

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

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Traditionally, all authors in Latvia summarize all agamic species of this complex under three species, *R. auricomus* L., *R. fallax* (Wimm. et Grab.) Sloboda and *R. cassubicus* L. However, there are a lot of compelling studies on the subject that *R. auricomus* complex is a large assembly of apomictic microspecies. In this article, 18 species of the *Ranunculus fallax* group in Latvia are presented: *Ranunculus antigophyllus* (Markl.) Ericss., *Ranunculus attingens* (Markl.) Ericss., *Ranunculus euprepes* (Markl.) Ericss., *Ranunculus euryanthes* (Markl.) Ericss., *Ranunculus fagerstroemii* (Markl.) Ericss., *Ranunculus grandilobatus* (Fagerstr.) Ericss., *Ranunculus gregalis* (Markl.) Ericss., *Ranunculus heikkinenii* (Markl.) Ericss., *Ranunculus kalinensis* Jasiew., *Ranunculus mendax* (Markl.) Ericss., *Ranunculus mesidius* (Markl.) Ericss., *Ranunculus nemoricola* (Markl.) Ericss., *Ranunculus platycolpoides* (Markl.) Ericss., *Ranunculus prionodes* (Markl.) Ericss., *Ranunculus quadrivaginatatus* (Valta) Ericss., *Ranunculus subindivisus* (Markl.) Ericss., *Ranunculus viburgensis* (Markl.) Ericss. and *Ranunculus zmudae* Jasiew.

Key words: *Ranunculus fallax* (Wimm. et Grab.) Sloboda, flora, apomictic microspecies, Latvia.

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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 & Hörandl 2011).

In Central Europe, the *Ranunculus auricomus* complex has gained increasing interest in recent years (Dunkel 2010, 2014, 2019, Hörandl & Gutermann 1998a, 1998b, 1998c, Hörandl et al. 2009). The *Ranunculus auricomus* aggregate species is a Central and Eastern European

group of apomictic and partially sexual taxa. Traditionally, all authors in Latvia summarize 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 & Birkmane 1980, Gavrilova & Šulcs 1999, Priedītis 2014). However, there are lots of compelling studies reporting that *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, 2001, Hörandl & Gutermann, 1998a, Hörandl & Greilhuber, 2002). However, microspecies of the *R. auricomus* complex may only be considered in some areas to have been described completely and covered by long-term studies (Ericsson 2001), such as Austria (Hörandl & Gutermann 1998a, 1998b, 1998c, 1999), 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 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 a significant progress in broadening the knowledge of the genus *Ranunculus*, including knowledge about phylogenetic relationships and the evolution of the microspecies (e.g. Emadzade & Hörandl 2011, Hörandl & 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. fallax* species complex is mainly an Eastern European and Siberian 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. fallax* 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*. Similarly, it indicated a high level of morphological and ecological diversity within this group, and it all necessitated the need to update and clarify the species composition of *R. auricomus* complex and its distribution patterns in Latvia.

MATERIALS AND METHODS

During our studies, 18 *R. fallax* group species have been recognized in Latvia. Material collected in the whole territory of Latvia during numerous field trips since 2016 was studied. The floristic diversity of *R. fallax* group was studied with an emphasis on suitable habitats – nemoral forests alluvial forests, clearcuts, etc., as well as different types of grasslands - alluvial meadows, pastures etc. Special attention was paid to old manor parks and other dendrological plantations, botanical gardens and arboretums. Many of them

have a long-term continuity and with an excellent nemoral grass layer with co-dominance of *R. fallax* s.l.

Comprehensive revision of major herbaria in Latvia – Daugavpils University, Institute of Life Sciences and Technology, Laboratory of Botany (DAU, 2800 herbaria specimens, most of which are collected by authors during previous years), University of Latvia, Institute of Biology, Laboratory of Botany (LATV, appr. 300 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 – morphology of basal and cauline leaf, morphology of basal leaf blade: lobed, divided, dissected, degree of incision, etc., morphology of reproductive organs: receptacle, carpellophores are used by Dunkel (2005a, 2010, 2019).

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 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. Most important groups of characters:

