

Agonimia species and other rare lichens in Central Poland

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Eight lichen species are presented. Four of them: *Agonimia flabelliformis*, *A. opuntiella*, *A. tristicula* and *Micarea adnata* are new to Central Poland. *Caloplaca cerina* var. *chloroleuca*, *Micarea hedlundii* and *Porina leptalea* are very rare in the Świętokrzyskie Mts and in Central Poland.

Key words: Ascomycota, lichen distribution, protected areas

INTRODUCTION

Although the Świętokrzyskie Mts have relatively well known lichen biota, recent explorations provide new species. As a result of these investigations eight species rarely reported from Poland have been found, including *Agonimia flabelliformis*, *A. opuntiella*, *A. tristicula*, *Bacidia sulphurella*, *Caloplaca cerina* var. *chloroleuca*, *Micarea adnata*, *M. hedlundii* and *Porina leptalea*. So far four of them were not recorded in Central Poland.

The species of the genus *Agonimia* deserve special attention. So far, seven species of this genus have been identified in Poland (Tab. 1): *Agonimia allobata*, *A. gelatinosa*, *A. opuntiella*, *A. repleta*, *A. tristicula*, *A. vouauxii* and recently described *A. flabelliformis*. Most of them occur mainly in mountain areas and in northern part of Poland. *Agonimia allobata*, corticolous species or found also on plant debris, has been reported at several sites in Śnieżnik Massif and Białskie Mts (Szczepańska 2008), Pieniny Mts (Kiszka 2000), Gorce Mts (Czarnota et al. 2005), Borecka Forest (Cieśliński 2003) and Mazovia region (Kubiak 2009). *Agonimia gelatinosa* is terricolous, on calcareous soil, muscicolous and grows also on plant debris. This rare species in Poland is known from Kujawy area (Ceynowa-Gieldon 2001), Gorce Mts (Czarnota 2000) and Sudety Mts (Kossowska 2008). *Agonimia opuntiella* in Poland is

known mostly from mountain regions, the Eastern and Western Carpathians (Kiszka 1997; Bielczyk 2003; Fałtynowicz 2003) where it grows on calcareous soil and on bryophytes in sunny places. *Agonimia repleta* is more frequent species in this country. It is saxicolous, muscicolous and corticolous species found usually in wet forests on deciduous trees: *Acer*, *Alnus*, *Fagus* and *Ulmus*. It is reported for example from the north-eastern part of the country (Czyżewska et al. 2001; Cieśliński 2003), from its central part (Łubek 2012a, b) and from its south part (Czarnota, Coppins 2000; Kiszka, Kościelniak 2001; Bielczyk et al. 2004). *Agonimia tristicula* grows on calcareous soil, on bryophytes and on plant debris in open habitats being quite common in mountain areas, the Western and Eastern Tatry Mts and Pieniny Mts. Only locality in northern part of Poland, in the Mazurian Lake District is also known (Olech, Kiszka 1999). *Agonimia vouauxii* in this country is reported from anthropogenic habitats from Olkusz region (Bielczyk 2012).

The main aim of this work is to provide the most up-to-date information for the new and rare species in Central Poland, especially for those recently described.

