

Present or Absent? About a Threatened Fern, *Asplenium adulterinum* Milde, in South-Eastern Carpathians (Romania)

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Abstract

Asplenium adulterinum Milde is one of the rarest and most threatened representatives of the *Aspleniaceae* family in the Carpathians. Botanical literature mentioned the ladder spleenwort in many localities in South-Eastern Carpathians in the past, but during the last decades the species has not been collected and deposited in public herbaria by any botanist. All existing herbarium material in Romanian herbaria (including *Asplenium trichomanes* and *A. trichomanes-ramosum*) was revised and all available information from botanical literature was critically compiled in order to clarify the distribution of *Asplenium adulterinum* in the South-Eastern Carpathians. After almost 80 years since the first mention of the species in the Carpathians, this paper reports the recent identification of *Asplenium adulterinum* in three new locations in South-Eastern Carpathians (Țesna Valley, Vânturătoarea Waterfall and Șugăului Gorges).

Keywords: *Aspleniaceae*, chorology, endangered species, flora, Red Book, threatened species

Introduction

Asplenium L. is a relatively large genus of *Aspleniaceae* family with about 700 species. They are also one of the most widespread fern groups and occur in temperate and tropical regions of all continents, except Antarctica (Schneider *et al.*, 2004). Thirty-one species of this genus are present in European flora (Crabbe *et al.*, 1993), ten of these species occurring in Romanian flora (*Asplenium scolopendrium* L., *A. septentrionale* (L.) Hoffm., *A. trichomanes* L., *A. trichomanes-ramosum* L., *A. adulterinum* Milde, *A. ruta-muraria* L., *A. lepidum* C. Presl, *A. cuneifolium* Viv., *A. adiantum-nigrum* L., *A. onopteris* L.) (Sârbu *et al.*, 2013).

Some fern species of *Asplenium* genus (*Asplenium adulterinum*, *A. adiantum-nigrum* and *A. cuneifolium*) are often called serpentine ferns, because their occurrence is almost strictly related to serpentine rocks (Hayek, 1916). Serpentinites is a rock composed of one or more serpentine group minerals. Serpentinization is a geological low-temperature metamorphic process involving heat and water, in which low-silica mafic and ultramafic rocks are oxidized and hydrolysed with water into serpentinite. Serpentinite is formed from olivine via several reactions, some of which are complementary (Sleep *et al.*, 2004).

Serpentinites have a limited number of characteristic plants, which are confined exclusively to magnesium silicates or carbonates (serpentine, magnesite) and these species may be considered strictly serpentine species. In Europe, serpentinites occur in the Alps, Carpathians, Balkan Peninsula, Southeast Portugal and Great Britain (Roberts and Proctor, 1992). In Romania they grow in South-Eastern Carpathians (Southern Carpathians and Apuseni Mountains, less in the Eastern

Carpathians) (Corvin Papiu, 1963). Serpentine ferns are extremely rare and have been declining at an alarming rate.

The present study focuses on *Asplenium adulterinum* Milde, one of the rarest and most threatened plant species in the Romanian flora. *Asplenium 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 was also listed together with *Asplenium cuneifolium* 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.

Asplenium adulterinum was considered to be an European endemic species (Holderegger, 1994) before it was found on Vancouver Island, Canada (Klinkenberg, 2008). Also, the species is considered a glacial relict (Holderegger, 1994). The first description of the species was made by Milde (1865). *Asplenium adulterinum* is considered a natural hybrid between *A. trichomanes* and *A. trichomanes-ramosum* (Lovis and Reichstein, 1968; Reichstein, 1984). *Asplenium adulterinum* is a vascular cryptogam whose roots are not proliferous. Stems are short-creeping, mainly unbranched; scales are black or with narrow pale borders, narrowly lanceolate (with dimensions 1.5-3 × 0.2-0.4 mm), with entire margins. Leaves are monomorphic. Petiole is dark reddish brown (1-4 mm). Blade is linear, 1-pinnate (2.5-14 × 0.5-1.2 cm), thick (in open habitat) to herbaceous (in shaded, moist habitat), essentially glabrous; base is somewhat tapered; apex is obtuse, not rooting. Rachis is reddish brown in proximal 1/2-4/5 part and green in distal part, lustrous, glabrous. Pinnae are in 10-30 pairs, ovate to rhombic to ovate-oblong (with dimensions of 2.5-11 × 2-6 mm), very short petiolated;