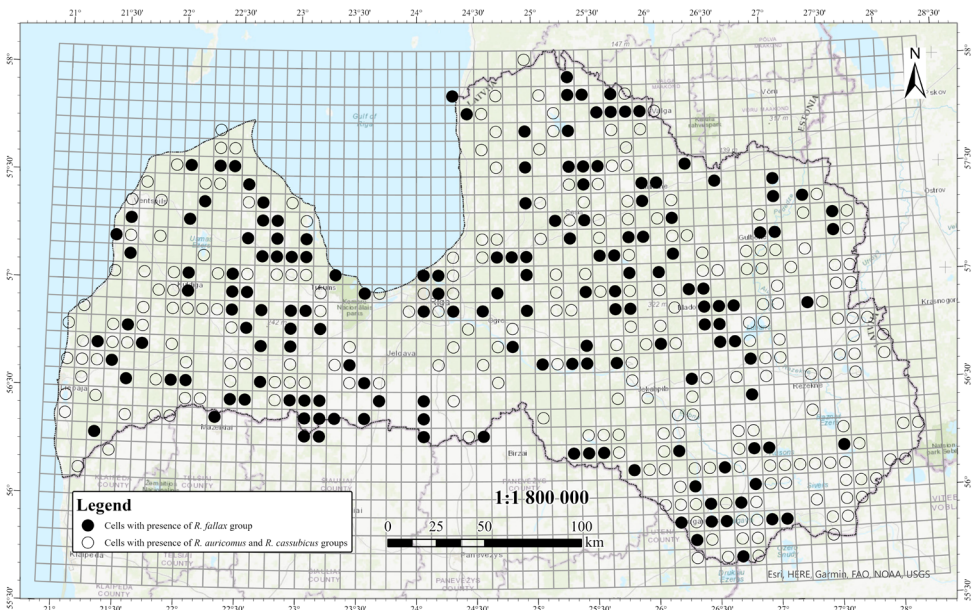


Fig. 1. Map of geobotanical grid cells of Latvia with studied cells of *Ranunculus auricomus* complex species.

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 by 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).

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, 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. Another important distinctive character is the length of the carpelophores (short – up to 0,2 mm, long – up to 0,4 mm and longer). All characters must 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. 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. Species distribution maps for Latvia were prepared by applying the square method, which is related to the geographical coordinates, where

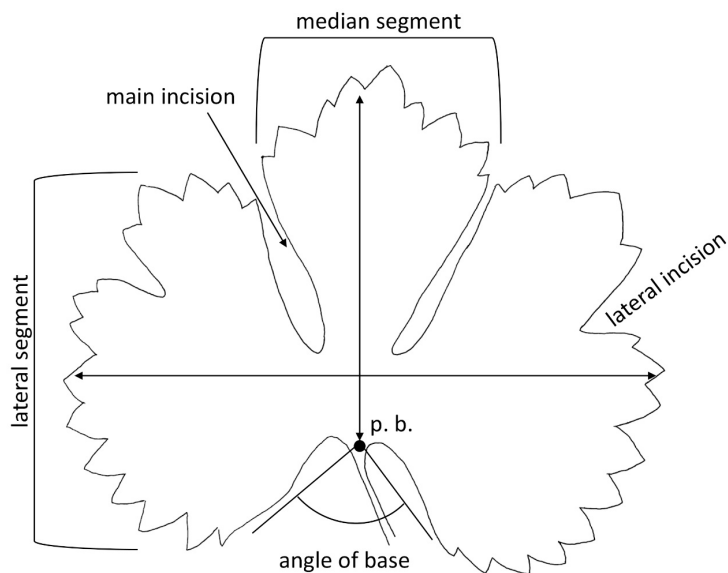


Fig. 2. Basal leaf of *Ranunculus auricomus* s.l. – schematic diagram illustrates the most important characteristics: the length and the width of a leaf; the mode of division of main segments, the basal point (p.b.) is defined by junction of the main leaf veins; the angle of the base is measured from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

one square corresponds approximately to 7.6×9.3 km or 71 km². 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 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) (Fatara 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 Daugavpiliensis (Evarte-Bundere et al. 2020).

RESULTS AND DISCUSSION

In distinguishing species of *R. fallax* group, we were guided by following morphological characters, which separate relatively this informal group from other groups of *R. auricomus* complex: mainly oblanceolate or linear-lanceolate cauline leaves with some teeth or even with whole leaf margin; full or nearly full number (6–7) of basal leaves with typically threlobate or divide, reniform leaf blade, where some leaves are atypically in some populations – even all leaves of basal leaf cycle can be with nearly whole leaf blade, as well as hairiness of receptacle at different intensities (at least for species of this group in Latvia) – the characters, which are commonly used to recognize *R. fallax* 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. cassubicus* or even *R. auricomus* group. Therefore, *R. fallax* group is considered to be artificial and used mainly for simplification of identification. In some floras and other works, *R. fallax* and *R. cassubicus* group species are

used as one aggregate – *R. cassubicus* (Jasiewicz 1956, 1985), therefore some distribution maps for Europe look inaccurate and ambiguous (Fig. 3).

There were 18 *R. fallax* 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 comparative table of morphological characters, given in this work (see Annex 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, species epithets in Latvian have been assigned for all species.

1. *Ranunculus antigophyllus* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 133. Tavastijas gundega (Fig. 3.)

Most important morphological characters:
Robust plant with oblanceolate, irregularly



Fig. 3. *Ranunculus antigophyllus* (Markl.) Ericss.

toothed, cauline leaves and medium-sized to robust most developed basal leaves with angle 40–90° of leaf base. Basal cycle leaves with very different form of leaf blades – most developed leaves with 3-lobed leaf blade with unlobed lateral segments, but, at same time, smallest leaves with whole and with dissected leaf blades. Flowers with fully or nearly fully developed petals.

Distribution and ecology in Latvia: Occurs rarely and scattered, in two types of habitats – in old parks in Ezere, Juzefova, Nogale, Užava as well as in natural habitats – in alluvial grasslands in Burtņieki, Meirāni, Niderkūni (Daugavpils) and other places.