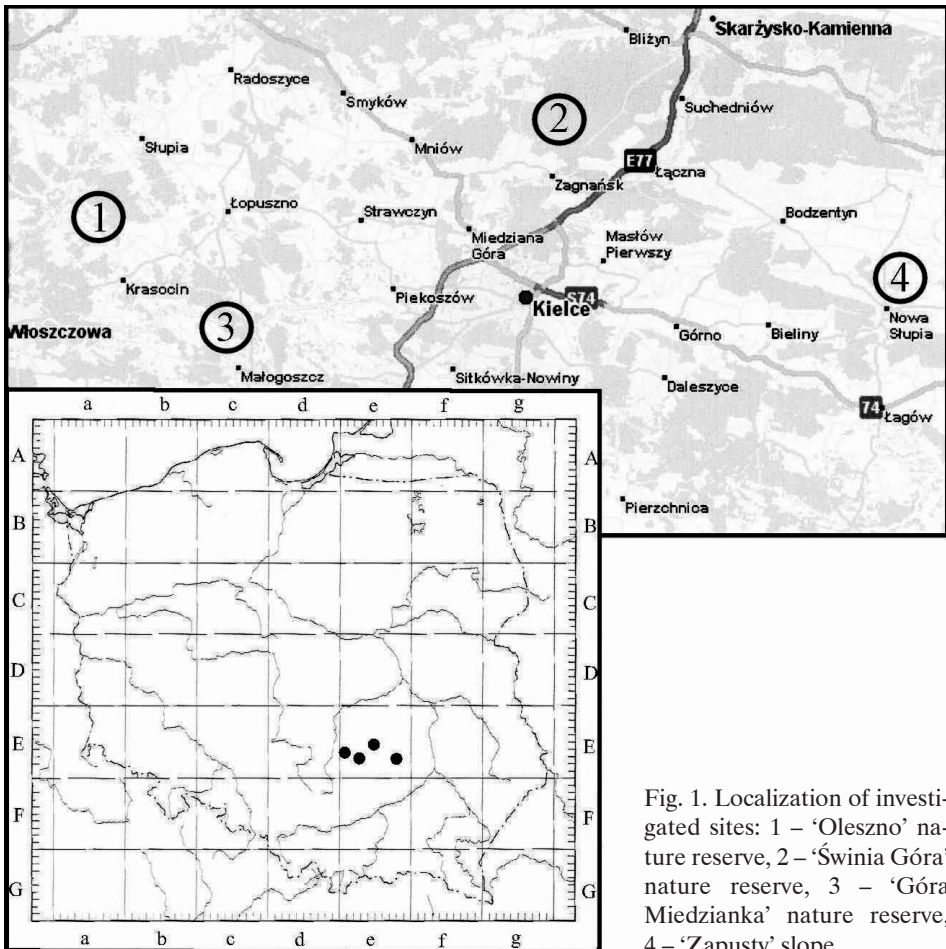


Fig. 1. Localization of investigated sites: 1 – ‘Oleszno’ nature reserve, 2 – ‘Świnia Góra’ nature reserve, 3 – ‘Góra Miedzianka’ nature reserve, 4 – ‘Zapusty’ slope.

MATERIAL AND METHODS

Lichens were collected in 2001, 2007, 2010 and 2011 at four sites in the Świętokrzyskie Mts and in their immediate vicinity (Fig. 1): in ‘Góra Miedzianka’ nature reserve in the Chęcińsko-Kielecki Landscape Park, in ‘Zapusty’ slope in the Świętokrzyski National Park, in ‘Swinia Góra’ nature reserve in the Suchedniowsko-Oblęgorzki Landscape Park and in ‘Oleszno’ nature reserve in the Przedborski Landscape Park, located in squares Ee 54, 60, 72, 77 of ATPOL grid square system (Cieśliński, Fałtynowicz 1993). The material was analyzed with standard morphological and anatomical methods.

RESULTS AND DISCUSSION

The nomenclature of the species follows Smith et al. (2009) with exception of *Agonimia flabelliformis* – Guzow-Krzemińska et al. (2012). Characteristics of *Agonimia* representatives (Tab. 1) according to Smith et al. (2009), Guzow-Krzemińska et al. (2012) and Sérusiaux et al. (1999). The specimens are deposited in the herbarium of the Jan Kochanowski University (KTC).

Abbreviations: ŚNP – Świętokrzyski National Park; S-OLP – Suchedniowsko-Oblęgorzki Landscape Park; PrzLP – Przedborski Landscape Park, Ch-KLP – Chęcińsko-Kielecki Landscape Park.

Agonimia flabelliformis Halda, Czarnota & Guzow-Krzemińska

This species was described from the Czech Republic, and mentioned additionally from Germany and Great Britain (Guzow-Krzemińska et al. 2012). In Poland it is only known from Tatry Mts (Czarnota 2012). Its site in ‘Oleszno’ nature reserve is the first in Central Poland.

Species is characterized by a small flabelliform thallus and globose perithecia with 8-spored asci. For the full description of the species see Guzow-Krzemińska et al. (2012). *A. flabelliformis* resembles *A. allobata*, from which it differs only in the presence of flabelliform aggregations of goniocysts (Guzow-Krzemińska et al. 2012). *Agonimia flabelliformis* prefers rather humid, shaded, mossy places within deciduous forests where usually grows on bark and on soil. The collection from the Przedborski Landscape Park was found on the trunk of *Fraxinus excelsior* with the company of *Bacidia pycnidata* and *Bacidina sulphurella*. It has a dull-green minutely flabelliform squamulose to coralloid thallus, a few grey-brown perithecia which are superficial or partially immersed between squamules.

