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Pteridophyte spores of Bulgaria - preliminary results

Abstract

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An atlas with morphological descriptions of the recent pteridophyte spores of Bulgaria is being prepared. The main object of the project is to illustrate the spores of pteridophytes native in Bulgaria with the aim to facilitate the palaeopalynological and taxonomic studies. Data on four species - *Cryptogramma crispera*, *Athyrium distentifolium*, *Cystopteris fragilis* and *Polystichum aculeatum* - are presented as examples, including morphological, distributional and habitat information.

Introduction

Ferns and their close relatives, the horsetails, quillworts and clubmosses, grow in nearly every corner of the world, except in the sand and ice deserts. The pteridophytes are significantly represented in the tropical and subtropical flora, with a great number of species, distributed in diverse habitats. Many species can also be found in the temperate zones.

In Bulgaria about 60 native species, belonging to 17 families and 30 genera of Lycopsidea, Sphenopsida and Filicopsida have been recognised. Up to now the Bulgarian pteridophyte flora has not been very well studied, and only recently biosystematic studies have been undertaken (Ivanova 1997, 1998, 1999; Stefanova & Ivanova 2000).

An atlas with morphological characterization of recent pteridophyte spores of Bulgaria is now being prepared. The aim of this atlas is to facilitate palaeopalynological research and palaeoecological analysis, as well as to provide palynological information for taxonomic studies on Bulgarian pteridophytes. In addition to the spore description, information on the nomenclature, the most striking features of each species, as well as on the habitat and geographical distribution, is given.

Some data on the species - *Cryptogramma crispera* (L.) Hook., *Athyrium distentifolium* Opiz, *Cystopteris fragilis* (L.) Bernh. and *Polystichum aculeatum* (L.) Roth - are shown here as examples of what will be presented for each species in the atlas.

Material and methods

The spores were obtained from herbarium specimens housed in the Herbarium of the Institute of Botany, BAS (vouchers cited). All spores were submitted to acetolysis. For

photographic documentation of the spore morphology both light microscopy and scanning electron microscopy (providing more detailed information about the surface of the spore wall) were used. For each species a photograph of a herbarium sporophyte exsiccate and photographs of different spores, representing different positions, are given. Each measure given for the spore descriptions represents the arithmetic mean of 30 measurements. The information about the geographic distribution of the species in Bulgaria was obtained from the personal collections of the first author and from five Bulgarian herbaria - at the Institute of Botany, BAS (SOM), at the Faculty of Biology, Sofia University "St. Kliment Ohridski" (SO), at the Agricultural University, Plovdiv (SOA and AUP), at the Natural History Museum, Plovdiv (NHMP).

The palynological terminology follows Punt & al. (1994). The systematics essentially follows the classification in the 2nd edition of *Flora Europaea* (Tutin & al. 1993).

***Cryptogramma crispera* (L.) Hook.**

Spores (Plate 1) - Herbarium reference: SOM 155813

Shape: Tetrahedral-globose with rounded angles.

Aperture: Trilete, laesurae strait, almost extending equatorial margin.

Description: Spores with verrucate surface, without equatorial flange; verrucae densely spaced, rounded, with diameter ca. 1,5 - 3,5 μm .

Size: (45,0) - 51,8 - (59,2) μm . Sporoderm thickness: 1,1 - 2,0 μm (without sculptural elements).

Habitat

In high mountains, amongst mountain rocks, boulders and screes, in rock fissures. A definite calcifuge.

Geographical distribution in Bulgaria (Fig. 1)

Floristic regions: Vitosha region, Pirin Mts, Rila Mts.

***Athyrium distentifolium* Opiz**

Spores (Plate 2) - Herbarium reference: SOM 155198

Shape: Ellipsoidal.

Aperture: Monolete, 2/3 - 3/4 to the spore length.

Description: Spores with well developed perispore. The perispore is cavate with well formed rugate surface. The ridges ca. 3-4 μm wide. Perispore easily eroded by acetolysis, resulting in an almost smooth surface.

