Plant Ecology and Evolution 158 (3): 418–427, 2025
https://doi.org/10.5091/plecevo.167734

RESEARCH ARTICLE

Notes on the genus *Pulsatilla* (Ranunculaceae) in Kosovo – Southeast Europe

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Academic editor: Federico Selvi ♦ **Received** 4 August 2025 ♦ **Accepted** 19 September 2025 ♦ **Published** 29 October 2025

Abstract

Background and aims – The genus *Pulsatilla* (Ranunculaceae) comprises ecologically and biogeographically significant taxa in the mountainous regions of the Balkans. Despite its importance, the diversity and distribution of *Pulsatilla* taxa in Kosovo have remained poorly documented. This study provides an updated overview based on new field data and critical taxonomic assessment.

Material and methods – Extensive fieldwork was carried out across various mountain massifs in Kosovo, supplemented by herbarium revisions and morphological comparisons with reference material. Elevational ranges, ecological preferences, and population data were recorded for each taxon.

Key results – A total of four species comprising five taxa are confirmed for the flora of Kosovo: *Pulsatilla alpina* subsp. *apiifolia*, *P. halleri* subsp. *rhodopaea*, *P. montana* subsp. *balkana*, *P. montana* subsp. *jankae*, and *P. vernalis*. New distributional records are provided, including the first confirmed presence of *P. halleri* subsp. *rhodopaea* in Kosovo and *P. vernalis* in the Sharri Mountains. Past misidentifications of *P. montana* subsp. *jankae* as *P. vulgaris* subsp. *grandis* are corrected. Conservation assessments suggest that *P. alpina* subsp. *apiifolia* remains nationally endangered, while *P. halleri* subsp. *rhodopaea* qualifies as Vulnerable due to its restricted range and occurrence at only two sites.

Conclusion – The study clarifies the taxonomy, distribution, and conservation status of *Pulsatilla* taxa in Kosovo. It highlights the regional importance of certain populations and underscores the need for continued monitoring and habitat protection in light of environmental pressures and climate change. These findings contribute to the broader understanding of plant diversity in the Western Balkans and support evidence-based conservation planning.

Keywords

conservation, Balkans, flora, Kosovo, Pulsatilla, Ranunculaceae

INTRODUCTION

The genus *Pulsatilla* Mill. (Ranunculaceae) comprises 48 recognized species and an additional 11 reported hybrids (Euro+Med 2006+; POWO 2025). The members of the genus are distributed throughout the northern hemisphere, mainly in Europe and temperate Asia, extending east to Japan (Tamura 1995). Of the total number of species, 12 are found in Europe, two in North America, and the remaining 34 in Asia, where the genus has its greatest diversity and centre of distribution (Sramkó et al. 2019). Several species are native to alpine and subalpine habitats, reflecting their adaptation to cold, mountainous regions. Due to their large and decorative flowers, many *Pulsatilla* species are widely cultivated as garden plants (Szczecińska et al. 2016; Weryszko-Chmielewska et al. 2017). In addition, some taxa are also known for their medicinal properties (Zhong et al. 2022), particularly in traditional medicine. Despite their ecological and horticultural importance, the taxonomic identification of wild *Pulsatilla* species remains a challenge due to overlapping morphological features (Grey-Wilson 2014), unresolved intraspecific variations (Li et al. 2020), and frequent hybridization (Valuyskikh et al. 2020).

The Balkan Peninsula represents a hotspot of genetic and species diversity and served as an important source

Plant Ecology and Evolution is published by Meise Botanic Garden and the Royal Botanical Society of Belgium.

for the dispersal of lineages to northern regions of the European continent following the end of the Pleistocene glaciation (Hewitt 2011; Nieto Feliner 2014; Španiel and Rešetnik 2022). The Balkans is an outstanding centre of plant species diversity and endemism and is undoubtedly one of the floristically richest regions in Europe (Tomović et al. 2014; Frajman et al. 2014; Vuksanović et al. 2016). It harbours around 6,500 plant species, of which over a third (~2,650) are endemic and around 400 are considered local endemics (Horvat et al. 1974; Kryštufek and Reed 2004; Stevanović et al. 2007). These numbers are probably underestimated, given that Greece alone, including Crete and its islands, hosts 5,752 species, of which 1,278 are endemic to the country (Dimopoulos et al. 2013).

