

NEW DATA ON THE DISTRIBUTION OF *DRYOPTERIS DILATATA* (HOFFM.) A. GRAY (DRYOPTERIDACEAE) IN SERBIA

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During field research conducted in central and western Serbia, new populations of *Dryopteris dilatata* were discovered on the mountains Kopaonik, Golija, Tara and Jelova gora. In view of the existing taxonomic challenges within the complex to which *D. dilatata* belongs to (*D. carthusiana* agg.), flow cytometry was employed to validate the identifications made during the fieldwork. On Mts. Golija and Kopaonik, the species has been documented in forests of the *Piceetum abietis* type, while on Mts. Tara and Jelova gora it occurs in mixed deciduous–coniferous forests of the *Abieto-Piceeto-Fagetum* type. On Mt. Jastrebac, the species was recorded in deciduous forests of the *Aceri heldreichii-Fagetum* type. The presence of *D. dilatata* has been observed on both silicate and limestone substrates, suggesting that its distribution is not limited to any particular geological substrate. However, to date, it has not been observed on serpentine substrates.

Key words: *Dryopteris dilatata*, Serbia, strictly protected species, new records

INTRODUCTION

The fern genus *Dryopteris* Adans. (woodfern) belongs to family Dryopteridaceae, subfamily Dryopteridoideae. It is monophyletic and encompasses about 400 species (Zhang *et al.* 2012, Liu *et al.* 2016, PPG I

2016). *Dryopteris* is characterised by an almost cosmopolitan distribution, encompassing all continents (with the exception of Antarctica) and numerous oceanic islands (e.g., Hawaii). The primary center of diversity is located in the regions of southern and eastern Asia (Li & Lu 2006), while the secondary centers are located in the Americas, Europe, Africa and the Pacific islands (Sessa *et al.* 2017, and the references therein).

The circumscription of *Dryopteris* has been the subject of considerable debate, with various genera being included and excluded from it. Based on morphological traits Fraser-Jenkins (1986) proposed a classification system dividing *Dryopteris* into four subgenera and eleven sections. However, recent molecular studies did not confirm the monophyly of all of Fraser-Jenkins' sections and three of the four proposed subgenera (Sessa *et al.* 2012). Woodferns constitute a particularly intricate taxonomic group that has been profoundly impacted by interspecific hybridization. This phenomenon complicates their classification and taxonomy. In temperate regions, *Dryopteris* is among the most hybrid-prone genera, with nearly every combination of species pairs have been documented, as well as one intergeneric hybrid (Ekrt *et al.* 2010).

An illustrative example of this phenomenon in the European flora is the *Dryopteris carthusiana* complex. It consists of one diploid species *D. expansa* (C. Presl) Fraser-Jenk. et Jermy ($2n = 2x = 82$), and two tetraploids – *D. carthusiana* (Vill.) H. P. Fuchs and *D. dilatata* (Hoffm.) A. Gray ($2n = 4x = 164$). These species are among the most abundant ferns in European forests. They are classified in the subgenus *Dryopteris*, section *Lophodium* (Newman) C. Chr. ex H. by Fraser-Jenkins (1986), a classification that has been supported by more recent phylogenetic analyses (Zhang *et al.* 2012). This section includes ferns that are characterized by usually thick, glossy, and bicolor stipe-base scales, narrow lobes of ultimate segments, terminating in long, hair-tipped aristate teeth. The spore morphology is unique, with a minutely spinulose surface on the perispore. All three possible hybrid combinations within the *D. carthusiana* group have been documented in previous research, albeit with significantly different levels of occurrence (Ekrt *et al.* 2010).

Dryopteris dilatata is predominantly a European species, most common in western and Central Europe, and especially widespread in the British Isles. In Central Europe, the species is found in both lowlands and mountains, reaching altitudes of up to 1700 m in the Tatras. In the mountainous regions of southern Europe, it is less frequent. In regions where it occurs at the periphery of its geographical distribution, such as in the Ukrainian Carpathians and southern Scandinavia, the species is quite common. However, in southern Finland, the Baltic States, and western Russia, it is considered rare. The south-eastern limit extends into scattered

locations between the Black Sea and the Caspian Sea. It is absent from the extensive Mediterranean and Black Sea regions (Runk *et al.* 2012, and the references therein). On the Balkan Peninsula, *D. dilatata* is registered in Albania (Barina *et al.* 2017), Bosnia and Herzegovina (Beck-Mannagetta 1889, Hayek 1927, Maly 1933, Milanović *et al.* 2015), Bulgaria (Andreev *et al.* 1992), Croatia (Nikolić 2025), Greece (Dimopoulous *et al.* 2013), Montenegro (Čaković & Stešević 2013), and Slovenia (Martinčič 1999).