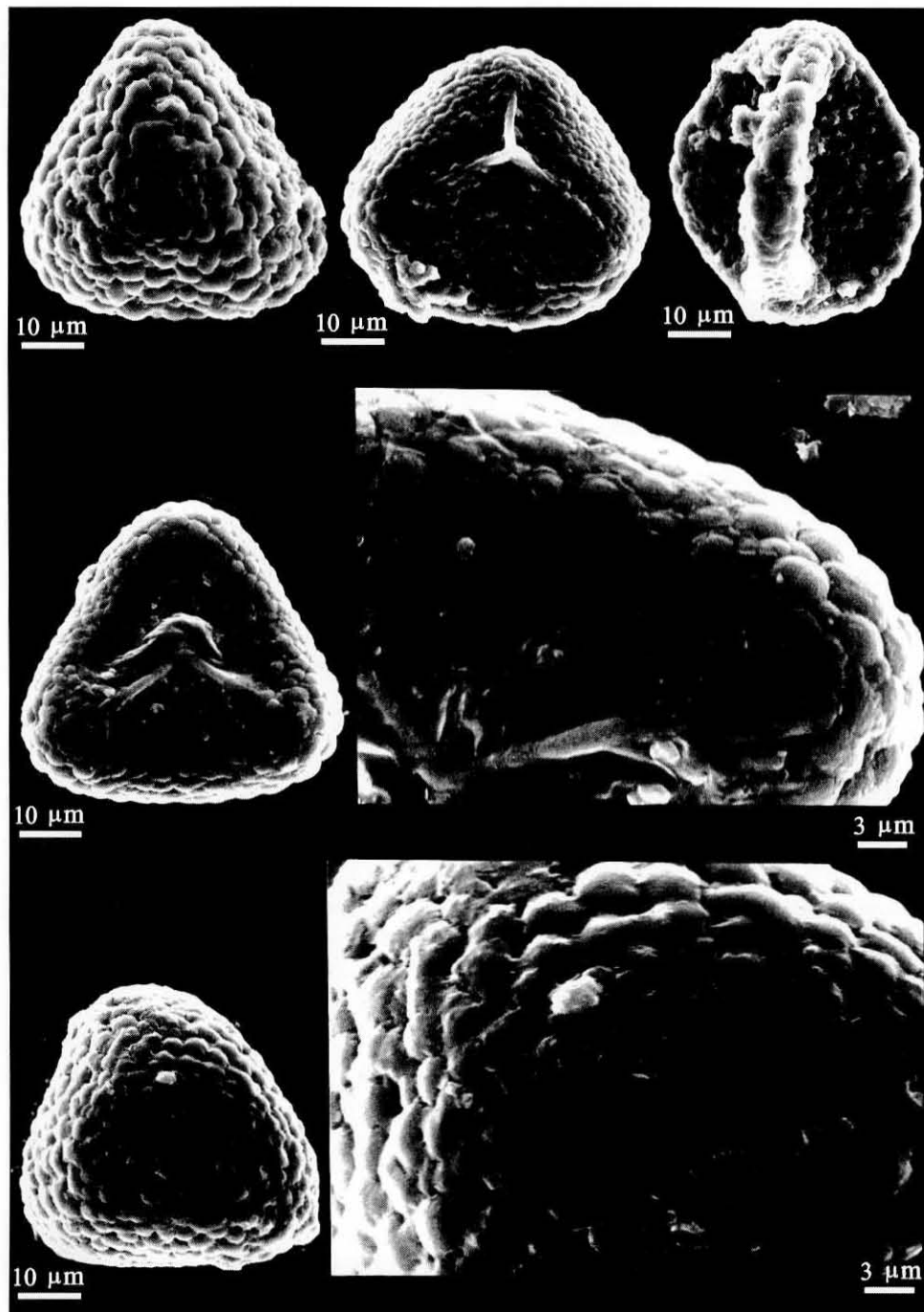
Size: (37,5) - 44,1 - (50,0) μm x (25,0) - 33,5 - (40,0) μm . Sporoderm thickness: 1,8-2,5 μm . Perispore thickness: 4,0-5,3 μm .