In particular, the high mountain systems of the Dinarides (Dinaric Alps) exhibit an extraordinary diversity of ecosystems, species richness, and geological substrates (Horvat et al. 1974; Stevanović et al. 2009; Millaku et al. 2013; Caković et al. 2017). Despite a long history of botanical research in the Balkans (Grisebach 1843; Pančić 1875; Hayek 1924–1933; Turrill 1929; Fukarek 1954; Micevski 1970; etc.), currently, there is a notable reduction in floristic fieldwork across certain areas. Due to past conflicts and prolonged political instability in parts of the Western Balkans, floristic research in the region has declined significantly. Countries like Kosovo remain under-explored from a floristic perspective and still lack comprehensive, up-to-date checklists, an important gap that hinders phylogeographic research and poses challenges for effective conservation planning (Frajman et al. 2014; Krasniqi et al. 2019, 2020; Berisha et al. 2020; Millaku et al. 2025).

Given the exceptional biodiversity of the Balkan Peninsula and the floristic knowledge gaps that persist in Kosovo, it is essential to update data on important plant genera such as *Pulsatilla*. A better understanding of the distribution, ecology, and diversity of *Pulsatilla* species in Kosovo is crucial, not only for a more accurate and comprehensive assessment of the country's flora, but also for the floristic and biogeographical knowledge of Southeast Europe as a whole. Such data can provide valuable insights for phylogeographic studies and have important implications for the development of conservation strategies (Wagensommer 2023), especially with regard to ongoing environmental changes and threats to biodiversity (Gavilan 2003).

Records of *Pulsatilla* taxa in Kosovo are scarce and sometimes contradictory. Early floristic and vegetation works (Gajić 1970; Rexhepi 1986; Diklić 1992) mentioned *Pulsatilla* taxa, often without clear locality data. Later accounts (Krivošej 2013; Tomović et al. 2014) reported them at the subspecies level, but either with uncertain taxonomy or again without precise locality information. These inconsistencies highlight the need for updated field investigations.

In this study, we aim to document the diversity of the genus *Pulsatilla* in Kosovo by providing an updated list of known species and subspecies, analysing their distribution, and assessing their conservation status according to IUCN criteria. In addition, we provide new data specifically on *Pulsatilla montana* subsp. *jankae* and *Pulsatilla halleri* subsp. *rhodopaea*, whose occurrence in Kosovo has only now been confirmed.

MATERIAL AND METHODS

The present study is based on extensive field research conducted between 2023 and 2025, supplemented by a thorough and critical examination of the existing herbarium specimens of the genus *Pulsatilla*, which are kept in the herbarium of the University of Prishtina (UPH). Voucher specimens of all recorded taxa of *Pulsatilla* are deposited in the same herbarium. The taxonomic identification and determination was based on standard floristic and taxonomic works (Rummelspacher 1965; Micevski 1985; Diklić 1992; Tutin et al. 2010; Pils 2016; Jäger et al. 2017). The nomenclature and taxonomic framework applied in this study follow the Euro+Med Plant Base (Euro+Med 2006+). Nevertheless, it should be noted that the infraspecific classification within *P. montana* and *P. halleri* remains taxonomically complex and subject to different interpretations. For example, Plants of the World Online (POWO 2025) does not recognise any subspecies within *P. montana*, while Euro+Med (2006+) does. This emphasises the need for further research to clarify the taxonomic delimitation.

RESULTS

Diversity and distribution patterns of *Pulsatilla* taxa in Kosovo

A total of four species of the genus *Pulsatilla* were confirmed in Kosovo based on extensive field surveys and herbarium studies (Table 1; Fig. 1).

1. ***Pulsatilla alpina*** subsp. ***apiifolia*** (Scop.) Nyman (Nyman 1878: 2)

Figs 1A, 2

Anemone apiifolia Scop. (Scopoli 1771: 385)

Pulsatilla apiifolia (Scop.) Chaz. (Chazelles de Prizy 1790: 326)

Anemone alpina subsp. *apiifolia* (Scop.) O.Bolòs & Vigo (Bolòs and Vigo 1974: 65)

Description. *Pulsatilla alpina* (L.) Delarbre is represented in Kosovo only by *P. alpina* subsp. *apiifolia*. It is a perennial herbaceous plant characterised by its finely divided basal leaves, which resemble those of *Apium* L., distinguishing it from the other subspecies of *P. alpina*.

Distribution and habitat. This taxon occurs mainly in the alpine regions of Central Europe, with its distribution area extending across the Eastern Alps and parts of the Balkans. It inhabits alpine zones, typically at elevations of around 1,200 to 2,800 m a.s.l. (Moser 2003; Aeschimann

Table 1. Confirmed species of the genus *Pulsatilla* in Kosovo based on field observations and herbarium specimens.