In Serbia, *D. dilatata* grows in shady deciduous and coniferous forests (most often spruce), as well as in moist rocky areas of the mountain belt, on acidic soils of various geological substrates. Two distinct forms of this species are recognized: f. *dilatata*, which is documented only in the mountainous region of Jastrebac in central Serbia (localities Tri sestrice and Strazimir), and an unconfirmed record for Prokletije (Žljeb, Koprivnik). The second form, f. *oblonga*, has an unconfirmed record in Koprivnik (Prokletije, Metohija region) (Vukićević & Niketić 1992). It is listed in the Rulebook on the Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi in Serbia as a strictly protected species (OFFICIAL GAZETTE RS 2010-2011).

MATERIALS AND METHODS

The investigations were conducted using recent field studies, and published data from Flora of Serbia (Vukićević & Niketić 1992). The occurrence of the species in the field was recorded using a GPS device (Garmin GPS Map 64s). Voucher specimens are deposited in the Herbarium of the Institute of Botany and Botanical Garden “Jevremovac”, Faculty of Biology, University of Belgrade (BEOU). The nomenclature of taxa mentioned in the text is in accordance with Euro+Med PlantBase. The distribution map was prepared in the software QGIS software version 3.20. Coordinates are provided in the World Geodetic System 84 (WGS84).

RESULTS – DISTRIBUTION IN SERBIA

The first report on the occurrence of *D. dilatata* in Serbia was published by Pančić (1884) and refers to population from Kopren on the Stara planina Mt. (“na Koprenu u Pirotskoj”, sub. *Polystichum dilatatum* Sm.), and this record is supported by the herbarium material collected by Pančić in 1881 and deposited at BEOU (acronym according to Thiers 2025). An additional specimen was examined, which was collected in 1869 by Pančić on Čemerno in western Serbia. However, these records were not included in

the taxonomic treatment of *Dryopteris dilatata* in Flora of Serbia (Vukićević & Niketić 1992) due to the revisions made by the eminent botanist M. Niketić in 1991, who reidentified both specimens as *D. expansa*. In light of the aforementioned revisions, the only reliable finding for Serbia remained the area of Jastrebac.

The identification of representatives of this complex in herbarium collections is extremely demanding for botanists, due to pronounced morphological similarity, significant plasticity and the occurrence of interspecific hybridization. This is particularly evident when working with old herbarium specimens, where there is a risk of the loss of key diagnostic characters during pressing. The species *D. dilatata* and *D. expansa* are often confused with each other, but also with the unrelated species *Athyrium filix-femina* (Piekos-Mirkowa 1979, Holubova 2006); the morphological criteria, once used to distinguish them, are now considered unreliable due to overlapping quantitative parameters and the influence of environmental factors. Therefore, a detailed revision of old herbarium specimens in comparison with new data is necessary, as well as the application of methods independent of morphology, such as flow cytometry, which has proven effective in distinguishing taxa and their hybrids (Holubová 2006, Ekrt *et al.* 2010).

During the course of the field investigations conducted in central and western Serbia, new populations of *D. dilatata* were revealed on the following mountains: Mt. Kopaonik, Mt. Golija, Mt. Tara, and Mt. Jelova gora. In view of the above mentioned taxonomic problems within the complex, we employed flow cytometry to corroborate our identifications made in the field (Kuzmanović *et al.*, *in prep.*), demonstrating that these do indeed constitute novel populations of *D. dilatata*.

Based on our most recent field research we provide chorological data and distribution map of *D. dilatata* in Serbia (Fig. 1).

