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Original Paper

STUDIES ON SPECIES OF THE *RANUNCULUS AURICOMUS* COMPLEX IN THE FLORA OF LATVIA: *RANUNCULUS CASSUBICUS* GROUP

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Traditionally, all authors in Latvia summarise all agamic species of the Ranunculus auricomus *complex under three species,* auricomus *L.,* R. fallax *(Wimm. et Grab) Sloboda, and* R. cassubicus *L. However, there are many compelling studies showing that the* R. auricomus *complex is a large assembly of apomictic microspecies. In this article, 17 species of the* R. cassubicus *group in Latvia are presented:* R. angustior *(Markl.) Ericss.* R. cajanderi *(Fagerstr.) Ericss.,* R. cassubicus *L. s.str.,* R. circinatifrons *(Markl.) Ericss.,* R. elatior *(Fries.) Ericss.,* R. hannae *Jasiew.,* R. imitans *(Markl.) Ericss.,* R. inopinus *(Markl.) Ericss.,* R. karelicus *(Markl.) Ericss.,* R. macrantherus *(Markl.) Ericss.,* R. niepolomicensis *Jasiew.,* R. pawlowskii *Jasiew.,* R. prorsidens *(Markl.) Ericss.,* R. scalaridens *(Markl.) Ericss.,* R. serratifrons *(Markl.) Ericss.,* R. svirensis *(Markl.) Ericss., and* R. tranzschelii *(Fagerstr.) Ericss.*

Keywords: Ranunculaceae*, buttercup, apomictic microspecies, floristic studies, biodiversity.*

INTRODUCTION

The genus *Ranunculus* L. comprises about 600 herbaceous species and more than 600 agamic species with a cosmopolitan distribution (Tamura, 1995; Emadzade *et al.*, 2011). It is the largest genus of *Ranunculaceae* and ranges among the 50 biggest genera of angiosperms (Frodin, 2004). *Ranunculus* has its greatest diversity in the submeridional to temperate zones of both hemispheres, and in high mountain systems (Emadzade *et al.*, 2011; Emadzade and Hörandl, 2011).

In Central Europe, the *Ranunculus auricomus* complex has gained increasing interest in recent years (Hörandl and Gutermann, 1998a; 1998b; 1998c; Hörandl *et al.*, 2009; Dunkel, 2010; 2014; 2019). The *Ranunculus auricomus* aggregate species is a Central and Eastern European group of apomictic and partially sexual taxa. Traditionally, all authors in Latvia summarise all agamic species of this complex under three species*, R. auricomus* L., *R. fallax* (Wimm. et Grab) Sloboda and *R. cassubicus* L. (e.g., Pētersone and Birkmane, 1980; Gavrilova and Šulcs, 1999; Priedītis, 2014). However, there are many compelling studies showing that the *R. auricomus* complex is a large assembly of apomictic microspecies. Since the first reports on apomixis in the *R. auricomus* complex by Rozanova (1932), there have been many investigations 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 characterised by internal constancy of features (e.g., Borchers-Kolb, 1983, 1985; Ericsson, 1992; Hörandl and Gutermann, 1998a; Ericsson, 2001; Hörandl and Greilhuber, 2002). However, only in some areas microspecies of the *R. auricomus* complex may be considered to have been described completely and covered by long-term studies (Ericsson, 2001), such as Austria (Hörandl and Gutermann, 1998a; 1998b; 1998c; 1999), Ba-

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varia (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; Fagerström *et al.*, 1975; Valta, 1968), Sweden (Julin, 1964; 1980) and partially some other countries (Russia, Poland). Data for other parts of the total range of the complex varies from incomplete to none. For instance, in Latvia and in the Baltic States overall, such studies even at a very preliminary level have never been done before.

During the last decades, there has been significant progress in broadening knowledge of the genus *Ranunculus*, including knowledge about phylogenetic relationships and the evolution of microspecies (e.g., Emadzade and Hörandl, 2011; Hörandl and Emadzade, 2012; Karbstein *et al.*, 2020), however, taxonomy in all *R. auricomus* apomictic complexes, including Northern European apomictic species, has not been developed. Therefore, *R. auricomus* complex is classified here only by means of informal groups. The *R. cassubicus* species complex is a Central and Eastern European group of apomictic and sexual taxa.

The *R. auricomus* complex in Latvia is interesting 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, and the Baltic region is an ancient agricultural land with ancient transport routes; this means that the flora is relatively rich here and agamic species from all these floristic areas can be found here. At the same time, Latvia is not isolated by geographical barriers, and no fully endemic plant species are known here. Therefore, it can be easily predicted that *R. auricomus*, and, in this case, *R. cassubicus* group species, described in Scandinavia (Marklund, 1961; 1965; Valta, 1968; Fagerström, 1965; 1974; 1976; Fagerström *et al.*, 1975), Poland (Jasiewicz, 1956; 1985) and Russia (Tzvelev, 1994; 2001; 2012) can be found here.

Critical study of herbaria specimens from Latvia and all 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, all leading to the necessity to update and clarify the species composition of the *R. auricomus* complex and its distribution patterns in Latvia.

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

MATERIALS AND METHODS

During our previous work, it was found that 17 *R. cassubicus* group species have been recognised in Latvia. Material collected in the whole territory of Latvia during numerous field trips since 2016 was studied. The floristic diversity of the *R. cassubicus* group was studied with an emphasis on suitable habitats — nemoral forests with dominance of broad-leaved trees, disturbed forests, clearcuts, etc. Special attention was paid to old manor parks and other dendrological plantations, botanical gardens, arboretums, etc. Many of them had long-term continuity and an excellent nemoral grass layer with co-dominance of *R. cassubicus* s.l. (Fig. 1).

