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Alien *Rubus* species in Hungary: distribution, habitats and threats

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Abstract: Alien brambles (*Rubus,* Rosaceae) generate significant ecological and nature conservational threats worldwide, however, the European flora and vegetation is not seriously affected by their impacts. In this study, I report on the distribution and habitats of alien brambles in Hungary, on the basis of comprehensive field studies and complete herbarium revision. The first introduction of a non-native species of bramble (*R. phoenicolasius*) was reported in 1999 in the country. *R. armeniacus* was first recognized in 2014 (but it had been present probably decades earlier). It typically occurs in forest-poor landscapes, in regions with larger closed forests it is mainly confined to plantations, but few occurrences in nature-like stand are also found. The occurrences in the forest steppe region indicate its drought tolerance; besides, it is the only bramble species present in the areas of typical forest-steppe climate. The species is obviously advancing (with more than 100 localities altogether) and constitutes an actual threat for the diversity and structure of fringes and wooded grassland mosaics in drier regions. Two new casual aliens, *R. laciniatus* and *R. occidentalis*, are reported here for the first time for Hungary. Another two species, *R. odoratus* and *R. xanthocarpus*, are known only from cultivation.

Keywords: bramble, forest fringes, herbaria, invasion, non-native species

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Introduction

Brambles (*Rubus* L.) represent a species-rich group of vascular plants of worldwide distribution. They have more than one thousand accepted species (Weber, 1995). Several species occur outside of the natural distribution area due to their use in the horticulture or some of them were introduced accidentally. Alien brambles can become established very far from their original range, and part of them became invasive (Evans & Weber, 2003; Henderson, 2007; Bennett et al., 2011; Clark et al., 2013). The identification of the taxa in the secondary range is difficult (especially in the case of apomict species of Eurasian origin), and misidentifications are, even using molecular methods, not rare (Alice et al., 2015; Bruckart et al., 2017). The mass spread of non-native brambles often causes serious challenges for the nature conservation and agricultural management (DiTomaso & Healy, 2007; Gaire et al., 2015; Rejmánek, 2015).

In Europe, Kurtto et al. (2010) reported on 10 non-native brambles species, mainly from the north-western part of the continent; furthermore, they characterized about 20 native species with secondary occurrences outside of the original range. The highest number of alien brambles (19 species) was recorded in Britain (Clement & Foster, 1994).

The Hungarian bramble flora was unexplored taxonomically for a long time, so it is not surprising that older records for introduction of alien species practically do not exist. The monograph of Soó (1968) mentioned merely the occurrence of two species (*R. laciniatus* Willd. and *R. odoratus* L.) as being cultivated in gardens. Király & Király (1999) recorded the first

feral stands of *R. phoenicolasius* Maxim., which is the only bramble species included in the alien checklist of Hungary (Balogh et al., 2004). Finally, Király et al. (2014) documented the first steps of the spread of *R. armeniacus* Focke. In the last years the knowledge was significantly deepened on alien brambles in the country. Based on these results, I summarize here the known distribution data (including for two species new for the country), possible pathways, trends of spread and concerned habitats for the alien bramble species in Hungary.

Methods

Field studies on brambles were conducted between 2005 and 2016 at more than 800 localities in Hungary. For each locality, the altitude and geo-coordinates in the WGS 84 projection were determined. Nearby localities (within 500 metres) were only considered when situated in a different quadrant or municipality. Grid maps following the Central European Flora Mapping System Niklfeld (1971) were compiled using ArcGIS software.

The voucher specimens collected during recent studies are deposited in BP and OL. The following herbaria (acronyms according to Thiers, 2018) were examined personally: BP, BPU, BRA, BUNS, DE, GJO, GZU, JPU, LI, OL, PECS, SAMU, SAV, SLO, W, WU, and ZA.

The DNA ploidy level for two *Rubus* species was assessed based on the relative fluorescence of propidium iodide-stained nuclei, as determined by flow cytometric measurements of fresh leaves using a BD Accuri C6 flow cytometer (BD Biosciences, Franklin Lakes, NJ, USA) and *Solanum lycopersicum* 'Stupické polní rané' (2C =1.96 pg; Doležel et al., 1989) as an internal standard.

Habitat types used in the analysis were derived from the classification of Bölöni et al. (2011). For each locality a single (dominant) habitat type was given. This arbitrary treatment caused, however, minor difficulties because the localities studied were mainly uniform (with one major habitat type), or in mixed habitats the species studied occurred in a certain vegetation unit only.

Results

Rubus armeniacus Focke 1874, Abh. Naturwiss. Vereins Bremen 4: 183

Taxonomy and range

Rubus armeniacus is a representative of the *Rubus* subsect. *Hiemales* E.H.L.Krause, ser. *Discolores* (P.J.Müller) Focke, which consist of about 80 native species to Europe. *R. armeniacus* is an apomictic tetraploid (2n=28) (Boratyńska, 1995; Krahulcová et al., 2013), the same count was proven by our DNA ploidy level investigation in a Hungarian stand (Sopronhorpács, BP). Despite its morphological similarity to European representatives of *R. praecox* agg., in most cases they can be apparently separated based on several qualitative features of the inflorescence and the first-year stem (see e.g. Weber, 1995). *R. armeniacus* is an apomictic taxon, the creation of spontaneous hybrids with related taxa (unlike to *R. praecox* agg.) is not yet proven in Central Europe.

Its native range is a bit unclear, major Floras (Weber, 1995; Kurtto et al., 2010) place it into the Caucasus. The species was brought to Europe around 1830 (Poppendieck et al., 2010), its massive spread started in the 1930s (Weber, 2014). Now it is quite common in Central Europe and the British Isles, the eastern border of the known area lies at the longitude of 22° E (Kurtto et al., 2010; Király et al., 2014). The species is still certainly undermapped in several regions (e.g. France, Italy, the Balkans). Outside of Europe, it is a noxious invader in North America, South Africa and Australia (Gaire et al., 2015).