Chorological data:

WESTERN SERBIA, New findings – **Mt. Golija:** Dajičko Lake: 43.424935 N, 20.26424 E, 1456.9 m, *Piceetum abietis* (Vukojičić, S., Kuzmanović, N. BEOU 64116, 08.08.2025; Kuzmanović, N. BEOU 64133, 07.09.2025); **Mt. Jelova gora:** Đakov kamen; 43.9249108 N, 19.7822534 E, 960 m, *Abieto-Piceeto-Fagetum* with a significant presence of Douglas fir (*Pseudotsuga menziesii*) (Vukojičić, S., Kuzmanović, N. BEOU 64281, 04.07.2025); **Mt. Tara:** Manita ravan, 43.911055 N, 19.411695 E, 1144.1 m, limestone, *Abieto-Piceeto-Fagetum* (Kuzmanović, N. BEOU 64118, 18.08.2025); Mitrovac, Crveni Potok, 43.91404 N, 19.420087 E, 1090.2 m,

limestone, *Abieto-Piceeto-Fagetum* (Kuzmanović, N. BEOU 64134, 07.09. 2025).

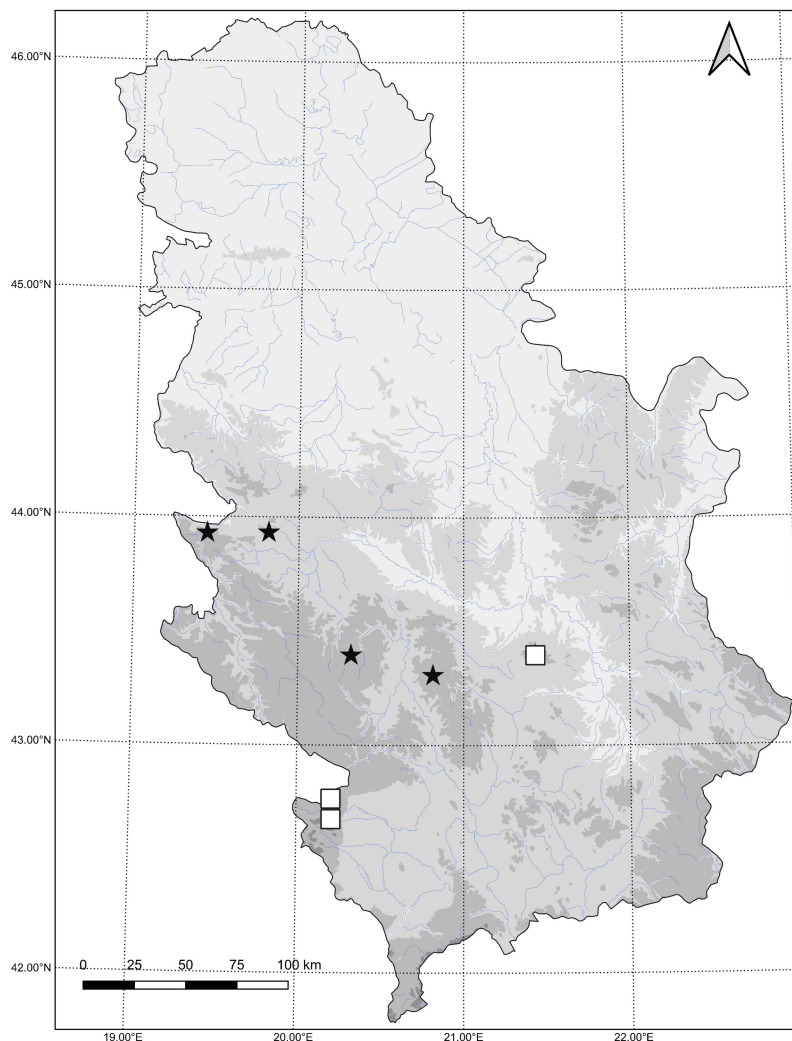


Fig. 1. – Distribution of *Dryopteris dilatata* in Serbia in UTM squares of 10 × 10 km. Black stars – new records, white squares – literature data.

CENTRAL SERBIA, Mt. Veliki Jastrebac: Tri sestrice: 43.386028 N, 21.472806 E, 1421.3 m, limestone, *Aceri heldreichii-Fagetum* (Kuzmanović, N. BEOU 64121, 23.08.2025; Kuzmanović, N. BEOU 64124, 06.09.

