

A contribution to lichen diversity in North Macedonian mountainous areas

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Abstract

The collection of field data is crucial to deepen the knowledge about the distribution and abundance of organisms. Since the lichen diversity of the North Macedonian mountains still is rather poorly investigated, this thesis seeks to provide further insights thereto, especially focusing on Korab, Shar Planina, Jakupica, Pelister, Kajmakchalan and Voras. All these mountains are over 2500 m a.s.l., except Voras. A collecting trip was carried out in summer 2017 with an emphasis on hilltop positions taking into consideration the alpine belts and additional sites along the way to the summits. The fieldwork resulted in an output of 1200 samples. 386 taxa were identified whereof 101 taxa are new lichen records and 8 are new lichenicolous fungi for North Macedonia. The amount of lichens known from North Macedonia has risen to 785 taxa (including 6 subspecies, 17 varieties and 2 forma) and the number of lichenicolous fungi to 32.

New lichen records: *Acarospora peliscypha*, *Allocetraria madreporiformis*, *Amandinea punctata* f. *musciola*, *Anaptychia setifera*, *Arthonia mediella*, *Arthrorhaphis alpina*, *A. citronella*, *Aspicilia caesiocinerea*, *A. simoensis*, *A. supertegens*, *Bacidia bagliettoana*, *Bellemerea cinereorufescens*, *B. sanguinea*, *Biatora beckhausii*, *Bilimbia microcarpa*, *Bryobilimbia hypnorum*, *Buellia disciformis*, *Caloplaca brachyspora*, *C. cerinelloides*, *C. herbidella*, *C. tetraspora*, *Candelariella faginea*, *C. plumbea*, *Carbonea vorticosa*, *Catillaria picila*, *Cephalophysia leucospila*, *Cetraria sepincola*, *Chaenotheca trichialis*, *Cladonia borealis*, *C. mitis*, *C. pleurota*, *Cliostomum corrugatum*, *Coenogonium pineti*, *Dacampia hookeri*, *Dermatocarpon arnoldianum*, *Diplotomma lutosum*, *Epilichen scabrosus*, *Euopsis pulvinata*, *Gyalecta jenensis*, *Gyalolechia epiphyta*, *Koerberiella wimmeriana*, *Lecanora cadubriae*, *L. circumborealis*, *L. epanora*, *L. impudens*, *L. printzenii*, *L. rupicola* subsp. *subplanata*, *L. sarcopidoides*, *L. symmicta*, *Lecidea berengeriana*, *L. diducens*, *L. sarcogynoides*, *L. speiroides*, *Lecidella elaeochroma* var. *flavicans*, *L. flavosorediata*, *L. wulfenii*, *Lecidoma demissum*, *Lepra excludens*, *L. alpine*, *L. borealis*, *L. celata*, *L. elobata*, *L. granulata*, *Leptogium cyanescens*, *Lopadium pezizoideum*, *Micarea misella*, *Miriquidica intrudens*, *Mycobilimbia tetramera*, *Ochrolechia androgyna*, *O. upsaliensis*, *Parmeliopsis hyperopta*, *Peltigera lepidophora*, *P. membranacea*, *Phaeorrhiza nimbosea*, *Placynthiella icmalea*, *Placynthium dolichoterum*, *Polysporina urceolata*, *Porpidia crustulata*, *Protoparmelia badia* var. *cinereobadia*, *Protoparmeliopsis peltata*, *Pseudevernia furfuracea* var. *ceratea*, *Psorinia conglomerata*, *Psoroma tenue*, *Pycnora praestabilis*, *Pyrenula nitidella*, *Rhizocarpon badioatrum*, *R. ferax*, *R. lecanorinum*, *R. macrosporum*, *R. postumum*, *Rinodina exigua*, *R. mniaroeiza*, *R. orculata*, *R. roscida*, *Ropalospora viridis*, *Sarcogyne hypophaea*, *Tetramelas chloroleucus*, *Thelidium pyrenophorum*, *Toninia nordlandica*, *T. rosulata*, *Trapeliopsis granulosa*, *Umbilicaria maculata*, *U. subpolyphylla*, *Varicellaria lactea*, *V. transfugiens* and *Xylographa pallens*.

New lichenicolous fungi records: *Carbonea supersparsa*, *Cercidospora epipolytropia*, *Intralichen christiansenii*, *Lichenocodium erodens*, *Lichenothelia rugosa*, *Muellerella pygmaea* var. *athallina*, *Nigropuncta rugulosa*, *Stigmidium schaeferi*

Zusammenfassung

Die Erhebung von Felddaten ist für das Wissen über das Vorkommen und die Verbreitung von Organismen von grundlegender Bedeutung. Um den Mangel an Informationen über die Flechten der nordmazedonischen Gebirge zu verringern, wurden die Gebirgsstöcke Korab, Shar Planina, Jakupica, Pelister, Kajmakchalan und Voras als Exkursionsziele ausgewählt. Mit Ausnahme des Voras erheben sich alle genannten Gebirge auf mehr als 2500 Meter. Die Sammelexkursion wurde im Sommer 2017 durchgeführt. Der Schwerpunkt der Feldarbeit lag in den Gipfellagen unter besonderer Berücksichtigung der alpinen Höhenstufe und zusätzlichen ausgewählten Standorten am Weg zu den Gipfelregionen. Etwa 1 200 Belege wurden gesammelt. 386 Taxa wurden bestimmt. Darunter sind 101 neue Nachweise von Flechten und 8 von lichenicolen Pilzen. Damit erhöht sich die Zahl, der aus Nordmazedonien bekannten Flechten, auf 785 Taxa (mit 6 Unterarten, 17 Varietäten, und 2 Formen) und die an lichenicolen Pilzen auf 32 Taxa.

Neue Flechtennachweise *Acarospora peliscypha*, *Allocetraria madreporiformis*, *Amandinea punctata* f. *muscicola*, *Anaptychia setifera*, *Arthonia mediella*, *Arthrorhaphis alpina*, *A. citronella*, *Aspicilia caesiocinerea*, *A. simoensis*, *A. supertegens*, *Bacidia bagliettoana*, *Bellemeria cinereorufescens*, *B. sanguinea*, *Biatora beckhausii*, *Bilimbia microcarpa*, *Bryobilimbia hypnorum*, *Buellia disciformis*, *Caloplaca brachyspora*, *C. cerinelloides*, *C. herbidella*, *C. tetraspora*, *Candelariella faginea*, *C. plumbea*, *Carbonea vorticosa*, *Catillaria picila*, *Cephalophysia leucospila*, *Cetraria sepincola*, *Chaenotheca trichialis*, *Cladonia borealis*, *C. mitis*, *C. pleurota*, *Cliostomum corrugatum*, *Coenogonium pineti*, *Dacampia hookeri*, *Dermatocarpon arnoldianum*, *Diplotomma lutosum*, *Epilichen scabrosus*, *Euopsis pulvinata*, *Gyalecta jenensis*, *Gyalolechia epiphyta*, *Koerberiella wimmeriana*, *Lecanora cadubriae*, *L. circumborealis*, *L. epanora*, *L. impudens*, *L. printzenii*, *L. rupicola* subsp. *subplanata*, *L. sarcopidoides*, *L. symmicta*, *Lecidea berengeriana*, *L. diducens*, *L. sarcogynoides*, *L. speirodes*, *Lecidella elaeochroma* var. *flavicans*, *L. flavosorediata*, *L. wulfenii*, *Lecidoma demissum*, *Leprea excludens*, *L. alpina*, *L. borealis*, *L. celata*, *L. elobata*, *L. granulata*, *Leptogium cyanescens*, *Lopadium pezizoideum*, *Micarea misella*, *Miriquidica intrudens*, *Mycobilimbia tetramera*, *Ochrolechia androgyna*, *O. upsaliensis*, *Parmeliopsis hyperopta*, *Peltigera lepidophora*, *P. membranacea*, *Phaeorrhiza nimbosea*, *Placynthiella icmalea*, *Placynthium dolichoterum*, *Polysporina urceolata*, *Porpidia crustulata*, *Protoparmelia badia* var. *cinereobadia*, *Protoparmeliopsis peltata*, *Pseudevernia furfuracea* var. *ceratea*, *Psorinia conglomerata*, *Psoroma tenue*, *Pycnora praestabilis*, *Pyrenula nitidella*, *Rhizocarpon badioatrum*, *R. ferax*, *R. lecanorinum*, *R. macrosporum*, *R. postumum*, *Rinodina exigua*, *R. mniaroeiza*, *R. orculata*, *R. roscida*, *Ropalospora viridis*, *Sarcogyne hypophaea*, *Tetramelas chloroleucus*, *Thelidium pyrenophorum*, *Toninia nordlandica*, *T. rosulata*, *Trapeliopsis granulosa*, *Umbilicaria maculata*, *U. subpolyphylla*, *Varicellaria lactea*, *V. transfugiens* und *Xylographa pallens*.

Neu nachgewiesene lichenicole Pilze: *Carbonea supersparsa*, *Cercidospora epipolytropia*, *Intralichen christiansenii*, *Lichenocodium erodens*, *Lichenothelia rugosa*, *Muellerella pygmaea* var. *athallina*, *Nigropuncta rugulosa*, *Stigmidium schaeereri*

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Introduction

History and Politics

Surrounded by Kosovo and Serbia in the north, Bulgaria in the east, Greece in the South and Albania in the West, North Macedonia is located on the south-central Balkan. Apart from the Republic of North Macedonia, shown in Figure 1 (DEUTSCHE WELLE 2018) – labelled as Macedonia, highlighted with blue colour – the name Macedonia traditionally refers to a geographical region that includes the Republic of North Macedonia (DANFORTH, L. 2019a).



Figure 1 Macedonia (now North Macedonia) is shown in blue. Shown in grey are other parts of the region, traditionally called Macedonia. Figure by Deutsche Welle, www.dw.com, 2018



Figure 2 Different concepts of Macedonia over time. Defined by a yellow border, the modern approach of the region of Macedonia. Figure by Deutsche Welle, www.dw.com, 2018

The region of Macedonia in a modern approach comprises parts of Bulgaria, Greece and the Republic of North Macedonia, pointed out with a yellow border in Figure 2 (DEUTSCHE WELLE 2018). About 40 percent of the area belong to North Macedonia yet almost 50 percent to

Greece. Historically the name Macedonia refers to the ancient kingdom of Macedonia in the 4th century BC. Later rulers changed frequently; it was part of the Roman, Byzantine, Bulgarian, Serbian and Ottoman Empire, often united in one province. After the Russo-Turkish War in 1878, Bulgaria, Greek and Serbia were claiming the territory. A time of partition and wars followed on the Balkan Peninsula. With the collapse of Yugoslavia, the Republic of Macedonia was established, only including the northern part of the region of Macedonia. Due to disagreements with Greece, the new republic had to accept the provisional designation as “the former Yugoslav Republic of Macedonia”, short FYROM, to join the United Nations (DANFORTH, L. 2019b).

If not indicated otherwise in this thesis, the name Macedonia refers to the Republic of North Macedonia.

This 27-year old name dispute finally came to an end in January 2019 when Prime Minister Zoran Zaev achieved a two-thirds majority to change the name to Republic of North Macedonia. This eventually might enable Macedonia to join the European Union and the NATO (BBC NEWS. 2019). As the Ministry of Foreign Affairs announced on their webpage, a full-fledged membership in the EU and a NATO membership are amongst the main priorities of the country (MINISTRY OF FOREIGN AFFAIRS, REPUBLIC OF NORTH MACEDONIA 2019).

Since 2005, Macedonia has the status of an EU candidate and before May 2020 the European Council will ‘revert to the issue of enlargement’ (GENERAL SECRETARIAT OF THE EUROPEAN COUNCIL 2019).

Geography

People

Macedonia comprises a total area of 25,713 square kilometres. Its exact location in Southern Europe is described above in Figure 1. In 2019 the population of Macedonia was estimated at about 2,083 million by the World Population Review. About 25 percent of the population live in Skopje, the capital city of the country. Other big cities (more than 70,000 people) are Bitola, Kumanovo, Prilep and Tetevo. The population density has been calculated to be about 81 inhabitants per square kilometre. Macedonians form the largest ethnic group, followed by Albanians and Roma. Most people belong to the Macedonian Orthodox Church but a considerable number of 33% are Muslims (WORLD POPULATION REVIEW 2019).

Landscape

Macedonia's geography can be seen in Figure 3 (MELOVSKI et al. 2013). South to West it extends from Anishte (north of Kriva Palanka) to Chengino Kale (east of Berovo) to Markova Noga (east shore of Prespa Lake) and Kestenjar (southwest of Debar) (MELOVSKI et al. 2013).

The relief of Macedonia is characterized by mountains, gorges, valleys and plains. Beside the highest mountain, Golem Korab, which towers 2,752 meters above sea level, Titov Vrv, Pelister, Solunska Glava and Kajmakchalan are four more peaks with 2,500 meters above sea level. Another eight reach 2,000 meters. An overview of Macedonian mountains is given in Figure 4 (MILEVSKI 2015). Pelagonia, the largest plain in the south of the country, extends over 1,357 square kilometers (MELOVSKI et al. 2013).

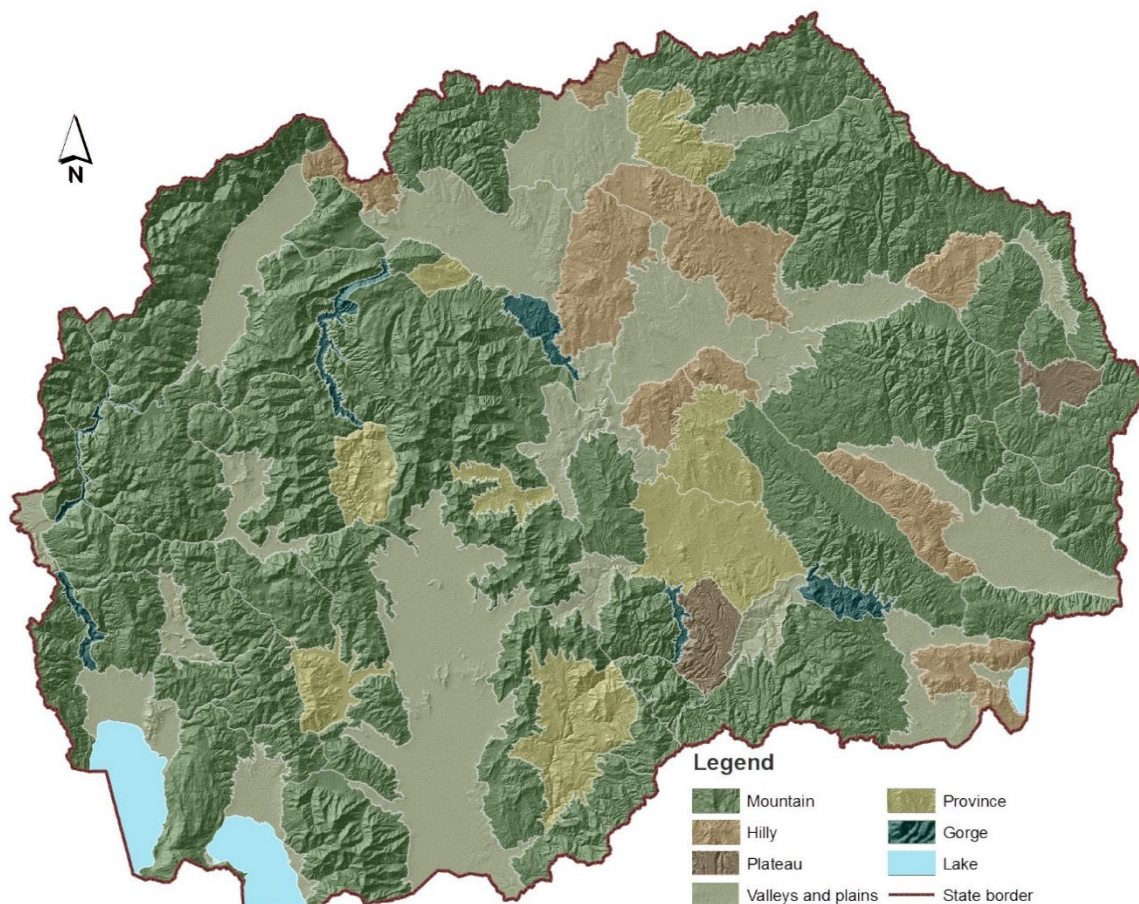


Figure 3 Overview of Macedonian geomorphology. Figure by MELOVSKI, et al. (2013) out of *Macedonian Journal of Ecology and Environment*, Vol. 15.

An overview is given in Figure 3 showing Macedonia, divided into six geomorphological types. These 6 types are mountains (covering most of the area), valleys and plains, province, hilly regions, plateaus and gorges (MELOVSKI et al. 2013).

The Vardar River is the biggest water drainage system in Macedonia. About 90% of the counties' water flows with Vardar into the Aegean Sea. The remaining 10 percent empty into Lake Doiran, the Aegean via other rivers or the Adriatic Sea via Crni Drim River (DANFORTH, L. 2019b).

Geology

In Macedonia four main tectonic zones, the Serbo-Macedonian Massif, the Vardar zone, the Palagonian Massif and the West-Macedonian zone are to be found and were most active in the Alpine orogeny. An overview of these four zones is given in Figure 4 (MILEVSKI 2015). Ongoing geological activities are indicated by frequently occurring earthquakes (DANFORTH, L. 2019a).

