

## Cladoniaceae of Montenegro

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**Abstract.** As a result of collections made in 61 locations during the year 2018, the number of *Cladonia* taxa is enlarged to 42, and ten new records of *Cladonia* are provided to Montenegro, *Cladonia cariosa*, *C. coccifera*, *C. cyathomorpha*, *C. digitata*, *C. diversa*, *C. homosekikaica*, *C. imbricarica*, *C. merochlorophaea*, *C. novochlorophaea* and *C. subulata*. The distribution of many taxa previously known for the territory is extended. The chemical variation and the distribution of each species are discussed.

**Key words.** *Cladonia*; diversity; phytogeography; lichens; chemical metabolites; Mediterranean Region.

### [es] Cladoniaceae de Montenegro

**Resumen.** Como consecuencia de la recolección en 61 localidades efectuada en 2018, se amplía a 42 taxones del género *Cladonia*, además se aportan diez especies nuevas para Montenegro, *Cladonia cariosa*, *C. coccifera*, *C. cyathomorpha*, *C. digitata*, *C. diversa*, *C. homosekikaica*, *C. imbricarica*, *C. merochlorophaea*, *C. novochlorophaea* y *C. subulata*. Se amplía la distribución de muchos de los taxones citados con anterioridad para el territorio. Se discute la variabilidad química y la distribución de cada una de las especies encontradas.

**Palabras clave:** *Cladonia*; diversidad; fitogeografía; líquenes; metabolitos químicos; región Mediterránea.

### Introduction

The lichenological exploration of Montenegro started with BIASOLETTO (1841), being *Cladonia fimbriata* one of the first reports for the country, as KNEŽEVIĆ & MAYRHOFFER (2009) pointed out. Several generalistic lichenological studies were carried out in Montenegro up to date. Out of the 850 taxa of lichenized fungi published, 33 species belong to the genus *Cladonia*, but no monographic study of the genus has been carried out (MAYRHOFFER et al. 2017). However, some authors must be highlighted because they contributed with a greater number of species of the genus *Cladonia*, such as KUŠAN (1953) who publishes all the information known to date about the territories of the former Yugoslavia, BILOVITZ et al. (2008), KNEŽEVIĆ & MAYRHOFFER (2009) and STRASSER et al. (2015).

Although the genus *Cladonia* has been well studied in many regions of Europe, especially in some bordering countries such as Albania, which has 27 species (BURGAZ et al. 2019), Bosnia-Her-

zegovina with 25 species, or Croatia with 45 species (BURGAZ & PINO-BODAS 2012; BURGAZ et al. 2017), others are still poorly explored, especially the countries of southeastern Europe.

The aim of this contribution is to summarize the results of floristic survey from Montenegro in the framework of a project on the family Cladoniaceae in the Mediterranean area of Eurasia.

### Materials and Methods

#### Description of studied area

Montenegro is a small mountainous Mediterranean country limited by the Adriatic Sea and surrounded by Croatia, Bosnia-Herzegovina, Serbia and Kosovo (from the old Yugoslavian territories), and Albania. It is located in the SE of Europe, where the Dinaric Alps run parallel to the sea, with many peaks above 2000 m high. The Durmitor massif, as part of the

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Dinaric Alps, are located in the NW, with the highest altitude at Bobotov peak (2522 m), while the Bjelasica mountains range in the NE, reaching 2139 m at Crna Glava peak. The dominant substrate is constituted by limestones and dolomites, and more than two-thirds of the country is karstic, intersected by river canyons and gorge stretches (Radulovic & Radulovic 1997), although there are some locations with siliceous rocks.

In general, the country has a Mediterranean climate, but with many variations related to the altitudinal elevation and exposures. There are three main climatic zones: Mediterranean, temperate continental and mountains (Horvat et al. 1974), with very variable annual precipitations. This climatic variation places Montenegro among the biological hotspots of European and world biodiversity (NBSAP 2010). The Mediterranean vegetation consisting of maquis and garrigue is located at lower terrains, while the mixed deciduous woodland,

beech forests, mixed beech-fir and spruce forests are situated in localities higher than 1000 m altitude. Above the timberline, subalpine grassland covers large areas.

The result of collections made in 61 locations during the summer of 2018 and the analysis of 352 specimens can be found in Annex 1. The specimens were deposited in Madrid (MACB) and Helsinki (H). Numerous specimens of each species were analysed by means of thin-layer chromatography (TLC) to identify the major lichen substances (Orange et al. 2001). The main secondary metabolites identified from *Cladonia* are listed in Table 1. Distribution maps are presented according to the administrative divisions of Montenegro (Figure 1). Figure 2 shows the most probable altitude where the species can be found as the average with the standard deviation values and the extreme values are the maximum and minimum where the species was found.



A



B

Figure 1. A-Map of Montenegro (<https://www.ezilon.com/maps/europe/montenegro-physical-maps.html>). B-Montenegro Municipalities ([https://en.wikipedia.org/wiki/Municipalities\\_of\\_Montenegro#/media/File:Municipalities\\_of\\_Montenegro.svg](https://en.wikipedia.org/wiki/Municipalities_of_Montenegro#/media/File:Municipalities_of_Montenegro.svg)).



Species	ATR	BAR	BOU	CNST	CPSO	FUM	HSEK	MER	NST	PSO	RAN	SPHAE	SQU	THAM	USN	ZEO
<i>C. imbricaria</i> 1												+				
<i>C. imbricaria</i> 2						+						+				
<i>C. macilentia</i> 1		+												+		
<i>C. macilentia</i> 2		+														
<i>C. macroceras</i> 1	+															
<i>C. macroceras</i> 2						+										
<i>C. macrophyllodes</i>	+					+										
<i>C. merochlorophaea</i>						+		+								
<i>C. mitis</i>											+				+	
<i>C. novochlorophaea</i>						+	+									+
<i>C. peziformis</i>						+										
<i>C. phyllophora</i>						+										
<i>C. pleurota</i>															+	
<i>C. pyxidata</i>						+										
<i>C. ramulosa</i>						+										
<i>C. rangiferina</i>	+					+										
<i>C. rangiformis</i> 1	+										+					
<i>C. rangiformis</i> 2	+					+					+					
<i>C. rangiformis</i> 3	+									+	+					
<i>C. rei</i> 1							+									
<i>C. rei</i> 2						+	+									
<i>C. squamosa</i>													+			
<i>C. subulata</i>						+										
<i>C. sulphurina</i>													+		+	
<i>C. symphyycarpa</i> 1	+			+					+							
<i>C. symphyycarpa</i> 2	+			+					+							+
<i>C. symphyycarpa</i> 3				+					+							
<i>C. symphyycarpa</i> 4									+		+					
<i>C. symphyycarpa</i> 5	+				+				+							
<i>C. uncialis</i>													+		+	

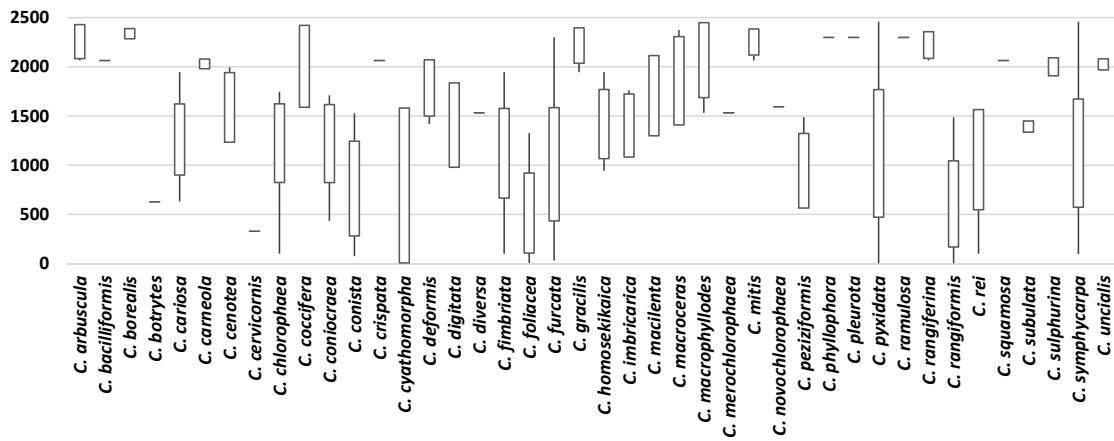


Figure 2. Species altitudinal rank in Montenegro.

The species morphologically variable in southern Europe and those in which we have found chemical variability are discussed in greater depth.

## Results and discussion

*Cladonia* is the only genus of Cladoniaceae represented in Montenegro. The species studied occur between sea level and 2400 m of altitude, taking into account both our data and other bibliographic references published by different authors (Figure 2). The Montenegro forests located at the main mountainous areas of the center and north of the country contain the greatest diversity of species between 1000 and 2000 m altitude. The fir and spruce forest, present in altitudes above 1500 m, harbours the largest number of species. Altitudes above 2000 m, where *Pinus mugo* prevails accompanied by *Juniperus communis*, are also important growth areas for the species studied. Beech and other deciduous forests host too a high number of species, although in a smaller quantity, decreasing with altitude. The areas with Mediterranean vegetation type maquis are very scarce, therefore the

number of species found in these formations is low. Although basic substrates dominate in Montenegro, there are scattered locations of acidic rocks which allow the entrance of many acidophilic species.

A total of 42 *Cladonia* taxa were found, out of which the following are new records to the former lichen checklist for Montenegro (\*): *Cladonia cariosa*, *C. coccifera*, *C. cyathomorpha*, *C. digitata*, *C. diversa*, *C. homosekikaica*, *C. imbricaria*, *C. merochlorophaea*, *C. novochlorophaea* and *C. subulata*.

The commonest species are: *Cladonia cariosa*, *C. fimbriata*, *C. foliacea*, *C. furcata*, *C. pyxidata*, *C. rangiformis* and *C. symphylicarpa*. Most of the species (64%) have NW-NE distribution along the Dinaric Alps, which mostly enjoys a temperate continental climate (Vuksanović et al. 2016), being 43% of them located in the eastern subregions of Montenegro and only 7% growing in the northern subregions; while *C. chlorophaea*, *C. coniocraea*, *C. conista*, *C. cyathomorpha*, *C. hosekikaica* and *C. rei* also grow in the mountainous locations of SW areas (Figure 3). *Cladonia cervicornis* is the only Mediterranean species s.str. in Montenegro following the geographical regionalization of Vuksanović et al. (2016).



*Cladonia arbuscula*



*Cladonia bacilliformis*



*Cladonia borealis*



*Cladonia botrytes*



*Cladonia cariosa*



*Cladonia carneola*



*Cladonia cenotea*



*Cladonia cervicornis*



*Cladonia chlorophaea*



*Cladonia coccifera*



*Cladonia coniocraea*



*Cladonia conista*



*Cladonia crispata*



*Cladonia cyathomorpha*



*Cladonia deformis*



*Cladonia digitata*



*Cladonia diversa*



*Cladonia fimbriata*



*Cladonia foliacea*



*Cladonia furcata*



*Cladonia gracilis*



*Cladonia homosekikaica*



*Cladonia imbricarica*



*Cladonia macilenta*





*Cladonia macroceras*



*Cladonia macrophyllodes*



*Cladonia merochlorophaea*



*Cladonia mitis*



*Cladonia novochlorophaea*



*Cladonia peziziformis*



*Cladonia phyllophora*



*Cladonia pleurota*



*Cladonia pyxidata*



*Cladonia ramulosa*



*Cladonia rangiferina*



*Cladonia rangiformis*



*Cladonia rei*



*Cladonia squamosa*



*Cladonia subulata*



*Cladonia sulphurina*



Figure 3. Distribution of *Cladonia* species in Montenegro. Bibliographic reports: ■, new records: ▲.

Seven species are chemically variable (Table 1), *C. cariosa* with 4 chemotypes, *C. furcata* with 3, *C. macilentata* with 2, *C. macroceras* with 2, *C. rangiformis* with 2, *C. rei* with 2 and *C. symphycarpa* with 5. A complex combination of chemotypes was found in the so-called *C. cariosa* group. Most of the specimens of *C. cariosa* have podetia but not *C. symphycarpa*, which difficulties the adequate morphological identification. Similar chemical variability was published of Poland (Osyczka & Skubala 2011) and Albania (Burgaz et al. 2019). Pino-Bodas et al. (2012a) confirmed that morphological or chemical characters were insufficient to delimit the species boundaries in the group and considered the existence of four phylogenetic lineages. At present, a molecular study on this group is underway including specimens from other European and American countries, but we do not yet have definitive results (Pino-Bodas et al. in prep).

**1. *Cladonia arbuscula*** (Wallr.) Flot., in Wendt, *Thermen Warmbrunn* 94 (1893)

A scattered terricolous species reported of Plav and Rožaje municipalities (Strasser et al. 2015) and Plužine municipality (Kušan 1953; Knežević & Mayrhofer 2009) growing at 2065-2403 m altitude.

**2. *Cladonia bacilliformis*** (Nyl.) Sarnth., *Osterr. Bot. Z.* 46: 264 (1896)

This is a rare species in the country, only reported by Strasser et al. (2015) from Plav municipality growing at 2065 m altitude on rotten wood.

**3. *Cladonia borealis*** S. Stenroos, *Ann. Bot. Fenn.* 26: 160 (1989)

A terricolous species only reported of Plav municipality (Strasser et al. 2015) growing at 2300-2374 m altitude on siliceous soil.

**4. *Cladonia botrytes*** (K.G. Hagen) Willd., *Fl. Berol. Prodr.*: 365 (1787)

This species has only been reported by Žukovec (2005) from Tera Canyon of Durmitor National Park (Knežević & Mayrhofer 2009).

**\*5. *Cladonia cariosa*** (Ach.) Spreng., *Syst. Veg.* 4(1): 272 (1827)

It is a common species found in Andrijevića, Berane, Cetinje, Herceg Novi, Nikšić, Plav, Plužine, Rožaje and Žabljak municipalities growing at 858-1947 m altitude. It was collected on bare soils of limestone and calcareous rock substrate on shrubs and pasture of several woodland formations, fir, spruce, coniferous, beech and mixed forests. Most of the specimens have the characteristic fissured podetia. The specimens analysed are chemically variable (Table 1), most of them belong to the chemotype 1, containing atranorin, norstictic and connorstictic acids. The chemotype 2, with atranorin and rangiformic acid, and some with additionally zeorin was also common; less common are the chemotypes with only atranorin or atranorin and fumarprotocetraric acid, in both cases also with zeorin.

**6. *Cladonia carneola*** (Fr.) Fr., *Lichenogr. Eur. Reform.*: 233 (1831)

A very rare species only reported of Plav municipality (Strasser et al. 2015) growing at

1995-2065 m altitude on coniferous lignum and siliceous soils.

**7. *Cladonia cenotea*** (Ach.) Schaer., Lich. Helv. Spic. 1(1): 35 (1823)

This is an uncommon species which contains only squamatic acid and was collected in Žabljak municipality on *Abies alba* stumps. It was also reported from Plav municipality (Kušan 1953; Strasser et al. 2015) and Žabljak municipality (Bilovitz et al. 2008).

**8. *Cladonia cervicornis*** (Ach.) Flot., Jahresber. Schles. Ges. Vaterl. Cult. 27: 105 (1849)

This is a very rare species only reported of Budva municipality, growing on limestone boulder, at 330 m altitude (Bilovitz et al. 2008).

