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# Hidden on both sides of the Alps: *Rubus noricus*, a new species of bramble (*Rosaceae*) from Austria and Germany

MICHAEL HOHLA[1], KONRAD PAGITZ[2] & GERGELY KIRÁLY[3]*

[1]*Therese-Riggle-Straße 16, A-4982 Obernberg am Inn, Austria.*
*m.hohla@eduhi.at;* *https://orcid.org/0000-0002-3880-9417*

[2]*University of Innsbruck, Department of Botany, Sternwartestraße 15, A-6020 Innsbruck, Austria.*
*konrad.pagitz@uibk.ac.at;* *https://orcid.org/0000-0002-0536-1708*

[3]*University of Sopron, Institute of Silviculture and Forest Protection, H-9400 Sopron, Bajcsy-Zs. u. 4., Hungary.*
*kiraly.gergely@uni-sopron.hu;* *https://orcid.org/0000-0002-8439-2616*

**Author for correspondence*

## Abstract

*Rubus* ser. *Rhamnifolii* includes apomictic polyploid species, which occur in north-western and central Europe, with rare outposts to eastern central Europe. A regionally distributed tetraploid species of the series occurring north and south of the Eastern Alps in Austria and Germany, *Rubus noricus* is described here. The new species is morphologically compared with similar taxa of the series, moreover, comprehensive iconography, data on distribution and ecology are presented.

**Keywords:** apomixis, biogeography, ecology, postglacial spread, *Rubus* ser. *Rhamnifolii*, taxonomy

## Introduction

The brambles (*Rubus* subgen. *Rubus* Linnaeus 1753: 492) constitute one of the taxonomically most complicated groups of vascular plants in Europe. Beside the continuous recognition of new species, novel aspects of evolutionary processes (incl. the role of hybridization and polyploidization) were discussed by various authors (e.g. Weber 1995, Šarhanová *et al.* 2012, Sochor *et al.* 2015), and brambles also became a model group for the study of apomixis (Nybom 1996, Majeský *et al.* 2017, Sochor *et al.* 2017).

Within the subgenus, *Rubus* sect. *Rubus* ser. *Rhamnifolii* (Bab.) Focke (1877: 125) includes species characterized by the combination of thick first-year stems with strong prickles, the dark green (sometimes coriaceous) leaves green to grey felted beneath; stalked glands absent or only a few on the stem or in the inflorescence (Weber 1995; Zieliński 2004). Based on preliminary molecular studies (Sochor *et al.* 2015), the series is probably polyphyletic. Its traditional, morphology-based delimitation is not unequivocal, some transitional species, e.g. to the ser. *Discolores* (P.J. Müll.) Focke (1914: 152) or the ser. *Rubus*, have a controversial position in the literature. On the other hand, when investigating the micromorphology of the leaf indumentum of five representative species, Tomaszewski *et al.* (2013) found some explicitly specific characters for the series.

The number of accepted species in the ser. *Rhamnifolii* is about 50, the centre of their distribution is situated in NW Europe (especially the British Isles and northern Germany, see the map "AFE 4042" in Kurtto *et al.* 2010). The series is fairly species poor in eastern central Europe, it is represented in Austria by four species (see Kurtto *et al.* 2010, Pagitz *et al.* 2020, and comments of Király *et al.* 2019 on the classification of *Rubus angustipaniculatus* Holub 1991: 339). Besides the widely accepted species, stabilized local types bearing the feature-set of the ser. *Rhamnifolii* were also described by earlier authors (e.g. *R. rorulentus* Halácsy in Kerner 1884: 39), but they have no taxonomic significance.

A characteristic biotype (= morphologically defined, stable type) of bramble has been found since 2000 at several localities both north and south of the Eastern Alps representing a hitherto unknown, distinct species of *Rubus* ser. *Rhamnifolii*. Here we describe it as a new species, and we discuss its taxonomic position, distribution, and ecology.

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## Material and methods

The field study was carried out between 2010 and 2020 in Austria and adjacent regions. We visited more than 1000 localities (mainly forest fringes and open forests) with brambles. For each locality, the geo-coordinates and altitude were determined using a GPS handheld device in WGS84 projection. Nearby localities within 500 m were not considered separately unless they are situated in a different country or federal state. Distribution maps were compiled using ArcGIS software. Terms on range size are adopted from Weber in Kurtto *et al.* (2010), also taking the approaches of Holub (1997) and Haveman & de Ronde (2013) into consideration.