base is truncated to shortly acute; margins are shallowly crenate (shade forms) to essentially entire (exposed forms); apex is obtuse, broadly rounded. Sori are linear with 1-3 pairs per pinna. Spores are 64 per sporangium (Wagner Jr. *et al.*, 1993).

The species occurs on ledges and crevices of ultrabasic rocks (serpentine, magnesite) or rarely on basic rocks. *Asplenium adulterinum* Milde subsp. *presolanense* Mokry, Rasbach & Reichst. occurs in North of Italy and South of Switzerland on limestone or mica-schist (Crabbe *et al.*, 1993).

In the Romanian botanical literature *Asplenium adulterinum* is considered a rare species (Boşcaiu *et al.*, 1994; Oltean *et al.*, 1994; Oprea, 2005) or placed in the “Insufficiently Known” (K) zoological category (Dihoru and Dihoru, 1994). The species was included in the Red Book of Vascular Plants of Romania (Dihoru and Negrean, 2009). Inclusion in a zoological category of species in Romania was difficult, considering that the fern has not been seen by botanists in recent decades. Since 1931 no botanist has collected *Asplenium adulterinum* from the Romanian Carpathians and deposited in a public herbarium (in reality there is a single herbarium voucher in BUCA Herbarium (BUCA no. 004147), whereas the plant was collected by Grințescu on 3 July 1931, near Băile Herculane, but the data have never been published).

According to the Red Book of Vascular Plants of Romania (Dihoru and Negrean, 2009) it seems that there is also a specimen deposited in the CL herbarium: “Custura Mătaniei, 12 VII 1964, N. Boşcaiu [CL]”. The authors hereby checked this information in CL herbarium (on 15 and 16 January 2015) and did not find any specimens of *Asplenium adulterinum*.

Materials and Methods

The 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. All existing herbarium material (including *Asplenium trichomanes* and *A. trichomanes-ramosum*) was revised and all available information from botanical literature was critically compiled in order to clarify the distribution of *Asplenium adulterinum* in the South-Eastern Carpathians.

Several field surveys were made between 2004 and 2014 in Almăjului Mts., Aninei Mts., Mehedinți Mts., Țarcu Mts., Ceahlău Mts., Hășmaș Mts., Călimani Mts., Rarău Mts. (South-Eastern Carpathians) where the species was reported.

Phytosociological characteristics of possible sites with *Asplenium adulterinum* were studied according to the Braun-Blanquet approach (Braun-Blanquet, 1932).

The collected material has been lodged in the personal herbarium of A. Bartók.

Results and Discussion

Distribution of Asplenium adulterinum Milde in South-Eastern Carpathians

Rarău Mountains, Eastern Carpathians

Pietrele Doamnei (Lady's Stones) and their surroundings represent maybe the most intensively investigated region by the botanists, considering the whole range of Rarău Mountains.

In this mountain range the presence of *Asplenium adulterinum* was reported by some authors (Mititelu *et al.*, 1989;

Oprea and Sârbu, 2012, 2013; Bădăraș, 2013), but without exact localisation and never confirmed by herbarium material. The main botanists (Morariu, 1965; Raclaru, 1973, 1976) who investigated in detail the mountain and subalpine flora of Rarău Mountains did not mention *Asplenium adulterinum*; they both refer only to *Asplenium trichomanes-ramosum* and *Asplenium trichomanes*.

During the current research surveys, the species was not found near Pietrele Doamnei or in other parts of this mountain group (Bartók A, pers. obs. 2007, 2010, 2011, 2014). It can be said that certainly it was confused here with *Asplenium trichomanes-ramosum* or *Asplenium trichomanes*, since these two species are frequently encountered in the region.