**9. *Cladonia chlorophaea*** (Flörke ex Sommerf.) Spreng., Syst. Veg. 4(1): 273 (1827)

A common species collected in Cetinje, Kolašin, Mojkovac, Plav, Plužine, Rožaje, Šavnik and Žabljak municipalities. It grows on limestones, schists, pastures and stumps of deciduous and coniferous woodlands. It was reported from Herceg Novi (Servit 1931; Knežević & Mayrhofer 2009) and Plav (Strasser et al. 2015) municipalities. An additional specimen from Žabljak municipality was collected by O. Vitikainen in 1971 (H). It grows at 100-1746 m altitude. The specimens analysed contain fumarprotocetraric acid.

**\*10. *Cladonia coccifera*** (L.) Willd., Fl. Berol. Prodr.: 361 (1787)

This is a rare species only collected in Rožaje municipality on *Picea-Abies* forest and schist substrate, at 1711 m altitude. The specimen analysed contains usnic acid and zeorin. It was reported from Plav municipality growing at 2300 m altitude (Strasser et al. 2015).

**11. *Cladonia coniocraea*** (Flörke) Spreng., Syst. Veg., 4(1): 272 (1827)  
syn. *C. ochrochlora* Flörke

This common species was collected in Andrijevica, Bar, Berane, Kolašin, Plav, Rožaje and Žabljak municipalities. It grows at 435-1638 m altitude, on siliceous rock substrates, road slopes banks with schists, limestones or calcareous substrates and stumps of several woods. The specimens analysed contain fumarprotocetraric acid. All of the Montenegrin specimens studied belong to *C. coniocraea* s.str. (Ahti & Stenroos 2013). It was reported from Bar (Bilovitz et al. 2008;

Mayrhofer et al. 2013), Mojkovac (Bilovitz et al. 2010), Plav (Strasser et al. 2015), Plužine (Savić 2001; Knežević & Mayrhofer 2009), Tivat (H, collected by O. Vitikainen in 1971, between stones in olive groove), and Žabljak municipalities (Bilovitz et al. 2008).

**12. *Cladonia conista*** (Nyl.) Robbins, in Allen, Rhodora 32: 92 (1930)

A common species collected in Andrijevica, Budva, Cetinje, Kolašin, Kotor and Plav municipalities at 75-1528 m altitude. It is poorly represented in the bibliography because it was only reported of Kolašin municipality at 215 m altitude (Mayrhofer et al. 2017). It grows on road slope banks, bare soils, shrublands, maquis and woodlands. On schist, limestone and calcareous substrates. The specimens analysed contain bourgeanic and fumarprotocetraric acids, traditionally considered a chemotype of *C. humilis* (Pino-Bodas et al. 2012b). However, *C. humilis* s. str. was not found in Montenegro.

**13. *Cladonia crispata*** (Ach.) Flot., in Wendt, Thermen Warmbrunn: 93 (1839)

A very rare species only reported by Savić (2001) and Strasser et al. (2015) of Plav municipality, collected at 2065 m altitude on siliceous soil.

**\*14. *Cladonia cyathomorpha*** Stirt. ex Walt. Watson, J. Bot. 73: 156 (1935)

This terricolous species was only collected in Kotor municipality at 238 m altitude in maquis woodlands and limestone substrate. Also from Žabljak municipality was collected at 1350 m altitude by O. Vitikainen in 1971 (H). The specimens analysed contain fumarprotocetraric acid.

**15. *Cladonia deformis*** (L.) Hoffm., Deutschl. Fl. 2: 120 (1796)

The species was collected in Rožaje and Žabljak municipalities growing on pastures of *Picea-Abies* forest, *Betula pendula* and *Pinus mugo*, on schist and limestone substrates. The specimens analysed contain usnic, isousnic acids and zeorin. It was reported of Plav municipality at 2065 m altitude (Strasser et al. 2015).

**\*16. *Cladonia digitata*** (L.) Hoffm., Deutschl. Fl. 2: 124 (1796)

This uncommon species was collected in Rožaje municipality growing on *Picea abies* stump in a *Picea-Abies* woodland. One speci-

men analysed contains thamnolic acid and the other specimen fumarprotocetraric acid additionally.

\*17. *Cladonia diversa* Asperges ex Stenroos, in Ahti & Stenroos, *Bot. Complut.* 35: 326 (2012)

A very rare species growing on acid rock in *Picea abies* forest. The specimen analysed contains usnic acid and zeorin and it was collected in Plav municipality.

18. *Cladonia fimbriata* (L.) Fr., *Lich. Eur. Reform.* (Lund): 222 (1831)

A common species collected in Andrijevica, Bar, Berane, Budva, Cetinje, Gusinje, Kolašin, Nikšić, Plav, Plužine, Rožaje and Žabljak municipalities. It grows on pastures, shrubs, tree bases, stumps and woodlands of several forests; on limestone, calcareous, acid rocks, schist substrate and road slope banks. All the specimens analysed contain fumarprotocetraric acid. It was reported of Kolašin (Bilovitz et al. 2008), Mojkovac (Bilovitz et al. 2009), Podgorica (Bilovitz et al. 2008, Dragičević et al. 2011) and Žabljak municipalities (Bilovitz et al. 2008).

19. *Cladonia foliacea* (Huds.) Willd., *Fl. Berol. Prodr.*: 363 (1787)

incl. *C. convoluta* (Lam.) Anders

This common species was collected in Budva, Cetinje, Danilovgrad, Herceg Novi, Kotor, Mojkovac, Nikšić, Plužine, Podgorica, Ulcinj and Žabljak municipalities. It grows from sea level to 1327 m altitude on bare soils, pastures, shrublands, woodlands, rocks and humus of several forests. It was found on karstic limestone and calcareous rock substrate. All the specimens analysed contain fumarprotocetraric and usnic acids. It was reported of Budva (Bilovitz et al. 2008), Herceg Novi (Servít 1931, Knežević & Mayrhofer 2009), Pljevlja (Bilovitz et al. 2010), Plužine (Savić 2001, Knežević & Mayrhofer 2009), Podgorica (Zahlbruckner 1888, Kušan 1953, Bilovitz et al. 2008, Dragičević et al. 2011) and Ulcinj municipalities (Kušan 1953, Knežević & Mayrhofer 2009). Most of these bibliographic records were published as *C. convoluta* but we include it in the concept of *C. foliacea* according the results of Pino-Bodas et al. (2010, 2018) and the existence of many intermediate morphologies.

20. *Cladonia furcata* (Huds.) Schrad., *Spicil. Fl. Germ.* 1: 107 (1794)

incl. *C. subrangiformis* Sandst.

A very common species collected in Andrijevica, Bar, Berane, Budva, Cetinje, Danilovgrad, Gusinje, Kolašin, Kotor, Mojkovac, Nikšić, Plav, Pljevlja, Plužine, Podgorica, Rožaje, Šavnik, Ulcinj and Žabljak municipalities. Most of the specimens analysed contain fumarprotocetraric acid. Other chemotypes are also abundant: one containing atranorin and fumarprotocetraric acid, other containing atranorin, bourgeanic and fumarprotocetraric acids. For a long time the latter chemotypes were considered as different species, *C. subrangiformis*, but we included them as different chemotypes of *C. furcata* following the conclusions of Pino-Bodas et al. (2015). It grows on pastures, road slope banks, shrublands, maquis, woodlands, rocks, humus of several forests and limestone, schist, acid rock and calcareous substrates. *Cladonia subrangiformis* was previously recorded but without chemical indication. There was reported for Andrijevica (Strasser et al. 2015), Budva (Bilovitz et al. 2008), Kolašin (Bilovitz et al. 2017), Plav (Strasser et al. 2015), Pljevlja (Bilovitz et al. 2010), Plužine (Kušan 1953, Knežević & Mayrhofer 2009), Podgorica (Bilovitz et al. 2008) and Žabljak municipalities (Bilovitz et al. 2008). Savić (2001) reported it without municipality.

21. *Cladonia gracilis* (L.) Willd., *Fl. Berol. Prodr.*: 363 (1787)

A rare species only reported of Mojkovac (Bilovitz et al. 2009), Plav (Strasser et al. 2015) and Rožaje municipalities (Bilovitz et al. 2008) on siliceous and calcareous soils.

\*22. *Cladonia homosekikaica* Nuno, *J. Jap. Bot.* 50: 294 (1975)

This common species of the *C. chlorophaea* group, containing fumarprotocetraric and homosekikaic acids, was collected in Cetinje, Gusinje, Kolašin, Plav, Plužine, Rožaje and Žabljak municipalities. It grows on limestone and acid rock substrates, on pastures with deciduous and coniferous woodlands.

\*23. *Cladonia imbricarica* Kristinsson, *Lichenologist* 6: 143 (1974)

This is a rare species containing sphaerophorin and in one specimen additionally fumarprotocetraric acid. It was collected in Nikšić and



Žabljak municipalities growing at 1140-1761 m altitude, on limestone substrate and shrublands with *Ostrya carpinifolia*, *Pinus mugo*, *Juniperus communis* and *Pinus nigra*. This species is common in high mountains of the Neotropic and was also recorded from northern Europe (Ahti & Stenroos 2013), it was recently reported from Slovakia at 616 m altitude (Palice et al. 2018) in the western Carpathians. This species is difficult to identify without chemical analysis and has probably been overlooked.

**24. *Cladonia macilenta*** Hoffm., *Deutschl. Fl., Zweiter Theil* (Erlangen): 126 (1796)

Some specimens of this uncommon species contain thamnolic and barbatic acids, while others only have barbatic acid; it was collected in Žabljak municipality. It grows on stumps of *Picea abies*. It was reported of Rožaje municipality (Strasser et al. 2015).

**25. *Cladonia macroceras*** (Delise) Hav., *Bergens Mus. Årbok, Naturvidensk. Rekke* 1927(3): 12 (1928 `1927`)

A rare species collected at 1488 m altitude of Žabljak municipality on pastures with *Juniperus communis* and limestone substrate. The specimens contain fumarprotocetraric acid and another only atranorin. It was reported of Plav municipality growing on conifer forest and siliceous rock substrate (Strasser et al. 2015).

**26. *Cladonia macrophyllodes*** Nyl., *Flora* 58: 447 (1875)

Only one specimen of this species was found in Plav municipality at 1532 m altitude, on *Picea abies* forest and acid rock substrate. It contains atranorin and fumarprotocetraric acid. Previously Strasser et al. (2015) reported this species from Plav at 2300 m altitude on siliceous soil.

**\*27. *Cladonia merochlorophaea*** Asahina, *J. Jap. Bot.* 16: 713 (1940)

This is a very rare species collected at 1532 m altitude in Plav municipality, on *Picea abies* forest and acid rock substrate. It contains fumarprotocetraric and merochlorophaeic acids.

**28. *Cladonia mitis*** Sandst., *Cladon. Exs.* n° 55 (1918)

It was only reported of Plav municipality at 2065 m altitude (Strasser et al. 2015).

**\*29. *Cladonia novochlorophaea*** (Sipman) Brodo & Ahti (1996)

A very rare species only found in Žabljak municipality at 1761 m altitude growing on

limestone substrate in *Pinus mugo* and *Juniperus communis* woodlands.

**\*30. *Cladonia peziziformis*** (With.) J.R. Laundon, *Lichenologist* 16: 220 (1984)

This uncommon species was collected in Herceg Novi and Žabljak municipalities probably unnoticed in other localities by its small size. It grows on pasture karstic limestone substrate, with *Carpinus orientalis*, *Ostrya carpinifolia* and *Juniperus communis*. The specimens analysed contain fumarprotocetraric acid and zeorin.

**31. *Cladonia phyllophora*** Hoffm., *Deutschl. Fl.* 2: 123 (1796)

A very rare species only reported of Plav municipality at 2374 m altitude growing on siliceous rocks (Strasser et al. 2015).

**32. *Cladonia pleurota*** (Flörke) Schaer., *Enum. Crit. Lich. Eur.*: 186 (1850)

It was only reported of Plav municipality at 2300 m altitude growing on siliceous rocks (Strasser et al. 2015).

**33. *Cladonia pyxidata*** (L.) Hoffm., *Deutschl. Fl., Zweiter Theil* (Erlangen): 121 (1796) incl. *C. pocillum* (Ach.) Grognot; *C. monomorpha* Aptroot, Sipman & van Herk

A very common species found in Bar, Budva, Cetinje, Gusinje, Herceg Novi, Kolašin, Kotor, Mojkovac, Nikšić, Plav, Pljevlja, Plužine, Podgorica, Rožaje, Šavnik, Ulcinj and Žabljak municipalities. It was collected at 3-2460 m altitude growing on calcareous karstic rocks, limestone road slopes, schists and acid substrates, on mosses, pastures, maquis, rotten log, bark, sclerophyllous and deciduous forest. All the specimens analysed contain fumarprotocetraric acid. We do not distinguish *C. pocillum* as a different entity because molecular studies do not support it (Kotelko & Piercey-Normore 2010) and we found several specimens with intermediate morphologies.

It was reported as *C. pocillum* from Andrijevica (Mayrhofer et al. 2017), Cetinje (Kušan 1953; Knežević & Mayrhofer 2009), Plav (Strasser et al. 2015), Plužine (Kušan 1953), Podgorica (Kušan 1953; Knežević & Mayrhofer 2009), Rožaje (Kušan 1953; Knežević & Mayrhofer 2009; Strasser et al. 2015) and Žabljak (Bilovitz et al. 2008; Mayrhofer et al. 2017). As *C. pyxidata* from Andrijevica (Strasser et al. 2015; Mayrhofer et al. 2017), Bar (Bilovitz et al. 2008; Mayrhofer et al.

2017), Berane (Lakušić 1966; Dragović et al. 2007; Knežević & Mayrhofer 2009), Budva (Bilovitz et al. 2008), Cetinje (Knežević & Mayrhofer 2009), Danilovgrad (Bilovitz et al. 2008), Kolašin (Bilovitz et al. 2008; Mayrhofer et al. 2017), Mojkovac (Bilovitz et al. 2008; Mayrhofer et al. 2017), Plav (Strasser et al. 2015), Pljevlja (Bilovitz et al. 2010), Plužine (Kušan 1953; Savić 2001; Knežević & Mayrhofer 2009), Podgorica (Bilovitz et al. 2008; Knežević & Mayrhofer 2009), Rožaje (Strasser et al. 2015) and Žabljak (Bilovitz et al. 2008, Mayrhofer et al. 2017) municipalities.

**34. *Cladonia ramulosa*** (With.) J.R. Laundon, *Lichenologist* 16: 225 (1984)

This very rare species only is reported of Plav municipality at 2300 m altitude growing on siliceous rocks (Strasser et al. 2015).

**35. *Cladonia rangiferina*** (L.) Weber ex F.H. Wigg., *Prim. Fl. Holsat.*: 90 (1780)

A rare species reported of Plav (Strasser et al. 2015), Plužine (Kušan 1932; Knežević & Mayrhofer 2009) and Žabljak municipalities (Dragović et al. 2008; Knežević & Mayrhofer 2009).