The material of the following herbaria was used for comparative morphological studies: BP, GJO, GZU, IB, KL, LI, LJU, W, WU, and the private herbaria of M. Hohla, W. Jansen, G. Király, K. Pagitz and P. Pilsl. Type specimens were deposited in BP, IB, KL, LI, M, OL and W (for herbarium acronyms see Thiers 2021+).

Morphological investigations were based on the assessment of 120 specimens, while some characters (e.g. features of flowers) were investigated on living plants in the field. For the demonstration of distinctive features, we also applied the following sources: Weber (1984, 1995), Holub (1991), Zieliński (2004), Trávníček & Zázvorka (2005), and Henker & Kiesewetter (2009).

The DNA ploidy level was assessed based on the relative fluorescence of stained nuclei, as determined by flow cytometric measurements of fresh leaves using a Partec CyFlow ML flow cytometer (Sysmex Partec, Görlitz, Germany) in the laboratory of the Department of Botany, Palacký University (Olomouc, Czech Republic). *Zea mays* 'CE-777' was used as an internal standard and staining was performed with 4',6-diamidino-2-phenylindole (DAPI). For more details on the methods used, see Sochor & Trávníček (2016).

## Results and discussion

***Rubus noricus*** Hohla, Pagitz & Király, ***sp. nov.***

Type:—AUSTRIA, Upper Austria, Innviertel, Ort im Innkreis, Aichberg, 0.4 km N of the village, 0.15 km NNW of Bründlkapelle, forest clearings, 48.321054° N, 13.434257°, 410 m, 19 July 2019, Hohla M. s. n. (holotype: LI 02715247, LI 02715254, parts of the same specimen; isotypes: BP 00026781, IB 109450, KL BP-188627, KL BP-188628, M 0308856, M 0308857, OL 38004, W 0109817, W 0109818). Fig. 1, 2.

**Description**:—Shrub, usually to 100(–150) cm tall. First-year stems low-arching, (3–)5–8(–10) mm in diameter, bluntly angled to slightly furrowed; sides bright to greyish green or intense purple when exposed to the sun. Stem slightly hairy (mainly on the angles and base of prickles) with simple and tufted hairs 0.2–0.6 mm long, 0–5(–10) hairs per 1 cm length of stem side, and with scattered (sub)sessile glands (shorter than 0.1 mm). Prickles coloured as stem, intense purple (especially when exposed to sun) in the lower, and pale (ochre) in the upper part. Prickles straight, slender, somewhat unequal, (3–)5–8(–10) per 5 cm length of stem, patent or slightly declining, compressed and (4–)5–6(–7) mm broad at base, ± abruptly tapering, (3–)6–10(–12) mm long.

Leaves on the first-year stem 5-foliolate, digitate (rarely slightly pedate); lamina leathery, upper surface dark green, not hairy to the touch with 5–60 (–110) appressed, 0.2–0.8(–1.2) mm long hairs per $cm^2$, lower surface light or whitish green, with dense short tomentose hairs ± covering the entire surface, in addition with scattered 0.5–1.5(–2.0) mm long straight, ± erecto-patent hairs on the stronger veins making it softly hairy to the touch. Venation weak, veins not or very slightly depressed into surface of leaf. Terminal leaflet usually broadly obovate or nearly round (rarely broadly ovate), rounded or very slightly cordate at base, apex conspicuous, abruptly narrowed, often remarkably twisted, (7–)10–15(–20) mm long; petiolule 30–40 mm long, (32–)40–50(–56)% as long as its lamina. Basal leaflets obovate, usually slightly asymmetric, 0.75–0.90× as long as the petiole; their petiolules (4–)5–6(–8) mm long. Indentation unevenly (often, especially near the apex, doubly) serrate, with incisions 1.0–3.0(–4.0) mm deep, teeth 1–2.5(–4)× as wide as long, with a distinct narrow apex c. 0.5 mm long. Petioles scattered to densely hairy with ±erect simple and tufted hairs, and scattered sessile glands; prickles (10–)12–18(–22), up to 4 mm long, strongly curved. Stipules filiform, with scattered longer hairs and fewer stalked glands.