Călimani Mountains, Eastern Carpathians

Neither Csűrös (1951) nor Höhn (1998a) mentioned *Asplenium adulterinum* in the area of Călimani Mountains. However, Mititelu *et al.* (1986) and Chifu *et al.* (2008) reported ladder spleenwort in the flora of this mountain range, but without exact localisation or citation. Although Höhn (1998a) did not mention *Asplenium adulterinum* in the flora of Călimani Mountains, the same author highlights in another publication (Höhn, 1998b) (according to personal observations) that species with affinity for basic soils (e.g. *Asplenium adulterinum* Milde, *Carex sempervirens* L., *Phyteuma orbiculare* L., *Saxifraga adscendens* L.) do not occur on the south part of Călimani Mountains, but on the north face.

Yet, the most recent checklist of Călimani National Park (ICB Iași, 1994) does not mention *Asplenium adulterinum* in Călimani Mountains. Since it is known that the list of Mititelu *et al.* (1986) is partly based on older literature without citations, *Asplenium adulterinum* could not be observed in the field (Bartók A, pers. obs. 2007, 2010, 2011) and therefore it can be concluded that it was confused with *Asplenium trichomanes-ramosum* or *Asplenium trichomanes*, since these two species are frequently encountered in this region. There are no herbarium specimens of *Asplenium adulterinum* from the floristically well explored Călimani Mountains, in all herbaria checked.

Bistriței Mountains, Eastern Carpathians

Asoltani (2007) listed *Asplenium adulterinum* in this mountain range from Șaru Bucovinei and Șeștișă, but it was not confirmed by herbarium voucher. Seghedin in his thesis and in floristically synthesis of Suceava County (Seghedin, 1985, 1987) did not mention *Asplenium adulterinum*, but *Asplenium trichomanes-ramosum* and *Asplenium trichomanes* instead, in this mountain group. Also Mardari (2008) in a floristical synthesis of Bistriței Mountains flora could not confirm the presence of ladder spleenwort in this area.

The flora of this mountain range is not well studied, and the presence of *Asplenium adulterinum* remains doubtful (there was no herbarium voucher in all checked herbaria).

Hășmaș Mountains, Eastern Carpathians

Asplenium adulterinum was first listed in this mountain group by Nechita and Mititelu (1996) and Nechita (2000) in two separate phytosociological papers, in composition of two plant associations: *Asplenietum trichomano-rutae murariae* Kuhn 1937, Tx. 1937 (in Bicăjel Gorges and Piatra Singuratică Mts., Hășmaș Mountains, Eastern Carpathians) and *Aspleno-*



Fig. 1. A: Habitus of *Asplenium adulterinum*, growing on limestone rocks, near Șugăului Gorges (original photo by Ioana Popescu); B, C: Habitus of *Asplenium adulterinum*, growing on limestone rocks, in Țesna Valley (original photo by Adrian Schlesinger)

Cystopteridetum fragilis Oberd. (1936) 1949 (in Hășmașul Mare, Hășmașul Negru and Hășmașul Mic Mts., Hășmaș Mountains, Eastern Carpathians). Interestingly, the same author in a floristical and phytosociological monograph of Hășmaș Mountains (Nechita, 2003) did not include the relevés where *Asplenium adulterinum* was present.

Asplenium adulterinum was listed by Nechita (2003) in Suhardul Mic Mountains, but unfortunately the citation was erroneously based on Soó publication (Soó, 1940); the cited paper was probably confused with another one (Nagy, 1942) in which *Asplenium* × *brennii* Retz. (*Asplenium trichomanes* × *Asplenium septentrionale*) was mentioned, not *Asplenium adulterinum*.