**36. *Cladonia rangiformis*** Hoffm., *Deutschl. Fl., Zweiter Theil (Erlangen)*: 114 (1796)

This very common species was collected in Andrijevica, Bar, Budva, Cetinje, Danilovgrad, Gusinje, Herceg Novi, Kotor, Mojkovac, Nikšić, Plav, Pljevlja, Plužine, Podgorica, Rožaje, Ulcinj and Žabljak municipalities. The chemotypes with atranorin, fumarprotocetraric and rangiformic acids; atranorin and rangiformic acid, has similar representation in the country. But, the chemotype containing atranorin, rangiformic and psoromic acids is not common. It grows from sea level to 1488 m altitude, on acidic and basophilous substrates, in pastures, shrublands, maquis, mixed forests, spruce with scattered fir formations and road slope banks. It was reported of Berane, Kolašin and Podgorica (Bilovitz et al. 2008), Kotor and Plav (Strasser et al. 2015), Pljevlja (Bilovitz et al. 2010) and Plužine municipalities (Kušan 1953) but without chemical indication.

**37. *Cladonia rei*** Schaer., *Lich. Helv. Spicil.* 1(1): 34 (1823)

A rare species collected of Andrijevica, Berane, Gusinje, Plužine and Rožaje municipalities. There was found specimens with homosekikaic acid and others additionally with fumarprotocetraric acid. It

grows on road slope banks, pastures, schists and limestone substrates on mixed forests, beech and spruce woodlands. It was reported of Podgorica in a willow forest at 6 m altitude (Bilovitz et al. 2008).

**38. *Cladonia squamosa*** Hoffm., *Deutschl. Fl.* 2: 125 (1796)

This rare species was only reported of Plav at 2065 m (Strasser et al. 2015).

**\*39. *Cladonia subulata*** (L.) F.H. Wigg., *Prim. Fl. Holsat.*: 90 (1780)

This is a rare species collected in Berane on pastures and *Picea abies* woodlands with acid substrate at 1352 m. The specimen analysed contains fumarprotocetraric acid.

**40. *Cladonia sulphurina*** (Michx.) Fr., *Lichenogr. Eur. Reform.*: 237 (1831)

This species was only reported of Plav and Rožaje municipalities (Strasser et al. 2015) and Podgorica (Kušan 1953).

**41. *Cladonia symphyocarpa*** (Flörke) Fr., *Sched. Crit. Lich. Suec.* 8-9. 20 (1826) incl. *C. dahliana* Kristinsson

A very common species collected of Andrijevica, Budva, Cetinje, Gusinje, Herceg Novi, Kotor, Mojkovac, Nikšić, Pljevlja, Plužine, Podgorica, Šavnik, and Žabljak municipalities. It grows on calcareous boulder substrate, road slope bank with schist substrate, pasture, maquis, mixed forests or conifer woodlands. Only few specimens have podetia. There were found several chemotypes: atranorin, norstictic, connorstictic acids and some additionally zeorin; norstictic and connorstictic acids; atranorin, psoromic and conpsoromic acids. This last chemotype is considered a different species by several authors but after molecular analysis support the inclusion on *C. symphyocarpa* (Pino-Bodas et al. 2012a; Ahti & Stenroos 2013). It was reported without chemical data of Andrijevica, Plav and Rožaje (Strasser et al. 2015); Kolašin and Podgorica (Bilovitz et al. (2008); Pljevlja (Bilovitz et al. 2010) and Žabljak collected by O. Vitikainen in 1971 (H). The records of Savić (2001) and Knežević & Mayrhofer (2009) are without municipality.

**42. *Cladonia uncialis*** (L.) F.H. Wigg., *Prim. Fl. Holsat.*: 90 (1780)

A very rare species only reported of Plav at 1985 m altitude subsp. *uncialis* and at 2065 m altitude subsp. *biuncialis* (Hoffm.) M. Choisy (Strasser et al. 2015).

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## Annex 1. Selected specimens examined

### *Cladonia cariosa* (Ach.) Spreng.

**Atranorin, norstictic and connorstictic acids chemotype:** ANDRIJEVICA: Gnjili Potok, Trešnjevnik Pass, Andrijevica-Matešev road, M9 (AN03), 42°44'29"N 019°41'25"E, *Fagus sylvatica* and *Picea abies*, road slope bank schist substrate, 1528 m, 06-VIII-2018, A.R. Burgaz, (MACB 111957). BERANE: Kalica, Ravna Gora, Turjak Pass, Berane-Rožaje old road, P20, 42°51'44"N 020°03'29"E, pastures with *Picea abies*, acid substrate, 1352 m, 07-VIII-2018, A.R. Burgaz (MACB 111973). GUSINJE: Dolja, Dolina Grebaje, Prokletije mts., 42°31'15"N 019°47'06"E, *Carpinus orientalis*, *Juniperus communis*, limestone substrate, 943 m, 08-VIII-2018, A.R. Burgaz (MACB 111969). HERCEG NOVI: Sitnica, Meljine-Trebinje road, 42°33'06"N 018°27'00"E, deciduous *Quercus*, *Carpinus orientalis*, *Ostrya carpinifolia*, limestone substrate, 858m, 16-VIII-2018, A.R. Burgaz (MACB 111958). NIKŠIĆ: Lukovo, 42°48'13"N 019°01'44"E, *Ostrya carpinifolia*, *Carpinus orientalis*, limestone substrate, 876 m, 10-VIII-2018, A.R. Burgaz (MACB 111939). PLAV: Gornja Ržanica, Ravna Gora, Murino-Čakor-Peć road, M9, 42°39'29"N 019°55'34"E, deciduous *Quercus*, *Fagus sylvatica*, road slope bank schist substrate,

940 m, 07-VIII-2018, A.R. Burgaz (MACB 111965). Velika, Krlje, way up Čakor Pass, Murino-Čakor-Peć road, M9, 42°40'15"N 020°00'17"E, *Picea abies*, acid rock substrate, 1746 m, 07-VIII-2018, A.R. Burgaz (MACB 112695, 111943). ROŽAJE: Dacići, Rožaje-Peć road, P8, 42°48'21"N 020°10'37"E, *Picea abies*, *Juniperus communis*, limestone substrate, 1288 m, 06-VIII-2018, A.R. Burgaz (MACB 111932). Kalače, Berane-Rožaje old road, P20, 42°51'32"N 020°04'43"E, *Picea abies*, *Fagus sylvatica*, *Juniperus communis*, 1280 m, 07-VIII-2018, A.R. Burgaz (MACB 111972). ŽABLJAK: Žabljak, Motički Gaj, 43°08'29"N 019°07'14"E, pasture, *Juniperus communis*, limestone substrate, 1488 m, 09-VIII-2018, A.R. Burgaz (MACB 111656). Žabljak, along Crno jezero road, 43°08'58"N 019°05'59"E, *Picea abies*, limestone substrate, 1418 m, 10-VIII-2018, A.R. Burgaz (MACB 111993). Žabljak, Tepačko Polje, 43°09'54"N 019°10'14"E, pasture, *Betula pendula*, *Pinus mugo*, karstic limestone substrate, 1327 m, 10-VIII-2018, A.R. Burgaz (MACB 111998, 111997). Žabljak, Bosača, Durmitor mts., Mala Crna Gora road, 43°10'13"N 019°04'42"E, *Pinus mugo*, *Juniperus communis*, limestone substrate, 1761 m, 10-VIII-2018, A.R. Burgaz (MACB 111662, 111661). Žabljak, Durmitor mts., deviation Veliki Stouc, Mala Crna Gora

road, 43°11'19"N 019°03'36"E, *Pinus mugo*, limestone substrate, 1947 m, 10-VIII-2018, A.R. Burgaz (MACB 111994). **Atranorin and rangiformic acid chemotype additionally zeorin:** ANDRIJEVICA: Gnjili Potok, Trešnjevik Pass, Andrijevica-Mateševo road, M9 (AN03), 42°44'29"N 019°41'25"E, *Fagus sylvatica*, *Picea abies*, road slope bank schist substrate, 1528 m, 06-VIII-2018, A.R. Burgaz (MACB 112005). BERANE: Kalica, Ravna Gora, Turjak Pass, Berane-Rožaje old road, P20, 42°51'44"N 020°03'29"E, pastures with *Picea abies*, acid substrate, 1352 m, 07-VIII-2018, A.R. Burgaz (MACB 111955, 112027). CETINJE: Lovćen mt., 42°23'59"N 018°49'45"E, pasture with *Fagus sylvatica*, limestone substrate, 1358 m, 14-VIII-2018, A.R. Burgaz (MACB 111946). KOTOR: Dragalj, Morinj-Carine road, P11, 42°35'20"N 018°41'16"E, pasture, deciduous *Quercus*, *Fraxinus excelsior*, *Betula pendula*, stony plateau substrate, 631 m, 15-VIII-2018, A.R. Burgaz (MACB 111944). NIKŠIĆ: Riječani, Velimlje road, 42°45'14"N 018°38'05"E, shrubs, deciduous *Quercus*, *Acer monspessulanum*, *Fraxinus* sp., calcareous rock substrate, 824 m, 15-VIII-2018, A.R. Burgaz (MACB 111942). Lukovo, 42°48'13"N 019°01'44"E, *Ostrya carpinifolia*, *Carpinus orientalis*, limestone substrate, 876 m, 10-VIII-2018, A.R. Burgaz (MACB 111948). Gornje Polje, Grahovo-Nudo road, P23, 42°39'40"N 018°36'41"E, deciduous *Quercus*, *Fraxinus excelsior*, limestone substrate, 899 m, 15-VIII-2018, A.R. Burgaz (MACB 111954). PLAV: Gornja Ržanica, Ravna Gora, Murino-Čakor-Peć road, M9, 42°39'29"N 019°55'34"E, deciduous *Quercus*, *Fagus sylvatica*, road slope bank schist substrate, 940 m, 07-VIII-2018, A.R. Burgaz (MACB 111940, 111964). PLUŽINE: Donja Brezna, Nikšić-Plužine road, M18, 42°57'03"N 018°54'37"E, *Fagus sylvatica*, *Abies alba*, limestone substrate, 1134 m, 11-VIII-2018, A.R. Burgaz (MACB 111917, 111912). ROŽAJE: Dacići, Kulina Pass, Rožaje-Peć road, P8, 42°48'10"N 020°13'34"E, pasture, *Picea-Abies* forest, *Betula pendula*, schist substrate, 1711 m, 06-VIII-2018, A.R. Burgaz (MACB 111970, 111971). ŽABLJAK: Žabljak, Motički Gaj, 43°08'29"N 019°07'14"E, pasture, *Juniperus communis*, limestone substrate, 1488 m, 09-VIII-2018, A.R. Burgaz (MACB 111951). Njegovuda, 43°08'30"N 019°14'05"E, shrub, *Juniperus communis*, *Pinus nigra*, limestone

substrate, 1309 m, 09-VIII-2018, A.R. Burgaz (MACB 111941). Žabljak, Bosača, Durmitor mts., Mala Crna Gora road, 43°10'13"N 019°04'42"E, *Pinus mugo*, *Juniperus communis*, limestone substrate, 1761 m, 10-VIII-2018, A.R. Burgaz (MACB 111938). Žabljak, Durmitor mts., deviation Veliki Stouc, Mala Crna Gora road, 43°11'19"N 019°03'36"E, *Pinus mugo*, limestone substrate, 1947 m, 10-VIII-2018, A.R. Burgaz (MACB 111950). **Atranorin, fumarprotocetraric acid chemotype additionally zeorin:** CETINJE: Dubovik, Lovćen mt., Trojica-Cetinje road, P1, 42°24'54"N 018°52'51"E, deciduous *Quercus*, *Carpinus orientalis* and *Fraxinus excelsior*, limestone substrate, 936 m, 14-VIII-2018, A.R. Burgaz (MACB 111996). **Atranorin chemotype additionally zeorin:** CETINJE: Lovćen mt., 42°23'59"N 018°49'45"E, pasture with *Fagus sylvatica*, limestone substrate, 1358 m, 14-VIII-2018, A.R. Burgaz (MACB 111947). Dubovik, Lovćen mt., Trojica-Cetinje road, P1, 42°24'54"N 018°52'51"E, deciduous *Quercus*, *Carpinus orientalis*, *Fraxinus excelsior*, limestone substrate, 936 m, 14-VIII-2018, A.R. Burgaz (MACB 111996). ŠAVNIK: Krnovo, Krnovo Pass, 42°53'45"N 019°05'53"E, *Picea abies* stumps, limestone substrate, 1487 m, 10-VIII-2018, A.R. Burgaz (MACB 111949).

### *Cladonia cenotea* (Ach.) Schaer.

**Squamatic acid chemotype:** ŽABLJAK: Žabljak, along Crno jezero road, 43°08'58"N 019°05'59"E, *Picea abies* stumps, limestone substrate, 1418 m, 10-VIII-2018, A.R. Burgaz (MACB 111982).

### *Cladonia chlorophaea* (Flörke ex Sommerf.) Spreng.

**Fumarprotocetraric acid chemotype:** CETINJE: Bjeloši, Lovćen mt., Cetinje-Lovćen road, 42°22'46"N 018°51'51"E, *Fagus sylvatica*, limestone substrate, 1127 m, 14-VIII-2018, A.R. Burgaz (MACB 111778). KOLAŠIN: Kolašin, Mioska, Kolašin-Podgorica road, 42°48'05"N 019°24'07"E, *Fagus sylvatica*, road slope bank schist substrate, 803 m, 06-VIII-2018, A.R. Burgaz (MACB 111738). MOJKOVAC: Bistrica, Mojkovac-Pljevlja road, P4, 42°59'28"N 019°25'58"E,

pasture, *Juniperus communis* and *Pinus nigra*, limestone substrate, 846 m, 09-VIII-2018, A.R. Burgaz (MACB 111737). PLAV: Plav, Meteh, Babino Polje, 42°36'46"N 020°02'30"E, *Picea abies*, acid rock substrate, 1532 m, 08-VIII-2018, A.R. Burgaz (MACB 111977). Velika, Krlje, way up Čakor Pass, Murino-Čakor-Peć road, M9, 42°40'15"N 020°00'17"E, *Picea abies*, acid rock substrate, 1746 m, 07-VIII-2018, A.R. Burgaz (MACB 112003). PLUŽINE: Plužine, near Piva Monastery, Nikšić-Plužine road, M18, 43°07'09"N 018°49'07"E, *Juniperus communis* and deciduous *Quercus*, limestone substrate, 974 m, 11-VIII-2018, A.R. Burgaz (MACB 111981). ROŽAJE: Kalače, Berane-Rožaje old road, P20, 42°51'32"N 020°04'43"E, *Picea abies*, *Fagus sylvatica*, *Juniperus communis*, 1280 m, 07-VIII-2018, A.R. Burgaz (MACB 111736). ŠAVNIK: Krnovo, Krnovo Pass, 42°53'45"N 019°05'53"E, *Picea abies* stumps, limestone substrate, 1487 m, 10-VIII-2018, A.R. Burgaz (MACB 111980). ŽABLJAK: Žabljak, Motički Gaj, 43°08'29"N 019°07'14"E, pasture and *Juniperus communis*, limestone substrate, 1488 m, 09-VIII-2018, A.R. Burgaz (MACB 111979). Žabljak, along Crno jezero road, 43°08'58"N 019°05'59"E, *Picea abies*, limestone substrate, 1418 m, 10-VIII-2018, A.R. Burgaz (MACB 111983). Žabljak, Bosača, Durmitor mts., Mala Crna Gora road, 43°10'09"N 019°05'25"E, *Picea abies* stumps, limestone substrate, 1594 m, 10-VIII-2018, A.R. Burgaz (MACB 111984).