Habitat

An alpine plant, occurring above 1550 m a.s.l. In open humid places in the subalpine and alpine zones - amongst rocks and boulders, in rock crevices, at stone- and rock-bases, along mountain streams and by lakes, amongst screes. On silicate. Found only once in wet gulch in a beech forest, near the timberline.

Geographical distribution in Bulgaria (Fig. 2)

Floristic regions: C Balkan Range, Vitosha region, Pirin Mts, Rila Mts.



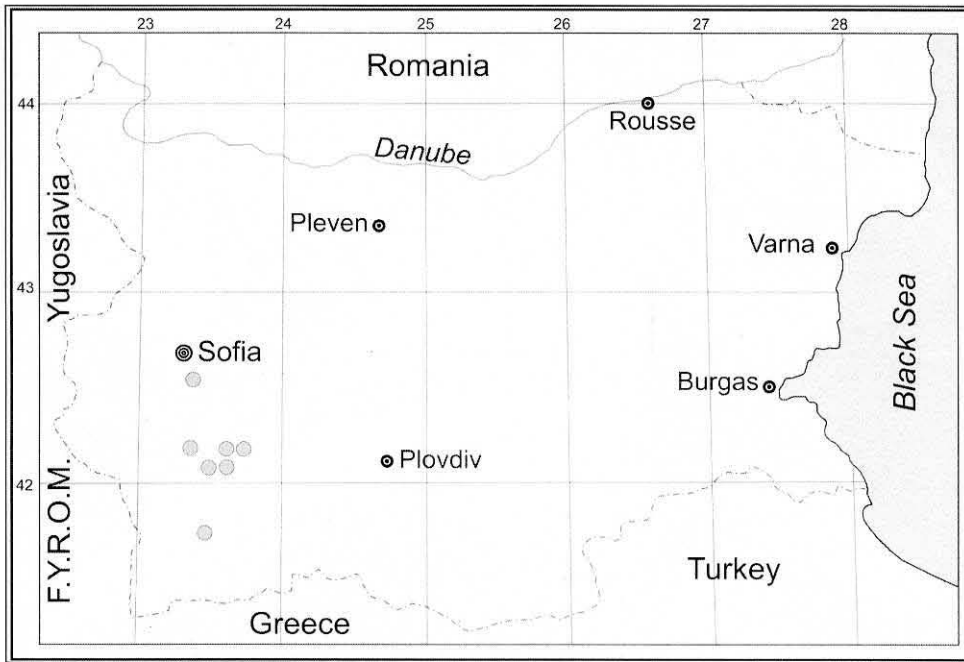


Fig. 1. Distribution of *Cryptogramma crista* (L.) Hook. in Bulgaria.

***Cystopteris fragilis* (L.) Bernh.**

Spores (Plate 3) - Herbarium reference: SOM 155205

Shape: Ellipsoidal.

Aperture: Monolete, 2/3 - 3/4 to the spore length.

Description: Spores with well developed perispore. The perispore is echinate with the echinae projecting from a coarsely rugate and finely perforate surface of perispore. The echinae ca. 3 - 5 μm long. Perispore sometimes eroded by acetolysis, resulting in an almost smooth surface.

Size: (50,0) - 60,6 - (67,5) μm x (35,0) - 38,4 - (45,0) μm . Sporoderm thickness: 2,0-2,5 μm . Perispore thickness: 3,0-5,0 μm .

Habitat

Mostly in wet and shady places in forests - on soil, in fissures of moist rocks, in stony habitats, on tree-roots, along streamsides; also in open places above the timberline - in rock crevices, amongst boulders, at stone-bases, on screes. Calcareous and non-calcareous substrates.

Geographical distribution in Bulgaria (Fig. 3)

Floristic regions: All except N Black Sea Coast, Sofia region and Mesta Valley.