The flora of Hășmaș Mountains and Bicazului Gorges was well explored and other floristical or phytosociological publications (Gușuleac, 1932; Nyárády, 1937; Soó, 1940, 1943; Ștefan *et al.*, 2007) did not mention the occurrence of *Asplenium adulterinum* in this mountain range. Horeanu (1979) did not mention *Asplenium adulterinum* in the floristical paper regarding flora of Munticelu-Cheile Șugăului Nature Reserve, but *Asplenium trichomanes-ramosum* or *Asplenium trichomanes* instead.

However, Nechita and Bliderșanu (2006) listed ladder spleenwort in Bicazului Mts. but without exact locality or citation. The species was reticently mentioned to appear in Stânișoarei Mountains (Oprea and Sărbu, 2008, 2009). It might be supposed that the mentioned coronym (Bicazului Mts.) refers to the Northeastern part of Hășmaș Mountains, which is situated near Stânișoarei Mountains. Bădăraș (2013) mentioned *Asplenium adulterinum* in “Cheile Bicazului-Hășmaș” (ROSCI 0027) Natura 2000 network, but without exact locality or citation. Also, ladder spleenwort is listed in the Management Plan of Cheile Bicazului-Hășmaș National Park, but without exact locations or citation. There are no herbarium vouchers of *Asplenium adulterinum* in all checked herbaria.

Moreover, ladder spleenwort was recently reported on Munticelu-Cheile Șugăului Nature Reserve near Șugăului Gorges by Associate Professor Dr. Ioana Popescu (Fig. 1, photo A). Herbarium material was not collected, but in the pictures taken it is clear that the colour of rachis is green in distal part. *Asplenium adulterinum* is growing here in a non-typical habitat on limestone rocks (the studied area does not include serpentine rocks) (Corvin Papiu, 1963).

Ceahlău Mountains, Eastern Carpathians

Grecescu in his floristical monograph (Grecescu, 1906) did not mention *Asplenium adulterinum* in Ceahlău Mountains, but *Asplenium trichomanes-ramosum* or *Asplenium trichomanes* instead. Neither later studies in this mountain range (Panțu, 1911; Grințescu, 1923; Nyárády, 1924; Papp, 1931; Borhidi, 1958; Burduja, 1962; Horeanu and Borcea, 1982) did not mention ladder spleenwort from the floristically well explored Ceahlău Mountains. In more recent publications (Chifu *et al.*, 1987; Manoliu *et al.*, 2002), the authors mentioned *Asplenium adulterinum* in Neamț County (Ceahlău Mountains), but without exact locality or citation. Also Bădăraș (2013) mentioned *Asplenium adulterinum* in “Ceahlău” (ROSCI 0024) Natura 2000 network, but without exact data or citation.

Ladder spleenwort is listed in the Management Plan of Ceahlău National Park, but without exact data. There are no herbarium specimens of *Asplenium adulterinum* from the floristically well explored Ceahlău Mountains in all checked herbaria.

Evenmore, *Asplenium adulterinum* could not be found in this mountain group (Bartók A, pers. obs. 2004, 2005, 2006, 2007, 2009, 2011). Similar as in other mountain range in the Eastern Carpathians, *Asplenium adulterinum* was probably confused with the omnipresent *Asplenium trichomanes-ramosum* or *Asplenium trichomanes*, which are well documented (Grecescu, 1906; Papp, 1931; Manoliu *et al.*, 2002) as proved by numerous vouchers in I, IAGB or IASI.

Mehedinți Mountains, Southern Carpathians

This mountain range was not well explored floristically; only Domogled Peak with its surroundings and Țesna Valley were studied more rigorously from the botanical point of view. Borbás (1874) and Simkovics (1878) followed by Degen (1901) studied the flora of Domogled Massif, without any report about the occurrence of *Asplenium adulterinum* in this mountain group, but *Asplenium trichomanes-ramosum* and *Asplenium trichomanes* instead. Nor the more recent research of Resmeriță (1970, 1971, 1972) did not demonstrate the occurrence of ladder spleenwort in the floristically explored Țesna Valley. Neither Georgescu (1934) nor Buia (1959) or Bujorean and Popescu (1966) mentioned *Asplenium adulterinum* for the Mehedinți Mountains.