SPECIMEN EXAMINED. ATPOL grid square Ee 60 – PrzLP, near the ‘Oleszno’ nature reserve, forest section no 79, 50°56’42”N/ 20°06’17”E, on a trunk of *Fraxinus excelsior*, 7 Feb. 2008.

Agonimia opuntiella (Buschardt & Poelt) Vězda

Syn. *Phaeophyscia opuntiella* (Buschardt & Poelt) Hafellner

The species occur in many countries in Europe such as: Belgium, Luxembourg, France (Diederich et al. 2011), Great Britain and Ireland (Smith et al. 2009), the

Czech Republic (Vězda, Liška 1999), Switzerland (Clerc, Truong 2010) and Germany (Wirth et al. 2010).

Agonimia opuntiella deserves special attention because of the perithecia which are formed very rarely. This species is characterized by greenish-grey to brownish minutely squamulose thallus (lobes up to 4 mm width) with marginal ellipsoid to subglobose blastidia. Surface of thallus has minute hyaline hairs. Perithecia are formed rarely or if so they are small pyriform, black and rugose (0.2-0.5×0.2-0.4 mm) on the lobe bases (Aptroot et al. 2008; Aptroot 2011). Two densely muriform ascospores, 40-70×20-30 µm, are produced in asci.

So far, in Poland ascocarps of *Agonimia opuntiella* have not been reported (Kiszka 1997). The collection from the Chęcińsko-Kielecki Landscape Park has no perithecia indeed, but the specimen from Świętokrzyski National Park produces a few small, inconspicuous black perithecia, located on the lobe base. They are sometimes partially hidden by adjacent squamules and blend with dark ground decaying bryophytes: more visible when wet. Spores of *Agonimia opuntiella*, similarly to *A. tristicula*, are produced per two in ascus, but they are much smaller. Ascospores of *A. opuntiella* from the Świętokrzyski National Park have dimensions of 60-63×26-28 µm and in *A. tristicula*, which was found in the Chęcińsko-Kielecki Landscape Park, they reach 72-96×36-48 µm.

Agonimia opuntiella from the Świętokrzyski National Park was already published, however under the name *Phaeophyscia kairamoi* – young thallus in the initial stage of growth was difficult to determine (Łubek 2003; Łubek, Cieśliński 2004; Łubek 2007). After a careful examination of the specimen, a few small perithecia have been found, thus now there is no doubt that it represents *A. opuntiella*. These two species are similar because of the presence of marginal blastidia and tiny hyaline hairs on the surface of thallus. Because of this mistake, *Ph. kairamoi* should be deleted from the list of lichens of the Świętokrzyskie Mts. Here *A. opuntiella* is reported also as new to Central Poland.

SPECIMENS EXAMINED. ATPOL grid square Ee 72 – Ch-KLP, ‘Góra Miedzianka’ nature reserve, on bryophytes growing on calcareous rocks, Sexposure, 50°50’44”N/20°2’46”E, 8 Oct. 2011, leg. B. Słowińska (KTC); Ee 77 – ŚNP, ‘Zapusty’ slope, on bryophytes growing on calcareous rocks, S exposure, 50°53’51”N/ 21°06’09”E, 31 Aug. 2001.

***Agonimia tristicula* (Nyl.) Zahlbr**

Syn. *Verrucaria tristicula* Nyl.

This species occurs in many countries in Europe such as: Belgium, Luxembourg, France (Diederich et al. 2011), the Czech Republic (Vězda, Liška 1999), Estonia (Randlane, Saag 1999), Sweden and Norway (Santesson 1993), Switzerland (Clerc, Truong 2010) and Germany (Wirth et al. 2010).

Agonimia tristicula is reported here as new to the Świętokrzyskie Mts and Central Poland. It was found in the Chęcińsko-Kielecki Landscape Park, where grew on bryophytes on calcareous soil. It characterizes by dull to pale green or brown minutely squamulose thallus, which often forms small, aggregate patches. Perithecia are frequent, fairly big, barrel-shaped, black, matt and plicate-rugose. Asci produce two spores: 72-96×36-48 µm.

