

A NEW SPECIES OF *POLYSTICHUM*
(DRYOPTERIDACEAE) TO THE BULGARIAN FLORA

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Abstract

The fern species *Polystichum braunii* (Dryopteridaceae) is reported for the first time for the Bulgarian flora. It was discovered in a beech forest on the northern slopes of Western Balkan Range, above Varshets town, Montana district. The nearest known locality is in SW Romania. The article presents data on the morphology, distribution, population, habitat, ecology, and conservation status of *P. braunii*. The population is extremely small, vulnerable and of conservation concern in Bulgaria.

Key words: Bulgarian flora, first record, *Polystichum braunii*, Western Balkan Range

Introduction. *Polystichum* Roth is one of the largest, morphologically most diverse and taxonomically most complex fern genera [1,2]. According to some authors and the species concept they adopt, genus *Polystichum* includes at least 260 species [3] to ca. 500 species [4]. It is an almost cosmopolitan genus widespread throughout the world (except Antarctica).

In Europe, *Polystichum* is represented by four native species – *P. aculeatum* (L.) Roth, *P. braunii* (Spenn.) Fée, *P. lonchitis* (L.) Roth, and *P. setiferum* (Forssk.) Woy. [5]. Thus far, only three of the European species have been reported in the Bulgarian botanical literature (e.g., [6]), namely *P. lonchitis*, *P. aculeatum* and *P. setiferum*. During a field work carried out in the western part of the Balkan mountain range in 2018, a frond of *Polystichum* was collected. More

detailed examination of the dried specimen revealed it to be *P. braunii*, not previously recorded for the Bulgarian flora. The site was revisited several times and more data were collected. The aim of the present article is to report the first record of this new native species to the Bulgarian flora and to provide morphological description, information on its habitat, ecological requirements, population size and conservation status.

Material and methods. The present study was based on personal collections of *P. braunii* from its natural habitat. Field work was performed in 2018–2020 in the Western Balkan Range, above Varshets town. The herbarium specimens gathered were deposited in the herbarium of the Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences (SOM). The distribution in Bulgaria was mapped on 10 × 10 km UTM grid.

Morphological and spore analyses were carried out. The morphological characters of the species were noted from both herbarium materials collected or live plants observed and then compared with data from relevant literature (e.g., [7,8]). Data about the habitat, ecology and population are based mainly on personal observations.

For the spore study a light microscope was used. Spores were mounted in Euparal on glass slides, without prior chemical treatment. Micrographs were taken with a Nikon DS-5Mc digital camera. Qualitative and quantitative features of mature spores were studied. Measurements of spore length and width were made at the largest diameter, without the perisporium. Fifty mature spores per sample ($N = 200$, 4 samples) were measured using imaging software NIS-Elements BR 2.30; and the average ($\bar{x}$), minimum and maximum values were reported.

Results and discussion.

Polystichum braunii (Spenn.) Fée, Mém. foug., 5. Gen. filic.: 278. 1850–1852.

Basionym: $\equiv$ *Aspidium braunii* Spenn., Fl. friburg. 1: 9, t. 2. 1825.

Family: Dryopteridaceae

Morphological description (based on Bulgarian material) (Fig. 1, 2). Hemicryptophyte. *Fronds* growing in a crown or in tufts, arching slightly; up to 70 cm long, summer-green. *Petiole* usually much shorter than the blade, 4.5–11 cm long, very densely scaly. *Rachis* densely covered with soft scales (denser abaxially). *Scales* glossy, pale, of two kinds (large and small scales intermixed), large ones triangular, ovate, ovate-lanceolate, lanceolate or broadly lanceolate, small ones almost linear, hairy-like; long acuminate or caudate. *Lamina* thin, soft and supple, shiny when alive, somewhat leathery; many times longer than the petiole, (35–)49–60 cm long × (8–)12–16 cm wide, broadest at or near the middle, tapering gradually towards the acuminate apex and the greatly narrowed base; lanceolate to oblong-lanceolate, generally bipinnate; on both surfaces clearly covered with numerous, whitish to brownish, filiform, linear or linear-lanceolate, thinly pointed scales. *Petiole/lamina ratio* 1:4.5 to 1:11. *Pinnae* numerous, up to



Fig. 1. *Polystichum braunii*: A – frond silhouette, scale bar = 10 cm; B – habitus in the nature; C – pinna and pinnules; D–E – scales on the abaxial (D) and adaxial (E) surfaces of pinnules and midribs (photos by D. Ivanova)