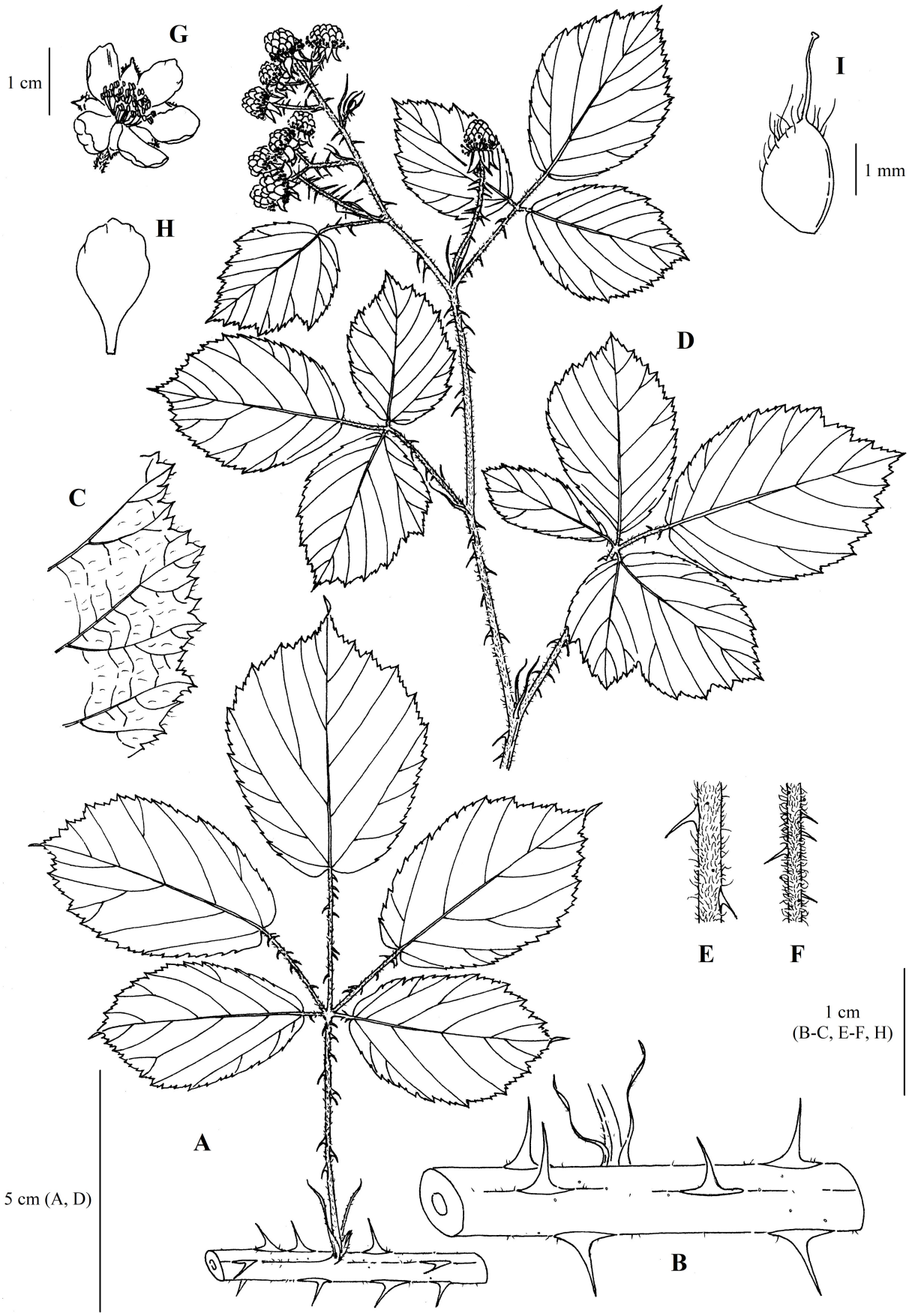


**FIGURE 1.** *Rubus noricus.* A: section of leafed first-year stem; B: detail of first-year stem; C: margin of terminal leaflet; D: infructescence; E: inflorescence axis; F: peduncle; G: flower; H: petal; I: young carpel. Del. J. Táborská.