SPECIMEN EXAMINED. ATPOL grid square Ee 72 – Ch-KLP, ‘Góra Miedzianka’ nature reserve, on bryophytes growing on calcareous rocks, S exposure, 50°50’44”N/ 20°21’46”E, 8 Oct. 2011, leg. B. Słowińska.

Bacidina sulphurella (Samp.) M. Hauck & V. Wirth

Syn. *Bacidia sulphurella* Samp.

In Europe this species is known from many countries: Belgium, Luxembourg, France (Diederich et al. 2011), Great Britain and Ireland (Smith et al. 2009), Switzerland (Clerc, Truong 2010) and Germany (Wirth et al. 2010). In Poland *Bacidina sulphurella* is known for example from: Góry Sowie Mts and Puszcza Knyszyńska Forest (Brand et al. 2009), Gorce Mts (Czarnota 2010) and Pogórze Wiśnickie foothills (Śliwa 2010). In Central Poland the species was reported from few localities in ‘Las Bielański’ forest reserve (Kubiak et al. 2010) and Wzniesienia Łódzkie Landscape Park (Hachułka 2011). It is surely more common species but formerly many times determined as *Bacidina arnoldiana* (see Czarnota 2010).

Bacidina sulphurella is characterized by finely granular, green thallus and white, pale to greyish coloured, usually present pycnidia, producing filiform, at least in one end strongly hooked, 0-3 septate conidia (Brand et al. 2009). The specimen from the ‘Oleszno’ nature reserve has few typical pycnidia and well developed thallus. The species grow in the company of *Agonimia flabelliformis*.

SPECIMEN EXAMINED. ATPOL grid square **Ee 60** – PrzLP, near ‘Oleszno’ nature reserve, forest section no 79, on a trunk of *Fraxinus excelsior*, 50°56’42”N/ 20°06’17”E, 7 Feb. 2008, (KTC, with *Agonimia flabelliformis* and *Bacidia pycnidiata*), det. P. Czarnota.

Caloplaca cerina* var. *chloroleuca (Sm.) Th. Fr.

Syn. *Caloplaca cerina* var. *muscorum* A. Massal.

This is a very rare species in Poland (Fałtynowicz 2003). It is known primarily from mountain areas: Sudety Mts, Western Carpathians Mts and Wyżyna Śląsko-Krakowska Upland (Fałtynowicz 2003) as well as from the north-eastern part of Poland (Cieśliński 2003) where grows on plant debris, soil or on mosses in xerothermic grasslands and gravel pits. In Central Poland *Caloplaca cerina* var. *chloroleuca* is known from Zelejowa Mt. near ‘Skorocie’ nature reserve and near Lasocin village in the Świętokrzyskie Mts (Cieśliński 1979).

Specimen of *C. cerina* var. *chloroleuca* collected in the Chełciński-Kielecki Landscape Park is small and has a scurfy, green-grey thallus, and a few sessile apothecia with thick, grey thalline margin and orange-yellow disc.

SPECIMEN EXAMINED. ATPOL grid square **Ee 72** – Ch-KLP, ‘Góra Miedzianka’ nature reserve, on bryophytes growing on calcareous rocks, S exposure, 50°50’44”N/ 20°21’46” E, 8 Oct. 2011, leg. B. Słowińska.

Micarea adnata Coppins

This is the first information on the occurrence of this species in the Świętokrzyskie Mts and in Central Poland. In this country it is known only from two mountain regions: Karkonosze Mts (Kossowska 2001) and Western Beskidy Mts (Czarnota 2007). In Europe this species is widespread; known from the Czech Republic (Vězda, Liška 1999), Sweden (Santesson 1993), Switzerland (Clerc, Truong 2010), Germany (Wirth et al. 2010) and other countries (see Czarnota 2007).

Micarea adnata is easily to identify owing to its characteristic apothecia and sporodochia (Czarnota 2007). It grows on the bark of coniferous trees, on wood or decaying stumps. The specimen mentioned here has numerous straw-coloured apothecia, which are immarginate or sometimes surrounded with distinctly visible white

Table 1
 Comparison of selected features of Polish representatives of the genus *Agonimia*
 Characteristics of the species according to: ¹Smith et al. (2009); ²Guzow-Krzemińska et al. (2012); ³Sérusiaux et al. (1999)