No	Taxon	Distribution in Kosovo	Habitat type	Elevation range (m a.s.l.)	Notes
1.	*Pulsatilla alpina* subsp. *apiifolia*	Gjeravicë, Dervish Kom, Pllaçicë e Junikut, Kurvallë	Alpine grasslands and open scrubs	1800–2400	Rare taxon
2.	*Pulsatilla halleri* subsp. *rhodopaea*	Mt Pashtrik, Mt Koritnik	Subalpine calcareous grasslands	1500–1900	First record for Kosovo
3.1.	*Pulsatilla montana* subsp. *balkana*	Gjeravicë	Subalpine, siliceous grasslands	1400–1900	Scattered small populations
3.2.	*Pulsatilla montana* subsp. *jankae*	Domorovcë, Zubin Potok, Gërmi, Bërnicë	Dry meadows, light oak/pine forests	400–900	First record for Kosovo, formerly misidentified as *P. vulgaris* subsp. *grandis*
4.	*Pulsatilla vernalis*	Albanian Alps of Kosovo: Pllaqicë e Junikut, Kurvallë, Gjeravicë, Marjash, Roshkodol, Bjeshka e Strellcit, Bjeshka e Dobroshit. Sharri Mts.: Guri i Zi, Guri i Dhive	Subalpine to alpine silicate grasslands	1700–2300	Newly reported from the Sharri Mts in Kosovo

et al. 2004). Habitat preferences include calcareous soils on grassy slopes, alpine meadows, rocks and open scrub, often in areas with good drainage and strong sunlight. Although the species is generally not considered threatened in its core alpine range, some local populations may come under pressure from climate change, habitat disturbance and tourism-related impacts in sensitive mountain ecosystems (Lauber et al. 2018). In Kosovo, the species inhabits similar habitats and is listed as an endangered taxon (Millaku et al. 2013). It is distributed only in the Albanian Alps of Kosovo, within the Bjeshkët e Nemuna National Park (Fig. 2) (Rexhepi 1986; Diklić 1992; Millaku et al. 2013).

Material examined. KOSOVO – **Albanian Alps of Kosovo** • Gjeravicë; 2410 m; 27 Apr. 1988; fl.; *F. Rexhepi 014-001571*; UPH • Gjeravicë; 42.530223°N, 20.138315°E; 2364 m; 19 Apr. 2011; fl.; *F. Millaku 017-001798*; UPH • Dervish Kom; 42.558085°N, 20.137589°E; 2115 m; fl.; 2 May 2022; *F. Millaku 017-001799*; UPH • Pllaçicë e Junikut; 42.550766°N, 20.131977°E; 2027 m; 29 Apr. 2005; fl.; *F. Rexhepi 014-001572*; UPH • Kurvallë; 2209 m; 7 May 2000; fl.; *F. Millaku 017-001800*; UPH.

2. ***Pulsatilla halleri*** subsp. ***rhodopaea*** (Stoj. & Stef.) K.Krause (Krause 1958: 44)

Figs 1B, 2

Anemone rhodopaea (Stoj. & Stef.) Stoj. & Stef. (Stojanov and Stefanov 1948: 452)

Pulsatilla vulgaris var. *velezensis* Beck (Beck 1909: 162)

Pulsatilla halleri subsp. *macedonica* K.Krause (Krause 1958: 43)

Pulsatilla montana subsp. *olympica* Voliotis (Voliotis 1988: 88)

Description. *Pulsatilla halleri* Willd. is represented in Kosovo only by *P. halleri* subsp. *rhodopaea*. It is a low-growing perennial herb that rarely grows more than 5 cm tall when in flower. It is characterised by densely lanceolate basal leaves with typically five primary divisions, which are often petiolate. The leaf blades have a high number of lobes (50–100), which distinguishes it from other subspecies. The entire plant is usually covered with a dense silvery indumentum (Aichele and Schwegleb 1957; Jordanov and Kozhuharov 1970; Tutin et al. 1993; Tashev 2008).