In the document compiled by Faculty of Biology and Geography - Babeș-Bolyai University Cluj-Napoca - “Research about flora and vegetation of the parcels with Banat black pine from the Domogled-Valea Cernei National Park” (2006) the occurrence of *Asplenium adulterinum* was mentioned in this mountain range, but without any specific locality or citation. Moreover, the authors of this publication recognized the absence of the species on field. Bădăraș (2013) mentioned *Asplenium adulterinum* in “Domogled-Valea Cernei” (ROSCI 0069) Natura 2000 network, but without exact locality or citation.

A previously unknown citation about a population of *Asplenium adulterinum* was noted in Mehedinți Mountains (Southern Carpathians) on 1 June 2013, referring to the middle part of the Țesna Valley, in semi shady rocky place, exposed to the north, at approximately 600 m a.s.l. *Asplenium adulterinum* was growing there in a non-typical habitat: on limestone rocks, in crevices of rocks, not far from the tourist path. Although the authors of the current study researched in detail a great part of the area, a single individual was found. Accordingly, it may be supposed there was a very small population in that place. Because a single specimen was found, herbarium material was not collected. This discovery was documented by photos (Fig. 1. B, C).

Additionally, it is worth mentioning that only one voucher specimen of *Asplenium adulterinum* from Romanian Carpathians was found in all herbaria consulted (BUCA no. 004147). The plant was collected by Grințescu on 3 July 1931 near Băile Herculane (in humid rock crevices), the only specimen previously known from the Romanian Carpathian, but the data have never been published.

Mehedinți Mountains are one of the few mountains in Romanian Carpathians wherein the presence of this rare fern was confirmed.

Cernei Mountains, Southern Carpathians

The area of Arjana Peak and Vânturătoarea Waterfall from Cernei Mountains, shelter a very interesting flora, with rare species e.g. *Minuartia graminifolia* (Ard.) Jáv. subsp. *hungarica* Jáv., considered endemic for Southern Carpathians (Conti, 2003). There are no previous collected herbarium specimens of *Asplenium adulterinum* or floristic data about this species in the Cernei Mountains.

During the current study field research, a population of *Asplenium adulterinum* was identified on 27 April 2014, near Vânturătoarea Waterfall, in adumbral rocky place, exposed to the north, at 550 m a.s.l. *Asplenium adulterinum* was growing there in a non-typical habitat: on limestone rocks, in crevices of rocks. The area is protected; it is included in Domogled-Valea Cernei National Park. The population was poor, counting only three specimens of plants. The population was probably more numerous, but it was not possible to examine the whole area in detail. The collected material was lodged in the personal herbarium of A. Bartók.

Țarcu Mountains, Southern Carpathians

This area was studied by Borbás (1874) and Simkovics (1878) who did not report the occurrence of the fern. The first mention of the presence of *Asplenium adulterinum* in Țarcu Mountains was signalled by Boșcaiu (1971) who investigated the flora and vegetation of this mountain range. Boșcaiu (1971) reported *Asplenium adulterinum* population in Țarcu Mountains, near Custura Mătaniei at an altitude of 1,750 m a.s.l., slope 80°, on a surface of 9 m², in a single phytosociological relevé (*Asplenietum trichomano-rutae murariae* Kuhn 1937, Tx. 1937). Bădăraș (2013) mentioned *Asplenium adulterinum* in "Munții Țarcu" (ROSCI 0126) Natura 2000 network, but without exact locality or citation. Based on this publication, *Asplenium adulterinum* was included in Management Plan of "Munții Țarcu" (ROSCI 0126) Natura 2000 protected area.

There are no herbarium specimens from the Țarcu Mountains in all checked herbaria. Moreover, the authors could not find *Asplenium adulterinum* in the area of Custura Mătaniei nor in other parts of this mountain range (Bartók A, pers. obs.

2013, 2014), but *Asplenium trichomanes-ramosum* instead.

Unfortunately, the occurrence of *Asplenium adulterinum* in Țarcu Mountains remains doubtful.

