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RANUNCULUS AURICOMUS COMPLEX IN THE FLORA OF LATVIA. *RANUNCULUS AURICOMUS* GROUP – SPECIES WITH GLABROUS RECEPTACLES

Pēteris Evarts-Bunders*, Gunta Evarte-Bundere, Dana Krasnopoļska, Aiva Bojāre

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Abstract
Traditionally, authors in Latvia summarize all agamic species of *Ranunculus auricomus* complex under three species: *R. auricomus* L., *R. fallax* (Wimm. et Grab.) Sloboda and *R. cassubicus* L. However, numerous compelling studies have found that *R. auricomus* complex is a large assembly of apomictic microspecies. In this article, 15 species with glabrous or nearly glabrous receptacles of the *R. auricomus* group in Latvia are presented: *R. acrifolius* (Nannf. & H. Sm.) Ericss., *R. amplisinus* (Markl.) Ericss., *R. brachyphyllarius* (Markl.) Ericss., *R. cosmophyllus* Ericss., *R. exiguifrons* (Cedercr.) Ericss., *R. inconspectus* (Markl.) Ericss., *R. latisinuatus* (Cedercr.) Ericss., *R. lepidus* (Markl.) Ericss., *R. ostrobottnicus* (Markl. ex G. Kvist) Ericss., *R. pseudoacris* Tzvel. (*R. acriformis* Soó), *R. pseudovertumnalis* Haas, *R. rotundellus* (Markl.) Ericss., *R. rotundidens* (Julin) Ericcs., *R. schillerii* Soó, and *R. spissidens* (Markl. ex Fagerstr.) Ericss.

Keywords: *Ranunculus*, buttercup, apomictic microspecies, Latvia.

*Corresponding author: *Pēteris Evarts-Bunders. Institute of Life Sciences and Technology, Daugavpils University, Parades Str. 1A, Daugavpils, LV-5401, Latvia, E-mail: peteris.evarts@du.lv*

Dana Krasnopoļska. Institute of Life Sciences and Technology, Daugavpils University, Parades Str. 1A, Daugavpils, LV-5401, Latvia

Gunta Evarte-Bundere. Joint Stock Company "Latvia's State Forests", Vainodes Str. 1, LV–1004, Rīga, Latvia

Aiva Bojāre. National Botanical Garden, Miera Str. 1, Salaspils, LV-2169, Latvia

INTRODUCTION

The *Ranunculus auricomus* L. species complex belongs to *R. auricomus* group comprises about 800 taxa distributed throughout Greenland, Europe (from the Arctic zone to the Mediterranean region), Western Siberia, Central Asia and Alaska (Jalas & Suominen 1989, Tamura 1995, Emadzade et al. 2011), and at least 700 of them are agamic microspecies. Only in

Scandinavia 605 apomictic *R. auricomus* group species have been recorded as new taxa (Ericsson 2001). It is the largest genus of *Ranunculaceae* and ranges among the 50 biggest genera of angiosperms (Frodin 2004). In Europe, its representatives are common in temperate regions and more fragmentary towards the south with isolated southernmost localities in Southern Europe (Hultén & Fries 1986, Jalas & Suominen 1989, Dunkel 2015). The *R. auricomus* complex is a group of apomictic and partially sexual taxa and reaches the highest species diversity with high morphological diversity in Central and Eastern Europe, most of species being polyploids (predominantly allopolyploids) and propagating via apomixis (Hörandl 1998, 2008). Taxonomically, only few diploid sexual species are recognized, which are theorized to be the primary progenitors of the hundreds of morphotypes present throughout Europe (Ericsson 2001, Karbstein et al. 2020, Bradican et al. 2023).

In Central Europe, the *R. auricomus* complex has gained increasing interest in recent years, and new species (mostly apomictic polyploids) of this group are still being described from various regions of Europe (Dunkel 2010, 2014, 2019, Hörandl & Gutermann 1998a, 1998b, Hörandl et al. 2009).

Traditionally, authors in Latvia summarize all agamic species of this complex under three complex species: *R. auricomus*, *R. fallax* (Wimm. et Grab.) Sloboda and *R. cassubicus* L., and there have been no attempts to distinguish species of this group (e.g., Pētersone & Birkmane 1980, Gavrilova & Šulcs 1999, Priedītis 2014). However, there are lots of compelling studies that have found that *R. auricomus* complex is a large assembly of apomictic microspecies including Northern and Eastern Europe. Since the first reports on apomixis in the *R. auricomus* complex by Rozanova (1932), there have been a lot of investigations from the middle of 20th century till nowadays regarding the species spectrum in several European countries, and, as a result, apomictic *R. auricomus* species are more appropriately described as a number of separate microspecies representing fixed basic evolutionary units characterized by internal constancy of features (e.g. Jasiewicz 1956, Soó 1964, 1965, Borchers-Kolb 1983, 1985, Ericsson 1992, 2001, Hörandl & Greilhuber 2002). However, only in some areas microspecies of the *R. auricomus* complex may be considered to be described completely and covered by long-term studies, such as Bavaria (Borchers-Kolb 1983, 1985, Dunkel 2005b, 2005c), northern parts of Italy (Dunkel 2005a, 2010), Alsace (Dunkel 2014), Slovenia (Dunkel 2019), Finland (Marklund 1940, 1961, 1965, Cedercreutz 1965, Fagerström 1965, 1974, 1976, Valta 1968, Fagerström et al. 1975), Sweden (Julin 1963 1966, 1980) and partially some other countries (Russia, Poland). Data for other parts of the species distribution range of the *R. auricomus* complex varies from incomplete to none. For instance, in Latvia and in the Baltic States, such studies even at a very preliminary level in general flora compilations have never been done before (Laasimer et al. 1993), and only during recent years some attention has been paid to this group in Latvia (Evarts-Bunders et al. 2021, 2022).

Concerning the *R. auricomus* complex in Latvia, it is worth exploring for several reasons. Latvia and other Baltic States are situated on the border of the European, Scandinavian and Western Russia, and even Siberian species distribution ranges. At the same time, the Baltic states have a long history of agricultural land use and ancient transport routes; this means that the flora is relatively rich here, and agamic species from all these floristic areas can be found here. Latvia is not strictly isolated by any geographical barriers, and no fully endemic plant species are known here. It can be easily predicted that species of *R. auricomus* complex, described in Finland (Marklund 1961, 1965, Valta 1968, Fagerström 1965, 1974, 1976, Fagerström et al. 1975), Sweden (Julin 1963, 1966, 1967, 1980, Julin & Nannfeldt 1966), Russia (Tzvelev 1994, 2001, 2012) and even Hungary (Soó 1964, 1965) can be found here.

A critical study of herbaria specimens from Latvia and other Baltic States showed many

cases of misidentifications within the species complex of *R. auricomus*, as well as it indicated a high level of morphological and ecological diversity within this group, and it all leads to the necessity to update and clarify the species composition of *R. auricomus* complex and its distribution patterns in Latvia.

