



<https://doi.org/10.15407/ukrbotj80.04.306>

RESEARCH ARTICLE

## *Blechnum spicant* (Blechnaceae) in the Ukrainian flora

Olesya O. BEZSMERTNA<sup>1,2,10\*</sup> , Svitlana M. IEMELIANOVA<sup>5,11</sup> ,  
Heorhii M. BONDARENKO<sup>6</sup> , Ruslan Y. HLEB<sup>7,10</sup> , Yevhenii O. SHTANKO<sup>1</sup>,  
Halyna V. HERASYMCHUK<sup>2</sup> , Volodymyr O. LOIKO<sup>2</sup>, Andriy I. BABYTSKIY<sup>3,4</sup> ,  
Vasyl V. BUDZHAK<sup>8</sup> , Ivan M. DANYLYK<sup>9</sup> , Nina O. MERLENKO<sup>2</sup>, Vitaliy V. DERKACH<sup>2</sup>

<sup>1</sup> Taras Shevchenko National University of Kyiv,  
64/13 Volodymyrska Str., Kyiv 01601, Ukraine

<sup>2</sup> Tsumanska Pushcha National Nature Park,  
20 Nezalezhnosti Str., Kivertsy 45200, Volyn Region, Ukraine

<sup>3</sup> National University of Life and Environmental Sciences of Ukraine,  
15 Heroiv Oborony Str., Kyiv 03041, Ukraine

<sup>4</sup> I.I. Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine,  
15 B. Khmel'nitskogo Str., Kyiv 01030, Ukraine

<sup>5</sup> M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine,  
2 Tereshchenkivska Str., Kyiv 01601, Ukraine

<sup>6</sup> V.N. Karazin Kharkiv National University,  
4 Svobody Square, Kharkiv 61022, Ukraine

<sup>7</sup> Carpathian Biosphere Reserve,  
77 Krasne Pleso Str., Rakhiv 90600, Ukraine

<sup>8</sup> Institute for Evolutionary Ecology, National Academy of Sciences of Ukraine,  
37 Lebedeva Str., Kyiv 03143, Ukraine

<sup>9</sup> Institute of Ecology of the Carpathians, National Academy of Sciences of Ukraine,  
4 Kozel'nyts'ka Str., Lviv 79026, Ukraine

<sup>10</sup> Ukrainian Nature Conservation Group, <https://uncg.org.ua/en/>

<sup>11</sup> Department of Botany and Zoology, Faculty of Science, Masaryk University,  
2 Kotlářská, Brno 61137, Czech Republic

\* Address for correspondence: [olesya.bezsmertna@gmail.com](mailto:olesya.bezsmertna@gmail.com)

**Abstract.** The article contains data about the historical and current distribution patterns of *Blechnum spicant* (Blechnaceae) in Ukraine. This species is quite common in the Carpathian Mountains but is very rare in other regions of Ukraine. Until recently, there were only two known localities of *B. spicant* in the Western Forest-Steppe (within the Podolian Upland) and only one in Crimea. We discovered one new locality of *B. spicant* in the Polissian (Polesian) Lowland, in Volyn Region. The article provides phytosociological and topographic data on the Polissian population. This population consists of two sub-populations, which are located not far from each other. Both of them were found in an immature birch-pine forest aged approximately 20 years, in an area of former agricultural lands. We summarise the data on the general distribution of *B. spicant* in Ukraine. The article also provides phytosociological, biotopic and populational information on localities of *B. spicant*.

**Keywords:** chorology, montane species, new locations, Polissian Lowland

ARTICLE HISTORY. Submitted 24 February 2023. Revised 13 August 2023. Published 08 September 2023

CITATION. Bezsmertna O.O., Iemeljanova S.M., Bondarenko H.M., Hleb R.Y., Budzhak V.V., Danylyk I.M., Shtanko Y.O., Babytskiy A.I., Herasymchuk H.V., Loiko V.O., Merlenko N.O., Derkach V.V. 2023. *Blechnum spicant* (Blechnaceae) in the Ukrainian flora. *Ukrainian Botanical Journal*, 80(4): 306–322.

© M.G. Kholodny Institute of Botany, NAS of Ukraine, 2023

© Publisher PH "Akademperiodyka" of the NAS of Ukraine, 2023

This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>)

## Introduction

*Blechnum spicant* (L.) Roth (*Struthiopteris spicant* (L.) Weiss; *Blechnaceae*) is a Holarctic mountain-plain species with a disjunct geographic range. This species is the only native representative of the genus *Blechnum* L. in Ukraine and in Europe. The global range of the species includes three separate regions: European-Submediterranean, Eastern Asian (Japan and China), and North American (the Pacific Ocean Coast) (Meusel et al., 1965). The eastern limit of the European part of its range goes through Ukraine.

According to available literature data and herbarium samples, *B. spicant* grows in Ukraine in the Carpathians, Western Forest-Steppe, and Crimea (Opredelitel..., 1987; Didukh et al., 2000; Vasheka, Bezsmertna, 2012; Yena, 2012). However, detailed data on the distribution and traits of its populations is lacking. The paucity of records and data prompted us to research and revise the locations of *B. spicant* in Ukraine, assess the status of its populations, and analyze the ecological features of the species.

## Material and Methods

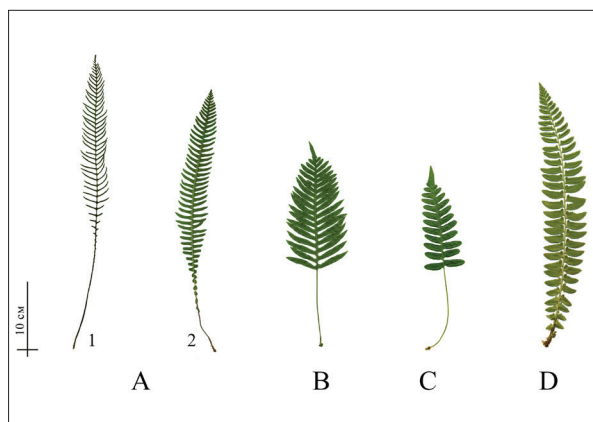
**Revision of locations.** We examined herbarium specimens of *B. spicant* deposited in herbaria of 55 scientific institutions of Ukraine (CHER, CWU, DNZ, DSU, KHER, KW, KWHU, KWH, LW, LWS, LWKS, MELIT, MSUD, PWU, SOF, UU, YALT), Austria (GJO, GZU, W, WU), the Czech Republic (BRNU, PR, PRC), Hungary (BP), Poland (KRA, KRAM, WA, WABG, WRSL), Romania (BUC, CL, I, IAGB, IASI), the Slovak Republic (BRA, KO, SAV, SLO), and the herbaria from aggressor state, which were revised before the full-scaled invasion (LE, MSU, MW) (acronyms follow *Index Herbariorum*: Thiers, 2016). We also examined additional material from other regional herbaria (those without registered acronyms in *Index Herbariorum*): Iasi Museum of Natural History (Romania), Taras Shevchenko National University of Kyiv (Ukraine), Lviv National Forestry Engineering University (Ukraine), Lesya Ukrainka Volyn National University (Ukraine), Volyn Regional Museum (Ukraine), Rivne National University of Water and Nature Management (Ukraine), Rivne Natural History Museum (Ukraine), Volodymyr Hnatyuk Ternopil National Pedagogical University (Ukraine), Kryvyi Rih Botanical Garden (Ukraine),

T.H. Shevchenko Chernihiv State Pedagogical University (Ukraine), Ivan Ohienko Kamianets-Podilsky University (Ukraine), Vasyl Stefanyk Prykarpatskyi University (Ukraine), and Ferenz Rakoczy II Transcarpathian Institute (Ukraine). Colleagues from many scientific institutions in Austria, the Czech Republic, Hungary, Romania, and the Slovak Republic helped us to evaluate some specimens from their herbarium collections. We also checked electronic resources, such as the virtual herbarium management system JACQ (<https://herbarium.univie.ac.at/database/collections.htm>), data from the Global Biodiversity Information Facility (GBIF..., 2023), as well as the citizen science platforms *iNaturalist* (<https://www.inaturalist.org/home>) and *UkrBIN* (<https://ukrbin.com/>).

We prepared a map of distribution of *Blechnum spicant* in Ukraine based on our analysis of the literature data, open databases, herbarium specimens from the institutions mentioned above, and our own field research data. We used Quantum GIS 3.16.5 Hannover (<https://www.qgis.org/uk/site/>) to create the maps and charts. The locations of the studied species are indicated in accordance with the present administrative divisions of Ukraine and the current toponymy in relevant databases and other resources.

We discovered a new locality of this predominantly montane (in the European part of the range) species on the lowland plain area of Ukraine during floristic investigations in the Tsumanska Pushcha National Nature Park (Luts'k District, Volyn Region, Ukraine). The geographical coordinates are given in the decimal system, according to open data from Google Maps. We determined the approximate age of young trees by the number of annual rings of the lateral branches of the 1<sup>st</sup> tier.

**Phytosociological characteristics: data sampling and species nomenclature.** We studied vegetation in 2008–2023. We made vegetation relevés on the newly discovered sites with an area ranging from 0.5 to 10 m<sup>2</sup> using the Braun-Blanquet (1936) approach. To analyze phytosociological affinities and characteristics, we also included 16 relevés from published literature sources (Malynovskiy, Krichfalushii, 2000; Onyshchenko, Budzhak, 2003; Solomakha et al., 2004; Klimuk et al., 2006; Vorobyov et al., 2016). These provided information on vegetation and habitat preferences of *Blechnum spicant* from elsewhere in Ukraine. We stored data using TURBOVEG software (Hennekens & Schaminée,



**Fig. 1.** Frond of different species of ferns: A: *Blechnum spicant* (A1: fertile frond; A2: sterile frond); B: *Polypodium interjectum*; C: *Polypodium vulgare*; D: *Polystichum lonchitis* (Vasheka, Bezsmertna, 2012, modified)

2009) and included it in the Ukrainian Grassland Database (EU-UA-001; Kuzemko, 2012). To find out the phytosociological affiliation of *B. spicant*, JUICE software (Tichý, 2002) was used for cluster analysis and further vegetation classification. In particular, we used modified TWINSpan (Roleček et al., 2009) with Whittaker's beta as a measure of clusters' heterogeneity and cover of 0–5–25% as pseudospecies cut levels. Due to the small number of vegetation plots, we did not use the fidelity measure (Chytrý et al., 2002) as a value of species' diagnosticity for syntaxa. To identify the obtained vegetation units, we used the lists of diagnostic species provided in the current edition of the *Prodrome of the vegetation of Ukraine* (Dubyna et al., 2019). To clarify the habitat preferences of *B. spicant*, we assigned vegetation plots to corresponding habitat types using the EUNIS-ESy expert system (Chytrý et al., 2020).

The nomenclature was harmonized following *Euro+Med* (2006–2021) for vascular plants (Christenhusz, Raab-Straube, 2013), Boiko (2014) for mosses, and Kondratyuk et al. (2021) for lichens. The names of the vegetation classes are given according to Mucina et al. (2016); names of associations are based on the current *Prodrome of the vegetation of Ukraine* (Dubyna et al., 2019).