2. *Ranunculus attingens* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 133. Platdaivu gundega (Fig. 4.)

Most important morphological characters: Robust plant with oblanceolate and petiolate, irregularly toothed cauline leaves with several (4–10) long tooth. Most developed basal cycle

leaves medium-sized to robust with angle 40–90° of leaf base, with 3-lobed leaf blade with wide, overlapped and unlobed lateral segments. Flowers with developed petals.

Distribution and ecology in Latvia: Occurs rarely and scattered in the whole territory of Latvia. Characteristic mostly for disturbed habitats – roadsides, shrublands, abandoned gravel queries, but grows also in rich broad-leaved forests (Ukri) and in old manor parks (Mangaļmuiža, Smukas).

3. *Ranunculus euprepes* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 139. Atšķirīgā gundega (Fig. 5.)

Most important morphological characters: Medium-sized (slim) plant with oblanceolate, petiolate, irregularly toothed (2–3 long teeth) cauline leaves. Most developed basal cycle leaves medium-sized with angle 30–60° of leaf base, with undivided and 3-lobed leaf blades with unlobed and non-overlapped lateral segments. Flowers with nearly of fully developed petals.



Fig. 4. *Ranunculus attingens* (Markl.) Ericss.



Fig. 5. *Ranunculus euprepes* (Markl.) Ericss.

Distribution and ecology in Latvia: Occurs relatively rarely and unequally in the whole territory of Latvia, however, the frequency distribution declines from north to south in Latvia, largest part of localities in Kurzeme, Sēlija and Zemgale. Grows in old manor parks, as well as in in different wet grasslands – *Molinia* meadows, alluvial grasslands (6410*) and other habitats.

4. *Ranunculus euryanthes* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 138. Eiriantes gundega (Fig. 6.)

Most important morphological characters: Medium-sized (slim) plant with oblanceolate, subsessile or petiolate, irregularly toothed (1–3 long teeth) cauline leaves. Most developed basal cycle leaves small to medium-sized with angle 60–120° of leaf base, with 3-lobed leaf blade, where lateral lobes divided or even dissected, therefore leaves look round resembling small leaves of *R. acris* from which differs from other similar species of this group (*R. attingens*, *R. antyophyllus*). All flowers have developed petals.



Fig. 6. *Ranunculus euryanthes* (Markl.) Ericss.

Distribution and ecology in Latvia: Occurs very rarely in the whole territory of Latvia. Grows mainly in old manor parks (Budberga, Graši) as well as in different grasslands – pastures, alluvial grasslands (Nereta, Randu plavas) and other places.

5. *Ranunculus fagerstroemii* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 139. Fāģerstrēma gundega (Fig. 7.)

Most important morphological characters: Medium-sized (slim) or even robust plant with oblanceolate, subsessile or petiolate, irregularly toothed (3–8 long teeth) cauline leaves. Most developed basal cycle leaves medium-sized with angle 60–100° of leaf base, with 3-divided leaf blades with unlobed and non-overlapped lateral segments without leaves with whole leaf blade. Flowers with fully reduced petals.

Distribution and ecology in Latvia: Occurs relatively rarely in the whole territory of Latvia. Grows mostly in old manor parks, much less common in different wet, alluvial forest habitats and other habitats.



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

6. *Ranunculus grandilobatus* (Fagerstr.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 141. Diždaivu gundega (Fig. 8.)

Most important morphological characters: Medium-sized (slim) plant with lanceolate or oblanceolate, sessile or subsessile irregularly toothed (1–2 long or often without teeth) cauline leaves. Most developed basal cycle leaves medium-sized with angle 100–150° of leaf base, with 3-divided leaf blades with unlobed and non-overlapped lateral segments, without leaves with whole leaf blade. Flowers with fully reduced petals. This plant resembles *R. fagerstroemii*, from which differs by cauline leaves with different teeth mode, or *R. nemoricola*, from which differs with only deeply trilobate basal leaves.

Distribution and ecology in Latvia: Occurs rarely and unequally – mainly in northern part of Latvia – Vidzeme. Grows mostly in old manor parks (Alūksne, Ķemeri, Ropaži, Trapene, Vecsalaca) as well as rich broad-leaved forests (Barkava), and species-rich natural pastures.

7. *Ranunculus gregalis* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 141. Burvīgā gundega (Fig. 9.)

Most important morphological characters: Robust (50 cm and more) plant with oblanceolate or rhomboidal – lanceolate, subsessile irregularly toothed (2–6 teeth) cauline leaves. Most developed basal cycle leaves medium-sized to robust with angle 20–100° of leaf base, with 3-divided leaf blades with unlobed and non-overlapped lateral segments, but at the same time with at least one leaf with whole blade. Flowers with partially or fully reduced petals. Species resembles *R. euprepes*, from which differs by basal leaves with mostly divided (not only lobed) leaf blade and reduced petals.

Distribution and ecology in Latvia: Occurs not very common in the whole territory of Latvia. Grows mostly in parks and in rich nemoral broad-leaved forests, as well as different contact zones – forest edges, roadsides and ditches.