The aim of the study was to carry out a taxonomic and floristic revision of the *Ranunculus auricomus* complex, as well as to clarify the most important morphological characteristics and trends of distribution in Latvia.

MATERIALS AND METHODS

During our studies, more than 3000 herbaria units of *R. auricomus* complex were collected in Latvia. Material collected in the whole territory of Latvia during numerous field trips since 2016 was studied (Fig. 1). The floristic diversity of *R. auricomus* complex was studied with an emphasis on suitable habitats: different grassland habitats – pastures, species-rich meadows, species-rich broad-leaved forests, alluvial meadows, alluvial forests, etc., as well as different types of human-affected habitats – ruderal places, gardens, and roadsides. Special attention was paid to old manor parks and other dendrological plantings, botanical gardens and arboretums. Many of them have a long-term continuity and with an excellent broadleaved ground vegetation with co-dominance of *R. auricomus* s.l.

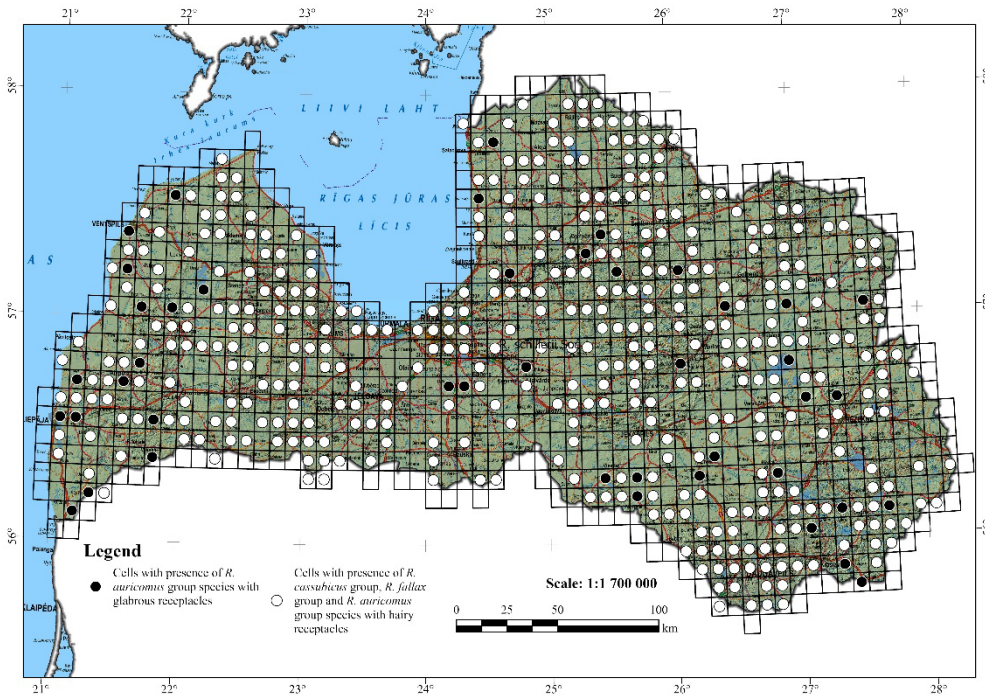

Figure 1. Map of geobotanical grid cells of Latvia with studied cells of *Ranunculus auricomus* complex. Map author: M. Nitcis.

Comprehensive revision of major herbaria in Latvia: Daugavpils University, Institute of Life Sciences and Technology, Laboratory of Botany (DAU, 370 herbaria specimens, most of which were collected by the authors of this paper during previous years); University of Latvia, Institute of Biology, Laboratory of Botany (LATV, approximately 100 herbaria specimens), University of Latvia, Museum of Botany (RIG, approximately 50 herbaria

specimens) was carried out during this study. Additionally, data were obtained from some herbaria abroad: Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences, Department of Botany (TAA) and National Academy of Sciences of Belarus, Institute of Experimental Botany (MSK).

This study is a part of research on agamic complex of genus *Ranunculus* in Latvia. In this case, we consider it appropriate to apply more or less similar research methodology for all articles in this cycle (Evarts-Bunders et al. 2021, 2022, 2024). Special terminology, definitions, and morphological characters by Dunkel (2005a, 2010, 2019) – morphology of basal and cauline leaf, morphology of basal leaf blade: lobed, divided, dissected, degree of incision, etc., morphology of reproductive organs: receptacle, carpellophores – were used.

Opinion of different authors differs on the priorities for the importance of choosing different characters. Jasiewicz (1956), Tzvelev (1994, 2001) and most Scandinavian experts have stated that characters present during anthesis – the period during which a flower is fully open and functional – should be given priority in distinguishing microspecies. More generally, several authors (Jasiewicz 1985) were of the opinion that presence or absence of cataphylls is a first-order systematic criterion. However, according to Ericsson (2001) characters present in the fruiting stage (shape and pilosity of the receptacle) are taxonomically useful, whereas the number and form of petals and the presence or absence of cataphylls may be misleading. In our work, we hold to similar views. Another approach requires use of all leaf cycles, including first, juvenile and later, summer leaves in the description and identification of *R. auricomus* microspecies (e.g. Dunkel 2010, 2019). Our approach was that plants must be recognizable in the herbarium stage, otherwise, scientific collections can lose their relevance, and therefore characters present during anthesis were preferred in this work. The most important groups of characters:

1. **Habitus.** According to the size of the flowering shoot and the diameter of the stalk, the plants are divided into: gracile (height of 10–20 cm, diameter of stalk 1 mm), slim (height 20–40 cm, diameter – 1,5–2,5 mm) or robust (height 41–60 cm, diameter – 3–5 mm).
2. **Basal leaves**. Well-established fact that this character is the most important in the *R. auricomus* complex (Fig. 2). The cycle of the basal leaves consists of four, five, seldom six, or mostly seven leaves. The leaf blades were described by the angle of the base (aperture), mode of division (dissected (100%), divided (66–99%), cleft (33–65%), lobed (25–32%), undivided (0–24%), the form of leaf edge, and form of central or middle lobe, etc. Main identification characters are described for the latest developed leaves in the leaf cycle during anthesis (Fig. 2).
3. **Cauline leaves.** Important characters are the ratio of length/width (linear, lanceolate, oblanceolate or rhomboidal, number and shape of teeth as well as the leaf attachment type to the stem (sessile, subsessile or petiolate).
4. **Generative characters.** The number, length and level of development of the petals are characteristic for identify-cation. In all diploid (and sexual) species, the flowers consist of five (rarely 6–7) well-developed petals, form apomictic asexual species corolla that is partially or fully reduced. More important are the characters of the gynoclinium (the main part of receptacle): size, shape and hairiness – for this group hairless or only with few separate hairs (Fig. 3). Another important distinctive character is the length of the carpellophores (short – up to 0,2 mm, long – up to 0,4 mm and longer).

