

Additions to the lichen diversity of Macedonia (FYROM)

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Abstract: MALÍČEK, J. & MAYRHOFER, H. 2017. Additions to the lichen diversity of Macedonia (FYROM). – Herzogia 30: 431–444.

Selected localities in Galičica National Park, Matka canyon in the Suva Gora Mountains, Mavrovo National Park, Ohrid Basin, Vardar River valley and Popova Šapka in the Šar Planina Mountains were briefly studied during a field excursion in 2014. Seventy-seven lichenized fungi are reported for the first time from Macedonia (FYROM); eight species (*Candelariella aggregata*, *Halecania viridescens*, *Lecanora albula*, *Lepraria diffusa*, *Normandina acroglypta*, *Parmelia barrenoae*, *Sarcogyne fallax* and *Schaereria corticola*) are new to the Balkan Peninsula. *Caloplaca substerilis*, *Fuscopannaria mediterranea*, *Gyalecta croatica*, *G. geoica*, *Leptochidium albociliatum*, *Lobarina scrobiculata*, *Protoblastenia lilacina*, *Sclerophora pallida* and *Thelopsis rubella* represent other remarkable records. An enigmatic collection of an *Immersaria*, closely resembling *I. athroocarpa* and possibly representing a new species, is briefly discussed. The present paper brings the total number of lichenized and lichenicolous fungi known for Macedonia to 675 and 22, respectively.

Zusammenfassung: MALÍČEK, J. & MAYRHOFER, H. 2017. Ergänzungen zur Flechtendiversität von Makedonien (FYROM). – Herzogia 30: 431–444.

Ausgewählte Lokalitäten im Galičica Nationalpark, in der Matka-Schlucht, im Suva-Gora-Gebirge, im Mavrovo-Nationalpark, im Ohridbecken, im Tal des Flusses Vardar und auf der Popova Šapka im Šar-Gebirge wurden während einer Exkursion im Jahre 2014 untersucht. 77 Flechten werden erstmals aus Makedonien gemeldet; acht Arten (*Candelariella aggregata*, *Halecania viridescens*, *Lecanora albula*, *Lepraria diffusa*, *Normandina acroglypta*, *Parmelia barrenoae*, *Sarcogyne fallax* und *Schaereria corticola*) sind neu für die Balkanhalbinsel. *Caloplaca substerilis*, *Fuscopannaria mediterranea*, *Gyalecta croatica*, *G. geoica*, *Leptochidium albociliatum*, *Lobarina scrobiculata*, *Protoblastenia lilacina*, *Sclerophora pallida* und *Thelopsis rubella* sind bemerkenswerte Funde. Eine rätselhafte Aufsammlung einer *Immersaria*, die *I. athroocarpa* sehr ähnlich ist, ist wahrscheinlich eine neue Art, die kurz diskutiert wird. Mit der aktuellen Studie sind 675 lichenisierte und 22 lichenicole Pilze aus diesem Land bekannt.

Key words: Balkan Peninsula, Galičica, *Immersaria*, lichenised fungi, Matka canyon, Mavrovo, Šar Planina.

Introduction

Macedonia (FYROM) is a small but geomorphologically and geologically rich country. It belongs to the lichenologically less explored countries in Europe. A catalogue of Macedonia lichenized and lichenicolous fungi has recently been published (MAYRHOFER et al. 2013). It comprises 593 lichens and 19 lichenicolous fungi published in 147 sources. Since that publication, several studies with additional records on lichenized and lichenicolous fungi have been published or discovered among older sources, resulting in the addition of five lichenized and three lichenicolous species for the country: *Absoconditella delutula* (Nyl.) Coppins & Kiliyas (FARKAS 2014), *Cercidospora crozalsiana* (H.Olivier) Nav.-Ros., C.Roux & Casares, *C. macrospora* (Uloth) Hafellner & Nav.-Ros., *Protoparmeliopsis garovaglii* (Körb.) Arup, X.Zhao & Lumbsch (CALATAYUD et al. 2013, as *Lecanora garovaglii*), *Solenopsis cesatii* (A.Massal.) Zahlbr., *S. candicans* (Dicks.) J.Steiner, *S. grisea* (Bagl.) Kotlov (GUTTOVÁ et al. 2014) and

Sphinctrina paramerae Muñiz & Hladun (MUÑIZ et al. 2013). The following seven lichens were additionally noticed in the literature: *Caloplaca anularis* Clauzade & Poelt (VONDRÁK & MAYRHOFFER 2013), *Lobaria pulmonaria* (L.) Hoffm. (WIDMER et al. 2012), *Ramalina polymorpha* (Lilj.) Ach. (OBERMAYER 2013), *Squamarina cartilaginea* (With.) P.James, *S. lentigera* (Weber) Poelt (CALATAYUD et al. 2013), *Usnea barbata* (L.) Weber ex F.H.Wigg. (ZIZOVIC et al. 2012, VANOVIĆ et al. 2013, 2014) and *Xanthoparmelia stenophylla* (Ach.) Ahti & D.Hawksw. (HALE 1990, as *X. somloënsis*).

In 2014, a one-week field excursion for students, organized by a biological section of Charles University in Prague, included several interesting and lichen-rich localities in Macedonia. This resulted in the discovery of many more species new for the country.