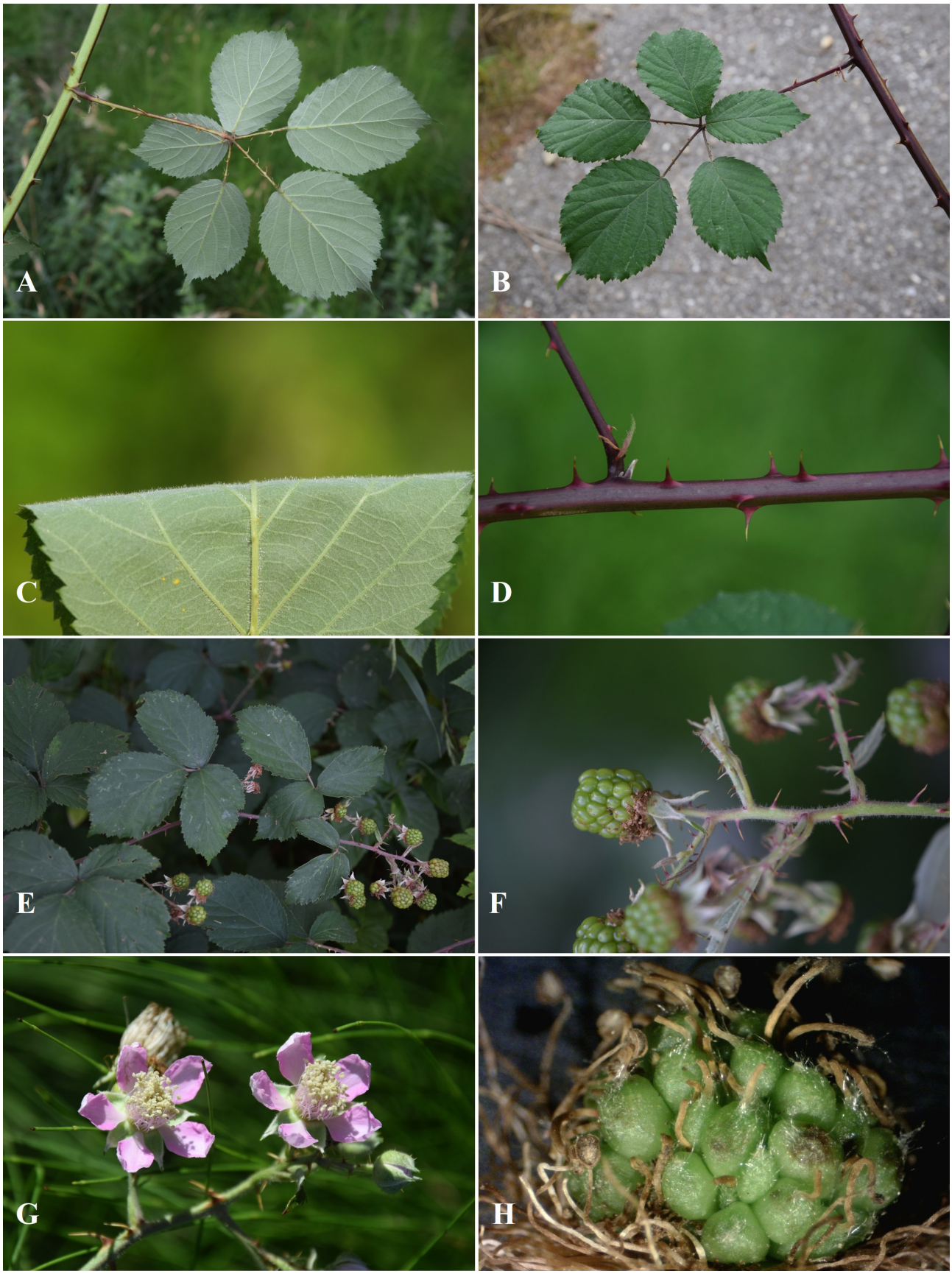


**FIGURE 2.** *Rubus noricus*. A: typical leaf of first-year stem (underside); B: typical leaf of first-year stem (upperside); C: close-up of lower surface of a leaf on first-year stem; D: first-year stem; E: infructescence; F: terminal part of infructescence; G: flowers; H: young collective fruits (with hairy carpels). Austria, Upper Austria, Lochen, Tannberg, July and August 2019, phot. M. Hohla.

Inflorescence usually 20–35 (–40) cm long, broadly paniculate, relatively few-flowered, terminal part compact, rounded at apex, distal 2–8 cm leafless (rarely leafy to the apex), lowermost branch(es) often distinct, lateral branches patent or erecto-patent, up to 11 cm long, with conspicuous, long, narrow stipules at base. Uppermost (0–)1–3(–5) leaves of inflorescence axis simple, lanceolate to ovate, lower one(s) broader; leaves at bottom of the inflorescence 3- or 5-foliolate (rarely asymmetrically 4-foliolate). Inflorescence axis with dense, short tomentose hairs and scattered ± erect hairs up to 1.0 mm long, and with rather scattered subsessile glands up to 0.2 mm long. Prickles 3–8 per 5 cm length of axis, slightly to conspicuously declining, straight or slightly curved, slender, (1.5–)2.5–7.0(–10.0) mm long, usually yellow with purplish base. Inflorescence branches 1–3(–4)-flowered; pedicels (5–)10–20 mm long, densely hairy and with scattered subsessile and few stalked glands up to 0.5 mm long; prickles 6–15, yellowish, straight or slightly curved, (0.5–)2–4 mm long. Sepals reflexed after anthesis, oblong ovate, 7–10 mm long with a narrow, distinct apex, whitish-greyish felted with longer hairs, with scattered sessile and few minute stalked glands, and reddish pricklets 0.5–1 mm long. Petals not touching each other, glabrous on the upper-, and hairy on the lower side, spatulate, rounded or slightly emarginate at apex, bright pink, (6–)8–11(–13) mm long. Stamens longer than the yellowish-green styles; filaments pink, anthers pale yellow, glabrous. Carpels densely hairy (with hairs up to 0.4 mm) at the base of the style. Collective fruits round to slightly ovoid, with (30–)40–60(–70) drupelets.

