

Notes on species of the genus *Cladonia* from Bosnia-Herzegovina and Croatia

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Abstract: Burgaz, A. R. & Pino-Bodas, R. 2012. Notes on species of the genus *Cladonia* from Bosnia-Herzegovina and Croatia. *Bot. Complut.* 36: 13-18.

Field studies in the south of Bosnia-Herzegovina and Croatia have revealed six lichen species new to Bosnia-Herzegovina: *Cladonia cervicornis*, *C. conista*, *C. phyllophora*, *C. pulvinella*, *C. subcariosa* and *C. subrangiformis*. Two species are new to Croatia: *C. cryptochlorophaea* and *C. humilis*.

Key words: *Cladonia*, lichens, chorology, SE Europe.

Resumen: Burgaz, A. R. & Pino-Bodas, R. 2012. Notas sobre especies del género *Cladonia* de Bosnia-Herzegovina y Croacia. *Bot. Complut.* 36: 13-18.

Se aportan seis novedades para Bosnia y Herzegovina: *Cladonia cervicornis*, *C. conista*, *C. phyllophora*, *C. pulvinella*, *C. subcariosa* y *C. subrangiformis* y dos nuevas especies para Croacia: *C. cryptochlorophaea* y *C. humilis*.

Palabras clave: *Cladonia*, líquenes, corología, SE Europa.

INTRODUCTION

The state Bosnia and Herzegovina belonged to the former Federal Republic of Yugoslavia up to 1992. In the north and west it is bordered by Croatia, in the south by Montenegro and in the east by Serbia. Bosnia-Herzegovina is a mountainous country where the extensions of the Dinaric Alps reach Bosnia in the west and support a moderately continental climate. The northeastern parts reach into the Pannonian Basin, while in the south it approaches the Adriatic Sea with a Mediterranean climate. Floristically it is included in the Holarctic Kingdom and is shared between the Illyrian province of the Circumboreal Region (Polunin & Walters 1989), where the beech forests are dominant above 1000 m, with different vegetation series related to the substrate, and the Adriatic province of the Mediterranean Region with xerothermic evergreen vegetation dominated by *Pinus halepensis* and *Quercus ilex* close to the sea level, and substituted by deciduous and thermophilous oaks when the sea influence decreases (Trišnjaković 1995). The dominant substrate is calcareous (limestones, karst and dolomites).

As a result of some field surveys mainly in the south of the territory several species of the genus *Cladonia* were collected. The earliest lichen records from Bosnia-Herzegovina were recorded by Zahlbruckner (1890) but the references are few compared to those from Croatia (Zahlbruckner 1901, 1903, 1905, 1907a, b). After an examination of recent works on lichens of Bosnia-Herzegovina (Christensen 1994; Weckesser & Visnjic 2005; Bilovitz & Mayrhofer 2009, 2011; Bilovitz *et al.* 2009) and Croatia (Christensen & Hansen 1994, Ozimec *et al.* 2009) some of our collections represent extensions of the range of the species, including records to Bosnia and Herzegovina (indicated by *) or Croatia (indicated by +).

MATERIALS AND METHODS

The study is based on 66 specimens of fresh material collected in different Cantons of Bosnia-Herzegovina and Croatia (Fig. 1). The material studied is deposited in MACB herbarium (Dpto. Biología Vegetal I, Universidad Complutense de Madrid, Spain) with some duplicates in the herbarium H (Botanical Museum, University of Helsinki, Finland). The species were determined by their morphology and chemical

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Recibido: 23 enero 2012. Aceptado: 19 febrero 2012.



Fig. 1– Studied localities. **Bosnia and Herzegovina:** Federation of Bosnia and Herzegovina: **1:** Herzegovina-Neretva Canton, Ljubusky, Stubica, vadopa Kravica; **2:** Herzegovina-Neretva Canton, Bijakovici, Medugorje; **3:** Biletići Polje, viewpoint over Neretva river; **4:** Sarajevo Canton, Trevići; **5:** Capljina, Hutovo Blato; **6:** Ruište. Republica Srpska; **8:** Trebinje. Croatia: Dubrovnik-Neretva County: **7:** Zamaslina, Pelsejac peninsula; **9:** Palje Brdo.

characters. The secondary compounds were analyzed according to standard procedures (White & James 1985).

