




# SOME RARE AND THREATENED PLANT SPECIES OF THE FLORA OF BOSNIA AND HERZEGOVINA IN THE NEVESINJSKO POLJE

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Nevesinjsko Polje is one of the large karst fields of the Dinaric karst (western Balkans). There is a long tradition of floristic research into the Nevesinjsko Polje, starting at the end of the 19th century. During our field research into the wetland ecosystems of the Nevesinjsko Polje, new and noteworthy chorological data for rare and threatened vascular plant species were recorded: *Achillea ptarmica*, *Drosera rotundifolia*, *Menyanthes trifoliata* and *Sanguisorba officinalis*. Also, data concerning their habitats and population sizes are presented, and the conservation status of the studied species is assessed as Critically Endangered in Bosnia and Herzegovina. Possible negative anthropogenic influences could threaten the wetland habitats where these species occur, and the paper highlights the need to monitor the population trends of the studied species.

**Key words:** *Achillea ptarmica*, *Drosera rotundifolia*, *Menyanthes trifoliata*, *Sanguisorba officinalis*, karst fields, Balkans

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Nevesinjsko polje pripada grupi velikih krških polja Dinarskog krša (zapadni Balkan). Floristička istraživanja Nevesinjskog polja imaju dugu tradiciju i započela su krajem 19. stoljeća. Tokom naših terenskih istraživanja vlažnih ekosustava Nevesinjskog polja zabilježeni su novi i vrijedni horološki podaci za rijetke i ugrožene vaskularne biljne vrste: *Achillea ptarmica*, *Drosera rotundifolia*, *Menyanthes trifoliata* i *Sanguisorba officinalis*. Također, prikazani su podaci o njihovom staništu i veličini populacija, a konzervacijski status za proučavane vrste je procijenjen kao kritično ugrožen u Bosni i Hercegovini. Mogući negativni antropogeni utjecaji mogli bi ugroziti vlažna staništa na kojima se ove vrste pojavljuju, te se u radu ističe potreba praćenja trenda populacija proučavanih vrsta.

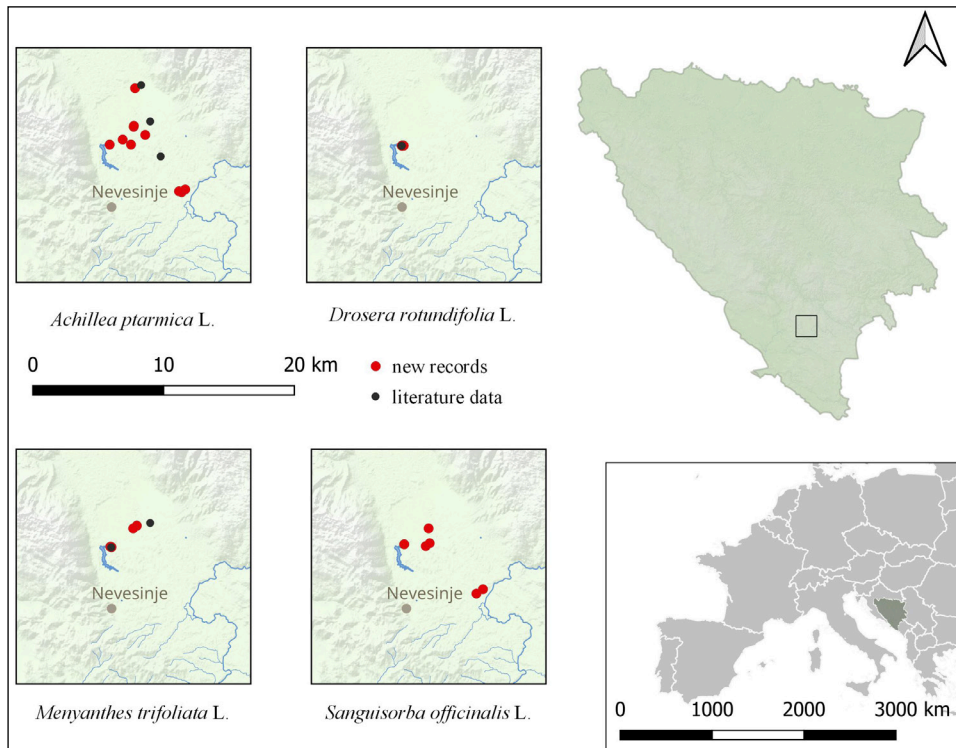
**Ključne riječi:** *Achillea ptarmica*, *Drosera rotundifolia*, *Menyanthes trifoliata*, *Sanguisorba officinalis*, krška polja, Balkan