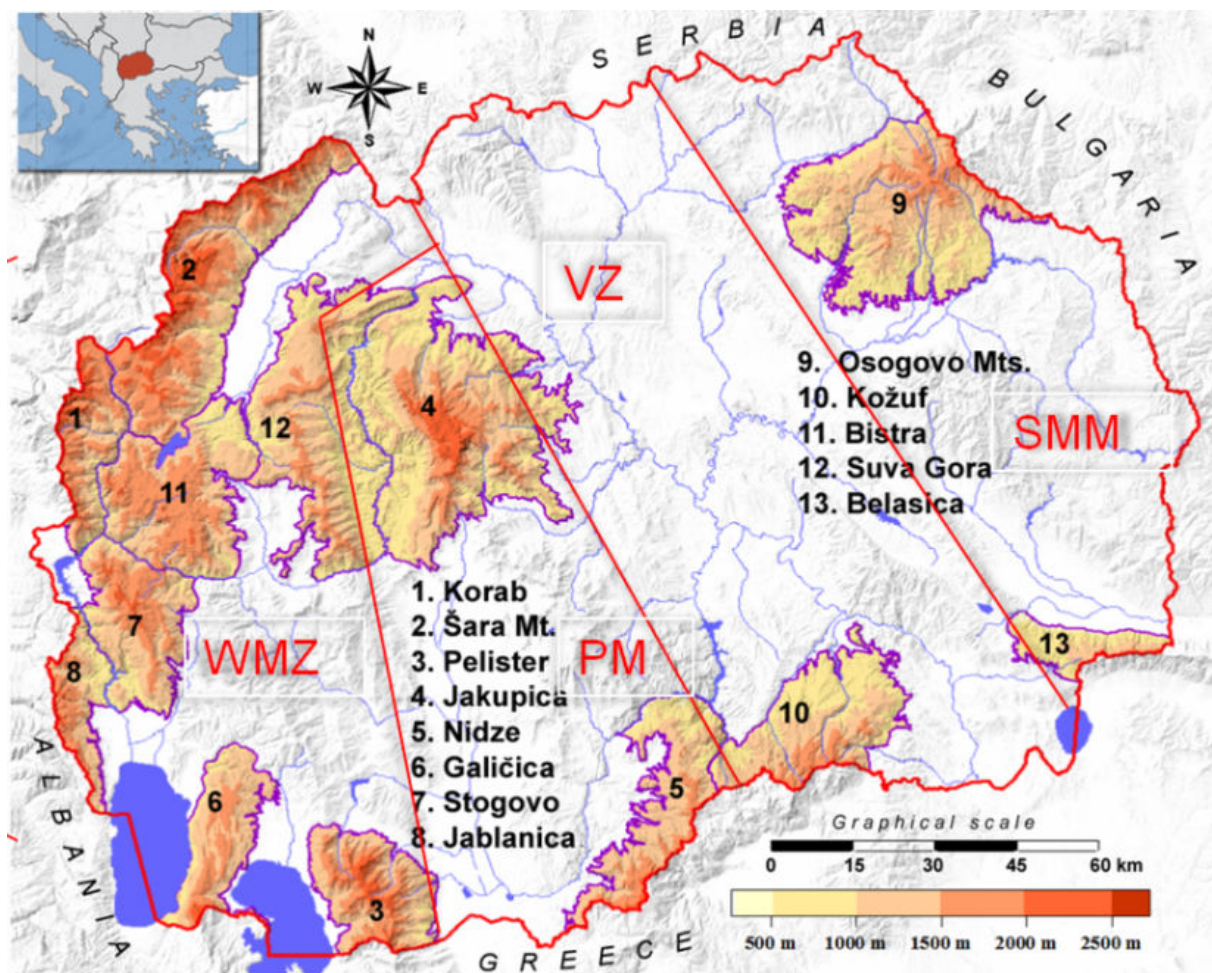


Figure 4 Macedonian Mountains above 2,000 meters height and division of tectonic zones. Figure by Milevski (2015) out of Geographical Reviews Vol. 48.

Serbo-Macedonian Massif

The Serbo-Macedonian Massif is a region of old lithological complexes such as gneisses, mica- and green-schists and amphibolites. Its formation has been connected to intense volcanic activity. Best remnants of paleovolcanic landscapes can be found in the northeast of Macedonia at Kratovo-Zletovo paleovolcanic area and even preserved top calderas on Plavica and Lesnovo. The Serbo-Macedonian Massif, located between the Dinarides and the Carpatho-Balkanides is considered to be a fragment of the Rhodopian Massif (MILEVSKI 2015). During the Carbon and Perm, parts of the Massif were covered by the sea while it was mostly dry land during other geological eras (MELOVSKI et al. 2013).

Vardar zone

The Vardar Zone is a very long lineament reaching from Belgrade to Thessaloniki. This zone includes many fragments of other zones and complexes (MILEVSKI 2015). Parts of this zone were covered by sea water during Carbon, Perm, Mesozoic and Paleogene (MELOVSKI et al. 2013).

West-Macedonian zone

This area is characterized by predominantly carbonaceous formations on the tops and volcanic and sedimentary formations below. 10% of Macedonia's surface consists of carbonate rocks. Most of these carbonate rocks can be found in this zone and the Pelagonian Massive. Therefore, huge karst areas can be found on Galičica Mountain, for example. The West-Macedonian zone includes most of the Macedonian highest mountain massifs (Korab, Šara, Pelister, ...). Hence glaciers existed on many mountains during the Würm ice age and glacial landforms are consequently prevalent. For example, small U-shaped valleys on Korab Mountain or Šara still testify to the glacial erosion. On Shar Planina about 40 lakes of glacial origin occur while Ohrid and Prespa Lake are two remnants of tectonic activity but not glacial relics. Both were tectonically formed during the Aegean crustal extension (MILEVSKI 2015).

Climate

The Climate in Macedonia can be differentiated into three main zones. These are a modified Mediterranean, a moderate continental and a mountainous climate. In all three zones, most precipitation occurs during autumn and winter. The Mediterranean climate dominates the south of Vardar valley but has an influence even on the Skopje plain or the Debar and Ohrid-Struga valley. In this zone, summers are warm and winters are mild. While snow hardly falls in this area, winters are colder in the moderate-continental climate and rain and snow occur frequently. Among others, Prespa and Pelagonia are dominated by this climate regime. Areas above 1,000 meters largely have long and cold winters and short and chilly summers, as it is typical for a mountainous climate. Here snow accounts for most of the precipitation (MELOVSKI et al. 2013). An overview on climate differences between these three climate regimes is given in Figure 5 (CLIMATE-DATA.ORG. no date). The graphs were taken from climate-data.org web page and jointed to make them comparable. From left to right, Dojran (modified Mediterranean climate), Prilep (moderate continental climate) and Mavrovo (mountainous climate) are given. Lines and bigger numbers were inserted to make the data legible.

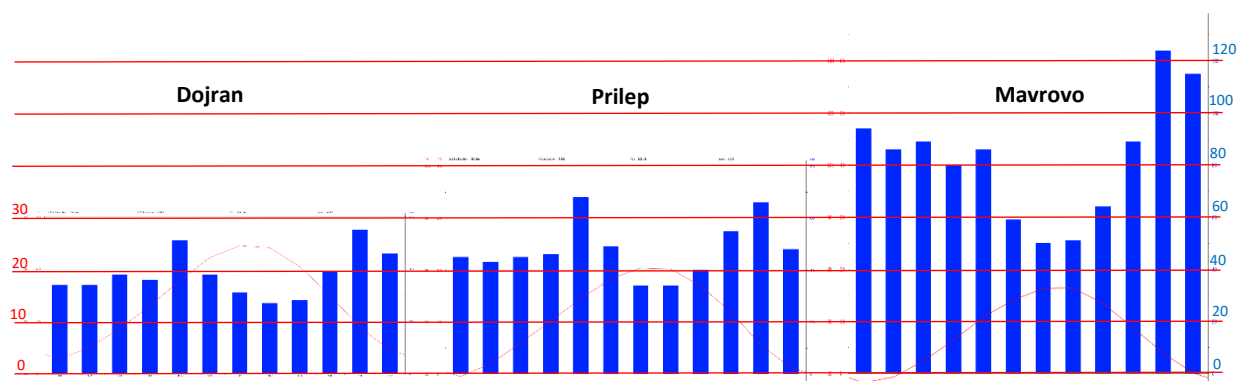


Figure 5 Comparison of 3 climate graphs From left to right: Dojran (alt.: 204m, av.°C: 13.9, prec.: 457mm, modified Mediterranean climate), Prilep (alt.: 656m, av.°C: 10.6, prec.: 573mm, moderate continental climate) and Mavrovo (alt.: 1,247m, av.°C: 7.5, prec.: 987mm mountainous climate). Figure modified from climate-data.org, no date.

In Macedonia average temperatures from 20°C in July to 0°C in January result in a 11°C average annual temperature. Precipitation ranges from 1,400 mm in western parts of Macedonia to less than 500 mm in central Macedonia. Summer droughts with more than 30 days without rain occur every year (MELOVSKI et al. 2013).

For the future the Centre for Atmospheric Research at the University of Nova Gorica predict a substantial increase in summer temperatures while precipitation during summer will decrease considerably. In winter a modest decrease in temperatures will occur with no changes in precipitation (BERGANT 2006).

Pelagonian Massif

Metamorphic crystalline rocks, gneiss, mica-schists and marbles have been forming the Pelagonian Massif, a relic of the Precambrian crust. Karstification and karst landforms occur on Jakupica Mountain and some others (MILEVSKI 2015). The Pelagonian Massif was covered by water during Mesozoic (MELOVSKI et al. 2013).

Vegetation and Biodiversity

Unlike many other European countries, Macedonia still offers many natural and semi-natural habitats. Since about 37% of the Macedonian area is covered by forests, it is especially them which contribute to the Macedonian habitat diversity. Some examples of natural habitats are pseudomauis, thermophyllous oak belts, mesophyllous oak, beech and conifer belts and arctic tundra-like habitats. Wetlands are lost due to melioration activities, except for some Areas like Monospitovo or Blechishta (MELOVSKI et al. 2013).

A comprehensive compilation of the Macedonian diversity is provided in the National Strategy for Nature Protection by MARKOSKI et al. (2018) published by the Ministry of Environment and Physical Planning – Republic of Macedonia. This report, apart from giving information on the current situation of nature protection in Macedonia, should set guidelines for the decade between 2017 and 2027.

Species and endemism

With more than 30 vegetation classes, 60 vegetation orders, 90 alliances and 300 plant associations the Macedonian country, is home to about 3.200 vascular plants. Moreover, there are 2.000 algae species, 2.000 fungi, 500 moss taxa, 13.000 invertebrate and about 550 vertebrate taxa to be found. Particularly endemic species play a major role in nature conservation. Among these endemic species, there are about 120 endemic vascular plants. Compared to the number of other species, the 450 species of lichens found in this study is relatively low. There will be a focus on this topic in the next chapter. Many high mountains, gorges, lowland belts and steppe-like areas are mentioned to be the most important centres of (sub)endemic angiosperm plants (MARKOSKI et al. 2018).

National parks

The beginning of protecting natural resources can be traced back to 1948. Back then, the first national park protected parts of the Pelister Mountain. One year later, Mavrovo national park was proclaimed and in 1958 Galičica followed. Those three national parks still exist and cover about 4.5% of the surface of Macedonia nowadays, although an area of 15% is sought (MARKOSKI et al. 2018).

Threats to biodiversity

Beginning after World War II, dewatering swamps and expansion of agricultural land have become the biggest threats for biodiversity. Subsequently, an expansion of the industry sector became more and more of a problem. Not only mining and the deposition of tailings, but also landfills with hazardous waste destroyed big areas. Re-cultivation, however, was mostly absent. Another threat is the uncontrolled and discontinuous urbanisation in Macedonia. Due to the rising number of people and the considerably greater need for industry, the energy sector and the intensive development of the transport sector have caused environmental destruction (MARKOSKI et al. 2018).

Lichenological history

The first compilation of lichens in Macedonia is from 1953 when KUŠAN (1953) reported 185 lichen species back then. The currently known lichen biota of the country comprises 675 species based on the evaluation of 147 published sources (MAYRHOFER et al. 2016) and additions based on fieldwork as well as the evaluation of ten further publications (MALÍČEK & MAYRHOFER 2017).

Due to extensive fieldwork conducted by Murat Murati in the seventies, the Šar Planina mountain range is the most extensively investigated region of the country with 384 species (PAVLETIĆ & MURATI 1977; MURATI 1979, 1984, 1985; KOBALD 2016; MALÍČEK & MAYRHOFER 2017). 95 species are only known from the subalpine and alpine belts of the Kosovar side of the mountain range which are partly outlined in MAYRHOFER, et al. (2016). A similar diversity of 381 species from the same belts of the Prokletije mountain range of Montenegro and Kosovo is reported by STRASSER et al. (2015).

Several papers containing lichen records have been published since the last additions. Considering these papers (BALABANOVA et al. 2010, 2012, 2014; HUNECK & LISICKÁ 1990; KUŠAN

1932; MALIČEK et al. 2017; MURATI & JUSUFI 2004; OBERMAYER 2017; STEINER & PEVELING 1984; TSCHERMAK-WOESS 1995; WIDMER et al. 2012) seven new taxa for Macedonia have been documented and mentioned. These are the lichens: *Lecanora allophana* (Ach.) Nyl f. *sorediata* Vain. (MALIČEK et al. 2017); *Physcia biziana* (A.Massal.) Zahlbr. (HUNECK & LISICKÁ 1990); *Chaenotheca phaeocephala* (Turner) Th.Fr., *Hypotrachyna revoluta* (Flörke) Hale, *Usnea dasopoga* (Ach.) Nyl. (MURATI & JUSUFI 2004), and the lichenicolous fungi: *Tremella anaptychia* J.C.Zamora & Diederich (ZAMORA et al. 2017), *Teloggalla olivieri* (Vouaux) Nik.Hoffm. & Hafellner (HAFELLNER & MAYRHOFER, in press).

Species which are already documented for Macedonia are not listed. Furthermore, two of the species out of my collection have been published. This applies to *Vulpicida pinastri* (Scop.) J.-E.Mattsson & M.J.Lai (KALTENBÖCK et al. 2018) and *Calicium pinicola* (Tibell) M.Prieto & Wedin (OBERMAYER 2017)

Methods

Collecting

In order to further improve the knowledge about lichen diversity in Macedonia, six different mountain ranges have been chosen for detailed investigations. These areas include Mokra Planina with the highest peak Solunska Glava (2540 m), Šar Planina with peaks around Titov Vrv (2748 m), Korab mountain range with Golem Korab (2764 m), Pelister Mountain with Pelister (2601 m), Kajmakchalan (2524 m) and Kožuf mountain (2171 m). Stops between these sampling points resulted in a few further collecting points. A detailed description of all sampling points will be given.

Between July 15th and August 7th, 2017, about 1200 samples were collected, spread on 35 sampling sites. One more sampling was carried out on October 5th on a fieldtrip to Pelister Mountain, in the course of the “Fungal Conservation in a Changing Europe” meeting in Ohrid.

Locations

As suggested by MELOVSKI et al.(2013), locations will be structured and assigned to the regional divisions, described in this paper. Figure 6 provides an overview of the six chosen sampling areas, not including the few additional stops mentioned before. The borders for regional divisions were taken from the webpage of the MACEDONIAN JOURNAL OF ECOLOGY AND ENVIRONMENT (2019). The map was generated with ArcGIS, an Esri product, and a standard basemap was used for the background. The same data and procedures were used for all following maps.

The locations will be listed approximately in the same order as visited.

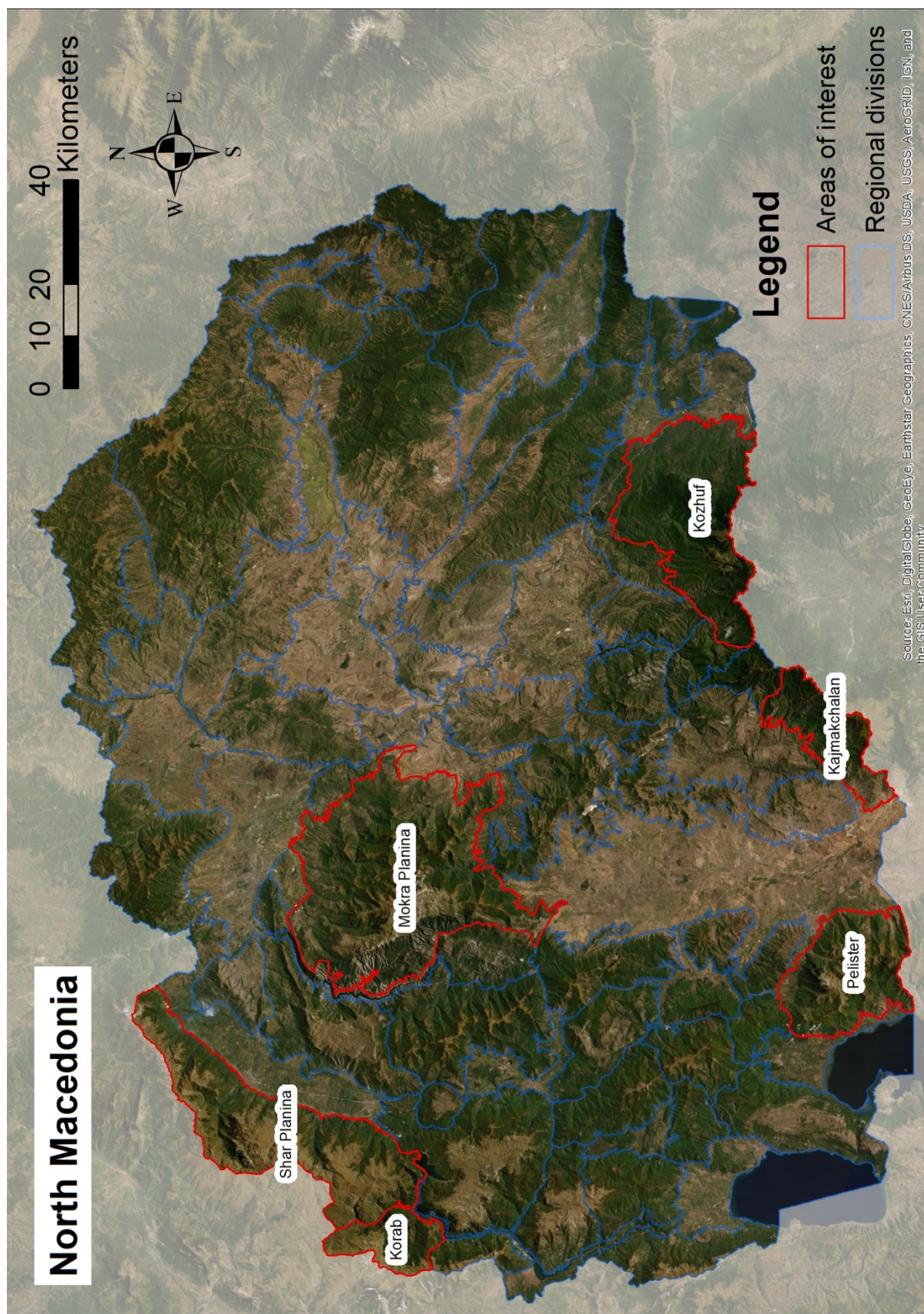


Figure 6 Location of the six chosen sampling areas. Borders of regional division (MELOVSKI, et al. 2013) are added. The background is an ArcGIS standard base map of Esri.