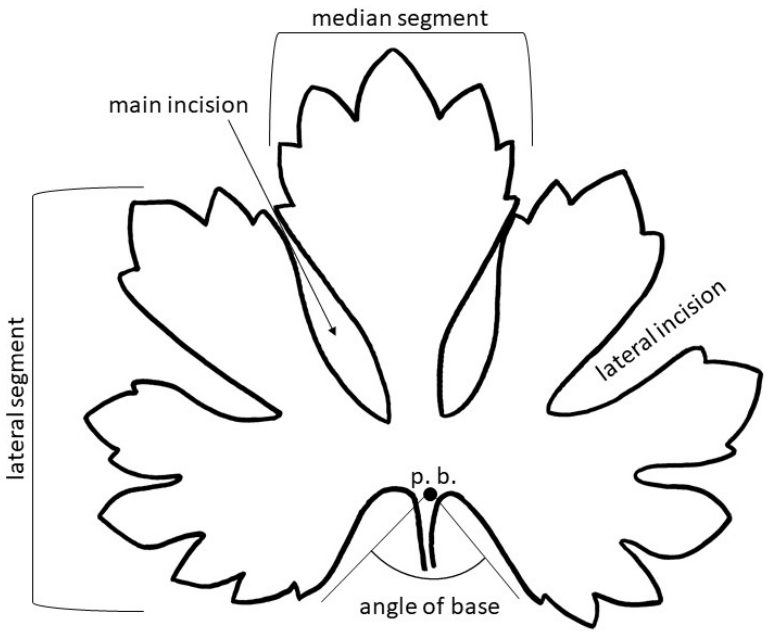

Figure 2. Basal leaf of *Ranunculus auricomus* s.l. The schematic diagram illustrates the most important characteristics: the length and the width of a leaf; the mode of division of main segments, the basal point (p.b.) is defined by junction of the main leaf veins; the angle of the base is measured from the basal point. Drawing: I. Svilāne.

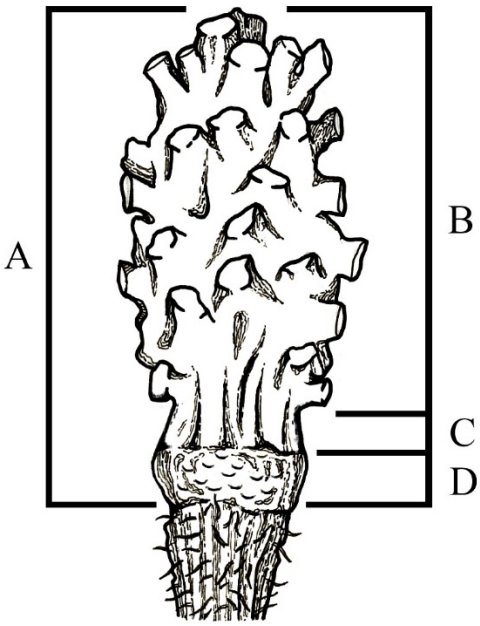

Figure 3. Receptacle of *Ranunculus auricomus* s.l.: A – receptacle, B – gynoclinium with carpellophores (in this case – the most important feature), C – interval, D – androcliunium. Drawing: A. Vasiļjeva.

All characters must be checked several times if possible. It is necessary to collect more than one herbarium from one locality, better at least 4–5. Specimens should be carefully selected to show the full range of basal leaf form. Atypical plants, growing in dense shade, poor substrate, grazed or mowed, often have no characteristic basal leaves and other characters, they can be poorly developed and even the latest leaves can be atypical. As a result, they are often difficult or impossible to determine.

Species distribution maps were prepared only for those species that are clearly unevenly distributed in Latvia and that obviously have a distribution limit here, by applying the square grid, which is related to the geographical coordinates, where one square corresponds approximately to 7,6 × 9,3 km or 71 km^2. The total number of the grid cells in Latvia is 1017, from which 822 are completely located and 195 are partially located in the territory of Latvia (Tabaka et al. 1980). To describe the distribution of the species frequency of occurrence, a standardized frequency rating scale developed for flora analysis in Latvia was used. The scale is based on the number of grid cells in which the species has been found: very rare (1–10 grid cells), rare (11–30), relatively rare (31–100), not very common (101–250), fairly common (251–500), common (501–750), very common (more than 751) (Fatare 1992).

All collected and cited herbarium specimens are deposited at the Herbarium of Daugavpils University, Institute of Life Sciences and Technology (DAU) and registered in the database of the Herbarium Universitatis Daugavpilensis (Evarte-Bundere et al. 2020).

RESULTS AND DISCUSSION

The *R. auricomus* complex is a catch-all assembly composed of what is left after the other groups have been segregated (Ericsson 1992). It is more diverse than the other groups combined, and work on further subdivision not fully completed for the territory of Latvia; the refinement needs to be continued. Therefore, *R. auricomus* complex is considered to be artificial and used mainly for simplification of identification.

In distinguishing species of *R. auricomus* complex, we were guided by following morphological characters, which separate relatively this informal group from other groups of *R. auricomus* complex: mainly linear or linear-lanceolate cauline leaves with whole leaf blades or sometimes with one or few teeth; full number (6–7) of basal leaves with typically trilobate or divide leaf blade with divided or whole lateral segments. At the same time, some of the most developed basal leaves or even all leaves of basal leaf cycle can be with nearly whole leaf blade. Glabrous or nearly glabrous receptacle for species of this group is a one of typical character. Here, however, must be noted that receptacles for some species (for instance, *R. acrifolius, R. cosmophyllus*) are with some hairs, especially near carpellophores and cursory assessment can be incorrect. We consider these morphological characters to be formal, as for several species these characters overlap with similar characters of *R. fallax* or even *R. cassubicus* group.

There were 15 species of *R. auricomus* complex with glabrous receptacles found during our studies. As the species are morphologically very similar, identification of this group by classical dichotomous keys is almost impossible. For best results, evaluation of several morphological characters at the same time is recommended. To determine these species, we offer to use a comparative table of morphological characters, given in this work (Appendix 1). Thus, only short descriptions of species – explanation of the main characters and differences from the nearest (most similar) species are given, as well as main facts of species distribution and habitats in Latvia.

***Ranunculus acrifolius* (Nannf. & H. Sm.) Ericss.** 1992. In: Svensk Bot. Tidskr. 86(2): 78.

Most important morphological characters: slim plant with toothless (some cauline leaf

segments can be with lobes) linear cauline leaves (length-width ratio ± 10:1), and small most developed basal leaves with angle 60–120° of leaf base. Basal cycle leaves mostly trilobated with no leaves with whole leaf blade– most developed leaves with 3-lobed leaf blade with deeply lobed lateral segments, lateral and main segments with short petioles. Flowers with partially reduced petals (Fig. 4).