Almăjului Mountains, Western Romanian Carpathians, Banat Mountains

The flora of Almăjului Mountains was relatively well studied, but the presence of *Asplenium adulterinum* was not yet demonstrated by herbarium material.

Volume I of Romanian flora (Grințescu, 1952) mentioned the occurrence of ladder spleenwort in Danube Gorges on the serpentine massif between Poiana Mraconia and Baia Nouă, but without any specific location or citation. It is curious that Grințescu did not specify Cernei-valley coronim in Flora of Romania, although he collected herbarium material in 1931. There is no publication (before 1952) which listed the presence of this rare fern in that mountain range.

Matacă (2005) mentioned the occurrence of *Asplenium adulterinum* in Poștile de Fier Nature Park, but she only cites the Romanian flora (Grințescu, 1952). Other publications (Borbás, 1874; Simkovics, 1878; Hayek, 1916; Borza, 1931; Resmeriță et al., 1968; Csűrös et al., 1968; Pop et al., 1969; Dihoru et al., 1972) did not list the presence of ladder spleenwort in this mountain group. Bădăraș (2013) mentioned *Asplenium adulterinum* in "Poștile de Fier" (ROSCI 0206) Natura 2000 network, but without exact locality or citation.

The area of "Cazanele Mari" is dominated by serpentine rocks (the ideal substrate for *Asplenium adulterinum*) and in the authors' opinion this is the explanation for undocumented citation of this rare fern in the mountain group.

Asplenium adulterinum could not be found near Cazanele Mari nor in other parts of this mountain range (Bartók A, pers. obs. 2009, 2010, 2011, 2012, 2013, 2014), but *Asplenium trichomanes* instead.

Aninei Mountains, Western Romanian Carpathians, Banat Mountains

In this mountain range, the presence of *Asplenium adulterinum* was reported once (Peia, 1982) in a short floristical paper; the author only listed a few species and specified their locations (e.g. *Asplenium adulterinum* on rocks in Rudăriei Gorges). New floristical and phytocenological papers (Grigoriu et al., 2005; Imbrea et al., 2014) highlighted that ladder spleenwort was listed in older literature (Peia, 1982), but it was not recently identified in the field. Bădăraș (2013) mentioned *Asplenium adulterinum* in "Cheile Rudăriei" (ROSCI 0032) Natura 2000 network, but without exact locality or citation. Floristical and phytocenological research in Nerei Gorges (Anina Mountains) (Schrött, 1968, 1969, 1972, 1996) did not demonstrate the occurrence of *Asplenium adulterinum* in this mountain group. Peia (1978) did not mention ladder spleenwort in other floristically interesting area of Aninei Mountains, Minișului Gorges. Also Nicolin, in her publications regarding Minișului Gorges and Izvorul Bigăr protected area (Nicolin and Imbrea 2007, 2009) did not mention the occurrence of *Asplenium adulterinum* in those areas.

Ladder spleenwort could not be found in Aninei Mountains (Bartók A, pers. obs. 2011, 2013). There are no herbarium specimens of *Asplenium adulterinum* from that mountain range in all checked herbaria.

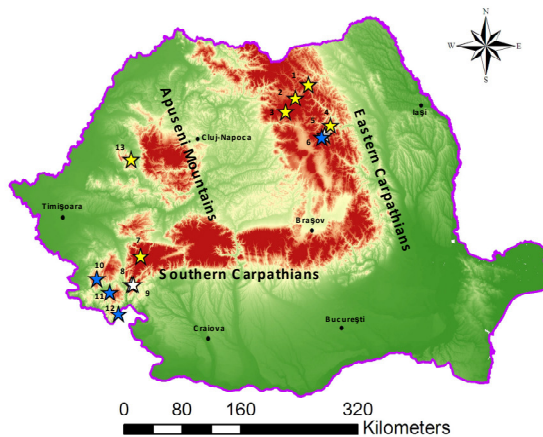


Fig. 2. Chorological map of *Asplenium adulterinum* distribution in South-Eastern Carpathians; the white star represents certain location, the blue star represents possible locations, the yellow star represents uncertain locations of *A. adulterinum* in the Romanian Carpathians

Legend: 1-Rarău Mountains; 2-Bistriței Mountains; 3-Călimani Mountains; 4-Ceahlău Mountains; 5,6-Hășmaș Mountains; 7-Țarcu Mountains; 8-Cernei Mountains; 9-Mehedinți Mountains; 10,11-Aninei Mountains; 12-Almăjului Mountains; 13-Codru-Moma Mountains.

