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# NOVELTIES IN THE VASCULAR FLORA OF CROATIA

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We report on and discuss records of five species new to the vascular flora of Croatia. *Calamagrostis canescens* was found near Đurđevac in remnants of fen vegetation, and we consider it a critically endangered species in the flora of Croatia. *Agrimonia procera* is native or archaeophyte in central Croatia and its discovery is in accordance with its earlier use as a medicinal plant. *Amaranthus emarginatus* is an exotic newcomer that was previously found in urban habitatson the north Adriatic coast. *Carex vulpinoidea* and *Oenothera suaveolens* were shown to be locally established species, in meadows along the Kupa River, and on the bars of the Drava River, respectively. In addition, we present new distributional and ecological data on two neophytes (*Cardamine occulta*, *Humulus scandens*) that were only briefly mentioned in earlier sources from Croatia.

**Key words**: *Agrimonia procera*, *Amaranthus emarginatus*, *Calamagrostis canescens*, *Carex vulpinoidea*, *Oenothera suaveolens*, plant invasions, secondary habitats, threatened species

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U radu su prikazani i protumačeni nalazi pet vrsta vaskularne flore koje su nove za Hrvatsku. Rijetka vrsta *Calamagrostis canescens* nađena je u blizini Đurđevca u ostatcima močvarne vegetacije i autori preporučaju tretman ove svojte kao kritično ugrožene. *Agrimonia procera* je vjerojatno nativna vrsta središnje Hrvatske, lokalno možda moguće i kao ostatak nekadašnjeg uzgoja kao ljekovite biljke. *Amaranthus emarginatus* je egzotična pridošlica nađena na antropogeno utjecanim staništima duž obale sjevernog Jadrana. Za vrstu *Carex vulpinoidea* je utvrđena lokalna naturalizacija na livadama uz rijeku Kupu, a za vrstu *Oenothera suaveolens* na obalama rijeke Drave. Dodatno, dani su novi podaci o nalazima i ekologiji dviju neofitskih vrsta (*Cardamine occulta* i *Humulus scandens*), o kojima postoje izvješća ograničena obima.

**Ključne riječi**: *Agrimonia procera*, *Amaranthus emarginatus*, *Calamagrostis canescens*, *Carex vulpinoidea*, *Oenothera suaveolens*, invazivne biljke, sekundarna staništa, ugrožene vrste

## INTRODUCTION

The vascular flora of Croatia is one of the richest in Europe (Nikolić, 2001), and is generally well-documented (Nikolić, 2005-onwards). However, there is some discrepancy in the level of exploration of the different regions: the Adriatic and Dinaric regions of the country, hotspots of plant diversity, and sites of endemic species, were often in the spotlight (e.g. Bogdanović & Brullo, 2015; Bogdanović *et al*., 2019). On the other hand, the continental part of Croatia was paid less attention, and several species, which are not rare in neighbouring countries, have been found recently as a

floristic novelty even in these under-represented regions (e.g. Purger *et al.*, 2008, 2017; Stančić, 2009; Alegro *et al.*, 2010). The distribution, taxonomy and threats of alien plants, especially invasive species, has been assessed in several recent studies (e.g. Nikolić *et al.*, 2013; Boršić *et al.*, 2018; Vuković *et al.*, 2019), nevertheless, trade and transport, tourism and changing climate are drivers of repeated introductions. We recently undertook several field excursions focusing particularly on inland Croatia, devoting particular attention to pioneer habitats, weedy and fringe vegetation, and urban sites. In the present study we summarize the most significant results of these surveys, reporting on five species new to the Croatian flora, and significant additions for two further species previously recorded in the country.

## MATERIAL AND METHODS

The field studies were carried out by G. Király and M. Hohla between 2012 and 2020. For each locality, the geo-coordinates and altitude were determined using a GPS handheld device in WGS84 projection. The material of the following herbaria was used for revision of former records, and comparative morphological studies: BP, LI, LJU and ZA, as well as the private herbaria of M. Hohla, and G. Király. Vouchers collected during the study are deposited in ZA or LI (for herbarium acronyms see Thiers, 2021).