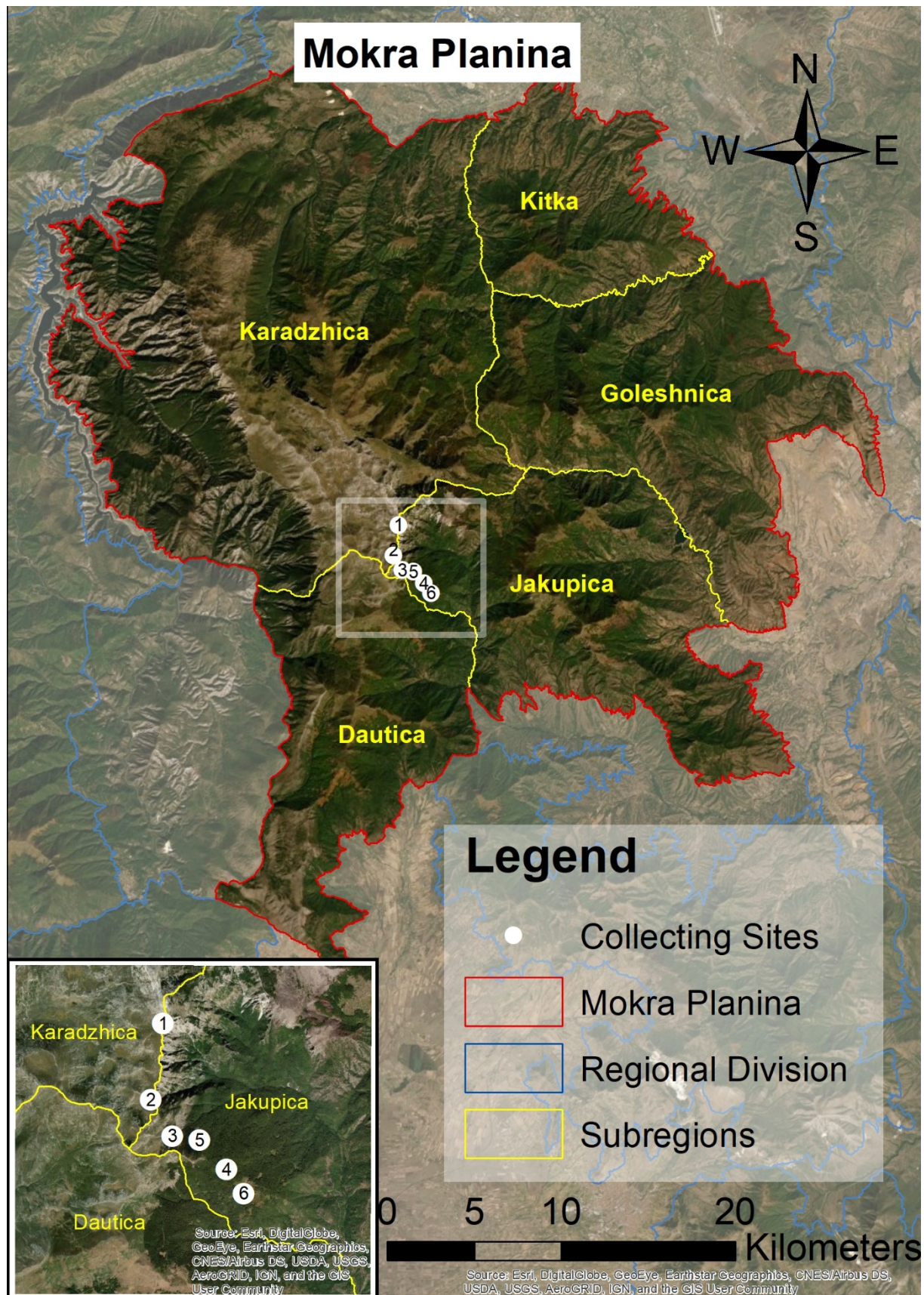


Figure 7 Mokra Planina: This map shows the area of Mokra Planina according to MELOVSKI et al. (2013). Subregions are added and sampling points are given. A more detailed map is added to locate sampling sites referring to the subregions.

Mokra Planina

Mokra Planina is a term used for five mountains in the centre of Macedonia which are all ridges of the Mokra Planina massif. These five mountains are: Karadzhica, Kitka, Goleshnica, Jakubica and Dautica. The highest peak is Solunska Glava at 2540 meters. The summit can be seen in Figure 8 and the location of Mokra Planina is shown in Figure 6. The total area is about 1,330 square kilometres and is divided into subregions, named after the five mountain ridges. The locations of the subregions can be seen in Figure 7 (MELOVSKI et al. 2013). A more detailed description of the two subregions with main emphasis will follow.

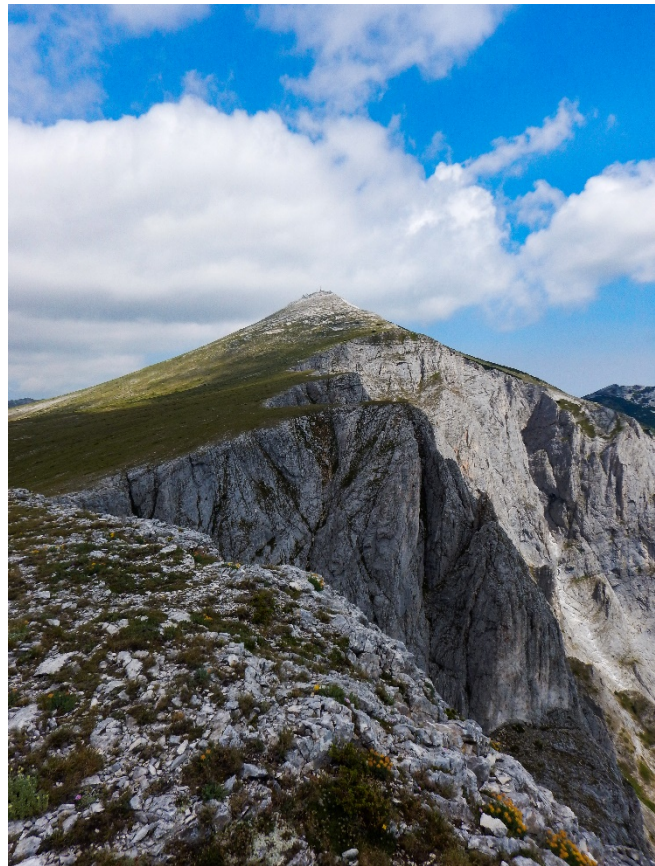


Figure 8 Solunska Glava in the background, the highest peak in the Mokra Planina massif at the border between the two subregions Karadzhica and Jakupica.

Karadzhica

The biggest subregion is Karadzhica. Its location in the northwest of the Mokra Planina can be seen in Figure 7. With an area of around 560 square kilometres, this is the biggest subunit. Together with Jakupica, it shares the peak of Solunska Glava. (2540 m a.s.l.). The geology of the area includes large carbonaceous masses (marbles) with siliceous rocks such as gneisses, and granites in between. Mountain climate is dominant in this region. Only northern and western slopes have a moderate Mediterranean influence. The region is mostly used for sheep pastures, but a considerable part is under protection due to its high conservation value (MELOVSKI et al. 2013).

Mok1

The first two sampling spots, Mok1 and Mok2, are located along the border of Karadzhica and Jakupica but are still on the Karadzhica side. Mok1 is located about 400 meters below and southwards of the peak of Solunska Glava (2540 m a.s.l.) since the peak itself is inaccessible due to a military station. A picture of the collecting site is shown in Figure 8. The sampling site

can be seen in the background of the picture closer to the peak. In this area, alpine grasslands with interspersed marble rocks occurred.

Collecting date:

July 15th, 2017

Elevation: 2350 m a.s.l.+/- 50 m

Bedrock:

carbonaceous bedrock, marbles

Makro Exposition: S – SW

Coordinates:

41° 41' 57" N 21° 24' 13" E

Radius: 200 m

Substrates:

mosses, soil, dwarf shrubs, rocks

Mok2

This sampling site is located along the path from Cheples to the peak of Solunska Glava shortly after reaching the plateau. A picture of the site is given in Figure 9. The surroundings of the boulder were similar to Mok1 but with isolated *Pinus mugo* appearing.



Figure 9 Picture of the collecting site Mok2. A big marble boulder, lying on the edge of the plateau.

Collecting date:

July 15th, 2017

Elevation: 2150 m a.s.l.+/-30 m

Radius: 100 m

Bedrock:

carbonaceous bedrock, marbles

Coordinates:

41° 41' 0" N 21° 24' 1" E

Makro Exposition: no specifics

Substrates:

mosses, soil, rocks

Jakupica

Jakupica mountain is located southeast of Karadzhica. Both share Solunska Glava (2540 m a.s.l.) as their highest peak. The Bedrock is composed by carbonaceous rocks (Precambrian marbles). While moderate continental climate is dominating lower parts, mountainous and even alpine climate occur on higher elevations. Although this area is of high conservation value, no protection exists (MELOVSKI et al. 2013).

Mok3

The sampling site is located next to the hiking path from Cheples to the summit of Solunska Glava and is widely dominated by *Pinus mugo*. Along this path from about 1800 up to 2000 m a.s.l. these mountain pine belts occur. A picture is given in Figure 10.

Collecting date:

July 15th, 2017

Elevation: 1900 m a.s.l. +-30 m

Radius: 50 m

Bedrock:

carbonaceous bedrock, marbles

Makro Exposition: E



Figure 10 *Pinus mugo* belts along the path from Cheples to the peak of Solunska Glava.

Coordinates:

41° 40' 33" N 21° 24' 22" E

Substrates:

marble rocks, *Pinus mugo*,

Mok4

This location is close to the mountain shelter of Cheples. *Fagus sylvatica* is the dominant tree for this area and elevation. Young specimens of *Abies alba* are interspersed. *Lobaria pulmonaria* indicates humid conditions with good air quality. A picture of the location is given in Figure 11.

Collecting date:

July 16th, 2017

Elevation: 1560 m a.s.l. +-50 m

Radius: 100 m

Bedrock:

carbonaceous bedrock, marbles

Makro Exposition: E



Figure 11 A typical *Fagus sylvatica* dominated forest with *Abies alba* interspersed.

Coordinates:

41° 40' 8" N 21° 25' 16" E

Substrates:

Fagus sylvatica, mosses

Mok5

This collecting area is located along the path to the top of Solunska Glava but is still below the tree line. With conditions like Mo5 but at higher elevation, *Abies alba* is dominant and *Fagus sylvatica* plays only a minor role. Some very old firs (*Abies alba*) are present and Caliciales occur.

Collecting date:July 16th, 2017**Elevation:** 1700 m a.s.l. +-50 m**Bedrock:**

carbonaceous bedrock, marbles

Makro Exposition: E**Coordinates:**

41° 40' 30" N 21° 24' 49" E

Radius: 100 m**Substrates:***Abies alba*, soil*Mok6*

This sampling site is located in the vicinity of the Cheples mountain shelter. Here, forestry plays a major role and planted *Populus tremula* trees dominate the landscape. *Pteridium aquilinum* and *Bromus* spp. are covering the ground.

Collecting date:July 17th, 2017**Elevation:** 1400 m a.s.l. +-30 m**Bedrock:**

carbonaceous bedrock, marbles

Makro Exposition: S**Coordinates:**

41° 39' 50" N 21° 25' 33" E

Radius: 200 m**Substrates:***Juniperus communis* subsp. *nana*, *Populus tremula*, *Fagus sylvatica*



Figure 12 Korab mountain: This map shows the area of Korab mountain according to MELOVSKI et al. (2013). In addition, the area of Radika Gorge and Bistra with one Sampling side each are displayed.

Korab mountain range

Korab mountain belongs to de Shara-Korab massif in the northwest of the country (Figure 6) bordering with Kosovo and Albania. According to MELOVSKI et al. (2013) it is the only Macedonian mountain with alpine landscape. The highest peak of the country, Golem Korab, with 2764 m a.s.l. is located here. Limestone and other calcareous rocks alternate with silicate formations such as schists or granites. Glacial relics such as



Figure 13 Flock of sheep on Korab mountain. A herdsman with some Šarplaninac (Yugoslavian Shepherd Dog) is accompanying the flock.

glacial lakes occur. The climate varies depending on the elevation from continental to mountainous and alpine (MELOVSKI et al. 2013). Flocks of sheep can be found all over the mountain and contribute to the typical picture on Korab shown in Figure 13.

The location of the sampling sites is given in Figure 12.

Kor1

Kor1 is situated on the summit of Golem Korab, at 2764 m a.s.l. It is the highest point in Macedonia and therefore also the highest sampling location. On the top of Korab mountain, carbonaceous rocks like limestone dominate. Some spots with calcareous schists and other siliceous rocks are interspersed. A picture of the summit area is given in Figure 14.



Figure 14 Stone indicating the top of mount Korab, the highest place in Macedonia at 2764 m a.s.l.

Collecting date:

July 20th, 2017

Elevation: 2735 m a.s.l. +-30 m

Coordinates:

41° 47' 21" N 20° 32' 49" E

Radius: 150 m

Bedrock:

mostly carbonaceous bedrock, limestone, siliceous rocks, schists, intermediate rocks

Substrates:

rocks, rock crevices, soil

Makro Exposition: no specific

Kor2

This site is located about 350 meters below the summit of Korab Mountain. The summit can be seen in the background in Figure 15. The site offers a big diversity of substrates with partly uncovered soil. Siliceous rocks are interspersed.



Figure 15 View from Kor2 sampling site to Golem Korab.

Collecting date:

July 20th, 2017

Elevation: 2370 m a.s.l. +-30 m

Bedrock:

siliceous bedrock, schists

Makro Exposition: S, SE

Coordinates:

41° 47' 5" N 20° 33' 35" E

Radius: 50 m

Substrates:

soil, mosses, rocks

Kor3

This sampling site is located close to the tree line and is characterized by many glades (Figure 16) where siliceous rocks and shrubs are typical. Forests surrounding these open areas are widely dominated by *Fagus sylvatica*.



Figure 16 Picture of Kor3 sampling site. Open grass areas with siliceous rocks and shrubs surrounded by beeches.

Collecting date:

July 21st, 2017

Elevation: 1810 m a.s.l. +-30 m

Coordinates:

41° 47' 1" N 20° 37' 5" E

Radius: 200 m

Makro Exposition: E

Bedrock:

siliceous rocks, schists

Substrates:

rocks, mosses, soil, *Fagus sylvatica*



Figure 17 View from meadows along the tree line towards North. The treeline in this area is approximately 1800 meters.

Kor4

The location is underneath the tree line and beech trees are dominating. Conifers are interspersed. A streamlet is accompanying the small path. Along a logging road uncovered soil occurs. In Figure 17 the view from meadows along the tree line towards North shows the sampling site from above. It is located in the forest-covered valley in the background.

Collecting date:

July 21st, 2017

Elevation: 1610 m a.s.l. +/-30 m

Bedrock:

carbonaceous rocks, limestone

Makro Exposition: N

Kor5

This sampling site is located along the hiking path to Golem Korab. It is quite a steep place with pastures and rock formations, as shown in Figure 18. The formations predominantly consist of limestone, but also siliceous spots occur.

Collecting date:

July 22nd, 2017

Elevation: 2360 m a.s.l. +/-50 m

Radius: 50 m

Makro Exposition: S

Coordinates:

41° 47' 5" N 20° 34' 38" E

Coordinates:

41° 48' 10" N 20° 36' 48" E

Radius: 80 m

Substrates:

rocks, mosses, soil, conifers, *Fagus sylvatica*



Figure 18 View towards the Kor5 sampling points with an upcoming thunderstorm, as it is typical for this time of the year.

Bedrock:

carbonaceous bedrock, limestone, siliceous rocks, intermediate rocks

Substrates:

Rocks, soil, mosses

Kor6

Partly snow-covered shady areas between hills out of schist host the Kor6 sampling side. It is located close to the hiking path. Only small patches of snow are left at this time of the year. A picture of one of these small valleys is given in Figure 19.

Collecting date:

July 22nd, 2017

Elevation: 2470 m a.s.l. +/- 30 m

Coordinates:

41° 47' 11" N 20° 33' 21" E

Radius: 50 m

Bedrock:

siliceous bedrock, schists

Makro Exposition: E-SE

Substrates:

rocks



Figure 19 Partly snow-covered valleys between hills of schist.



Figure 20 View over a plateau on about 2300 m a.s.l.

Kor7

Kor7 is located on a plateau on the Macedonian side of Golem Korab. The elevation is about 2300 m a.s.l. and it is used for intense grazing. Mostly alpine meadows alternate with patches of open soil and rocky hills. An overview of the plateau is given in Figure 20.

Collecting date:

July 22nd, 2017

Elevation: 2300 m a.s.l. +/- 50 m

Coordinates:

41° 46' 54" N 20° 34' 4" E

Radius: 300 m

Bedrock:

carbonaceous and siliceous bedrock, limestone, schists

Makro Exposition: flat to E

Substrates:

Rocks, soil, plant remains, mosses

Radika Gorge

The region of Radika Gorge is embedded between high mountains. The northern part of the gorge receives the highest amount of precipitation in Macedonia. This extraordinarily humid part is located between Korab, Shar Planina and Bistra. Southern areas of the gorge are under moderate Mediterranean influence. Figure 12 shows Radika Gorge within yellow borders (MELOVSKI et al. 2013). The sampling site in this region was added due to the necessity of a break and not primary included.

Rad1

The sampling point Rad1 is located on the way up to the police station at Strezimir. It is used for picnicking and leisure activities by locals. It is right next to a small river. Trees are fully covered by lichens, indicating a high level of humidity. Numerous trees of *Acer monspessulanum* grow along the river.

Collecting date:July 23rd, 2017**Coordinates:**

41° 43' 55" N 20° 40' 13" E

Elevation: 920 m a.s.l. +- 30 m**Radius:** 20 m**Bedrock:**

varbonaceous bedrock

Substrates:*Acer monspessulanum***Makro Exposition:** no specific*Bistra*

Another region close to Korab and Shar Planina is Bistra, a high mountain marble-limestone plateau. Continental and mountainous climate is most prevalent (MELOVSKI et al. 2013). The big artificial Mavrovo Lake is located in this area. The location can be seen in Figure 12. The sampling site in this region was added due to the necessity of a break and not primary included.

Bis1

Bis1 is located on the north-eastern side of Mavrovo Lake. It is at an area for hiking trips with benches and tables. The climate of this location is noticeably influenced by the big waterbody of the lake. Artificial substrates such as timber were used for the collection work.