**The ecological niche characteristics.** We obtained the ecological characteristics of *B. spicant* based on calculation of the 12 leading ecological factors' phytoindication indices: thermal climate (thermal regime; Tm); climate humidity

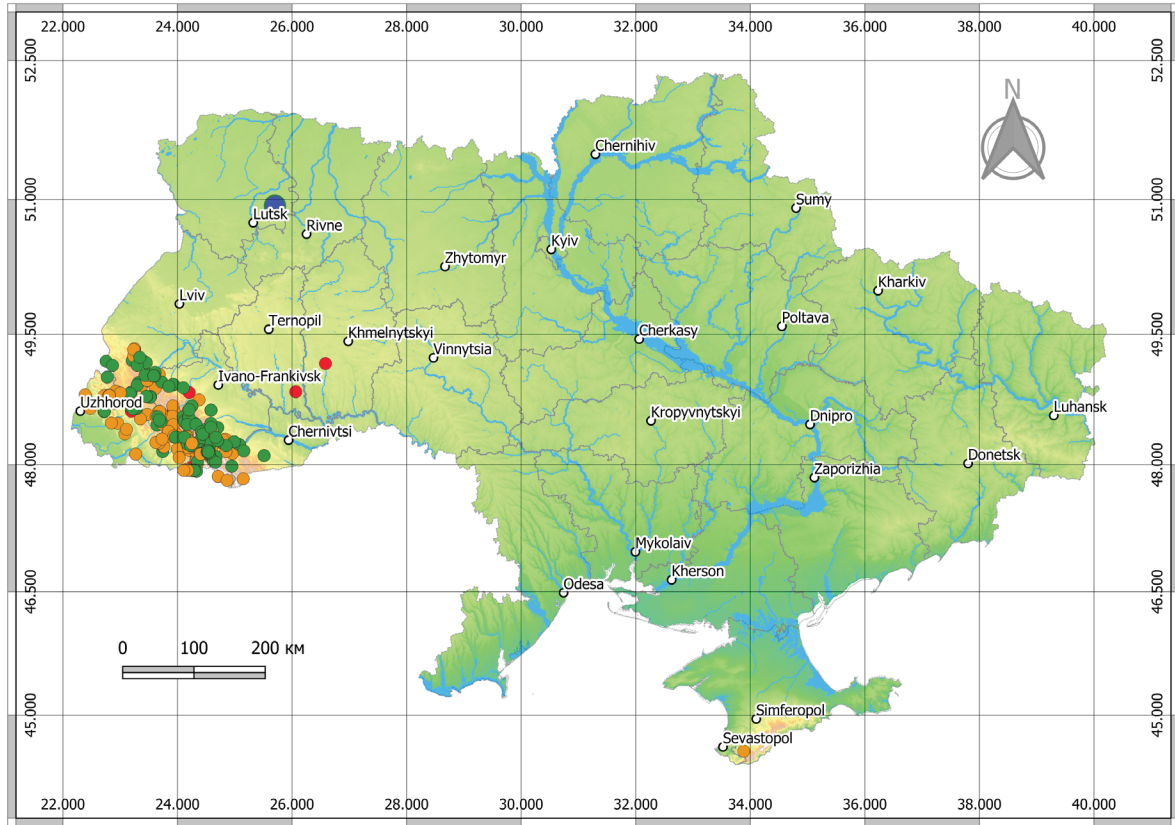
(ombroregime; Om); continentality of climate (contrast regime; Kn); harshness of winter (cryoregime; Cr); luminosity (Lc); soil humidity (hydrological regime; Hd); damping variability of the substrate (fH); soil aeration (Ae); soil acidity (Rc); total salt regime (Sl); concentration of carbonates in soil (Ca); and mineral nitrogen content in the substrate (Nt). We used ecological scales (Didukh, Plyuta, 1994; Didukh et al., 2000; Didukh, 2011) integrated into the JUICE program (Tichý, 2002). We determined the eco-groups and ecological valence in an Excel environment using our original software (Didukh, Budzhak, 2020).

## Results

**Taxonomy and synonyms.** We present here the nomenclatural citations, with references to main taxonomic and floristic publications.

***Blechnum spicant* (L.) Roth, 1794, in Usteri, Ann. Bot., 10: 56; Ledeb., 1853, Fl. Ross., 4: 523; Фомін, 1926, Фл. Укр., 1: 47; Фомин, 1934, Фл. СССР, 1: 71; Фомін, 1938, Фл. УРСР, 1: 94; Lawal-ree, 1964, Fl. Europ., 1: 22; Кузнецова, 1965, Визн. росл. Укр.: 31; А. Бобров, 1974, Фл. евр. ч. СССР, 1: 91; Чопик, 1976, Висок. фл. Укр. Карпат: 21; Протопопова, 1977, Визн. росл. Укр. Карпат: 34; Протопопова, 1987, Опред. высш. раст. Укр.: 35; Дідух, 2000, Екофл. Укр., 1: 188. — *B. spicant*, cum auct. "(L.) With." [1796, Arr. Brit. Pl., 3: 765]: Б. Федченко, 1908, Фл. Евр. Рос., 1: 14; Фомін, 1935, Фл. УРСР, 1: 66. — *Osmunda spicant* L., 1753, Sp. Pl.: 1066. — *Struthiopteris spicant* (L.) Weiss, 1770, Pl. Crypt. Fl. Gott.: 287. — *Onoclea spicant* (L.) Hoffm., 1795, Deutschl. Fl., 2: 11. — *Blechnum boreale* Sw., 1800, Schrad. Journ., 2: 75. — *Asplenium spicant* (L.) Bernh., 1799, Schrad. Journ., 1: 309. — **блехнум колосистий, ребрівка звичайна.****

**Morphology.** *Blechnum spicant* is an easily recognizable plant species. It is a hemicryptophyte up to 50 cm tall. Rhizome thick, oblique, black-brown, branched, covered by almost black triangular scales with heart-shaped bases and cuspidate tips. Fronds in a rosette, dimorphic, sterile ones evergreen, fertile ones annual. Blades of sterile fronds leathery, lanceolate, pinnate (Fig. 1, 2), rachis green and glabrous. Lobes sessile and elongate, tip rounded and slightly falcate. Fertile fronds in the centre of the rosette, directed up. Blades narrow-lanceolate and pinnate. Rachis dark brown and lustrous, green in the apical part. Lobes sessile, elongate-linear,



**Fig. 2.** Distribution of *Blechnum spicant* in Ukraine. Red dots — records made in the 19<sup>th</sup> century; yellow dots — records made in the 20<sup>th</sup> century; green dots — records in the 21<sup>st</sup> century; large blue dot indicates the new find in the Polissia Lowland territory

and aristate in the tip, the edge rolled to abaxial surface almost fully covered by sori. Sori arranged along the midrib in two continuous lines. Indusium membranous, attached to the outer edge of the segment (Vasheka, Bezsmertna, 2012).

Morphologically, *Blechnum spicant* is superficially similar to *Polypodium interjectum* Shivas, *Polypodium vulgare* L. and *Polystichum lonchitis* (L.) Roth (Fig. 1), the taxa represented in the Ukrainian flora. However, it can be easily distinguished from these species by its dimorphic leaves and by the location of sori. Moreover, the shape of the blade and pinnae, as well as a combination of other traits, can help to distinguish this species from similar ones (Opredelitel..., 1987; Vasheka, Bezsmertna, 2012).

**Distribution in adjacent territories in the European-Submediterranean part of the range.** *Blechnum spicant* is widely distributed in Western (except the southeastern part of Spain), Southern,

Central, and Northern Europe (Meusel et al., 1965; Hultén, Fries, 1986; Ekim et al., 2000; POWO, 2023). To understand the main patterns of distribution of *B. spicant* in the lowland plains of Ukrainian Polissia, we need to study similar population features in the adjacent areas westward and northward, in particular, in Poland and Belarus. For Belarus, the first available specific record of *B. spicant* was in the 18<sup>th</sup> century for the Grodno city outskirts (Gilibert, 1781). In the 19<sup>th</sup> century, *B. spicant* was found in the vicinity of Velyasnitsa (Velesnitsa) village, now in Pinsk District, Brest Region of Belarus (Twardowska, 1896). P. Ascherson has confirmed the correct identification of that specimen (Paczoski, 1900; Blazhevich et al., 2009). Later, this species was found in the Bialowieza Forest (Mikhailovskaya, 1953). This locality is closest to Ukraine. However, the current localities of *B. spicant* in Belarus are not confirmed (Blazhevich et al., 2009).

In Poland, most of the known populations of *B. spicant* are recorded from the mountains regions (the Sudetes and Carpathians) and along the Baltic coast. Rarely, the plants occur in the lowland plains, but their populations there are thought to be in decline (Zajac, Zajac, 2001).

*Blechnum spicant* also occurs in the Caucasus, Turkey, and is mostly confined to the Black Sea coast (GBIF, 2023).

**Distribution in Ukraine and the state of the newly revealed population.** Until now, *Blechnum spicant* was usually reported in Ukraine for the Carpathians, and rarely for the Western Forest-Steppe and the Crimean Peninsula (Opredelitel..., 1987; Yena, 2012). In 2022, we discovered the first location of this species in Polissia. We recorded this population in the Tsumanska Pushcha National Nature Park (Lutsk District, Volyn Region). In Ukraine in general, the species occurs in the administrative regions of Volyn, Lviv, Ivano-Frankivsk, Zakarpattia (Transcarpathia), Chernivtsi, Ternopil, and Khmelnytskyi. It has also been reported from the Autonomous Republic of Crimea (Fig. 2) (Bezsmertna et al., 2023 and references therein).

The distribution of the *B. spicant* populations in Ukraine is very uneven. Most of them are concentrated in the Carpathians, where the species distribution is sometimes continuous over large areas. *Blechnum spicant* often forms clonal colonies with an area of up to several square meters each. Due to the branching of the rhizome, it is difficult to establish the exact number of daughter individuals. The revision of herbarium collections demonstrated that it is difficult to establish the accurate number of localities in general and in each area separately. Some samples collected in the same area have labels without an exact indication of the collection locality, and it is impossible to determine if one or several locations are represented by the specimens. Modern finds are not numerous enough to make a distinct inventory. Below we describe the characteristics of its distribution in the regions of Ukraine, according to the studied sources and our research.

According to literature data, open resources data, herbarium labels, and our own field investigations, we detected 461 records of *B. spicant* in Ukraine.

**The Carpathians.** Many articles contain data about the species' locations in the Carpathian Mountains. However, detailed information about the chorological and population features of the species is absent. It usually occurs in the middle and

upper mountain belts of the Carpathians, especially in the dark spruce forests, and sometimes in the meadows, shrub vegetation or areas with rocky outcrops (Figs 3, 4, 5) (Zawadzki, 1835; Knapp, 1872; Margittai, 1923(2010), 1927, 1937; Bobrov, 1974; Fodor, 1974). The numerous herbarium specimens also indicate a widespread distribution of *B. spicant* in the Carpathian Mountains.