### ***Cladonia coccifera* (L.) Willd.**

**Usnic acid and zeorin chemotype:** ROŽAJE: Dacići, Kulina Pass, Rožaje-Peć road, P8, 42°48'10"N 020°13'34"E, pasture, *Picea-Abies* forest and *Betula pendula*, schist substrate, 1711 m, 06-VIII-2018, A.R. Burgaz (MACB 112006).

### ***Cladonia coniocraea* (Flörke) Spreng.**

**Fumarprotocetraric acid chemotype:** ANDRIJEVICA: Gnjili Potok, Trešnjevik Pass, Andrijevica-Mateševo road, M9 (AN03), 42°44'29"N 019°41'25"E, *Fagus sylvatica* and *Picea abies*, road slope bank schist substrate, 1528 m, 06-VIII-2018, A.R. Burgaz (MACB 111875). BAR: Livari, Rumija mts.,

42°07'50"N 019°13'33"E, *Castanea sativa*, 435 m, 12-VIII-2018, A.R. Burgaz (MACB 111745). BERANE: Kalica, Ravna Gora, Turjak Pass, Berane-Rožaje old road, P20, 42°51'44"N 020°03'29"E, pastures and *Picea abies*, acid substrate, 1352 m, 07-VIII-2018, A.R. Burgaz (MACB 111878). KOLAŠIN: Kolašin, Kolašin ski resort 1600, way up Vranjak Pass, Jezerine-Vranjak road, 42°50'39"N 019°38'19"E, *Picea abies* and *Fagus sylvatica*, road slope bank calcareous substrate, 1638 m, 09-VIII-2018, A.R. Burgaz (MACB 111743). PLAV: Plav, Komaraca, 42°37'01"N 019°57'52"E, *Carpinus orientalis*, deciduous *Quercus*, road slope bank schist substrate, 975 m, 08-VIII-2018, A.R. Burgaz (MACB 111742). Gornja Ržanica, Ravna Gora, Murino-Čakor-Peć road, M9, 42°39'29"N 019°55'34"E, deciduous *Quercus*, *Fagus sylvatica*, road slope bank schist substrate, 940 m, 07-VIII-2018, A.R. Burgaz (MACB 111874). Plav, Meteh, Babino Polje, 42°36'47"N 020°01'47"E, *Picea abies*, acid rock substrate, 1433 m, 08-VIII-2018, A.R. Burgaz (MACB 111876). Plav, Meteh, Babino Polje, 42°36'46"N 020°02'30"E, *Picea abies*, acid rock substrate, 1532 m, 08-VIII-2018, A.R. Burgaz (MACB 111877). ROŽAJE: Kalače, Berane-Rožaje old road, P20, 42°51'32"N 020°04'43"E, *Picea abies*, *Fagus sylvatica* and *Juniperus communis*, 1280 m, 07-VIII-2018, A.R. Burgaz (MACB 111740). Bandžov, close Ibar river, Bandžov road, 42°48'41"N 020°07'49"E, *Picea abies* stump, 1105 m, 07-VIII-2018, A.R. Burgaz (MACB 111741). Dacići, Kulina Pass, Rožaje-Peć road, P8, 42°48'10"N 020°13'34"E, pasture, *Picea-Abies* forest, *Betula pendula*, schist substrate, 1711 m, 06-VIII-2018, A.R. Burgaz (MACB 111945). ŽABLJAK: Žabljak, Bosača, Durmitor mts., Mala Crna Gora road, 43°10'09"N 019°05'25"E, *Picea abies* stumps, limestone substrate, 1594 m, 10-VIII-2018, A.R. Burgaz (MACB 111739). Žabljak, along Crno jezero road, 43°08'58"N 019°05'59"E, *Picea abies*, limestone substrate, 1418 m, 10-VIII-2018, A.R. Burgaz (MACB 111744).

### ***Cladonia conista* (Nyl.) Robbins**

**Fumarprotocetraric and bourgeanic acids chemotype:** ANDRIJEVICA: Gnjili Potok, Trešnjevik Pass, Andrijevica-Mateševo road, M9 (AN03), 42°44'29"N 019°41'25"E,



*Fagus sylvatica*, *Picea abies*, road slope bank schist substrate, 1528 m, 06-VIII-2018, A.R. Burgaz, MACB 112007. BUDVA: Brajići, Budva-Cetinje road, M2.3, 42°18'16"N 018°55'01"E, *Ostrya carpinifolia*, *Juniperus oxycedrus*, *Carpinus orientalis*, calcareous substrate, 833 m, 14-VIII-2018, A.R. Burgaz (MACB 111935). Novoselje, Valdanos beach road, 42°13'02"N 018°58'23"E, deciduous *Quercus*, *Carpinus orientalis*, *Ostrya carpinifolia*, limestone substrate, 657 m, 13-VIII-2018, A.R. Burgaz (MACB 112011). CETINJE: Lovćen mt., 42°23'59"N 018°49'45"E, pasture, *Fagus sylvatica*, limestone substrate, 1358 m, 14-VIII-2018, A.R. Burgaz (MACB 111995). KOLAŠIN: Kolašin, Mioska, Kolašin-Podgorica road, 42°48'05"N 019°24'07"E, *Fagus sylvatica*, road slope bank schist substrate, 803 m, 06-VIII-2018, A.R. Burgaz (MACB 111936). KOTOR: Bigova, 42°21'39"N 018°42'24"E, *Pistacia lentiscus*, *P. terebinthus*, *Juniperus oxycedrus*, *Arbutus unedo*, *Erica arborea*, limestone substrate, 238 m, 13-VIII-2018, A.R. Burgaz (MACB 111903). Radanovici, 42°21'38"N 018°45'14"E, maquis, *Erica arborea*, *Arbutus unedo*, *Myrtus communis*, acid substrate, 75 m, 13-VIII-2018, A.R. Burgaz (MACB 111933). PLAV: Gornja Ržanica, Ravna Gora, Murino-Čakor-Peć road, M9, 42°39'29"N 019°55'34"E, deciduous *Quercus*, *Fagus sylvatica*, road slope bank schist substrate, 940 m, 07-VIII-2018, A.R. Burgaz (MACB 111904). Plav, Komaraca, 42°37'01"N 019°57'52"E, *Carpinus orientalis*, deciduous *Quercus*, road slope bank schist substrate, 975 m, 08-VIII-2018, A.R. Burgaz (MACB 111934).

#### ***Cladonia cyathomorpha* Stirt. ex Walt. Watson**

**Fumarprotocetraric acid chemotype:** KOTOR: Bigova, 42°21'39"N 018°42'24"E, *Pistacia lentiscus*, *P. terebinthus*, *Juniperus oxycedrus*, *Arbutus unedo*, *Erica arborea*, limestone substrate, 238 m, 13-VIII-2018, A.R. Burgaz (MACB 112012).

#### ***Cladonia deformis* (L.) Hoffm.**

**Usnic acid and zeorin chemotype:** ROŽAJE: Dacići, Kulina Pass, Rožaje-Peć road, P8, 42°48'10"N 020°13'34"E, pasture, *Picea-Abies* forest, *Betula pendula*, schist

substrate, 1711 m, 06-VIII-2018, A.R. Burgaz (MACB 112016). ŽABLJAK: Žabljak, along Crno jezero road, 43°08'58"N 019°05'59"E, *Picea abies*, limestone substrate, 1418 m, 10-VIII-2018, A.R. Burgaz (MACB 112013). Žabljak, Durmitor mts., deviation Veliki Stouc, Mala Crna Gora road, 43°11'19"N 019°03'36"E, *Pinus mugo*, limestone substrate, 1947 m, 10-VIII-2018, A.R. Burgaz (MACB 112015).

#### ***Cladonia digitata* (L.) Hoffm.**

**Thamnolic acid chemotype:** ROŽAJE: Bandžov, close Ibar river, Bandžov road, 42°48'41"N 020°07'49"E, *Picea abies* stump, 1105 m, 07-VIII-2018, A.R. Burgaz (MACB 111746). **Thamnolic and fumarprotocetraric acids chemotype:** ROŽAJE: Dacići, Kulina Pass, Rožaje-Peć road, P8, 42°48'10"N 020°13'34"E, pasture, *Picea-Abies* forest and *Betula pendula*, schist substrate, 1711 m, 06-VIII-2018, A.R. Burgaz (MACB 111747).

#### ***Cladonia diversa* Asperges ex Stenroos**

**Usnic acid and zeorin chemotype:** PLAV: Plav, Meteh, Babino Polje, 42°36'46"N 020°02'30"E, *Picea abies*, acid rock substrate, 1532 m, 08-VIII-2018, A.R. Burgaz (MACB 111990).

#### ***Cladonia fimbriata* (L.) Fr.**

**Fumarprotocetraric acid chemotype:** ANDRIJEVICA: Gnjili Potok, Trešnjevnik Pass, Andrijevica-Mateševo road, M9 (AN03), 42°44'29"N 019°41'25"E, *Fagus sylvatica*, *Picea abies*, road slope bank schist substrate, 1528 m, 06-VIII-2018, A.R. Burgaz (MACB 111937). BAR: Livari, Rumija mts., 42°07'50"N 019°13'33"E, *Castanea sativa*, 435 m, 12-VIII-2018, A.R. Burgaz (MACB 111779). BERANE: Kalica, Ravna Gora, Turjak Pass, Berane-Rožaje old road, P20, 42°51'44"N 020°03'29"E, pastures, *Picea abies*, acid substrate, 1352 m, 07-VIII-2018, A.R. Burgaz (MACB 111922). BUDVA: Novoselje, Valdanos beach road, 42°13'02"N 018°58'23"E, deciduous *Quercus*, *Carpinus orientalis*, *Ostrya carpinifolia*, limestone substrate, 657 m, 13-VIII-2018, A.R. Bur-

gaz (MACB 111756). CETINJE: Bjeloši, Lovćen mt., Cetinje-Lovćen road, 42°22'46"N 018°51'51"E, *Fagus sylvatica*, limestone substrate, 1127 m, 14-VIII-2018, A.R. Burgaz (MACB 111925). GUSINJE: Dolja, Dolina Grebaje, Prokletije mts., 42°31'15"N 019°47'06"E, *Carpinus orientalis*, *Juniperus communis*, limestone substrate, 943 m, 08-VIII-2018, A.R. Burgaz (MACB 111930). KOLAŠIN: Kolašin, Biočinovići, 42°50'05"N 019°33'50"E, *Carpinus orientalis*, *Fagus sylvatica*, acid rock substrate, 1054 m, 09-VIII-2018, A.R. Burgaz (MACB 111758). Kolašin, Mioska, Kolašin-Podgorica road, 42°48'05"N 019°24'07"E, *Fagus sylvatica*, road slope bank schist substrate, 803 m, 06-VIII-2018, A.R. Burgaz (MACB 111926). Kolašin, Kolašin ski resort 1600, way up Vranjak Pass, Jezerine-Vranjak road, 42°50'39"N 019°38'19"E, *Picea abies*, *Fagus sylvatica*, road slope bank calcareous substrate, 1638 m, 09-VIII-2018, A.R. Burgaz (MACB 111929). NIKŠIĆ: Nikšić, Trebjesa park, 42°46'05"N 018°57'35"E, *Ostrya carpinifolia*, *Pinus nigra*, limestone substrate, 698 m, 11-VIII-2018, A.R. Burgaz (MACB 111752). Gornje Polje, Grahovo-Nudo road, P23, 42°39'40"N 018°36'41"E, deciduous *Quercus*, *Fraxinus excelsior*, limestone substrate, 899 m, 15-VIII-2018, A.R. Burgaz (MACB 111775). Nudo, Grahovo-Nudo road, P23, 42°39'37"N 018°36'07"E, *Ostrya carpinifolia*, *Tilia tomentosa*, road slope bank limestone substrate, 906 m, 15-VIII-2018, A.R. Burgaz (MACB 111915). PLAV: Plav, Meteh, Babino Polje, 42°36'47"N 020°01'47"E, *Picea abies*, acid rock substrate, 1433 m, 08-VIII-2018, A.R. Burgaz (MACB 111757). Plav, Meteh, Babino Polje, 42°36'46"N 020°02'30"E, *Picea abies*, acid rock substrate, 1532 m, 08-VIII-2018, A.R. Burgaz (MACB 111916). Plav, Komaraca, 42°37'01"N 019°57'52"E, *Carpinus orientalis*, and deciduous *Quercus*, road slope bank schist substrate, 975 m, 08-VIII-2018, A.R. Burgaz (MACB 111927). Gornja Ržanica, Ravna Gora, Murino-Čakor-Peć road, M9, 42°39'29"N 019°55'34"E, deciduous *Quercus* and *Fagus sylvatica*, road slope bank schist substrate, 940 m, 07-VIII-2018, A.R. Burgaz (MACB 111928). PLUŽINE: Plužine, near Piva Monastery, Nikšić-Plužine road, M18, 43°07'09"N 018°49'07"E, *Juniperus communis* and deciduous *Quercus*, limestone substrate, 974 m, 11-VIII-2018, A.R. Burgaz (MACB 111754). Donja Brezna, Nikšić-Plužine road, M18,

42°57'03"N 018°54'37"E, *Fagus sylvatica* and *Abies alba*, limestone substrate, 1134 m, 11-VIII-2018, A.R. Burgaz (MACB 111755). ROŽAJE: Kalače, Berane-Rožaje old road, P20, 42°51'32"N 020°04'43"E, *Picea abies*, *Fagus sylvatica* and *Juniperus communis*, 1280 m, 07-VIII-2018, A.R. Burgaz (MACB 111913). Dacići, Kulina Pass, Rožaje-Peć road, P8, 42°48'10"N 020°13'34"E, *Picea-Abies* forest and *Betula pendula*, schist substrate, 1711 m, 06-VIII-2018, A.R. Burgaz (MACB 111914). ŽABLJAK: Žabljak, along Crno jezero road, 43°08'58"N 019°05'59"E, *Picea abies*, limestone substrate, 1418 m, 10-VIII-2018, A.R. Burgaz (MACB 111748). Žabljak, Bosača, Durmitor mts., Mala Crna Gora road, 43°10'09"N 019°05'25"E, *Picea abies* stumps, limestone substrate, 1594 m, 10-VIII-2018, A.R. Burgaz (MACB 111753). Žabljak, Durmitor mts., deviation Veliki Stouc, Mala Crna Gora road, 43°11'19"N 019°03'36"E, *Pinus mugo*, limestone substrate, 1947 m, 10-VIII-2018, A.R. Burgaz (MACB 111905).