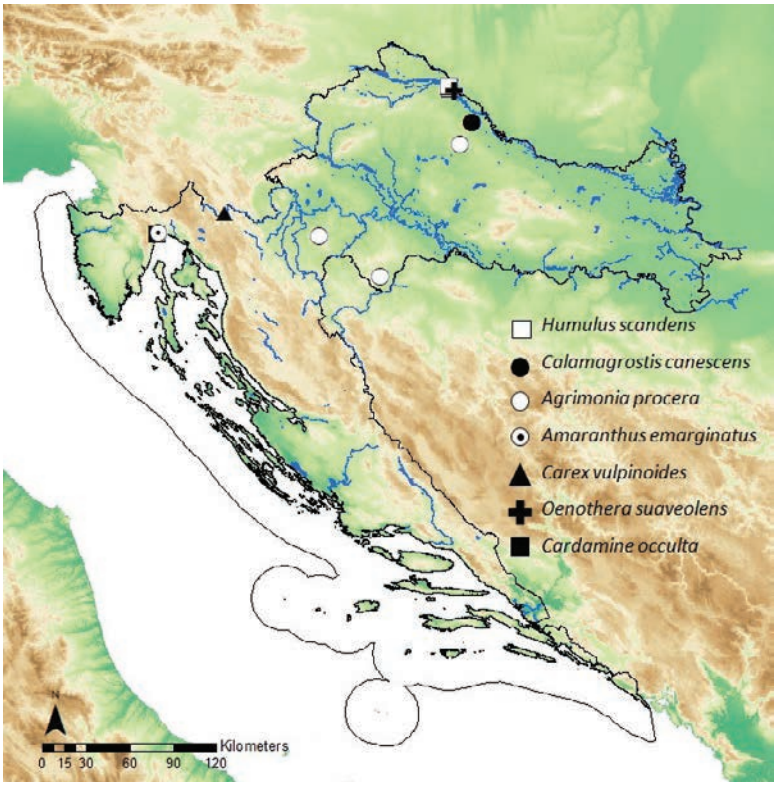


**Fig. 1.** Distribution map of the floristic novelties found in Croatia.

## RESULTS AND DISCUSSION

***Agrimonia procera* Wallr.**, Erst. Beitr. Fl. Hercyn. 203. (1840)

– Karlovac County, Vojišnica, along road nr. 6 at the crossroads to Šarići, mesic meadows and fringes, 161 m, 45°20'20'' N, 15°43'48'' E; leg. et det. G. Király & M. Hohla, 04/07/2019 [ZA 58330].
– Sisak-Moslavina County, Kosna (Boromise), tall-herb vegetation along the public road, 163 m, 45°05'37''; 16°16'10''; G. Király & M. Hohla, 02/07/2019 (observation).
– Bjelovar-Bilogora County, Maglenča, forest fringes 1.1 km SE of Manduševac (Zakletište), 174 m, 45°54'59'' N, 16°58'25'' E; G. Király, 08/07/2012 (observation).

The only species of the genus reportedly occurring in Croatia is *Agrimonia eupatoria* L., which is quite common in the country (Nikolić, 2005-onwards). *A. procera* has a closed distribution area in central and western Europe, with scattered outposts in the Balkans as far south as northern Greece (Greuter & Raus, 1998). Although the species was recorded in several localities close to the state border in both Slovenia (Jogan, 2001) and Hungary (Király & Király, 2004), with the exception of questionable records mentioned by Scholz & Scholz (1995) there are no reliable data in Croatia from former times. We found it after 2012 at three sites (with well-established populations), but it has probably been overlooked (due to its similarity with *A. eupatoria*) and is likely to be present in other parts of the country. The status of the species is not entirely clear (either native or an archaeophyte?). It is a traditional medicinal herb (source of *Agrimoniae herba*), and some central European authors (e.g. Wittmann & Strobl, 1987) generally consider it a relict of former cultivation. On the other hand, the habitats (mesic meadows and forest fringes) found in Croatia are like those in the neighbouring countries – where *A. procera* is treated as a native species (Fig. 2). In terms of conservational status we suggest assessing it preliminarily as a "vulnerable" (VU) species.

**Fig. 2.** The habitat of *Agrimonia procera* near Vojišnica (4 July 2019, photo by M. Hohla)

**Fig. 3.** Fruits and inflorescence axis of *Agrimonia procera* (left) and *A.* × *wirtgenii* (right) (Vojišnica, 4 July 2019, photo by M. Hohla)

An extended key proposed for the genus *Agrimonia* in Croatia:

1a. Stem densely hairy with long and short non-glandular hairs, but with no or few yellow sessile glands. Leaves densely hairy or tomentose and with no or few sessile glands on the lower side. Ripe hypanthium obconical, 5–8 mm wide (incl. outer bristles), deeply grooved to apex, its outer bristles patent to erecto-patent. . . . . ***A. eupatoria***

1b. Stem sparsely hairy with long hairs, and with many yellow sessile glands. Leaves slightly hairy and with many sessile glands on the lower side. Ripe hypanthium bell-shaped, 9–11 m wide (incl. outer bristles), shallowly grooved (with grooves not reaching the apex), outer bristles reflexed. . . . . ***A. procera***

A rare hybrid between *A. eupatoria* and *A. procera* (*A.* × *wirtgenii* Asch. & Graebn.) has been reported from several countries where the parents co-occur; it is characterized by intermediate leaf indumentum and sterile fruits; however, Stace (2010) underlines the necessity of cytological evidence for putative hybrids. We found morphologically transitional, sterile plants among typical specimens of *A. eupatoria* and *A. procera* in a locality near Vojišnica that probably belong to this hybrid (Fig. 3); however, these plants need further research (e.g. flow cytometrical revision).