## INTRODUCTION

Bosnia and Herzegovina is located in the Western Balkans and is characterized by a significant diversity of flora and vegetation. The flora and vegetation of the karst

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fields, which were systematically researched for the first time by RITER-STUDNIČKA (1954), are particularly noteworthy. The subject of our investigations was the wetland habitats in the area of Nevesinjsko Polje. Nevesinjsko Polje is one of the large karst fields of the Dinaric karst. It is located in eastern Herzegovina (Republic of Srpska, Bosnia and Herzegovina) and covers an area of 188.8 km<sup>2</sup> (Fig. 1). The altitude ranges from 830 to 900 m (CVIJIĆ, 1895; RITER-STUDNIČKA, 1954; ŠKONDRIĆ, 2019). Nevesinjsko Polje and its edges are structured of limestone, dolomite, conglomerate, marl and clay, while the karst field floor is covered with alluvial deposits. The hydrographic network is represented by the Zalomka River and its tributaries. Periodic flooding, a phenomenon characteristic of karst fields, is present in Nevesinjsko Polje in the area along the Zalomka River. In the area of Nevesinjsko Polje, there is an artificial lake, Alagovac, with an area of cca. 40 ha (RITER-STUDNIČKA, 1954; ŠKONDRIĆ, 2019). Srednja Voda is a unique locality in the area of Nevesinjsko Polje. This locality could be characterized as an acidic transitional *Sphagnum*-mire developed on Lower Triassic (Werfen) strata fractions (RITER-STUDNIČKA, 1954). Srednja Voda is one of the important localities of rare and/or threatened vascular plant species such as *Carex limosa* L. and *Drosera rotundifolia* L. in Bosnia and Herzegovina (RITER-STUDNIČKA, 1954; PERIĆ *et al.*, 2018). Acidophilous mires are, moreover, among the most threatened habitat types, and in neighboring Croatia, they are nearly extinct (TOPIĆ & STANČIĆ, 2006).



**Fig. 1.** Geographical position of the Nevesinjsko Polje and finding localities of the studied plant species (literature data related to the Nevesinjsko Polje, without closer localities, are not shown on the map).

Floristic research into Nevesinjsko Polje began at the end of the 19th century and has continued intermittently to the present day (MURBECK, 1891; RITER-STUDNIČKA, 1954; LAKUŠIĆ *et al.*, 1982; PERIĆ *et al.*, 2018; ŠKONDRIĆ, 2019). There are different types of vegetation in Nevesinjsko Polje ranging from aquatic and swamp vegetation, through wet and mesophilic meadows, to peripheral foothill thermophilic meadows. Among the vascular plants of Nevesinjsko Polje, a special place is accorded to medicinal plants, because of the long-standing tradition of their use (ŠKONDRIĆ, 2019).

The first list of rare and threatened vascular plant species of Bosnia and Herzegovina was published by ŠILJIĆ (1996) and it contains 678 taxa. That list was supposed to be used for the Red Book of Vascular Flora of Bosnia and Herzegovina, which has not been published to date. At the entity level of Bosnia and Herzegovina, the situation is slightly different compared to the state level. Thus, the Rulebook on the red list of protected species of flora and fauna of the Republic of Srpska was adopted in Republic of Srpska in 2012 (ANONYMOUS, 2012), while in the Federation of Bosnia and Herzegovina, the Red List of the Flora of the Federation of Bosnia and Herzegovina was published in 2013 (ĐUG *et al.*, 2013). Also, in the territory of the Republic of Srpska, in which Nevesinjsko Polje is located, a Rulebook of strictly protected and protected wild species in the Republic of Srpska was adopted (ANONYMOUS, 2020). This rulebook (ANONYMOUS, 2020) includes wild species that are threatened or potentially threatened. Also, these taxa are significant from genetic, ecological, ecosystem, scientific, health, economic and other aspects. Since Nevesinjsko Polje is characterized by a significant ecosystem and species diversity, it is very important to sensitize decision-makers and local people to the biological importance of these species and to emphasize the need to preserve these habitats.