**Crimea.** The herbarium specimen of *B. spicant* was found in the MW herbarium (Yena, 2012). The label description indicates the occurrence in the Crimean Reserve: "Crimea. State Reserve. In the beech forest. 06.VII 1961. leg. Pokrovskaya". However, that find has not been confirmed for a long time and needs new investigations of that territory. The current status of the population there is unknown.

**The Western Forest-Steppe.** This little-known location occurred in a swamp in the vicinity of Tsyhany village (Chortkiv District, Ternopil Region) (Tyniecki, 1877). More recently, S. Makowiecki gathered a herbarium specimen of *B. spicant* in the Zbruch River valley within the former Horodok District of Khmelnytskyi Region (Novosad, Krytska, 2010; Lyubinska, Yuglichek, 2017). Within this locality, the species occurred in shaded habitats amongst limestone rocks. However, the record is poorly localized and reported for the whole Khmelnytskyi Region without further specification (Bobrov, 1974; Opredelitel..., 1987).

**Polissia.** This is a newly discovered population for *Blechnum spicant* and is the first and only record known so far from the Ukrainian Polissia. We found the species in Urochyshe Davydiv Lis (Lopatynske Forestry) in the southern vicinity of Domashiv village (Kivertsii municipality, Lutsk District, Volyn Region) within the Tsumanska Pushcha National Nature Park. The Polissian population consists of two sub-populations within the same forest, situated about 80 m from each other. Both of them were represented by solitary vegetative individuals, therefore they should probably be considered as loci of just one population. Generative shoots were not evident. The individual in one of the loci is separated into three spatially differentiated daughter individuals (Fig. 6).

We have provided two herbarium specimens collected from the newly discovered locality to the herbaria of the M.M. Hrysko National Botanical Garden (KWA) and to the M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine (KW).



**Fig. 3.** *Blechnum spicant* (Sydivets, Drahobrat, Rakhiv District, Zakarpattia Region). Photo by I. Danylyk



**Fig. 4.** *Blechnum spicant* (Gorgany Nature Reserve, Ivano-Frankivsk Region). Photo by R. Hleb



**Fig. 5.** *Blechnum spicant* (Gorgany Nature Reserve, Ivano-Frankivsk Region). Photo by R. Hleb



**Fig. 6.** *Blechnum spicant* in the territory of Tsumanska Pushcha National Nature Park. Photo by O. Bezsmertna

1. Specimen: Volyn Region, Lutsk District, the southeastern vicinity of Domashiv village, Davydiv Forest, the birch-pine forest (up to 20 years old) on the agriculture lands, one colony (one individual), 50.933493° N, 25.699068° E, October 22, 2022; V. Loiko, H. Herasymchuk, O. Bezsmertna, O. Shynder.
2. Specimen: Volyn Region, Lutsk District, the southeastern vicinity of Domashiv village, Davydiv Forest, the birch-pine forest (up to 30 years old) on the agriculture lands, one colony (one individual), 50.933777° N, 25.700067° E, October 22, 2022; V. Loiko, H. Herasymchuk, O. Bezsmertna, O. Shynder.

**Phytosociology and habitat preferences.** According to current data (FloraVeg.EU, 2023), *Blechnum spicant* is considered to be one of the diagnostic species of the vegetation classes *Vaccinio-Piceetea* (coniferous-birch forests), *Carpino-Fagetea sylvaticae* (mesic deciduous and mixed forests) and *Quercetea robori-petrea* (acidophilous oak and oak-birch forests) in Ukraine. *Blechnum spicant* is also included in the lists of the diagnostic taxa of the EUNIS habitat type T18 *Fagus* forest on acid soils.

To clarify the habitat and vegetation requirements of *B. spicant* in Ukraine, we analyzed all available vegetation plots that contain this species. Using the expert system for the EUNIS habitat classification, we referred all relevés to some habitat types (Table 1). The vast majority of vegetation plots were classified to broad habitat groups at Level 1. Only 7 relevés could be assigned to specific habitat types at the more detailed Level 3.

We assigned some biotopes with *B. spicant* using the *National Habitat Catalogue of Ukraine* (2018). All the habitats belong to the forest (Д), herbaceous (Т) or rocky groups (К). Most of the finds occurred in the broadleaf and coniferous forests biotopes. Some biotopes where we found *B. spicant* were identified and assigned by using our expert knowledge and field experience, but without recourse to phytosociological relevés. Below is a full list of the biotopes in accordance with our field observations and the *National Habitat Catalogue of Ukraine*.

#### The list of forest biotopes:

1. Acidophilous beech forests (Д1.1.3) (rare biotopes, listed in the Resolution 4 of the Bern Convention); presumably EUNIS 2020: T18.
2. Fir and spruce forests of the lower part of the forest belt on rich soils (Д2.1.3) (rare biotopes, listed in the Resolution 4 of the Bern Convention); presumably EUNIS 2020: T31, T32.
3. Spruce forests of the upper part of the forest belt on rich soils (Д2.1.4); (rare biotopes, listed in the Resolution 4 of the Bern Convention); presumably EUNIS 2020: T31, T32.
4. Acidophilous mesic and moist Scots pine forests (Д2.2.2); presumably EUNIS 2020: T35, T36, T37.
5. Arolla pine forests (Д2.2.5); (rare biotopes, listed in the Resolution 4 of the Bern Convention); presumably EUNIS 2020: T34.

Table 1. Overview of the EUNIS habitat types with *Blechnum spicant* and the number of plots assigned to each of them by the EUNIS-ESy expert system

| EUNIS 2020 code | EUNIS 2020 habitat name                                    | No. of plots |
|-----------------|------------------------------------------------------------|--------------|
| T18             | <i>Fagus</i> forest on acid soils                          | 1            |
| T31             | Temperate mountain <i>Picea</i> forest                     | 6            |
| T               | Forests and other wooded lands                             | 9            |
| R               | Grasslands and lands dominated by forbs, mosses or lichens | 3            |

The authors observed the studied species in herbaceous biotopes in the Gorgany Nature Reserve only. We can assume that they are secondary herbaceous biotopes developed in former afforested vegetation, given the presence of the forest species.

#### The list of herbaceous biotopes:

1. Subalpine fern stands (T4.4.3); (rare biotopes, listed in the Resolution 4 of the Bern Convention); presumably EUNIS 2020: R56.

In addition, we assigned one occurrence of the studied species as growing on screes in the Gorgany Nature Reserve.

#### The list of rocky biotopes:

1. Siliceous screes of the Carpathians (K1.2); (rare biotopes, listed in the Resolution 4 of the Bern Convention); presumably EUNIS 2020: U22.

We also analyzed the phytosociological affiliation of vegetation plots with *B. spicant*. Our results showed that most occurrences of the species tend towards forest vegetation communities. The most significant number of localities (15) was found across the typical green-moss spruce forests of the Ukrainian Carpathians (Table 2). In the system of ecological-floristic classification, this vegetation belongs to the associations *Luzulo sylvaticae-Piceetum* and *Athyrio alpestris-Piceetum*. Within this vegetation type, *Blechnum spicant* has cover values up to 10 (40)%.

Stands of these associations are characterized by dense (cover of 60–90%) tree layer. *Picea abies* (L.) H. Karst., with coverage to 70% and a height of 15–25 m, is the dominant canopy species. It is often accompanied by *Fagus sylvatica* L. The shrub layer is sparse (up to 10%), formed by *Sorbus aucuparia* L. and saplings of *Picea abies* and *Abies alba* Mill. The herb layer is species-poor, with a total cover of 30–50%. It is mostly dominated by

Table 2. Phytosociological relevés with participation of *Blechnum spicant* in Ukraine

|                          |    |    |      |     |      |     |    |      |     |      |      |      |    |     |    |    |    |      |    |
|--------------------------|----|----|------|-----|------|-----|----|------|-----|------|------|------|----|-----|----|----|----|------|----|
| Number of relevé         | 1  | 2  | 3    | 4   | 5    | 6   | 7  | 8    | 9   | 10   | 11   | 12   | 13 | 14  | 15 | 16 | 17 | 18   | 19 |
| Cover of tree layer (%)  | 50 | 70 | 85   | 40  | 80   | 50  | 60 | 80   | 90  | 70   | 70   | 30   | 70 | 60  | 90 | 90 | -  | -    | -  |
| Cover of shrub layer (%) | -  | -  | -    | 10  | -    |     | -  | -    | -   | -    | -    | -    | -  | -   | 5  | 20 | -  | -    | -  |
| Cover of herb layer (%)  | 10 | 10 | 20   | 30  | 25   | 15  | 60 | 1    | 60  | 5    | 5    | 40   | 40 | 90  | 35 | 60 | 75 | 95   | 95 |
| Cover of bryophytes (%)  | 1  | -  | 20   | 100 | 15   | 20  | 20 | 3    | 40  | 40   | 30   | 70   | 25 | 90  | 70 | 90 | -  | -    | -  |
| Aspect                   | -  | -  | NE   | -   | NE   | E   | NW | NW   | NW  | NE   | NE   | -    | S  | NW  | -  | -  | -  | SW   | -  |
| Slope (°)                | -  | -  | 20   | -   | 55   | 15  | 50 | 45   | 35  | 40   | 40   | -    | 40 | 35  | -  | -  | -  | 15   | -  |
| Altitude (m)             | -  | -  | 1312 | -   | 1420 | 780 | -  | 1000 | 750 | 1400 | 1400 | 1400 | -  | 750 | -  | -  | -  | 1250 | -  |
| Number of syntaxon       | 1  | 2  | 3    |     |      |     |    |      |     |      |      |      |    |     |    | 4  | 5  |      | 6  |