***Amaranthus emarginatus*** **Moq. ex Uline & W. L. Bray**, Bot. Gaz. 19: 319 (1894) subsp. ***pseudogracilis*** **(Thell.) Hügin**, Willdenowia 16: 463 (1987)

– Primorje-Gorski Kotar County, Opatija, S of Voslosko, "Obalno šetalište Franje Josipa I", one specimen in a flowerbed, 4 m, 45°20'49'' N; 14°19'14'' E; leg. M. Hohla, det. D. R. Letz & M. Hohla, 25/07/2019 [LI 02769370].

The genus *Amaranthus* is represented by 14 species in the Croatian flora (Nikolić, 2005-onwards), which are (except *A. blitum* L., see Thellung, 1914) neophytes in Europe (mostly from the Americas or the subtropics and tropics of the Old World). *A.*

*emarginatus* belongs to the *A. blitum*-aggregate. In Europe, it is a relatively late newcomer that was found in Britain in 1822 but was first recognized in most of western Europe as late as the 20th century, in south-eastern Europe only after 1980. In regions adjacent to Croatia it has been observed in Austria, Italy, and Hungary (Walter & Dobeš, 2004; Király *et al*., 2010; Dřevojan & Letz, 2016). It occurs most often in pioneer swarms of riverbanks (without obvious invasive trends) and in degraded urban habitats.

The nomenclature and taxonomy of *Amaranthus emarginatus* was discussed for quite a long time; it was treated as a subspecies of *A. blitum* by some authors (e.g. Walter & Dobeš, 2004; Fischer et al., 2008; Király, 2009), however, here we adopt the concept of Hügin (1987) and Iamonico (2015, 2016) who accepted it as a well separable species. Within *A. emarginatus*, two infraspecific taxa (regularly as subspecies) are recorded in Europe: subsp. *emarginatus*, and subsp. *pseudogracilis* (Thell.) Hügin.

*Amaranthus emarginatus* differs from *A. blitum* in several features and intermediate specimens are extraordinarily rare (Hügin, 1987; Walter & Dobeš, 2004; Dřevojan & Letz, 2016). At the recently reported locality in Croatia, we found subsp. *pseudogracilis* (Fig. 4), which is in Europe more frequent than the nominate subspecies.

Features of the *A. blitum* agg. are the ± glabrous stem, the retuse or emarginate leaves, the (2–)3 tepals that are much shorter than fruits, and the indehiscent, not inflated fruits. Within this aggregate, we suggest the following identification key:

1a. Plant dark green, leaves often reddish coloured, with dark or light spots, slightly emarginate at apex. Fruit reddish brown, seeds mainly longer than 1.2 mm, and wider than 1.1 mm. . . . . ***A. blitum*** s. str. (syn.: *A. lividus* L.)

1b. Plant light green, without reddish colours and darker or lighter spots, deeply emarginate at apex. Fruits light yellowish to greenish-brown, seeds mainly a maximum of 1.2 mm length and 1.1 mm of width. . . . . ***A. emarginatus***

a. Axillary and apical inflorescences short and reduced . . . . subsp. ***emarginatus***

b. Axillary and apical inflorescences long and slender (the apical one is often flexuous). . . . . subsp. ***pseudogracilis***

**Fig. 4.** Fruiting specimen of *Amaranthus emarginatus* subsp. *pseudogracilis* in Opatija (25 July 2019, photo by M. Hohla)

***Calamagrostis canescens* (Weber) Roth**, Tent. Fl. Germ. 2(1): 93 (1789).

(Syn.: *C. lanceolata* Roth)

– Koprivnica-Križevci County, Đurđevac, 0.5 km NE of the village, wet depressions among pine plantations along the road to Severovci, 130 m; 46°02'58'' N; 17°05'07'' E; leg. et det. G. Király, 15/07/2016 [ZA 3425] (the species was observed at the site already on 9 Aug 2015).