The aim of this paper is to present new and noteworthy records, habitat preferences and population size for the rare and threatened vascular plant species in the area of Nevesinjsko Polje: *Achillea ptarmica* L., *Drosera rotundifolia* L., *Menyanthes trifoliata* L. and *Sanguisorba officinalis* L. as well as to propose the IUCN conservation status of these species in Bosnia and Herzegovina.

## MATERIAL AND METHODS

Field floristic research into Nevesinjsko Polje was conducted during the vegetation seasons of 2011, 2017, 2018 and 2019. Also, all relevant literature was reviewed. Herbarium specimens are deposited in the collections of the Faculty of Natural Sciences and Mathematics, University of Banja Luka and the Institute for Nature Conservation of Vojvodina province (PZZP, s/n; THIERS, 2023). The determination of the plant material was made on the basis of dichotomous morphological keys (DOMAC, 1967; JÁVORKA & CSAPODY, 1975; JOSIFOVIĆ, 1970-1977; SARIĆ, 1986, 1992; TUTIN *et al.*, 1968-1980, 1993; NIKOLIĆ, 2019, 2020a, b). Nomenclature and systematics are presented according to Euro+Med PlantBase (EURO+MED, 2006-onwards). Author citations follow Rec. 46A, note 1 of the Code (TURLAND *et al.*, 2018). Floral elements are given according to GAJIĆ (1980). Life forms were determined according to RAUNKIAER (1934) and elaborated according to KOJIĆ *et al.* (1997). The threat status of the species presented is estimated according to the categorization criteria given in the most recent IUCN Red List Categories and Criteria (IUCN, 2012).

## RESULTS AND DISCUSSION

During the field research of the wetland habitats of Nevesinjsko polje, we recorded new and noteworthy chorological data for the rare and threatened vascular plant species: *Achillea ptarmica*, *Drosera rotundifolia*, *Menyanthes trifoliata* and *Sanguisorba officinalis*.

### *Achillea ptarmica* L.

**Specimens examined:** Bosnia and Herzegovina, Republic of Srpska, Nevesinjsko Polje, Obradov Teg, wet meadows, 43.2684°N, 18.17924°E, altitude 851 m a.s.l., 4 May 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Obradov Teg, wet meadows, 43.26823°N, 18.1797°E, altitude 850 m a.s.l., 17 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Obradov Teg, wet meadows, 43.27009°N, 18.18302°E, altitude 850 m a.s.l., 17 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Obradov Teg, wet meadows, 43.26881°N, 18.17711°E, altitude 851 m a.s.l., 24 July 2019, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Srednja Voda, wet meadows, 43.30076°N, 18.11185°E, altitude 845 m a.s.l., 16 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Zelena Bara-Jamlik, wet meadows, 43.30742°N, 18.14535°E, altitude 844 m a.s.l., 18 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Zelena Bara, wet meadows, 43.30423°N, 18.12411°E, altitude 843 m a.s.l., 23 September 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Zelena Bara, wet meadows, 43.30078°N, 18.13194°E, altitude 843 m a.s.l., 25 July 2019, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Stubo, wet meadows, 43.31297°N, 18.13444°E, altitude 842 m a.s.l., 18 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Stubo, wet meadows, 43.31368°N, 18.13465°E, altitude 842 m a.s.l., 25 July 2019, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Ružica, wet meadows, 43.33941°N, 18.13577°E, altitude 837 m a.s.l., 19 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić.

**Known distribution in Nevesinjsko Polje (Bosnia and Herzegovina):** swamp meadows between Nevesinje and Postoljani [Pustoljane] (SAGORSKI, 1901); Nevesinjsko Polje, Dušila stream (RITER-STUDNIČKA, 1954; BECK-MANNAGETTA *et al.*, 1983); Nevesinjsko Polje, near Zlatac (RITER-STUDNIČKA, 1954); Nevesinjsko Polje (BECK-MANNAGETTA *et al.*, 1983).