|                                                 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <i>Blechnum spicant</i>                         | 1 | + | + | + | + | + | + | + | 1 | + | 1 | 1 | + | 1 | + | + | + | + | + | 5 |
| <b>D. sp. <i>Stellario holostea</i>-Fagetum</b> |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| <i>Fagus sylvatica</i>                          | 5 | 2 | . | . | 1 | 3 | 1 | 2 | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Populus tremula</i>                          | + | 2 | . | . | . | . | . | . | . | . | . | . | . | . | r | . | . | . | . | . |
| <i>Anemone nemorosa</i>                         | 1 | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Luzula pilosa</i>                            | 1 | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Maianthemum bifolium</i>                     | 1 | 1 | . | . | . | . | . | . | . | . | . | . | 1 | . | . | . | . | . | . | . |
| <b>D. sp. <i>Athyrio alpestris</i>-Piceetum</b> |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| <i>Picea abies</i>                              | 4 | 5 | 5 | 5 | 5 | 4 | 5 | 5 | 4 | 5 | 5 | 4 | 5 | 4 | . | . | . | . | . | . |
| <i>Athyrium distentifolium</i>                  | . | . | 2 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Caltha palustris</i>                         | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Cicerbita alpina</i>                         | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Chaerophyllum hirsutum</i>                   | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Crepis paludosa</i>                          | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Doronicum austriacum</i>                     | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Stellaria nemorum</i>                        | . | . | + | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . |
| <b>D. sp. <i>Luzulo sylvaticae</i>-Piceetum</b> |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| <i>Luzula sylvatica</i>                         | 3 | . | + | + | . | . | 1 | + | + | + | . | 1 | . | + | . | . | . | . | . | 1 |
| <i>Phegopteris connectilis</i>                  | 2 | . | + | . | + | 1 | . | . | 1 | + | + | . | . | . | . | . | . | . | . | . |
| <i>Gentiana asclepiadea</i>                     | 1 | 1 | + | . | . | . | 1 | . | + | . | + | . | . | + | . | . | . | . | . | . |
| <i>Huperzia selago</i>                          | . | . | . | . | . | + | 1 | . | 1 | + | + | . | 1 | . | . | . | . | . | . | . |
| <b>D. sp. <i>Molinio</i>-Pinetum</b>            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| <i>Pinus sylvestris</i>                         | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2 | 5 | . | . | . | . |
| <i>Betula pendula</i>                           | . | 1 | . | . | . | . | . | . | . | . | . | . | . | . | 4 | 5 | . | . | . | . |
| <i>Salix cinerea</i>                            | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 3 | . | . | . | . |
| <i>Frangula alnus</i>                           | . | . | . | . | . | . | . | . | . | . | . | . | . | . | + | 1 | . | . | . | . |
| <i>Calluna vulgaris</i>                         | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2 | 5 | . | . | . | . |
| <i>Juncus effusus</i>                           | . | . | . | . | . | . | . | . | . | . | . | . | . | . | r | + | . | . | . | . |
| <i>Lysimachia vulgaris</i>                      | . | . | . | . | . | . | . | . | . | . | . | . | . | . | r | + | . | . | . | . |
| <b>D. sp. <i>Soldanello</i>-Nardetum</b>        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| <i>Nardus stricta</i>                           | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2 | 5 | . | . |
| <i>Potentilla erecta</i>                        | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 1 | . | . |
| <i>Festuca picturata</i>                        | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2 | 1 | . | . |

Table 2 (continued)

|                          |    |    |      |     |      |     |    |      |     |      |      |      |    |     |    |    |    |      |    |
|--------------------------|----|----|------|-----|------|-----|----|------|-----|------|------|------|----|-----|----|----|----|------|----|
| Number of relevé         | 1  | 2  | 3    | 4   | 5    | 6   | 7  | 8    | 9   | 10   | 11   | 12   | 13 | 14  | 15 | 16 | 17 | 18   | 19 |
| Cover of tree layer (%)  | 50 | 70 | 85   | 40  | 80   | 50  | 60 | 80   | 90  | 70   | 70   | 30   | 70 | 60  | 90 | 90 | -  | -    | -  |
| Cover of shrub layer (%) | -  | -  | -    | 10  | -    | -   | -  | -    | -   | -    | -    | -    | -  | -   | 5  | 20 | -  | -    | -  |
| Cover of herb layer (%)  | 10 | 10 | 20   | 30  | 25   | 15  | 60 | 1    | 60  | 5    | 5    | 40   | 40 | 90  | 35 | 60 | 75 | 95   | 95 |
| Cover of bryophytes (%)  | 1  | -  | 20   | 100 | 15   | 20  | 20 | 3    | 40  | 40   | 30   | 70   | 25 | 90  | 70 | 90 | -  | -    | -  |
| Aspect                   | -  | -  | NE   | -   | NE   | E   | NW | NW   | NW  | NE   | NE   | -    | S  | NW  | -  | -  | -  | SW   | -  |
| Slope (°)                | -  | -  | 20   | -   | 55   | 15  | 50 | 45   | 35  | 40   | 40   | -    | 40 | 35  | -  | -  | -  | 15   | -  |
| Altitude (m)             | -  | -  | 1312 | -   | 1420 | 780 | -  | 1000 | 750 | 1400 | 1400 | 1400 | -  | 750 | -  | -  | -  | 1250 | -  |
| Number of syntaxon       | 1  |    | 2    |     | 3    |     |    |      |     |      |      |      |    |     | 4  |    | 5  |      | 6  |

|                                                         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <i>Antennaria dioica</i>                                | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 1 | . |
| <i>Carex pilulifera</i>                                 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 1 | . |
| <i>Achillea salicifolia</i>                             | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 1 | . |
| <i>Vaccinium vitis-idaea</i>                            | . | . | . | 1 | . | . | + | . | . | . | . | . | . | . | . | . | 1 | + | . |
| <i>Veronica officinalis</i>                             | . | . | . | . | + | 1 | . | . | + | . | . | . | . | . | . | . | 1 | + | . |
| <i>Soldanella hungarica</i>                             | . | . | . | . | . | . | . | . | . | + | + | . | . | + | . | . | 1 | 1 | . |
| <i>Potentilla aurea</i>                                 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 1 | . |
| <i>Thymus alpestris</i>                                 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 1 | . |
| <i>Anthoxanthum odoratum</i>                            | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 1 | . |
| <i>Festuca rubra</i>                                    | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 3 | 1 | . |
| <b>Other species</b>                                    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| <i>Abies alba</i>                                       | . | . | . | . | . | + | + | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Agrostis capillaris</i>                              | . | . | . | . | . | . | . | . | . | . | . | . | . | . | r | 1 | 1 | . | . |
| <i>Athyrium filix-femina</i>                            | . | . | . | . | . | . | . | . | + | + | . | + | . | . | . | . | + | . | . |
| <i>Calamagrostis arundinacea</i>                        | . | . | + | . | . | . | + | . | . | . | . | 2 | . | . | . | . | . | . | . |
| <i>Campanula patula</i>                                 | . | . | . | . | . | . | . | . | + | . | . | . | . | + | . | . | . | . | . |
| <i>Corylus avellana</i>                                 | . | 1 | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Deschampsia cespitosa</i>                            | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 1 | 1 | 1 | . |
| <i>Dryopteris carthusiana</i>                           | 1 | 1 | + | 1 | + | + | . | + | + | . | + | . | 1 | + | 3 | 1 | . | . | . |
| <i>Gymnocarpium dryopteris</i>                          | 3 | . | + | . | . | 1 | . | . | 1 | . | . | . | . | . | . | . | . | . | . |
| <i>Hieracium murorum</i>                                | . | . | . | + | . | . | . | . | 1 | . | . | . | . | . | . | . | . | . | . |
| <i>Homogyne alpina</i>                                  | 3 | 2 | . | . | 1 | + | . | . | . | + | + | + | 1 | . | . | . | . | 1 | 1 |
| <i>Luzula luzuloides</i>                                | . | 1 | . | + | . | . | . | . | . | . | . | . | . | . | . | . | 1 | . | . |
| <i>Lycopodium annotinum</i>                             | . | . | . | 1 | . | 1 | 1 | . | . | . | . | . | 1 | 1 | . | . | . | . | . |
| <i>Oxalis acetosella</i>                                | 1 | + | + | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Oxalis stricta</i>                                   | . | . | . | . | + | 1 | . | 1 | 1 | . | . | . | . | + | . | . | . | . | . |
| <i>Polygonatum verticillatum</i>                        | . | . | + | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . | . |
| <i>Prenanthes purpurea</i>                              | . | . | . | . | . | 1 | + | . | . | . | + | . | . | . | . | . | . | . | . |
| <i>Rubus plicatus</i>                                   | 1 | 1 | . | . | . | 1 | . | . | + | . | . | . | . | + | . | . | . | . | . |
| <i>Rumex acetosella</i>                                 | . | . | . | . | . | . | . | . | . | + | + | . | . | . | . | . | . | . | . |
| <i>Senecio nemorensis</i><br>subsp. <i>jacquinianus</i> | . | . | . | . | . | . | . | . | + | . | . | . | + | . | . | . | . | . | . |

Table 2 (continued)

|                          |    |    |      |     |      |     |    |      |     |      |      |      |    |     |    |    |    |      |    |
|--------------------------|----|----|------|-----|------|-----|----|------|-----|------|------|------|----|-----|----|----|----|------|----|
| Number of relevé         | 1  | 2  | 3    | 4   | 5    | 6   | 7  | 8    | 9   | 10   | 11   | 12   | 13 | 14  | 15 | 16 | 17 | 18   | 19 |
| Cover of tree layer (%)  | 50 | 70 | 85   | 40  | 80   | 50  | 60 | 80   | 90  | 70   | 70   | 30   | 70 | 60  | 90 | 90 | -  | -    | -  |
| Cover of shrub layer (%) | -  | -  | -    | 10  | -    |     | -  | -    | -   | -    | -    | -    | -  | -   | 5  | 20 | -  | -    | -  |
| Cover of herb layer (%)  | 10 | 10 | 20   | 30  | 25   | 15  | 60 | 1    | 60  | 5    | 5    | 40   | 40 | 90  | 35 | 60 | 75 | 95   | 95 |
| Cover of bryophytes (%)  | 1  | -  | 20   | 100 | 15   | 20  | 20 | 3    | 40  | 40   | 30   | 70   | 25 | 90  | 70 | 90 | -  | -    | -  |
| Aspect                   | -  | -  | NE   | -   | NE   | E   | NW | NW   | NW  | NE   | NE   | -    | S  | NW  | -  | -  | -  | SW   | -  |
| Slope (°)                | -  | -  | 20   | -   | 55   | 15  | 50 | 45   | 35  | 40   | 40   | -    | 40 | 35  | -  | -  | -  | 15   | -  |
| Altitude (m)             | -  | -  | 1312 | -   | 1420 | 780 | -  | 1000 | 750 | 1400 | 1400 | 1400 | -  | 750 | -  | -  | -  | 1250 | -  |
| Number of syntaxon       | 1  | 2  | 3    |     |      |     |    |      |     |      |      |      | 4  |     |    | 5  |    | 6    |    |

|                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-----------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <i>Solidago virgaurea</i>         | . | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Sorbus aucuparia</i>           | 1 | 1 | + | 1 | . | . | . | . | . | . | . | . | + | + | . | . | + | . | . |
| <i>Streptopus amplexifolius</i>   | . | . | + | . | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . |
| <i>Vaccinium myrtillus</i>        | 3 | 3 | 1 | 3 | 1 | + | 5 | . | 1 | + | + | 2 | 1 | 1 | . | + | + | 1 | 1 |
| <i>Dicranum polysetum</i>         | . | . | . | . | 2 | 3 | 1 | 1 | . | . | . | . | 1 | 4 | . | . | . | . | . |
| <i>Dicranum scoparium</i>         | . | . | 2 | 4 | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| <i>Marchantia polymorpha</i>      | . | . | . | . | . | . | . | . | . | + | + | . | . | . | . | . | . | . | . |
| <i>Pleurozium schreberi</i>       | . | . | . | 4 | 1 | + | . | . | . | . | + | . | . | . | . | . | 2 | + | . |
| <i>Polytrichum commune</i>        | 1 | 2 | . | . | 1 | . | 2 | 1 | 3 | 4 | 4 | 4 | 3 | 5 | . | . | . | + | . |
| <i>Polytrichum formosum</i>       | . | . | 3 | 2 | . | . | . | . | . | . | . | . | . | . | . | . | + | . | . |
| <i>Polytrichum juniperinum</i>    | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 3 | + | . |
| <i>Rhytidiadelphus squarrosus</i> | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | 2 | 2 | . |
| <i>Sphagnum</i> sp.               | . | . | . | . | . | . | 1 | . | . | . | . | 4 | . | . | . | . | . | . | . |

**Numbers mark syntaxons:** 1 — *Stellario holosteeae-Fagetum*; 2 — *Athyrio alpestris-Piceetum*; 3 — *Luzulo sylvaticae-Piceetum*; 4 — *Molinio-Pinetum*; 5 — *Soldanello-Nardetum*; 6 — *Blechnum spicant* comm.