Comprehensive revision of major herbaria in Latvia — Daugavpils University, Institute of Life Sciences and Technology, Laboratory of Botany (DAU, 664 herbaria specimens, most of which were collected by authors during previous years), University of Latvia, Institute of Biology, Laboratory of Botany (LATV, approx. 50 herbaria speci-

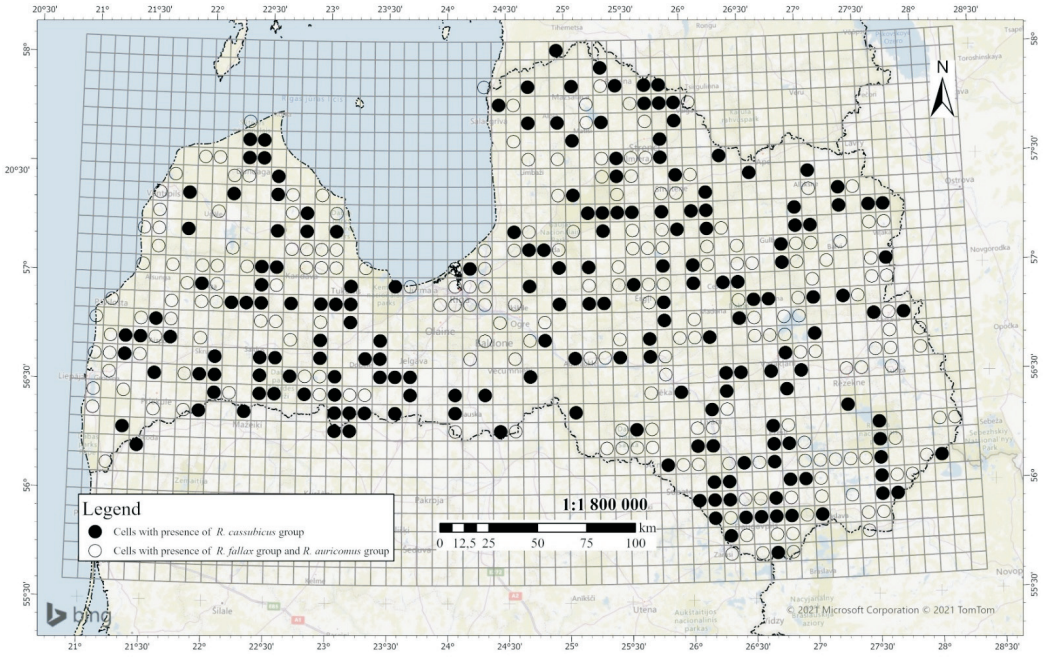


Fig. 1. Map of geobotanical grid cells of Latvia with studied cells of *Ranunculus auricomus* complex species.

mens), University of Latvia, Museum of Botany (RIG, approx. 20 herbaria specimens) was carried out during this study. Additionally, data were obtained from some foreign herbaria – 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).

Special terminology, definitions and morphological characters like morphology of basal and cauline leaf, morphology of basal leaf blade (lobed, divided, dissected, degree of incision, etc.) and morphology of reproductive organs (receptacle, and carpellophores) were used as by Dunkel (2005a; 2010; 2019).

The opinion of authors differs on the priorities for the importance of choosing different characters. Jasiewicz (1956), Tzvelev (1994; 2001), and most Scandinavian experts 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. Another approach requires the 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 recognisable 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 considered were:

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.** It is a well-established fact that this character is the most important in the *R. cassubicus* group (Fig. 2). The cycle of the basal leaves consists of two, three, and seldom four leaves. The leaf blades were described by the angle of the base (aperture), mode of division (in this group only in some cases) (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. The main identification characters are described for the latest developed leaves in the leaf cycle during anthesis.

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).

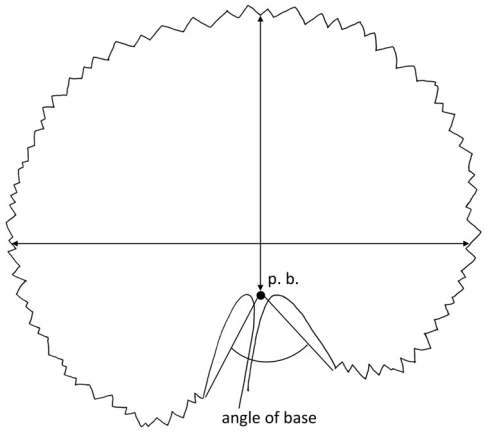


Fig. 2. Basal leaf of *Ranunculus auricomus* s.l. Schematic diagram illustrates the most important characteristics: the length and the width of a leaf; the basal point (p.b.) is defined by junction of the main leaf veins; the angle of the base is measured from the basal point.

4. **Generative characters.** The number, length and level of development of the petals are characteristic for identification. In all diploid (and sexual) species, the flowers consist of five (rarely 6–7) well-developed petals; for apomictic asexual species the corolla is partially or fully reduced. More important are the characters of the gynoclinium (the main part of receptacle): size, shape, and hairiness. Another important distinctive character is the length of the carpellophores (short — up to 0.2 mm, long — up to 0.4 mm and longer).

In a study on *R. auricomus* microspecies, the following should be considered. All characters should be checked several times, if possible. It is necessary to collect more than one herbarium from one population, better at least 4–5, if it is possible. If the size of the population allows it, a series of 4–5 plants of a specific species should be collected each time in the research. 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 will often be difficult or impossible to determine. For these reasons, with some exceptions only the herbaria collected during our research were taken into account for compiling the distribution maps.

Species distribution maps for Latvia were prepared by applying the square method using 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, the standardised 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), and very common (more than 751) (Fatare, 1992).

All collected and cited herbarium specimens are deposited in 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

In distinguishing species of *R. cassubicus* group, we were guided by following morphological characters, which separate relatively this informal group from other groups of *R. auricomus* complex: oblanceolate or rhomboidal cauline leaves at least with some teeth; smallest number (only 2–4) of basal leaves with whole, reniform leaf blade, where some leaves or atypically in some populations — even all leaves of basal leaf cycle can be lobed or even divided; as well as hairiness of receptacle (at least for species of this group in Latvia) — the characters, which are commonly used to recognise *R. cassubicus* group *sensu lato*. Here, however, it must be admitted that we consider these morphological characters to be formal, as for several species these characters overlap with similar characters of *R. fallax* group. Therefore, the *R. cassubicus* group is considered to be artificial and used mainly for simplification of identification. In some floras and other works, therefore, the *R. fallax* and *R cassubicus* group species are used as one aggregate — *R. cassubicus* (Jasiewicz, 1956; 1985).