Collecting date:July 23rd, 2017**Coordinates:**

41° 43' 16" N 20° 48' 16" E

Elevation: 1250 m a.s.l. +- 20 m**Radius:** 50 m**Bedrock:** -**Makro Exposition:** no specific**Substrates:** wood

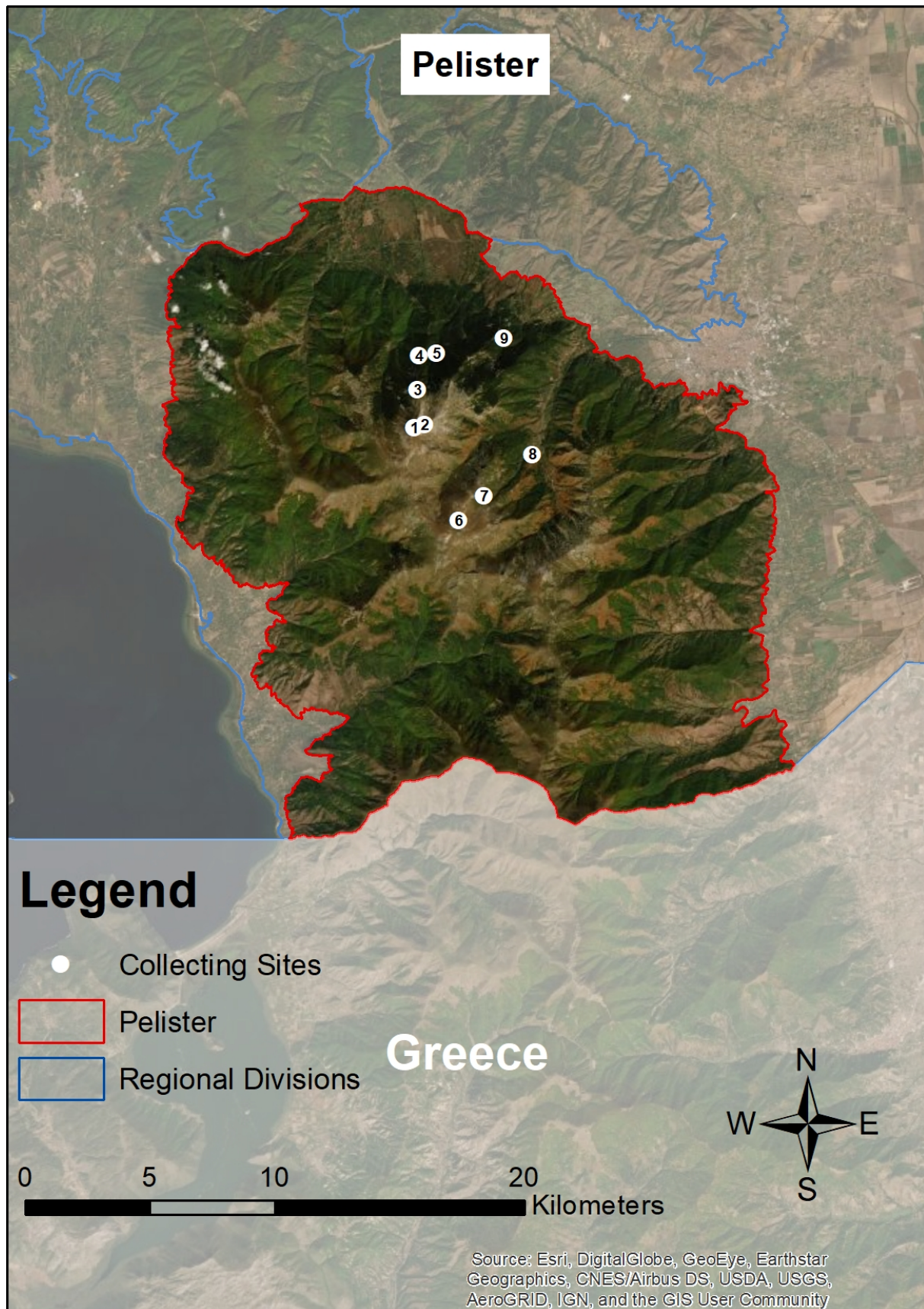


Figure 21 Pelister: This map shows the region of Pelister according to Melovski et al. (2013). All sampling points are added to the map.

Pelister Mountain

Pelister Mountain, or synonymously Baba Mountain, is located in the South of Macedonia on the eastern side of Prespa Lake. Its exact location can be seen in Figure 6. Southern parts of the mountain belong to Greece. With its summit at 2601 m a.s.l. it is one out of 5 Macedonian mountains with a height of more than 2500. The bedrock of the whole mountain is almost entirely siliceous, mainly granites and Palaeozoic schists. A mountainous climate regime is dominant and only the highest parts have an alpine influence. Pelister is also hosting one of the Macedonian national parks, proclaimed in 1949 to protect its well-developed Macedonian pine forests with *Pinus peuce* (MELOVSKI et al. 2013).

An overview of all sampling locations on Pelister mountain is given in Figure 21.

Pel1

Pel1 is located at the top of Pelister on the northern and western side of the radio station. Pictures of both locations are given in Figure 22. The bedrock of the mountain top consists of schists and granites. Additionally, artificial substrates such as timber, concrete or rubber do occur.

Collecting date:

July 25th, 2017

Coordinates:

41° 0' 11" N 21° 11' 1" E

Radius: 100 m

Elevation: 2590 m a.s.l. +- 20 m

Bedrock:

siliceous bedrock, schists, granites

Makro Exposition: np specific



Figure 22 This picture shows the radio station on top of Pelister. The top picture depicts the building from the west side, while the bottom picture shows the north side.

Substrates:

rocks, soil, mosses, timber, rubber



Figure 23 This picture depicts a mountain ridge from the top towards east.

Pel2

The sampling area is located on the northern side of a ridge from the top towards east. Big granite boulders are covering the area. Between these rocks patches without grass and rock cover can be found, forming a habitat for some soil lichens. A picture of the location of the sampling site is given in Figure 23.

Collecting date:

July 25th, 2017

Elevation: 1810 m a.s.l. +/-30 m

Bedrock:

siliceous bedrock, granites

Makro Exposition: N

Pel3

Pel3 is located on a lower mountain ridge towards North. The location is characterized by grassland with many Macedonian pine trees and rock formations interspersed. A picture of this landscape is given in Figure 24. In the background of the picture, Pelister Mountain partly covered in clouds is visible.

Collecting date:

July 26th, 2017

Elevation: 2050 m a.s.l. +/-100 m

Radius: 300 m

Coordinates:

41° 1' 1" N 21° 11' 6" E

Coordinates:

41° 0' 15" N 21° 11' 18" E

Radius: 100 m

Substrates:

rocks, soil



Figure 24 Pelister covered in clouds photographed from a smaller mountain ridge in the North. *Pinus peuce* trees are growing till the treeline. Pel3 is located in the area with grasses in the foreground.

Makro Exposition: N, E, W

Bedrock:

siliceous bedrock, granites, schists

Substrates:

rocks, soil, mosses, *Pinus peuce*

Pel4

Pel4 is located along the hiking path to the top of the mountain, ascending from the northern side shown in Figure 25. Trees of different age alternate, yet juvenile trees are dominant. Only very few dead specimens can be found.

Collecting date:

July 26th, 2017

Coordinates:

41° 1' 44" N 21° 11' 8" E

Radius: 300 m

Elevation: 1700 m a.s.l. +-150 m

Makro Exposition: N

Bedrock:

siliceous bedrock, granites

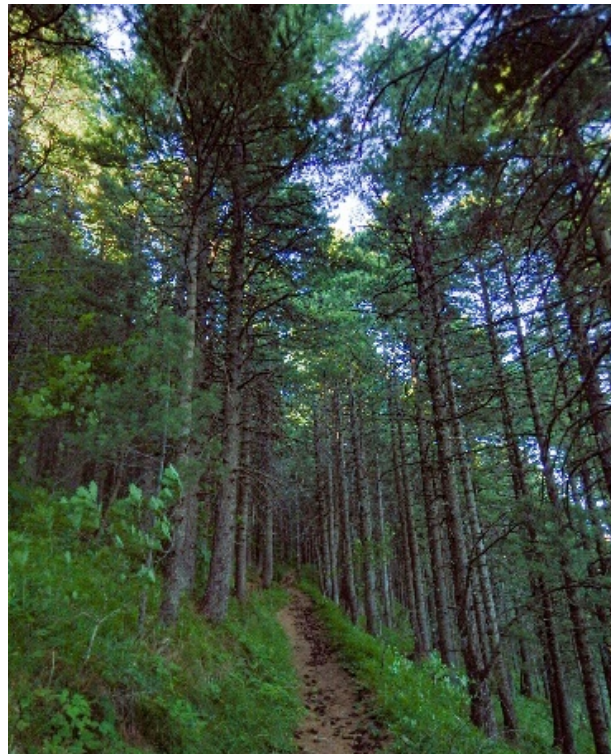


Figure 25 *Pinus peuce* forest on the north side of Pelister mountain along the hiking path to the top.

Substrates:

Pinus peuce, *Abies alba*, wood

Pel5

This small sampling site is located along the logging road used to support the radio station. In this area a streamlet and a spring occur. Due to the dense Macedonian pine forest, it is a very shady sampling area.

Collecting date:

July 26th, 2017

Elevation: 1530 m a.s.l. +-30 m

Bedrock:

Siliceous bedrock, granites

Makro Exposition: N

Coordinates:

41° 1' 47" N 21° 11' 39" E

Radius: 50 m

Substrates:

Pinus peuce



Figure 26 View on Golemo Ezero from above. Steeper slopes with overhangs are covered with *Pleopsidium flavum*.

Pel6

Pel6 is located along the steep walls on the north and west side of Golemo Ezero. A picture of the Lake is shown in Figure 26. The lake is located at an elevation of more than 2200 m a.s.l. A picture of the typical overhangs characteristic for this location is given in Figure 27. The yellow spots, visible in the picture, pointed out with a red arrow, indicate spots of *Pleopsidium flavum*, cooccurring with different species of *Rhizocarpum*.



Figure 27 Cliffs in the north and west of Golemo Ezero with big yellow spots of *Pleopsidium flavum*.

Collecting date:

July 28th, 2017

Elevation: 2300 m a.s.l. +/-100 m

Bedrock:

Siliceous bedrock, schists

Makro Exposition: SE, E

Coordinates:

40° 58' 10" N 21° 12' 17" E

Radius: 400 m

Substrates:

Rocks, soil

Pel7

This sampling spot is located about 200 meters below the Pel6 spot and shares many qualities. Steep cliffs and overhangs occur and *Pleopsidium flavum* and different *Rhizocarpon* species in yellow cover the walls. A picture of these walls can be seen in Figure 28.

Collecting date:August 1st, 2017**Elevation:** 2030 m a.s.l. +-50 m**Bedrock:**

siliceous bedrock, schists

Makro Exposition: E**Coordinates:**

40° 58' 42" N 21° 12' 59" E

Radius: 100 m**Substrates:**

Rocks, soil

Pel8

This location features a single *Salix* sp. tree on the east side of Pelister mountain. It is located along the hiking path to Golemo

Ezero, still close to the town of Nizhepole. The place is mostly covered by shrubs. Only some taller individuals of *Salix* and *Acer* species are present.



Figure 28 Siliceous cliffs along the east side of Pelister Mountain, approximately one kilometre east of Golemo Ezero

Collecting date:August 1st, 2017**Elevation:** 1220 m a.s.l. +-30 m**Bedrock:**

unknown

Makro Exposition: E*Pel9*

This location is close to the Hotel Molinka on the northwest side of Pelister Mountain. The area is covered by Macedonian pine trees. Along the parking lot, open areas occur.

Collecting date:September 5th, 2017**Elevation:** 1450 m a.s.l. +-50 m**Bedrock:**

Siliceous bedrock

Makro Exposition: NE**Coordinates:**

40° 59' 36" N 21° 14' 23" E

Radius: 20 m**Substrates:***Salix* sp.**Coordinates:**

41° 2' 7" N 21° 13' 34" E

Radius: 200 m**Substrates:**

Moss, soil

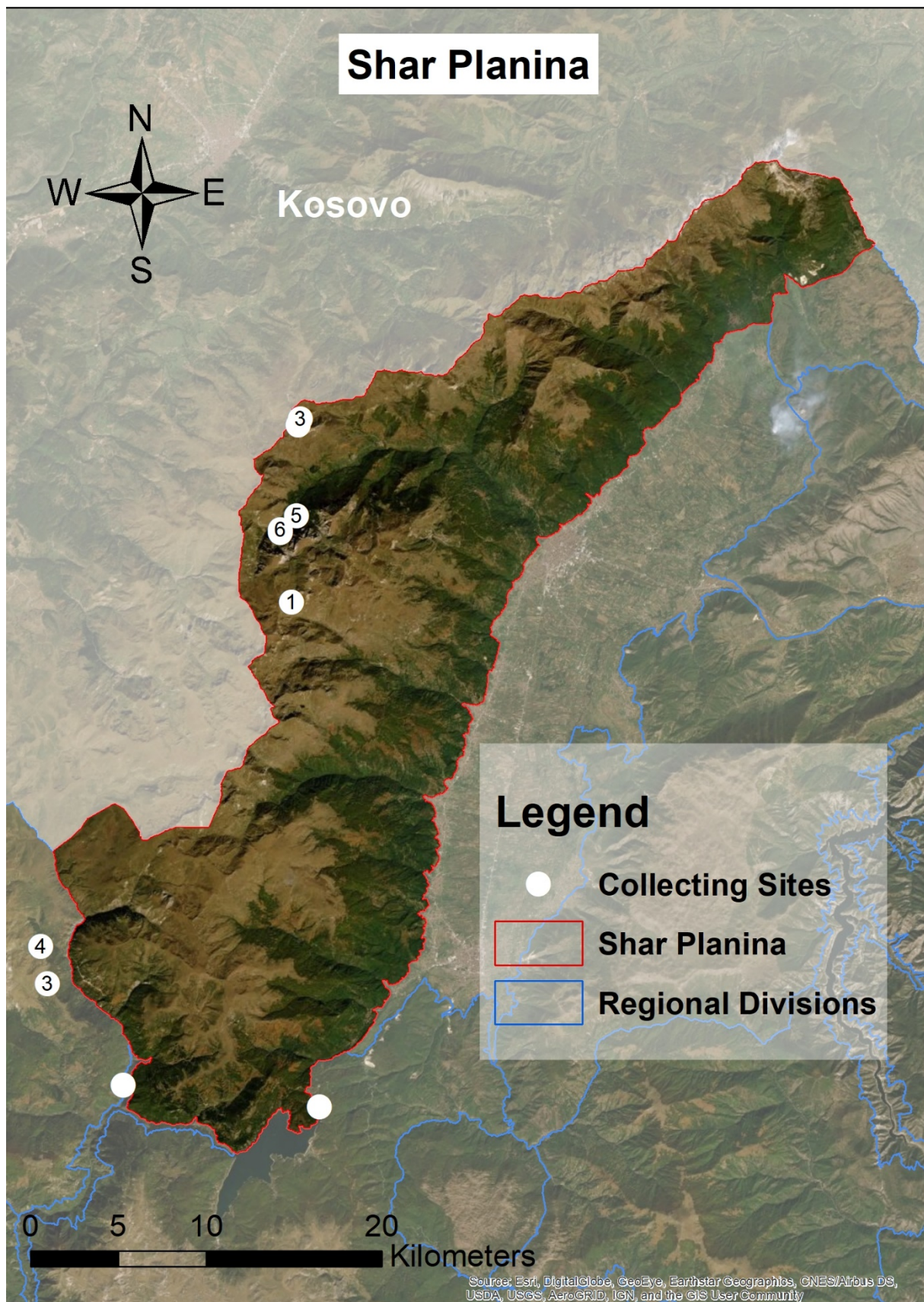


Figure 29 Shar Planina: This map shows the region of Shar Planina according to MELOVSKI et al. (2013). All sampling points are added to the map. Additional sampling sites on Korab Mountain, Radika Gorge and Bistra are visible, indicating the small geographical distance. Sha2 is not distinguishable from Sha 3 but slightly towards south-southwest. Sampling site number 4 is hidden under number 6 and is located a bit more southern.

Shar Planina

Shar Planina, or synonymously called Šar Planina or Shar Mountain, is located along the north western border of Macedonia. The exact position can be seen in Figure 6. Shar Planina is the second highest mountain in Macedonia after Korab. The Shar Planina mountain range is in fact the longest and largest of Macedonia with its highest peak Titov Vrv with 2748 m a.s.l. Shar mountain is geologically and geomorphologically very diverse. Silicate formations such as schist and granites abundantly occur, while smaller areas are formed by calcareous rocks, mainly limestone. The landscape is strewn with glacial relics such as glacial lakes and valleys. The climate varies from continental to alpine depending on the elevation (MELOVSKI et al. 2013).

An overview of sampling sites on Shar Planina is given in Figure 29. Sampling points visible on the map from Korab mountain indicate how near these to mountains are.

Sha1

Sha1 sampling site is located on mountain ridges along the southern parts of the valley shown in Figure 30. The picture provides a view at the sampling site towards Titov Vrv, the highest mountain of Shar Planina. The valley visible is on an elevation of about 2200 m a.s.l.

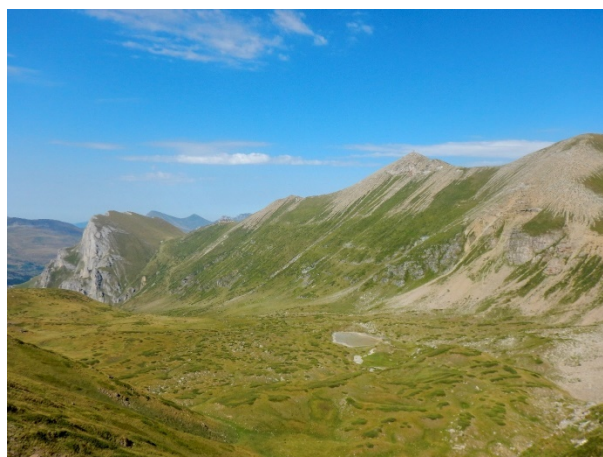


Figure 30 View from Sha1 sampling side to the north. Titov Vrv, the highest mountain of Shar Planina is visible in the middle.

Collecting date:

August 3rd, 2017

Coordinates:

41° 58' 48" N 20° 47' 4" E

Bedrock:

Mixed bedrock of carbonaceous and siliceous compounds, limestone, calcareous schist, schist, other siliceous rocks

Radius: 200 m

Elevation: 2400 m a.s.l. +/-100 m

Substrates:

Rocks, soil, mosses

Makro Exposition: no specific

Sha2

The sampling site is located close to the glacial lake of Karanikolichko Ezero, also known as Golem Gjol. The lake is depicted in Figure 31. The sampling site is located at the spot where the picture was taken.

Collecting date:

August 4th, 2017

Elevation: 2300 m a.s.l. +-30 m

Radius: 50 m

Bedrock:

siliceous bedrock

Makro Exposition: N, NE



Figure 31 Karanikolichko Ezero, a glacial lake on Shar Planina.

Coordinates:

42° 4' 15" N 20° 47' 21" E

Substrates:

rocks, soil, mosses, *Juniperus communis* subsp. *nana*

Sha3

The sampling area is located along the shore of Karanikolichko Ezero. The lake and the sampling area on the left of it are shown in Figure 31. Partly submersed rocks, siliceous boulders and patches with *Juniperus communis* subsp. *nana* alternate.

Collecting date:

August 4th, 2017

Elevation: 2240 m a.s.l. +-50 m

Bedrock:

siliceous bedrock, schist, other siliceous rocks

Makro Exposition: E

Coordinates:

42° 4' 26" N 20° 47' 26" E

Radius: 100 m

Substrates:

rocks, soil, mosses, wood, *Juniperus communis* subsp. *nana*

Sha4

Sha4 is located about one kilometer along the valley bottom towards south-west from the basecamp in Lešnica. A small river, shown in Figure 32, is accompanying the path to a waterfall. The area is very humid and shady due to dense vegetation.

Collecting date:

August 5th, 2017

Coordinates:

42° 0' 57" N 20° 46' 37" E

Elevation: 1580 m a.s.l. +-30 m

Radius: 100 m

Bedrock:

siliceous and intermediate Bedrock, schist, calcareous schist

Makro Exposition: E

Sha5

The sampling area is located around the basecamp (Figure 33) of Lešnica. Close to the camp, Bozovska Reka, a rather small river, passes. Due to human intervention, vast parts are kept free from trees. Rock formations in between contribute to a higher structure diversity.