***Polystichum aculeatum* (L.) Roth**

Spores (Plate 4) - Herbarium reference: SOM 155194

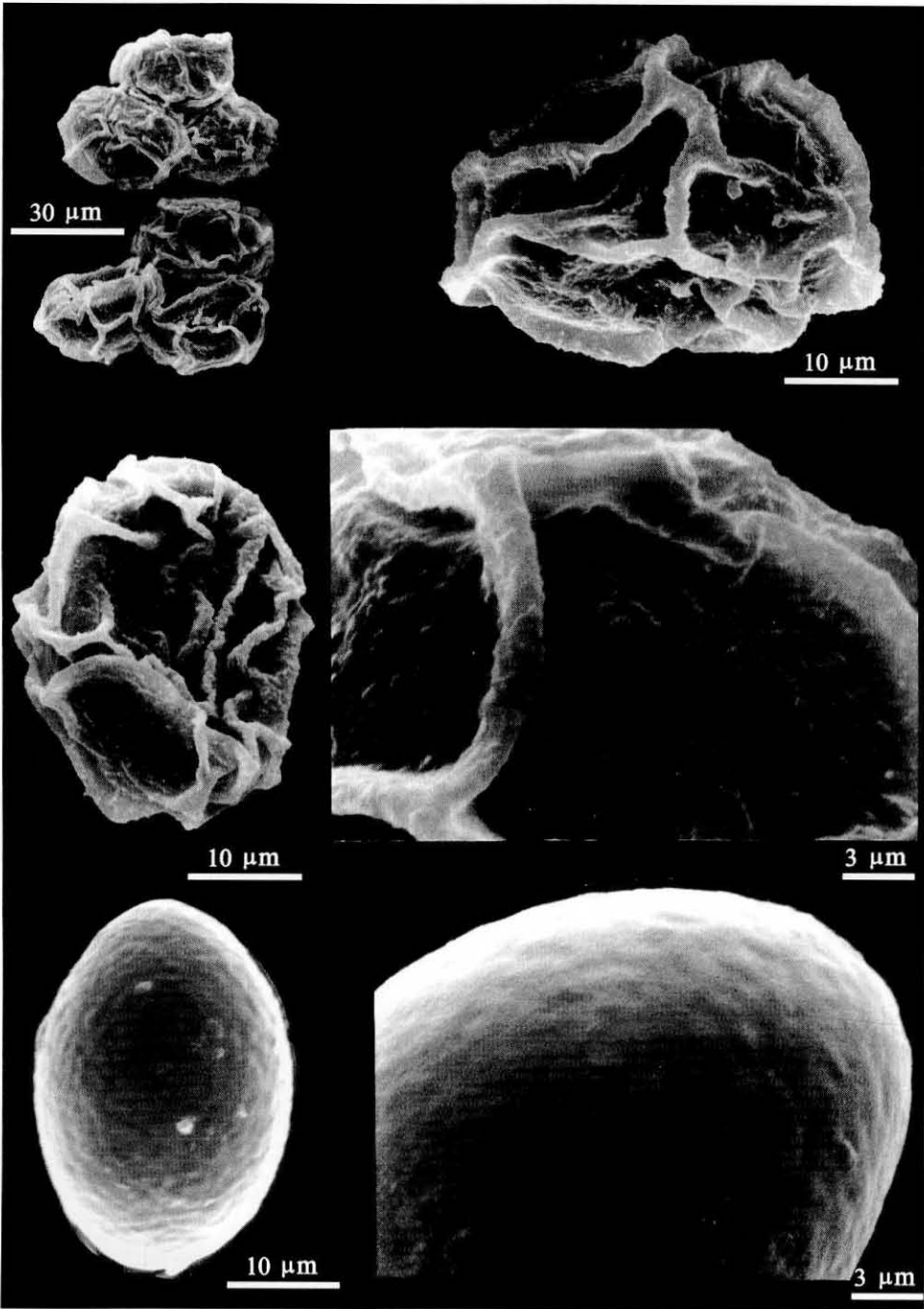


Plate 2. Spores of *Athyrium distentifolium* Opiz in different positions with and without perisporium.