**Species recorded in only one relevé:** *Abelmoschus esculentus* (1: 3); *Aposeris foetida* (19: +); *Bazzania trilobata* (1: 1); *Calamagrostis villosa* (14: 2); *Campanula rotundifolia* (18: 1); *Carex canescens* (19: +); *C. leporina* (18: 1); *C. pallescens* (19: 1); *Cerastium fontanum* subsp. *vulgare* (19: 1); *Cetraria islandica* (19: +); *Cladonia rangiformis* (19: +); *Cladonia* sp. (6: +); *Dicranella* sp. (18: +); *Dicranum* sp. (18: +); *Dryopteris filix-mas* (4: 1); *Euphorbia carniolica* (2: +); *Eurhynchium praelongum* (2: +); *Galeopsis speciosa* (3: +); *Hylocomium splendens* (18: 4); *Hypericum richeri* subsp. *grisebachii* (19: +); *Laserpitium krapfii* (7: +); *Luzula campestris* (19: 1); *Mnium* sp. (2: +); *Neottia cordata* (2: +); *Onoclea struthiopteris* (2: +); *Pinus cembra* (1: 1); *Plagiomnium affine* (18: +); *Plagiomnium* sp. (2: +); *Plagiothecium* sp. (18: +); *Plagiothecium undulatum* (2: 1); *Poa chaixii* (19: 1); *Pogonatum* sp. (18: +); *Polygala vulgaris* (19: +); *Polypodium vulgare* (4: +); *Ptilium crista-castrensis* (18: +); *Pyrola rotundifolia* (16: r); *Ranunculus acris* (18: 1); *Rhytidiadelphus triquetrus* (19: 1); *Ribes alpinum* (6: +); *Rubus idaeus* (2: +); *Scorzonera rosea* (10: +); *Senecio nemorensis* (2: +); *Soldanella montana* (2: 1); *Solenopsis candicans* (16: r); *Stellaria graminea* (18: 1); *Succisa pratensis* (18: 1); *Symphytum cordatum* (2: +); *Veratrum lobelianum* (3: 1); *Veronica chamaedrys* (18: 1); *Viola declinata* (19: +)

**Localities:** 1, 2 — Skolivski Beskydy National Nature Park (3.27 (19, 20))\* (Solomakha et al., 2004); 3 — Chornyi Chermosh (1 (11)) (Onyshchenko, Budzhak, 2003); 4 — Gorgany Nature Reserve (6.2.5 (6)) (Klimuk et al., 2006); 5, 6 — Synevyr National Nature Park (4.1.4 (14, 15)) (Vorobyov et al., 2016); 7–14 — Synevyr National Nature Park (4.1.4 (7, 17, 19, 20, 26, 27, 30, 35)) (Vorobyov et al., 2016); 15 — Volyn Region, Lutsk District, Domashiv village, south-eastern vicinity, Davydiv Lis local protected area, 50.933777° N, 25.700067° E (22.10.2022, authors — V. Loiko, H. Herasymchuk, O. Bezsmertna, O. Shnyder); 16 — Volyn Region, Lutsk District, Domashiv village, south-eastern vicinity, Davydiv Lis local protected area, 50.933493°, 25.699068° (22.10.2022, authors — V. Loiko, H. Herasymchuk, O. Bezsmertna, O. Shnyder); 17 — polonyna Plai (38 (11)) (Malynovskiy, Krichfalushii, 2000); 18 — Gemba Mountain (37 (1)) (Malynovskiy, Krichfalushii, 2000); 19 — Volyn Region, Lutsk District, Domashiv village, south-eastern vicinity, Davydiv Lis local protected area, 50.933493° N, 25.699068° E (22.10.2022, authors — V. Loiko, H. Herasymchuk, O. Bezsmertna, O. Shnyder).

\* — in parentheses, we indicate the number of the table and relevé in each cited publication.

*Vaccinium myrtillus* L. Acidophilous shade-tolerant ferns (*Athyrium filix-femina* (L.) Roth, *Onoclea struthiopteris* (L.) Roth), grasses (*Avenella flexuosa* (L.) Drejer, *Calamagrostis villosa* J.F. Gmel.) and herbs (*Gentiana asclepiadea* L., *Huperzia selago* (L.) Bernh. ex Schrank & Mart., *Luzula sylvatica* (Huds.) Gaudin, *Soldanella hungarica* Simonk.) are constant companions. The moss layer is well developed, usually exceeds 40%, and can reach 100%. The most frequent dominating bryophytes are *Polytrichum commune* Hedw., *P. formosum* Hedw., *Dicranum scoparium* Hedw., and *D. polysetum* Sw. In total, the floristic structure of stands with *B. spicant* was formed by 70 species (53 vascular plants and 17 bryophytes) from 9 to 33 per plot.

This vegetation is found in the upper part of the forest belt, mainly at altitudes above 1000 m on the coarse sandstones of high moraine ramparts. It has been found within the Chyvchyno-Hryniavski Ridge of the Ukrainian Carpathians (Dubyna et al., 2019).

Two vegetation plots, according to our data processing, we defined as beech forests belonging to the association *Stellario holostaeae-Fagetum*. This vegetation occurs on moist acidic soils poor in nutrients. The tree layer with cover to 70% usually consists of *Fagus sylvatica* and *Picea abies*, accompanied by *Betula pendula* Roth and *Populus tremula* L. In the shrub layer, *Corylus avellana* L. and saplings of *Picea abies* and *Fagus sylvatica* are prominent. A sparse herb layer (total cover not exceeding 10%) is formed by *Dryopteris carthusiana* (Vill.) H.P. Fuchs, *Gentiana asclepiadea*, *Maianthemum bifolium* (L.) F.W. Smichdt, *Luzula sylvatica* and *L. pilosa* (L.) Willd.

Another two localities with *B. spicant* within the birch-pine forests near the local protected area Davydiv Lis in Volyn Region in the south-eastern vicinity of Domashiv village we identified as the association *Molinio-Pinetum*. This vegetation occurs in flat, moist sites on medium-podzolic sandy soils. Only single individual plants of *B. spicant* were found within this locality (Fig. 7). The canopy (cover to 90%, height 5–8 m) is formed by *Betula pendula* (age 8–30 years) and *Pinus sylvestris* L. (age 5–19 years), with the admixture of *Populus tremula*. The shrub layer (cover to 20%) consists of *Salix cinerea* L. and *Frangula alnus* Mill., accompanied by saplings of *Pinus sylvestris* and *Quercus robur* L. The herb layer is usually dominated by *Calluna vulgaris* (L.) Hull and *Dryopteris carthusiana*. The characteristic attribute of this vegetation is the combination

of species such as *Agrostis capillaris* L., *Deschampsia cespitosa* (L.) P. Beauv., *Juncus effusus* L., *Lysimachia vulgaris* L., *Vaccinium myrtillus*, *Pyrola rotundifolia* L., and *Solidago canadensis* L. A moss layer is well developed (with cover up to 90%) with the predominance of *Polytrichum* sp. and admixture of lichens. The most frequent lichen species are *Cladonia arbuscula* (Wallr.) Hale & W.L. Culb., *C. subulata* (L.) F. Weber ex F.H. Wigg., *Evernia prunastri* (L.) Ach., *Hypogymnia physodes* (L.) Nyl., and *Parmelia sulcata* Taylor. The total number of species in the phytocoenoses reaches 24 (14 vascular plants, 5 bryophytes, and 5 lichens), in some relevés — 11–12.

*Blechnum spicant* was also characterized for the grasslands, in particular for species-rich secondary grasslands of the montane belt in the Ukrainian Carpathians. *Blechnum spicant* was found, as a rare occurrence, within plant communities of the association *Soldanello-Nardetum*. Phytocoenosis of this association inhabits slopes with an inclination to 15°, soddy-loamy post-forest soil with an admixture of a gravelly fraction. The stands are usually species-rich (number per relevé varies from 32 to 39, with a total of 52 species), dense (total cover to 80–95%) and two-layered. The herb layer is dominated by *Nardus stricta* L., while *Festuca rubra* L. and *F. picturata* Pils occur as subdominants. An abundant occurrence of *Potentilla aurea* L., *Anthoxanthum odoratum* L., *Carex pilulifera* L., *Vaccinium vitis-idaea* L., *V. myrtillus* L., *Thymus alpestris* (Čelak.) Tausch ex A. Kern. is also characteristic of this community. The moss layer had total cover of 40–60%. *Polytrichum juniperinum* Hedw. and *Pleurozium schreberii* were the most frequent dominant bryophytes.

Thus, summing up the syntaxonomical scheme of plant communities with *B. spicant* in Ukraine is as follows:

Class VACCINIO-PICEETEA BR.-BL. IN BR.-BL. ET AL. 1939:

Order Piceetalia excelsae Pawłowski et al. 1928

Alliance Piceion excelsae Pawłowski et al. 1928

*Blechnum spicant* community: *Luzulo sylvaticae-Piceetum* Wraber 1963

Order Athyrio filicis-feminae-Piceetalia Hadač in Hadač et al. 1969

Alliance Chrysanthemo rotundifolii-Piceion (Krajina 1933) Březina et Hadač in Hadač 1962

*Blechnum spicant* community: *Athyrio alpestris-Piceetum* Hartmann in Hartmann et Jahn 1967



Fig. 7. The *Blechnum spicant* location in the territory of Tsumanska Pushcha National Nature Park. Photo by Oleksandr Shynder

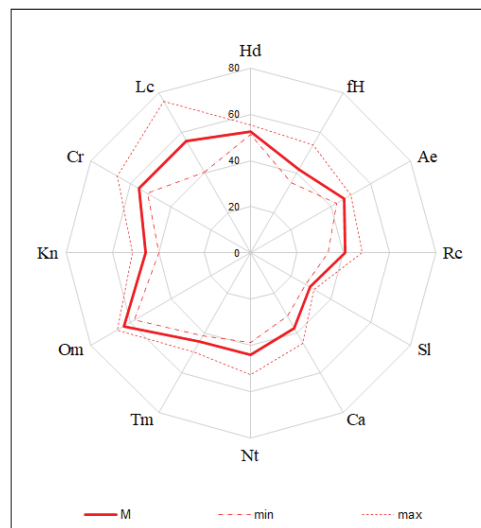


Fig. 8. The ecological characteristics of the *Blechnum spicant*'s ecological niche in the studied region

Order *Pinetalia sylvestris* Oberd. 1957  
 Alliance *Dicrano-Pinion sylvestris* (Libbert 1933)  
 Matuszkiewicz 1962  
*Blechnum spicant* community: *Molinio-Pinetum*  
 Matuszkiewicz (1973) 1981  
 Class *CARPINO-FAGETEA SYLVATICAE* JAKUCS  
 EX PASSARGE 1968  
 Order *Fagetalia sylvaticae* Pawłowski 1928  
 Alliance *Fagion sylvaticae* Luquet 1926  
*Blechnum spicant* community: *Stellario holostea-*  
*ae-Fagetum* Onyshchenko 2017  
 Class *JUNCETEA TRIFIDI* HADAČ IN KLIKA ET  
 HADAČ 1944  
 Order *Festucetalia spadiceae* Barbero 1970  
 Alliance *Nardion strictae* Br.-Bl. 1926  
*Blechnum spicant* community: *Soldanello-Nar-*  
*detum* Malinovsky et Krichfalushiy 2000

**The ecological niche characteristics.** Based on the results of the synphytoindication, we made a multi-factor cyclic graph illustrating the ecological niche of *B. spicant* (Fig. 8). The limiting factors for *B. spicant* are the salt and humidity regimes of the substrate. Their indices are characterized by minor variations in range.