Distribution and habitats in Hungary

Rubus armeniacus was first collected in the wild in 1999 near Győr (NW Hungary), but its occurrence was confirmed only by Király et al. (2014). It reached the country from north-western direction (from the area of the well-developed secondary range in Central Europe), approximately between 1960 and 1980. The species was probably present in Hungarian gardens also prior to this expansion, however, these isolated cultures did not result in spontaneous spread, and – despite the intensive herbarium revisions – I could not find any older vouchers (neither from cultivation). Main routes of the recent spread were in connection of major railway lines.

According to Király et al. (2014), and our recent surveys, the centre of the distribution of the species is in the North-West, whereas rather isolated localities are present in all major regions of Hungary (Fig. 1). Compared to 2014, the number of the known localities doubled by the end of 2017 (now with over 100 localities), however, despite the clear advance it is still rare east of the Balaton and south of the Lake Balaton. Most of the stands of *R. armeniacus* lie in the closed oak forest region of Hungary. Its invasive habit is doubtless in the lowlands where huge stands exist, on the other hand, the stands in hilly regions are weaker and mountain occurrences are extraordinary. The maximum elevation recorded in Hungary is 392 m a.s.l., while the average is 156 m a.s.l. The relatively many occurrences in the forest steppe region

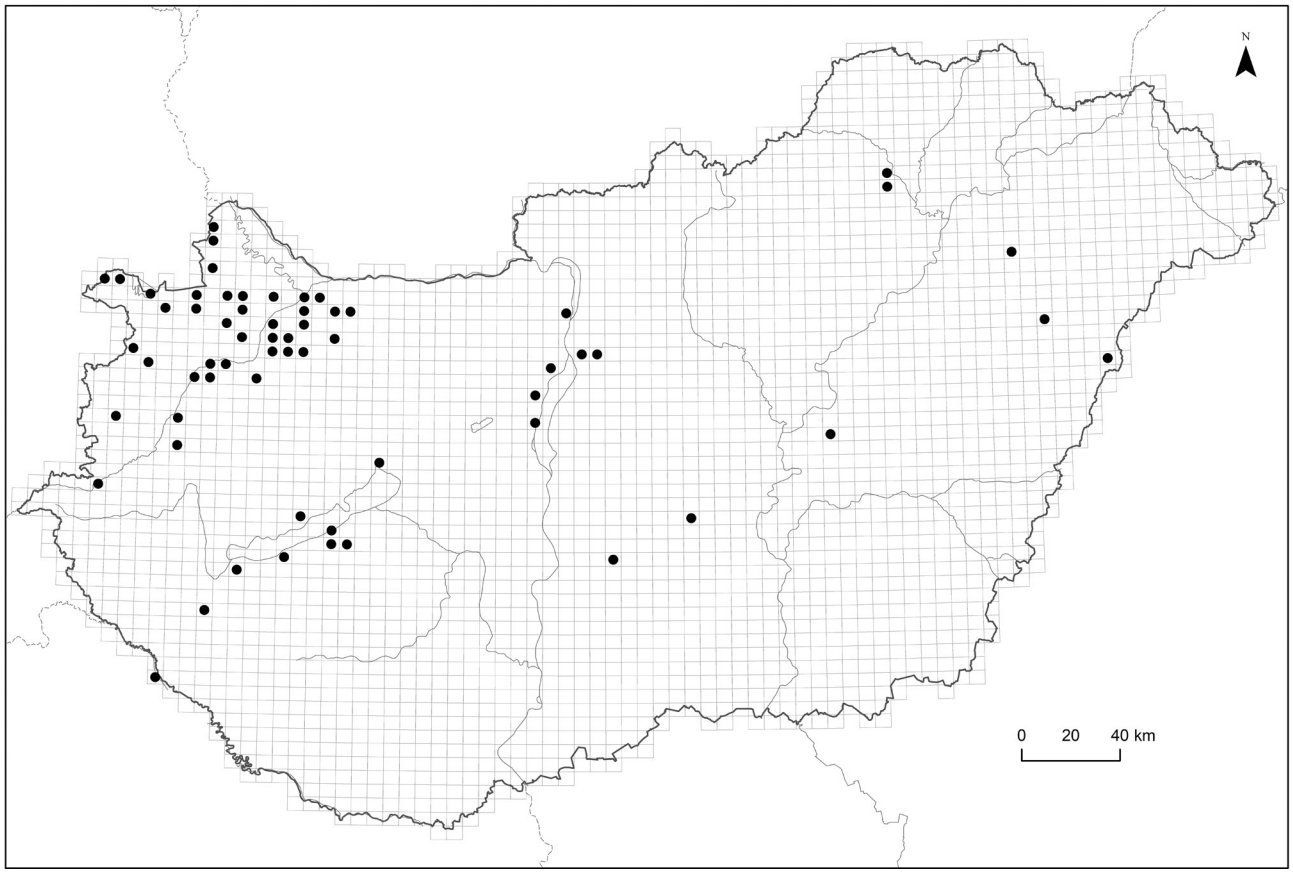

Fig. 1. Distribution of *Rubus armeniacus* in Hungary

indicate its drought tolerance, it is the only bramble species present in the areas of typical forest-steppe climate.

Rubus armeniacus typically occurs in Hungary in forest-poor landscapes that are still rich in linear woody habitats elements (scrubs, hedges), preferably on dry, and only exceptionally on wet soils (Fig. 2). In regions with larger closed forests it is mainly confined to plantations (*Pinus* and *Robinia*), and quite rare in semi-dry or mesic Turkey oak and oak-hornbeam forests and its derivates. Non-negligible part of localities is to find in artificial habitats (i.e. in parks, along fences), often in the surrounding of the starting-point (i.e. gardens, orchards) of the introduction (Fig. 3).