Collecting date:

August 5th, 2017

Coordinates:

42° 4' 26" N 20° 47' 26" E

Radius: 500 m

Elevation: 1490 m a.s.l. +-30 m

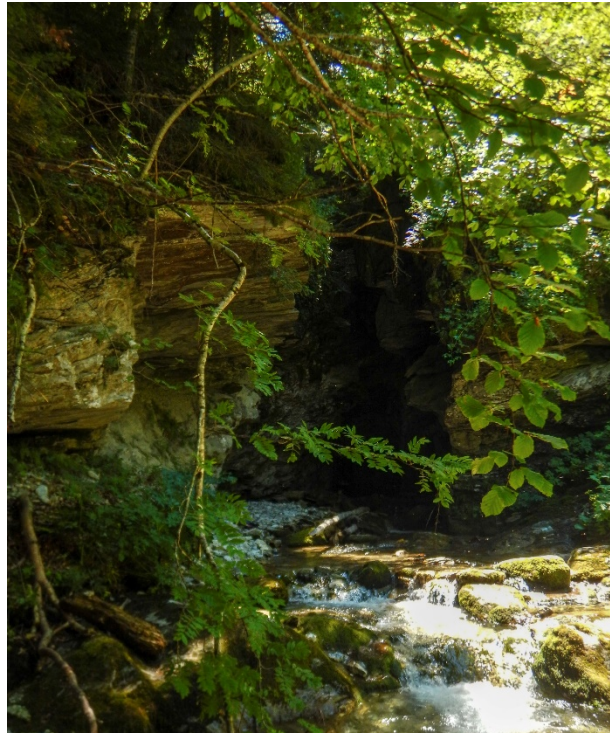


Figure 32 Small river next to the sampling site. Dense vegetation causes shady conditions.

Substrates:

rocks, soil, mosses, wood, *Fagus sylvatica*, deciduous trees



Figure 33 The basecamp in Lešnica with more than 2400 meter tall mountains in the background.

Bedrock:

siliceous and intermediate bedrock, schist, calcareous schist

Substrates:

rocks, soil, mosses, conifers

Makro Exposition: no specific

Sha6

This sampling spot is located close to Sha4. Moisty microclimate dominates due to small waterfalls and dense forests. An *Ostrya carpinifolia* tree on a clearing serves as substrate for many corticolous lichens such as *Anaptychia ciliaris*.

Collecting date:August 5th, 2017**Elevation:** 1540 m a.s.l. +/-30 m**Bedrock:**

siliceous and carbonaceous bedrock

Makro Exposition: E**Coordinates:**

42° 1' 1" N 20° 46' 37" E

Radius: 50 m**Substrates:***Ostrya carpinifolia*

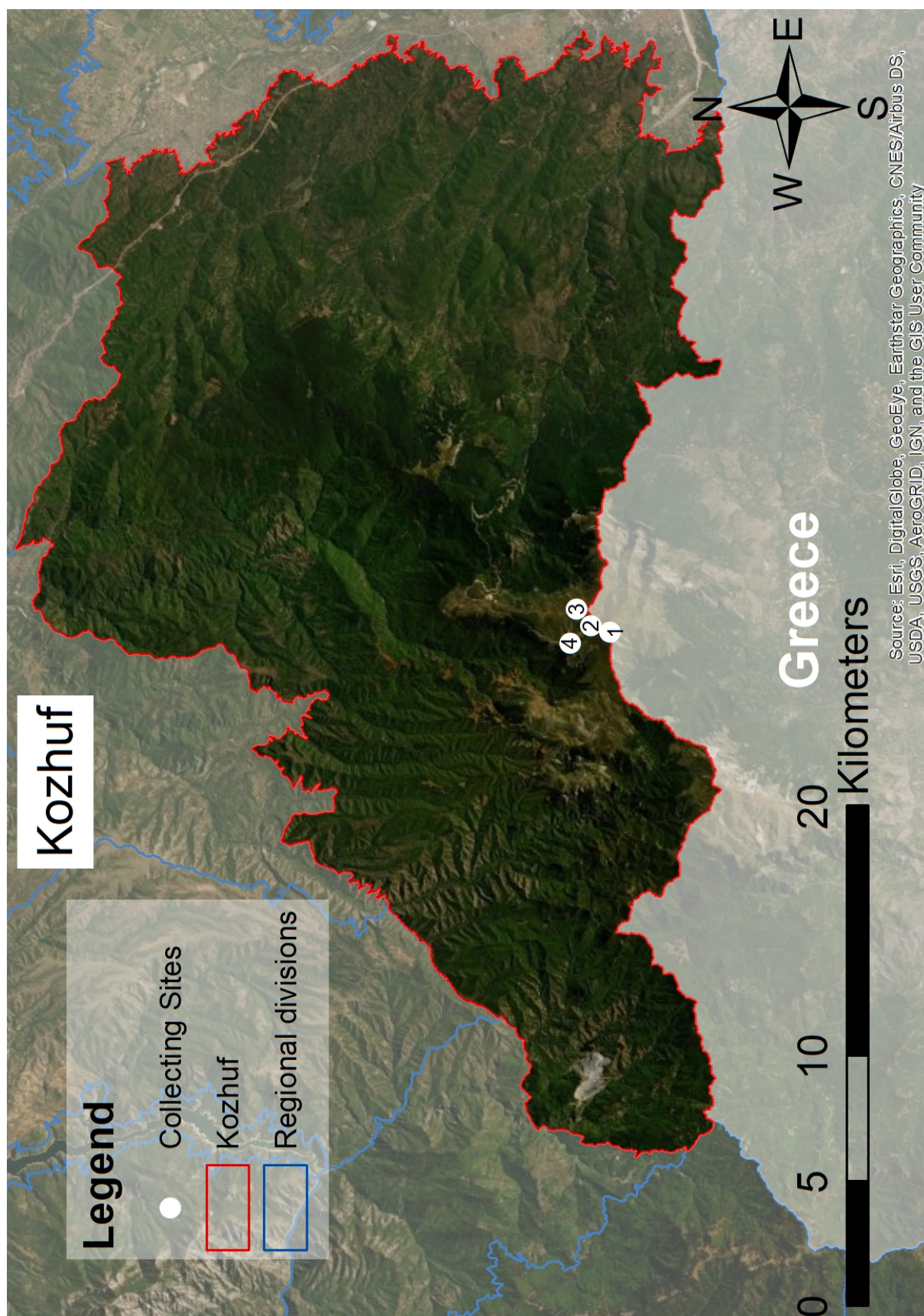


Figure 34 Kozhuf: This map shows the region of Kozhuf according to MELOVSKI et al. (2013). All sampling points are added to the map.

Kozhuf Mountain

Kozhuf or Kožuf mountain is located in the southeast of Macedonia between Skopje and Thessaloniki. Its exact position is shown in Figure 6. Kozhuf, though lower than other mountains investigated in this study, points out remarkable features. The geology of the mountain is very complex for large areas with carbonaceous bedrock such as marbles and limestone, various siliceous rocks such as gabbro as well as diabases and volcanic deposits occur. The climate is can be described as Mediterranean at lower elevations yet as mild to harsh mountainous at higher elevations (MELOVSKI et al. 2013).

An overview of the sampling plots on Kozhuf is given in Figure 34.

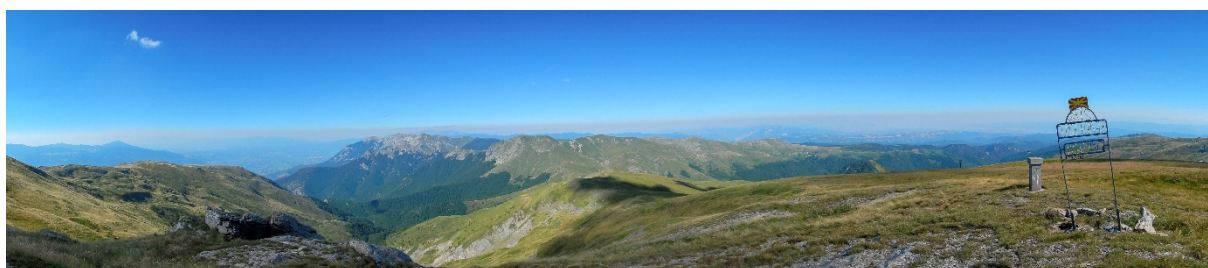


Figure 35 View from the top of Kozhuf mountain at 2171 m a.s.l. The collecting site is in the foreground on the right-hand side of the picture.

Koz1

This collecting site is located on the top of Kozhuf mountain on 2171 m a.s.l. Different bedrocks form the summit, including limestone, schists, calcareous schists and other siliceous rocks. One part of the sampling site can be seen in the right-hand corner of Figure 35. The sampling site only covers the Macedonian part of the Mountain since Kozhuf is at the border to Greece, shown in Figure 34.

Collecting date:

July 30th, 2017

Elevation: 2150 m a.s.l. +-20 m

Bedrock:

mixed bedrock of carbonaceous and siliceous compounds, limestone, schists, other siliceous rocks

Coordinates:

41° 9' 42" N 22° 12' 19" E

Radius: 100 m

Substrates:

rocks, soil, mosses

Makro Exposition: NE

Koz2

This spot is located on the northern hillside of Kozhuf Mountain between the slopes of the Kozhuf Ski Centre. The location can be seen in the very background of Figure 36. Due to the exposition, many big mosses and other indicators for high moisture occur.

Collecting date:

July 30th, 2017

Elevation: 1990 m a.s.l. +-50 m

Bedrock:

mixed bedrock of carbonaceous and siliceous compounds

Makro Exposition: N

Koz3

Koz3 is located about one kilometre northeast of the peak of Kozhuf and north of peak 92. The mountain ridge is not completely covered by vegetation and plants show signs of wind erosion. A picture of this sampling site is given in Figure 37.

Collecting date:

July 31st, 2017

Elevation: 2060 m a.s.l. +-30 m

Radius: 100 m

Bedrock:

Siliceous bedrock

Makro Exposition: no specific



Figure 36 Picture of Kozhuf Mountain taken at the Kozhuf Ski Centre.

Coordinates:

41° 10' 7" N 22° 12' 30" E

Radius: 100 m

Substrates:

soil, mosses

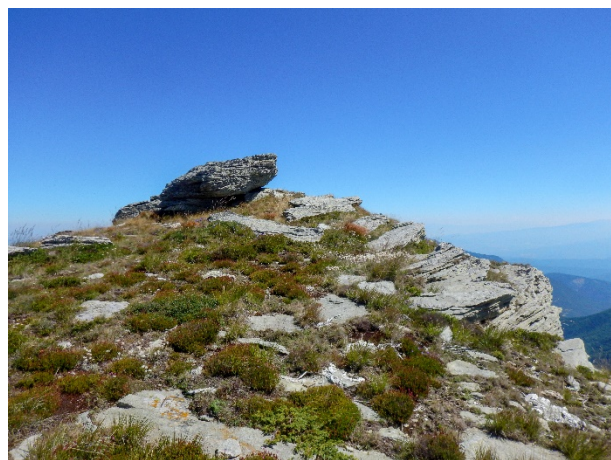


Figure 37 Siliceous boulders along the mountain ridge towards North viewed from peak 92.

Coordinates:

41° 10' 25" N 22° 12' 59" E

Substrates:

Rocks, soil, mosses, wood

Koz4

Koz4 is a sampling site lower and closer to the Kozhuf Ski Centre. Due to its lower altitude of 1610 m a.s.l., most of the places are covered by spruce. More open areas are manmade due to preparation work for slopes. The small streamlet which can be seen in Figure 34 is flowing through the sampling site.

Collecting date:

July 31st, 2017

Coordinates:

41° 10' 34" N 22° 12' 1" E

Elevation: 1610 m a.s.l. +-40 m

Radius: 200 m

Bedrock:

mixed bedrock of carbonaceous and siliceous compounds



Figure 38 Small streamlet originating at the northern hillside of Kozhuf Mountain. A mixture of carbonaceous and siliceous rocks occur.

Substrates:

rocks, soil, mosses, conifers

Makro Exposition: N



Figure 39 Kajmakchalan: This map shows the region of Kajmakchalan according to Melovski et al. (2013). One site is in the region of Mariovo.

Kajmakchalan

Kajmakchalan is located in the south of Macedonia along the border to Greece, as depicted in Figure 6. Kajmakchalan is also known as Nidzhe Mountain. With its summit at 2521 m a.s.l. it is one of the five Macedonian mountains higher than 2500 meters. Most of the mountain is formed by siliceous bedrock, except for some eastern parts where Precambrian dolomites occur. Mountain climate is widely dominating (MELOVSKI et al. 2013).

Kaj1

The sampling side is located on the summit of Kajmakchalan along the border to Greece. A picture of the top is provided in Figure 40. A small chapel can be seen on the highest point. The picture was taken from the Greek side and the sampling area is located behind the buildings. Small overhangs, flat rocks and open grassland dominate the landscape.



Figure 40 Small chapel on the summit of Kajmakchalan.

Collecting date:

August 7th, 2017

Elevation: 2490 m a.s.l. +-40 m

Bedrock:

siliceous bedrock

Makro Exposition: E

Coordinates:

40° 55' 52" N 21° 47' 15" E

Radius: 300 m

Substrates:

rocks, soil, mosses, artificial substrates

Mariovo

The region of Mariovo is located north of Kajmakchalan. It is a large hilly plateau with an average elevation of about 760 m a.s.l. (MELOVSKI et al. 2013)

Mar1

This sampling site is located next to the road from Makovo to Budimici. The area in this location is rather dry and hot. Some dying trees serve as substrate for lichens.

Collecting date:

July 29th, 2017

Elevation: 700 m a.s.l. +-50 m

Radius: 50 m

Coordinates:

41° 5' 30" N 21° 41' 0" E

Substrates:

deciduous trees

Identification

Identification of the collected samples was primarily carried out with WIRTH et al. (2013). Additionally, other books such as POELT and VĚZDA, (1977;1981), the NORDIC LICHEN FLORA VOL. 2 & 3 (2002, 2007) and SMITH et al. (2009) were used. Furthermore, special articles for different groups (e.g. *Xylographa*: SPRIBILLE et al. (2014), *Usnea*: RANDLANE et al. (2009), *Lepraria*: SAAG et al. (2009))

Some critical or unknown species were given to experts to confirm our results or for further identification. If others confirmed identifications or identified species it is written in the results.

List of people contributing to the results, their institution and the species group:

Institute of Biology, University of Graz:

Josef Hafellner (lichenicolous fungi, unknown samples of different groups), Walter Obermayer (*Arthrorhaphis*, *Bryoria*), Fernando Fernandez Mendoza (*Cetraria*, *Caloplaca variabilis* group), Martin Grube (*Arthonia*), Adriana Atanassova (*Physconia*).

Institute of Botany, The Czech Academy of Sciences

Jan Vondrák (*Caloplaca* s.l.), Jiří Malíček (*Lecanora*, unknown samples of different groups), Zdeněk Palice (*Biatora*).

Faculty of Biology, Altai State University

Evgeny Davydov (*Umbilicaria*)

University of Vienna

Othmar Breuss (Pyrenocarpeous lichens)

Department of Ecology, Czech University of Life Sciences Prague

Kerry Kent Knudsen (*Acarospora*)

Department of Vegetal Biology, Complutense University of Madrid

Ana Rosa Burgaz (*Cladonia*)

University of Alberta

Toby Spribille (*Xylographa*)

Conservatoire et Jardin botaniques de la Ville de Genève

Philippe Clerc (*Usnea*)

Ludwig-Maximilians-University of Munich

Philipp Resl (*Xylographa*)

TLC

To support identification of unknown species or to verify assumptions, standardized thin-layer chromatography (TLC) was used, following WHITE & JAMES (1985) and ORANGE et al. (2010) and was carried out with the technical support of Peter Kosnik.

Nomenclature

The nomenclature used for the species list follows Nimis et al. (2018). If not included in this list, applicable for Mediterranean species, NIMIS (2016) was used. Nomenclature of species not included in either follows MYCOBANK (2019)

List of substrates and abbreviations

sil	siliceous rocks	xyl	lignum
cal	calciferous rocks	art	artificial substrates (rubber)
int	intermediate rocks	-par	parasitic on other lichens
ter-sil	siliceous soil	-aqu	temporary submerged
ter-cal	calciferous soil	* top left	new record for Macedonia
ter-int	intermediate soil	** top left	new record due to this
bry	bryophytes		fieldwork but published
deb	plant debris		
cor	bark		

Results

As the outcome of the fieldwork undertaken in 2017, some 1,200 samples were collected. Identification work revealed 385 taxa. These included 363 species 1 subspecies, 6 varieties and 2 forms of lichens, 11 species of lichenicolous fungi and 1 non lichenised species, typically reported by lichenologists. Furthermore, 10 samples (5 species) from the GZU herbarium collected in the seventies by J. Hafellner, H. Mayrhofer, J. Poelt were added to the list. This samples are yet unpublished and were taken from Shar Planina.

One species from GZU herbarium, collected on Galičica mountain, has not been published so far but is new for Macedonia and therefore listed as well.

Lichens

Acarospora A.Massal.

Acarospora cervina A.Massal.

Loc.: Kor7, Shar Planina - Popova Sapka
1700-2000m

Sub.: cal

Date: June 1st, 1971

leg.: J. Poelt

det./conf.: Kerry Knudsen

Note: second location from GZU 3-92

Acarospora irregularis H.Magn.

Loc.: Sha3

Sub.: sil

det./conf.: Kerry Knudsen

**Acarospora peliscypha* Th.Fr.

Loc.: Sha2

Sub.: sil

det./conf.: Josef Hafellner

Agonimia Zahlbr.

Agonimia tristicula (Nyl.) Zahlbr.

Loc.: Koz1, Sha2, Sha4

Sub.: ter-cal, bry, deb

det./conf.: Josef Hafellner, Jan Vondrák

Allocetraria Kurok. & M.J.Lai

**Allocetraria madreporiformis*

(Ach.) Kärnefelt & A.Thell Loc.: Mok1

Sub.: ter-cal

Amandinea M.Choisy ex Scheid. &
H.Mayrhofer

Amandinea punctata (Hoffm.) Coppins &
Scheid. f. *punctata*

Loc.: Pel3, Sha3, Bis1, Pel7, Bis1

Sub.: cor, xyl, sil

**Amandinea punctata* f. *musciicola*
(Hepp) ined.

Loc.: Pel3, Sha3

Sub.: bry

Anaptychia Körb.

Anaptychia ciliaris (L.) Flot.

Loc.: Sha2, Pel4, Mok6, Sha6

Sub.: bry, cor

**Anaptychia setifera*

(Meresch.) Räsänen

Loc.: Rad1, Mok4

Sub.: cor

Arthonia Ach. nom. cons.

**Arthonia mediella* Nyl.

Loc.: Pel4

Sub.: xyl, cor

det./conf.: Martin Grube, Jiří Malíček

Arthonia radiata (Pers.) Ach.