#### *Cladonia foliacea* (Huds.) Willd.

**Fumarprotocetraric and usnic acids chemotype:** BUDVA: Novoselje, Valdanos beach road, 42°13'02"N 018°58'23"E, deciduous *Quercus*, *Carpinus orientalis* and *Ostrya carpinifolia*, limestone substrate, 657 m, 13-VIII-2018, A.R. Burgaz (MACB 111854). CETINJE: Dubovik, Lovćen mt., Trojica-Cetinje road, P1, 42°24'54"N 018°52'51"E, deciduous *Quercus*, *Carpinus orientalis* and *Fraxinus excelsior*, limestone substrate, 936 m, 14-VIII-2018, A.R. Burgaz (MACB 111703). Očinići, 42°21'01"N 018°55'53"E, *Carpinus orientalis*, deciduous *Quercus* and *Juniperus oxycedrus*, limestone substrate, 730 m, 06-VIII-2018, A.R. Burgaz (MACB 111733). DANILOVGRAD: Jovanovići, Danilovgrad-Ostrog monastery road, 42°36'04"N 019°06'11"E, *Quercus trojana*, *Pistacia terebinthus* and *Paliurus spina-christi*, limestone substrate, 239 m, 11-VIII-2018, A.R. Burgaz (MACB 111708). HERCEG NOVI: Mokrine, Orjen mts., Meljine-Trebinje road, 42°30'47"N 018°29'13"E, *Acer monspessulanum*, karstic limestone substrate, 571 m, 16-VIII-2018, A.R. Burgaz (MACB 111711). Kruševica, Orjen mts., Vrbanje road, 42°32'15"N 018°29'55"E, *Carpinus orientalis* and *Ostrya carpinifolia*,

karstic limestone substrate, 755 m, 16-VIII-2018, A.R. Burgaz (MACB 111856). KOTOR: Bigova, 42°21'39"N 018°42'24"E, *Pistacia lentiscus*, *P. terebinthus*, *Juniperus oxycedrus*, *Arbutus unedo* and *Erica arborea*, limestone substrate, 238 m, 13-VIII-2018, A.R. Burgaz (MACB 111705). Radanovici, 42°21'38"N 018°45'14"E, maquis, *Erica arborea*, *Arbutus unedo* and *Myrtus communis*, acid substrate, 75 m, 13-VIII-2018, A.R. Burgaz (MACB 111851). Dragalj, Morinj-Carine road, P11, 42°35'20"N 018°41'16"E, pasture, deciduous *Quercus*, *Fraxinus excelsior* and *Betula pendula*, stony plateau substrate, 631 m, 15-VIII-2018, A.R. Burgaz (MACB 111855). MOJKOVAC: Bistrica, Mojkovac-Pljevlja road, P4, 42°59'28"N 019°25'58"E, pasture, *Juniperus communis* and *Pinus nigra*, limestone substrate, 846 m, 09-VIII-2018, A.R. Burgaz (MACB 111735). NIKŠIĆ: Gornje Polje, Grahovo-Nudo road, P23, 42°39'40"N 018°36'41"E, deciduous *Quercus* and *Fraxinus excelsior*, limestone substrate, 899 m, 15-VIII-2018, A.R. Burgaz (MACB 111704). Rudine, Nikšić-Vilusi road, M6, 42°45'04"N 018°48'10"E, pasture with *Carpinus orientalis*, limestone substrate, 869 m, 15-VIII-2018, A.R. Burgaz (MACB 111707). Nikšić, Trebjesa park, 42°46'05"N 018°57'35"E, *Ostrya carpinifolia* and *Pinus nigra*, limestone substrate, 698 m, 11-VIII-2018, A.R. Burgaz (MACB 111709). Grahovac, Morinj-Carine road, P11, 42°41'12"N 018°38'05"E, deciduous *Quercus*, limestone substrate, 981 m, 15-VIII-2018, A.R. Burgaz (MACB 111712). Riječani, Velimlje road, 42°45'14"N 018°38'05"E, shrubs, deciduous *Quercus*, *Acer monspessulanum* and *Fraxinus*, calcareous rock substrate, 824 m, 15-VIII-2018, A.R. Burgaz (MACB 111732). Lukovo, 42°48'13"N 019°01'44"E, *Ostrya carpinifolia* and *Carpinus orientalis*, limestone substrate, 876 m, 10-VIII-2018, A.R. Burgaz (MACB 111853). PLUŽINE: Plužine, near Piva Monastery, Nikšić-Plužine road, M18, 43°07'09"N 018°49'07"E, *Juniperus communis* and deciduous *Quercus*, limestone substrate, 974 m, 11-VIII-2018, A.R. Burgaz (MACB 111852). PODGORICA: Bioče, Morača river valley, 42°31'34"N 019°20'54"E, *Juniperus oxycedrus*, *Pistacia terebinthus* and *Paliurus spina-christi*, calcareous boulder substrate, 98 m, 12-VIII-2018, A.R. Burgaz (MACB 111706). Podgorica, Doljani, Podgorica-Ubli road, 42°27'25"N 019°19'24"E, *Pistacia terebinthus*, *Quercus trojana* and

*Juniperus oxycedrus*, calcareous rock substrate, 211 m, 12-VIII-2018, A.R. Burgaz (MACB 111734). ULCINJ: Utjeha-Bušat, way up wind turbine camp road, 41°59'42"N 019°09'59"E, *Juniperus oxycedrus*, *Arbutus unedo* and *Pistacia terebinthus*, limestone substrate, 234 m, 12-VIII-2018, A.R. Burgaz (MACB 111710). Bratica, Valdanos beach road, 41°57'07"N 019°10'48"E, maquis, *Quercus coccifera* and *Juniperus oxycedrus*, limestone substrate, 221 m, 13-VIII-2018, A.R. Burgaz (MACB 111731). ŽABLJAK: Njegovuđa, 43°08'30"N 019°14'05"E, shrubs with *Juniperus communis* and *Pinus nigra*, limestone substrate, 1309 m, 09-VIII-2018, A.R. Burgaz (MACB 111700). Žabljak, Tepačko Polje, 43°09'54"N 019°10'14"E, pastures with *Betula pendula* and *Pinus mugo*, karstic limestone substrate, 1327 m, 10-VIII-2018, A.R. Burgaz (MACB 111701).

#### *Cladonia furcata* (Huds.) Schrad.

**Fumarprotocetraric acid chemotype:** ANDRIJEVICA: Gnjili Potok, Trešnjevik Pass, Andrijevica-Mateševo road, M9 (AN03), 42°44'29"N 019°41'25"E, *Fagus sylvatica* and *Picea abies*, road slope bank schist substrate, 1528 m, 06-VIII-2018, A.R. Burgaz (MACB 111865). BAR: Godinje, Virpazar-Vladimir road, P16, 42°13'09"N 019°07'27"E, *Punica granatum* & *Cotinus coggygria*, calcareous substrate, 31 m, 12-VIII-2018, A.R. Burgaz (MACB 111895). BERANE: Kalica, Ravna Gora, Turjak Pass, Berane-Rožaje old road, P20, 42°51'44"N 020°03'29"E, pastures with *Picea abies*, acid substrate, 1352 m, 07-VIII-2018, A.R. Burgaz (MACB 111863). BUDVA: Novoselje, Valdanos, beach road, 42°13'02"N 018°58'23"E, deciduous *Quercus*, *Carpinus orientalis* and *Ostrya carpinifolia*, limestone substrate, 657 m, 13-VIII-2018, A.R. Burgaz (MACB 111887). CETINJE: Dubovik, Lovćen mt., Trojica-Cetinje road, P1, 42°24'54"N 018°52'51"E, deciduous *Quercus*, *Carpinus orientalis* and *Fraxinus excelsior*, limestone substrate, 936 m, 14-VIII-2018, A.R. Burgaz (MACB 111859). Lovćen mt., 42°23'59"N 018°49'45"E, pasture with *Fagus sylvatica*, limestone substrate, 1358 m, 14-VIII-2018, A.R. Burgaz (MACB 111893). DANILOVGRAD: Jovanovići, Danilovgrad-Ostrog monastery road, 42°36'04"N 019°06'11"E, *Quercus trojana*, *Pistacia*



*terebinthus* and *Paliurus spina-christi*, limestone substrate, 239 m, 11-VIII-2018, A.R. Burgaz (MACB 111888). GUSINJE: Dolja, Dolina Grebaje, Prokletije mts., 42°31'15"N 019°47'06"E, *Carpinus orientalis* and *Juniperus communis*, limestone substrate, 943 m, 08-VIII-2018, A.R. Burgaz (MACB 111897). Vusanje, 42°31'38"N 019°50'08"E, *Carpinus orientalis* and *Juniperus communis*, limestone substrate, 943 m, 07-VIII-2018, A.R. Burgaz (MACB 111900). KOLAŠIN: Kolašin, Mioska, Kolašin-Podgorica road, 42°48'05"N 019°24'07"E, *Fagus sylvatica*, road slope bank schist substrate, 803 m, 06-VIII-2018, A.R. Burgaz (MACB 111864). Kolašin, Biočinovići, 42°50'05"N 019°33'50"E, *Carpinus orientalis* and *Fagus sylvatica*, acid rock substrate, 1054 m, 09-VIII-2018, A.R. Burgaz (MACB 111882). Kolašin, Kolašin ski resort 1600, way up Vranjak Pass, Jezerine-Vranjak road, 42°50'39"N 019°38'19"E, *Picea abies* and *Fagus sylvatica*, road slope bank calcareous substrate, 1638 m, 09-VIII-2018, A.R. Burgaz (MACB 111883). KOTOR: Bigova, 42°21'39"N 018°42'24"E, *Pistacia lentiscus*, *P. terebinthus*, *Juniperus oxycedrus*, *Arbutus unedo* and *Erica arborea*, limestone substrate, 238 m, 13-VIII-2018, A.R. Burgaz (MACB 111892). Ledenice, Morinj-Carine road, P11, 42°33'03"N 018°42'50"E, deciduous *Quercus*, limestone substrate, 691 m, 15-VIII-2018, A.R. Burgaz (MACB 111896). Dragalj, Morinj-Carine road, P11, 42°35'20"N 018°41'16"E, pasture, deciduous *Quercus*, *Fraxinus excelsior* and *Betula pendula*, stony plateau substrate, 631 m, 15-VIII-2018, A.R. Burgaz (MACB 111861). MOJKOVAC: Bistrica, Mojkovac-Pljevlja road, P4, 42°59'28"N 019°25'58"E, pasture, *Juniperus communis* and *Pinus nigra*, limestone substrate, 846 m, 09-VIII-2018, A.R. Burgaz (MACB 112025). NIKŠIĆ: Gornje Polje, Grahovo-Nudo road, P23, 42°39'40"N 018°36'41"E, deciduous *Quercus* and *Fraxinus excelsior*, limestone substrate, 899 m, 15-VIII-2018, A.R. Burgaz (MACB 111858). Grahovac, Morinj-Carine road, P11, 42°41'12"N 018°38'05"E, deciduous *Quercus*, limestone substrate, 981 m, 15-VIII-2018, A.R. Burgaz (MACB 111889). Riječani, Velimlje road, 42°45'14"N 018°38'05"E, shrubs, deciduous *Quercus*, *Acer monspessulanum* and *Fraxinus*, calcareous rock substrate, 824 m, 15-VIII-2018, A.R. Burgaz (MACB 111890). PLAV: Plav, Meteh, Babino Polje, 42°36'46"N 020°02'30"E, *Picea abies*, acid rock substrate, 1532 m, 08-VIII-2018, A.R. Burgaz (MACB 111901). Plav, Komaraca, 42°37'01"N 019°57'52"E, *Carpinus orientalis* and deciduous *Quercus*, road slope bank schist substrate, 975 m, 08-VIII-2018, A.R. Burgaz (MACB 111899). Plav, Komaraca, 42°37'01"N 019°57'52"E, *Carpinus orientalis* and deciduous *Quercus*, road slope bank schist substrate, 975 m, 08-VIII-2018, A.R. Burgaz (MACB 111902). Velika, Krlje, way up Čakor Pass, Murino-Čakor-Peć road, M9, 42°40'15"N 020°00'17"E, *Picea abies*, acid rock substrate, 1746 m, 07-VIII-2018, A.R. Burgaz (MACB 111885). PLUŽINE: Donja Brezna, Nikšić-Plužine road, M18, 42°57'03"N 018°54'37"E, *Fagus sylvatica* and *Abies alba*, limestone substrate, 1134 m, 11-VIII-2018, A.R. Burgaz (MACB 111898). PODGORICA: Podgorica, Doljani, Podgorica-Ubli road, 42°27'25"N 019°19'24"E, *Pistacia terebinthus*, *Quercus trojana* and *Juniperus oxycedrus*, calcareous rock substrate, 211 m, 12-VIII-2018, A.R. Burgaz (MACB 112023). Bioče, Morača river valley, 42°31'34"N 019°20'54"E, *Juniperus oxycedrus*, *Pistacia terebinthus* and *Paliurus spina-christi*, calcareous boulder substrate, 98 m, 12-VIII-2018, A.R. Burgaz (MACB 111862). ROŽAJE: Dacići, Kulina Pass, Rožaje-Peć road, P8, 42°48'10"N 020°13'34"E, pasture, *Picea-Abies* forest and *Betula pendula*, schist substrate, 1711 m, 06-VIII-2018, A.R. Burgaz (MACB 111884). Kalače, Berane-Rožaje old road, P20, 42°51'32"N 020°04'43"E, *Picea abies*, *Fagus sylvatica* and *Juniperus communis*, 1280 m, 07-VIII-2018, A.R. Burgaz (MACB 111886). ULCINJ: Bratica, Valdanos beach road, 41°57'07"N 019°10'48"E, maquis, *Quercus coccifera* and *Juniperus oxycedrus*, limestone substrate, 221 m, 13-VIII-2018, A.R. Burgaz (MACB 111860). ŽABLJAK: Žabljak, along Crno jezero road, 43°08'58"N 019°05'59"E, *Picea abies*, limestone substrate, 1418 m, 10-VIII-2018, A.R. Burgaz (MACB 111881). Žabljak, Bosača, Durmitor mts., Mala Crna Gora road, 43°10'13"N 019°04'42"E, *Pinus mugo* and *Juniperus communis*, limestone substrate, 1761 m, 10-VIII-2018, A.R. Burgaz (MACB 111857). Žabljak, Durmitor mts., deviation Veliki Stouc, Mala Crna Gora road, 43°11'19"N 019°03'36"E, *Pinus mugo*, limestone substrate, 1947 m, 10-VIII-2018, A.R. Burgaz (MACB 112021). **Atranorin and fumarprotocetraric acid chemotype:** CETINJE: Očinići,

42°21'01"N 018°55'53"E, *Carpinus orientalis*, deciduous *Quercus* and *Juniperus oxycedrus*, limestone substrate, 730 m, 06-VIII-2018, A.R. Burgaz (MACB 112026). NIKŠIĆ: Rudine, Nikšić-Vilusi road, M6, 42°45'04"N 018°48'10"E, pasture and *Carpinus orientalis*, limestone substrate, 869 m, 15-VIII-2018, A.R. Burgaz (MACB 111894). Nikšić, Trebjesa park, 42°46'05"N 018°57'35"E, *Ostrya carpinifolia* and *Pinus nigra*, limestone substrate, 698 m, 11-VIII-2018, A.R. Burgaz (MACB 112018). PLJEVLJA: Rasova, Narodnih Heroja road, P5, 43°09'04"N 019°15'42"E, pasture, *Juniperus communis* and *Pinus nigra*, limestone substrate, 1226 m, 09-VIII-2018, A.R. Burgaz (MACB 112024). PLUŽINE: Plužine, near Piva Monastery, Nikšić-Plužine road, M18, 43°07'09"N 018°49'07"E, *Juniperus communis* and deciduous *Quercus*, limestone substrate, 974 m, 11-VIII-2018, A.R. Burgaz (MACB 112017). ŠAVNIK: Krnovo, Krnovo Pass, 42°53'45"N 019°05'53"E, *Picea abies* stumps, limestone substrate, 1487 m, 10-VIII-2018, A.R. Burgaz (MACB 112020). ŽABLJAK: Žabljak, Motički Gaj, 43°08'29"N 019°07'14"E, pasture and *Juniperus communis*, limestone substrate, 1488 m, 09-VIII-2018, A.R. Burgaz (MACB 112022). Žabljak, Tepačko Polje, 43°09'54"N 019°10'14"E, pasture, *Betula pendula* and *Pinus mugo*, karstic limestone substrate, 1327 m, 10-VIII-2018, A.R. Burgaz (MACB 112019). **Atranorin, bourgeanic and fumarprotocetraric acids chemotype:** NIKŠIĆ: Nikšić, Trebjesa park, 42°46'05"N 018°57'35"E, *Ostrya carpinifolia* and *Pinus nigra*, limestone substrate, 698 m, 11-VIII-2018, A.R. Burgaz (MACB 112009). PLUŽINE: Plužine, near Piva Monastery, Nikšić-Plužine road, M18, 43°07'09"N 018°49'07"E, *Juniperus communis* and deciduous *Quercus*, limestone substrate, 974 m, 11-VIII-2018, A.R. Burgaz (MACB 112010).