Feature	<i>Agonimia allobata</i> ¹	<i>Agonimia flabelliformis</i> ²	<i>Agonimia gelatinosa</i> ¹	<i>Agonimia opuntiiella</i>	<i>Agonimia repleta</i> ¹	<i>Agonimia tristicula</i> ¹	<i>Agonimia vouauxii</i> ³	
Thallus	grey-green to brown, continuous and minutely roughened to granular, sometimes composed of branched structures	dull-green minutely flabelliform to squamulose	dark brown composed of rounded or lobed goniocysts, prothallus conspicuous	greenish-grey to brownish, minutely of squamules to 4 mm diam., marginal ellipsoid to subglobose blastidia, minute hyaline hairs on surface of thallus	dull green, granular, verrucose or minutely squamulose	dull to pale green or brown, minutely squamulose, forming small, spreading, aggregate patches	greenish to brownish, granulose to squamulose, papillate, with squamules of 0,6-2 mm diam.	
Perithecia	frequent, globose or taller than wide; surface: grey-brown to black, smooth, matt	frequent, globose, superficial or partially immersed between squamules; surface: grey-brown, smooth and matt	frequent, globose, subspherical; surface: smooth, black, matt	very rare, pyriform, on the lobe bases; surface: black, rugose	frequent, pyriform, half to three-quarters immersed; surface: grey-brown to black, roughened with vertical cracks	rather frequent, fairly big, barrel-shaped, between and overgrown by squamules; surface: black, matt and plicate-rugose	frequent, subspherical to slightly obpyriform, half-immersed; surface: blackish, glossy	
Size of perithecia	12-22 µm diam.	15-25 µm diam.	30-50 µm diam.	20-50 µm diam.	14-20 µm diam.	24-50 µm diam.	12-23 µm diam.	
Spores	8, in ascus, 29-35 × 10-15 µm, muriform	8 in ascus, 23-35 × 11-15 µm, muriform	8 in ascus, 31-55 × 15-20 µm, muriform	2 in ascus, 40-70 × 20-30 µm, desently muriform	8 in ascus, 20-46 × 12-20 µm, muriform	(1-) 2 in ascus, 57-120 × 26-50 µm, muriform	2 in ascus, 60-72 × 15-24 µm, muriform	
Substrate of occurrence in Europe	bark (<i>Quercus</i> , <i>Ulmus</i> , <i>Alnus</i> , <i>Fraxinus</i> , <i>Acer</i> , <i>Pinus</i> , <i>Picea</i> , <i>Tilia</i> , <i>Carpinus</i>), plant debris	bark (<i>Picea</i> , <i>Fraxinus</i> , <i>Fagus</i> , <i>Tilia</i> , <i>Larix</i> , <i>Quercus</i>), decaying wood, rocks	calcareous soil, bryophytes, plant debris	calcareous soil, bryophytes, rarely on bark (<i>Quercus</i>)	bark (<i>Acer</i> , <i>Alnus</i> , <i>Fagus</i> , <i>Ulmus</i> , <i>Picea</i>), bryophytes on rocks	calcareous soil, in crevices of calcareous rocks, bryophytes, plant debris, rarely on bark (<i>Acer</i> , <i>Ulmus</i> , <i>Fraxinus</i> , <i>Alnus</i> , <i>Sorbus</i>)	calcareous soil, bryophytes, plant debris, soil	bryophytes, plant debris, soil
Habitat requirements	moist places in deciduous forest	humid, shaded and mossy places in deciduous to mixed forest	shady and moist places in calcareous habitats	sunny places in rocks grasslands	moist places in deciduous forests	sunny places in xerothermic and rocks grasslands	thermophilous grassland, open habitats of limestone areas and anthropogenic habitats	

rim. Convex or globose sporodochia, resembling small apothecia, are numerous and produces macroconidia $8\text{-}9 \times 2\text{-}3 \mu\text{m}$.

Due to the specific habitat requirements and its occurrence only in natural forests, *M. adnata* is proposed to be regarded as an indicator of ecological continuity for woodlands of lower mountain belt in Central Europe (Czarnota 2007). Also the site in Central Poland is located in such natural forest. 'Świnia Góra' nature reserve is one of the oldest in the Świętokrzyskie Mts, being remnants of the Puszcza Świętokrzyska Forest.

SPECIMEN EXAMINED. ATPOL grid square **Ee 54** – S-OLP, 'Świnia Góra' nature reserve, on lignum, $51^{\circ}03'16''\text{N}/20^{\circ}41'58''\text{E}$, 10 Nov. 2010.