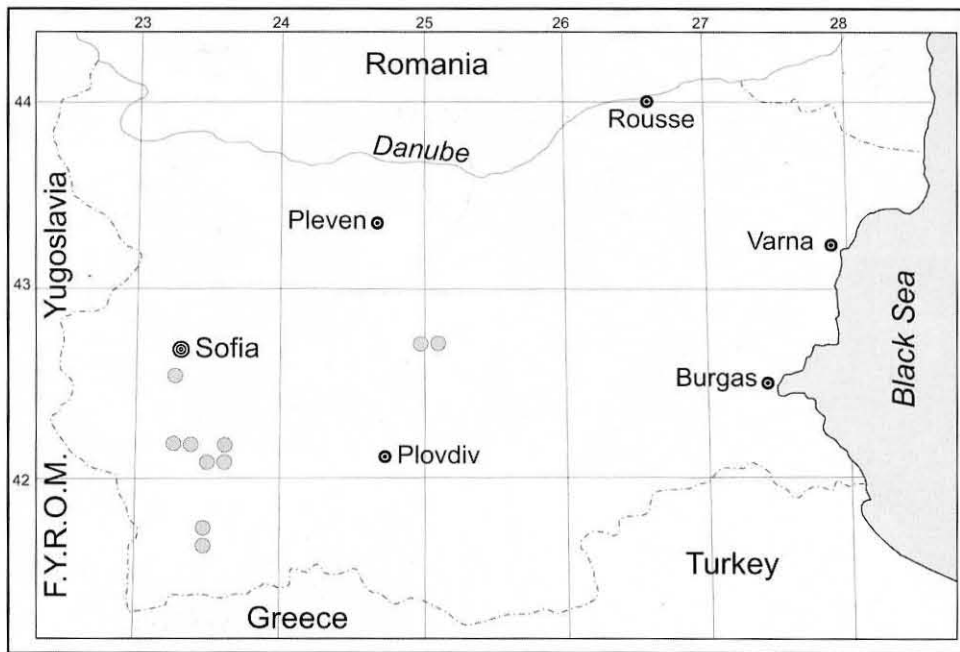


Fig. 2. Distribution of *Athyrium distentifolium* Opiz in Bulgaria.

Shape: Ellipsoidal.

Aperture: Monolete, ca. 3/4 to the spore length.

Description: Spores possess a complex perispore. The outer folds of perispore are fenestrate, and microechinate, with microechinae on the surface of perispore. The spore contour is \pm cristate. Perispore sometimes eroded by acetolysis, and the spore surface without perispore is laevigate (psilate).

Size: (42,5) - 48,2 - (57,5) μm x (30,0) - 35,7 - (42,5) μm . Sporoderm thickness: 1,3-2,5 μm . Perispore thickness: 5,0-7,0 μm .

Habitat

In damp shady places in forests - on humid soil, along streamsides, in gulches, by forest trails; in the subalpine zone - in open stony and rocky places, amongst stones and boulders, sometimes in shaded rock fissures. No substrate preference.

Geographical distribution in Bulgaria (Fig. 4)

Floristic regions: S Black Sea Coast, Northeast Bulgaria, the Balkan Range, Znepole region, Vitosha region, West Frontier Mts, Mt Belasitsa, Mt Slavyanka, Pirin Mts, Rila Mts, W and C Rhodope Mts, Mt Strandzha.