There were 17 *R. cassubicus* group species 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 (see Table 1). Thus, only short descriptions of species — explanation of the main characters and differences from nearest species are given, as well as main facts of species distribution and habitats in Latvia. For the first time,

Table 1. Comparison of diagnostic characters for the species of the *Ranunculus cassubicus* group in Latvia

	Flowering shoot	Lower steam leaves	Lower steam leave tooth	Basal leaves	Largest basal leaf	Basal lobes	Perianth	Carpellophores
Ranunculus angustior	Slim, 30–35 (40) cm	oblanceolate; sessile	with 3–8 regular teeth on each side	undivided	reniform, crenate-serrated	up to 5.5 (7) cm wide, leaves with narrow angled base (20°–100°)	well developed	short
Ranunculus cajanderi	Robust, (35) 40–50 cm	oblanceolate; subsessile	with 5–10 long, more or less acute, irregular teeth on each side	undivided	reniform, crenate-serrated	7–9 (10) cm wide, leaves with narrow angled base (60°–90°)	partially or fully reduced	short
Ranunculus cassubicus	Robust, 45–65 (70) cm	wide lanceolate; sessile	with 7–9 large irregular teeth on each side	undivided	reniform, irregularly toothed	9–15 cm wide, leaves with narrow angled base (20°–60°)	fully reduced	long
Ranunculus circinatifrons	Robust, (40) 50–70 cm	rhomboidal – lanceolate; subsessile	with (3) 4–8 (9) long, mostly irregular teeth on each side	undivided	reniform, crenate-serrated	8,5–11 (13) cm, angled of the leaf base is narrow or lobes overlapped	partially or fully reduced	long
Ranunculus elatior	Robust, 45–60 (65) cm	rhomboidal – lanceolate; sessile or near sessile	with 7–12 (15) short regular teeth on each side (rarely teeth may be longer)	undivided	reniform, crenate-serrated	8–13 (15) cm wide, all basal leaves with narrow angled base (20°–60°)	partially or fully reduced	long
Ranunculus hannae	Slim, 23–35 (40) cm	rhomboidal – lanceolate; subsessile or petiolate	with 6–10 (12) long, irregular teeth on each side	undivided	reniform, irregularly toothed	5–8 (9) cm wide, angled of the leaf base is narrow or lobes overlapped	well developed	short
Ranunculus imitans	Slim, 35–40 cm	rhomboidal – lanceolate; sessile or subsessile	with 5–7 short irregular teeth on each side (rarely leaves tooth may be longer)	undivided (leaves of individual plants in the population may also be forked)	reniform, crenate-serrated	6–8 cm wide, all basal leaves with narrow angled base (30°–90°)	partially reduced	long

Continuation of Table 1.

	Flowering shoot	Lower steam leaves	Lower steam leave tooth	Basal leaves	Largest basal leaf	Basal lobes	Perianth	Carpellophores
Ranunculus inopinus	Robust, (35) 40–60 cm	lanceolate; subsessile	with 2–6 large irregular teeth	undivided and lobed	reniform, irregularly toothed	6–8 cm wide, leaves with narrow angled base (10°–40°)	partially reduced	short
Ranunculus karelicus	Slim, 30–40 cm	rhomboidal – lanceolate; sessile	with 7–9 regular teeth on each side	undivided	reniform, irregularly toothed (with 30-40 teeth on each side)	4–8 (11) cm wide, leaves with narrow angled base (20°–70°)	semi-developed or well developed	short
Ranunculus machrantherus	Robust, 50–75 cm	lanceolate; subsessile or petiolate	with 6–10 regular teeth on each side	undivided	reniform, irregularly toothed	8–10 (14) cm wide, leaves with narrow angled base (10°–40°)	well developed	short
Ranunculus niepolomicensis	Slim, 25–35 (40) cm	lanceolate; subsessile or petiolate	with 6–11 large irregular teeth on each side	undivided	reniform, irregularly toothed (with up to 40 teeth on each side)	5–7 cm wide, all basal leaves with narrow angled base (10°–40°)	well developed	short
Ranunculus pawlowskii	Slim, 25–40 cm	lanceolate; subsessile or petiolate	with 5–8 irregular teeth on each side	undivided and lobed	reniform, irregularly toothed (up to 20 teeth on each side)	up to 5 cm, all basal leaves with narrow or wide angled base (75°–135°)	partially reduced	long
Ranunculus prorsidens	Slim, 30–50 (60) cm	rhomboidal – lanceolate; subsessile or petiolate	with 5–8 (10) short regular teeth	undivided	reniform, crenate-serrated	up to 10 cm wide, all basal leaves with narrow angled base (10°–80°)	fully reduced	short
Ranunculus scalaridens	Slim, 35–55 cm	oblanceolate; subsessile or petiolate	with 3–6 (8) irregular teeth on each side	undivided	reniform, irregularly toothed	7–10 cm, all basal leaves with narrow angled base (20°–90°)	fully reduced	short
Ranunculus serratifrons	Slim 30–40 (50) cm	oblanceolate; subsessile or petiolate	with 2–6 long irregular teeth on each side	undivided	reniform, distinctly irregularly toothed	5–7 (8) cm, all basal leaves with narrow angled base (30°–60°)	partially reduced	long
Ranunculus svirensis	Robust 40–60 cm	oblanceolate to rhomboidal-lanceo late; sessile or subsessile	with 5–8 regular teeth on each side	undivided	reniform, crenate-serrated	8–10 (12) cm, all basal leaves with narrow or wide angled base (30°–120°)	well developed	long
Ranunculus tranzschelii	Robust (35) 40–50 cm	oblanceolate; subsessile or petiolate	with 2–8 long irregular teeth on each side	undivided, basal leaves fully developed after flowering	reniform, irregularly toothed	7–10 cm wide, all basal leaves with narrow angled base (10°–30°)	well developed	long

species epithets in Latvian have been assigned for all species.

1. ***Ranunculus angustior* (Markl.) Ericss.** 1992, Ann. Bot. Fenn. 29, 2: 143. Šaurdaivu gundega (Fig. 3)

Most important morphological characters: Medium-sized (slim) plant with oblanceolate, shortly regularly toothed, cauline leaves and medium-sized most developed basal leaves with angle 20°–100° of leaf base. Flowers with fully or nearly fully developed petals.

Distribution and ecology in Latvia: Occurs very rare and scattered, mostly in the southern part of Latvia — Zemgale, Southern Kurzeme, and Sēlija — in old parks in Aknīste, Dobele, Vilce, as well as in natural habitats — rich broad-leaved and ravine forests in Ruba, Venta valley, and other places (Fig. 4).

2. ***Ranunculus cajanderi* (Fagerstr.) Ericss.** 1992, Ann. Bot. Fenn. 29, 2: 135. Kajandera gundega (Fig. 5)



Fig. 3. Ranunculus angustior (Markl.) Ericss.

