currently known (Kučera and Marhold 2006, Kučera et al. 2010, Nikolić 2015). An interesting group of the amphi-Adriatic plants is the *Cardamine maritima* complex that has been studied recently from morphological and phylogenetic points of view (Kučera et al. 2008, 2010). This complex has a diversity centre in the Balkan Peninsula and extends with one species beyond the Adriatic. The complex includes seven endemic species with very restricted distributions, six of which occur in the Balkan peninsula (*C. maritima* Port. ex DC., *C. adriatica* Jar. Kučera, Lihová & Marhold, *C. serbica* Pančić, *C. fialae* Fritsch, *C. montenegrina* Jar. Kučera, Lihová & Marhold and *C. rupestris* (O.E. Schulz) K. Malý) and one species on the Apennine peninsula (*C. monteluccii* Brilli-Catt. & Gubellini). Within this complex an annual to biennial species has been described from Klobuk in Bosnia and Herzegovina and named *C. fialae* by Fritsch (1897). In the past, some authors treated this taxon at different taxonomic levels, mainly at infraspecific level. Trinajstić (1976) considered it a subspecies of *C. maritima* and Sagorski (1911) a variety of *C. maritima*, but modern phylogenetic combined with morphological studies have shown that this taxon merits being treated as an independent species (Kučera et al. 2008, 2010). Hitherto, C. *fialae* has been known only from three localities in Bosnia and Herzegovina: Klobuk, Ružići and Grude (Fritsch 1897, Beck Mannagetta 1903, Kučera et al. 2008, 2010), which are only about 10 km north-east of the present localities.

In April 2013 and 2015, during floristic mapping of Matokit Mountain (Vukojević 2011, Vukojević and Vitasović Kosić 2012) in the vicinity of Vrgorac in central Dalmatia, ten kilometres aerial distance from the *locus classicus* (Klobuk in Herzegovina), a population of *C. maritima* complex was found, and identified as *C. fialae*. This species is not listed in the plant identification handbook of Croatia (Domac 2002) or in the Flora Croatica Database (Nikolić 2015). The Euro+Med Plantbase (Marhold 2011) note the occurrence and distribution of this species only for Bosnia and Herzegovina. Since the endemic *C. fialae* has not been previously recorded in Croatia, it should be treated as a new species of the Croatian vascular flora.

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Materials and methods

Field research was carried out on Matokit Mountain and in the surroundings of the city of Vrgorac in central Dalmatia (Fig. 1). The whole researched area has about 53 square km and belongs to the belt of sub-Mediterranean deciduous forest of downy oak (*Quercus pubescens* Willd.) belonging to the alliance *Querco-Carpinion orientalis* Horvatić 1939. The terrain elevation throughout the whole area is from 300–830 m a.s.l. The climate is a combination of sub-Mediterranean and continental climate, with an average annual temperature of 14.3 °C and 1720 mm of average annual precipitation measured in the period of 1981–2010 for the city of Vrgorac (Vukojević 2011).

Identification of *C. fialae* regarding its morphology, general habit, shape of leaves and fruits, was done according to the identification key for *C. maritima* complex proposed by Kučera et al. (2010). The morphological description presented here follows Beck Mannagetta (1903), Trinajstić (1976), Šilić (1990), Akeroyd and Marhold (1993), Kučera et al. (2010) and additional authors' observations. Herbarium vouchers of collected plants are digitized and deposited in the herbarium ZAGR; images are accessible through Virtual Herbarium ZAGR (Bogdanović 2015). Type specimens of *C. fialae* (lectotype and isotypes form GZU and W) were also consulted and compared with Croatian populations (abbreviations are according to Thiers 2015).

Results and discussion

***Cardamine fialae* Fritsch,** Österr. Bot. Z. 47: 44 (1897)

Synonyms – *C. maritima* Port. ex DC. subsp. *fialae* (Fritsch) Trinajstić, Suppl. Fl. Anal. Jugosl. 4: 8 (1976); *C. maritima* Port. ex DC. var. *fialae* (Fritsch) Sagorski, Österr. Bot. Z. 61: 18 (1911). Lectotype was designated by Kučera et al. (2010) in WU herbarium.

Morphological description – *C. fialae* is an overwinter annual or rarely biennial plant, 12–30(50) cm high, whole plant is hairy. Stems are erect and branched, on lower part usually purple-violet. Rosette and stem leaves are bipinnate, with serrate margin of leaflets, petiole of stem leaves auriculate. Sepals hairy, winged, mucronate, 2 longer (5.1–) 5.4–8.3(–9.5) mm long. Petals white, glabrous, (11.7–) 12.8–17.9(–19.7) mm long, with long ungues, limb obovate to obcordate. Siliqua linear, glabrous, flat, light brown when ripe, 40–55 (–60) mm long, 1.4–2.0(–2.5) mm wide, with 10–12 (–15) mm long beak, siliqua pedicel 10–15 (–20) mm long. Seeds 4, brown, 5 mm long and ca 1.5 mm wide (Figs. 2A–E). Flowering time is from April to May.

