

THE PRESENCE A THREATENED FERN, *ASPLENIUM ADULTERINUM* MILDE, IN MEHEDIŢI PLATEAU (ROMANIA)

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ABSTRACT

This paper reports identification of serpentine fern, Asplenium adulterinum, in the South-Eastern Carpathians, Mehedinţi Plateau, on serpentine substrate, in a vegetative context specific to these rocks: Cheilanthes marantae-Asplenium cuneifolium Pinto da Silva 1965 ap. de Foucault 1986 association. In 2016 it was identified the Asplenium adulterinum fern on „Dealul cu zgură”, to Obârşia Cloşani village. The perimeter under consideration is an enclave (rocks and serpentine screes) in a Quercus dalechampii and Fagus sylvatica forest. About a Threatened Fern, Asplenium adulterinum Milde, has recently published a study that analyzes all previous literature and herbarium material and indicates three new site for the species in Romania. Nevertheless, the three site are on limestone rocks, so the presence of the species in these site is doubtful.

INTRODUCTION

Milde (1865) made the first description of the species *Asplenium adulterinum*. According to the literature (Lovis and Reichstein, 1968 a, b; Brownsey, 1976) the ladder spleenwort (*A. adulterinum*) [allotetraploid species (2n=144)] is considered a natural hybrid between *A. trichomanes* L. subsp. *trichomanes* and *A. trichomanes-ramosum* (*A. viride* Huds.) [diploid species (2n=72)]. According to Schmid et al. (1937), Holderegger (1994), *A. viride*, one of the parents, has considered a glacial relict, the classic place being Küsnachter Tobel, at an altitude of 480 m above sea level.

In Europe *A. adulterinum* Milde includes two taxa: *A. adulterinum* Milde subsp. *adulterinum* and *A. adulterinum* subsp. *presolanense* Mokry & al., the last taxon present only in Switzerland and Italy (Christenhusz & Raab-Straube, 2013).

A. adulterinum has reported from Scandinavia, Italy, Switzerland, western and eastern Germany, Austria, Czechoslovakia, Yugoslavia, Poland, Rumania, and Greece (Jalas and Suominen, 1972, map 82). It has considered a European endemic species (Jalas & Suominen, 1972; Reichstein,

1981) before it has found on Vancouver Island, Island at the west coast of Canada (Käsermann, 1999; Klinkenberg, 2020). *A. adulterinum* was included in the list of species as an extension to Annex II of the Habitat Directive (Directive 92/43/EEC) so that its protection requires the designation of a Special Area of conservation. It has also listed in Annex IV of The Convention of European Wildlife and Natural Habitats (Bern Convention) concerning plant species demanding strict protection in all European Union countries. *A. adulterinum* is a threatened species and have an IUCN category from EN in Poland (Zolnierz, 2001; Fabiszewski and Kwiatkowski 2002) to CR in Poland (Świerkosz & Szczesniak, 2003), the Czech Republic and Slovakia (Čeřovský and Klauisová, 1999), Great Britain, and many other countries (Marszał-Jagaska & Kromer, 2011).

In the Romanian botanical literature (Boşcaiu et al., 1994; Oltean et al., 1994; Oprea, 2005), *A. adulterinum* is considered a rare species or placed in the “Insufficiently Known” (K) zoological category (Dihoru & Dihoru, 1994). The species was included in the Red Book of

Vascular Plants of Romania (Dihoru and Negrean, 2009).

In 2015, Bartók and Irimia, following some investigations were based on recent field studies and analysis of herbarium material stored at CL, BUCA, BUCF, BVS, SIB, I, IAGB, IASI, B, W, WU, P, CRAI (acronyms according to Thiers, 2015), as well as literature data, concluded that only three population of *A. adulterinum* are certainly known in the Romanian Carpathians, in restricted area of Hășmaș - Șugăului Gorges, in Mehedinți Mountains - Țesna Valley and Cernei Mountains - Vânturătoarea Waterfall (Bartók and Irimia, 2015). All three locations are substrates limestone.