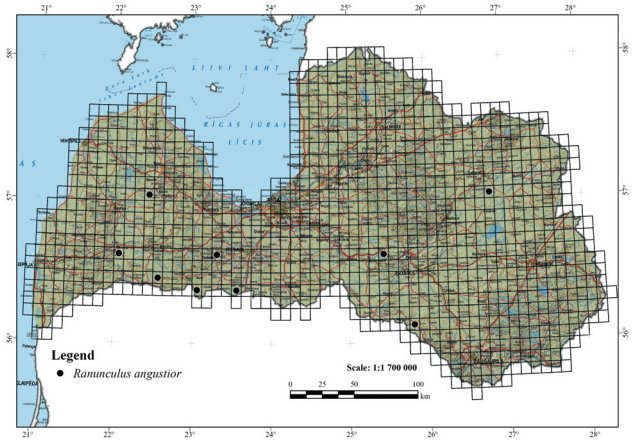


Fig. 4. Distribution of *Ranunculus angustior* (Markl.) Ericss. in Latvia.



Fig. 5. Ranunculus cajanderi (Fagerstr.) Ericss**.**

Most important morphological characters: Robust plant with characteristic bluish-green colour, oblanceolate cauline leaves with several large, irregular teeth and massive, reniform and regularly toothed most developed basal leaves with angle 50°–90° of leaf base. Flowers with fully or nearly fully developed petals.



Fig. 6. Ranunculus cassubicus L.

Distribution and ecology in Latvia: Occurs very rare and scattered in the whole territory of Latvia — Palsmane, Pilsrundāle, Slītere, Venta valley, and other places. Grows in rich nemoral broad-leaved forests and ravine forests, as well as in old manor parks and contact zones — roadsides.

3. ***Ranunculus cassubicus* L.** 1753, Sp. Pl.: 551, s.str. Kasūbijas gundega (Fig. 6)

Most important morphological characters: Robust plant with characteristic irregularly toothed oblanceolate, sessile cauline leaves, and robust (up to 15 cm) and irregularly toothed most developed basal leaves with narrow angle of leaf base. Flowers with nearly or fully reduced petals.

Distribution and ecology in Latvia: Occurs very rare or relatively rare and unequally in the whole territory of Latvia, however, the frequency of distribution is declining from east to west of Latvia. Grows in rich nemoral broad-leaved forests and in parks.

It should be noted that the type specimen of *R. cassubicus* in Linnean herbaria is still with an unclear origin, but may come from Northern Poland or Central Russia, or even the Ural Mountains (Kvist, 1987). *R. cassubicus* like-plants from Central Europe are classified as *R. cassubicifolius* W. Koch, *R. carpaticola* Soó or some other species of this group — mostly with well-developed corolla. We believe that similar to the flora of Western Russia this species also can be found in Latvia. Thus, more research is needed on the patterns of *R. cassubicus* distribution in the Baltic States.

4 ***Ranunculus circinatifrons* (Markl.) Ericss**. 1992, Ann. Bot. Fenn. 29, 2: 136. Apaļlapu gundega (Fig. 7)

Most important morphological characters: Robust plant with rhomboidal-lanceolate, shortly regularly toothed, cauline leaves and medium sized most developed basal cycle leaves with very narrow or usually with overlapped lower lobes; therefore leaves look rounded. All flowers with reduced or nearly reduced petals, by which well distinguishable from similar *R. hannae*.



Fig. 7. *Ranunculus circinatifrons* (Markl.) Ericss.



Fig. 9. Ranunculus elatior (Fries.) Ericss.

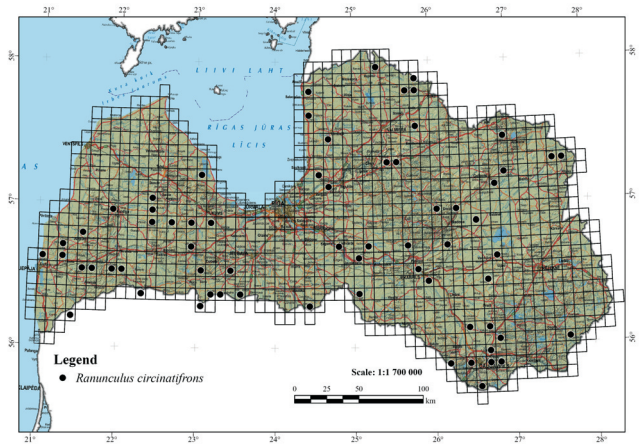


Fig. 8. Distribution of *Ranunculus circinatifrons* (Markl.) Ericss. in Latvia.

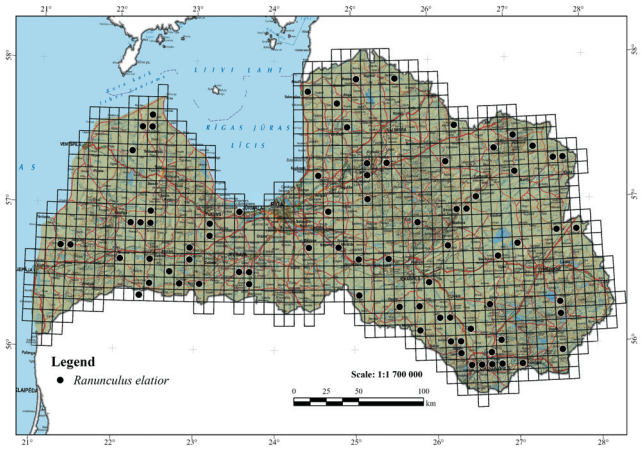


Fig. 10. Distribution of *Ranunculus elatior* (Markl.) Ericss. in Latvia.

Distribution and ecology in Latvia: Occurs not very common in the whole territory of Latvia. Grows mainly in old manor parks, as well as rich nemoral and alluvial forests, clearcuts and different contact zones — roadsides and forest edges (Fig. 8).

5. ***Ranunculus elatior* (Fries.) Ericss.** 1992, Svensk Bot. Tidskr. 86: 79. Augstā gundega (Fig. 9)

Most important morphological characters: Species, associated with typical *R. cassubicus* s.l.: robust plants with rhomboidal-lanceolate, shortly regularly toothed, cauline leaves and large reniform and robust (up to 15 cm) and regularly toothed most developed basal leaves with narrow angle of 20°–60° of leaf base. Flowers with fully or nearly fully reduced petals.

Distribution and ecology in Latvia: Occurs not very common on the whole territory of Latvia in typical habitats — rich broad-leaved forests, ravine forests and parks as well as in clearcuts, and young forest stands (Fig. 10).