Distribution and ecology in Latvia: Occurs relatively often evenly throughout the territory of Latvia in different types of grasslands: in mesic pastures, alluvial grasslands, forest margins and roadsides, to a much lesser extent in parks and anthropogenic areas. One of the commonest species of this group in Latvia.

Figure 4. *Ranunculus acrifolius* (Nannf. & H. Sm.) Ericss.

***Ranunculus amplisinus* (Markl.) Ericss.** 1992. In: Ann. Bot. Fenn., 29(2): 131.

Most important morphological characters: slim plant with linear, proportionally very long and narrow, toothless cauline leaves and small to medium-sized most developed basal leaves with angle 60–120° of leaf base. Basal cycle leaves mostly trilobated with no leaves with whole leaf blade – most developed leaves with 3-lobed leaf blade with deeply lobed lateral segments with narrow lobes, the outline of leaf blade looks round. Lateral segments petiolate. Flowers with partially reduced petals. The species resembles small plants of *R. acrifolius* but differs by proportionally much longer cauline leaves (length-width ratio ± 15:1), most developed basal leaf blades in outline are rounded (Fig. 5).

Figure 5. *Ranunculus amplisinus* (Markl.) Ericss.

Distribution and ecology in Latvia: rarely, scattered in the whole territory of Latvia. Grows mostly in different types of anthropogenic habitats: old manor parks and dendrariums (Bauņi, Bojas, Juzefova, Ikšķile, Trikāta, Vaiņode, Silva arboretum, as well as

greeneries of public settlements, farmhouses and disturbed forest habitats. It is very likely that the species should be considered as an anthropophyte in Latvia.

***Ranunculus brachyphyllarius* (Markl.) Ericss.** 1992. In: Svensk Bot. Tidskr. 86: 78.
Most important morphological characters: gracile or slim plant with toothless (some cauline leaf segments can be with some large teeth) linear cauline leaves (length-width ratio ± 10:1), and small most developed basal leaves with angle 40–100° of leaf base. Basal cycle leaves mostly trilobated with no leaves with whole leaf blade – most developed leaves with 3-lobed leaf blade with deeply lobed lateral segments, lateral and main segments sessile, without petioles, lobes with rounded tips Flowers with fully or nearly fully developed petals. The species resembles small plants of *R. acrifolius* or *R. amplisinus* but differs by sessile main segments of basal leaves and fully developed corollas (Fig. 6).

Figure 6. *Ranunculus brachyphyllarius* (Markl.) Ericss.

Distribution and ecology in Latvia: relatively rarely and evenly throughout the whole territory of Latvia, relatively less often in the northern part of Latvia. Species known mostly from old manor parks: Ēbeļmuiža, Kazdanga, Degole, Dole, Vilce, Ambeļi, Ziemeļblāzma, much less often in alluvial meadows and forest edges – such as Lubāns wetland and Laucese river floodplain.

***Ranunculus cosmophyllus* Ericcs.** 1992. In: Ann. Bot. Fenn. 29(2): 136.
Most important morphological characters: small or medium-sized (slim) plant with linear, narrow toothless cauline leaves. Most developed basal cycle leaves small to medium-sized with angle 40–100° of leaf base, with 3-lobed leaf blade, where biggest, most developed lateral lobes shallowly divided, but some smallest leaves in cycle with deeply lobed lateral segments, lateral and main segments sessile. All flowers with reduced petals. The species resembles R. *acrifolius* or other similar species of this group, but differs by only shallowly lobed lateral lobes of biggest basal leaves (Fig. 7).

Figure 7. *Ranunculus cosmophyllus* Ericss.

Distribution and ecology in Latvia: not very common, evenly in the whole territory of Latvia in different types of grasslands: in mesic pastures, alluvial grasslands, forest margins and roadsides, to a much lesser extent in parks and anthropogenic areas. One of the commonest species of this complex in Latvia.

***Ranunculus exiguifrons* (Cedercr.) Ericss.** 1992. In: Ann. Bot. Fenn. 29(2): 139.
Most important morphological characters: gracile or slim plant with toothless, linear cauline leaves and small to medium-sized most developed basal leaves with wide angle 120–180° of leaf base. Basal cycle leaves mostly trilobated with no leaves with whole leaf blade – most developed leaves with 3-lobed leaf blade with deeply lobed lateral segments, lobes short with rounded tips. Lateral and main segments sessile. Flowers with fully or nearly fully reduced petals. The species resembles *R. brachyphyllarius* but differs by relatively smaller, rounded basal leaves and fully or nearly fully reduced corollas (Fig. 8).

Figure 8. *Ranunculus exiguifrons* (Cedercr.) Ericss.

Distribution and ecology in Latvia: rare and scattered in the whole territory of Latvia. Mostly grows in different types of grasslands (mesic pastures, alluvial meadows), as well different anthropogenic habitats – plantations, parks, cemeteries, countryside alleys and green areas.

***Ranunculus inconspectus* (Markl.) Ericss.**1992. In: Svensk Bot. Tidskr., 86: 79.
Most important morphological characters: gracile or slim plant with linear, toothless cauline leaves and small to medium-sized most developed basal leaves with narrow angle 30–70° of leaf base. Basal cycle leaves with 3-lobed leaf blade with lobed or even dissected lateral segments, median segments regular, oblong – lanceolate, usually with entire, non-toothed leaf margin. Some leaves in basal cycle with trilobated leaf blade with nearly whole, only shallowly lobed lateral segments. All main segments of basal leaves sessile without well-developed petioles. Flowers with nearly fully reduced petals (Fig. 9).

Figure 9. *Ranunculus inconspectus* (Markl.) Ericss.

Distribution and ecology in Latvia: very rare, known only from four localities in the central part of Latvia. Species known only from anthropogenic habitats – Sēja and Snēpele parks and two green territories in Riga. It is very likely that the species should be considered as an anthropophyte in Latvia.

***Ranunculus latisinuatus* (Cedercr.) Ericss.** 1992. In: Ann. Bot. Fenn., 29(2): 144.
Most important morphological characters: medium-sized (slim) plant with oblanceolate, toothless, linear cauline leaves and medium-sized most developed basal leaves with wide angle 120°–180° of leaf base. Basal cycle leaves mostly trilobated with no leaves with whole leaf blade – most developed leaves with 3-lobed leaf blade, mostly with shallowly lobed lateral segments, main segment coarsely toothed or even lobed, not overlapped with lateral lobes, therefore leaves looks trilobated and resembling leaves of *R. fallax* complex species. Flowers with nearly completely reduced petals (Fig. 10).

Figure 10. *Ranunculus latisinuatus* (Cedercr.) Ericss.