### *Cladonia homosekikaica* Nuno

**Fumarprotocetraric and homosekikaic acids chemotype:** CETINJE: Lovćen mt., 42°23'59"N 018°49'45"E, pasture with *Fagus sylvatica*, limestone substrate, 1358 m, 14-VIII-2018, A.R. Burgaz (MACB 111869). GUSINJE: Dolja, Dolina Grebaje, Prokletije mts., 42°31'15"N 019°47'06"E, *Carpinus orientalis*, *Juniperus communis*, limestone substrate, 943 m, 08-VIII-2018, A.R. Burgaz (MACB 111920, 111978).

KOLAŠIN: Kolašin, Kolašin ski resort 1600, way up Vranjak Pass, Jezerine-Vranjak road, 42°50'39"N 019°38'19"E, *Picea abies* and *Fagus sylvatica*, road slope bank calcareous substrate, 1638 m, 09-VIII-2018, A.R. Burgaz (MACB 111777). PLAV: Plav, Meteh, Babino Polje, 42°36'47"N 020°01'47"E, *Picea abies*, acid rock substrate, 1433 m, 08-VIII-2018, A.R. Burgaz (MACB 111770). Velika, Krlje, way up Čakor Pass, Murino-Čakor-Peć road, M9, 42°40'15"N 020°00'17"E, *Picea abies*, acid rock substrate, 1746 m, 07-VIII-2018, A.R. Burgaz (MACB 111776). PLUŽINE: Donja Brezna, Nikšić-Plužine road, M18, 42°57'03"N 018°54'37"E, *Fagus sylvatica* and *Abies alba*, limestone substrate, 1134 m, 11-VIII-2018, A.R. Burgaz (MACB 111772). ROŽAJE: Kalače, Berane-Rožaje old road, P20, 42°51'32"N 020°04'43"E, *Picea abies*, *Fagus sylvatica* and *Juniperus communis*, 1280 m, 07-VIII-2018, A.R. Burgaz (MACB 111774). ŽABLJAK: Žabljak, Durmitor mts., deviation Veliki Stouc, Mala Crna Gora road, 43°11'19"N 019°03'36"E, *Pinus mugo*, limestone substrate, 1947 m, 10-VIII-2018, A.R. Burgaz (MACB 111773). Žabljak, Bosača, Durmitor mts., Mala Crna Gora road, 43°10'13"N 019°04'42"E, *Pinus mugo* and *Juniperus communis*, limestone substrate, 1761 m, 10-VIII-2018, A.R. Burgaz (MACB 111868).

### *Cladonia imbricarica* Kristinsson

**Sphaerophorin chemotype:** ŽABLJAK: Njegovuda, 43°08'30"N 019°14'05"E, shrubs, *Juniperus communis* and *Pinus nigra*, limestone substrate, 1309 m, 09-VIII-2018, A.R. Burgaz (MACB 111716). **Fumarprotocetraric acid and sphaerophorin chemotype:** NIKŠIĆ: Jasenov Polje, 42°56'16"N 018°55'42"E, *Ostrya carpinifolia*, limestone substrate, 1140 m, 11-VIII-2018, A.R. Burgaz (MACB 111717). ŽABLJAK: Žabljak, Bosača, Durmitor mts., Mala Crna Gora road, 43°10'13"N 019°04'42"E, *Pinus mugo* and *Juniperus communis*, limestone substrate, 1761 m, 10-VIII-2018, A.R. Burgaz (MACB 111715).

### *Cladonia macilenta* Hoffm.

**Barbatic and thamnolic acids chemotype:** ŽABLJAK: Žabljak, along Crno je-



zero road, 43°08'58"N 019°05'59"E, *Picea abies*, limestone substrate, 1418 m, 10-VIII-2018, A.R. Burgaz (MACB 112004). **Barbatic acid chemotype:** ŽABLJAK: Žabljak, along Crno jezero road, 43°08'58"N 019°05'59"E, *Picea abies*, limestone substrate, 1418 m, 10-VIII-2018, A.R. Burgaz (MACB 112014).

### *Cladonia macroceras* (Delise) Hav.

**Atranorin chemotype:** ŽABLJAK: Žabljak, Motički Gaj, 43°08'29"N 019°07'14"E, pasture and *Juniperus communis*, limestone substrate, 1488 m, 09-VIII-2018, A.R. Burgaz (MACB 111750). **Fumarprotocetraric acid chemotype:** CETINJE: Lovćen mt., 42°23'59"N 018°49'45"E, pasture with *Fagus sylvatica*, limestone substrate, 1358 m, 14-VIII-2018, A.R. Burgaz (MACB 112691). ŽABLJAK: Žabljak, Motički Gaj, 43°08'29"N 019°07'14"E, pasture and *Juniperus communis*, limestone substrate, 1488 m, 09-VIII-2018, A.R. Burgaz (MACB 111749).

### *Cladonia macrophyllodes* Nyl.

**Atranorin and fumarprotocetraric acid chemotype:** PLAV: Plav, Meteh, Babino Polje, 42°36'46"N 020°02'30"E, *Picea abies*, acid rock substrate, 1532 m, 08-VIII-2018, A.R. Burgaz (MACB 111751).

### *Cladonia merochlorophaea* Asahina

**Fumarprotocetraric and merochlorophaeic acids chemotype:** PLAV: Plav, Meteh, Babino Polje, 42°36'46"N 020°02'30"E, *Picea abies*, acid rock substrate, 1532 m, 08-VIII-2018, A.R. Burgaz (MACB 111919).

### *Cladonia novochlorophaea* (Sipman) Brodo & Ahti

**Fumarprotocetraric and homosekikaic acids chemotype:** ŽABLJAK: Žabljak, Bosača, Durmitor mts., Mala Crna Gora road, 43°10'13"N 019°04'42"E, *Pinus mugo*, *Juniperus communis*, limestone substrate, 1761 m, 10-VIII-2018, A.R. Burgaz (MACB 112692).

### *Cladonia peziziformis* (With.) J.R. Laundon

**Fumarprotocetraric acid and zeorin chemotype:** HERCEG NOVI: Kruševica, Orjen mts., Vrbanje road, 42°32'15"N 018°29'55"E, *Carpinus orientalis* and *Ostrya carpinifolia*, karstic limestone substrate, 755 m, 16-VIII-2018, A.R. Burgaz (MACB 111953). KOTOR: Dragalj, Morinj-Carine road, P11, 42°35'20"N 018°41'16"E, pasture, deciduous *Quercus*, *Fraxinus excelsior*, *Betula pendula*, stony plateau substrate, 631 m, 15-VIII-2018, A.R. Burgaz (MACB 112693). NIKŠIĆ: Gornje Polje, Grahovo- Nudo road, P23, 42°39'40"N 018°36'41"E, deciduous *Quercus*, *Fraxinus excelsior*, limestone substrate, 899 m, 15-VIII-2018, A.R. Burgaz (MACB 112711). ŽABLJAK: Žabljak, Motički Gaj, 43°08'29"N 019°07'14"E, pasture and *Juniperus communis*, limestone substrate, 1488 m, 09-VIII-2018, A.R. Burgaz (MACB 111952).

### *Cladonia pyxidata* (L.) Hoffm.

**Fumarprotocetraric acid chemotype:** BAR: Virpazar, 42°14'21"N 019°05'46"E, *Pinus halepensis* and *Pistacia terebinthus*, calcareous rock substrate, 3 m, 12-VIII-2018, A.R. Burgaz (MACB 111829, 111714). Godinje, Virpazar-Vladimir road, P16, 42°13'09"N 019°07'27"E, *Punica granatum* and *Cotinus coggygria*, calcareous substrate, 31 m, 12-VIII-2018, A.R. Burgaz (MACB 111827). Livari, Rumija mts., 42°07'50"N 019°13'33"E, *Castanea sativa*, 435 m, 12-VIII-2018, A.R. Burgaz (MACB 112009). BUDVA: Brajići, Budva-Cetinje road, M2.3, 42°18'16"N 018°55'01"E, *Ostrya carpinifolia*, *Juniperus oxycedrus* and *Carpinus orientalis*, calcareous substrate, 833 m, 14-VIII-2018, A.R. Burgaz (MACB 111768). Novoselje, Valdanos beach road, 42°13'02"N 018°58'23"E, deciduous *Quercus*, *Carpinus orientalis* and *Ostrya carpinifolia*, limestone substrate, 657 m, 13-VIII-2018, A.R. Burgaz (MACB 111821, 111819). CETINJE: Vrela, Budva-Cetinje road, M2.3, 42°19'33"N 018°55'53"E, *Carpinus orientalis* and *Juniperus oxycedrus*, limestone substrate, 704 m, 14-VIII-2018, A.R. Burgaz (MACB 111818, 111815). Očinići, 42°21'01"N 018°55'53"E, *Carpinus orientalis*, deciduous *Quercus* and *Juniperus oxycedrus*, limestone substrate, 730 m, 06-

VIII-2018, A.R. Burgaz (MACB 111848, 111847). Dubovik, Lovćen mt., Trojica-Cetinje road, P1, 42°24'54"N 018°52'51"E, deciduous *Quercus*, *Carpinus orientalis* and *Fraxinus excelsior*, limestone substrate, 936 m, 14-VIII-2018, A.R. Burgaz (MACB 111765). Bjeloši, Lovćen mt., Cetinje-Lovćen road, 42°22'27"N 018°52'09"E, pasture and *Fagus sylvatica*, limestone substrate, 1085 m, 14-VIII-2018, A.R. Burgaz (MACB 111763). Lovćen mt., 42°23'59"N 018°49'45"E, pasture and *Fagus sylvatica*, limestone substrate, 1358 m, 14-VIII-2018, A.R. Burgaz (MACB 111782). GUSINJE: Vusanje, 42°31'38"N 019°50'08"E, *Carpinus orientalis*, *Juniperus communis*, limestone substrate, 943 m, 07-VIII-2018, A.R. Burgaz (MACB 111720, 111725). Dolja, Dolina Grebaje, Prokletije mts., 42°31'15"N 019°47'06"E, *Carpinus orientalis*, *Juniperus communis*, limestone substrate, 943 m, 08-VIII-2018, A.R. Burgaz (MACB 111844, 111730). HERCEG NOVI: Mokrine, Orjen mts., Meljine-Trebinje road, 42°30'47"N 018°29'13"E, *Acer monspessulanum*, karstic limestone substrate, 571 m, 16-VIII-2018, A.R. Burgaz (MACB 111816, 111814). Kruševica, Orjen mts., Vrbanje road, 42°32'15"N 018°29'55"E, *Carpinus orientalis* and *Ostrya carpinifolia*, karstic limestone substrate, 755 m, 16-VIII-2018, A.R. Burgaz (MACB 111781). Sitnica, Meljine-Trebinje road, 42°33'06"N 018°27'00"E, deciduous *Quercus*, *Carpinus orientalis* and *Ostrya carpinifolia*, limestone substrate, 858 m, 16-VIII-2018, A.R. Burgaz (MACB 111784, 111785). KOLAŠIN: Kolašin, Biočinovići, 42°50'05"N 019°33'50"E, *Carpinus orientalis* and *Fagus sylvatica*, acid rock substrate, 1054 m, 09-VIII-2018, A.R. Burgaz (MACB 111850, 111849). Kolašin, Kolašin ski resort 1600, way up Vranjak Pass, Jezerine-Vranjak road, 42°50'39"N 019°38'19"E, *Picea abies* and *Fagus sylvatica*, road slope bank calcareous substrate, 1638 m, 09-VIII-2018, A.R. Burgaz (MACB 111846). KOTOR: Radanovići, 42°21'38"N 018°45'14"E, maquis, *Erica arborea*, *Arbutus unedo* and *Myrtus communis*, acid substrate, 75 m, 13-VIII-2018, A.R. Burgaz (MACB 111787). Bigova, 42°21'39"N 018°42'24"E, *Pistacia lentiscus*, *P. terebinthus*, *Juniperus oxycedrus*, *Arbutus unedo* and *Erica arborea*, limestone substrate, 238 m, 13-VIII-2018, A.R. Burgaz (MACB 111767, 111766). Pobrđe, 42°21'12"N 018°44'27"E, *Erica arborea*, *Arbutus unedo*, *Carpinus orientalis* and *Pistacia terebinthus*, limestone substrate, 238 m, 13-VIII-2018, A.R. Burgaz (MACB 111817). Ledenice, Morinj-Carine road, P11, 42°33'03"N 018°42'50"E, deciduous *Quercus*, limestone substrate, 691 m, 15-VIII-2018, A.R. Burgaz (MACB 111761). MOJKOVAC: Bistrica, Mojkovac-Pljevlja road, P4, 42°59'28"N 019°25'58"E, pasture, *Juniperus communis* and *Pinus nigra*, limestone substrate, 846 m, 09-VIII-2018, A.R. Burgaz (MACB 111838). NIKŠIĆ: Nikšić, Trebjesa park, 42°46'05"N 018°57'35"E, *Ostrya carpinifolia* and *Pinus nigra*, limestone substrate, 698 m, 11-VIII-2018, A.R. Burgaz (MACB 111713, 111835). Riječani, Velimlje road, 42°45'14"N 018°38'05"E, shrubs, deciduous *Quercus*, *Acer monspessulanum* and *Fraxinus*, calcareous rock substrate, 824 m, 15-VIII-2018, A.R. Burgaz (MACB 111789 111822). Rudine, Nikšić-Vilusi road, M6, 42°45'04"N 018°48'10"E, pasture and *Carpinus orientalis*, limestone substrate, 869 m, 15-VIII-2018, A.R. Burgaz (MACB 111783, 111786). Gornje Polje, Grahovo-Nudo road, P23, 42°39'40"N 018°36'41"E, deciduous *Quercus* and *Fraxinus excelsior*, limestone substrate, 899 m, 15-VIII-2018, A.R. Burgaz (MACB 111820). Nudo, Grahovo-Nudo road, P23, 42°39'37"N 018°36'07"E, *Ostrya carpinifolia* and *Tilia tomentosa*, road slope bank limestone substrate, 906 m, 15-VIII-2018, A.R. Burgaz (MACB 111764, 111762). Grahovac, Morinj-Carine road, P11, 42°41'12"N 018°38'05"E, deciduous *Quercus*, limestone substrate, 981 m, 15-VIII-2018, A.R. Burgaz (MACB 111759). Jasenovo Polje, 42°56'16"N 018°55'42"E, *Ostrya carpinifolia*, limestone substrate, 1140 m, 11-VIII-2018, A.R. Burgaz (MACB 111833). PLAV: Gornja Ržanica, Ravna Gora, Murino-Čakor-Peć road, M9, 42°39'29"N 019°55'34"E, deciduous *Quercus* and *Fagus sylvatica*, road slope bank schist substrate, 940 m, 07-VIII-2018, A.R. Burgaz (MACB 111845). Plav, Meteh, Babino Polje, 42°36'47"N 020°01'47"E, *Picea abies*, acid rock substrate, 1433 m, 08-VIII-2018, A.R. Burgaz (MACB 111843). Plav, Meteh, Babino Polje, 42°36'46"N 020°02'30"E, *Picea abies*, acid rock substrate, 1532 m, 08-VIII-2018, A.R. Burgaz (MACB 111728). Velika, Krlje, way up Čakor Pass, Murino-Čakor-Peć road, M9, 42°40'15"N 020°00'17"E, *Picea abies*, acid rock substrate, 1746 m, 07-VIII-2018, A.R. Burgaz (MACB 111721). PLJEVLJA: Rasova, Narodnih Heroja road, P5, 43°09'04"N