RESULTS

* *Cladonia cervicornis* (Ach.) Flot. subsp. *cervicornis* Jahrb. schles. Ges. vaterl. Kultur 27: 31, 1849

This species is usually easy to recognize by its brown and squamulose primary thallus, but not very often encountered. Thallus Pd+ red, K–, contains fumarprotocetraric, protocetraric and confumarprotocetraric acids. It grows on calcareous soil mixed with bryophytes. Earlier recorded from Croatia (Partl 2009) but new to Bosnia-Herzegovina.

Specimens examined. **BOSNIA AND HERZEGOVINA:** 5. **FEDERATION OF BOSNIA AND HERZEGOVINA:** Herzegovina-Neretva Canton, Capljina, Hutovo Blato, 33TYH291599, 20 m, limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus spina-christi*, 29-III-2010, A. R. Burgaz, MACB 101125. **CROATIA:** 7. **DUBROVNIK-NERETVA COUNTY:** Zamaslina, Pelsejac peninsula, 33TYH231456, 20 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 31-III-2010, A. R. Burgaz, MACB 101126.

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

A characteristic species with regular podetia covered with coarse and rounded soredia. It was collected on tree bases. Podetia Pd+ red, K–, contains fumarprotocetraric acid and traces of protocetraric, confumarprotocetraric and quesitic acids. Earlier recorded from Bosnia-Herzegovina (Christensen 1994).

Specimens examined. **BOSNIA AND HERZEGOVINA:** 4. **FEDERATION OF BOSNIA AND HERZEGOVINA:** Sarajevo Canton, Trevići, 34TBP955536, 1629 m, limestone, woods of *Picea abies*, 28-III-2010, A. R. Burgaz, MACB 101092.

Cladonia coniocraea (Flörke) Spreng. Syst. Veg. 4, 1: 272, 1827

Pointed or very narrow podetia cover with farinose soredia is characteristic of this species. It was collected on rotting wood of beech. Podetia Pd+ red, K–, contains the fumarprotocetraric acid complex. It has been recorded from Bosnia-Herzegovina (Christensen 1994).

Specimens examined. **BOSNIA AND HERZEGOVINA:** 6. **FEDERATION OF BOSNIA AND HERZEGOVINA:** Herzegovina-Neretva Canton, Ruište, 33TYJ335165, 1100 m, limestone, *Fagus sylvatica* forest, 30-III-2010, A. R. Burgaz, MACB 101093.

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

A problematic species morphologically similar to *C. humilis* and usually identified by the presence of fumarprotocetraric and bourgeanic acids. The primary thallus has rounded and persistent squamules, and develop short and regular podetia, partially or totally covered with farinose soredia. It grows on bare, calcareous soil or mixed with bryophytes. Thallus Pd+ red, K–. Archer (1989) considered these specimens as *C. humilis* var. *bourgeanica* while Holien & Tønberg (1985) treated them as different taxa, viz. *C. conista* Robbins. Recent molecular study (Pino-Bodas *et al.* 2012) has clarified the relationships between these taxa and revealed two different lineages related with these two chemotypes also with some morphological differences. *C. conista* shows longer podetia stalks and wider scyphi than *C. humilis*. The soredia size is similar in both species. It is new to Bosnia-Herzegovina.

Specimens examined. **BOSNIA AND HERZEGOVINA:** **FEDERATION OF BOSNIA AND HERZEGOVINA:** 2. Herzegovina-Neretva Canton, Bijakovici, Medugorje, way up to the Hill of Apparitions,

33TYH188845, 200 m, karstic limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus spina-christi*, 26-III-2010, *A. R. Burgaz*, MACB 101101. 4. Sarajevo Canton, Trevići, 34TBP955536, 1629 m, limestone, woods of *Picea abies*, 28-III-2010, *A. R. Burgaz*, MACB 101102, H.