We established that in the studied region, *B. spicant* is a stenotopic species. It belongs to the groups of sub-microtherms, meso-ombrophytes, hemi-oceanics, hemi-cryophytes, and hemi-scyophytes. By relation to edaphotopic factors, *B. spicant* is a stenotopic mesophyte, hemi-aerophobe, mesotrophe, hemi-carbonatophobe and hemi-nitrophile, and

also hemi-stenotopic hemi-hydrocontrastophile and acidophile.

Due to the narrow amplitude of ecological tolerance in relation to the soil humidity, the changes in the hydrological regime caused by climate changes may lead extinction of *B. spicant* in most lowland plain territories.

**Protection.** Among the countries adjacent to Ukraine, *Blechnum spicant* is protected only in Hungary, where it is included in the Red list of the vascular flora of Hungary with the CR status (Király, 2007).

However, this is more likely to be related to the features of the studied species' distribution and the number of appropriate biotopes than to the critical state of the populations. In Ukraine, *B. spicant* is protected as a regionally rare species in Khmelnytskyi Region only (Official lists..., 2012). Due to the new finding in Volyn Region, monitoring of lowland plain populations, and their protection requirements, we recommend including this species in the correspondent list of the regional rare plant species. At the global level and in Ukraine, this species is evaluated as LC (Onyshchenko et al., 2022).

*Blechnum spicant* grows and is protected in such protected areas as the Crimean Nature Reserve, Gorgany Nature Reserve, Carpathian Biosphere Reserve, Tsumanska Pushcha National Nature Park (NNP), Skolivski Beskydy NNP, Zacharovanyi Krai NNP, Hutsulshchyna NNP, Synevyr NNP, Vyzhnytskyi NNP, Verkhovynskyi NNP, Carpathian NNP, Synhora NNP, and Nadsyansky Regional Landscape Park.

## Discussion

*Blechnum spicant* often occurs at altitudes from 500 up to 1500 m a.s.l. Despite the numerous available herbarium specimens from the Carpathians, there is not enough comprehensive data about the distribution and population status of the studied species. Locations of the *Blechnum spicant* need monitoring and additional investigations.

The discovery of a new locality of *B. spicant* in Polissia significantly supplemented the chorological information about this species in the Ukrainian flora and at its eastern border in the European part of its range. Geographically, the location of *B. spicant* is one of the insular ones in this disjunctive range and is probably a derivative in a series of more northern European plain populations in the territory of Belarus (now probably extinct) and Poland. Noticeably, Fomin (1926) indicated that *B. spicant* could be found in Volyn.

In Belarus, there is no new or confirmed information about the finds of this species for almost 100 years. Polissian Lowland populations are considered endangered (Zajac, Zajac, 2001; Atlas roślin..., 2012). We found only two individuals, without fertile fronds, so we can suppose that the Polissian plain population of *B. spicant* in Ukraine is also degrading. However, the relatively young age of both detected individuals is commensurate with the age of the seed-origin afforestation on former agricultural lands. It could indicate the possible presence of older individuals of *B. spicant* in this area.

The relative xerothermic conditions formed in that part of the area led to plain populations of *B. spicant* extinction in Eastern Europe. Nowadays, global climate changes probably make these processes faster.

The Volynian locality of *B. spicant* does not have a direct linkage with the Carpathian populations. In contrast, the Western Podolian locations formed as a result of the possible dissemination of species' diaspores from the Carpathians in the times of climatic optimum. Considering their chorological isolation from the Carpathian part of the range, they are probably of a relict nature. However, in the territory of the lowland plain part of Poland, Szafer (1930) assigned *B. spicant* to the group of doubtful relicts. His statement is based on the dissemination capacity of *B. spicant* through long-distance dispersal of its small spores. Moreover, the location of the Western Podolian populations does not correlate with the

Carpathian mountainous plants' migration patterns to the territory of the Western regions of Ukraine (Malynovsky, 1991). *Blechnum spicant* penetration into the Podolian Upland could have occurred through the territory of the Eastern Precarpathians. The provided searches of this species in the western regions during the floristic investigations are still relevant. The discovery of new localities can clarify the genesis of its range part in Ukraine.

It could be expected that new localities may be discovered in Crimea, given its known occurrences in the European-Submediterranean part of the area in Turkey.

## Conclusions

In the territory of Ukraine, *Blechnum spicant* most often occurs in the Carpathian Mountains. Given the species' numerous occurrences in the Caucasus, additional finds in Crimea are likely. The decline and extinction of the lowland plain populations of *B. spicant* in Eastern Europe may have led to the reduction of local populations of this species and is an example of the negative impact of current climate changes on the spread of a moisture-loving montane-plain plants.

The newly discovered Polissian population of *B. spicant* is probably related to the Northern European migration flow and is not associated with the Carpathian localities. At the same time, the species' populations in Podillya are connected precisely with the Eastern Carpathian center of growth of *B. spicant*. The search for new locations of this species in the Western regions of Ukraine, which can clarify the genesis of its range in Ukraine, remains relevant.

## Acknowledgment

We are grateful to Dr. Eva Andrik (Ferenc Rákóczi II Transcarpathian Hungarian College of Higher Education, Ukraine) for the translation from the Hungarian language. We express our thanks to the curators of herbarium collections from different countries, who responded to our requests and provided the necessary information, particularly to Maja Graniszewska (Herbarium of the Faculty of Biology, University of Warsaw), Júlia Tamás and Dr. Beáta Papp (Hungarian Natural History Museum, Hungary), Dr. Mihai Pușcaș (Babes-Bolyai University, Romania). Also, we are grateful to Dr. Oleksandr Shnyder (M.M. Hryshko National Botanical Garden,

NAS of Ukraine) for helping with the data collection. We are grateful to Prof. Sergei L. Mosyakin (M.G. Kholodny Institute of Botany, NAS of Ukraine) for contributing to improving the article. We are also grateful to Dr. Neil Lockhart (Bryologist, National Parks and Wildlife Service, Government of Ireland) for proofreading our manuscript.

## Ethics Declaration

The authors declare no conflict of interest.

## ORCID

O.O. Bezsmertna: <https://orcid.org/0000-0001-8764-8878>  
 S.M. Iemelianova: <https://orcid.org/0000-0001-5885-3186>  
 H.M. Bondarenko: <https://orcid.org/0000-0001-9936-3482>  
 R.Y. Hleb: <https://orcid.org/0000-0002-5396-962X>  
 H.V. Herasymchuk: <https://orcid.org/0000-0001-7036-9653>  
 A.I. Babytskiy: <https://orcid.org/0000-0003-2758-0319>  
 V.V. Budzhak: <https://orcid.org/0000-0002-7754-6437>  
 I.M. Danylyk: <https://orcid.org/0000-0001-5779-4778>

## REFERENCES

- Atlas roślin chronionych, zagrożonych i rzadkich powiatu limanowskiego Limanowa*. 2012. Eds S. Gawroński, M. Szewczyk, R. Zelek. Limanowa: Starostwo Powiatowe w Limanowej Wydział Ochrony Środowiska, Rolnictwa i Leśnictwa, 100 pp.
- Bezsmertna O., Gleb R., Shtanko Y. 2023. *Historical finds of deer fern (Blechnum spicant) from the territory of Ukraine. Version 1.1. Ukrainian Nature Conservation Group (NGO). Occurrence dataset*. In: GBIF. Available in: <https://doi.org/10.15468/mb9zek> (Accessed 2 February 2023).
- Blazhevich R.Yu., Parfenov V.I., Rykovskiy G.F. 2009. *Blechnum spicant* (L.) Roth. In: *Flora Belarusi. Sosudistye rasteniya*. Vol. 1. Minsk: Belaruskaya Navuka, p. 105. [Блажевич Р.Ю., Парфенов В.И., Рыковский Г.Ф. 2009. В кн.: *Флора Беларуси. Сосудистые растения*. Т. 1. Минск: Беларуская навука, С. 105].
- Bobrov A.E. 1974. *Blechnum*. In: *Flora partis Europaeae URSS*. Vol. 1. Ed. A.A. Fedorov. Leningrad: Nauka, pp. 90–91. [Бобров А.Е. 1974. *Blechnum*. В кн.: *Флора Европейской части СССР*. Т. 1. Ред. А.А. Федоров. Ленинград: Наука, с. 90–91].
- Boiko M.F. 2014. The Second checklist of Bryobionta of Ukraine. *Chornomorski Botanical Journal*, 10(4): 426–487. <https://doi.org/10.14255/2308-9628/14.104/2>
- Braun-Blanquet J. 1936. Un joyau floristique et phytosociologique. "L'Isoetion" méditerranéen. *Communication de la Station Internationale de Géobotanique Méditerranéenne et Alpine de Montpellier (SIGMA)*, No. 42. Montpellier, 23 pp. [repr. *Bulletin de la Société d'Étude des Sciences Naturelles de Nîmes*, 47: 141–163].
- Christenhusz M., Raab-Straube E. von. 2013. *Polypodiopsida*. In: *Euro+Med Plantbase — the information resource for Euro-Mediterranean plant diversity*. Available at: <https://www.europlusmed.org/> (Accessed February 2023).
- Chytrý M., Tichý L., Holt J., Holt J., Botta-Dukát Z. 2002. Determination of diagnostic species with statistical fidelity measures. *Journal of Vegetation Science*, 13: 79–90. <https://doi.org/10.1111/j.1654-1103.2002.tb02025.x>
- Chytrý M., Hennekens S.M., Jiménez-Alfaro B., Knollová I., Dengler J., Jansen F., Landucci F., Schaminée J.H.J., Acic S., Agrillo E., Ambarll D., Angelini P., Apostolova I., Attorre F., Berg C., Bergmeier E., Biurrun I., Botta-Dukát Z., Brisse H., Campos J.A., Carlón L., Čarni A., Casella L., Csiky J., Čuštèrevska R., Dajić Stevanović Z., Danihelka J., De Bie E., de Ruffray P., De Sanctis M., Dickoré W.B., Dimopoulos P., Dubyna D., Dziuba T., Ejrnæs R., Ermakov N., Ewald J., Fanelli G., Fernández-González F., FitzPatrick Ú., Font X., García-Mijangos I., Gavilán R.G., Golub V., Guarino R., Haveman R., Indreica A., Işık Gürsoy D., Jandt U., Janssen J.A.M., Jiroušek M., Kački Z., Kavgacı A., Kleikamp M., Kolomiychuk V., Krstivojević Čuk M., Krstonošić D., Kuzemko A., Lenoir J., Lysenko T., Marcenò C., Martynenko V., Michalcová D., Moeslund J.E., Onyshchenko V., Pedashenko H., Pérez-Haase A., Peterka T., Prokhorov V., Rašomavičius V., Rodríguez-Rojas M.P., Rodwell J. S., Rogova T., Ruprecht E., Rüşia S., Seidler G., Šibík J., Šilc U., Škvorc Ž., Sopotlieva D., Stančić Z., Svenning J.-C., Swacha G., Tsiropidis I., Turtureanu P.D., Uğurlu E., Uogintas D., Valachovič M., Vashenyak Y., Vassilev K., Venzoni R., Virtanen R., Weekes L., Willner W., Wohlgemuth T., Yamalov S. 2016. European Vegetation Archive (EVA): an integrated database of European vegetation plots. *Applied Vegetation Science*, 19: 173–180. <https://doi.org/10.1111/avsc.12191>
- Didukh Ya.P. 2011. *The ecological scales for the species of Ukrainian flora and their use in synphytoindication*. Kyiv: Phytosociocentre, 176 pp.
- Didukh Ya.P., Plyuta P.H. 1994. *Fitoindykatsiya ekologichnykh faktoriv*. Kyiv: Naukova Dumka, 280 pp. [Дідух Я.П., Плюта П.Г. 1994. *Фітоіндикація екологічних факторів*. Київ: Наукова думка, 280 с.].
- Didukh Ya.P., Budzhak V.V. 2020. *Prohrama dlya avtomatyzatsii protsesu rozrakhunku balnykh pokaznykiv ekologichnykh faktoriv: metodichni rekomendatsii*. Chernivtsi: Yuriy Fedkovych Chernivtsi National University, 40 pp. [Дідух Я.П., Буджак В.В. 2020. *Програма для автоматизації процесу розрахунку бальних показників екологічних факторів: методичні рекомендації*. Чернівці: Чернівецький національний університет імені Юрія Федьковича, 40 с.].