*Achillea ptarmica* (Compositae) (Fig. 2A) occurs in Europe, the Caucasus, Asia Minor, Armenia, Siberia, and is naturalized in North America (GAJIĆ, 1975). It belongs to the Boreal-Eurasian floral element. This species is the only representative of the *Achillea* sect. *Ptarmica* subsect. *Ptarmica* on the Balkan Peninsula, and due to its specific natural range and phylogenetic isolation, can be considered as a Boreal relic species (STEVANOVIĆ & VUKOJIČIĆ, 1999). In relation to the classification of life forms according to Runkiaer, it belongs among the geophytes. *A. ptarmica* occurs in wet and damp habitats (BILZ, 2013).

*Achillea ptarmica* grows in the wet meadows of Nevesinjsko Polje, where it was first recorded by SAGORSKI (1901) between Nevesinje and Postoljani. Other historical findings in Nevesinjsko Polje refer to the Dušila stream and Zlatac (RITER-STUDNIČKA, 1954; BECK-MANNAGETTA *et al.*, 1983) (Fig. 1). Additionally, its occurrence in the wet and swampy meadows of Nevesinjsko Polje was confirmed by our field research. During



Fig. 2. Rare and threatened plant species of the flora of Bosnia and Herzegovina in the Nevesinjsko Polje: A – *Achillea ptarmica* (Photo by S. Škondrić); B – *Drosera rotundifolia* (Photo by J. Knežević); C – *Menyanthes trifoliata* (Photo by S. Škondrić); D – *Sanguisorba officinalis* (Photo by S. Škondrić).

our field research in 2017 and 2019, we found this species in wet meadows at six localities in Nevesinjsko Polje: Srednja Voda, Zelena Bara, Zelena Bara-Jamljik, Stubo, Ružica and Obradov Teg (Fig. 1). Our findings in the areas of Zelena Bara and Zelena Bara-Jamljik are relatively close to its first record between Nevesinje and Postoljani. In the Srednja Voda locality, *A. ptarmica* occurs on the northeastern edge of the Srednja Voda mire. At each investigated site, cca. 100 individuals were recorded. *A. ptarmica* is most often accompanied by *Anthoxanthum odoratum* L., *Deschampsia cespitosa* (L.) P. Beauv. subsp. *cespitosa*, *Filipendula ulmaria* (L.) Maxim., *Lysimachia vulgaris* L., *Molinia*



*caerulea* (L.) Moench, *Potentilla erecta* (L.) Rausch. and *Sanguisorba officinalis*. The main cause that can lead to the decline of this species in Nevesinjsko Polje is the reclamation of wet and marshy meadows. *A. ptarmica* is a rare species in the flora of Bosnia and Herzegovina. As well as in the localities in Nevesinjsko Polje, this species was recorded in Lijevče Polje, Livanjsko Polje, Zelengora and along the Sana River near Pejići (KOLJANIN *et al.*, 2023).

*A. ptarmica* has been assessed for the IUCN Red List of Threatened Species at the global and European levels as of Least Concern (LC). The overall population trend is unknown, and no threats to this species have been recorded at the European level (BILZ, 2013). In Bosnia and Herzegovina and neighboring countries, the situation seems to be different. According to ŠILJIĆ (1996), *A. ptarmica* is assessed as Vulnerable (VU) in Bosnia and Herzegovina. Also, this species is on the Red List of the Flora of the Federation of Bosnia and Herzegovina in the category Vulnerable (VU) (ĐUG *et al.*, 2013). According to KOLJANIN *et al.* (2023), it was proposed that the conservation status of this species in Bosnia and Herzegovina should be Critically Endangered (CR). This threat category is in accordance with our field observation of *A. ptarmica* and data regarding its spatial distribution, area of occupancy and observed/projected decline of area of occupancy, extent of occurrence and quality of habitat in the area of Nevesinjsko Polje. Therefore, the revised and detailed threat status in Bosnia and Herzegovina, based on combined field data from our research and recent data published by KOLJANIN *et al.* (2023), according to the most recent IUCN criteria, is estimated as Critically Endangered (CR B2ab (iii)). *A. ptarmica* is on the Rulebook on the Red List of protected species of flora and fauna of the Republic of Srpska (ANONYMOUS, 2012). Also, *A. ptarmica* is listed on the Rulebook of strictly protected and protected wild species in the Republic of Srpska in the category of strictly protected species (ANONYMOUS, 2020). In Serbia, *A. ptarmica* is estimated as Extinct (EX) (STEVANOVIĆ & VUKOJIČIĆ, 1999; BILZ, 2013), while in Montenegro it is known only from Durmitor (STEVANOVIĆ & VUKOJIČIĆ, 1999). In Croatia, that species is listed on the Red Book as Data Deficient (DD) (NIKOLIĆ & TOPIĆ, 2005) and is also strictly protected (ANONYMOUS, 2016). The main threats to this species are drainage, the construction of embankments and habitat destruction (STEVANOVIĆ & VUKOJIČIĆ, 1999; STROH *et al.*, 2020a).