Distribution and habitat. *Pulsatilla halleri* subsp. *rhodopaea* is a high-mountain specialist, occurring principally on calcareous substrates in the subalpine to lower alpine zones (1200–2000 m a.s.l.). It is typically found in open limestone grasslands, rocky ledges, and crevices. The plants form small, densely lanate cushions that protect meristematic tissues from frost and desiccation. Flowering occurs in early to mid spring when snowbanks melt, ensuring access to early pollinators in otherwise sparse alpine communities (Jordanov and Kozhuharov 1970; Tutin et al. 1993). In Kosovo, the taxon has been recorded in the subalpine calcareous grasslands of Mt Pashtrik and Mt Koritnik, where it exhibits the same ecological preferences and morphological features described throughout its range (Fig. 2). As a species, *Pulsatilla halleri* was first recorded in Kosovo from Mt Pashtrik by Wraber (1987), and subsequently confirmed from Mt Koritnik by Hashani and Shuka (2013). These two neighbouring mountain massifs are separated by the river Drini i Bardhë. The population on Mt Pashtrik occupies a wider area and comprises a significantly higher number of individuals (Table 1), in contrast to the very limited and spatially restricted population observed on Mt Koritnik. However, a recent taxonomic work (Niketić et al. 2023) has expressed doubts about the identity of the Balkan populations traditionally referred to *P. halleri* subsp. *rhodopaea*, noting that the type specimen resembles *P. montana*. This emphasises the need for further research to clarify the taxonomic position of these populations.

Material examined. KOSOVO • Pashtrik Mt; 42.210445°N, 20.541290°E; 1517 m; 6 Apr. 2014; fl.; *E. Krasniqi 018-002392*; UPH • Pashtrik Mt; 42.210355°N, 20.534988°E; 1675 m; 29 Mar. 2024; fl.; *F. Millaku & N. Berisha 020-002758*; UPH • Pashtrik Mt; 42.211193°N, 20.529358°E; 1831 m; 2 Jul. 2025; fr.; *N. Berisha 020-002759*; UPH • Koritnik Mt; 42.091910°N, 20.580527°E; 2057 m; 2 May 2025; fl.; *E. Krasniqi & N. Berisha 020-002760*; UPH.

3. ***Pulsatilla montana*** (Hoppe) Rchb. (Reichenbach 1832: 733)

Anemone montana Hoppe ex Sturm (Hoppe 1826: pl. 4)

Anemone pratensis subsp. *montana* (Hoppe) Hayek (Hayek 1924: 321)

Description. *Pulsatilla montana* is a perennial hemicryptophyte characterised by its deeply dissected basal leaves and solitary, nodding, bell-shaped flowers, which are typically dark purple to bluish-purple. The entire plant is densely covered with soft hairs, especially in the early phenological stages. It is one of the earliest flowering *Pulsatilla* species in Europe (Jäger et al. 2017), with anthesis taking place from March to April.

Distribution and habitat. The species typically inhabits open, dry, calcareous to gravelly grasslands and sparse pine or oak forests, often on south-facing slopes (Nikolić 2020). In Kosovo, *P. montana* is represented by two subspecies: *P. montana* subsp. *balkana* and *P. montana* subsp. *jankae*.

3.1. ***Pulsatilla montana*** subsp. ***balkana*** (Velen.) Zämelis & Paegle (Zämelis and Paegle 1927: 159)

Fig. 2

Distribution and habitat. *Pulsatilla montana* subsp. *balkana* is known from Mt Gjeravicë in the Albanian Alps of Kosovo (Fig. 2) (Millaku 2005). It occurs in subalpine, siliceous grasslands on the eastern and south-eastern slopes of the massif at elevations between 1,400 and 1,900 m a.s.l., where it forms rather small and scattered populations.

Material examined. KOSOVO – **Albanian Alps of Kosovo** • Gjeravicë; 42.523863°N, 20.160504°E; 1890 m; 22 Apr. 2004; fl.; *F. Millaku 017-001804*; UPH • Gjeravicë; 42.517853°N, 20.158286°E; 1866 m; 30 Apr. 2022; fl.; *N. Berisha 020-002762*; UPH.

3.2. ***Pulsatilla montana*** subsp. ***jankae*** (F.W.Schultz) Zämelis & Paegle (Zämelis and Paegle 1927: 159)

Figs 1C, 2

Distribution. *Pulsatilla montana* subsp. *jankae*, on the other hand, is newly reported for the flora of Kosovo. This taxon has been documented for Serbia in the Flora of Serbia (Diklić 1992), although listed under the synonym *Pulsatilla montana* subsp. *dacica* Rummelsp., but has

Figure 1. A. *Pulsatilla alpina* subsp. *apiifolia*. **B**. *P. halleri* subsp. *rhodopaea*. **C**. *P. montana* subsp. *jankae*. **D**. *P. vernalis*. Photos by Fadil Millaku (A), Naim Berisha (B, D), and Elez Krasniqi (C).

