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RESEARCH ARTICLE

Ranunculus lateriflorus (*Ranunculaceae*) within the Prytysianska lowland (Ukraine): distribution, ecology, and conservation assessment

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Abstract. The transformation of landscapes and changes in the hydrological regime of the Tisza River basin amid climate change have led to the decline or even local extinction of many hydro- and hygrophilous vascular plant species due to the destruction or deterioration of their habitats from the lowlands to the subalpine zone of the Eastern Carpathians. One of these species, *Ranunculus lateriflorus* (*Buschia lateriflora*), a rare species known only from five areas within southern and western Ukraine, was for a long time considered extinct from the territory of Zakarpattia (Transcarpathian) Region of Ukraine. We analysed the distribution pattern of the species based on our study of herbarium specimens deposited in public herbarium collections, supported with intensive field surveys in seasons of 2022–2025. The species is locally distributed between Uzhhorod, Chop, and Batovo and occupies field depressions with temporary water bodies where salts accumulate, and small saline marshes. We provide here a list of locations and their characteristics, as well as the species' response to the leading environmental factors. Based on our analysis of the collected data, we determined the conservation status of the species in Ukraine and, in accordance with the IUCN methodology, classified it as Endangered (EN). To preserve *Ranunculus lateriflorus* in our region, we consider it necessary to expand the area of the existing Prytysiansky Regional Landscape Park to include the identified locations.

Keywords: conservation, endangered species, floodplain meadows, habitat, IUCN Red List, Pannonic semi-saline meadows, *Ranunculus lateriflorus*, Tisza basin

Introduction

Marsh vegetation and hygro- and hydrophilic vascular plants have been studied in the Zakarpattia Oblast (Transcarpathian Region) of Ukraine for a long time (Margittai, 1933; Boros, 1925–1926; Felbaba-Klushyna, 2010; Felbaba-Klushyna et al., 2023). Over the past decades, human activities have

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affected the hydrological regime of the Tisza River basin and led to a drop in the water table, drying up of marshes, and the transformation of moisture-loving vegetation into vegetation with moderate water supply. These phenomena have been observed in the Ukrainian Carpathians from lowlands to highlands (Felbaba-Klushyna et al., 2023). In this regard, a significant number of plant species confined to habitats with excessive moisture have disappeared or are on the verge of extinction locally. In particular, annuals (therophytes) of the exposed bottom vegetation, such as *Eleocharis carniolica* W.D.J. Koch, *Limosella aquatica* L., *Lindernia procumbens* (Krock.) Philcox, and *Schoenoplectiella supina* (L.) Lye (*Scirpus supinus* L.), are extremely rare and require constant monitoring and protection actions (Felbaba-Klushyna, 2007).

One of the rare species that was considered locally extinct in the territory of Zakarpattia Region of Ukraine is *Ranunculus lateriflorus* DC. [= *Buschia lateriflora* (DC.) Ovcz.] (Margittai, 1933; Boros, 1925–1926; Krycsfalushy et al., 1999; Hamor et al., 2009; Felbaba-Klushyna, 2010) — Fig. 1.

The generalized distribution range of *Ranunculus lateriflorus* reaches northwestern Africa, Europe, western Siberia, and Central Asia (POWO, 2025–onward). For the European part of the former Soviet Union, it was reported as occurring in Crimea, Lower Volga, Middle Dnipro and Southern Transcaucasia floristic regions. *Ranunculus lateriflorus* grows in shores of freshwater bodies, flooded terrain depression in lowlands, muddy riverbanks, clay saline steppes, and occasionally in moist places in crops (Ovchinnikov, 1937; Visulina, 1953; Morozyuk, 1987).

During the fieldwork in southeastern Slovakia throughout the vegetation season of 2022, when we focused on monitoring of selected species for the preparation of a new Slovak Red Data Book, several previously reported populations of *R. lateriflorus* have been confirmed and some new populations have been found. Because the easternmost population were found between Veľké Kapušany and Leles, only four kilometres from the Slovak-Ukrainian border, we supposed that the species could be found in the Ukrainian part of the lowland (Zakarpattia Region) as well.

This article reports new findings of *R. lateriflorus* with a list of selected herbarium specimens, literature sources, and citizen science database (https://www.inaturalist.org/). Generalized information on the species distribution within Ukraine and adjacent territories is presented, and the ecological conditions of habitats and habitat types are provided. The conservational status of the species within Ukraine has been clarified.