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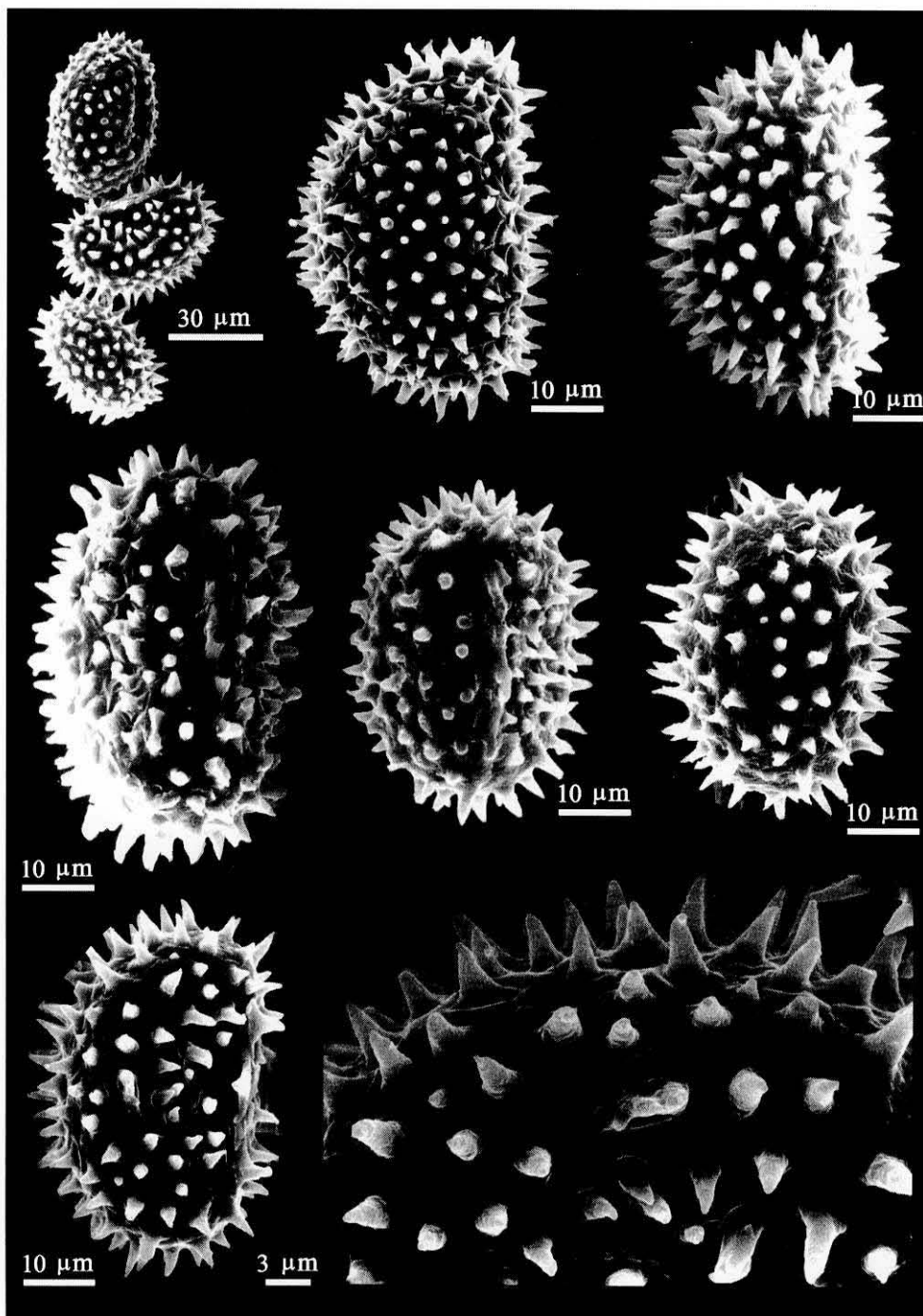


Plate 3. Spores of *Cystopteris fragilis* (L.) Bernh. in different positions.