019°15'42"E, pasture, *Juniperus communis* and *Pinus nigra*, limestone substrate, 1226 m, 09-VIII-2018, A.R. Burgaz (MACB 111722, 111726). PLUŽINE: Plužine, Krastavica, 43°09'08"N 018°49'37"E, deciduous *Quercus*, limestone substrate, 733 m, 11-VIII-2018, A.R. Burgaz (MACB 111830). Plužine, near Piva Monastery, Nikšić-Plužine road, M18, 43°07'09"N 018°49'07"E, *Juniperus communis* and deciduous *Quercus*, limestone substrate, 974 m, 11-VIII-2018, A.R. Burgaz (MACB 111841, 111842). Donja Brezna, Nikšić-Plužine road, M18, 42°57'03"N 018°54'37"E, *Fagus sylvatica* and *Abies alba*, limestone substrate, 1134 m, 11-VIII-2018, A.R. Burgaz (MACB 111834, 111836). PODGORICA: Podgorica, Doljani, Podgorica-Ubli road, 42°27'25"N 019°19'24"E, *Pistacia terebinthus*, *Quercus trojana* and *Juniperus oxycedrus*, calcareous rock substrate, 211 m, 12-VIII-2018, A.R. Burgaz (MACB 111828). ROŽAJE: Dacići, Rožaje-Peć road, P8, 42°48'21"N 020°10'37"E, *Picea abies* and *Juniperus communis*, limestone substrate, 1288 m, 06-VIII-2018, A.R. Burgaz (MACB 111727, 111718). Dacići, Kulina Pass, Rožaje-Peć road, P8, 42°48'10"N 020°13'34"E, pasture, *Picea-Abies* forest and *Betula pendula*, schist substrate, 1711 m, 06-VIII-2018, A.R. Burgaz (MACB 111719). ŠAVNIK: Krnovo, Krnovo Pass, 42°53'45"N 019°05'53"E, *Picea abies* stumps, limestone substrate, 1487 m, 10-VIII-2018, A.R. Burgaz (MACB 111826). ULCINJ: Bratica, Valdanos beach road, 41°57'07"N 019°10'48"E, maquis, *Quercus coccifera* and *Juniperus oxycedrus*, limestone substrate, 221 m, 13-VIII-2018, A.R. Burgaz (MACB 111760, 111921, 111771). Utjeha-Bušat, way up wind turbine camp road, 41°59'42"N 019°09'59"E, *Juniperus oxycedrus*, *Arbutus unedo* and *Pistacia terebinthus*, limestone substrate, 234 m, 12-VIII-2018, A.R. Burgaz (MACB 111837). ŽABLJAK: Njegovuđa, 43°08'30"N 019°14'05"E, shrub, *Juniperus communis* and *Pinus nigra*, limestone substrate, 1309 m, 09-VIII-2018, A.R. Burgaz (MACB 111832). Žabljak, Tepačko Polje, 43°09'54"N 019°10'14"E, pasture, *Betula pendula* and *Pinus mugo*, karstic limestone substrate, 1327 m, 10-VIII-2018, A.R. Burgaz (MACB 111831). Žabljak, along Crno jezero road, 43°08'58"N 019°05'59"E, *Picea abies*, limestone substrate, 1418 m, 10-VIII-2018, A.R. Burgaz (MACB 111839). Žabljak, Motički Gaj, 43°08'29"N 019°07'14"E, pasture and *Juniperus communis*,

limestone substrate, 1488 m, 09-VIII-2018, A.R. Burgaz (MACB 111825, 111824). Žabljak, Durmitor mts., deviation Veliki Stouc, Mala Crna Gora road, 43°11'19"N 019°03'36"E, *Pinus mugo*, limestone substrate, 1947 m, 10-VIII-2018, A.R. Burgaz (MACB 111729, 111840).

### *Cladonia rangiformis* Hoffm.

**Atranorin and rangiformic acid chemotype:** BERANE: Kalica, Ravna Gora, Turjak Pass, Berane-Rožaje old road, P20, 42°51'44"N 020°03'29"E, pastures and *Picea abies*, acid substrate, 1352 m, 07-VIII-2018, A.R. Burgaz (MACB 111689). CETINJE: Dubovik, Lovćen mt., Trojica-Cetinje road, P1, 42°24'54"N 018°52'51"E, deciduous *Quercus*, *Carpinus orientalis* and *Fraxinus excelsior*, limestone substrate, 936 m, 14-VIII-2018, A.R. Burgaz (MACB 111923). GUSINJE: Vusanje, 42°31'38"N 019°50'08"E, *Carpinus orientalis* and *Juniperus communis*, limestone substrate, 943 m, 07-VIII-2018, A.R. Burgaz (MACB 111702). KOTOR: Dragalj, Morinj-Carine road, P11, 42°35'20"N 018°41'16"E, pasture, deciduous *Quercus*, *Fraxinus excelsior* and *Betula pendula*, stony plateau substrate, 631 m, 15-VIII-2018, A.R. Burgaz (MACB 111910). NIKŠIĆ: Rudine, Nikšić-Vilusi road, M6, 42°45'04"N 018°48'10"E, pasture and *Carpinus orientalis*, limestone substrate, 869 m, 15-VIII-2018, A.R. Burgaz (MACB 111823). Grahovac, Morinj-Carine road, P11, 42°41'12"N 018°38'05"E, deciduous *Quercus*, limestone substrate, 981 m, 15-VIII-2018, A.R. Burgaz (MACB 111908). Riječani, Velimlje road, 42°45'14"N 018°38'05"E, shrubs, deciduous *Quercus*, *Acer monspessulanum* and *Fraxinus*, calcareous rock substrate, 824 m, 15-VIII-2018, A.R. Burgaz (MACB 111909). Gornje Polje, Grahovo-Nudo road, P23, 42°39'40"N 018°36'41"E, deciduous *Quercus* and *Fraxinus excelsior*, limestone substrate, 899 m, 15-VIII-2018, A.R. Burgaz (MACB 111911). Lukovo, 42°48'13"N 019°01'44"E, *Ostrya carpinifolia* and *Carpinus orientalis*, limestone substrate, 876 m, 10-VIII-2018, A.R. Burgaz (MACB 111985). PLAV: Plav, Komaraca, 42°37'01"N 019°57'52"E, *Carpinus orientalis*, deciduous *Quercus*, road slope bank schist substrate, 975 m, 08-VIII-2018, A.R. Burgaz (MACB 111676). PLJEVLJA: Rasova, Narodnih Heroja road,



P5, 43°09'04"N 019°15'42"E, pasture, *Juniperus communis* and *Pinus nigra*, limestone substrate, 1226 m, 09-VIII-2018, A.R. Burgaz (MACB 111651). PLUŽINE: Plužine, near Piva Monastery, Nikšić-Plužine road, M18, 43°07'09"N 018°49'07"E, *Juniperus communis* with deciduous *Quercus*, limestone substrate, 974 m, 11-VIII-2018, A.R. Burgaz (MACB 111653). ROŽAJE: Kalače, Berane-Rožaje old road, P20, 42°51'32"N 020°04'43"E, *Picea abies*, *Fagus sylvatica* and *Juniperus communis*, 1280 m, 07-VIII-2018, A.R. Burgaz (MACB 111780). ŽABLJAK: Žabljak, Motički Gaj, 43°08'29"N 019°07'14"E, pasture with *Juniperus communis*, limestone substrate, 1488 m, 09-VIII-2018, A.R. Burgaz (MACB 111652). Žabljak, Tepačko Polje, 43°09'54"N 019°10'14"E, pasture, *Betula pendula* and *Pinus mugo*, karstic limestone substrate, 1327 m, 10-VIII-2018, A.R. Burgaz (MACB 111677). **Atranorin, fumarprotocetraric and rangiformic acids chemotype:** BAR: Virpazar, 42°14'21"N 019°05'46"E, *Pinus halepensis* and *Pistacia terebinthus*, calcareous rock substrate, 3 m, 12-VIII-2018, A.R. Burgaz (MACB 111962). Godinje, Virpazar-Vladimir road, P16, 42°13'09"N 019°07'27"E, *Punica granatum* and *Cotinus coggygria*, calcareous substrate, 31 m, 12-VIII-2018, A.R. Burgaz (MACB 111963). BUDVA: Novoselje, Valdanos beach road, 42°13'02"N 018°58'23"E, deciduous *Quercus*, *Carpinus orientalis* and *Ostrya carpinifolia*, limestone substrate, 657 m, 13-VIII-2018, A.R. Burgaz (MACB 111989). Brajići, Budva-Cetinje road, M2.3, 42°18'16"N 018°55'01"E, *Ostrya carpinifolia*, *Juniperus oxycedrus* and *Carpinus orientalis*, calcareous substrate, 833 m, 14-VIII-2018, A.R. Burgaz (MACB 111975). CETINJE: Vrela, Budva-Cetinje road, M2.3, 42°19'33"N 018°55'53"E, *Carpinus orientalis* and *Juniperus oxycedrus*, limestone substrate, 704 m, 14-VIII-2018, A.R. Burgaz (MACB 111976). Očinići, 42°21'01"N 018°55'53"E, *Carpinus orientalis*, deciduous *Quercus* and *Juniperus oxycedrus*, limestone substrate, 730 m, 06-VIII-2018, A.R. Burgaz (MACB 111891). Dubovik, Lovćen mt., Trojica-Cetinje road, P1, 42°24'54"N 018°52'51"E, deciduous *Quercus*, *Carpinus orientalis* and *Fraxinus excelsior*, limestone substrate, 936 m, 14-VIII-2018, A.R. Burgaz (MACB 112002). DANILOVGRAD: Jovanovići, Danilovgrad-Ostrog monastery road, 42°36'04"N 019°06'11"E, *Quercus trojana*, *Pistacia terebinthus* and *Paliurus*

*spina-christi*, limestone substrate, 239 m, 11-VIII-2018, A.R. Burgaz (MACB 111966). GUSINJE: Vusanje, 42°31'38"N 019°50'08"E, *Carpinus orientalis*, *Juniperus communis*, limestone substrate, 943 m, 07-VIII-2018, A.R. Burgaz (MACB 111687). HERCEG NOVI: Mokrine, Orjen mts., Meljine-Trebinje road, 42°30'47"N 018°29'13"E, *Acer monspessulanum*, karstic limestone substrate, 571 m, 16-VIII-2018, A.R. Burgaz (MACB 111906). Kruševica, Orjen mts., Vrbanje road, 42°32'15"N 018°29'55"E, *Carpinus orientalis* and *Ostrya carpinifolia*, karstic limestone substrate, 755 m, 16-VIII-2018, A.R. Burgaz (MACB 111907). Sitnica, Meljine-Trebinje road, 42°33'06"N 018°27'00"E, deciduous *Quercus*, *Carpinus orientalis* and *Ostrya carpinifolia*, limestone substrate, 858 m, 16-VIII-2018, A.R. Burgaz (MACB 111924). KOTOR: Pobjrdje, 42°21'12"N 018°44'27"E, *Erica arborea*, *Arbutus unedo*, *Carpinus orientalis* and *Pistacia terebinthus*, limestone substrate, 238 m, 13-VIII-2018, A.R. Burgaz (MACB 111988). Radanovici, 42°21'38"N 018°45'14"E, maquis, *Erica arborea*, *Arbutus unedo* and *Myrtus communis*, acid substrate, 75 m, 13-VIII-2018, A.R. Burgaz (MACB 111987). Bigova, 42°21'39"N 018°42'24"E, *Pistacia lentiscus*, *P. terebinthus*, *Juniperus oxycedrus*, *Arbutus unedo* and *Erica arborea*, limestone substrate, 238 m, 13-VIII-2018, A.R. Burgaz (MACB 111974). Ledenice, Morinj-Carine road, P11, 42°33'03"N 018°42'50"E, deciduous *Quercus*, limestone substrate, 691 m, 15-VIII-2018, A.R. Burgaz (MACB 112001). MOJKOVAC: Bistrica, Mojkovac-Pljevlja road, P4, 42°59'28"N 019°25'58"E, pasture, *Juniperus communis* and *Pinus nigra*, limestone substrate, 846 m, 09-VIII-2018, A.R. Burgaz (MACB 111678). NIKŠIĆ: Grahovac, Morinj-Carine road, P11, 42°41'12"N 018°38'05"E, deciduous *Quercus*, limestone substrate, 981 m, 15-VIII-2018, A.R. Burgaz (MACB 111724). Rudine, Nikšić-Vilusi road, M6, 42°45'04"N 018°48'10"E, pasture with *Carpinus orientalis*, limestone substrate, 869 m, 15-VIII-2018, A.R. Burgaz (MACB 112000). Riječani, Velimlje road, 42°45'14"N 018°38'05"E, shrubs, deciduous *Quercus*, *Acer monspessulanum* and *Fraxinus*, calcareous rock substrate, 824 m, 15-VIII-2018, A.R. Burgaz (MACB 111723). Lukovo, 42°48'13"N 019°01'44"E, *Ostrya carpinifolia* and *Carpinus orientalis*, limestone substrate, 876 m, 10-VIII-2018, A.R. Burgaz (MACB

111654). PLAV: Gornja Ržanica, Ravna Gora, Murino-Čakor-Peć road, M9, 42°39'29"N 019°55'34"E, deciduous *Quercus* and *Fagus sylvatica*, road slope bank schist substrate, 940 m, 07-VIII-2018, A.R. Burgaz (MACB 111690). PLJEVLJA: Rasova, Narodnih Heroja road, P5, 43°09'04"N 019°15'42"E, pasture, *Juniperus communis* and *Pinus nigra*, limestone substrate, 1226 m, 09-VIII-2018, A.R. Burgaz (MACB 111880). PLUŽINE: Plužine, Krastavica, 43°09'08"N 018°49'37"E, deciduous *Quercus*, limestone substrate, 733 m, 11-VIII-2018, A.R. Burgaz (MACB 111867). PODGORICA: Bioče, Morača river valley, 42°31'34"N 019°20'54"E, *Juniperus oxycedrus*, *Pistacia terebinthus* and *Paliurus spina-christi*, calcareous boulder substrate, 98 m, 12-VIII-2018, A.R. Burgaz (MACB 111967). Podgorica, Doljani, Podgorica-Ubli road, 42°27'25"N 019°19'24"E, *Pistacia terebinthus*, *Quercus trojana* and *Juniperus oxycedrus*, calcareous rock substrate, 211 m, 12-VIII-2018, A.R. Burgaz (MACB 111968). ULCINJ: Bratica, Valdanos beach road, 41°57'07"N 019°10'48"E, maquis, *Quercus coccifera* and *Juniperus oxycedrus*, limestone substrate, 221 m, 13-VIII-2018, A.R. Burgaz (MACB 111986). Utjeha-Bušat, way up wind turbine camp road, 41°59'42"N 019°09'59"E, *Juniperus oxycedrus*, *Arbutus unedo* and *Pistacia terebinthus*, limestone substrate, 234 m, 12-VIII-2018, A.R. Burgaz (MACB 111961). ŽABLJAK: Njegovuđa, 43°08'30"N 019°14'05"E, shrub, *Juniperus communis* and *Pinus nigra*, limestone substrate, 1309 m, 09-VIII-2018, A.R. Burgaz (MACB 111788). Žabljak, Tepačko Polje, 43°09'54"N 019°10'14"E, pasture, *Betula pendula* and *Pinus mugo*, karstic limestone substrate, 1327 m, 10-VIII-2018, A.R. Burgaz (MACB 111866). **Atranorin, rangiformic and psoromic acids chemotype:** ŽABLJAK: Njegovuđa, 43°08'30"N 019°14'05"E, shrubs, *Juniperus communis*, *Pinus nigra*, limestone substrate, 1309 m, 09-VIII-2018, A.R. Burgaz (MACB 112758).