*A. ptarmica* is a medicinal plant and possesses a chemical composition similar to that of *Achillea millefolium* L., so both show similar effects (TUČAKOV, 2014). Recent studies show that *A. ptarmica* possesses antiprotozoal activity (ALTHAUS *et al.*, 2014). In folk medicine, both species are used for digestive and stomach problems (RIGAT *et al.*, 2007; ŠAVIKIN *et al.*, 2013).

### *Drosera rotundifolia* L.

**Specimens examined:** Bosnia and Herzegovina, Republic of Srpska, Nevesinjsko Polje, Srednja Voda, *Sphagnum* mire, 43.30017°N, 18.11369°E, altitude 844 m a.s.l., 14 August 2011, leg. et det. R. Perić, S. Škondrić; Nevesinjsko Polje, Srednja Voda, *Sphagnum* mire, 43.30011°N, 18.11369°E, altitude 844 m a.s.l., 3 May 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Srednja Voda, *Sphagnum* mire, 43.30005°N, 18.11346°E, altitude 844 m a.s.l., 16 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Srednja Voda, *Sphagnum* mire, 43.30005°N, 18.11346°E, altitude 844 m a.s.l., 23 September 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Srednja Voda, *Sphagnum* mire, 43.30010°N, 18.11511°E, altitude 844 m a.s.l.,

23 September 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Srednja Voda, *Sphagnum* mire, 43.30005°N, 18.11517°E, altitude 844 m a.s.l., 23 September 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Srednja Voda, *Sphagnum* mire, 43.30002°N, 18.11349°E, altitude 844 m a.s.l., 25 July 2019, leg. et det. S. Škondrić, J. Knežević, R. Perić.

**Known distribution in Nevesinjsko Polje (Bosnia and Herzegovina):** Nevesinjsko Polje, Srednja Voda (RITER-STUDNIČKA, 1953, 1954, 1956; PERIĆ *et al.*, 2018; ŠKONDRIĆ, 2019); Nevesinjsko Polje (RITER-STUDNIČKA, 1959; RITTER-STUDNIČKA, 1974).

*Drosera rotundifolia* (Droseraceae) (Fig. 2B) inhabits Europe, subarctic Asia, arctic and temperate parts of North America and Greenland (JANKOVIĆ, 1972). It is a representative of the Boreal-circumpolar floral element. According to Raunkiaer's systematization of life forms, it is a hemicryptophyte. *D. rotundifolia* is an insectivorous plant that grows in nitrogen poor habitats, in lowland to montane wet acid heaths, moors and *Sphagnum* bogs (KHELA, 2012).

In the area of Nevesinjsko Polje, *D. rotundifolia* inhabits *Sphagnum* bogs at the Srednja Voda locality, where it was first recorded by RITER-STUDNIČKA (1953). PERIĆ *et al.* (2018) confirmed the presence of this species in the area of Srednja Voda (Fig. 1), together with the relict arctic-Boreal species *Carex limosa*. Both species are rare in southeastern Europe. During our field research, a few hundred individuals of *D. rotundifolia* were recorded at the Srednja Voda locality (Fig. 1). Individuals occur on small, mosaic arranged *Sphagnum* hummocks on the southern edge of the mire in a confined area estimated to cover no more than a few dozen square meters. A community of *Caricetum limosae* Br.-Bl. was developed on these *Sphagnum* hummocks, where *D. rotundifolia* was accompanied by *Sphagnum* spp. and *Carex limosa*. Based on our field data, the threat status of *D. rotundifolia* according to current IUCN criteria can be estimated as Critically Endangered (CR B1ab(iii)+B2a,b(iii)) in Bosnia and Herzegovina.