Loc.: Sha4

Sub.: cor

Arthrorhaphis Th.Fr. nom. cons.

**Arthrorhaphis alpina* (Schaer.) R.Sant.

Loc.: Pel2

Sub.: ter-sil

det./conf.: Walter Obermayer

**Arthrorhaphis citrinella* (Ach.) Poelt

Loc.: Kaj1

Sub.: ter-sil

det./conf.: Walter Obermayer

Aspicilia A.Massal. nom. cons.**Aspicilia caesiocinerea*

(Nyl. ex Malbr.) Arnold

Loc.: Sha3, Sha5

Sub.: sil

Aspicilia calcarea (L.) Bagl.

Loc.: Koz1

Sub.: cal, int

Aspicilia cinerea (L.) Körb.

Loc.: Pel1

Sub.: sil

Aspicilia contorta (Hoffm.) Körb.

Loc.: Koz1

Sub.: int, cal

Aspicilia hoffmanniana

(S.Ekman & Fröberg ex R.Sant.)

Cl.Roux & M.Bertrand

Loc.: Kor4, Sha1

Sub.: cal, int

**Aspicilia simoensis* Räsänen

Loc.: Pel2

Sub.: sil

**Aspicilia supertegens* Arnold

Loc.: Pel6

Sub.: sil-aqu

Aspicilia verrucosa (Ach.) Körb.

Loc.: Koz1, Mok1, Sha1, Sha2, Kor7

Sub.: bry, deb

Aspilidea Hafellner*Aspilidea myrinii* (Fr.) Hafellner

Loc.: Pel7

Sub.: sil

Bacidia De Not.**Bacidia bagliettoana*

(A.Massal. & De Not.) Jatta

Loc.: Koz1, Koz2, Kor7

Sub.: ter-cal, deb

Bacidia subincompta (Nyl.) Arnold

Loc.: Pel3, Pel4

Sub.: cor

det./conf.: Jiří Malíček

Baeomyces Pers.: Fr.*Baeomyces rufus* (Huds.) Rebent.

Loc.: Pel1, Koz1, Sha2

Sub.: ter-sil

Bagliettoa A.Massal.*Bagliettoa baldensis* (A.Massal.) Vězda

Loc.: Koz1

Sub.: cal

det./conf.: Othmar Breuss

Bellemerea Hafellner & Cl.Roux*Bellemerea alpina*

(Sommerf.) Clauzade & Cl.Roux

Loc.: Pel2, Sha3, Kor1, Pel7

Sub.: sil

**Bellemerea cinereorufescens*

(Ach.) Clauzade & Cl.Roux

Loc.: Pel2

Sub.: sil

**Bellemerea sanguinea*

(Kremp.) Hafellner & Cl.Roux

Loc.: Pel2, Pel7

Sub.: sil

det./conf.: Josef Hafellner

Biatora Fr. non Ach.

**Biatora beckhausii* (Körb.) Tuck.

Loc.: Kor4

Sub.: cor

det./conf.: Zdeněk Palice

Biatora globulosa (Flörke) Fr.

Loc.: Mok5

Sub.: cor

Bilimbia De Not.

Bilimbia lobulata

(Sommerf.) Hafellner & Coppins

Loc.: Mok2, Sha1, Koz1

Sub.: ter-cal

**Bilimbia microcarpa* (Th.Fr.) Th.Fr.

Loc.: Pel1

Sub.: deb

Bilimbia sabuletorum (Schreb.) Arnold

Loc.: Kor7, Mok2, Sha6

Sub.: ter-cal, deb

Brodoa Goward

Brodoa intestiniformis (Vill.) Goward

Loc.: Pel2, Pel3, Sha2, Kaj1, Koz3, Sha2,
Kor3

Sub.: sil

Bryobilimbia Fryday, Printzen &
S.Ekman

**Bryobilimbia hypnorum*

(Lib.) Fryday, Printzen & S.Ekman

Loc.: Kaj1

Sub.: ter-sil

Bryonora Poelt

Bryonora castanea (Hepp) Poelt

Loc.: Pel1

Sub.: deb

Bryoria Brodo & D.Hawksw.

Bryoria fuscescens s.l.

Loc.: Koz3

Sub.: sil

det./conf.: Walter Obermayer

Buellia De Not. nom. cons.

**Buellia disciformis* (Fr.) Mudd

Loc.: Koz4

Sub.: cor

Buellia erubescens Arnold

Loc.: Pel3

Sub.: cor

Calicium Pers.

***Calicium pinicola*

(Tibell) M.Prieto & Wedin

Loc.: Pel3, Pel4

Sub.: xyl

Caloplaca Th.Fr. nom. cons.

Caloplaca alnetorum

Giralt, Nimis & Poelt

Loc.: Mar1, Pel4, Sha6

Sub.: cor

det./conf.: Jan Vondrák

Caloplaca alociza (A.Massal.) Mig.

Loc.: Kor5

Sub.: cal

Caloplaca ammiospila

(Wahlenb. ex Ach.) H.Olivier

Loc.: Sha3

Sub.: deb

det./conf.: Jan Vondrák

Caloplaca arnoldiiconfusa

Gaya & Nav.-Ros.Loc.: Shar Planina -
Popova Sapka,
1700-2300m

Date: July 8th, 1977

leg.: J. Hafellner (3002, 3003), H.
Mayrhofer (109), J.Poelt (10130)

det./conf.: Jan Vondrák

Note: from GZU 5-2004, 151-83, 19-
2012, 6-91

**Caloplaca brachyspora* Mereschk.

Loc.: Kor4

Sub.: cal

det./conf.: Jan Vondrák

Caloplaca cacuminum Poelt

Loc.: Sha3

Sub.: int

det./conf.: Jan Vondrák

Caloplaca cerina (Hedw.) Th.Fr.

Loc.: Sha3, Kor3, Pel3

Sub.: xyl, cor

det./conf.: Jan Vondrák

Caloplaca cerinella (Nyl.) Flagey

Loc.: Bis1

Sub.: xyl

det./conf.: Jan Vondrák

**Caloplaca cerinelloides* (Erichsen) Poelt

Loc.: Mok1, Sha4

Sub.: cor

det./conf.: Jan Vondrák

Caloplaca chalybaea (Fr.) Müll. Arg.

Loc.: Koz1

Sub.: cal

Caloplaca chrysodeta (Vain.) Dombr.

Loc.: Sha4

Sub.: int

Caloplaca coccinea (Müll.Arg.) Poelt

Loc.: Koz1, Mok2, Kor7

Sub.: int, cal

det./conf.: Jan Vondrák

Caloplaca crenulatella s.l.

Loc.: Sha4

Sub.: int

Caloplaca dalmatica s.l.

Loc.: Mok2, Galičica, Otesevo to Trpejca,
1600m

Sub.: cal

Date: August 26th, 1976

leg.: H. Mayrhofer (170)

det./conf.: Josef Hafellner, Jan Vondrák

Note: one sample from GZU 19-2012

Caloplaca grimmiae (Nyl.) H.Olivier

Loc.: Sha3

Sub.: sil-par, on Candelariella vitellina

Caloplaca haematites (Chaub.) Zwackh

Loc.: Mar1, Sha6

Sub.: cor

det./conf.: Jan Vondrák

**Caloplaca herbidella*

(Nyl. ex Hue) H.Magn.

Loc.: Koz4

Sub.: cor

det./conf.: Jan Vondrák

Caloplaca holocarpa s.l.

Loc.: Koz1

Sub.: int

det./conf.: Jan Vondrák

Caloplaca isidiigera Vězda

Loc.: Sha3

Sub.: int

Caloplaca obliterans

(Nyl.) Blomb. & Forssell

Loc.: Sha4

Sub.: sil

det./conf.: Jan Vondrák

Caloplaca percrocata (Arnold) J.Steiner

Loc.: Sha3, Koz1, Sha2

Sub.: sil

det./conf.: Jan Vondrák

Caloplaca pyracea (Ach.) Zwackh

Loc.: Mar1, Bis1

Sub.: cor, xyl

det./conf.: Jan Vondrák

Caloplaca saxifragarum Poelt

Loc.: Mok1, Pel6

Sub.: cor, bry

det./conf.: Jan Vondrák

Caloplaca schistidii (Anzi) Zahlbr.

Loc.: Mok2

Sub.: bry

det./conf.: Jan Vondrák

Caloplaca stillicidiorum s.l.

Loc.: Sha3, Kaj1, Kor7, Koz1, Sha2

Sub.: deb, ter-sil, ter-cal

det./conf.: Jan Vondrák

**Caloplaca tetraspora* (Nyl.) H.Olivier

Loc.: Koz1

Sub.: deb

det./conf.: Jan Vondrák

Caloplaca tirolensis Zahlbr.

Loc.: Mok1, Sha2, Pel1

Sub.: cor, deb, xyl

det./conf.: Jan Vondrák

Caloplaca variabilis s.l.

Loc.: Kor5, Koz1, Sha1, Sha5

Sub.: cal

det./conf.: Fernando Fernandez
Mendoza*Calvitimela* Hafellner*Calvitimela armeniaca* (DC.) Hafellner

Loc.: Pel2, Pel3

Sub.: sil

Candelariella Müll.Arg.*Candelariella aurella* (Hoffm.) Zahlbr.Loc.: Koz1, Koz3, Kor1, Kor5, Kor7, Sha4,
Mok2, Sha1

Sub.: int, cal, ter-cal, deb

Candelariella coralliza (Nyl.) H.Magn.

Loc.: Koz3, Pel6, Koz3

Sub.: sil

**Candelariella faginea*

Nimis, Poelt & Puntillo

Loc.: Sha3, Sha2

Sub.: cor

det./conf.: Jan Vondrák

**Candelariella plumbea* Poelt & Vězda

Loc.: Kor5

Sub.: cal

Candelariella vitellina (Ehrh.) Müll.Arg.Loc.: Pel3, Sha3, Kaj1, Koz3, Mok1, Sha1,
Sha2, Kor2, Sha5

Sub.: cor, sil, art

Candelariella xanthostigma

(Ach.) Lettau

Loc.: Pel3, Kor3, Pel8

Sub.: cor

Carbonea (Hertel) Hertel**Carbonea vorticosa* (Flörke) Hertel

Loc.: Kaj1

Sub.: sil

det./conf.: Josef Hafellner

Catapyrenium Flot.*Catapyrenium cinereum* (Pers.) Körb.

Loc.: Koz1, Mok1

Sub.: ter-cal

Catapyrenium daedaleum

(Kremp.) Stein

Loc.: Koz1

Sub.: bry

det./conf.: Othmar Breuss

Catillaria A.Massal.**Catillaria picila* (A.Massal.) Coppins

Loc.: Kor4

Sub.: cal

Cephalophysia (Hertel) H.Kiliass**Cephalophysia leucospila*

(Anzi) H.Kiliass & Scheid.

Loc.: Sha1

Sub.: int

Cetraria Ach. nom. cons.*Cetraria aculeata* (Schreb.) Fr.

Loc.: Kor2

Sub.: ter-sil

det./conf.: Fernando Fernandez
Mendoza*Cetraria ericetorum* Opiz

Loc.: Koz1, Sha1, Sha2, Mok1

Sub.: ter-cal, ter-sil

Cetraria islandica (L.) Ach.

Loc.: Pel3, Pel2, Kaj1, Koz1, Kor1, Sha2

Sub.: ter-sil, ter-cal

Cetraria muricata (Ach.) Eckfeldt

Loc.: Sha3, Kaj1

Sub.: ter-sil, ter-cal

det./conf.: Fernando Fernandez
Mendoza**Cetraria sepincola* (Ehrh.) Ach.

Loc.: Sha3

Sub.: xyl

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

Loc.: Koz4

Sub.: cor

Chaenotheca furfuracea (L.) Tibell

Loc.: Mok5, Kor4

Sub.: cor

Chaenotheca phaeocephala

(Turner) Th.Fr.

Loc.: Mok5

Sub.: cor

**Chaenotheca trichialis* (Ach.) Th.Fr.

Loc.: Koz4, Mok5, Pel4

Sub.: cor

Chrysothrix Mont. nom. cons.*Chrysothrix candelaris* (L.) J.R.Laundon

Loc.: Pel5, Kor4

Sub.: cor

Chrysothrix chlorina (Ach.) J.R.Laundon

Loc.: Sha4

Sub.: int

Cladonia P.Browne nom. cons.**Cladonia borealis* S.Stenroos

Loc.: Kor5, Kaj1

Sub.: bry, ter-sil

det./conf.: Ana Rosa Burgaz

Cladonia chlorophaea

(Flörke ex Sommerf.) Spreng.

Loc.: Kaj1, Koz1

Sub.: ter-sil, bry

Cladonia coniocraea (Flörke) Spreng.

Loc.: Pel2

Sub.: ter-sil

Cladonia fimbriata (L.) Fr.

Loc.: Koz2, Kaj1

Sub.: bry, ter-sil

det./conf.: Ana Rosa Burgaz

Cladonia furcata (Huds.) Schrad.

Loc.: Pel1, Koz2, Koz1

Sub.: bry, ter-cal, ter-sil

det./conf.: Ana Rosa Burgaz

Cladonia gracilis (L.) Willd.

Loc.: Sha2

Sub.: ter-sil

Cladonia macroceras (Delise) Hav.

Loc.: Pel1, Pel2, Sha3, Kaj1

Sub.: bry, ter-sil

Cladonia macrophyllodes Nyl.

Loc.: Pel3, Sha3

Sub.: ter-sil

**Cladonia mitis* Sandst.

Loc.: Pel2, Sha1

Sub.: ter-sil, ter-int

**Cladonia pleurota* (Flörke) Schaer.

Loc.: Kor5, Koz3

Sub.: ter-int

Cladonia pocillum (Ach.) Grognot

Loc.: Kor1, Kor5, Koz1, Pel1, Sha1

Sub.: ter-cal, bry

Cladonia pyxidata (L.) Hoffm.Loc.: Kor1, Kor3, Koz1, Koz3, Mok3, Pel1,
Pel3, Sha1, Sha2, Sha3, Sha4, Sha5

Sub.: ter-cal, ter-sil, ter-int, bry

Cladonia symphycarpa (Flörke) Fr.

Loc.: Kor1, Koz1, Sha1

Sub.: ter-cal, bry, ter-int

Cliostomum Fr.**Cliostomum corrugatum* (Ach.) Fr.

Loc.: Mok5

Sub.: cor

Coenogonium Ehrenb.**Coenogonium pineti*

(Ach.) Lücking & Lumbsch

Loc.: Sha3

Sub.: cor

Collema F.H.Wigg. nom. cons.*Collema flaccidum* (Ach.) Ach.

Loc.: Sha4

Sub.: bry

Collema furfuraceum (Arnold) Du Rietz

Loc.: Mok4

Sub.: cor

Collema subflaccidum Degel.

Loc.: Mok4

Sub.: cor

Cornicularia (Schreb.) Hoffm .*Cornicularia normoerica*

(Gunnerus) Du Rietz

Loc.: Kor3, Pel2, Sha3

Sub.: sil

Dacampia A.Massal.**Dacampia hookeri* (Borrer) A.Massal.

Loc.: Kor1, Sha1

Sub.: ter-cal-par

det./conf.: Josef Hafellner

Dermatocarpon Eschw.**Dermatocarpon arnoldianum* Degel.

Loc.: Kor6

Sub.: sil-aqu

det./conf.: Othmar Breuss

Dermatocarpon intestiniforme

(Körb.) Hasse

Loc.: Kor1, Koz1, Pel7

Sub.: cal, ter-cal, int, sil

det./conf.: Othmar Breuss

Dermatocarpon miniatum (L.) W.Mann

Loc.: Kor5, Mok3

Sub.: cal

det./conf.: Othmar Breuss

Dimelaena Norman*Dimelaena oreina* (Ach.) Norman

Loc.: Kor3

Sub.: sil

Note: Cemotype I, fumarprotocetraric acid, usnic acid

Diploschistes Norman*Diploschistes gypsaceus* (Ach.) Zahlbr.

Loc.: Sha4

Sub.: int

Diploschistes muscorum (Scop.) R.Sant.

Loc.: Sha4

Sub.: bry

Diploschistes scruposus

(Schreb.) Norman

Loc.: Pel7, Sha1

Sub.: sil

Diplotomma Flot.*Diplotomma hedinii*

(H.Magn.) P.Clerc & Cl.Roux

Loc.: Kor7, Koz1, Mok2

Sub.: cal

**Diplotomma lutosum* A.Massal.

Loc.: Sha1

Sub.: cal

Enchylium (Ach.) Gray*Enchylium polycarpon*

(Hoffm.) Otálora, P.M.Jørg. & Wedin

Loc.: Kor1

Sub.: cal

Ephebe Fr.*Ephebe lanata* (L.) Vain.

Loc.: Pel7

Sub.: sil

Epilichen Clem.**Epilichen scabrosus* (Ach.) Clem.

Loc.: Kaj1

Sub.: ter-sil

det./conf.: Josef Hafellner

Euopsis Nyl.**Euopsis pulvinata* (Schaer.) Vain.

Loc.: Pel7

Sub.: sil

Evernia Ach.*Evernia prunastri* (L.) Ach.

Loc.: Mok6, Pel4, Rad1, Sha6

Sub.: cor

Farnoldia Hertel*Farnoldia jurana* (Schaer.) Hertel

Loc.: Sha1

Sub.: cal

Farnoldia micropsis (A.Massal.) Hertel

Loc.: Koz4, Kor1

Sub.: cal

Flavocetraria Kärnefelt & A.Thell

Flavocetraria nivalis

(L.) Kärnefelt & A.Thell

Loc.: Kaj1, Kor2

Sub.: ter-sil, ter-cal

Fuscopannaria M.Jørg.

Fuscopannaria praetermissa

(Nyl.) M.Jørg.

Loc.: Pel3

Sub.: bry

Gyalecta Ach.

Gyalecta foveolaris (Ach.) Schaer.

Loc.: Pel1

Sub.: bry

**Gyalecta jenensis* (Batsch) Zahlbr.

Loc.: Sha4

Sub.: int

Gyalolechia A.Massal.

Gyalolechia bracteata

(Hoffm.) A.Massal.

Loc.: Mok1, Sha1

Sub.: ter-cal

**Gyalolechia epiphyta* (Lynge) Vondrák

Loc.: Kor1

Sub.: bry

det./conf.: Jan Vondrák

Gyalolechia flavovirescens

(Wulfen) Søchting, Frödén & Arup

Loc.: Koz4, Sha4

Sub.: cal, int

det./conf.: Jan Vondrák

Hypogymnia (Nyl.) Nyl.

Hypogymnia physodes (L.) Nyl.

Loc.: Sha3, Sha5

Sub.: cor, bry

Hypogymnia tubulosa (Schaer.) Hav.

Loc.: Mok6, Pel3, Pel4, Sha5

Sub.: cor

Koerberiella Stein

**Koerberiella wimmeriana* (Körb.) Stein

Loc.: Pel7

Sub.: sil

Lambiella Hertel

Lambiella insularis (Nyl.) T.Sprib.