The ladder spleenwort (*A. adulterinum*) has called serpentine fern, because its occurrence has almost strictly related to serpentine rocks (Hayek, 1916). Serpentine are a group of siliceous rocks characterized by a deficiency of calcium, a high concentration of aluminum, iron, magnesium, nickel, cobalt and chromium and few nutrients for plants. The pH value of the serpentine substrate varies from base to ultrabasic (pH 5.5-8). As it was shown by Stevanović et al. (2003), the specific chemical composition of the serpentine substrate determines the xerothermic character of the plants on the serpentine. All of this results in a great number of specific adaptations (nanism, purpur escence, glaucescence, stenophyllism, plagiotropism, etc.) as well as the occurrence of numerous relic and endemic species (Stevanović et al., 2003; Kabaš et al., 2013). Due to the high content of magnesium and heavy metals it contains, serpentines exerts a toxic influence on many plant species.

The article signals the presence of *A. adulterinum* in the Mehedinți Plateau, on serpentine substrate, in a vegetative context specific to these rocks: *Cheilanthe marantae-Asplenium cuneifolii* Pinto da Silva 1965 ap. de Foucault 1986 association.

MATERIAL AND METHOD

The studied area

In the eastern part of the Mehedinți Mountains, can be distinguished the Mehedinți Plateau area, represented by the Motru and Topolniței hilly peaks, with heights varying from 700 to 400 m, marking the transition to the plains.

Mehedinți Plateau is represented by two units of relief (hills and plateau) placed between Mehedinți Mountain ridge to the west and the Getic Piedmont to the east. However, the relief is much closer to the mountains not only the structure and rocks but through the evolution of the relief. The hilly unit is in the vicinity Mountains Mehedinți (the hills between Moisești until Mălărișca and the hills of Isverna), while the plateau occupies the Cosuștea hills.

Between the plateaus unit (east) and the depression area (center) can be define another morphological unit, namely the limestone cornets, which marks the Jurassic limestone's alignment of the Danubian Autochthonous, developed in the NE-SV direction. The most impressive and most popular cornets are Cerboanii (810 m), Babelor (770 m), Bălții (701 m), Piatra Încălecată, Obârșia Cloșani. When crossing the bar of limestone, the rivers forming keys behind them runs depression areas; the most important are the Bahna-Baia de Aramă depression corridor: Bahna, Cireșu, Balta, Isverna, Nadanova and Obârșia Cloșani depressions.

In the Mehedinți Mountains, within the crystalline patch type Sebeș drifted over the Danubian Autochthonous, it is mentioned the presence of serpentines in the Bahna crystalline patch at Prejna, Dâlbocița, Podeni (Ciolanul Mare, Câmpul lui Ciopec), Costești, Sulița Peack, Plătica Peack, Vodița Valley, Vârciorova Valley, Chița Mountain, Baia de Aramă, Rudina, Ungureanului Hill, Firizu Hill (Rădulescu & Dimitrescu, 1966), and serpentines from Camena Valley, La Margină Hill, Grădeșnița Valley, which would be a continuation of the Massif Ciolanu Mountain serpentines

(Focșa & Hurduzeu, 1967). In addition, to these areas are added to serpentines patches of the Porțile de Fier, two from Jidoștița Valley and each of Ogașul lui Sânpetru (Focșa & Hurduzeu, 1967; Ghiurcă, 2002).

In the area of Pânza de Severin, overlaid over the Danubian Autochthonus, there is a series of serpentine patches formed by the metamorphosis of the ophiolite rocks. Of these, 18 serpentine patches from have been investigated so far in the entire Geopark Plateau Mehedinți. Our research had as purpose the compared study of the serpentine flora from the Geopark Plateau Mehedinți (Ciortan & Negrean, 2012).