Micarea hedlundii Coppins

In Poland it is reported mainly from Eastern and Southern Poland (Czarnota 2007). In Central Poland *Micarea hedlundii* was already recorded in the Świętokrzyski National Park (Łubek 2003), in the 'Spała' nature reserve and the Puszcza Kozienicka Forest (Czyżewska et al. 2005; Czarnota 2007).

Characteristic feature of this species are pycnidia coated with white tomentum and orange droplets of an oil substance in goniocysts which reacting K^+ purple-violet. Specimen examined from the Suchedniowsko-Oblęgorski Landscape Park has only pycnidia.

SPECIMEN EXAMINED. ATPOL grid square **Ee 54** – S-OLP, 'Świnia Góra' nature reserve, on lignum, $51^{\circ}03'16''\text{N}/20^{\circ}41'58''\text{E}$, 10 Nov. 2010.

Porina leptalea (Durieu & Mont.) A. L. Sm.

This species is known from many European countries, for example: Belgium, Luxembourg, France (Diederich et al. 2011), Switzerland (Clerc, Truong 2010), Germany (Wirth et al. 2010) and the Czech Republic (Vězda, Liška 1999). In Poland is a rare species found in mountain areas: Gorce Mts (Czarnota 2000), Pieniny Mts (Kiszka 2000), Bieszczady Niskie Mts (Kościelniak 2004) and Sudety Mts (Szczepeńska 2007). In the Świętokrzyskie Mts it seems to be also rare. Its first four sites in the Świętokrzyski National Park have already been published (Łubek 2003) and here is presented additional locality of this species in this region.

Specimen examined has dull orange-brown to red-brown perithecia, hemispherical to subglobose $0,1\text{-}0,4 \text{ mm}$ diam., which are one quarter to one half immersed in thin grey-green thallus. Ascospores are fusiform-cylindrical or oblong, 3-septate and $15\text{-}25 \times 2\text{-}4 \mu\text{m}$. It has also orange pycnidia with narrowly ellipsoid conidia $3\text{-}4,5 \times 1 \mu\text{m}$.

SPECIMEN EXAMINED. ATPOL grid square **Ee 54** – S-OLP, 'Świnia Góra' nature reserve, on trunk of *Fagus sylvatica*, $51^{\circ}03'16''\text{N}/20^{\circ}41'58''\text{E}$, 10 Nov. 2010.

CONCLUSIONS

The Świętokrzyskie Mts appear to be very interesting from lichenological point of view. The specific topography, various geology and often natural vegetation, make appropriate conditions for lichens both widespread and of narrow ecological-scale. Particularly noteworthy are the species occurring in Poland only in mountain areas, including *Agonimia opuntiella*, *Micarea adnata* and *Porina leptalea*.

Among the studied areas noteworthy are ‘Oleszno’ nature reserve in the Przedborski-Landscape Park and ‘Świnia Góra’ nature reserve in the Suchedniowsko-Oblegorski Landscape Park. The natural character of forests in the ‘Oleszno’ nature reserve has already been underlined few times by the presence of very rare epiphytic lichens in Poland (Łubek 2009a, b). In this paper two next lichen-forming fungi are interesting: *Agonimia flabelliformis* and *Bacidina sulphurella*. First one because up to now it was found in Poland only once, and the second species because its real distribution in Europe is still poorly known.

‘Świnia Góra’ nature reserve appears to be also noteworthy protected area owing to a large amount of dead wood inhabited by lignicolous lichens, such as: *Micarea adnata* and *M. hedlundii*.

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Gatunki z rodzaju *Agonimia* i inne rzadkie porosty w Polsce Środkowej

Streszczenie

W pracy przedstawiono osiem gatunków porostów: *Agonimia flabelliformis*, *A. opuntiella*, *A. tristicula*, *Bacidina sulphurella*, *Caloplaca cerina* var. *chloroleuca*, *Micarea adnata*, *M. hedlundii* i *Porina leptalea*, które stwierdzono ostatnio w Górach Świętokrzyskich i ich najbliższym sąsiedztwie. Wśród nich, cztery nie były dotąd znane z tego pasma górskiego i z Polski Środkowej. Są to: *Agonimia flabelliformis*, *A. opuntiella*, *A. tristicula* i *Micarea adnata*.

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