Materials and Methods

The field course was held on 18 June 2023, 2 and 9 June 2024, and 9 June 2025 in field depressions between Uzhhorod, Chop, and Batovo. Herbarium specimens in several Central European collections (BP, BRA, BRNU, CL, DE, EGR, KO, LW, LWS, LWKS, SAV, SLO, UU, ZV, W, WU) were studied; acronyms of public herbaria follow Thiers (2025–onward). Ecological characteristics of the species are given according to the scale of Didukh (2011). Photo documentation was published on the *iNaturalist* platform (https://www.inaturalist.org/) and the relevant observations are cited at localities in the list below. Herbarium specimens are deposited in the Herbarium collection of the Botanical Garden of Pavol Jozef Šafárik University (acronym KO). The assessment of the conservation status of *Ranunculus lateriflorus* was carried out in accordance with the methodology outlined in the *IUCN Red List Categories and Criteria* (IUCN, 2017).

Natural conditions of the research area

The Prytysianska Lowland (Zakarpattia Lowland) was formed in the northwestern part of the Zakarpattia Internal Trough and the northeastern edge of the Pannonian Basin. Geologically, it corresponds to the tectonic element of the Chop-Mukachevo depression, which began to form in the Late Miocene-Pliocene. The territory continued to lower in the Anthropocene, and in the Holocene, the submergence of the territory was replaced by an uplift (Mykyta, Saluyk, 2013). Absolute elevations range from 105–120 m above sea level. The Mukachevo morphostructure is composed of Miocene and Quaternary sediments. The surface of the morphostructure is a flat lowland alluvial plain, which is a low terrace of the Tisza and its tributaries and rises above the current river water level by an average of 5–6 m (Gerenchuk, 1981).

The study area is characterised by a temperate continental European climate and is influenced by Atlantic air flows from the plains of Central Europe. The average monthly air temperature in the Prytysianska Lowland ranges from –0.7 °C in January

Fig 1. *Ranunculus lateriflorus*, young flowering plant (left) and fruiting plant (right). Photographed by M. Dudáš

to +21.9 °C in July-August, and the average annual temperature is 8.8 °C, which is highest in the Ukrainian Carpathians. The average annual precipitation in the lowlands is 650–750 mm (Ozymko, Karabiniuk, 2023). This is a warm climatic zone that covers the Zakarpattia Lowland and Pokutska Plain in the Dniester and Prut rivers (Milkina, 1988a, 1988b). In areas with constant or prolonged periodic moisture, meadow-bog soils are common, characterized by heavy texture, poor filtration, strong acidity and high humus content.

The main landscape type of this area is the floodplain-lower terraced plain. In the past, it was often flooded by floods and flood waters of the Tisza, Latorytsia, and Borzhava rivers, which maintained a high-water table, contributing to the glazing of the sod soils. To optimize them, significant reclamation work was carried out in the form of a network of canals hundreds of kilometres long, and dams were built along the rivers to protect the plain from catastrophic floods.

In the floodplains of the lowland rivers, alluvial meadow-brown loam and sod-brown loam soils with varying degrees of glaciation were formed, and meadow-bog and bog soils are sporadically distributed. In the Tysa-Latoritsa interfluve within the Chop depression, sod-gley, meadow podzolized gley and, less frequently, meadow soils are found on sandy loam deposits (Vovk, Orlov, 2005).

Results and Discussion

During the field research, we found several localities of *R. lateriflorus*, which are listed below:

– Uzhhorod District, between Mali Selmentsi and Siurte, several populations on the edge of fields and in flooded terrain depression, 48°29'34.27"N 22°10'39.25"E, 48°29'30.89"N 22°10'33.23"E (here frequent; Fig. 5), 48°28'46.96"N 22°11'3.51"E (sporadically), 48°29'57.51"N 22°11'36.69"E (tens of plants), ca 100 m a.s.l. (M. Dudáš, 11.05.2025, KO38442, 09.06.2025; https://www.inaturalist.org/observations/288268038, 280311613, 288267968 and 288268062).

– Uzhhorod District, Tyihlash, flooded terrain depression on corn field on SE edge of village behind the railway underpass, hundreds of plants, 48°28'37.7"N 22°13'54.2"E, 101 m a.s.l. (M. Dudáš, 18.06.2023, KO37470; https://www.inaturalist.org/observations/220518112).

– Uzhhorod District, Mali Heivtsi, field depression near farm on W edge of village, waterlogged after storm, rare, 48°29'30.07"N 22°17'21.62"E, 100 m a.s.l. (M. Dudáš, 18.06.2023, observation).