Cardamine fialae can possibly be confused with other members of the *C. maritima* complex. It differs from typical *C. maritima* in having auricules on the base of stem leaves, denser indumentum and bigger flowers (Figs. 2C, D). Morphologically it is more similar to Serbian endemic *C. serbica* with which it shares the following characteristics: auricules at the base of lower cauline leaves (Fig. 2D), stem and rosette leaves bipinnate (Fig. 2B), margin of leaflets serrate with hairy main stem and sepals, but it differs in having bigger petals and sepals (Fig. 2C), longer filaments and only 1–2 lateral stems.

Habitat and ecology – *C. fialae* grows in limestone rocky ground within degraded forests of downy oak (*Q. pubescens*) and oriental hornbeam (*Carpinus orientalis* Mill.) in the sub-Mediterranean zone. It grows individually or in scattered groups on dry and shallow humose soils among rocks. On Matokit Mountain it grows on lower altitudes in rocky ground within the vegetation of forest fringes and secondarily also in ruderal places, in arable fields (Fig. 2F), on shady screes and very rarely in rock crevices. These are relatively open microhabitats not overgrown by other plants. Such semi-natural habitats and their conditions are particularly suitable for seeds to spread. When the first population of *C. fialae* was recorded in early April, the plants

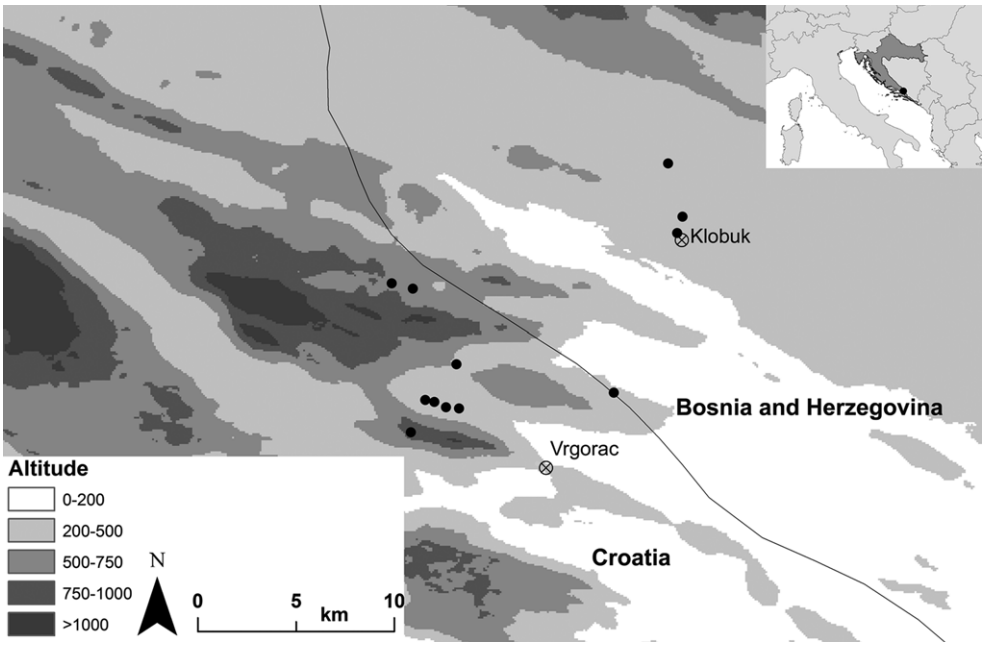

Fig. 1. Present distribution of *Cardamine fialae* Fritsch in Croatia and in Bosnia and Herzegovina.