Codru-Moma Mountains, Western Romanian Carpathians, Apuseni Mountains

In the area of Codru-Moma Mountains, *Asplenium adulterinum* was mentioned in Izbug Brook (Briheni village) by Burescu and Pășcuț (2010) in a phytosociological paper. The authors only mentioned the presence of ladder spleenwort within *Asplenium trichomano-rutae murariae* Kuhn 1937 association, but without other comments of this important biogeographical and floristical finding. In this plant association, the ladder spleenwort would be present together with *Poa nemoralis* L. and *Doronicum columnae* Ten.

The flora of this mountain group was studied by Paučă (1936, 1941a, 1941b), but the occurrence of this rare fern was not mentioned. There are no herbarium specimens of *Asplenium adulterinum* from that mountain group in all checked herbaria.

In contrast, *Asplenium trichomanes* coming from this mountain range was well documented in the Romanian botanical literature.

Habitat description of Asplenium adulterinum Milde in Romanian Carpathians

According to the Romanian phytosociological literature, *Asplenium adulterinum* is a species that grows on rocks (Chifu, 2014), characteristic for *Tortulo-Cymbalarietalia* and *Asplenietalia septentrionalis* orders.

Boșcaiu (1971) comprises *Asplenium adulterinum* in *Asplenietum rutae-murariae* plant association which occurs in alpine part of Țarcu Mountains (e.g. gabbroic breccia from Custura Mătaniei) together with: *Asplenium trichomanes-ramosum* L., *Cystopteris fragilis*

Table 1. Associations of *Asplenio-Silenetum petraeae* Boșcaiu 1971

Exposition	North	North
Slope (degrees)	80°	85°
Altitude (m, a.s.l.)	600	550
Surface (m ²)	1	2
Relevé no.	1	2
Char. ass.		
<i>Asplenium ruta-muraria</i>	1	1
<i>Asplenium trichomanes</i>	3	2
<i>Silene saxifraga</i> subsp. <i>petraea</i>	2	2
<i>Micromerion pulegii</i>		
<i>Athamanta turbith</i> subsp. <i>hungarica</i>	■	+
<i>Ceterach officinarum</i>	1	+
<i>Dianthus petraeus</i>	+	■
<i>Edraianthus graminifolius</i>	+	■
<i>Micromeria pulegium</i>	+	+
Cystopteridion		
<i>Poa nemoralis</i>	+	+
<i>Tortulo-Cymbalarietalia</i>		
<i>Asplenium adulterinum</i>	+	+
<i>Asplenietea trichomanis</i>		
<i>Saxifraga paniculata</i>	1	■
<i>Sedum telephium</i> subsp. <i>maximum</i>	■	+
<i>Stipo pulcherrimae-Festucetalia pallentis</i> s.l.		
<i>Alyssoides utriculata</i>	■	+
<i>Draba lasiocarpa</i>	+	■
<i>Silene flavescent</i>	■	+
<i>Veronica crassifolia</i>	+	■
Variae syntaxa		
<i>Geranium rotundifolium</i>	1	■
<i>Arabis collina</i>	+	■

Place and date of relevés: 1. Mehedinți Mts., middlepart of Țesna valley, limestone rocks and screes (1.VI.2013); 2. Cernei Mts., near Vânturătoarea Waterfall, limestone rocks and screes (27.IV.2014)

(L.) Bernh., *Asplenium ruta-muraria* L., *Asplenium trichomanes* L., *Silene pusilla* Waldst. & Kit.