Distribution and ecology in Latvia: very rare, known only from five localities mostly in the eastern part of Latvia. Species known only from anthropogenic habitats – different margins, such as diches and roadsides in Varakļāni, Vecokra, Biķernieki in Augšdaugava district as well as park around Vaiņode school.

***Ranunculus lepidus* (Marklund) Ericcs.** 1992. In: Ann. Bot. Fenn. 29(2): 144.
Most important morphological characters: medium-sized (slim) plant with linear sessile cauline leaves with whole margin. Most developed basal cycle leaves small to medium-sized, angle of leaf base varies considerably 30–130°, some leaves in leaf cycle even with overlapped basal segments. Most developed basal cycle leaves with 3-lobed leaf blade, where lateral lobes divided or even dissected, main segments on some leaves petiolate. Flowers with fully developed petals. From similar species with developed petals differs by toothless cauline leaves and deeply divided or dissected lateral lobes of basal leaves (Fig. 11).
Distribution and ecology in Latvia: rare and occurs unevenly – mostly known from southeastern and western part of Latvia, rarely in other regions. Grows mostly in old manor parks and other anthropogenic habitats (Bebrene, Asare, Daugavpils, Rucava, Grīva, Viļķene, Valmiermuiža) as well as in alluvial forests and shrublands.

***Ranunculus ostrobottnicus* (Markl. ex G. Kvist) Ericss.** 1992. In: Ann. Bot. Fenn., 29(2): 147.
Most important morphological characters: medium-sized (slim) plant with long, linear, toothless cauline leaves and small to medium-sized most developed basal leaves with angle 90–160° of leaf base. Basal cycle leaves with very leaf blades - most developed with whole, coarsely toothed or shallowly trilobated leaves with whole lateral segments, at the same time other basal leaves with deeply 3-lobed or dissected leaf blade with deeply dissected lateral segments, some main lobes in leaf cycle even petiolate. Flowers with partially

developed petals. This species is well distinguished by a whole more developed basal leaves, differs from similar *R. schilleri* by linear, toothless cauline leaves (Fig. 12).

Distribution and ecology in Latvia: relatively rare in the whole territory of Latvia, mostly in old manor parks (Degole, Dole, Juzefova, Snēpele, Zvārtava, Zūras and others). Characteristic habitats for this species are wet shrublands and disturbed, Anthropogenic habitats – rural homesteads, green areas in villages, around churches, wooded meadows, alleys and under individual large trees.

Figure 11. *Ranunculus lepidus* (Markl.) Ericss.

***Ranunculus pseudoacris* Tzvel.** 1996. In: Novosti Sist. Vyssh. Rast. 30: 67.

Most important morphological characters: small or medium-sized (slim) plant with linear, sessile cauline leaves with 1–2 long teeth on each side, only some leaves toothless. Most developed basal cycle leaves small to medium-sized with narrow angle 20–80° of leaf base, with 3-lobed leaf blade, where lateral lobes divided or even dissected, therefore leaves looks round and resembling leaves of *R. acris* L. All flowers with partially or fully reduced petals. The species differs from other similar species of this complex (*R. acrifolius*, *R. amplisinus*) by typical long, narrow teeth of cauline leaves (Fig. 13).

Figure 12. *Ranunculus ostrobottnicus* (Markl. ex Kvist) Ericss.

Species firstly described in 1964 from eastern part of Hungary, Debrecen by R. Soó as *R. acriformis*. However, the epithet turned out to be illegitimate, because *Ranunculus* with such epithet – *Ranunculus acriformis* A. Gray was described from America much earlier. Later, in 1996, the Russian botanist N. Tzvelev corrected this error, and gave a new, correct epithet with reference to the description of the basionym, but it should be noted that everything is not completely correct here either. In the first description of the species Soó emphasizes that the species has partially

developed corollas. Despite that, in several latest works written by Tzvelev, the species is erroneously mentioned with a fully developed petals (Tzvelev 2001, 2012), which later led to misunderstandings and misidentifications.

Figure 13. *Ranunculus pseudoacris* Tzvelev.

Distribution and ecology in Latvia: rare, only in some parks and greeneries in south-western part of Latvia: Grobiņa, Aizpute, Cīrava, Ēdole, Nīgrande, Bārta, and not known from natural habitats. Additional research on the distribution and additional herbaria material in Latvia and in neighboring Lithuania are needed to discuss about species status and trends of distribution here, but it is possible, that the species should be considered as an anthropophyte in Latvia.

***Ranunculus pseudovertumnalis* Haas.** 1954. In: Ber. Bayer. Bot. Ges. 30: 30.
Most important morphological characters: small or medium-sized (slim) plant with oblanceolate or linear, sessile, mostly regularly toothed (1–3 short teeth) cauline leaves and small to medium-sized most developed basal leaves with narrow angle 10–60° of leaf base, lateral lobes sometimes overlapped. Basal cycle leaves with no leaves with whole leaf blade, all most developed basal leaves with 3-lobed leaf blade with lobed lateral segments. First, smaller basal leaves with whole, unlobed lateral segments. Lateral and main segments sessile or with short petioles. Flowers with fully or nearly fully developed petals. The species resembles small plants of *R. obtusulus* – outline of biggest leaves are rounded but differs by toothed cauline leaves and developed corollas (Fig. 14).

Figure 14. *Ranunculus pseudovertumnalis* Haas.

Distribution and ecology in Latvia: species is described from Central Europe, but known also from neighboring countries of Latvia (Tzvelev 2001, 2012). Very rare, known only from one locality in central part of Latvia – Riga, Vecdaugava Nature Reserve. Species grows in unmanaged, disturbed contact zone near reed grove in alluvial habitat. There is not

enough material to discuss about it with certainty, but it is very possible that the species should be considered as an anthropophyte in Latvia.

***Ranunculus rotundidens* (Julin) Ericss.** 1992 In: Ann. Bot. Fenn. 29: 151.

Most important morphological characters: medium-sized (slim) plant with linear or oblanceolate, toothless cauline leaves, medium-sized most developed basal leaves with angle 0–40° of leaf base. Basal cycle leaves trilobated with no leaves with whole leaf blade – most developed leaves with 3-lobed leaf blade with deeply lobed or even divided lateral segments and wide, deeply lobed main segment, overlapped with lateral segments, therefore the outline of leaf blade looks round, resembling leaves of *R. acris*. Flowers with partially developed petals. From similar species with rounded leaves differs by much bigger, lobated and overlapped main lobes of basal leaves (Fig. 15).

Figure 15. *Ranunculus rotundidens* (Julin) Ericss.

Distribution and ecology in Latvia: very rare, with uneven distribution pattern, mostly from southern part – in various natural and semi-natural habitats, such as alluvial grasslands (Tadenava), pine forests (Spuņciems) and parks (Džūkste). We cannot discuss about characteristic habitats and distribution in the region, additional research on the distribution and additional herbaria material in Latvia are needed.