Fig. 8. *Ranunculus grandilobatus* (Fagerstr.) Ericss.



Fig. 9. *Ranunculus gregalis* (Markl.) Ericss.

8. *Ranunculus heikkinenii* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 141. Heikinena gundega (Fig. 10.)

Most important morphological characters: Robust plant with oblanceolate to rhomboidally lanceolate, sessile or subsessile, irregularly toothed (6–9 teeth) or sometimes even lobed cauline leaves. Most developed basal cycle leaves robust with angle 50–130° of leaf base, with at least one leaf with whole blade and at least one – with 3-lobed leaf blade with wide, non-overlapped and deeply lobed lateral segments. Flowers with completely developed petals. Species resembling *R. antigohyllus*, from which differs by significantly bigger, most developed basal leaves with whole, unlobed leaf blade.

Distribution and ecology in Latvia: Occurs rarely and unequally in Latvia, mostly in central part – in different habitats – natural alluvial forests, different contact zones – roadsides, ditches and other habitats.

9. *Ranunculus kalinensis* Jasiew. 1956, Fragm. Fl. Geobot. (Kraków), 2, 1: 84 Kalinas gundega (Fig. 11.)

Most important morphological characters: Medium-sized (slim) plant with oblanceolate or rhomboidal, sessile or subsessile irregularly toothed (4–6 teeth) cauline leaves. Most developed basal cycle leaves medium-sized with 3-divided leaf blades with angle 30–60° of leaf base, with shallowly lobed and non-overlapped lateral segments without leaves with whole leaf blade. Flowers with partially of fully reduced petals.

Distribution and ecology in Latvia: Occurs very rarely in Latvia, only in some parks – Linde, Puze, Urga and other places. Species is not known from natural habitats, however, in order to discuss about species status in region, additional research on the distribution and additional herbaria material in Latvia are needed.



Fig. 10. *Ranunculus heikkinenii* (Markl.) Ericss.



Fig. 11. *Ranunculus kalinensis* Jasiew.

10. *Ranunculus mendax* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 141. Mānīgā gundega (Fig. 12.)

Most important morphological characters: Medium-sized (slim) or robust plant with oblanceolate to rhomboidal sessile or subsessile, irregularly toothed (5–9 long teeth) cauline leaves. Most developed basal cycle leaves medium-sized to robust with angle 10–50° of leaf base, with 3-lobed leaf blade with wide, overlapped and deeply lobed lateral segments. Flowers with at least partially developed petals. Species resembling *R. attingens*, from which differs by lobed lateral segments of basal leaves, and *R. mesidius* – differs by irregularly toothed cauline leaves and at least partially developed petals.

Distribution and ecology in Latvia: Occurs rarely in the whole territory of Latvia. Localities are known mainly from parks (Aknīste, Burtnieki, Cēre, Dižlāņi, Drabeši, Jaunsvente, Lielplatone and other places), as well as from rich nemoral

broad-leaved or alluvial forests in some protected nature territories – “Raudas meži” and “Ukru gārša”.

11. *Ranunculus mesidius* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 144. Vehkalahti gundega (Fig. 13.)

Most important morphological characters: Medium-sized (slim) or robust plant with oblanceolate, subsessile or petiolate, irregularly toothed (1–5 teeth) cauline leaves. Most developed basal cycle leaves medium-sized to robust with angle 30–120° of leaf base, with 3-lobed leaf blade with wide, overlapped and deeply lobed median segment and lateral segments. Flowers with partially or completely reduced petals. Species resembling *R. mendax*, from which differs by smaller number and different form of teeth on cauline leaves as well as nearly reduced petals.

Distribution and ecology in Latvia: Occurs rarely and unequally in Latvia, mostly from



Fig. 12. *Ranunculus mendax* (Markl.) Ericss.



Fig. 13. *Ranunculus mesidius* (Markl.) Ericss.

southern and western part – in manor parks (Cēre, Dundaga, Eleja, Koknese, Vecauce) as well as in rich broad-leaved forest habitats and contact zones – roadsides, shrublands, ditches.

12. *Ranunculus nemoricola* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 146. Mežmalu gundega (Fig. 14.)

Most important morphological characters: Robust plant with oblanceolate, subsessile or petiolate, irregularly toothed (1–5 teeth) cauline leaves. Most developed basal leaves medium-sized, reniform, with wide angle 70–140° of leaf base. Leaf blades 3-divided or lobed with no leaves with whole leaf blade. Flowers with partially or fully reduced petals. Species resembling *R. mesidius* from which differs by much longer and irregular teeth of cauline leaves and wider angle of leaf base and *R. fagerstroemi* – differs by lobed lateral segments of basal leaves and wider angle of leaf base.

Distribution and ecology in Latvia: Occurs very

rarely in Latvia, only in two parks in Kurzeme – Aizpute and Kabile, and not known from natural habitats. Additional studies on the distribution and additional herbaria material in Latvia are needed to discuss species status and trends of distribution here.