**DNA-ploidy level**:—Tetraploid, 2n = 4x (~28) (examined in the specimen Austria, Carinthia, Köttmannsdorf, 14 Aug 2018, herb. G. Király; published by Sochor *et al.* 2019 under the name "morphotype *Rhamnifolii*-1"). Because all taxa (ca. 20 species) of *Rubus* ser. *Rhamnifolii* investigated by now for ploidy level proved to be tetraploid (Krahulcová *et al.* 2013, Sochor *et al.* 2019), this count on ploidy is as expected.

**Phenology**:—Flowering in June and July.

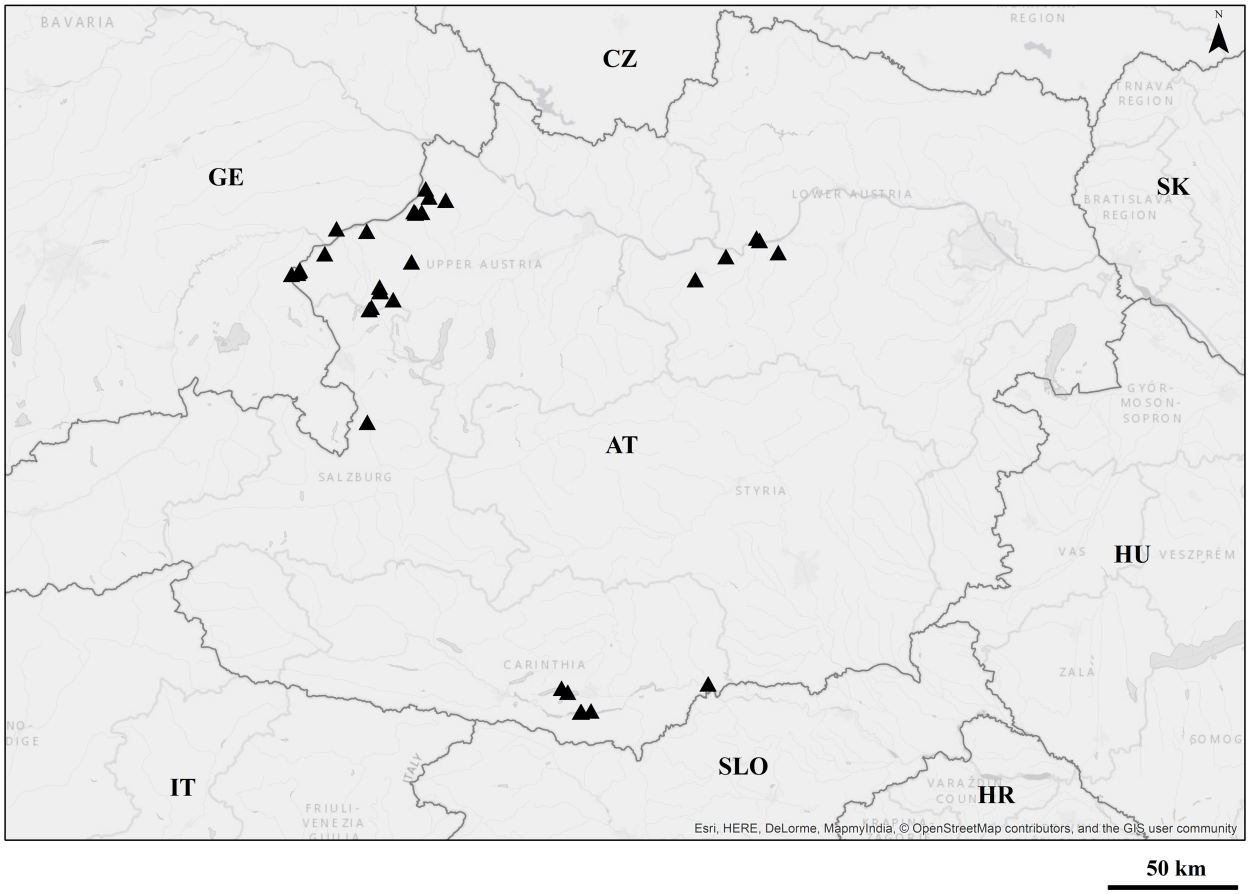


**FIGURE 3.** Distribution of *Rubus noricus* based on localities supported by herbarium vouchers.

**Distribution**:—*Rubus noricus* was found in several localities in Austria (in the federal states Carinthia, Lower Austria, Salzburg, and Upper Austria), and at a single site in Germany (Bavaria). Its range does not overlap with any similar species from the ser. *Rhamnifolii* (e.g. *R. marssonianus* H.E. Weber 1984: 613, and *R. nemoralis* P.J. Müll. 1858: 139, see also the taxonomic notes below). There are three rather disjunct parts of the distribution area as follows: 1) in the Innviertel in Upper Austria with few occurrences in the bordering Bavaria and Salzburg, 2) in the western Lower

Austria both south and north of the Danube in the surrounding of Ybbs, and 3) in central Carinthia south of the lake Wörthersee (Fig. 3). The longest diameter of the distribution area is more than 200 km; therefore, the species can be considered a regionally distributed bramble. This kind of disjunction in the Eastern Alps and its forelands was observed in several other species (for examples see Maurer & Drescher 2000, and Király *et al.* 2019), and it probably can be explained by the simultaneous postglacial development of forest associations preferred by brambles, and the effects of secondary spread by ornithochory. Although *R. noricus* occurs in regions with intensive batological activities in the past, surprisingly, no collections prior to 2002 have been found in public herbaria.

**TABLE 1.** Distinctive features of *Rubus noricus* and selected similar species.

| Characters | *R. noricus* | *R. nemoralis* | *R. marssonianus* | *R. austromoravicus* |
|---|---|---|---|---|
| No. of prickles on first-year stem (per 5 cm length) | (3–)5–8(–10) | 5–11 | 3–7 | 2–6 |
| Length of prickles on first-year stem (mm) | (3–)6–10(–12) | 4–9(–10) | 7–9 | 6–8 |