– Uzhhorod District, Demechi, waterlogged field depression on field W from village, tens of plants, 48°25'25.1"N 22°19'12.5"E, 100 m a.s.l. (M. Dudáš, 18.06.2023, KO37476; https://www.inaturalist.org/observations/194004423; Fig. 4). – ibid., waterlogged field depression on field SW from the village, only several plants, 48°24'51.41"N 22°19'31.34"E, 100 m a.s.l. (L. Felbaba-Klushyna & M. Dudáš, 09.06.2025, https://www.inaturalist.org/observations/288408400 and 288408405).

– Beregovo District, Batovo, field depression north from village (old grounded Latoritsa riverbed), scattered, 48°23'32.29"N 22°24'9.92"E,

Fig. 2. General distribution of *Ranunculus lateriflorus* (black triangles) in Ukraine

105 m a.s.l. (M. Dudáš & L. Felbaba-Klushyna, 09.06.2024; https://www.inaturalist.org/observations/221596332 and 221596353).

All these findings of *R. lateriflorus* were made within the elevation range of 100–110 m above sea level. An average population of this species usually covers areas of 20–50 m^2, with only the population in the vicinity of the village of Siurte being the largest, covering an area of 80 m^2. The number of individuals per 1 m^2 varies from 2 to 5 (rarely more). The distance between populations in the villages of Mali Selmentsi and Siurte, Mali Heivtsi, and Tyihlash ranges from 2 to 5 km. The other two populations are located southeast of this distribution centre. The population in the village of Demechi is 13 km southeast of this centre, and the population in the village of Batovo is at least 30 km southeast (Fig. 3). The range of *R. lateriflorus* is here fragmented and consists of small populations.

In Ukraine (Fig. 2), the species has significant disjunction areas — the southern one in Kherson Region (Dzharylhach Bay) and in Crimea, the western area in the Forest-Steppe in Ternopil Region (Horodok District, Lisovody village), and on the Left-bank Steppe in Zakarpattia Region (Ovchinnikov, 1937; Visulina, 1953; Morozyuk, 1987).

For Zakarpattia Region (Fig. 3), the species has been reported only from its lowland part, exclusively in the Transcarpathian Lowland (Chopyk, Fedoronchuk, 2015), where it grows in swamps and marshes (Fodor, 1974). According to Fodor's own scale of species abundance in the region, *R. lateriflorus* belongs to the category II (not much — scarce). In general, this species is not widespread throughout its range, due to the peculiarities of its ecological characteristics.

We found only several herbarium specimens in the Ukrainian herbarium collections in Lviv (LW, LWS, LWKS) and Uzhhorod National University (UU), and small number of specimens in other significant Central European public herbaria collections as part of exsiccate collection. The herbarium specimens are listed below (in original script and transcription from Cyrillic scripts):