13. *Ranunculus platycolpoides* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 149. Platrievu gundega (Fig. 15.)

Most important morphological characters: Medium-sized (slim) plant with lanceolate irregularly toothed (1–5 teeth), sessile or petiolate cauline leaves. Most developed basal leaves relatively small, up to 5 cm, reniform, with wide angle 120–190° of leaf base. Leaf blades completely differ even in one population – from nearly whole to deeply lobed leaf blade, divided lateral lobes and narrow median lobe (segment). Flowers with nearly or completely developed petals. The best diagnostic character, which can be used to distinguish it from similar medium-sized species, is a very wide angle of



Fig. 14. *Ranunculus nemoricola* (Markl.) Ericss.



Fig. 15. *Ranunculus platycolpoides* (Markl.) Ericss.

basal leaves and relatively small dimensions of this species as well as at least one basal leaf with deeply divided lateral lobes.

Distribution and ecology in Latvia: Occurs rarely, mostly in central and western part of Latvia. Localities are known mainly from parks (Gatarta, Kabile, Zvārtava), as well as from different grasslands. E. Julin (1980) considers this species as mostly common in Scandinavia, and it is possible, that after additional studies, species will prove to be more widespread in Latvia.

14. *Ranunculus prionodes* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 149. Zoblapu gundega (Fig. 16.)

Most important morphological characters: Robust plant with oblanceolate, subsessile or petiolate irregularly toothed (1–3 long or some without teeth) cauline leaves. Most developed basal cycle leaves medium-sized with angle 30–120° of leaf base, with 3-divided leaf blades with unlobed and non-overlapped lateral segments

without leaves with whole leaf blade. Flowers with developed petals. This plant resembles *R. grandilobatus*, from which differs by well-developed flowers, or *R. euprepes* from which differs with only deeply trilobate basal leaves and different mode of toothed of basal leaves.

Distribution and ecology in Latvia: Occurs very rarely and unequally – mainly in central part of Latvia – Vidzeme. Grows mostly in old manor parks (Ineši, Vecbebrī) as well as in rich nemoral forests (Ukru gārša).

15. *Ranunculus quadrivaginatatus* (Valta) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 151. Makstainā gundega (Fig. 17.)

Most important morphological characters: Medium-sized (slim) plant with lanceolate or linear-lanceolate, sessile or subsessile cauline leaves with whole margin or with 1–3 irregular teeth. Most developed basal leaves relatively small, up to 6 cm (often smaller), reniform, with angle 20–120° of leaf base. All basal leaf cycle



Fig. 16. *Ranunculus prionodes* (Markl.) Ericss.



Fig. 17. *Ranunculus quadrivaginatatus* (Valta) Ericss.

with nearly whole leaf blades, first (juvenile) leaves with very wide angle of leaf base. Flowers with partially developed petals.

Distribution and ecology in Latvia: Occurs relatively rarely in the whole territory of Latvia. Localities are known mainly from different natural habitats – rich nemoral broad leaved, mixed spruce and white alder forests, different grasslands (Barkava, Dviete floodlands, Rite, Tilža, Valgale) and old manor parks (Augstkalne, Kabile, Krote, Vecauce).

16. *Ranunculus subindivisus* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 153. Zāgžobu gundega (Fig. 18.)

Most important morphological characters: Medium-sized (slim) plant with lanceolate, sessile or subsessile cauline leaves with whole margin or with 1–3 irregular teeth. Most developed basal cycle leaves medium-sized to robust with angle 30–120° of leaf base, largest leaves with whole leaf blade, but some leaves with 3-lobed

leaf blade with wide, non-overlapped and whole lateral segments. Flowers with partially reduced petals. Species resembling *R. quadrivaginat*us, from which differs by bigger, and different form or basal leaves.

Distribution and ecology in Latvia: Occurs very rarely in Latvia. Grows in old manor parks mainly in Kurzeme (Nurmuiža, Pastende, Strazde, Šķēde).

17. *Ranunculus viburgensis* (Markl.) Ericss. 1992, Ann. Bot. Fenn. 29, 2: 156. Viborgas gundega (Fig. 19.)

Most important morphological characters: Robust plants with oblanceolate, sessile or subsessile, irregularly toothed (3–4 long teeth) cauline leaves. Most developed basal cycle leaves medium-sized to robust with angle 40–140° of leaf base, with 3-lobed or divided leaf blade with narrow, non-overlapped and deeply lobed lateral segments. Flowers with completely reduced petals. Species resembling *R. mesidius*,



Fig. 18. *Ranunculus subindivisus* (Markl.) Ericss.



Fig. 19. *Ranunculus viburgensis* (Markl.) Ericss.

from which differs by narrow median segment of basal leaves and *R. mendax*, from which differs by smaller number and different form of teeth on cauline leaves as well as completely reduced petals.

Distribution and ecology in Latvia: Occurs rarely in the whole territory of Latvia. Localities are known mainly from parks (Bēne, Biksti, Dižlāņi, Linde, Omuļi and other places), as well as from National Botanical garden and Kalsnava arboretum.