Considering that in the area of Nevesinjsko Polje, *D. rotundifolia* inhabits the only peat habitat – Srednja Voda, together with other rare species, additional protection measures for and monitoring of the population trend of this species are necessary. Possible negative anthropogenic factors (vegetation succession caused by an artificially altered water regime, pollution, peat digging, habitat flooding after the construction of the Alagovac Lake) are a threat to the survival of this species.

*Drosera rotundifolia* is listed as Least Concern (LC) at the European level (KHELA, 2012) as well as at the global level (MAIZ-TOME, 2016a). However, the overall population trend is decreasing in Europe, where this species is included in several national red lists (KHELA, 2012). This species is on the List of Rare and Threatened Vascular Plant Species of Bosnia and Herzegovina in the category of Vulnerable (VU) species (ŠILIC, 1996). It is also on the Rulebook on the Red List of Protected Species of Flora and Fauna of the Republic of Srpska (ANONYMOUS, 2012), as well as on the Rulebook of Strictly Protected and Protected Wild Species in the Republic of Srpska in the Category of Strictly Protected Species (ANONYMOUS, 2020). On the Red List of the Flora of the Federation of Bosnia and Herzegovina, *D. rotundifolia* is in the category of Critically Endangered (CR) species (ĐUG *et al.*, 2013). In neighboring Croatia, this species is Critically Endangered (CR) (NIKOLIĆ & TOPIĆ, 2005) and strictly protected (ANONYMOUS, 2016). Furthermore, *D. rotundifolia* is a strictly protected species in Serbia (ANONYMOUS, 2010-2016). The main threat factors are the loss of acidophilous mires through natural progressive vegetation succession and drainage (NIKOLIĆ & TOPIĆ, 2005; TOPIĆ & STANČIĆ,

2006). Also, this species is sensitive to the increase in soil acidity, which is caused by atmospheric nitrogen and sulfur deposition in heathlands (KHELMA, 2012).

*D. rotundifolia* is used as an antiseptic, antispasmodic and antitussive, as well as for bronchospasm and spasms of the digestive organs, whooping cough and atherosclerosis (KOJIĆ *et al.*, 1998; KOVAČEVIĆ, 2002; REDŽIĆ, 2007; TUČAKOV, 2014). In folk medicine, since it contains proteolytic enzymes, it is used to remove warts (KOJIĆ *et al.*, 1998).

### *Menyanthes trifoliata* L.

**Specimens examined:** Bosnia and Herzegovina, Republic of Srpska, Nevesinjsko Polje, Srednja Voda, mire, 43.30040°N, 18.11249°E, altitude 845 m a.s.l., 3 May 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Srednja Voda, mire, 43.30032°N, 18.11327°E, altitude 851 m a.s.l., 3 May 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Srednja Voda, mire, 43.30009°N, 18.11346°E, altitude 844 m a.s.l., 16 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Srednja Voda, mire, 43.30011°N, 18.11359°E, altitude 844 m a.s.l., 29 April 2018, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Stubo, pool margins, 43.31481°N, 18.13743°E, altitude 839 m a.s.l., 17 June 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Stubo, pool margins, 43.31473°N, 18.13735°E, altitude 839 m a.s.l., 18 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Novaci-Stubo, ditch margins, 43.31293°N, 18.13400°E, altitude 841 m a.s.l., 17 June 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić.

**Known distribution in Nevesinjsko Polje (Bosnia and Herzegovina):** Nevesinjsko Polje, Srednja Voda (RITER-STUDNIČKA, 1953, 1954, 1956; ŠKONDRIĆ, 2019); Nevesinjsko Polje, Dušila (RITER-STUDNIČKA, 1954); Nevesinjsko Polje (RITTER-STUDNIČKA, 1974); Nevesinjsko Polje, Srednja Voda [Srednje vode] (BECK-MANNAGETTA *et al.*, 1974); Nevesinje (BECK-MANNAGETTA *et al.*, 1974).