Material and methods

The field research was carried out from 6.–13. June 2014. In this paper, only species not yet recorded from Macedonia are presented with particular localities, but specimens of other already published species were acquired as well and some of them are mentioned in the discussion. The specimens were identified by standard techniques (examination under the light microscope, spot/UV reactions) and thin layer chromatography (TLC) using solvent systems A, B', C, following ORANGE et al. (2010). Specimens analyzed by TLC are indicated by an asterisk (*), species new to the Balkan Peninsula by an exclamation point (!). Nuclear ITS and mitochondrial SSU were sequenced for *Immersaria* aff. *athroocarpa* (GenBank accession numbers MF149862 and MF149861) and mitochondrial SSU for *Parmelia barrenoae* (MF149860) and *Parmelia ernstiae* (MF149859). Herbaria vouchers are deposited in the personal herbarium of Jiří Malíček and several duplicates in PRC. The samples deposited with a specimen of another species (intermixed taxa) are marked by the abbreviation 'dep.' (i.e. deposited under) followed by the name of lichen under which it is placed. Nomenclature follows HAFELLNER & TÜRK (2016).

List of recorded species

Acrocordia gemmata (Ach.) A.Massal.

Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'16"N, 20°50'17"E, alt. 1500 m, on bark of *Fagus sylvatica* (JM/7931).

Alyxoria varia (Pers.) Ertz & Tehler (= *Opegrapha varia*)

Mavrovo National Park, Zhirovica – beech forest in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on bark of *Fagus sylvatica* (JM/7723).

Anisomeridium bifforme (Borrer) R.C.Harris

Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path 1 km SE of dam, c. 41°56'40"N, 21°18'14"E, alt. 340 m, on bark of *Fraxinus ornus* (JM/7770).

Arthonia didyma Körb.

Mavrovo National Park, Zhirovica – beech forest in deep valley of a river 1.5 km S of Bibaj village, 41°42'59"N, 20°37'44"E, alt. 940 m, on bark of *Fagus sylvatica* (JM/7753).

Arthopyrenia cinereo-pruinosa (Schaer.) A.Massal.

Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path 1 km SE of dam, c. 41°56'40"N, 21°18'14"E, alt. 340 m, on bark of *Fraxinus ornus* (dep. *Anisomeridium* sp., JM/7771, det. F. Berger).

Bacidia arceutina (Ach.) Arnold

Mavrovo National Park, Zhirovnica – in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on branch of *Salix eleagnos* (JM/7719).

Bacidia circumspecta (Nyl. ex Vain.) Malme

Mavrovo National Park, Zhirovnica – beech forest in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on bark of *Fagus sylvatica* (JM/7731). Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'16"N, 20°50'17"E, alt. 1500 m, on decaying bark of *Fagus* (JM/7949). Galičica National Park, Stenje – tourist path in oak forests 2.5 km W of village, NE-facing slopes of Mt Magaro, 40°56'46"N, 20°52'16"E, alt. 1150 m, on bark of very old *Quercus cerris* (dep. *Caloplaca monacensis*, JM/7961).

Bacidia fraxinea Lönnr.

Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path 1.8 km SSE of dam, 41°56'10"N, 21°18'03"E, alt. 360 m, on bark of *Pistacia terebinthus* (JM/7788).

Bacidia subincompta (Nyl.) Arnold

Galičica National Park, Trpejca – N-facing slope of Mt. Magaro covered by beech forest 3.2 km ESE of village, c. 40°56'53"N 20°49'07"E, alt. 1700 m, on bark of *Fagus sylvatica* (JM/7916).

Bacidia vermifera (Nyl.) Th.Fr.

Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'10"N, 20°50'33"E, alt. 1500 m, on bark of old *Fagus sylvatica* (JM/7957).

Bacidina phacodes (Körb.) Vězda

Mavrovo National Park, Zhirovnica – beech forest in deep valley of a river 1.5 km S of Bibaj village, 41°42'59"N, 20°37'44"E, alt. 940 m, on bark of *Fagus sylvatica* (JM/7751).

Biatora globulosa (Flörke) Fr.

Mavrovo National Park, Zhirovnica – in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on bark of *Quercus cerris* (JM/7720). Mavrovo National Park, Zhirovnica – beech forest in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on bark of *Fagus sylvatica* (JM/7724).

Caloplaca chlorina (Flot.) H.Olivier

Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'10"N, 20°50'33"E, alt. 1500 m, on bark of old *Fagus sylvatica* (JM/7953).

Caloplaca hungarica H.Magn.

Suva Gora Mts, Shishevo – trees along Treska River, parking place near in the starting point to Matka canyon, 41°57'41"N, 21°17'49"E, alt. 300 m, on bark of *Alnus* (JM/7798).

Caloplaca monacensis (Leder.) Lettau

Galičica National Park, Stenje – tourist path in oak forests 2.5 km W of village, NE-facing slopes of Mt Magaro, 40°56'46"N, 20°52'16"E, alt. 1150 m, on bark of very old *Quercus cerris* (JM/7961, PRC).

Caloplaca sinapisperma (Lam.) Maheu & Gillet

Šar Planina Mts, Tetovo – Popova Šapka: alpine vegetation along tourist path 1 km W of village, 42°00'53"N, 20°52'11"E, alt. 1950 m, on mosses (JM/7702).