not yet been recorded in Kosovo. It typically occurs at elevations between 400 and 900 m a.s.l. Based on the flower morphology (size and orientation of the flowers), the leaf division and the size and shape of the involucral bracts, our specimens from Kosovo correspond to *P. montana* subsp. *jankae*. This identification is supported by the diagnostic features described in the Flora of Serbia (Diklić 1992), in particular the narrower, lanceolate basal leaves, the medium-sized nodding flowers and the linear, hairy bracts. These features clearly distinguish it from the morphologically similar *P. montana* subsp. *bulgarica* (C.Rosenthal) W.Zimm. and *P. montana* subsp. *australis* (Heuff.) Zämelis & Paegle.

Material examined. KOSOVO – **Gjilan** • Domorovcë; 649 m; 19 Mar. 1988; fl.; *F. Rexhepi 014-001575*; UPH • Zubin Potok; 783 m; 17 Mar. 1990; fl.; *S. Jakovljević 014-001576*; UPH. – **Prishtinë** • Gërmi; 42.666116°N, 21.223180°E; 861 m; 28 Mar. 2011; fl.; *F. Krasniqi 018-002394*; UPH • Bërnicë; 42.727766°N, 21.175133°E; 778 m; 21 Mar. 2018; fl.; *N. Berisha 020-002763*; UPH.

4. ***Pulsatilla vernalis*** (L.) Mill. (Miller 1768: 934)

Figs 1D, 2

Anemone vernalis L. (Linnaeus 1753: 538)

Anemone sulphurea L. (Linnaeus 1767: 78)

Description. *Pulsatilla vernalis* is a low-growing perennial herb that is easily recognized by its early spring flowering and bell-shaped single flowers. Initially, the flowers are whitish or pale purple on the inside and densely covered with long, silky hairs on the outside. With increasing age, they turn a bluish to purple colour. The deeply dissected basal leaves usually appear after flowering.

Distribution and habitat. Ecologically, it is native to subalpine to alpine zones and thrives in acidic, nutrient-poor grasslands, heathlands, and alpine meadows. It prefers well-drained, siliceous soils on open, sunny slopes near or above the tree line. It is well adapted to the harsh climate and short growing seasons and flowers soon after the snow melts (Ronikier et al. 2008; Nikolić 2020). In terms of distribution, *P. vernalis* is widespread in Central and Northern Europe, ranging from the Alps and Carpathians to the Scandinavian mountains. It also occurs sporadically on the Balkan Peninsula (Dakskobler et al. 2008), but is generally considered rare and localised there. Due to habitat loss, climate change, and changes in land use, the species is considered threatened or declining in several parts of its range in Europe (IUCN 2014; Scheuerer 2020). In Kosovo, the taxon has been recorded in the subalpine to alpine silicate grasslands and heathlands, just near the treeline up to the alpine grasslands.

Material examined. KOSOVO – **Albanian Alps of Kosovo** • Gjeravicë; 2000 m; 14 May 1991; fl.; *F. Rexhepi 014-001577*; UPH • Gjeravicë; 42.536306°N, 20.141675°E; 2421 m; 27 May 2000; fl.; *F. Millaku 017-001805*; UPH • Gjeravicë; 42.535351°N, 20.131184°E; 2319 m; 2 Jun. 2011; fl.; *F. Millaku & F. Rexhepi 017-001802*; UPH • Dervishkom; 42.554071°N, 20.131209°E; 2039 m; 28 Apr. 2011; fl.; *F. Millaku 017-001806*; UPH • Pllaqicë e Junikut; 2100 m; 17 May 2012; fl.; *F. Millaku 017-001807*; UPH • Roshkodol; 42.627432°N, 20.091094°E; 2027 m; 2 Jun. 2020; fl.; *N. Berisha 018-002765*; UPH • Gjeravicë; 42.526505°N, 20.133597°E; 2228 m; 27 May 2021; fl.; *N. Berisha 018-002766*; UPH • Bjeshka e Dobroshit; 42.559409°N, 20.088129°E; 2041 m; 19 May 2024; fl.; *N. Berisha 018-002767*; UPH • Bjeshka e Strellcit; 42.592660°N, 20.224720°E; 2057 m; 28 May 2024; fl.; *N. Berisha 018-002768*; UPH • Marjash; 42.608648°N, 20.093401°E; 2294 m; 1 Jun. 2025; fl.; *N. Berisha 018-002769*; UPH. – **Sharri Mts** • Guri i Dhive; 42.071823°N, 20.770572°E; 2100 m; 20 May 1993; fl.; *F. Rexhepi 014-001580*; UPH • Guri i Zi; 2100 m; 29 May 1990; fl.; *F. Rexhepi 014-001581*; UPH.