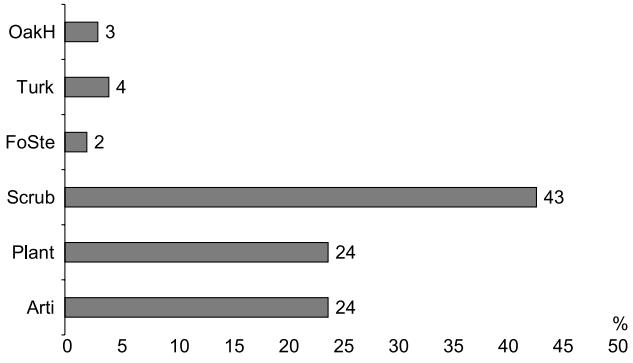

Fig. 2. Distribution of the localities (102 sites) of *Rubus armeniacus* in Hungary according to main habitat types. (OakH – Oak-hornbeam forests and derivates, Turk – Turkey oak forest and derivates, FoSte – forest steppe communities and derivates, Plant – Forest plantations, Scrub – Secondary scrubs and hedges in open land, Arti – anthropogenic and ruderal habitats; main habitat types after Bölöni et al. (2011))

Fig. 3. *Rubus armeniacus* in a mesic fringe near Budapest (Central Hungary), 12 July 2012

List of localities in Hungary (Fig. 1, records marked by an asterisk were included in Király et al. (2014); locality descriptions due to the high number of records are simplified)

Nagyalföld (Great Plain) macroregion: Budapest, Békásmegyer, scrubs*, 47.6064°N, 19.0607°E, 19 Sept 2013, Király G. (obs.). Budapest, Ferencváros railway station, at fences*, 47.4677°N, 19.0853°E, 22 May 2014, Barina Z., BP. Budapest, 22nd distr., shrubbery along the Danube*, 47.3869°N, 18.8963°E, 12 July 2012, Király G. (photo). S of Ercsi, scrubs*, 47.2405°N, 18.8880°E, 12 July 2012, Király G. (obs.); N of Százhalombatta, scrubs*, 47.3313°N, 18.8944°E, 12 July 2012, Király G. (obs.). E of Csengőd, pine plantations*, 46.7143°N, 19.2948°E, 27 June 2014, Király G. (obs.). SE of Karcag, scrubs at an abandoned farm*, 47.2637°N, 20.9625°E, 9 Sept 2014, Király G. (photo). Debrecen, scrubs along the railway line at "Nagyerdő Cemetery"*, 47.5547°N, 21.6505°E, 20 Sept 2011, Király G. (photo). N of Kokad, *Robinia* wood, 47.4434°N, 21.93371°E, 25 May 2015, Király G. (obs.). Budapest, 19th distr., dry oak forest, 47.4527°N, 19.2016°E, 4 May 2016, Király G. (obs.). S of Hajdúnánás, plantations along Újvárosi Street, 47.8267°N, 21.4245°E, 3 Aug 2016, Király G. (obs.). E of Törökszentmiklós, bushes along the road nr. 4., 47.1934°N, 20.4636°E, 13 June 2017, Gulyás G. (photo). N of Debrecen, "Nagyerdő" Forest, 47.5820°N, 21.6307°E, 3 Sept 2017, Király G. (obs.).

Kisalföld (Lesser Plain) macroregion: Győrladmér, "Fragario-Rubetum"*, 28 July 1999, Jeney E., (BP, as "*R. procerus* ssp. *lacertosus*"). Jánossomorja, along fences*, 47.7918°N, 17.1409°E, 13 July 2013, Király G. (BP). Mosonszolnok, near Irénmajor on rodsides*, 47.8558°N, 17.1058°E, 5 July 2012, Király G. & Király A. (BP). N of Fertőszéplak, scrub at the "Körgát" dam*, 5 Sept 2014, 47.6764°N, 16.8242°E, Király G. & Takács G. (obs.). Csorna, E of the railway station, scrubs*, 47.5991°N, 17.2286°E, 16 June 2012, Király G. (obs.). W edge of Rábacsanak, scrubs*, 47.5236°N, 17.2758°E, 5 Sept 2012, Király G. (BP). Győr, "Pósdomb", hedges*, 47.6718°N, 17.6091°E, 11 Oct 2012, Schmidt D. (obs.). Markotabödöge, scrubs at river "Keszeg-ér"*, 47.6838°N, 17.3072°E, 18 Sept 2012, Király G. (obs.). NE of Rábapatona, scrubs along the road nr. 85*, 47.6713°N, 17.6911°E, 2 Sept 2011, Király G. (obs.). N of Duka, shrubbery*, 47.1270°N, 17.1097°E, 10 Sept 2013, Király G. & Király A. (obs.). S of Mórichida, pine plantation near Tekepuszta*, 47.4883°N, 17.4305°E, 28 Aug 2010, Király G. & Schmidt D. (photo). NE of Mórichida, *Robinia* woods near Ferencházapuszta*, 47.5169°N, 17.4323°E, 22 Apr 2013, Király G. & Schmidt D. (obs.). E of Mórichida, pine plantation along the road to Tét*, 47.5150°N, 17.4658°E, 5 Sept 2015, Király G. (obs.). E of Nagyacsád, shrubbery at the fishponds*, 47.3667°N, 17.3462°E, 13 Sept 2013, Király G. (obs.). Tét, near the vineyards of "Szenkút", pine plantations*, 47.4988°N, 17.4834°E, 28 Aug 2010, Király G. & Schmidt D. (obs.). Győr, Csendes Street, ruderal places*, 47.6605°N, 17.4830°E, 2 Sept 2011, Király G. (photo). Győr, Gyárváros railway station, scrubs*, 47.6838°N, 17.6741°E, 19 June 2012, Király G. (obs.). Győr, Szabadhegy, ruderal places*, 4 Sept 2012, 47.6572°N, 17.6654°E, Schmidt D. (obs.). Győr, Pápai Street, scrubs*, 47.6600°N, 17.6266°E, 20 Sept 2012, Schmidt D. (obs.). Győr, Kisbarátfalu, shrubbery*, 47.6292°N, 17.6339°E, 11 Oct 2012, Schmidt D. (obs.). W of Rétalap, hedges*, 23 Sept 2014, 47.6097°N, 17.9026°E, Király G. (obs.). Tétszentkút, at the road nr. 83, *Robinia* wood, 47.4930°N, 17.5001°E, 8 Oct 2014, Király G. (obs.). Győr, Kandó Street, bushes, 47.6859°N, 17.6736°E, 7 Aug 2015, Király G. & Diran R. (obs.). Hegyeshalom, SE of the railway station, shrubbery, 47.9076°N, 17.1541°E, 7 Aug 2015, Király G. & Diran R. (obs.). Lovászpatona, Kiskajár, bushes along the road to Gyömöre, 47.4524°N, 17.6091°E, 14 Aug 2015, Király G. (obs.). SE of Tét, bushes along the road to Gyömöre, 47.5107°N, 17.5245°E, 14 Aug 2015, Király G. (obs.). Tét, SW of Lesvárpuszta, forest fringes, 47.5520°N, 17.4731°E, 14 Aug 2015, Király G. (obs.). Pér, shrubbery along the road nr. 81, 47.6127°N, 17.8171°E, 25 Oct 2015, Király G. (obs.). Győr, Budai Street, bushes, 47.6925°N, 17.6528°E, 10 June 2016, Király G. (obs.). S of Mosonmagyaróvár, bushes along the road nr. 1, 47.8391°N, 17.2909°E, 31 July 2016, Király G. (obs.). E of Osli, bushes along the road to Földsziget, 47.6414°N, 17.0824°E, 31 July 2016, Király G. (obs.). Acsalag, along a fence near the church, 47.6750°N, 17.1972°E, 12 Aug 2016, Király G. (obs.). Kapuvár, N of Osli village, shrubs, 47.6631°N, 17.0791°E, 29 Oct 2016, Király G. (obs.). Vág, SW of the bridge of Rába river, bushes, 47.4400°N, 17.2069°E, 17 April 2017, Király G. (obs.). N of the Várkesző, bushes, 47.4338°N, 17.3175°E, 17 April 2017, Király G. (obs.). Csorna, Thököly Street, at a fence, 47.6296°N, 17.2515°E, 23 June 2017, Király G. (obs.).