Caloplaca substerilis Vondrák, Palice & P.Boom

Galičica National Park, Trpejca – N-facing slope of Mt. Magaro covered by beech forest 3.2 km ESE of village, c. 40°56'53"N 20°49'07"E, alt. 1700 m, on bark of *Fagus sylvatica* (JM/7920, rev. J. Vondrák 2015).

!Candelariella aggregata M.Westb.

Šar Planina Mts, Tetovo – Popova Šapka: close to W margin of recreation area, 42°00'50"N, 20°52'31"E, alt. 1800 m, on mosses on calcareous outcrop (JM/7806).

This species is recognized by its yellow, granular to areolate thallus, numerous apothecia with a thin margin, 8-spored asci with narrowly ellipsoid spores (14–) 15–18 (–21) × 5–6 μm, and a terricolous

habitat usually in arctic-alpine areas (WESTBERG & CLERC 2012). In Europe, it has been reported from Switzerland (SPINELLI 2011), Russia (URBANAVICHUS & URBANAVICHENE 2008) and Romania (VONDRÁK & LIŠKA 2013). However, the last record belongs to the recently described and very similar *C. commutata*, distinguished by its larger apothecia (up to 2 mm in diam.) with a thick, often raised margin, and longer spores 20–28 (–32) × 5.0–6.5 (–7.5) µm (OTTE et al. 2013).

***Candelariella subdeflexa* (Nyl.) Lettau**

Ohrid Basin, Ljubanishta – St. Naum of Ohrid, parking place at monastery, trees at bank of Ohrid lake, 40°54'57"N, 20°44'42"E, alt. 700 m, on bark of *Populus* (JM/7850, PRC).

***Catillaria lenticularis* (Ach.) Th.Fr.**

Mavrovo National Park, Zhirovnica – rocky outcrops along road in Ribnica River valley 1.7 km S of Nistrovo, 41°43'04"N, 20°38'02"E, alt. 920 m, on shady calcareous rock (dep. *Protoblastenia lilacina*, JM/7839). Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path 1 km SE of dam, c. 41°56'40"N, 21°18'14"E, alt. 340 m, on limestone rock (JM/7763).

***Catillaria nigroclavata* (Nyl.) J.Steiner**

Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path 1.8 km SSE of dam, 41°56'10"N, 21°18'03"E, alt. 360 m, on bark of *Fraxinus ornus* (dep. *Candelariella lutella*, JM/7784). Ohrid Basin, Ljubanishta – St. Naum of Ohrid, parking place at monastery, trees at bank of Ohrid lake, 40°54'57"N, 20°44'42"E, alt. 700 m, on bark of *Populus* (dep. *Candelariella subdeflexa*, JM/7850). Mavrovo National Park, Zhirovnica – in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on branch of *Salix eleagnos* (JM/7718). Suva Gora Mts, Shishevo – trees along Treska River, parking place near in the starting point to Matka canyon, 41°57'41"N, 21°17'49"E, alt. 300 m, on bark of *Alnus* (JM/7799).

***Chaenotheca brachypoda* (Ach.) Tibell**

Galičica National Park, Stenje – tourist path in oak forests 2.5 km W of village, NE-facing slopes of Mt Magaro, 40°56'46"N, 20°52'16"E, alt. 1150 m, on bark of very old *Quercus cerris* (JM/7965).

***Fuscopannaria mediterranea* (Tav.) P.M.Jørg.**

Mavrovo National Park, Zhirovnica – beech forest in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on mosses on *Fagus sylvatica* (JM/7729).

***Gabura fascicularis* (L.) P.M.Jørg. (= *Collema fasciculare*)**

Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'10"N, 20°50'33"E, alt. 1500 m, on bark of old *Fagus sylvatica* (JM/7954).

***Gyalecta croatica* Zahlbr.**

Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'10"N, 20°50'33"E, alt. 1500 m, on bark of old *Fagus sylvatica* (JM/7955).

Gyalecta croatica is nowadays regarded as a synonym for *G. derivata* (e.g. WIRTH et al. 2013). However, we follow the concept of VĚZDA (1958), who distinguished both species based on the ascospores shape and septation (8-septate and broader spores in *G. croatica*, 9–13-septate in *G. derivata*). *Gyalecta croatica* has been described from Croatia (ZAHLEBRUCKNER 1905) and afterwards reported from two Balkan countries: Bulgaria (PIŠÚT 1969) and Montenegro (e.g. SERVÍT 1931); probably also several other records of *G. derivata* (e.g. GRUBE et al. 2001, SAVIĆ 2001, HAFELLNER & KASHTA 2003, BILOVITZ & MAYRHOFER 2010) might belong to *G. croatica*.

***Gyalecta fagicola* (Hepp) Kremp.**

Galičica National Park, Stenje – tourist path in oak forests 2.5 km W of village, NE-facing slopes of Mt Magaro, 40°56'46"N, 20°52'16"E, alt. 1150 m, on bark of very old *Quercus cerris* (JM/7970). Mavrovo National Park, Zhirovnica – beech forest in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on bark of *Fagus sylvatica* (dep. *Lecania cyrtella*, JM/7734).

***Gyalecta geoica* (Wahlenb. ex Ach.) Ach.**

Mavrovo National Park, Zhirovnica – rocky outcrops along road in Ribnica River valley 1.7 km S of Nistrovo, 41°43'04"N, 20°38'02"E, alt. 920 m, on shady calcareous rock (JM/7836).