Conservation notes

The genus *Pulsatilla* in Kosovo includes both regionally rare and more widespread taxa, reflecting a spectrum of conservation priorities. Among the four confirmed taxa, *Pulsatilla alpina* subsp. *apiifolia* and *P. halleri* subsp. *rhodopaea* deserve particular attention due to their limited distribution and ecological specificity, while the *P. montana* subspecies and *P. vernalis* represent different but currently more stable conservation scenarios.

Pulsatilla alpina subsp. *apiifolia* is legally protected in Kosovo and listed as an endangered taxa (Millaku et al. 2013). It is restricted to alpine grasslands in the Albanian Alps (Bjeshkët e Nemuna National Park), where it inhabits high elevation habitats (1800–2400 m a.s.l.). Although the populations appear to be viable, they are endangered due to habitat destruction, climate change, and anthropogenic pressures in the sensitive alpine zones.

Pulsatilla halleri subsp. *rhodopaea* is currently only known from two isolated populations in Kosovo: Mt Pashtrik and Mt Koritnik. These two mountain massifs, which are about 9 km apart and separated by the river Drini i Bardhë river, represent distinct localities with no evidence of a connection between the populations. The total extent of occurrence (EOO) is estimated at 4.7 km^2, while the combined area of occupancy (AOO) is 61.3 ha (0.613 km^2), of which 58 ha are in Pashtrik and 3.3 ha in Koritnik. The Koritnik population is extremely limited in terms of spatial extent and number of individuals. In accordance with the IUCN Red List criteria (IUCN Standards and Petitions Committee 2024) and due to the small EOO and AOO as well as the occurrence at only two locations, the subspecies qualifies for the category Vulnerable VU B1a+2a. Subcriterion (a) is fulfilled as the two sites are geographically and ecologically isolated and represent separate threat units. However, subcriterion (b) regarding ongoing decline is not applied as no data on population trends, habitat degradation, or other dynamic threats are available. Given its restricted distribution and isolated populations, *P. halleri* subsp. *rhodopaea* should be considered a priority conservation target warranting regular monitoring and habitat protection, especially in view of possible future pressures such as grazing, tourism, or climate change-induced shifts in subalpine ecosystems.

The two subspecies of *Pulsatilla montana* – *P. montana* subsp. *balkana* and *P. montana* subsp. *jankae* – are currently not listed in any national threat category in Kosovo. The subspecies *balkana* is restricted to Mt Gjeravicë in the Albanian Alps, where it inhabits stable subalpine grassland habitats on siliceous substrates. Field data collected over the last two decades indicate a stable population restricted to the same slopes, with no signs of decline or range contraction observed. Although this taxon has a limited distribution and is considered endemic to the Balkan Peninsula, its limited range alone does not necessarily justify its categorisation as threatened according to IUCN criteria (Mounce et al. 2017). Rather, we recommend that it be placed under periodic ecological monitoring to ensure early detection of potential pressures. In contrast, *P. montana* subsp. *jankae* is widespread throughout Kosovo, with populations ranging from lowland meadows to sparse oak and pine forests. Given the wide distribution and the fact that there are currently no known threats, there is no immediate conservation need for this taxon.

Pulsatilla vernalis continues to be well distributed and ecologically secure in the subalpine and alpine silicate grasslands of the Albanian Alps and the Sharri Mountains. Numerous healthy populations have been recorded, many of which are located in protected areas. However, as the species is considered threatened or declining in other parts of its European range (Grzyl and Ronikier 2011; Betz et al. 2013), conservation planning in Kosovo should continue to monitor the long-term stability of its habitat, especially under changing climatic conditions.

To summarise, priorities for the conservation of *Pulsatilla* taxa in Kosovo should focus on *P. alpina* subsp. *apiifolia* and *P. halleri* subsp. *rhodopaea*, both of which have limited distribution and are vulnerable.