The natural range of *Menyanthes trifoliata* (Menyanthaceae) (Fig. 2C) includes Europe, Central and Eastern Asia and the northern parts of North America (STJEPANOVIĆ-VESELIČIĆ, 1973). It belongs to the circumpolar floral element and is considered to be a glacial relic species. In the classification system of life forms, the species *M. trifoliata* belongs to geophytes. Populations of this species grow in mountain and subalpine zones, in various wetland habitats (fens, pools, lakes, springs, ditches, bogs, marshy areas and wet meadows) (STJEPANOVIĆ-VESELIČIĆ, 1973; SORENSSEN *et al.*, 2011).

In the area of Nevesinjsko Polje, *M. trifoliata* was recorded for the first time at the Srednja Voda locality (RITER-STUDNIČKA, 1953), and our field research contributed to the discovery of new localities of this species in Nevesinjsko Polje (Fig. 1). In addition to the Srednja Voda locality, during our field research, this plant was recorded in two other localities: Stubo and Novaci-Stubo. In the Srednja Voda locality, this species forms dense stands of several hundred square meters, as well as in the ditches on the northern edge of the mire. A dense stand of this plant on an area of several dozen square meters was recorded at the Stubo site. Also, in the ditch at the Novaci-Stubo site, a dense stand of *M. trifoliata* was recorded, covering an area of several dozen square meters. Based on the above data, its most recent IUCN threat status can be assessed as Critically Endangered (CR B2a,b(iii)) in Bosnia and Herzegovina. Possible local threats to this species include drainage, eutrophication and habitat destruction.

*Menyanthes trifoliata* is listed on the IUCN Red List of Threatened Species on the global (AKHANI, 2014), Mediterranean (RHAZI *et al.*, 2010) and European (SORENSSEN *et al.*,



2011) levels as Least Concern (LC). In Europe, the populations of this species are stable, without extreme fluctuations and are not fragmented. However, there are local declines, as recorded in Croatia, Hungary, Italy, Slovenia and Switzerland (SORENSEN *et al.*, 2011). *M. trifoliata* is listed on the List of Rare and Threatened Vascular Plant Species of Bosnia and Herzegovina (ŠILIĆ, 1996), as well as on the Red List of the Flora of the Federation of Bosnia and Herzegovina (ĐUG *et al.*, 2013) and assessed as Vulnerable (VU). Also, it is listed on the Rulebook on the Red List of Protected Species of Flora and Fauna of the Republic of Srpska (ANONYMOUS, 2012). *M. trifoliata* is a strictly protected species in the Republic of Srpska (ANONYMOUS, 2020). In the Croatian flora, *M. trifoliata* is an Endangered (EN) (NIKOLIĆ & TOPIĆ, 2005) and strictly protected species (ANONYMOUS, 2016). It is also a strictly protected species in Serbia (ANONYMOUS, 2010-2016). The main threats to this species are drainage, eutrophication, habitat loss and collecting for use in traditional medicine (especially in the past) (NIKOLIĆ & TOPIĆ, 2005; SORENSEN *et al.*, 2011).

The leaf of this plant is used as a drug therapeutically, and it acts as a bitter tonic and diuretic. In folk medicine, it is used for general strengthening of the organism and treatment of fever, nervous diseases and stomach disorders (SARIĆ, 1989; KOJIĆ *et al.*, 1998; KOVAČEVIĆ, 2002; REDŽIĆ, 2007; TUČAKOV, 2014).

### *Sanguisorba officinalis* L.

**Specimens examined:** Bosnia and Herzegovina, Republic of Srpska, Nevesinjsko Polje, Obradov Teg-Gradac, wet meadows, 43.27127°N, 18.18575°E, altitude 848 m a.s.l., 16 June 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Obradov Teg, wet meadows, 43.26826°N, 18.17955°E, altitude 850 m a.s.l., 17 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, near Alagovac lake, wet meadows, 43.30212°N, 18.11159°E, altitude 845 m a.s.l., 16 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, near Alagovac lake, wet meadows, 43.30206°N, 18.11160°E, altitude 845 m a.s.l., 17 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Stubo, wet meadows, 43.31296°N, 18.13456°E, altitude 842 m a.s.l., 18 July 2017, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Zelena Bara, wet meadows, 43.30085°N, 18.13189°E, altitude 843 m a.s.l., 25 July 2019, leg. et det. S. Škondrić, J. Knežević, R. Perić; Nevesinjsko Polje, Zelena Bara, wet meadows, 43.30281°N, 18.13559°E, altitude 842 m a.s.l., 25 July 2019, leg. et det. S. Škondrić, J. Knežević, R. Perić.