+ *Cladonia cryptochlorophaea* Asahina

J. Jap. Bot. 16: 711, 1940

A characteristic species with scyphose podetia coarsely sorediate in the upper part, sometimes considered a chemotype of *C. chlorophaea* s. lat. (James 2009). Podetia Pd+ red, K+ yellow-red, C+ wine red, contains fumarprotocetraric and cryptochlorophaeic acids. It was collected on soil mixed with bryophytes. It is new to Croatia.

Specimens examined. **CROATIA: 7. DUBROVNIK–NERETVA COUNTY:** Zamaslina, Pelsejac peninsula, 33TYH231456, 20 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 31-III-2010, *A. R. Burgaz*, MACB 101127.

Cladonia fimbriata (L.) Fr.

Lichenogr. Eur. Ref.: 222, 1831

Podetia with farinose soredia and gobblet shape. Pd+ red, K–, contains fumarprotocetraric, protocetraric and quaesitic (inconstant) acids. It grows on rotting wood mixed with bryophytes. Earlier recorded from the area (Bilovitz & Mayrhofer 2011, Partl 2009).

Specimens examined. **BOSNIA AND HERZEGOVINA: 4. FEDERATION OF BOSNIA AND HERZEGOVINA:** Sarajevo Canton, Trevići, 34TBP955536, 1629 m, limestone, woods of *Picea abies*, 28-III-2010, *A. R. Burgaz*, MACB 1011094, H. 6. Herzegovina-Neretva Canton, Ruište, 33TYJ335165, 1100 m, limestone, *Fagus sylvatica* forest, 30-III-2010, *A. R. Burgaz*, MACB 101095. **CROATIA: 9. DUBROVNIK–NERETVA COUNTY:** Palje Brdo, 34TBN863085, 160 m, limestone, *Pinus halepensis*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Cupressus sempervirens*, 2-IV-2010, *A. R. Burgaz*, MACB 101096.

Cladonia foliacea (Huds.) Willd.

Fl. Berol. Prodr.: 363, 1787

A very variable species characterized by the size of its primary thallus and preferences for calcareous or acid substrates, sometimes difficult to separate from *C. convoluta* (Lam.) Anders. Most of the specimens have larger squamules and they should be classified as *C. convoluta*. Actually the status of *C. convoluta* is highly doubtful because the molecular data do not support the delimitation of *C. foliacea* and *C. convoluta*, and the morphological

differences between the two taxa probably reflect a phenotypic response to different environmental conditions (Pino-Bodas *et al.* 2010). Thallus Pd+ red, K+ yellow, contains fumarprotocetraric and usnic acids. It is widely distributed in the Mediterranean region with extensions to temperate areas of Europe and Asia (Litterski & Ahti 2004). It has earlier been recorded from Bosnia-Herzegovina (Bilovitz & Mayrhofer 2011) and Croatia (Zahlbruckner 1901, 1905).