The genus *Calamagrostis* is represented in Europe by approximately 20 species, of which six are reported from Croatia (Meusel *et al.*, 1965; Nikolić, 2005-onwards). All but one species are well documented in Croatia. The exception, *C. canescens*, is distributed in the European mainland and western Siberia (Meusel *et al.*, 1965). In the Balkans it is rare in Romania (Şerbănescu & Beldie, 1972), its occurrence in Serbia (Josifović, 1976) and Bulgaria (Assyov & Petrova, 2006) is doubtful. Although *C. canescens* is mentioned in the Croatian key of Domac (2002), we could not find any vouchers confirming it from the country. There is a recent record in the Flora Croatica Database (Nikolić, 2005-onwards) from the surroundings of Đurđevac, that, however, refers to two herbarium specimens (ZA 43419, 43420, collected by T. Ređep at "Đurđevački pijesci"), which unambiguously belong to *C. epigeios* (L.) Roth. Therefore, the abovementioned locality – curiously, also from Đurđevac – represents the first reliable record of the species from Croatia. This site is situated in wet depressions on sand, covered by Scots pine plantations, but formerly a part of a mosaic of alder swamps and sedge beds in connection with "Preložnički berek" N of Đurđevac on the alluvium of the Drava valley. Worthy of mention is that *C. canescens* is a typical element of willow carrs and swamps of the Belső-Somogy region in bordering Hungary (Bartha *et al.*, 2015), it often forms larger clones due to its rhizomes. Based on this single, small population found near Đurđevac, the species can be preliminarily classified as "critically endangered" in the Croatian flora.

From most of the Croatian species of the genus, *C. canescens* is separable by the short (<2.5 mm) awn not protruding from the spikelet, and by the basal hairs of the


**Fig. 5.** Lemma of *Calamagrostis canescens* with a short awn among the apical teeth, and with basal hairs ca. 3 mm long (ZA 3425, photo by G. Király)

lemma shorter than 4 mm. The most similar species is *C. villosa* (Chaix) J. F. Gmel., for their separation, contrary to Domac (2002), we suggest the following key:

1a. Awn of the lemma terminal, arising between two teeth at the apex; lemma usually not longer than 2.5 mm. Base of the leaf blade without a hair-collar. . . . . ***C. canescens*** (Fig. 5)

1b. Awn of the lemma not terminal, arising from the back of the lemma; lemma usually 2.5–3.0 mm long. Base of the leaf blade with a conspicuous hair-collar. . ***C. villosa***

Although *Calamagrostis canescens* and *C. villosa* are quite similar in morphology, they occupy very different habitats. *C. canescens*, as given above, is a plant of marshes and fens, *C. villosa* occurs in acidophilous forests and their clearings.

***Cardamine occulta* Hornem.**, Hort. Bot. Hafn. Suppl. 71 (1819).

– Primorje-Gorski Kotar County, Opatija, SW margin of Angiolina Park, few specimens in a flowerbed, 16 m, 45°20′08′′ N; 14°18′29′′ E; leg. et det. M. Hohla, 24/07/2019 [LI 02769363].

*Cardamine occulta*, most likely native to eastern Asia, has been introduced into several parts of the world, often behaving as an invasive species. However, its taxonomy and nomenclature were long controversial. The species was first collected in Europe in 1993 (Spain), and since then has been discovered in many other countries where it was identified under various names ("Asian C. *flexuosa*", "*C. flexuosa* subsp. *debilis*", and "*C. hamiltonii*"). The first evidence that it differs from *C. flexuosa* With. and that they represent two distinct evolutionary lineages was released by Lihová *et al*. (2006), and the issue was eventually disentangled by Marhold *et al*. (2016) and Mandáková *et al*. (2019). In the neighbourhood of Croatia, it was found in Italy (2003), Hungary (2004), and Austria (2007) (see Bleeker *et al*., 2008; Marhold *et al*., 2016; Takács *et al*., 2020). It was previously recorded in Croatia as a container plant in a nursery of Zadar (Hruševar *et al*., 2018), presumably imported with soil material. We found the species at a further locality in Opatija, and we assume that it is probably overlooked throughout the country and is already more frequent due to the capacity for spontaneous spreading. Typical habitats of *C. occulta* are flowerbeds in parks, plant nurseries, and cemeteries, rarely found also in natural communities, such as riverbanks.