The Geopark Platoul Mehedinți is the protected area of Mehedinți County, according to the County Council (HG. no. 2151/30.11.2004). It is located in the south-west of Romania, to the north of Drobeta-Turnu Severin, and has a surface area of 106,000 ha. According to the IUCN classification, Geopark Plateau Mehedinți is a protected area from Category V, managed mainly for landscape conservation and recreation land. The altitudinal interval: about 1312 m (Pietrele Albe Peak) and about 100 m in SE (Topolnița Meadow).

Material

In April 2016, on a field trip, it was identified the *A. adulterinum* fern on „Dealul cu zgură”. The analyzed site is located in the south of the DN67D, on the right side of the Brebina brook, at about 30-35 m from the entrance to Obârșia Cloșani village, in Obârșia Cloșani depressions (fig. 1).

Methods

Subsequent to the date of species identification, we have done field trips in June, July, October and April, over five years-period (2011-2016), but the ladder spleenwort not found. On the field trips, the floristic composition of the phytocenosis installed in the analyzed perimeter and neighborhoods have identified.

The analyzed area is about 1000 m², but the species is spread over an area of about 200 m² around the central point (45°01'11.03"N, 22°41'42.63"E) (fig. 1).



Figure 1: Map of location of *A. adulterinum* in Mehedinți Plateau
(source: <https://www.arcgis.com/home/webmap/viewer.html?useExisting=1>)

Determination and identification of the taxa had been did on fresh material using the binocular magnifier and the following „floras”: Grințescu (1952), Ciocârlan (2009) and Sârbu et al. (2013). Species names follow The Euro+Med PlantBase (ww2.bgbm.org). The synonyms of the species after Christenhusz and Raab-Straube (2013).

National and international specialized literature was consulted. Phytosociological characteristics of sites with *A. adulterinum* were presented in accordance to the Mucina (1993) and Świerkosz (2004). Photographs did on site during each field trip. Thus, at a careful analysis of the photos of 2011, we found that the species was present at one point of the analyzed area.

The collected material was registered and stored in the Herbarium of Botanical Garden „Alexandru Buia” from Craiova [CRAI]. Herbarium acronyms follow Thiers, 2015.

RESULTS AND DISCUSSIONS

Results

In the analyzed area, the substrate is represented by basic rocks and ultramafic, sedimentary deposits (serpentine, serpentinized peridotite, meta-serpentine) of the Jurassic - Neocomian which are part of the Severin Unit (Pânza de Severin), Obârșia Complex - ophiolite formation. The perimeter under consideration is an enclave (rocks and serpentine screes) in a *Quercus dalechampii* and *Fagus sylvatica* forest. The area is quite anthropized, being located at the entrance to the locality.

Until 2016, *A. adulterinum* was not been identified in any site from Geopark Plateau Mehedinți. In 21.04.2016, on a field trip, it was identified the *A. adulterinum* fern on „Dealul cu zgură”, together with *Paragymnopteris marantae* (L.) K. H. Shing, *Asplenium ruta-muraria* L., *A. trichomanes* subsp. *trichomanes* and *A. adiantum-nigrum* subsp. *serpentini* (Tausch) Heufl.

After 21.04.2016, analyzing the photographic material from previous years, I discovered with surprise that in a photo of 2011 the ladder spleenwort was present on this site.

Table 1 shows the species identified in the perimeter analyzed.

Along with specialized ferns, serpentines mainly host species from adjacent forests or prairies. Add to the list of species presented four species of moss publishes by Ștefureac in 1948 from the perimeter analyzed:

Tortella tortuosa (L.) Limpr. – Serpentine rock on the right bank of the river Brebina (km. 13-14) village Cloșani, border with the village Mărășești, expoziție N, 7 VII 1945, leg. E. Țopa, det. T. Ștefureac [BUC] (Ștefureac 1948: 139).

Weissia microstoma (Hedw.) C. Müll. – Serpentine rock on the right bank of the river Brebina (km. 13-14) village Cloșani, border with the village Mărășești, expoziție N, 7 VII 1945, leg. E. Țopa, det.