- Didukh Ya.P., Korotchenko I.A., Fitsailo T.V., Burda R.I., Moysiyenko I.I., Pashkevich N.A., Iakushenko D.M., Shevera M.V. 2000. *Ecoflora of Ukraine*. Vol. 1. Ed. Ya.P. Didukh. Kyiv: Phytosociocentr, 284 pp. [Дідух Я.П., Коротченко І.А., Фіцайло Т.В., Бурда Р.І., Мойсієнко І.І., Пашкевич Н.А., Якушенко Д.М., Шевера М.В. 2000. *Екофлора України*. Т. 1. Відпов. ред. Я.П. Дідух. Київ: Фітосоціоцентр, 284 с.].
- Dubyna D.V., Dzyuba T.P., Yemelyanova S.M., Bagrikova N.O., Borysova O.V., Borsukevych L.M., Vynokurov D.S., Gapon S.V., Gapon Yu.V., Davydov D.A., Dvoretzky T.V., Didukh Ya.P., Zhmud O.I., Kozyr M.S., Konishchuk V.V., Kuzemko A.A., Pashkevych N.A., Ryff L.E., Solomakha V.A., Felbaba-Klushyna L.M., Fitsaylo T.V., Chorna H.A., Chorney I.I., Shelyag-Sosonko Yu.R., Yakushenko D.M. 2019. *Prodrome of the vegetation of Ukraine*. Eds D.V. Dubyna, T.P. Dzyuba. Kyiv: Naukova Dumka, 782 pp. [Дубина Д.В., Дзюба Т.П., Ємельянова С.М., Багрикова Н.О., Борисова О.В., Борсукевич Л.М., Винокуров Д.С., Гапон С.В., Гапон Ю.В., Давидов Д.А., Дворецький Т.В., Дідух Я.П., Жмуд О.І., Козир М.С., Конішчук В.В., Куземко А.А., Пашкевич Н.А., Рифф Л.Е., Соломаха В.А., Фельбаба-Клушина Л.М., Фіцайло Т.В., Чорна Г.А., Чорней І.І., Шеляг-Сосонко Ю.Р., Якушенко Д.М. *Продромус рослинності України*. 2019. Ред. Д.В. Дубина, Т.П. Дзюба. Київ: Наукова думка, 783 с.].
- Ekim T., Koyuncu M., Vural M., Duman H., Aytac Z., Adigüzel N. 2000. *Türkiye bitkileri kırmızı kitabı. Egreli ve Tohumlu Bitkiler*. Ankara: Turkish Association for the Conservation of Nature and Natural Resources, 246 pp.
- FloraVeg.EU — *Database of the European Flora and Vegetation*. 2023. Available at: [www.floraveg.eu](http://www.floraveg.eu) (Accessed February 2023).
- Fodor S.S. 1974. *Flora Zakarpattia*. Lviv: Vyshcha shkola, 207 pp. [Фодор С.С. *Флора Закарпаття*. Львів: Вища школа, 207 с.].
- Fomin O. 1926. *Flora Ukrainy*. Vol. 1. *Pteridophyta*. *Trudy fizyko-matematichnoho viddilu VUAN*, 2(1): 1–90. [Фомін О.В. 1926. Флора України. Т. 1. *Pteridophyta*. *Труди фізико-математичного відділу ВУАН*, 2(1): 1–90].
- GBIF Secretariat. 2023. *GBIF Backbone Taxonomy. Checklist dataset. Blechnum spicant* (L.) Roth. Available at: <https://www.gbif.org/species/7742948> (Accessed 05 August 2021).
- GBIF.org. *GBIF Occurrence Download*. 2023. Available at: <https://doi.org/10.15468/dl.6w4tqt> (Accessed 19 January 2023).
- Gilibert J.E. 1781. *Chloris grodnensis seu conspectus plantarum agri grodnensis ordine Linnaeano*. 2 vols. Grodno [Grodno], suppl. Vilnae [Vilnius], 428 pp.
- Hultén E., Fries M. 1986. *Atlas of North European Vascular Plants*. Königstein: Koeltz Scientific Books, 1172 pp.
- Király G. 2007. *Vörös Lista. A magyarországi edényes flóra veszélyeztetett fajai*. Ed. G. Király. Sopron: Saját kiadás, 73 pp.
- Klimchuk Yu.V., Miskevych U.D., Yakushenko D.M., Chornei I.I., Budzhak V.V., Nyporko S.O., Shpilchak M.B., Cherniavskyi M.V., Tokariuk A.I., Oleksiv T.M., Tymchuk Ya.Ia., Solomakha V.A., Solomakha T.D., Maior R.V. 2006. *Pryrodnyi zapovidnyk "Gorgany". Roslynni svit*. Kyiv: Phytosociocentre, 400 pp. [Клімчук Ю.В., Міскевич У.Д., Якушенко Д.М., Чорней І.І., Буджак В.В., Ніпорко С.О., Шпільчак М.Б., Чернявський М.В., Токарюк А.І., Олексів Т.М., Тимчук Я.Я., Соломаха В.А., Соломаха Т.Д., Майор Р.В. 2006. *Природний заповідник "Торгани". Рослинний світ*. Київ: Фітосоціоцентр, 400 с.].
- Knapp J.A. 1872. *Die bisher bekannten Pflanzen Galiziens und der Bucowina*. Wien: Wilhelm Braumüller, 520 pp.
- Kondratyuk S.Ya., Popova L.P., Khodosovtsev O.Y., Lököš L., Fedorenko N.M., Kapets N.V. 2021. *The fourth checklist of Ukrainian lichen-forming and lichenicolous fungi with analysis of current additions*. *Acta Botanica Hungarica*, 63(1–2): 97–163. <https://doi.org/10.1556/034.63.2021.1-2.8>
- Kuzemko A. 2012. *Ukrainian Grasslands Database. Biodiversity & Ecology*, 4: 430–430. <https://doi.org/10.7809/b-e.00217>
- Lyubinska L.G., Yuglichek L.S. 2017. *Flora Khmelnychchyny. Navchalnyi posibnyk*. Khmelnytskyi: Polihraphist, 240 pp. [Любінська Л.Г., Юглічек Л.С. 2017. *Флора Хмельницьчини. Навчальний посібник*. Хмельницький: ТЗОВ "Поліграфіст", 240 с.].
- Malynovsky A.K. 1991. *Mountain element of the flora of the Ukrainian Carpathians*. Kyiv: Naukova Dumka, 240 pp. [Малиновський А.К. 1991. *Монтанний елемент флори Українських Карпат*. Київ: Наукова думка, 240 с.].
- Malynovskiy K.A., Krichfalushii V.V. 2000. *Vysokohirna roslynnist*. Kyiv: Phytosociocentre, 230 pp. [Малиновський К.А., Крічфалущий В.В. 2000. *Високогірна рослинність*. Київ: Фітосоціоцентр, 230 с.].
- Margittai A. 1923. *Vznosy k flore Podkarpatskoy Rusi*. Eds R.Ya. Kish, M.V. Shevera, R.V. Dzakhman. 2010. Uzhhorod: Karpaty, pp. 14, 99. [Маргітай А. 1923. *Взносы к флоре Подкарпатской Руси*. Ред. Р.Я. Кіш, М.В.Шевера, Р.В. Джакман. 2010. Ужгород: Карпати, с. 14, 99].
- Margittai A. 1927. *Adatok az Északkeleti felvidék flórájához*. *Botanikai Közlemenyek*, 44(5–6): 154–164.
- Margittai A. 1937. *A nagyszőlősi Feketehegy nevezetes növényei. Bericht über die interessanteren Pflanzenfunde am Berge Feke-tehegy bei Nagyszőlős (Nordostkarpathen)*. *Botanikai Közlemenyek*, 34(1–2): 48–52.
- Meusel H., Jäger E., Weinert E. 1965. *Verleichende Chorologie der Zentraleuropäischen Flora*. Bd 1. Jena: Veb G. Fischer Verlag, 583 pp.
- Mikhailovskaya V.A. 1953. *Flora Polesskoy nizmennosti*. Minsk: Izdatelstvo AN BSSR, 453 pp. [Михайловская В.А. 1953. *Флора Полесской низменности*. Минск: Изд-во АН БССР, 453 с.].
- Mosyakin S.L., Fedoronchuk M.M. 1999. *Vascular plants of Ukraine. A nomenclatural checklist*. Kyiv, 346 pp. + xxiii.
- Mucina L., Bültmann H., Dierßen K., Theurillat J.-P., Dengler J., Čarni A., Šumberová K., Raus T., di Pietro R., Gavilan García R., Chytrý M., Iakushenko D., Schaminée J.H.J., Bergmeier E., Santos Guerra A., Daniëls F.J.A., Ermakov N., Valachovič M., Pignatti S., Rodwell J.S., Pallas J., Capelo J., Weber H E., Lysenko T., Didukh Ya.P., Pignatti S., Capelo J., Weber H.,