Halecania viridescens Coppins & P.James

Mavrovo National Park, Zhirovnica – in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on branch of *Salix eleagnos* (dep. *Bacidia arceutina*, JM/7719).

This species is usually sterile and forms green soralia with a distinct Pd⁺ red reaction due to the presence of argopsin. Soredia are farinose and the surface hyphae have grey- to dark brown walls (FLETCHER & COPPINS 2009) what gives the typical appearance of the species. *Halecania viridescens* occurs in nitrophytic communities on broad-leaved trees (e.g. *Fraxinus*, *Populus*, *Salix*), especially on twigs and branches. It can be easily overlooked or misidentified for *Scoliciosporum sarothamni*, but its soralia are Pd⁻ and usually C⁺ reddish. *Halecania viridescens* is a widespread species in Central and Western Europe (e.g. FLETCHER & COPPINS 2009, WIRTH et al. 2013) and surprisingly, it has not yet been reported from the Balkan Peninsula.

Immersaria* aff. *athrocarpa (Ach.) Rambold & Pietschm.

Mavrovo National Park, Zhirovnica – in deep valley of a river S of Ribnica village, 41°42'56"N, 20°36'40"E, alt. 960 m, on calcareous slate rock (JM/7717).

This taxon (Fig. 1) does not fully correspond to any described *Immersaria* (see for example CALATAYUD & RAMBOLD 1998, VALADBEIGI et al. 2011), but it shares most characters with *I. athrocarpa*, from which it differs in the brown hypothecium and large apothecia (up to 1.5 mm) with a thick thalline exciple (up to 0.2 mm). Confluent and 2'-0-methylmicrophyllinic acids were detected by TLC. It possibly represents an undescribed species or alternatively, it could be a very atypical form of *I. athrocarpa* or a chemotype of *I. cupreoatra*. Both species have already been reported from Macedonia several times (see MAYRHOFER et al. 2013). The nrITS and mtSSU sequences of the Macedonian specimen were placed into GenBank for future studies.

Lecania cyrtella (Ach.) Th.Fr.

Mavrovo National Park, Zhirovnica – beech forest in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on bark of *Fagus sylvatica* (JM/7734).



Fig. 1. Habitus of *Immersaria* aff. *athrocarpa*; specimen JM/7717. Scale = 1 mm. Photo by J. Malíček.

***Lecania naegelii* (Hepp) Diederich & P.Boom**

Suva Gora Mts, Shishevo – trees along Treska River, parking place near in the starting point to Matka canyon, 41°57'41"N, 21°17'49"E, alt. 300m, on bark of *Alnus* (JM/7800).

***Lecania sambucina* (Körb.) Zahlbr.**

Mavrovo National Park, Zhirovnica – valley of Ribnica River 1.9km SSE of Nistrovo, 41°42'55"N, 20°38'26"E, alt. 900m, on bark of *Salix eleagnos* (JM/7840).

!*Lecanora albula* (Nyl.) Hue

Šar Planina Mts, Tetovo – Popova Šapka: alpine vegetation in glacial cirque 2km WSW of village, 42°00'30"N, 20°51'26"E, alt. 2100m, on limestone rock (JM/7824).

A poorly known species very similar to *Lecanora polytropa*, from which it differs by the greyish-white thallus composed of large areoles or small lobes and larger apothecia (1–2 mm in diam.). *Lecanora albula* is an alpine species occurring on calcareous silicates and rarely directly on limestones (POELT 1958). It has been reported from several countries in Central and Western Europe: Austria (POELT 1958, HAFELLNER & TÜRK 2016), Germany (WIRTH et al. 2013), Czech Republic (VĚZDA 1961), Slovakia (GUTTOVÁ et al. 2013), France (ROUX et al. 2016) and Switzerland (POELT 1958).

***Lecanora horiza* (Ach.) Linds.**

Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path 1.8km SSE of dam, 41°56'10"N, 21°18'03"E, alt. 360m, on bark of *Pistacia terebinthus* (JM/7789, PRC). Suva Gora Mts, Shishevo – trees along Treska River, parking place near in the starting point to Matka canyon, 41°57'41"N, 21°17'49"E, alt. 300m, on bark of *Alnus* (JM/7795*).

***Lecanora leptyroides* (Nyl.) Degel.**

Šar Planina Mts, Tetovo – Popova Šapka: trees along road to Tetovo, 2km NW of village, 42°01'24"N, 20°54'16"E, alt. 1500m, on bark of *Salix alba* (dep. *Caloplaca cerinella*, JM/7713). Suva Gora Mts, Shishevo – Matka canyon,



Fig. 2. Habitus of *Lecanora albula* and *Caloplaca percrocata* (on right side); specimen JM/7824. Scale = 1 mm. Photo by J. Malíček.

deep limestone valley of Treska River, along tourist path in surrounding of dam, 41°57'07"N, 21°17'56"E, alt. 340m, on bark of *Carpinus orientalis* (JM/7775). Suva Gora Mts, Shishevo – trees along Treska River, parking place near in the starting point to Matka canyon, 41°57'41"N, 21°17'49"E, alt. 300m, on bark of *Alnus* (JM/7796). Ohrid Basin, Ljubanishta – St. Naum of Ohrid, parking place at monastery, trees at bank of Ohrid lake, 40°54'57"N, 20°44'42"E, alt. 700m, on bark of *Populus* (JM/7853).