It was mentioned in "Vegetated siliceous inland cliffs" (Corine 62.2) or "Acid siliceous inland cliffs" (EUNIS H 3.1) (Doniță et al., 2005).

Based on the current study field research, analysis of stored herbarium material and literature data, it was developed the chorological map of distribution of *Asplenium adulterinum* in Romanian Carpathians (Fig. 2).

Field observations

During the botanical trips in the Mehedinți and Cernei Mountains (2013 and 2014, respectively) very rare and endangered species in Romanian flora were recorded on limestone rocks and screes, in two small phytocoenoses (1-2 m²) of the association *Asplenio-Silenetum petraeae* Boșcaiu 1971 (Table 1). The location of the two populations of *Asplenium adulterinum* identified in these mountains and their phytosociological context are as follows:

1) Romania, Southern Carpathians, Mehedinți Mountains, Țesna valley, alt. 600 m a.s.l., on limestone rocks and screes, in ass. *Asplenio-Silenetum petraeae* Boșcaiu 1971, total area approximately 1 m². In this phytocenosis (Table 1, relevé 1) *Asplenium trichomanes* L., *Asplenium ruta-muraria* L., *Silene saxifraga* L. subsp. *petraea* (Waldst. & Kit.) Guşul. were dominant, seconded by *Geranium rotundifolium* L., *Saxifraga paniculata* L., *Dianthus petraeus* Waldst. & Kit., *Micromeria pulegium* (Rochel) Benth., *Arabis collina* Ten. etc.

2) Romania, Southern Carpathians, Cernei Mountains, Vânturătoarea Waterfall, alt. 550 m a.s.l., on limestone rocks and screes, in ass. *Asplenio-Silenetum petraeae* Boşcaiu 1971, total area approximately 2 m² (leg. A. Bartók and S. I. Bartók, personal herbarium A. Bartók). In this phytocenosis (Table 1, relevé 2) *Asplenium trichomanes* L. and *Silene saxifraga* L. subsp. *petraea* (Waldst. & Kit.) Guşul. were dominant, seconded by *Athamanta turbith* (L.) Brot. subsp. *hungarica* (Borbás) Tutin, *Alyssoides utriculata* (L.) Medik., *Sedum telephium* L. subsp. *maximum* (L.) Krock. etc.

During other botanical trip in Cernei Mountains, Southern Carpathians on 27 April 2014 *Asplenium adulterinum* was identified in the same phytocenosis.

In the Munticelu-Cheile Şugăului Natural Reserve (Hăşmaş Mountains, Eastern Carpathians), near Şugăului Gorges, *Asplenium adulterinum* was found on jurrasic limestones, together with *Asplenium trichomanes*, *Asplenium ruta-muraria*, *Campanula carpatica*, *Aurinia saxatilis*, *Saxifraga paniculata*, *Polypodium vulgare*, *Thymus comosus* etc. (Associate Professor Dr. Ioana Popescu, 24 May 2008).

Recommended IUCN threat category

Only three population of *Asplenium adulterinum* are certainly known in the Romanian Carpathians, in restricted area of Hăşmaş, in Mehedinţi and Cernei Mountains. The places where the species occurs are apparently protected (Domogled-Valea Cernei and Cheile Bicazului- Hăşmaş National Park), but in reality the area is exposed to human activities (e.g. tourism, grazing).

On the basis of new chorological data and estimation of the number of individuals and population condition, *Asplenium adulterinum* can be define as IUCN CR C2a(i) (IUCN, 2012) in Romania.

Conclusions

All available information from Romanian botanical literature was critically compiled in order to clarify the distribution of *Asplenium adulterinum* in the South-Eastern Carpathians.

Based on field studies, three new localities of *Asplenium adulterinum* (one important threatened species in Europe) were discovered. The occurrence of *Asplenium adulterinum* in Romanian Carpathians was recorded and the threatened status according to criteria and categories of IUCN was determined.

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