**Known distribution in Nevesinjsko Polje (Bosnia and Herzegovina):** Nevesinjsko Polje [Nevesinsko polje] (MURBECK, 1891); Nevesinjsko Polje (BECK-MANNAGETTA, 1927; RITER-STUDNIČKA, 1954; RITTER-STUDNIČKA, 1974; ŠKONDRIĆ, 2019).

*Sanguisorba officinalis* (Rosaceae) (Fig. 2D) occurs in Europe, Asia, Japan and North Africa and is naturalized in North America (GAJIĆ, 1972). It is a Eurasian species. According to Raunkiaer's systematization of life forms, it belongs to hemicryptophytes. The habitats of this species are wet meadows, pastures and arable fields.

The first data on the distribution of this species in Nevesinjsko Polje originate from MURBECK (1891). During our field research, this species was recorded at five localities in Nevesinjsko Polje, where it grew in wet meadows: Obradov Teg, Obradov Teg-Gradac, near Alagovac Lake, Stubo and Zelena Bara (Fig. 1). In the localities of Stubo, Zelena Bara and Obradov Teg, *S. officinalis* was recorded with *Achillea ptarmica*. Some 50-100 individuals of *S. officinalis* were recorded at each of the investigated localities.

Since this species inhabits wet habitats, the destruction of this type of habitat could threaten the population of *S. officinalis* at Nevesinjsko Polje. According to our field data, its IUCN threat status is estimated to be Critically Endangered (CR B2a,b(iii)) in Bosnia and Herzegovina.

*Sanguisorba officinalis* was assessed for the IUCN Red List of Threatened Species as Least Concern (LC) at the global (MAIZ-TOME, 2016b) and European levels (KHELA, 2013). The current population trend in Europe is assessed to be decreasing mainly due to habitat loss (KHELA, 2013), as well as through the "improvement" and drainage of pastures in the United Kingdom and Ireland (STROH *et al.*, 2020b). Some of its habitats, such as Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*), are protected under the EU Habitats Directive (Annex I habitat type 6510). *S. officinalis* is not listed on the List of Rare and Threatened Vascular Plant Species of Bosnia and Herzegovina (ŠILIĆ, 1996), or on the Red List of the Flora of the Federation of Bosnia and Herzegovina (ĐUG *et al.*, 2013). However, it is listed on the Rulebook on the Red List of Protected Species of Flora and Fauna of the Republic of Srpska (ANONYMOUS, 2012) and is a protected species in the Republic of Srpska (ANONYMOUS, 2020). In the Croatian flora, this species is on the list of Data Deficient taxa (DD) (NIKOLIĆ & TOPIĆ, 2005).

*Sanguisorba officinalis* is used as an astringent, antidiarrheal and hemostyptic, and in folk medicine as well as in the treatment of snake bites and diabetes (SARIĆ, 1989; KOJIĆ *et al.*, 1998; REDŽIĆ, 2007; TUČAKOV, 2014).

## CONCLUSIONS

Field investigations of the wetland ecosystems of Nevesinjsko Polje were conducted during the vegetation seasons of 2011, 2017, 2018 and 2019. New and noteworthy chorological data were recorded for rare and threatened vascular plant species of Bosnia and Herzegovina: *Achillea ptarmica*, *Drosera rotundifolia*, *Menyanthes trifoliata* and *Sanguisorba officinalis*. Data concerning their habitat preferences and population size are also presented. The IUCN conservation status of the studied species is assessed as Critically Endangered in Bosnia and Herzegovina. These plant species occur in wetland habitats and possible negative anthropogenic influences, such as vegetation succession caused by artificially altered water regimes, pollution, peat digging, habitat flooding after the construction of the Alagovac Lake, could threaten their habitats in the area of Nevesinjsko Polje. It is necessary to monitor the population trends of these species as well as to make decision-makers and local people aware of the biological importance of these species and to emphasize the need to preserve their habitats.

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