***Lecanora subcarpineae* Szatala**

Šar Planina Mts, Tetovo – Popova Šapka: beech forest at camping place 1,5 km NE village, 42°01'21"N, 20°54'08"E, alt. 1550m, on bark of *Fagus sylvatica* (JM/7825). Šar Planina Mts, Tetovo – Popova Šapka: trees along road between village and Shipkovnica, 42°01'24"N, 20°54'16"E, alt. 1500m, on bark of *Salix caprea* (JM/7827). Mavrovo National Park, Zhirovnica – Volkovija: small camping place close to junction of Ribnica and Radika Rivers, trees along river bank, 41°42'32"N, 20°39'01"E, alt. 880m, on bark of *Alnus* (JM/7848). Galičica National Park, Trpejca – N-facing slope of Mt. Magaro covered by beech forest 3.2 km ESE of village, c. 40°56'53"N 20°49'07"E, alt. 1700m, on bark of *Fagus sylvatica* (JM/7926).

***Lepraria diffusa* (J.R.Laundon) Kukwa**

Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path in surroundings of dam, 41°57'07"N, 21°17'56"E, alt. 340m, on mosses and soil on limestone rock (JM/7758*).

This is one of a few *Lepraria* species with a yellowish thallus and preferring basic substrata. In the field, it can be easily confused with *L. eburnea*, *L. nivalis* and *L. vouauxii*. All these species have a positive orange or red reaction with Pd and occur frequently on limestone overhangs, on bryophytes, plant debris, soil or directly on rocks. Therefore, it is necessary to analyze all collections by TLC. *Lepraria diffusa* is a widespread, but generally rare and locally occurring lichen in Europe (e.g. KUKWA 2006, ORANGE & LAUNDON 2009, WIRTH et al. 2013, NIMIS & MARTELOS 2017). The collected specimen contained 4-oxypannaric acid 2-methylester, the characteristic substance for this species.

***Lepraria eburnea* J.R.Laundon**

Mavrovo National Park, Zhirovnica – beech forest in deep valley of a river 1.5 km S of Bibaj village, 41°42'59"N, 20°37'44"E, alt. 940m, on overhang of calcareous slates (JM/7755*). Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path 1-2 km SSE of dam, c. 41°56'35"N, 21°18'16"E, alt. 350m, on calcareous soil (JM/7792*).

***Lepraria nivalis* J.R.Laundon**

Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path in surrounding of dam, 41°57'07"N, 21°17'56"E, alt. 340m, on mosses and soil on limestone rock (JM/7760*). Šar Planina Mts, Tetovo – Popova Šapka: alpine vegetation in glacial cirque 2 km WSW of village, 42°00'30"N, 20°51'26"E, alt. 2100m, on calcareous soil and plant debris (JM/7821).

***Lepraria rigidula* (de Lesd.) Tønsberg**

Galičica National Park, Trpejca – N-facing slope of Mt. Magaro covered by beech forest 3.2 km ESE of village, c. 40°56'53"N 20°49'07"E, alt. 1700m, on bark of *Fagus sylvatica* (JM/7915). Galičica National Park, Trpejca – N-facing slope of Mt Magaro covered by beech forest 3.2 km ESE of village, c. 40°56'53"N 20°49'07"E, alt. 1700m, at base of *Fagus sylvatica* (JM/7918*).

***Lepraria vouauxii* (Hue) R.C.Harris**

Šar Planina Mts, Tetovo – Popova Šapka: alpine vegetation in glacial cirque 2 km WSW of village, 42°00'30"N, 20°51'26"E, alt. 2100m, on mosses on limestone overhang (JM/7815*).

***Leproplaca chrysodeta* (Vain. ex Räsänen) J.R.Laundon**

Mavrovo National Park, Zhirovnica – beech forest in deep valley of a river 1.5 km S of Bibaj village, 41°42'59"N, 20°37'44"E, alt. 940m, on overhang of calcareous slates (dep. *Lepraria eburnea*, JM/7755).

***Leptochidium albociliatum* (Desm.) M.Choisy**

Mavrovo National Park, Zhirovnica – in deep valley of Ribnica River S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970m, on bark of old *Betula pendula* (JM/7828).

***Lobarina scrobiculata* (Scop.) Nyl. ex Cromb.**

Mavrovo National Park, Zhirovnica – in deep valley of Ribnica River S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970m, on bark of *Quercus cerris* (JM/7831, PRC).

***Micarea denigrata* (Fr.) Hedl.**

Galičica National Park, Trpejca – N-facing slope of Mt. Magaro covered by beech forest 3.2 km ESE of village, c. 40°56'53"N 20°49'07"E, alt. 1700 m, on wood of *Fagus* (JM/7922). Galičica National Park, Trpejca – mountain pastures on limestone along tourist path 3 km E of village, 40°57'12"N, 20°49'08"E, alt. 1540 m, on stump of *Juniperus* (JM/7929).

***Myriolecis reuteri* (Schaer.) Šliwa, X.Zhao & Lumbsch (= *Lecanora reuteri*)**

Šar Planina Mts, Tetovo – Popova Šapka: alpine vegetation in glacial cirque 2 km WSW of village, 42°00'30"N, 20°51'26"E, alt. 2100 m, on vertical limestone rock (JM/7810).