***Ranunculus rotundellus* (Marklund) Ericcs.** 1992. In: Ann. Bot. Fenn. 29(2): 151.

Figure 16. *Ranunculus rotundellus* (Markl.) Ericss.

Most important morphological characters: small or medium-sized (slim) plant with linear, sessile cauline leaves with 1–2 long teeth or even lobes on each side. Basal cycle leaves small to medium-sized with angle 0–70° of leaf base, most developed leaves of basal cycle mostly deeply trilobated or even fully dissected with petiolate main leaf segments, smallest

leaves can be with nearly whole or shallowly lobed leaf blade. Flowers with partially or fully reduced petals. Latvian and Estonian herbarium material slightly differs from the type materials in Finland, where species described, by more divided smaller leaves, so additional research may be needed here (Fig. 16).

Distribution and ecology in Latvia: rare, with uneven distribution pattern – mostly from southern and western part of Latvia, not known form central and northern Latvia. Mostly grows in old manor parks and other anthropogenic habitats, as well as in alluvial meadows and different forest types – from deciduous ravine forests to anthropogenically impacted shrublands and other sites.

***Ranunculus schilleri* Soó** 1965. In: Acta Bot. Acad. Sci. Hung. 11: 395.

Figure 17. *Ranunculus schilleri* Soó.

Most important morphological characters: small or medium-sized (slim) plant with linear or linear-lanceolate cauline leaves usually with 1–2 (3) big teeth or even lobes. Most developed basal cycle leaves small to medium-sized up to 5 cm width, at least 1–3 largest leaves with whole leaf blade with angle 40–100° of leaf base, some smallest leaves in leaf cycle with 3–5 lobed or dissected leaf blade with whole lateral segments. Flowers with nearly fully reduced petals (Fig. 17).

Distribution and ecology in Latvia: the species is described from northern part of Hungary, Alsóhámor and records are known also from Ukraine and western part of Russian federation (Tzvelev 2001, 2012). In Latvia, occurs very rarely and unevely, mostly from southern part – in different grasslands in parks and urban areas (Daugavpils, Tukums, Ērberģe park, Embūte). It is very likely that the species should be considered as an anthropophyte in Latvia.

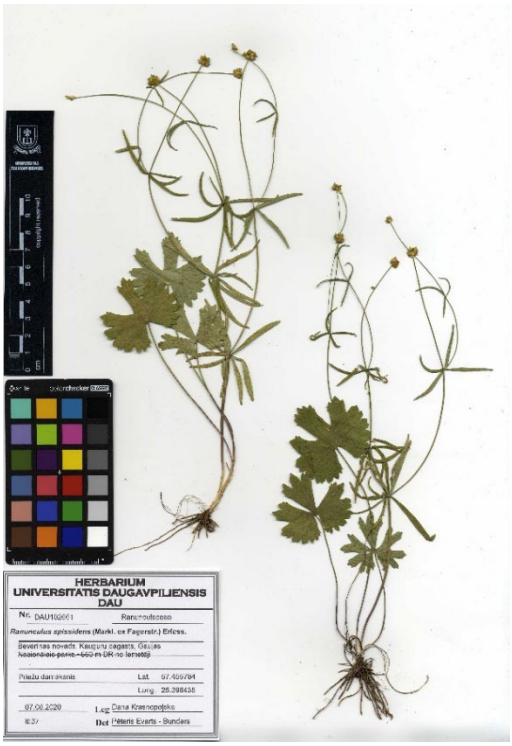

Figure 18. *Ranunculus spissidens* (Markl. ex Fagerstr.) Ericss.

***Ranunculus spissidens* (Markl. ex Fagerstr.) Ericss.** 1992. In: Ann. Bot. Fenn. 29(2): 152.
Most important morphological characters: small or medium-sized (slim) plant with linear, narrow toothless cauline leaves. Most developed basal cycle leaves medium-sized with angle 30–70° of leaf base. Basal cycle leaves mostly trilobated with no leaves with whole leaf blade – most developed leaves with 3-lobed leaf blade with lobed lateral segments, but, at same time, at least one leaf blade with whole, divided but not lobated lateral segments. Flowers with fully or nearly fully developed petals (Fig. 18).

Distribution and ecology in Latvia: occurs very rarely in central and northern part of Latvia, only in three localities in Lubāna mitrājs Nature Reserve and near Kauguri in Gauja National Park. Species is known from different forest habitats – wet birch forests and shrublands as well as from wet pine forest on mineral soil.

DISCUSSION

The native range of *R. auricomus* L. s. l. covers Northern and Central Europe, European part of Russia and Western Asia (Hulten & Fries 1986). More than 800 microspecies have been described in Eastern Europe, they show a low morphological differentiation (Julin 1963, 1966, Jalas & Suominen 1989, Ericsson 1992, Dunkel et al. 2018) with a very large number of endemic species in countries and regions. Narrow distribution ranges and very local distribution of apomictic *R. auricomus* complex species are widely recognized in Europe, even in the last years (e.g. Dunkel 2019, 2021). A good example is a new flora of the British Isles and Ireland, where all complex (58 species of *R. auricomus* complex) is only endemic, British-origin species with no taxa with wide, continental area (Leslie 2018). We cannot agree with such a position, because we believe that the flora is not formed in a "glass ball" without external influences, and it is affected both by the natural routes of entry of species from other regions, and, to a large extent, by anthropogenic activity.
Our research shows that at least 68 species of this group are found in Latvia – 17 from *R. cassubicus* complex, 18 from *R. fallax* complex, and 33 from *R. auricomus* complex (Evarts-Bunders et al. 2021, 2022, 2024). At the same time, the overall level of research in the region is not sufficient, at least for now, to discuss about new species or even endemic species of *R. auricomus* complex in this region. On the other hand, in the case of Latvia, there are also no significant geographical barriers to seriously consider the possibility of endemic species here, especially knowing that there is no flora endemism in Latvia.
Discussing about the entry routes of species and the status of species in Latvia and in the Baltic States in general, it must be admitted that there are very few such studies on this field. Research of the Swedish auricomologist E. Julin on the origin centers, species status and paths of distribution of *Ranunculus* species in the eastern part of the Baltic Sea (Julin 1973) is the almost only one. It should be added that this work mentions the region of the Baltic States and mentions some species found here, mainly in Northern Estonia. E. Julin (1973) expresses the opinion that all the species described in Finland and Sweden originated in Scandinavia after the retreat of the last glacier. The region of the Baltic States as a possible place of origin of some species of the *R. auricomus* complex is not considered mainly because there were no data about it at that time. However, knowing the patterns of flora formation after the retreat of the glacier, we cannot rule out such a possibility.
Comparing the species diversity and origin of *R. auricomus* group with glabrous receptacles in Latvia, species described in the Scandinavian region undoubtedly dominate here. In our study concerning 15 species of *R. auricomus* complex with glabrous receptacle, approximately one half from the whole number of *R. auricomus* complex species in Latvia are given. Even if the number of species will change in future after more detailed

research, it is obvious that this group is richly represented in Latvia. The largest proportion – 12 (*R. acrifolius, R. amplisinus, R. brachyphyllarius, R. cosmophyllus, R. exiguifrons, R. inconspectus, R. latisinuatus, R. lepidus, R. ostrobottnicus, R. rotundellus, R. rotundidens* and *R. spissidens* are taxa described by G. Marklund, C. Cedercreutz, E. Julinand; others are known from the southern part of Finland or Sweden. In this case, these species should be considered as autochthonous flora element originating from the Baltic Sea region.