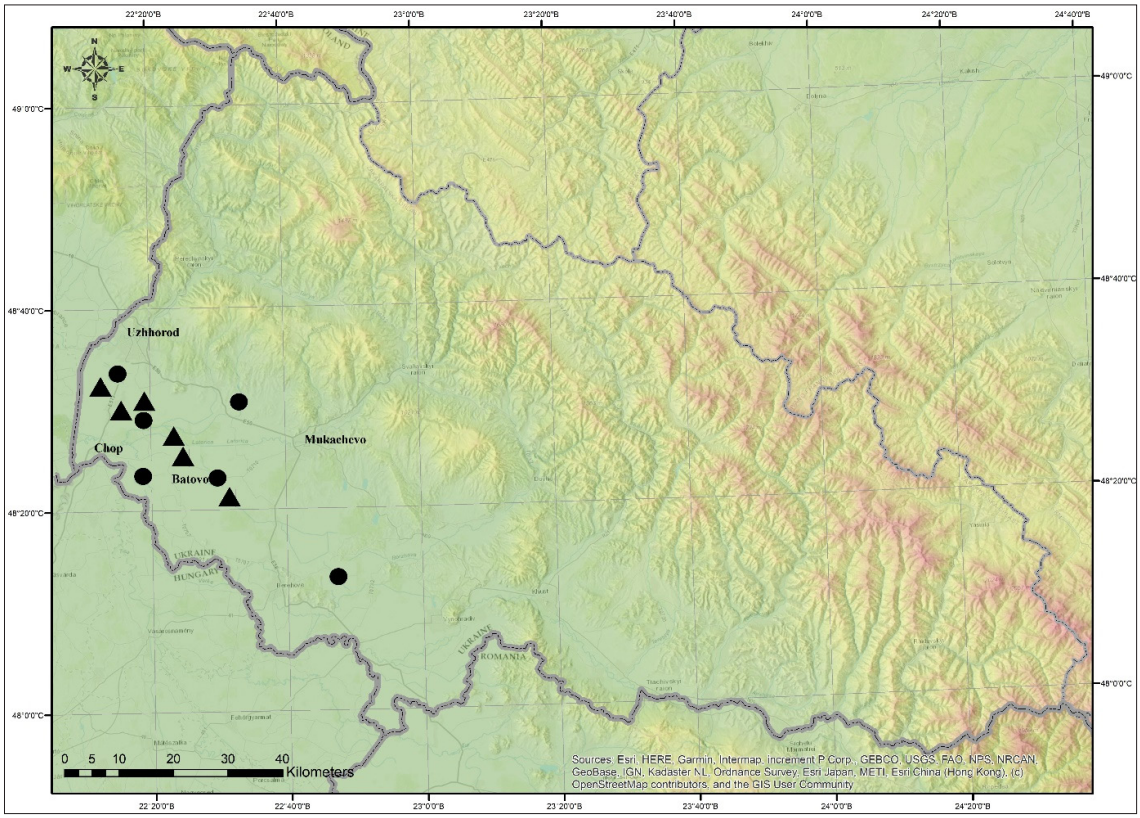

Fig. 3. Distribution of *Ranunculus lateriflorus* within the Prytysianska Lowland (Zakarpattia Region): new localities (black triangles) and herbarium specimens (black circles)

– Flora exsiccate Reipublicae Bohemicae Slovenicae. Rossia subcarpathica: Bereg: locis paludosis aquosisque ad p. Baťu, dit. Bereg, solo argiloso, ca. 110 m, V 1926, leg. A. Margittai (BRNU175562; CL; LW102257; SLO; ZV; BP); – Flora carpatica. Hab. in locis humidis ad pag. Bátyú, com. Bereg, V 1926, leg. A. Margittai (BRNU129309); – In paludosis ad pad. Bátyú, Com. Bereg, V 1926, leg. A. Margittai (CL), (*handwritten*); – In locis paludosis inter Kovaszóva — Nagy Bereg", VI 1922, leg. A. Margittai (CL), (*handwritten*); – Tsehlivka, leg. S.S. Fodor (UU), (*handwritten*); – Zakarpatska Region, Ivanivs'ke lisnytstvo, hrabova dyubrava, 20.V 1977, leg. O. Dumnych (UU), (*handwritten*); – Esen', volohyy luh, 28.V 1956, leg. S.S. Fodor (UU), (*handwritten*); 21.VI 1947, leg. E. Tovt; – Demychevo, volohyy luh, 21.V 1964, leg. E. Tovt (UU), (*handwritten*); – Palad'-Komarivtsi, pole, 16.V 1963, leg. S.S. Fodor (UU), (*handwritten*); – Chervone boloto, 15.V 1962, leg. E.S. Tovp (UU), (*handwritten*); – Zakarpatska Obl., Uzgorodskyy r-n, okolitsi s. Veliki Heivtsi, Zakarpatska nizovyna, zaplava r. Latoritsya. Peresykhayukhyj osochnik z *Carex vuplina* L. pri dorozy bilya mosta cherez r. Latoritsya, leg. R. Kisch, 18.V 2011 (LWKS033583).

The analysis of herbarium collections shows that until the middle of the 20th century this species was quite rare in the Prytysianska Lowland. Herbarium specimens of *R. lateriflorus* collected by A. Margittai in years 1922–1923 and Á. Boros in 1923 (Chornyi močar) are deposited in BP (Kricsfalusy et al., 1999), and this record was later separately published by Boros (1925–1926) and Margittai (1933). Margittai later collected *R. lateriflorus* near Batovo several times during 1922–1928.

Our research has shown that the species can be preserved in suitable habitats, such as water bodies with temporary water levels in spring and early summer, which subsequently dry up in summer, as well as field depressions among crops, especially in areas where winter crops are grown, the harvest of which coincides with the beginning of the growing

Fig. 4. *Ranunculus lateriflorus* near Demechi (yellow bunches over 40 cm high). Photo by M. Dudáš, 2023

Fig. 5. *Ranunculus lateriflorus* near Siurte. Photo by M. Dudáš, 2025

season of some annuals, including the species that we studied. The number of populations could be higher due to the fact that field depressions are rarely visited by botanists or even overlooked at the end of spring. On the other hand, the reason may also be the absence of field flora studies in the given area.