Loc.: Kaj1

Sub.: sil-par, on *Lecanora rupicola*

Lathagrium (Ach.) Gray

Lathagrium cristatum

(L.) Otálora, M.Jørg. & Wedin

Loc.: Sha4

Sub.: cal

Lecanora Ach.

Lecanora albellula (Nyl.) Th. Fr.

Loc.: Kor3

Sub.: xyl

det./conf.: Jiří Malíček

Lecanora allophana Nyl.

f. *allophana*

Loc.: Mok4, Mok6, Sha6

Sub.: cor

det./conf.: Jiří Malíček

*Lecanora allophana*f. *sorediata* Vain.

Loc.: Sha6

Sub.: cor

det./conf.: Jiří Malíček

Lecanora bicincta Ramond

Loc.: Koz1, Koz3, Pel6, Pel7, Sha1, Sha3

Sub.: sil, int

**Lecanora cadubriae* (A.Massal.) Hedl.

Loc.: Pel4

Sub.: cor

Lecanora carpineae (L.) Vain.Loc.: Kor3, Kor4, Koz4, Mar1, Mok6,
Pel3, Pel4, Sha3, Sha4, Sha6

Sub.: cor, xyl

det./conf.: Jiří Malíček

Lecanora cenisia Ach.Loc.: Kaj1, Kor3, Koz3, Pel1, Pel2, Pel6,
Pel7, Sha3

Sub.: sil

Lecanora chlarotera Nyl.

Loc.: Koz4, Mar1, Mok6, Pel3, Sha4, Sha6

Sub.: cor

**Lecanora circumborealis* Brodo & Vitik.

Loc.: Sha3

Sub.: xyl

**Lecanora epanora* (Ach.) Ach.

Loc.: Kor3

Sub.: sil

**Lecanora impudens* Degel.

Loc.: Sha6

Sub.: cor

Lecanora intumescens

(Rebent.) Rabenh.

Loc.: Sha6, Mok4

Sub.: cor

det./conf.: Jiří Malíček

Lecanora leptyroides (Nyl.) Degel.

Loc.: Sha6

Sub.: cor

det./conf.: Jiří Malíček

Lecanora polytropae (Hoffm.) Rabenh.Loc.: Kaj1, Kor2, Kor3, Kor5, Koz3, Pel1,
Pel2, Pel3, Pel7, Sha1, Sha3

Sub.: cor, art, int

**Lecanora printzenii*

Perez-Ortega, Vivas & Hafellner

Loc.: Koz3, Pel2, Sha3

Sub.: sil-par, on *Umbilicaria cylindrica* s.l.

det./conf.: Josef Hafellner

Lecanora pulicaris (Pers.) Ach.

Loc.: Pel4

Sub.: xyl

det./conf.: Jiří Malíček

Lecanora rupicola (L.) Zahlbr.subsp. *rupicola*

Loc.: Kaj1, Kor3, Koz3, Pel7, Sha5

Sub.: sil

**Lecanora rupicola* subsp. *subplanata*

(Nyl.) Leuckert & Poelt

Loc.: Pel6, Sha1

Sub.: sil, int

Lecanora saligna (Schrader.) Zahlbr.

Loc.: Bis1, Koz3, Mok1, Pel3

Sub.: xyl, cor

**Lecanora sarcopidoides*

(A.Massal.) A.L.Sm.

Loc.: Pel1

Sub.: cor

**Lecanora symmicta* (Ach.) Ach.

Loc.: Koz3, Mok3, Pel3, Pel4, Sha2, Sha3

Sub.: xyl, cor

Lecidea Ach.*Lecidea atrobrunnea* (DC.) Schaer.

Loc.: Kor1, Pel6, Pel7, Sha2, Sha3

Sub.: sil

**Lecidea berengeriana* (A.Massal.) Nyl.

Loc.: Kor1

Sub.: ter-cal

Lecidea confluens (Weber) Ach.

Loc.: Kor1, Kor5, Kor6, Koz1, Koz3, Pel2, Sha3

Sub.: int, sil

**Lecidea diducens* Nyl.

Loc.: Kor5

Sub.: sil

Lecidea lapicida (Ach.) Ach.var. *lapicida*

Loc.: Pel1, Pel7, Kaj1, Kor5, Sha5

Sub.: sil, int

Lecidea lapicida var. *pantherina* (Hoffm.) Ach.

Loc.: Kaj1, Kor3, Sha3

Sub.: sil

Lecidea lithophila (Ach.) Ach.

Loc.: Kaj1, Sha5

Sub.: sil

det./conf.: Josef Hafellner

Lecidea promiscens Nyl.

Loc.: Baba planina – northern slopes of Pelister

Sub.: sil

Date: July 13th, 1977

leg.: J. Hafellner (3443), J. Poelt

det./conf.: M. Pietschmann

Note: GZU

**Lecidea sarcogynoides* Körb.

Loc.: Koz3

Sub.: sil

**Lecidea speirodes* Nyl.

Loc.: Sha1, Sha2, Sha3

Sub.: int, sil

Lecidea tessellata Flörke

Loc.: Kaj1, Kor1

Sub.: sil, cal

det./conf.: Josef Hafellner

Lecidea umbonata (Hepp) Mudd

Loc.: Koz1

Sub.:

Lecidella Körb.*Lecidella achristotera*

(Nyl.) Hertel & Leuckert

Loc.: Bis1, Koz4, Pel3, Pel4, Pel8, Sha2, Sha5

Sub.: xyl, cor

Lecidella carpathica Körb.

Loc.: Sha5, Koz3

Sub.: sil

Lecidella elaeochroma (Ach.) M.Choisy
var. *elaeochroma*

Loc.: Kor3, Kor4, Koz1, Koz4, Mok1, Mok6, Pel1, Pel3, Pel4, Rad1, Sha1, Scha2, Sha3, Sha4, Sha5, Sha6

Sub.: cor, xyl

**Lecidella elaeochroma* var. *flavicans*

(Ach.) Hertel

Loc.: Koz4

Sub.: cor

det./conf.: Jiří Malíček

**Lecidella flavosorediata*

(Vězda) Hertel & Leuckert

Loc.: Pel4

Sub.: cor

Lecidella patavina

(A.Massal.) Knoph & Leuckert

Loc.: Kor1, Kor2, Kor7, Koz1, Mok2, Sha1

Sub.: int, cal

Lecidella stigmathea

(Ach.) Hertel & Leuckert

Loc.: Kor7, Koz1, Sha4

Sub.: cal, int

**Lecidella wulfenii* (Hepp) Körb.

Loc.: Sha3

Sub.: deb

Lecidoma Gotth.Schneid. & Hertel**Lecidoma demissum*

(Rutstr.) Gotth.Schneid. & Hertel

Loc.: Kaj1, Koz3

Sub.: ter-sil, bry

Lepra Scop.*Lepra albescens* (Huds.) Hafellner

Loc.: Mok4, Koz4

Sub.: cor

Lepra amara (Ach.) Hafellner

Loc.: Mok6

Sub.: cor

det./conf.: Jiří Malíček

**Lepra excludens* (Nyl.) Hafellner

Loc.: Pel2

Sub.: sil

Lepraria Ach. nom. cons.**Lepraria alpina*

(B.de Lesd.) Tretiach & Baruffo

Loc.: Sha3

Sub.: bry

**Lepraria borealis* Loht. & Tønsberg

Loc.: Kor3

Sub.: sil

Lepraria caesioalba

(B.de Lesd.) J.R.Laundon

Loc.: Kaj1, Pel6, Pel7

Sub.: ter-sil, bry, sil

**Lepraria celata* Š.Slavíková

Loc.: Pel1

Sub.: sil

Lepraria eburnea J.R.Laundon

Loc.: Kor1, Kor7, Pel5

Sub.: ter-int, cor

**Lepraria elobata* Tønsberg

Loc.: Mok4

Sub.: cor

Lepraria finkii (de Lesd.) R.C.Harris

Loc.: Kaj1, Koz4, Pel3

Sub.: ter-sil, cor

**Lepraria granulata* Slavíková

Loc.: Kaj1, Kor3

Sub.: bry-sil

Lepraria incana (L.) Ach.

Loc.: Sha4

Sub.: sil

Lepraria rigidula (de Lesd.) Tønsberg

Loc.: Kor3, Sha4

Sub.: bry, cor

Lepraria vouauxii (Hue) R.C.Harris

Loc.: Sha4

Sub.: bry

Leptogium (Ach.) Gray**Leptogium cyanescens* (Ach.) Körb.

Loc.: Sha5

Sub.: int

Leptogium saturninum (Dicks.) Nyl.

Loc.: Mok4, Sha6

Sub.: cor

Lobaria (Schreb.) Hoffm .*Lobaria pulmonaria* (L.) Hoffm.

Loc.: Mok4

Sub.: cor

Lobothallia (Clauzade & Cl.Roux)
Hafellner

Lobothallia praeradiosa (Nyl.) Hafellner
Loc.: Sha3
Sub.: int

Lobothallia radiosa (Hoffm.) Hafellner
Loc.: Kor1, Kor5, Sha4
Sub.: sil, cal

Lopadium Körb. nom. cons.

**Lopadium pezizoideum* (Ach.) Körb.
Loc.: Sha3
Sub.: bry
det./conf.: Josef Hafellner

Melanelia Essl.

Melanelia stygia (L.) Essl.
Loc.: Koz3
Sub.: sil

Melanelixia O.Blanco et al.

Melanelixia fuliginosa
(Fr. ex Duby) O.Blanco et al.
Loc.: Koz3
Sub.: sil

Melanelixia glabra
(Schaer.) O.Blanco et al.
Loc.: Kor3, Mok4, Pel4, Sha4, Sha6
Sub.: cor

Melanelixia glabratula
(Lamy) Sandler & Arup
Loc.: Kor4, Pel3, Sha6
Sub.: cor

Melanelixia subaurifera
(Nyl.) O.Blanco et al.
Loc.: Mok6, Rad1
Sub.: cor

Melanohalea O.Blanco et al.

Melanohalea exasperata
(De Not.) O.Blanco et al.
Loc.: Kor3, Pel3, Pel4, Sha4
Sub.: cor

Melanohalea exasperatula
(Nyl.) O.Blanco et al.
Loc.: Pel3
Sub.: cor

Micarea Fr. nom. cons.

**Micarea misella* (Nyl.) Hedl.
Loc.: Pel3
Sub.: xyl

Miriquidica Hertel & Rambold

Miriquidica garovaglii
(Schaer.) Hertel & Rambold
Loc.: Kaj1, Kor5, Koz3, Pel2
Sub.: sil

**Miriquidica intrudens*
(H.Magn.) Hertel & Rambold
Loc.: Pel7
Sub.: sil-par
det./conf.: Josef Hafellner

Mycobilimbia Rehm

**Mycobilimbia tetramera*
(De Not.) Vitik. et al.
Loc.: Koz1
Sub.: bry
det./conf.: Jiří Malíček

Myriolecis Clem.

Myriolecis agardhiana
(Ach.) Šliwa, Zhao Xin & Lumbsch
Loc.: Kor7
Sub.: cal

Myriolecis crenulata

(Hook.) Šliwa, Zhao Xin & Lumbsch

Loc.: Sha4

Sub.: int

Myriolecis dispersa s.l.

Loc.: Mok1, Sha2, Sha4

Sub.: cor, int

Myriolecis hagenii var. *hagenii*

(Ach.) Šliwa, Zhao Xin & Lumbsch

Loc.: Bis1, Mok6, Pel1, Sha2

Sub.: cor, xyl

det./conf.: Jiří Malíček

Myriolecis hagenii (Hepp) Hafellner & Türk var. *fallax*

Loc.: Kor7

Sub.: deb

det./conf.: Josef Hafellner

Myriolecis semipallida

(H.Magn.) Šliwa, Zhao Xin & Lumbsch

Loc.: Koz1

Sub.: cal

Myriospora Nägeli ex Uloth (non Hue)*Myriospora smaragdula*

(Wahlenb. ex Ach.) Nägeli ex Uloth

Loc.: Koz3

Sub.: sil

Nephroma Ach.*Nephroma parile* (Ach.) Ach.

Loc.: Kor3

Sub.: bry

Ochrolechia A.Massal.**Ochrolechia androgyna* (Hoffm.) Arnold

Loc.: Sha6

Sub.: cor

det./conf.: Jiří Malíček

Ochrolechia pallescens (L.) A.Massal.

Loc.: Sha6

Sub.: cor

Ochrolechia szatalaensis Verseghy

Loc.: Sha6

Sub.: cor

**Ochrolechia upsaliensis* (L.) A.Massal.

Loc.: Koz3

Sub.: sil

Note: on fine soil crust on siliceous rock

Ophioparma Norman emend. R.W.Rogers & Hafellner*Ophioparma ventosa* (L.) Norman

Loc.: Sha3

Sub.: sil

Parmelia Ach. nom. cons.*Parmelia saxatilis* (L.) Ach.

Loc.: Koz3, Sha3, Kor3

Sub.: deb, sil

Parmelia sulcata Taylor

Loc.: Rad1

Sub.: cor

Parmelina Hale*Parmelina quercina* (Willd.) Hale

Loc.: Mok6

Sub.: cor

Parmeliopsis (Nyl.) Nyl. nom. cons.*Parmeliopsis ambigua* (Hoffm.) Nyl.

Loc.: Mok3, Pel3

Sub.: cor

**Parmeliopsis hyperopta* (Ach.) Arnold

Loc.: Mok3, Pel3

Sub.: cor

Peltigera Willd. nom. cons.

Peltigera canina (L.) Willd.

Loc.: Kor4

Sub.: bry

Peltigera degenii Gyeln.

Loc.: Pel9

Sub.: bry

Peltigera didactyla (With.) J.R.Laundon

Loc.: Pel9

Sub.: bry

Peltigera elisabethae Gyeln.

Loc.: Koz1

Sub.: bry

det./conf.: Josef Hafellner

Peltigera horizontalis (Huds.) Baumg.

Loc.: Mok4

Sub.: bry

**Peltigera lepidophora* (Vain.) Bitter

Loc.: Sha2

Sub.: bry, ter-sil

Peltigera leucophlebia (Nyl.) Gyeln.

Loc.: Sha3

Sub.: ter-sil

**Peltigera membranacea* (Ach.) Nyl.

Loc.: Sha4

Sub.: bry

Peltigera praetextata

(Flörke ex Sommerf.) Zopf

Loc.: Koz4, Mok4, Sha5

Sub.: bry

Peltigera rufescens (Weiss) Humb.

Loc.: Kaj1, Kor1, Pel1, Sha2

Sub.: ter-sil, ter-cal, bry

Peltigera venosa (L.) Hoffm.

Loc.: Sha2

Sub.: ter-sil

Pertusaria DC. nom. cons.

Pertusaria flavicans Lamy

Loc.: Sha3, Sha4

Sub.: sil, int

Phaeophyscia Moberg

Phaeophyscia orbicularis

(Neck.) Moberg

Loc.: Sha6

Sub.: cor

Phaeorrhiza H.Mayrhofer & Poelt

**Phaeorrhiza nimbosa*

(Fr.) H.Mayrhofer & Poelt

Loc.: Koz1, Mok1

Sub.: ter-cal

Phlyctis (Wallr.) Flot. nom. cons.

Phlyctis argena (Spreng.) Flot.

Loc.: Koz4, Sha5

Sub.: xyl, cor, bry

Physcia (Schreb.) Michx.

Physcia adscendens H.Olivier

Loc.: Mar1, Mok6

Sub.: cor

Physcia aipolia (Ehrh. ex Humb.) Fűrnr.

Loc.: Kor3, Mok6, Pel4, Sha6

Sub.: cor

Physcia albinea (Ach.) Nyl.

Loc.: Koz3

Sub.: sil

Physcia biziana (A.Massal.) Zahlbr.

Loc.: Kor3, Mar1

Sub.: cor

Physcia caesia (Hoffm.) Fűrnr.

Loc.: Mok2, Kor7

Sub.: cal

det./conf.: haf

Physcia dubia (Hoffm.) Lettau

Loc.: Koz3

Sub.: sil

Physcia leptalea (Ach.) DC.

Loc.: Pel4, Rad1, Sha4

Sub.: cor

Physconia Poelt nom. cons.

Physconia distorta (With.) J.R.Laundon

Loc.: Mok4

Sub.: cor

Physconia muscigena (Ach.) Poelt

Loc.: Kor7, Sha1, Sha2, Sha3

Sub.: bry, deb

Physconia perisidiosa

(Erichsen) Moberg

Loc.: Sha6

Sub.: cor

det./conf.: Adriana Atanassova

Physconia venusta (Ach.) Poelt

Loc.: Pel4, Sha5, Sha6

Sub.: cor

Placidium A.Massal.

Placidium squamulosum (Ach.) Breuss

Loc.: Kor1, Mok1, Sha1

Sub.: ter-cal

det./conf.: Othmar Breuss

Placynthiella Elenkin

Placynthiella dasaea (Stirt.) Tønsberg

Loc.: Pel4, Sha2

Sub.: ter-sil

det./conf.: Jiří Malíček

**Placynthiella icmalea*

(Ach.) Coppins & P.James

Loc.: Sha4

Sub.: xyl

Placynthium (Ach.) Gray

**Placynthium dolichoterum* (Nyl.) Trevis.

Loc.: Sha4

Sub.: sil

det./conf.: Jiří Malíček

Pleopsidium Körb.

Pleopsidium chlorophanum

(Wahlenb.) Zopf

Loc.: Pel1

Sub.: sil

Pleopsidium oxytonum (Ach.) Rabenh.

Loc.: Pel6, Sha2

Sub.: sil

Pleurosticta Petr.

Pleurosticta acetabulum

(Neck.) Elix & Lumbsch

Loc.: Pel3, Pel4

Sub.: cor

Polyblastia A.Massal. nom. cons.

Polyblastia cupularis A.Massal.

Loc.: Sha1, Sha4

Sub.: cal, int, int

Polysporina Vězda nom. cons.

Polysporina simplex (Taylor) Vězda

Loc.: Kor1, Koz3

Sub.: int, sil

**Polysporina urceolata* (Anzi) Brodo

Loc.: Kor5

Sub.: cal

Porpidia Körb.**Porpidia crustulata*

(Ach.) Hertel & Knoph

Loc.: Kaj1, Kor3, Sha1, Sha2

Sub.: sil, int

Porpidia macrocarpa

(DC.) Hertel & A.J.Schwab

Loc.: Kor3, Koz1, Pel7

Sub.: sil, int

Porpidia speirea (Ach.) Kremp.

Loc.: Kor1, Koz1

Sub.: sil

Protoblastenia (Zahlbr.) J.Steiner**Protoblastenia aurata* Poelt & Vězda

Loc.: Sha4

Sub.: cal

Protoblastenia calva (Dicks.) Zahlbr.