Only three species of this complex are described from Central Europe: *R. pseudoacris* and *R. schillerii* are described from Hungary by R. Soó; *R. pseudovertumnalis* by the German botanist T. Haas. These species have a relatively wide range – Central and Eastern Europe (Jalas & Suominen 1989, Tzvelev 2001). However, this rises a discussion on the floristic status of the species – is it autochtonous or an anthropophyte? *R. pseudoacris* occurs rarely only in some parks and greeneries in south-western part of Latvia (Fig. 19), and at least so far there are no known localities from natural habitats. The situation is quite similar with the other Hungarian species *R. schilleri* (Fig. 20) – localities are known from parks and urban grasslands only. The status of the species should be re-evaluated if there were studies on the Lithuanian and Polish *R. auricomus* complex and these species in these countries, however, at least for now, there are no such studies.

Regarding to the third Central European species, *R. pseudovertumnalis*, there is only one record in Latvia – a disturbed contact strip near reed grove in alluvial habitat, therefore we have not enough material to discuss the species autochtonity. The species may be considered an anthropophyte in Latvia.

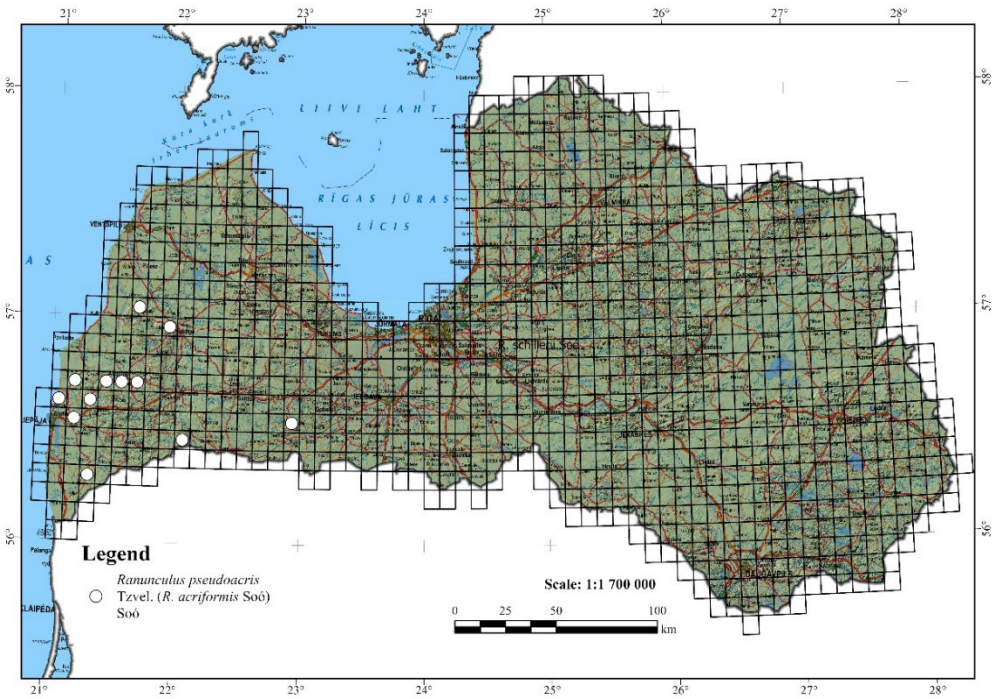

Figure 19. Distribution of *R. pseudoacris* Tzvel. in Latvia. Map author: M. Nitcis.

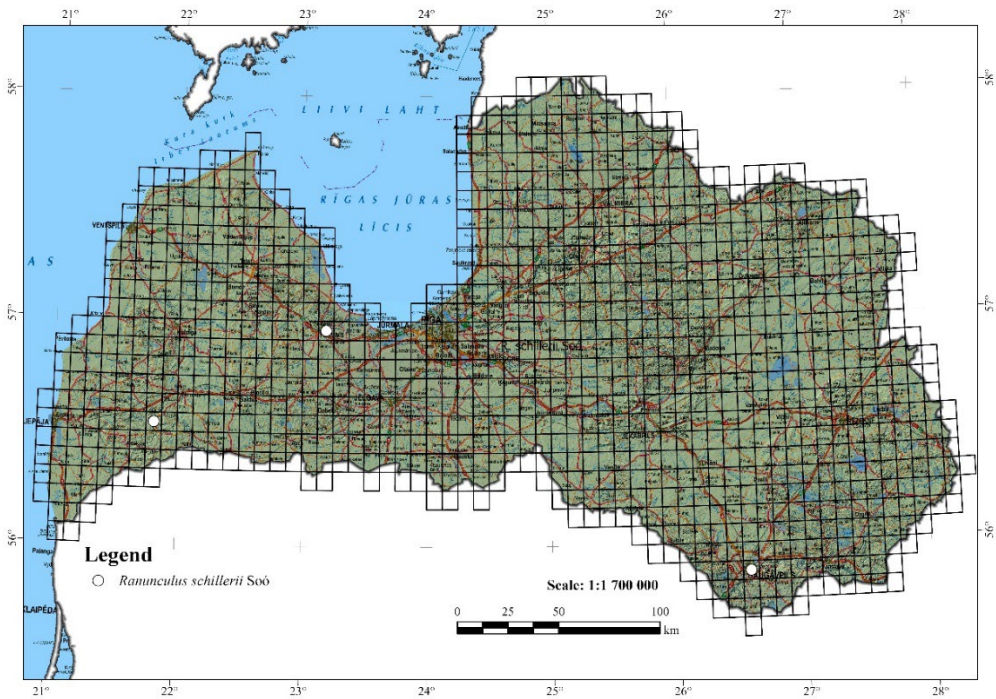

Figure 20. Distribution of *R. schilleri* Soó in Latvia. Map author: M. Nitcis.

It is too early to discuss about the patterns of distribution and entry routes as well as predict the appearance of new *R. auricomus* complex species in Latvia. At the same time, it is very probable that after more detailed further studies both new species, known from neighbouring countries, and completely new, neoendemic taxa of apomictic *R. auricomus* complex can be found in this floristically rich and peculiar region, especially – knowing the "crossroad" status of Latvian flora in the Eastern European flora context, a relatively high number of *R. auricomus* complex species was predictable.