38 on each side, graduating in length from 4.5–8 cm at the middle to only about 0.7–1.6 cm at the base; 1-pinnate, some very shortly stalked; all elongated, oblong, lanceolate, oblong-lanceolate or falcate, lowermost pinnae $\pm$ straight sided; acute, acuminate, apiculate to aristate (middle ones) or obtuse (upper and lower ones); pinna bases asymmetrical, except proximal 3–4(6) pinnae. *Pinnules* up to 14(–16) on each side, usually broad, oblong; apex broadly acute or obtuse, aristate; base

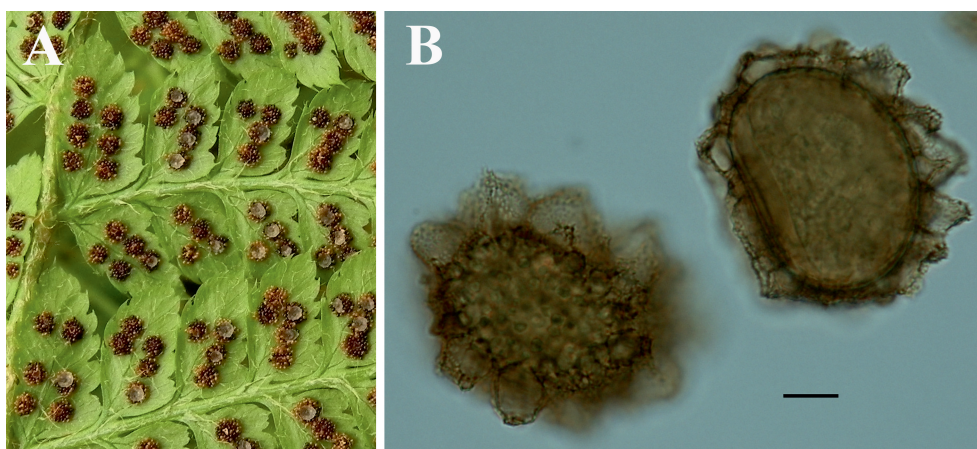


Fig. 2. *Polystichum braunii*: A – parts of pinnae, abaxial surface showing sori, sporangia and indusia; B – microphotographs of mature spores in lateral view, at 100×, scale bar = 10 μm (photos by D. Ivanova)

cuneate, proximal side straight, distal side typically with small, sometimes barely marked, rounded auricle at base; margins roughly serrate with obtuse, aristate teeth. *Sori* large, orbicular, up to 10 per pinnule, nearer the midrib than the margin. *Indusium* pale, delicate, peltate, shrivelling and soon hidden by the maturing sporangia. *Spores* brown to light brown, monolete, bilaterally symmetrical, ellipsoidal, plano-convex to slightly concavely convex in lateral view; perisporium fenestrate, with numerous, wide, ± prominent, wavy folds and crests with sparsely echinulate margins; size (33.33–)43.55(–58.37) × (18.64–)27.73(–36.95) μm. *Spore maturity* VII–VIII.

Habitat, ecology and accompanying taxa. *P. braunii* inhabits cool, moist northern forests and is an obligate air humidity hygrophyte [9]. Microhabitat seems to be crucial in providing the cooler temperatures needed.

In Bulgaria, *P. braunii* was found in a shady beech forest (Habitats Directive 92/43/EEC: 91W0 Moesian beech forests) with dense canopy and high and relatively constant air humidity; on stony, steep (30–35°) slope with N-NE exposition (Fig. 3); on brown forest soils (Cambisols), siliceous bedrock, at ca. 897 m a.s.l. There is a stream in the vicinity. The place is characterized by a temperate-continental climate with a pronounced mountainous character. The summer is relatively cool (average July temperatures 16–22 °C).

The following plant species were found on and near the site: *Fagus sylvatica*, *Carpinus betulus*, *Tilia platyphyllos*, *Corylus avellana*, *Rubus* aff. *hirtus*, *Aegopodium podagraria*, *Anthriscus sylvestris*, *Asarum europaeum*, *Athyrium filix-femina*, *Brachypodium pinnatum*, *Brachythecium salebrosum*, *B. velutinum*, *Caltha palustris*, *Cardamine bulbifera*, *Chrysosplenium alternifolium*, *Circaea lute-tiana*, *Dryopteris borreari*, *D. dilatata*, *Galium odoratum*, *Geranium robertianum*,



Fig. 3. Habitat of *Polystichum braunii* (photo by D. Ivanova)

Hypnum cupressiforme, *Impatiens noli-tangere*, *Isothecium alopecuroides*, *Lactuca muralis*, *Luzula sylvatica*, *Melica uniflora*, *Oxalis acetosella*, *Polypodium vulgare*, *Polystichum braunii*, *P. aculeatum*, *Telekia speciosa*, *Urtica dioica*, etc.