T. Ștefureac [BUC] (Ștefureac 1948: 139).

Cinclidotus riparius (Host.) Arnott. – Waterfall on the Brebina River, thalweg of serpentine, village Cloșani, water with high flow and fast course, VI 1945, leg. E. Țopa, det. T. Ștefureac [BUC] (Ștefureac 1948: 139).

Saelania caesia (Vill.) Lindb. – Serpentine rock on the right bank of the river Brebina (km. 13-14) village Cloșani, border with the village Mărășești, expoziție N, 7 VII 1945, leg. E. Țopa, det. T. Ștefureac [BUC] (Ștefureac 1948: 139).

The chasmophytic vegetation from „Dealul cu zgură” (specific to serpentines) falls into *Cheilanthe marantae-Asplenium cuneifolii* Pinto da Silva 1965 ap. de Foucault 1986. The plant groups described as the *Cheilanthe marantae-Asplenium cuneifolii* Pinto da Silva 1965 ap. de Foucault 1986 are part of the *Asplenium serpentini* Br.-Bl. et R. Tx. 1943 ex Egger 1955 alliance [*Asplenium serpentini* Br.-Bl. & Tüxen 1943 nom. nud. (art. 2b, 8), *Asplenium cuneifolii* Br.-Bl. & Tüxen ex Egger 1955 nom. mut. illeg.] (Biondi et al., 2012; Blasi, 2010; Chytrý, 2007; Guido and Montanari, 1983; Theurillat et al., 1994).

According to the EUR 28, and Gafta & Mountford (2008) the habitat of the species is 8220: Siliceous rocky slopes with chasmophytic vegetation: 62. 21 - Saxicolous communities of the plain to hill levels under Middle European climate (*Asplenium septentrionalis*): *Asplenium septentrionale*, *A. adiantum-nigrum*, *A. onopteris*; Hercynian serpentine cliffs (*Asplenium cuneifolii*): *Asplenium adiantum nigrum* subsp. *serpentini*, *A. adulterinum*).

The *Cheilanthe marantae-Asplenium cuneifolii* Pinto da Silva 1965 ap. de Foucault 1986 association was not been shown from the Romania so far. In the Geopark Plateau Mehedinți, this type of vegetation also encountered at Rudina, but here was not identified *A. adulterinum* species.

Discussions

All plant groups specific for serpentines recorded in Central Europe were attributed to the association *Asplenium serpentini* Gauckler 1954 (sin. *Asplenietum cuneifolii* Gauck. 1954, *Asplenietum serpentini* Knapp. 1942) (Hilbig & Reichhoff, 1977; Oberdorfer, 1977a; Müller-Stoll & Toman, 1984; Berdowski & Panek, 1999; Świerkosz, 2004). Serpentine groups where *Paragymnopteris marantae* species appears, in terms of Phytocoenology, are assigned to *Cheilanthes marantae-Asplenietum cuneifolii* Pinto da Silva 1965 ap. de Foucault 1986 / *Asplenion serpentini* Braun-Blanq. & Tüxen ex Egger 1955.

The *Asplenion serpentini* alliance is present on the serpentinic substrates of northern Italy and Europe. The communities belonging to this alliance has been characterized by the presence of some ferns limited to these habitats, such as *A. adulterinum* and *A. adiantum-nigrum* subsp. *serpentini*.