Nyugat-magyarországi peremvidék (West Hungarian Borderland) macroregion: Sopron, Mt Károly, forest fringes*, 47.6636°N, 16.5611°N, 1 Aug 2011, Király G., Trávníček B. & Žíla V. (obs.). S of Sopron, near "Harkai Camping", forest fringes*, 47.6601°N, 16.5838°E, 9 Sept 2010, Király G. (obs.). Sopron, University Botanical Garden, spontaneous spread*, 47.6783°N, 16.5752°E, 9 Sept 2010, Király G. (obs.). Sopron, Alsó-Lövérek, along fences*, 47.6773°N, 16.5745°E, 17 Sept 2013, Király G. (obs.). Sopron, at Tómalom Spa, hedges*, 47.7191°N, 16.6258°E, 7 Sept 2010, Király G. (BP). Sopron, E of Nyugatmajor, *Robinia* plantation*, 47.7080°N, 16.5680°E, 31 Aug 2010, Király G. (obs.). Kőszeg, Mt Szabó, shrubbery*, 47.3788°N, 16.5321°E, 3 July 2012, Király G. (photo). S of Sopronhorpács, scrubs along the road to

Zsira*, 47.4753°N, 16.7339°E, 11 June 2014, Király G. (BP, DNA ploidy level investigated). Szombathely, Újperint, pine plantation*, 47.2083°N, 16.6166°E, 20 Sept 2014, Király G. (obs.). Kemestaródfa, Csákányi Street, shrubbery*, 46.9983°N, 16.5180°E, 20 Sept 2014, Király G. (photo). Csehimindszent, "Farkas-erdő" Forest, pine plantation*, 47.1197°N, 16.9783°E, 13 Sept 2011, Király G. & Mesterházy A. (obs.). S of Kenyeri, pine plantations*, 47.3672°N, 17.0794°E, 13 Sept 2011, Király G. & Mesterházy A. (obs.). Kenyeri, scrubs along the road to Pápoc*, 47.3925°N, 17.1022°E, 13 Sept 2011, Király G. & Mesterházy A. (obs.). SE of Pápoc, pine plantations*, 47.3836°N, 17.1741°E, 13 Sept 2011, Király G. & Mesterházy A. (obs.). Sárvár, SE of Hegyközség settlement, pine plantation*, 47.2361°N, 16.9755°E, 13 Sept 2011, Király G. & Mesterházy A. (obs.). N of Sitke, pine plantations*, 47.2688°N, 17.0038°E, 13 Sept 2011, Király G. & Mesterházy A. (obs.). S of Galambok, fringes of oak forest*, 46.5072°N, 17.1072°E, 7 July 2014, Király G. (BP). W of Őrtilos, *Robinia* plantation*, 46.2805°N, 16.9124°E, 9 July 2012, Király G., Trávníček B. & Žíla V. (obs.). Bük, Petőfi Street, shrubbery, 47.3920°N, 16.7405°E, 24 Oct 2014, Király G. (obs.). Sopron, W of the TV tower, pine plantations, 47.6619°N, 16.5662°E, 26 Oct, 2015, Király G. (obs.). S of Tormásliget, along the railway line, shrubbery, 47.4164°N, 16.7758°E, 4 Febr 2016, Király G. (obs.). N of Vönöck, bushes near the cemetery, 47.3194°N, 17.1549°E, 9 Aug 2016, Király G. (obs.). Nagycenk, N of the railway station, bushes, 47.6034°N, 16.6881°E, 11 Aug 2016, Király G. (obs.). N of Sopron, shrubs along the road to Fertőrákos, 47.7086°N, 16.6083°E, 3 Oct 2016, Király G. (obs.). Sopron, NW of Harka railway station, bushes, 47.6474°N, 16.6129°E, 13 Oct 2016, Király G. (obs.). Magyargencs, NW of Hertelendyújhely, pine plantations, 47.3756°N, 17.2317°E, 18 Aug 2017, Király G. (obs.). N of Kőszeg, shrubbery along the road to Horvátzsidány, 47.3860°N, 16.5602°E, 18 Febr 2017, Király G. (obs.).