| Basal width of prickles on first-year stem (mm) | (4–)5–6(–7) | (2–)4–8(–9) | 5–8 | (5–)6–8(–9) |
| Hairiness of first-year stem | slightly hairy | glabrous or slightly hairy | glabrous or slightly hairy | glabrous |
| Leaf on first-year stem | digitate (rarely slightly pedate) | digitate (rarely slightly pedate) | slightly pedate | digitate |
| Ratio of length of petiole and basal leaflets (on first-year stem) | significantly longer | significantly longer | significantly (often twice) longer | shorter |
| Ratio of lamina and petiolule of terminal leaflet on first-year stem (%) | (32–)40–50(–56) | 30–48 | 30–36 | 30–42 |
| Length of petiolule of basal leaflet (mm) | (4–)5–6(–8) | 4–8 | 3–6 | 3–5 |
| Length of the apex of the terminal leaflet of first-year stem (mm) | (7–)10–15(–20) | 10–20 | 14–22 | 8–13(–15) |
| No. of prickles on petiole | (10–)12–18(–22) | 9–19 | 9–14 | 12–20 |
| Depth of serration on leaves of first-year stem (mm) | 1.0–3.0(–4.0) | 2.0–3.0 | 1.0–3.0 | 1.5–3.5 |
| Shape of the inflorescence | broadly paniculate | conical-narrow paniculate | narrow paniculate-pyramidal | broadly ovoid-pyramidal |
| Form of prickles on inflorescence axis | straight or slightly curved | distinctly curved, partly hooked | slightly curved to falcate | slightly curved |
| Length (mm) of prickles on inflorescence axis | (1.5–)2.5–7.0(–10.0) mm long | 4.0–8.0(–9.0) mm long | 3.0–5.0 mm long | 4.0–5.0 mm long |
| Length of prickles on pedicels (mm) | (0.5–)2.0–4.0 | (1.0–)2.0–3.0(–5.0) | 2.0–3.0 | 0.5–2.0(–2.5) |
| Colour of petals | bright pink | pale to bright pink | pale pink | white to pale pink |
| Filaments | pink | pink | white to a touch of pink | white |
| Carpels | densely hairy | glabrous or nearly so | glabrous | glabrous |

**Ecology**:—*Rubus noricus* was found in the colline and submontane altitudinal belts from 320 to 600 m above sea level. The species generally grows on slightly acidic (e.g. silicate-rich gravel or granite) to base-rich (e.g. limestone) substrates, on semi-dry to mesic soils, both in natural forest communities (most often in associations of the *Fagetalia*

order), and their derivates (e.g. planted coniferous stands, partly mixed with native deciduous tree species). It prefers half-shady fringes or somewhat opened forest stands, in turn, it avoids exposed sunny sites.