6. ***Ranunculus hannae* Jasiew.** 1956, Fragm. Fl. Geobot. (Krákow), 2, 1: 102. Hannas gundega (Fig. 11)

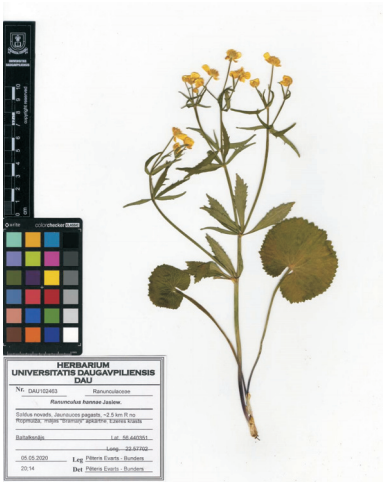


Fig. 11. Ranunculus hannae Jasiew.

Most important morphological characters: Medium-sized (slim) plant with rhomboidal-lanceolate, irregularly toothed cauline leaves and medium sized most developed basal cycle leaves with very narrow or usually with overlapped lower lobes, therefore leaves look rounded. All flowers with well-developed petals. This plant resembles smaller *R. circinatifrons*, from which it differs by well-developed flowers, or *R. angustior*, from which it differs with irregularly toothed cauline leaves.

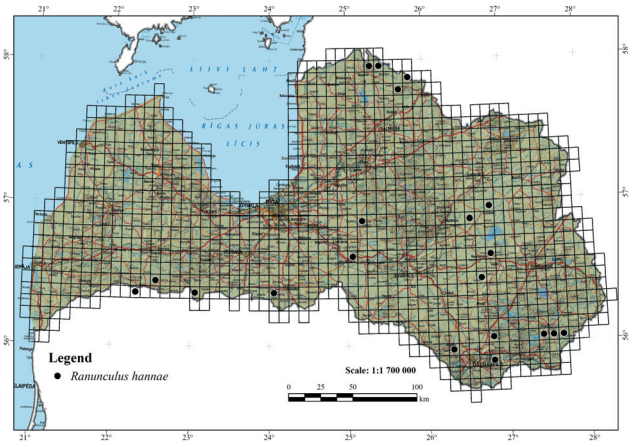


Fig. 12. Distribution of *Ranunculus hannae* Jasiew. in Latvia.

Distribution and ecology in Latvia: Occurs rare and unequally, mainly in the southern part of Latvia — Zemgale and Kurzeme — Ezere, Ukri, Ziedoņi, protected landscape area "Augšdaugava", and other places. Grows in rich broad-leaved forests and old manor parks (Fig. 12).

7. ***Ranunculus imitans*** **(Markl.) Ericss.** 1992, Ann. Bot. Fenn. 29, 2: 142. Mānīgā gundega (Fig. 13)

Most important morphological characters: Medium-sized (slim) plant with rhomboidal-lanceolate, shortly irregularly toothed cauline leaves and medium-sized reniform (up to 8 cm) and regularly toothed most developed basal leaves with narrow angle of leaf base of 30°–90°. Species resemble a relatively small plant of *R. elatior*. It should be noted that in some populations a part or even all most developed leaves of the basal leaf cycle can be with shallow lobes or evenly divided leaf blades, therefore, collecting 4–5 herbaria from one population in these cases is essential. Flowers with partially or even nearly developed petals.

Distribution and ecology in Latvia: Occurs not very common in the whole territory of Latvia. Grows in rich nemoral broad-leaved forests, as well in parks and different contact zones — forest edges, roadsides and forest meadows (Fig. 14).

8. ***Ranunculus inopinus*** **(Markl.) Ericss.** 1992, Ann. Bot. Fenn. 29, 2: 142. Pārsteidzošā gundega (Fig. 15)

Most important morphological characters: Medium-sized (slim) plant with wide-lanceolate, irregularly toothed cauline leaves with large teeth or even lobes. Most developed basal leaves medium-sized, reniform, and undivided and at the same time lobed and even divided leaf blade with narrow basal angle of 10°–40°. Flowers with partially reduced petals.

Distribution and ecology in Latvia: Occurs rare in Latvia, mostly only in the northern part of Latvia — Vidzeme. Grows in rich broad-leaved forests and in parks — Cēsis, Drabeši, Graši, Kauguri, Liezēre, Trapene, and other places.



Fig. 13. Ranunculus imitans (Markl.) Ericss.

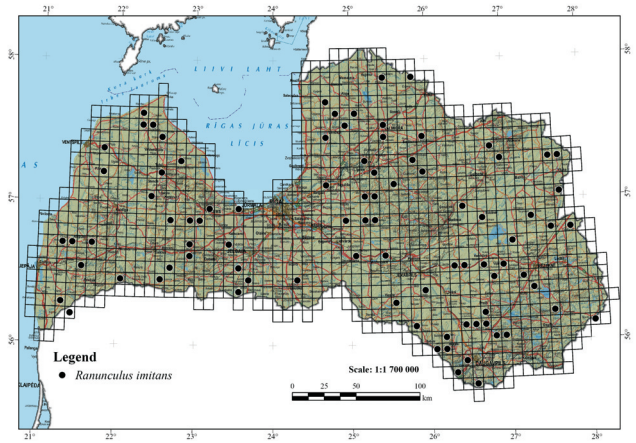


Fig. 14. Distribution of *Ranunculus imitans* (Markl.) Ericss. in Latvia.



Fig. 15. Ranunculus inopinus (Markl.) Ericss.

9. ***Ranunculus karelicus*** **(Markl.) Ericss.** 1992, Ann. Bot. Fenn. 29, 2: 143. Karēlijas gundega (Fig. 16)

Most important morphological characters: Medium-sized (slim) plant with wide, rhomboidal-lanceolate cauline leaves. Leaf margin with regular teeth, cauline leaves and most developed basal leaves medium-sized, reniform, and undivided, leaf margin finely toothed. Flowers with nearly or fully developed petals. Species resembling *R. angustior*, but distinguished by rhomboidal cauline leaves, and from



Fig. 16. Ranunculus karelicus (Markl.) Ericss.

other similar species — *R. niepolomicensis* it differs by larger number of teeth along margin of most developed cauline leaves (more than 40).

Distribution and ecology in Latvia: Occurs very rare in Latvia, known only from a few localities. Localities are known mainly from parks (Dviete, Višķi), as well as from rich nemoral broad-leaved or/and alluvial forests in Central Vidzeme.