Dunántúli-dombság (Transdanubian Hills) macroregion: Gyenesdiás, Alsógyenes, scrubs along the railway line*, 46.7631°N, 17.2774°E, 8 July 2014, Király G. (obs.). E of Balatonszentgyörgy, oak forest along the road to Marcali*, 46.6854°N, 17.3318°E, 7 July 2012, Király G., Trávníček B. & Žíla V. (BP, OL). Keszthely, Kertváros, bushes along the road to Hévíz, 46.7910°N, 17.2113°E, 26 Nov 2014, Király G. (obs.). S of Kereki, Turkey oak forest, 46.7806°N, 17.9094°E, 5 June 2015, Király G. (obs.). S of Balatonszemes, Turkey oak forest, 46.7778°N, 17.7875°E, 23 June 2015, Király G. (obs.). Balatonszemes, Bajcsy-Zsilinszky Street, shrubbery, 46.8054°N, 17.7730°E, 23 June 2015, Király G. (obs.). W of Balatonszemes, forest fringes along the road nr. 7, 46.7962°N, 17.7277°E, 23 June 2015, Király G. (obs.). Fonyód, forest fringes along the road nr. 7, 46.7434°N, 17.5416°E, 25 Oct 2015, Király G. (obs.).

Dunántúli-középhegység (Transdanubians Mts) macroregion: Balatonfűzfő, Fűzfőgyártelep, scrubs along the road nr. 72*, 47.0759°N, 18.0355°E, 28 June 2014, Király G. (obs.). Pannonhalma, Imremajor, hedges*, 23 Sept 2014, 47.5363°N, 17.7583°E, Király G. (obs.). Törökbálint, scrubs along the highway M0*, 47.4261°N, 16.9219°E, 19 Aug 2012, Király G. (obs.). W of Zánka, shrubbery on the roadside, 46.8847°N, 17.6592°E, 18 July 2016, Király G. (obs.). Nagydém, S of Sokorópátka-Újtelep, *Robinia* stand, 47.4665°N, 17.7106°E, 23 Sept 2016, Király G. (obs.). N of Tényő, *Robinia* forest, 47.5757°N, 17.6314°E, 23 Sept 2016, Király G. (obs.).

Északi-középhegység (North Hungarian Mts) macroregion: Miskolc, Kőporos Street, spontaneously in hedges, 48.1059°N, 20.7555°E, 3 May 2014, Koscsó J. (photo). Miskolc, Rákóczi Street, spontaneous scrub, 48.1003°N, 20.7824°E, Koscsó J. (photo). Miskolc, Tímár Street, at a garden fence, 48.0706°N, 20.7579°E, 18 Apr 2016, Király G. & Schmotzer A. (obs.).

***Rubus laciniatus* Willd. 1706, Hort. Berol. 2(7): 82**

Rubus laciniatus is a domesticated bramble belonging to *Rubus* subsect. *Hiemales* E.H.L.Krause, ser. *Rhamnifolii* (Bab.) Focke, which is probably mutationally derived from *R. nemoralis* P.J.Müller. It was cultivated a long time ago, its first report (a book illustration) is dated back to 1691 (Weber, 1993). The species is often naturalised in Europe (Clement & Foster, 1994; Kurtto et al., 2010; Pyšek et al., 2012), and North America (Alice et al., 2015), but only locally classified (see Gaire et al., 2015) as an invader. In Eastern Central Europe it has a clear sub-Atlantic character (e.g. Zieliński, 2004), and has not established in drier regions despite its common use in the horticulture.

The species was reported previously from Hungary as a garden plant only (Soó, 1968), vouchers are also known solely from botanical gardens. Recently, it has been planted rarely in Hungarian parks and gardens. The first introduction of the species was discovered in Western Hungary in the forest block adjacent to a botanical garden ("Jeli Arborétum") where it was also collected in the 1960s; the established stand is obviously originated from this garden. This microregion is relatively precipitation-rich (yearly average is approx. 700 mm) and is characterized by acidic brown forests soils; these factors explain the successful micro-scale introduction of the species. Because more than hundred individuals of clones of different age have been found in the forest of Jeli, it can be classified as a locally naturalised, non-invasive species in the Hungarian flora. The possibility of the