- Solomesh A., Dimopolous P., Aguiar C., Freitag H., Hennekens S.M., Tichý L. 2016. Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen and algal communities. *Applied Vegetation Science*, 19 (Supplement 1): 3–264. <https://doi.org/10.1111/avsc.12257>
- National Habitat Catalogue of Ukraine. 2018. Eds A.A. Kuzemko, Ya.P. Didukh, V.A. Onyshchenko, Ya. Sheffer Kyiv: FOP Klymenko Yu.Ya., 442 pp. [Національний каталог біотопів України. 2018. Ред. А.А. Куземко, Я.П. Дідух, В.А. Онищенко, Я. Шеффер Київ: ФОП Клименко Ю.Я., 442 с.].
- Novosad V.V., Krytska L.I. 2010. *Phyto- and flora diversity of the Middle Dnister region. Vascular plants*. Vol. 1. Kyiv: Phytoton, 148 pp. [Новосад В.В., Крицька Л.І. 2010. Фіто- та флорорізноманіття Середнього Придністров'я. Судинні рослини. Т. 1. Київ: Фітон, 148 с.].
- Official lists of regional rare plants of administrative of Ukraine (reference book). 2012. Eds T.L. Andrienko., M.M. Peregrym. Kyiv: Alterpress, 148 pp. [Офіційні переліки регіонально рідкісних рослин адміністративних територій України. 2012. Ред. Т.Л. Андриєнко, М.М. Перегрим. Київ: Альтерпрес, 148 с.].
- Onyshchenko V.A., Buddzak V.V. 2003. Lisy klasu *Vaccinio-Piceetea* Br.-Bl. 1939 v pivdenniy chastyny Ivano-Frankivskoi oblasti. In: *Roslynnist khvoinykh lisiv Ukrainy. Materialy robochoi narady*. Eds Yu.R. Shelyag-Sosonko, Ya.P. Didukh, D.V. Dubyna, V.A. Solomakha, A.A. Kuzemko. Kyiv: Phytosociocentre, pp. 131–145. [Онищенко В.А., Буджак В.В. 2003. Ліси класу *Vaccinio-Piceetea* Br.-Bl. 1939 в південній частині Івано-Франківської області. В зб.: *Рослинність хвойних лісів України. Матеріали робочої наради*. Київ: Фітосоціоцентр, с. 131–145].
- Onyshchenko V.A., Mosyakin S.L., Korotchenko I.A., Danylyk I.M., Burlaka M.D., Fedoronchuk M.M., Chorney I.I., Kish R.Ya., Olshanskyi I.H., Shiyani N.M., Zhygalova S.L., Tymchenko I.A., Kolomyichuk V.P., Novikov A.V., Boiko G.V., Shevera M.V., Protoporova V.V. 2022. *IUCN Red List categories of vascular plant species of the Ukrainian flora*. Ed. V.A. Onyshchenko. Kyiv: FOP Hulieva V.M., 198 pp.
- Opredelitel vysshikh rasteniy Ukrainy*. 1987. Ed. Yu.N. Prokudin. Kiev: Naukova Dumka, 548 pp. [Определитель высших растений Украины. 1987. Ред. Ю.Н. Прокудин. Киев: Наукова думка, 548 с.].
- Paczoski I. 1900. Flora Poles'ya i prilezhaschikh mestnostey. Okonchanie [Part 3]. *Trudy S.-Peterburgskogo Imperatorskogo Obshchestva Estestvoispytatelei: Otdelenie Botaniki* [Travaux de la Société Impériale des Naturalistes de Saint-Petersbourg: Section de Botanique], 30(3): 1–103. [Пачоский И. 1900. Флора Полесья и прилежащих местностей. Окончание [Часть 3]. Труды Императорского С.-Петербургского общества естествоиспытателей, Отделение ботаники, 30(3): 1–103].
- POWO (2023). *Plants of the World Online*. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet. Available at: <http://www.plantsoftheworldonline.org/> (Accessed 05 August 2023).
- Roleček J., Tichý L., Zelený D., Chytrý M. 2009. Modified TWINSPAN classification in which the hierarchy respects cluster heterogeneity. *Journal of Vegetation Science* 20(4): 596–602. <https://doi.org/10.1111/j.1654-1103.2009.01062.x>
- Solomakha V.A., Yakushenko D.M., Kramarets V.O., Milkina L.I., Vorontsov D.P. 2004. *Natsionalnyi pryrodnyi park "Skolivski Beskydy". Roslynniyi svit*. Kyiv: Phytosociocentre, 240 pp. [Соломаха В.А., Якушенко Д.М., Крамарець В.О., Мілкіна Л.І., Воронцов Д.П. 2004. Національний природний парк "Сколівські Бескиди". Рослинний світ. Київ: Фітосоціоцентр, 240 с.].
- Szafer W. 1930. Element górski we florze niżu polskiego. *Rozprawy Wydziału Matematyczno-Przyrodniczego, Polska Akademia Umiejętności, Seria 3, Dział B*, 69: 83–196.
- Thiers B. 2008–onward. *Index Herbariorum*. A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available at: <http://sweetgum.nybg.org/science/ih>
- Twardowska M. 1896. Spis roślin z Szemetowszczyzny i Weleńnicy w latach 1893–1894. *Pamiętnik Fizjograficzny*. T. 14, dział III: 115–118.
- Tyniecki W. 1877. *Wycieczka na Podole w jesieni 1875*. Lwow: Kosmos, 2: 1–19.
- Vasheka O.V., Bezsmertna O.O. 2012. *Atlas paporotey flory Ukrainy*. Kyiv: Palyvoda, 160 pp. [Вашека О.В., Безсмертна О.О. 2012. Атлас папоротей флори України. Київ: Паливода А.В., 160 с.].
- Vorobyov E.O., Solomakha V.A., Solomakha I.V., Shevchyk V.L., Senchylo O.O., Tyukh Y.Y., Yakushenko D.M. 2016. Syn-taxonomiia roslinnosti NPP "Synevyr". In: *National Natural Park "Synevyr". Plant World*. Ed. V.A. Solomakha. Kyiv: Phytosociocentre, pp. 78–283. [Воробйов Є.О., Соломаха В.А., Соломаха І.В., Шевчик В.Л., Сенчило О.О., Тюх Ю.Ю., Якушенко Д.М. 2016. Синтаксономія рослинності НПП "Синевир". В кн.: *Національний природний парк "Синевир"*. Ред. В.А. Соломаха. Рослинний світ. Київ: Фітосоціоцентр, с. 78–231].
- Yena A.V. 2012. *Prirodnaia flora Krimskogo poluostrova: monografiya*. Simferopol: N. Orianda, 232 pp. [Ена А.В. 2012. Природная флора Крымского полуострова: монография. Симферополь: Н. Орианда, 232 с.].
- Zajac A., Zajac M. 2001. *Atlas rozmieszczenia roślin naczyniowych w Polsce*. Kraków: Nakładem Pracowni Chorologii Komputerowej Instytutu Botaniki Uniwersytetu Jagiellońskiego, 714 pp.
- Zawadzki A. 1835. *Enumeratio plantarum Galiciae et Bucowin oder die in Galizien und der Bukowina wildwachsenden Pflanzen mit genauer Angabe ihrer Standorte*. Breslau: bei Wilhelm "Gottlich Korp.", 200 pp.

***Blechnum spicant* (Blechnaceae) у флорі України**

Олеся О. БЕЗСМЕРТНА <sup>1,2,10</sup>, Світлана М. ЄМЕЛЬЯНОВА <sup>5,11</sup>, Георгій М. БОНДАРЕНКО <sup>6</sup>,  
Руслан Ю. ГЛЕБ <sup>7,10</sup>, Василь В. БУДЖАК <sup>8</sup>, Іван М. ДАНИЛИК <sup>9</sup>, Євген О. ШТАНЬКО <sup>1</sup>,  
Андрій І. БАБИЦЬКИЙ <sup>4</sup>, Галина В. ГЕРАСИМЧУК <sup>2</sup>, Володимир О. ЛОЙКО <sup>2</sup>,  
Ніна О. МЕРЛЕНКО <sup>2</sup>, Віталій В. ДЕРКАЧ <sup>2</sup>

<sup>1</sup> Київський національний університет Тараса Шевченка,  
вул. Володимирська 64/13, Київ 01601, Україна

<sup>2</sup> Національний природний парк "Цуманська пуца",  
вул. Незалежності 20, Ківерці 45200, Волинська область, Україна

<sup>3</sup> Національний університет біоресурсів та природокористування України,  
вул. Героїв Оборони, 15, Київ 03041, Україна

<sup>4</sup> Інститут зоології ім. І.І. Шмальгаузена НАН України,  
вул. Б. Хмельницького 15, Київ 01030, Україна

<sup>5</sup> Інститут ботаніки ім. М.Г. Холодного НАН України,  
вул. Терещенківська 2, Київ 01601, Україна

<sup>6</sup> Харківський національний університет імені В.Н. Каразіна,  
площа Свободи 4, Харків 61022, Україна

<sup>7</sup> Карпатський біосферний заповідник,  
Красне Плесо 77, Рахів 90600, Україна

<sup>8</sup> Інститут еволюційної екології НАН України,  
вул. Лебедева 37, Київ 03143, Україна

<sup>9</sup> Інститут екології Карпат НАН України,  
вул. Козельницька 4, Львів 79026, Україна

<sup>10</sup> Українська природоохоронна група

<sup>11</sup> Кафедра ботаніки та зоології, Факультет природничих наук,  
Університет Масарика, вул. Котларска 2, Брно 611 37, Чеська Республіка

**Реферат.** У роботі подано відомості щодо особливостей поширення на території України голарктичного диз'юнктивноареального монтанно-рівнинного виду папороті *Blechnum spicant*. Він доволі часто трапляється на території Карпат і дуже рідкісний в інших регіонах України. До нашого часу були відомі тільки два локалітети у Західному Лісостепу на Подільській височині та один локалітет у Криму. Авторами вперше було виявлено новий локалітет *B. spicant* на території Поліської низовини (Волинська обл.). У статті наведено детальний геоботанічний і топографічний описи поліської популяції виду, яка складається з двох одиничних локусів на невеликій відстані один від одного. Обидва місцезростання приурочені до молодого березово-соснового лісу віком приблизно 20 років на місці сільськогосподарських угідь. Також узагальнено відомості про поширення виду на території України. Подано відомості щодо фітоценологічних, біотопічних та популяційних особливостей місцезростань *Blechnum spicant*.

**Ключові слова:** монтанний вид, нові місцезнаходження, Поліська низовина, хорология