10. ***Ranunculus macrantherus* (Markl.) Ericss.** 1992, Ann. Bot. Fenn. 29, 2: 144. Lielziedu gundega (Fig. 17)

Most important morphological characters: Robust plant with characteristic regularly toothed lanceolate, subsessile to petiolate cauline leaves, and robust (8–10) and irregularly toothed most developed basal leaves with narrow angle of leaf base (10°–40° degrees). Flowers with well-developed petals, largest in this group, usually larger than 3 cm in diameter. One of the biggest species in this group and can reach up to 70–75 cm in height.

Distribution and ecology in Latvia: Occurs very rare in Latvia, known only from four populations — in Ziedoņi manor park, as well as rich forest habitats near Līkupēni, Idus, and Mazsalaca.

11. ***Ranunculus niepolomicensis* Jasiew.** 1956, Fragm. Fl. Geobot. (Krákow), 2, 1: 97. Ņepolomices gundega (Fig. 18)

Most important morphological characters: Medium-sized (slim) plant with lanceolate or oblanceolate, irregularly toothed cauline leaves with large teeth. Most developed basal leaves medium-sized, reniform, and undivided, with narrow basal angle of 10°–40°. Flowers with well-developed petals. Species resembling *R. karelicus* and *R. angustior*, from which it differs by irregularly toothed cauline leaves and relatively smaller number of teeth along margin of most developed cauline leaves (up to 40).

Distribution and ecology in Latvia: Occurs rare in central and southern part of Latvia – Kaķenieki, Ķevele, Meirāni, Prauliena, and other places. Grows in rich nemoral broad-



Fig. 17. Ranunculus macrantherus (Markl.) Ericss.



Fig. 18. Ranunculus niepolomicensis Jasiew.



Fig. 19. Ranunculus pawlowskii Jasiew.

leaved forests, as well as alluvial forests and flooding grasslands near rivers.

12. ***Ranunculus pawlowskii* Jasiew.** 1956, Fragm. Fl. Geobot. (Krákow), 2, 1: 94. Pavlovska gundega (Fig. 19)

Most important morphological characters: Medium-sized (slim) plant with lanceolate or oblanceolate, irregu-

larly toothed cauline leaves with short or medium-sized teeth. Most developed basal leaves are relatively small, up to 5 cm, reniform, undivided, but some leaves of leaf cycle with lobed leaf blade, with wide basal angle of 70°–130°. Flowers with partially developed petals. Species resembling *R. karelicus* and *R. angustior*, from which it differs by irregularly toothed cauline leaves and relatively smaller number of teeth along margin of most developed cauline leaves (up to 40). This species differs from similar *R. niepolomicensis* by the wide basal angle of basal leaves.

Distribution and ecology in Latvia: Occurs very rare in central and south-eastern part of Latvia — in anthropogenic habitats in Atašiene and Daugavpils, as well as in broad-leaved forests in some protected nature territories — "Raudas meži" and "Ukru gārša". This species is very similar to another species, described by Polish botanist Adam Jasiewicz — *R. zmudae* Jasiewicz, but belongs to the *R. fallax* group; therefore, further more detailed research and more collected herbaria are needed for thorough clarification.

13. ***Ranunculus prorsidens* (Markl.) Ericss.** 1992, Ann. Bot. Fenn. 29, 2: 150. Vienādzobu gundega (Fig. 20)

Most important morphological characters: Medium-sized (slim) light green plant with rhomboidal-lanceolate, shortly regularly toothed cauline leaves and medium-sized to relatively large reniform (up to 10 cm) and regularly toothed most developed basal leaves with narrow 10°–80° angle of leaf base. Species resembles a relatively small *R. elatior.* Petals are completely reduced in flowers, which can be well distinguished from similar medium-sized species *R. imitans.* Another similar medium-sized species — *R. scalaridens* has irregularly toothed and petiolate cauline leaves.

Distribution and ecology in Latvia: Occurs relatively rare in the whole territory of Latvia, but it is possible that after more detailed studies it will turn out to be one of the most common species of this group in Latvia. Grows in rich nemoral broad-leaved forests, in parks, wet grasslands and similar places (Fig. 21).

14. ***Ranunculus scalaridens* (Markl.) Ericss.** 1992, Ann. Bot. Fenn. 29, 2: 152. Aszobu gundega (Fig. 22)

Most important morphological characters: Medium-sized (slim) plant with oblanceolate, medium sized irregularly toothed cauline leaves and medium to relatively large (up to 10 cm) reniform and regularly toothed most developed basal leaves with 20°–90° angle of leaf base. Species resembling a relatively smaller *R. cassubicus*, with different cauline leaves — petiolate or subsessile and different mode of toothing, as well as shorter carpellophores. Corollas are completely reduced in all flowers, by which it can be well distinguished from similar medium-sized species *R. imitans*. Another similar medium-sized species — *R. prorsidens* has markedly regularly toothed and petiolate cauline leaves.

Distribution and ecology in Latvia: Occurs relatively rare in the whole territory of Latvia. Localities are known



Fig. 20. Ranunculus prorsidens (Markl.) Ericss.

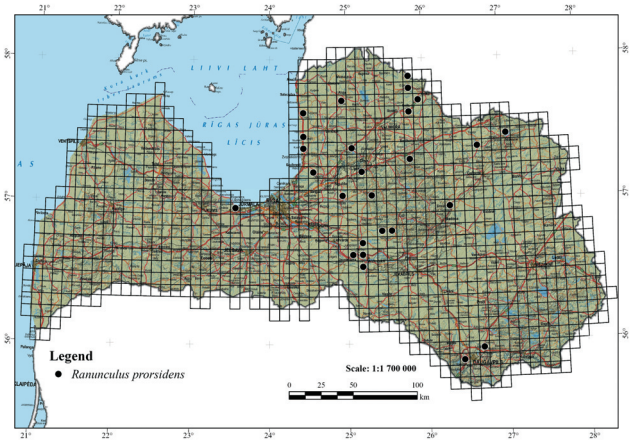


Fig. 21. Distribution of *Ranunculus prorsidens* (Markl.) Ericss. in Latvia.

mainly from parks, as well as from rich nemoral broad-leaved or mixed forests and alluvial forests (Fig. 23).