Specimens examined. **BOSNIA AND HERZEGOVINA: 2. FEDERATION OF BOSNIA AND HERZEGOVINA:** Herzegovina-Neretva Canton, Bijakovići, Medugorje, way up to the Hill of Apparitions, 33TYH188845, 200 m, karstic limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus spina-christi*, 26-III-2010, *A. R. Burgaz*, MACB 101129. 3. Biletići Polje, viewpoint over Neretva river, 33TYH258869, 100 m, karstic limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus spina-christi*, 26-III-2010, *A. R. Burgaz*, MACB 101130. 5. Capljina, Hutovo Blato, 33TYH291599, 20 m, limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus spina-christi*, 29-III-2010, *A. R. Burgaz*, MACB 101131. 6. Ruište, 33TYJ335165, 1100 m, limestone, *Fagus sylvatica* forest, 30-III-2010, *A. R. Burgaz*, MACB 101132. 8. **REPUBLICA SRPSKA:** Trebinje, surrounding the orthodox Monastery of Turdoš, 34TBN823322, 270 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 1-IV-2010, *A. R. Burgaz*, MACB 101166, H. **CROATIA: 7. DUBROVNIK–NERETVA COUNTY:** Zamaslina, Pelsejac peninsula, 33TYH231456, 20 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 31-III-2010, *A. R. Burgaz*, MACB 101165. 9. Palje Brdo, 34TBN863085, 160 m, limestone, *Pinus halepensis*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Cupressus sempervirens*, 2-IV-2010, *A. R. Burgaz*, MACB 101133, H.

Cladonia furcata (Huds.) Schrad.

Spicil. Fl. Germ.: 107, 1794

This is a morphologically variable species with subulate and dichotomously branched podetia. Pd+ red, K–, contains fumarprotocetraric and protocetraric acids. It grows on calcareous soil mixed with bryophytes. Early recorded from Bosnia-Herzegovina (Zahlbruckner 1890, Bilovitz *et al.* 2009, Bilovitz & Mayrhofer 2011), and Croatia (Zahlbruckner 1901, 1903, 1907a, b).

Specimens examined. **BOSNIA AND HERZEGOVINA: 5. FEDERATION OF BOSNIA AND HERZEGOVINA:** Herzegovina-Neretva Canton, Capljina, Hutovo Blato, 33TYH291599, 20 m, limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus spina-christi*, 29-III-2010, *A. R. Burgaz*, MACB 101097. 8. **REPUBLICA SRPSKA:** Trebinje, surrounding the orthodox Monastery of Turdoš, 34TBN823322, 270 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 1-IV-2010, *A. R. Burgaz*, MACB 101099. **CROATIA: 7. DUBROVNIK–NERETVA COUNTY:** Zamaslina, Pelsejac peninsula, 33TYH231456, 20 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus*

phoenicea, 31-III-2010, *A. R. Burgaz*, MACB 101098. **9.** Palje Brdo, 34TBN863085, 160 m, limestone, *Pinus halepensis*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Cupressus sempervirens*, 2-IV-2010, *A. R. Burgaz*, MACB 101100.

+ *Cladonia humilis* (With.) J. R. Laundon
Lichenologist 16: 220, 1984

A characteristic species with squamulose and persistent, rounded primary thallus, short and regular podetia, partially or totally covered with farinose soredia. It grows on bare, calcareous soil or mixed with bryophytes. Thallus Pd+ red, K+ yellow, contains fumarprotocetraric acid and atranorin. It is new to Croatia.

Specimens examined. **CROATIA: 7. DUBROVNIK-NERETVA COUNTY:** Zamaslina, Pelsejac peninsula, 33TYH231456, 20 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 31-III-2010, *A. R. Burgaz*, MACB 101103.

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

This is a morphologically variable species. The irregular podetia with a variable number of squamules and blackish bases are the main characters to distinguish this species. It grows on calcareous soil mixed with bryophytes. Pd+ red, K-, contains fumarprotocetraric, protocetraric acid (constants), hypoprotocetraric acid and zeorin (inconstants). This species has earlier been recorded from Croatia (Partl 2009) but it is new to Bosnia-Herzegovina.

Specimens examined. **BOSNIA AND HERZEGOVINA: 8. REPUBLICA SRPSKA:** Trebinje, surrounding the orthodox Monastery of Turdoš, 34TBN823322, 270 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 1-IV-2010, *A. R. Burgaz*, MACB 101107. **CROATIA: 9. DUBROVNIK-NERETVA COUNTY:** Palje Brdo, 34TBN863085, 160 m, limestone, *Pinus halepensis*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Cupressus sempervirens*, 2-IV-2010, *A. R. Burgaz*, MACB 101108, H.