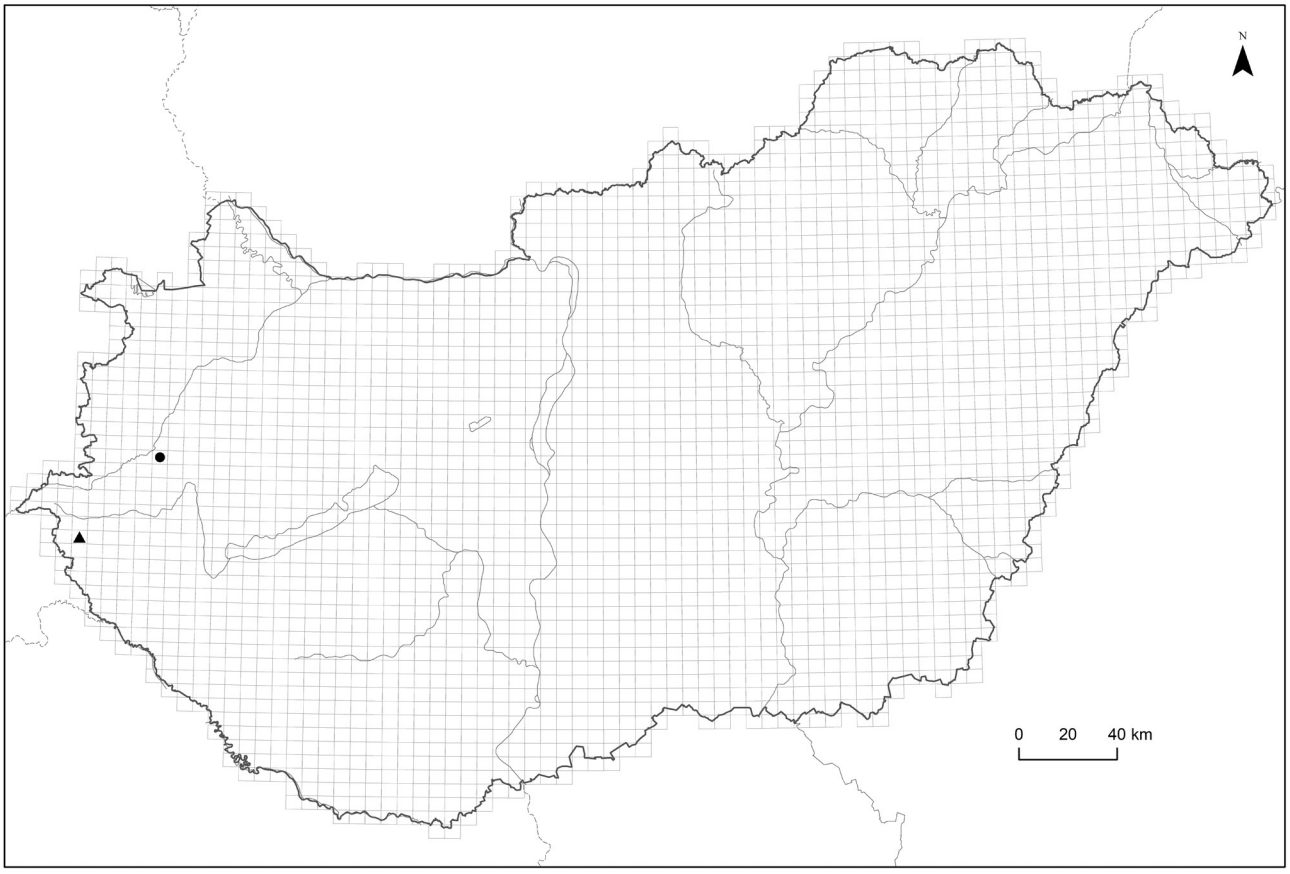

Fig. 4. Distribution of *Rubus laciniatus* (full circle) and *R. occidentalis* (triangle) in Hungary

further expansion is rather limited, new occurrences are expected only locally, under extraordinary ecological circumstances (i.e. close to places of cultivation).

List of localities (Fig. 4)

Nyugat-magyarországi peremvidék (West Hungarian Borderland) macroregion: Vas County, Kám, Scots pine plantations S of the Jeli Arboretum, 240 m a.s.l., 47.0697°N, 16.8986°E, 24 July 2012, Király G. (BP).

Cultivated specimens:

Budapest, "Hortus Kertészeti-intézet", 1 June and 17 June 1908, Simkovics L. (BP). Vas County, Kám, "Jeli Arborétum", 12 May 1967, Vöröss L. Zs. (PTE). Hajdú-Bihar County, Debrecen, "Egyetemi botanikus kert" (=University Botanical Garden), 26 June 1946, Siroki Z. (det. Jávorka S.) (DE).

***Rubus occidentalis* L. 1753, Sp. Pl. 1: 493.**

Rubus occidentalis, native to North-Eastern America (Alice et al., 2015), is (like the raspberry, *R. idaeus* L.) the member of *Rubus* subgen. *Ideobatus* (Focke) Focke). It is widely cultivated both in North America and Europe as the source of most of "black raspberries". Naturalization of the species is rare in Europe: it was reported from Austria, Czechia, Germany, Poland, Russia, and Slovakia (single or few localities for each, see Janchen, 1956–60; Weber, 1995; Kurtto et al., 2010; Kosiński et al., 2014). *R. occidentalis* is diploid (2n=14) (Kurtto et al., 2010; Krahulcová et al., 2013), the same count was proven by our DNA ploidy level investigation in the single Hungarian stand (Ramocsa, BP).

The species is mentioned only as a domesticated plant in the Hungarian horticultural literature (e.g. Porpáczy, 2013). The single locality (with few non-flowering specimens, due to the shady forest structure) was discovered in 2016, in a young mixed spruce and oak forest in Zala County (Ramocsa). *R. occidentalis* can be considered as a new, local casual species in the Hungarian flora; nature conservational threats are not expected.

The origin of the stand near Ramocsa is not unequivocal; however, it can be considered a result of spontaneous spread (probably by seeds transmitted by birds), but not the consequence of former cultivation at the same plot. According to forest plans, the forest compartment concerned was used along the forestry rules (which do not allow plantations of domesticated species) in the last decades. Furthermore, the compartment has a medium-rich bramble flora (with approx. native 10 species) showing semi-natural character, which indicate a quite extensive earlier management.

List of localities (Fig. 4)

Nyugat-magyarországi peremvidék (West Hungarian Borderland) macroregion: Ramocsa, 0.8 km SE of the village, young forests along the road to Kerkafalva, 204 m a.s.l., 46.7703°N, 16.4634°E, 17 Aug 2016, Király G. (BP, DNA ploidy level investigated).

***Rubus phoenicolasius* Maxim. 1871, Bull. Acad. Imp. Sci. Saint-Pétersbourg 17: 160**

Rubus phoenicolasius, native to the Far East: Japan, Korea, Northern China (Bailey, 1941–45), is the representative of *Rubus* subgen. *Idaeobatus* (Focke) Focke). It was brought (and almost immediately naturalized) as "wineberry" to European and North American gardens between 1870 and 1890, later also to South Africa and Australia, respectively (Focke, 1910–14; Stirton, 1981; Weber, 1995). Recently, the species is scattered in Central Europe and the British Isles (Kurtto et al., 2010).