15. ***Ranunculus serratifrons* (Markl.) Ericss.** 1992, Ann. Bot. Fenn. 29, 2: 152. Zāģzobu gundega (Fig. 24)

Most important morphological characters: Medium-sized (slim) plant with oblanceolate, shortly irregularly serrate cauline leaves with long tooth and medium-sized to relatively large reniform (up to 7 cm) and distinctly irregularly serrated most developed basal leaves with narrow 30°–60° angle of leaf base. By the characteristic form with irregularly serrate margin of most developed basal leaves it is relatively easily distinguished from the other species of *R. cassubicus* group in Latvia.

Distribution and ecology in Latvia: Occurs rare in Latvia. Grows mainly in contact zones — forest edges, roadsides, shrublands, as well as in wet grasslands and parks — Dagda, Galēni, Sidgunda, Stukmaņi, Vilce.

16. ***Ranunculus svirensis* (Markl.) Ericss.** 1992, Ann. Bot. Fenn. 29, 2: 153. Sviras gundega (Fig. 25)

Most important morphological characters: Robust plant with oblanceolate to rhomboidal, regularly toothed sessile



Fig. 22. Ranunculus scalaridens (Markl.)



Fig. 25. Ranunculus svirensis (Markl.)

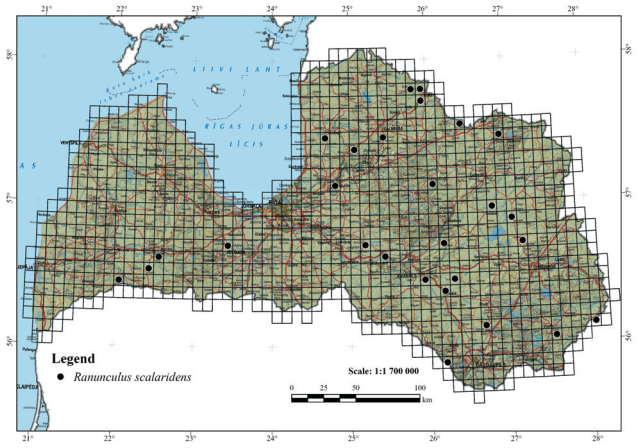


Fig. 23. Distribution of *Ranunculus scalaridens* (Markl.) Ericss. in Latvia.

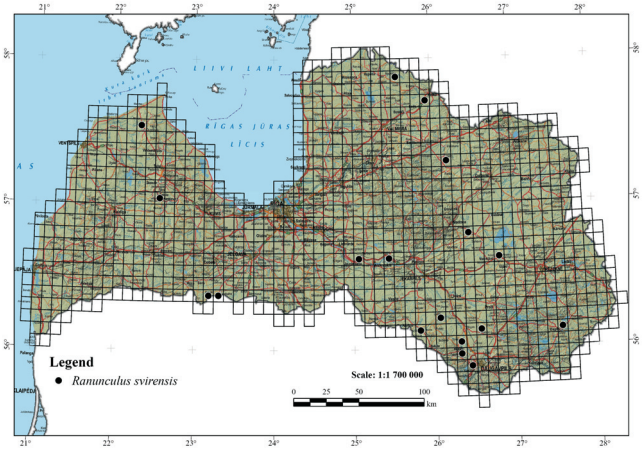


Fig. 26. Distribution of *Ranunculus svirensis* (Markl.) Ericss. in Latvia.



Fig. 24. Ranunculus serratifrons (Markl.) Ericss.



Fig. 27. Ranunculus tranzschelii (Fagerstr.) Ericss.

to subsessile cauline leaves and large reniform, robust (up to 12 cm) and regularly toothed most developed basal leaves with 30°–120° angle of leaf base. *R. svirensis* is similar to the other large, robust species of this group — *R. elatior,* but distinguished by fully developed petals, and *R. tranzschelii*, from which it differs by regularly serrate cauline leaves and fully developed largest basal cycle leaves already during flowering time.

Distribution and ecology in Latvia: Occurs rare in the whole territory of Latvia. Grows in rich nemoral broad-leaved forests, in park ground cover and contact zones — roadsides, under tree alleys, or even under separately growing big trees in agricultural lands (Fig. 26).

17. ***Ranunculus tranzschelii* (Fagerstr.) Ericss.** 1992, Ann. Bot. Fenn. 29, 2: 153. Tranšēla gundega (Fig. 27)

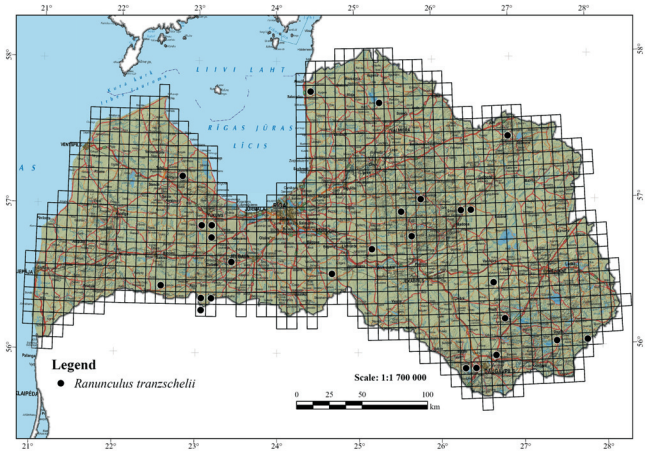


Fig. 28. Distribution of *Ranunculus tranzschelii* (Fagerstr.) Ericss. in Latvia.

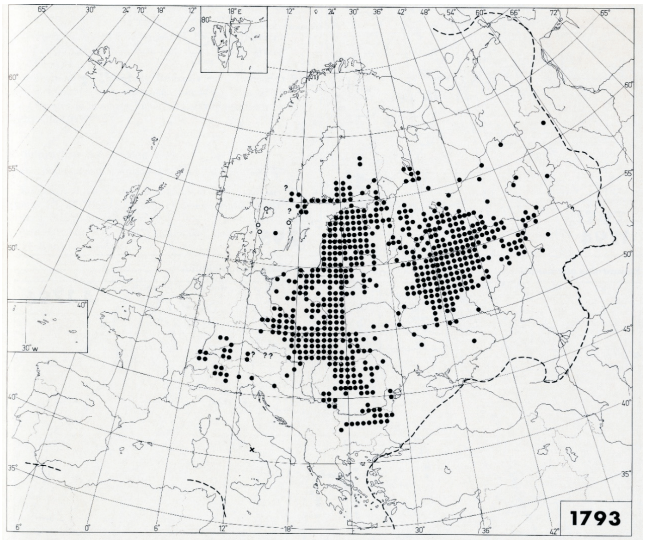


Fig. 29. Distribution of species complex of *R. cassubicus* in Europe (Jalas and Suominen, 1989).