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Appendix 1. Comparison of diagnostic characters for the species of the *Ranunculus auricomus* group with glabrous receptacles in the Latvia.

Species	Flowering shoot	Lower stem leaves	Lower stem leave tooth	Basal leaves cycle	Size of most developed basal leaves, angle of basal lobes	Perianth	Receptacle (Gynoclinium)
R. acrifolius	Slim, (20) 25–35cm	Linear. Length-width ratio ± 10–1	Without teeth, rarely with some long teeth	All leaves with 3-lobed blades, but only most developed basal cycle leaves with deeply lobed or dissected main segments. Lateral segments petiolate.	3-4–5 (6.5) cm, all basal leaves narrow or wide angle (60°–120°)	Partially reduced	Glabrous
R. amplisinus	Slim, (20–) 25–30 (–35) cm	Long, linear. Length-width ratio ± 15–1	Without teeth, relatively very long.	All leaves mostly 3-lobated with no leaves with whole leaf blade – most developed leaves with 3-lobed leaf blade with deeply lobed lateral segments with narrow lobes, the outline of leaf blade looks round. Lateral segments petiolate.	4–6 (7.5) cm all basal leaves narrow or wide angle (60°–120°)	Partially reduced	Glabrous or with very sparse hairs
R. brachyphyllarius	Gracile or slim, (15–) 18–25 (–30) cm	Linear. Length-width ratio ± 10–1	Without teeth, rarely with some long teeth.	All leaves with 3-lobed blades, most developed basal cycle leaves with deeply lobed main segments, all lobes with rounded tips. Lateral segments sessile.	2.5–4 (5) cm, all basal leaves mostly with narrow angle (40°–100°)	Fully or nearly fully developed	Glabrous
R. cosmophyllus	Slim, (20–) 25–35 (–40) cm	Long, linear. Length-width ratio ± 15–1	Without teeth.	All leaves with 3-lobed leaf blade, lateral lobes of biggest, most developed shallowly divided, but some smallest leaves in cycle with deeply lobed lateral segments, main segments sessile.	Most developed basal cycle leaves small to medium-sized with angle 40–100° of leaf base,	Fully reduced	Glabrous
R. exiguifrons	Gracile or Slim, 20–30 (–35) cm	Linear	Without teeth, some leaves with linear lobes. Length-width ratio ± 10-1	Mostly trilobated with no leaves with whole leaf blade – most developed leaves with 3-lobed leaf blade with deeply lobed main segments, lobes short with rounded tips. Lateral and main segments sessile.	3.5–5.5 (6.5) cm, all basal leaves with wide angled base (120°–180°)	Fully reduced	Glabrous

R. inconspectus	Gracile or slim, (15–) 20–30 cm	Linear	Without teeth	Leaves with trilobated leaf blade with lobed or even dissected lateral segments, median segments regular, oblong-lanceolate, usually with entire, non-toothed leaf margin. All main segments sessile, without well-developed petioles	2.5–4 cm, all basal leaves with narrow angled base (30°–70°)	Partially or fully reduced	Glabrous
R. latisinuatus	Slim (20–) 25–35 cm	Linear	Without teeth	Basal cycle leaves trilobated with no leaves with whole leaf blade. Leaf blade, mostly with shallowly lobed lateral segments, main segment coarsely toothed or even lobed, not overlapped with lateral lobes.	3–4.5 (–5.5) cm, all basal leaves with wide angled base (120°–180°)	Nearly fully reduced	Glabrous
R. lepidus	Slim, 25–40 (–45) cm	Linear	Without teeth	Most developed leaves with trilobated leaf blade, where lateral lobes divided or even dissected, main segments on some leaves petiolate.	3.5–5 (–6) cm, all basal leaves narrow – or wide angle (30°–130°)	Fully developed	Glabrous or with very sparse hairs
R. ostrobottnicus	Slim, 20–30 (–40) cm	Long, linear	Without teeth	Most developed leaves with whole, coarsely toothed or shallowly trilobated leaves with whole lateral segments, at the same time some basal leaves with deeply trilobated or dissected leaf blade with deeply dissected lateral segments.	(2.5–) 3–4.5 cm, all basal leaves with wide angled base (90°–160°)	Partially developed	Glabrous
R. pseudoacris	Gracile or slim, (12–) 15–25 cm	Linear	With 1–2 long, narrow teeth on each side	Most developed leaves with trilobed leaf blade, where lateral lobes divided or even dissected, therefore leaves looks round and resembling leaves of *R. acris*.	3–4.5 cm, all basal leaves with narrow angled base (20°–80°)	Partially or fully reduced	Glabrous
R. pseudovertumnalis	Gracile or slim, 15–25 cm	Oblanceolate or linear	Regularly toothed (1–3 short teeth).	Basal cycle leaves with no leaves with whole leaf blade, all most developed basal leaves with 3-lobed leaf blade with lobed lateral segments. Outline of biggest leaves rounded. First, smaller basal leaves with whole lateral segments.	2.5–4 cm, all basal leaves with narrow angled base (10°–60°)	Partially or fully developed	Glabrous

R. rotundidens	Slim, 25–35 cm	Linear	Without teeth	All basal cycle leaves trilobated with no leaves with whole leaf blade. Most developed leaves with 3-lobed leaf blade with deeply lobed or even divided lateral segments and wide, deeply lobed main segment, overlapped with lateral segments.	3.5–5 (–6) cm, all basal leaves narrow angle or overlapped lobes (0°–40°)	Partially developed	Glabrous
R. rotundellus	Slim, 20–30 (–35) cm	Linear	With 1–2 long teeth or even lobes on each side	Most developed leaves mostly deeply trilobated or even fully dissected with petiolate main leaf segments, outline of biggest leaves rounded. Smallest leaves can be with nearly whole or shallowly lobed leaf blade.	2.5–3.5 cm, all basal leaves narrow or wide angle of base (0°–70°)	Partially or fully reduced	Glabrous or with very sparse hairs
R. schilleri	Gracile or slim, 15–25 cm	Linear or linear-lanceolate	Usually with 1–2 (3) big teeth or even lobes.	Most developed 1-3 leaves with whole leaf blade, some smallest leaves in leaf cycle with 3–5 lobed or dissected leaf blade with whole lateral segments.	2.5–4 (–5) cm, all basal leaves narrow or wide angle (40°–100°), leaves with whole leaf blade mostly with wide angle of base	Nearly fully reduced	Glabrous
R. spissidens	Gracile or slim, 15–25 cm	Linear	Without teeth	Leaves mostly trilobated with no leaves with whole leaf blade – most developed leaves with trilobated leaf blade with shallowly lobed lateral segments, at least one leaf blade with whole, divided but not lobated lateral segments.	3–4.5 cm, all basal leaves narrow or wide angle of base(30°–70°)	Fully developed	Glabrous