Cladonia pocillum (Ach.) Grognot
Pl. Crypt. Saône-et-Loire: 82, 1863

This species is usually easy to recognize by the adnate squamules of the primary thallus forming compact rosettes. In the central part of the rosettes usually the squamules have some cracks. Regular podetia cover with granules in upper parts is characteristic. It is very often encountered growing on calcareous bare soil. Pd+ red, K-, contains fumarprotocetraric, protocetraric acids, zeorin and

hypoprotocetraric acid (inconstants). Earlier recorded from Bosnia-Herzegovina (Zahlbruckner 1890), and Croatia (Zahlbruckner 1903, 1907a).

Specimens examined. **BOSNIA AND HERZEGOVINA: 4. FEDERATION OF BOSNIA AND HERZEGOVINA:** Sarajevo Canton, Trevići, 4TBP955536, 1629 m, limestone, woods of *Picea abies*, 28-III-2010, *A. R. Burgaz*, MACB 101109. **5.** Herzegovina-Neretva Canton, Capljina, Hutovo Blato, 33TYH291599, 20 m, limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus spina-christi*, 29-III-2010, *A. R. Burgaz*, MACB 101110. **8. REPUBLICA SRPSKA:** Trebinje, surrounding the orthodox Monastery of Turdoš, 34TBN823322, 270 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 1-IV-2010, *A. R. Burgaz*, MACB 101111. **CROATIA: 7. DUBROVNIK-NERETVA COUNTY:** Zamaslina, Pelsejac peninsula, 33TYH231456, 20 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 31-III-2010, *A. R. Burgaz*, MACB 101112. **9.** Palje Brdo, 34TBN863085, 160 m, limestone, *Pinus halepensis*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Cupressus sempervirens*, 2-IV-2010, *A. R. Burgaz*, MACB 101113, H.

* *Cladonia pulvinella* S. Hammer
Mycotaxon 40: 192, 1991

This species has squamulose and persistent rounded primary thallus, short and regular podetia coarsely granulose in upper parts. It grows on calcareous bare soil. Pd+ red, K-, contains fumarprotocetraric, protocetraric and bourgeanic acids. A species chemically variable described from California (Hammer 1991), recorded from Central America (Ahti 2000) with extensions to thermic Mediterranean localities from the Iberian Peninsula (Burgaz & Ahti 2009). Difference in the size of the podetia granules is the main character to distinguish from *C. humilis*. It is new to Bosnia-Herzegovina.

Specimens examined. **BOSNIA AND HERZEGOVINA: 5. FEDERATION OF BOSNIA AND HERZEGOVINA:** Herzegovina-Neretva Canton, Capljina, Hutovo Blato, 33TYH291599, 20 m, limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus spina-christi*, 29-III-2010, *A. R. Burgaz*, MACB 101114.

Cladonia pyxidata (L.) Hoffm.
Deutschl. Flora 2: 121, 1796

This species is distinguished by the corticate and regular scyphose podetia cover with peltate and flat squamules in upper part. It is very often encountered growing on calcareous soil mixed with bryophytes. Pd+ red, K-, contains fumarprotocetraric, protocetraric acid (constants), hypoprotocetraric and quaesicitic acids (inconstants), rarely also atranorin in traces. This species has earlier been

recorded from Bosnia-Herzegovina (Zahlbruckner 1890, Christensen 1994, Bilovitz *et al.* 2009) and Croatia (Zahlbruckner 1901, 1905).