Most important morphological characters: Robust plant with oblanceolate, irregularly toothed, subsessile to petiolate cauline leaves with robust, long teeth or even lobes. Basal leaves large, reniform and robust (up to 10 cm) and irregularly serrated, most developed leaves with 10°–30° angle of leaf base. The largest basal cycle leaves are not fully developed during flowering time. *R. tranzschelii* is quite similar to the other robust species of this group — *R. elatior*, *R. circinatifrons*, etc., however, distinguishable by characteristic fully developed petals. Other similar species *R. niepolomicensis* and *R. hannae* differ by smaller dimensions of all parts, and fully developed biggest life cycle leaves during flowering time.

Distribution and ecology in Latvia: Occurs relatively rare in the whole territory of Latvia. Grows in rich nemoral broad-leaved or mixed forests, in alluvial forests, as well in parks (Burtnieki, Jaunsvente, Juzefova, etc.) and contact zones — forest edges, roadsides and similar (Fig. 28).

DISCUSSION

The native range of *R. cassubicus* L. s.l. covers North-Eastern and Eastern Europe (Fig. 29). About 28 species have been described in Eastern Europe, they show a low morphological differentiation (Jalas and Suominen, 1989; Hörandl and Greilhuber, 2002), and the number of species appears to be declining from east to west. For instance, ten species are recognised in Finland (Kurtto *et al.*, 2019), but only one (*R. imitans*) in Sweden (Julin, 1980). Only a pair or few species of *R. cassubicus* complex are known from the regions of Central or Western Europe, where detailed analysis of the *R. auricomus* complex analysis has been done (e.g., Dunkel, 2010; 2019). At the same time, in territories, where the research level, according to Adam Halamski *et al.* (2018), is considered as incomplete, patchy or none, a significantly higher number of species is found — 21 species for the whole Western part of Russia (Tzvelev, 2001; 2012), and only for the Pskov region of Russia — 8 species (Efimov and Konechnaya, 2018). In this regard, knowing the "crossroad" status of Latvian flora.

In the Eastern European flora context, a relatively high number of *R. cassubicus* complex species in Latvia — 17 — was predictable. Even if the number of species change in future after more detailed research, it is clear that this group is richly represented in Latvia.

Despite the relatively large number of taxa, only three species of this group are considered to be relatively common in suitable habitats — *R. elatior, R. imitans,* and *R. circinatifrons.* These species have been found in more than 100 localities in Latvia, and it is expected that there will be significantly more deposits as the level of species research increases. Another four species are considered as relatively rare, known from 30–50 localities — *R. prorsidens, R. scalaridens, R. transzschelii,* and *R. hannae.* The other 10 species occur rare or very rare, some, such as *R. macrantherus, R. inopinus* or *R. karelicus* are known only from a few places.

Considering the chorological and distributional aspects of the species of *R. cassubicus* group in Latvia, convincingly the largest part — 10 species (*R. angustior*, *R. cajaderi*, *R.circinatifrons*, *R. imitans*, *R. inopinus*, *R. karelicus*, *R. macrantherus*, *R. prorsidens*, *R. scalaridens*, *R. serratifrons*) are described by G. Marklund (1965) and L. Fagerström (1965) and known from the southern part of Finland, and later recognised also in Western Russia (Tzvelev, 2001; 2012). There are another two species described nearby — from Northwest Russia by G. Marklund and L. Fagerström (*R. svirensis, R. transzschelii*). Three species (*R. hannae, R. niepolomicensis,* and *R. pawlowskii*) were originally described as local populations of *R. casubicus* group from Krakow surroundings by A. Jasiewicz (1956) with a very narrow area of distribution. Only two species of this group in Latvia — *R. cassubicus* and *R. elatior* have a wide distribution area —— Central Europe and even Western Siberia

(Tzvelev, 2001; Jalas and Suominen, 1989). Narrow ranges and very local distribution of the apomictic *R. auricomus* complex species are widely recognised in Europe, even in the last years (e.g., Dunkel, 2019; 2021). A good example is a new book *Flora of the British Isles and Ireland*, where the entire complex (58 species of *R. auricomus* complex) consists of only British-origin species with no taxa with wide, continental area (Leslie, 2018).

It is too early to discuss the ways and patterns of distribution and entry routes as well as predict the appearance of new *R. cassubicus* complex species in Latvia. At the same time, it is very possible, that after more detailed further studies both new species known from neighbouring countries, as well as completely new, neoendemic taxa of apomictic *R. cassubicus* group could be found in this floristically rich and peculiar region. The greatest species richness in this group is observed in species-rich fertile broad-leaf forests, as well as in old manor parks, which often, especially in heavily transformed agricultural regions, largely replace such suitable habitats. Parks and other dendrological plantations, where often planted alien trees are brought from other regions with all the soil and seed bank in it, are expected to be very promising sites for future research in this regard.

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RANUNCULUS AURICOMUS SUGU KOMPLEKSA PĒTĪJUMI LATVIJAS FLORĀ: *RANUNCULUS CASSUBICUS* GRUPA

Tradicionāli visi autori Latvijā floristiskajos darbos gundegu ģintī *Ranunculus* sīksugas neizdala, bet min tikai trīs kompleksās sugas, *Ranunculus auricomus* L., *R. fallax* (Wimm. et Grab) Sloboda un *R. cassubicus* L., tomēr ir daudz pārliecinošu pētījumu, ka *R. auricomus* komplekss sevī ietver plašu apomiktisku sīksugu kopumu. Šajā rakstā ir izdalītas 17 Kasūbijas gundegas *R. cassubicus* grupas sugas Latvijā: *R. angustior* (Markl.) Ericss., *R. cajanderi* (Fagerstr.) Ericss., *R. cassubicus* L. s.str., *R. circinatifrons* (Markl.) Ericss., *R. elatior* (Fries.) Ericss., *R. hannae* Jasiew., *R. imitans* (Markl.) Ericss., *R. inopinus* (Markl.) Ericss., *R. karelicus* (Markl.) Ericss., *R. macrantherus* (Markl.) Ericss., *R. niepolomicensis* Jasiew., *R. pawlowskii* Jasiew., *R. prorsidens* (Markl.) Ericss., *R. scalaridens* (Markl.) Ericss., *R. serratifrons* (Markl.) Ericss., *R. svirensis* (Markl.) Ericss. un *R. tranzschelii* (Fagerstr.) Ericss.