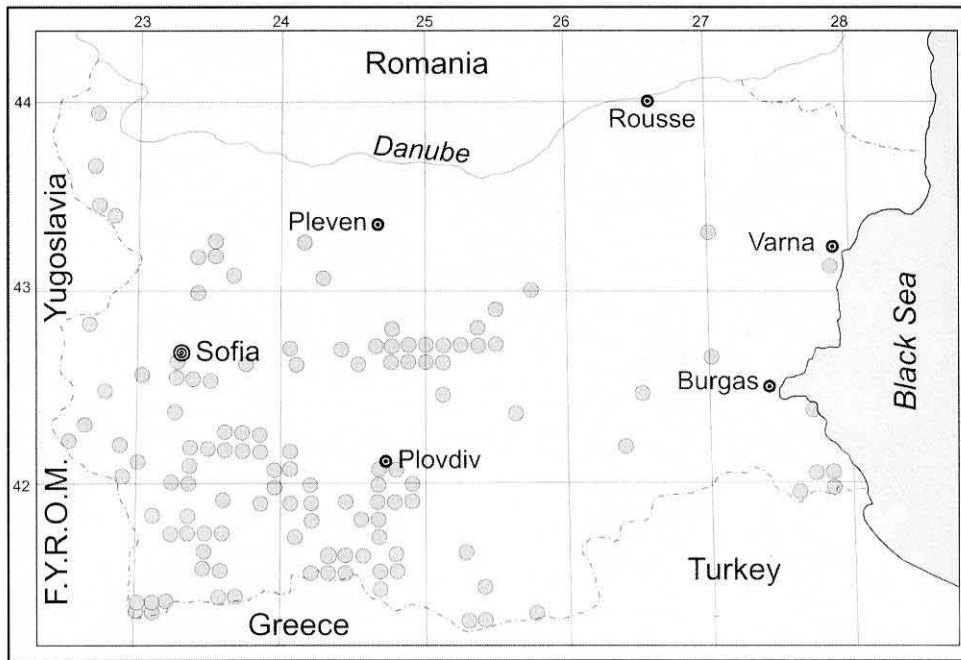


Fig. 3. Distribution of *Cystopteris fragilis* (L.) Bernh. in Bulgaria.

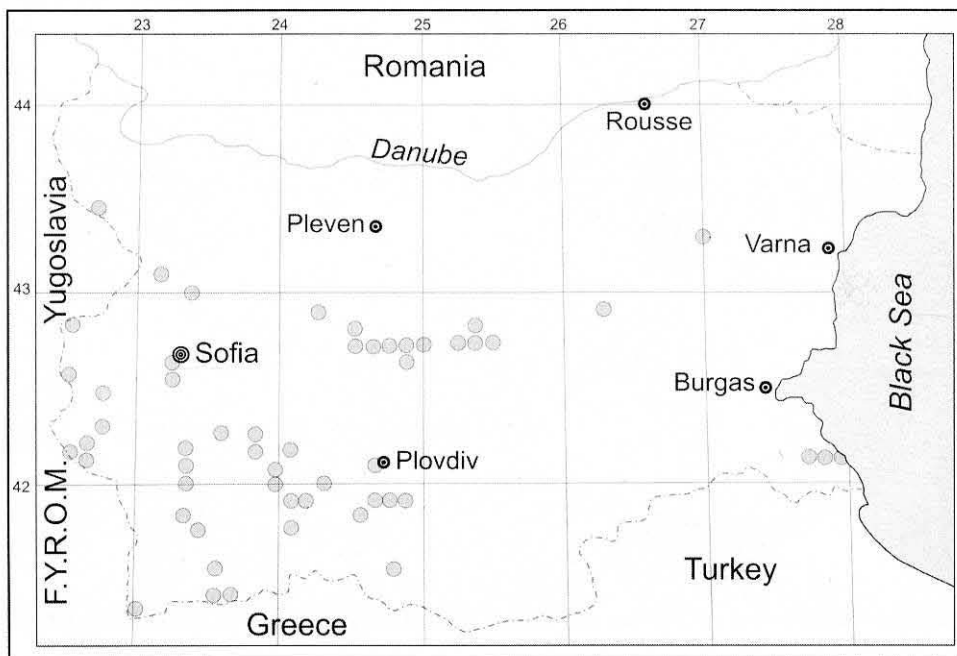


Fig. 4. Distribution of *Polystichum aculeatum* (L.) Roth in Bulgaria.