Loc.: Sha1

Sub.: cal

Protoblastenia incrustans

(DC.) J.Steiner

Loc.: Kor1

Sub.: cal

Protoblastenia rupestris

(Scop.) J.Steiner

Loc.: Sha1

Sub.: cal

Protoblastenia terricola (Anzi) Lynge

Loc.: Koz1

Sub.: ter-cal

Protoparmelia M.Choisy*Protoparmelia badia* (Hoffm.) Hafellner
var. *badia*

Loc.: Kaj1, Kor1, Koz1, Sha1

Sub.: sil, int, cal

**Protoparmelia badia* var. *cinereobadia*

(Harm.) Clauzade & Cl.Roux ex

Hafellner & Türk

Loc.: Kaj1, Kor5, Sha1, Sha3

Sub.: sil, cal

Protoparmeliopsis M.Choisy*Protoparmeliopsis muralis*

(Schreb.) M.Choisy

Loc.: Koz1, Pel7, Sha5

Sub.: sil, int

**Protoparmeliopsis peltata*

(Ramond) Arup, Zhao Xin & Lumbsch

Loc.: Kor1

Sub.: sil

Protoparmeliopsis versicolor

(Pers.) M.Choisy

Loc.: Koz1, Mok2

Sub.: cal

Pseudephebe M.Choisy*Pseudephebe pubescens* (L.) M.Choisy

Loc.: Koz3, Pel2, Sha3

Sub.: sil

Pseudevernia Zopf*Pseudevernia furfuracea* (L.) Zopfvar. *furfuracea*

Loc.: Koz3, Sha5

Sub.: bry, cor

**Pseudevernia furfuracea* var. *ceratea*

(Ach.) D.Hawksw.

Loc.: Pel3, Sha4

Sub.: cor

Pseudosagedia (Müll.Arg.)
M.Choisy

Pseudosagedia aenea
(Wallr.) Hafellner & Kalb
Loc.: Sha4
Sub.: cor

Psora Hoffm. nom. cons.

Psora decipiens (Hedw.) Hoffm.
Loc.: Kor1, Mok1, Sha1
Sub.: ter-cal

Psorinia Gotth.Schneid.

**Psorinia conglomerata*
(Ach.) Gotth.Schneid.
Loc.: Koz3
Sub.: sil

Psoroma Michx.

**Psoroma tenue* Henssen

var. *boreale* Henssen
Loc.: Kaj1
Sub.: ter-sil

Pycnora Hafellner

**Pycnora praestabilis* (Nyl.) Hafellner
Loc.: Pel4
Sub.: xyl
det./conf.: Jiří Malíček

Pyrenula Ach. nom. cons.

**Pyrenula nitidella*
(Flörke ex Schaer.) Müll.Arg.
Loc.: Sha5
Sub.: cor

Ramalina Ach. nom. cons.

Ramalina capitata (Ach.) Nyl.
Loc.: Koz3, Sha2
Sub.: sil

Ramalina farinacea (L.) Ach.
Loc.: Sha5
Sub.: cor

Ramalina fraxinea (L.) Ach.
Loc.: Kor3, Pel3, Sha5
Sub.: cor

Ramalina pollinaria (Westr.) Ach.
Loc.: Koz3, Sha3
Sub.: sil

Rhizocarpon Ramond ex DC.

Rhizocarpon atroflavescens Lynge
Loc.: Koz1, Sha1
Sub.: int

**Rhizocarpon badioatrum*
(Flörke ex Spreng.) Th.Fr.
Loc.: Pel7
Sub.: sil-aqu

Rhizocarpon distinctum Th.Fr.
Loc.: Pel2
Sub.: sil

**Rhizocarpon ferax* H.Magn.
Loc.: Pel7
Sub.: sil

Rhizocarpon geminatum Körb.
Loc.: Pel7
Sub.: sil

Rhizocarpon geographicum (L.) DC.
Loc.: Kor1, Kor3, Kor5, Koz3, Pel1, Pel6,
Pel7, Sha1, Sha2, Sha3, Sha5, Kaj1
Sub.: sil

Rhizocarpon lavatum (Fr.) Hazsl.

Loc.: Pel7

Sub.: sil-aqu

**Rhizocarpon lecanorinum* Anders

Loc.: Pel7

Sub.: sil

**Rhizocarpon macrosporum* Räsänen

Loc.: Sha3

Sub.: sil

Rhizocarpon polycarpum (Hepp) Th.Fr.

Loc.: Kaj1, Koz3, Pel2, Sha3, Sha5

Sub.: sil

**Rhizocarpon postumum* (Nyl.) Arnold

Loc.: Sha5

Sub.: sil

Rhizocarpon reductum Th. Fr.

Loc.: Sha2

Sub.: sil

Rhizocarpon saanaense Räsänen

Loc.: Kor1

Sub.: sil

Rhizoplaca Zopf

Rhizoplaca melanophthalma

(DC.) Leuckert & Poelt

Loc.: Sha3

Sub.: sil

Rinodina (Ach.) Gray

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

Loc.: Kor3, Sha6

Sub.: cor

Rinodina bischoffii (Hepp) A.Massal.

Loc.: Koz1, Mok3

Sub.: int, cal

Rinodina calcarea

(Hepp ex Arnold) Arnold

Loc.: Mok2

Sub.: cal

**Rinodina exigua* (Ach.) Gray

Loc.: Pel3, Pel8

Sub.: cor

Rinodina freyi H.Magn.

Loc.: Bis1, Kaj1, Koz1, Mok1, Sha2, Sha3

Sub.: xyl, cor

Rinodina milvina (Wahlenb.) Th.Fr.

Loc.: Kaj1, Kor3, Pel6, Sha3

Sub.: sil

Rinodina mniaroea (Ach.) Körb.

Loc.: Sha3

Sub.: bry

**Rinodina mniaroeiza* (Nyl.) Arnold

Loc.: Kor1

Sub.: ter-cal

**Rinodina orculata* Poelt & M.Steiner

Loc.: Pel3, Sha3

Sub.: cor

Rinodina parasitica H.Mayrhofer & Poelt

Loc.: Koz3

Sub.: sil-par

Rinodina pyrina (Ach.) Arnold

Loc.: Bis1, Pel8

Sub.: xyl

**Rinodina roscida* (Sommerf.) Arnold

Loc.: Koz1

Sub.: deb

Rinodina sophodes (Ach.) A.Massal.

Loc.: Kor3, Pel3

Sub.: cor

Romjularia Timdal*Romjularia lurida* (Ach.) Timdal

Loc.: Koz1

Sub.: ter-cal, int

det./conf.: Othmar Breuss

Ropalospora A.Massal.**Ropalospora viridis*

(Tønsberg) Tønsberg

Loc.: Mok3

Sub.: cor

Sarcogyne Flot. nom. cons.**Sarcogyne hypophaea* (Nyl.) Arnold

Loc.: Sha3

Sub.: sil

Schaereria Körb. nom. cons.*Schaereria fuscocinerea*

(Nyl.) Clauzade & Cl.Roux

Loc.: Kor3

Sub.: sil

Scytinium (Ach.) Gray*Scytinium gelatinosum*

(With.) Otálora, M.Jørg. & Wedin

Loc.: Sha1, Sha4

Sub.: ter-int, int, bry

det./conf.: Jiří Malíček

Scytinium lichenoides

(L.) Otálora, M.Jørg. & Wedin

Loc.: Sha4, Sha5

Sub.: bry, int

Scytinium pulvinatum

(Hoffm.) Otálora, P.M.Jørg. & Wedin

Loc.: Sha4

Sub.: bry

det./conf.: Jiří Malíček

Solorina Ach.*Solorina bispora* Nyl.Loc.: Kor1, Kor2, Koz1, Mok1, Mok5,
Sha1

Sub.: ter-cal, ter-sil

Solorina crocea (L.) Ach.

Loc.: Kaj1

Sub.: ter-sil

Solorina saccata (L.) Ach.

Loc.: Sha1, Sha4

Sub.: ter-int

Sporastatia A.Massal.*Sporastatia polyspora* (Nyl.) Grummann

Loc.: Kaj1, Kor3, Koz3

Sub.: sil

Sporastatia testudinea (Ach.) A.Massal.

Loc.: Kor5, Koz3, Pel2, Sha2, Sha3

Sub.: sil

Sporodictyon A.Massal.*Sporodictyon cruentum* (Körb.) Körb.

Loc.: Koz4

Sub.: int

Squamarina Poelt*Squamarina gypsacea* (Sm.) Poelt

Loc.: Kor1, Mok2

Sub.: cal

Staurothele Norman nom. cons.*Staurothele areolata* (Ach.) Lettau

Loc.: Kor1, Sha3

Sub.: sil

Stereocaulon Hoffm. nom. cons.

Stereocaulon alpinum Laurer

Loc.: Kaj1, Kor5

Sub.: ter-sil

Tephromela M.Choisy

Tephromela atra (Huds.) Hafellner

Loc.: Koz3

Sub.: sil

Tetramelas Norman

**Tetramelas chloroleucus*

(Körb.) A.Nordin

Loc.: Pel3

Sub.: cor

Thamnolia Ach. ex Schaer. nom. cons.

Thamnolia subuliformis

(Ehrhart) W.L.Culberson

Loc.: Kaj1, Kor2, Sha1, Sha3

Sub.: ter-sil, ter-cal

Thelidium A.Massal.

Thelidium incavatum Nyl. ex Mudd

Loc.: Koz1

Sub.: cal

**Thelidium pyrenophorum*

(Ach.) A.Massal.

Loc.: Sha1

Sub.: cal

det./conf.: Othmar Breuss

Toninia A.Massal. nom. cons.

Toninia athallina (Hepp) Timdal

Loc.: Kor5

Sub.: cal

Toninia candida (Weber) Th.Fr.

Loc.: Kor1

Sub.: cal, ter-cal

**Toninia nordlandica* Th.Fr.

Loc.: Mok1, Sha1

Sub.: ter-cal, cal

**Toninia rosulata* (Anzi) H.Olivier

Loc.: Sha1

Sub.: ter-cal

Toninia taurica (Szatala) Oksner

Loc.: Mok2

Sub.: cal

Trapeliopsis Hertel & Gotth.Schneid.

**Trapeliopsis granulosa*

(Hoffm.) Lumbsch

Loc.: Kaj1, Pel1

Sub.: ter-sil, bry

Tremolecia M.Choisy

Tremolecia atrata (Ach.) Hertel

Loc.: Pel2, Pel3

Sub.: sil

Umbilicaria Hoffm. nom. cons.

Umbilicaria crustulosa (Ach.) Frey

Loc.: Kor3, Koz3, Pel7, Sha3

Sub.: sil

det./conf.: Evgeny Davydov

Umbilicaria cylindrica

(L.) Delise ex Duby

Loc.: Kaj1, Sja3

Sub.: sil

det./conf.: Evgeny Davydov

Umbilicaria decussata (Vill.) Zahlbr.

Loc.: Koz3, Sha2, Sha3

Sub.: sil

det./conf.: Evgeny Davydov

Umbilicaria deusta (L.) Baumg.

Loc.: Kaj1, Kor5, Koz3, Sha3

Sub.: sil

det./conf.: Evgeny Davydov

**Umbilicaria maculata*

Krzewicka, M.P.Martín & M.A.García

Loc.: Sha3

Sub.: sil

det./conf.: Evgeny Davydov

Umbilicaria nylanderiana

(Zahlbr.) H.Magn.

Loc.: Koz3, Sha3

Sub.: sil

det./conf.: Evgeny Davydov

Umbilicaria polyphylla (L.) Baumg.

Loc.: Kor3, Koz3

Sub.: sil

det./conf.: Evgeny Davydov

**Umbilicaria subpolyphylla* Oxner

Loc.: Kor3, Pel1

Sub.: sil

det./conf.: Evgeny Davydov

Umbilicaria vellea (L.) Ach.

Loc.: Pel7

Sub.: sil

det./conf.: Evgeny Davydov

Usnea Dill. ex Adans.

Usnea barbata (L.) F.H.Wigg.

Loc.: Pel4

Sub.: cor

det./conf.: Philippe Clerc

Usnea dasopoga (Ach.) Nyl.

Loc.: Pel4

Sub.: cor

Usnea perplexans Stirt.

Loc.: Pel3

Sub.: cor

Vahliella M.Jørg.

Vahliella leucophaea (Vahl) M.Jørg.

Loc.: Sha4

Sub.: sil

Varicellaria Nyl.

**Varicellaria lactea*

(L.) Schmitt & Lumbsch

Loc.: Sha3

Sub.: sil

Verrucaria Schrad. nom. cons.

Verrucaria hochstetteri s.l.

Loc.: Koz1

Sub.:

det./conf.: Othmar Breuss

Verrucaria nigrescens Pers.

Loc.: Sha4

Sub.: int

det./conf.: Othmar Breuss

Verrucaria poeltii (Servít) Breuss

Loc.: Sha1

Sub.: cal

det./conf.: Othmar Breuss

Verrucaria sphaerospora s.l.

Loc.: Kor7, Shar Planina - Popova Sapka
1700-1800m

Sub.: cal

Date: June 1st, 1971

leg.: J. Poelt

det./conf.: Othmar Breuss

Note: GZU - no number on envelope

**Verrucaria transfugiens* Zschacke

Loc.: Sha4

Sub.: cal

det./conf.: Othmar Breuss

Vulpicida J.-E.Mattsson & M.J.Lai

***Vulpicida pinastri*

(Scop.) J.-E.Mattsson & M.J.Lai

Loc.: Mok3, Pel3

Sub.: cor

Xanthoparmelia (Vain.) Hale nom. cons.

Xanthoparmelia pulla (Ach.) O.Blanco et

al. subsp. *pulla* var. *pulla*

Loc.: Pel3

Sub.: sil

det./conf.: Josef Hafellner

Xanthoparmelia pulla subsp. *pulla* var.

delisei (Duby) ined.

Loc.: Kor3

Sub.: sil

Xanthoparmelia stenophylla

(Ach.) Ahti & D.Hawksw.

Loc.: Kor2, Sha2

Sub.: sil

Xanthoria (Fr.) Th.Fr. nom. cons.

Xanthoria elegans (Link) Th.Fr.

Loc.: Kor1, Kor5, Kor7, Mok2

Sub.: cal, int

Xanthoria parietina (L.) Th.Fr.

Loc.: Mar1, Pel4

Sub.: cor

Xylographa Fr.

**Xylographa pallens* (Nyl.) Malmgren

Loc.: Pel4, Pel7

Sub.: xyl

det./conf.: Toby Spribille, Philipp Resl

Xylographa parallela (Ach.: Fr.) Fr.

Loc.: Koz3, Pel3, Sha3, Sha4

Sub.: xyl

det./conf.: Toby Spribille, Philipp Resl

Lichenicolous fungi

Arthonia Ach. nom. cons.

Arthonia varians (Davies) Nyl.

Loc.: Sha1

Sub.: int-par, *Lecanora bicincta*

det./conf.: Josef Hafellner

Carbonea (Hertel) Hertel

Carbonea intrudens

(H. Magn.) Hafellner

Loc.: Pel7

Sub.: sil-par, on *Rhizocarpon geographicum*

det./conf.: Josef Hafellner

**Carbonea supersparsa* (Nyl.) Hertel

Loc.: Pel3

Sub.: sil-par, on *Lecanora polytropia*

det./conf.: Josef Hafellner

Carbonea vitellinaria (Nyl.) Hertel

Loc.: Koz3

Sub.: sil-par, on *Candelariella vitellina*

det./conf.: Josef Hafellner

Cercidospora Körb.**Cercidospora epipolytropa*

(Mudd) Arnold

Loc.: Pel7

Sub.: sil-par, on *Lecanora polytropa*

det./conf.: Josef Hafellner

Intralichen D.Hawksw. & M.S.Cole**Intralichen christiansenii*

(D.Hawksw.) D.Hawksw. & M.S.Cole

Loc.: Mok1

Sub.: xyl-par, on *Lecanora saligna*

det./conf.: Josef Hafellner

Lichenocodium Petr. & Syd.**Lichenocodium erodens*

M.S.Christ. & D.Hawksw.

Loc.: Mok1

Sub.: ter-cal-par, on *Allocetraria
madreporiformis*

det./conf.: Josef Hafellner

Lichenothelia D.Hawksw.**Lichenothelia rugosa*

(G.Thor) Ertz & Diederich

Loc.: Sha1

Sub.: sil-par, on *Diploschistes scruposus*

det./conf.: Josef Hafellner

Muellerella Hepp ex Müll. Arg.**Muellerella pygmaea* (Körb.) D.Hawksw var. *athallina* (Müll. Arg.)

Triebel

Loc.: Mok2, Sha3

Sub.: cal-par, on *Caloplaca velana*,
Lecidea sp.

det./conf.: Josef Hafellner

Nigropuncta D.Hawksw.**Nigropuncta rugulosa* D.Hawksw.

Loc.: Pel2

Sub.: sil-par, on *Bellemerea
cinereorufescens*

det./conf.: Josef Hafellner

Roselliniopsis Matzer & Hafellner*Roselliniopsis* sp.

Loc.: Sha1

Sub.: sil-par, on *Diploschistes scruposus*

det./conf.: Josef Hafellner

Note: a new species

Stigmatidium Trevis.**Stigmatidium schaereri*

(A.Massal.) Trevis.

Loc.: Sha1

Sub.: sil-par, on *Dacampia hookeri*

det./conf.: Josef Hafellner

Non lichenised taxon frequently treated by lichenologists

Mycocalicium Vain.**Mycocalicium subtile* (Pers.) Szatala

Loc.: Koz4, Pel4, Sha4

Sub.: xyl

Conclusion

During the fieldwork in summer 2017 sampling was carried out on 36 locations on 6 Macedonian mountains. The chosen mountains are the five Macedonian mountains higher than 2500 meters – Korab Mountain (2764 m a.s.l.), Shar Planina (2748 m a.s.l.), Pelister Mountain (2601 m a.s.l.), Mokra Planina (2540 m a.s.l.), Kajmakchalan (2521 m a.s.l.) – and Kozhuf Mountain (2171 m a.s.l.) in the east of the country. The collection work resulted in over 1,200 samples and revealed 386 taxa including 114 new records for Macedonia. This confirms the assumption that the subalpine and alpine areas in Macedonia are still poorly investigated. The same conclusion was drawn by her Strasser (2012), who focused on the Prokletije mountain range in Montenegro. Their work resulted in 313 lichenized and 21 lichenicolous fungi whereof 68 species were new records for Montenegro.

The total number of species reported for Macedonia now increases to 785 lichens taxa (inc.: 6 subsp., 17 var. and 2 f.) and 32 species of lichenicolous fungi, which is a considerable share of all lichens known from the Balkan peninsular, regarding the small size of Macedonia. All over the peninsular slightly more than 2,000 taxa are known (MAYRHOFER, pers. comm.).

Especially the eastern parts of Macedonia have been little investigated but offer interesting habitats and substrates as mentioned in the introduction. These might be ideal areas for future projects.

All in all, this considerable output of new records consolidates the assumption that there are still many species to be discovered. Therefore, further investigations are crucial to deepen the knowledge on the lichen diversity in these areas.

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