Specimens examined. **BOSNIA AND HERZEGOVINA: 4. FEDERATION OF BOSNIA AND HERZEGOVINA:** Sarajevo Canton, Trevići, 34TBP955536, 1629 m, limestone, woods of *Picea abies*, 28-III-2010, *A. R. Burgaz*, MACB 101117, H. **6. Herzegovina-Neretva Canton,** Ruište, 33TYJ335165, 1100 m, limestone, *Fagus sylvatica* forest, 30-III-2010, *A. R. Burgaz*, MACB 101118. **8. REPUBLICA SRPSKA:** Trebinje, surrounding the orthodox Monastery of Turdoš, 34TBN823322, 270 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 1-IV-2010, *A. R. Burgaz*, MACB 101119. **CROATIA: 7. DUBROVNIK-NERETVA COUNTY:** Zamaslina, Pelsejac peninsula, 33TYH231456, 20 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 31-III-2010, *A. R. Burgaz*, MACB 101120. **9. Palje Brdo,** 34TBN863085, 160 m, limestone, *Pinus halepensis*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Cupressus sempervirens*, 2-IV-2010, *A. R. Burgaz*, MACB 101121, H.

Cladonia rangiformis Hoffm.
Deuschl. Flora 2: 114, 1796

This is a morphologically variable species with podetia subulate and dichotomously branched, bare or bearing squamules. The podetial surface is sometimes cracked and maculate, with discontinuous algal layer. It was very often encountered growing on calcareous bare soil or mixed with bryophytes. It is a widespread species in xerothermic areas of Eurasia (Litterski & Ahti 2004). Pd–, Pd+ red (less frequently), K+ yellow, chemically variable, usually containing atranorin, rangiformic and norrangiformic acids, but additional fumarprotocetraric acid can be present, as in most of our material. This species has earlier been recorded from Bosnia-Herzegovina (Christensen 1994, Bilovitz *et al.* 2009, Bilovitz & Mayrhofer 2011) and Croatia (Zahlbruckner 1901, 1903, 1905, 1907b).

Specimens examined. Atranorin, rangiformic acid chemotype: **BOSNIA AND HERZEGOVINA: 2. FEDERATION OF BOSNIA AND HERZEGOVINA:** Herzegovina-Neretva Canton, Bijakovići, Medugorje, way up to the Hill of Apparitions, 33TYH188845, 200 m, karstic limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus spina-christi*, 26-III-2010, *A. R. Burgaz*, MACB 101135. **4. Sarajevo Canton,** Trevići, 34TBP955536, 1629 m, limestone, woods of *Picea abies*, 28-III-2010, *A. R. Burgaz*, MACB 101138. **6. Ruište,** 33TYJ335165, 1100 m, limestone, *Fagus sylvatica* forest, 30-III-2010, *A. R. Burgaz*, MACB 101139, H.

Atranorin, rangiformic and fumarprotocetraric acids chemotype: **BOSNIA AND HERZEGOVINA: 1. FEDERATION OF BOSNIA AND HERZEGOVINA:** Herzegovina-Neretva Canton, Ljubusky, Stubica, vadopa Kravica, 33TYH141809, 100 m, calcareous soil, *Quercus* sp. forest, 26-III-2010, *A. R. Burgaz*, MACB 101143. **2. Bijakovići,** Medugorje, way up to the Hill of Apparitions, 33TYH188845, 200 m, karstic limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus*

spina-christi, 26-III-2010, *A. R. Burgaz*, MACB 101134. **3. Biletići Polje,** viewpoint over Neretva river, 33TYH258869, 100 m, karstic limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus spina-christi*, 26-III-2010, *A. R. Burgaz*, MACB 101136. **5. Capljina,** Hutovo Blato, 33TYH291599, 20 m, limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus spina-christi*, 29-III-2010, *A. R. Burgaz*, MACB 101137. **8. REPUBLICA SRPSKA:** Trebinje, surrounding the orthodox Monastery of Turdoš, 34TBN823322, 270 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 1-IV-2010, *A. R. Burgaz*, MACB 101140, H. **CROATIA: 7. DUBROVNIK-NERETVA COUNTY:** Zamaslina, Pelsejac peninsula, 33TYH231456, 20 m, limestone, *Quercus ilex*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Juniperus phoenicea*, 31-III-2010, *A. R. Burgaz*, MACB 101141. **9. Palje Brdo,** 34TBN863085, 160 m, limestone, *Pinus halepensis*, *Pistacia terebinthus*, *Arbutus unedo*, *Erica arborea*, *Cupressus sempervirens*, 2-IV-2010, *A. R. Burgaz*, MACB 101142, H.