2025); Vukićević & Niketić (1992); **New findings** – **Mt. Kopaonik**: Gljivarska staza: 43.294365 N, 20.815111 E, 1718.6 m, *Piceetum abietis* (Kuzmanović, N. BEOU 64119, 23.08.2025; Kuzmanović, N. BEOU 64132, 06.09.2025).

METOHIIJA, **Mt. Žljeb** (Vukićević & Niketić 1992); **Mt. Koprivnik** (Vukićević & Niketić 1992).

Newly recorded populations of *Dryopteris dilatata* were found in coniferous, mixed deciduous–coniferous, and, less frequently, in pure deciduous forests. On Mt. Golija and Mt. Kopaonik (Fig. 2), the species has been documented within spruce forests of the *Piceetum abietis* type, whereas on Mt. Tara and Mt. Jelova gora it occurs in forests of the *Abieto-Piceeto-Fagetum* type. On Mt. Jastrebac the species was recorded in deciduous forests of the *Aceri heldreichii-Fagetum* type. Its populations were found on both silicate and limestone bedrock, indicating that its presence is not limited to any specific geological substrate. Nevertheless, it has not yet been observed on serpentine substrates.



Fig. 2. – *Dryopteris dilatata* on Mt. Kopaonik (left) and Mt. Golija (right).

The observed populations are relatively small, usually comprising approximately 15–30 individuals within an area of 50 m². At all newly recorded sites, the forest blackberry (*Rubus hirtus* aggr.) was the dominant species in the understory layer. Its aggressive growth and rapid spatial expansion represent a significant competitive pressure for other plant species, as it quickly occupies available space. In addition to *Rubus*, several fern species were observed in lower abundance, including *Athyrium filix-*

femina (L.) Roth, *Dryopteris carthusiana* (Vill.) H. P. Fuchs, *D. filix-mas* (L.) Schott, and *Polystichum setiferum* (Forssk.) Woyt. The accompanying vegetation is composed mainly of typical forest species such as *Cardamine bulbifera* (L.) Crantz, *Carex brizoides* L., *Galeopsis speciosa* Mill., *Lamium galeobdolon* (L.) Crantz, *Luzula sylvatica* (Huds.) Gaudin, *Oxalis acetosella* L., *Vaccinium myrtillus* L., among others.

A preliminary revision of the herbarium material deposited at BEO and BEOU suggests that *D. dilatata* is most likely a much more widespread species in Serbia. However, further extensive field studies and genome size analyses are required to determine the species' distribution more precisely, especially considering the age of the herbarium material and the lack of diagnostic features in certain specimens. Additionally, *Dryopteris* species frequently hybridize, creating intermediate forms that share characteristics of both parents, making them difficult to assign to a specific taxon.

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НОВИ ПОДАЦИ О РАСПРОСТРАЊЕЊУ *DRYOPTERIS DILATATA* (HOFFM.) A. GRAY (DRYOPTERIDACEAE) У СРБИЈИ

НЕВЕНА КУЗМАНОВИЋ, АНА ВАРЕЛОВА, СНЕЖАНА ВУКОЛИЧИЋ

РЕЗИМЕ

Током теренских истраживања спроведених у централној и западној Србији, нове популације *Dryopteris dilatata* откривене су на планинама Копаоник, Голија, Тара и Јелова гора. С обзиром на постојеће таксономске проблеме унутар комплекса коме припада *D. dilatata* (*D. carthusiana* agg.), коришћена је додатна метода проточне цитометрије ради потврде идентификација извршених на терену. На Голији и Копаонику, врста је документована у шумама типа *Piceetum abietis*, док се на Тари и Јеловој гори јавља у шумама типа *Abieto-Piceeto-Fagetum*. На планини Јастребац врста је забележена у листопадним шумама типа *Aceri heldreichii-Fagetum*. Популације *D. dilatata* су пронађене и на силикатној и на кречњачкој подлози, што указује да њено присуство није ограничено на специфичну геолошку подлогу. Ипак, још увек није регистрована на серпентинској подлози.