**Taxonomy**:—*Rubus noricus* is a typical representative of the ser. *Rhamnifolii* based on the thick first-year stems with strong prickles, the dark green, leathery lamina of leaves that are light to whitish green coloured beneath (due to the dense short tomentum), furthermore the loosely branched inflorescences with long prickles on the axis and the pedicels. From the similar species of ser. *Rhamnifolii* (as *R. marssonianus* and *R. nemoralis*) it differs in having densely hairy carpels, in addition, it is distingushable from *R. marssonianus* in the colour of the petals and filaments, and the length of prickles on the inflorescence axis, from *R. nemoralis* in the form of the prickles on the inflorescence axis, respectively. The shape of the leaves and inflorescences of *R. austromoravicus* Holub 1991: 335 (ser. *Discolores*) is close to that of *R. noricus*, however, it is easily separable based on the different hair cover on the leaves beneath (*austromoravicus* has pure white tomentum), the different ratio of the petiole and the length of the basal leaflets, and the lower number of prickles on the first-year stem (for details see Table 1).

**Etymology**:—The epithet "*noricus*" derives from the former Roman province "*Noricum*" that approximately covered the eastern Alps and its foregrounds, which overlap well with the species' distribution area.

**Additional specimens examined**:—AUSTRIA, **Carinthia**: Hollenburg, Forstweg nordöstlich, 560 m, 18 Sep 2018, *Pagitz K*. (IB 95328, IB 95330); Hollenburg, Forstwegrand, 548 m, 19 Jul 2011, *Pagitz K*. (IB 42078, IB 42082, IB 42087); Köttmannsdorf, 0.4 km SE of Wegscheide settlement, coniferous forests S of the road Nr. 91, 560 m, 26 Jul 2013 and 14 Aug 2018, *Király G*. (Herb. G. Király); Krumpendorf west, "Am Föhrenwald", Waldlichtung, Schlagfläche, 455 m, 21 Jul 2007, *Pagitz K*. (IB 35589); Lavamünd, SW of the village Ettendorf, forest fringes, 437 m, 15 Jul 2020, *Hohla M. & Király G*. (LI 02715230, LI 02715223); Pörtschach a. W., Winklern, Straßenböschung, Zaun, 510 m, 20 Jul 2011, *Pagitz K*. (IB 42119); St. Ulrich b. Maria Rain nach Haimach, Waldrand nördlich der Straße, ca. halbe Strecke, Waldrand, 595 m, 18 Sep 2018, *Pagitz K*. (IB 95332).—**Lower Austria**: Grossweichselbach, 0.8 km N of the village, spruce forests and fringes along the road to Rosenfeld, 417 m, 23 Aug 2015, *Hohla M. & Király G*. (Herb. G. Király); Klein-Pöchlarn, 0.9 km of NW of the village, spruce implantations and young forests along the road to Wimm, 329 m, 11 Jul 2019, *Hohla M. & Király G*. (LI 02709123, LI 02708942, Herb. G. Király); Maria Taferl, 0.3 km of NW Wimm, 0.3 km S of Unterthalheim, forest fringes near forest road, 361 m, 11 Jul 2019, *Hohla M. & Király G*. (LI 02709161, LI 02709154, LI 02709147, LI 02709130, Herb. G. Király); St. Martin am Ybbsfelde, forest on the NE edge of the village, mixed forest, 326 m, 10 Jul 2019, *Hohla M. & Király G*. (LI 02950365, LI 029550327, LI 02950280, LI 02950242, Herb. G. Király); Winklarn, 0.5 km SE of Holzing, Espachwald, forest fringes near forest road, 326 m, 10 Jul 2019, *Hohla M. & Király G*. (LI 02950204, LI 02709185, LI 02709178, Herb. G. Király).—**Salzburg**: Tennengau, Göll-Gruppe, Bluntautal, Bachufer am Torrener Bach E der Bluntauhütte, 485 m, 22 Aug 2016, *Pilsl P.