In Hungary it was known long as a garden plant (Kollányi, 1990), with the earliest herbarium collections from the 1890s, and was reported for the first time by Király & Király (1999) as an escape from cultivation. Balogh et al. (2004) listed the species as casual. Our actual investigations showed that it is a slightly advancing species with populations already in four different macroregions of Hungary and can be classified as established. The stands are restricted to the sub-Atlantic regions in the West, and grow under diverse soil conditions (on loess, basic and acidic sand, and gravel, respectively). Its occurrences can be divided in two types: single plants occur (often only temporarily) close to gardens; stronger spontaneous populations typically establish in forest (especially Scots pine) plantations. However, some few occurrences in oak and alder forests indicate its ability also for entering natural habitats.

List of localities (Fig. 5)

Kisalföld (Lesser Plain) macroregion: Felpéc, Sisek Hill, *Robinia* plantations, Schmidt (2015). Felpéc, 1.3 km N of the village, *Robinia* stand, 127 m a.s.l., 47.5376°N, 17.5835°E, 29 Aug 2016, Mesterházy A. (photo). Doba, 0.5 km NE of the Erdődy Palace, oak-hornbeam forests, 170 m a.s.l., 47.1759°N, 17.3987°E, 29 June 2017, Király G. (obs.).

Nyugat-magyarországi peremvidék (West Hungarian Borderland) macroregion: Fertőrákos, "Kovácsdomb" Hill, oak-hornbeam forest, 165 m a.s.l., Király & Király (1999). Sopron, "Pinty-tető" Hill, forest fringes, 180–200 m a.s.l., Király & Király (1999). Csörötnek, 1.2 km SW from the village, Mt "Sáfárhegy", abandoned orchards, 290 m a.s.l., 46.9413°N, 16.3572°E, 13 Sept 2010, Király G. (BP). Und, 1.6

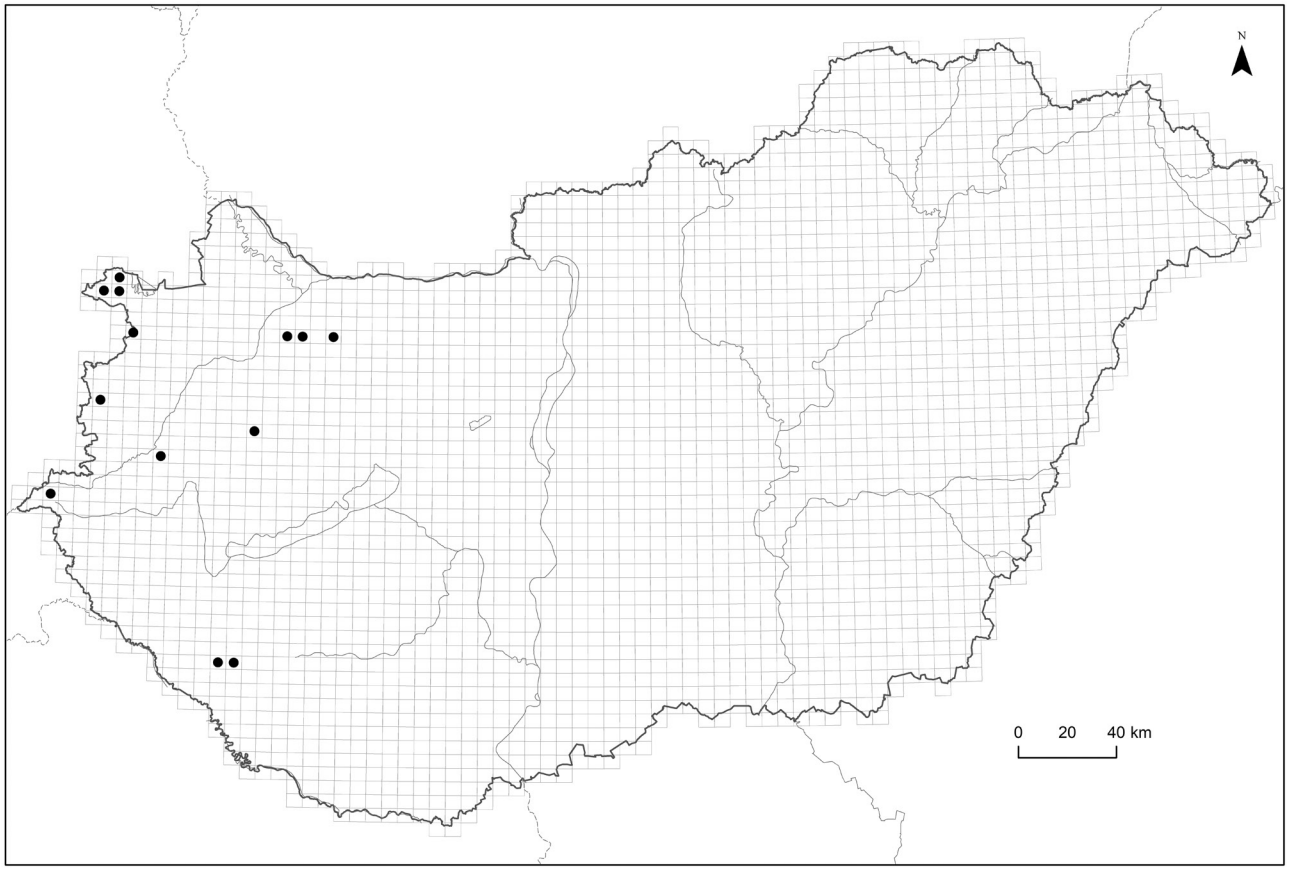

Fig. 5. Distribution of *Rubus phoenicolasius* in Hungary

Fig. 6. First-year stems of *Rubus phoenicolasius* in a disturbed oak-hornbeam forest near Kaszó (SW Hungary), 1 September 2011