Coming back to Bartók and Irimia (2015) study, in area of Hășmaș - Șugăului Gorges, although the authors make the following remark: "Herbarium material was not collected... *Asplenium adulterinum* is growing here in a non-typical habitat on limestone rocks (the studied area does not include serpentine rocks) (Corvin Papiu, 1963)". They accept the presence of species in the area only based on a photo taken by Associate Professor Dr. Ioana Popescu. In Mehedinți Mountains - Țesna Valley, Bartók and Irimia (2015) argues the presence of the species also on the basis of a photograph (photo by Adrian Schlesinge), "because a single specimen was found, herbarium material was not collected". Moreover, in this site the species growing there in a non-typical habitat: on limestone rocks, in crevices of rocks (Bartók and Irimia, 2015). In Cernei Mountains, *A. adulterinum* was growing there in a non-typical habitat: on limestone rocks, in crevices of rocks. The collected material was stored in the

personal herbarium of A. Bartók (Bartók and Irimia, 2015). Therefore, of the three new sites, confirmed by herbarium material (collected by A. Bartók) it is just the Cerna Mountains site, in *Asplenio-Silenetum petraeae* Boșcaiu 1971 associations. This one develops on the steep walls of the limestone rocks in the Cerna Mountains. It is endemic in the Southern Carpathians and is homologous to those in Croatia - *Asplenio-Silenetum haekiana* Horvat 1931 (endemic vegetation of rock fissures and crevices of carbonate rocks) (Sanda et al, 2008: 182).

Analyzing the data presented by Bartók and Irimia (2015) we retain that all three locations are substrates limestone, or know that ladder spleenwort (*A. adulterinum*) has called serpentine fern, because its occurrence has almost strictly related to serpentine rocks (Hayek, 1916).

Due to this, and the small number of identified specimens, I believe that the presence of *A. adulterinum* remains doubtful in all three locations indicated by Bartók and Irimia (2015).

CONCLUSIONS

Based on field studies, were discovered one new site of *A. adulterinum* in Romania.

The substrate and floral composition of the vegetation corresponds to the specialty literature relating to *A. adulterinum* (serpentine fern).

In addition, *Cheilanthes marantae-Asplenietum cuneifolii* Pinto da Silva 1965 ap. de Foucault 1986 association was not been shown from the Romania so far.

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Table 1

The list of species from the perimeter analyzed

Date	23.06.2011	18.07.2011	25.10.2012	21.04.2016
Altitude (m.s.m.)	400-500	400-500	400-500	400-500
Slope (degrees) (°)	cca 75	cca 75	cca 75	cca 75
Exposition	N	N	N	N
Surface (m ²)	200	200	200	200
Substrat	serpentine	serpentine	serpentine	serpentine
Site	Dealul cu zgură	Dealul cu zgură	Dealul cu zgură	Dealul cu zgură
Androsacetalia vandellii				
Asplenion serpentinii				
Asplenietum serpentinii – Cheilanthes marantae – Asplenietum cuneifolii				
Paragymnopteris marantae	+	+	+	+
Asplenium adiantum-nigrum subsp. serpentini	+	+	+	+
Asplenium adulterinum	+	-	-	+
Asplenium	+	+	+	+

trichomanes subsp. trichomanes				
Asplenium ruta- muraria	+	+	+	+
Cohabiting species				
Cardaminopsis arenosa ssp. arenosa	-	-	-	+
Moehringia pendula	-	+	-	+
Poa pumila	+	+	-	+
Pilosella pavichii	+	+	-	+
Dorycnium pentaphyllum subsp. germanicum	+	+	-	+
Thymus serpyllum	+	+	+	+
Euphrasia stricta	-	+	+	-
Festuca valesiaca	+	+	+	+
Galium verum	-	+	-	-
Brachypodium pinnatum	+	+	+	+
Cruciata glabra	-	-	-	+
Viola reichenbachiana	+	-	-	+
Fragaria vesca	+	+	-	-
Carlina biebersteinii subsp. brevibracteata	-	+	-	-
Potentilla thuringiaca	+	+	-	+
Potentilla erecta	-	-	-	+
Luzula campestris	+	+	+	-
Melica picta	-	-	-	+
Lactuca muralis	-	+	-	-
Rumex acetosella	-	-	-	+
Achnatherum calamagrostis	+	+	+	+
Silene armeria	+	-	-	-
Achillea millefolium	+	-	-	+
Chondrilla juncea	+	-	-	-