* (Herb. P. Pilsl, nr. 25469).—**Upper Austria**: Andorf, 0.6 km NE of Hof, spruce forest, on clearings and forest fringes, 391 m, 27 Jul 2014, *Hohla M.* (LI 02715414, LI 02715407, LI 02715391, LI 02715384, LI 02715377, LI 02715360); Lengau, Krenwald, 0.8 km SW of Schneegattern, forest fringes near forest road, road embankment, 560 m, 30 Aug 2018, *Hohla M.* (LI 02715575, LI 02715568); Lochen, Tannberg, 0.3 km SE of Petersham spruce forest fringes, 562 m, 19 Jul 2019, *Hohla M.* (LI 02715308); Lochen, Tannberg, 0.35 km SW of Dirnham, damp mixed forest, 600 m, 19 Jul 2019, *Hohla M.* (LI 02709024, LI 02709017, LI 02709000, LI 02715292, LI 02715285, LI 02715278, LI 02715261); Mettmach, 0.9 km SE of Großenreith, forest fringes in a small gravel pit, on a steep slope, 555 m, 18 Jul 2019, *Hohla M. & Kellerer S.* (LI 02709048, LI 02709086); Munderfing, Kobernaußerwald, 0.2 km E of Parz, forest fringes, 515 m, 27 Aug 2018, *Hohla M.* (LI 02708980, LI 02708997, LI 02708928, LI 02708935); Munderfing, Kobernaußerwald, 0.5 km ENE of Parz, forest fringes along the forest road, 540 m, 27 Aug 2018, *Hohla M.* (LI 02709055); Munderfing, Kobernaußerwald, 2 km SE of Bradirn, spruce forest, clearing, 590 m, 29 Jun 2014, *Hohla M*. (LI 02708980, LI 02708997, LI 02708928, LI 02708935); Ort im Innkreis, Aichberg, 0.4 km N of the village, 0.15 km NNW of Bründlkapelle, forest clearings, 410 m, 27 Aug 2017, *Hohla M. & Király G*. (LI 02715506, LI 02715490, LI 02715483, LI 02715476, LI 02715469, LI 02715452, Herb. G. Király); 9 Jul 2018, *Hohla M*. (LI 02709093, LI 02709062); Reichersberg, Hartwald, 358 m, 6 Aug 2002, *Hohla M.* (LI 414992, LI 415005); Reichersberg, Hartwald, 0.2 km W of Hart, mixed forest, on a clearing, 363 m, 19 Sep 2013, *Hohla M*. (LI 02715421); St. Florian am Inn, Lindetwald, ca. 1,6 km S of the village Roßbach, mixed forest, along the road, 347 m, 19 Aug 2020, *Hohla M. & Hofbauer M*. (LI 03277751, LI 03277744); St. Marienkirchen bei Schärding, 0.3 km SW of Oberfucking, *Picea abies* forest fringes, 394 m, 16 Oct 2009, *Hohla M*. (LI 02715353, LI 02715346, LI 02715339, LI 02715322, LI 02715315); St. Radegund, 2.5 km NE of Hadermarkt, mixed forests along the road to Holzgassen, 478 m, 4 Jul 2017, *Hohla M. & Király G.* (Herb. G. Király); St. Radegund, NW Lohjörgl, am Wegrand, 365 m, 31 Jul 2008, *Hohla M*. (LI 01084917); St. Radegund, Oberer Weilhartforst, 1.2 km ENE of Schwabenlandl, mixed forest, on a clearing, 508, 4 Jul 2017, *Hohla M. & Király G.* (LI 02715551); St. Radegund, Oberer Weilhartforst, ca. 1.0 km ENE of Werfenau, mixed forest,

on a clearing, 469 m, 19 Aug 2020, *Hohla M. & Hofbauer M.* (LI 03277737, LI 03277720); Überackern, Unterer Weilhartforst, 1.1 km NW of Bierberg, forest fringes near forest road, 408 m, 23 Aug 2013, *Hohla M*. (LI 02708973, LI 02708966, LI 02715445, LI 02715438); Weng im Innkreis, Hartwald, 1.2 km WNW of Elling, forest fringes near road Bundesstraße 148, 365 m, 23 Oct 2019, *Hohla M*. (LI 02709031).—GERMANY, **Bavaria**: Kirchdorf am Inn, 0.2 km NE of Stadleck, Stadlecker Weg, road embankment, bushes, 380 m, 21 Sep 2017, *Hohla M. & Király G*. (LI 02709109, LI 02709079, LI 02709116, LI 02715582, Herb. G. Király).


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