km NW-N from the village, pine and *Robinia* plantations, 243 m a.s.l., 47.5002°N, 16.6747°E, 31 Aug 2011, Király G. (obs.). Sopron, 2.0 km E from the city, Szárhalom Forest, mesophilous oak stands, 210 m a.s.l., 47.6955°N, 16.6322°E, 2 July 2012, Király G. (obs.). Szombathely, W of Herény settlement, pine plantation near road nr. 89, 225 m a.s.l., 47.2586°N, 16.5824°E, 21 June 2013, Király G. (obs.). Oszkó, 2.2 km NE of the village, pine plantations, 238 m a.s.l., 47.0604°N, 16.8995°E, 1 July 2015, Schmidt D. (obs.). Sopron, scrubs on roadsides in streets S of the University Botanical Garden, 256 m a.s.l., 47.6799°N, 16.5720°E, 15 June 2017, Király G. (obs.).

Dunántúli-dombság (Transdanubian Hills) macroregion: Somogyszob, near to "Bükki-őrház", alder forest (Kevey ap. Király & Király 1999). Kaszó, "Kaszói-erdő" Forest, fringes at the W end of the settlement, 167 m a.s.l., 46.3202°N, 17.2188°E, 1 Sept 2011, Király G. (obs.).

Dunántúli-középhegység (Transdanubians Mts) macroregion: Felpéc, "Szemere vonulat", Kánya Hill Schmidt (2015). Győrszemere, Kányavár, Pincefő, Tanú Valley Schmidt (2015). Pannonhalma, Illak Forest, Scots pine plantations, 223 m a.s.l., 47.5287°N, 17.7736°E, Schmidt (2015, and pers. comm.).

Cultivated specimens:

Nyugat-magyarországi peremvidék (West Hungarian Borderland) macroregion: Kőszeg ("Güns"), 5 July 1899, Piers W. (SAMU).

Notes on further species in cultivation

There are two alien bramble species found in Hungarian herbaria that are established in other European countries. However, all known specimens from Hungary refer to cultivated plants, and their introduction neither as casuals was reported.

Rubus odoratus L., native to North America, is sporadically naturalized in Europe north of the Alps and the Carpathians (Kurtto et al., 2010). The species is not rare as ornamental plant in Hungarian gardens and parks, nevertheless, its generative spread has probably climatic limits for in the Carpathian Basin. It is worth noting that it tends to develop strong root suckers (e.g. in abandoned parks and gardens), these clones should not be assessed as naturalized plants.

Rubus xanthocarpus Bureau & Franch., from China, is planted for ornamental purposes in moderate regions of the World, naturalized very locally (Czechia and Poland) in Europe (Holub & Palek, 1981; Bróź & Zieliński, 1993; Lingdi & Boufford, 2003). It has never been reported from Hungary and is recently present only in few botanical gardens. A single herbarium specimen was found from a north-east Hungarian arboretum, which obviously refers for a cultivated plant. Its spontaneous spread is not at all expected.

List of the localities:

***Rubus odoratus* L. 1753, Sp. Pl. 1: 494**
Cultivated specimens:

Nyugat-magyarországi peremvidék (West Hungarian Borderland) macroregion: Kőszeg ("Güns"), 6 July 1895, 7 July 1902, 14 July 1907, 21 June 1909, 13 July 1910, Piers W. (SAMU). Sorkiújfalu, n. d., Márton J. (SAMU).

***Rubus xanthocarpus* Bureau & Franch., 1891, J. Bot. (Ed. Morot, Paris) 5: 46**
Cultivated specimens:

Nagyalföld (Great Plain) macroregion: "Erdőtelek, arborétum", 3 Sept 1953, Papp J. (PTE).

Discussion

Alien brambles generate significant ecological and nature conservational threats worldwide. The genus is among the top 5 genera of the world ranked by the total number of naturalized species (Pyšek et al., 2017), and one bramble (*Rubus ellipticus* Sm.) was listed among the world's 100 worst invasive species (Lowe et al., 2000). The risks for the native flora and natural habitats are particularly high in archipelagos (Buddenhagen, 2006; Rentería et al., 2012). European species play leading role in oversea invasions, nearly in all regions of the World, e.g. North

America, South-eastern America, South Africa, Australia and New Zealand (Webb et al., 1988; Evans & Weber, 2003; Henderson, 2007; Alice et al., 2015).

In contrary, it seems that the European flora and vegetation is not seriously affected by the impacts of these species when considering the simple quantity (10 species altogether) of exotic alien brambles in Europe. Bramble invasions have significant climatic barriers in Europe, especially the continentality (cold winters and repeated summer drought) creates unfavourable conditions in large areas. This applies for the studied area in particular: even species cultivated in and widely naturalized west of Hungary, are restricted to a single point (*R. laciniatus*) or to very scarce localities (*R. phoenicolasius*) in the western (sub-Atlantic) strip of the country.

Before being over-optimistic, we must have a look for *R. armeniacus*, which is classified in the West and Central European countries either as naturalized, potentially invasive or invasive species, and which is overall advancing in the area. Concrete threats (in nature conservation: colonization of grasslands – Schrumpf & Treiber, 2016; transportation: growing maintenance costs along railways and roads – Nobis, 2008) are still rare in Europe (and only presumed in Hungary), but probably they will become increasingly frequent. *R. armeniacus* is already present in Hungary in or close to important, fragile lowland habitats. These vegetation units are under heavy pressure due to anthropogenic impacts, invasive plants and changing ecological (e.g. hydrological) backgrounds (Molnár et al., 2012). Thus, I am concerned that the quick spread of *R. armeniacus* in dry oak forests, forest-steppes and grasslands causes fundamental changes both in species diversity and stand structure; therefore, I consequently foresee troubles in grassland farming (due to colonization of pastures) and in railway maintenance and flood-control (due to colonization of ramps, ditches, dams).

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