Thus, according to the current state of research in Ukraine, the Prytysianska Lowland is the place where the largest number of *R. lateriflorus* populations are presently concentrated.

Ranunculus lateriflorus is an annual plant with a short growing season (May–June). As a rule, a period of drought begins in late June in the Prytysianska Lowland. However, by this time, the species individuals are mostly finished with their growing season, and this circumstance makes it difficult to detect them to some extent. The main habitat of this species is swampy depression areas of fields, where rainwater is retained for a long time, and the constant alternation of drying and moistening processes leads to the accumulation of salts. Therefore, moist, slightly saline substrates with a sparse herbage stand, which is formed on sowing fields after harvesting winter crops, are particularly favourable for this species.

According to the requirements for and response to the main ecological factors (Didukh, 2011), *R. lateriflorus* belongs to hygromesophytes in relation to the soil water regime; to the hyper-hydrocontrastophiles in relation to moisture variability; to the aerophobes in relation to the soil aeration; to the basophiles in relation to soil acidity; to the glycotrophes in relation of plant species to total salt regime; the acarbonatophiles in relation to carbonate content in soil to; to the hemi-nitrophiles in relation to nitrogen content in soil; to the mesotherms in relation to the thermal climate; to the sub-continentals in relation to the continentality of climate (in Ukraine, this indicator is typical for the Steppe zone and the Black Sea region); to the acryophytes in relation to the cryo-climate, and to the heliophytes in relation to light.

The requirements of *R. lateriflorus* and its response to key environmental factors significantly limit its range, primarily due to soil conditions. Saline floodplain meadows and saline marshes are rare in Ukraine. Such rare ecological conditions and habitats existed in the Prytysianska Lowland before its large-scale drainage amelioration and plowing (Felbaba-Klushyna, 2009). However, over the past decades, the decline of agriculture and the neglect of the canal system have contributed to the natural recovery of hydrological and salt regimes in the lowest areas. Therefore, *R. lateriflorus* and some other species with similar ecological characteristics are also more common here.

To preserve biodiversity in general, and *R. lateriflorus* in particular, and to ensure the natural development of soil formation processes in the Prytysianska Lowland, the area of the Prytysiansky Regional Landscape Park should be expanded to include floodplain meadows and marshes in the vicinity of the villages of Demechi, Batovo, Tyihlash, Siurte, Mali Heivtsi, and Mali Selmentsi. Intensive field research will certainly result in findings additional new localities and populations. We assume that the species is more widely distributed up to the Carpathian foothills bordered with the line Uzhhorod–Mukachevo–Vynohradiv.

In accordance with the Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, the habitat with *R. lateriflorus* as well as other species we found in these communities, such as *Ranunculus sardous* Crantz, *R. sceleratus* L., *Limosella aquatica*, *Mentha pulegium* L., *Rorippa sylvestris* (L.) Besser, etc., formed on floodplain saline meadows of the Transcarpathian Lowland, are identified as Pannonic semi-saline meadows, and according to the EUNIS classification: B4.31 Pannonic salt steppes and salt marshes; E 6.2 Continental inland saline grass and herb-dominated habitats; Pal. Hab.: 15.A12 Pannonic saline meadows. In the Transcarpathian Lowland, this habitat is critically endangered (CR) and is located at the northeastern border of its natural distribution, where it is only fragmentarily represented by the halophilic meadow vegetation type, which is characterized by a relatively low dependence on the degree of salinity and by an impoverished species composition (Prots, Kagalo, 2012). As we have already noted, we found that the plant communities that are the main indicator of the above conditions are formed in depressed relief forms in fields sown mainly with winter crops.

Ranunculus lateriflorus has been assessed for The IUCN Red List of Threatened Species in 2013 as Least Concern (Lansdown, Rhazi, 2014). However, after 12 years, this data has become outdated and needs to be updated. This is especially true given that plants that grow in excessively moist ecotopes and have a narrow ecological amplitude in relation to the hydrological regime, such as the species we

studied, are increasingly found on lists of endangered species. The species is enlisted in the Czech and Slovak Red Data Book (Holub, 1999) and in Slovakia is considered in category Vulnerable (VU) (Eliáš et al., 2015; Dudáš, 2024). In Hungary it is protected and Near Threatened (Király, 2007). The species is not listed in the *Red Data Book of Ukraine* (Didukh, 2009; https://zakon.rada.gov.ua/laws/show/z0370-21#n17).