18. *Ranunculus zmudae* Jasiew. 1956, Fragm. Fl. Geobot. (Kraków), 2, 1: 81. Žmudas gundega (Fig. 20.)

Most important morphological characters: medium-sized (slim) plant with lanceolate irregularly toothed (2–6 small, irregular teeth) sessile or subsessile cauline leaves. Most developed basal leaves relatively small, up to 6 cm, reniform, with wide angle 100–180° of leaf base. Leaf blades very differs even in one leaf cycle – from whole to deeply lobed and even divided. Lateral lobes and narrow median lobe irregularly serrate, but unlobed. Flowers with nearly or completely reduced petals. The best diagnostic character, which can be used to distinguish it from similar medium-sized species (*R. platycolpoides*), is reduced petals and basal leaves with only undivided lateral lobes.

Distribution and ecology in Latvia: Occurs rarely, mostly in central part of Latvia. Localities are known mainly from parks (Augstroze, Bikšēre, Mēri, Sigulda and other places), as well as from different contact zones – roadsides, forest edges and other habitats.

Overall distribution trends in the *R. fallax* group in Latvia

The native range of *R. fallax* (Wimm. et Grab.) Sloboda s. l. covers Eastern Europe (Fig. 21) and further in Siberia. Above 90 microspecies have been described in Eastern Europe, they show a low morphological differentiation (Jalas & Suominen 1989), and the number of species

appears to be declining from east to west. For instance – 92 species are recognized in Finland (Kurto et al. 2019), but at the same time, only one (*R. platycolpoides*) – in Sweden (Julin 1980). Because of unclear morphological boundaries between the main four groups, (*Ranunculus auricomus*, *R. cassubicus*, *R. fallax* and *R. monophyllus* Ovcz.), four species concept has not been used in Central Europe (e.g. Hörandl 1998a; Dunkel 2010; Dunkel et al., 2018), therefore, species of *R. fallax* complex are not known to be separated from the regions of Central or Western Europe, even where detailed analysis of *R. auricomus* microspecies complex analysis is done (e.g. Dunkel 2010, 2019). At the same time – in territories, around the Baltic Sea and Eastern Europe, species of *R. fallax* complex are undoubtedly separated – 24 for the whole Western part of Russia (Tzvelev 2001, 2012), and for Pskov region of Russia – 6 (Efimov & Konechnaya 2018). In our work we also agree with this concept and use unformal *R. fallax* group for dividing in groups of *R. auricomus* complex.



Fig. 20. *Ranunculus zmudae* Jasiew.

Knowing the ‘crossroad’ status of Latvian flora in the Eastern European flora context, a relatively high number of *R. fallax* complex species – 18 – was predictable. Even if the number of species will change in future after more detailed research, it is clear that this group is richly represented in Latvia.

Relating to the chorological and distributional aspects of the species of *R. fallax* group in Latvia, convincingly largest part – 16 (*R. antigophyllus*, *R. attingens*, *R. euprepes*, *R. euryanthes*, *R. fagerstroemii*, *R. grandilobatus*, *R. gregalis*, *R. heikkinenii*, *R. mendax*, *R. mesidius*, *R. nemoricola*, *R. platycolpoides*, *R. prionodes*, *R. quadrivaginus*, *R. subindivisus* and *R. viburgensis* are taxa, described by G. Marklund (1965), L. Fagerström (1965) and A. Valta (1968)

and known from the Southern part of Finland, and later recognized also in Western Russia (Tzvelev 2001, 2012). Two species (*R. kalinensis* and *R. zmudae*) were originally described as local populations of *R. fallax* group from Krakow surroundings by A. Jasiewicz (1956) with very narrow area of distribution. Notably, there are no species of this group in Latvia with a wide distribution area – in Central Europe and even whole Scandinavia. Only some of them have a more wider distribution area – *R. antigophyllus*, *R. mesidius* and *R. subindivisus* are known from Perm oblast (Tzvelev 2001; Jalas & Suominen 1989, Chugainova 1997). Narrow 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