Nikolić (2005-onwards) presented 20 taxa of the genus *Cardamine* (incl. *Dentaria*) from Croatia at species rank. We suggest using the following identification key on the annual / biennial species (after Fischer *et al*., 2008; Verloove, 2021; and own observations):

1a. Stem-leaves with basal auricles. Petals 2–3 mm long (sometimes lacking), early deciduous. . . . . ***C. impatiens***

1b. Stem-leaves without basal auricles. Petals persisting. . . . . 2

2a. Stem and leaves glabrous (or with very few hairs not longer than 0.2 mm). Petals 1.8–2.5 mm long. . . . . ***C. parviflora***

2b. Hairs on stem and leaves at least 0.5 mm long. Petals longer than 2.5 mm . . . . . 3

3a. Stem with 1–4(–6) leaves, basal leaves many (forming a typical rosette), mostly with 1–3 pairs of leaflets. Stamens usually 4. . . . . ***C. hirsuta***

3b. Stem with 4–7(–10) leaves, basal few (if any, not in a rosette), mostly with 3–6 pairs of leaflets. Stamens usually 6. . . . . 4

**Fig. 6.** Typical specimen of *Cardamine occulta* (Germany, Bavaria: Simbach, 3 April 2014, photo by M. Hohla)

4a. Middle stem leaves hairy on upper surface, with a terminal leaflet lobed (with deep and shallow incisions) or unlobed. Stem base distinctly hairy. . . ***C. flexuosa***

4b. Middle stem leaves glabrous on upper surface, with a terminal leaflet 3–5-lobed (with deep and sharp incisions). Stem base glabrous to slightly hairy. . . . . ***C. occulta*** (Fig. 6)

***Carex vulpinoidea* Michx.**, Fl. Bor.-Amer. (Michaux) 2: 169 (1803).

– Primorje-Gorski Kotar County, Belo, 0.1 km E of the village, along the road to Čedanj, wet forest fringes close to the Kupa River, 226 m; 45°28'26'' N, 14°53'55'' E; leg. et det.: G. Király & M. Hohla, 03/07/2019 [ZA 58333].

– Primorje-Gorski Kotar County, Belo, 0.4 km W of the village, along the road to Golik, wet herb vegetation on the roadside, 228 m; 45°28'24 N, 14°53'09 E; G. Király & M. Hohla, 03/07/2019 (observation).

*Carex vulpinoidea* is a North American representative of the subgen. *Vignea* sect. *Multiflorae* that has been recorded in several European countries. The species is one of the most common sedges in North America, often occurring in secondary wet habitats (ditches, roadsides, degraded meadows). In Europe, it was first observed in 1856 (France), the most likely pathway of its introduction being in fodder (as seed contaminant) (Standley, 2002; Wallnöfer, 2012). South of the Eastern Alps it was first recorded in Italy in the 1980s, in Austria (Styria) in 1938, and in Slovenia very recently (2019) (Argenti, 1983; Wallnöfer 2012; Mihorič 2020). Although it is naturalized in several European countries, it is nowhere a noxious weed or a nature conservational threat, and many occurrences are casual only. We found the species in Croatia in wet fringes of abandoned meadows, and on roadsides along the upper section of the Kupa River (Fig. 7). Based on the density of the stands seen here, it is unambiguously established in the Gorski Kotar region.

Most similar species in the European (and Croatian) flora are the species of the *Carex vulpina*-aggregate (*C. otrubae* Podp., *C. vulpina* L.), their common characters are the densely tufted growth form, the relatively thick stems (which are more than 2 mm

in diameter), and the adaxially flat utricles. The distinguishing features are, nevertheless, clear:

1a. Leaves transversally rugose. Utricles 2.0–2.7(–3.2) mm, their beak 0.7–1.2 mm long. Proximal bracts setaceous, partly much longer than the spikes. . . . . ***C. vulpinoidea*** (Fig. 8)

1b. Leaves not rugose. Utricles (3.5–)4.0–6.0 mm, their beak 1.0–1.5 mm long. Proximal bracts broader, not longer than the spikes. . . . . ***C. vulpina*** agg.

**Fig. 7.** The habitat of *Carex vulpinoidea* near Belo (3 July 2019, photo by M. Hohla)

**Fig. 8.** Inflorescence of *Carex vulpinoidea* – bristle-like bracts and small utricles are well visible (Belo, 3 July 2019, photo by M. Hohla)

***Humulus scandens* (Lour.) Merr.**, Trans. Amer. Philos. Soc. ser. 2, 24(2): 138 (1935).

(Syn.: *H. japonicus* Siebold & Zucc.)