***Myriolecis sambuci* (Pers.) Clem. (= *Lecanora sambuci*)**

Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'16"N, 20°50'17"E, alt. 1500 m, on decaying bark of *Fagus* (JM/7948).

! *Normandina acroglypta* (Norman) Aptroot

Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path 1 km SE of dam, c. 41°56'40"N, 21°18'14"E, alt. 340 m, on liverworts on *Ostrya carpinifolia* (JM/7768).

Normandina acroglypta resembles several other mostly sterile lichens without a spot reaction of the soralia, e.g. *Lecania croatica* and *Mycobilimbia epixanthoides*. However, the thallus is not continuous, areolate-subsquamulose at least in part, or rarely almost indistinct. It can be easily overlooked when perithecia are absent. The species grows on shaded rocks and tree trunks covered by bryophytes, especially by liverworts. It prefers humid sites, in more continental areas usually deep river valleys. In Europe it is common in oceanic regions like the British Isles and Scandinavia, rare in inland and Southern Europe (GBIF 2017).

***Ochrolechia turneri* (Sm.) Hasselrot**

Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'10"N, 20°50'33"E, alt. 1500 m, on bark of old *Fagus sylvatica* (JM/7958*).

***Opegrapha vulgata* Ach.**

Galičica National Park, Trpejca – N-facing slope of Mt. Magaro covered by beech forest 3.2 km ESE of village, c. 40°56'53"N 20°49'07"E, alt. 1700 m, on bark of *Fagus sylvatica* (dep. *Caloplaca substerilis*, JM/7920).

! *Parmelia barrenoae* Divakar, M.C.Molina & A.Crespo

Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'16"N, 20°50'17"E, alt. 1500 m, on bark of *Fagus sylvatica* (JM/7933).

Parmelia barrenoae is a closely related species to the common *P. sulcata*. However, *P. barrenoae* differs in simple to furcate rhizines, revolute older lobes and only laminar soralia (DIVAKAR et al. 2005). This species was not distinguished from *P. sulcata* in the past, but after its description (DIVAKAR et al. 2005), it has been reported from several countries in Western and Central Europe (see ŠOUN et al. 2015 and OSSOWSKA & KUKWA 2016). The identification of *P. barrenoae* was confirmed by mtSSU region.

***Parmelia ernstiae* Feuerer & A.Thell**

Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'16"N, 20°50'17"E, alt. 1500 m, on bark of *Fagus sylvatica* (JM/7938*).

***Parmelia submontana* Hale**

Mavrovo National Park, Zhirovnica – beech forest in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on bark of *Fagus sylvatica* (JM/7725).

***Parmeliella triptophylla* (Ach.) Müll.Arg.**

Mavrovo National Park, Zhirovnica – in deep valley of Ribnica River S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on bark of old *Betula pendula* (JM/7829).

***Peltigera ponojensis* Gyeln.**

Šar Planina Mts, Tetovo – Popova Šapka: alpine vegetation at the beginning of glacial cirque 2 km SW of village, 42°00'53"N, 20°52'11"E, alt. 2060 m, on ±calcareous soil (JM/7704).

Pertusaria coccodes (Ach.) Nyl.

Mavrovo National Park, Zhirovnica – beech forest in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on bark of *Alnus* (JM/7735).

Pertusaria coronata (Ach.) Th.Fr.

Galičica National Park, Trpejca – N-facing slope of Mt. Magaro covered by beech forest 3.2 km ESE of village, c. 40°56'53"N 20°49'07"E, alt. 1700 m, on bark of *Fagus sylvatica* (JM/7919). Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'10"N, 20°50'33"E, alt. 1500 m, on bark of old *Fagus sylvatica* (JM/7956).

Placidium squamulosum (Ach.) Breuss

Šar Planina Mts, Tetovo – Popova Šapka: alpine vegetation in glacial cirque 2 km WSW of village, 42°00'30"N, 20°51'26"E, alt. 2100 m, on calcareous soil (JM/7812).

Placyntiella dasaea (Stirt.) Tønsberg

Galičica National Park, Trpejca – N-facing slope of Mt. Magaro covered by beech forest 3.2 km ESE of village, c. 40°56'53"N 20°49'07"E, alt. 1700 m, on wood of *Fagus* (JM/7921).

Polyblastia cupularis A.Massal.

Šar Planina Mts, Tetovo – Popova Šapka: alpine vegetation in glacial cirque 2 km WSW of village, 42°00'30"N, 20°51'26"E, alt. 2100 m, on basic siliceous stone (JM/7706).

Polyblastia dermatodes A.Massal.

Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path 1 km SE of dam, c. 41°56'40"N, 21°18'14"E, alt. 340 m, on limestone rock (JM/7774).

Protoblastenia lilacina Poelt & Vězda

Mavrovo National Park, Zhirovnica – rocky outcrops along road in Ribnica River valley 1.7 km S of Nistrovo, 41°43'04"N, 20°38'02"E, alt. 920 m, on shady calcareous rock (JM/7839, rev. Z. Palice 2015).

On the Balkan Peninsula this taxon was only known from the type locality on the Island of Korčula in Croatia and from Greece (ABBOTT 2009). It is a rather poorly known species of sunny calcareous rocks below the subalpine belt (NIMIS 2016, HAFELLNER & TÜRK 2016). It is also reported from Austria, Germany and Italy (KAINZ & RAMBOLD 2004).