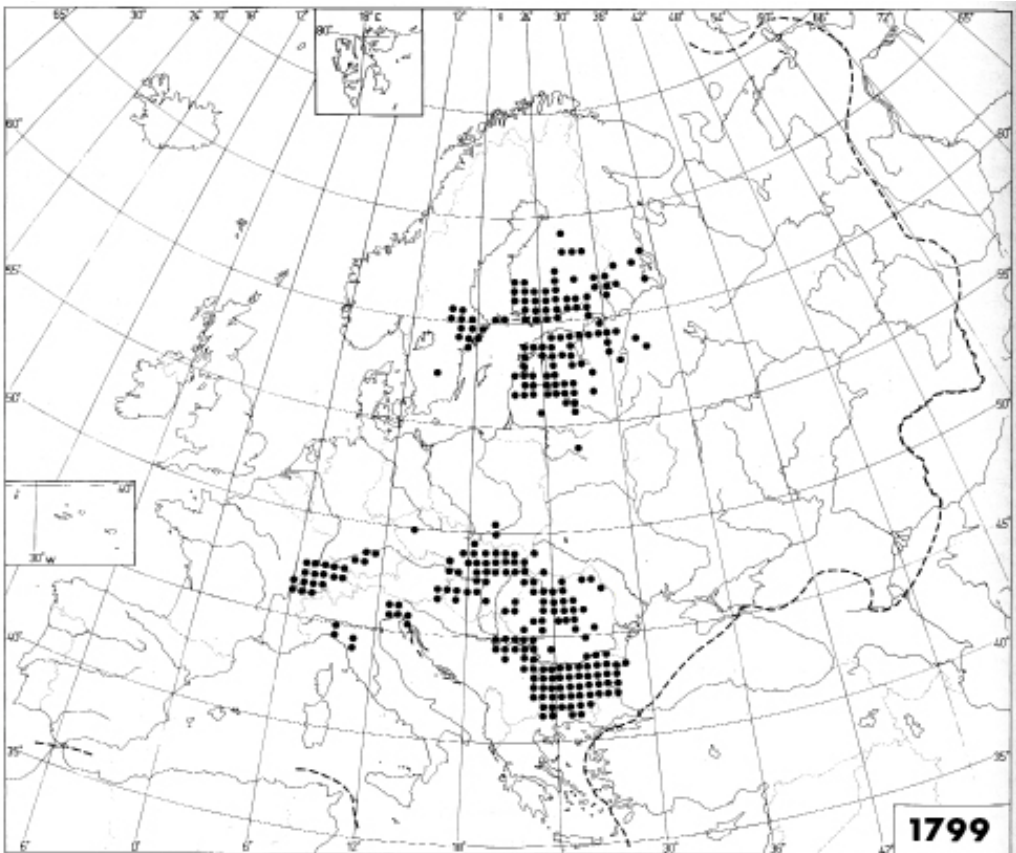


Fig. 21. Distribution of species complex of *R. fallax* in Europe (Jalas and Suominen, 1989). Disjunction on the part of Poland and Lithuania does not correspond to reality.

Isles and Ireland, where all complex (58 species of *R. auricomus* complex) is 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. fallax* 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. fallax* group can be found in this floristically rich and peculiar region.

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Annex 1. Comparison of diagnostic characters for the species of the *Ranunculus fallax* group in the Latvia

	Flowering shoot	Lower stem leaves	Lower stem leaf tooth	Basal leaves	Basal lobes	Pertanth	Carpellophores
<i>Ranunculus antygraphyllus</i>	Robust, (38–) 40–55 cm	Oblanceolate; sessile or subsessile	With 2–6 irregular teeth on each side	Most developed leaves with 3-lobed leaf blade with unlobed lateral segments, but, at same time, smallest leaves with whole and with dissected leaf blades	6–10 cm, all basal leaves with narrow angled base (40°–90°)	Well developed	Long, sparsely hairy
<i>Ranunculus attingens</i>	Robust, (40–) 50–60 cm	Oblanceolate; subsessile or petiolate	With (3) 6–10 (11) long irregular teeth on each side	With 3-lobed leaf blade with wide, overlapped and unlobed lateral segments	6–10 (–11) cm, all basal leaves with narrow angled base (0°–70°)	Well developed	Long, densely hairy
<i>Ranunculus euprepes</i>	Slim, 30–40 (–50) cm	Oblanceolate; subsessile or petiolate	With 2–3 long irregular teeth on each side	With undivided and 3-lobed leaf blades with unlobed and non-overlapped lateral segments	(4–) 6–7 cm, all basal leaves with narrow angled base (30°–60°)	Well developed	Long, sparsely hairy
<i>Ranunculus euryanthes</i>	Slim, 30–40 (–50) cm	Oblanceolate; subsessile or petiolate	With 1–3 (5) irregular teeth on each side	With 3-lobed leaf blade, where lateral lobes divided or even dissected	3–8 cm, all basal leaves narrow or wide angle (60°–120°)	Well developed	Short, densely hairy
<i>Ranunculus fagersroemii</i>	Robust, 40–55 (–60) cm	Oblanceolate; subsessile or petiolate	With 3–8 irregular teeth on each side	With 3-divided leaf blades with unlobed and non-overlapped lateral segments without leaves with whole leaf blade	6–8 (–10) cm all basal leaves narrow or wide angle (60°–100°)	Fully reduced	Long, densely hairy
<i>Ranunculus grandilobatus</i>	Slim, 35–50 (–58) cm	Oblanceolate; subsessile	With 0–4 irregular teeth on each side	With 3-divided leaf blades with unlobed and non-overlapped lateral segments, without leaves with whole leaf blade	4–7 cm, all basal leaves narrow or wide angle (75°–135°)	Fully reduced	Long, densely hairy