Recently, Ukraine assessed the conservation status of plant species according to the IUCN (Onyshchenko et al., 2022). *Ranunculus lateriflorus* was classified as "Critically Endangered" (CR), but the quality of this national assessment was rated as poor, indicating a lack of high-quality data on this species. The criterion for national assessment (for species in categories CR, EN, VU, and sometimes NT) was defined as C2a(i). This means that, based on observations, conclusions, or projections, it has been established that the population is continuing to decline, with no subpopulation exceeding 50 mature individuals. However, the subpopulation (according to the meaning of this term adopted in the IUCN methodology) that we studied in Transcarpathia numbers about 1,000 individuals. At the same time, we assume that there may be more localities than those we have identified. Over the past 50 years, the number of localities has decreased due to increased anthropogenic impact. This trend will intensify due to the war, which has provoked a mass migration of the population from the east of the country to Transcarpathia, specifically to the lowlands, as well as the relocation of production facilities and the development of residential infrastructure. Despite this, *R. lateriflorus* will continue to occur for some time in suitable conditions in fields, especially those where winter crops are grown, which are harvested before the start of its vegetation period, allowing the formation of halophytic communities of annuals. Therefore, based on careful analysis of the collected data, we identify *R. lateriflorus* as "Endangered" (EN) with the criterion of the national assessment as "E". This means that there is a significant risk of extinction in the wild due to population decline, habitat loss, and habitat quality changes. Our quantitative analysis shows that the species has ≥20% chance of extinction within the next 20 years, or 5 generations (whichever is longer, but not more than 100 years). Using this criterion, we recommend adding *R. lateriflorus* to the new edition of the *Red Data Book of Ukraine*.

Conclusion

This article presents the results of research on *Ranunculus lateriflorus*, a rare species in Ukraine that was long considered extinct in the Zakarpattia Region of Ukraine. According to current research on the species in Ukraine, the Prytysianska Lowland is the place where most of its populations are concentrated. The range in the Prytysianska Lowland is fragmented, with populations occupying small areas of 20–50 m^2, and only one population covering an area of 80 m^2. Analysis of herbarium specimens, supported by intensive field research, shows that *R. lateriflorus* is locally distributed between Uzhhorod, Chop, and Batovo. It occupies saline floodplain meadows or small saline marshes. In accordance with the Council Directive 92/43/EEC, the habitats with *R. lateriflorus* are identified as "Pannonic semi-saline meadows". The species is characterized by a narrow ecological amplitude in relation to the leading ecological factors of the environment and is particularly vulnerable to their change. According to the IUCN criteria, the conservation status of *Ranunculus lateriflorus* within Ukraine is defined as "Endangered" (EN), with the criterion of the national assessment as "E".

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ETHICS DECLARATION

Authors declare no actual or potential conflict of interest with other persons or institutions.

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***Ranunculus lateriflorus* (*Ranunculaceae*) на Притисянській низовині (Україна): поширення, екологічна та созологічна оцінка**

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Реферат. Трансформація ландшафтів і порушення гідрологічного режиму басейну річки Тиси в умовах кліматичних змін призвели до зникнення багатьох видів гідро- та гігрофільних судинних рослин через руйнування їхніх оселищ від низовини до субальпійського поясу Східних Карпат. Один із таких видів, *Ranunculus lateriflorus*, відомий лише з п'яти ділянок на півдні та заході України, тривалий час вважався зниклим на території Закарпатської області. Поширення виду було проаналізовано на основі вивчення зразків, що зберігаються у державних гербарних колекціях, та інтенсивних польових досліджень у 2022–2025 роках на території Притисянської низовині. Встановлено, що *R. lateriflorus* локально поширений між містами Ужгородом та Чопом і селищем Батьово і займає польові западини з тимчасовими водоймами, у яких накопичуються солі, та невеликі солонуваті болота. У статті наведено перелік місцезнаходжень та їхні характеристики, а також проаналізовано відношення виду до провідних екологічних факторів. Відповідно до методології МСОП було визначено созологічний статус виду в Україні й класифіковано його як такий, що перебуває під загрозою зникнення (EN). Для охоплення виявлених місцезнаходжень і забезпечення збереження *Ranunculus lateriflorus* у Закарпатській обл. ми вважаємо за доцільне розширити територію існуючого Притисянського регіонального ландшафтного парку.

Ключові слова: басейн річки Тиси, вид під загрозою зникнення, заплавні луки, панонські напівсолоні луки, оселища, охорона, Червоний список МСОП, *Ranunculus lateriflorus*