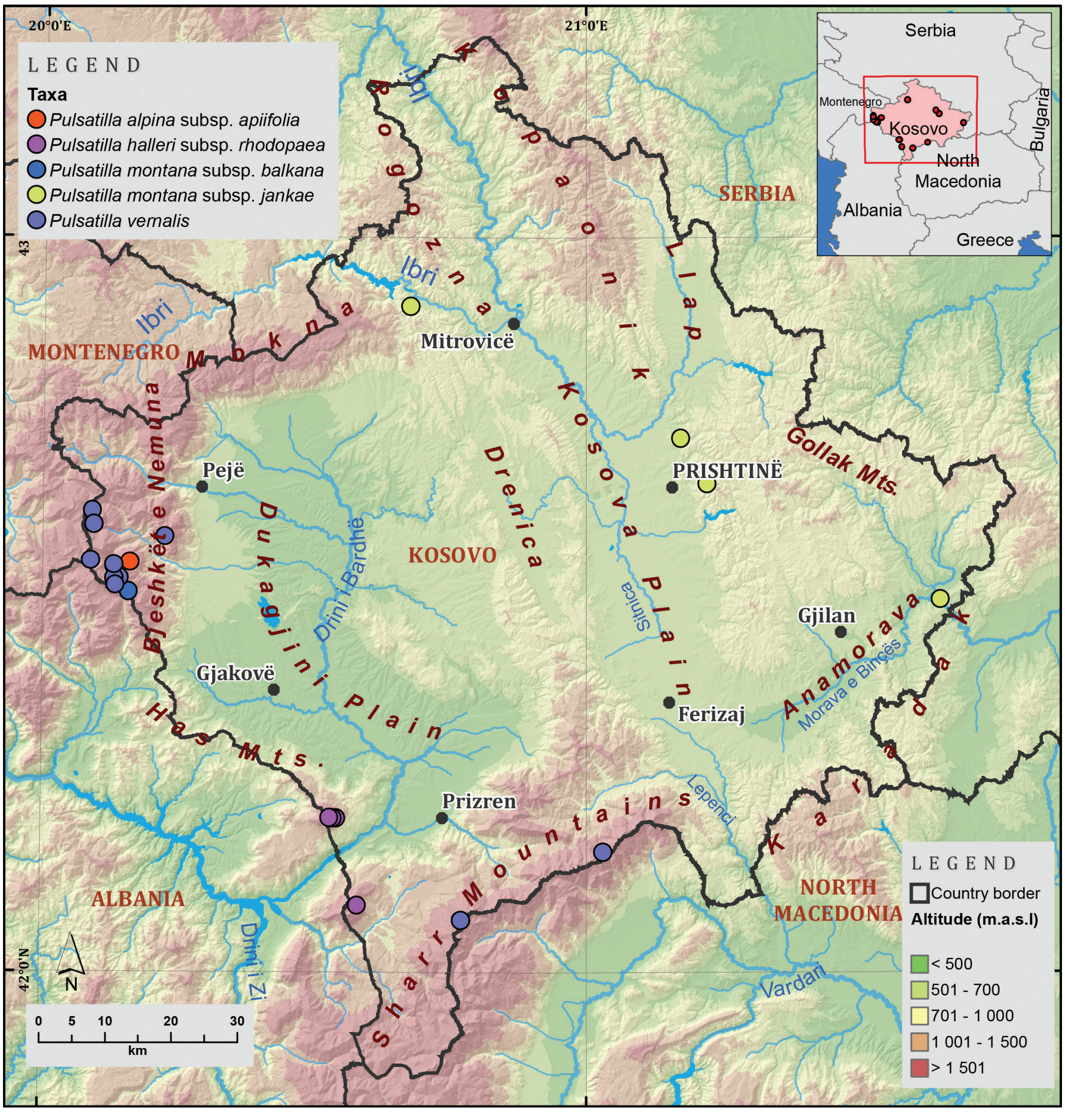

Figure 2. Map showing the distribution of all confirmed taxa of the genus *Pulsatilla* in Kosovo.

DISCUSSION

This study provides important new insights into the presence and distribution of *Pulsatilla* taxa in Kosovo and offers valuable data for regional biodiversity research and conservation planning. Confirmed localities, ecological preferences, and population observations contribute significantly to the understanding of these taxa in the Balkan Peninsula.