Pseudoschismatomma rufescens (Pers.) Ertz & Tehler (= *Opegrapha rufescens*)

Mavrovo National Park, Zhirovnica – beech forest in deep valley of a river S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on bark of *Alnus* (JM/7737). Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path 1 km SE of dam, c. 41°56'40"N, 21°18'14"E, alt. 340 m, on bark of *Ostrya carpinifolia* (JM/7765).

Rinodina albana (A.Massal.) A.Massal.

Šar Planina Mts, Tetovo – Popova Šapka: beech forest at camping place 1.5 km NE village, 42°01'21"N, 20°54'08"E, alt. 1550 m, on bark of *Fagus sylvatica* (JM/7709).

Rinodina conradii Kərb.

Šar Planina Mts, Tetovo – Popova Šapka: alpine vegetation along tourist path 1 km W of village, 42°00'53"N, 20°52'11"E, alt. 1950 m, on mosses (JM/7705).

Sarcogyne fallax H.Magn.

Mavrovo National Park, Zhirovnica – rocky outcrops along road 1.5 km in Ribnica River valley S of Bibaj village, 41°42'59"N, 20°37'44"E, alt. 940 m, on overhang of calcareous slates (JM/7833).

Sarcogyne fallax belongs to those members of the genus with globose ascospores. It is distinguished by its pruinose apothecia without carbonized tissues, absence of the thallus and a high hymenium, exceeding 100 µm (MAGNUSSON 1935). Macroscopically, it resembles the common *S. regularis*. In Europe, it is a widespread, but rare lichen occurring on calcareous rocks (e.g. MAGNUSSON 1936, HAFELLNER & TÜRK 2016).

Sclerophora pallida (Pers.) Y.J.Jao & Spooner

Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'16"N, 20°50'17"E, alt. 1500 m, on decaying bark of *Fagus* (JM/7947, PRC). Galičica National Park, Stenje – tourist path in oak forests 2.5 km W of village, NE-facing slopes of Mt Magaro, 40°56'46"N, 20°52'16"E, alt. 1150 m, on bark of very old *Quercus cerris* (JM/7960).

Schaereria corticola Muhr & Tønberg

Mavrovo National Park, Zhirovnica – in deep valley of Ribnica River S of Ribnica village, 41°43'00"N, 20°36'23"E, alt. 970 m, on bark of old *Betula pendula* (JM/7830*).

This species is characterized by its punctiform, usually convex, brown soralia and small (up to 0.3 mm), black, lecideoid apothecia (TØNSBERG 1992). The record of *Schaereria corticola* was quite surprising because it is more or less restricted to oceanic parts of Europe (Scandinavia, Scotland) and the Canary Islands (TØNSBERG 1992, KLEPSLAND & TØNSBERG 2014). However, it has been also reported from a very humid region in the Austrian Alps (TØNSBERG et al. 2001). The sterile Macedonian specimen was compared with typical material from Norway and tested by TLC (gyrophoric and 5-0-methylhiassic acids confirmed). The ecology corresponds well too. It occurred on acidic bark of a birch in a humid mountain valley.

Scytinium schraderi (Bernh.) Otálora, P.M.Jørg. & Wedin (= *Leptogium schraderi*)

Vardar River valley, Negotino – Krivolak: steppe grasslands at right bank of the river, NE of the village, 41°32'15"N, 22°08'19"E, alt. 120-160 m, on calcareous soil (JM/7973).

Thelidium papulare (Fr.) Arnold

Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path 1 km SE of dam, c. 41°56'40"N, 21°18'14"E, alt. 340 m, on limestone rock (JM/7761).

Thelopsis rubella Nyl.

Suva Gora Mts, Shishevo – Matka canyon, deep limestone valley of Treska River, along tourist path 1 km SE of dam, c. 41°56'40"N, 21°18'14"E, alt. 340 m, on bark of *Ostrya carpinifolia* (JM/7767).

Trapeliopsis flexuosa (Fr.) Coppins & P.James

Galičica National Park, Trpejca – mountain pastures on limestone along tourist path 3 km E of village, 40°57'12"N, 20°49'08"E, alt. 1540 m, on stump of *Juniperus* (JM/7930).

Usnea dasopoga (Ach.) Nyl.

Galičica National Park, Trpejca – N-facing slope of Mt. Magaro covered by beech forest 3.2 km ESE of village, c. 40°56'53"N 20°49'07"E, alt. 1700 m, on bark of *Fagus sylvatica* at margin of forest (JM/7911).

Usnea substerilis Motyka

Galičica National Park, Trpejca – tourist path in old beech forest, in valley close to road between Trpejca and Stenje, 40°57'16"N, 20°50'17"E, alt. 1500 m, on bark of *Fagus sylvatica* (JM/7945).

Verrucaria elaeomelaena (A.Massal.) Anzi

Mavrovo National Park, Zhirovnica – valley of Ribnica River 1.9 km SSE of Nistrovo, 41°42'55"N, 20°38'26"E, alt. 900 m, on inundated calcareous boulder (JM/7843).

Verrucaria funckii (Spreng.) Zahlbr.