	Flowering shoot	Lower stem leaves	Lower stem leaf tooth	Basal leaves	Basal lobes	Pertanth	Carpellophores
<i>Ranunculus gregalis</i>	Robust, (40-) 50-65 cm	Oblanceolate to rhomboidally - lanceolate; subsessile	With 2-6 (-8) irregular teeth on each side	With 3-divided leaf blades with unlobed and non-overlapped lateral segments, but at the same time with at least one leaf with whole blade	7-11 cm, all basal leaves with narrow angled base (20°-100°)	Partially or fully reduced	Short, densely hairy
<i>Ranunculus heikkinenii</i>	Robust, 50-65 (-75) cm	Oblanceolate to rhomboidally - lanceolate, rarely petiolate, rarely subsessile	With 6-9 (-11) long irregular teeth on each side or the leaves are divided into lobes	With at least one leaf with whole blade and at least one - with 3-lobed leaf blade with wide, non-overlapped and deeply lobed lateral segments	8-13 cm, all basal leaves narrow or wide angle (50°-130°)	Well developed	Long, densely hairy
<i>Ranunculus kalinensis</i>	Slim, (30-) 35-45 (-50) cm	Oblanceolate to rhomboidally - lanceolate; sessile or subsessile	With 4-6 irregular teeth on each side	With shallowly lobed and non-overlapped lateral segments without leaves with whole leaf blade	3,5-7 cm, all basal leaves with narrow angled base (30°-60°)	Fully reduced, rarely partially developed	Long, densely hairy
<i>Ranunculus mendax</i>	Robust, (40-) 45-55 (-60) cm	Oblanceolate to rhomboidally - lanceolate; sessile, subsessile or petiolate	With (3-) 5-9 long irregular teeth on each side	With 3-lobed leaf blade with wide, overlapped and deeply lobed lateral segments	(5-) 6-9 (-11) cm, all basal leaves with narrow angled base (0°-50°)	Partially reduced, very rare well developed	Long, densely hairy
<i>Ranunculus mesidius</i>	Robust, (35-) 40-55 (-60) cm	Oblanceolate; sessile, subsessile or petiolate	With 1-5 irregular teeth on each side	With 3-lobed leaf blade with wide, overlapped and deeply lobed median segment and lateral segments	(6-) 7-10 (-11) cm, all basal leaves narrow or wide angle (30°-120°)	Partially or fully reduced	Long, densely hairy
<i>Ranunculus nemoricola</i>	Robust, 40-55 cm	Oblanceolate; subsessile or petiolate	with 1-5 irregular teeth on each side	Leaf blades 3-divided or lobed with no leaves with whole leaf blade	7-8 cm, all basal leaves narrow or wide angle (70°-140°)	Partially reduced very rare well developed	Long, densely hairy

	Flowering shoot	Lower stem leaves	Lower stem leaf tooth	Basal leaves	Basal lobes	Pertanth	Carpelliphores
<i>Ranunculus platycarpoides</i>	Slim, 30-43 (-50) cm	Lanceolate, sessile, subsessile or petiolate	With 1-2 (-4) irregular teeth on each side	Leaf blades very differs even in one population – from nearly whole to deeply lobed leaf blade, divided lateral lobes and narrow median lobe (segment)	4-5,5 (-6) cm, all basal leaves with wide angled base (120°-190°)	Mostly well developed	Long, sparsely hairy
<i>Ranunculus prionodes</i>	Robust, (38-) 40-55 cm	Oblanceolate; subsessile or petiolate	With 1-3 (-5) irregular teeth on each side	With 3-divided leaf blades with unlobed and non-overlapped lateral segments without leaves with whole leaf blade	4,5-8 cm, all basal leaves narrow or wide angle (30°-120°)	Well developed	Long, densely hairy
<i>Ranunculus quadrivaginatius</i>	Slim, 28-43 cm	Linear-lanceolate or lanceolate, sessile or subsessile	With 0-3 irregular teeth on each side	All basal leaf cycle with nearly whole leaf blades, first (juvenile) leaves with very wide angle of leaf base	(3-) 4-6 cm, all basal leaves narrow or wide angle (30°-160°)	Partially developed	Short, sparsely hairy
<i>Ranunculus subindivisus</i>	Slim, 29-35 cm	Lanceolate, sessile or subsessile	With 0-2 (-3) irregular teeth on each side	Largest leaves with whole leaf blade, but some leaves with 3-lobed leaf blade with wide, non-overlapped and whole lateral segments	(3-) 5,5-6,5 (-8,5) cm, all basal leaves narrow or wide angle (30°-120°)	Partially developed	Short, densely hairy
<i>Ranunculus viburgensis</i>	Robust, (38-) 40-57 cm	Lanceolate, sessile or subsessile	With (0-) 3-4 (-6) long irregular teeth on each side	With 3-lobed or divided leaf blade with narrow, non-overlapped and deeply lobed lateral segments	6,5-8 (-10) cm, all basal leaves narrow or wide angle (40°-140°)	Fully reduced	Short, densely hairy
<i>Ranunculus zmude</i>	Slim, 28-35 (-44) cm	Lanceolate, sessile or subsessile	With (0-) 2-6 irregular teeth on each side	Leaf blades very differs even in one leaf cycle – from whole to deeply lobed and even divided. Lateral lobes and narrow median lobe irregularly serrate, but unlobed	4-6 (-8) cm, all basal leaves with wide angled base (100°-180°)	Partially reduced	Long, densely hairy