– Koprivnica-Križevci County, Legrad, left bank of the Drava River 0.25 km SE of the border pole nr. 175, wet tall-herb riverside vegetation, 125 m; 46°16'34'' N, 16°53'41'' E; leg. et det.: G. Király, 16/06/2020 [ZA 58332].
– Koprivnica-Križevci County, Legrad, Jagnjedinje, bar of the Drava River, pioneer vegetation, 124 m; 46°15'35'' N, 16°55'12'' E; G. Király, 16/06/2020 (observation and photodocumentation);

**Fig. 9.** *Humulus scandens*, dominating in riverside herb vegetation of the Drava near Legrad (16 June 2020, photo by G. Király)

**Fig. 10.** *Humulus scandens*, typical leaves with 7 divisions, at the Drava near Legrad (16 June 2020, photo by G. Király)

– Koprivnica-Križevci County, Đelekovec, left bank of the Drava River 0.25 km W of the border pole nr. 174, tall-herb riverside vegetation 128 m; 46°16'37'' N, 16°53'16'' E; G. Király, 02/06/2016 (observation and photodocumentation), 16/06/2020 (observation).

*Humulus scandens* is a neophyte of eastern Asian origin, introduced into Europe as an ornamental plant and first observed in the wild in the last quarter of the 19th century. The species, spreading in riparian habitats, is classified as an invader in Hungary, Italy, and France (Balogh & Dancza, 2008, Celesti-Grapow *et al*., 2009, EPPO 2019). It was observed close to the Croatian borders along the Mura River in Slovenia, and the Drava River in Hungary, as well as in a canal in Vojvodina, Serbia – Jogan, 2001, Savić *et al*., 2008, Bartha *et al*., 2015. The species was collected by Á. Károlyi between 1956 and 1960 near Őrtilos in Hungary (BP 219708, BP 292518), and was rediscovered here both on the Croatian and the Hungarian sections of the Drava by G. Király from 2016 onwards. Šegota *et al*. (2018) reported the species (as *H. japonicus*) from the same region (from a Drava oxbow SE of Legrad). During the systematic survey of the Croatian section of the Drava between Legrad and Drnje in 2020, opposite to Őrtilos, huge stands of *H. scandens* were found in riverside habitats, and therefore it is considered at least a regional invader. However, we are concerned that the species is already generally present along the Drava River in northern Croatia. Worthy of note is that *H. scandens* is (contrary to the perennial archaeophyte, *H. lupulus* L.) a thermophilous, late germinating, annual species having strategy and role (i.e. forming monodominant carpets in riverside communities) similar to those of *Echinocystis lobata* Torr. & A. Gray (Fig. 7 and 8).

We propose the key below for the identification of *Humulus* species occurring in Croatia:

1a. Perennial plant, with leaves divided into 3–5 lobes, petioles as long as or shorter than blades. Veins on abaxial surface of the leaf glabrous or with soft hairs. Pistillate bracteoles ± glabrous. . . . . ***H. lupulus***

1b. Annual plant, with leaves divided into 5–7(–9) lobes, petioles longer than blades. Veins on abaxial surface of the leaf with stiff, erect hairs. Pistillate bracteoles densely ciliate. . . . . ***H. scandens***

***Oenothera suaveolens* Desf. ex Pers.**, Syn. Pl. 1: 408 (1805)

– Koprivnica-Križevci County, Drnje, gravel bars in the Drava River 1.0 km N of the railway bridge, pioneer vegetation on bare gravel, two flowering specimens, 124 m; 46°15'01'' N, 16°55'51'' E; leg. et det.: G. Király, conf. M. Hassler, 16/06/2020 [ZA 58331]

Evening primroses (*Oenothera* sect. *Oenothera*), native to North America but invading Europe since the 18th century, constitute one of the taxonomically most complicated groups of vascular plants. Representatives of the group have a unique cytogenetic character, their repeated hybridization resulting in the establishment of numerous genotypes, which can be assessed as distinct taxa (often considered species). Not only is there a large amount of morphologically distinguishable biotypes, but their documentation is problematic: they can be identified better using high-resolution images of living specimens rather than herbarium vouchers. Connected to the long-lasting activity of K. Rostański, the taxonomy of *Oenothera* is going through a new renaissance, and the number of the European species exceeds one hundred (see

**Fig. 11.** *Oenothera suaveolens*, habitat on a gravel bar of the Drava near Drnje (16 June 2020, photo by G. Király)

**Fig. 12.** *Oenothera suaveolens*, leaves with green midrib and relatively large flowers (Drnje, 16 June 2020, photo by G. Király)

Rostański *et al*., 2010; Hassler, 2020). Nikolić (2005-onwards) listed only three species from the genus in the flora of Croatia (*Oe. biennis* L., *Oe. glazioviana* Micheli and *Oe. rubricaulis* Kleb.), which are generally widespread in Europe. However, this fact rather reflects the lack of targeted investigations of the genus, and it is certainly represented by more species in a country that is rich in suitable habitats (secondary pioneer swarms, riverbanks, etc.).