* *Cladonia subcariosa* Nyl.
Flora 59: 560, 1876

This species has squamulose and persistent primary thallus, lobate, green olivaceous above, brownish below. It grows on calcareous bare soil. Pd+ yellow, K+ yellow slowly turning red. This is a chemically variable species. Our specimen contains norstictic, connorstictic, stictic and constictic acids, apparently representing chemotype III of Ahti (2000), also recognized as *C. polycarpoides* Nyl. It is new to Bosnia-Herzegovina.

Specimens examined. **BOSNIA AND HERZEGOVINA: 4. FEDERATION OF BOSNIA AND HERZEGOVINA:** Sarajevo Canton, Trevići, 34TBP955536, 1629 m, limestone, woods of *Picea abies*, 28-III-2010, *A. R. Burgaz*, MACB 101122.

* *Cladonia subrangiformis* Sandst.
Abh. Naturwiss. Vereine Bremen 25: 165, 1922

This is a morphologically variable species with subulate and dichotomously branched podetia. Frequently basal areas bear esorediate fissures with white medulla bursting out. Pd+ red, K–, contains atranorin, fumarprotocetraric and protocetraric acids (constant), additional bourgeanic acid can be found. It grows on bare calcareous soil or mixed with bryophytes. It is often regarded as a subspecies of *C. furcata* (Wirth 1995, James 2009). It is new to Bosnia-Herzegovina.

Specimens examined. Atranorin and fumarprotocetraric acid chemotype: **BOSNIA AND HERZEGOVINA: 2. FEDERATION OF BOSNIA AND HERZEGOVINA:** Herzegovina-Neretva Canton, Bijakovići, Medugorje, way up to the Hill of Apparitions, 33TYH188845, 200 m, karstic limestone, woods of oaks with *Juniperus oxycedrus* and *Paliurus spina-christi*, 26-III-2010, *A. R. Burgaz*, MACB 101104.

Atranorin, bourgeanic and fumarprotocetraric acids chemotype: **BOSNIA AND HERZEGOVINA: 4. FEDERATION OF BOSNIA AND HERZEGOVINA:** Sarajevo Canton, Trevići, 34TBP955536, 1629 m, limestone, woods of *Picea abies*, 28-III-2010, A. R. Burgaz, MACB 101105. **6. Herzegovina-Neretva Canton, Ruište, 33TYJ335165,** 1100 m, limestone, *Fagus sylvatica* forest, 30-III-2010, A. R. Burgaz, MACB 101106, H.

Cladonia symphycarpa (Flörke) Fr.
Sched. Crit. Lich. Suec. 8-9: 20, 1826

This species has squamulose and persistent primary thallus, lobate, green olivaceous above, white below. It grows on calcareous bare soil. Pd+ yellow, K+ yellow

slowly turning red. This is chemically variable species. Our collections represent the European widespread “chemical race 1” of Osyczka & Skubala (2011), containing atranorin, norstictic and connorstictic acids. This species has been recorded from Bosnia-Herzegovina before (Bilovitz *et al.* 2009) and Croatia (Partl 2009).

Specimens examined. **BOSNIA AND HERZEGOVINA: 3. FEDERATION OF BOSNIA AND HERZEGOVINA:** Herzegovina-Neretva Canton, Biletići Polje, viewpoint over Neretva river, 33TYH258869, 100 m, karstic limestone, woods of oaks with *Juniperus oxycedrus* and *Palurus spina-christi*, 26-III-2010, A. R. Burgaz, MACB 101123. **4. Sarajevo Canton, Trevići, 34TBP955536,** 1629 m, limestone, woods of *Picea abies*, 28-III-2010, A. R. Burgaz, MACB 101124.

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