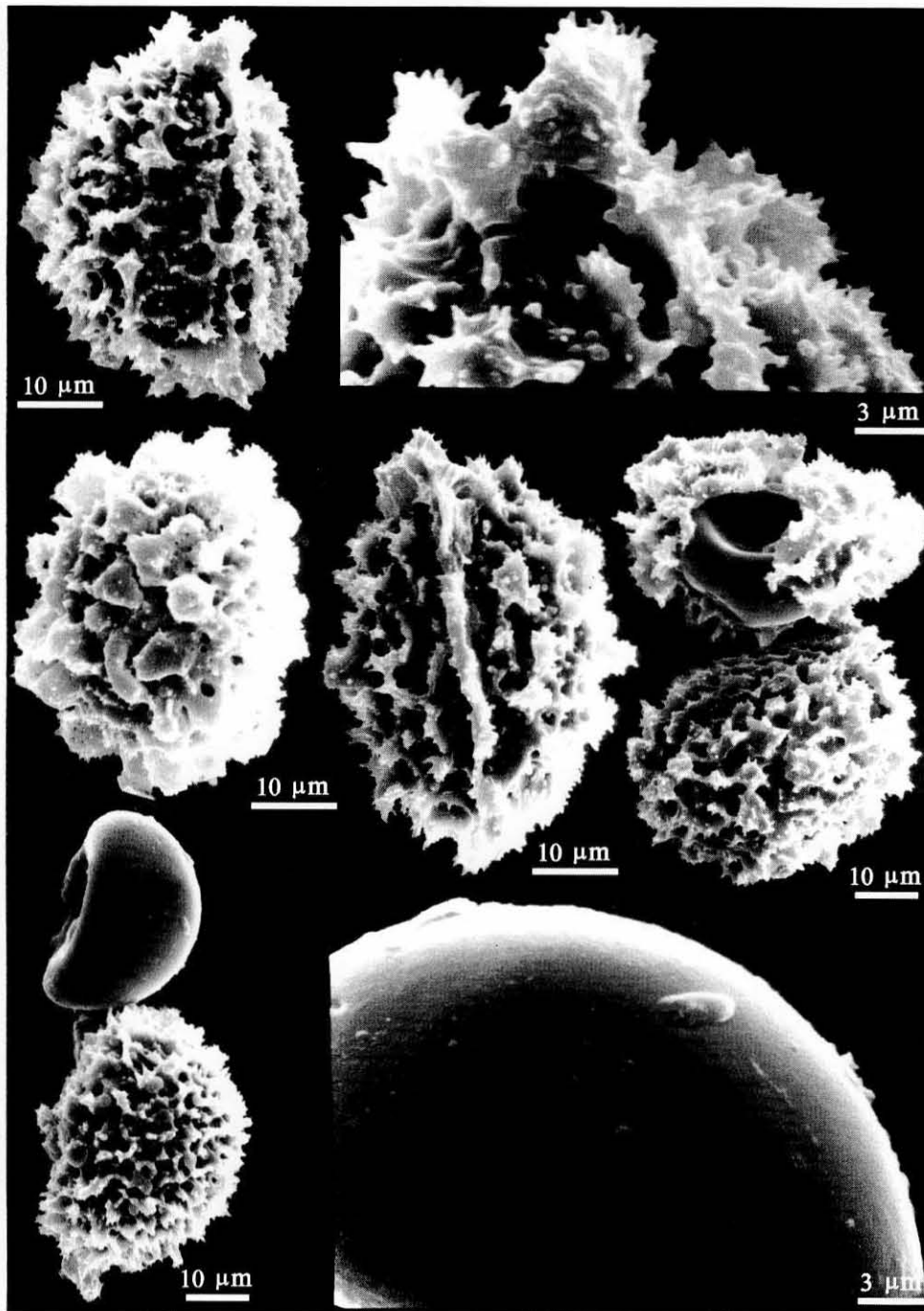


Plate 4. Spores of *Polystichum aculeatum* (L.) Roth in different positions with and without perisporium.

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