As a novelty for the Croatian flora, we recognized *Oenothera suaveolens* near Drnje, on river bars of the Drava. In the neighborhood, this species has been previously found in Hungary (Király, 2009), but not mapped in Bartha et al. (2015). *Oe. suaveo-*

*lens* is a "base species" of the genus and has several hybrids in Europe (Hassler, 2020). It can be easily distinguished from other species reported from Croatia by the lack of any red pigmentation in all parts of the plant.

For the inclusion of this species in the Croatian key, we suggest the following solution:

1a. Flower buds red-striped. Petals 35–60 mm long. . . . . ***Oe. glazioviana***

1b. Flower buds green. Petals usually not longer than 35 mm. . . . . 2

2a. Stem and inflorescence axis red-punctate. Rhachis conspicuously red. Petals 10–20 mm long. . . . . ***Oe. rubricaulis*** (syn.: *Oe. muricata* auct., nom. dub.)

2b. Stem and inflorescence lack red punctation. Rhachis green. Petals usually longer than 20 mm. . . . . 3

3a. Leaf midrib red. Petals broader than long, (15–)20–30 mm long. . . . . ***Oe. biennis***

3b. Leaf midrib green. Petals as long or longer than broad, (25–)30–35 mm long. . . . . ***Oe. suaveolens*** (Fig. 9 and 10)

## CONCLUSIONS

We report on and discuss records of five species new to the vascular flora of Croatia, and on two additional neophytes that were only briefly mentioned in earlier sources. All but two species are of anthropogenic origin. *Calamagrostis canescens* is a certainly native species, but with few earlier mentions from Croatia; here we clarify the former erroneous data, and describe the first reliable locality near Đurđevac, on the southernmost margin of the distribution area. The species was found in degraded wet forests as a remnant of fen vegetation, its occurrence is of high nature protection value. *Agrimonia procera*, an emerging species in central Europe was found at three distinct localities in central Croatia, these occurrences being in accordance with its use as a medicinal plant. *Amaranthus emarginatus* and *Cardamine occulta* are newcomers throughout Europe (the first from the tropics and subtropics, the latter from Asia); we report here on their findings in urban habitats on the Adriatic coast. *Carex vulpinoidea* is an ephemeral North American alien in Europe that has been increasingly recorded lately; we consider it a locally established species along the Kupa River. *Humulus scandens* (East Asia) was brought to Europe as an ornamental plant, and it became an invader in riverine biotopes. We observed its massive spread along the Drava River. Although Croatia is rich in suitable habitats for the occurrence of evening primroses, only few representatives of the genus are known for the country. Here we report on the first data of *Oenothera suaveolens*, a widespread species in Europe, recorded on the bars of the Drava River. All the abovementioned species were included in new identification keys (the Croatian version of these keys is presented in Appendix 1).

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## APPENDIX 1 – PRILOG

## KLJUČEVI ZA DETERMINACIJU NOVONAĐENIH SVOJTI NA HRVATSKOM JEZIKU

### *Agrimonia procera* **Wallr.**

1a. Stabljika je gusto dlakava, dlake su dvojake – duge i kratke nežljezdane, žutih sjedećih žljezdi nema ili su žljezde rijetke; listovi su gusto dlakavi ili su pustenasti, s donje strane sjedećih žljezdi nema ili su žljezde rijetke; zreli hipantij je obrnuto čunjast, širok je 5 – 8 mm (uključujući čekinje), na vrhu je duboko žljebast, čekinje su otklonjene do uzlazno otklonjene . . . . . ***A. eupatoria***

1b. Stabljika je narijetko dlakava, dlake su jednolike – duge, žute sjedeće žljezde su brojne; listovi su narijetko dlakavi, s donje strane su sjedeće žljezde brojne; zreli hipnatij je zvonolik, širok je 9 – 11 mm (uključujući čekinje), na vrhu je plitko žljebast, čekinje su silazno otklonjene . . . . . ***A. procera***

### *Amaranthus emarginatus* **Moq. ex Uline & W. L. Bray**

1a. Biljka je tamno zelena, listovi su crvenkasti (često) s tamnijim i svijetlijim mrljama, na vrhu su plitko izrubljeni; plod je crvenkasto-smeđ, sjemenke su duge > 1,2 mm i široke > 1,1 mm (većinom). . . . . ***A. blitum*** (= *A. lividus* L.)