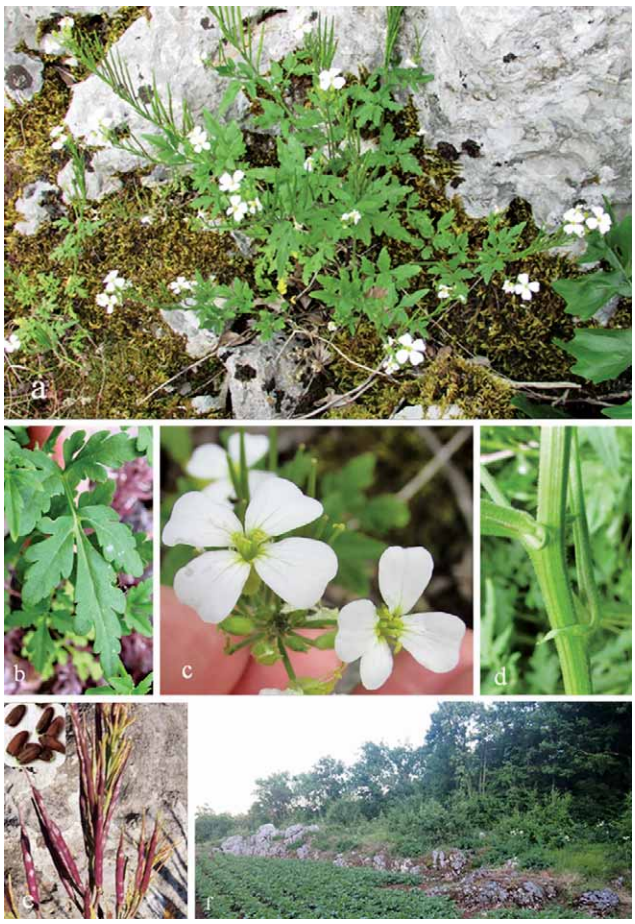

Fig. 2. *Cardamine fialae* Fritsch: a) habitus, b) stem bipinnate leaf, c) flowers, d) auricule, e) fruits and seeds, f) habitat (forest fringe) in Turića dočići (photos by M. Vukojević).

were already in flower and some of the specimens were even producing fruits. This can be considered an early flowering time as the literature indicates it starts flowering in April or May, lasting until July or August (Beck Mannagetta 1903, Šilić 1990). This endemic species can be classified as an Illyrian-Adriatic floristic element according to the classification of Horvatić (1963a, b) and Horvatić et al. (1967–1968).

Distribution in Croatia and in Bosnia and Herzegovina – In April 2013 a population of *C. fialae* was found on the northern slope of Matokit Mountain in Turića dočići between a forest fringe and an arable field, and is the biggest among all known populations. Afterwards, in May and June 2015 it was found at another eight localities within different habitats, as follows. The three localities in Bosnia and Herzegovina are taken from Kučera et al. 2008 (Fig. 1):

1. Vrgorac, northern slope of Matokit Mountain, Turića dočići, between forest fringe and arable field, representative population about 500 plants, 350 m a.s.l., 14.04.2013, 43°14'5.17'' N, 17°19'19.83'' E,
2. Vrgorac, Prapatnice, Vegari, Popriki dolac, on rocks in the forest, about 50 plants, 339 m a.s.l., 07.06.2015, 43°13'56.16'' N, 17°19'39.04'' E,
3. Vrgorac, Prapatnice, Velika njiva, on deeper soil, very near rocks in the forest, about 20 plants, 319 m a.s.l., 06.06.2015, 43°13'54.29'' N, 17°20'0.51'' E,
4. Vrgorac, Prapatnice – Stilja, put Vukmira, on bare rocks of the forest edge, about 20 plants, 371 m a.s.l., 03.06.2015, 43°14'8.32'' N, 17°19'4.74'' E,
5. Vrgorac, on the entry of the village Gornje Kašče, on bare rocks (without soil) of the oriental hornbeam forest edge, about 20 plants, 465 m a.s.l., 20.05.2015, 43°15'7.43'' N, 17°19'56.25'' E,
6. Vrgorac, Mijaca, within the walls of former barns on shallow soil, about 50 plants, 565 m a.s.l., 27.05.2015, 43°17'11.24'' N, 17°18'44.17'' E,
7. Vrgorac, on the way to Mijaca, near the road, on rocks of the forest edge, about 10 plants, 704 m a.s.l., 27.05.2015, 43°17'19.92'' N,17°18'9.24'' E,
8. Vrgorac, hilly area Orah, on the way to Kućerina, on rocks of rocky pastures, about 20 plants, 317 m a.s.l., 19.05.2015, 43°14'20.47'' N,17°24'15.62'' E,
9. Razdolje, transition to the southern side of the mountain trail toward Ravča, bare rocks, about 10 plants, 830 m a.s.l., 30.05.2015, 43°13'14.94'' N, 17°18'40.88'' E.

Conservation status – According to the standards of IUCN (2014) the endemic *C. fialae* should be classified in the category of Vulnerable (VU) species, the criterion D2 being adopted. In April 2013 and May 2015, in all, approximately 900 mature individuals were counted within the complete range of the species including Croatian and Bosnian and Herzegovinian locations. The threat status is based on number of mature individuals, which is below 1000, as well as on the area of occupancy (AOO) which is less than 20 km^2, while extent of occurrence (EOO) is less than 90 km^2. There are potential threats to the habitats (human impacts in agriculture, fires and forest managements) and further studies need to be conducted in order to monitor the population size of *C. fialae*. As a rare endemic species, *C. fialae* should be protected by law and included in the national Red list of Croatia.

Conclusion – The area of Dalmatian Zagora e.g. Vrgorac and Matokit Mountain belongs among regions that have been poorly botanically explored. All Croatian localities of *C. fialae* were found close to the border with Bosnia and Herzegovina (near the *locus classicus*) and potentially new localities of *C. fialae* could be expected within similar habitats in this region. The newly recorded Adriatic endemic species has very delimited distribution range, and the finding of *C. fialae* is a valuable contribution to the Croatian flora.

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