### *Cladonia rei* Schaer.

**Homosekikaic acid chemotype:** ANDRIJEVICA: Gnjili Potok, Trešnjevik Pass, Andrijevica-Mateševo road, M9 (AN03), 42°44'29"N 019°41'25"E, *Fagus sylvatica* and *Picea abies*, road slope bank schist substrate,

1528 m, 06-VIII-2018, A.R. Burgaz (MACB 111871). GUSINJE: Dolja, Dolina Grebaje, Prokletije mts., 42°31'15"N 019°47'06"E, *Carpinus orientalis*, *Juniperus communis*, limestone substrate, 943 m, 08-VIII-2018, A.R. Burgaz (MACB 111873). ROŽAJE: Kalače, Berane-Rožaje old road, P20, 42°51'32"N 020°04'43"E, *Picea abies*, *Fagus sylvatica* and *Juniperus communis*, 1280 m, 07-VIII-2018, A.R. Burgaz (MACB 111870). **Fumarprotocetraric and homosekikaic acids chemotype:** ANDRIJEVICA: Gnjili Potok, Trešnjevik Pass, Andrijevica-Mateševo road, M9 (AN03), 42°44'29"N 019°41'25"E, *Fagus sylvatica* and *Picea abies*, road slope bank schist substrate, 1528 m, 06-VIII-2018, A.R. Burgaz (MACB 111698). BERANE: Kalica, Ravna Gora, Turjak Pass, Berane-Rožaje old road, P20, 42°51'44"N 020°03'29"E, pastures with *Picea abies*, acid substrate, 1352 m, 07-VIII-2018, A.R. Burgaz (MACB 111696). GUSINJE: Dolja, Dolina Grebaje, Prokletije mts., 42°31'15"N 019°47'06"E, *Carpinus orientalis*, *Juniperus communis*, limestone substrate, 943 m, 08-VIII-2018, A.R. Burgaz (MACB 111697). PLUŽINE: Donja Brezna, Nikšić-Plužine road, M18, 42°57'03"N 018°54'37"E, *Fagus sylvatica* and *Abies alba*, limestone substrate, 1134 m, 11-VIII-2018, A.R. Burgaz (MACB 111699). ROŽAJE: Kalače, Berane-Rožaje old road, P20, 42°51'32"N 020°04'43"E, *Picea abies*, *Fagus sylvatica* and *Juniperus communis*, 1280 m, 07-VIII-2018, A.R. Burgaz (MACB 111872).

### *Cladonia subulata* (L.) F.H. Wigg.

**Fumarprotocetraric acid chemotype:** BERANE: Kalica, Ravna Gora, Turjak Pass, Berane-Rožaje old road, P20, 42°51'44"N 020°03'29"E, pastures and *Picea abies*, acid substrate, 1352 m, 07-VIII-2018, A.R. Burgaz (MACB 111879). PLAV: Plav, Meteh, Babino Polje, 42°36'47"N 020°01'47"E, *Picea abies*, acid rock substrate, 1433 m, 08-VIII-2018, A.R. Burgaz (MACB 112690).

### *Cladonia symphycarpa* (Flörke) Fr.

**Atranorin, norstictic and connorstictic acids chemotype:** ANDRIJEVICA: Gnjili Potok, Trešnjevik Pass, Andrijevica-Mateševo road, M9 (AN03), 42°44'29"N 019°41'25"E,

*Fagus sylvatica* and *Picea abies*, road slope bank schist substrate, 1528 m, 06-VIII-2018, A.R. Burgaz (MACB 111931). BUDVA: Brajići, Budva-Cetinje road, M2.3, 42°18'16"N 018°55'01"E, *Ostrya carpinifolia*, *Juniperus oxycedrus* and *Carpinus orientalis*, calcareous substrate, 833 m, 14-VIII-2018, A.R. Burgaz (MACB 111694). CETINJE: Očinići, 42°21'01"N 018°55'53"E, *Carpinus orientalis*, deciduous *Quercus* and *Juniperus oxycedrus*, limestone substrate, 730 m, 06-VIII-2018, A.R. Burgaz (MACB 111655). Bjeloši, Lovćen mt., Cetinje-Lovćen road, 42°22'27"N 018°52'09"E, pasture with *Fagus sylvatica*, limestone substrate, 1085 m, 14-VIII-2018, A.R. Burgaz (MACB 111692). Bjeloši, Lovćen mt., Cetinje-Lovćen road, 42°22'46"N 018°51'51"E, *Fagus sylvatica*, limestone substrate, 1127 m, 14-VIII-2018, A.R. Burgaz (MACB 111691). Dubovik, Lovćen mt., Trojica-Cetinje road, P1, 42°24'54"N 018°52'51"E, deciduous *Quercus*, *Carpinus orientalis* and *Fraxinus excelsior*, limestone substrate, 936 m, 14-VIII-2018, A.R. Burgaz (MACB 111682). Lovćen mt., 42°23'59"N 018°49'45"E, pasture, *Fagus sylvatica*, limestone substrate, 1358 m, 14-VIII-2018, A.R. Burgaz (MACB 112696). GUSINJE: Dolja, Dolina Grebaje, Prokletije mts., 42°31'15"N 019°47'06"E, *Carpinus orientalis*, *Juniperus communis*, limestone substrate, 943 m, 08-VIII-2018, A.R. Burgaz (MACB 111670). Vusanje, 42°31'38"N 019°50'08"E, *Carpinus orientalis*, *Juniperus communis*, limestone substrate, 943 m, 07-VIII-2018, A.R. Burgaz (MACB 111671). HERCEG NOVI: Kruševice, Orjen mts., Vrbanje road, 42°32'15"N 018°29'55"E, *Carpinus orientalis* and *Ostrya carpinifolia*, karstic limestone substrate, 755 m, 16-VIII-2018, A.R. Burgaz (MACB 111686). Sitnica, Meljine-Trebinje road, 42°33'06"N 018°27'00"E, deciduous *Quercus*, *Carpinus orientalis* and *Ostrya carpinifolia*, limestone substrate, 858 m, 16-VIII-2018, A.R. Burgaz (MACB 111960). KOTOR: Ledenice, Morinj-Carine road, P11, 42°33'03"N 018°42'50"E, deciduous *Quercus*, limestone substrate, 691 m, 15-VIII-2018, A.R. Burgaz (MACB 111685). Dragalj, Morinj-Carine road, P11, 42°35'20"N 018°41'16"E, pasture, deciduous *Quercus*, *Fraxinus excelsior* and *Betula pendula*, stony plateau substrate, 631 m, 15-VIII-2018, A.R. Burgaz (MACB 111684). MOJKOVAC: Bistrica, Mojkovac-Pljevlja

road, P4, 42°59'28"N 019°25'58"E, pasture, *Juniperus communis* and *Pinus nigra*, limestone substrate, 846 m, 09-VIII-2018, A.R. Burgaz (MACB 111660, 111659). NIKŠIĆ: Gornje Polje, Grahovo-Nudo road, P23, 42°39'40"N 018°36'41"E, deciduous *Quercus* and *Fraxinus excelsior*, limestone substrate, 899 m, 15-VIII-2018, A.R. Burgaz (MACB 111991). Grahovac, Morinj-Carine road, P11, 42°41'12"N 018°38'05"E, deciduous *Quercus*, limestone substrate, 981 m, 15-VIII-2018, A.R. Burgaz (MACB 111695). Lukovo, 42°48'13"N 019°01'44"E, *Ostrya carpinifolia* and *Carpinus orientalis*, limestone substrate, 876 m, 10-VIII-2018, A.R. Burgaz (MACB 111666). Riječani, Velimlje road, 42°45'14"N 018°38'05"E, shrubs, deciduous *Quercus*, *Acer monspessulanum* and *Fraxinus*, calcareous rock substrate, 824 m, 15-VIII-2018, A.R. Burgaz (MACB 111683). Rudine, Nikšić-Vilusi road, M6, 42°45'04"N 018°48'10"E, pasture and *Carpinus orientalis*, limestone substrate, 869 m, 15-VIII-2018, A.R. Burgaz (MACB 111688). PLUŽINE: Donja Brezna, Nikšić-Plužine road, M18, 42°57'03"N 018°54'37"E, *Fagus sylvatica* and *Abies alba*, limestone substrate, 1134 m, 11-VIII-2018, A.R. Burgaz (MACB 111956). Plužine, near Piva Monastery, Nikšić-Plužine road, M18, 43°07'09"N 018°49'07"E, *Juniperus communis* and deciduous *Quercus*, limestone substrate, 974 m, 11-VIII-2018, A.R. Burgaz (MACB 111959). ROŽAJE: Dacići, Rožaje-Peć (ALBANIA) road, P8, 42°48'21"N 020°10'37"E, *Picea abies*, *Juniperus communis*, limestone substrate, 1288 m, 06-VIII-2018, A.R. Burgaz, (MACB 112694). ŠAVNIK: Krnovo, Krnovo Pass, 42°53'45"N 019°05'53"E, *Picea abies* stumps, limestone substrate, 1487 m, 10-VIII-2018, A.R. Burgaz (MACB 111667). ŽABLJAK: Žabljak, Motički Gaj, 43°08'29"N 019°07'14"E, pasture with *Juniperus communis*, limestone substrate, 1488 m, 09-VIII-2018, A.R. Burgaz (MACB 111657). Žabljak, Tepačko Polje, 43°09'54"N 019°10'14"E, pasture, *Betula pendula* and *Pinus mugo*, karstic limestone substrate, 1327 m, 10-VIII-2018, A.R. Burgaz (MACB 111675). Žabljak, Bosača, Durmitor mts., Mala Crna Gora road, 43°10'13"N 019°04'42"E, *Pinus mugo* and *Juniperus communis*, limestone substrate, 1761 m, 10-VIII-2018, A.R. Burgaz (MACB 111668). **Atranorin, norstictic, connorstictic acids and zeorin chemotype:** CETINJE: Bjeloši,



Lovćen mt., Cetinje-Lovćen road, 42°22'27"N 018°52'09"E, pasture and *Fagus sylvatica*, limestone substrate, 1085 m, 14-VIII-2018, A.R. Burgaz (MACB 111693). MOJKOVAC: Bistrica, Mojkovac-Pljevlja road, P4, 42°59'28"N 019°25'58"E, pasture, *Juniperus communis* and *Pinus nigra*, limestone substrate, 846 m, 09-VIII-2018, A.R. Burgaz (MACB 111665). NIKŠIĆ: Rudine, Nikšić-Vilusi road, M6, 42°45'04"N 018°48'10"E, pasture with *Carpinus orientalis*, limestone substrate, 869 m, 15-VIII-2018, A.R. Burgaz (MACB 111992). Riječani, Velimlje road, 42°45'14"N 018°38'05"E, shrubs, deciduous *Quercus*, *Acer monspessulanum* and *Fraxinus*, calcareous rock substrate, 824 m, 15-VIII-2018, A.R. Burgaz (MACB 111681). Nikšić, Trebjesa park, 42°46'05"N 018°57'35"E, *Ostrya carpinifolia* and *Pinus nigra*, limestone substrate, 698 m, 11-VIII-2018, A.R. Burgaz (MACB 111679). Lukovo, 42°48'13"N 019°01'44"E, *Ostrya carpinifolia* and *Carpinus orientalis*, limestone substrate, 876 m, 10-VIII-2018, A.R. Burgaz (MACB 111664). PLJEVLJA: Rasova, Narodnih Heroja road, P5, 43°09'04"N 019°15'42"E, pasture, *Juniperus communis* and *Pinus nigra*, limestone substrate, 1226 m, 09-VIII-2018, A.R. Burgaz (MACB 111673). ŠAVNIK: Krnovo, Krnovo Pass, 42°53'45"N 019°05'53"E, *Picea abies* stumps, limestone substrate, 1487 m, 10-VIII-2018, A.R. Burgaz (MACB 111669). ŽABLJAK: Žabljak,

Motički Gaj, 43°08'29"N 019°07'14"E, pasture with *Juniperus communis*, limestone substrate, 1488 m, 09-VIII-2018, A.R. Burgaz (MACB 111658). Njegovuđa, 43°08'30"N 019°14'05"E, shrubs, *Juniperus communis* and *Pinus nigra*, limestone substrate, 1309 m, 09-VIII-2018, A.R. Burgaz (MACB 111674). **Norstictic and conorstictic acids chemotype:** KOTOR: Dragalj, Morinj-Carine road, P11, 42°35'20"N 018°41'16"E, pasture, deciduous *Quercus*, *Fraxinus excelsior* and *Betula pendula*, stony plateau substrate, 631 m, 15-VIII-2018, A.R. Burgaz (MACB 111999). **Norstictic and rangiformic acids chemotype:** PLUŽINE: Donja Brezna, Nikšić-Plužine road, M18, 42°57'03"N 018°54'37"E, *Fagus sylvatica* and *Abies alba*, limestone substrate, 1134 m, 11-VIII-2018, A.R. Burgaz (MACB 111918). **Atranorin, psoromic and conpsoromic acids chemotype:** GUSINJE: Vusanje, 42°31'38"N 019°50'08"E, *Carpinus orientalis*, *Juniperus communis*, limestone substrate, 943 m, 07-VIII-2018, A.R. Burgaz (MACB 111672). PODGORICA: Bioče, Morača river valley, 42°31'34"N 019°20'54"E, *Juniperus oxycedrus*, *Pistacia terebinthus* and *Paliurus spina-christi*, calcareous boulder substrate, 98 m, 12-VIII-2018, A.R. Burgaz (MACB 111680). ŽABLJAK: Žabljak, Bosača, Durmitor mts., Mala Crna Gora road, 43°10'13"N 019°04'42"E, *Pinus mugo* and *Juniperus communis*, limestone substrate, 1761 m, 10-VIII-2018, A.R. Burgaz (MACB 111663).