Distribution in Bulgaria. The only known Bulgarian locality so far is on the northern slopes of Western Balkan Range, in the land of Varshets town (Montana district), Koritata locality, 43°08'41"N 23°13'28"E (UTM-code FN88, Fig. 4). This is the most southeastern site in Europe. The closest locality of *P. braunii* seems to be in SW Romania: Stârmina Hill, near Hinova village, Oltenia [10], ca. 155 km far away. The records in Serbia [11] are farther. In the other surrounding countries, this species was not recorded.

General distribution. Widespread but highly fragmented distribution, in the temperate (predominantly) and cold regions of the Northern Hemisphere. Detailed list of the countries is given in [12]. Spain should also be added to that list, as recently *P. braunii* has been confirmed in the Spanish Pyrenees [13].

Population data, conservation status. *P. braunii* is an "occasional" species throughout its global range and typically occurs locally, growing singly or in small numbers within suitable habitat.

The occurrence of *P. braunii* in Bulgaria is restricted to an area of only 5 m². During the field survey in the area it was recorded that the population consists

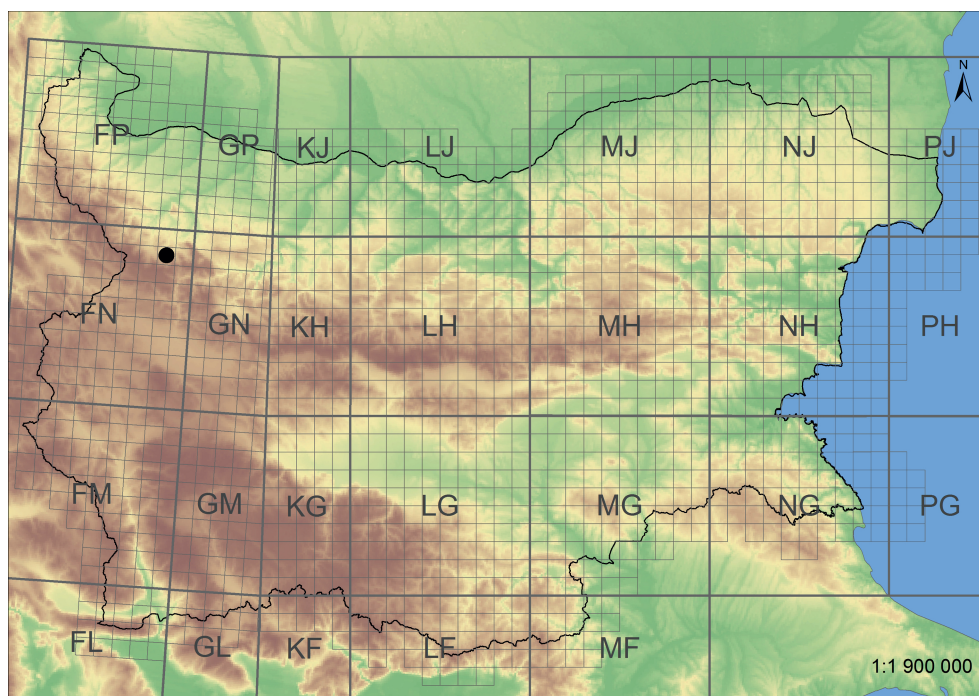


Fig. 4. Distribution map of *Polystichum braunii* in Bulgaria

of only three mature individuals in total. Even a small-scale disturbance can destroy the entire local population. Careful search in the vicinities of this site did not result in discovery of other individuals.

The locality of the newly found species falls within 'Koritata' Protected Site. Moreover, it is included in SCI BG0001040 'Western Stara Planina and Fore-Balkan' under the Habitats Directive, and in SPA BG0002002 'Western Balkan' under the Birds Directive, as well as in Important Plant Area BGIPA041 'Western Balkan'.

In some regions worldwide *P. braunii* is extremely rare, but in other countries it is locally abundant. The species was evaluated as Least Concern (LC) for Europe and Vulnerable (VU B2ab(v); C2a(i)) for the European 28 Member States [14]. It is being listed as threatened in the national Red Lists of many European countries. The European population is severely fragmented and there is an overall declining population trend.

Considering the extremely low number of individuals, appearing at only a single location in Bulgaria, *P. braunii* should be treated as a Critically Endangered (CR) on a national level and should be protected by law even though knowledge of more localities could increase with further investigation.

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