Mavrovo National Park, Zhirovnica – valley of Ribnica River 1.9 km SSE of Nistrovo, 41°42'55"N, 20°38'26"E, alt. 900 m, on inundated slate boulder (JM/7841).

Verrucaria praetermissa s.lat.

Mavrovo National Park, Zhirovnica – valley of Ribnica River 1.9 km SSE of Nistrovo, 41°42'55"N, 20°38'26"E, alt. 900 m, on inundated slate boulder (JM/7842).

Verrucaria sphaerospora Anzi

Šar Planina Mts, Tetovo – Popova Šapka: close to W margin of recreation area, 42°00'50"N, 20°52'31"E, alt. 1800 m, on mosses on calcareous outcrop (JM/7807).

Discussion

Seventy-seven lichens were recorded for the first time from Macedonia. *Candelariella aggregata*, *Halecania viridescens*, *Lecanora albula*, *Lepraria diffusa*, *Normandina acroglypta*, *Parmelia barrenoae*, *Sarcogyne fallax* and *Schaereria corticola* are new to the Balkan Peninsula. Most of the species reported here are crustose, some of them even very inconspicuous (e.g. *Verrucaria*) or sorediate without apothecia (e.g. *Lepraria*). Currently, 675 lichens are known from this country. The high number of additions found during a short fieldwork suggests that this number is still a strong underestimation and the total lichen diversity of Macedonia may reach in fact more than 1500 species in view of its extremely diversified geomorphological and geological conditions.

Primeval and old-growth forests on slopes of Mt Magaro in the Galičica National Park were the most interesting sites with epiphytes. Old beeches harboured several old-growth forest species, e.g. *Bacidia vermifera*, *Chaenotheca brachypoda*, *Gyalecta croatica* and *Sclerophora pallida*; rare cyanolichens like *Collema nigrescens* (Huds.) DC., *Gabura fascicularis*, *Leptogium saturninum* (Dicks.) Nyl., *Nephroma resupinatum* (L.) Ach., and several other noteworthy species, e.g. *Evernia divaricata* (L.) Ach., *Chromatochlamys muscorum* (Fr.) H.Mayrhofer & Poelt and *Ochrolechia tartarea* (L.) A.Massal., confirmed by TLC as well. A few very old oaks were explored at lower elevations below 1200 m a.s.l.; species that occurred there included *Bacidia circumspecta*, *Caloplaca monacensis*, *Gyalecta fagicola*, *G. ulmi* (Sw.) Zahlbr. and *Sclerophora pallida*.

A deep river valley in the surrounding of Ribnica in the Mavrovo National Park was another locality rich in epiphytic lichens, especially in cyanolichens, e.g. *Fuscopannaria mediterranea*, *Lobaria pulmonaria*, *Lobarina scrobiculata*, *Nephroma resupinatum*, *Scytinium lichenoides* (L.) Otálora, P.M.Jørg. & Wedin s.str., *Leptochidium albociliatum* and *Parmeliella triptophylla*. Saxicolous lichens were studied on a few low limestone outcrops. *Leproplaca xantholyta* (Nyl.) Hue, *Gyalecta geoica*, *Myriolecis pruinosa* (Chaub.) Šliva, X.Zhao & Lumbsch, *Protoblastenia lilacina* and *Sarcogyne fallax* represent remarkable species from these habitats.

The deep limestone valley of the Treska River, the Matka canyon in the Suva Gora Mts, is a site with Mediterranean lichen biota. Lichens were collected mostly on *Fraxinus ornus*, *Ostrya carpinifolia* and *Pistacia terebinthus*. *Anisomeridium biforme*, *Arthopyrenia cinereo-pruinosa*, *Bacidia fraxinea*, *Candelariella lutella* (Vain.) Räsänen, *Lecanora horiza*, *Normandina acroglypta* and *Thelopsis rubella* represent less common corticolous species. Limestone rocks were rich in sorediate and pyrenocarpous lichens, e.g. *Lepraria diffusa*, *L. eburnea*, *L. nivalis*, *Polyblastia dermatodes* and *Thelidium papulare*. In the valley, outcrops of basic silicates, with *Pertusaria leucosora* Nyl. for example, occur as well.

In the Šar Planina Mts, lichens were collected in the surroundings of Popova Šapka. On bryophytes covering limestone rocks occurred e.g. *Caloplaca sinapisperma*, *Candelariella aggregata*, *Physconia muscigena* (Ach.) Poelt and *Rinodina conradii*. A glacial cirque 2 km from Popova Šapka dominated by limestone rocks was explored more in detail; *Bilimbia lobulata* (Schaer.) Hafellner & Coppins, *Calogaya biatorina* (A.Massal.) Arup, Fröden & Söchting, *Caloplaca australis* (Arnold) Zahlbr., *C. percrocata* (Arnold) J.Steiner, *Catapyrenium cinereum* (Pers.) Körb., *Gyalolechia bracteata* (Hoffm.) A.Massal., *Lecanora albula*, *Lepraria nivalis*, *Myriolecis reuteri*, *Pyrenodesmia albopruinosa* (Arnold) ined. and *Staurothele areolata* (Ach.) Lettau are examples of the most valuable records.



Fig. 3. The Matka canyon in the Suva Gora Mts. Photo by J. Maliček.



Fig. 4. Rocky slopes of a glacial cirque in the Šar Planina Mts close to Popova Šapka. Photo by J. Maliček.

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