1b. Biljka je svijetlo zelena, listovi nisu crvenkasti i nemaju tamnije i svijetlije mrlje, na vrhu su duboko izrubljeni; plod je svijetlo žut do zelenkasto-smeđ, sjemenke su ≤ 1,2 mm i široke ≤ 1,1 mm . . . . . ***A. emarginatus***

a. Cvat je pazušni i vršni, kratak je i zbit, vršni nije viseći . . . . . **subsp. *emarginatus*** (nije zabilježena u Hrvatskoj) (= *A. blitum* subsp. *emarginatus* (Salzm. ex Uline & Bray) Carretero, Muñoz Garm. & Pedrol)

b. Cvat je pazušni i vršni, dug je i tanak, vršni je viseći (često) . . . . . **subsp. *pseudogracilis*** (zabilježena u Hrvatskoj) (= *A. blitum* var. *pseudogracilis* (Thell.) Lambinon)

### *Calamagrostis canescens* **(Weber) Roth**

1a Obuvenac je na vrhu urezan (dvozub), dug je ≤ 2,5 mm (obično), ima vršnu sinusnu osat; na spoju lisne plojke i rukavca nema dlaka. . . . . ***C. canescens***

1b Obuvenac je na vrhu urezan (dvozub), dug je 2,5 – 3 mm (obično), ima vršnu sub-sinusnu osat; na spoju lisne plojke i rukavca ima dlaka (izrazitih) . ***C. villosa***

***Cardamine occulta* Hornem.**

1a Stabljika i listovi su goli ili su dlake vrlo rijetke, dlake su duge ≤ 0,2 mm, latice su duge 1,8 – 2,5 mm . . . . . ***C. parviflora***

1b Stabljika i listovi su dlakavi, dlake su duge ≥ 0,5 mm, latice su duge ≥ 2,5 mm **2**

2a Stabljičnih listova ima 1 – 4 (– 6), bazalni su listovi brojni (tipična rozeta), listovi imaju 1 – 3 parova lisaka (većinom), prašnika ima 4 (obično) . . . . . ***C. hirsuta***

2b Stabljičnih listova ima 4 – 7 (– 10), bazalni su listovi nisu brojni ili ih nema, listovi imaju 3 – 6 parova lisaka, prašnika ima 6 . . . . . **3**

3a Srednji stabljični listovi su s gornje strane dlakavi, vršna je liska režnjasta (s plitkim i dubokim sinusima) ili nije režnjasta, prizemni dio stabljike je izrazito dlakav . . . . . ***C. flexuosa***

3b Srednji stabljični listovi su s gornje strane goli, vršna je liska režnjasta s 3 – 5 režnjeva, prizemni dio stabljike je gol do narijetko dlakav. . . . . ***C. occulta***

***Carex vulpinoidea* Michx.**

1a Listovi su poprečno naborani, utrikulus je dug 2,0 – 2,7 (– 3,2) mm, kljun je dug 0,7 – 1,2 mm, bazalne brakteje su čekinjolike, mnogo su dulje od klasića . . . . . ***C. vulpinoidea***

1b Listovi nisu poprečno naborani, utrikulus je dug (3,5 – ) 4,0 – 6,0 mm, kljun je dug 1,0 – 1,5 mm, bazalne brakteje nisu čekinjolike (šire su), nisu mnogo dulje od klasića . . . . . ***C. vulpina* agg.**

***Humulus scandens* (Lour.) Merr.**

1a Trajnice, listovi imaju 3 – 5 režnjeva, petljke su duge ≤ od duljine plojki; provodni su snopovi s donje strane goli ili su mekano dlakavi; brakteole ženskih cvjetova su gole . . . . . ***H. lupulus***

1b Jednogodišnje biljke, listovi imaju 5 – 7 (– 9) režnjeva, petljke su duge > od duljine plojki, provodni su snopovi s donje strane kruto dlakavi; brakteole ženskih cvjetova su trepavičave . . . . . ***H. scandens***

***Oenothera suaveolens* Desf. ex Pers.**

1a Cvjetni pupovi imaju crvene pruge, latice su duge 25 – 60 mm . . . . . ***O. glazioviana*** (= *O. erythrosepala* Borb.)

1b Cvjetni pupovi nemaju crvene pruge (zeleni su), latice su duge ≤ 35 mm (obično) . . . . . **2**

2a Stabljika i os cvata su crveno istočkani, os je izrazito crvena, latice su duge 10 – 20 mm . . . . . ***O. rubricaulis*** (= *O. muricata* L.)

2b Stabljika i os cvata nisu crveno istočkani, os je zelena, latice su duge > 20 mm (obično) . . . . . **3**

3a Srednji lisni provodni snop je crven, latice su duge (15–) 20 – 30 mm, širina je > od duljine . . . . . ***O. biennis***

3b Srednji lisni provodni snop je zelen, latice su duge (25–) 30 – 35 mm, širina je ≤ od duljine . . . . . ***O. suaveolens***