Pulsatilla alpina subsp. *apiifolia* is already listed as Endangered (EN) in the Red Book of the Vascular Flora of Kosovo (Millaku et al. 2013). Our results confirm the occurrence of this taxon in the Albanian Alps, where it inhabits alpine grasslands on Mt Gjeravica. These populations are of high biogeographical importance. As stated by Barina and Pifkó (2011), *P. alpina* is extremely rare in the Balkans, and the only documented populations in Kosovo, Albania, and Montenegro are restricted to the neighbouring mountain massifs of the Albanian Alps. Its regional importance for the conservation of the species is therefore beyond doubt and it deserves to continue to be legally protected and monitored in its habitat. Furthermore, the distribution of *Pulsatilla alpina* subsp. *apiifolia* and *P. vernalis* corresponds exactly to the Alpine sector of Kosovo as defined in the recent biogeographical regionalization (Berisha et al. 2025), which underlines the importance of high mountain habitats in the Albanian Alps of Kosovo for nature conservation.

The case of *Pulsatilla halleri* subsp. *rhodopaea* is particularly noteworthy. Its occurrence in Kosovo was previously vague and based only on a generic reference in a regional checklist (Tomović et al. 2014), in which it was listed without further details for the Dukagjini Plain. In addition, a misidentification of this taxon as *P. halleri* subsp. *halleri* on Mt Koritnik (Hashani and Shuka 2013) further obscured its status. Based on our field work and morphological observations, these populations belong to *Pulsatilla halleri* subsp. *rhodopaea*, which is supported by the typical leaf arrangement, dense indumentum, elvevational range, and is consistent with descriptions from neighbouring Macedonia and Bulgaria (Jordanov and Kozhuharov 1970; Micevski 1985; Tashev 2008). Our study corrects this misidentification and provides clear evidence from both Pashtrik and Koritnik mountains. Given the narrow distribution (EOO = 4.7 km^2), the limited AOO (Koritnik: 3.3 ha; Pashtrik: 58 ha) and the confirmed presence in only two locations more than 9 km apart, the taxon qualifies for the IUCN category Vulnerable VU B1a+2a (IUCN Standards and Petitions Committee 2024).

The identity and distribution of *Pulsatilla montana* subsp. *jankae* in Kosovo also required clarification. In some previous reports, this taxon was incorrectly identified as *Pulsatilla vulgaris* subsp. *grandis* (Wender.) Zämelis (Krivošej 2013; Prodanović et al. 2020), a Pontic relict restricted to Central and Eastern Europe with its southernmost distribution area in the Pannonian Plain. Our critical revision of the available specimens and comparison with diagnostic characters confirm that all these records from Kosovo actually refer to *P. montana* subsp. *jankae*. Although morphologically similar to *P. vulgaris* subsp. *grandis*, especially in the early flowering stage, *P. montana* subsp. *jankae* differs by narrower leaves, linear involucral bracts and nodding flowers. The identification is further confirmed by comparative herbarium specimens from the region (e.g. TUB 011026 (W), from the Vranje area, Serbia), which were collected near the border with Kosovo. Moreover, the distribution of *P. montana* subsp. *jankae* in Kosovo corresponds well with the delineation of the subspecies' distribution ranges in the Balkans as proposed by Rummelspacher (1965). In contrast, *P. montana* subsp. *balkana* is restricted to Mt Gjeravica and has shown a stable population trend over the last 20 years. Although both taxa are currently not threatened, their habitats are vulnerable to land-use change, climate alterations and succession. We recommend regular monitoring and ecological surveillance, especially for the locally endemic *P. montana* subsp. *balkana*.

Finally, the confirmed occurrence of *Pulsatilla vernalis* in the Sharri Mountains represents a new chorological addition for this massif in Kosovo. The species is well represented in both the Albanian Alps of Kosovo and the Sharri Mts, forming healthy and viable populations in subalpine and alpine siliceous grasslands. While *P. vernalis* is considered threatened or declining in many parts of Europe (Grzyl and Ronikier 2011; Betz et al. 2013), our data suggest that populations in Kosovo remain stable and often occur in protected or semi-natural landscapes. Nevertheless, the species' ecological sensitivity and early spring phenology make it a good indicator of potential climate change impacts, justifying long-term monitoring.

To summarise, our results underline the floristic richness and conservation value of *Pulsatilla* taxa in Kosovo. While some taxa such as *P. alpina* subsp. *apiifolia* and *P. halleri* subsp. *rhodopaea* require active conservation measures, others such as *P. montana* and *P. vernalis* should remain under regular ecological monitoring to detect early signs of population decline or habitat disturbance.

ACKNOWLEDGEMENTS

The authors would like to thank Prof. Kit Tan and an anonymous reviewer for their valuable comments and suggestions that helped improve the quality of the manuscript. Special thanks are extended to Prof. Valbon Bytyqi (University of Prishtina) for his kind assistance in preparing the distribution map of the taxa.

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